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Mark S. Young

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# A SURVEY OF THE GOVERNMENTAL REGULATION OF NUCLEAR POWER GENERATION

Of the innumerable activities regulated by the federal government, none has inspired more extensive or elaborate governmental control than nuclear technology. Although initially motivated by a concern over the military uses of nuclear energy, the federal government regulatory structure today is more involved with the domestic environmental ramifications of the nuclear generation of electric power.

This great interest in surveilling and regulating nuclear energy is not unwarranted. It is difficult to conceive of a catastrophe which could compare to the consequences of a major escape of nuclear debris in a densely populated area. This article will examine the regulation of nuclear power generation and its relation to environmental law.

## I. INTRODUCTION

At the present time nuclear generation provides approximately six percent of the electrical capacity of the United States, but it is expected that by the year 2000 fifty percent of the national electric power capacity will be produced by nuclear reactors.<sup>1</sup> Presently there are fifty-six operable nuclear reactors, sixty-three are under construction,<sup>2</sup> and projections indicate that by the turn of the century between five hundred to one thousand nuclear reactors will be operating commercially in the United States.<sup>3</sup>

Studies have demonstrated that domestic oil and gas supplies may provide only ten years of our energy needs at the current prices, and domestic coal resources represent eight hundred years of energy at its current rate of use.<sup>4</sup> On the other hand, independent of the development of nuclear fusion (combination of nuclei as differing from the splitting of nuclei or

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1. *Toward an Energy Policy: Recent Studies Offer Guidance in Assessing the Administration's Forthcoming Proposals*, 5 E. R. - CURR. DEV. 10003 (1975) (hereinafter cited as *Toward an Energy Policy*); 14 NAT. RES. J. 411 (1975); Lieberman, *Generic Hearings: Preparation for the Future*, 16 AT. EN. L. J. 141 (1974).

2. Kennedy, *Mutual Cooperation With State Governments*, 17 AT. EN. L. J. 152, 155 (1975).

3. Tamplin, *Reacting to Reactors*, 10 TRIAL 15 (1974).

4. *Toward an Energy Policy*, *supra* note 1.

fission) generated electricity, and considering full implementation of the fast breeder reactor, the uranium and thorium sources in the United States offer twenty thousand years of energy through nuclear fission.<sup>5</sup> Nuclear fusion presents an even more abundant source of energy because it utilizes as fuel an isotope of hydrogen which may be obtained from the oceans.<sup>6</sup>

Nuclear generation of electricity, however, while seemingly offering the final answer to the energy crisis, requires that society accept both the risks of nuclear disaster and the care of lethal radioactive wastes. The operation of a nuclear power reactor produces vast amounts of such radioactive materials as plutonium, one of the most toxic substances known to man, presenting both somatic and genetic hazards.<sup>7</sup>

It has been estimated that assuming the worst possible combination of factors, a reactor accident could result in the deaths of up to 45,000 persons and contamination of over 150,000 square miles of land.<sup>8</sup> The risk of a catastrophic accident has been estimated at approximately one in 17,000 per reactor per year,<sup>9</sup> but considering projections of a potential 1,000 reactors by the year 2000, this estimate provides little solace. While nuclear energy proponents boast an unparalleled safety record,<sup>10</sup> the Nuclear Regulatory Commission reported 1400 abnormal events in 1974, four of which had a direct and significant bearing on nuclear safety and control.<sup>11</sup>

Thus, the benefits to be obtained from nuclear power are

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5. Plumlee, *Perspectives in U.S. Energy Resource Development*, 3 ENV. AFF. 1, 9 (1974).

6. S. GLASSTONE & R. LOVBERG, *CONTROLLED THERMONUCLEAR REACTIONS* 2 (1960).

7. Gofman & Tamplin, *Nuclear Power, Technology and Environmental Law*, 2 ENV. LAW 57 (1971) (hereinafter cited as *Nuclear Power*).

8. Jacks, *The Public and the Peaceful Atom: Participation in AEC Regulatory Proceedings*, 52 TEX. L. REV. 466, 470, n. 7 (1914) (hereinafter cited as *Peaceful Atom*); *Nuclear Power*, *supra* note 7, at 66.

9. AEC, *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, 16 AT. EN. L. J. 177 (1974) (hereinafter cited as *Reactor Safety Study*). This is a summary of the controversial preliminary study performed under the direction of Dr. Norman C. Rasmussen of the Massachusetts Institute of Technology. These conclusions were confirmed in the final report of this three year study released on October 30, 1975. *NRC Reports Little Probability of Nuclear Accidents Causing Deaths*, 6 E. R.-CURR. DEV. 1242 (1974).

10. Doubt, *Nuclear Power: A Cool Approach*, 10 TRIAL 18 (1974).

11. Chicago Sun-Times, Feb. 14, 1975 at 18, col. 1, cited in Porter County Chapter of the Izaak Walton League of America, Inc. v. Atomic Energy Commission, 515 F.2d 513 (7th Cir. 1975).

counterbalanced by grave environmental consequences, and in order to take advantage of this energy source it is necessary that its hazards be vigorously regulated in the public interest.

## II. BASIC REGULATORY SCHEME

### A. *The Atomic Energy Act and the Energy Reorganization Act of 1974*

The Atomic Energy Act of 1954<sup>12</sup> (hereinafter referred to as the 1954 Act) constitutes the major statutory regulation of the utilization of atomic power and, thus, also radioactive pollution. The 1954 Act gave the Atomic Energy Commission (hereinafter referred to as the AEC) authority over essentially all activities concerning radioactive materials and facilities for their production or use.<sup>13</sup> The AEC was entrusted with not only the management of the military uses of atomic energy, but also the development of its peaceful applications and the regulation of radiation to assure public health and safety.<sup>14</sup> The combination of the responsibilities of promotion and development of the commercial uses of atomic energy with the regulatory function has proved to be one of the greatest governmental conflicts of interest.<sup>15</sup> Only recently, under the Energy Reorganization Act of 1974<sup>16</sup> (hereinafter referred to as the Reorganization Act), have these functions been separated.

The Reorganization Act, which became effective in February of 1975, created two separate and independent agencies to carry out the responsibilities of the AEC, which was abolished.<sup>17</sup> The Energy Research and Development Administration was established and given all the functions of the AEC,<sup>18</sup> excepting those of regulation and licensing, which were transferred to the new Nuclear Regulatory Commission<sup>19</sup> (hereinafter referred to as the NRC). Thus, it is the activities and functions of the NRC which are most relevant to this discussion.

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12. 42 U.S.C. §§ 2011-2296 (1970).

13. FEDERAL ENVIRONMENTAL LAW 1026-27 (1974).

14. Moore, *The Environmentalist and Radioactive Waste*, 49 CHI.-KENT L. REV. 55, 62 (1972) (hereinafter cited as Moore).

15. Jacks & Raff, *The Bureaucracy of Power*, 10 TRIAL 28 (1974).

16. 42 U.S.C.A. § 5801 (1975).

17. 42 U.S.C.A. § 5814(a) (1975).

18. 42 U.S.C.A. § 5811 (1975).

19. 42 U.S.C.A. § 5841 (1975).

Basically, the powers of the NRC are composed of complete jurisdiction over the handling of special nuclear materials<sup>20</sup> (those materials most readily fissionable to produce energy — plutonium, uranium-233, uranium-235), source materials<sup>21</sup> (those materials essential to the production of special nuclear material), and by-product materials<sup>22</sup> (any material yielded in the use of special nuclear material). No one may deal with these materials without a license from the NRC. The 1954 Act also requires that all facilities which either produce or use special nuclear material be licensed by the NRC.<sup>23</sup>

In regard to radioactive pollution and its environmental threat, the 1954 Act provides that the regulation of nuclear energy must provide "adequate protection to the health and safety of the public."<sup>24</sup> Thus, the standards of protection of the public and the environment from nuclear hazards are placed within the administrative discretion of the NRC. An extensive code of regulations promulgated by the AEC are contained in Title 10 of the Code of Federal Regulations. These regulations specify, among other things, standards for protection against radiation<sup>25</sup> and general design criteria for nuclear power plants.<sup>26</sup> The regulations also recognize a duty on the part of the NRC and those handling nuclear materials to protect the public and the environment. Thus, it is provided that an activity such as the licensing of a power plant will be permitted only if the NRC finds "a reasonable assurance that the health and safety of the public will not be endangered."<sup>27</sup> Under the statutes, a violation of the licensing requirements may result in a fine of up to \$10,000 and/or ten years in prison.<sup>28</sup> The regulations provide for injunctive relief if they are violated.<sup>29</sup>

### *B. The National Environmental Policy Act*

Because it has affected every aspect of environmental law,

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20. 42 U.S.C. §§ 2071-78 (1970); 42 U.S.C. § 2014(aa) (1970).

21. 42 U.S.C. § 2014(z) (1970); 42 U.S.C. §§ 2091-99 (1970).

22. 42 U.S.C. § 2014(e) (1970); 42 U.S.C. §§ 2111-12 (1970).

23. 42 U.S.C. § 2131 (1970).

24. 42 U.S.C. § 2232(a) (1970).

25. 10 C.F.R. Part 20 (1975).

26. 10 C.F.R. Part 50, App. A (1975).

27. 10 C.F.R. § 50.40(a) (1975).

28. 42 U.S.C. § 2272 (1970).

29. 10 C.F.R. § 20.601, § 50.110 (1975).

the National Environmental Policy Act<sup>30</sup> (hereinafter referred to as NEPA) has had a profound impact upon the regulatory responsibilities of the NRC. Chief among its provisions is the requirement that all federal agencies must include in every recommendation relating to major federal actions significantly affecting the quality of the human environment a detailed discussion, termed an environmental impact statement, of basic short-term and long-term environmental consequences of the proposed action, as well as any alternative courses of action.<sup>31</sup> Equally important is NEPA's requirement that each federal agency utilize a systematic, interdisciplinary approach to insure the integrated use of the natural and social sciences in any decision making which may have an impact on the environment.<sup>32</sup>

The landmark case of *Calvert Cliffs' Coordinating Committee, Inc. v. Atomic Energy Commission*<sup>33</sup> interpreted NEPA to impose an expansion of the regulatory duties of the AEC. Prior to this decision, the AEC had been able to avoid consideration of all non-radiological environmental effects, such as thermal pollution, at its hearings for reactor licensing.<sup>34</sup> The AEC procedural rules prior to *Calvert Cliffs'* not only limited environmental considerations to radiological pollution, but also provided that the AEC would only consider at a licensing hearing those matters which were raised by intervenors to the process and which had not been the subject of consideration of another agency. As one may imagine, this procedure virtually excluded all but limited consideration of the radiological effect of the plant's operation. The First Circuit Court in *Calvert Cliffs'*, however, interpreted NEPA to require detailed consideration of all environmental matters.

### C. Public Participation in Nuclear Power Regulation

The 1954 Act requires that the NRC grant a hearing to any "person whose interest may be affected" by the "granting, suspending, revoking, or amending of any license of construction permit."<sup>35</sup> Under current practice, the NRC, before issuing a

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30. 42 U.S.C. §§ 4321-49 (1970).

31. 42 U.S.C. § 4332 (1970).

32. 42 U.S.C. § 4332(2)(A) (1970).

33. 449 F.2d 1109 (D.C. Cir. 1971).

34. See *New Hampshire v. Atomic Energy Commission*, 406 F.2d 170 (1st Cir. 1969), cert. denied, 395 U.S. 962 (1969).

35. 42 U.S.C. § 2239(a) (1970).

construction permit or operation license, issues a notice of receipt of the application and allows public participation in a hearing. There exist two major problems, however, in the area of public participation. First, the public is effectively excluded from the critical site selection process. This is basically because there are no requirements for public intervention in this process, and power companies planning to build nuclear plants generally proceed in the utmost secrecy when selecting land to prevent increases in the selling price and lessen adverse public reaction. Secondly, by the time of the initial public participation, extensive deliberations between the NRC and the applicant for a permit have taken place regarding most, if not all, of the substantive details of the proposed plant. By this time, therefore, the NRC has invested significant resources in coming to agreement with the applicant on most of these matters.

Because these important agreements have been reached out of the public view and usually without a significant public input, except for possible comment on the draft environmental impact statement, it is not unnatural that public intervenors regard the issuance of a license as a *fait accompli* and their participation as a meaningless sop granted for cosmetic purposes.<sup>36</sup>

Until recently, there has also been limited public involvement in the setting of exposure and design standard in the NRC regulations. In order to implement a recently announced standardization policy,<sup>37</sup> the NRC has recognized the desirability of a generic approach to the licensing of nuclear power plants. This approach involves the identification and separate treatment, in a single proceeding, of issues common to all plants. Thus far, four such generic type hearings have been completed concerning the standards for the design of emergency core cooling systems, power plant effluents, the uranium fuel cycle, and the transportation of fuel and wastes.<sup>38</sup>

The generic hearing approach may be criticized for limiting the opportunities for public involvement and also for excluding

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36. Whitney, *Enhancing Public Acceptance of Nuclear Decisionmaking*, 15 WM. & MARY L. REV. 557, 564 (1974) (hereinafter cited as Whitney).

37. Commission Policy Statement on Standardization of Nuclear Power Plants (April 28, 1972).

38. Trosten & Moore, *Nuclear Power Plant Standardization: Promises and Pitfalls*, 15 WM. & MARY L. REV. 527, n. 3 (1974) (hereinafter cited as Trosten & Moore).

local intervenors from contesting matters which were decided at a generic hearing. On the other hand, this procedure, in conjunction with a standardization program, fosters greater safety in the construction and operation of plants. Two basic reasons for this are that both the promoting group and the public interest group would be permitted to concentrate technical and financial resources in a single consolidated proceeding affecting nuclear power use in general, and there will be a great advantage in the experience gained in the construction, start-up, and operation of a particular standardized design.<sup>39</sup>

### III. REGULATION IN RESPECT TO PARTICULAR ENVIRONMENTAL RISKS

Due to the complicated nature of the engineering of atomic power and the magnitude of the environmental hazards it presents, the subject matter for a broad treatment of the regulation of nuclear energy is too vast. Therefore, to facilitate discussion of the legal and environmental issues involved, it is worthwhile to examine regulation in the context of its approach to particular hazards of the utilization of nuclear energy.

#### A. *Radioactive Pollution*

One subject which has been the source of great controversy is the setting of standards which govern public exposure to radiation. These standards are contained in Part 20 of the AEC regulations<sup>40</sup> which have been transferred to the NRC under the Reorganization Act, and apply to activities requiring a license under the 1954 Act. The President's Reorganization Plan No. 3 of 1970<sup>41</sup> transferred to the Environmental Protection Agency (hereinafter referred to as the EPA) the authority to set standards for public exposure, but the EPA has not yet modified the preexisting Part 20 standards.<sup>42</sup>

The primary standard is that no person outside the perimeter of a nuclear facility shall receive more than 0.5 rem per year.<sup>43</sup> In addition, the Federal Radiation Council has recom-

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39. *Id.* at 531-32.

40. 10 C.F.R. Part 20 (1975).

41. 42 U.S.C. § 4321 (1970).

42. FEDERAL ENVIRONMENTAL LAW 1027 (1974).

43. 10 C.F.R. § 20.105(a) (1975). A "rem" is a unit of radiation dosage related to biological effects, roentgen equivalent man. The average chest X-ray delivers a dose of 0.2 rem.



mended that the average exposure of the United States population should be kept below 0.17 rem per year.<sup>44</sup> The adequacy of these standards has been vigorously attacked on the ground that there exist unrefuted findings of serious cancer and genetic danger at those levels of exposure.<sup>45</sup> Arthur L. Tamplin and John W. Gofman of the Lawrence Radiation Laboratory published a paper in 1970 which concluded that if everyone in the United States were to receive 0.17 rem per year, an increase of 32,000 cancer cases would occur each year.<sup>46</sup>

Of course, this area of regulation involves basic risk-benefit determinations — a certain amount of risk is warranted in order to obtain the benefits of the peaceful applications of nuclear power. The fact is, however, that the standard itself is a calculated risk. Scientific knowledge of the effects of radiation exposure, particularly in low doses, is only twenty-five years old and very limited, and is consequently insufficient to determine the precise risk of danger.<sup>47</sup>

Considering the state of the knowledge, therefore, it is disturbing that while nuclear proponents argue that presently no one in the United States is exposed to even a small fraction of the permissible amounts, the standards have not been reduced and licensees have merely been admonished to “make every reasonable effort to maintain radiation exposure, and releases of radioactive materials in effluents . . . as far below the limits . . . as practicable.”<sup>48</sup> It is also unfortunate that the risk-benefit judgments are being made by scientific experts based upon incomplete knowledge with virtually no public input whatsoever as to what benefits the public desires or what risk it is willing to accept.

Challenges through the judicial system to the Part 20 standards alleging that the standards are not reasonably adequate to protect the public health and safety as required under the 1954 Act have proven unsuccessful.<sup>49</sup> The refusal to alter the standards has been based upon judicial deference to the discre-

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44. *Nuclear Power*, *supra* note 7, at 60.

45. *Id.* at 61.

46. Gofman & Tamplin, *A Proposal for a Five Year Moratorium on Above Ground Nuclear Power Plants* (1970), cited in *Peaceful Atom*, *supra* note 8, at 474, n. 27.

47. Green, *Radioactive Wastes and the Environment*, 11 NAT. RES. J. 281, 292 (1971).

48. 10 C.F.R. § 20.1 (1975).

49. See *Crowther v. Seaborg*, 312 F. Supp. 1205 (D. Colo. 1970).

tion and expertise of the administrative agency in setting the standards.<sup>50</sup> It has been suggested that under the requirements of NEPA to evaluate all environmental factors, challenges to Part 20 standards may be considered during the licensing process.<sup>51</sup> Deference to the discretion of the agency which is the major proponent of the project virtually denies the public protection from nuclear hazards. Perhaps the division of the development and regulatory functions of the old AEC will provide more protection. In addition, it would appear that the generic hearing approach could serve to present before the public in a controlled setting bona fide scientific challenges to the present standards. Where the evidence is in such conflicting confusion, as it is in this area, it would be better for those who are to bear the risk, the public, to have the opportunity to be represented on the matter.

At the present time there is considerable dispute over the regulation of radioactive pollution of water. In the case of *Colorado Public Interest Research Group v. Train*<sup>52</sup> the question has been raised whether under the Federal Water Pollution Control Act Amendments of 1972 (hereinafter referred to as the 1972 Amendments) the Administrator of EPA has been charged with the nondiscretionary duty to control discharges of radioactive materials into navigable waters. Under the 1972 Amendments it is unlawful to discharge any pollutant into navigable waters without a permit issued by the Administrator.<sup>53</sup> Before a permit may be issued, the Administrator must allow opportunity for public hearing.<sup>54</sup>

The conflict between the 1972 Amendments and the 1954 Act arises from the definition of "pollutant" under the 1972 Amendments.<sup>55</sup> That definition includes "radioactive materials." In regulations promulgated on July 1, 1973, the Administrator of the EPA, Russell Train, limited the application of the 1972 Amendments to only those "radioactive materials which are not encompassed in the definition of source, by-product, or special nuclear materials as defined by the Atomic Energy Act

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50. *Id.* at 1231.

51. *Taming the Technological Tyger*, 1 *FORD. URB. L. J.* 149, 162 (1972) (hereinafter cited as *Technological Tyger*).

52. 507 F.2d 743 (10th Cir. 1974), *cert. denied*, 421 U.S. 998 (1975).

53. 33 U.S.C. § 1311(a) (Supp. 1973).

54. 33 U.S.C. § 1342(a)(1) (Supp. 1973).

55. 33 U.S.C. § 1362(6) (Supp. 1973).

of 1954.”<sup>56</sup> It is the goal of the plaintiffs in the *Train* case to compel the Administrator to control all radioactive discharges into navigable waters.

The Tenth Circuit, reversing the Colorado District Court, and applying basic rules of statutory construction, held that to exclude “source, by-product, and special materials” from the 1972 Amendments would “devour the general policy of the statute.”<sup>57</sup> This decision to compel the Administrator to regulate such discharges, if affirmed by the United States Supreme Court, will work to the advantage of nuclear opponents in two ways. First, it provides another review of the level of radioactive pollution produced by a particular plant. Second, the required administrative review constitutes another obstacle and delay in the path of construction of a nuclear plant.

### B. Thermal Pollution

Under NEPA and the *Calvert Cliffs*’ case,<sup>58</sup> the NRC is required to consider thermal effects in its risk-benefit analysis of license applications. A nuclear plant requires the utilization of large quantities of water for cooling purposes, which is cycled through the plant and returned to its original source, generally a stream or river. This type of pollution can have a disastrous effect on the ecosystem of the water source. Nevertheless, this topic is merely one which must be considered by the NRC in its licensing procedures.

In addition, under the 1972 Amendments, “heat” is included in the definition of “pollutant,” and therefore, thermal pollution is subject to the regulatory powers of the Administrator of the EPA.<sup>59</sup> The EPA has recently suggested imposing a requirement that all nuclear power plants employ “closed cycle” cooling systems, which would totally eliminate a thermal effect.<sup>60</sup>

### C. Loss of Coolant Accident

In the event that the cooling system of a nuclear power reactor would malfunction so as to cause a loss of coolant acci-

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56. 40 C.F.R. § 125.1(x) (1973).

57. 507 F.2d at 749.

58. 449 F.2d 1109 (D.C. Cir. 1971).

59. 33 U.S.C. § 1362(6) (Supp. 1973).

60. *Peaceful Atom*, *supra* note 8, at 478.

dent (hereinafter referred to as a LOCA), it is possible for the reactor core to overheat, and even though the chain fission reaction would be stopped by the control rods within the fuel core, thereby averting nuclear explosion, the fuel and by-products would generate enough decay heat to melt down the fuel core as well as its containment structure.<sup>61</sup> This heat would also be capable of causing a steam explosion within the inactive reactor cooling system. Such an accident, of course, would release large amounts of radioactive material.

In order to prevent this occurrence the NRC requires that reactors be equipped with an emergency core cooling system (hereinafter referred to as an ECCS). The adequacy of the design criteria for the ECCS, like the radiation exposure standards discussed earlier, has been challenged as being below the capabilities of modern engineering science.<sup>62</sup> Due to a lack of large-scale test information, the debate over the ECCS reduces to the weighing of the benefits versus the risks in the absence of knowledge as to what the risk is, as well as to whether the design criteria embodies an adequate protection.

On the one hand, nuclear proponents argue that the likelihood of a core melt accident (which includes failure of the ECCS) is much smaller than many non-nuclear accidents, such as fires, earthquakes, or airplane crashes, which have similar consequences.<sup>63</sup> It is claimed that the likelihood of a core melt is one in 17,000 per reactor per year and that only one in ten core melts will result in measurable health effects.<sup>64</sup> Critics of the NRC contend that the release of even a small fraction of radioactive material will have lethal results, and they point to the projections of one thousand plants by the year 2000 as increasing the likelihood of a core melt to a virtual certainty.<sup>65</sup> Statistically it is noteworthy that the individual chance of fatality in an automobile accident per year is one in four thousand, while it has been estimated that the chance of fatality due to a nuclear reactor accident with one hundred plants in operation is only one in three hundred million.<sup>66</sup>

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61. *Reactor Safety Study*, *supra* note 9.

62. Ford & Kendall, *What Price Nuclear Power?*, 10 TRIAL 11 (1974).

63. *Reactor Safety Study*, *supra* note 9, at 178.

64. *Id.* at 191.

65. Ford & Kendall, *What Price Nuclear Power?*, 10 TRIAL 11 (1974).

66. *Reactor Safety Study*, *supra* note 9, at 182.

On June 29, 1971 the AEC announced the adoption of the ECCS Interim Acceptance Criteria.<sup>67</sup> The AEC then held a two-year-long rulemaking proceeding to determine whether the Interim Criteria should be adopted permanently.<sup>68</sup> At this proceeding critics argued for a moratorium on the construction and operation of nuclear plants pending the determination of the ECCS's reliability.<sup>69</sup> Actions were also commenced in federal court based upon the theory that it had not been established that the ECCS's (which had been based upon the Interim Acceptance Criteria) of particular plants satisfied the test of reasonable assurance of adequate protection to the health and safety of the public, and that therefore the plants should not be allowed to operate.<sup>70</sup> In those cases, *Nader v. Nuclear Regulatory Commission*<sup>71</sup> and *Union of Concerned Scientists v. Atomic Energy Commission*,<sup>72</sup> the District of Columbia District Court resolved this question in favor of the Commission, essentially deferring to the expertise and discretion of the agency.

Stringent technological regulation does not necessarily guarantee safety. In January of 1975, upon the discovery of cracks in the ECCS of a reactor near Joliet, Illinois, the NRC ordered a shut-down of more than one-half of the operating reactors.<sup>73</sup> In addition, technological failure does not present the only danger. This was clearly illustrated by the near catastrophic occurrence on March 22, 1975, at the Brown's Ferry nuclear plant, the world's largest reactor complex. An accidental fire disabled the plant's electrical and safety systems. While a meltdown was narrowly averted, the fact that the fire was started by a careless technician using a candle for lighting is disturbing.

The Brown's Ferry accident was a factor in the recent dramatic resignations of three managing engineers of the nuclear energy division of General Electric Company. The three

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67. 36 F.R. 12247 (1971).

68. 36 F.R. 22774 (1971).

69. *Peaceful Atom*, *supra* note 8, at 469.

70. *Nader v. Nuclear Regulatory Commission*, 513 F.2d 1045 (D.C. Cir. 1975); *Union of Concerned Scientists v. Atomic Energy Commission*, 499 F.2d 1069 (D.C. Cir. 1974).

71. 513 F.2d 1045 (D.C. Cir. 1975).

72. 499 F.2d 1069 (D.C. Cir. 1974).

73. Evans, *Sierra Club Involvement in Nuclear Power: An Evolution of Awareness*, 54 ORE. L. REV. 607, 614, n. 46 (1975) (hereinafter cited as Evans).

middle-management engineers, Gregory Minor, Richard Hubbard, and Dale Bridenbaugh, resigned on February 2, 1976, citing concerns about the human factor in reactor safety and the proliferation of nuclear technology in other nations as among their reasons for leaving the industry to join the nuclear opponents.<sup>74</sup> No less significant was the resignation on February 13, 1976, of Robert D. Pollard, a project manager for the NRC. Pollard protested poorly designed reactor safeguards and the lack of enthusiasm on the part of the NRC to receive views which are opposed to its own policy.<sup>75</sup>

In regard to the type of accident the ECCS guards against, it is relevant to examine the Price-Anderson Act,<sup>76</sup> which would appear to be theoretically opposed to the proposition that there exists reasonable assurance of safety in nuclear power plants. This Act has been recently extended through 1987.<sup>77</sup> The Price-Anderson Act gives financial protection to licensees of nuclear power plants by providing for government indemnification against loss in the event of a major nuclear accident and also requires the licensee to waive certain defenses to liability in the event of such an occurrence.<sup>78</sup> The indemnification under this law has been critically important to the proliferation of nuclear power plants, in that the private insurance industry has refused to insure nuclear reactors to any significant extent. The Price-Anderson Act, however, places a maximum of 560 million dollars on the liability for a single accident,<sup>79</sup> when it has been estimated that such liability could be from six billion to seventeen billion dollars.<sup>80</sup>

The avowed purpose of the Price-Anderson Act is to provide financial protection for the public and to assure the nuclear power industry that it would not be wiped out by the virtually unlimited liability which would result from a major nuclear occurrence.<sup>81</sup> Nevertheless, the fundamental reason for the Act is that the private insurance industry will not provide the necessary amounts of insurance because it lacks the actuarial ex-

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74. 122 CONG. REC. S1081 (daily ed. Feb. 3, 1976); 122 CONG. REC. H960 (daily ed. Feb. 11, 1976); *Time*, Feb. 16, 1976, at 78.

75. 122 CONG. REC. S1082 (daily ed. Feb. 3, 1976); *Time*, Feb. 23, 1976, at 45.

76. 42 U.S.C. § 2210 (1970).

77. Act of Dec. 31, 1975, Pub. L. No. 94-197, 89 Stat. 1111.

78. 6 RUT.-CAM. L. REV. 360 (1974).

79. 42 U.S.C. § 2210(e) (1970).

80. 122 CONG. REC. S1081 (daily ed. Feb. 3, 1976).

81. 121 CONG. REC. S22599 (daily ed. Dec. 17, 1975).

perience on which to base a judgment as to the likelihood of such an accident.<sup>82</sup> The question may be asked, therefore, in that it has been projected that one hundred nuclear reactors would have an accident involving one thousand or more deaths only once in a million years, how long will it be before the actuarial experience is obtained? If such an accident must first occur, liability coverage will be too late. Despite the arguments of Price-Anderson proponents, the underlying implication of this piece of legislation could not be made more clear than by this passage:

Nuclear power proponents have stated that the private insurance industry lacks the actuarial experience and that this accounts for its reluctance to insure nuclear power plants for a significant portion of the potential liability. Precisely correct! What is not stated by the nuclear power proponents is that the U.S. public also lacks the actuarial experience with respect to loss of life from nuclear power plant accidents. But the public is not granted the same option as the insurance companies — the public is forced to take the risk of life itself.

It is a strange spectacle indeed for the AEC to be licensing nuclear power plants that are uninsurable. If the plants were safe, they should be insurable. If they are uninsurable, it defeats understanding how they may be considered worthy of licensing.<sup>83</sup>

#### *D. Earthquakes and Sabotage*

It is apparent that an earthquake could seriously damage a reactor causing the release of large amounts of radioactivity. This danger is complicated by the imprecision in the science of seismology coupled with the secrecy employed in the siting decision.<sup>84</sup> Despite this threat, consideration of the potentiality of an earthquake at the reactor site is only regulated by the "reasonable assurance" language of the statute, and thus is determined on a case-by-case basis.

In this regard, it is worthwhile to note another example of the fact that even the most stringent technological regulation does not guarantee safety. Recently, the NRC fined the Virginia Electric and Power Company \$60,000 for making false

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82. H.R. REP. No. 883, 94th Cong., 1st Sess. 8 (1975).

83. *Nuclear Power*, *supra* note 7, at 69.

84. *Peaceful Atom*, *supra* note 8, at 472.

statements when it denied knowledge of a geologic fault at the site of its reactor near Charlottesville, Virginia.<sup>85</sup>

With the dramatic increase in terrorist activities, it is important to consider the threat of sabotage or theft of radioactive material for building home-made atomic weapons. While sabotage has been held not to be a matter which requires the NRC's attention in a licensing proceeding or requires a special design for protection,<sup>86</sup> the NRC has taken affirmative action by adopting regulations requiring protective measures against domestic sabotage. The threat of nuclear theft has been discounted, however, on the basis of the immense difficulty in first obtaining the nuclear fuel and finally constructing a weapon. It has been suggested that a major paramilitary effort would be required to merely obtain the fuel, perhaps involving up to fifteen men who are willing to die. The construction of the bomb could take several months, and over that period of time the terrorists would be subjecting themselves to a very grave danger of death through radiation exposure.<sup>87</sup>

### *E. Disposal of Radioactive Wastes*

The disposal of radioactive wastes produced by uranium mining and power plant operations is subject to the same standards for radiation exposure as apply to power plant operations. This disposal is, of course, subject to the provisions of NEPA and the hearing requirements of the 1954 Act. The major problem of this aspect of nuclear power generation is the long-lived radioactivity of nuclear waste combined with a lack of knowledge, both scientific and economic, of methods for disposal.

There are two classifications of radioactive waste. Low level wastes are those of low activity, which, it is believed, may be released to the environment. High level wastes, generally produced during the reprocessing of spent fuel, are dangerously radioactive and must be stored perpetually to prevent escape to the environment.<sup>88</sup> In order to appreciate the continual danger of high level wastes, one need only consider that the esti-

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85. *Virginia Power Company Fined \$60,000 For Making False Statements to NRC*, 6 E. R. - CURR. DEV. 876 (1975).

86. *Siegel v. Atomic Energy Commission*, 400 F.2d 778 (D.C. Cir. 1968).

87. *Milwaukee Journal*, Nov. 30, 1975, part 5, at 1, col. 1.

88. 10 C.F.R. § 50.34 (1975).



mates of the time which plutonium, a waste product of nuclear power plant operation and one of the most toxic substances known to man, must be excluded from the environment range from 240,000 to 500,000 years,<sup>89</sup> while man has existed for only about 100,000 years.<sup>90</sup>

The store of radioactive waste is constantly growing. Presently there exist two billion cubic feet of waste from uranium mining operations, and it is predicted that by the turn of the century the accumulation of these wastes will approach twenty billion cubic feet.<sup>91</sup> At the end of 1969 there were more than eight million gallons of power plant waste stored underground,<sup>92</sup> and it has been estimated that by the year 2000, the volume of these wastes will reach 200 million cubic feet of high level classification,<sup>93</sup> while fifteen thousand tons will be produced each year.<sup>94</sup>

No real strategy has yet been developed for the control of radioactive wastes, and the present storage systems are of an interim nature.<sup>95</sup> The most prevalent method of storage is in underground tanks imbedded in concrete at NRC facilities. While taking thousands of years to decay, these materials are constantly boiling and so corrosive that they must be transferred to new tanks about every ten years.<sup>96</sup> It is planned to store these wastes permanently in salt mines, where the geology is particularly stable, but perhaps the best proposal suggested is to shoot the wastes into the sun,<sup>97</sup> if the risk of such a space launch could be tolerated. While stored on earth these materials are susceptible to natural catastrophe, war, or human mistake.

#### IV. STATE REGULATION

In the case of *Northern States Power Co. v. Minnesota*,<sup>98</sup> the AEC had issued a construction permit to the plaintiff Northern

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89. Evans, *supra* note 73, at 616; Milwaukee Journal, April 11, 1976, Accent sec., at 1, col. 1.

90. R. LAZARUS, POPULATION 9 (1969).

91. Milwaukee Journal, *supra* note 89.

92. Moore, *supra* note 14.

93. Strelow Calls For Development of Permanent Waste Disposal Method, 6 E. R. - CURR. DEV. 1368 (1975) (hereinafter cited as Strelow).

94. Green, *Radioactive Waste and the Environment*, 11 NAT. RES. J. 281, 284 (1971).

95. Milwaukee Journal, *supra* note 89; Strelow, *supra* note 93; Evans, *supra* note 73, at 616.

96. 10 NEW ENG. L. REV. 305 (1974).

97. Moore, *supra* note 14, at 61.

98. 320 F. Supp. 172 (D. Minn. 1970).

States to construct a nuclear power plant. After construction, the Pollution Control Agency of Minnesota issued a permit to Northern States to operate by attached conditions regulating the radioactive content of the waste discharge which were more stringent than the federal standards. The plaintiff could not meet the state standards, and thus commenced suit alleging that Minnesota was without authority to regulate the discharge of radioactive waste because the field had been preempted by the federal government. The district court found that it was the intent of Congress to preempt the field, and thus, the federal government has the exclusive authority to regulate radioactive emissions from nuclear power facilities.

Such preemption does not extend beyond radiological pollution. For example, in *State of New Jersey, Department of Environmental Protection v. Jersey Central Power & Light Company*<sup>99</sup> the defendant power company was fined six thousand dollars under state law for the damage it caused to the ecosystem when its nuclear power plant shut down, thereby discharging cooler waters into a nearby creek and producing a thirteen degree drop in temperature. This caused the death of one half million fish.

In the recent case of *Marshall v. Consumers Power Company*<sup>100</sup> this radiological/nonradiological dichotomy has been further clarified. The plaintiff claimed that the defendant's proposed nuclear power plant constituted a private and public nuisance for both radiological and nonradiological reasons. The Michigan Court of Appeals held that the federal law preempted any consideration by a state court of the radiological hazards presented by the workability of the emergency core cooling system or the possibility of a nuclear accident. The court further held, however, that it could consider the claims arising from nonradiological hazards, such as fogging caused by the plant's cooling towers. The court stated:

[Congress] also was careful not to impinge on state authority over nonradiological problems resulting from nuclear plant operation. Commentators have placed in this category such matters as site selection and zoning, local pollution, building and equipment codes on nonradiation machinery and working conditions of plant employees. All such concerns

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99. 133 N.J. Super. 375, 336 A.2d 750 (1975).

100. 65 Mich. App. 237, 237 N.W.2d 266 (1975).

are intricately related to the construction and operation of nuclear plants, but all have historically been left to state regulation. (footnotes omitted).<sup>101</sup>

While in the *Marshall* case it was found that the plaintiff's claims of nonradiological hazards were not actionable, the court did state that it had the power to enjoin, at least temporarily, the construction of the plant if it found a nuisance to exist.<sup>102</sup> The most significant aspect of the *Marshall* opinion, however, is its statement that a state, for whatever hazards, radiological or nonradiological, could not declare a nuclear power plant a nuisance per se.<sup>103</sup> The court remarked:

Specifically, if it [were] found that a nuisance did exist, a court could, if there were no remedy at law, exercise its equitable powers and require defendant to establish measures to abate the nuisance, given current technology. If such measures made the construction impossible, they could not be required. In such a case, the Federal interest would prevent state action from absolutely prohibiting construction of nuclear power plants within its boundaries. Short of such a situation, state required abatement procedures would be legitimate.<sup>104</sup>

At this time, twenty-one states are actively considering legislative proposals which would limit the proliferation of nuclear power plants in their states.<sup>105</sup> These proposals typically provide for a moratorium on further construction while a special state commission conducts studies in order to make a safety determination in regard to nuclear technology. As the Michigan Court of Appeals concluded in the *Marshall* case, there can be no doubt that any state measure which would forbid the construction of nuclear power plants in a state is unconstitutional, in that such a measure would impinge on federal regulation of radioactive hazards. Thus, a state's passage of a nuclear moratorium bill would be valueless, except as an expression of opinion. It would be wiser for nuclear opponents to concentrate their finances and energies on the passage of a federal moratorium.<sup>106</sup>

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101. *Id.* at 251, 237 N.W.2d at 276-77.

102. *Id.* at 263, 237 N.W.2d at 282.

103. *Id.* at 262, 237 N.W.2d at 281-82.

104. *Id.* at 263-64, 237 N.W.2d at 282.

105. 122 CONG. REC. S325 (daily ed. Jan. 22, 1976).

106. See H.R. 11880, 94th Cong., 2d Sess. (1976). This is a bill to terminate the granting of construction licenses of nuclear fission plants pending study by Congress of nuclear fuel cycles with particular reference to safety and environmental hazards.

## V. PROBLEM ASSESSMENT AND CONCLUSION

It is clear that a major factor in the problem of nuclear power is its immediacy. The energy crisis requires that action be taken now in terms of decisions as to where our energy comes from. The dilemma which is therefore presented arises from the fact that all is not clear as to the dangers involved in the use of nuclear power. It is important to realize the potential for time lag effects in the impact of nuclear power upon society. One only need consider the length of time which elapsed before we recognized the injurious characteristics of automobile exhaust or DDT to appreciate the need for proceeding cautiously. Add to this the fact that today there are fifty-six plants in operation and sixty-three in the process of construction along with the projections of a reliance upon nuclear energy for fifty percent of this nation's electrical needs by the year 2000, and one can see the terrible impact upon the nation if at the turn of the century it is discovered that the risks of nuclear energy are as great as some experts suggest.

Thus, in order to promote the wise implementation of this energy source it is imperative that nuclear energy be vigorously regulated to insure the utmost in safety. Strong steps in this direction will be made through the adoption of a standardization policy employing the generic hearing procedure. Although it is argued that generic consideration of vital issues will exclude the ordinary person from his opportunity to be heard, it should be realized that a standardized approach will foster greater safety in the construction of plants.

Steps must be taken to attempt to solve some of the scientific disputes over nuclear power which have recently been brought to light by resignations of industry engineers. While there is no more reason to expect total agreement on technical issues than on the social issues, it is probably more important that, if plants are to be built, consensus be reached as to the safest methods. The intriguing proposal of physicist Arthur Kantrowitz to create a panel which would hear arguments and render a decision as to factual issues in scientific public policy disputes<sup>107</sup> might practically serve to rectify some of the public confusion.

Another measure that would greatly enhance the credibility of the commercial development of nuclear power would be a

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107. *Time*, Feb. 23, 1976, at 45.

major program to inform the public of all aspects of the use of nuclear power.<sup>108</sup> Because of the present procedures for public participation, generally the public is only involved in the adjudications in respect to a particular plant, and the public rarely takes part in the more basic questions surrounding the use of atomic power. Because of the conflicting view and lack of scientific knowledge, it is important that the public be given the opportunity to voice its opinion concerning the risks involved and also to take part in the fundamental decisions.

Also, in conjunction with a more conservative approach to the proliferation of nuclear power plants it is essential that the ultimate effort be made to conserve present energy sources to "buy" time for advancement in nuclear safety.

Therefore, the implementation of standardization policy, a greater awareness and participation by the public, and a concerted effort to conserve energy would serve to insure safety at a level at which the public is willing to take the risk.

MARK S. YOUNG

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108. Whitney, *supra* note 36, at 563.