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## INTRODUCTION

The expansion of our nuclear capacity is the most controversial of the manifold issues presently associated with the production of energy. This controversy centers about two separate but related aspects of nuclear energy production. The first is associated with the safety of the reactors themselves. The second, which will be addressed in this article, concerns itself with the ultimate safe disposal of the high level radioactive wastes generated as a byproduct of these reactor operations.[1] The expected quantity of high level waste is immense,[2] and the safe disposal of these wastes poses a technological and societal problem of the highest magnitude. Spent fuel elements must be reprocessed, and it is precisely at this juncture where the forces of sociology, psychology, law, politics, economics, and technology meet in a head-on collision. It is clear that unless the problems associated with the storage can be satisfactorily resolved, the pace of construction of nuclear generating facilities cannot proceed at a rate commensurate with needs as perceived in many quarters of the government charged with planning and effectuating an overall energy supply program for the nation. The importance of nuclear waste disposal and the need to consider this disposal in the planning of new facilities is just now beginning to attract judicial attention. In a recent decision[3] the United States Court of Appeals for the District of Columbia remanded the licensing of the Vermont

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1. High level radioactive wastes are highly radioactive "wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactive fuels." 10 C.F.R. § 50 app. F (1978).

2. If predicted capacities are actually met, permanent storage facilities for 75,000 containers, each containing 6.3 cubic feet of high level wastes will be required by the year 2010.

3. NRDC v. NRC, 547 F.2d 633 (D.C. Cir. 1976), *rev'd sub nom.* Vermont Yankee Nuclear Power v. NRDC, 435 U.S. 519 (1978).

Nuclear plant because of the failure to consider the problem of waste disposal. Effective with that decision, nuclear waste disposal must now form an integral part of the planning considerations in the construction of new nuclear power plants.

## WASTE PRODUCTS

The features of the waste problem may be seen by reference to the regulations contained in Appendix F, 10 CFR § 50 (1978) which provide that

1. Facilities for the temporary storage of high-level radioactive wastes may be located on privately owned property.
2. A fuel reprocessing plant's inventory of high-level radioactive liquid waste will be limited to that produced in the prior five years.
3. High-level liquid wastes shall be converted to a dry solid as required to comply with this inventory limitation and placed in a sealed container prior to transfer to a Federal repository in a shipping cask meeting the requirements of 10 CFR Part 71.
4. The dry solid shall be chemically, thermally, and radiolytically stable to the extent that the equilibrium pressure in the sealed container will not exceed the safe operating pressure for that container during the period from canning through a minimum of 90 days after receipt at the Federal repository.
5. All of these high-level radioactive wastes shall be transferred to a Federal repository no later than 10 years following separation of fission products from the irradiated fuel.
6. Upon receipt, the Federal repository will assume permanent custody of these radioactive waste materials although industry will pay the Federal Government a charge which together with interest on unexpended balances will be designed to defray all costs of disposal and perpetual surveillance.
7. USAEC will take title to the radioactive waste material upon transfer to a Federal repository.
8. Disposal of high-level radioactive fission product waste material will not be permitted on any land other than that owned and controlled by the Federal Government.

The criteria which specify land ownership and control are trivial and require no comment. The balance of the criteria are based upon certain characteristic hazards and operational constraints, both as used in the past and as proposed for the future.

In the past it has been the low level wastes which have received serious attention. This is due only to the much simpler problems posed by these low level wastes. Low level wastes may be described as secondary or indirect wastes. These consist of tools, wiping rags, and vessels which have either intentionally or unintentionally acquired the property of being radioactive by coming into contact with radioactive materials. These generally have a rather low specific activity and are normally buried in trenches in land which has been set aside for that purpose. It is the *high level* wastes which pose the real problem.

The high level wastes include the radioactive material which is directly formed by the fission process taking place in the nuclear reactor itself. In the past these have generally been dissolved and stored in the liquid state in large tanks designed to hold the contents for periods of about twenty years. We have only recently reached the point where serious thought is being given to the storage of this ever-increasing quantity of waste material for indefinite times into the future. The most recent thinking calls for converting the liquid *radwaste* into a solid form by various sintering processes in which the radioactive material is brought to a high temperature and formed into a ceramic material which is insoluable and hence resistant to leaching by water. This sintered material will then be placed in cylinders having a capacity of 6.3 cubic feet of material.

The material would be sintered and packaged after ten years storage at a fuel processing site, the purpose of the storage being to allow some of the radioactivity to decay, especially that associated with the shorter half-lived species. These cannisters would then be delivered to Federal fuel repositories for long-term storage.[4]

What do we do with this high level waste? Shall we store it above ground in what has been called a Retrievable Surface Storage Facility (RSSF), or shall we store it below ground in geological forma-

4. The nature of these repositories has not yet been established. It is estimated that by the year 2010 the U.S. nuclear capacity will be such that 7300 cannisters per year will be shipped to the federal repositories containing some 6400 megacuries of radioactive material. The heat output of these cannisters will be approximately 22,000 kilowatts. The cumulative number of cannisters by the year 2010 will be 75,000. This material must be stored safely for periods of time ranging up to hundreds or even thousands of years under such conditions that the material cannot reach the biosphere. *See* Draft, Environmental Statement, *Management of Commercial High Level and Transuranium-Contaminated Radioactive Waste* 2, 3-9 (September 1974) (USAEC, WASH 1539).

tions such as salt domes? Suppose we put it in a salt dome. Can we guarantee that because no water has infiltrated the dome for the past millions of years water will not infiltrate the formation during the next thousand? The formation may have been seismically stable for the past millions of years, but that does not guarantee stability for the next thousand years. What about the heat generated? The heat generated by the radioactive decay process is sufficient to raise the temperature of the cannisters to several hundred degrees Fahrenheit after a few years. What effect would this have on the physical integrity of the storage facility? What are the effects of radiation upon the materials over long periods of time? Should the disposal sites be located near the plants or at great distances from the plants? If the latter, what are the hazards associated with transporting the wastes? Also, what is the stability of our social and political institutions over a time scale measured in centuries? Engineering projects are not designed to last forever, unless one is building an Egyptian pyramid. The pyramids eventually fell into neglect and disrepair. Would the same thing happen to a waste storage facility? How does one establish an experimental data base for the migration of radioactive materials occurring over thousands of years?[5]

There are a number of other questions, which, while they may be less obvious, are no less important. For example: the high level wastes consist of two components. The first component consists of the fission products themselves. These are radioactive atoms of medium atomic weight formed by the fission of uranium 235 or plutonium 239. These generally have relatively short half lives of thirty years or less. This means that in 700 years the radioactivity due to this component will decrease by a factor of ten million, and by then the material can be considered as radioactively inert. The required waste storage time for these components is thus measured on a scale of hundreds of years. The other component consists of the actinides (such as actinium, thorium, uranium, neptunium and plutonium) which are formed not by the fission process itself, but rather by neutron absorption of the original fuel material, be it

5. Recently some evidence has come to light which suggests that the peculiar conditions required for a self-sustaining nuclear reaction can, in rare circumstances, be met in nature. This apparently happened at the Oklo mine in Gabon, Africa. It is believed that a uranium deposit underwent spontaneous fission about 1.8 billion years ago. The reaction is estimated to have lasted for about 600,000 years. This event may provide the only experimental evidence regarding the migration of fission products over a geological time scale. This event is described in G.A. Cowan, *A Natural Fission Reactor,* 235 SCIENTIFIC AMERICAN 36 (July 1976).

uranium or plutonium, or thorium in the case of the thorium breeder reactor. These are highly toxic from a chemical toxicity point of view, and generally have half lives measured in thousands of years. While the actinides initially contribute a much smaller portion of the total radioactivity, they eventually become the dominant contributors after a few hundred years as a result of their much longer half lives. This disparity suggests that it might be advantageous to separate these two components by chemical procedures, and adopt different storage strategies for each.

## SOME LITIGATIONAL ASPECTS

It is of interest to note that concern for the environmental hazards of radioactive materials antedated the present environmental movement by several decades. This was due, no doubt, to the greater and more easily perceived hazards associated with radioactive material than with less intimidating substances such as sulfur dioxide ($SO_2$). The development of the entire field of nuclear reactors and radioactive material production was a slow process which started at the turn of the century. The dangers were perceived before the magnitude of the problem became too large. In addition, most of this development during the first fifty years took place in a scientific atmosphere which was more concerned with the effects on the outside world than would be true of the atmosphere present in the profit oriented industrial sector of our society. It is noteworthy that despite the complete absence of governmental regulations, the World War II Manhattan project, which developed the nuclear reactor, displayed a degree of safety and concern for the environment which is extraordinary when viewed in hindsight. The regulations were internally imposed by the very people engaged in the work itself.

Following the war it rapidly became evident that the prolifieration of nuclear reactors as an important source of electrical power generation would require serious regulation on the national level, and, hopefully, on the international level as well. The Atomic Energy Act of 1954, as amended,[6] provides for the licensing of commercial reactors in a two stage proceeding. The first stage determines whether the facility should be constructed in the first place, while

6. 42 U.S.C. § 2242 (Supp. V 1975).

the second stage is designed to determine whether the facility, once constructed, should be licensed to operate.[7] These proceedings are directed mainly toward the safety of the nuclear reactor viewed as an isolated system. The responsibility for all aspects of the nuclear industry, including licensing, overseeing, and research and development was placed in the hands of the Atomic Energy Commission (AEC). The AEC was abolished by the Energy Reorganization Act of 1974[8] and its functions were divided between two new administrative organizations. The Energy Research and Development Administration (ERDA)[9] was given the responsibility for overseeing all the technological aspects of the development of nuclear power (as well as all other energy sources); thus ERDA (now DOE) might be considered as the hardware agency. The regulatory functions and aspects of the AEC were handed over to the Nuclear Regulatory Commission (NRC) which now handles all licensing proceedings previously handled by the AEC. The regulatory aspects of the Atomic Energy Act have been greatly broadened and complicated by the National Environmental Policy Act of 1969 (NEPA)[10] which, insofar as it is applied to nuclear reactor matters, may be considered as a substantial amendment to the Atomic Energy Act.

NEPA, as it has developed since its inception, has become the single most powerful weapon in the hands of the intervening organizations. At the present time, almost all of the technical issues regarding nuclear wastes as discussed in the previous section have received judicial attention, either directly or indirectly. Nuclear power is particularly susceptible to attack under NEPA, since the installation of any nuclear facility requires the active concurrence of the NRC through its licensing proceedings; this is a major federal action, and brings to bear the full force of NEPA.

The first major blow was struck in 1971, a scant two years after passage of NEPA, while the courts, as well as the litigants on both sides, were still struggling with the meaning and effect of NEPA. In promulgating its NEPA rules,[11] the AEC proposed a number of

7. *See generally* Power Reactor Development Corp. v. IUEW, 367 U.S. 396 (1961). These proceedings are conducted before a three member Atomic Safety Licensing Board, 42 U.S.C. § 2241, which is the counterpart of an Administrative Law Judge in other agencies. The board is typically composed of two nuclear physicists and one lawyer who acts as chairman.

8. 42 U.S.C. § 5814 (Supp. V 1975).

9. The Energy Research and Development Administration is now known as the Department of Energy.

10. 42 U.S.C. § 4321 (1970). NEPA became effective January 1, 1970.

11. 10 C.F.R. § 50 app. D (1971). Appendix D is currently being revised.

points which were considered weak by environmentalists. These included (1) that hearing boards conducting independent reviews of staff recommendations need not take into account environmental factors unless affirmatively raised; (2) a prohibition against raising non-radiological issues; (3) a prohibition against considering issues which were deemed satisfactory by other federal agencies; and (4) a deferral of consideration of the environmental issues to the operating licensing stage of the proceedings under certain conditions. These points were successfully challenged in *Calvert Cliffs' Coordinating Committee, Inc. v. AEC.*[12] In dealing with the fourth point the court noted:[13]

> Once a facility has been completely constructed, the economic cost of any alteration may be very great. In the language of NEPA, there is likely to be an "irreversible and irretrievable commitment of resources," which will inevitably restrict the Commission's options.
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> By refusing to consider requirement of alterations until construction is completed, the Commission may effectively foreclose the environmental protection desired by Congress. It may also foreclose rigorous consideration of environmental factors at the eventual operating license proceedings. If "irreversible and irretrievable commitment[s] of resources" have already been made, the license hearing (and any public intervention therein) may become a hollow exercise.

The potential power of the words "irretrievable commitments" was in all probability not recognized by the framers of NEPA. Taken at their face value, the words seemingly refer to separate and independent projects. This was the manner in which the *Calvert Cliffs'* court used the words "irretrievable commitment" in applying them to a particular facility. The meaning was soon to be greatly broadened.

Having decided that extensive environmental considerations were required for the construction and licensing of nuclear facilities, it remained to be seen how far these considerations were to be extended. In *Scientists' Institute for Public Information, Inc. v. AEC (SIPI),*[14] the issue of new expanding technology was directly

12. 449 F.2d 1109 (D.C. Cir. 1971).
13. *Id.* at 1128.
14. 481 F.2d 1079 (D.C. Cir. 1973).

confronted. Here the expanding technology was the new liquid metals fast breeder reactor (LMFBR), a technology in which ERDA (then AEC) was prepared to invest billions of dollars in an effort to get the new technology off the ground and prepare for the demand for nuclear facilities which was forecast for the latter part of this century. The program was stopped dead in its tracks by environmental considerations. The decision was also pregnant with implications for the entire nuclear waste problem. The court noted that "[s]tatements must be written late enough in the development process to contain meaningful information, but they must be written early enough so that whatever information is contained can practically serve as an input into the decision-making process."[15] The same statement would presumably apply to the high level nuclear waste storage program since the long-term schedule for developing that program is similar to the long lead time for the development of the LMFBR. In considering the waste issue directly it was noted that "[t]hese wastes will pose an admitted hazard to human health for hundreds of years, and will have to be maintained in special repositories. The environmental problems attendant upon processing, transporting and storing these wastes, and the other environmental issues raised by widespread deployment of LMFBR power plants, warrant the most searching scrutiny under NEPA."[16] The same statement, of course, can be applied to the deployment of any type of nuclear reactor.

The following year saw some backing off from this position by the Second Circuit. In *Ecology Action v. AEC,*[17] the United States Court of Appeals for the Second Circuit refused to dismiss a licensing order for reason of the exclusion of certain broad environmental issues, among them the lack of consideration of the incremental effects of mining and processing the fuel requirements of the plant, and also the incremental burden placed upon long term storage facilities.[18] This court adopted, as it were, a "point source" criterion for the consideration of environmental factors, leaving the consideration of broader factors to other proceedings and other environmental statements.[19]

15. *Id.* at 1094.

16. *Id.* at 1098.

17. 492 F.2d 998 (2d Cir. 1974).

18. The court also considered the energy conservation issue. *Id.* at 999. *But see* note 25 *infra*.

19. [I]t would be absurd that the issue of the environmental effect of uranium

It is questionable whether this approach is currently good law. In a recent decision the D.C. Circuit remanded NRC's licensing of the Vermont Yankee nuclear plant precisely because of a failure to consider the joint problems of fuels reprocessing and nuclear waste.[20] Again the "irretrievable commitment" issue rose to the fore. "Once a series of reactors is operating, it is too late to consider whether the wastes they generate should have been produced. . . ."[21] It would appear that nuclear waste processing and disposal must now form an integral part of the planning considerations in the construction of new nuclear power plants. The court specifically rejected the argument that a more appropriate occasion for the determination of these environmental effects would be at the time of construction of the processing and waste disposal facilities themselves. We appear to be reaching the point where in each instance the complete circle of environmental factors must be considered, and the greater the perceived hazard, the more complete the circle must be. At the moment the circle appears to be undergoing a rapid expansion in its circumference.

Population density in the vicinity of the site must be given consideration.[22] The possibility of plutonium theft was specifically addressed in *NRDC v. NRC*[23] where it was observed that the draft environmental impact statement "was inadequate, particularly since it failed to address adequately the special dangers of sabotage and theft posed by large scale transportation of plutonium materials."[24] In addition the court also found the environmental impact statement lacking in a consideration of energy alternatives to nuclear power. This question was addressed specifically in *Aeschliman*

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> mining in Wyoming should have to be separately considered on every application to construct nuclear plants from Maine to California. Rather the idea that a licensing agency should endeavor to identify environmental issues common to many applications and handle them in "generic" proceedings would seem to benefit all the parties, particularly the poorly-financed environmental groups.

492 F.2d at 1002.

20. NRDC v. NRC, 547 F.2d 633 (D.C. Cir. 1976), *rev'd sub nom.* Vermont Yankee Nuclear Power v. NRDC 435 U.S. 591 (1978).

21. 547 F.2d at 640.

22. Porter County Chapter of the Izaak Walton League of America v. AEC, 515 F.2d 513 (7th Cir. 1975). Here the population center contained less than the 25,000 maximum at the time just prior to the opening of the proceedings. The construction approval by the AEC was set aside because by the time the plant would have become operational, the population would exceed 25,000. *Id.* at 520-21.

23. 539 F.2d 824 (2d Cir. 1976).

24. *Id.* at 833.

*v. NRC*[25] where construction permits for two nuclear power plants were remanded to NRC for failure to consider the possibility of alternative sources of energy, and in particular whether the need for these plants could be vitiated by proper "energy conservation". Cost-benefit approaches with regard to human health are difficult to quantify, particularly when taken in conjunction with the criterion "as low as practicable".[26] An interim value of $1,000 per total body man-rem[27] was established in *York Committee for a Safe Environment v. NRC.*[28]

A basic problem underlying much of the discussion lies in our lack of knowledge in many areas. The quantity of nuclear waste which is produced by any given plant can be predicted to a high degree of accuracy. Such is not the case for the ultimate damage which may be caused by these wastes. This problem was noted in SIPI with the words "one of the functions of a NEPA statement is to indicate the extent to which environmental effects are essentially unknown."[29]

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25. 547 F.2d 622 (D.C. Cir. 1976). This case was reversed and remanded in Consumers Power Company v. Aeschliman, 435 U.S. 519 (1978). The Supreme Court considered this case along with the *Vermont Yankee* case, notes 3 and 20 *supra,* and remanded the decision on a procedural basis. The Court did not hold that energy conservation measures need not be considered, but only that they did not have to be considered by NRC in the stage of the proceedings under litigation, and that a determination by another regulatory agency might suffice. *Id.* at 524. The final result may be the addition of a new section to environmental impact statements which discusses whether the need for a new facility can be mitigated by proper conservation measures.

Note that the two cases were handled in one decision by the Supreme Court.

26. In connection with the requirements relating to radioactive iodine emissions, 10 C.F.R. §§ 20.1,50.34a, 50.36a (1975), the following definition is put forth:

> The term "as low as practicable" as used in this part means as low as is practicably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety . . . and in relation to the utilization of atomic energy in the public interest.

10 C.F.R. § 50.34a (1975). This terminology was changed to "reasonably achievable" in 10 C.F.R. § 50.34a (1978). The related terms "best practicable technology" (BPT), "best available technology" (BAT) and "best available technology economically achievable" (BATEA) are also in vogue with regulatory agencies, not only in the nuclear area, but also in ordinary land, air and water areas. The terms mean different things to different people, depending upon whether one is on the enforcement or non-compliance side, and much recent debate has been engendered by these terms.

27. The rem is an acronym for "roentgen-equivalent-man" and is the amount of radiation which has the same biological effect as one roentgen (the classical radiation unit) of X-ray radiation. *See* 10 C.F.R. § 20.4(c) (1975). The annual natural background radiation exposure in the U.S. varies from about 0.1 to 0.25 rem.

28. 527 F.2d 812 (D.C. Cir. 1975). The court did not say how it arrived at the dollar figure, but noted that it would be used "[a]s an interim measure and until establishment and adoption of better values (or other appropriate criteria)." *Id.* at 815.

29. 481 F.2d at 1092.

One basic problem is the fact that the public often misinterprets the scientific criteria of "truth." Just as "beyond the shadow of a doubt" in criminal prosecutions does not imply absolute certainty, so too are scientific statements regarded as "true" despite the fact that they may not be true in the sense of absolute certainty. Inherent in the statement that a particular sample weighs 1.3275 grams is the notion that in all probability the sample weighs something other than 1.3275 grams. On the other hand, it is more probable that the sample weighs 1.3275 grams than any other individual value with that same number of significant figures. In more complex matters the uncertainty in conclusions may be much greater. This was recognized to some extent in *North Anna Environmental Coalition v. NRC*[30] where the plaintiff sought review of a license allowing the construction of a power plant on a geological fault which had been inactive for 500,000 years. The court refused the sought-for relief, and observed that the Atomic Energy Act did not require risk-free siting of power plants. This problem was addressed by Chief Judge Bazelon of the United States Court of Appeals for the District of Columbia:

> This case raises for me several lurking problems of untested technology and protection of the public against risk. Here that concern is presented in a highly rarefied form: there is essentially no dispute over the amount of radiation to be released to the environment by the Maine Yankee Atomic Power Station. Nor is there pitched battle over the low risk factor presently assigned to the release of such amounts. Science believes that it can quantify and understand the danger posed to organisms and the environment by those undisputed levels. The risk at issue herein is the risk that such present scientific knowledge is simply wrong or blind in such degree that after the passage of time and further study, the danger to society will be seen as greater than expected by orders of magnitude. Said differently, the twin risks are that either science is ignorant of entire categories of harm, or that rule-permitted quantities of radiation do the type of damage they are thought to, but to a far greater extent, or in a cumulative fashion with other factors so as to render difference in degree a difference in kind. These risks are hardest to calculate because they surpass the problems posed

30. 533 F.2d 655 (D.C. Cir. 1976).

> by mere ignorance of a new technology. The scientists and decision-makers are asked to assess and make allowance for the probabilities that present scientific understanding is itself terribly wrong.[31]

The problem is far from resolution.

## The Value Judgment Dichotomy

In the ordinary contract or tort case the issues raised are closely related to the goals, aims, and aspirations of the adversaries with particular reference to the specific cause of action at hand. The contract breachee wants the contract declared valid and further wishes a particular quantum of damages; the breacher desires the opposite. In a tort action the injured party wishes to show negligence and damage and wishes a monetary reward; the tortfeasor desires the opposite. The aims of the two parties go no further than the particular case in point. In the usual environmental intervenor proceeding, on the other hand, it is often not the specific cause of action which is the real controversy, but rather the entire policy which is in issue. The real issue is an underlying moral value judgment. The specific case in hand serves as a means of furthering the attainment of these moral values.

The present national concern with the twin problems of energy production and pollution production has generated an intense debate over the last several years. The debate will in all probability continue with undiminished fervor for at least another decade, and will take place in the press, in the courts, in the polling booths, and in other public forums. The parties to the controversy often have diametrically opposed views.

At the one extreme we have a group which we might term pro-expansionist. According to this group the economic well-being of the nation presently faces a crisis, and unless we rapidly expand our electrical generation capacity the result might well be economic chaos. Part of this expanded capacity can come from coal fired stations, at least in the short term future, but our long term problems can only be met by a heavy reliance on nuclear power generation. The environmental problems associated with radioactive

31. Citizens for Safe Power v. NRC, 524 F.2d 1291, 1303 (D.C. Cir. 1975) (Bazelon, J., concurring).

wastes from nuclear stations and with SO2 emissions from coal fired plants have been grossly overestimated. The regulations which have been established are in excess of what is needed, and can only be met at a prohibitive cost, if indeed present technology suffices to meet these limits.

At the other extreme is the intervening group whom we might term the anti-expansionists. This group feels that the immense problems associated with the radioactive wastes from nuclear power plants, and the dangers from the plants themselves, must first be greatly reduced before any expansion of this industry is possible. Particularly severe are the problems associated with nuclear waste and with the plutonium produced by breeder reactors since there is no fail-safe method to ensure that a radical guerrilla group cannot acquire sufficient plutonium to manufacture an atomic bomb. The environmental problems associated with power generation have not been overestimated; if anything they have been underestimated, and the costs of meeting the environmental and safety regulations are not incommensurate with the gains to be achieved.

These are the extreme views, and most of the responsible opinion lies somewhere between the two extremes. What many people in both camps fail to realize is that there are several subjective factors in their respective views which are associated with certain desired goals in life, and these are value judgments. As an example, suppose we assume that the following two statements are irrefutably true.

1. If we continue to expand our electrical power generation base as proposed by the pro-expansionist group, then the increased pollution levels arising from these extra plants, radioactive wastes from the nuclear plants and SO2 emissions from the conventional plants, will cause reduction in the average life expectancy by five years.
2. If we maintain our present generation base as proposed by the anti-expansionists then future electrical shortages will cause a severe curtailment of our industrial base and result in unemployment figures as high as 20 percent (not to mention widespread brownouts and lack of air conditioning in the consumer sector).

Note very carefully that we do not in any way mean to imply that either of these statements is in fact true. We merely assume that they are for the sake of this exercise. It should be clear from the above two stated possibilities that an ultimate decision cannot always be based upon technological arguments alone. In fact, technological arguments may be irrelevant. These two grossly simplified statements present a choice between shortened life and economic well-being. In the real world the choice is more complex.

Even the above two statements have been stated in a grossly simplified fashion, and both have several consequences which follow. The first statement stopped with a shortened life expectancy. It can be safely assumed that if the life expectancy is shortened by five years, there will be severe consequences to the health of people before they die. People will be sicker, and our national health bill will soar to even higher levels. The second statement stopped with the much higher unemployment rate. Those who suffer unemployment will also suffer from the dietary deficiency which results from lack of money, and their life expectancy will be shortened. The cost of governmental relief would soar to even higher levels. Finally, it is questionable whether our present system of government could continue in the face of such high continuous unemployment levels.

There is, however, some common ground in the two diverse camps. Both sides agree that in the best of all possible worlds solar energy is the best solution, it being non-polluting, but even in this agreement there is still a dichotomy of views. Solar energy is far from being technologically feasible. Some even argue that it will never become commercially viable on a large scale. The pro-expansionists argue that we cannot wait for solar energy developments, and we must expand with presently available technology. The anti-expansionists, on the other hand, argue that we should invest heavily in the development of solar energy rather than expanding facilities with the present polluting systems.

What is particularly unfortunate is the severe lack of technical information and the capacity to understand the available information.[32] This lack of understanding is all too common in both camps

32. Some environmental groups have criticized environmental reports on the basis of their lack of readability by laymen. *See, e.g.*, the Letter from Natural Resources Defense Council, Inc. to Dr. James Livermore of the A.E.C. which appears in Draft, Environmental Report, note 4 *supra*, at C-2. In Sierra Club v. Froehlke, 359 F. Supp. 1289, 1342 (S.D. Tex. 1973), it was noted that environmental impact statements must be "written in language that is understandable to non-technical minds and yet contain enough scientific reasoning to alert specialists to particular problems within the field of their expertise". It would be rather difficult to write a technical document which was comprehensible in its entirety to laymen. Perhaps

in the raging controversy. While the problems are not exclusively technological, it is not possible for any individual to make an intelligent decision on the matter without some understanding of the technical issues. At the same time, consideration of the technical issues alone is not suficient.

The problem is finding a solution within the context of our present industrial society which is based upon an expanding economy. The momentum for that system was set in motion at the start of the industrial revolution, and the inertia which presently exists is so great that the trend cannot be reversed without a great effort. According to Newton's Laws of Motion, the direction of a moving body can only be altered by the application of a force, and this force must be proportional to the momentum. The same holds true for economic systems. The Club of Rome may be correct in their analysis and predictions, but they have given us no viable alternatives or plans of action.[33]

The problems of an energy short industrial society have been brought to the fore in the years since the oil boycott, and have been accentuated in the gas short winter of 1977 and the coal strike of 1977-78. It seems highly likely that solar energy can become a reality, but not before the next century. The basic question is whether we can get through the next twenty five years in one piece so that the alternatives may come to fruition. The only present alternatives are coal and nuclear, and both have their problems.

The present intervention system has severe deficiencies and appears to be weighted in favor of the intervenors. The cost of the legal regulatory process has been vastly increased both in direct money outlays and in time spent. A realistic assessment of the intervention process has never been carried out. It is not yet known whether any real substantive changes have been introduced into project designs as a result of this intervention process. It may well be that the only result is the rewriting of environmental impact statements with the inclusion of additional alternatives, all of them non-viable. The present actions are all being taken piecemeal. From a logical point of view it seems absurd to carefully consider the waste problem

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environmental impact statements should be issued in two versions, a technical one for technical people, and an "unofficial" simplified one for laymen.

33. D. H. Meadows, D. L. Meadows, J. Randers, and W. W. Hehrens III, *The Limits to Growth*, A Report for the Club of Rome's Project on the Predicament of Mankind (2d ed. 1972) (New York, Universe Books).

separately for each plant under consideration when the problems are identical for each plant.[34] It would seem appropriate to examine the underlying issue in its entire context thoroughly examining the basic issue itself rather than relegating this consideration on a piecemeal basis to a large number of individual environmental impact statements. It would seem appropriate to make one grand decision on the suitability of nuclear power itself, and then to proceed from there with a consideration of the site specific problems associated with individual plants. The intervenors, in many instances, are arguing a moral cause which may or may not be correct.[35] They feel they are the saviours of society, and they may well be. Unfortunately the constraints imposed upon our present society are such that society as we know it might first have to be destroyed before it can be saved in this manner.

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34. *See* note 19 *supra*.

35. For example: "There is just one question: what gives anyone the right to build or operate nuclear plants anywhere? . . . The wisdom of creating a massive radioactive legacy should and must be taken seriously—with the intention of preparing a realistic environmental statement and acting accordingly, even if such action is not in line with the morally bankrupt atomic establishment". Letter from Citizens Association for Safe Energy to the USAEC (Dec. 8, 1973) appearing in Draft, Environmental Statement, note 4 *supra*, at C-46.