PDR

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CAMBRIDGE, MASSACHUSETTS 02138

15 September 1978

Dr. Joseph Hendrie
Nuclear Regulatory Commission
1717 H Street N.W.
Washington, DC 20006

Dear Dr. Hendrie,

On behalf of Scientists and Engineers for Secure Energy, hereinafter called SE_2, I write to protest the extreme slowness of NRC in proceeding toward a construction permit for the proposed nuclear power plant Pilgrim II. SF_2 have many members who live in areas served by the New England Power Pool, others in adjacent power pools and several customers of Boston Edison Co., including myself. SE_2 has therefore concern for public health, environmental and financial aspects of any decision.

There are important societal reasons for proceeding at once with Pilgrim II. Firstly, by 1986 the legitimate demand for electric power in the New England region, coupled with phasing out of some older power plants, is likely to lead to a need for more baseload generating capacity. The best device is likely to be nuclear because it is cheaper and less polluting than coal. Secondly, there is considerable national interest in switching from use of oil to other fuels. Even if the anticipated increase in electricity demand fails to materialize, the new power station will enable us to reduce dependence on imported oil.

SE_2 supports fully the need for comparing alternatives and exploring them fully in a public hearing process as mandated by the Atomic Energy Act as amended and the National Environmental Policy Act. However, these Acts do not envisage unnecessary delay. Indeed SE_2 maintains that unnecessary delay violates the fundamental legal requirements of due process and can lead to increased environmental and public health hazards. SE_2 maintain that prompt action is a fundamental requirement which should bind NRC.

The Pilgrim II hearing proceeds with excruciating slowness. It appears that the NRC staff are considering alternate sites and reconsidering the financial status; no hearing in public has been held for a year and it appears that none are scheduled. SE_2 maintains that this is an unconscionable and unacceptable delay.

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It is possible that NRC do not have adequate staff to cope with the workload. If this is the case it would seem that the laws demand that NRC hire more. If a policy of the U.S. administration prevents such hiring, this would seem invalid and in any case contrary to the publicly expressed intention of the administration to speed up the hearing process.

SE_2, therefore, urge you to speed up this process and request that you take into account the adverse consequences of delay. Enclosed with this request is a paper entitled "The Environmental Consequences of Delay," shortly to be published in the referred journal Energy, which describes these in more detail.

Yours sincerely,

Robert V. Kline

Robert V. Kline

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Enclosure

THE ENVIRONMENTAL AND PUBLIC HEALTH CONSEQUENCES OF

REPLACEMENT ELECTRICITY SUPPLY

Richard Wilson*
Harvard University Department of Physics

The following paper contains topics presented by Dr. Wilson at the EPRI workshop and has been included for informational purposes.
on the effects of unreliable electricity supply.

ABSTRACT

The usual problem discussed by environmentalists is the total environmental impact of an electricity generating plant while it is generating electricity. However, a plant is part of a system and cannot be treated in isolation. Provided no generating shortage develops, almost the same amount of electricity will be generated in any case, but in different ways. Although a good case can be made for spending money on reducing electricity demand instead of on generating capacity, this is not well discussed in the context of an individual power station.

THE LOGIC OF ENVIRONMENTAL IMPACT STATEMENTS

The National Environmental Policy Act of 1969, and in particular its Section 102, is the most important energy legislation of the decade. It enjoins each federal agency to consider the environmental consequences of both the proposed decision and all possible alternatives before making a decision. This has been interpreted very widely by the courts.

As a result of this legislation and its interpretation by the courts, and in particular the Calvert Cliffs decision,[1] federal agencies write lengthy environmental impact statements for each electricity generation station that they are called upon to approve in any way. For a large 1000 MWe power station, whether coal-fired or nuclear, the impact statement may go into several volumes and cover 1000 or more pages.

However, there is a deficiency of the logic of these impact statements, and this often leads to an overly pessimistic approach. The estimated environmental impact

*Supported in part by a contract with the Electric Power Research Institute.

of the proposed power station is listed in considerable detail. When its impact is compared with the impact of not building the power stations, all too often the power station is considered in isolation. This leads to an unbalanced comparison--the environmental impact of generating the power compared with the economic impact of not having the electrical power.

In fact, the power station must not be considered in isolation because it is tightly coupled to an electricity generating system. If the power station is not built, life will still proceed. Men will be born; they will live, and die, and use electricity. What will happen as they turn on the switch? Until they turn on the switch, no electricity is generated. If a particular power station is not built and no other action is taken, the electricity will still be generated--by another generating means if it exists. Beyond a certain point, the system will be overloaded, and there will be forced electricity shutdowns. It is the purpose of this brief discussion to collect together the information required to approach the first part of this question in a logical way. I will here discuss the effects only of supplying electricity by replacing older units in the system. This is based on personal New England experience in the operating license hearings of Maine Yankee, Vermont Yankee, and Pilgrim and recent construction permit hearings at Seabrook.

In so limiting the discussion, it must be noted that there are other possibilities. It is possible that the same capital that might be spent on a new power station might be spent upon advertising or devices to curb demand--these might include insulation or individual electricity generators such as windmills. In this sense, therefore, the discussion is not yet complete, but the options usually open to a utility are covered. Another forum should be used for these discussions.

ENVIRONMENTAL AND PUBLIC HEALTH EFFECTS OF AN ALTERNATE ELECTRICITY SUPPLY

The newer electricity generating stations, if of the same type and in the same location as those built before, will normally have an environmental impact of the same kind but reduced. If electricity is generated by a power station of a different type--such as nuclear replacing oil--the environmental impact is different.

The environmental impacts of an average 1000 MWe power plant have been extensively documented.[2-6] As a first approximation of the environmental impact of not building a power station, we can estimate the impact from a mix of alternate fuels.

PUBLIC HEALTH IMPACT OF OPERATING A NUCLEAR PLANT

We can make various illustrations of how to approach this problem. The impact on public health is emphasized rather than the impact on the environment because this interests me most.

Firstly, in Table 1 (taken from Reference 2) the average public health effects of various methods of generating electricity are listed. This list includes all parts of the fuel cycles.

TABLE 1

ESTIMATED YEARLY FATALITIES FROM OPERATION OF A 1000 MWe POWER STATION AT 75% CAPACITY

	NATURAL GAS	COAL	OIL	NUCLEAR
EXTRACTION	0.1	1-8*	0.1	0.1-0.3*
TRANSPORT	0	0	0.05	0
PROCESSING	0.01	0.02	1	0.5
TRANSPORT	0.02	1-3	0.05	0
ELECTRICAL GENERATION** (AIR POLLUTION)	0-100?***	3-300	1-300	0.1†
WASTE DISPOSAL	0	0-10	0	0.01††
TOTAL	0.05-100	15-310	2-300	0.7-1

* THIS ASSUMES THAT EITHER THE MINE TAILINGS ARE COVERED OR THE CUMULATIVE HEALTH EFFECT OVER THE NEXT 100000 YEARS IS DISCOUNTED AT ANY RATE EXCEEDING 1%.

** THE AIR POLUTION NUMBERS ARE MULTIPLIED BY 3 FROM REFERENCE 2 TO ALLOW FOR EFFECTS OF SULFATES, ETC., TRANSPORTED OVER LONG DISTANCES.

*** THE HIGHER FIGURE ADDED HERE IF THE MEASURED HEALTH EFFECT OF AIR POLLUTION IS IN FACT DUE TO NITRATES, NOT SULFATES OR PARTICULATES.

† THIS FIGURE IS REDUCED FROM REFERENCE 2 TO ALLOW FOR IMPROVED HOLDUP OF RADIOACTIVITY AND LACK OF REPROCESSING TO RELEASE ^{85}Kr. THIS ALSO INCLUDES AN AVERAGE OVER ACCIDENT EFFECTS FROM WASH 1400. THERE IS ALSO A REDUCTION FROM CONSIDERATION OF THE REDUCTION IN HEALTH HAZARD WHEN THE DOSE IS AT A LOW RATE.

†† THIS LOW FIGURE INCLUDES WASTE DISPOSAL. ACCORDING TO B. COHEN, "REVISED MODERN PHYSICS," JANUARY 1977, THIS SHOULD RESULT IN FEW FATALITIES.

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Let us consider two examples of the construction of a new power station taken from New England considerations. What is the effect of building a new 1000 MWe nuclear plant, operating at 75% capacity factor, at a site which is an average over existing sites? Since nuclear capacity is capital intensive and fuel is cheap, the nuclear

plant will always be operated and other plants turned off. We will then generate 6.6×10^6 MWh/yr of electricity. In the recent past, electricity has been generated countrywide by natural gas, oil, and coal in the percentages 25, 20, and 55, respectively. It is assumed that nuclear electricity will replace fossil-fueled electricity proportionately. Whether these proportions are correct depends upon the particular decision problem. If no alternative baseload power is built, the electricity will be generated by "peaking power"--probably oil driven. Although oil is less polluting than coal, peaking power is less efficient, and the impact of the large amount of oil is probably comparable. (Hydropower is omitted because it is also capital intensive, has a cheap operating cost, and will always be operated at full capacity.)

TABLE 2

ESTIMATED U. S. FATALITIES FROM 750 MEGAWATT-HOURS OF ELECTRIC POWER GENERATION (1967 - DECEMBER 1976)*

	NATURAL GAS	COAL	OIL	TOTAL REPLACEMENT FOSSIL FUELS	TOTAL NUCLEAR FUELS
FATALITIES	(180×10^6 Mwh)	(420×10^6 Mwh)	(150×10^6 Mwh)	(750×10^6 Mwh)	(750×10^6 Mwh)
EXTRACTION	2.5	60-500	2.0	52-500	11-31
TRANSPORT before processing	0		1.1	1	0
PROCESSING	0.25	(2) + (620)	23 + (180-2500)	25	57**
TRANSPORT after processing	0.6	62-190	1.1	62-190	0
ELECTRICAL GENERATION (AIR POLLUTION)	(-)	185-18000	23-6750	25500	11-91**
WASTE DISPOSAL	0	(640)	0	(640)	0
TOTAL FATALITIES (REFERENCE 2)	3.5	940-19000	6750	1000-27000	80-189
TOTAL FATALITIES (REFERENCE 4)				11300	

* FOSSIL FUELS: 55% COAL, 20% OIL, 25% NATURAL GAS OPERATING IN ONE HUNDRED FOURTEEN 1000 MW PLANTS WITH 1000-FT STACKS (99% PARTICULATE SUPPRESSION) AT 75% CAPACITY FACTOR WITH 33% THERMAL EFFICIENCY. NUCLEAR FUELS: U. S. DESIGN, LIGHT-WATER REACTORS OPERATING WITH 31% THERMAL EFFICIENCY. PARENTHESES ARE USED TO INDICATE ESTIMATES WITH LARGE UNCERTAINTY. THE FATALITIES FROM AIR POLLUTION ARISING FROM COAL AND OIL BURNING ARE INCREASED BY A FACTOR OF 3 PRIMARILY DUE TO EFFECTS AT LARGE DISTANCES FROM THE POWER PLANTS NOT INCLUDED IN REFERENCE 2.

** THIS IS PROBABLY PESSIMISTIC AND ASSUMES MAXIMUM ALLOWED RADIATION RELEASES. UNTIL FUEL IS REPROCESSED, MOST OF THE ^{85}Kr, FOR EXAMPLE, WILL NOT BE RELEASED.

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Using these assumptions and the data of Table 2, it is found that, for the 1 power plant, we would have between 9 and 250 fewer fatalities per year. A similar calculation carried out by Van Horn for 750 x 10^6 MWh of generation indicated a decrease of between 1000 and 27000 fatalities per year. The lower figures assume that sulfur (SO_2, SO_x), nitrates (NO_x), and pa iculates are suppressed so that the concentrations are below an assumed threshold--under which there are no health effects caused in man. For existing power plants in the eastern U.S., from Boston south to Washington and as far west as Chicago and St. Louis, it seems that pollution levels are already above a threshold for health effects (if there is one) and the higher figure probably applies.

This number may yet be low for two reasons: 1) the power is now (1977 onwards) more likely to replace oil or coal than natural gas, so the figures may be increased by 20%, and 2) the nuclear power is more likely to replace older generating capacity in populous areas and with poorer stackgas suppression and scrubbing than to replace new plants in the countryside.

PUBLIC HEALTH IMPACT OF A NEW, WELL-SITED, COAL PLANT

Another illustration comes when we consider operation of a coal plant in a good location. Assuming that this has good (99%) particulate suppression, uses low-sulfur fuel, or has scrubbers, let us also assume that it is placed in a coastal site on the eastern seaboard, northeast of Boston (the proposed plant at Sears Island, Maine, could be an example).

There are two ways in which this coal plant is an improvement over the average. First, the prevailing wind is from the west, so it is downwind of the U.S. (The international problems of transfrontier pollution to Nova Scotia and New Brunswick are ignored for this discussion.) Even in the absence of a prevailing wind, a coastal site takes the airborne pollutants over the sea half of the time, and the sulfates and nitrates are probably more readily absorbed there than over land. These factors are discussed by Chang and Wilson.[7] The reduction can be estimated to be at least a factor of 10 from the maximum effects in Table 2. This brings the total reduction in fatalities to between -2 and 224 per year. The negative figure comes from replacing oil and gas by coal which has major health problems at extraction, and the positive figure comes from a good choice of site--so that polluted air, if indeed it causes health effects, is not over major population centers.

A similar gain will come from placing a coal plant in an underpopulated western state, 1000 miles west of the Chicago, St. Louis, Boston, Washington population centers, e.g., Kaiporowitz. This gain is greatest if it is assumed that the health effects from sulfates and nitrates are zero below a threshold and this threshold is above the existing sulfate levels (5 $\mu g/m^3$) in the region.

ENVIRONMENTAL IMPACTS

The environmental impacts are also important, particularly, of course, for Kaiporowitz. The visual environmental impacts are almost all concerned with the construction and existence of the power plant and not its operation. The impacts of "acid rain" on plants are clearly worse for existing fossil plants than for a new nuclear plant, and a fossil fuel plant with tall stacks sited on a coast will give less impact than older ones inland. Impacts on water are likely to be similar, but there is usually a benefit from operating a new plant rather than an old one. The environmental effects of new plants may well be different from old ones. Wet-cooling towers are replacing once-through cooling systems. Although there is less fish entrapment and fish-kills generally, the wet towers can cause increased precipitation downwind.

Thus, the only net negative environmental impact of a new power plant that is important is the visual one of the existence of the plant itself and its power lines--provided we do not allow a shortage to develop.

EFFECT OF DELAY

The National Environmental Protection Act requires that all alternatives be considered to the proposed action and that there should be a comparison of the environmental effects of these alternatives. In application of this law, the procedures are those of the U.S. District Courts, and these procedures, by their nature, lend themselves to delay. In criminal cases this may well be right; better to delay than to execute an innocent man. Delay is also likely in an opposed hearing merely because of inertia.

In environmental and public health matters, delay is often more damaging than action. While the delay is going on, life proceeds. Certainly we waste energy excessively, but the experiences of life in Europe during and following World War II demonstrated the human expense of an unreliable electricity supply. To oppose power stations is probably the worst way of curtailing consumption.

SECONDARY EFFECTS (INCREASE OF ELECTRICITY COSTS)

Let us now consider two secondary effects which have different signs. If a power station which is unnecessary to maintain adequate system reliability is built, it will raise the cost of electricity. Since the amortization of the capital expense can be added to the rate base, it will also raise the price. The increase in price will reduce consumption, and this will have environmental and public health impacts. Although the total impacts of reduced consumption are unknown--since the environmental effects of cheap electricity are unknown--the listings in Tables 1 and 2 are proportional to electricity use so that in these ways reducing consumption reduces both environmental and public health impacts proportionally. These ways are assumed to dominate the total.

To take a numerical example, consider adding a new 1000 MWe power plant to a system of 10000 MWe capacity (very close to the capacity of the Boston area). It turns out to be unnecessary and therefore unnecessarily adds to the cost. It adds more than 10%--perhaps 20%--to the total capital carried on the rate base because it is a new plant and, in times of inflation, new plants are carried at more than old plants. We can estimate, therefore, that building this unnecessary power plant raises the overall price of electricity to the consumer by 10%. Assuming a long-term price elasticity of 0.5, the consumption of electricity will go down 5%, with about a 5% direct reduction in overall, system-wide public health and environmental impacts.

Assuming the system has power plants operating according to the average of modern plants as discussed before, this demand reduction will further reduce the mortality rate by

$$\frac{5}{100} \times \frac{10000 \text{ MWe}}{1000 \text{ MWe}} \times \text{average effect of a 1000 MWe plant,}$$

or 4 to 110 fatalities per year.

REDUCING ENERGY DEMAND

There may be good reasons for wishing, at some time, to restrict demand for energy. Environmental and public health effects will eventually increase faster than the energy consumption increases. Resource depletion is also an important factor.

So far the principal way of attempting to reduce energy demand has been to use the requirements of the National Environmental Policy Act to slow or stop construction of new electrical generating capacity or other energy systems. However, if the

argument is logically carried out, the conclusion is reached that the increase in generating capacity should not be curtailed.

It is clear that if demand should be curtailed, it is better to curtail it more directly. An increase in price (by taxation or otherwise) is the conventional way. This is objected to because it is politically unfeasible and because it may hit the poor harder than the rich. Since we want to curb increases more than we want to increase existing demand, an electricity price rising with demand for each individual customer has been suggested. This would be hard to implement because the price increase can be avoided by increasing the number of customers. A flat rate could, however, be adopted, but a mere curtailment of generating capacity to cause a shortage may bring many undesirable public health and environmental impacts and possibly even have the opposite effect to that desired.

SECONDARY EFFECTS (INCENTIVES)

As will be seen in the foregoing, the net gain to public health and the environment of building a new power plant may be large. Why then do environmentalists continuously oppose them? There are at least four reasons.

1. The issues may be incorrectly perceived.

2. There may be a net local disadvantage either to a whole town or to some individuals in the town. To some extent, the taxes on the power station help to compensate the local area. It is important that the effects of these taxes be distributed over a wide enough area to compensate.

3. The environmentalist may wish to impose his will on others (and we all wish to impose our will on others at times) by creating a shortage and thereby reducing demand. The usual method of reducing demand--by increasing energy prices by a tax--has repeatedly been rejected by the American people through their representatives in Washington.

4. The environmentalist may wish to further reduce public health and environmental impact by creation of incentives for the power company. For example, it costs nearly $300,000 in replacement fuel for every day a large nuclear power plant is off line. A power company may well agree to make some costly environmental improvement merely to get a particular intervenor off its back.

It would seem that these desires (2, 3, and 4) are at least to some extent legitimate and society should be able to devise means of meeting them in a more direct manner.

CONCLUSIONS

The net environmental and public health effects of building and operating a new power plant, of a type well chosen and in a site well placed, are probably beneficial even if the power plant proves to be unnecessary. But in order that this may not be frustrated by interventions, several steps are necessary.

1. Improved explanation and public perception of the issues.

2. There must be proper discussion of the local versus the countryside advantages and disadvantages and, if necessary, adjustment of procedures of taxation and distribution of benefits.

3. A discussion of whether and how to reduce demand is important and this discussion must be complete so that those who wish to use indirect and undesirable methods (such as the creation of a shortage) can be isolated and repudiated. In particular, it is essential to decide whether the cost of massive efforts to reduce demand is less than the cost of increasing supply. This decision may not be the same as the decision on individual bases; an individual usually pays an average cost of electricity whereas the cost of the last kilowatt hour may be more. Although some individuals will reduce demand on principle, it seems unlikely that a majority of individuals will act independently and contrary to their financial interests.

4. There must be discussion of how much to improve public health and reduce environmental impact independent of a particular power plant.

When these are accomplished, we will be in a position to demand the final improvement.

5. A speed-up of the legal system so that unnecessary delays should not occur. Possibly federal judges should be forced to write brief environmental statements <u>before</u> issuing a stay of action. This last improvement may well spill over into other segments of society.

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