41

Susquehanna Alliance
P O Box 249
Lewisburg, Pa 17837

June 10, 1980

U S Nuclear Regulatory Commission
Washington, D.C. 20555
Att: Director, Division of Site Safety &
Environmental Analysis

6/10/80

Dear Sir/Madam,

We are enclosing several documents which we hope will be of help in improving the quality of the Draft Environmental Statement and its Supplement which have been prepared in relation to the planned operation of the Susquehanna Steam Electric Station Units 1 & 2 (Docket No's 50-387 and 50-388). On May 26 we requested and were granted a 15 day extension of time in which to submit these comments by Mr Singh Bajwa, the NRC Environmental Project Manager for the project.

The documents enclosed include 1) a summary of the reasons we feel the Draft Supplement to the Draft Environmental Impact Statement with regard to the Pond Hill Reservoir is inadequate and incomplete; 2) comments on the Draft Statement itself to supplement our comments submitted on August 17 which reinforce our belief that as an Environmental Impact Statement this document is inadequate and incomplete, and 3) a copy of a recent PP&L news release which bolsters our contention that an inadequate assessment of the need for the plant has been done.

We hope that these comments will be of value to the staff in continuing the process of fully and diligently evaluating the full range of impacts of the proposed operation of the Susquehanna Steam Electric Station. It is our opinion that in order to adequately address the areas of concern raised by us and other commenters, extensive revisions to the draft must be made. In this context we request that a second draft be issued and be made available for further public comment before the final EIS is adopted. Please let us know if this request will be honored.

41 - NRC OGL

Sincerely,

David Mann

Tony Sade

Tony Sade

for the Susquehanna Alliance

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COMMENTS ON DRAFT SUPPLEMENT TO DRAFT EIS FOR THE SUSQUEHANNA STEAM ELECTRIC STATION

1) One of the conclusions drawn by the Staff of the NRC's office of Nuclear Reactor Regulation and of paramount concern to residents of the vicinity is that construction of the "Pond Hill" water storage reservoir will have a significantly negative impact on water quality. In particular, the supplement states that nutrient levels, specifically phosphorous, "will considerably exceed" the criteria established by the Environmental Protection Agency for nutrient levels and thus "the potential that eutrophic conditions will occur in the Pond Hill reservoir is relatively high". Missing from the statement is a polution abatement or mitigation plan by the applicant. Until such a plan is included, this draft supplement is incomplete.

41-1 Carlin Freeman

2) The safety analysis of the project is clearly insufficient, especially given the unpredictable nature of the Susquehanna River and its tributaries, and the fact that severe flooding has occured in the region twice within the last eight years as a result of extraordinarily heavy rains from tropical storms Agnes (1972) and Eloise (1975) in unprecedented concentrations. The maximum flood danger and impacts of overtopping the dam have not been adequately assessed, a rather glaring ommission in light of the NRC's mandate to protect the health and safety of the public. Specifically, the staff noted in section 4.4.2.3 that:

41-2 NRC

> If the dam were to be overtopped the staff believes that the dam could fail. The flooding that would result from failure of the dam would produce rapidly rising water elevations downstream of the dam site. The potential exists to trap and drown persons and wildlife in the downstream floodplain during such flooding (emphasis added). The potential for harm to persons using Route 239 and the railroad during such flooding also exists.

The issue of safety should be settled on the conservative side, with the maximum benefit to and protection of the public the overriding consideration. These hazards are not acceptable and a plan to mitigate these dangers should be included.

3) The report does not adequately address the consideration of alternatives to the construction of the Pond Hill Reservoir. The use of the Army Corp of Engineers Cowanesque Reservoir now under construction in Pennsylvania has not been fully explored, especially in light of the applicant's own admission that the costs of this alternative over a 30 year period would be $12 million (as compared with the $48-50 million cost of Pond Hill, $63 million if property taxes are treated as an additional project cost). In fact the Staff has concluded that:

41-3 NRC AWC

> The best economic alternative would appear to be the use-an-existing-reservoir-alternative (emphasis added). Based on the information available, Cowanesque appears to be the most economic among all alternative reservoirs, given that concerned authorities grant the use of water for flow augmentation.

The Baltimore District Corps of Engineers is currently studying the feasibility of modifying the existing project to include water supply storage as a project purpose in addition to flood control and recreation. It is felt that this modification would increase the economic efficiency of the Cowanesque Lake Project. Preliminary findings indicate that this could be done without affecting the flood control capabilities, that substantial releases could be provided into the Susquehanna River during low stream flow periods and these releases would generally improve the riverine environment during naturally low streamflow periods. Rather than expend over $63 million on what may become a putrid, stinking lake at Pond Hill, the utility and the public would be better served by the applicant's aggressive investigation of the resources required to effectuate

SUPPLEMENT COMMENTS CONTINUED

the necessary approval for their use of the Cowanesque project.

41-4 Prasad

In addition to the foregoing criticism regarding alternatives to the proposed project, the applicant and staff have not fairly treated the "No Action" or "River Following" alternative, whereby SSES would merely shut down during times of low flow in the Susquehanna River. Based on an average annual occurence of low flow of 4 days (a roughly 90% probability according to table 5.3) "the cost of Pond Hill Reservoir alternative would be very close to the replacement cost of electricity under the river following alternative". Given the excess capacity figures of both the applicant and the PJM interconnection, the staff concluded that "PP&L could provide reliable service to its customers even during a short interval of shut down of SSES". The attached press release from PP&L provides support for this statement.

41-5 Curtis

4) The final area of comment in regard to this project concerns the impact of the project on the cultural resources of the area. Although the applicant is "committed to carry out an archeological survey" and certain preventative measures if resources are discovered, the applicant does not specify in sufficient detail what those measures will be and what, if any, action will be taken (including halting construction) if substantial resources are in fact discovered. This survey should be performed before an EIS is prepared and the results included. The applicant has illustrated in the construction undertaken at the recreation area near the plant that it has no regard for cultural resources. A repeat of this performance must not be allowed.

ADDITIONAL COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT FOR SSES

41-8 NRC

1) The report does not adequately address the continuing and even escalating controversy regarding the health effects of continued exposure to low level radiation. In addition no mention is given to what has been dubbed the "Heidelberg Report" which has also been translated and printed by the NRC as "Radioecological Assessment of the Whyl Nuclear Power Plant". In studying existing data on the transfer factors to plant life (and ultimately human tissue) of certain radioactive isotopes emanating from operating nuclear power reactors, the authors of the report concluded that the NRC's judgments on how much plutonium, cesium, strontium, etc was picked up from the soil were "between 10 and 1,000 times to low". Even more outrageous than the error factor calculated by the W German scientists is their contention that the old AEC in an attempt to mollify critics of earlier nuclear policy, deliberately rigged the experiments to minimize the high transfer factors inherent in the isotopes. The steps include, but were not limited to:

RAB

a. pre-testing and selection of soils so as to choose those which absorbed the minimum amount of the isotope

b. adding radiotoxic substances to the soil shortly before harvesting, thereby avoiding realistic conditions, where plants would grow from seeds in the contaminated soil

c. cooking the soil in ovens to reduce the bacteriological effect upon the isotope and thus assure lower readings

The Heidelberg Report is the first time that independent scientists have examined the NRC's safety assurances about routine emmissions from operating plants. Although, in all fairness, it should be noted that the report may have come into the NRC's hands after or only shortly before the release of the Draft Environmental Statement for SSES, its conclusions warrant a thorough review of the issues raised, not only by the NRC, but by the applicant as well. The EIS must assess the full range of impact on the human environment before it can be considered complete.

41-9 Curtis

2) It is interesting to note that in the Draft Supplement to the Draft EIS, the applicant promises that it is "committed to carry out an archaeological survey" and to take whatever preventative measures are necessary to protect cultural resources. The irony inherent in that position is that no such survey was undertaken or even alluded to for the original project itself, one that involves considerable more expense, area, and intensity of construction than the Pond Hill Reservoir. In addition, part of the plant's secondary construction involves establishment of a recreation area on the low-lying flatlands adjacent to the Susquehanna River, similar areas of which have proven to be archeological motherlodes of information on and relics of pre-existing indigenous populations. As the applicant itself notes in Appendix B to the Draft Supplement ...

> Such assessments (inventories of historic or archeological resources which may be impacted by the proposed construction are to be made pursuant to 36 CFR 800, Section 106 of the National Historic Preservation Act of 1966 as amended (16 USC 470). by Executive Order 11593, May 13, 1971, "Protection and Enhancement of the Cultural Environment", and by the President's Memorandum on Environmental Quality and Water Resources Management, July 12, '78.

The applicant should be required to conduct such an inventory in compliance with the

above-cited legislation, regulations, and executive pronouncements, before construction continues and an operating license is granted. In addition a plan for mitigating the damage done by construction should be implemented.

41-9 Prasad Wanters

3) The Staff and applicant's cost-benefit analysis do not adequately reflect the impact of a renewed anthracite industry on the region. In an analysis prepared recently for the Susquehanna Alliance entitled "Economic, Social, and Environmental Impacts of Renewed Mining in the Anthracite Region", it was found that a revitalization of this industry, especially one employing new open-pit mining technologies, could remove all economically extractable coal and restore presently unusable areas to productive land uses, improve water quality beyond the requirements of the Pennsylvania Clean Streams Law, create 1500 new jobs in mining and related industries, and stem the outmigration of young people from the area. All of this could be accomplished in the process of producing a fuel cost-competive (based on BTU equivalents) with those currently in use. Again we state our belief that the operation of SSES will preclude the need for such an industry and the loss of these benefits should be included in the cost-benefit analysis.

41-9 NRC

4) As with all other Environmental Impact Statements relating to the construction of nuclear power plants, the Staff and the utility concerned have dismissed out of hand the possiblity of a serious, or Class IX accident and the health effects of such a catastrophe on the local population. Although this omission will be addressed shortly in a summary of the President's Council on Environmental Quality's generic criticisms of the entire EIS process, it is especially glaring both in light of the recent events at TMI and SSES's proximity to that crippled reactor, where in the Staff's own estimation (made in conjunction with a proceeding dealing with the Salem plant) a Class IX accident did occur. A thorough review of the possibilities of such an occurrence at SSES should be made that is site-specific not only to the nature of the technology employed by the applicant in the construction of the plant and certain geographic and geologic features but which also throughly reviews, analyzes, and assesses the probability of success of a large-scale evacuation of area residents should such a measure be necessitated by extraordinary events at the site. If the NRC is to even begin to restore public confidence in its ability to safely regulate the nuclear industry, the attitude that "it can't happen here" must no longer be standard operating procedure.

41-10

5) In a recent letter to John Ahearne, Chairman of the NRC, Gus Speth of the President's Council on Environmental Quality outlined several generic deficiencies, which he characterized as "disturbing" in the NRC Impact Statement Process of nuclear power reactors.

NRC

The most damning of CEQ's criticisms was that the discussion of potential accidents and their environmental impacts in these impact statements was "perfunctory, remarkably standardized, and uninformative to the public". Speth found that despite wide variations in the size, location, and design of nuclear power plants that have been licensed by the NRC, "virtually every EIS contains essentially identical "boilerplate" language written in an unvarying format". The failure to consider the worst case, or Class IX accident is exemplified in the Statement prepared for the licensing of TMI Units I & II, where no consideration is given to the Class IX scenario. This omission looms quite large in view of the Staff's own view that such an accident did occur on March 28, 1979.

Speth also urges the Commission to "broaden its range of variables (e.g. radiation pathways) in determining accident's impacts, and expand its discussions in EIS's of the

impacts of nuclear accidents on human health, the natural environment, and local economies". Once again, this criticism seems to stem from the belief that EIS's as currently prepared are simply general regurgitations of pre-existing data and positions that bear limited if any relevance to particular and unique site-specific information. The inability to translate this information in non-technical terms easily comprehensible to the general public also meets with CEQ's disapproval.

Finally, Speth suggests that the NRC vigorously pursue the goal of fulfilling to the utmost extent the requirements of the National Environmental Protection Act and the "legitimate public interest in full disclosure of nuclear plant hazards" (emphasis added) in the obvious belief that such disclosure has not been a top priority of the NRC's agenda in preparing Environmental Impact Statements for the operation of nuclear power plants.

We believe it is the responsibility of the NRC to bring the EIS's they prepare within the guidelines set by CEQ. Until this is done for the draft EIS in question here, it remains wholly inadequate and incomplete.

11/15/79

A few corrections are needed on this memo. [illegible]

NOV 0 9 1979

MEMORANDUM FOR: Donald E. Sells, Acting Chief
Environmental Projects Branch 2, DSE

FROM: Thomas D. Murphy, Chief
Radiological Assessment Branch, DSE

SUBJECT: RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL STATEMENT ON SUSQUEHANNA UNITS 1 AND 2

In response to your memorandum dated September 20, 1979, enclosed are our responses to comments on the Draft Environmental Statement (DES) on Susquehanna Units 1 and 2 (NUREG-0564). Several changes are needed in the radiological sections of the Final Environmental Statement because of a change in source terms. Changes to Sections 4.5 and 5.3 of the DES will be sent to you after we receive new source terms from ETSB.*

/s/

Thomas D. Murphy, Chief
Radiological Assessment Branch
Division of Site Safety and
Environmental Analysis, NRR

*Note: Since our response to comment #5-1 is also dependent on the new source term, it will be sent with our marked-up copy of Sections 4.5 and 5.3 of the DES.

Enclosure: as stated

Has this ~~not~~ response to #5-1 been received by STARK?
10/21/81

cc: D. Muller
W. Kreger
F. Congel
E. Branagan

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OFFICE	RAB:DSE	RAB:DSE	RAB:DSE			
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DATE	10/31/79	11/2/79	11/2/79			

RESPONSE TO COMMENTS ON DRAFT
ENVIRONMENTAL STATEMENT ON
SUSQUEHANNA UNITS 1 AND 2

Comment #5-4, M. L. Hershey

I strongly disapprove the issuance of any license to operate the Susquehanna plant until you have:

... can be sure through independent studies that the effects of low level radiation emitted from the plant over the 30 to 40 year life span will not harm the public.

Response

See response to comment #5-1.

Comment #8-2, T. A. Drazdowski, Sierra Club

A preliminary review finds the report flawed and incomplete in the following:

...2. Discussion of the health effects of radiation and radioactive waste disposal do not note the present controversy among scientists concerning risks, safe dosage, and waste disposal techniques.

Response

The risks from waste disposal are addressed in Section 4.5.5 "Uranium Fuel Cycle" of NUREG-0564. See response to comment #5-1 for additional information on potential health effects associated with effluents from Susquehanna Units 1 and 2.

Comment #9-1, EPA

We request the NRC to explain the changes which allowed a five to seven fold increase in projected gaseous iodine releases (found by comparison of the Statements of 1973 and 1979) and to explain why the increases did not result in any substantial change in the associated doses to a child's thyroid. (For details, see the Draft Statement, page 4-16 versus page G-56, and 4-18 versus G-75, 77.)

In support of this request, it may be noted that our 1973 comments on projected gaseous iodine releases and associated doses were sharply critical, and we recommended the use of engineered iodine control systems and other design modifications to reduce iodine release such that the offsite dose to a child's thyroid did not exceed 5 millirem per year. Our comments are reproduced in the Draft Statement, pages G-151, 152.

Comment #9-1, EPA - cont'd

The 1973 response to those comments, shown on page G-123, item 11.13, stipulated use of design modifications, and referenced a revised radiological impact as described on page G-77, section 5.4.1. Even though section 5.4.1 noted the existence of uncertainties in the calculational model, and the dose impact has now been recalculated using new source-term calculations, per page 4-1, but the Statement does not contain any specific discussion of lessened impact per unit of iodine release. This discussion of lessened impact per unit of iodine release must be incorporated in the Final Environmental Impact Statement.

Response

The models used in estimating doses in the environmental statement for the operating license are state-of-the-art models. The source term, meteorological dosimetry models have been improved since the issuance of the construction permit. These models have been reviewed by the U.S. Environmental Protection Agency in regards to implementing the Uranium Fuel Cycle Standard (40 CFR 190). The doses calculated by these models are thought to be conservative (i.e., the models probably overestimate actual doses).

Comment #9-3, EPA

We are encouraged that the NRC is now calculating annual population dose commitments to the U.S. population, which is a partial evaluation of the total potential environmental dose commitments (EDC) of H-3, Kr-85, C-14: iodines and "particulates." This is a big step toward evaluating the EDC, which we have urged for several years. However, it should be recognized that several of these radionuclides (particularly C-14 and Kr-85) will contribute to long-term population dose impacts on a world-wide basis, rather than just in the U.S. To the extent that this draft statement (1) has limited the EDC to the annual discharge of these radionuclides, (2) is based on the assumption of a population of constant size, and (3) assesses the doses during 50 years only following each release, it does not fully provide the total environmental impact. Assessment of the total impact would (1) incorporate...by estimating the health impact for a period reflecting multi-generation times.

Response - Comment #9-3, EPA

The staff does not believe that presently available worldwide dose models are capable of making such projections with meaningful results. The staff has determined that present models for the U.S. sufficiently represent the population exposure due to operation of this plant.

Environmental impacts from uranium mining and milling are addressed in Section 4.5.5, "Uranium Fuel Cycle Impacts", of NUREG-0564.

Comment #9-7, EPA

The assessment of the direct radiation from the nitrogen-16 is not discussed in sufficient detail to allow meaningful interpretation (see pages 4-16 to 4-21). For example, it is stated that the applicant calculated a direct radiation dose of 2.7 mrem/year per unit at 0.55km south of the plant...therefore should be more fully discussed in the final EIS.

Response

The calculated value for the direct radiation dose (20 mrem/yr at a typical site boundary of 0.6 km from the turbine building) given in the Braun Safety Analysis Report is for a standard BWR plant design. The direct radiation dose of 2.7 mrad/yr in NUREG-0564 is an estimated dose for the specific design incorporated in the Susquehanna plant. Since the direct radiation dose is dependent on the shielding incorporated in the specific plant design the above values are not directly comparable. Nonetheless, since the actual direct radiation dose could be higher (or lower) than 2.7 mrad/yr, a survey will be required at the time of plant operations. If the survey indicates that the limits of 40 CFR 190 could be exceeded then steps will be taken to reduce the dose.

Comment #9-8, EPA

The health risk conversion factor slisted on page 4-27 appear low and are inconsistent with the factors used in the Generic EIS on Uranium Milling (NUREG-0511). These values should be made consistent with those used in NUREG-0511.

Response

The basis for the risk estimators on p. 4-27 of NUREG-0564 is more fully described in Ch. 4, Section J, Appendix B, "Health Risks from Irradiation", of the Final Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors (NUREG-0002). As stated in NUREG-0002, "Though these risk estimates are the upper bound estimates given in the Rasmussen Report,[3] higher estimates can be developed by use of the "relative risk" model along with the assumption that risk pervails for the duration of life. This would produce risk values up to sevenfold greater than those used in GESMO." Consequently, the risk estimators in NUREG-0511 are consistent with those used in NUREG-0002.

Comment #10-4, D. Mann, Susquehanna Alliance

The report does not fairly represent the growing controversy over the effects of low level radiation. Time after time...federal standards be lowered.

Response

We are not aware of any studies that have established that there is no safe level of radiation. However, as a conservative and prudent assumption, ~~we~~ it has been assumed that no amount of radiation is safe. For more

Response to Comment #10-4 - cont'd

than four decades, radiation has been the most thoroughly studied carcinogen. Numerous major biological research programs have been well documented and may be found in the open literature. While the United States has been the forerunner in radiation research, many other countries also have pursued similar programs and have contributed substantially to the knowledge. While the relationship between ionizing radiation dose and biological effects among humans is not precisely known for all levels of radiation, the principal uncertainty exists at very low dose levels where natural souces of radiation (cosmic and terrestrial) and the variations in these sources are comparable to the doses being evaluated. The most important biological effects from radiation are somatic diseases (principally cancer) and hereditary diseases. Both of these are identical to those which occur normally among humans from other causes. It is this last point in combination with other confounding factors, e.g., magnitude and variations (1) in normal incidence of diseases, (2) in doses from natural radiation sources, (3) in radiation doses from man-made sources other than the nuclear industry, and (4) in exposures to other (non-nuclear) carcinogens, which is responsible for much of the uncertainty in the dose-risk relationship at low dose levels.

Data from studies of animals and humans are reviewed continuously by teams of scientific experts which evaluate radiological information and provide recommendations. In the United States, the principal expertise in radiological matters lies with the National Council on Radiological Protection (NCRP) and the National Academy of Science/ National Research Council (NAS/NRC). Federal agencies also retain

Response to Comment #10-4 - cont'd

expertise in the radiologic disciplines in order to fulfill their responsibilities, however, these agencies rely heavily on recommendations of these advisory organizations. Other countries have national advisory organizations similar to those of the United States. Further, there are cooperative international organizations which evaluate data from all sources and present recommendations and conclusions, for example, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the International Commission on Radiological Protection (ICRP). In summary, not only have the radiological data been ascertained by the world's outstanding biologists and epidemiologists, but the data have been evaluated independently by their peers.

In lieu of precise knowledge of this relationship, a linear non-threshold extrapolation from high radiation levels to the lower levels is assumed for radiation protection purposes. This means that it is assumed that any dose of radiation, no matter how low, may be harmful.

Several federal agencies, principally the Environmental Protection Agency, Occupational Safety and Health Administration and the Nuclear Regulatory Commission, have responsibilities for regulating exposures to radiation or radioactive material. In all cases, the staffs of these agencies are well aware of the potential health effects and have expertise in biology and the other disciplines needed either within the staff or available to them.

Comment #11-3, F. L. Shelly

Uranium Fuel Cycle Impacts - Radon-222

I refer you to the transcript of the TMI-2 Operating License Hearing July 5, 1977, page 2890 and the testimony of Dr. Chauncy Kepford and Dr. Reginald Gotchy...The naturally occurring costs are bad enough without adding to them.

Response

With regard to Dr. Kepford's testimony regarding use of $1,000 per man-rem for environmental health costs, the Staff would like to make the following points.

(1) The $1,000 per man-rem value was selected by the Commissioners as the upper bound of all the numerical estimates in the literature. The purpose was to estimate the potential monetary costs of health effects during the lifetimes of persons living within 50 miles of a nuclear power plant (no other facility) so that those potential costs could be compared with the real costs of adding additional radiological waste treatment systems to each proposed nuclear power plant to determine if the operation of the plant would result in meeting the 10 CFR Part 50, Appendix I "as low as reasonably achievable" rule. It was never the intent of the Commissioners to use that monetary value for any other purpose, such as estimating the monetary costs of future health effects from other sources on today's populations or future populations. The obsurdity of future monetary costs can be demonstrated very simply assuming human institutions and the human race persist into the future in the same manner as today. Ignoring the real possibility that radon health effects may not occur in the future due

to technological advances in the cure and prevention of such effects, it is possible to calculate how much money would have to be deposited in a savings account now to meet "future monetary costs" of 10 billion dollars per reference reactor year.

As a conservative estimate, it was assumed a 5 percent simple interest rate would demonstrate the meaninglessness of such calculations. Conservative Staff estimates indicate only a few health effects might occur within 1,000 years. It is obvious that essentially all of Dr. Kepford's "health effects" would occur over periods of time which exceed the probable life expectancy of the human-race and our solar system. Nevertheless, tongue-in-cheek, it can be shown that if the utility were to deposit one-cent in a perpetual savings account to pay for any future health costs that might occur, that fund would contain contain nearly $16 million-trillion after only 1,000 years. Clearly, one-cent would not significantly modify the future costs of electrical power generated today.

With regard to Dr. Kepford's estimates of millions of future deaths from radon-222 per Reference Reactor Year, the Staff response to comment 16-1 are also relevant here.

The Long Term Health Consequences of Susquehanna Steam Electric Station

by

William A. Lochstet
The Pennsylvania State University*
August 1979

The Nuclear Regulatory Commission has attempted to evaluate the health consequences of operation of the Susquehanna Steam Electric Station, Units 1 and 2 in its draft environmental statement NUREG - 0564.

The health consequences of radon-222 releases from the uranium fuel cycle are estimated for the first 1000 years in section 4.5.5. In evaluating the radon-222 emissions from the coal fuel cycle in section 8..4.4 , (item #7 on page 8-10), the staff recognizes that the emissions continue for "millions of years". Neither approach is correct. Footnote 12 of NRDC v. USNRC, 547 F.2d 633 (1976) requires that the wastes be considered for their entire toxic life. Thus, the only proper evaluation is with no temporal cutoff. Such an evaluation is attached as an appendix to this statement ("Comments on NUREG - 0332"). This evaluation shows that the Staff has underestimated the health consequences of both the coal and uranium fuel cycles.

The NRC apparently justifies its allowing of health consequences by comparison with background (P. 4-27 to 4-28). This is totally irrelevant and contrary to NEPA. NEPA requires an evaluation of the benefits and all of the costs of the Federal action under consideration (Susquehanna 1 & 2). Background radiation is not a justified federal action. The harm caused by background cannot justify other harm. This improper comparison of costs to background is contrary to the decision in Calvert Cliffs Coordinating Committee v. USAEC, 449 F.2d 1109 ,1115 (1971).

* The opinions and calculations presented here are my own, and not necessarily those of The Pennsylvania State University. My affiliation is given here for identification purposes only.

Comments on NUREG-0332

by

Dr. William A. Lochstet
The Pennsylvania State University
November 1977

In the document NUREG-0332 (Draft), the NRC estimates the excess deaths per 0.8 gigawatt-year electric (GWy(e)) to be about 0.5 for an all nuclear economy and about 15 to 120 for the use of coal(Ref. 1). These estimates are much too small because they ignore the health effects due to the slow release of radon-222 resulting from the decay of radioactive components of the coal, uranium mill tailings, and of the tailings from the uranium enrichment process.

If the health effects are estimated by the procedure used by the NRC, then the excess deaths are about 600,000 in the nuclear case and twentythousand for coal. The estimates presented here are all based on the production of 0.8 GWy(e).

Radon Produced by the Uranium Fuel Cycle

The production of 0.8 GWy of electricity by a LWR will require about 29 metric tons of enriched uranium for fuel. With uranium enrichment plants operating with a 0.2% tails assay, 146 metric tons of natural uranium will be required. In the absence of the LMFBR, 117 metric tons of depleted uranium would be left over. With a uranium mill which extracts 96% of

the uranium from the ore (Ref. 2), a total of 90,000 metric tons of ore is mined, containing 152 metric tons of uranium. The uranium mill tailings will contain 2.6 kilograms of thorium-230 and 6 metric tons of uranium. As Pohl has pointed out (Ref.3) the thorium - 230 decays to radium - 226, which in turn decays to radon - 222. This process results in the generation of 3.9×10^8 curies of radon-222, with the time scale determined by the 8×10^4 year half life of thorium - 230.

The 6 metric tons of uranium contained in the mill tailings decay by several steps to radon - 222 thru thorium - 230. This process occurs on a time scale governed by the 4.5×10^9 year half life of uranium - 238, the major isotope present (99.3%). The total amount of radon - 222 which will result from this decay is 8.6×10^{11} curies.

The 117 metric tons of depleated uranium from the enrichment process is also mainly uranium - 238 which also decays. The decay of these enrichment tailings results in a total of 1.7×10^{13} curies of radon - 222. This is listed in Table 1, along with the other radon yields.

It is instructive to compare these quantities of activity to the activity of the fission products which result from the use of the fuel which they are associated with. The total fission product inventory resulting from 0.83 y(e) with half lives of 25 years or more is about 10^7 curies. This is much less than any of the numbers in Table 1. We should be more careful with these tailings.

Radon Produced by the Coal Fuel Cycle

Item 2 i of Appendix A of NUREG-0332 (Ref. 1) assumes a 75% capacity factor, which for a 1000 MWe plant would produce only 0.75 GWy(e). A capacity factor of 80% will be used here. The production of 0.8 GWy(e) by a coal plant operating at 40% efficiency, using 12,000 BTU per pound coal would require 2.5 million short tons of coal. This is close to the value of 3 million tons suggested on page 9 of NUREG-0332 (Ref. 1).

There is great variability in the amount of uranium contained in coal. An analysis of coal samples at one TVA plant reported by the EPA (Ref. 4) indicates a range of almost a factor of ten in uranium content. Eisenbud and Petrow (Ref. 5) report a value of about 1 part per million. A recent survey by the USGS based on several hundred samples suggests that in the United States coal contains an average of 1.8 part per million of uranium(Ref. 6). Both values of 1.0 and 1.8 ppm will be used here. Thus 2.5 million tons of coal will contain between 2.3 and 4.1 thousand kilograms of uranium. Using the assumption of NUREG-0332 (Ref. 1) that there is 99% particulate removal from plant emissions, 1% of this uranium will be dispersed into the air and the remainder carted away as ashes for land burial. Table 1 indicates that with 1.0 ppm coal the uranium in the resulting ash will decay to a total of 3.2×10^{11} curies

of radon - 222, while the stack emissions will lead to 3.2×10^9 curies. For 1.8 ppm coal the values are 5.8×10^{11} curies from ash and 5.8×10^9 curies from emissions.

Evaluation of the Health Effects

It is necessary to evaluate the number of deaths which result from the release of one curie of radon - 222. For the purpose of this evaluation the population and population distributions are assumed to remain at the present values. This should provide a good first estimate.

NUREG-0332 (Ref. 1) suggests that a release of 4,800 curies of radon - 222 from the mines (page 11) would result in 0.023 excess deaths (Table 1a, page 18). This provides a ratio of 4.8×10^{-6} deaths per curie. Data from Chapter IV of GESMO (Ref. 7) suggests a value of 1.7×10^{-6} deaths per curie as a lower limit. The value of 4.8×10^{-6} deaths per curie will be used here as the NRC estimate. It is understood that this is very approximate.

The EPA has evaluated the health effects of a model uranium mill tailings pile. They estimate a total of 200 health effects (Ref. 8, page 73) for a pile which emits at most 20,000 curies of radon - 222 for 100 years. The resulting estimate is 1.0×10^{-4} deaths per curie and will be used here as the EPA estimate.

Evaluation of Health Effects - Nuclear

At present some recent uranium mill tailings piles have 2 feet of dirt covering. In this case the EPA estimate (Ref. 8) is that about 1/20 of the radon produced escapes into the air. This factor of 20 is listed in Table 1 and is used to find the effective releases. Thus the 3.9×10^{8} curies of radon which results from thorium in the mill tailings results in a release of 1.9×10^{7} curies into the atmosphere, which with the NRC estimate of 4.8×10^{-6} deaths per curie results in 90 deaths. With the EPA estimate 1900 deaths result. A similar treatment applied to 8.6×10^{11} curies of radon from the uranium in the mill tailings results in 200,000 dead for the NRC estimate and 4.3 million for the EPA estimate. It is here assumed that no future generation will see fit to take any better care of the mill tailings than is presently practiced.

The uranium enrichment tailings are presently located in the eastern part of the country. It is assumed that these are buried near their present locations. Radon will not escape so easily through wet soil. A reduction factor of 100 is used to estimate this effect. The accuracy of this estimate depends on the particulars of the burial which can only be projected. An additional factor of 2 is used to reduce the effect due to the fact that much of this radon would decay over the ocean rather than populated

land areas. No compensation is taken for the greater population density near the point of release as compared to the uranium mill tailings piles of the western states. With this total reduction factor of 200 the NRC estimate is 400,000 dead while the EPA value is 8 million.

Evaluation of Health Effects - Coal

It is assumed that the ashes from the coal plants will be buried in a manner similar to the tailings from the uranium enrichment process. Thus a reduction factor of 200 is used in this case also. Again the higher population density is ignored.

The particulate which is released into the air by the coal plant is taken to contain 1% of the contained uranium. Since most such plants are in the eastern part of the country it is estimated that half will fall into the ocean rather than onto land. A second factor of 2 is used to reduce the effect of the resulting radon due to the fact that some of this radon will decay over ocean as with the radon from the uranium in the enrichment tailings. Again no compensation is taken for the greater population density near the point of release. This gives the total reduction factor of 4 shown in table 1.

With these reduction factors applied to the radon released by the ashes and emissions, in the two cases of 1.0 ppm and 1.8ppm uranium content coal, the health effects are calculated. These are shown in Table 1, and range from 7,700 dead from ashes and 3,800additional dead from airborn emissions for 1.0 ppm coal in the NRC estimate to 290,000dead from ashes and 140,000 dead from airborn releases in the case of 1.8 ppm coal in the EPA estimate.

Discussion

It is obviously very difficult to estimate with any precision how many health effects result from the release of a given curie of radon - 222 from some specific site in the west. The estimates presented here differ by a factor of 20. This might best be used as a range of expected deaths. The reduction factors used here are crude estimates in some cases, and could be improved upon. Changes in public policy could also change the manner in which this material is disposed, thus greatly changing these factors. In particular deep burial could practically eliminate the escape of radon to the atmosphere (Ref. 8).

It is important to compare Table 1 here with Table 1 of NUREG-0332 (Ref. 1), which shows 0.47 dead for the nuclear case and at most 120 dead for coal. These last numbers totally ignore the effects of long term radon emissions, which result in at least 100 times higher mortality. These long term effects are not only significant, but dominate the effect.

It is important to use Table 1 to compare the relative risk of the nuclear and coal option in their present forms. In this case deaths due to all causes considered in NUREG-0332 can be ignored as insignificant, since they are so small. The absolute number of deaths per curie released is irrelevant since it enters in both cases. The relative risk is determined solely by the quantities of radon - 222 generated and the reduction factors. Unless there is a clear decision to treat coal ashes differently from uranium enrichment tailings, the health effects from the tailings will be 50 times greater since there is

50 times more uranium there. The nuclear option remains more hazardous than coal unless the releases from all of the tailings piles can be reduced below the releases from the airborn particulates of the coal plant. This is not the present policy.

Additional Comment

There is a typographical error on page 25 of NUREG-0332. Reference #33 is listed there as being in volume 148 of Science, whereas it appears in volume 144.

Acknowledgment

The above comments were inspired by the 5 July 1977 testimony of Dr. Chauncey R. Kepford in the matter of the Three Mile Island Unit 2 (Docket No. 50-320) operating license entitled: " Health effects Comparison for Coal and Nuclear Power".

Table 1

Energy Source Excess Mortality per 0.8 GWy(e)
due to Radon - 222 emissions

Origin of Radon	Radon Generated Curies	Reduction Factor	Deaths NRC	Deaths EPA
Nuclear				
Thorium in Mill Tails	3.9×10^{8}	20	90	1900
Uranium in Mill Tails	8.6×10^{11}	20	200,000	4.3×10^{6}
Uranium in Enrichment Tails	1.7×10^{13}	200	400,000	8×10^{6}
Coal 1.0 ppm U				
Ashes	3.2×10^{11}	200	7,700	1.6×10^{5}
Air Particulate	3.2×10^{9}	4	3,800	8×10^{4}
Coal 1.8 ppm U				
Ashes	5.8×10^{11}	200	14,000	2.9×10^{5}
Air Particulate	5.8×10^{9}	4	6,800	1.4×10^{5}

References

1 "Health Effects Attributable to Coal and Nuclear Fuel Cycle Alternatives" NUREG-0332, Draft, U.S. Nuclear Regulatory Commission (September 1977)

2 "Environmental Analysis of The Uranium Fuel Cycle, Part I - Fuel Supply" EPA-520/9-73-003-B, U.S. Environmental Protection Agency, (October 1973)

3 R.O. Pohl, "Health Effects of Radon - 222 from Uranium Mining" Search, 7(5), 345-350 (August 1976)

4 P.H. Bedrosian, D.G. Easterly, and S.L. Cummings, "Radiological Survey Around Power Plants Using Fossil Fuel" EERL 71-3, U.S. Environmental Protection Agency, (July 1970)

5 M. Eisenbud, and H.G. Petrow," Radioactivity in the Atmospheric Effluents of Power Plants that Use Fossil Fuels," Science 144,:288-289 (1964)

6 V.E. Swanson et al, "Collection, Chemical Analysis, and Evaluation of Coal Samples in 1975", Open-file report 76-468, U.S. Department of the Interior, Geological Survey, (1976)

7 "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors," NUREG-0002. U.S. Nuclear Regulatory Commission, (August 1976)

8 See Ref. 2

Response

Dr. Lochstet's comments are inaccurate and erroneous in so many areas, it would be impossible to respond completely in a meaningful way. Our major differences center around:

(1) Dr. Lochstet's insistence on calculating radon-222 releases (both coal and nuclear) and resultant health effects over periods of time exceeding the life expectancy of the solar system much less the probable life expectancy of the human species.

(2) Incorrect use of previous NRC estimates of cancer mortality per curie of Rn-222 released.

(3) Incorrectly equating EPA estimates of health effects with cancer mortality.

(4) Improper assumptions of Rn-222 releases from uranium mill tailings and uranium enrichment tailings.

It is the staff's position that the cure and/or prevention of cancer is likely to occur well within the 100 to 1,000 year period evaluated by the staff in the Summer OL-DES. Although population dose commitments may continue into the future, the staff does not believe there will be any significant cancer mortality associated with such dose commitments. Therefore, it is reasonable to truncate estimates of cancer mortality at 100 to 1,000 years from the present time.

Dr. Lochstet incorrectly drived 4.8×10^{-6} deaths per Ci of Rn-222 released to the atmosphere from draft NUREG-0332. He assumed that the 0.023 cancer deaths listed in the NUREG came from release of 4,800 Ci of Rn-222, also mentioned in the NUREG. The 0.023 cancer death estimate

Response to Comment #16-1 - cont'd

actually comes from the estimated 1130 curie release during active milling only. Therefore, a more appropriate value would be 20 X 10^{-6} deaths per Ci (i.e., about a factor of 4 higher than he assumed.)

Dr. Lochstet misused the EPA estimate of health effects (his Ref. 8) by equating it with cancer mortality. In addition, the EPA later (1975) reduced their estimate of health effects in the Eastern U.S. from 120 to 30 giving a total of 110 health effects. Still later, EPA concluded their estimate of 80 health effects in the Northern Hemisphere was too high. More recent EPA estimates of cancer mortality are included in the Perkins Hearing record in testimony by Dr. R. L. Gotchy, author of NUREG-0332. In March, 1978, Dr. W. H. Ellet, U.S. EPA, provided Dr. Gotchy with his latest estimates, which resulted in about twice as many cancer deaths per curie of Rn-222 released as shown in the Summer DES.

Finally, Dr. Lochstet chooses to ignore current NRC licensing and industrial practice which will result in much smaller releases of radon-222 than he assumed for his calculations. In fact, deeply buried mill tailings may result in long-term radon releases which are less than could occur in nature had the uranium not been mined, milled and used to generate electricity. This is because over 90% of the long-lived U-238 and U-234 is removed from an ore-body which geologic processes could eventually bring to the surface of the earth. Once on the surface, the radon-222 releases could occur undiminished over millions or billions of years.

Response to Comment #16-1 - cont'd

Furthermore, Dr. Lochstet's assumption of radon-222 releases from uranium enrichment tailings are without any factual basis. Such tailings are being held for use in breeder reactors. In the event the U.S. doesn't use this valuable resource domestically, other nations will be purchasing the depleted uranium for their own breeder programs. In the interim period, no radon-222 will be released from enrichment tailings.

In conclusion, the staff finds Dr. Lochstet's evaluation of the radon-222 impacts to be unrealistic and incorrect, both philosophically and technically.

Comment #17-3, M. Huntington

Another major point that I contend in this report is the establishment of the uranium mining and milling necessary for this plant as having an "acceptable" impact upon the environment...of another group of 1.2 million people per year in this situation too.

Response

The contention by Mr. Huntington that "The NRC itself has been unable to disagree with Dr. Chauncey Kepford's findings that 1.2 million people per year will die in the future from the effects of radon gas emitted from the tailings produced just to fuel TMI", is incorrect. The NRC Staff has refuted such claims in several hearings as meaningless for many reasons. Some of the more important reasons are discussed in responses 11-3 to Mr. Shelly, and 16-1 to Dr. Lochstet, and need not be repeated here.

Comment #18-2, S. Laughland

Radiation causes cancer. This is an accepted medical fact. The United States has a surplus of power plant, so why add the Berwick plant to the long list of environmental and health hazards of this country.

Response

See response to Comment #10-4.

Comment #19-13, N.W. Curtis, Pennsylvania Power and Light Company

ENVIRONMENTAL MONITORING

1. Table 5.1, pg. 5.3 - This table has been updated to reflect changes in sampling locations and station nomenclature corrections. The lower limits of detection have also been revised per NUREG-0473. A copy of the table with corrections indicated will be forwarded under separate cover.

Response

The above revisions will be used in establishing that the environmental radiation monitoring program meets the staff's position on environmental monitoring. Lower limits of detection will be incorporated in the applicant's technical specifications.

Comment #20-2, C. L. Jones, Dept. of Environmental Resources, Commonwealth of Pennsylvania

Spent Fuel Storage

Section 4.5.5 - Radioactive Wastes - This section should be expanded to include contingencies for the long-term storage of spent fuel on site. This may be required if a decision has not been made on the final disposition of spent fuel after the plant has been operating for a few years.

Response

The storage of spent fuel is addressed in an NRC document entitled "Final Generic Enviornmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel" (NUREG-0575). The storage of spent fuel addressed in NUREG-0575 is considered to be an interim action, not a final solution. The commission has clearly distinguished between permanent disposal and interim storage.

One of the findings of NUREG-0575 is that the storage of light water reactor (LWR) spent fuels in water pools has an insignificant impact on the environment, whether stored at a reactor or away from a reactor. Primarily this is because the physical form of the material, sintered ceramic oxide fuel pellets hermetically sealed in Zircaloy cladding tubes. Zircaloy is a zirconium-tin alloy which was developed for nuclear power applications because of its high resistance to water corrosion in addition to its favorable nuclear properties. Even in cases where defective tubes expose the fuel material to the water environment, there is little attack on the ceramic fuel.

Response to Comment #20-2 - cont'd

The technology of water pool storage is well developed; radioactivity levels are routinely maintained at about 5 X 10^{-4} μCi/ml. Maintenance of this purity requires treatment (filtration and ion exchange) of the pool water. Radioactive waste that is generated is readily confined and represents little potential hazard to the health and safety of the public.

There may be small quantities of ^{85}Kr released to the environment from defective fuel elements. However, for the fuel involved (fuel at least one year after discharge), experience has shown this to be not detectable beyond the immediate environs of a storage pool.

There will be no significant discharge of radioactive liquid effluents from a spent fuel storage operation as wastes will be in solid form.

This statement supports the finding that the storage of spent fuel in away-from-reactor facilities is economically and environmentally acceptable.

References

1. Natural Resources Defense Council, Denial of Petition for Rulemaking, July 5, 1977, 42 FR 34391. Available in the NRC Public Document Room.

Comment #20-3a, C. L. Jones, Department of Environmental Resources, Commonwealth of Pennsylvania

Radiation Releases

Section 4.5.2 - Direct Radiation - The direct radiation dose of 2.7 mrad/yr calculated by the applicant could be low by about an order of magnitude based on a more...measurements taken near several of the operating boiling water reactors (BWR's).

Response

See response to Comment #9-7.

Comment #20-4b, C. L. Jones, Dept. of Environmental Resources, Commonwealth of Pennsylvania

The calculated radionuclide releases in liquid effluents is discussed in terms of dose commitments (pages 4-14, 4-15). The Department believes that the impact of radionuclide releases and resulting river quality concentrations should be compared to the National Drinking Water Standards.

Response

Annual doses per site from liquid effluents were given in Table 4.10. The estimated dose to the total body or any organ of the hypothetical maximum individual from all pathways was about 1.0 mrem/yr. This dose includes the dose from ingestion of fish as well as consumption of water. The dose to the average individual using the nearest community water system would be less than 1.0 mrem/yr. The Environmental Protection Agency's "National Interim Primary Drinking Water Regulation" states that "the average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year", (Sect. 141.16). The annual doses from liquid effluents from Susquehanna Units 1&2 are below the above limits.

Comment #21-4, T. R. Duck

The statements in Section 4 which state that radioactive releases, both occupationally and environmentally, will have no significant environmental impact are misleading when one considers that the effects of low level radiation are unknown. Groups such as the National Academy of Sciences hesitate to place acceptable low dose limits on human health effects.

Response

See response to Comments #5-1 and 10-4.

Comment #21-8, T. R. Duck

The tables in Section 8 dealing with the effects of coal versus nuclear plants presumably used coal in the general sense. The SESS is located near the heart of the anthracite coal region. Anthracite, because it is a cleaner burning coal, has been exempted from any EPA air pollution regulations. Since this is the coal that should be used at SESS, it is the coal that should be used in any comparative studies.

Response

As stated in NUREG-0564, there is a considerable amount of uncertainty in estimating health effects over long periods of time (greater than 100 years). The overall uncertainty in the nuclear fuel cycle is probably about an order of magnitude (increased or decreased by a factor of 10) over 100 years and about two or more orders of magnitude over 1000 years. The uncertainty associated with the coal fuel cycle tends to be much larger because of the inability to estimate total health impacts from all the pollutants released to the environment from that cycle. However, if one assumes most of the public impact over a period of several decades is caused by inhalation of sulfur compounds and associated pollutants, there is as much as a two-order-of-magnitude uncertainty in the assessment of the coal fuel cycle. In view of the large uncertainties in any comparison of the health effects of coal versus nuclear power plants, a site specific comparison is not warranted.

Comment #23-1, L. E. Watson

There was quite a bit of data collected on fish and wildlife but there was none collected on humans--no health picture of the human population within 10 miles of the plant--before the startup of operation. I feel this should have been done--to have some comparison with data that might be taken a few years later, with respect to effects of radiation

Comment #23-1 - cont'd

etc., with normal operation of the plant and also in case of an accident such as at T.M.I.

Response

Animal and food crop samples were taken prior to the startup of the plant. The background activity in these samples is determined by destructive means. Similar destructive testing of humans would not be possible. Although whole body counting (a non-destructive test) could be done of humans near the site, this would not be effective because of the mobility of the human population and the cost of whole body counting.

Comment #23-3, L. E. Watson

On page G87, 6.2.2 in the Environmental Statement of June 1973, the staff comments "the applicant does not appear to have made arrangements for interchange of data as yet, with nearby radiological monitoring programs at Peach Bottom, TMI, Oyster Creek, Indian Point, Shoreham, Forked River, Newbold Island, Salem, or Limerick. In the revised Draft Statement of June 1979, this omission has not been corrected.

Response

Results of environmental monitoring programs at nuclear power reactors are routinely made available to the public. For example, see an NRC document entitled "Radioactive Materials Released from Nuclear Power Plants, Annual Report 1977" (NUREG-0521).

This response is not accurate, & should be revised!

Comment #23-4, L. E. Watson

In the section 4.5.5 on Uranium Fuel Cycle Impacts, we object to the conclusion that both the dose commitment and health effects of the uranium cycle are insignificant when compared with dose commitment and potential health effects to the U.S. population resulting from all the natural background sources. The effects are additive, and even the natural background sources are considered ersponsible for mutations, cancer, and other diseases. Just because one must tolerate natural background sources it does not follow that radiation from the uranium fuel cycle is harmless. It could be the "straw that breaks the camel's back".

Response

See response to comments #5-1 and 10-4.

Comment #25-5, L. E. Meierotto, U.S. Dept. of Interior

Page 5-2

We agree with the staff that the applicant should monitor groundwater both upgradient and downgradient on a monthly basis. We note that the potential for radionuclide contamination of groundwater is implied on page D-1 of Appendix D (item 1.6); however, figure 4.1 (p. 4-13) does not indicate groundwater as an exposure pathway to humans.

Response

The applicant states that "In general, ground water in the Paleozoic rock formations of the Appalachian Highlands flows from the topographically higher areas (recharge areas) to the valleys (Ref. 2.4-25). This groundwater, it is believed, discharges to springs and to the streams and rivers of the region, except at flood stage."* Consequently, the doses from ingestion of groundwater should be no greater than the doses from ingestion of water from the river. Any use of groundwater as a drinking water supply should be balanced by a decrease in river water as a drinking water supply.

*Susquehanna SES-ER-OL, p. 2.4-12