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May 26, 1981

Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
COMMENTS ON SUPPLEMENT 2 OF
DRAFT ENVIRONMENTAL STATEMENT
ER 100450 FILE 991-2 PLA-818

Dear Mr. Youngblood:

Attached are PP&L's comments on Supplement 2 of the Draft Environmental Statement.

Very truly yours,

N W Curtis

N. W. Curtis
Vice President-Engineering & Construction-Nuclear

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Applicants have reviewed Supplement No. 2 to the Draft Environmental Statement related to the operation of the Susquehanna Steam Electric Station Units 1 and 2 (NUREG-0564) and in general concur with the Staff's analyses, evaluations, and conclusions. Applicants believe the Supplement meets the intent of the Commission's statement of interim policy regarding accident considerations and agree with the Staff's conclusion that while the environmental impacts of the accidents considered may be severe, the likelihood of their occurrence is remote. Therefore, the conclusions reached in the Draft Environmental Statement should remain unchanged.

Applicants do have the following specific comments on Supplement No. 2.

A) The Staff's analysis makes several assumptions which tend to overstate the impacts of the events being considered.

1. <u>7-Day Ground Dose Assumption</u>

Page 6-12 of Supplement No. 2 contains the following statement:

> The RSS consequence model also contains a provision for incorporating the consequence reduction benefits of evacuation and other protective actions. Except as otherwise indicated below, the results shown for Susquehanna do not include this provision. With respect to this aspect of the calculations, therefore, the results are "worst case" estimates. The model does, however, provide for relocation of persons to avoid prolonged exposure to ground contamination. Unless otherwise specified, the calculations for Susquehanna incorporate this provision for relocation following seven days of exposure.

PP&L (A

This "seven days of exposure" refers to irradiation from fission products deposited on the ground following a postulated core-melt accident. It is extremely conservative to assume the population would remain in place and be exposed to this radiation for as long as seven days. This over-conservatism is particularly great for early health effects, such as acute fatalities. The results of the Reactor Safety Study (RSS)(1) show that in the highly unlikely event of accidental releases of large amounts of radioactivity, the incidence of acute fatalities in the population is dominated by the radiation dose from deposited gamma-emitters.(2) It is therefore particularly important to try to make a more realistic estimate of the magnitude of this dose, taking into account what can reasonably be expected by way of protective actions such as evacuation. The Staff recognizes this, since it refers to the results as being "worst case" and includes calculations which incorporate a model for early evacuation as indicated in Table 6.1.4-5. The use of the seven-day ground dose in Supplement No. 2 results in the prediction of unwarrantedly large consequences and conveys an incorrect impression of the risk of reactor accidents.

Realistic values should be presented as the main results of the report. Table 6.1.4-5 shows that the use of realistic protective actions reduces the predicted annual average values of public risk due to population exposure or to latent cancer fatalities by a factor of between five and twelve. The risk due to early fatalities is similarly reduced by a factor of about thirty. Figure 6.1.4-4 shows the marked reduction in acute fatalities which results when realistic protective means are assumed. However, most of the data in Supplement No. 2 does not reflect realistic protective actions and is therefore overly conservative. (See figures 6.1.4-2, 6.1.4-3, 6.1.4-5, 6.1.4-7, 6.1.4-8.) The plot of isopleths in Fig. 6.1.4-7 and Fig. 6.1.4-8 by incorporating the 7-day ground dose assumption gives a misleading impression of how far downwind acute fatalities might be expected to occur following a reactor accident.*

2. Comments on the Use of CRAC

It is Applicants' understanding that the version of the CRAC (Calculation of Reactor Accident Consequences) computer code used in the preparation of Supplement No. 2 was essentially the same as that used for the preparation of the RSS. A significant difference was the incorporation of an evacuation model, recently developed at Sandia Laboratories(3). Although this model represents an improvement over that used in the RSS, there are other modifications which could be incorporated into CRAC. These have been described in recent studies such as that of the Limerick BWR(4). Applicants believe the omission of these modifications is another significant source of conservatism. Examples of these conservative elements include: PP&L(A2)

* Applicants also have reservations about the meaningfulness of isopleths of individual risk at the 10^{-10} or 10^{-11} per year level. At this vanishingly small probability level (one in 10 billion or one in 100 billion per year), these values have little meaning.

(a) Plume Width

The width of the plume in the dispersion model used in the RSS and in Supplement No. 2 is based upon releases of radioactive material for only three minutes duration; that is, the formulae used for calculating the plume width are phenomenological fits to data taken in experiments in which the duration of release was about three minutes. In practice, the shortest release duration considered in the RSS and Supplement No. 2 was thirty minutes. It is a well-known characteristic of dispersing plumes that, roughly speaking, their average width is an increasing function of the duration of cloud passage.(1) If plume widths for a thirty-minute release are used, predicted plume center line concentrations are reduced by a factor of about two. Radiation doses are also reduced by the same factor. The predicted effect on the number of acute fatalities depends upon the population distribution around the reactor, but should be a reduction by at least a factor of two.

(b) Shielding Factors

The CRAC analysis incorporates shielding factors for people assumed to be sheltered from gamma-rays emitted by deposited fission products. In the RSS and presumably Supplement No. 2, a shielding factor of 0.3 was used. In the Limerick Study(4) the shielding factor was estimated by considering the shielding provided by typical houses found in Pennsylvania. Since brick houses with basements are common there, with excellent shielding characteristics, a more realistic shielding factor of 0.15 was deduced. Since the accumulated ground dose is the dominant contributor to the radiation dose that is used in calculations of early fatalities, this shielding factor can lead to a substantial reduction in that dose.

Taken together with the factor of two due to the change from a 3-minute to a 30-minute plume width, a reduction by a factor of 3-4 in predicted doses is possible. The corresponding reduction in the predicted number of early deaths may be even greater because of the thresholds in the early fatality dose-risk relationships. These considerations would suggest that a considerable reduction of the acute fatality probability distributions shown on Figure 6.1.4-4 is possible with appropriate changes in CRAC. Consequently, the results as shown are conservative and overstate the risk.

B) Table 6.1.4-1 provides a list of some Design Basis Accidents. The indicated frequency categories for these accidents are not consistent with previous NRC documents. This table implies that these accidents were included in the design basis as Infrequent Accidents, when in fact they have been considered as Limiting Faults based on the acceptance criteria contained in the Standard Review Plan. PP&L(B)

C) On pages 6-8 in Section 6.1.3.2, the fourth paragraph states that only one industrial plant, the Luzerne Outerwear Company, is located within the LPZ. Last summer, CAR-MAR moved into an industrial park which is also within the LPZ. CAR-MAR employs approximately 70 people. This industrial park is located in Sector 10 approximately 1.7 miles from the site. PP&L(C)

D) On page 6-16, the second paragraph in Section 6.1.4.5 states that there are no wells between the plant and the river via the northern bedrock valley pathway. While this statement is correct in terms of pathways for exposure to the public, there are five wells located on Applicants' property in the area in question. In the unlikely event of an accident involving releases to groundwater, these wells would not be used. PP&L(D)

REFERENCES:

1. Reactor Safety Study, WASH-1400 (NUREG 75/014), 1975.

2. Wall, I.B. Yaniv, S.S., Blond, R.M., et al, "Overview of the Reactor Safety Study." Paper presented at the International Conference of Nuclear Systems Reliability Engineering and Risk Assessment, Gatlinburg, Tennessee, June 19-25, (1977).

3. Aldrich, D.C., Blond, R.M. and Jones, R.B., "A Model of Public Evacuation for Atmospheric Radiological Releases", Sandia Laboratories Report SAND, 78-0092 (1978).

4. Probabilistic Risk Assessment, Limerick Generating Station, Philadelphia Electric Company, Docket Nos. 50-352 and 50-353, (March, 1981).

-PP&L(A1)

Analyses and text now presented in FES are different from those in the DES Supp. No. 2.

Regarding use of individual risk at 10^{-10} or 10^{-11} levels per reactor-year in the isopleths, these levels are not meaningless when there would be distribution of several million persons in the regions spanned by these isopleths. Societal risk from those regions would be in the range of 10^{-4} to 10^{-5} cases per reactor year - as directly derived by multiplying the individual risks and the number of persons in the regions.

-PP&L(A2)

The staff has not completed the review of the accident consequence calculations in the Limerick Risk Analysis Study referenced in the comment.

However, the licensing staff is in the process of reviewing the recent changes made to the CRAC code used at the Sandia National Laboratories and the staff will incorporate any appropriate and qualified changes into the version of CRAC currently used in licensing actions.

-PP&L(B)

See minor text change in the second paragraph of Section 6.1.4.1 Design Basis Accidents.

-PP&L(C)

The staff has recently learned of this industrial activity near the site. The staff is requesting additional information from the applicant regarding CAR-MAR activities, as well as anticipated plans for the industrial park, and will provide an evaluation in a forthcoming supplement to the Safety Evaluation Report.

-PP&L(D)

The staff has corrected the statment to indicate that there are no offsite wells that could be encountered via the northern bedrock valley pathway.

7. NEED FOR PLANT AND ALTERNATIVES TO THE PROPOSED ACTION

7.1 RÉSUMÉ

When the FES-CP was issued in June 1973, the applicant, Pennsylvania Power & Light Co., scheduled operation of the Susquehanna Steam Electric Station, Units 1 and 2, to begin operation in 1981 and 1982, respectively. In 1973, need for the plant was projected to occur between 1978 and 1982 in order to meet the projected annual energy demand increase of 7.2%. Since 1973, the oil embargo and rising electricity costs have led to a decline in growth of electrical energy and peak demands in the nation and in the PP&L service area. The PP&L service area demand for power did not continue to grow at the historical rates occurring prior to the 1973 Arab oil embargo. PP&L had projected a 1980 winter peak demand of 4970 MW, without UGI (Luzerne Electric Division of UGI Corp.), a 25% reduction from the 1973 forecast of 6600 MW. Construction has proceeded approximately on schedule with operation of Susquehanna Units 1 and 2 now scheduled for the second quarter of 1982 and the second quarter of 1983, respectively. Since 1973, PP&L has agreed to sell a 10% share of both units to the Allegheny Electric Cooperative.

During the construction-permit stage, the staff analyzed alternative sites, plant designs, and methods of power generation, including the alternative of not adding production capacity. The staff concluded, based on its analysis of these alternatives, as well as on a cost-benefit analysis, that additional capacity was needed, that a nuclear-fueled plant would be an environmentally acceptable means of providing the capacity, and that SSES, Units 1 and 2, at a specified site and of a specified design, were acceptable from both economic and environmental perspectives. Since that time, construction of SSES has been nearly completed; and many of the economic and environmental costs associated with the construction of the station have already been incurred and must be viewed as "sunk costs" in any prospective assessment.

7.2 APPLICANT'S SERVICE AREA AND REGIONAL RELATIONSHIPS

The PP&L service region is shown in Figure 8.1 of the FES-CP. The applicant supplies electric power to about 26,000 km^2 in east central Pennsylvania (22% of the area of the state). In 1973, the population of the service area was about 2.3 million (20% of the state total). Major cities served by PP&L include Allentown, Bethlehem, Harrisburg, Hazelton, Lancaster, Scranton, Wilkes-Barre, and Williamsport.

Along with the following utilities, PP&L is a signee to the Pennsylvania-New Jersey-Maryland (PJM) Interconnection Agreement: Public Service Electric and Gas Co. (PS); Philadelphia Electric Company (PE); Baltimore Gas and Electric Company (BC); General Public Utility (GPU), which consists of Jersey Central Power & Light Company (JC), Metropolitan Edison Company (ME), and Pennsylvania Electric Company (PN); Potomac Electric Power Company (PEPCO); Atlantic City Electric Company (AE); Delmarva Power & Light Company (DPL); and Luzerne Electric Division of UGI Corporation (UGI). These eleven companies, operating their transmission and generation facilities as a single system with free-flowing power interchange between companies, account for energy flow between companies and use after-the-fact accounting procedures. The agreement with PJM requires that PP&L meet its generation capacity obligation as a part of the PJM interconnection.

7.3 BENEFITS OF OPERATING THE PLANT

SSES-1 and -2 are being constructed for the purpose of assuring an adequate low cost supply of electrical energy for the needs of the PP&L and PJM service area needs. At the operating license stage, consideration of alternatives involves only the decision as to whether the plant should operate or not. This decision is based on a weighing of the benefits of operation against environmental impacts (including production costs). Potential benefits of operating Susquehanna 1 and 2 include reliability, diversity, and economic advantage.

7.3.1 Operation of the PJM Interchange

One of the most important concepts of the PJM interconnection is its economic operation as a single system with centralized dispatch of generation and free-flowing power exchanges between member companies. Transmission lines connecting the various PJM companies provide for the transfer of energy from one company to another as required to meet the loads of each company. This allows for the full utilization of the resources of all companies to meet the customer loads of all companies most economically. Coordination is not restricted to the generation phase; it is also implemented in capacity, maintenance, and transmission planning.

Central dispatch of all PJM generating units is accomplished by providing the Interconnection Office, located at Valley Forge, PA, with the necessary data, control equipment, and computers to economically load all PJM units at levels needed to meet the PJM load. The Interconnection Office, a central coordinating office, is connected to all company dispatch centers (i.e., applicant's Allentown Power Control Center) via voice, digital and analog computers, and teletypewriter circuits.

In order to meet a specific PJM load the Interconnection Office transmits to all companies the incremental cost, taken from the combined loading schedule, needed to provide generation at the required level. As the PJM load increases, higher incremental cost values are transmitted to the various companies and the level of generation is increased. Each company will raise or lower generation on its units according to the PJM incremental cost signal regardless of its own load requirement.

Occasionally, due to unit operating constraints, transmission limitations, or reliability considerations, units are operated at above the incremental cost level at either the company's or PJM's request, depending upon the circumstances.

Since some companies have a larger amount of less expensive generation, such as nuclear or coal-fired units, these companies may be generating at levels above their own load and as such may be supplying energy to other companies over the interconnected transmission lines. To provide a means of compensating for this exchange of energy between member companies, an accounting procedure, based on the split-savings principle, is used.

The interchange accounting procedure used on PJM provides both the supplying companies (sellers) and the receiving companies (buyers) with a savings as a result of the energy transactions between them. The billing for each transaction is halfway between the cost incurred by the supplying companies and the cost that would have been incurred by the receiving companies had they used their own higher-cost generation to meet their loads (split-savings principle).

7.3.2 Minimization of Production Costs

In order to determine the potential economic advantage of operating SSES, the staff studied the cost associated with operation of SSES Units 1 and 2 and the projected cost of replacement electricity. The unit costs for fuel, operation and maintenance, and the projected source and its share of supply of replacement electricity provided by the applicant are shown in Table 7.1. It appears that 75% of the replacement electricity would come from other members of the PJM interchange. Compared to other sources, the cost projections provided by the applicant are reasonable (Table 7.2). Based on the applicant's 90% share of SSES-1 and the unit's projected operation at 70%, the savings (in fuel and operation and maintenance costs) for the initial year of operation are estimated to be $64.5 million ($1980). However, the applicant's assumption as to the capacity factor of the Susquehanna units during their initial years of operation is probably high (based on the experience of nuclear units in general).[1] If a lower capacity factor were assumed, e.g., 50% to 60%, the savings per unit per year would be about $46 million to $55 million. However, the cost savings would not be confined only to the initial year of operation; the applicant would continue to save as long as SSES Units 1 and 2 were capable of operating, a period of about 30 years.

In 1980, the fuel cost for generating electricity from an oil-fired unit was 43.1 mills/kWh, which is higher than the applicant's projection (made in 1978) of 25 mills/kWh.[2] This is due to the rapid rise in the price that electric utilities paid for oil from 1978 to 1980. Hence, the savings to the applicant, using current cost of oil-fired generated electricity, would be $100 million and $118 million per unit per year, respectively (assuming the units were operating at 60% and 70% capacity factor). If it is assumed that the replacement cost of electricity to Allegheny Electric Cooperative, Inc., which owns 10% undivided interest in SSES Units 1 and 2, is the same, the total savings from the operation of SSES would be $112 million per unit per year (assuming the units were operating at 60% capacity). In calculating the savings, it was assumed that the quantity of electricity demanded would remain the same regardless of whether or not SSES were operated.

The staff views the applicant's assessment of potential savings as reasonable to conservative (ER-OL, p. 1.1-4). The results could not be significantly altered if the demand for electricity grew at a lower rate than assumed; this is because the applicant's marginal energy source would continue to be oil. Thus, the staff concludes that economic considerations justify adding the Susquehanna facility in the scheduled time period.

Table 7.1. Projected Type/Cost[a] of Replacement Energy Associated with Applicant's Share[b] of Susquehanna Unit 1

	Susquehanna Nuclear	Applicant			PJM (less applicant)		
		Coal	Oil[c]	Combustion Turbine[c]	Coal	Oil[c]	Combustion Turbine[c]
Percent or replacement energy generated	-	15	10	-	30	40	5
Fuel cost[d] (mills/kWh)	9	14	25	50	14	27	45
O&M costs[c] (mills/kWh)	4	2	1	10	2	1	10
Total operating cost (mills/kWh)	12[d]	16	26	60	16	28	55
Partial costs (million dollars)	73	13.9	15.0	-	27.8	64.9	15.9
Total costs (million dollars)	73	137.5					

[a]1980 dollars.

[b]With a 70% unit capacity factor, applicant's 90% share (945 MW) of Susquehanna Unit 1 would provide approximatelv 5794 GWh.

[c]Does not reflect price increases due to events in the Mideast during 1979.

[d]Due to rounding errors, column does not add up.

Table 7.2. A Relative Comparison of Projected Cost by PP&L, Commonwealth Edison, and NRC (mills/kWh)

	Nuclear	Coal	Oil
PP&L[a] (in projected $1980)	13	16	26
CE (in $1977)	9	17[c]	27
NRC[d] (in projected $1980)	10	16	

[a]From Table 7.1, in 1980 dollars.

[b]In 1977 dollars. See Reference 3.

[c]Low-sulfur coal without scrubbers.

[d]Based on 1980 as first year of operation. See Reference 4.

7.3.3 Diversity of Supply Source

Regardless of the relative economic advantage of nuclear or coal, it is to the advantage of a public utility to have diverse sources of power available. In the event of the unavailability of imported oil, major strikes, frozen coal piles, enrichment facility shortages, or regulatory uncertainties, a reliance upon one primary fuel, especially for baseload operation, could cause cutbacks in power to the grid. Currently, all of PP&L's baseload units utilize coal or oil. As noted in Table 7.1, no baseload nuclear is available to PP&L as replacement power. With the Susquehanna nuclear station in operation, PP&L will be better prepared to meet unexpected changes in the supply of coal and oil. The fact that operation of SSES Units 1 and 2 will improve the diversity of generation supply for the applicant is an important factor in support of issuing an operating license.

7.3.4 Reliability Analysis

7.3.4.1 PP&L Projections

Table 7.3 presents the applicant's historical winter peak load and energy between 1966 and 1977 and the projected winter peak load and energy sales between 1978 and 1990. The growth rates for winter peak and energy sales for the period 1966 to 1977 were 7.1% and 6.8%, respectively. The rates of increase of peak load and energy sales through the projected period 1978 to 1990 are 2.7% and 3.1%, respectively.

7.3.4.2 PP&L Reserve Margin

The PP&L reserve margin, with and without the Susquehanna facility, is presented in Table 7.4 for the period 1978 through 1985. Adjusted peak is defined to be "peak load plus sales minus purchases." Reserve is defined as "capacity minus adjusted peak," and reserve margin as "reserve divided by adjusted peak."

The rate of growth of peak demand and energy has been much smaller than anticipated during the planning for construction of Susquehanna. Consequently, the reserve margin for PP&L, even without the Susquehanna facility, is much larger than the 5% required by the interchange agreement or the 15 to 25% recommended by the Federal Economic Regulatory Commission (formerly Federal Power Administration).* At the time construction was planned (early 1970s), the reserve requirement was 20% (not 5% as now). There is, however, the possibility that this reserve requirement could increase toward the current PJM reserve requirement of 20%. If PJM summer-peaking companies tend toward winter peaking as more electric heating loads are substituted for gas and oil, the applicant's credit for peak load diversity will be reduced and its capacity obligation could approach the 20% requirement of PJM. If the PJM reserve requirement increases as a result of such conditions, it is expected that an equivalent and direct change

*PP&L's 5% reserve margin is due to diversity on the PJM system; i.e., with the exception of PP&L, all utilities belonging to PJM are summer peaking. PP&L can rely upon the capacity of other PJM utilities to support its winter peak load.

Table 7.3. Applicant's Peak Load and Energy Sales: Past and Projected[a]

Year	Energy Sales kWh × 10^6	Energy Sales % Increase	Winter Peak MW	Winter Peak % Increase
Historical				
1966	10,157	--	2,085	--
1967	10,967	8.0	2,326	13.3
1968	12,081	10.1	2,514	8.1
1969	13,531	12.0	2,850	13.4
1970	14,683	8.5	3,238	13.6
1971	15,685	6.8	3,294	1.7
1972	17,013	8.5	3,598	9.2
1973	18,865	10.9	3,662	1.8
1974	18,963	0.5	3,772	3.0
1975	19,113	0.8	4,122	9.3
1976	20,354	6.5	4,514	9.5
1977	20,926	0.3	4,431	-1.8
Projected				
1978	21,650	3.5	4,650	4.9
1979	22,400	3.5	4,790	3.0
1980	23,400	4.5	4,970	3.7
1981	24,350	4.0	5,140	3.4
1982	25,251	3.7	5,310	3.3
1983	26,110	3.4	5,480	3.2
1984	26,919	3.1	5,630	2.7
1985	27,673	2.8	5,770	2.5
1986	28,379	2.6	5,910	2.4
1987	29,069	2.4	6,030	2.0
1988	29,754	2.4	6,160	2.1
1989	30,439	2.3	6,290	2.1
1990	31,124	2.2	6,420	2.1

[a]Source: ER-OL, Table 1.1-9.

Table 7.4. 1977 Projection of Applicant's Loads, Capacity, and Reserves for the 1978-1985 Period (mid-range load projection)[a]

	1978	1979	1980	1981	1982	1983	1984	1985
Winter Peak (MWe)	4,650	4,790	4,970	5,140	5,310	5,480	5,630	5,770
Total capacities (MWe)								
Fossil (coal)	4,145	4,145	4,145	4,145	4,145	4,145	4,145	4,145
Fossil (oil)	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640
CT & Diesel	539	539	539	539	539	539	539	539
Hydro	146	146	146	146	146	146	146	209
Nuclear	--	--	--	--	945	1,890	1,890	1,890
Firm purchase	76	76	76	76	76	76	76	76
Capacity Transactions	(41)	(50)	(110)	(65)	(31)	(62)	(93)	(125)
Total (MWe)	6,505	6,496	6,436	6,481	7,460	8,374	8,343	8,374
Adjusted peak	4,650	4,790	4,970	5,140	5,310	5,480	5,630	5,770
With Susquehanna								
Reserve (MWe)	--	--	--	--	2,150	2,894	2,713	2,604
Reserve margin (%)	--	--	--	--	40	53	48	45
Without Susquehanna								
Reserve (MWe)	1,855	1,706	1,466	1,341	1,205	1,004	823	714
Reserve margin (%)	40	36	29	26	23	18	15	12

[a]Data from ER-OL, Answer to Cost-Benefit questions January 1979, Table CAB-11.1; ER-OL, Table 1.1-4.

in the applicant's capacity obligation will occur. The staff also recognizes that additional reserve capacity above 20% may be desirable for a system with units that are large in relation to system size (as will be the case with the Susquehanna facility in service).

7.3.4.3 PJM Reserve Margin

In Table 7.5, the staff presents the reserve and reserve-margin calculations for PJM with and without the Susquehanna facility through 1985. Since there are no firm purchases or sales outside PJM and since all PJM utilities except PP&L are summer peaking, the reserve margin is defined as "capacity minus summer peak load, divided by summer peak load." Without the Susquehanna facility, the reserve margin of PJM could be as low as 23% in 1983 and 1984. In an interchange such as PJM, with about 7000 MW or more than 20% nuclear baseload operation, a 23% reserve margin might not be adequate to meet minimum reliability standards. With the Susquehanna facility, the reserve margin for PJM will be an acceptable 28% in 1983 and 1984.

Table 7.5. Projection of PJM Loads, Capacities, and Reserves

	1978	1979	1980	1981	1982	1983	1984	1985
Summer peak (MWe)	31,686[a]	33,670	34,870	36,200	37,630	39,000	40,310	41,650
Total capacities (MWe)								
Fossil (coal)	15,501	15,487	15,887	15,870	15,884	15,791	15,791	16,191
Fossil (oil)	12,132	12,132	12,132	12,132	13,164	13,383	13,993	13,525
Nuclear	6,197	8,192	8,192	8,192	9,182	10,242	11,362	13,484
CT and diesel	7,926	7,960	7,960	7,959	7,972	8,247	8,246	8,132
Hydro	2,236	2,236	2,236	2,267	2,267	2,267	2,267	2,267
Total (MWe)[b]	43,992	46,007	46,407	46,420	48,469	49,930	51,659	53,599
Reserve over summer peak:								
With Susquehanna								
Reserve (MWe)	--	--	--	--	10,839	10,930	11,349	11,949
Reserve margin (%)	--	--	--	--	29	28	28	29
Without Susquehanna								
Reserve (MWe)	12,306	12,337	11,537	10,220	9,849	8,960	9,399	10,019
Reserve margin (%)	39	37	33	28	26	23	23	24

[a]Actual 1978 summer peak; occurred on 16 August 1978.

[b]Capacity as shown in "Load and Capacity Forecast," PJM Interconnection, 1 June 1978.

7.4 ALTERNATIVES

The staff believes that the only reasonable alternative to the proposed action of granting an operating license for SSES available for consideration at the operating license stage is denying the license for operation of the facility and thereby not permitting the constructed nuclear facility to be added to the applicant's generating system. Alternatives such as construction at alternative sites, extensive station modification, or construction of facilities utilizing different energy sources would each require additional construction activity with its accompanying economic and environmental costs, whereas operation of the already constructed plant would not create these costs. Therefore, unless major safety or environmental concerns resulting from operating the plant that were not evident and considered during the construction-permit review are revealed, these alternatives are unreasonable as compared to operating the already constructed plant. No such concerns have been revealed with regard to operation of SSES.

With respect to the proposed action of operating the facility, it was shown that the addition of SSES to the PJM system is expected to result in savings in system production costs of about $112 million per year for each of the two units of SSES. Further, as stated, operation of these units will provide diversity of fuel sources, thereby decreasing dependence on fuel supplies of uncertain availability (gas, oil, and lignite) and will contribute to increased system reliability. The environmental impacts of operation are reassessed in Section 4 of this Statement. As discussed in Section 4, as a result of this reassessment, the staff has been able to forecast more accurately the effects of operation of SSES and has determined that the station will operate with acceptable environmental impact.

The alternative of not operating the facility will require the utility to substitute approximately 11 billion kWh per year of electrical energy that would have been provided by SSES with other sources of energy that have a greater economic cost and an equal or greater environmental cost. As indicated, the additional economic cost has been estimated at approximately $112 million per year for each of the two units.

After weighing the described options, the staff concludes that the preferable choice is operation of SSES.

References

1. U.S. Nuclear Regulatory Commission, "Licensed Operating Reactor Status Report," Vol. 5, No. 2, NUREG-0020, February 1981.*

2. "Energy Review," Vol. 5, No. 2, Spring 1981.

3. A. D. Rossin and T. A. Rieck, "Economics of Power," Science (201)582-589, 18 August 1978.

4. J. O. Roberts, S. M. Davis, and D. A. Nash, "Coal and Nuclear: A Comparison of the Cost of Generating Baseload Electricity by Region," NUREG-0480, December 1978.**

*Available for purchase from the NRC/GPO Sales Program, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and/or the National Technical Information Service, Springfield, VA 22161.
**Available for purchase from the National Technical Information Service, Springfield, VA 22161.

8. EVALUATION OF THE PROPOSED ACTION

8.1 ADVERSE EFFECTS THAT CANNOT BE AVOIDED

The staff has re-assessed the physical, social, biological, and economic impacts that can be attributed to the operation of SSES. Inasmuch as the units are currently under construction, many of the predicted and expected adverse impacts of the construction phase are evident. The staff has not identified any additional adverse effects from those presented in the FES-CP that will be caused by the operation of the units. The applicant is committed to a program of restoration and redress of the station site that will begin at the end of the construction period.

8.2 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

There have been no significant changes in the staff's evaluation of the use of land for the Susquehanna Steam Electric Station since the preconstruction environmental review. There have been major changes in the location of some of the transmission corridors since the FES-CP was issued; however, the staff's evaluation of the environmental impacts of the transmission lines remains essentially as before. The presence of the station in Luzerne County will continue to influence the future use of other land in its immediate environs as well as the continued removal of county land from agricultural and timber use as the result of any increased industrialization.

8.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

There has been no change in the staff's assessment of this impact since the earlier review except that the continuing escalation of costs has increased the dollar values of the materials used for construction and fueling of the plant. The staff has expanded and updated the discussion of uranium fuel availability in Section 8.5.

8.4 COMPARISON OF NUCLEAR AND COAL-FIRED POWER PLANTS

8.4.1 Health Effects

In addition to the environmental costs attributable to coal and nuclear fuels (Table 8.1), the differing health effects from using coal and nuclear fuels have been considered in the environmental assessment of each alternative. In making these assessments, the entire fuel cycle rather than just the power-generation phase was considered to compare the total impacts of each cycle. For coal, the cycle consists of mining, processing, fuel transportation, power generation, and waste disposal. The nuclear fuel cycle includes mining, milling, uranium enrichment, fuel preparation, fuel transportation, power generation, irradiated fuel transportation and reprocessing, and waste disposal.

In preparing this assessment it was recognized that there are great uncertainties due to the lack of an adequate data base in certain areas of each fuel-cycle alternative. 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. The much greater uncertainty associated with the coal fuel cycle results from the relatively sparse and equivocal data regarding cause-effect relationships for most of the principal pollutants in the coal fuel cycle, the effect of federal laws on the future performance of coal-fired power plants, mine safety, and culm-bank stabilization, and the long-term impacts of coal ash and flue gas desulfurization sludges.

"Health effects," as the term is used here, is intended to mean excess mortality, morbidity (disease and illness), and injury among occupational workers and the general public ("excess" refers to mean effects occurring at a higher-than-normal rate; in the case of death, "excess" is

Table 8.1. Comparative Environmental Costs for an 1800-MWe Coal Plant and SSES at Full Output

Impact	Coal	Nuclear
Land use, ha		
Station proper and associated ponds; fuel and waste storage areas	≈1,600	470
Release to air[a]		
Dust, kg/day	20,000	None
Sulfur dioxide, kg/day	230,000	None
Nitrogen oxides, kg/day	132,000	None
Radioactivity, Ci/yr	Small	21,000
Releases to surface water		
Chemicals dissolved in blowdown, kg/day	b/	
Radioactivity, Ci/yr	None	160
Water consumed, m^3/min	≈55	106
Fuel		
Consumed, kg/day	≈20,000,000	186[c]
Ash, kg/day	≈2,000,000	
Social	Moderate	Moderate
Esthetic	Both require large industrial-type structures and cooling towers	
	Coal yard, ash pit, tall stack required	

[a]Coal-fired plant emissions estimated on the basis that the plant just meets applicable EPA standards.

[b]Information not available.

[c]Of U_3O_8.

used synonymously with "premature mortality"). The most recent and detailed assessments of health effects of the coal fuel cycle have been prepared by the Brookhaven and Argonne national laboratories.[1-6] The most complete and recent assessment of the radiological health effects of the uranium fuel cycle for normal operations was prepared for the "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors (GESMO I)".[7]

However, in accordance with 10 CFR Part 51.20(e), the current impact of the uranium fuel cycle (excluding reactors and mines) is defined by the 14 March 1977 revision of Table S-3, 10 CFR Part 51. [Consistent with the Commission's announced intention to reexamine the rule periodically to accommodate new information (39 FR 14188, 22 April 1974, and 42 FR 13803, 14 March 1977), staff studies are under way to determine what areas, in addition to waste management and reprocessing, may require updating in Table S-3 (Notice of Proposed Rulemaking, Docket No. RM 50-3, Environmental Effects of the Uranium Fuel Cycle, 41 FR 45849, 18 October 1976).] Using the Table S-3 effluents and the models developed for GESMO I, it was possible to estimate the impact of the uranium fuel cycle on the general public for routine operations. These values are shown in Tables 8.2-8.7 and some critical assumptions related to estimates are shown in Appendix H.

Because Table S-3 (Table 4.16) excludes radon releases from uranium mines, the health effects of such releases on the general public are not included in Tables 8.2-8.7. The effects of such releases would result in some small increases in the total risks of mortality and morbidity as discussed further under "Other Considerations."

Table 8.2. Summary of Current Energy Source Excess Mortality per Year per 0.8 GWy(e)

Fuel Cycle	Occupational Accident	Occupational Disease	General Public Accident	General Public Disease	Total
Nuclear (U.S. population)					
All nuclear	0.22[a]	0.14[b]	0.05[c]	0.18-1.3[b]	0.59-1.7 (1.0)[d]
With 100% of electricity used in the fuel cycle produced by coal power	0.24-0.25[a,e]	0.14-0.46[a,b]	0.10[c,f]	0.77-6.3[g]	1.2-6.8 (2.9)
Coal (regional population)	0.35-0.65[e]	0-7[h]	1.2[f]	13-110[g]	15-120 (42)
Ratio of coal to nuclear (range): (geometric means)	42 (all nuclear) 14 (with coal power)[i]				

[a]Primarily fatal nonradiological accidents, such as falls or explosions.

[b]Primarily fatal radiogenic cancers and leukemias from normal operations at mines, mills, power plants, and reprocessing plants.

[c]Primarily fatal transportation accidents (Table S-4, 10 CFR Part 51) and serious nuclear accidents.

[d]Values in parentheses are the geometric means of the ranges ($\sqrt{ab}$).

[e]Primarily fatal mining accidents, such as cave-ins, fires, and explosions.

[f]Primarily members of the general public killed at rail crossings by coal trains.

[g]Primarily respiratory failure among the sick and elderly from combustion products from power plants, but includes deaths from waste-coal-bank fires.

[h]Primarily coal workers pneumoconiosis (CWP) and related respiratory diseases leading to respiratory failure.

[i]With 100% of all electricity consumed by the nuclear fuel cycle produced by coal power; amounts to 45 MWe per 0.8 GWy(e).

Although Table S-3 no longer includes release estimates for Rn-222 from uranium and milling operations,* the staff has reevaluated the question and prepared new estimates which were used in this assessment. These new estimates indicate that Rn-222 releases account for most of the potential premature mortality from the uranium fuel cycle.

In addition, Table S-3 does not generically address releases for light-water-cooled power reactors. The estimated total body population dose commitments for both occupational workers and the general public were taken from GESMO I (uranium recycle only option). In addition, the occupational dose commitments to workers in uranium mines, mills, uranium hexafluoride plants, uranium fuel plants, and uranium enrichment plants were taken from GESMO I, because they are not considered in Table S-3. However, these dose commitments are comparable to those that would result from the radiological releases described in NUREG-0216, which provides background support for Table S-3.

The dose commitments to the public and occupational workers in the March 1977 Table S-3 were used for estimating health effects from the reprocessing and waste-management aspects of the uranium fuel cycle. The risk estimators used to estimate health effects from radiation dose commitments were taken from GESMO I and WASH-1400.[8]

*Effective 14 April 1978 [Fed. Reg. 43(15613) (11 April 1978)], NRC directed the staff to delete the 74.5-Ci Rn-222 source term from Table S-3 (10 CFR Part 51), and consider such health effects as might result from radon releases from mining and milling one RRY of uranium on a case-by-case basis.

Table 8.3. Excess Mortality per 0.8 GWy(e) -- Nuclear[a]

Fuel-cycle Component	Occupational		General Public		Total
	Accident[b]	Disease[c,d,e]	Accident[e,f]	Disease[g]	
Resource recovery (mining, drilling, etc.)	0.2	0.038	≈0	0.085	
Processing[h]	0.005[i]	0.042	j/	0.026-1.18	
Power generation	0.01	0.061	0.04	0.016-0.20	
Fuel storage	j/	≈0	j/	≈0	
Transportation	≈0	≈0	0.01	≈0	
Reprocessing	j/	0.003	j/	0.054-0.062	
Waste management	j/	≈0	j/	0.001	
Total	0.22	0.14	0.05	0.18-1.3	0.59-1.7

[a]Breakdown of Table 8.2.

[b]L. D. Hamilton, ed., "The Health and Environmental Effects of Electricity Generation: A Preliminary Report," Brookhaven National Laboratory, July 1974.

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

[d]10 CFR Part 51, Table S-3.

[e]10 CFR Part 51, Table S-4.

[f]U.S. Nuclear Regulatory Commission, "Reactor Safety Study," WASH-1400 (NUREG-75-014), October 1975.

[g]Long-term effects from Rn-222 releases from mills and tailings piles account for all but 0.001 health effects.

[h]Includes milling, uranium hexafluoride production, uranium enrichment, and fuel fabrication.

[i]Corrected for factor of 10 error based on referenced value (report WASH-1250).

[j]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in the column.

Table 8.4. Excess Mortality per 0.8 GWy(e) -- Coal[a]

Fuel-cycle Component	Occupational		General Public		Total
	Accident	Disease	Accident	Disease	
Resource recovery (mining, drilling, etc.)	0.3-0.6	0-7	b/	b/	
Processing	0.04	b/	b/	10	
Power generation	0.01	b/	b/	3-100	
Fuel storage	b/	b/	b/	b/	
Transportation	b/	b/	1.2	b/	
Waste management	b/	b/	b/	b/	
Total	0.35-0.65	0-7	1.2	13-110	15-120

[a]Breakdown of Table 8.2. See also L. D. Hamilton, ed., "The Health and Environmental Effects of Electricity Generation: A Preliminary Report," Brookhaven National Laboratory, July 1974.

[b]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in the column.

Table 8.5. Summary of Current Energy Source Excess Morbidity and Injury per 0.8 GWy(e) Power Plant

Fuel Cycle	Occupational		General Public		Total
	Morbidity	Injury	Morbidity	Injury	
Nuclear (U.S. population)					
All nuclear	0.84[a]	12[b]	1.0-3.1[c]	0.1[d]	14-16 (15)[e]
With 100% of electricity used by the fuel cycle produced by coal power	1.7-4.1[f]	13-14[b]	1.5-7.6[g]	0.55[h]	17-24 (21)
Coal (regional population)[i]	20-70[f]	17-34[j]	10-100[g]	10[h]	57-210 (109)
Ratio of coal to nuclear (range): (geometric means)	7.3 (all nuclear) 5.2 (with coal power)[k]				

[a]Primarily nonfatal cancers and thyroid nodules.

[b]Primarily nonfatal injuries associated with accidents in uranium mines, such as rock falls or explosions.

[c]Primarily nonfatal cancers, thyroid nodules, genetically related diseases, and nonfatal illnesses (such as radiation thyroiditis, prodromal vomiting, and temporary sterility) following high radiation doses.

[d]Transportation-related injuries from Table S-4, 10 CFR Part 51.

[e]Values in parentheses are the geometric means of the ranges ($\sqrt{ab}$).

[f]Primarily nonfatal diseases associated with coal mining such as CWP, bronchitis, and emphysema.

[g]Primarily respiratory diseases among adults and children caused by sulfur emissions from coal-fired power plants and waste-coal bank fires.

[h]Primarily nonfatal injuries among members of the general public from collisions with coal trains at railroad crossings.

[i]Coal effects are based on a regional population of 3.8 million people within 80 km of the coal plant.

[j]Primarily injuries to coal miners from cave-ins, fires, and explosions.

[k]With 100% of all electricity consumed by the nuclear fuel cycle produced by coal power; amounts to 45 MWe per 0.8 GWy(e).

The impact of accidents in fuel-cycle facilities[9] and reactors[8] generally does not markedly increase the impact of normal operations for the uranium fuel cycle, but has been included in this assessment for completeness. No comparable analysis of health effects resulting from accidents in coal-fired plants is available at this time.

Estimates of death, disease and injury from nonradiological causes for the uranium fuel cycle are from the Brookhaven evaluations,[1-3] with the exception of transportation-accident-related deaths, which were taken from Table S-4, 10 CFR Part 51. The results of these assessments are shown in Tables 8.2-8.7. It should be noted that there are two lines under the nuclear fuel cycle: the first assumes all of the electricity used within the uranium fuel cycle is generated by nuclear power (i.e., all-nuclear economy); the second line assumes, as shown in Table S-3 (10 CFR Part 51), that 100% of the electricity used within the nuclear fuel cycle comes from coal power. This is equivalent to a 45-MWe coal-fired plant, or 4.5% of the power produced.

8.4.2 The Uranium Fuel Cycle

Currently the NRC estimates that the excess deaths per 0.8 gigawatt-year electric [GWy(e)] will be about 0.47 for an all-nuclear economy. This is probably somewhat high due to the conservatism required in evaluations of generic plants and sites ("Conservatism" is used to mean that assumptions regarding atmospheric dispersion, deposition of particulates, bioaccumulation, etc., generally

Table 8.6. Morbidity and Injury per 0.8 GWy(e) -- Nuclear[a]

Fuel-cycle Component	Occupational		General Public		Total
	Morbidity	Injury[b]	Morbidity	Injury[c]	
Resource recovery (mining and drilling)	d/	10	e/	≈0	
Processing[f]	d/	0.6	e/	≈0	
Power generation	d/	1.3	e/	≈0	
Fuel storage	d/	g/	e/	≈0	
Transportation	d/	<1	e/	0.1	
Reprocessing	d/	g/	e/	g/	
Waste management	d/	g/	e/	≈0	
Total	0.84	12	1.0-3.1	0.1	14-16

[a]Breakdown of Table 8.5..

[b]L. D. Hamilton, ed., "The Health and Environmental Effects of Electricity Generation: A Preliminary Report," Brookhaven National Laboratory, July 1974.

[c]Table S-4, 10 CFR Part 51.

[d]Nonfatal cancers ≤ fatal cancers (excluding thyroid) or ≈0.14. Nonfatal thyroid cancers and benign nodules ≈3 x fatal cancers or ≈0.42. Genetic defects ≈2 x fatal cancers or ≈0.28.

[e]Reactor accidents: 10 x fatalities or ≈0.40 nonfatal cases.
Normal operations: Nonfatal cancers ≤ fatal cancers or ≈0.18-1.3.
Nonfatal thyroid cancers and nodules ≈3 x fatal cancers (from total body doses) or ≈0.26-0.84.
Genetic effects ≈2 x fatal cancers (from total body doses) or ≈0.17-0.56.

[f]Includes milling, uranium hexafluoride production, uranium enrichment, and fuel fabrication.

[g]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in the column.

Table 8.7. Morbidity and Injury per 0.8 gWy(e) -- Coal[a]

Fuel-cycle Component	Occupational		General Public		Total
	Morbidity	Injury	Morbidity	Injury	
Resource recovery (mining and drilling)	20-70	13-30	b/	b/	
Processing	b/	3	b/	b/	
Power generation	b/	1.2	10-100	b/	
Fuel storage	b/	b/	b/	b/	
Transportation	b/	b/	b/	10	
Waste management	b/	b/	b/	b/	
Total	20-70	17-34	10-100	10	57-210

[a]Breakdown of Table 8.5. See also L. D. Hamilton, ed., "The Health and Environmental Effects of Electricity Generation: A Preliminary Report," Brookhaven National Laboratory, July 1974.

[b]The effects associated with these activities are not known at this time. Although such effects are generally believed to be small, they would increase the total in the column.

result in estimates of impact that are typically upper bound estimates. In most cases, the estimates would be lower for real plants). However, it is not greatly different from estimates by others such as Comar and Sagan[10] (0.11 to 1.0), Hamilton[1] (0.7 to 1.6), and Rose et al.[11] (0.50). The uncertainty in the estimate is about an order of magnitude for periods up to about 100 years, and probably two or more orders of magnitude for estimates as far into the future as 1000 years. If, as shown in Table S-3, 100% of the electrical power used by the uranium fuel cycle comes from coal-fired power plants, NRC estimates there would be about 1.1 to 5.4 excess deaths per 0.8 GWy(e). Of this total, about 0.62 to 4.9 excess deaths per 0.8 GWy(e) would be attributable to coal power (Table 8.6). The uncertainty in the estimate is about one order of magnitude.

The total number of injuries and diseases that might occur among workers and the entire U.S. population as a result of normal operations and accidents in the uranium fuel cycle was estimated to be about 14 per 0.8 GWy(e) for an all-nuclear economy. Injuries among uranium miners from accidents account for 10 of the 14 cases (Table 8.5). If 100% of the electrical power used by the uranium fuel cycle comes from coal-fired power plants, NRC estimates there would be about 17 to 24 injuries and diseases per 0.8 GWy(e). Of this total, about 3 to 10 excess events per 0.8 GWy(e) would be attributable to coal power (Table 8.6). The uncertainty in the estimate is also about one order of magnitude.

Although anticipated somatic (nongenetic) effects associated with normal releases of radioactive effluents from the nuclear fuel cycle are limited to potential cancers and leukemias, for the higher doses associated with serious nuclear accidents there is some small risk of various nonfatal somatic effects (Table 8.5, Footnote c). At this time only light-water-cooled power reactors have been thoroughly evaluated.[8] However, it should be noted that power reactors probably account for most of the potential health effects associated with nuclear accidents in the uranium fuel cycle.

This results from the fact that power reactors represent 80% of all fuel-cycle facilities expected to be operating for the balance of this century[7] and account for the majority of occupationally exposed individuals. In addition, although the probability of serious accidents is extremely small, if one were to occur, the health effects would be larger than for any other type of fuel-cycle facility. Serious nuclear accidents in power reactors might also contribute about 0.04 excess deaths per 0.8 GWy(e), whereas transportation-related accidents are estimated to contribute about 0.01 excess deaths per 0.8 GWy(e) (Table 8.2, Footnote c).

Early and latent nonfatal somatic effects that might be expected after high radiation doses include a variety of effects (Table 8.5, Footnote c). It is possible that nonfatal somatic effects could be an order of magnitude greater than excess deaths resulting from accidents;[8] thus, the total number per 0.8 GWy(e) would be about 0.4. This accounts for about one third of the morbidity shown for the general public and an all-nuclear economy in Table 8.5. The number of nonfatal thyroid cancers (5-10% mortality rate) and benign thyroid nodules would be about 0.6 per 0.8 GWy(e) from routine releases to the public and occupational exposures (primarily external irradiation), whereas other nonfatal cancers would be less than or equal in number to fatal cancers [about 0.2 per 0.8 GWy(e)] (Table 8.5, Footnote c).

It is believed that genetically related diseases (e.g., cystic fibrosis, hemophilia, certain anemias, and congenital abnormalities such as mental retardation, short-limbed dwarfism, and extra digits), and abnormalities in the descendants of workers and the general public from both normal operations and accidents would be perhaps twice the number of excess deaths due to cancer from total body irradiation;[6,12] this could add another 0.3 health effects per 0.8 GWy(e) among workers and 0.2 health effects per 0.8 GWy(e) among the general public (Tables 8.5 and 8.6, Footnote c).

In assessing the impact of coal power used in the uranium fuel cycle, Table S-3 (10 CFR Part 51) was the basis for the assumption that 100% of the electricity used in the uranium fuel cycle, primarily for uranium enrichment and reactor operation, came from coal-fired plants. Adding 4.5% of the health effects per 0.8 GWy(e) from the coal fuel cycle significantly increases the health effects power 0.8 GWy(e) from the uranium fuel cycle, as shown on the second lines of Tables 8.2 and 8.7.

8.4.3 The Coal Fuel Cycle*

Current estimates of mortality and morbidity resulting from the coal fuel cycle are quite uncertain; this is the principal reason for the wide range of values reported in the literature. These uncertainties result from the limited number of epidemiological studies and differences in

*See also "Activities, Effects, and Impacts of the Coal Fuel Cycle for a 1,000 MWe Electric Power Generating Plant," NUREG/CR-1060, U.S. Nuclear Regulatory Commission, February 1980.

interpretation of the results of such studies. There is additional uncertainty regarding the effects of new federal laws on coal cycle facilities in the next decade. Current estimates of excess deaths for the entire coal cycle range from 15 to 120 per 0.8 GWy(e), whereas disease and injury estimates range from 57 to 210 per 0.8 GWy(e).

In the case of occupational effects, there is considerable uncertainty because of anticipated reductions in health effects resulting from the implementation of the Federal Coal Mine Health and Safety Act of 1969 (PL 91-173). The provisions of this act should result in significant improvement of the underground work environment, particularly regarding coal dust. Coal dust is both a cause of underground explosions and fires and a cause of coal workers pneumoconiosis (CWP), commonly called black lung disease, and subsequent progressive massive fibrosis (PMF).[1-5] In addition, more coal in the years ahead is expected to be produced by strip mining, which results in lower mortality rates.[1] As a result, the frequencies of both types of events are anticipated to decline in the years ahead, on a per GWy(e) basis. On the other hand, statistics show new coal miners experience higher mortality and injury rates than experienced miners.[5] As a result of expected increases in coal production, an influx of inexperienced miners will tend to increase the mortality and injury rates for miners as a group.

For the general public, there is also considerable uncertainty in the estimation of health effects. (In the case of coal-plant effluents, consideration of health effects was limited to the population within 80 km of such plants.) For example, although there are estimates of health effects related to burning culm banks (waste banks from coal screening), recent efforts by mine operators have greatly reduced such fires, and future processing activities are expected to avoid fires as a result of new methods of stabilizing the banks to prevent slides.[13] Current estimates of excess deaths in the public from sulfates from such fires range from one to ten per 0.8 GWy(e) (Table 8.2, Footnote f). Power generation is estimated to result in 3 to 100 excess deaths per 0.8 GWy(e) (Table 8.2, Footnote f), whereas excess morbidity ranges from about 10-100 per 0.8 GWy(e) (Table 8.5, Footnote e).

The uncertainties are even greater in the power-generation phase of the coal cycle, where estimates of health effects range over several orders of magnitude.[10] This is largely due to the lack of a reliable data base for predicting health effects from the various pollutants emitted from coal plants, and the effect of the EPA New Source Performance Standards for coal plants regarding particulate and sulfur emissions in future years on a long-term basis. There is some uncertainty as to whether these standards can be met in large coal-fired power plants over the life of the plant. The major pollutants emitted include:

1. Particulates: Contain large amounts of toxic trace metals in respirable particle size[14] such as arsenic, antimony, cadmium, lead, selenium, manganese, and thallium;[5] significant quantities of beryllium, chromium, nickel, titanium, zinc, molybdenum, and cobalt;[15] and traces of Ra-226 and -228 and Th-228 and -232[16]
2. Hydrocarbons: Include very potent carcinogens (cancer-causing substances) such as benzo(a)pyrene
3. Sulfur oxides
4. Nitrogen oxides
5. Other gases: Include ozone, carbon monoxide, carbon dioxide, mercury vapor, and Rn-222

Regarding the preceding list of pollutants, there are no well-established epidemiologic cause-effect relationships that can be used to estimate total health effects accurately, either from acute exposures during air-pollution episodes or from chronic long-term exposures.

Although definitive cause-effect relationships are lacking, tentative cause-effect relationships for sulfur emissions have been used by numerous groups to estimate health effects from sulfur emissions from coal plants; they are described by the National Academy of Sciences in a recent report to the U.S. Senate.[17] The most widely quoted studies are those by Lave and Seskin,[18] Winkelstein et al.,[19] and an unpublished study by EPA that was used in the NAS/NRC study for the U.S. Senate.[17]

In general, the effects range from excess deaths from cardiovascular failure and increases in asthma attacks during severe air pollution to excess respiratory disease from long-term chronic exposures. Most of the acute deaths are among the elderly and the severely ill, whereas morbidity from long-term exposure also includes children. Although widely accepted cause-effect relationships were not derived from studies of acute air-pollution episodes in London in 1952;[20] Donora, Pennsylvania, 1948;[21] and New York,[22] these studies definitely support the conclusions regarding excess death and disease associated with emissions from combustion of coal.

There are no estimates of possible long-term carcinogenic effects by sulfur oxides or associated pollutants. In addition, the large-scale EPA Community Health and Environmental Surveillance System (CHESS) study (completed in 1976) failed to provide any new or definitive cause-effect relationships for any of the pollutants from coal-fired plants that could be used to provide better estimates of health effects than are currently available.[23] The $22 million CHESS study attempted to correlate air-pollution data collected from six U.S. cities with a variety of health problems.

Assuming that new coal-fired plants in the 1980s can meet EPA New Source Performance Standards (which could require 90% sulfur removal for high-sulfur coal and about 99% particulate removal) and other federal laws regarding mine safety and culm-bank stabilization, the number of deaths should be reduced. Thus, current estimates of 15 to 120 per 0.8 GWy(e), due largely to sulfates from combustion of coal, may be reduced by about half.

Argonne National Laboratory recently developed a predictive model for deaths from emission of benzo(a)pyrene, which indicates about 1 to 4 deaths per 0.8 GWy(e) depending on use of conventional combustion or fluidized-bed combustion.[6] Such effects, although greater than the expected deaths from the entire uranium fuel cycle (all-nuclear economy), do not significantly change the total impact of the coal fuel cycle and were not included in the effects listed in Table 8.2.

Probably the most reliable estimates of deaths associated with the coal fuel cycle are those associated with transportation accidents. Because a 1000-MWe coal-fired plant consumes about 2.7 million tonnes (three million tons) of coal per year, there are literally thousands of carloads of coal being transported by rail from mines to plants. It has been estimated that about one out of every ten trains in the U.S. is a coal train going to a coal-fired power plant.[24] These trains are estimated to travel an average distance of about 480 km from the mine to the plants.[13] As a result, there are about 1.2 deaths per 0.8 GWy(e) among workers and the general public. Further, because most of these deaths occur at railroad crossings, the numbers can be expected to increase as more automobiles are operated and driven greater distances, and as rail-transportation distances increase when hauling low-sulfur western coals to eastern markets.

Sickness among coal miners and the general public accounts for most of the nonfatal occurrences in the coal fuel cycle, with most of the remainder due to injuries among coal miners. As a result of implementation of federal laws, it is probable that future rates among underground miners will be substantially reduced. It is not unreasonable to assume that current estimates of about 57 to 210 cases of sickness and injury among workers and the general public could be reduced in the years ahead, inasmuch as occupational sickness and injury currently account for about half of the total nonfatal health effects.

The overall uncertainty in the estimates of health effects for the coal fuel cycle in this assessment is probably about one to two orders of magnitude. Although the breakdown estimates generally fall within the range of estimates in the literature, such estimates represent only the impacts occurring over a period of a few decades (e.g., while a power plant is operating) and do not include potential long-term health effects resulting from Rn-222 and toxic heavy metals which may be released to the biosphere from coal ash and flue gas desulfurization sludge waste pits. Such releases, which may occur over centuries or millenia, could substantially increase the estimated health impacts presented in this assessment. Therefore, these potential long-term impacts substantially increase the uncertainty in the health impacts just discussed.

8.4.4 Other Considerations

Although the Reactor Safety Study[8] has helped provide a perspective of the risk of mortality or morbidity from potential power-reactor accidents (the current experience for serious accidents is zero),* there is the additional problem associated with individual perception of risk. Thus,

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*In July 1977, NRC organized the independent Risk Assessment Review Group to: 1) clarify the achievements and limitations of the Reactor Safety Study (RSS); 2) assess peer comments thereon and responses to those comments; 3) study the present state of such risk assessment methodology; and 4) recommend how and whether such methodology can be used in the regulatory and licensing process. The results of this study were issued in September 1978 (NRC, "Risk Assessment Review Group Report," NUREG/CR-0400, September 1978). While praising the RSS's general methodology and recognizing its contribution to assessing the risks of nuclear power, the Review Group found that it was unable to determine whether the absolute probabilities of accident sequences in report WASH-1400 are high or low; it did conclude that the error bounds on those estimates are, in general, greatly understated. On 19 January 1979, NRC issued a statement of policy concerning the RSS and Review Group Report. NRC accepted the findings of the Review Group and concluded that the RSS's numerical estimates of the overall risks of reactor accidents should not be regarded as reliable.

The importance of this uncertainty can be better perceived by considering the effects of an increase in the risks of reactor accidents on the estimated overall mortality rate associated with the nuclear fuel cycle. Assuming the reactor accident risk to be 100 times that estimated in the RSS, the upper bound of the range of mortality per reference reactor year presented in this document from the nuclear fuel cycle could increase from 1.7 to 3.7. If, however, the risk of such accidents were lower than estimated in the RSS, the lower bound of the range of mortality would not change appreciably.

although the study concluded that "All non-nuclear accidents examined in this study, including fires, explosions, toxic chemical releases, dam failures, airplane crashes, earthquakes, hurricanes and tornadoes, are much more likely to occur and can have consequences comparable to or larger than, those of nuclear accidents," uncertainty will continue to be associated with such evaluations. Furthermore, there may be a problem of public acceptance of potential accidents, because the consequences can be severe. In fact, it appears that some people[25] more readily accept, for example, having 55,000 people actually killed each year in violent highway accidents, one or two at a time, than they do the unlikely occurrence of perhaps several thousand possible deaths from a single catastrophic accident during their lifetime.

As noted in Footnote 5 to the March 1977 revision of Table S-3 the GESMO I Rn-222 release increases from 74.5 Ci to about 4800 Ci when releases from mines are included. This would result in a small increase in the total number of excess deaths shown in Table 8.2, although the mortality per 0.8 GWy(e) for the general public would increase by about 30%.

With regard to the coal fuel cycle, it is a well-established fact that the use of coal results in numerous other costs to society that have not yet been adequately quantified. These include

1. The short- and long-term impacts of sulfur and nitrogen oxides on biota and materials. Acid rain, for example, is known to be severely damaging to terrestrial and aquatic habitats. Argonne National Laboratory provides a detailed discussion of these and other effects of sulfur and nitrogen oxide emissions.[5] However, as more coal plants come on line, these effects can be expected to expand to surrounding areas.

2. Damage to materials, such as paints, building surfaces, statuary, and metals, caused by emissions of sulfur oxides, ozone, and nitrogen oxides. A 1976 review of such effects indicates that the costs could range into billions of dollars per year in the United States alone.[26]

3. Contamination of soil and vegetation to toxic levels by such mechanisms as deposition and bioaccumulation of trace elements present in gaseous emissions.

4. Destruction of entire ecosystems in streams and rivers by acid-mine drainage, and the potential for public-health effects from downstream use of such water for domestic or agricultural purposes.

5. In addition to the occurrence of excess mortalities, injuries, and morbidities, the costs to society in terms of medical costs, lost productivity, and other social losses, represent a significant consideration that has not been completely evaluated at this time. Two recent studies, which dealt with these extremely complex issues,[27,28] concluded that social costs from one coal-fired plant may currently be about $50 million per year, not considering the rest of the costs for the coal fuel cycle.

6. The possibility of the so-called "greenhouse effect," a phenomenon expected to occur sometime early in the next century as a result of the present and future anticipated production rates of carbon dioxide from the combustion of fossil fuels.[29] Because each 1000-MWe coal plant produces about 7.5 to 10.5 million tons of carbon dioxide per year,[1] it is believed that these emissions from hundreds of fossil-fueled power plants may result in greater releases of carbon dioxide than the atmosphere and oceans can cycle. As a result, the carbon dioxide concentrations would be expected to increase in the atmosphere. Because carbon dioxide strongly absorbs infrared, it is postulated that the mean atmospheric temperature will rise several degrees. This may cause all or part of the polar ice caps to melt, resulting in inundation of many inhabited areas of the world. At the same time, drought would be expected to prevail in many of the agricultural areas of the temperate zones, resulting in huge crop losses. It is possible that the particulates emitted by fossil plants will counteract some of the greenhouse effect by reducing the amount of sunlight reaching the surface of the earth.

   However, another effect from carbon dioxide released by coal combustion occurs because coal has essentially no carbon-14. In effect, the stable carbon dilutes the carbon-14 in the biosphere, resulting in a reduction in the radiological impact of both naturally occurring and manufactured carbon-14.

7. An additional consideration that has not been evaluated for the coal cycle is the radiological impact of mining and burning coal. Of interest is the release of radon-222 from the decay of radium-226 in coal. Not only is the radon released during mining and combustion, but it will continue to emanate from flyash for millions of years after the coal has been burned. Although Pohl[30] has shown that this is not a problem with most eastern coal (generally of high sulfur content but with 1-3 ppm uranium content), the average uranium and radium content of some reserves of low-sulfur western coal is as much as 50 times higher than that of most eastern coal.[31,32] Combustion of the coal and disposal of the remaining ash leads to about the same health effects from radon-222 emissions as do uranium-mill-tailings piles. These releases would account for less than one excess death per 0.8 GWy(e) due to fuel-cycle activities during the rest of this century. As a result, such releases do not significantly affect the conclusions reached with regard to a comparison of the two alternative fuel cycles. In addition, some

believe[33] that if the physical and biological properties of the radium released from conventional coal-powered plants (burning coal with 1-2 ppm U-238 and Th-232) are considered, such plants discharge relatively greater quantities of radioactive materials into the atmosphere than do nuclear plants of comparable size. The Environmental Protection Agency has estimated radiation doses from coal and nuclear plants of early designs and reached similar conclusions.[17]

8.4.5 Summary and Conclusions

For the reasons discussed, it is extremely difficult to provide precise quantitative values for excess mortality and morbidity, particularly for the coal fuel cycle. Nevertheless, a number of estimates of mortality and morbidity have been prepared based on present-day knowledge of health effects, and present-day plant design and anticipated emission rates, occupational experience and other data. These are summarized in Tables 8.2 and 8.5 (see Footnote k, Table 8.5), with some important assumptions inherent in the calculations of health effects listed in Appendix H.

Although future technological improvements in both fuel cycles may result in significant reductions in health effects, based on current estimates for present-day technology, it must be concluded that the nuclear fuel cycle is considerably less harmful to man than the coal fuel cycle.[1-5,10,11,27,28,33-36] As shown in Tables 8.2-8.7, the coal fuel-cycle alternative may be more harmful to humans by factors of 7 to 42 depending on the effect being considered, for an all-nuclear economy, or factors of 6 to 14 with the assumption that all of the electricity used by the uranium fuel cycle comes from coal-powered plants.

Although there are large uncertainties in the estimates of most of the potential health effects of the coal cycle, it should be noted that the impact of transportation of coal is based on firm statistics; this impact alone is greater than the conservative estimates of health effects for the entire uranium fuel cycle (all-nuclear economy) and can reasonably be expected to worsen as more coal is shipped over greater distances. In the case where coal-generated electricity is used in the nuclear fuel cycle, primarily for uranium enrichment and auxiliary reactor systems, the impact of the coal power accounts for essentially all of the impact of the uranium fuel cycle.

However, lest the results of this be misunderstood, it should be emphasized that the increased risk of health effects for either fuel cycle represents a very small incremental risk to the average public individual. For example, Comar and Sagan[10] have shown that such increases in risk of health effects represent minute increases in the normal expectation of mortality from other causes.

A more comprehensive assessment of these two alternatives and others is anticipated in 1979 from the National Research Council Committee on Nuclear and Alternative Energy Systems. This study may assist substantially in reducing much of the uncertainty in the analysis presented.

8.5 URANIUM RESOURCE AVAILABILITY

This section reviews information available from the Department of Energy (DOE) on the domestic uranium resource situation and the outlook for development of additional domestic supplies, availability of foreign uranium, and the relationship of uranium supply to planned nuclear generating capacity.

Analysis of uranium resources and their availability has been carried out by the government since the late 1940s. The work was carried out for many years by the Atomic Energy Commission (AEC). The activity was made part of the Energy Research and Development Administration (ERDA) when the agency was created in early 1975[37] and was subsequently transferred to DOE when the department was formed 1 October 1977.

8.5.1 U.S. Resource Position

To establish some basic terminology, a review of resource concepts and nomenclature would be worthwhile. Figure 8.1 defines resource categories based on varying geologic knowledge. Resources designated as ore reserves have the highest assurance regarding their magnitude and economic availability. Estimates of reserves are based on detailed sampling data, primarily from gamma ray logs of drill holes. DOE obtains basic data from industry from its exploration effort and estimates the reserves in individual deposits. In estimating ore reserves, detailed studies of feasible mining, transportation, and milling techniques and costs are made. Consistent engineering, geologic, and economic criteria are employed. The methods used are the result of more than thirty years of effort in uranium resource evaluation.

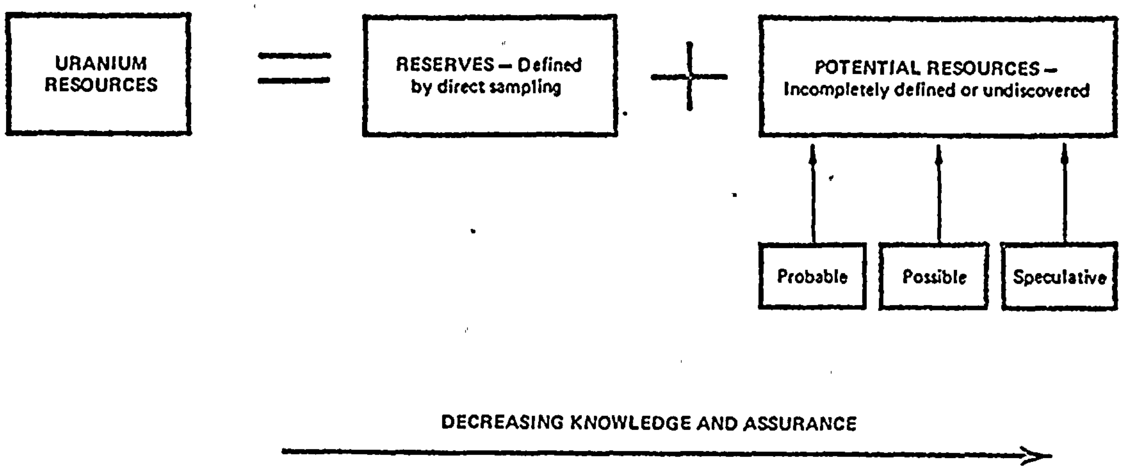

Fig. 8.1. DOE Uranium Resource Categories.

Resources that do not meet the stringent requirements of reserves are classed as potential resources. For its study of resources, DOE subdivides potential resources into three categories: probable, possible, and speculative.[38] Probable potential resources are those contained within favorable trends, largely delineated by drilling, within productive uranium districts, i.e., those having more than 10 tons of U_3O_8 production and reserves. Quantitative estimates of potential resources are made by considering the extent of the identified favorable areas and by comparing certain geologic characteristics with those associated with known ore deposits.

Possible potential resources are outside of identified mineral trends but are in geologic provinces and formations that have been productive. Speculative resources are those estimated to occur in formations or geologic provinces that have not been productive but which, based on the evaluation of available geologic data, are considered to be favorable for the occurrence of uranium deposits.

Because any evaluation of resources is dependent upon the availability of information, the estimates themselves are, to a large degree, a scorecard on the state of development of information. Thus, appraisal of U.S. uranium resources is heavily dependent on the completeness of exploration efforts and on the availability of subsurface geologic data. Since the geology of the United States as it relates to mineral deposits can never be completely known in detail, it is not possible to produce a truly complete appraisal of domestic uranium resources. It is likely that the total resource picture will eventually prove larger than currently estimated, given the nature and status of estimation methodology. The key factor may be the timeliness with which resources are identified, developed, and produced.

Conceptually, a resource, whether uranium or other mineral commodity, would initially be in the potential category. Development of additional data and clarification of production techniques and economics would be required to delineate and understand specific ore deposits to a degree that they could be categorized as reserves.

We can expect a dynamic balance between anticipated markets and prices and the extent to which exploration and reserve delineation will be done. There is no economic incentive for industry to expand reserves if the additional uranium will not be needed for many years, and especially if the long-term market outlook is uncertain. This has been true for uranium. The mining companies are concentrating on markets for the next five to fifteen years. The utilities and government are concerned with the outlook for the next thirty to forty years.

Conversion of the currently estimated potential resources into ore reserves will take many years and will cost several billion dollars. It would be difficult to economically justify accelerating such an effort to delineate ore reserve levels equal to lifetime requirements of all planned reactors covering some thirty to forty years in the future simply to satisfy planners. Supply assurance through continued timely additions to reserves and maintenance of a resource base adequate to support production demands, coupled with carefully developed information on potential resources, is considered to be adequate and a more realistic and economic approach.

The conversion of potential resources to ore reserves and expansion of production facilities can be accomplished when needed as markets expand and production is needed.

All uranium resource estimates made by DOE and its predecessor agencies before 1979 were single estimates of tons of ore and grade for various cost categories. The estimtes were made by experienced geologists and engineers according to standard procedures, and represented a reasonable measure of resources. The current procedures for estimating uranium resources provide both mean values and distributions to characterize the reliability of the estimates at specific confidence levels. All available geologic information and the expertise of the estimators are fully utilized. These procedures are standardized and documented to minimize personal biases and to facilitate reviews and revisions as new information is acquired.

The estimates of resources in the United States are developed from a data base accumulated during the past three decades of government and industry activities and enhanced by National Uranium Resource Evaluation program investigations of the past five years. Data acquired to support resource assessment have been extensive and varied. The assessment includes the evaluation of several hundred thousand industry-drilled holes; aerial radiometric surveys; sampling and geochemical analyses of groundwater, stream water, and stream sediment; selective drilling to fill voids in subsurface information; and extensive geologic field examinations. These data have been evaluated to determine those areas favorable for uranium occurrences. Evaluation criteria have been developed from studies of uranium deposits throughout the world. In favorable areas, the uranium endowment, material greater than 0.01 percent U_3O_8, is estimated, and subsequently economic factors are applied to assess the potential resources available at selected costs.

The costs used to calculate uranium resources are forward costs that consider both operating and capital costs (in current dollars) that would be incurred in producing the uranium. These costs include power, labor, materials, royalties, payroll, severance and ad valorem taxes, insurance, and applicable general and administrative costs. All previous expenditures (before the time of the estimate) for such items as property acquisition, exploration, mine development, and mill construction are excluded. Also excluded are income taxes, profit, and the cost of money. The resources assigned to the various cost categories are independent of the market price at which the uranium might be sold.

There are two major methodologies in uranium assessment: one is used for the estimation of reserves based on sample results from drill holes on specific properties, the second involves the use of a variety of geologic information to subjectively estimate potential resources. Reserves are calculated individually for properties throughout the United States using data voluntarily provided by the uranium companies to DOE. The data consist primarily of radiometric drill hole logs and maps. Parameters evaluated include thickness and tenor of mineralized rock; depth and spatial relationships, mining methods, ore dilution, and recovery; and amenability of ores to processing. The amounts of uranium that could be exploited at the forward cost levels are calculated according to conventional engineering practices utilizing available engineering, geologic, and economic data.

A regional reserves distribution estimate is obtained by mathematically combining the estimates of individual distributions for each property. These regional distributions are then combined to provide a total for the United States. Estimates include all material over a selected minimum thickness with a uranium content above 0.01% U_3O_8. A recovery factor is applied, after rate procedures are used for properties on which solution mining is in progress or is planned.

Potential resource estimates are based on geologic analogy. Geologic characteristics related to uranium potential in the area being investigated are compared with those in an area with similar characteristics, that is, a control area that contains uranium deposits for which the frequency distribution of grades and tonnages in the deposits has been developed. The analogy-based methodology is made feasible by DOE's extensive data base from which detailed characterizations of the distribution of uranium have been developed. From systematic comparison with an appropriate control area, an estimate is developed of the total amount of uranium, above 0.01% U_3O_8, that might be present in an area being evaluated. Uranium endowment factors, such as surface area, fraction underlain by endowment, grade, and tonnage are estimated at three confidence levels, i.e., a modal value that is considered as most likely, and a low and high estimate corresponding respectively to a 95 and 5% probability that the factor is at least that large. The endowment estimate is analyzed to determine the portions that are producible at various cost categories within stated confidence levels.

Table 8.8 provides the mean reserve and potential resource estimates for each cost category, as well as estimates at the 95th and 5th percentile. The 95th percentile value provides an estimate for which there is a 95% confidence that at least that amount exists. The 5th percentile provides an estimate for which there is a 5% probability that it will be exceeded. Due to the correlation of the individual estimates that are aggregated to generate the regional and national totals, the estimates at the 95th and 5th percentile are not directly additive; however, the mean values are additive.

Table 8.8. Uranium Resources of the United States[a]

Forward-cost Category	Mean	95th Percentile	5th Percentile
At \$15 per pound uf U_3O_8[b]			
Reserves	225,000	190,000	260,000
Probable	295,000	185,000	448,000
Possible	87,000	42,000	156,000
Speculative	74,000	30,000	162,000
Totals	681,000	447,000	1,026,000
At \$30 per pound of U_3O_8[c,d]			
Reserves	645,000	567,000	729,000
Probable	885,000	659,000	1,161,000
Possible	346,000	194,000	530,000
Speculative	311,000	155,000	600,000
Totals	2,187,000	1,731,000	2,748,000
At \$50 per pound of U_3O_8[c,e]			
Reserves	936,000	821,000	1,060,000
Probable	1,426,000	1,102,000	1,802,000
Possible	641,000	346,000	973,000
Speculative	482,000	251,000	890,000
Totals	3,485,000	2,771,000	4,313,000
At \$100 per pound of U_3O_8[c,f]			
Reserves	1,122,000	971,000	1,291,000
Probable	2,080,000	1,646,000	2,573,000
Possible	1,005,000	521,000	1,526,000
Speculative	696,000	378,000	1,225,000
Totals	4,903,000	3,875,000	6,056,000

[a]Uranium resources are estimated quantities recoverable by mining. Reserves shown as of 1 January 1980; other resources as of 7 October 1980. Tons U_3O_8 probability distribution values.

[b]\$6.80/kg.

[c]Includes lower cost resource categories.

[d]\$13.60/kg.

[e]\$22.65/kg.

[f]\$45.30/kg.

Conversion Factors: to convert lb to kg, multiply by 0.454.
to convert tons to tonnes, multiply by 0.907.

Most of the uranium resources are located in a few areas in the Colorado Plateau of New Mexico, Arizona, Colorado, and Utah, in the Wyoming Basins, and in the Texas Gulf Coastal Plain (Figs. 8.2 and 8.3). It should be noted that the reserve estimates in Table 8.8 were as of 1 January 1980, and the lower cost reserves have undoubtedly decreased since that date because of continuing rising costs.

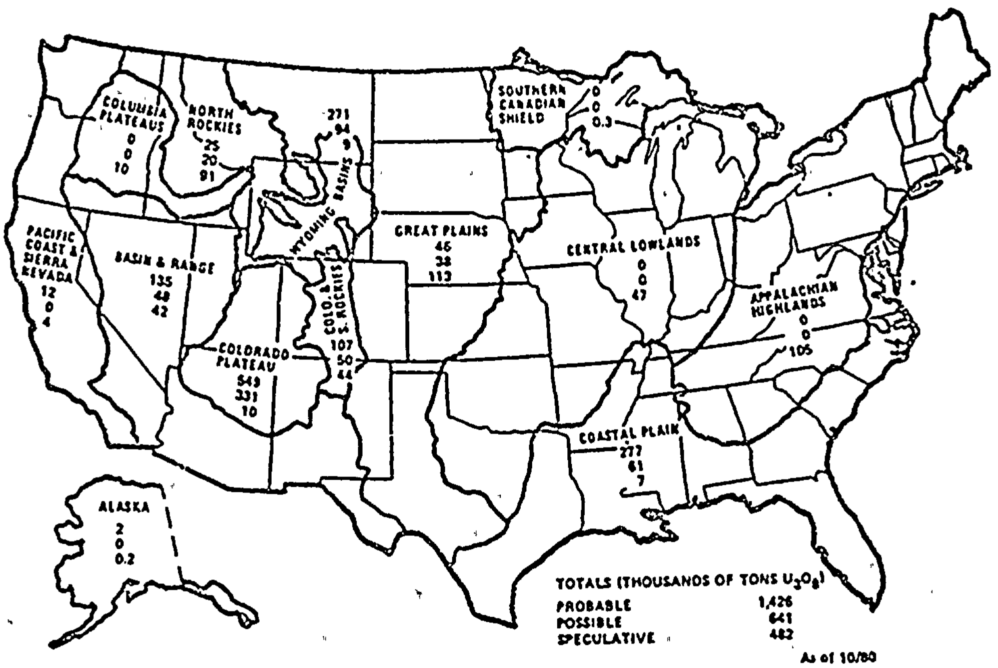

Fig. 8.2. Potential Uranium Resources by Region ($22.65/kg; $50/lb of U_3O_8).

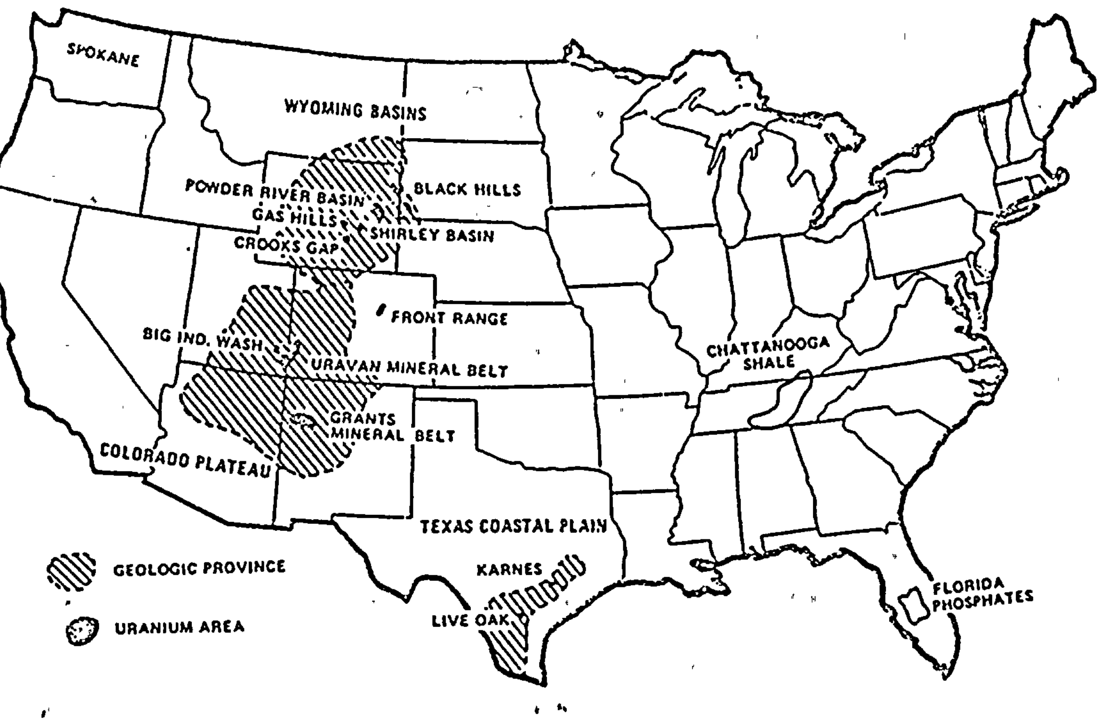

Fig. 8.3. Uranium Areas of the United States.

8.5.2 Uranium Exploration Activities

Uranium exploration in the United States reached its all-time high in 1978 as measured by the principal exploration indicator, surface drilling. Data provided to DOE by the exploration companies indicated a total of 14.6 million meters of drilling in 1978. In 1979, however, drilling declined to 12.5 million meters and the downward trend steepened during 1980 with drilling estimated to be approximately 8.5 million meters for the year (Fig. 8.4).

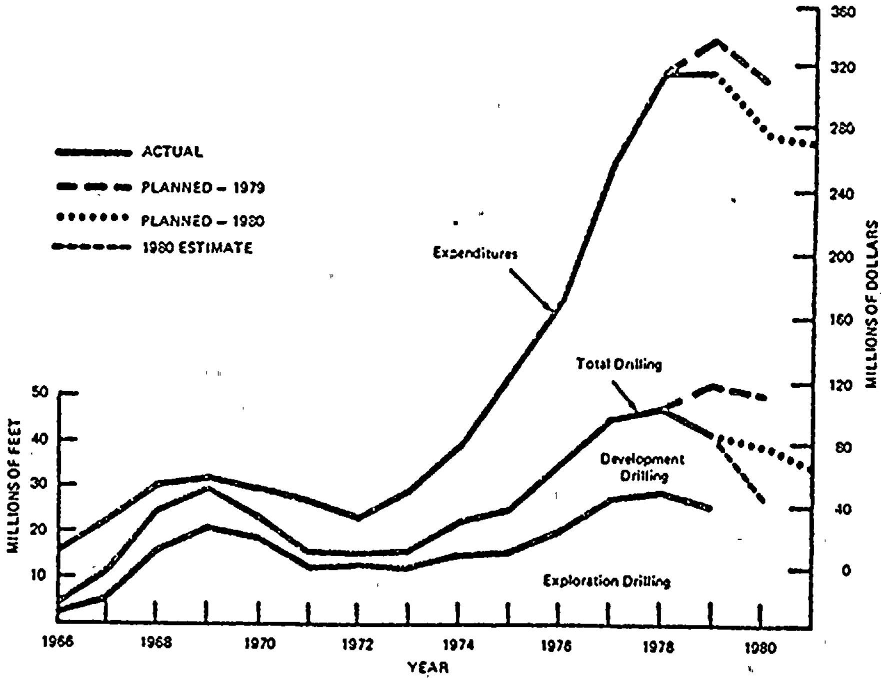

Fig. 8.4. U.S. Exploration Activity and Plans. (To convert ft. to m, multiply by 0.3048.)

Annual gross additions to reserves, a measure of exploration success, have been at high levels for the higher cost, i.e., \$13.60 to \$22.65 per kilogram U_3O_8 categories, but have been decreasing for lower cost levels. Costs have increased significantly in recent years raising the quality of resources needed to produce at a given cost level and reducing the quantities available at that level. For example, in 1979 only 907 tonnes (1000 tons) were added to \$6.80 (\$15) cost revenues, but 47,164 tonnes (52,000 tons) were removed, largely because of inflation, and an additional 12,698 tonnes (14,000 tons) were depleted by production. Hence, in 1979, \$6.80 (\$15) reserves decreased from 263,030 to 204,075 tonnes (290,000 to 225,000 tons). This trend continued in 1980. On the other hand, in 1979 some 84,351 tonnes (93,000 tons) were added to \$22.65 (\$50) reserves and 69,839 tonnes (77,000 tons) removed for a net increase of 14,512 tonnes (16,000 tons) U_3O_8. Thus, while exploration has been successful, the costs of producing the resources found are high in comparison with current prices and concurrently the cost of producing previously found resources has also increased.

The sharp rise in exploration resulted from the increase in prices in the 1974 to 1976 period, the active procurement activity of utilities, and the optimistic projections of future growth in uranium demand. Many new companies became active in exploration. More than 150 companies were involved in exploration in 1979. Considering the drop in requirement projections, the level of activity reached probably was in excess of real needs. Therefore, some reduction of effort more in line with future needs is not detrimental.

8.5.3 Domestic Uranium Production and Capability

Domestic uranium production in 1980 was 19,573 tonnes (21,850 tons) U_3O_8 in concentrate. This represents a 15% increase over 1979 and is the highest U.S. production level for any single year. Production in recent months has been at record rates; the equivalent of more than 19,954 tonnes (22,000 tons) U_3O_8 per year. This production comes from conventional mine-mill operations as well as from such nonconventional sources as solution mining and byproduct recovery from processing of other minerals. The high production levels are in response to prior sales contracts. Buyers are actually receiving uranium in excess of their currently scheduled needs.

Several new uranium processing facilities are under construction or planned, which could bring the total national capacity to around 27,000 tonnes (30,000 tons) per year by the mid-1980s.

Despite the increases in ore throughput and uranium production in 1980, a widespread curtailment of uranium mining and milling activities is underway. Production at some operating mines has been reduced and some planned mill expansions and construction are being postponed. The reduction in mine output will not be reflected in decreased uranium production until mine and mill ore stockpiles are reduced.

Studies have been conducted on attainable uranium production levels from uranium reserves in the United States and related costs. The uranium production capability projections should not be construed as being estimates of actual future supply, but simply as potential production that may be available to meet whatever demand eventually exists.

Using the "production center" concept, U.S. uranium production capability has been projected from ore reserves estimated as of January 1980, to be available at forward costs of $13.60 to $22.65 per kilogram U_3O_8 or less. The production centers consist of operating (Class 1), committed (Class 2), planned (Class 3) uranium extraction and processing facilities, and projected (Class 4) facilities based on probable potential resources. The study included conventional mills supplied by open-pit and/or underground mines; solution mining and heap-leach operations; and operations where uranium is recovered as a byproduct of phosphate, copper, or beryllium mining and processing activities.

Projections are based primarily on operating conditions--average ore grades, mill recoveries, and operating and capital costs--similar to those currently prevalent in the uranium mining and milling industry. Specific information on company plans, costs, and operating methods has been considered.

Figure 8.5 shows the total projected production capability for $13.60 ($30) resources by resource category. Figure 8.6 shows the capability for $22.65 ($50) resources. Projected uranium demand and current sales commitments are also shown. Domestic demand is based on the DOE's Office of Uranium Resources and Enrichment (URE) 1980 nuclear-power growth projections, assuming no reprocessing and a 0.20% U-235 enrichment tails assay.

8.5.4 Domestic Reactor Requirements

The outlook for uranium requirements is closely related to the growth of nuclear power. On 1 December 1980, 75 nuclear power reactors were licensed to operate in the United States, concentrated mostly in the East and Midwest. These plants have an electrical generating capacity of 55 GWe. In addition to operating plants, 86 plants are under construction with a total rated capacity of 95 GWe. Some of the plants are at such an early construction stage that they may be deferred or canceled completely. An additional 17 reactors with 20 GWe capacity are on order. Together the group aggregates 170 GWe of capacity. However, the future for some of the ordered reactors is questionable.

Latest projections of nuclear-power growth by URE and the Energy Information Administration (EIA) (Table 8.9) show an increase in nuclear power licensed to operate from 55 GWe at the end of 1980 to 96 GWe in 1985, 129 GWe in 1990, 155 GWe in 1995, and 180 GWe in 2000. EIA also projected a low case of 160 GWe and a high case of 200 GWe for the year 2000.

There are alternative views on U.S. power growth. The DOE's Office of Planning and Analysis has projected nuclear growth to the year 1990 at 125 GWe and to the year 2000 at 150 GWe, based on historic delays to nuclear power growth. The DOE Office of the Assistant Secretary of Nuclear Energy has projected 400 GWe, based on energy demand, growth, nuclear competitiveness, and industry construction capability. All of these values are sharply reduced from the projected growth of the nuclear industry of just a few years ago. For example, in 1976 U.S. nuclear capacity in the year 2000 had been projected to be 500 GWe, and in 1978 it had been projected to be 320 GWe.

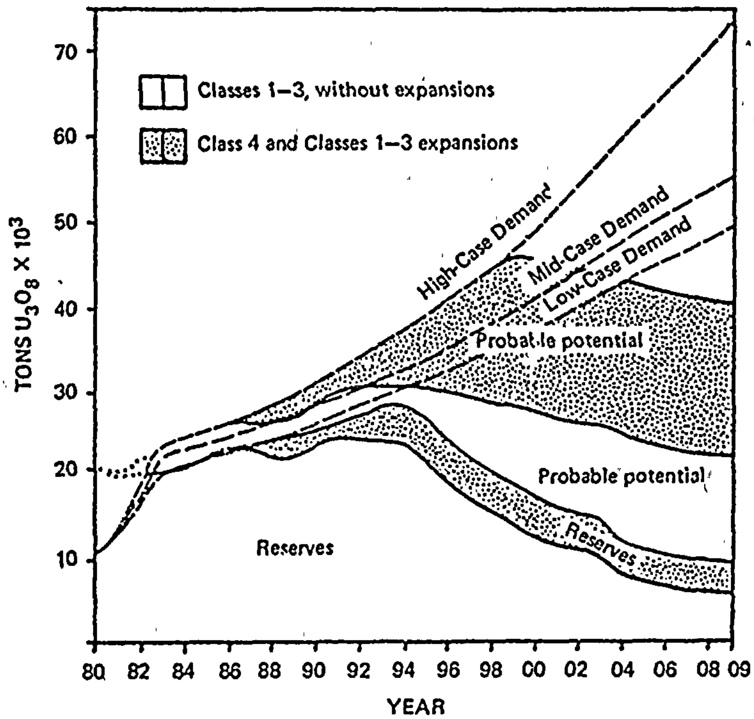

Fig. 8.5. Estimated Annual Near-term Production Capability from Resources Available at \$13.60/kg of U_3O_8 or Less with Class 1, 2, and 3 Expansions and Class 4.

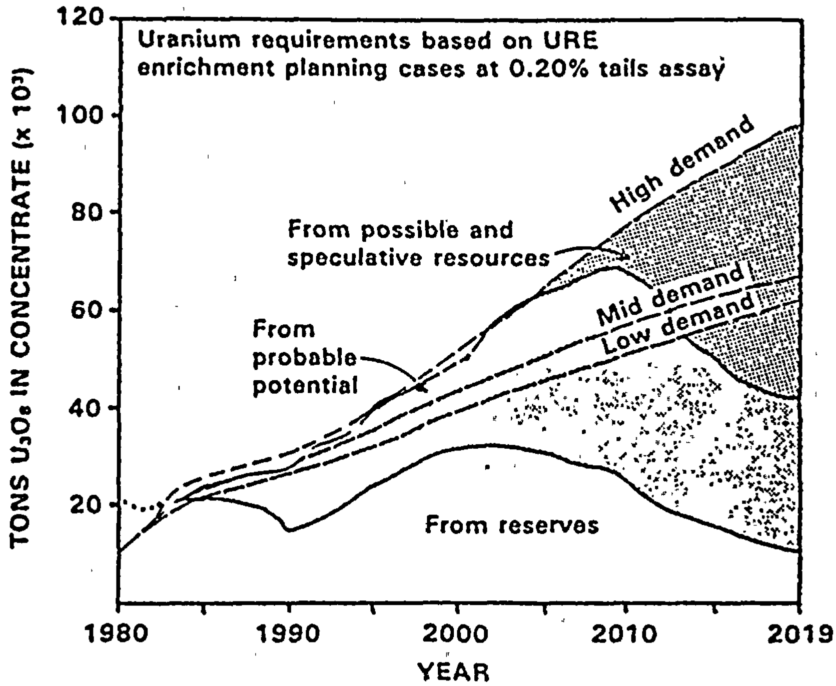

Fig. 8.6. Annual Production Capability from Resources Available at \$22.65/kg of U_3O_8 or Less Projected to Meet Nuclear-Power Growth Demand.

Table 8.9. U.S. Nuclear-Power Growth Projections, June 1980

End of Year	Power Range (GWe)		
	Low	Mid	High
1985	85	96	105
1990	125	129	140
1995	142	155	165
2000	160	180	200

Even at the more conservative estimates, nuclear capacity still is expected to expand substantially and to provide a significant portion of future domestic electric capacity. Current methods of projecting nuclear growth and uranium requirements are based on estimates of reactor startup dates considering construction and licensing times, and systems power requirements. Accurate forecasts have proven to be difficult.

The uranium needed to be delivered by uranium concentrate-producing plants as fuel for the nuclear plants will also increase over time; for the URE mid-case, from 12,063 tonnes (13,300 tons) U_3O_8 in 1981 to 21,405 (23,600) in 1985, 26,212 (28,900) in 1990, 31,745 tonnes (35,000 tons) in 1995, and 36,280 tonnes (40,000 tons) in 2000, if the enrichment plants are operated at 0.20% U-235 tails assay. Cumulative uranium requirements through the year 2000 range from 462,570 to 562,340 tonnes (510,000 to 620,000 tons) U_3O_8 with 516,990 tonnes (570,000 tons) U_3O_8 for the mid-case.

Uranium requirements are based on normal lead times for fuel-cycle steps and current technology for enrichment and for reactor design and operation. There are possible improvements in enrichment that would allow use of lower tails assays, which would reduce uranium requirements. There are also possible improvements to reactor design and operation that could reduce uranium requirements. These factors are not likely to have a significant impact on uranium demands until at least well into the 1990s.

8.5.5 Uranium Inventories

Buyers' inventories of uranium have been increasing for several years as actual deliveries have been in excess of needs. Inventories at the beginning of 1980 totalled 32,742 tonnes (36,100 tons) of natural uranium (Table 8.10), with 25,033 tonnes (27,600 tons) held by utilities. In 1980, U.S. utilities sent an equivalent of 15,691 tonnes (17,300 tons) U_3O_8 to the DOE gaseous diffusion plants for enrichment. Thus, the 25,033 tonnes (27,600 tons) inventory level amounted to 1.6 years of U.S. utilities' needs. Of those U.S. utilities that responded to questions on inventory levels, most indicated that they desire a level amounting to about one year's needs, although some reported inventory levels as small as three month's needs, while others desire inventories as great as two year's needs. Producers also had inventories of about 2,177 tonnes (2,400 tons) U_3O_8 at the beginning of 1980, which is about a normal working inventory. The outlook is for a continuing buildup of buyers' inventories, as current contracted deliveries are in excess of actual needs.

Table 8.10. Buyers' Inventories of Natural Uranium in Tons U_3O_8

Beginning of Year	Domestic Origin	Foreign Origin	Total
1976	22,600	1,100	23,700
1977	25,800	3,500	29,300
1978	25,100	3,600	28,700
1979	28,000	5,200	33,200
1980	30,800	5,300	36,100

Conversion Factor: to convert tons to tonnes, multiply by 0.907.

8.5.6 Analysis of Production Capability and Reactor Capacity

Study of attainable production capability from currently estimated \$13.60 (\$30) U.S. ore reserves and probable potential resource indicates that production levels of 40,815 tonnes (45,000 tons) U_3O_8 per year can be achieved with aggressive resource development and exploitation, including both mining and milling. Although the level may be achieved by use of domestic \$13.60 (\$30) ore reserves and probable resources alone, development and utilization of \$30 possible and speculative categories and use of \$22.65 (\$50) ore reserves and potential resources would provide added assurance that the levels could be attained and sustained. Considering the use of \$22.65 (\$50) resource, a level of 54,240 tonnes (60,000-tons) per year supply is achievable from currently estimated resources. Such a level could be reached by the early 1990s. Imported uranium and inventories would add to the supply from these projections.

The level of nuclear generating capacity supportable with 54,240 tonnes (60,000 tons) per year of uranium, will vary with enrichment tails assay and recycle assumptions. Without recycle of uranium or plutonium and with a 0.30% U-235 enrichment tails assay, about 260,000 MWe could be supported. Without recycle and at 0.20% tails assay, about 310,000 MWe could be supported. With recycle of uranium and plutonium and a 0.20% tails assay, about 520,000 MWe could be supported. All the levels of supportable capacity are above the 170,000 MWe of capacity in operation (55,000 MWe), under construction (95,000 MWe), and on order (20,000 MWe), as of late 1980. Thus, currently estimated resources can provide adequate uranium supplies for a sizable expansion to U.S. nuclear generating capacity.

The cumulative lifetime (30 years) uranium requirements for all of the above reactors (170,000 MWe) would be about 0.907 million tonnes (1.0 million tons) U_3O_8 at 0.20% enrichment tails with no recycle, compared to the 1.45 million tonnes (1.6 million tons) mean value in \$13.60 [(\$30) or the 2.27 million tonnes at \$22.65 (2.5 million tons at \$50)] ore reserves, by-product, and probable potential resources. Evaluation of long-term fuel commitments on the basis of ore reserves and probable potential resources is considered a prudent course for planning. The lifetime commitment would be less than one third of currently estimated \$22.65 (\$50) domestic resources, including the possible and speculative categories (see Table 8.8).

8.5.7 Uranium Resource Recovery

In regard to the availability of estimated uranium resources considering recoveries in mining and ore processing, estimates of U.S. uranium resources represent the quantity of uranium estimated to be minable expressed as tons of U_3O_8 of ore in the ground. These estimates are a reflection of the information available to DOE at the time of the estimate; thus, they are dependent on the extent of exploration. In view of the considerations involved in preparing the resource estimates and the uranium resource outlook, no adjustment for losses is warranted.

U.S. mining practice results in recovery of high percentages of the uranium contained in a deposit. DOE resource estimation procedures consider the capabilities and requirements of mining systems currently in use so that the estimates are a realistic appraisal of what is minable. Because deposits frequently are not fully delineated before they are developed, it is not unusual for more uranium to be recovered from deposits than was included in ore reserves before such deposits were put into production. Mining company practice seeks to recover as much of the contained mineral content as possible before abandoning a mine. A strong incentive for such practice is the increase in financial returns. In the processing of uranium ores, recoveries generally are over 90%; in 1980, mill recovery averaged about 93%. Higher recoveries are usually possible if economically justified.

8.5.8 High Cost Resources

An alternative to identification of additional low-cost resources is the utilization of higher cost resources. The highest cutoff cost category included in DOE resources in Table 8.8 is \$45.30/kg of U_3O_8. This level is an upper range of what might be of interest for utilization in light water reactors over the next few decades.

The increased price of oil and coal in the last few years has been a contributing factor to the increased price of uranium economically acceptable in light water reactors. This impact results from the relative insensitivity of nuclear electric power costs to increases in uranium prices. The cost of fuel is a very small fraction of the cost of power from a nuclear plant. In turn, the cost of natural uranium is only a small fraction of the fuel cost; enrichment, fabrication, reprocessing, and carrying charges make up the balance. As a result, large increases in uranium prices result in comparatively small increases in power costs. As pointed out in Section 8.5.6, nuclear capacity currently in operation, under construction, and on order is expected to have adequate supplies of U_3O_8 at prices much lower than \$45.30/kg in 1980 dollars.

Knowledge of U.S. resources in the above $22.65 ($50) category is meager, largely because of the lack of past economic interest. There has been virtually no industry activity to search for or to develop such resources. Prospects for discovery of higher cost resources in the United States are considered promising at this stage of U.S. exploration. The principal large, very low-grade deposits that have been studied in some detail in the past are the shales and phosphates. The Chattanooga shale in Tennessee is of particular interest because of its large size. This deposit was extensively drilled, sampled, and studied in the 1950s. The higher grade part of the Chattanooga shale has an average uranium content of about 60 to 80 ppm compared to 1500 ppm in present-day ores. It contains in excess of 4.5 million tonnes (5 million tons) of U_3O_8 that may be producible at a cost of $45.30 or more per kilogram of U_3O_8. Additional work to develop production technology will be needed.

If Chattanooga shale were mined to fuel an 1150-MWe reactor, assuming recycle of uranium (but not of plutonium) and a 0.3% enrichment tail, about 11,428 tonnes (12,600 tons) of shale would have to be processed each day; with uranium and plutonium recycle (should that be practiced) and 0.20% enrichment tails, about 7,710 tonnes (8500 tons) per day would have to be processed. An average of about 10,250 tonnes (11,300 tons) of coal would have to be burned each day if 20 MJ/kg of coal were used to produce power equivalent to that produced by a 1150-MWe reactor.

Utilization of the very low-grade resources such as Chattanooga shale would, of course, involve mining and processing very much larger quantities of ore than is currently mined to produce the same amount of uranium. From an environmental as well as from an economic point of view, identification and utilization of additional higher grade ores would be preferable. However, the shales are available if their use should become necessary.

8.5.9 Prices

During the period 1973-1979, the average delivery price per kilogram of U_3O_8 for sales from domestic producers to domestic buyers, in year-of-delivery dollars, increased from $3.22 to $10.80, as shown in Table 8.11.

Table 8.11. Historical Trend of Average Uranium Prices

Year	Final Price[a]
1973	3.22
1974	3.58
1975	4.76
1976	7.30
1977	8.95
1978	9.78
1979	10.80

[a]In dollars/kg in year-of-delivery dollars.

Future prices for material under contract as of 1 July 1980, as reported to DOE, is shown in Table 8.12. Also shown are the percentages of material under contract price arrangements covering the price presented. The remainder is in market price contracts or in captive production.

8.5.10 Foreign Uranium Resource Position

The most reliable source of information on world uranium resources is that compiled by the Working Party on Uranium Resources sponsored jointly by the Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA). This group has been gathering and publishing uranium resource estimates since 1965 and includes most of the significant uranium resource countries. In compiling its estimates, this group classifies resources as "reasonably assured" resources

Table 8.12. Average Contract Prices and Settled Market Price Contracts for Uranium, 1 July 1980

Year	Price[a]	Percentages of Procurement under Contract Price Contracts
1980	11.78[b]	66
1981	13.00[b]	55
1982	15.76	47
1983	18.75	43
1984	19.68	35
1985	19.68	32
1986	21.22	16
1987	19.73	18
1988	19.34	22
1989	23.49	23
1990	24.12	16

[a]In dollars/kg in year-of-delivery dollars.

[b]These years include settled market price contracts. Market price contract prices are determined sometime before delivery, based on prevailing market prices.

(roughly comparable to ore reserves in the usual mining industry sense) and "estimated additional" resources (roughly comparable to DOE's probable potential resources). Resources in the world outside of the centrally planned economies area (WOCA) are tabulated by continents and major countries in Table 8.13.

Almost 80% of these resources are concentrated in three continents: North America, Africa, and Australia. Six countries, within those continents--the United States, Canada, South Africa, Namibia, Niger, and Australia--have about three quarters of the reasonably assured resources. This geographic concentration is a reflection of the geologic favorability of these areas as well as the extent of exploration and resource appraisal efforts to date.

8.5.11 Foreign Production Capacity and Plans

Studies by the NEA and the IAEA have also provided reliable information on world production capacity. The current production capacity of existing non-U.S. plants (Class 1) is about 34,466 tonnes (38,000 tons) U_3O_8 annually, as shown in Table 8.14. This production is primarily in Canada, France, Namibia, Niger, and South Africa.

Construction of new plants (Class 2) with a capacity of about 7,256 additional tonnes (8,000 tons) is taking place, primarily in Australia and Canada. Plants that are planned (Class 3), could increase total annual production by another 32,652 tonnes (36,000 tons) U_3O_8 for a total of 76,188 tonnes (84,000 tons) U_3O_8 by 1990. Since needs for uranium are well below attainable production capacity levels, and prices would not justify all operations, it is likely that many of the projected plants will be built on a deferred schedule. It is also possible that some new plants will replace existing operations. Countries of particular significance in future production expansion are Australia and Canada, which have 82% of capacity under construction and 70% of the planned additional capacity.

8.5.12 Foreign Reactor Requirements

The uranium requirements in non-Communist foreign countries have been projected by the Energy Information Administration based on the reactors planned and timing of construction. Table 8.15 shows three cases of power plant growth which, by the year 2000, range from 300 to 400 GWe of

Table 8.13. World Uranium Resources by Continent[a]

Continent	Reasonably Assured $30/lb[b]	Reasonably Assured $50/lb[b]	Estimated Additional $30/lb[b]	Estimated Additional $50/lb[b]
North America				
United States	645	940	885	1,430
Canada	280	305	480	945
Other	9	44	44	65
Total	930	1,290	1,410	2,440
Africa				
South Africa	320	508	70	180
Niger	210	210	69	69
Namibia	152	173	39	69
Other	109	115	2	22
Total	790	1,000	180	340
Australia				
Total	380	390	165	180
Europe				
France	51	72	34	60
Spain	13	13	11	11
Sweden	1	390	0	4
Other	22	31	19	53
Total	90	510	60	130
Asia				
India	39	39	1	31
Other	13	21	0	0
Total	50	60	0	30
South America				
Brazil	96	96	117	117
Argentina	30	36	5	12
Other	0	0	7	8
Total	130	130	130	140
Worldwide total (rounded)	2,400	3,400	1,900	3,300

[a]Modified from "Uranium Resources, Production and Demand" OECD, Nuclear Energy Agency (NEA), and the International Atomic Energy Agency (IAEA), December 1979. "World" refers to world outside centrally planned economic area. Resources given in 1000 tons U_3O_8.

[b]Includes resources at $30 per pound of U_3O_8.

Conversion Factors: to convert tons to tonnes, multiply by 0.907
to convert $/lb to $/kg, multiply by 0.453.

Table 8.14. Foreign Uranium Production Capability[a]

Year	Australia 1[b]	Australia 2	Australia 3	Canada 1	Canada 2	Canada 3	France 1	France 2	France 3	Namibia 1	Namibia 2	Namibia 3	Niger 1	Niger 2	Niger 3	S. Africa 1	S. Africa 2	S. Africa 3	Other[c] 1	Other[c] 2	Other[c] 3	Foreign Total 1	Foreign Total 2	Foreign Total 3
1980	1.3	0	0	9.8	0	0	4.5	0	0	5.3	0	0	5.2	0	0	8.3	0	0	4.1	0	0	38.5	0	0
1981	1.8	1.1	0	9.8	1.4	0	4.5	0.2	0	5.3	0	0	5.2	0	0	8.3	0	1.2	4.1	0	0.8	39.0	2.7	2.0
1982	1.8	3.3	0	9.8	1.9	0	4.5	0.5	0	5.3	0	0	5.2	0	0	8.3	0	2.9	4.1	0	3.0	39.0	5.7	5.9
1983	1.8	3.3	0	10.5	1.9	2.0	4.5	0.7	0	5.3	0	1.2	5.2	0	0	8.3	0	4.6	4.1	0	4.1	39.7	5.9	11.9
1984	1.8	3.3	0	11.0	2.9	4.0	4.5	0.7	0	5.3	0	1.2	5.2	0	0.7	8.3	0	5.2	4.1	0	4.4	40.2	6.9	15.5
1985	1.8	3.3	6.5	12.0	2.9	5.0	4.5	0.7	0	5.3	0	1.2	5.2	0	2.5	8.3	0	5.5	4.1	0	5.1	41.2	6.9	25.8
1986	1.2	3.3	11.5	12.0	2.9	7.2	4.5	1.4	0	5.3	0	1.2	5.2	0	5.2	8.3	0	5.6	4.1	0	5.1	40.6	7.6	35.8
1987	1.2	3.3	11.5	12.0	2.9	7.2	4.5	1.4	0	5.3	0	1.2	5.2	0	5.2	8.3	0	5.6	4.1	0	5.2	40.6	7.6	35.9
1988	1.2	3.3	11.5	12.0	2.9	7.2	4.5	1.4	0	5.3	0	1.2	5.2	0	5.2	8.3	0	5.5	4.1	0	5.3	40.6	7.6	35.9
1989	1.2	3.3	11.5	12.0	2.9	7.2	4.5	1.4	0	5.3	0	1.2	5.2	0	5.2	8.3	0	5.5	4.1	0	5.4	40.6	7.6	36.0
1990	1.2	3.3	11.5	12.0	2.9	7.2	4.5	1.4	0	5.3	0	1.2	5.2	0	5.2	8.3	0	5.2	4.1	0	5.5	40.6	7.6	35.8
Total																							84.0	

[a]In thousand tons U_3O_8 per year.

[b]Class: 1. Currently operating plants
2. Plants under construction
3. Planned plants

[c]Includes Argentina, Brazil, CAR, Gabon, India, Italy, Mexico, Portugal, Spain, Yugoslavia. Based on "Uranium Resources, Production and Demand," December 1979.

Conversion Factor: to convert tons to tonnes, multiply by 0.907.

Table 8.15. Foreign Nuclear Capacity and Uranium Requirements

Year	Capacity (GWe) Low	Mid	High	Requirements (tons U_3O_8)[a] Low	Mid	High
1980	66	68	77	17,300	18,400	19,800
1985	117	124	128	24,000	26,200	29,200
1990	165	181	201	27,500	31,600	32,700
1995	229	252	280	34,600	41,500	47,800
2000	300	350	400	42,700	54,100	64,300

[a]0.20% U-235 tails assay.

Conversion Factor: to convert tons to tonnes, multiply by 0.907.

nuclear power in operation. The mid-case is taken as the most likely one. However, nuclear power growth projections have been subject to continual downward revision in the last several years.

In order to supply these nuclear plants, EIA has estimated the amount of uranium required assuming 0.20% U-235 enrichment plant tails and no recycle of uranium or plutonium. Table 8.15 gives the annual tons U_3O_8 from 1980 to 2000 for high-, mid-, and low-cases.

For the mid-case foreign requirements increase from 16,689 tonnes (18,400 tons) U_3O_8 in 1980 to 23,763 tonnes (26,200 tons) U_3O_8 in 1985, and to 49,069 tonnes (54,100 tons) U_3O_8 in the year 2000. Cumulative requirements through the year 2000 total 650,319 tonnes (717,000 tons) U_3O_8.

If all the planned foreign mine-mill production came on-stream as currently projected, there would be considerable excess capacity. If only operating mills or those under construction were available by the late 1980s, production capacity would cover annual demands through the late 1990s.

Additional projections of WOCA nuclear growth and uranium requirements were developed during the International Nuclear Fuel Cycle Evaluation (INFCE). While the projections are now considered as high by many, they do provide an additional, more optimistic, viewpoint on future nuclear growth. The INFCE low case--modified to exclude the United States--indicated a growth in foreign (WOCA) nuclear capacity from 82 GWe at the end of 1980 to 217 GWe in 1990 and to 580 GWe in the year 2000. Corresponding foreign uranium requirements would be 19,047 tonnes (21,000 tons) in 1980, 45,350 tonnes (50,000 tons) in 1990, and 108,840 tonnes (120,000 tons) in 2000. Such projections indicate a much larger possible growth in future uranium demands.

8.5.13 Foreign Competition and the Domestic Industry

The concentration of world uranium resources and production has, in past periods of low prices and ore production, fostered attempts to form cartel-like organizations seeking to restrict the free movement of uranium and influence pricing. The concentration of uranium production in a few countries will continue for some time, though there is an increasing diversity of supply sources. The opportunity for future foreign cartel-like activities will continue, particularly if uranium producer country governments are involved, which has been the case in the past. However, the severe criticism of such practice and the legal actions that have resulted in the United States might operate to discourage such activities in the future. Since the United States has the capability of producing a large portion, or all, of its uranium needs, and since United States uranium buyers historically have shown a strong preference for domestic uranium, the United States is not expected to develop a large dependence on foreign uranium. These factors would tend to reduce the susceptibility of the United States to direct impacts of any cartel-like activity.

8.5.14 Conclusions

In conclusion, DOE assessment of uranium resources indicates that currently estimated ore reserves and probable potential resources at forward costs up to \$13.60/kg U_3O_8 total more than 1.36 million tonnes (1.5 million tons), and at forward costs up to \$22.65/kg U_3O_8 total almost 2.17 million tonnes (2.4 million tons). The 2.17 million tonnes (2.4 million tons) U_3O_8 will support 390 GWe of nuclear power generating capacity, assuming a 30-year life for the reactors, no spent fuel reprocessing and an enrichment plant tails assay of 0.20% U-235. Under the latest DOE forecast for nuclear generating capacity in the post-2000 period, these resources should support U.S. nuclear power growth, including SSES 1 and 2, well into the next century. However, meeting the uranium requirements for an expanding U.S. nuclear power industry will require extensive industry efforts to sustain exploration, and success in discovering and developing the potential uranium resources.

Foreign uranium resources are substantial and have been growing. Some of the more recently discovered deposits, especially in Canada and Australia, will have comparatively low-cost uranium production. The staff, therefore, concludes that there will be sufficient nuclear fuel available for SSES 1 and 2.

8.6 DECOMMISSIONING

Termination of a nuclear license is required at the end of facility life. Such termination requires decontamination of the facility so that the level of any residual radioactivity remaining at the site is low enough to allow either unrestricted use of the site for nuclear or nonnuclear purposes. The objective of NRC regulatory policy in decommissioning nuclear facilities is to ensure that proper and explicit procedures are followed to mitigate any potential for adverse impact on public health and safety or on the environment.

Three alternative methods can be and have been used to decommission reactors.[39] DECON means to remove immediately all radioactive materials down to levels that would permit the property to be released for unrestricted use. SAFSTOR is defined as those activities required to place and maintain a radioactive facility in such condition that 1) the risk to safety is within acceptable bounds and 2) the facility can be safely stored for as long a time as desired and subsequently decontaminated to levels that would permit release of the facility for unrestricted use. ENTOMB means to encase and maintain property in a strong and structurally long-lived material to ensure retention until radioactivity decays to a level acceptable for releasing the facility for unrestricted use.

For a large BWR, DECON is estimated to cost \$43.6 million (in 1978 dollars); SAFSTOR is estimated to cost \$59.9 million with a 30-yr safe-storage period and \$55.6 million with a 100-yr safe-storage period. ENTOMB is estimated to cost \$35.0 million with the pressure vessel and its internals retained and \$41.7 million with the pressure vessel and internals removed; a \$40,000 annual maintenance and surveillance cost would be added in both cases. Either ENTOMB option requires indefinite dedication of the site as a radioactive waste burial ground. The security of the site could not be assured for thousands of years necessary for radioactive decay so this option will probably not be viable.

Although DECON is less costly than SAFSTOR, it results in slightly higher radiation exposures to the decommissioning workers and to the public. The person-rem of occupational exposure is estimated at 1955 for DECON as compared to 442 for 30-year SAFSTOR and 1624 for ENTOMB (internals retained). The person-rem exposure to the public is minimal for any of the alternatives: 10 for DECON, 2 for 30-year SAFSTOR, or 5 for ENTOMB.

Radiation doses to the public as a result of decommissioning activities should be very small and would come primarily from the transportation of decommissioning waste to waste burial grounds. Radiation doses to decommissioning workers should be a small fraction of the exposure they experience over the operating lifetime of the facility; these doses will usually be well within the occupational exposure limits imposed by regulatory requirements.

Decommissioning of nuclear facilities is not an imminent health and safety problem. However, planning for decommissioning can have an impact on health and safety as well as cost. Essential to such planning activity is the decommissioning alternative to be used and the timing. Also to be considered are 1) acceptable residual radioactivity levels for unrestricted use of the facility, 2) financial assurance that funds will be available for performing required decommissioning activities at the end of the facility operation (including permature closure), and 3) the facilitation of decommissioning.

Decommissioning of a nuclear facility generally has a positive environmental impact. Compared to operational requirements, the commitment of resources for decommissioning is generally small. The major environmental impact of decommissioning is the commitment of small amounts of land for the burial of waste. This is in exchange for being able to reuse the facility and site for other nuclear or nonnuclear purposes. Because the land has valuable resource capability, in many instances (such as at a reactor facility) the return of this land to the commercial or public sector is highly desirable.

8.7 EMERGENCY PLANNING

In connection with the promulgation of the Commission's upgraded emergency planning requirements, the staff (Office of Standards Development) issued NUREG-0685, "Environmental Assessment for Effective Changes to 10 CFR Part 50 and Appendix E to 10 CFR Part 50; Emergency Planning Requirements for Nuclear Power Plants," (August 1980). At this time, however, the staff does not have sufficient information to determine whether any environmental impacts will result from implementation by the applicant of the upgraded emergency planning requirements in 10 CFR Part 50, Appendix E, such as construction of a near-site emergency operations facility and the conduct of emergency preparedness exercises. Upon receipt of all components of the applicant's emergency plan and implementing procedures, the staff will be in a position to determine whether or not such plan and implementing procedures will result in significant environmental impacts. The NRC staff will discuss emergency planning in a Supplement to the Safety Evaluation Report.

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*Available for purchase from the National Technical Information Service, Springfield, VA 22161.
**Available free upon written request to the Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

9. BENEFIT-COST ANALYSIS

9.1 RÉSUMÉ

The following sections summarize the economic, environmental, and social benefits and costs associated with the operation of Susquehanna Units 1 and 2. Table 9.1 summarizes all benefits and costs of plant operation. Reduced generating costs are presented for the expected energy demand situation. The environmental costs are calculated for an assumed worst-case situation.

9.2 BENEFITS

The direct benefits of the plant to the PJM interchange include the approximately 11.0 to 12.9 billion kWh of electrical power the plant will be able to produce on an annual basis (assuming a plant capacity factor of between 60% and 70%), the increase in system reliability brought about by the addition of 1890 MW of generating capacity to the PJM interchange and 210 MW to the Cooperative, and the saving of $112 million in production costs per unit per year ($ 1980).[1] If "river-following" were to be undertaken by the applicant (see Appendix A, Sec. A.5.1), the staff has determined that occasional low-flow conditions resulting in forced outages would cause less than a 2% decrease in the direct energy benefit.

9.3 SOCIETAL COSTS

No significant socioeconomic costs are expected from either station operation or station personnel and their families living in the area.

9.4 ECONOMIC COSTS

The capital cost for completion of Susquehanna Units 1 and 2 is presently estimated to be $1833 million. Fuel and operation and maintenance costs for the first full year of operation of Unit 1 are estimated to be $51 and $22 million dollars, respectively. Decommissioning costs for the complete restoration of the site are estimated at $78.5 million ($ 1980).

9.5 ENVIRONMENTAL COSTS

The environmental costs of most land-use, water-use, and biological effects previously evaluated have not increased or otherwise adversely changed. The staff review of the water-intake structure revealed that there may be an increase in fish kills due to impingement and entrainment.

Chemical usage will result in a maximum discharge of 1.4×10^6 kg of chemicals per year into the Susquehanna River. This discharge should not result in any adverse effects to the environment.

The heat discharge system will result in an average water consumption of 1.4 m^3/s from evaporation and other uses. A maximum of 3.4×10^{11} J/hr will be rejected from the reactors into the Susquehanna River as heat. No adverse impacts are expected as a result of this discharge.

The design of the radioactive waste systems has been finalized. Under normal operation, each reactor will be in conformance with Appendix I to 10 CFR 50 and discharge a total of 17 curies of tritium and 0.46 curies of all other radionuclides to the Susquehanna River annually. Each reactor will also discharge approximately 19,000 curies of noble gases, 0.52 curies of radioiodines, 0.004 curies of radioactive particulates, 9.5 curies of carbon-14, and 69 curies of tritium into the atmosphere surrounding the Susquehanna Steam Electric Station facility annually. These effluents will result in a total body dose commitment of 40 person-rem per year to the general public of the U.S. population in the unrestricted area. This dose commitment will have no discernible effect on the population.

The operation of the Susquehanna facility, even for a brief period of time, will produce a radioactive structure requiring decommissioning and long-term protective storage. However, the

Table 9.1. Benefit-Cost Summary

Primary Impact and Population or Resource Affected	Unit Measure	Magnitude of Impact
	Direct Benefits	
Energy	kWh/yr × 10^6	11,000
Capacity	kw × 10^3	2,100
Reduced generating costs	\$(1980)/yr	About \$224,000,000
	Economic Costs	
Operating:		
Fuel	\$(1980)/yr per unit	51,000,000
Operation & maintenance	\$(1980)/yr per unit	22,000,000
Decommissioning	\$ (1980)	78,500,000
	Environmental Costs	
1. Impact on water		
1.1 Consumption (average)	m^3/s	1.4
1.2 Heat discharge to natural water body		
1.2.1 Cooling capacity of water body	J/hr	3.4×10^{11} (maximum)
1.2.2 Aquatic biota		Minor, acceptable
1.2.3 Migratory fish		Minor, acceptable
1.3 Chemical discharge to natural water body		
1.3.1 People		Not discernible
1.3.2 Aquatic biota		0
1.3.3 Water quality		0
1.3.4 Chemical discharge	kg/yr	1,400,000
1.4 Radionuclide contamination of natural surface water body		
1.4.1 All except tritium	Ci/yr per reactor	0.46
1.4.2 Tritium	Ci/yr per reactor	17.0
1.5 Chemical contamination of groundwater		
1.5.1 People		Not discernible
1.5.2 Plants		Not discernible
1.6 Radionuclide contamination of groundwater		
1.6.1 People		
1.6.2 Plants and animals		
1.7 Raising/lowering of groundwater levels		
1.7.1 People		Not discernible
1.7.2 Plants		Not discernible
1.8 Effects on natural water body of intake structure and condenser cooling systems		
1.8.1 Primary producers and consumers		Chemical discharges discernible but most likely of acceptable concentration
1.8.2 Fisheries		Minimal unless increased productivity caused by intake
1.9 Natural water drainage		
1.9.1 Flood control		No damage
1.9.2 Erosion control		Insignificant

Table 9.1. (Cont'd)

Primary Impact and Population or Resource Affected	Unit Measure	Magnitude of Impact
Environmental Costs (cont'd)		
2. Impact on air		
2.1 Chemical Discharge to ambient air		
2.1.1 Air quality, chemical		
2.1.1.1 CO	kg/yr	2,900
2.1.1.2 SO_2	kg/yr	Negligible
2.1.1.3 NO_x	kg/yr	8,700
2.1.1.4 Particulates	kg/yr	Negligible
2.1.1.5 HC	kg/yr	130
2.1.2 Air quality, odor		Negligible
2.2 Radionuclides discharged to ambient air		
2.2.1 Noble gases	Ci/yr per reactor	19,000
2.2.2 Radioiodines	Ci/yr per reactor	0.52
2.2.3 Particulates	Ci/yr per reactor	0.004
2.2.4 Carbon-14	Ci/yr per reactor	9.5
2.2.5 Tritium	Ci/yr per reactor	69.0
2.3 Fogging and icing		
2.3.1 Ground transportation		None
2.3.2 Air transportation		Negligible
2.3.3 Water transportation		None
2.3.4 Plants		Negligible
2.3.4.1 Cooling tower emissions		Not discernible
2.3.4.2 Spray pond emissions		Potential local ice-loading offsite
2.4 Salt discharge from cooling system		
2.4.1 People		Negligible
2.4.2 Plants and soil	kg/ha per yr	28.0 (maximum), staff estimate
	kg/ha per mo	0.88 (maximum), applicant's estimate
2.4.3 Property		Not discernible
3. Impacts on terrestrial systems		
3.1 Station area		
3.1.1 Proposed post-construction reclamation of station area (e.g., landscaping, erosion control)		Acceptable
3.2 Bird impingements on station facilities (e.g., cooling towers)	Individual impingements	Unknown (to be monitored)
4. Transmission line corridors		
4.1 Right-of-way maintenance and inspection		Acceptable
4.2 Production of ozone, other gaseous pollutants		Inconsequential
4.3 Audible noise		Minimal
4.4 Radio and TV interference	Individual complaints	Reception problems resolved by applicant as necessary
4.5 Electrical field effects		Acceptable
5. Total body dose commitments to U.S. population general public, unrestricted area	person-rem/yr	65
Societal Costs		
1. Operational fuel disposition		
1.1 Fuel transport (new)	Trucks/yr	10
1.2 Fuel storage		
1.3 Waste products (spent fuel)	Rail shipments/yr	
2. Plant labor force	people	200
3. Historical and archeological sites		Acceptable
4. Station operational noise	Sound level, dBA	Acceptable with proper mitigation; to be monitored.
5. Esthetics		
5.1 Visual impacts to station structures		Acceptable
5.2 Visual impacts to cooling tower plumes		Acceptable
5.3 Visual impacts of transmission corridors		Acceptable

nuclear waste associated with decommissioning of the Susquehanna facility will be a small quantity compared to that already generated by commercial and military nuclear applications.

9.6 ENVIRONMENTAL COSTS OF THE URANIUM FUEL CYCLE

The contribution of environmental effects associated with the uranium fuel cycle is indicated in Table 4.16 and described in Section 4.5.6. The staff has evaluated the environmental impacts of the fuel-cycle releases presented in Table 4.16 and has found these impacts to be sufficiently small so that, when they are superimposed upon the other environmental impacts assessed with respect to the construction and operation of the plant, they do not affect the benefit-cost balance.

9.7 ENVIRONMENTAL COSTS OF URANIUM FUEL TRANSPORTATION

The contribution of environmental effects associated with the transportation of fuel and waste to and from the facility are summarized in Section 4.5.2 and Table 4.13. These effects are sufficiently small so as not to affect the benefit-cost balance.

9.8 SUMMARY OF BENEFIT-COST

As a result of the analysis and review of potential environmental, technical, economic, and social impacts, the staff has been able to forecast more accurately the effects of the station's operation. No new information has been acquired that would alter the overall balancing of the benefits of this station versus the environmental costs. Consequently, the staff has determined that it would be possible to operate the station with only minimal environmental impacts. The staff believes that the primary benefits of providing 2100 MW of electrical energy, minimizing system production costs, and increasing system reliability through the addition of 2100 MW baseload capacity will greatly outweigh the environmental, social, technical, and economic costs. Benefit-costs are summarized in Table 9.1, which is explained in Appendix E.

Reference

1. "Technology, Safety, and Cost of Decommissioning a Reference Boiling Water Reactor Power Station," Vol. I., prepared for the U.S. Nuclear Regulatory Commission by Pacific Northwest Laboratory, Richmond, WA, NUREG/CR-0672, June 1980. Available for purchase from the NRC/GPO Sales Program, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and/or the National Technical Information Service, Springfield, VA 22161.

10. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to Paragraph A.6 of Appendix D to 10 CFR Part 50, the Draft Environmental Statement for the Susquehanna Steam Electric Station, Units 1 and 2, was transmitted, with a request for comments, to

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Department of Energy
Environmental Protection Agency
Federal Energy Regulatory Administration
Pennsylvania State Clearinghouse
Pennsylvania Department of Environmental Resources
Luzerne County Planning Commission
Economic Development Council of Northeastern Pennsylvania
Board of Supervisors, Berwick

The Draft Supplement to the Draft Environmental Statement Related to Operation of Susquehanna Steam Electric Station, Units 1 and 2, was transmitted, with a request for comments, to the same federal, state, and local agencies. The Draft Supplement was also transmitted to:

Susquehanna River Basin Commission

In addition, the NRC requested comments on the Draft Environmental Statement from interested persons by a notice published in the Federal Register on 24 June 1979. In response to the requests referred to above, comments were received from

Department of Agriculture, Forest Service (DA-FS)
Department of Agriculture, Soil Conservation Service (DA-SCS)
Department of Commerce (DOC)
Department of Health, Education, and Welfare (HEW)
Department of Housing and Urban Development (HUD)
Department of the Interior (DOI)
Department of Transportation (DOT)
T.R. Duck
Economic Development Council (EDC)
Environmental Protection Agency (EPA)
Federal Energy Regulatory Commission (FERC)
T.J. Halligan
M.L. Hershey
M.J. Huntington
H.C. Jeppsen
S. Laughland
W.A. Lochstet
Luzerne County Planning Commission (LUZ)
M.M. Molesevich
L. Moses
D. Oberst
Pennsylvania Power & Light Company (PP&L)
Pennsylvania State Clearinghouse, Department of Environmental Resources (PDER)
W.L. Prelesnik
SEDA - Council of Governments (SEDA)
F.L. Shelly
S. Shortz

Sierra Club, Pennsylvania Chapter (Sierra)
Susquehanna Alliance (SA)
Susquehanna River Basin Commission (SRBC)
F. Thompson
L.E. Watson

The comments are reproduced in this Statement as Appendix B. The staff's consideration of the comments received and its disposition of the issues involved are reflected in part by revised text in the pertinent sections of this Final Environmental Statement and in part by the following discussion. The comments are referenced by use of the abbreviations indicated above; also, the pages in Appendix B on which copies of the comments appear are indicated.

10.1 SUMMARY AND CONCLUSIONS, FOREWORD, INTRODUCTION

10.1.1 Summary and Conclusions (SRBC 8/30/79:B-68; HUD:B-6)

The staff agrees that the estimate of the 7-day, 10-year low flow based upon the longer record should be used. They concur in the value of 22.7 m^3/s. However, the controlling discharge should be considered fixed at 22.7 m^3/s to preclude annual changes due to new data affecting the 7-day, 10-year flow.

10.1.2 Foreword (SA 8/17/79:B-62; T.J. Halligan:B-26)

The Atomic Safety and Licensing Board for Susquehanna has considered the question of "piece-mealing" the NEPA review and has found no merit to this argument. It is the staff's conclusion that the Final Environmental Statement represents a comprehensive environmental assessment.

The NRC has published draft proposed procedures for implementing NEPA regulations. Public and agency comments have been received on the draft proposed procedures, and proposed final regulations are now before the Commissioners for approval. The final regulations provide that actions undertaken prior to publication of the final rule will not require adherence to the new procedures.

10.1.3 Introduction (PP&L 9/4/79:B-42; PDER 8/20/79:B-50)

National Pollution Discharge Elimination System (NPDES) Permit No. PA-0047325, effective 31 July 1979, was issued to cover the blowdown and other lesser discharges. This permit prohibited the discharge of floating debris, visible foam, and polychlorinated biphenyl compounds (PCBs); it also set limits for the discharge of free available chlorine, total iron, total suspended solids, oil and grease, but did not specify limits for sulfate in the discharge. The staff notes that this permit expired on 30 September 1980 and was administratively extended by PDER. Upon receipt of a new permit application from PP&L under the EPA's Consolidated Permit Regulation Program (45 FR 33425, 19 May 1980), the permit will be renewed. This is expected to occur by March 1982.

10.2 THE SITE

10.2.1 Résumé

No comments.

10.2.2 Sociocultural Profile (EDC 9/26/79:B-14)

10.2.2.1 Introduction

No comments.

10.2.2.2 Demography

No comments.

10.2.2,3 Settlement Pattern (M.M. Molesevich:B-39)

Figure 2.1 has been revised to reflect these comments.

10.2.2.4 Social Organization (M.M. Molesevich:B-39, EDC 8/27/79:B-13)

The state and local evacuation plans will be reviewed by NRC and the Federal Emergency Management Agency (FEMA) before the operating license can be issued. FEMA requires that the plans include all hospitals and institutions within the Susquehanna plant plume exposure.

10.2.2.5 Political Organization

No comments.

10.2.2.6 Land Use (M.M. Molesevich:B-39)

The text has been revised to reflect the comments on land-use categories.

10.2.2.7 Changes in the Local Economy

No comments.

10.2.3 Water Use (EPA 8/17/79:B-17; EDC 9/26/79:B-14)

The third paragraph of Comment B-17 is not clear: if it is intended to indicate the possibility of interactive effects, any such effects should be reflected in appropriate standards. Regarding stoichiometry, it is pointed out in Section 10.3.2.4 that the "maximum" conditions assumed in estimating chemical discharges are inconsistent and could not occur in practice. This inconsistency is largely responsible for the apparently high sulfate discharges estimated in the DES.

The applicant gave the following response to this comment (applicant's responses 13 November 1979):

> The NPDES permit for the Susquehanna SES has specified no average limitation on iron but a daily maximum of 7 mg/L. The iron content in the Susquehanna River normally does not meet Pennsylvania Department of Environmental Resources, Chapter 93, Water Quality Criteria. On DES pages 4-4 through 4-7 and Table 4-3, the discussion of the discharge from the station does not indicate the settling rate of suspended solids in the cooling tower basins. The ratio of suspended solids of the water in the cooling tower basins to the water in the discharge is about 3 to 1 which approximately offsets the concentration factors listed in Table 4-3. If the concentration of iron in the river exceeds DER criteria, the station will discharge approximately the same concentration. This is noted in the NPDES permit which states that the effluent quality need not exceed the quality of the raw water supply.

Since the DES was published, the applicant has indicated that the parking-lot pond has been deleted. Figure 2.3 has been amended accordingly. The only water discharged to the river through the drainage ditch will be rainfall-generated water and treated waste water from sumps and drains in non-radioactive plant areas (e.g. condenser, pumphouse, diesel generator and electrical equipment areas), estimated as 9.1 L/s. Oil will be separated and recovered where necessary. The waste water from raw water treatment (essentially clarified water) will be recycled to the condenser cooling system together with neutralized and filtered demineralizer waste. The total water so recycled is estimated as 3.15 L/s. The average demineralizer waste flow was estimated in the ER-CP as 0.21 L/s.

The applicant has provided the following additional information on other internal station flow rates (applicant's responses dated November 13, 1979):

Flow Path	Quantity
Raw Water Treatment Plant to Radioactive Area Waste Uses	0-12.6 L/s
Raw Water Treatment Plant to Demineralizer	7.6 L/s (batch)
Demineralizer to Radioactive Area Water Uses	1-12.6 L/s
Demineralizer to General Plant Uses	0-9.1 L/s
Raw Water Treatment Plant to General Plant Uses	0-9.1 L/s

Because these flow rates are variable or intermittent, a precise water balance is not possible, but the average rates are so small that the effect on the overall plant water balance will be negligible. In estimating the chemical discharges, the staff did not find it necessary to establish a precise water balance for each of these unit processes.

All water recycled to the condenser cooling system will be filtered. The solids from the water recovery filter will be trucked offsite and disposed of in a licensed landfill.

The staff has analyzed the construction and use of Pond Hill Reservoir in Appendix A. Responsibility for regulating downstream uses and users of water is assigned to the U.S. Environmental Protection Agency, the Susquehanna River Basin Commission, and the Pennsylvania Department of Environmental Resources.

The location of the plant relative to the floodplain of the Susquehanna River is discussed in Section 4.3.2.2. The major plant structures are well above the floodplain; only the intake structure, its access road, and some recreational facilities are in the floodplain.

The Tioga-Hammond Dam is primarily a flood control project. An analysis of the effects of its (hypothetical) sudden catastrophic failure showed that resulting water levels on the Susquehanna River near the plant site would be lower than the level of the flood for which the plant is designed.

10.2.3.1 Regional Water Use

No comments.

10.2.3.2 Hydrology

No comments.

10.2.3.3 Water Sources (PP&L 9/4/79:B-42)

Figure 2.3 has been modified as a result of the design change.

10.2.3.4 Water Quality (EPA 8/17/79:B-17; PP&L 9/4/79:B-42)

Table 2.8 has been updated to show the revised State Water Criteria published in July 1979, and applicable to the North Branch Susquehanna River from the Lackawanna River to the West Branch confluence, including the waters in the vicinity of the site, which are classified WWF (protection of warm water fishery). The criteria include the state-wide list plus dissolved oxygen, temperature, and manganese, but sulfate and chloride are not included. Although criteria for sulfate and chloride do not currently apply to this stretch of the river, criteria for them do exist in the state. These limitations could be applied in the future if deemed necessary by the state.

Section 2.3.4.1 has been revised to respond to the comments made.

10.2.4 <u>Meteorology</u> (PP&L 9/4/79:B-42)

The recovery rate of approximately 70% for onsite meteorological data collected during calendar year 1973 cited in the Susquehanna DES is for wind speed and wind direction measurements at the 9.6 m level and on temperature differential measured between 91.7 m and 9.6 m. The staff agrees that the data recoverability of joint wind speed, wind direction, and temperature differential may be enhanced by using temperature differences measured between 30.5 m and 9.6 m when the 91.7 m to 9.6 m are not available. However, because of the large difference in the depths of the two layers over which the temperature differences were measured (62.1 m and 20.9 m) and particularly the shallow depth of the lower layer (20.9 m), the staff questions the result of direct substitution of the lower temperature differential measurement when the 91.7 m to 9.6 m data are missing.

The staff acknowledges that the unusually high occurrence of unstable atmospheric conditions recorded at the Susquehanna site may represent the meteorological conditions that occurred in 1974 and 1975. However, in the staff's opinion, this period does not adequately represent average conditions expected to occur during the lifetime of the plant. Since these data would represent a substantial part of the meteorological data base if they were used in the evaluation, they could deceptively weight the resultant dispersion estimates. Therefore, the staff did not include the meteorological data collected during the 1974 and 1975 calendar years in its atmospheric dispersion evaluation.

The staff agrees that the wind from the west-southwest and west directions as recorded at the 9.6-m level occurred with frequencies of 13.5% and about 12.0%, respectively, during calendar year 1976. The recorded frequency of calm was 1.5%. These corrections have been made in the appropriate section of the text.

10.2.5 Site Ecology

10.2.5.1 Terrestrial Ecology (PP&L 9/4/79:B-42)

Section 2.5.1.3 has been revised to reflect the comment made.

10.2.5.2 Aquatic Ecology

No comments.

10.2.6 Cultural Resources (Sierra:B-61; SA 8/17/79:B-62; PDER 8/20/79:B-50; DOI 9/10/79: B-7; EDC 9/26/79:B-14)

See Section 10.4.7.

10.3 THE PLANT

10.3.1 Résumé

No comments.

10.3.2 Design and Other Significant Changes

10.3.2.1 Water Use (SRBC 8/30/79:B-68; EDC 8/27/79:B-13 and 9/26/79:B-14)

Section 3.2.1 has been revised to reflect the applicable comments. Table 3.1 has also been revised.

The applicant has calculated that, under the worst meteorological condition, which runs 1% of the time (a dry bulb temperature of 29.4°C or 85°F and a wet bulb of 23.9°C or 75°F) and a maximum plant load, the maximum evaporation rate will be 1.81 m^3/s.

Appendix A addresses the compensation reservoir proposed by the applicant to meet the Susquehanna River Basin Commission's regulations with respect to consumptive water use during periods of low river flow.

The plant river intake structure is designed to be operational during the Standard Project Flood (SPF), which is the most severe flood reasonably characteristic of the region. The calculated river level of the SPF at the intake location is more than 2.4 m above the maximum recorded level, which resulted from Tropical Storm Agnes. In the SPF analysis, no credit was taken for any protection the proposed Tioga-Hammond Dam would provide. In addition, it must be emphasized that the plant can be safely shut down without using the Susquehanna River intake. For further discussion of the safety-related aspects of plant water supply, see the Safety Evaluation Report (SER).

The effects of floods on SSES are discussed in detail in the SER, Section 2.4. The plant is well above the level of any credible flood on the Susquehanna River. The ability of the plant to safely shut down using the onsite spray pond in the event that the river intake structure is flooded is also addressed in the SER, Section 2.4.

10.3.2.2 Heat Dissipation System (EPA 8/17/79:B-17; SRBC 8/30/79:B-68)

The staff is familiar with EPA Document 660/2-73-016. Construction of the intake was essentially complete at the time of the site visit (September 1978). Determination of compliance with Section 316(b) of the Clean Water Act is the responsibility of EPA, not the NRC. Approval of the applicant's impingement/entrainment study, either under Section 402 or 316(b) of the Clean Water Act, is interpreted by NRC to mean that the design of a given intake is EPA approved. PDER (Pennsylvania being an agreement state) approved the applicant's impingement/entrainment study on 29 April 1980.[2] Should the applicant's entrainment study indicate that mitigative measures are necessary, appropriate modifications will be made. Section 5.3.4 has also been updated to reflect this information.

Construction of the intake is essentially complete. Determination of compliance with Section 316(b) of the Clean Water Act is the responsibility of EPA. Pennsylvania is an EPA agreement state with the Pennsylvania Department of Environmental Resources responsible for determining compliance with Section 316(b). PDER has accepted the applicant's proposed impingement/entrainment study.[1,2] A determination of the environmental acceptability of the intake will be made by PDER after the 316(b) study is complete. Section 5.3.4 has also been updated to reflect this information.

10.3.2.3 Radioactive Waste Systems

No comments.

10.3.2.4 Chemical, Sanitary, and Other Waste Treatment (EPA 8/17/79:B-17; DOI 9/10/79:B-7)

Sulfate

The NPDES permit does not limit the sulfate concentration in the discharge. The only currently applicable standards for river water quality are those shown in Table 2.8. The state criteria for protection of aquatic life in the stretch of the river adjacent to the plant site do not currently include a limit on sulfate concentration, although a limit of 250 mg/L for drinking water is included in the list of specific criteria, which could be applied if deemed desirable to any stream in the state. The recommended drinking water standard is based on taste perception; adverse (laxative) effects are not noticeable at sulfate concentrations below 400 mg/L.

Under the most adverse conditions, the staff estimates that the sulfate concentration in the river will not exceed 250 mg/L (Table 4.3) after complete mixing of the blowdown with the minimum river flow. As stated in Section 4.3.3.2, impurities not added in the plant will be concentrated by a factor of 1.06 to 1.08 by evaporation in the cooling towers. With a maximum observed sulfate concentration of 222.5 mg/L, the maximum final concentration would be about 241 mg/L if no sulfuric acid were added; thus, the maximum sulfate addition would produce an increase of only 6 mg/L under these unlikely conditions. As shown in Section 3.2.4.2, it may be possible to reduce this small contribution even further by operating with a more positive saturation index, which would also improve corrosion protection.

Other

Sulfuric acid addition is the most effective and economical method of scale control; it is used in virtually all large generating stations, nuclear and fossil-fueled, where water quality demands scale control. Its action depends on well-known physicochemical principles and the dosage can be calculated quite accurately for given water quality and plant conditions. Sulfate ion is present in most natural waters; its environmental effects have been well studied, and are reflected in water quality criteria. The staff's evaluation shows that sulfuric acid can be used at SSES without violating these criteria, although careful analytical control will be necessary because of the high and variable ambient sulfate level. The Amertap system of mechanical cleaning may retard the buildup of calcium carbonate scale, should scaling conditions prevail for prolonged periods. Controlled sulfuric acid addition should avoid these conditions.

Theoretically, hydrochloric acid could be used to reduce alkalinity and control scale, but it is never used for this purpose; corrosion is a major objection. EPA has already expressed concern regarding the chloride concentration in the discharge (see EPA 8/17/79, p. B-17); this would be greatly increased by the use of hydrochloric acid.

Organic scale control agents (tannins, lignins, polyacrylates, polyphosphonates) are known to be effective. They inhibit crystal growth rather than increase solubility. These agents are not in common use in large cooling systems, and their environmental effects are not well known. The phosphonates appear to be the most effective, but the release of phosphorus compounds on a large scale appears highly undesirable.

In any event, the purpose of the Environmental Impact Statement at the Operating License Stage is to assess the impacts of the station as designed; alternatives are not normally considered at this stage, unless the impact of the proposed system or procedure is assessed as being unacceptable. That is not the situation in this circumstance. A more detailed analysis is therefore not warranted.

10.3.2.5 Transmission Systems (Sierra:B-61)

The staff interprets the comment as being related to the Pennsylvania Scenic Rivers Act of 1972, which authorizes establishment of a scenic rivers system. Accordingly, the Pennsylvania Department of Environmental Resources conducts river studies and reports to the governor and general assembly regarding designation and management of candidate waterways.

The applicant indicates that the transmission line crossing at the Lehigh River Gorge was specifically selected to minimize the visibility of the line. The PDER reviewed and concurred with plans for the crossing (ER-CP, Amendment 5). The staff also notes that the PDER granted the applicant a permit for crossing the gorge (ER-OL, Sec. 12.1.2).

The staff has also contacted the Department of the Interior Heritage Conservation and Recreation Service (HCRS) concerning the status of the Lehigh River Gorge area for consideration in the National Wild and Scenic Rivers System. A Nationwide River Inventory has recently been developed by HCRS and the Lehigh River Gorge area is listed as having potential for inclusion in the Nationwide River System. However, it is the staff's understanding that, because the excavation, construction, and erection of the towers at the gorge crossing began in the fall of 1978, prior to publication of the Nationwide River Inventory list, the Susquehanna 500-kv line would not impact the future status of this river segment for inclusion into the National Wild and Scenic River System.

10.4 ENVIRONMENTAL EFFECTS OF STATION OPERATION

10.4.1 Résumé

No comments.

10.4.2 Impacts on Land Use (M.M. Molesevich:B-39)

The state and local evacuation plans will be reviewed by NRC and the Federal Emergency Management Agency (FEMA) before the operating license can be issued. FEMA requires that the plans include all hospitals and institutions within the Susquehanna plant plume exposure.

10.4.3 Impacts on Water Use (T.R. Duck:B-11)

The Pond Hill Reservoir is being planned to supplement river flow during periods of low river flow. The Susquehanna River Basin Commission has directed that the reservoir be constructed by 1 July 1984. The Pond Hill Reservoir is not required for the safe operation of the nuclear plant. Therefore, the Environmental Statement review dealt only with the effect of the construction and operation of the Pond Hill Reservoir on the environment.

10.4.3.1 Thermal Impacts in Water Use (PP&L 9/4/79:B-42; L.E. Watson:B-75)

Section 4.3.1 has been revised to reflect the conditions specified in the NPDES permit. Table 4.1 has also been revised.

The staff assumes that "additional destruction of habitat" refers to wildlife habitat. This was discussed in Section 4.3.1 of Appendix A.

10.4.3.2 Hydrological Alterations and Plant Water Supply

No comments.

10.4.3.3 Industrial Chemical Wastes (EPA 8/17/79:B-17; PP&L 9/4/79:B-42; PDER 8/20/79:B-50)

The increase in chloride ion is due primarily to evaporative concentration of the ambient chloride content, but the chlorine added as a biocide also contributes significantly. The applicant has demonstrated to the staff's satisfaction that the proposed chlorine usage does not exceed the quantity required to maintain an adequate biocidal concentration (Response to Staff Question CHE-1 in ER-OL, Rev. 1, 1/79). Even so, the estimated chloride concentrations at the edge of the mixing zone (Table 4.3) do not exceed the proposed criteria.

The applicant states that inhibitors containing chromium will be used in closed cooling loops. The text (Section 4.3.3.3) has been amended accordingly.

The frequency of discharge, if any, from these loops has not been specified by the applicant. However, review of the applicant's NPDES permit application indicates that none of the waste streams from the plant will contain chromium. This is consistent with the recently proposed EPA Effluent Limitations Guidelines for the Steam Electric Power Generating Point Source Category, which would prohibit discharge of power plant waste streams containing chromium.

The comment on sulfate concentration was addressed in Section 10.3.2.4.

10.4.3.4 EPA Effluent Guidelines and Limitations (EPA 8/17/79:B-17; DOI 9/10/79:B-7, EDC 9/26/79:B-14)

Section 4.3.4 has been revised to reflect the comments made.

An entrainment study will be conducted as part of the applicant's NPDES requirements.[1] The FES text has been modified to reflect this new information.

10.4.3.5 Effects on Water Users through Changes in Water Quality

No comments.

10.4.3.6 Sanitary Wastes (EPA 8/17/79:B-17)

The treated sanitary effluent is discharged to the river at a separate outfall (see FES Fig. 2.3). The treatment plant uses the activated sludge, extended aeration process. There are three independent aeration tanks and clarifiers, each designed for 15,000 gal/day. During construction, all three units were used, but the applicant expects to use only two units during operation, with the third as a standby for peak employment periods such as maintenance or refueling. The modular design should permit the effective handling of reduced loads without serious underloading.

10.4.4 Environmental Impacts

10.4.4.1 Terrestrial Environment (DA-FS:B-4; DA-SCS:B-4; DOI 9/10/79:B-7; EDC 9/26/79:B-14; W.L. Prelesnik:B-55)

Commitments by the applicant include a stipulation that "any chemicals used to control vegetation will be approved by state and federal authorities and applied as directed by said authorities" (ER-CP, Amendment 4, p. 5.5-4 and Amendment 5, p. 5.5-4). This commitment was a consideration in the staff's assessment, as indicated on page C-6, Appendix C of this Statement. Recent information indicates the "applicants presently anticipate using primarily Dicambra and Fosamine."[3] Ammonium sulfamate may also be used in watershed areas to a limited extent.

The staff differentiates between construction and operation impacts; the latter being the principal focus of this Statement. The staff does not foresee instances in which routine operation of the station and transmission facilities will result in appreciable impacts on additional important farmlands.

The environmental impacts of construction and use of the Pond Hill Reservoir are discussed in Appendix A; impacts related to the operation of the cooling towers are addressed in Section 4.4.3. Impacts on terrestrial wildlife habitat and aquatic organisms resulting from the proposed development and operation of the Pond Hill Reservoir are discussed in Section A.4.3.1.

The staff is not aware of any instance in which the planned operation of SSES will result in a temporary loss of habitat that "would kill all fish and wildlife currently living near the site." The staff does not foresee how operational impacts on aquatic communities would result in killing <u>all</u> local wildlife.

The staff offers the following observations. As indicated in Section 4.4.1.1, the anticipated operational noise levels referred to are estimates based on calculations and various assumptions. Thus, the extent to which operational noise may warrant mitigation is not clear at this time. The staff also wishes to point out that the applicant will be required to monitor local noise levels following initial operation of the station (see Section 5.3.5). Comparisons between preconstruction surveys and operational monitoring data will enable the estimation of increased noise levels attributable to station operation. If need for mitigation is indicated, the operational monitoring data will provide a basis for selecting between alternative methods, structures, and/or equipment to be used in reducing noise emissions from the station.

10.4.4.2 Aquatic Environment (EPA 8/17/79:B-17; PP&L 9/4/79:B-42; PDER 8/20/79:B-50; SRBC 8/30/79:B-68; EDC 9/26/79:B-14)

The staff agrees that the practicability of reintroducing shad to the Susquehanna River is questionable; however, the staff is also aware that various state and regional agencies are considering such a possibility. Therefore, the discussion is warranted.

With respect to the adult shad, the adults generally remain in the main channel of the river during their upstream migration. Operation of the existing intake would have a potential impact on those adults using the intake pool for resting. The staff feels that the greatest impact to migrating shad would be during the fall when young-of-the-year are using the pools and shallower portions of the river during the downstream migration.

The entrainment study to be conducted as part of the applicant's NPDES permit requirements will indicate what, if any, mitigative measures are necessary. The EPA has the authority to require future studies if conditions warrant them. Section 5.3.4 has also been updated to reflect this information.

The staff still believes that "the intake design at SSES as currently sited and designed will adversely affect the aquatic community within the immediate vicinity of the wing walls and associated riprap" (DES p. 4-9). Also, the staff stands by its statement relative to embayment-type intakes having a greater potential for "attracting" fish than other intakes. At the time the DES was written, the Pennsylvania Department of Environmental Resources had not accepted or rejected the intake design at SSES. With the acceptance of the applicant's impingement/entrainment study,[1] the PDER rules the intake design as environmentally acceptable. The entrainment study will indicate if mitigative measures are required to be in compliance with Section 316(b) of the Clean Water Act. The staff does not have the authority to require impingement/entrainment studies.

The staff agrees with the comment that the intake site does not necessarily occupy a particularly unique area of the river. The first paragraph of Section 4.4.2.1 of the FES has been modified to reflect this opinion. The staff feels the term "pool" is properly defined and used in the FES.

Page 4-10 has been modified to reflect new information on the impingement/entrainment study; however, the staff is still not convinced that impingement impacts can be accurately predicted based on results at another power plant.

The staff still does not believe that monitoring of the benthic community in the vicinity of the discharge is necessary. As stated on page 4-10 of the DES, "the vicinity of the discharge is not particularly unique to the river and any loss of habitat should not have a significant impact on the various populations."

The applicant will be operating the Pond Hill Reservoir to compensate for water consumed during periods of low flows; therefore, the staff concludes that impacts due to operation of SSES during low-flow periods will not be significant.

10.4.4.3 Atmospheric Effects of Cooling-Tower Operation (PDER 8/20/79:B-50; M.M. Molesevich: B-39)

The use of SSES in its planned baseload mode will probably result in the conversion of one or more oil- or coal-fired power plants to load-following or peaking duty. Since the operation of SSES will result in essentially zero emissions of particulates, SO_2, NO_x and other pollutants characteristic of fossil units, the staff expects an improvement in the region's air quality as a result of the use of SSES.

Test plants observed in the Chalk Point studies referenced in Section 4.4.1.1 include corn (*Zea mays*), soybeans (*Glycine max*), tobacco (*Nicotiana tobaccum*), dogwood (*Cornus florida*), black locust (*Robinia pseudo-acacia*), Virginia pine (*Pinus virginiana*), and sassafras (*Sassafras albidum*). Additional test species observed in other related studies include tulip poplar (*Liriodendron tulipifera*); privet (*Ligustrum* spp.); Amur and red maples (*Acer ginnala, A. rubrum*); and Scotch, white, and lobbolly pines (*Pinus sylvestria, P. strobus, P. taeda*).[4] Distributions of these species are not limited to Maryland nor to coastal areas affected by salt depositions of oceanic origin. In view of the extensive occurrence of these species in Pennsylvania, the staff believes that the Chalk Point vegetation studies are relevant to the future operation of the Susquehanna station. Soil investigations are also considered pertinent;[5] the staff is uncertain as to the intended meaning of statements implying that some soils are tolerant of or "accustomed to" salt depositions.

As reported in 1978, investigations (1975-1977) of test plant species and local soils at Chalk Point failed to reveal effects that could be attributed to cooling-tower operation. Conclusions presented by investigators included various caveats such as the need for future studies to document long-term effects. However, simulated salt-drift studies are indicative of levels of salt depositions being investigated. For example, "applications of salt up to 3.6 kg/ha per week failed to induce statistically significant reductions in yields for corn and soybeans" (Section 4, Reference 7). "Of the agricultural species investigated thus far," corn exhibits the highest sensitivity to salt drift.[5] In other simulated drift studies at Chalk Point involving an estimated salt deposition rate of 7.46 kg/ha per month, the reporting investigators concluded that "some injury may occur to a sensitive species such as dogwood under certain cooling tower operating conditions."[6] The investigators also cautioned against assuming that the reported deposition rate was "a general indicator of any salt drift injury." However, the staff believes a general comparison is warranted since the reported deposition rate (7.4 kg/ha per month) is almost nine times greater than the maximum deposition rate (880 g/ha per month) estimated to occur during SSES operation.

Postoperational surveys of vegetation in the vicinity of the Three Mile Island Nuclear Station are also of interest since the Susquehanna River is the source of that station's cooling water. Reported results of 1975 plant pathology surveys and quantitative vegetation studies did not indicate any effects that could be attributed to salt drift from station cooling towers.[7] Nor were any effects detected in 1974.

The staff expects no adverse effects from the mineral drift from the plant's cooling towers due to the low salt deposition rates, the nature of the material deposited (primarily calcium sulfate vs sodium chloride typical of coastal areas), and the natural rainfall that is expected to dilute and wash away the salt deposits. This conclusion is supported by studies made at freshwater cooling towers (Refs. 22-25 and 29 of Chapter 4; also a recent study for USEPA: G. A. Englesson and M.C. Hu, Nonwater Quality Impacts of Closed-Cycle Cooling Systems and the Interaction of Stack Gas and Cooling Tower Plumes, EPA-600/7-79-090, Industrial Environmental Research Laboratory, Research Triangle Park, N.C., 1979, 214 pp.).

Observations of plume from natural-draft cooling towers, including several in Pennsylvania and Kentucky, show that the plumes do not reach to the ground and cause ground fog and icing because of their height and plume rise due to buoyancy and momentum. This is discussed in the DES and the references cited above.

10.4.5 Radiological Impacts from Routine Operation (SA 8/17/79:B-62; W.A. Lochstet:B-32; L.E. Watson:B-75; W.L. Prelesnik:B-55; EDC 8/27/79:B-13; EPA 8/17/79:B-17; F.L. Shelly: B-57)

Risks from Low-Level Radiation

The NRC staff is not aware of any studies that have established that there is no safe level of radiation. However, as a conservative and prudent assumption, it has been assumed that no amount of radiation is safe. For more than four decades, the effect of a radiation on humans and animals has been thoroughly studied. Numerous major biological research programs have been well documented and may be found in the open literature. The United States has been the forerunner in radiation research, but many other countries also have pursued similar programs and have contributed substantially to current 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 sources 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), hereditary diseases, abortions, and congenital anomalies. These effects are identical to those that 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 human-made sources other than the nuclear industry, and 4) in exposures to other (nonnuclear) carcinogens, that 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 who evaluate radiological information and provide recommendations. In the United States, the principal expertise in radiological matters lies with the National Council on Radiological Protection and Measurements and the National Academy of Science/National Research Council (NAS/NRC). Federal agencies also retain expertise in the radiologic disciplines in order to fulfill their responsibilities; these agencies, however, rely heavily on recommendations of the previously mentioned advisory organizations. Other countries have national advisory organizations similar to those of the United States. There are also cooperative international organizations that 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 the relationship between low-level radiation and biological effects, 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 EPA, the Occupational Safety and Health Administration (OSHA), and NRC 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.

The basis for the risk estimators on p. 4-27 of NUREG-0564 is more fully described in Chapter 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 prevails 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.

Several of the general statements in W. L. Prelesnik's comment reflect some misunderstandings regarding NRC policy and positions. Therefore, the staff has attempted to provide more detail on some of these concerns.

First, it is stated that "any low-level radiation releases are significant as has been admitted and proven, even by the old AEC and the NRC's own studies. There is no safe level of radiation exposure." The staff is not aware of any studies that have established that there is no safe level of radiation. However, as a conservative and prudent assumption, the staff assumes that no amount of radiation is safe (see Section 4.5.5 of the FES for additional information).

Secondly, it is stated that "The current standards were initially set in order to justify atomic bomb testing. Those standards were kept in order to justify nuclear power plants because the nuclear industry and our government recognizes that no plant operates without 'normal' releases of radiation." General information about radiation standards is provided in the NRC's "Radiation Standards Fact Sheet" (a copy has been sent to W. L. Prelesnik in a letter dated 18 October 1979, however, it is too lengthy to repeat here). As noted in this fact sheet and in Section 10.4.5, the radiation protection standards were based on the best scientific judgment available in the world.

In addition, see Section 4.5.5 of the FES and responses to comments in Section 10.6.2.

Impacts from the Fuel Cycle

Dr. Lochstet's basic contention is that "the health consequences of radon-222 emissions from the uranium fuel cycle are improperly evaluated" in the Susquehanna Draft Environmental Statement (DES, NUREG-0564). The basis for Lochstet's contention is that the staff has arbitrarily evaluated the health impacts of radon-222 releases from the wastes generated in the fuel cycle for 1000 years or less, rather than for "the entire toxic life of the wastes." Lochstet then estimates that radon-222 emissions from the wastes from each annual reactor fuel requirement will cause about 600,000 to 12 million deaths over a period of more than 1 billion years.

The major difference between the staff's estimated number of health effects from radon-222 emissions and Lochstet's estimated values is the issue of the time period over which dose commitments and health effects from long-lived radioactive effluents should be evaluated. Lochstet has integrated dose commitments and health effects over what amounts to an infinite time inverval, whereas the staff has integrated dose commitments from radon-222 releases over a 100-year period, a 500-year period, and a 1000-year period.

The staff has not estimated health effects from radon-222 emissions beyond 1000 years for the following reasons. Predictions over time periods greater than 100 years are subject to great uncertainties. These uncertainties result from, but are not limited to, political and social considerations, population size, health characteristics, and, for time periods on the order of thousands of years, geologic and climatologic effects. In contrast to Lochstet's conclusion, some authors[8] estimate that the long-term (thousands of years) impacts from the uranium used in reactors will be less than the long-term impacts from an equivalent amount of uranium left undisturbed in the ground. Consequently, the staff has limited its period of consideration to 1,000 years or less for decision-making and impact-calculational purposes.

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

The $1,000 per person-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 80 km 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 absurdity 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 per reference reactor year.

As a conservative estimate, it was assumed that a 5 percent simple interest rate would demonstrate the meaninglessness of such calculations. Conservative staff estimates indicate that only a few health effects might occur within 1000 years. It is obvious that essentially all of Dr. Kepford's "health effects" would occur over periods of time that 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 nearly $16 million-trillion after only 1000 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, see also Section 10.4.5.3.

The contention that "the NRC itself has been unable to disagree with Dr. 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 staff has refuted such claims in several hearings as meaningless for many reasons. Some of the more important reasons were discussed earlier.

It is the responsibility of NRC to protect the health and safety of the public as they relate to nuclear plant operations. NRC requires that the design and operations of nuclear facilities consider and protect the health and safety of the public. NRC reviews each nuclear facility and determines if it will endanger the health and safety of the public. NRC will only permit operation of a facility if it finds the facility can be safely operated.

Significance of Radiological Impact

W.L. Prelesnik's comments asked the following questions (responses follow each question):

Question 1: What is your definition of significant, and how was it arrived at?

Response: NRC currently evaluates the radiological impact to three individuals: 1) a hypothetical maximally exposed individual, 2) an average individual within 80 km of the site, and 3) an average individual in the United States. The risk to the first two types of individuals from radioactive effluents from one year of reactor operations is quantified in Table 4.17 of the FES.

For example, the risk of premature death to the hypothetical maximum exposed individual from gaseous effluents from one year of reactor operations is less than one chance in a million. (The risk from liquid and gaseous effluents has not been added because it is very unlikely that any real individual would be exposed at the maximum level from both sources.) This risk is much less than similarly calculated risks from many other types of radiation exposure (e.g., medical radiation exposure, natural background radiation, and air travel.) The risk to the maximum individual is within the range of many other common sources of radiation (e.g., airline travel, natural gas heating, and television viewing.) The risk to the average individual within 80 km of the site, and the risk to the average individual in the United States from one year of reactor operations is less than 1/100 of the risk to the maximum hypothetical individual. Since the risk from radioactive effluents from nuclear power plants is so low compared with many other types of risk (radiation related or otherwise) and since the radiation-related risks are based on conservative assumptions, the staff considers the risk to real individuals in the vicinity of nuclear power stations from normal operations to be insignificant. See Section 4.5.5 of the FES for additional information comparing the risk from annual operation of the reactor(s) with the risk from other sources of radiation, and the risk from the current incidence of cancer fatalities and genetic abnormalities.

Question 2: On what basis do you calculate the "anticipated" occurrences? The Rasmussen Report has already been proven to be incorrect.

Response: The anticipated occurrences to which the comments refer are based on operational occurrences and not on accident considerations. The Rasmussen Report is not used to calculate the impacts from operational occurrences. Furthermore, the Rasmussen report has not been proven to be incorrect, but as a result of the Lewis Committee report, it has been suggested that the numerical results may have a wider range of uncertainty than as suggested by the Rasmussen Report.

Question 3: How do you define "normal"? Normal operation levels of radiation emission are quite different and separate from normal background levels of radiation already existing in the environment. Also, because of bomb testing and power plants, the "normal" levels of background radiation have increased over the past 30 years.

Response: NRC regulations (10 CFR Part 50) require the light-water-cooled nuclear power stations be designed and operated in a manner that will limit radiation exposures to any individual in the general population to a small fraction of the general radiation standards during normal operation. An extensive rule-making proceeding (Docket No. RM-2) was conducted over a several-year period (December 1970 to May 1975) to quantify the numerical guides for keeping levels of radioactive material in the effluents of light-water-cooled nuclear power reactors as low as is reasonably achievable during normal operating conditions (Appendix I of 10 CFR Part 50). The normal operating conditions for these reactors were characterized by NRC during the course of the rule-making, based primarily upon data obtained during operations. Considerable more data have been obtained since 1975. The procedures used by the staff to characterize the radioactive material in the effluents are given in Regulatory Guide 1.112, "Calculation of Releases of Radioactive Material in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors." This guide is used in conjunction with information in NUREG-0016 and NUREG-0017 for boiling-water reactors and pressurized-water reactors, respectively (copies may be obtained from NRC). A narrative explanation of the population dose for the entire uranium fuel cycle for light water reactors was published on 4 March 1981 in the Federal Register (46 FR 15154-15175).

The estimated U.S. population dose from radioactive effluents from one year's operation of Susquehanna, Units 1 and 2, is about 50 person-rem (Table 4.10). This estimate is based upon a 15-year buildup of activity in sediment and soil (i.e., the nominal mid-point of the reactor's life). This dose is a very small fraction (less than 0.0002%) of the annual U.S. population dose from natural background radiation (i.e., 26,800,000 person-rem).

Question 4: What individuals, by name, set these "normal" levels?

Response: The "normal" levels of radiation from radioactive releases from nuclear reactors referred to are contained in Title 10 Code of Federal Regulations, Part 50, Appendix I (10 CFR 50, App. I). The annual dose design objectives set in 10 CFR 50, App. I, were set in a rule-making hearing by NRC. Although many people participated in the rule-making hearing, Commissioners Anders, Rowden, Mason, Gilinsky, and Kennedy made the final decision to adopt the limits set in 10 CFR 50, App. I. A copy of the Commission opinion in the matter of 10 CFR 50, App. I, has been sent to W. L. Prelesnik.

Question 5: How much "normal" radiation will be expected to be released in Berwick?

Response: The calculated releases of radioactive materials in liquid effluents are provided in Table 4.11 of the FES, and the calculated releases of radioactive materials in gaseous effluents are provided in Table 4.4. These two calculated source terms represent annual releases per reactor from normal operation, including anticipated operational occurrences, when averaged over the 30-year operating life of the plant. These source terms were used to calculate exposures due to releases (Table 4.8 of the FES). Dose estimates and lifetime risk estimates from these releases are given in Section 4.5 of the FES.

Question 6: What are the NRC's recorded, documented levels of "normal" radiation releases from the operating plants in the United States?

Response: The quantity of radioactive materials released from nuclear power plants in the year 1977 is contained in a document entitled, "Radioactive Materials Released from Nuclear Power Plants - Annual Report 1977," (NUREG-0521). NUREG-0521 contains a nuclide-by-nuclide summary of the radioactive effluents released from operating reactors in the year 1977, as well as a categorical summary (i.e., noble gases, I-131 and particulates, tritium, mixed fission and activation products) for earlier years. Excerpts from NUREG-0521 are too lengthy to repeat here, but have been sent to W. L. Prelesnik.

Population dose commitments for the year 1975 for about 50 reactors are given in a document entitled, "Population Dose Commitments Due to Radioactive Releases from Nuclear Power Plant Sites in 1975"; D. A. Baker, J. K. Soldat, and E. C. Watson; Battelle Pacific Northwest Laboratories; PNL-2439; pp. 3-4; October 1977. Population dose commitments were calculated for the population between 2 and 80 km of each reactor site. The average individual dose commitment to that population (about 0.02 mrem) represents about a 0.02% annual increase over background radiation. The dose to the hypothetical maximum individual would be higher.

10.4.5.1 Exposure Pathways

No comments.

10.4.5.2 Dose Commitments (PDER 8/20/79:B-50; EPA 8/17/79:B-17)

The Safety Evaluation Report was published in April 1981.

Modifications and design changes to the radwaste treatment systems since the FES/CP were considered in calculating the source terms. The staff's detailed evaluation of these systems and the capability of these systems to meet the requirements of Appendix I will be presented in Chapter II of the Safety Evaluation Report. However, for the FES, the quantities of radioactive materials in effluents used to assess radiological impacts are given in Tables 4.4 and 4.11.

The calculated value for the direct radiation dose (20 mrem/yr at a typical site boundary 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 operation. If the survey indicates that the limits of 40 CFR 190 could be exceeded, steps will be taken to reduce the dose.

Annual doses per site from liquid effluents were given in Table 4.9. The estimated dose to the total body or any organ of the hypothetical maximum individual from all pathways was about 1.0 mrem/yr for the site. 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" (Sec. 141.16). The annual doses from liquid effluents from Susquehanna, Units 1 and 2, are below the above limits.

10.4.5.3 Radiological Impacts on Humans (M.L. Hershey:B-27; EPA 8/17/79:B-17; T.R. Duck:B-11; PP&L 9/4/79:B-42; SA 6/10/80:B-64)

A formal program for the management of low-level radioactive wastes disposed of in commercial burial grounds is provided in "The NRC Low-Level Radioactive Waste Management Program," NUREG-0240, September 1977, available at the Public Document Room, NRC, 1717 H Street NW, Washington, DC, 20555. The program recommended new regulations and requirements for the Disposal of Low-Level Radioactive Waste and Low-Activity Bulk Solid Waste (Draft Regulation 10 CFR Part 61); these are presently being developed.

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 United States sufficiently represent the population exposure due to operation of this plant.

Environmental impacts from uranium mining and milling are addressed in Section 4.5.6, "Uranium Fuel Cycle Impacts," of NUREG-0564.

The FES includes credit for the leakoff collection system for the turbine building releases. The off-gas system releases were based on ambient operation conditions of 77°F (dew point 45°F) for the adsorption unit in reasonable agreement with the applicant's proposal of 60 to 65°F (dew point 40°F).

Table 4.12 provides estimates of transit time for effluents from various locations. As indicated in this table, it is assumed that sport fishermen may use the area near the plant discharge area. This is considered the "nearest sport fishing location" for purposes of an upper limit estimate.

Radiological Models

The staff has reviewed a report known formally as the "Radioecological Assessment of the Wyhl Nuclear Power Plant," and informally as the "Heidelberg Report." The report was written by a private group of individuals at the University of Heidelberg, West Germany, concerned with energy and environmental issues. The authors of this report are affiliated with a group called Institute for Energy and Environmental Research (IFEU), and have not been authorized to use the name of the University of Heidelberg. Hence, their report is now referred to as the IFEU Report, although it has been referred to as the "Heidelberg Report" in the past. The IFEU Report presents an assessment of the environmental radiological impact of a proposed pressurized-water reactor to be built near Wyhl, West Germany.

The assessment is based largely on mathematical models used to calculate doses to humans in the area surrounding a reactor site and to describe the movement of radioactive materials in the environment. These are the same mathematical models used by NRC to calculate doses to ensure that any radiation exposure resulting from reactor operations is far below national and international recommended "safe" levels.

The staff reviewed the IFEU Report because the report implied that NRC may be substantially underestimating doses to individuals living near nuclear power plants by using incorrect values for parameters in mathematical models. Although the IFEU Report assessment is based largely on environmental models described in four NRC Regulatory Guides, the staff's review of the report indicates that the IFEU authors used values for some model parameters that are too high.

As a result, the IFEU Report estimated doses to the public by some pathways that are up to 10,000 times higher than the doses calculated using the NRC's values for those parameters.

The staff's review concluded that the IFEU Report does not provide any substantial evidence that NRC significantly underestimates doses. This conclusion is based on: 1) measured effluent releases at reactors operating in the United States, which are much less than those used in the IFEU Report; 2) measured environmental concentrations near reactors operating in the United States, which are much lower than those calcualted in the IFEU Report; and 3) a detailed review of the literature regarding critical parameters employed in the models in question, which does not support the values used in the IFEU Report.

The results of the staff review have been published in draft form for public comment, both as a main report for the technical community (NUREG-0668) and as a summary report for general public information. The final report is expected in 1981.

In response to the contention that the "old AEC ... deliberately rigged the experiments," while NRC acknowledges that some of the AEC experiments done for some radionuclides in the 1950s could be done better today in light of advancements in technology, the staff has never characterized these studies as fraudulent and knows of no evidence to support such a claim.

The comment also states that the "Heidelberg Report is the first time that independent scientists have examined the NRC's safety assurances about routine emissions from operating plants," thus implying that the validity of NRC radionuclide transport and dose models have not been reviewed and assessed by scientists outside NRC. This is absolutely incorrect. The Environmental Protection Agency, Argonne National Laboratory, Oak Ridge National Laboratory, Battelle Northwest Laboratory, privately owned technical consulting companies, and numerous national and international scientific organizations all have radionuclide transport and dose models based on field measurements that yield results consistent with the NRC calculations. In September 1977, a workshop of "The Evaluation of Models Used for the Environmental Assessment of Radionuclide Releases" was held in Gatlinburg, TN, and the results were published as CONF-770901. Participants in this workshop were selected to ensure an appropriate combination of individuals representing a spectrum of scientific and administrative expertise. The working group on terrestrial food-chain transport at this meeting, whose members were predominantly from organizations other than NRC, concluded that transport models, as given in NRC Regulatory Guide 1.109, are very adequate for demonstrating compliance with NRC's regulations (as given in Appendix I of 10 CFR Part 50).

10.4.5.4 Radiological Impacts on Biota Other Than Humans

No comments.

10.4.5.5 The Uranium Fuel Cycle (Sierra:B-61; EPA 8/17/79:B-17; SA 8/17/79:B-62; F. Thompson: B-74; M.J. Huntington:B-27; S. Laughland:B-32; PDER 8/20/79:B-50)

Section 4.5.5,"The Uranium Fuel Cycle," (now Sec. 4.5.6) has been revised to reflect the Commission's final rule published to the Federal Register on 2 August 1979 (44 FR 45362). An explanatory narrative of the significance of release in Table 4-14 was also published in the Federal Register (46 FR 15154-15175, 4 March 1981).

Since there will be no radioactive waste disposal at the Susquehanna Steam Electric Station, waste disposal techniques are not part of the facility FES but will be considered in the formulation of regulations and the licensing of disposal facilities.

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 EPA in regard to implementing the Uranium Fuel Cycle Standard (40 CFR 190). The doses calculated by using these models are thought to be conservative (i.e., the models probably overestimate actual doses). In addition, new information since the publication of the DES concerning the receptor location at 0.7 miles NW has resulted in a change in the maximum receptor location for iodines and particulates from 0.7 miles NW to 2.2 miles E.

Spent Fuel Storage

The storage of spent fuel is addressed in an NRC document entitled "Final Generic Environmental 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.[8]

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 of 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.

The technology of water pool storage is well developed; radioactivity levels are routinely maintained at about 5×10^{-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.

10.4.6 Socioeconomic Impacts (EDC 9/26/79:B-14; S. Shortz:B-60)

The staff is unaware of any specific land use changes that have not been evaluated either in connection with the plant or reservoir. Unless the context of land use change is made more specific, monitoring effort would be an exercise without an objective.

10.4.6.1 Demography

No comments.

10.4.6.2 Settlement Pattern

No comments.

10.4.6.3 Social Organization

No comments.

10.4.6.4 Social Services (DOT 8/9/79:B-10)

The transportation impacts have been adequately addressed to the satisfaction of DOT, with the exception of sufficient coordination. It is the staff's view that the applicant and DOT should work together to consider adequate design of the access road to the reservoir as well as attendant impacts. NRC will not preempt DOT expertise in matters of design and traffic coordination.

The comment attributes many of the changes in the past years to construction of SSES. Many of these changes are due to other projects, including past highway construction, and to urbanization trends independent of SSES. The record shows that the blasting during construction did adversely affect residents, but this should not be considered in a decision as to whether or not the plant should be operated. The comment correctly states that the land used by SSES is an irrevocable loss, but the opinion that its former use was the best use cannot be demonstrated on economic grounds. The EIS mentions the effect of hurricane Agnes as part of the recent history and is not meant to characterize the local area surrounding the plant.

10.4.6.5 Political Organization (EDC 9/26/79:B-14)

The distribution of taxes generated by SSES is primarily a state and local government responsibility. For a discussion of taxes, see Section 4.6.6.2.

10.4.6.6 Economic Impacts (EDC 9/26/79:B-14)

The comment on anticipated noise levels was addressed in Section 10.4.4.

PP&L has undertaken a program of hiring local workers as discussed in Section 4.6.6.1.

10.4.6.7 Summary and Conclusions

No comments.

10.4.7 <u>Impacts to Cultural Resources</u> (DOI 5/29/80:B-9; Sierra:B-61; EDC 9/26/79:B-14; SA 8/17/79:B-62 and 6/10/80:B-64; PDER 8/20/79:B-50)

In the June 1973 FES-CP, the staff reviewed the effects of construction and aspects of operation on the total plant site plus the transmission line corridors. In that document, the staff identified those sites listed in the National Register that were within 32 km of the facility. The Advisory Council on Historic Preservation found the staff's statement procedurally adequate and suggested contact with the State Liaison Officer for Historic Preservation. The State Liaison Officer for Historic Preservation indicated that the project would not affect a known archeological or historical site or historical structure, and that it appeared to be consistent with the plans and objectives of the Pennsylvania Historical and Museum Commission.

In 1975, in Appendix B to the DES-OL (June 1979), the staff reviewed the applicants' proposed alternate transmission line corridors and determined that neither of the lines under review crossed or passed in the vicinity of any registered historic site. In the DES-OL, the staff requested that a survey be done of the recreation area. The staff later requested a survey of the Pond Hill Reservoir. These surveys resulted in the identification of three significant sites and one potentially significant site in the recreation area, which the staff, after consultation with the Pennsylvania Historic Preservation Officer, will submit to the Keeper of the National Register for a determination of eligibility.

10.5 ENVIRONMENTAL MONITORING

10.5.1 <u>Résumé</u>

No comments.

10.5.2 <u>Preoperational Monitoring Program</u>

10.5.2.1 Onsite Meteorological Program

No comments.

10.5.2.2 Water Quality Monitoring

No comments.

10.5.2.3 Groundwater Monitoring (DOI 9/10/79:B-7)

The applicant states that "In general, groundwater in the Paleozoic rock formations of the Appalachian Highlands flows from the topographically higher areas (recharge areas) to the valleys. This groundwater, it is believed, discharges to springs and to the streams and rivers of the region, except at flood stage" (ER-OL, p. 2.4-12). 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.

10.5.2.4 Aquatic Biology

No comments.

10.5.2.5 Terrestrial Monitoring Program

No comments.

10.5.2.6 Radiological Monitoring (PP&L 9/4/79:B-42)

The revisions discussed in PP&L's comment 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.

10.5.3 Operational Monitoring (SRBC 8/30/79:B-68; L.E. Watson:B-75; EDC 9/26/79:B-14)

As discussed in Section A.3.2.2, consumptive water use will be determined by measuring the difference in volume between the intake flows for SSES and blowdown to the river.

Results of radiological monitoring programs at nuclear power reactors are routinely made available to the public. For an example of radiological effluent monitoring see an NRC document entitled "Radioactive Materials Released from Nuclear Power Plants, Annual Report 1977" (NUREG-0521). Individual licensee reports on radiological environmental monitoring are available in the NRC Public Document Room, 1717 H Street NW, Washington, DC 20555, and in local document rooms located near each licensed facility.

NRC has factored the impact of the Three Mile Island accident into the review of the Susquehanna application. Specifically, the Environmental Statement has been supplemented to evaluate the site-specific environmental impacts attributable to plant-specific accident sequences that lead to releases of radiation and/or radioactive materials, including sequences that can result in inadequate cooling of reactor fuel and melting of the reactor core (see Sec. 6).

10.5.3.1 Onsite Meteorological Program

No comments.

10.5.3.2 Water Quality Monitoring

No comments.

10.5.3.3 Groundwater Monitoring

No comments.

10.5.3.4 Aquatic Biological Monitoring

No comments.

10.5.3.5 Terrestrial Monitoring Program

No comments.

10.5.3.6 Radiological Monitoring (M.M. Molesevich:B-39)

Radiological environmental monitoring is not the only type of radiological monitoring required at the Susquehanna Station. NRC requires two types of radiological monitoring at nuclear power reactors to ensure that radioactive effluents are within acceptable limits: 1) radiological effluent monitoring and 2) radiological environmental monitoring. Radiological effluent monitors are required to monitor and control, as applicable, the releases of radioactive materials in liquid and gaseous effluents during actual or potential releases. The radiological effluent monitors operate continuously. In addition, NRC requires that the licensee operator of a nuclear power reactor conduct radiological environmental monitoring to confirm that measured releases of radioactivity (i.e., radiological effluent monitoring) from the plant do not result in unanticipated buildups in the environment.

The requirements for an acceptable radiological environmental monitoring program for nuclear power reactors are contained in the NRC's "Branch Technical Position" (Revision 1, Nov. 1979; copies are available from NRC's Radiological Assessment Branch). The Branch Technical Position was developed by experts in the field of radiological environmental monitoring. The staff does not require more frequent sample collections for several reasons. First, based upon the staffs estimate of doses to maximum individuals (e.g., see Table 4.8), the staff does not anticipate a significant buildup of radioactivity in the environment due to normal operation of Susquehanna, Units 1 and 2. Second, hundreds of reactor-years of environmental monitoring experienced at nuclear power plants have shown that the concentrations of radioactive materials in environmental samples are at or very near background levels due to natural sources and previous atmospheric weapons tests. In addition, while it is true that the most frequent collection of environmental samples is on a weekly basis, this does not mean that environmental monitors are required to be in place continuously in order to obtain an integrated dose. The Susquehanna Station radiological monitoring program meets the basic requirements of the NRC's "Branch Technical Position" in regards to collection frequency.

The radiological environmental monitoring program is not described more fully in the final Environmental Impact Statement because the impacts of the monitoring program are negligible. However, individual licensee monitoring reports are available in the NRC Public Document Room, 1717 H Street NW, Washington, DC 20555, and in local document rooms located near each licensed facility.

10.6 ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

10.6.1 Résumé

No comments.

10.6.2 Postulated Accidents Involving Radioactive Materials (D. Oberst:B-41; H. C. Jeppsen: B-31; LUZ:B-38; L. Moses:B-41; Sierra:B-61; EPA 8/17/79:B-17; SA 8/17/79:B-62 and 6/10/80:B-64; F.L. Shelly:B-57; S. Shortz:B-60; M.J. Huntington:B-27; PP&L 9/4/79:B-42; PDER 8/20/79:B-50; T.R. Duck:B-11; L.E. Watson:B-75; DOI 9/10/79:B-7; EDC 9/26/79:B-14; SEDA:B-56; M.M. Molesevich:B-39)

NRC has factored the impact of the Three Mile Island accident into the review of the Susquehanna application. Specifically, the Environmental Statement has been supplemented to evaluate the site-specific environmental impacts attributable to plant-specific accident sequences that lead to releases of radiation and/or radioactive materials, including sequences that can result in inadequate cooling of reactor fuel and melting of the reactor core (see Sec. 6).

Emergency Response Plans are required by the Atomic Energy Act. Under this act, the NRC and the Federal Emergency Management Agency (FEMA) are responsible for reviewing evacuation plans. State and local evacuation plans will be generated and reviewed by the NRC and the Federal Emergency Management Agency (FEMA) before an operating license is issued.

The 28 March 1979 accident at TMI-2 resulted in greater amounts of radioactive water and waste than could be processed by the installed radwaste treatment systems in a short time. The solution to the problem was to contain these wastes so as to permit time for radioactive decay and for installing additional treatment equipment. The new equipment has been installed and cleanup is underway as planned.

For a discussion of the responsibility of NRC to protect the health and safety of the public as they relate to nuclear plants, see Section 10.4.5.

NRC has included an evaluation of Class 9 accidents in the FES. The radiation monitors described in Table 5.1 are for preoperational purposes only. The Technical Specifications will require additional monitors for operation.

State and local evacuation plans will be reviewed by the Federal Emergency Management Agency before an operating license is issued.

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.

NRC has studied postulated accidents associated with the storage of spent fuel at the Susquehanna site. The spent fuel storage area was evaluated by postulating the effects of floods, missiles, pipe breaks, and seismic events. The results of the NRC evaluation are documented in NUREG 0776, Section 9.1.2.

NRC has a full-time resident inspector at the Susquehanna site. As a result, the reporting of any accidents by PP&L will be supplemented with an independent NRC report and assessment.

10.6.3 Transportation Accidents

No comments.

10.7 NEED FOR PLANT

10.7.1 Résumé (L. Moses:B-41; PP&L 9/4/79:B-42)

Section 7.1 has been modified to incorporate the latest information on startup dates.

10.7.2 Applicant's Service Area and Regional Relationships

No comments.

10.7.3 Benefits of Operating the Plant (SA 8/17/79:B-62; F. Thompson:B-74; M.J. Huntington: B-27; PP&L 9/4/79:B-42; T.R. Duck:B-11; EDC 9/26/79:B-14; M.M. Molesevich:B-39)

The basis for operating SSES does not depend solely on reserve margin considerations. In the near-term, the economic basis is the lower cost of electricity production. In a few years, the staff expects that reserve margin requirements will no longer be adequate, and that SSES will be needed for peak-load as well as baseload energy. A further consideration is that the reserve margins were calculated as if both units of the Three Mile Island nuclear plant were in operation; the EIS has therefore overstated the actual energy available in the region, at least until decisions on operation of the TMI Units 1 and/or 2 are made and the unit(s) are back on line.

As discussed in the comparison of coal and nuclear fuel costs, the need for SSES in the immediate future depends on lower production costs of SSES compared to other units in the system. The comment points out that SSES could help replace energy loss due to TMI; this factor was not evaluated in the EIS. In the long run, reserve margins will not be adequate without SSES. SSES operation as scheduled and planned makes economic sense because of lower production costs and because of its contribution to meet peak energy needs.

The Price Anderson Act and government subsidies for research of waste disposal technology do represent cost advantages to nuclear energy that are available to the industry as a whole. Removal of these advantages would not make the cost of power from SSES prohibitive as you state. All insurance premiums are now paid by nuclear plant operators. Federally funded research in waste disposal quite likely will be a small part of the cost of waste disposal, which in turn is a small part of the cost of fuel. Waste disposal costs are already included in estimated fuel costs for SSES. Operation of SSES would prove economical even if the Price Anderson Act were repealed and government-sponsored research stopped.

Reasons for operating the plant were discussed and evaluated and do not consist solely of reserve margin considerations. See summary and conclusions (p. iv). Also note responses to similar questions in Coal vs. Nuclear and Benefit-Cost Analysis sections.

Although staff notes that EDC concurs that the plant is needed, reserve margin consideration is only one of several reasons for operating the plant as scheduled.

Anthracite is discussed in response to other comments on the subject (see Sec. 10.8.4).

10.7.3.1 Operation of the PJM Interchange

No comments.

10.7.3.2 Minimization of Production Costs (PP&L 9/4/79:B-42)

The text has been revised to reflect these comments.

10.7.3.3 Diversity of Supply Source

No comments.

10.7.3.4 Reliability of Analysis (M.M. Molesevich:B-39)

As discussed in Section 7.3.4.2 of the FES, a reserve capacity larger than 20% may be desirable for a system with units that are large in relation to the size of the system (as will be the case with SSES in service).

Table 7.4 has been revised to reflect the comments.

10.8 EVALUATION OF THE PROPOSED ACTION

10.8.1 Adverse Effects That Cannot Be Avoided

No comments.

10.8.2 Short-Term Uses and Long-Term Productivity

No comments.

10.8.3 Irreversible and Irretrievable Commitments of Resources

No comments.

10.8.4 Comparison of Nuclear and Coal-Fired Power Plants (H.C. Jeppsen:B-31; DOT 8/9/79: B-10; DA-FS:B-4; Sierra:B-61; SA 8/17/79:B-62 and 6/10/80:B-64; S. Shortz:B-60; M.J. Huntington:B-27; EDC 9/26/79:B-14)

The benefits of revitalizing the anthracite-coal-producing areas is a separate issue and not related to the operation of SSES. Very small amounts of anthracite are used for steam production by the utility industry primarily due to the high price of anthracite coal. The new source performance standards (NSPS) were rewritten to encourage the use of Eastern coal. These standards require removal of at least 70% of the SO_2 in the fluegas if an emission rate of 0.6 lb. of SO_2 per million Btus can be achieved. Ninety percent removal of SO_2 is required if the limit cannot be met.

Although these new rules do encourage the use of Eastern rather than low-sulfur Western coal because some scrubbing is required, there is plenty of Eastern bituminous coal that can meet these requirements. Much of this coal can be obtained in Pennsylvania. It is not likely that anthracite coal can economically compete as steam-market coal. Anthracite coal revitalization depends more on the steel industry; increased demand is also more likely to come from exports rather than domestic uses.

The economic argument for operating SSES rather than a coal plant is based on the lower operating cost of SSES compared to coal-fired plants. The cost of coal is two to three times the cost of comparable nuclear fuel. Nuclear fuel costs have ceased their rapid price escalation, while real coal prices are forecast to increase at 2.2% per year through 1990 and at 1.7% per year to the year 2000; this is over and above the rate of inflation (DRI, Energy Review, Autumn 1980, Lexington, MA).

The long-run differences between nuclear and coal prices are not expected to diminish. Currently negotiated uranium prices are at the level they were in late 1975; i.e., about \$28/lb U_3O_8. Primarily because of the difference in fuel costs, delay of operation of SSES makes no economic sense, even if more energy could be obtained from existing coal-fired plants. Construction of a new coal-fired plant to replace SSES would be economically unwise since SSES has already been constructed.

Comparison of coal vs. nuclear using anthracite coal as a reference case would not improve the economics of burning coal. Since SSES has already been constructed, the use of coal can only be evaluated for use in existing plants. Not only is anthracite more expensive than bituminous at the mine, but boilers and auxiliary equipment would have to be refurbished to use a different coal type. Derating may also be involved.

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 that 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.

Increased use of coal and solar power are expected, but these should not be considered as alternatives to the operation of SSES. Nuclear power may be as safe or safer than coal with respect to release of harmful emissions (Sec. 8.4). Solar power for electrical generation has not been developed to the stage that baseload electrical generation needs can be satisfied even with increased conservation.

The staff does not consider solar energy, biomass, cogeneration, and conservation to be adequate substitutes for amounts of power that will be generated by SSES, nor would the cost of generation from SSES be nearly as high as from building and operating these alternatives.

For a discussion of the transportation effects, see Section 10.4.6.

Impacts associated with both the coal and uranium fuel cycles have been addressed within a generic framework involving the development and use of various models (i.e. model mines and mining methods, model power plants, etc.). Discussion of the land requirements for supporting the uranium fuel cycle of a model 1000-mWe LWR is presented in Section 4.5.5. In contrast, Dvorak et. al. characterized the coal fuel cycle within selected source areas, thereby factoring in regional differences in coal quality, bed thickness, mining conditions, etc.[9] Accordingly, land disturbance resulting from surface mining to supply the annual fuel requirement of a model power plant (1000 MWe) from the various source areas was estimated as follows: Wyoming-12.1 ha, Arizona-40.5 ha, Pennsylvania 66.8 ha, Illinois 76.9 ha, and eastern Kentucky 78.9 ha. However, the listed areas (in hectares) pertain only to lands overlying the coal to be extracted. The total affected area would be dependent on the disposition of excavated overburden and, in some cases, may be twice or more times the areas listed.

The staff agrees that a general trend exists whereby continued extraction of a given unit of coal or uranium results in increasingly greater adverse impacts on the landscape. However, it should also be noted that contemporary requirements, standards, and reclamation programs implemented to limit such impacts are also becoming increasingly more stringent. The Surface Mining Control and Reclamation Act (SMCRA) of 1977 exemplifies the increasing public awareness of the need to prevent, control, and/or mitigate mining-related impacts. One provision of the act mandates the establishment of environmental and other criteria whereby some coal resource areas are or will be designated as unsuitable for surface mining. Some of the reclamation requirements of the act include specifications relative to restoring natural land contours, topsoil management and replacement, restoring land-use potentials to levels comparable to or exceeding those existing prior to mining, and revegetation standards.

The indirect impacts of the coal and nuclear fuel cycles have been treated in depth in other documents. Consideration of the coal fuel cycle is beyond the scope of this proposed action; however, nuclear power does compare favorably when "indirect effect of mining on the landscape" are examined. A comprehensive evaluation of uranium mining and milling is presented in the "Generic Environmental Impact Statement on Uranium Milling," April 1979, NUREG-0511 (two volumes).

If utilities choose to build coal-fired plants rather than nuclear plants in the future, it is not necessarily true that the cheapest coal will come from the area near the plant. It is unlikely that anthracite coal will be used because of the premium that that type of coal commands on the market.

The staff does not see any relation between the issuing of a permit for the construction of Pond Hill Reservoir and the impact of a renewed anthracite industry on the region. At this point, the cost of building a new coal plant and the recovery cost of SSES would be very large as compared to the benefit derived from the renewed anthracite industry.

10.8.4.1 Health Effects (PP&L 9/4/79:B-42)

Table 8.1 has been revised to reflect this comment.

10.8.4.2 The Uranium Fuel Cycle

No comments.

10.8.4.3 The Coal Fuel Cycle

No comments.

10.8.4.4 Other Considerations (T.R. Duck:B-11)

NRC has factored the impact of the Three Mile Island accident into the review of the Susquehanna application. Specifically, the Environmental Statement has been supplemented to evaluate the site-specific environmental impacts attributable to plant-specific accident sequences that lead to releases of radiation and/or radioactive materials, including sequences that can result in inadequate cooling of reactor fuel and melting of the reactor core.

10.8.4.5 Summary and Conclusions

No comments.

10.8.5 Uranium-Resource Availability (T.R. Duck:B-11)

Section 8.5 has been revised to reflect recent changes in the outlook for future uranium-fuel supplies.

10.8.6 Decommissioning (EPA 8/17/79:B-17; SA 8/17/79:B-61; T.R. Duck;B-11)

The discussion in Section 8.6 has been revised to reflect the current staff position relative to the decommissioning of nuclear facilities. These revisions summarize a more extensive treatment of this subject published in the "Draft Generic Environmental Input Statement on Decommissioning of Nuclear Facilities" (NUREG-0586, January 1981, U.S. Nuclear Regulatory Commission).

The decommissioning alternatives for a nuclear reactor are discussed in detail in NUREG-0586. The dollar amount indicated in the benefit-cost section refers to one of several decommissioning methods; no specific method of decommissioning for SSES has been selected at this time. All reasonable methods of decommissioning can be planned for with respect to engineering and financial considerations. The comparison to Three Mile Island is not appropriate, because TMI involves problems of criticality, the extent of the contamination at Unit two, and extraordinary precautions necessary to minimize occupational exposure.

10.9 BENEFIT-COST ANALYSIS

10.9.1 Résumé (F.L. Shelly:B-57; F. Thompson:B-74; M.J. Huntington:B-27; S. Laughland:B-32)

The assertion that nuclear power is not competitive with other sources of electrical energy production is incorrect. SSES has already been constructed and, because this is at least half of the electricity production cost, there is no need to evaluate the coal vs. nuclear vs. alternative sources issue. The overall energy source comparison is useful only at the construction stage, when all costs are variable and economic choices of interest are the widest possible. At the construction stage, SSES is a competitive option; at the operation stage, it is the only logical economic choice.

The use of 60 to 70% capacity factor is realistic for new nuclear plants; average capacity for nuclear units in 1979 was 65.2%. In 1979, with TMI included in the data for the first ten months, the average capacity factor was 58.9% (NUREG 0020, Operating Units Status Report, Vol. 4, No. 9, September 1980, p. 1-3).

The availability of electrical energy affects the demand for use through the price. With increasing electrical energy prices, the additional power provided by SSES is not going to encourage increased usage.

The subsidies to nuclear power mentioned in the comment cannot be attributed to the construction and operation of SSES. No subsidies were provided for this commercial plant. Waste disposal costs have been included in studies of nuclear power economics. Plant capacity factors of 60 to 70% and no accidents that release significant levels of radioactivity to the atmosphere are the expected future of SSES; therefore, these assumptions are the proper basis for the benefit-cost assessment.

The stress to some residents near TMI is real. The stress on those residents cannot be compared to that on people who live within a few miles of plants that have operated successfully without accident.

The comparative relative cost of nuclear power operation was used as the basis for assessing SSES; the absolute costs will change.

The capacity factors cited in M.J. Huntington's comment do not reflect current data. It is true that, over the life of a nuclear plant, capacity factors rise and then fall in the latter years. However, this is true of coal plants as well; this does not represent a disadvantage of nuclear plants.

The need for the plant in the proposed operating time frame is based primarily on the savings in fuel costs. SSES is also needed in the longer run to replace energy due to loss of generating capability, and to meet future demand for energy.

10.9.2 Benefits

No comments.

10.9.3 Societal Costs

No comments.

10.9.4 Economic Costs (M.M. Molesevich:B-39)

Decommissioning plans are prepared for plants that have completed their useful lives. In the case of TMI or any other accident, where decommissioning is considered prior to completion of a useful operating life of from 30 to 40 years, a special investigation and study would be required. Any attempt to speculate in advance on a decommissioning plan under such extraordinary circumstances would be useful only in a generic assessment and could not be specifically applied to SSES. The decommissioning cost is estimated in 1978 dollars and represents only one mode of decommissioning. No decommissioning alternative based on reasonable cost ranges would affect the conclusion that the plant should operate.

10.9.5 Environmental Costs

No comments.

10.9.6 Environmental Costs of the Uranium Fuel Cycle

No comments.

10.9.7 Environmental Costs of Uranium Fuel Transportation

No comments.

10.9.8 Summary of Benefit-Cost (SA 8/17/79:B-62; PP&L 9/4/79:B-42; EDC 9/26/79:B-14; M.M. Molesevich:B-39)

The text has been revised to reflect applicable comments.

The staff has found no evidence that employees in the area would quit their jobs if SSES were allowed to operate.

The cost/benefit analysis for Pond Hill is given in Section A.5.3.

10.A APPENDIX A: FINAL SUPPLEMENT TO THE EIS FOR SSES

10.A.1 Summary and Conclusions, Foreword, Introduction

10.A.1.1 Summary and Conclusions and Foreward (LUZ:B-38; PDER 5/20/80:B-54; HEW:B-6; DOI 5/29/80:B-9; PP&L 5/29/80:B-47)

The text of the Summary and Conclusion has been changed to reflect applicable comments.

The applicant has proposed the construction of a compensation reservoir at Pond Hill Creek in order to meet requirements of the Susquehanna River Basin Commission during periods of low flow. Discussion of the proposed Pond Hill Reservoir is contained in Appendix A.

Item 3.0 has been added to the Summary and Conclusions section of Appendix A. The operation of Pond Hill Reservoir for compensation releases will have a minimal impact on downstream portions of the Susquehanna River (Sec. 4).

The SRBC has established 1 July 1984 as the deadline for compliance with its consumptive water makeup requirements (SRBC Regulation 1, Section 803.61).

The Pennsylvania Fish Commission has been added to the distribution list for the Final Environmental Impact Statement.

10.A.1.2 Introduction (PP&L 5/29/80:B-47)

The text of the Introduction has been changed to reflect the applicable comments.

10.A.2 The Site and Its Environs (DOC:B-5)

The applicant will be required to determine if any USGS markers are located in the proposed construction area. If any markers are in this area, the applicant will notify the National Ocean Survey of the National Oceanic and Atmospheric Administration (NOAA) and take appropriate steps to relocate the markers.

10.A.2.1 Plant Location (PP&L 5/29/80:B-47)

Figures A.2.2, A.2.3, and A.2.4 have been replaced with revised figures.

10.A.2.2 Land Use

No comments.

10.A.2.3 Meteorology and Hydrology (PP&L 5/29/80:B-47)

Section A.2.3.3 has been revised to include a discussion of the spring within the project boundary.

10.A.2.4 Geology and Seismology

No comments.

10.A.2.5 Site Ecology (PP&L 5/29/80:B-47)

The references have been corrected.

10.A.2.6 Socioeconomic Profile of the Local Area

No comments.

10.A.2.7 Cultural Resources (SA 6/10/80:B-64)

For a discussion of cultural resources, see revised Section A.2.7.

10.A.3 Reservoir Description

The text of Section A.3 has been changed to reflect applicable comments.

10.A.3.1 Introduction (PP&L 5/29/80:B-47; SRBC 4/30/80:B-69)

Figures A.3.1 and A.3.2 have been replaced with revised figures. Revised Plates A-1, 2, 5, 6, 17, and 19, supplied by PP&L, were used to correct the figures.

10.A.3.2 Mode of Operation (EPA 5/30/80:B-23; PP&L 5/29/80:B-47; SRBC 4/30/80:B-69)

The staff has estimated the probability of occurrence of different periods (number of days) of low river flow that would interrupt the operation of the power station based on historical riverflow measurement. Replacement and starting energy costs associated with each shutdown have also been calculated (Table A.5.3). Because future occurrences of low river flow are impossible to forecast, the staff has simply provided the cost associated with probable different low riverflow periods. The decision to accept or reject the riverflow alternative will depend upon one's confidence that future river flow will follow the historic pattern. At present, the Susquehanna River has a greater degree of flow control than it had in the past. The analysis shows that, if there is an average of four days per year of low river flow over a period of 30 years, the cost of the Pond Hill project will be more than the replacement energy cost.

10.A.3.3 Recreation Area (EDC 9/26/79:B-14)

PP&L has proposed a recreational program for the Pond Hill Reservoir. The details of this program are provided in the Environmental Statement in Section A.3.3.

10.A.3.4 Esthetics

No comments.

10.A.4 Environmental Effects of Construction and Operation

10.A.4.1 Impacts on Land Use (DOT 4/28/80:B-11)

The transportation impacts have been adequately addressed to the satisfaction of DOT, with the exception of sufficient coordination. It is the staff's view that the applicant and DOT should work together to consider adequate design of the access road to the reservoir as well as attendant impacts. NRC will not preempt DOT expertise in matters of design and traffic coordination.

The comment attributes many of the changes in the past years to construction of SSES. Many of these changes are due to other projects, including past highway construction, and to urbanization trends independent of SSES. The record shows that the blasting during construction did adversely affect residents, but this should not be considered in a decision as to whether or not the plant should be operated. The comment correctly states that the land used by SSES is an irrevocable loss, but the opinion that its former use was the best use cannot be demonstrated on economic grounds. The EIS mentions the effect of Hurricane Agnes as part of the recent history and is not meant to characterize the local area surrounding the plant.

10.A.4.2 Impacts on Water Use (EPA 5/30/80:B-23; SRBC 4/30/80:B-69; SA 6/10/80:B-64)

Evaporation from and precipitation into the reservoir were included in the simulation of the drought of record.

The text has been changed to reflect these comments.

10.A.4.3 Environmental Impacts (PP&L 5/29/80:B-47; EPA 5/30/80:B-23; DOI 5/29/80:B-9; SRBC 4/30/80:B-69)

The text and Figure A.4.1 have been revised to reflect applicable comments.

The statements in the text do not support the comment pertaining to "significantly negative impact on water quality." With respect to phosphorous levels, the text states that ambient phosphorous level exceeds criteria.

The expression "approximate original contours" (Appendix A, Sec. A.4.3.1) is in general accord with the applicant's commitment: "The borrow areas will be restored as closely as possible to their original condition" (ER-OL, Appendix H, Sec. 4.2.2.4). The extent to which original contours can be restored will vary; however, the staff expects the applicant to reestablish original onsite drainage to the extent possible, thereby avoiding undue disruption of offsite drainage patterns.

PP&L's commitment on drainage features is in general agreement with a staff recommendation presented in the Section A.4.3.1, paragraph 6.

The staff acknowledges EPA's comment to the effect that "discussion on wildlife resources is acceptable." However, the rationale whereby the staff's statement concerning the relatively low density of eastern cottontail at the Pond Hill project site has been interpreted as asserting that the cottontail is of "minor importance" is not readily apparent, nor does the staff clearly understand the intended meaning of "minor importance." Given that populations of cottontail exhibit cyclic fluctuations in northern states (as do those of ruffed grouse and snowshoe hare), the local densities of cottontails generally parallel the availability of proper food and cover habitat. The extensive second-growth forest vegetation of the project site is approaching maturity, and the increasing closure of the overhead canopy has inhibited, and continues to inhibit, the production of shrubby and herbaceous vegetation that serves as food and cover for the cottontails. This principal consideration underlying the staff's contention is in general agreement with a citation (page A.2-12) to the effect that the cottontail population at the proposed reservoir site "is much lower due in part to the relatively sparse open field and meadow acreage and to high predation by great horned owl, eastern red and eastern gray foxes, and wild dogs."

The implementation of the fish and wildlife management plan is a state responsibility and is not normally handled by the NRC. The Pennsylvania State Fish Commission and the Pennsylvania Game

Commission, with the aid of the U.S. Fish and Wildlife Service, will design a state fish and wildlife management plan.

The text of Section A.4.3.2.3 ("Operational Impacts of Discharge System") has been revised to reflect this new information as well as the change in the design of the inlet-outlet structure. As a result of the design change, most compensation releases from the reservoir will be from the epilimnion layer, minimizing the potential for cold shock in the river.

Several points need to be considered. First, the staff agrees that nutrients may be resuspended during turnover. Water quality data presented in Table A.4.1 of the DES indicated pH values for Pond Hill Creek and the Susquehanna River. The staff feels the pH of the reservoir will be such that nutrients suspended during turnover will quickly precipitate and return to the bottom sediments. A second point is that high levels of phosphorous are already present in the river. It is therefore incorrect to imply that phosphorous levels associated with eutrophic conditions in the reservoir will adversely effect the Susquehanna at times of compensation. The third point is that information presented in Table 1.3.2-1 of Volume IV of the ER-OL suggests that compensation releases will primarily occur in early fall and therefore precede fall turnover. Table 1.3.2-1 has been added to Section 4.3.2.2 of the text.

Iron levels are already high in the river and have been shown not to have reduced primary productivity.

10.A.4.4 Hydrologic Impacts (DOI 5/29/80:B-9; EPA 5/30/80:B-23; SRBC 4/30/80:B-69; SA 6/10/80: B-64; PP&L 5/20/80:B-47)

The applicant has revised the spillway design. See Section A.4.4.2.3.

As stated in Section A.2.3.3, there is no information on historic flood flows in Pond Hill Creek because there is no gaging station on the stream.

The figures showing the floodplains of the Susquehanna River and Pond Hill Creek have been revised. See Figures A.2.5 and A.2.6.

Changes in the floodplain due to the construction and operation of the project are discussed in Section A.4 "Environmental Effects of Construction and Operation."

The difference between EPA's estimate of 986 mm and NRC's estimate of 973 mm for the 6-hr PMF is insignificant and would not alter the conclusions reached in Section A.4.4.2.3. The design precipitation series is chosen to represent an upper bound. The reservoir is designed to be able to accommodate this precipitation series without being overtopped. Less intense storms will result in lower maximum reservoir elevations.

The saddle referred to has a minimum elevation of 302.1 m MSL, 0.3 m above the dam crest elevation of 301.8 m MSL and 2.7 m above the emergency spillway weir elevation of 299.4 m MSL. The applicant is considering the construction of an impervious cutoff across this saddle, as shown in Figure A.3.2. The minimum elevation between Lily Lake and the reservoir is 311 m MSL, more than 9 m above the elevation of the dam crest. Therefore, the possibility of either of these locations becoming spillways during a flood is precluded.

The applicant calculated the discharge temperatures from the larger reservoir using the revised inlet-outlet structure (Section A.3.1.3 and Figure A.4.1), the larger reservoir area and volume, and both 1964 and 1975 temperature data (see PP&L 5/29/80, p. B-47). The calculated temperatures for the effluent stream flow, based on releases of 2.89 m^3/s are given in the cited comment.

The staff's assessment of the thermal impact of releases from Pond Hill Reservoir has not changed as a result of this design change and the modeling studies are based on 1975 meteorological data.

The reservoir is well above the level of any credible flood event on the Susquehanna River. The downstream toe of the dam is more than 70 m above the normal river level and more than 65 m above the historical maximum Susquehanna River stage (Tropical Storm Agnes, 1972). See Section A.4.4.2.3 for a discussion of the hydrologic design of the dam with the proposed revised spillway.

Table 1.3.2-1 of Volume IV of the ER-OL presents past history data on the Susquehanna River. This table indicates that withdrawal from the reservoir can be expected to be infrequent. This table has been included in Section A.4.3.2.2 of the text and should aid in clarifying the discussion.

The responsibility for requiring monitoring is the function of the EPA (see EPA 5/30/80, p. B-23), not the NRC. NRC cannot require monitoring of water quality. EPA is responsible for water quality monitoring and water quality.

Section A.4.4.2.1 has been revised to reflect these comments. The larger reservoir has been planned to meet SRBC's requirements and not specifically for the purpose of supplying additional storage capacity for other users or uses, such as sales to other utilities or industries on the Susquehanna River. Although these other uses are possible, the staff has not attempted to evaluate them.

10.A.4.5 Socioeconomic Impacts (EPA 5/30/80:B-23)

The section has been revised to reflect these comments.

10.A.4.6 Impacts to Cultural Resources (DOI 5/29/80:B-9)

For a discussion of cultural resources, see revised Section A.2.7.

10.A.5 Alternatives, Need for Facility, and Benefit-Cost Analysis

Section A.5 has been revised to incorporate applicable comments.

10.A.5.1 Alternatives to Constructing a Water Storage Reservoir (EPA 5/30/80:B-23; PP&L 5/29/80:B-47; SRBC 4/30/80:B-69; FERC:B-25; SA 6/10/80:B-64)

The Pond Hill Reservoir is being planned to supplement riverflow during periods of low riverflow. The Susquehanna River Basin Commission has directed that the reservoir be constructed by 1 July 1984. The Pond Hill Reservoir is not required for the safe operation of the nuclear plant. Therefore, the Environmental Statement review dealt only with the effect of the construction and operation of the Pond Hill Reservoir on the environment.

The staff does not see any relation between the issuing of a permit for the construction of Pond Hill Reservoir and the impact of a renewed anthracite industry on the region. At this point, the cost of building a new coal plant, and the recovery cost of nuclear portions of SSES would be very large as compared to the benefit derived from the renewed anthracite industry.

SRBC has failed to indicate in its comments the effect it believed its recommendation would have on the availability of a back-up water supply contemporaneous with construction and operation of SSES. The staff notes, however, that the conclusions reached in the FES do not rest on the availability of a back-up water supply. Instead, the staff assumed compliance with the SRBC rules without such a system.

The FES (see Sec. A.5.1.2) has been revised to reflect the SRBC's position on the Cowanesque Reservoir.

10.A.5.2 Alternative Sites (SRBC 4/30/80:B-69)

The text of Paragraph 1 of Section A.5.2 is correct. As stated in References 24 and 29 of Section 2 of this Appendix, the initial design criteria for the water storage reservoir were based on a Q_{7-10} river flow of 21.8 m^3/s; the alternative site analyses were conducted on this basis, including the 96-day compensation flow requirement. Later, the Q_{7-10} value was changed to 22.7 m^3/s. The dam design given in the ER-OL, Appendix H, and in this Environmental Statement is based on the higher Q_{7-10} value.

10.A.5.3 Benefit-Cost Analysis (FERC:B-25; PP&L 5/29/80:B-47; SRBC 4/30/80:B-69)

The staff disagrees with the change suggested by PP&L (5/29/80, p. B-47). If PP&L meets PJM's reserve requirements, PJM could still buy the needed amount of electricity from PP&L and would not suffer the loss of sale. However, the ability of PP&L to supply power to the rest of the network would be reduced if the river-following mode of operation were utilized.

The probability of a shutdown of less than or equal to 14 days is 94.1%. Section A.5.3.1 has been revised to reflect this comment.

A mathematical average of four-day shutdown does not mean that the plant will be closed every year for four days. Like any average, it simply means that the plant may be closed for more than four days in some years and for less than four days in others. Over the period of observation, the sum of deviation from the mean is expected to be zero. The calculation of the present value of the replacement energy cost gives an estimate of the cost incurred by the applicant if the future riverflow follows a similar historical pattern. Table 5.3 does present the cost associated with different expected values of number of days of plant shutdown.

As per the applicant's response, the average annual energy requirement, including the purchase of replacement energy during the four-day shutdown and the energy needed to start the plant are between 160,000 and 170,000 MWh, depending on the length of time associated with cold or hot reactor shutdown conditions. The staff assumed that the incremental amount of electricity required to start up the plant from cold vs. hot reaction shutdown condition to be 10,000 MWh. As there is no definite knowledge at this point of the plant shutdown condition, the staff assumed a 50/50 chance of hot or cold shutdown over the life of the project. Under this assumption, the yearly average amount of electricity requirement comes to 165,000 MWh. The staff assumes that the energy requirement is 146,000 MWh (2100 MW x 4 days x 24 hr/day x 0.70 cap. factor + 5000 MWh).

The staff agrees that there may not be a substantial savings in the operating variable cost during the shutdown period. The amount of savings realized (if any) would not alter the findings of the analysis.

The staff does not find any cost difference between the report based on the applicant's response and the one by the comment. Please note that the present value of the cost reported here includes the cost of the project ($65 million) and the yearly operating cost of $100,700 over 30 years.

The staff agrees that such a situation may arise (see PP&L 5/29/80, p. B-47), but it is highly unlikely that low river flow and fuel-oil curtailment would occur at the same time.

Table A.5.4 has been revised to reflect this comment.

10.A.5.4 Evaluation of Unavoidable Adverse Environmental Impacts of the Proposed Action

No comments.

10.B COMMENTS ON DES

No comments.

10.C ENVIRONMENTAL ASSESSMENT BY THE DIVISION OF SITE SAFETY AND ENVIRONMENTAL ANALYSIS FOR PROPOSED MODIFICATIONS TO THE TRANSMISSION LINE SYSTEM (DA-SCS:B-4; DOI 9/10/79:B-7; M.M. Molesevich:B-39)

Information presented by the applicant indicates that they sought and received an "erosion control program and permit" from the PDER (ER-OL, Sec. 12.1.2). Similar information indicates that the applicant periodically consulted with the Soil and Water Conservation Districts regarding methods to control soil erosion (ER-OL, Sec. 4.5). Furthermore, the staff evaluated the applicant's proposed plans for controlling erosion during transmission-line construction; such plans were found acceptable (see Appendix C, p. C-6 and Sec. 5.3.5).

The staff would also like to point out that land disturbance at the plant site and within transmission-line rights-of-way results primarily from construction activities; whereas the focus of this statement is on impacts associated with operation of the station and transmission facilities. The staff foresees no instances in which routine operation of the facilities will result in significant land disturbance.

The staff has elected to address the "possibility" referred to in the comment as follows. The applicant states that easements are usually acquired for transmission-line rights-of-way (ROW). These easements allow the owners continued use of the ROW consistent with safe and efficient operation and maintenance of the transmission lines and structures (ER-CP, Section 3.2.6). Thus, the future use of cleared ROW will be subject to individual agreements between the owners and the applicant, and may or may not involve plantings for wildlife food or cover.

As indicated in Appendix B (p. B-6), woody vegetation will be removed from the ROW by "selective" or "tailored" methods of clearing. Accordingly, complete removal of trees and underbrush will occur only in limited areas, such as tower-construction sites and service roads. In general, only tall trees and those of growth habits that could interfere with energy transmission will be removed from the ROW. Certain trees of limited-height growth potential, shrubs, herbs, and grasses will be preserved "to the greatest extent practical" (ER-CP, Amendment 5, Exhibit B), thereby limiting the area of disturbance and erosion potential. In many instances, the residual vegetation is expected to be sufficiently beneficial for wildlife so that plantings for food and cover will be unnecessary.

The staff encourages the establishment of wildlife habitat in areas where such management is compatible with other land-use priorities. However, "using plantings recommended by the

Pennsylvania Game Commission for all forested areas cleared during transmission line construction" is not considered a realistic objective.[10]

Figures have been changed in response to the comment made.

References

1. Letter from M.R. Buring (PP&L) to J.T. Ulanowski (PDER), 9 April 1980.

2. Letter from J.T. Ulanowski (PDER) to M.R. Buring (PP&L), 29 April 1980.

3. Letter from N.W. Curtis (PP&L) to D.E. Sells (NRC), 13 November 1979.

4. G.W. Patterson, C.R. Curtis, T.L. Lauves, and G. Hosokaiva, "Chalk Point Cooling Tower Project, Native Vegetation Study, Final Report, FY '78," Report No. PPSP-CPCTP-24, WRRC Special Report No. 10, Water Resources Research Center, University of Maryland, College Park, MD, June 1978.

5. C.L. Mulchi, D.C. Wolfe, and J.A. Armbruster, "Cooling Tower Effects on Crops and Soils, Postoperational Report No. 3, Final Report, FY-78," PPSP-CPCTP-23, WRRC Special Report No. 11, Water Resources Research Center, University of Maryland, College Park, MD, 1978.

6. C.R. Curtis, B.A. Francis, and T.L. Lauver, "Dogwood as a Bioindicator Species for Saline Drift," pp. I-65 through I-77, In Proceedings of a Symposium on Environmental Effects of Cooling Tower Emissions, May 2-4, 1978, University of Maryland, College Park, MD, 1978.

7. "An Ecological Study of the Susquehanna River in the Vicinity of the Three Mile Island Nuclear Station, Annual Report for 1975," By W.A. Potter, Project Leader, and Associates, for Metropolitan Edison Company, Ichthyological Associates, Inc., Ithaca, NY, February 1976.

8. B.L. Cohen, "Radon: Characteristics, Natural Occurrence, Technological Enhancement, and Health Effects," Vol. 4, Progress in Nuclear Energy, 1979.

9. A.J. Dvorak et al., "The Environmental Effects of Using Coal for Generating Electricity," NUREG-0252, prepared by Argonne National Laboratory for the U.S. Nuclear Regulatory Commission, 1977.*

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

11. U.S. Department of the Interior, Fish and Wildlife Service, "Management of Transmission Line Rights-of-Way for Fish and Wildlife," Vol. I, Chapter 3, Section 14, FWS/OBS-79/22, 1979.

*Available for purchase from the National Technical Information Service, Springfield, VA 22161.

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APPENDIX A

FINAL SUPPLEMENT

TO THE

ENVIRONMENTAL STATEMENT

BY THE

U.S. NUCLEAR REGULATORY COMMISSION

FOR

SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2

proposed by

PENNSYLVANIA POWER AND LIGHT COMPANY
ALLEGHENY ELECTRIC COOPERATIVE, INC.

Docket Nos. 50-387
50-388

SUMMARY AND CONCLUSIONS

This Appendix to the Final Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation (the staff).

1. The action is administrative.

2. The proposed action is the issuance of construction permits by local, state, and federal agencies (including the Susquehanna River Basin Commission, SRBC) for the construction of a water storage reservoir in the Pond Hill Creek drainage basin. The proposed site is located on a small tributary of the Susquehanna River in Conyngham Township, Luzerne County, Pennsylvania. The site is approximately 11 km northeast of the borough of Berwick, Pennsylvania, and about 3.7 km northeast of the Susquehanna Steam Electric Station (SSES), now under construction. The purpose of the proposed reservoir is to supply water to the Susquehanna River during periods of low river flow to replace the water consumptively used by SSES.

   Action by the NRC is not required for the issuance of construction permits for this reservoir. This Environmental Statement has been prepared by the Nuclear Regulatory Commission to describe the environmental impacts of construction and operation of the Pond Hill Reservoir since the facility is associated with the operation of the Susquehanna Steam Electric Station.

   The facility will consist of an earth and rockfill dam constructed across the valley, about 1.3 km east of the Susquehanna River, a spillway, an inlet-outlet structure, a pipeline, and a pumping station. The dam would be about 730 m in length at crest level; the maximum height above the streambed will be about 67 m. Normal water storage capacity of the reservoir would be about 30×10^6 m^3 (24,100 acre-feet), of which about 90% (27×10^6 m^3), will be available for compensation flow. The water area of the reservoir will be about 128 ha at the design normal water level of 299 m MSL.

3. The information in this statement represents an assessment of the environmental impacts associated with the construction of the Pond Hill Reservoir, pursuant to the guidelines of the National Environmental Policy Act of 1969 (NEPA) and 10 CFR 51 of the Commission's regulations. The staff has reviewed the impacts that would occur due to the construction and operation of the reservoir. The staff's analysis is based on a review of material supplied by the applicant, Pennsylvania Power & Light Co. (PP&L); a review of other material secured independently; a visit to the proposed and four of the alternate sites; and discussions with various state, local, and federal officials. The potential impacts, both beneficial and adverse, are summarized as follows:

   a. The valley and Pond Hill Creek will be permanently altered.

   b. Approximately 525 ha of land will be dedicated to the reservoir for the life of the facility.

   c. About 2.3 km of Pond Hill Creek will be converted from a free-flowing stream to a reservoir; the 1.3-km section of the creek below the dam will be converted from a free-flowing, sometimes intermittent, stream to a partially regulated stream with a minimum flow maintained by releases from the reservoir.

   d. As much as 195 ha of terrestrial environment may be directly affected and variously altered due to development of the Pond Hill Reservoir. About 128 ha of forested area will be inundated. Impoundment structures will occupy about 16 ha. Most of the remaining disturbed area will be reclaimed and landscaped following construction.

   e. Vegetation in the areas covered by water and structures will be converted into habitat for aquatic biota.

   f. Some wildlife mortality will occur as the result of construction activities and the initial filling of the reservoir; in addition, some animals will be displaced from affected areas. Adverse effects on terrestrial wildlife will be variously offset by reclamation of disturbed areas, creation of aquatic habitat, and the implementation of a wildlife habitat improvement program.

g. Land-clearing and construction activities will temporarily cause locally increased levels of noise as well as emissions of smoke and dust. Some soil erosion will occur despite the implementation of control measures. Also, topsoil materials used in reclamation will have undergone adverse physical and chemical changes that may be reflected by reduced future productivity of the affected areas.

h. Fluctuating water levels, to the extent the project is used for low-flow compensation, will result in exposed areas and will alter some of the aquatic habitat created by the dam for the period of drawdown and refill.

i. There will be a temporary increase in highway traffic due to workers commuting to and from the area during construction and to trucks bringing in construction materials and supplies and removing refuse.

j. The water quality of Pond Hill Creek below the reservoir will generally be lower than that prior to reservoir establishment.

k. Based on the droughts of record, the discharge and storage capacities of the reservoir are greater than those required to provide compensation water to the Susquehanna River as a result of SSES operation.

l. About 145 ha of land will be converted from their present use to certain recreational uses, such as hunting and hiking. The reservoir may be developed for certain water recreational activities, such as non-power boating and fishing.

m. As a result of reservoir development, an increase in waterfowl and aquatic and shoreline wildlife may occur.

n. Minor changes in local demography, settlement patterns, and sociocultural structures will result from the construction and operation of the reservoir.

o. The operation of Pond Hill Reservoir will have a minimal impact on water quality and aquatic ecology in the downstream portions of the Susquehanna River.

4. On the basis of the analysis and evaluation set forth in this Statement, and after weighing the environmental, economic, technical, and other benefits against environmental costs and after considering available alternatives it is concluded that the construction of the Pond Hill Reservoir is an acceptable method for complying with the low-flow water use requirements of the Susquehanna River Basin Commission. The staff's assessment indicates that the environmental and other impacts of the reservoir will be minimal.

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FOREWORD

This Appendix to the Final Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff), in accordance with the Commission's regulation, 10 CFR 51, which implements the requirements of the National Environmental Policy Act of 1969 (NEPA).

NEPA states, among other things, that it is the continuing responsibility of the federal government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate federal plans, functions, programs, and resources to the end that the nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of the national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of NEPA calls for preparation of a detailed statement on:

(i) the environmental impact of the proposed action

(ii) any adverse environmental effects that cannot be avoided should the proposal be implemented

(iii) alternatives to the proposed action

(iv) the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity

(v) any irreversible and irretrievable commitments of resources that would be involved in the proposed action, should it be implemented

An environmental report accompanies each application for a construction permit. A public announcement of the availability of the report is made. Any comments on the report by interested persons are considered by the staff. In conducting the required NEPA review, the staff meets with the applicant to discuss items of information in the environmental report, to seek new information from the applicant that might be needed for an adequate assessment; and generally to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff seeks information from other sources that will assist in the evaluation and visits and inspects the project site and surrounding vicinity. Members of the staff may meet with state and local officials charged with protecting state and local interests. On the basis of all the foregoing and other such activities or inquiries as are deemed useful and appropriate, the staff makes an independent assessment of the considerations specified in Section 102(2)(c) of NEPA and 10 CFR 51.

This evaluation leads to the publication of a draft environmental statement, prepared by the Office of Nuclear Reactor Regulation, which is then circulated to federal, state, and local governmental agencies for comment. A summary notice of the availability of the applicant's environmental report and the draft environmental statement is published in the Federal Register. Interested persons are also invited to comment on the proposed action and the draft statement. Comments should be addressed to the Director, Division of Licensing, at the address shown below.

After receipt and consideration of comments on the draft statement, the staff prepares a final environmental statement, which includes a discussion of questions and objections raised by the comments and the disposition thereof; a final benefit-cost analysis, which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects with the environmental, economic, technical, and other benefits of the facility.

This environmental review deals with the impact of construction and operation of the Pond Hill Reservoir on the environment. This evaluation is based on information supplied by the applicant, Pennsylvania Power & Light Company, in Appendix H to the Environmental Report for the Susquehanna Steam Electric Station (May 1979) and other documents, a visit to the site of the proposed reservoir (and four of the alternate sites), and meetings with state and local officials.

No NRC action is required prior to the start of construction or operation of this facility, since the nuclear power plant can be granted an operating license without the reservoir. Prior to start of construction, the applicant will obtain the necessary permits from state, local and federal agencies, such as the Susquehanna River Basin Commission (SRBC), U.S. Corps of Engineers (COE), and the U.S. Environmental Protection Agency (EPA).

Copies of this statement are available for inspection at the Commission's Public Document Room, 1717 H Street NW, Washington, DC, and at the Ousterhout Free Library, Reference Department, 71 South Franklin Street, Wilkes Barre, PA. Single copies of this statement may be obtained by writing to:

Director, Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Mr. Richard M. Stark is the NRC Project Manager for this project. Mr. Stark may be contacted at the above address or at 301/492-7238.

A.1. INTRODUCTION

A.1.1 HISTORY

Makeup water for the two nuclear reactors of the Susquehanna Steam Electric Station (SSES) will be withdrawn from the Susquehanna River. When construction permits CPPR-101 and CPPR-102 were issued on 2 November 1973, there were no restrictions on the amount of water that could be consumptively used by SSES. Water uses and withdrawals in the Susquehanna River Basin are controlled by the Susquehanna River Basin Commission (SRBC). This commission, formed by a compact between the states of New York, Pennsylvania, and Maryland and the federal government, issued new rules in 1976 prohibiting large water users, such as the applicant, from withdrawing water from the river and using it consumptively during periods of low river flow without returning to the river, from offstream storage reservoirs, water at a rate equal to actual consumptive losses. The cutoff point for limiting withdrawals has been set by the SRBC as the consecutive seven-day low flow to be expected every ten years (called the Q7-10 flow rate). In February 1980, SRBC established 1 July 1984 as the deadline for compliance with its water make-up requirements (SRBC Regulations, Sec. 803.61).

The SRBC has determined that, based on 80 years of riverflow data, the Q7-10 value applicable to SSES is 22.7 m^3/s, as measured at the Wilkes-Barre gauge (letter from R. J. Bielo, SRBC, to W. H. Regan, Jr., NRC, 30 August 1979).

The applicant has considered three alternatives for meeting the low-flow compensation requirements of SRBC:

1. Not to operate the plant whenever river flow is at or below the Q7-10 value plus consumptive use.

2. To purchase the required water from an existing reservoir.

3. To construct its own water storage reservoir.

Option 1, called "river following," would require replacement electrical-generating capacity, either from other Pennsylvania Power & Light facilities or from the PJM* grid.

The applicant has examined the relative merits of these three alternatives and has concluded that the most economically desirable and most reliable means of meeting the low-flow compensation requirement would be by the construction of a new reservoir owned and controlled by PP&L.

After examining thirteen sites along the Susquehanna River, the applicant selected a small unnamed valley on the east bank of the river about 3.7 km upstream of SSES as the site for the proposed reservoir. The valley contains a small creek that flows intermittently and is near the settlement of Pond Hill. The company has named the proposed facility "Pond Hill Reservoir."

A.1.2 PERMITS AND LICENSES

The NRC has no legal authority for the issuance or denial of any permit to construct or operate a water storage reservoir, since SSES can be granted an operating license without such a facility.

The NRC has reviewed the applicant's request to build an offstream water storage reservoir and has prepared this Appendix to the Final Environmental Statement to describe the environmental impacts of the proposed facility as well as alternatives to the proposed action.

In March 1979 the applicant submitted an application to the SRBC to build the Pond Hill Reservoir; to date the Commission has not completed its review of the application. The applicant will obtain the necessary permits from the Corps of Engineers, U.S. Department of Commerce National Ocean Survey, and other federal, state, and local officials. The proposed facility is in Conyngham Township, Luzerne County, Pennsylvania.

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*Interconnection Group located in Pennsylvania, New Jersey, and Maryland.

A.2. THE SITE AND ITS ENVIRONS

A.2.1 PLANT LOCATION

The site of the proposed Pond Hill Reservoir is a small valley drained by a small tributary of the Susquehanna River, about 3.7 km upstream of SSES (Fig. A.2.1). The site is about 24 km southwest of the city of Wilkes-Barre and 11 km northeast of the Borough of Berwick, PA. The site is about 32 river kilometers downstream of Wilkes-Barre. The creek draining this valley is not named on detailed U.S. Geological Survey maps (Nanticoke 7.5 minute U.S.G.S. Quadrangle), but is known locally as Catfish Creek. Figure A.2.2 is a plan view of the proposed project, showing the location of various structures as well as high and low water levels in the proposed reservoir.

The site of the proposed facility is in Conyngham Township of Luzerne County. Since the creek and valley are located just north of the settlement of Pond Hill, the applicant has used the terms Pond Hill Reservoir for the water storage facility and Pond Hill Creek for the tributary.

The coordinates of the site are 40°8'N, 76°7'W. Present access to the site is over secondary roads through the settlement of Pond Hill.

The north slope of the valley is steep, with a ridge rising from about 215 to 245 m above the valley floor (see Figs. A.2.2 and A.2.3). The south slope of the Pond Hill Creek drainage area is flatter, with a ridge line about 60 to 90 m above streambed.

State Highway 239 parallels the Susquehanna River just to the west of the site and connects the villages of Wapwallopen and Mocanaqua. The Pennsylvania Department of Transportation estimated that the average daily traffic on this stretch of Route 239 was 1550 cars/day in 1978. Local Road 40120 is the primary access road from Route 239, the Pond Hill Reservoir site, the settlement of Pond Hill, and the Lily Lake community bordering the lake; estimated usage in 1978 was 750 cars/day.

The Delaware and Hudson Railroad runs a single-track, north-south line parallel to the river just to the west of State Route 239. Maximum daily use of this line is four trains per day.

A.2.2 LAND USE

Although the exact site boundaries (and, therefore, the site area) have not yet been established, the area of the site is expected to be about 525 ha. The tentative site boundaries are shown in Figure A.2.3; this figure also shows local roads, local topography, and the settlements of Pond Hill and Lily Lake.

One unoccupied structure lies within the proposed site area. There are no inhabited structures.

About 93% of the site is presently covered with second-growth forests and about 7% consists of old fields and croplands. Less than 1% of the area is classified as wetlands.

Recreational use of the site includes walking, hiking, nature study, and hunting. Fishing is not now possible since the stream does not support a viable gamefish population.

A.2.3 METEOROLOGY AND HYDROLOGY

A.2.3.1 Meteorology

Since the site of the proposed reservoir is less than 4 km northeast of the site of SSES, meteorological and climatological conditions of the site are the same as those given in Section 2.4 of this Environmental Statement.

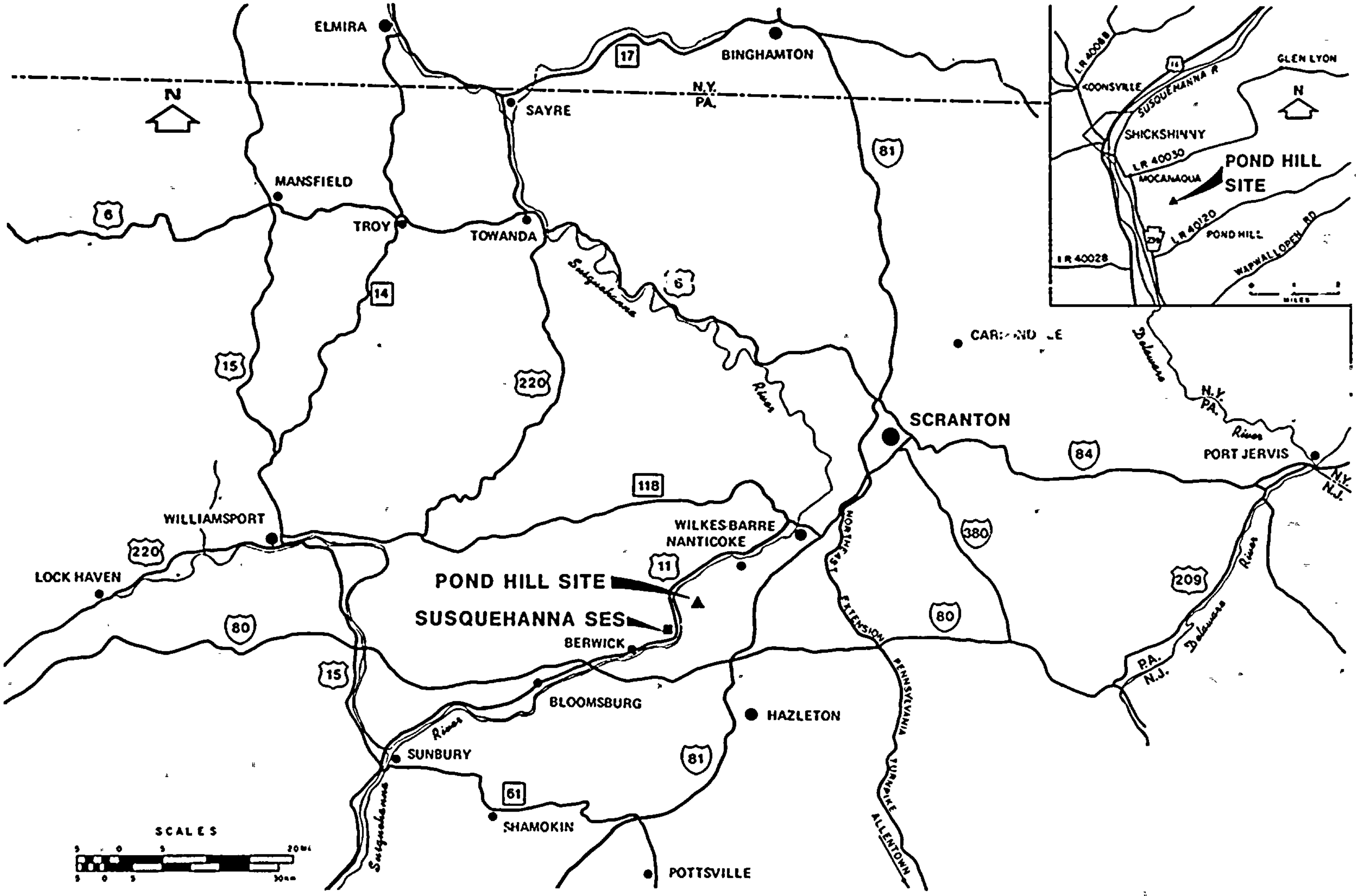


Fig. A.2.1. Pond Hill Reservoir Site Location.

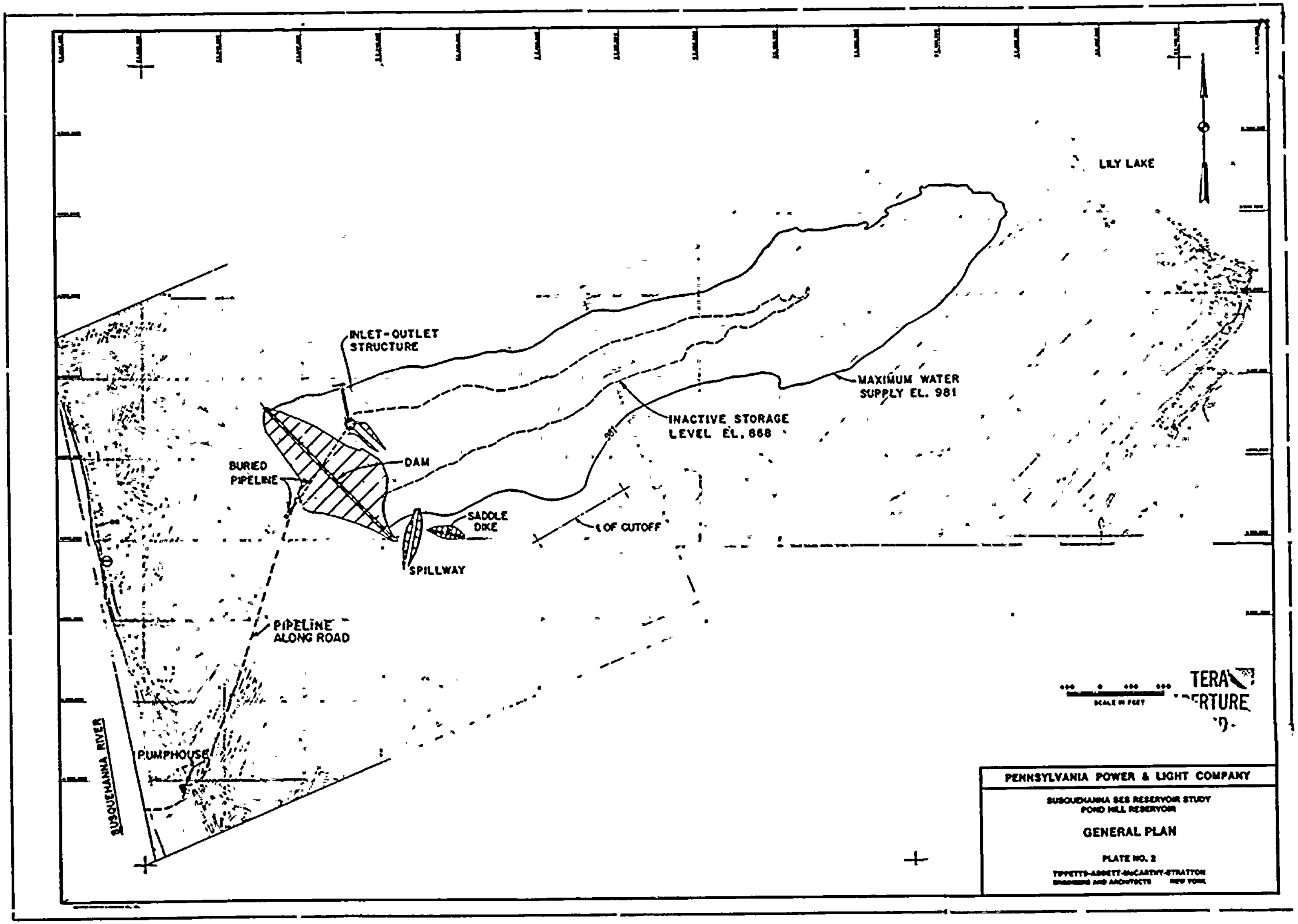
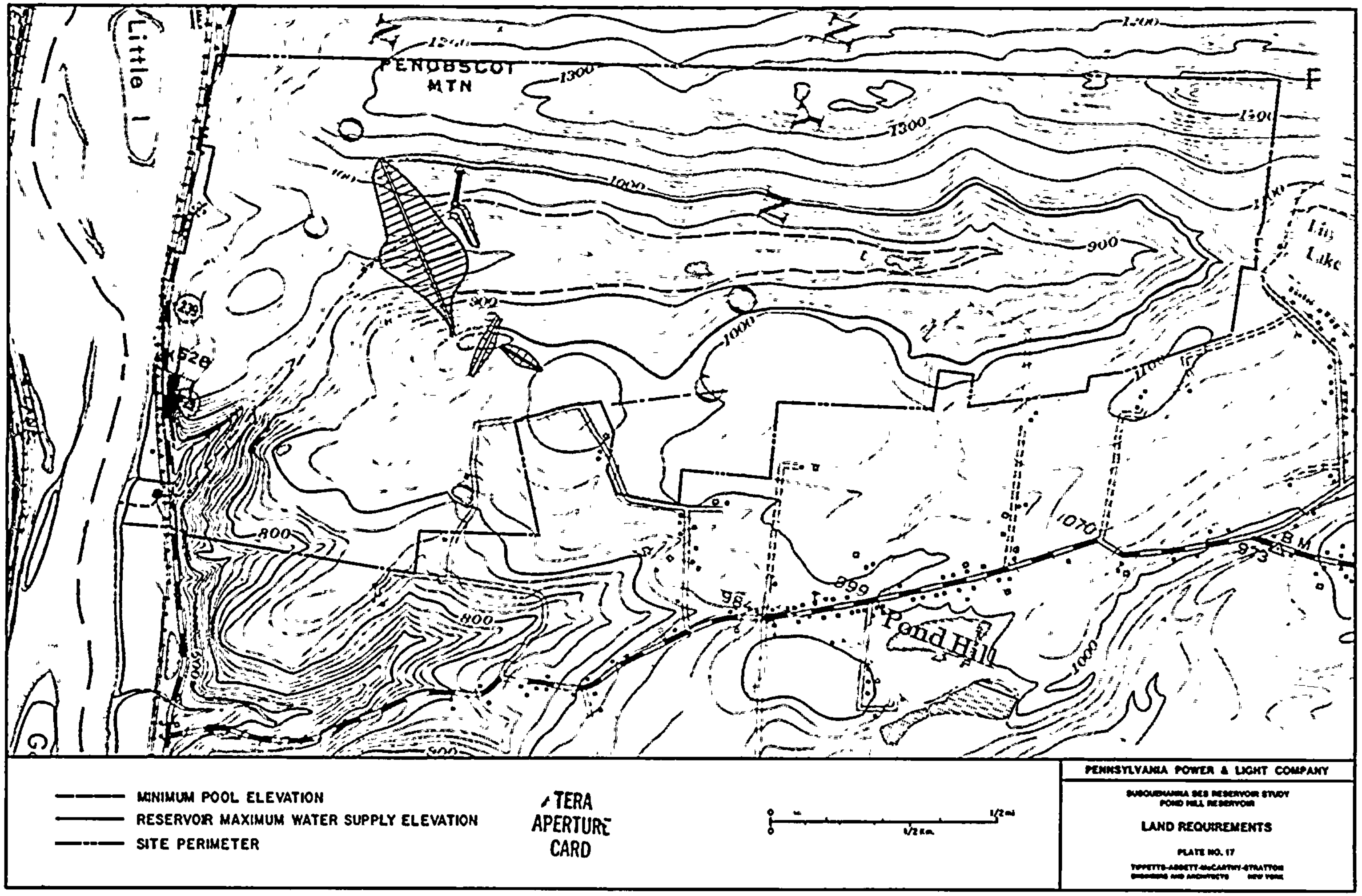


Fig. A.2.2. General Plan of the Pond Hill Reservoir Project



TERA APERTURE CARD

Fig. A.2.3. Land Requirements for the Pond Hill Reservoir Project

A.2.3.2 Hydrology

Pond Hill Creek is a small stream with headwaters approximately 1.3 km north of the town of Pond Hill. The stream flows westerly for 3.5 km to its confluence with the Susquehanna River, 3.7 km upstream from the Susquehanna Steam Electric Station. There are no significant tributaries to Pond Hill Creek. During dry periods, the streamflow decreases and some sections become essentially intermittent, with water remaining only in the streambed interstices. The proposed reservoir will inundate a 2.3-km (64%) upstream section of the stream, leaving 1.3 km from the dam to the Susquehanna River. For purposes of this discussion, the flooded stream and lower, unflooded section are referred to as the "upper" and "lower" portions of Pond Hill Creek, respectively.

The upper section of Pond Hill Creek has an average 11 m/km stream gradient. Throughout most of this section, the stream alternates between small-pool and riffle habitats, with a substrate of boulders, rubble, and some bedrock. This pattern is interrupted in two areas, which were previously inundated as a result of beaver dams. In these areas, the streambed is mostly silt, mud, and gravel. Thus, the resultant stream habitat becomes a long, continuous run. The upper stream has a 2.1-m average width, with measurements ranging from 0.8 to 3.6 m throughout the year. The average depth is approximately 0.1 m, with a total range of from 0.03 to 0.39 m. Current velocities average 0.005 m/s, ranging from 0.003 to 0.02 m/s.

The lower section of Pond Hill Creek has a much steeper gradient; the average stream gradient in this section is about 70 m/km. The 2.6-m average stream width ranges from 0.9 to 4.2 m, and the average depth is approximately 0.1 m, with a minimum of 0.03 and a maximum of 0.39 m. Current velocities average roughly 0.007 m/s, ranging from 0.003 to 0.02 m/s. Characteristically, the stream substrate is bedrock and boulders along with some rubble and isolated patches of gravel. Because of the sharp gradient, stream habitats are typically shallow, fast-flowing riffles interspersed with small pools. There are several small, and one relatively large, waterfalls in this part of the stream. In addition, at Route 239, the stream passes through a culvert and falls about 1.5 m from the elevated culvert back into the stream channel.

Since there are neither extensive nor accessible published data concerning the aquatic ecology of Pond Hill Creek, information presented in the following sections was gathered from field surveys conducted by the applicant from September 1977 to August 1978 (ER-OL, Section 3.2.3.1.1). The locations of the water quality and biological sampling stations used at Pond Hill Creek are presented in Figure A.2.4. Water quality samples were taken monthly at the site, and biological samples were collected quarterly. In addition, a fish sample was taken from three small farm ponds, which are located at the site and drain into Pond Hill Creek.

The drainage area of the stream above the proposed site of the dam is 329 ha. Because there is no gauging station on the stream, no information on historic flows is available. The applicant did, however, estimate flood flows using standard hydrologic methods. The estimated 4% chance (25-year recurrence) flood flow is 39.3 m^3/s, the 1% chance (100-year) flood flow is 49.7 m^3/s, and the estimated probable maximum flood flow is 202 m^3/s. In addition, the methodology utilized by the Pennsylvania Department of Environmental Resources (DER) to estimate the seven-day, ten-year low flow results in a flow of 0.005 m^3/s. It is probable, however, that the stream does not flow at all during drought periods. The hydrology of the Susquehanna River was discussed earlier.

The floodplain of Pond Hill Creek below the proposed site of the dam is very narrow (Fig. A.2.5). The floodplain of the Susquehanna River in the vicinity of the proposed location of the pumping station is shown in Figure A.2.6.

Data from borings and wells indicate that the groundwater contours in the vicinity of the proposed reservoir generally follow the surface contours. On the ridges north and south of the stream channel, groundwater was usually encountered between 4 and 15 m below the surface. The stream valley contains several marshes, springs, and farm ponds.

A.2.3.3 Water Sources

At present there are no users of Pond Hill Creek water. A spring within the proposed project boundary is used as a water supply during part of the year. Its use would have to be abandoned. Most of the nearby residences obtain water from individual wells. There are no wells within the proposed project boundary.

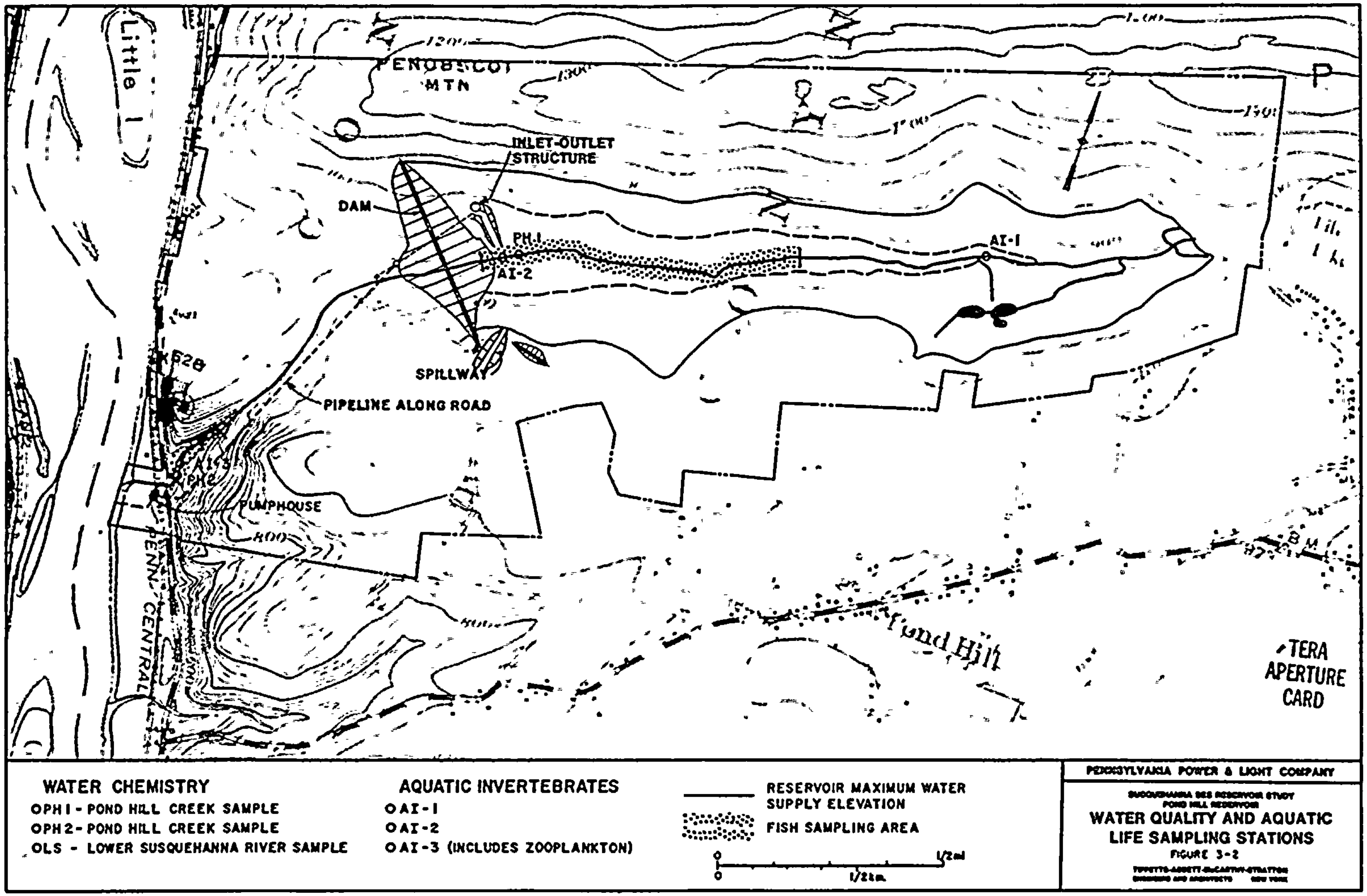
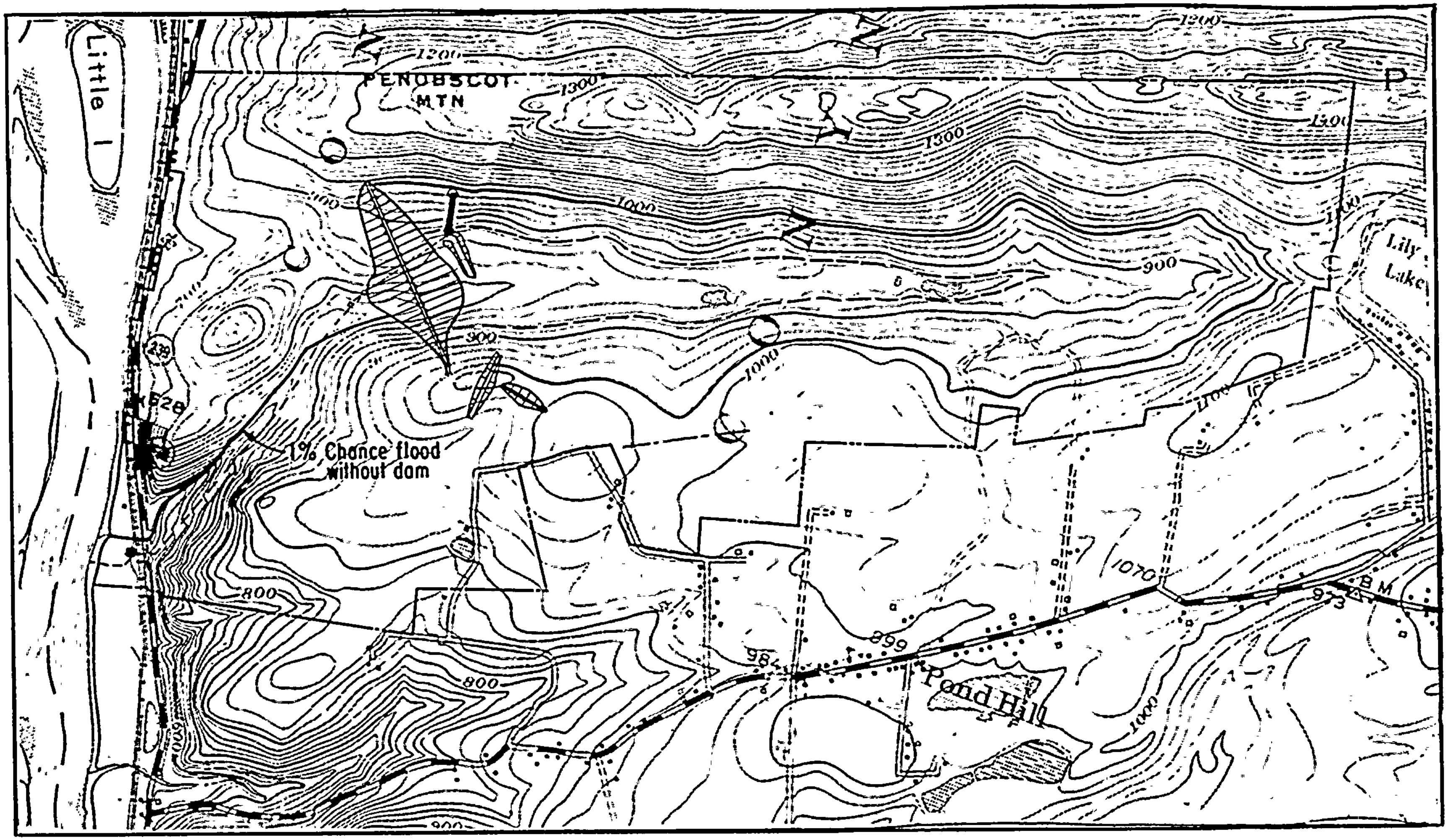


Fig. A.2.4. Water Quality and Aquatic Life Sampling Stations at Pond Hill Creek (Source: Tippetts-Abbett-McCarthy-Stratton/Engineering and Architects).



MINIMUM POOL ELEVATION
RESERVOIR MAXIMUM WATER SUPPLY ELEVATION
SITE PERIMETER

Fig. A.2.5. Floodplain of Pond Hill Creek

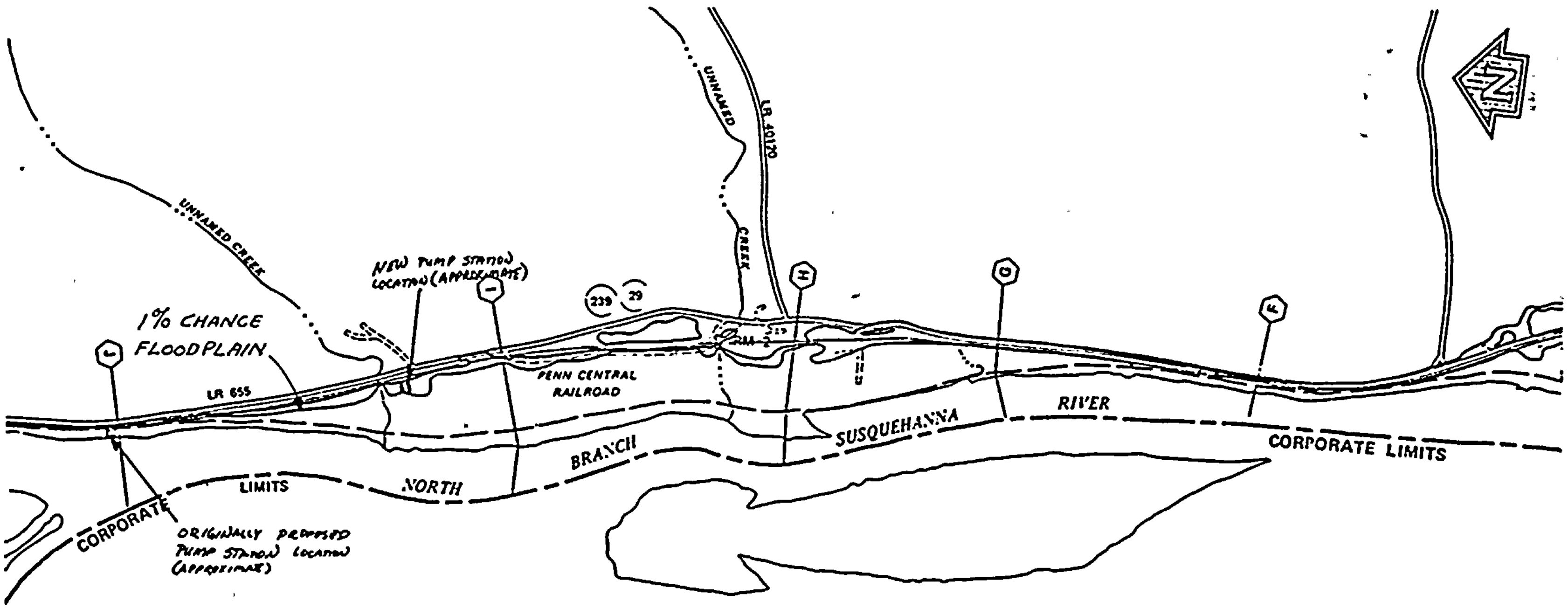


Fig. A.2.6. Floodplain of the Susquehanna River in the Vicinity of the Pond Hill Site.

A.2.4 GEOLOGY AND SEISMOLOGY

A.2.4.1 Geology

The proposed Pond Hill Reservoir site is located in the Penobscot Mountain area in the northern portion of the Valley and Ridge Physiographic Province. The province is characterized by intensely faulted and deeply eroded sedimentary rocks of Paleozoic age. Topographically, erosion-resistant sandstone formations form long narrow ridges; valleys were formed in the less resistant limestones and shales.

During the Paleozoic Era, the Appalachian Mountain region was a depositional basin collecting thick sediments. Sedimentation was interrupted several times by mountain-building activities climaxing in the Appalachian Mountains toward the end of the era. Since that time, the primary ongoing geologic process has been erosion.

The reservoir site is in an area that was glaciated during the last ice age, the Pleistocene Epoch. As a result, the highly weathered rocks (parent material) and original soil were removed; the present soils are typical of those formed in glaciated regions.

Bedrock in the reservoir area consists of sandstone, siltstone, and shale of the Catskill formation of Devonian age. To the north, the Catskill formation is overlain by younger Mississippian and Pennsylvanian formations including anthracite coal beds. To the south, the Catskill formation is underlain by older sedimentary rocks.

The strike of the formations is N 68 degrees E, and dip is northwesterly at angles from about 40 to 60 degrees, averaging about 45 degrees. Jointing is evident and primarily parallels the bedding, although a few low and high angle joints are also present. Joints in the weathered zone are filled with clay. Below the weatherbed zone, the joints are generally tight; some have been healed with calcite.

A.2.4.2 Seismology

The site is located in Zone 1 (minor damage) on the Seismic Risk Map of the Conterminous United States.[1] The site is about 160 km from the nearest Zone 2 (moderate damage) boundary and 210 km from the nearest Zone 3 (major damage) boundary.

Records of earthquake history in the site region were examined together with an evaluation of regional and local geologic structures to estimate the seismic risk at the site. This analysis resulted in a recommended design basis seismic coefficient of 0.025.

Several Intensity VI (Modified Mercalli Scale) earthquakes have been recorded within 160 km of the site. Many of these were not felt at the site; others were felt at the site with intensities equal to or less than IV.

No known faults have been identified in the vicinity of the site. Although low angle thrust faults abound in this part of the Valley and Ridge Province, they ordinarily cannot be identified except through detailed mapping. Thrust faults, however, are not generally associated with recurring seismic activity.

Reservoir-induced earthquakes are not anticipated as the proposed reservoir is small and there are no known subsurface structural weaknesses.

On the basis of this assessment, the seismic coefficient of 0.05 that has been used in the design of project features is considered by the staff as conservative.

A.2.5 SITE ECOLOGY

A.2.5.1 Terrestrial Ecology

The north and south boundaries of the Pond Hill site generally parallel the upper ridges of a small, steep-walled valley; thus the environmental conditions at given locations within the site strongly reflect the influence of the local topography (see Fig. A.2.3). The occurrence of aquatic environments is essentially limited to the narrow valley bottom traversed by Pond Hill Creek, a small drainageway that converges with the Susquehanna River near the west boundary of the site. In general, soil moisture levels in terrestrial environments decrease at increasing distances normal to Pond Hill Creek. However, the topographic influence on local soil moisture gradients is most pronounced in the northern portion of the site, where the valley wall is higher, the slopes are uniformly steeper, and the predominately south-facing slopes are exposed to greater insolation. Accordingly, plant communities occurring on the middle and upper valley slopes tend to be dominated by species tolerant of relatively low soil moisture levels, while lowland vegetation is typically dominated by species with relatively high moisture requirements.

A.2.5.1.1 Vegetation

The Pond Hill site is located in the extreme northern portion of the Ridge and Valley Section, a subdivision of the Oak-Chestnut Region delineated by Braun.[2] Although hardwood communities were considered characteristic vegetation for this part of the section, Braun also noted the presence of hemlock and hemlock-white pine communities, referred to as the "most mesic" communities of the higher valleys. The occurrence of hemlock and white pine was considered indicative of transition to the more northerly Hemlock-White Pine-Northern Hardwoods Region. The foregoing and other reported observations are generally consistent with the applicant's characterization of forest vegetation occurring at the Pond Hill site.

The applicant differentiated vegetation of the site into two forest types, two wetland communties, and undifferentiated old fields and cropland (ER-OL, Appendix H, Table 3-1). About 92% of the total site (525 ha) is classified as forest land, about 7% as old fields and cropland, and less than 1% as wetlands. Principal species of each vegetation type are indicated in Table A.2.1.

Essentially all forest vegetation is second growth having developed subsequent to logging believed to have occurred during the early 1900s (ER-OL, Appendix H, Section 3.2.2.2). Most of the forest stands have not been disturbed for the last 30 to 40 years. The Mixed Deciduous is the most extensive of the two forest types, occurring on about 74% of the site; the Mixed Coniferous-Deciduous type on about 19%. The latter type is present in relatively narrow, irregular belts paralleling all but the extreme lower portion of Pond Hill Creek where the stream gradient is particularly steep. This type also occurs as scattered stands on the lower slopes adjacent to the Susquehanna River, and as relatively small outliers on upland portions of the south valley slope where the more favorable soil moisture conditions prevail. The Mixed Deciduous type generally occurs on the drier uplands, thus flanking distributions of the Mixed Coniferous-Deciduous type. Stands of the Mixed Deciduous type do, however, occur adjacent to Pond Hill Creek in limited areas. Wetlands, old fields and cropland occurs on the remaining 7% of the site.

Small wetlands are located in the valley bottom adjacent to Pond Hill Creek. The Type 3 wetland, an inland shallow fresh marsh,[3] resulting from the union of several seeps and soils are saturated throughout the year. The presence of at least five small areas of Type 2 wetlands, inland fresh meadows, is attributed to previous beaver activities; the beaver dams are presently in disrepair.

Old field and cropland vegetation occurs as variously scattered blocks adjacent to, or near, the south boundary of the Pond Hill site. The distribution of this vegetation type generally corresponds with relatively level areas of upland terrain where farm machinery can be operated with relative ease. As observed by the staff during site inspection, most of these areas were being managed for hay production.

In addition to a general site survey, the applicant sampled systematically selected forest stands that would be inundated or otherwise disturbed during completion of the proposed project. The applicant's analysis involved pooling data and calculating overall importance values for individual species (ER-OL, Appendix H, Table 3.2.2-3). Accordingly, the principal overstory species include the following, in decreasing order of importance: red maple, American elm, white oak, eastern white pine, eastern hemlock, and shagbark hickory. A similar listing of understory species includes: American elm, red maple, flowering dogwood, witch-hazel, hawthorn, and round-leaved dogwood.

A.2.5.1.2 Wildlife Resources

A relatively broad array of wildlife habitat types exists within the Pond Hill site. However, as indicated in Section A.2.5.1.1, forest habitats prevail throughout most of the site. The predominance and the distribution of forest vegetation occurring onsite tends to limit the occurrence of less mobile animals that are at least partially dependent on resources of other habitat types. In general, transitions or ecotones between diverse, adjoining plant communities are utilized by animals common to both communities, as well as additional species variously dependent on habitat conditions existing only in the ecotone. The density of animals associated with the ecotone also frequently exceeds that for either of the adjoining communities.[4] Thus the diversity and density of wildlife animals associated with extensive, uniform forest vegetation tend to be lower than for populations frequenting an equal area in which forest and other plant communities are variously interspersed. In view of the greater interspersion of habitats (forest types, old fields, cropland, and wetlands) in the southern uplands and valley floor of the Pond Hill site, the abundance and diversity of wildlife populations is expected to be relatively high compared to that for northern portions of the site, where the vegetation consists primarily of uniform deciduous forest.

Table A.2.1. Principal Plant Species of Terrestrial Vegetation Types Occurring at the Pond Hill Site[a]

Vegetation Types	Principal Species
Mixed Coniferous-Deciduous	
Overstory:	American elm (*Ulmus Americana*), eastern hemlock (*Tsuga canadensis*), red maple (*Acer rubrum*), eastern white pine (*Pinus strobus*), white ash (*Fraxinus americana*)
Associate species:	Black ash (*Fraxinus nigra*), white oak (*Quercus alba*), round-leaved dogwood (*Cornus rugosa*), flowering dogwood (*C. florida*), hawthorn (*Crataegus* sp.), shagbark hickory (*Carya ovata*)
Understory and ground flora:	Chestnut oak (*Quercus prinus*), swamp white oak (*Q. bicolor*), American beech (*Fagus grandifolia*), witch-hazel (*Hamamelis virginiana*), hawthorn, Virginia creeper (*Parthenocissus quinquefolia*), lady fern (*Athyrium filix-femina*), Christmas fern (*Polystichum acrostichoides*) poison ivy (*Rhus radicans*)
Mixed Deciduous	
Overstory:	American elm, red maple, white oak, shagbark hickory, sassafrass (*Sassafras albidum*)
Associate species:	Chestnut oak, flowering dogwood, eastern white pine, eastern hemlock, gray birch (*Betula populifolia*)
Understory and ground flora:	Flowering and round-leaved dogwood, witch-hazel, American elm, red maple, white oak, gray birch, sassafrass, American chestnut (*Castanea dentata*), mountain laurel (*Kalmia latifolia*), ground cedar (*Lycopodium tristachyum*), tree clubmoss (*Lycopodium obscurum*)
Type 2 wetland:	
Overstory:	Dead trees
Understory and ground flora:	Mad-dog skullcap (*Scutellaria laterifolia*), goldenrods (*Solidago* sp.), sphagnum (*Sphagnum* sp.), skunk-cabbage (*Symplocarpus foetidus*)
Type 3 wetland:	
Overstory:	Eastern hemlock
Understory and ground flora:	Sphagnum, skunk-cabbage, cinnamon fern (*Osmunda cinnamomea*), common cattail (*Typha latifolia*), shining clubmoss (*Lycopodium lucidulum*), mayapple (*Podophyllum peltatum*)
Old-fields and cropland	
Ground flora:	White and red clover (*Trifolium repens*, *T. pratense*), common sorrel (*Rumex acetosella*), ox eye daisy (*Chrisanthemum leucanthemum*), common and English plantains (*Plantago major*, *P. lanceolata*), timothy (*Phelum pratense*), junegrass (*Koelria cristata*), sweet vernal grass (*Anthoxanthum odoratum*)

[a]Source: ER-OL, Appendix H, Section 3.2.2.2.

Mammals

Published distribution maps indicate that the Pond Hill site is within the ranges of about 55 mammals,[5] however, habitat requirements for many of these species is lacking or poorly represented at the site. The applicant has identified 15 species as being "field checked" during site surveys; an additional species, porcupine (*Erethizon dorsatum*), was subsequently observed at the site (ER-OL, Supp., Response to NRC Q.13, 28 September 1979).

The whitetail deer (*Odocoileus virginianus*) and black bear (*Ursus americanus*) are the largest of the game species occurring in the area. Eastern gray squirrels (*Sciurus carolinensis*) are abundant, but the density of eastern cottontail (*Sylvilagus floridanus*), a popular game species, is relatively low compared to that of other areas (ER-OL, Appendix H, Section 3.2.2.3). Other species that may be legally hunted with firearms and are known or likely to occur in the area include: eastern fox squirrel (*Sciurus niger*), red squirrel (*Tamiasciurus hudsonicus*), raccoon (*Procyon lotor*), woodchuck (*Marmota monax*), and snowshoe hare (*Lepus americanus*). Locally trapped species of fur-bearing animals include: raccoon, striped skunk (*Mephitis mephitis*), shorttail and longtail weasels (*Mustela erminea, M. frenata*), opossum (*Didelphis marsupialis*), mink (*Mustela vison*), red fox (*Vulpes fulva*), gray fox (*Urocyon cinereoargenteus*), muskrat (*Ondatra zibethica*), and beaver (*Castor canadensis*).

The applicant conducted small-mammal trapping studies at the site, resulting in the capture of shorttail shrew (*Blarina brevicauda*), boreal redback vole (*Clethrionomys gapperi*), and white-footed mouse (*Peromyscus leucopus*). The pine vole (*Pitymys pinetorum*), eastern chipmunk (*Tamias striatus*), and deer mouse (*Peromyscus maniculatus*) were also observed (ER-OL, Appendix H, Table 3.2.2.6).

None of the ten bat species reported to occur in the region[2] were observed during site surveys; however, all are variously associated with forest or woodland habitats. Some species probably frequent the site, at least on occasion. Other likely inhabitants of the site are noted as follows. Meadow jumping mouse (*Zapus hudsonius*) and meadow vole (*Microtus pennsylvanicus*) are frequently occurring species of moist meadows, old fields, and cropland.[6] Masked and smoky shrews (*Sorex cinereus, S. fumeus*) are also typical inhabitants; the former inhabits a wide range of habitats, the latter inhabits hemlock forest.

Birds

Information presented by the appliant indicates that "the list of birds for the region" includes 135 species, and that recent seasonal surveys verified the occurrence of 75 resident and migratory species at the Pond Hill site. Also noted, "60 species not field checked may also be using the area" (ER-OL, Supp., Response to NRC Q.11, 28 September 1979). However, a total of 210 bird species were identified during surveys conducted in the vicinity of the Susquehanna Steam Electric Station located about 4 km downstream from the Pond Hill site.[7] All species identified at Pond Hill are included in the inventory compiled from surveys at the SSES site. The inventories for the two sites are also similar in that both are comprised of a high proportion of species representative of the families Parulidae (wood warblers) and Fringillidae (grosbeaks, finches, sparrows). In combination, species of the named families comprise 35.8% (21.1 and 14.7%, respectively) of the Pond Hill species inventory. As derived from 1978 surveys at the SSES site, comparable percentages for the two families were 15.1 and 13.5, respectively.

The major difference between the SSES and Pond Hill inventories is apparent in that the latter does not include waterfowl and other species variously associated with aquatic habitats. However, the 1978 SSES surveys entailed censusing the Susquehanna River, including that portion of the river adjacent to the Pond Hill site. The species most frequently observed during the spring migration period included, in decreasing order of occurrence: Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), woodduck (*Aix sponsa*), common merganser (*Mergus merganser*), ring-necked duck (*Aythya collaris*), and black duck (*Anas rubripes*). Some of these species, especially woodduck and mallard, probably inhabit the Pond Hill site at various times. Other recorded species that variously use habitats similar to those onsite include: killdeer (*Charadrius vociferus*), spotted sandpiper (*Actitis macularia*), greater and lesser yellowlegs (*Tringa melanoleucus, T. flavipes*), belted kingfisher (*Megaceryle alcyon*), and great blue heron (*Ardea herodius*).

Upland game birds identified during surveys at the Pond Hill site include only ruffed grouse (*Bonasa umbellus*) and wild turkey (*Meleagris gallopavo*) (ER-OL, Appendix H, Table 3.2.2-6). Eastern portions of the site are periodically stocked with turkey and ring-necked pheasants (*Phasianus colchicus*); the latter species was not observed during surveys. Typical habitat of the American woodcock (*Philohela minor*) exists onsite, and, although not observed, the species is expected to be present (ER-OL, Appendix H, Section 3.2.2.3). The bobwhite (*Colinus virginianus*) is also known to occur in the Pond Hill area.[7] Ruffed grouse was the only commonly observed game bird species during site survey.

Information concerning the relative abundance of nongame birds that frequent the Pond Hill site is not available, but other studies serve to characterize local bird populations.[7,8] Accordingly, the characteristic species of forest habitats include: black-capped chickadee (*Parus atricapillus*), slate-colored junco (*Junco hyemalis*), white-breasted nuthatch (*Sitta carolinensis*), golden-crowned kinglet (*Regulus satrapa*), and downy woodpecker (*Dendrocopus pubescens*). Other species abundant during two or more seasons include: blue jay (*Cyanositta cristata*), ovenbird (*Seirus aurocapillus*), and wood thrush (*Hylocichla mustelina*).

Bird populations of open-field habitats tend to be dominated by field sparrows (*Spizella pusilla*), song sparrows (*Melospiza melodia*), starling (*Sturnus vulgaris*), and American goldfinch (*Spinis tristis*). Other seasonally abundant species include: yellowthroat (*Geothlypis trichas*), slate-colored junco, and indigo bunting (*Passerina cyanea*).

Characteristic species of wetland habitats include: swamp sparrows (*Melospiza georgiana*), song sparrows, red-winged blackbird (*Agelaius phoeniceus*), cardinal (*Richmondena cardinalis*), and American goldfinch. Other species well represented during two or more seasons include: robin (*Turdus migratorius*), yellow warbler (*Dendroica petechia*), gray catbird (*Dumetella carolinensis*), yellowthroat, and starling.

Reptiles and Amphibians

Inventories of reptiles and amphibians reported occurring in Pennsylvania consist of 48 and 38 species and subspecies, respectively.[9] Based on published species-distribution maps, only 20 amphibians and 19 reptiles are likely to inhabit the Pond Hill area.[10] Inventories compiled from surveys of the Pond Hill site consist of 5 reptiles and 17 amphibians (ER-OL, Appendix H, Table 3.2.2-6).

Reptiles reported as occurring onsite include 3 snakes and 2 turtles. The venomous northern copperhead (*Agkistrodon contortrix mokasen*) is associated with forest habitat; the northern water snake (*Ratrix sipedon sipedon*) with all aquatic habitats, and the eastern garter snake (*Thamnophis sirtalis sirtalis*) with all terrestrial and aquatic habitats. Midland painted turtles (*Chrysemys picta marginata*) were observed in the marshes; the eastern box turtle (*Terrapene carolina carolina*) occurred in all terrestrial habitats (ER-OL, Appendix H, Table 3.2.2-6).

Anurans (frogs and toads) reported as occurring in forest habitats near water include:, American toad (*Bufo americanus*), spring peeper (*Hyla crucifer*), and gray treefrog (*Hyla versicolor*). Wood frog (*Rana sylvatica*) were observed in moist woods, as well as streamside. Northern leopard frog (*Rana pipiens*) was observed to frequent meadow habitats. Other anurans (3 frogs) identified during surveys were associated with the limited stream and marsh habitats occurring onsite. Similarly, most salamanders, as well as the red-spotted newt (*Notopthalmus viridescens viridescens*) were observed in streamside habitats. The exceptions, red-backed and slimy salamanders (*Plethodon cinereus cinereus, Plethodon glutinosus glutinosus*), were associated with forest and rocky woodland habitats. Mountain dusky salamanders (*Desmognathus ochrophaeus*) and northern spring salamanders (*Gyrinophilus porphayriticus*) were reported to frequent wet woods as well as streamside habitats.

A.2.5.1.3 Endangered and Threatened Species

None of the current federally designated plant species (including varieties) of endangered or threatened status occur in Pennsylvania.[11] Five plants that were proposed for federal listing in 1976[12] are reported to occur in the state; known distributions of these five species, however, do not include Luzerne County, within which the Pond Hill site is located (see Appendix A). A grass species (*Poa paludigina*) proposed for federal listing in 1975[13] has been collected in Luzerne County; however, the species was not observed in 1979 site surveys (ER-OL, Supp., Response to NRC Q.9, 28 September 1979).

The Pond Hill site is within the reported distributional range of two mammals and three birds included in the federal list of threatened and endangered species;[11] namely, the eastern cougar (*Felis concolor cougar*), Indiana bat (*Myotis sodalis*), bald eagle (*Haliaeetus leucocephalus*), and American and arctic peregrine falcons (*Falco peregrinus anatum, F. p. tundrius*). None of these animals was observed during surveys of the Pond Hill site (ER-OL, Appendix H, Section 3.2.2.3), although recent local sightings of bald eagle and American peregrine falcon have been reported.[7,8] The nature of these sightings is consistent with information received by the staff that indicates federally listed or proposed endangered or threatened animals under the jurisdiction of the U. S. Fish and Wildlife Service (including those mentioned) are not known to frequent the Pond Hill area other than as occasional transient individuals (see Appendix A).

None of the reptiles and amphibians designated as threatened or endangered species by the Pennsylvania Fish Commission[14] were observed during surveys of the Pond Hill site (ER-OL, Appendix H, Section 3.2.2.3). Comparable state designations of endangered or threatened mammals and birds have not been made at this time (ER-OL, Supp., Response to NRC Q. TER- 6.1).

A.2.5.1.4 Soils

An estimated 84% of the Pond Hill site soils are of Capability Classes V through VIII as defined by the U.S. Soil Conservation Service (ER-OL, Appendix H, Table 3.2.6-4) and are unsuited for normal tillage of agricultural crops. These onsite soils are characterized by excessive stoniness, wetness, shallowness, and/or erosion hazard. Capability Class II soils (including prime farmland) are present on about 9.6% of the site, and occur as scattered, irregular tracts near or adjacent to the south boundary of the site. The distribution of Class II soils is limited to the more level areas of upland terrain.

The remaining soils of the site are designated as Class III and IV soils (ER-OL, Appendix H, Fig. 3-13), thus indicating suitability for the production of cultivated crops. However, the respective severe and very severe limitations of Class III and IV soils restrict cropland management alternatives, such as choice of crop plants and/or soil management practices required to conserve the soil resource. Some scattered patches of Class III and IV soils occur in the valley bottom and adjacent to the Susquehanna River; most of these soils, however, are contiguous with Class II soils in uplands of the southern portion of the site.

The foregoing groupings of onsite soils are based on relative potentials for agricultural productivity. In view of the high proportion of forest vegetation occurring onsite, soil-woodland site index correlations are also indicative of onsite soil productivity. With one exception, woodland productivity ratings for the major grouping of onsite soils are high (ER-OL, Appendix H, Table 3.2.6-5).

A.2.5.2 Aquatic Ecology

A.2.5.2.1 Water Quality

A.2.5.2.1.1 *POND HILL CREEK*. The Pennsylvania Department of Environmental Resources has recently promulgated a revised set of water quality regulations for the state's surface waters. The water quality criteria that apply to Pond Hill Creek under these regulations are presented in Table A.2.2. In this system, Pond Hill Creek is classified with the unnamed tributaries to the North Branch of the Susquehanna River, and has a designated protected water use for the maintenance and/or propagation of coldwater fishes, specifically the Salmonidae (trout); however, fish sampling failed to reveal the presence of trout in the stream (ER-OL, Section 3.2.3.1.2).

Monthly water samples were collected from both the upper and lower sections of Pond Hill Creek. Results of the analyses of these samples are presented in Tables A.2.3 and A.2.4. In general, Pond Hill Creek is a clear, highly oxygenated, coldwater stream. It has soft water and is weakly buffered. The water quality of Pond Hill Creek meets both the criteria proposed by DER and those recommended for fish and other aquatic life by EPA. A few parameters, specifically fecal coliforms and ammonia, occasionally exceeded DER criteria, but the magnitude by which the standards were surpassed was not excessive.

A.2.5.2.1.2 *SUSQUEHANNA RIVER AT RESERVOIR PUMP STATION SITE*. Water quality criteria and analyses for the Susquehanna River were discussed in the main body of this Statement.

Additional samples were collected from the river at the proposed intake location; results of the analyses are tabulated in Table A.2.5. Sampling was conducted from March to August 1978. The data indicate that all parameters except total iron and fecal coliform bacteria comply with the DER recommended criteria for the river.

A.2.5.2.2 Aquatic Life

A.2.5.2.2.1 *POND HILL CREEK*. Qualitative samples of plankton, periphyton, and macrophytes were collected in Pond Hill Creek. Quantitative sampling was conducted for benthic macroinvertebrates (ER-OL, Section 3.2.3.1.3) and fishes.

Very few organisms were found in any of the plankton samples taken at Pond Hill Creek. Virtually all of the planktonic species collected were washed out or detached from the periphyton community. These included the diatoms (*Synedra, Nitzschia, Navicula,* and *Stauroneis*) along with fragments of the filamentous green algae (*Spriogyra*). Zooplankton samples revealed the presence of a few rotifers, ostracods, cladocerans, copepods, and some drifting insect larvae. In general, the plankton of Pond Hill Creek is typical of most small streams, where the constant turbulent

Table A.2.2. Water Quality Criteria for Pond Hill Creek[a]

Stream	Zone
Unnamed Tributaries of the Susquehanna River (North Branch)	Basins, Lackawanna River to West Branch Susquehanna River
Protected water uses	Coldwater fishes; maintenance and/or propagation of fish species including the family Salmonidae and additional flora and fauna indigenous to a coldwater habitat.
Dissolved oxygen	Minimum daily average 6.0 mg/L; no value less than 5.0 mg/L. For lakes and impoundments only, no value less than 5.0 mg/L at any point.
pH	Not less than 6.0 and not more than 9.0.
Iron	Not to exceed 1.5 mg/L as total iron; not to exceed 0.3 mg/L as dissolved iron.
Temperature	No measurable rise when ambient temperature is 14¼C or above; not more than a 2.8¼C rise above ambient temperature until stream temperature reaches 14¼C; not to be changed by more than 1.1¼C during any one-hour period.
Total filterable residue at 105¼C	Not more than 500 mg/L as a monthly average value; not more than 750 mg/L at any time.
Bacteria (fecal coliform)	During the swimming season (May 1 - September 30), the fecal coliform level shall not exceed a geometric mean of 200 per 100 mL based on five consecutive samples collected on different days; for the remainder of the year, the fecal coliform level shall not exceed a geometric mean of 2000 per 100 mL based on five consecutive samples collected on different days.
Alkalinity	Alkalinity shall be 20 mg/L or more as $CaCO_3$ for freshwater aquatic life, except where natural conditions are less.
Total manganese	Not to exceed 1.0 mg/L.
Flouride	Not to exceed 2.0 mg/L.
Cyanide	Not to exceed 0.005 mg/L as free cyanide.
Sulfate	Not to exceed 250 mg/L.
Phenol	Not to exceed 0.005 mg/L.
Copper	Not to exceed 0.1 of the 96-hour LC 50 for representative important species.
Zinc	Not to exceed 0.01 of the 96-hour LC 50 for representative important species.
Aluminum	Not to exceed 0.1 of the 96-hour LC 50 for representative important species.
Arsenic	Not to exceed 0.05 mg/L.
Chromium	Not to exceed 0.05 mg/L as hexavalent chromium.
Lead	Not to exceed 0.05 mg/L.
Nickel	Not to exceed 0.01 of the 96-hour LC 50 for representative important species.
Nitrite plus nitrate as nitrogen	Not to exceed 10 mg/L as nitrate nitrogen.
Ammonia nitrogen	Not more than 0.5 mg/L.

[a]Source: ER-OL, Vol. IV, Appendix H, Table 3.2.3-1.

Table A.2.3 Water Quality Data from the Upper Section of Pond Hill Creek[a]

Parameter[b]	1977				1978												
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	N[c]	Mean	S.D.[d]	Max.	Min.
Temperature, water (°C)	17.0	9.0	6.0	3.5	-0.5	0.0	5.0	8.0	10.0	12.0	14.0	17.5	12	8.5	2.92	17.5	-0.5
Dissolved oxygen (ppm)	9.3	11.2	11.3	12.5	13.0	12.4	--	12.3	11.6	9.9	8.4	8.2	11	10.9	3.30	13.0	8.2
BOD	7.0	3.0	2.1	0.5	<0.5	<1	<1	<1	2.0	<1.0	<1.0	1.0	12	1.8	1.33	7.0	<0.5
COD	10.1	8.0	3.6	4.0	<5	7.3	<5	<5	<5	17.0	9.0	23.0	12	8.5	2.92	23.0	3.6
pH (s.u.)	7.00	6.30	7.25	6.70	6.80	7.25	6.45	7.20	--	7.30	6.60	6.80	11	6.88	2.622	7.30	6.30
Alkalinity as $CaCO_3$	5.5	2.8	2.3	6.4	17.5	3.7	1.8	8.3	4.0	14.0	17.0	17.0	12	8.4	2.89	17.5	1.8
Total hardness as $CaCO_3$	24.0	17.0	20.0	15.0	15.0	16.0	17.5	30.0	14.0	18.0	82.0	20.0	12	24.0	4.90	82.0	14.0
Total dissolved solids	89.4	44.8	8.4	<0.5	99.4	37.8	3.0	45.5	37.6	56.5	47.4	50.4	12	43.4	6.59	99.4	<0.5
Total suspended solids	150.0	<0.5	516.0	3.4	11.3	13.1	6.1	6.3	2.5	9.6	6.3	40.7	12	63.8	7.99	516.0	0.5
Turbidity (JTU)	--	1.0	2.5	0.6	2.2	6.0	2.3	2.0	1.9	5.5	7.0	10.0	11	3.7	1.93	10.0	0.6
Specific conductance (µmhos)	55	48	42	46	48	48	48	52	52	49	--	53	11	49.2	7.10	55	42
Color (CPU)	11	<1	3	4	5	6	<1	7	10	22	23	28	12	10.1	3.18	28	<1
Sulphate as S	13.7	11.0	12.0	11.0	16.0	10.5	11.3	12.0	11.0	6.0	1.0	<1.0	12	9.7	3.12	16.0	1
Ortho phosphate as P	0.02	0.01	0.01	0.02	0.01	0.04	0.01	<0.02	0.03	0.02	0.05	<0.01	12	0.02	0.144	0.05	0.01
Total phosphate as P	0.01	0.02	0.02	0.08	0.01	0.04	0.06	0.03	0.09	<0.02	0.05	1.11	12	0.13	0.358	1.11	0.01
Nitrate as N	0.01	0.05	0.10	0.03	0.27	0.20	0.24	0.20	0.43	0.13	0.12	0.16	12	0.16	0.402	0.43	0.01
Chloride	1.6	3.4	2.3	4.3	5.5	3.1	<0.5	0.5	1.7	0.4	1.7	0.6	12	2.1	1.461	5.5	0.4
Total copper	<0.02	<0.02	<0.02	0.03	<0.02	0.05	0.02	0.02	<0.02	<0.02	<0.02	<0.02	12	0.02	0.153	0.05	<0.02
Total iron	0.47	0.49	0.21	0.26	0.29	0.39	0.40	0.35	0.80	0.87	1.40	1.64	12	0.63	0.794	1.64	0.21
Total manganese	0.05	0.03	0.03	<0.02	0.02	0.02	0.04	<0.02	0.05	0.05	0.07	0.02	12	0.05	0.224	0.20	<0.02
Coliform total MPN/100 mL	1100	1100	1100	210	43	240	240	>2400	210	>2400	1100	2400	12	1045.3	32.33	>2400	43
Coliform fecal MPN/100 mL	93	93	150	64	<3	<3	240	460	23	1100	23	1100	12	279.3	16.71	1100	<3
Fecal streptococci MPN/100 mL	<1	<1	5	25	<1	<1	<1	<1	20	35	10	30	12	10.9	3.30	35	<1

[a]Source: ER-OL, Vol. IV, Appendix H, Table 3.2.3-2.
[b]Units mg/L unless stated otherwise.
[c]N = number of samples.
[d]S.D. = standard deviation.

Table A.2.4. Water Quality Data from the Lower Section of Pond Hill Creek[a]

Parameter[b]	1977 Sept.	Oct.	Nov.	Dec.	1978 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	N[c]	Mean	S.D.[d]	Max.	Min.
Temperature, water (°C)	16.0	9.0	6.5	3.5	0.0	1.0	4.0	6.5	8.0	10.0	14.5	19.0	12	8.2	2.86	16.0	0.0
Dissolved oxygen (ppm)	9.5	11.8	12.0	13.0	13.9	13.1	--	13.3	13.2	12.4	8.9	8.0	11	11.7	3.43	13.9	8.0
BOD	8.0	4.0	1.2	0.5	<0.5	<1	3	<1	2.0	<1.0	<1	1.0	12	2.0	1.42	8.0	<0.5
COD	11.1	7.4	3.4	9.0	6.8	<5.0	<5.0	<5.0	<5.0	7.0	18.0	12.0	12	7.9	2.81	18.0	3.4
pH (s.u.)	7.10	6.65	7.60	7.10	7.00	7.30	7.30	7.55	--	7.10	6.70	6.80	11	7.11	2.666	7.60	6.65
Alkalinity as $CaCO_3$	7.4	11.0	2.3	1.8	23.0	1.8	<1.0	11.0	5.0	11.0	19.0	16.0	12	9.2	3.03	23.0	<1.0
Total hardness as $CaCO_3$	24.0	23.0	19.0	15.0	16.0	17.0	15.5	21.0	22.0	14.0	20.0	21.0	12	19.0	4.35	24.0	14.0
Total dissolved solids	108.0	49.6	15.4	<0.5	102.0	56.0	14.2	133.0	43.3	52.3	44.4	56.2	12	56.2	7.50	133.0	<0.5
Total suspended solids	120.0	<0.5	1.4	3.1	8.9	6.1	5.2	4.9	8.3	8.2	22.4	8.0	12	16.4	4.05	120.0	<0.5
Turbidity (JTU)	--	0.7	3.0	0.8	1.6	5.5	0.6	1.3	2.5	3.6	5.2	3.8	11	2.6	1.61	5.5	0.7
Specific conductance (μmhos)	59	45	48	48	46	45	68	49	50	50	--	55	11	51	7.2	68	45
Color (CPU)	10	<1	3	4	5	4	<1	3	15	12	10	22	12	8	2.7	22	1
Sulphate as S	13.2	12.0	11.8	12.5	16.8	13.6	11.9	11.0	9.0	12.0	6.0	7.0	12	11.4	3.38	16.8	6.0
Ortho phosphate as P	0.02	0.01	0.02	<0.01	0.02	<0.02	0.02	<0.02	0.04	0.06	0.02	<0.01	12	0.02	0.150	0.06	<0.01
Total phosphate as P	0.01	<0.01	0.02	<0.01	0.01	0.05	0.10	<0.02	0.08	0.04	0.02	0.47	12	0.07	0.265	0.47	<0.01
Nitrate as N	<0.01	0.07	<0.05	0.03	0.33	0.21	0.12	<0.10	0.08	0.27	0.24	0.21	12	0.14	0.379	0.33	0.01
Chloride	0.7	2.6	9.5	<0.5	2.9	11.1	<0.5	<0.5	2.1	0.4	1.08	1.1	12	2.7	1.66	11.1	0.4
Total copper	<0.02	<0.02	<0.02	0.03	0.03	0.06	0.02	<0.02	<0.02	0.02	<0.02	<0.02	12	0.03	0.158	0.06	<0.02
Total iron	0.60	0.46	0.22	0.20	0.25	0.39	0.34	0.25	0.41	1.08	3.11	0.65	12	0.66	0.814	3.11	0.20
Total manganese	0.03	0.04	0.02	0.04	0.02	0.02	<0.02	<0.02	0.03	0.04	0.21	0.10	12	0.05	0.222	0.21	<0.02
Coliform total MPN/100 mL	460	240	150	150	43	43	460	460	210	>2400	240	>2400	12	609	24.7	>2400	43
Coliform fecal MPN/100 mL	240	9	23	23	4	<3	43	43	43	93	9	93	12	52	7.2	240	<3
Fecal streptococci MPN/100 mL	10	<1	<1	<1	<1	<1	<1	<1	10	20	<1	<1	12	4	2.0	20	<1

[a]Source: ER-OL, Vol. IV, Appendix H, Table 3.2.3-3.
[b]Units mg/L unless stated otherwise.
[c]N = number of samples.
[d]S.D. = standard deviation.

Table A.2.5. Water Quality in the Susquehanna River near the Proposed Intake Site[a]

Parameter[b]	1978 Mar.	Apr.	May	June	July	Aug.	N[c]	Mean	S.D.[d]	Max.	Min.
Temperature, water (°C)	3.0	7.0	13.5	16.0	22.0	25.0	6	14.4	3.80	25.0	3.0
Dissolved oxygen (ppm)	--	12.6	10.7	14.9	8.9	9.0	5	11.2	3.35	14.9	3.35
BOD	1.0	<1	3.0	<1	2.0	5.0	6	2.2	1.47	5.0	<1
COD	7.0	24.0	5.0	7.0	10.0	25.0	6	13.0	3.61	25.0	5.0
pH (s.u.)	7.25	7.60	--	8.60	7.20	7.20	5	7.57	2.751	8.60	7.20
Alkalinity as $CaCO_3$	23.0	41.4	19.0	46.0	66.0	60.0	6	42.6	6.52	66.0	19.0
Total hardness as $CaCO_3$	66.1	84.0	73.0	109.0	167.0	136.0	6	105.9	10.29	167.0	66.1
Total dissolved solids	67.2	122.0	138.0	196.0	290.0	215.0	6	171.4	13.09	290.0	67.2
Total suspended solids	9.1	21.7	7.5	19.9	9.5	36.5	6	17.4	4.17	36.5	9.1
Turbidity (JTU)	16	7.5	5.1	9.8	11.0	12.0	6	10.2	3.20	16.0	5.1
Specific conductance (μmhos)	160	190	200	230	--	330	5	222	14.9	330	160
Color (CPU)	26	7	25	68	65	80	6	45	6.72	80	7
Sulphate as S	28.8	30.0	46.0	97.0	180.0	148.0	6	88.3	9.40	180.0	28.8
Ortho phosphate as P	0.06	0.04	0.06	0.02	<0.01	0.10	6	0.05	0.22	0.10	<0.01
Total phosphate as P	0.07	0.05	0.12	0.10	0.04	0.84	6	0.20	0.45	0.84	0.04
Nitrate as N	0.97	1.00	0.73	0.61	0.43	0.55	6	0.72	0.846	1.00	0.43
Chloride	12.8	11.0	6.2	11.5	18.4	14.5	6	12.4	3.52	18.4	6.2
Total copper	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	6	<0.02	0.141	<0.02	<0.02
Total iron	2.11	1.96	1.63	2.43	2.34	4.70	6	2.53	1.590	4.70	1.63
Total manganese	0.29	0.19	0.32	0.49	0.66	0.90	6	0.48	0.689	0.90	0.19
Coliform, total MPN/100 mL	>2400	43	>2400	>2400	>2400	>2400	6	2007	44.8	>2400	43
Coliform, fecal MPN/100 mL	240	3	210	460	460	1100	6	412	20.3	1100	3
Fecal streptococci MPN/100 mL	10	<1	35	85	10	65	6	34	5.9	85	<1

[a]Source: ER-OL, Vol. IV, Appendix H, Table 3.2.3-7.

[b]Units mg/L unless stated otherwise.

[c]N = number of samples.

[d]S.D. = standard deviation.

and fast-flowing water usually inhibits the development of a true self-reproducing drift community. Instead, a normally sparse make-shift plankton community is derived from organisms washed out of small ponds and quiet backwaters or dislodged from the streambed and periphyton.

The periphyton community in Pond Hill Creek is dominated by filamentous algae and attached diatoms. The most abundant diatoms were those listed in the previous paragraph. Other relatively common diatoms included *Melosira* and *Cymbella*. The most commonly observed filamentous algae was the green algae *Spirogyra*. Collectively, filaments of *Spriogyra* often formed noticeable tufts upon rocks, sticks, and other debris in the stream. Other filamentous algae present in the periphyton included green algae (*Oedogonium* and *Desmidium*), red algae (*Batrachospermum*), and blue-green algae (*Oscillatoria*). Microfauna found in the periphyton consisted primarily of protozoans, particularly the ciliate *Colpidium* and rotifers from the family Brachionidae.

The most common flowering plants found in the stream included cattails (*Typha*), pondweed (*Potamogeton*), bush pondweed (*Najas*), waterweed (*Elodea*), iris (*Iris*), and watercress (*Nasturtium*). Cattails, pondweeds, and waterweeds were relatively abundant in the upper section of Pond Hill Creek in areas previously inundated by beaver dams. However, the most noticeable macrophytes in the stream were water moss (*Fontinalis*) and leafy liverwort (*Chiloscyphus*), both of which formed dense growths on most of the stones and boulders in the streambed. Water moss and liverwort are generally considered typical inhabitants of hard-bottomed, coldwater streams.[15]

A total of 12,435 macroinvertebrate specimens were collected from seasonal visits to each of three sampling stations at Pond Hill Creek. The average density of these macroinvertebrates was 3,844 organisms/m^2, ranging from a low of 1,789 to a high of 10,411.

The dominant insects found in the macroinvertebrate community of Pond Hill Creek were fly larvae (Diptera) and mayfly nymph (Ephemeroptera). These two groups of insect larvae comprised 44.2 and 28.3%, respectively, of all organisms collected. The most abundant Dipteran larvae were midge larvae of the family Chironomidae. *Ironopsis* and *Ephemerella* were the most numerous mayflies observed. Other well-represented macroinvertebrates included stonefly larvae (10.3% of the total specimens), caddisfly larvae (8.8%), beetles (2.3%), clams (2.1%), and worms (1.9%). Collectively, these macroinvertebrates are typical of stony-bottomed, small streams.

Diversity indices calculated for all of the macroinvertebrate samples collected in Pond Hill Creek ranged from 2.87 to 4.18. Only two of the twelve indices were below 3.0. The overall average index was 3.66. These very high values indicate that Pond Hill Creek supports a well-balanced community of macroinvertebrates.

The stream supports a very limited fish community. Seasonal fish samples collected in the upper and lower sections of the stream revealed only five species. The primary factor limiting the fish community in Pond Hill Creek is apparently the intermittent nature of the stream. Also, since fish are prevented from moving up into the stream from the Susquehanna River by an elevated culvert near the stream's mouth, there are no migratory species present in the stream.

Fish sampling in Pond Hill Creek covered a distance of about 250 m of the lower section and approximately 830 m of the upper section. Samples were collected with an electrical shocker and minnow seines.

Of the five species found, only the blacknose dace (*Rhinichthys atratulus*), a common minnow species in Pennsylvania and other parts of the northeastern United States, was abundant. Other common minnow species found included: golden shiners (*Notemigonus crysoleucas*), fathead minnows (*Pimephales promelas*), and creek chub (*Semotilus atromaculatus*). However, only 9, 10, and 1 specimens, respectively, of these three species were collected. The remaining fish species was represented by a single specimen of largemouth bass (*Micropterus salmoides*) caught in the lower section of the stream in December 1977. Since only this one individual was found in all the fish samples, it is clear that Pond Hill Creek does not support a large resident population of this species. Furthermore, it is probable that the single bass juvenile originated from one of the small farm ponds located near the stream. These ponds are connected to Pond Hill Creek near its source by a small rivulet.

None of the species found in Pond Hill Creek is included on either the U. S. Fish and Wildlife Service's list of Endangered and Threatened Wildlife and Plants or the Pennsylvania Fish Commission's list of Endangered, Threatened or Indeterminate Fishes, Amphibians or Reptiles of Pennsylvania. The stream has never been stocked by the Pennsylvania Fish Commission, and no fishermen were observed on the stream during the sampling program.

A.2.5.2.2.2 *SUSQUEHANNA RIVER AT RESERVOIR PUMP STATION SITE*. Biological data gathered near SSES provide the most adequate representation of the nature of the aquatic biota in the vicinity of the proposed reservoir intake site.

The reader is referred to the applicant's annual reports and to the main body of this Environmental Statement for additional information about the site.[16-20]

A.2.6 SOCIOECONOMIC PROFILE OF THE LOCAL AREA

The socioeconomic profile for the area surrounding the proposed Pond Hill reservoir will focus on Conyngham Township, Luzerne County. This area has been selected because the proposed reservoir site is centrally located in this township, and the most direct impacts of construction and operation are expected to occur here.

A.2.6.1 Demography

In 1970, the total population of Luzerne County was 342,301, a 22.5% decrease from 1940 (ER-OL, Table 3.1-1). Between 1970 and 1977, population declined at a rate of 1% per year.[21] In comparison, Conyngham Township's populations totaled 1,693 in 1970 and was projected to have increased to 1,788 in 1976, an increase of 5.6%.[22]

Compared to national trends, the age structure of the county and township can be characterized as an older population because of the proportion of people over 65 years of age.[22,23] In 1970, the proportion of people over 65 was 13.0% for the county and 13.1% for the township, as compared to 10.8% for the state.[24]

A.2.6.2 Settlement Pattern

Population concentrations are located in four areas of Conyngham Township: Mocanaqua, Wapwallopen, Pond Hill, and Lily Lake.[24] Scattered houses and small farms were observed surrounding these small population centers and in the areas between them.

Housing

In general, the township housing stock is characterized as old; about 83% of the current structures were built before 1939.[24] However, the condition of the available 1976 housing was still rated as fair to good, and the demand for new houses is expected to increase by 1980.[25] Repair and renovation of older homes and summer homes was observed by the staff, particularly in the Pond Hill and Lily Lake areas.

Recreation

A series of recreational facilities are located in Conyngham Township; these have been listed in a county recreational study and presented as Table 3.8.3 of Reference 24. In addition to these listed facilities, trout fishing is available in Little Wapwallopen Creek, fishing and boating opportunities at Lily Lake, and hunting and hiking in several of the state gamelands.[24]

Detailed information on current recreational needs and plans for the township are not available. However, a need for additional recreational facilities of different types has been identified for all of Luzerne County, which would include Conyngham Township (see Section 2.2.3.3).

A.2.6.3 Social Organization

An estimated 80% of the 1970 households in the township were composed of families. The sociocultural characteristics of the township have been described as rural in terms of its population density, atmosphere, and available services. However, the population concentrated in the settlement of Mocanaqua, which has been historically associated with the coal-mining industry, is now distinctively agricultural and more diverse than that typically associated with rural areas.[24]

A.2.6.4 Social Services

Sewage and Water

Public water services are currently available in Mocanaqua and Wapwallopen.[24] Mocanaqua has some public sewage, but needs renovation of its system.[26] Sewage treatment is planned for Wapwallopen and Lily Lake.[26]

Fire and Police Protection

The township has a part-time police force made up of four persons and is also served by the state police.[24] Volunteer fire companies provide fire protection.[24]

A.2.6.5 Political Organization

Conyngham is defined as a second-class township because it has fewer than 300 residents per square mile.[27] The township is governed by a board of three supervisors elected at-large for six-year terms.[27] The board exercises general governmental functions, including maintenance of a police force, the road system, and the levy and collection of taxes.[24]

A.2.6.6 Economic Organization

By the 1920s, anthracite mining was the chief source of employment and the economic base of Luzerne County.[27] As coal production began to decline in the 1930s, the economic base was diversified to counteract serious income and job losses.[27] Today the economy is broad-based and has a strong apparel-industry orientation.[27,28]

In 1976, the Department of Commerce listed only four establishments for this township employing a total of 154 employees.[28] One business is a sawmill, another a footwear firm;[24,27] two businesses were undefined. Additional retail and service facilities are located within the township, primarily in Mocanaqua, Wapwallopen, and Pond Hill.[24]

A.2.6.7 Sociocultural Characteristics

The staff observed no resident population living on the proposed site. The applicant states that the property does not contain any facilities or structures used by the local communities nor does it support any commercial or industrial activities.[24] The applicant also reports that there is no residential activity below the dam site.[24]

Recreation

The applicant stated that this site is used for walking, hiking, hunting, and nature study by the people living in the nearby vicinity.[24] Since this information has not been quantified,[24] neither the number of individuals using this site nor the person-days of usage can be determined. The applicant identified and characterized esthetic qualities of the site.[24] During the site visit, the staff observed that the site area was esthetically pleasing because of the steep topography, rock outcrops, waterfalls, and dense, but variable, forest cover. Therefore, it is reasonable that people would be attracted to the site to hike and enjoy the kind of natural environment present on the property.

In addition to recreational use of the natural area, the staff observed that a pond has been constructed on the site. The applicant stated that the pond was used for fishing and swimming by several local residents. The extent of the pond's usage cannot be quantified at this time.

A.2.7 CULTURAL RESOURCES

A.2.7.1 Region

A regional culture history for Luzerne and Columbia county areas is provided in Section 2.6.1 of this Environmental Statement.

A.2.7.2 Pond Hill Site

A prehistoric cultural survey has been made in two areas of the Pond Hill Site: 1) on the property designated for the reservoir and within the high water mark and 2) on a section of the floodplain. Fifty-meter intervals and walkover was utilized for the uplands, while closer spaced transects and test trenching were used in the floodplain.[29]

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8. R. M. Ruhe, "Birds,", Pages 311-342, in "Ecological Studies of the Susquehanna River in the Vicinity of the Susquehanna Steam Electric Station," T.V. Jacobsen (ed.), Annual Report for 1977, Ichthyological Associates, Inc., Ithica, NY, 1978.

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11. "List of Endangered and Threatened Wildlife and Plants," Federal Register, Vol. 44, No. 117, Department of the Interior, Fish and Wildlife Service, Washington, DC, 17 January 1979, pp. 3636-3654.

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13. "Threatened or Endangered Fauna or Flora," Federal Register, Vol. 40, No. 127, Department of the Interior, Fish and Wildlife Service, Washington, DC, 1 July 1975, pp. 27825-27924.

14. "Pennsylvania's Endangered Species, Reptiles and Amphibians", Reference Information, Pennsylvania Fish Commission, Harrisburg, PA, revised April 1978.

15. H.B.N. Hynes, The Ecology of Running Waters, Toronto: University of Toronto Press, 1972.

16. T.V. Jacobsen (ed.), "Ecological Studies of the North Branch Susquehanna River in the Vicinity of the Susquehanna Steam Electric Station," Annual Report for 1974, Pennsylvania Power & Light, Berwick, PA, May 1976.

17. ______________, Annual Report for 1975, ______________, August 1976.

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A.3. RESERVOIR DESCRIPTION

A.3.1 INTRODUCTION

In order to provide the desired water storage, a dam will be constructed across Pond Hill Creek 1.3 km upstream from its confluence with the Susquehanna River. The reservoir will have all of the features typical of this type of project, including a spillway and an inlet-outlet structure. Since the drainage area above the dam is too small to fill and refill the reservoir and also keep it full between uses, an intake structure and pumping plant near the bank of the Susquehanna River and a water conduit from the pumping station to the inlet-outlet structure on the north shore of the reservoir will be constructed. A permanent access road will be provided. During construction, a concrete batch plant and borrow pits will be used. The location of the batch plant and borrow pits are shown on Fig. A.3.1.

The applicant has supplied detailed design information for a dam with a normal water level of 287 m MSL and an active storage volume of 12.5×10^6 m^3 and a total water storage volume of 16.0×10^6 m^3 (ER-OL, Appendix H). In response to comments by PDER and SRBC regarding the desirability of optional development of the site to meet water supply needs in addition to those of SSES, the applicant submitted design information on a larger dam, one utilizing 85% of the valley's maximum capacity. The higher, larger dam (normal water level 299 m MSL) will have a storage volume of about 27.1×10^6 m^3 and a total volume of 29.7×10^6 m^3 (responses to NRC questions, letters from N.W. Curtis, PP&L, to D.E. Sells, NRC, 12 October, 13 November, and 17 December 1979). The minimum water level for the larger reservoir is 264.6 m MSL.

The following analyses are for the larger (299-m normal water level) dam and reservoir and the Q 10-7 riverflow value of 22.7 m^3/s.

Figures A.2.2 and A.2.3 show local topography, the layout of the higher dam and the other structures, and the area to be covered by water at maximum and minimum water elevations. Figure A.3.2 is a detailed plan view of the higher dam and related structures.

A.3.1.1 Embankment Dam

The dam will be of earth and rockfill construction using materials obtained mostly from the area to be inundated. The crest of the dam will be about 730 m long at 302 m MSL. The maximum height of the crest of the dam above the existing creekbed will be about 67 m. The applicant's engineering studies have shown that sufficient core materials are available from onsite borrow areas.

Because of low topography along the southern edge of the reservoir, construction of two additional water retention barriers will be required (see Fig. A.3.2). In the saddle area, immediately southeast of the main dam, a shallow dike (about 150 m long and 2.4 m high) will be constructed. About 800 m east of the dam an impervious subsurface cutoff (about 380 m long and 6 m deep) will be required to prevent seepage through the saddle.

A.3.1.2 Spillway

An overflow-type of spillway located on the south abutment of the dam will be provided to release floodwaters when water levels exceed the 299-m MSL crest of the spillway (see Fig. A.3.2). Figure A.3.3 is a detailed schematic of this spillway. A 425-m concrete-lined chute will carry the overflow water from the spillway to the existing riverbed. A concrete structure will be used to dissipate most of the kinetic energy of the flow.

A.3.1.3 Inlet-Outlet Structure

This structure will be used to both control releases from the reservoir for conservation and compensation purposes, and to discharge pumped inflows into the reservoir.

This structure has been redesigned since the DES was issued in March 1980 (letter from M.N.W. Curtis, PP&L to Mr. B.J. Youngblood, NRC, 29 May 1980: this letter is on page B-47 of Appendix B). The new structure is shown schematically in Figure A.4.1; its location is given in Figure A.2.3). The new design calls for a vertical structure inside the reservoir, with exit ports 7.6, 17.0 and 39.9 m below the normal water surface.

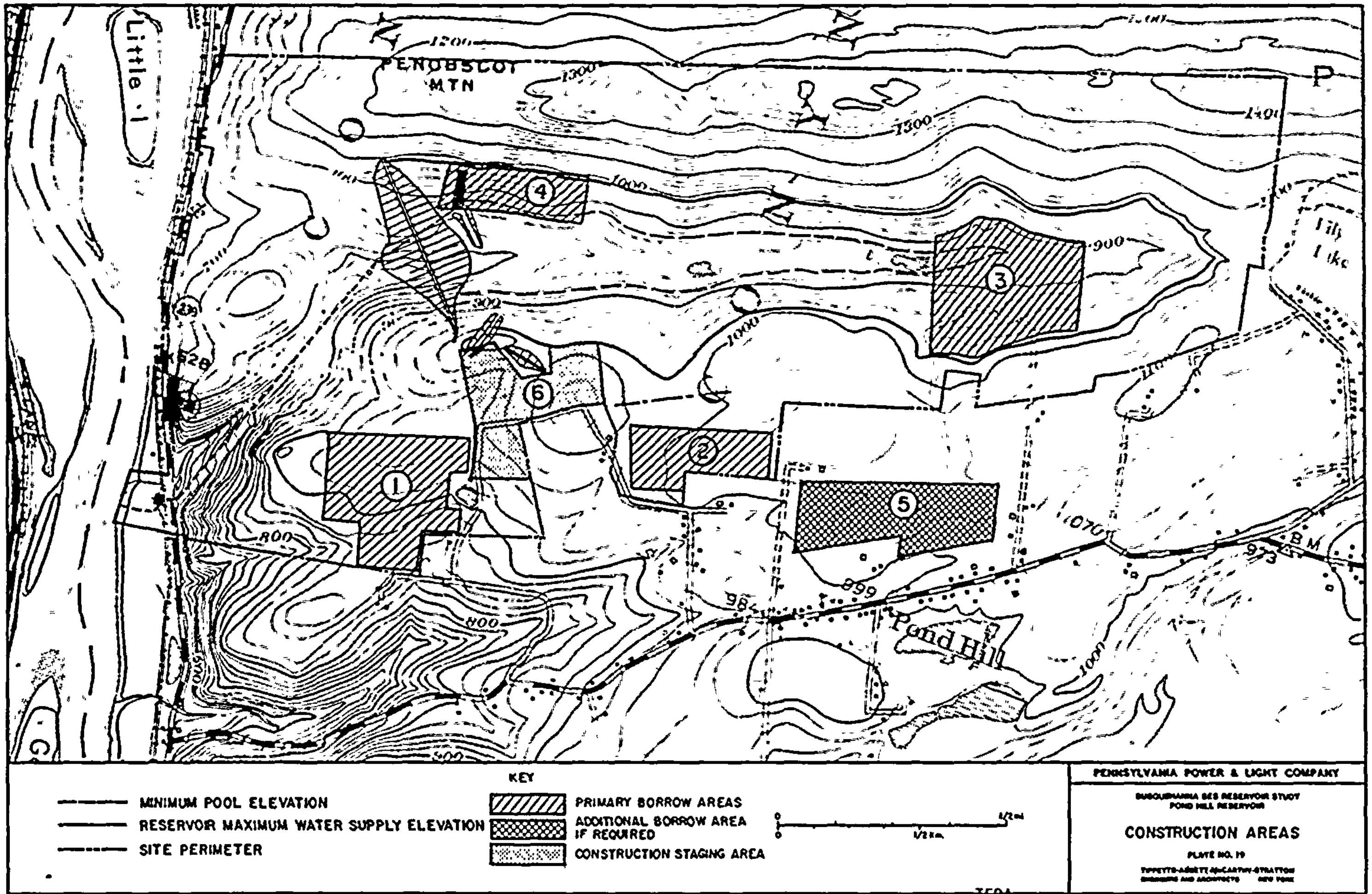

Fig. A.3.1. Pond Hill Reservoir Construction Areas. (Source: Reference 1)

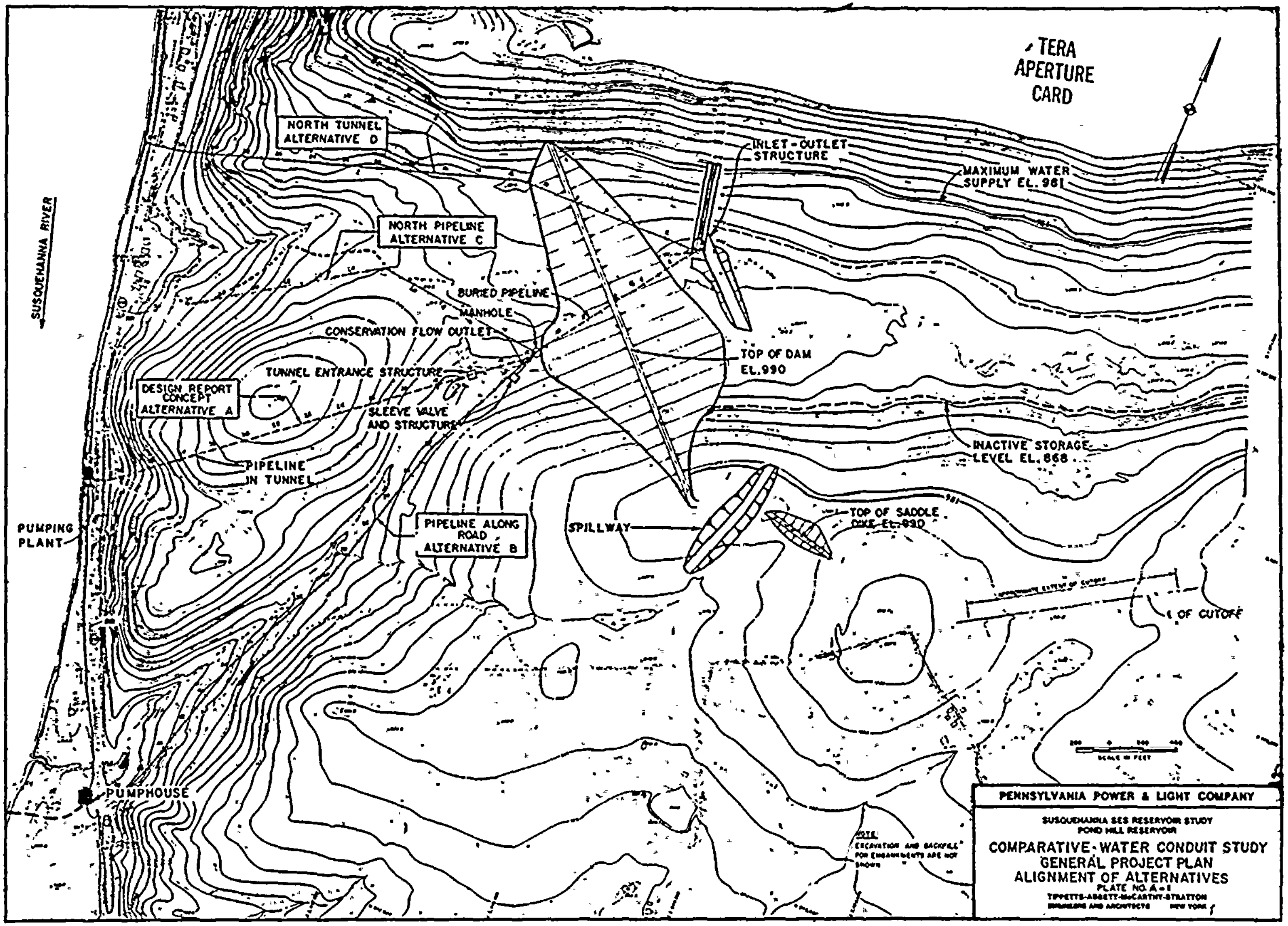

Fig. A.3.2. General Project Plan for Pond Hill Reservoir with Alignment of Alternatives. (Source: Reference 1)

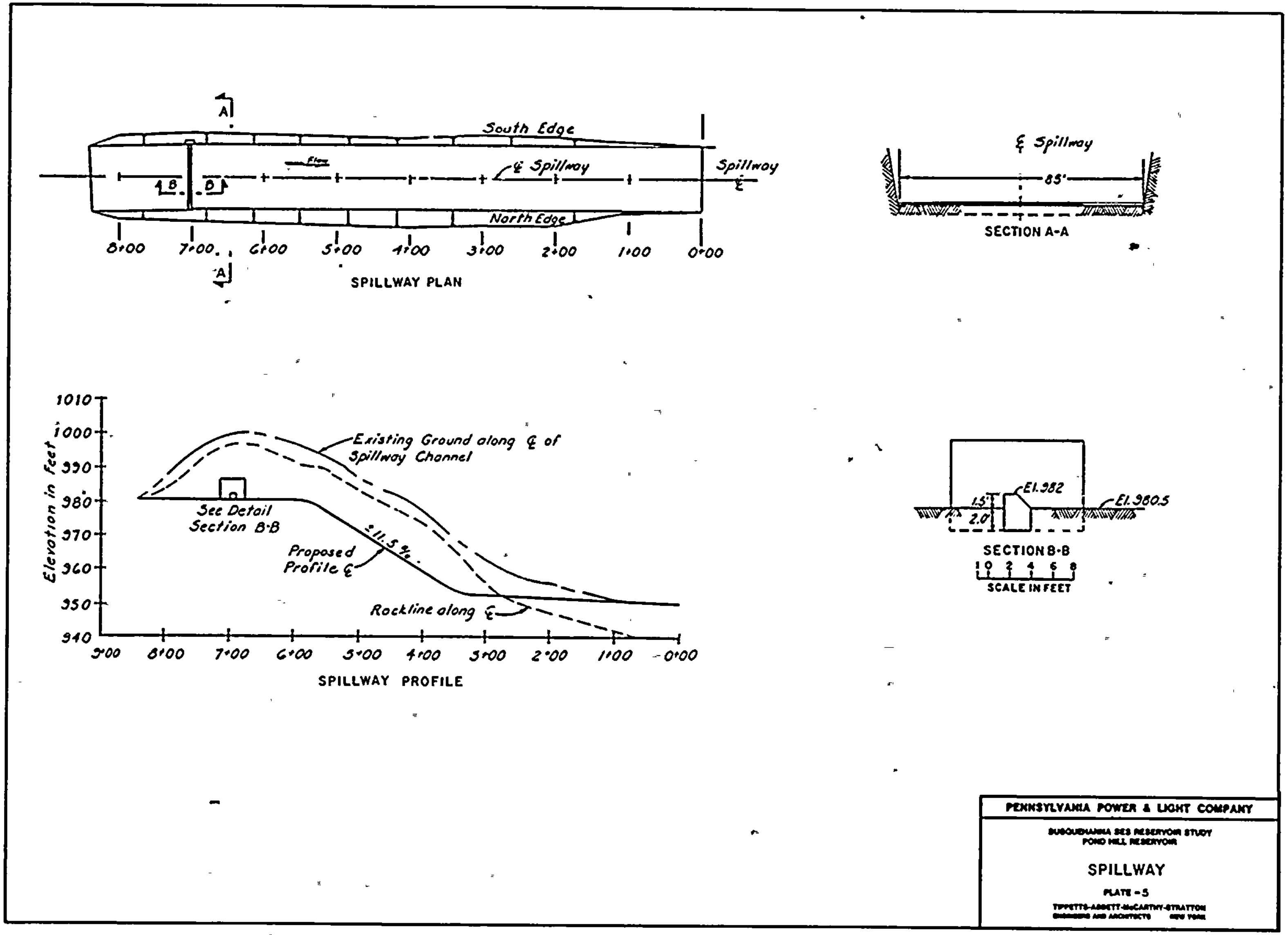

Fig. A.3.3. Detailed Schematic of Spillway Structure for Pond Hill Reservoir.

The concrete structure will be connected to the pumping plant by an underground pipeline (Fig. A.3.2, Alternative B). Pumped inflow will enter the reservoir at the base of the structure. Three outlet ports, each at a different level, will be used for compensation and conservation flows. The outlet port (or ports) used for a given release will be the one at which the temperature of the water in the reservoir most closely matches that of the Susquehanna River.

A.3.1.4 Water Conduit

A steel pipeline will be used to transport water between the pumping plant and the inlet-outlet structure (see Fig. A.3.2, Alternative B). The pipe will be capable of carrying 3.8 m^3/s of water from the pumps to the reservoir, and an average flow of 3.0 m^3/s for compensation releases. The maximum release flow will be 8.5 m^3/s. The pipe from the inlet-outlet structure to the pumping plant will have a diameter of 1.22 m. The pipeline will be constructed in a cut-and-cover trench along the proposed access road (see Fig. A.3.2).

A 0.61-m pipeline with a control valve will branch from the pipeline, near the downstream toe of the dam, to allow releases to Pond Hill Creek. The system will be able to release water at a rate of up to 0.57 m^3/s, a flow approximately equal to the capacity of the creek channel to carry water without flooding.

A.3.1.5 Pumping Plant and Intake Structure

The proposed pump station will be built adjacent to the railroad in an area outside the floodplain (see Figs. A.3.2 and A.3.4). The proposed intake will consist of two parallel steel pipes extending about 30 m into the river (see Fig. A.3.4). Although the final design of the intake structure has not been selected, screens similar to those manufactured by Johnson Screen Company or slotted steel pipes similar to those manufactured by Ranney Co., approximately 60 m of 0.6-m diameter screens, will be provided. The maximum approach velocity will be about 0.12 m/s. The pipe and screen low points will be about 0.6 m above river bottom; pipe tops will be about 1.2 m below water level at minimum pumping flows. Figure A.3.4 shows the contemplated configuration of the proposed pump station, intake structure, and the buried pipeline from the pumping plant to the intake screens. Compensation releases to the river would be through the screens. Three 1.25-m^3/s electrical driven pumps will be used to pump water into the reservoir.

A.3.1.6 Access Road

A new paved access road will be constructed from State Route 239 to the construction areas. The road will parallel the pipeline. The road will be approximately 1220 m long and 9 m wide; the area impacted by the construction of the road and pipeline will be about 2 ha. The use of this road will minimize construction traffic through the villages of Pond Hill and Lily Lake.

A.3.2 MODE OF OPERATION

A.3.2.1 Initial Filling of Reservoir

Most of the water required to fill the reservoir will come from the Susquehanna River, the remainder from drainage and precipitation. The applicant is committed to pumping only when river flow is greater than 85.4 m^3/s. The three pumps in the pumping plant are capable of delivering up to 3.8 m^3/s to the reservoir. Pumping at this rate, it would take 84 days to fill the reservoir.

A.3.2.2 Compensation Releases

During periods of low river flow, defined as the Q7-10 value of 22.7 m^3/s plus the actual consumptive use by SSES and dedicated compensation [18CFR803.61(c)(7)(i)], the applicant will be required to discharge water from the reservoir at the actual consumptive use rate. Consumptive water use of SSES will be determined by measuring the difference between the volume of water withdrawn from the river (primarily to replace that evaporated in the plant's cooling towers) and blowdown to the river.

The average rate of discharge from the reservoir will be 3.0 m^3/s; the active storage capacity of the dam will be such that this flow could be maintained for 106 days. The applicant estimates peak water consumptive use at about 1.8 m^3/s, and average use at 1.4 m^3/s.

Compensation water will be taken from one of the three outlet ports in the inlet-outlet structure, pass through the conduit, and be discharged into the Susquehanna River via the multislotted pipes. The outlet port selected would be the one at which the temperature in the reservoir most closely matches that of the river.

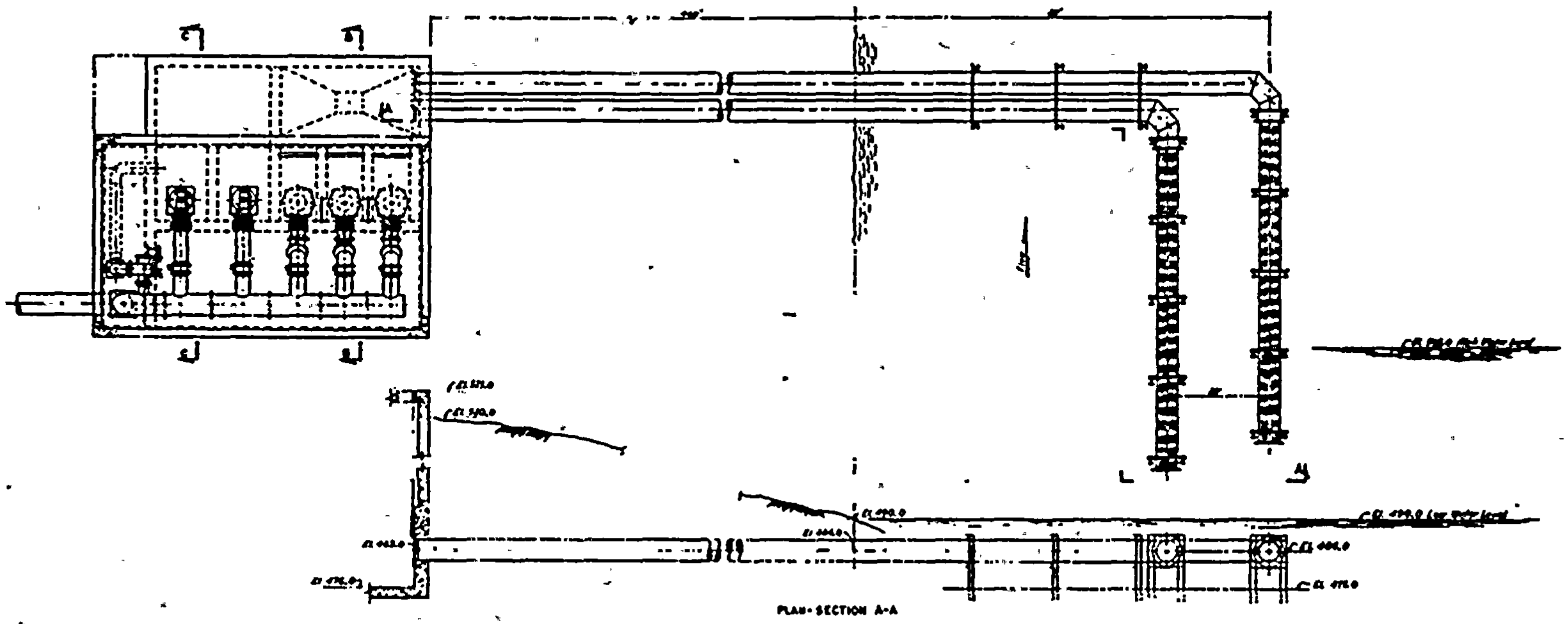

Fig. A.3.4. Proposed Intake for Pond Hill Reservoir (pumping station concept without traveling screens). (Source: Reference 1.)

A.3.2.3 Conservation Releases

The Pennsylvania Department of Environmental Resources requires that all new reservoirs provide a minimum release to maintain downstream flows. On streams without water-flow data, a value of 1.64 L/s per square kilometer of upstream drainage area is normally utilized by DER. Since the area upriver from the proposed dam is about 4.4 km^2, the applicant proposes a conservation release of at least 5.7 L/s. The release point for this discharge would be just west of the toe of the dam (see Fig. A.3.2).

Precipitation on the lake and drainage in excess of that required to keep the water level at 299 m would be discharged into Pond Hill Creek through the conservation-flow outlet (up to 0.57 m^3/s), over the spillway, or directly into the Susquehanna River via the conduit and the pumping plant.

A.3.2.4 Refilling the Reservoir

Additional water will be pumped into the reservoir whenever precipitation and drainage are insufficient to keep the pond full and replace losses due to seepage, evaporation, compensation, and conservation flows. As stated earlier, pumping will be permitted only with river flows in excess of 85.4 m^3/s.

A.3.3 RECREATION AREA

The applicant proposes to construct a recreation area so that the recreational potential of the reservoir may be utilized. The proposed facilities include a 30- to 50-car parking lot, a launching ramp for non-combustion-engine boats, and a system of trails for hiking and nature study (ER-OL, Appendix H, Section 4.2.8). Hunting will be permitted in season in the buffer areas around the reservoir. The Pennsylvania Fish Commission will be asked to stock the reservoir for sport fishing; the new aquatic habitat will be suitable for warmwater fishing.

A.3.4 ESTHETICS

A.3.4.1 Construction

The appearance of approximately 146 ha of land will be altered by construction and operation of the Pond Hill Reservoir. One hundred twenty-eight hectares of forested land will be inundated. Impoundment structures will convert about 16 ha from natural cover to built-up structures.

A.3.4.2 Operation

Since most of the buffer area surrounding the site will not be altered during construction, no appreciable changes in the esthetic quality of these areas will occur. The primary change in esthetic values will be the conversion of forested lands to a lake. None of the facilities will be visible from the settlements of Lilly Lake and Pond Hill, or from the roads leading to these communities. Since topographic features will screen the dam from view, the pumphouse will be the only structure visible from State Route 239.

Reference

1. Tippetts-Abbett-McCarthy-Stratton/Engineers and Architects, "Design Report: Pond Hill Reservoir," prepared for Pennsylvania Power & Light Company, February 1979.

A.4. ENVIRONMENTAL EFFECTS OF CONSTRUCTION AND OPERATION

A.4.1 IMPACTS ON LAND USE

Approximately 525 ha of land will be converted from present uses to land dedicated to a water storage project. Pond Hill Creek and most of the valley it drains will be permanently altered. About 146 ha of the site will be permanently altered by construction and operation of the reservoir; about 128 ha of presently wooded lands will be inundated and another 16 ha covered by impoundment structures, such as the dam, spillway, and inlet-outlet structure. The access road-pipeline corridors will occupy an additional 2 ha. Most of the areas disturbed by construction activities (about 51 ha) will be reclaimed and landscaped following construction; there will be only minor changes in land use in the remaining undisturbed areas of the site.

Farming on a controlled basis will be permitted to continue within the buffer area of the site.

The impacts of reservoir construction and operation on the terrestrial environment are discussed in Section A.4.3.1, those on the aquatic environment are discussed in Section A.4.3.2.

A.4.2 IMPACTS ON WATER USE

Construction

All effluents generated during the concrete batch plant operation will be collected in a holding pond. After the solids have settled out, the supernatant will be either recycled or discharged via a pipeline to Pond Hill Creek. With this treatment, the staff believes that the waste effluent disposal will meet PDER requirements for disposal of such waste.

A.4.3 ENVIRONMENTAL IMPACTS

A.4.3.1 Terrestrial

Construction Impacts

Construction plans for the proposed project have not yet been completely finalized. As currently reported by the applicant, the principal areas to be directly affected by construction activities are indicated in Figures A.2.2, A.2.3, A.3.1, and A.3.2; however, the use of some designated impact areas is qualified as follows. The location of the construction staging area, as well as facilities within the staging area, will be dependent on needs and requirements of the applicant's construction contractor. Also, borrow areas 3 and 4, located within the proposed impoundment area (see Fig. A.3.1), will be the principal sources of fill materials used in dam construction (ER-OL, Supp. Response to NRC Q. 17, 28 September 1979). To the extent that suitable core materials available at borrow area 3 are insufficient to complete the dam embankment, the required materials will be removed from either or both borrow areas 1 and 2. Although the need for additional materials is "not anticipated," the applicant has also identified borrow area 5 as a possible offsite source of core materials (ER-OL, Supp., Response to NRC Q. 17, 28 September 1979). Thus a total of about 45 ha of local land outside the impoundment area (borrow areas 1, 2, and 5) may be disturbed to acquire materials for dam construction (ER-OL, Supp. Response to NRC Q. 5; 28 September 1979).

The most obvious and extensive of the adverse construction impacts on the terrestrial environment will result from the destruction or alteration of local vegetation. Most of the vegetation to be affected during construction consists of forest and woodland. Merchantable wood products will be salvaged to the extent practicable (ER-OL, Appendix H, Sec. 4.3.2.5); however, the growth and growth potential of trees that have not yet attained merchantable size represent a loss of forest resources. The most significant loss of forest vegetation will occur within the proposed impoundment area and within the dam embankment and spillway sites (see Figs. A.2.2 and A.3.2), about 144 ha of total land area (ER-OL, Supp. Response to NRC Q. 1, 28 September 1979). Virtually all of this area will be cleared of woody vegetation prior to or during construction (ER-OL, Appendix H, Section 4.2.5.2); nearly 140 ha of mixed deciduous and coniferous-deciduous forest will be destroyed. Several small tracts of forest vegetation inside the perimeter of the impoundment area will be left intact to provide habitat for fish (ER-OL, Appendix H, Section 4.2.2.2).

The level of use and activity within the onsite construction staging area will be relatively intense, severely affecting the local vegetation. As noted previously, the size and location of the staging area are not yet resolved. However, given the area as indicated in Figure A.3.1, about 8 ha of forest and 6 ha of hayland and old field vegetation will be destroyed or disturbed. Also, the extent to which upland borrow areas (areas 1, 2, and 5; Fig. A.3.1) will be disturbed to acquire fill materials for dam construction has not been established (ER-OL, Supp., Response to NRC Q. 17, 28 September 1979). Assuming total utilization of all designated borrow areas, about 22 ha of forest and woodland, and a similar area of herbaceous vegetation will be destroyed. Some additional vegetation, primarily forest, will be disturbed in the vicinity of small construction sites, including those identified in Figure A.3.2; namely, the saddle dike and cutoff structure adjacent to the proposed impoundment, the pumping-plant site, and the narrow corridor (18 m wide) cleared for construction of water pipelines and the primary access road (Alternative B). About 2 ha of vegetation will be cleared from the common right-of-way required for pipeline and access-road construction; lesser areas will be affected at the other small construction sites.

The intensity and pattern of soil disturbance resulting from construction will closely correspond to impacts on the local vegetation as discussed. Soils of the proposed impoundment and dam sites will be committed, either totally disrupted during construction or inundated following construction. Land within these areas is unsuitable for cultivation, with the exception of isolated small tracts of Capability Class IV soils (see Sec. A.2.5.1.4).

About 29 ha of Class II soils (including prime farmland) occur within the construction staging and upland borrow areas (see Fig. A.3.1); the remaining land includes small tracts of Class III and IV soils and more extensive soils unsuited for cultivation (ER-OL, Appendix H, Fig. 3-13). These soils will be variously disturbed during construction; however, soil impacts will be mitigated as follows. The applicant will require that the construction contractor schedule project activities so as to minimize erosion potential. Further, work areas will be stripped of topsoil that, in turn, will be stockpiled and stabilized by establishing a temporary vegetative cover (ER-OL, Appendix H, Section 4.3.2.1). Reclamation of disturbed areas will entail establishing the approximate original contours, replacing topsoil, and providing suitable landscaping.

The applicant will also require the contractor to develop and submit an erosion and sediment control plan for the project site; this plan will be subject to review by appropriate agencies, including the Pennsylvania Department of Environmental Resources (ER-OL, Appendix H, Section 4.3.2.1). The plan will include details concerning practices to be employed, design specifications of control structure(s), and maintenance schedules to ensure effective erosion control. Given that the relatively marginal soils within the impoundment and dam sites will be disrupted or otherwise committed, the staff considers the foregoing provisions and requirements to be adequate precautions for conserving soil resources, provided that such measures are properly implemented. In view of the generally steep gradient of the proposed access road (see Fig. A.3.2), the staff recommends that culverts and water-spreader structures be installed at appropriate intervals to control the volume and velocity of runoff from the paved access road as well as runoff intercepted by the roadbed.

The applicant's commitment to landscaping certain disturbed areas will variously offset the adverse construction impacts on the local vegetation. Additionally, the established vegetation will partially offset losses of wildlife habitat incurred during land-clearing and construction activities. However, development of the dam and impoundment sites will preclude reclamation, thus more than two thirds (144 ha) of the total affected wildlife habitat will be severely altered during construction and will be unavailable for use by terrestrial wildlife during reservoir operation.

The extent and types of wildlife habitats affected during construction are implicit in the preceding discussion of impacts on the vegetation. Accordingly, the principal types to be affected will be forest and woodland habitats. Wildlife species strongly dependent on resources of these habitats include locally important game species such as whitetail deer, black bear, eastern red and gray squirrels, wild turkey, ruffed grouse, and American woodcock. Most of the locally occurring mammals utilize forest habitats to varying degrees. For example, the habitat preferences of the eastern cottontail includes brushy areas typical of forest - old field ecotones. However, representative areas of all major habitat types occurring onsite will be affected during construction; thus populations of all mammals identified in Section A.2.5.1.2 will probably be deprived of habitat to some extent. Characteristic habitat types of nongame birds as well as reported habitats of locally observed reptiles and amphibians are also indicated in Section A.2.5.1.2.

The alteration of habitats will be accompanied by a general migration of animals from the affected areas. The displaced animals will cause increased competition for habitat resources and space in adjacent habitats; the effects of this increased competition will be local and generally of short duration since habitat types similar to those onsite occur extensively throughout the surrounding area. However, all animals will not escape the impacted areas. Some of the less mobile animals, as well as juveniles of other species, will be impinged, buried, or otherwise destroyed during land-clearing and earth-moving activities. Any remaining animals will be subject to increased predation due to the removal of vegetative cover and to destruction of underground refuges. Some additional mortality will occur as the result of collisions with project-related traffic.

Construction noise and activity will also affect animal populations in areas not affected by construction. The applicant will require that noise emissions from construction equipment be in compliance with federal guidelines (OSHA, EPA) (ER-OL, Appendix H, Section 4.3.2.4). The intensity of blasting vibrations will also be controlled to the extent that local structures will not be affected. However, some of the more wary species, such as the wild turkey, will probably vacate the site during the construction period.

As noted, disturbed construction areas (with the exception of the proposed impoundment and dam sites) will be reclaimed if feasible, thus mitigating project impacts on wildlife. The applicant has further committed to improving wildlife habitat of the project site (see Sec. A.4.4.1). Pending final establishment of site boundaries, the applicant, in consultation with the Pennsylvania Fish and Game Commissions, will prepare a management plan for the site (ER-OL, Supp., Response to NRC Q. 15, 28 September 1979). Given proper implementation of a sound habitat management program, the staff believes the adverse construction impacts on wildlife can be offset to a substantial extent. The proposed reservoir will provide management opportunities not currently available.

Other construction impacts on the terrestrial environment include dust emissions from work areas and disturbed surfaces; however, the applicant will require the contractor to implement suitable dust control measures (ER-OL, Appendix H, Section 4.3.2.4). Slash materials and other combustible construction wastes will be burned in accord with applicable federal, state, and local regulations (ER-OL, Appendix H, Section 4.3.2.5). The disposition of waste effluents generated during batch plant operation will be in compliance with requirements of the Pennsylvania Department of Environmental Resources (ER-OL, Supp., Response to NRC Q. 6, 28 September 1979). The staff believes that adherence to the foregoing precautions will limit the anticipated impacts to acceptable levels.

Operational Impacts

The most significant operational impacts will occur with the initial filling of the reservoir, i.e., conversion of terrestrial habitats to an aquatic environment. Any residual soils and vegetation within the impoundment area will be inundated. Resident animals will either perish or be forced to migrate as the water level within the reservoir rises. Mortality will occur as animals seek temporary refuge on isolated islands created during initial filling of the reservoir, and as these islands are subsequently inundated. The number and kinds of animals that escape will be influenced by the swimming ability of the various species. The number of affected individuals will be relatively low since most will have been destroyed or displaced during land-clearing and construction activities.

Terrestrial habitat adjacent to the perimeter of the filled reservoir will be subject to disturbance due to wave action. However, the applicant proposes that "suitable ground cover of the slopes in the vicinity of the water line will be provided at all areas where sloughing may be a problem" (ER-OL, Supp. Response to NRC Q. 14, 28 September 1979). Thus, the onsite terrestrial habitat available to wildlife will be decreased by about 127 ha due to filling and operation of the reservoir. This loss of terrestrial habitat will to some extent be offset by the creation of a similar area of aquatic environment that will be used by both terrestrial and aquatic organisms. The future use of the reservoir by wildlife cannot be readily quantified. However, given the applicant's commitment to undertake a wildlife habitat improvement program, the staff does not believe that project related impacts will cause an unacceptable diminution in the overall wildlife productivity of the Pond Hill site.

Other impacts on the terrestrial environment directly attributable to reservoir operation will be of minor consequence. For example, vegetation within the utility right-of-way extending from the pumping-plant site to the reservoir (about 1.2 km) will be controlled. The applicant indicates that only chemicals approved by EPA will be used to control vegetation (ER-OL, Supp. Response to NRC Q. 15, 28 September 1979). Other human activities associated with routine operation and maintenance will generally result in negligible impacts on vegetation, soils, and terrestrial wildlife resources of the site. Operational noise levels will be relatively low; power units used for periodic refilling of the reservoir will consist of electric motors.

The applicant plans to allow public use of the site for specific recreational activities (ER-OL, Appendix H, Section 4.2.2.3). Such use will, however, be controlled to prevent degradation of the site resources (ER-OL, Appendix H, Section 4.3.3).

A.4.3.2 Aquatic

A.4.3.2.1 Pump House and Intake Screens

Construction

As presently proposed, the construction of the pump house will have minimal, if any, impact on either the water quality or the biota of the Susquehanna River. The applicant is committed to construction practices that minimize erosion and control sedimentation. The staff concludes that there will be no aquatic impacts to the two unnamed creeks bordering the proposed pump house on the north and south (see Fig. A.2.4).

Installation of the slotted-pipe or wedge-wire screen type of intake (see Sec. A.3.1.5) will result in loss of habitat, increased turbidity, and siltation. The staff concludes that the loss of habitat will be insignificant and that increases in turbidity and siltation will be temporary.

Operation

Operation of either a slotted-pipe or wedge-wire screen type of intake is expected to have minimal impact on the aquatic community of the Susquehanna River. The applicant did not indicate what the slot width would be; however, slot widths as small as 0.25 mm are suggested as a means of screening fine debris and preventing the entrainment of ichthyoplankton.[1] Impingement is purportedly minimized by the absence of a confining screenwell, which may entrap fish, and by the flushing action of ambient currents flowing around the cylindrical screen. To minimize impingement mortalities and to enhance the escape potential of organisms in the zone of influence of the intake flow, the entrance-slot velocity for cylindrical wedge-wire screen designs is generally taken as 12.2 cm/s or less.[2] As the proposed maximum approach velocity for the Pond Hill intake is 11.6 cm/s, the staff concludes that approach velocities should pose no problems.

A.4.3.2.2 Inundation and Operational Impacts

The rocky, shallow, fast-flowing stretch of Pond Hill Creek to be inundated will become a soft-bottomed, deep, slow-moving body of water. As a result, the aquatic biota will change from a lotic to a lentic community.

The effects of the reservoir on the water quality of lower Pond Hill Creek can be projected by comparing the water quality of the Susquehanna River with that of Pond Hill Creek. A comparison of the respective maximum, minimum, and average water-quality parameters is shown on Table A.4.1. The comparison shows that although some amelioration will take place in the reservoir, the water quality of lower Pond Hill Creek will be substantially lowered by the reservoir discharge.

The algae community in Pond Hill Creek consists of periphytic algae and diatoms that become free-floating only when detached during high flow. After inundation, conditions in the reservoir will permit the establishment of phytoplankton and zooplankton populations that will become the principal source of primary production. The reservoir will represent a significant ecosystem change from the present stream habitat, which relies upon the input of organic matter from the surrounding area as the chief source of primary production.

Productivity levels in Pond Hill Reservoir will depend, to a large extent, on the amount of nutrients available for the growth of phytoplankton. The Susquehanna River, which will be the main source of inflowing water for the reservoir, contains high nutrient concentrations year round (ER-OL, Section 4.2.3.2.2). To prevent the development of algal blooms and to control eutrophication, EPA has recommended that total phosphates as phosphorous should not exceed 0.050 mg/L in any stream at the point where it enters any lake or reservoir, nor 0.025 mg/L within the lake or reservoir.[3] Data gathered from 1972 to 1976 indicate that nearly all monthly and annual means of total phosphate levels in the river near SSES considerably exceeded these criteria (ER-OL, Section 4.2.3.2.2). Consequently, based on the total phosphate levels that would be expected in the inflowing water, the potential that eutrophic conditions will occur in Pond Hill Reservoir is relatively high.

The potential for high productivity (i.e., eutrophic conditions) during the first few years of impoundment will be enhanced, since the recently inundated terrestrial vegetation and soils will provide an additional large source of nutrients (ER-OL, Section 4.2.3.2.2). A reservoir becomes less productive over a period of time due to a decline in the quantities of land-supplied

Table A.4.1. Comparisons of Water Quality of Susquehanna River and Pond Hill Creek

Parameter[a]	Pond Hill Creek Mean	Pond Hill Creek Max.	Pond Hill Creek Min.	Susquehanna River Mean	Susquehanna River Max.	Susquehanna River Min.
Temperature (°C)	8.2	16.0	0.0	14.4	25.0	3.0
Dissolved oxygen	11.7	13.9	8.0	11.2	14.9	3.35
BOD	2.0	8.0	<0.5	2.2	5.0	<0.1
COD	8.9	18.0	3.4	13.0	25.0	5.0
pH (units)	7.1	7.6	6.65	7.6	8.6	7.2
Alkalinity as $CaCO_3$	9.2	23.0	<1.0	42.6	66.0	19.0
Total hardness as $CaCO_3$	19.0	24.0	14.0	105.9	167.0	66.1
Total dissolved solids	56.2	133.0	<0.5	171.4	290.0	67.2
Total suspended solids	16.4	120.0	<0.5	17.4	36.6	9.1
Turbidity (JTU)	2.6	5.5	0.7	1.2	16.0	5.1
Specific conductance (μmhos)	51.0	68.0	45.0	222.0	330.0	160.0
Color (CPU)	8.0	22.0	1.0	45.0	80.0	7.0
Sulphate as S	11.4	16.8	6.0	88.0	180.0	28.0
Ortho phosphate as P	0.02	0.06	<0.01	0.05	0.10	<0.01
Total phosphate as P	0.07	0.47	<0.01	0.2	8.84	0.04
Nitrate as N	0.14	0.33	0.01	0.72	1.0	0.43
Chloride	2.7	11.1	0.4	12.4	18.4	6.2
Total copper	0.03	0.06	<0.02	<0.02	0.02	<0.02
Total iron	0.66	3.11	0.20	2.5	4.7	1.63
Total manganese	0.05	0.21	<0.02	0.48	0.9	0.19
Coliform total MPN/100 mL	609.0	>2400.0	43.0	2007.0	72400.0	43.0
Coliform fecal MPN/100 mL	52.0	240.0	<3	412.0	1100.0	3.0
Fecal streptococci MPN/100 mL	4.0	20.0	<1	34.0	85.0	<1

[a]Units mg/L unless stated otherwise.

nutrients and organic matter and the loss of nutrients to bottom sediments.[3,4,5] Reservoirs act as traps for the nutrients, which adhere to clay particles and settle to the bottom. Once removed, nutrients are less likely to reach surface waters because thermal stratification and chemical conditions in the sediment hinder resuspension or dissolution. During spring and fall circulation of water in the reservoir, some of the nutrients are recycled to the surface for use by phytoplankton. However, once phosphorus reaches the bottom sediments, very little of it usually returns to the epilimnion (ER-OL, Section 4.2.3.2.2). With increasing age, productivity levels in the reservoir will, to a large extent, depend upon nutrients introduced by inflowing waters and brought to the surface during overturns.

Whenever water must be pumped from the river to meet storage requirements, nutrients in high concentrations will enter Pond Hill Reservoir. Consequently, although nutrients may be somewhat depleted in the reservoir as time passes, an additional supply will be provided during refilling operations. Data on Table A.4.2 indicate that very little pumping will be required during most years.

In general, Pond Hill Reservoir appears to have a relatively high potential for initial eutrophication, followed by a gradual decline in productivity levels as nutrients are lost to bottom sediments. This cyclic pattern may be repeated following periods of pumping to fill the reservoir.

Elevated concentrations of iron will enter the reservoir from the Susquehanna River (ER-OL, Section 3.2.3.2.2). Mean monthly levels of iron in the river ranged from 2.2 to 7.3 mg/L from 1972 to 1976. Most of the iron entering the proposed reservoir will be oxidized, forming precipitates that will subsequently settle to the bottom. Some of this iron will appear in the water column during spring and fall circulation, and in the hypolimnion if it becomes anaerobic;

Table A.4.2. Summary of Reservoir Operation Based on Historical Flow Records of the Susquehanna River at Wilkes-Barre[a]

Year	Drawdown				Refill	
	Period	Number of days	Minimum Level[b] (ft.)	Acres Exposed	Period	Number of days
1905-1907	No Operation					
1908	Sept. 17-28	12	935.0	12	Jan. 6-14	10
1909-1910	No Operation					
1911	Aug. 17-19	3	939.0	3	Sept. 1-3	3
1912	No Operation					
1913	Sept. 12	1				
	Sept. 16-17	2				
	Sept. 20	1	938.5	4	Oct. 21-23	4
1914-1938	No Operation					
1939	Aug. 26-31	6	937.5	6		
	Sept. 1-7	7				
	Sept. 10-24	15	927.5	28	Oct. 29-Nov. 19	24
1940	No Operation					
1941	Sept. 26-30	5	938.0	5	Nov. 9-13	
	Oct. 1-9	9	934.0	14	Dec. 24-29	12
1942-1952	No Operation					
1953	Sept. 1	1	939.8	2		
	Oct. 3-5	3	938.5	4	Nov. 23-25	4
1954	No Operation					
1955	July 31	1	939.8			
	Aug. 1	1				
	Aug. 3-10	8	936.0	9	Aug. 14-21	9
1956-1958	No Operation					
1959	Sept. 24-30	7	937.0	8	Oct. 9-14	6
1960-1961	No Operation					
1962	Aug. 3-6	4	938.5	4		
	Aug. 25-27	3	937.0	8		
	Aug. 31	1	936.6	8		
	Sept. 1-15	15	930.0	23		
	Sept. 20-27	8	926.0	32	Oct. 1-24	26
1963	Oct. 12-18	7	937.0	8		
	Oct. 20-31	12	931.5	20		
	Nov. 1-6	6	928.5	26	Nov. 29-Dec. 17	21
1964	-Critical Drought-					
	Aug. 8-11	4	937.5	5		
	Aug. 15-18	4	936.3	8		
	Aug. 20-21	2	935.3	11		
	Aug. 28-29	2	933.0	15		
	Sept. 3-30	28	919.0	45		
	Oct. 1-31	31	900.0	83	Dec. 28, 1964-Jan. 18, 1965	
	Nov. 1-25	25	878.0	127	Feb. 7-Apr. 12	86
1965	July 30-31	2	939.5	2	Sept. 26-27	2
1966-1975	No Operation					

[a]Does not include operations for maintenance purposes. Source: ER-OL, Vol. IV.

[b]To convert feet to meters, multiply by 0.305.

but, with the exception of iron chelated with organic matter, most of it will be oxidized and returned to the sediments as insoluble compounds. Since the iron will probably remain oxidized in bottom sediments, the dissolved iron concentration in the water column will be less than the 1.0 and 1.5 mg/L recommended for the protection of aquatic life.

Iron (by combination and precipitation) does not appear to have reduced phosphate levels nor severely limited phytoplankton productivity near SSES. Because iron concentrations in the Pond Hill Reservoir will decrease, and the levels recorded in the river at present do not appear to have seriously reduced primary production, the effects of iron on productivity in the Pond Hill Reservoir is not expected to be great.

Impacts on water quality from other substances entering the reservoir from the river should be insignificant, since the remaining parameters have been found to meet criteria recommended by DER and EPA. Fecal coliform levels in the river usually exceed standards acceptable for bathing waters. However, fecal pathogenic bacteria will survive for only a few days in the reservoir.[4]

Since the reservoir will be eutrophic, large growths or blooms of diatoms, green algae, and blue-green algae may seasonally occur in some years. However, extensive algal blooms would not be anticipated every year, since there will be a net loss of nutrient salts to the bottom sediments. Macrophytes, such as cattails and pondweeds, should appear in the shallow, inshore waters, but the amount of growth of macrophytes and periphytic algae in Pond Hill Reservoir will be limited, since much of the shoreline will be steep-sided. Mosses and liverworts, which are abundant in Pond Hill Creek, will be eliminated following inundation, since they require hard, unsilted substrates and continuously flowing water for survival.[5] Other periphyton will generally be confined to the littoral or inshore areas of the new reservoir, since growing conditions in the flooded stream channel will no longer be suitable. Iron deposits may also inhibit macrophyte development.

Following reservoir-pool formation, a thin layer of silt will accumulate on the bottom, and a fairly uniform benthic habitat will result throughout the new reservoir. Consequently, since quiet and riffle water habitats and a variety of substrates will be eliminated or covered over by silt, the diversity of benthic macroinvertebrates in the proposed reservoir should be less than that observed in Pond Hill Creek. Species composition will also change significantly. The Pond Hill Creek macroinvertebrates, which require a running-water habitat (stoneflies, caddisflies, and most mayflies), will not survive in the impoundment; those capable of adjusting to quieter waters and/or preferring soft substrates (oligochaete worms, snails, dragonflies, and midge larvae) will become more abundant in the reservoir. However, benthic macroinvertebrates may be further limited by iron deposits on the bottom and/or low dissolved oxygen levels in the hypolimnion. Thus, only the more tolerant macroinvertebrate forms would be expected to inhabit the bottom of the lake. Midge larvae (Chironomidae) will probably dominate the reservoir benthos, since they survive at very low oxygen levels and were found to be abundant in sections of the Susquehanna River in which heavy iron deposits were observed.

Pond Hill Creek is very small and presently supports a limited fish population comprised chiefly of minnows. No endangered or rare fish species inhabit the stream, nor are there any permanent game fish populations present.

A number of factors will affect the type of fish community that will develop in the reservoir. The fish species presently found in Pond Hill Creek, which prefer and/or require running-water habitats, are not expected to occur in the proposed reservoir. These include blacknose dace and creek chubs. On the other hand, golden shiner and fathead minnows, along with bluegills, largemouth bass, and other species inhabiting the small ponds adjacent to the stream may become abundant in the new reservoir.

Low dissolved oxygen and chemically-reduced substances released from bottom sediments may create an unfavorable habitat in the hypolimnion during late summer for many fish species. However, oxygen levels in the epilimnion should remain sufficiently high to support warmwater fishes (ER-OL, Section 4.2.3.3.2).

Iron levels near the intake site have been consistently higher than the 1.0 and 1.5 mg/L criteria. However, a total of forty-two fish species have been found to inhabit this section of the river. Apparently the ambient iron concentrations in the river are not directly toxic to these species. Nor do growth or spawning success seem to have been adversely affected. Consequently, most of the fish species, including a number of game fish, inhabiting the Susquehanna River near the intake site would be relatively unaffected by the iron levels in the reservoir. Possible detrimental effects of iron on the fish in the reservoir should be further reduced by the fact that iron concentrations will be lower than those usually found in the river.

Periodic drawdowns should have no major detrimental effects on fish or other aquatic life in the reservoir. Drawdowns generally will be infrequent and will expose a relatively small amount of the lake bottom; an extensive drawdown of the reservoir would be anticipated only once in about 71 years. All drawdowns would be expected to occur during the late summer and fall months.

The staff also concludes that evaporation rates will have insignificant effects on spawning habitat. The applicant's anticipated evaporation rates are presented in Table A.4.3.

In general, the proposed reservoir would be a suitable habitat for many warmwater game fish; these could include pickerel, muskellunge, catfish, bluegill (and other sunfish), crappie, smallmouth bass, largemouth bass, yellow perch, and walleye, all of which presently occur in the Susquehanna River near the intake site. These fish will be introduced and maintained by a fishery management program (ER-OL, Section 4.2.3.3.2). A number of these species would probably establish permanent populations in the reservoir.

Table A.4.3. Anticipated Evaporation Rated on a Monthly Basis for the Pond Hill Reservoir[a]

Month	Evaporation (cm)	Month	Evaporation (cm)
January	0.0	July	1.9
February	0.0	August	1.7
March	0.0	September	1.2
April	1.3	October	0.8
May	1.7	November	0.6
June	1.8	December	0.0

[a]Source: Response to NRC Question 23, 12 October 1979.

A.4.3.2.3 Discharge System

Construction Impacts

Since the discharge system, as presently proposed, will be contained within the same structure as the intake (see Fig. A.3.3), impacts associated with construction of the discharge will be the same as those discussed for the intake system (see Sec. A.4.4.2.1.1).

Operational Impacts

The applicant indicates that the quality and temperature of water discharged from the reservoir into the downstream section of Pond Hill Creek and the Susquehanna River will be controlled by the multilevel inlet-outlet structure (ER-OL, Sec. 4.3.1). The outlet ports for compensation releases in the revised inlet-outlet structure (Fig. A.4.1) will be at the 291.4, 282.0, and 259.1 m levels. The applicant has performed new thermal modeling analyses for the reservoir, using the schedule of compensation releases that would be required for 1964 drought conditions and the two sets of meteorological data, 1964 and 1975 (PP&L Comment letter, 29 May 1980; Letter 17 of Appendix B). The results of these calculations are given in the above comment letter.

The staff has not verified the applicant's calculations but does agree with their conclusion that, under most conditions, the compensation releases will be from the epilimnion layer, minimizing the potential for cold shock in the Susquehanna River. However, in the unusual event that the water level in the reservoir is below that of Outlet No. 2 (282.0 m) (the minimum pool level is 264.4 m), compensation water would be pumped through the outlet at 259.1 m and would be hypolimnetic water. Thus, a potential for cold shock remains. However, the staff believes that the multi-slotted discharge will enhance dilution and thus mitigate the effect to some degree.

In addition to extreme temperature changes, nutrient concentrations in the discharge may be higher than presently expected, depending on from what portion of the hypolimnion the water is withdrawn. The deeper the water, the higher the concentrations. An exception would be during turnover, when the concentrations would be more uniformly distributed.

Iron levels in the discharge water may be high, especially if release coincides with overturns. In addition, since the reservoir may be eutrophic, large amounts of organic matter may appear in discharges. High iron and organic-matter concentrations in the discharges should have little impact on the Susquehanna River, since compensation releases will be infrequent and usually small in volume.

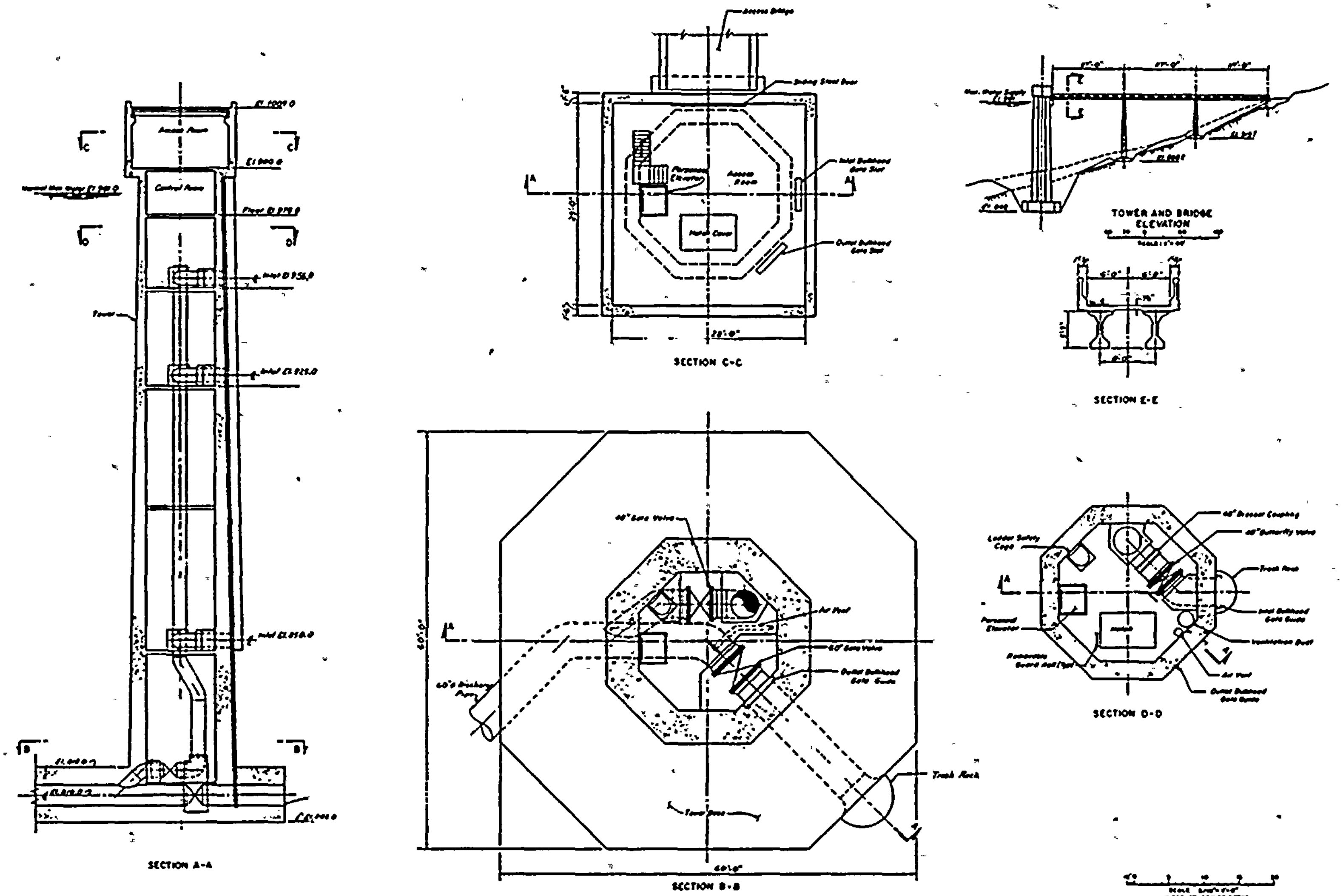

Fig. A.4.1. Inlet-Outlet Structure.

Dissolved oxygen concentrations vary inversely with reservoir depth. Anoxic conditions may exist in the deeper parts of the hypolimnion. Obviously the discharge of anoxic water to either Pond Hill Creek or the Susquehanna River would be adverse, with the effects being localized.

A conservation release of 5.7 L/s will be maintained for the remaining section of Pond Hill Creek below the dam. Most of the time, however, the downstream releases will exceed this rate due to natural runoff in the watershed. Although there should be a sufficient quantity of water to support the existing aquatic life in the stream, the quality of the downstream release water may be detrimental to some of the stream organisms. But iron levels in the release water may exceed the recommended criteria, particularly during reservoir overturns. This could result in the deposition or iron precipitates on the stream substrate, which in turn, could limit periphyton and macroinvertebrate communities to iron-tolerant species.

The average release velocity through the screens will be about 0.4 ft. per second (0.9 cm/s) (measured 1 foot from the screens) and the screens will be about 2 ft. (0.6 m) above the riverbed. Any scour that may result from compensation releases will be localized and temporary. The staff concludes that monitoring benthos in the vicinity of the discharge is not necessary.

A.4.3.3. Atmospheric

Converting 128 ha of mixed woodland/field vegetative cover to water will have minimal impact on the atmosphere. The thermal inertia of the stored water will moderate air temperatures slightly. In fall and early winter, light steam fog will occasionally form over the water and move a few tens of meters inland before evaporating. Since there is no heat load on the reservoir, the frequency and density of the steam fog will be similar to that of other small lakes in the area.

Equipment used in construction will comply with the criteria established by OSHA and EPA for noise and exhaust emissions. The applicant will require the contractor to employ dust control measures (ER-OL, Appendix H, pp. 4-87).

A.4.4 HYDROLOGIC IMPACTS

A.4.4.1 Construction

Stripping of vegetation from the area to be inundated and from other areas will increase the runoff coefficient, resulting in higher peak flows in Pond Hill Creek. However, since this effect will be temporary (the dam, when complete, will provide flood control for the remaining section of the stream) and since there are no residences that can be affected by the higher streamflows, the staff concludes that the impact will be minimal.

The major hydrologic impact of the construction of the dam will be to convert a natural stream, Pond Hill Creek, into a reservoir and a stream whose maximum and minimum flows will be controlled. The hydrologic aspects of the stream before construction are discussed in Section A.2.3.2. The upper portion of that stream will be replaced by a reservoir with a normal, or full-pool, elevation of 299 m MSL. This reservoir would cover 128 ha and contain approximately 30×10^6 m^3 of water. The maximum depth during normal pool operation would be about 67 m; the average depth would be 23.3 m.

The applicant used the Hydrologic Engineering Center (HEC) Water Quality Model to simulate the thermal behavior of the reservoir. The model results are sensitive to calibration constants that can only be determined by field measurements. For the Pond Hill thermal simulation, the vertical eddy diffusion coefficients were estimated by comparison with similar lakes and reservoirs. Although the analysis was performed for the smaller reservoir originally proposed by the applicant, the results are useful in that they provide a general description that should be representative of the proposed reservoir's thermal characteristics.

The HEC model predicted that the proposed reservoir would be thermally stratified during the summer with turnovers and mixing in early spring and late fall. A relatively stable thermocline was predicted to form in late April and remain throughout the rest of the spring, summer, and early fall (through October). The model predicted an epilimnion (upper layer) approximately 4.6 to 6.1 m thick with summer temperatures between 20° and 25°C. Temperatures in the hypolimnion (lower layer) were predicted to range from 5° to 10°C.

The proposed location of the pumping station is adjacent to the railroad in an area outside the 1% chance (100-year) floodplain as shown in Figure A.2.5. Pipelines connecting the pumping plant to the submerged intake and discharge will be buried in the floodplain. The applicant is committed to restore the land surface in the floodplain after completion of construction. The staff concludes that there is no practicable alternative to the construction of this section of pipeline in the floodplain and that the hydrologic impacts would be minimal.

A.4.4.2 Operation

A.4.4.2.1 Water Supply

The Pond Hill Reservoir was proposed to provide replacement for Susquehanna River water consumed by the Susquehanna Steam Electric Station during periods of low flow as defined in 18 CFR 803. The low-flow criterion is the seven-year, ten-day (Q7-10) low flow of the Susquehanna River plus the consumptive water use of the power plant. At Wilkes-Barre, the Q7-10 is estimated to be 22.7 m^3/s. Thus, the requirement for replacement of consumed water becomes effective whenever the river flow at Wilkes-Barre is below 22.7 m^3/s plus the plant's actual measured consumptive use. Average plant consumptive use is estimated to be 1.4 m^3/s, with the maximum estimated to be 1.8 m^3/s. Therefore, water replacement may be required when flow at Wilkes-Barre is below 24.5 m^3/s.

The reservoir was designed to be able to supply the required replacement water to the Susquehanna River during a recurrence of the drought of record, August to November 1964. The effects of precipitation onto and evaporation from the reservoir during the drought, although minor, were included. During this drought, flow at Wilkes-Barre was below 24.1 m^3/s on 106 days, including one period of 84 continuous days. There was only one additional day when the flow was below 24.5 m^3/s. If it were assumed that the maximum consumptive use occurred on that day, the conclusions would not change significantly. At normal full pool, the reservoir will contain approximately 29.7×10^6 m^3 of water with approximately 27.1×10^6 m^3 available for release. If released at an average rate of 1.4 m^3/s, the estimated average plant consumptive use, there will be enough water for more than 220 days without refilling the reservoir. The applicant has assumed a higher release rate of about 2.9 m^3/s. At this rate, the reservoir's available storage would be used up in about 106 days, the number of days for which replacement water would be required during a repeat of the drought of record.

At the assumed average release rate of 2.9 m^3/s, an average of 1.4 m^3/s would be needed for replacement of plant water consumption and 1.5 m^3/s would be available for other uses such as sales to other water users to supply compensation releases. During times of greater plant water consumption, the water available for other purposes would be reduced. At the maximum estimated plant consumption rate of 1.8 m^3/s, approximately 1.1 m^3/s would be available for other uses as described above.

The design rate at which the reservoir could be refilled with water from the Susquehanna River is 3.7 m^3/s. At this rate, it would take approximately 84 days to refill the reservoir. However, the applicant has stated that refilling will not occur at times when the flow in the Susquehanna River is below 85.0 m^3/s. Even with this restriction, it is almost certain that the reservoir would be refilled prior to the next low flow.

A.4.4.2.2 Pond Hill Creek

The operation of the Pond Hill Reservoir will change the character of the remaining portion of Pond Hill Creek, primarily during periods of high and low flow. Most of the time, with the reservoir full, surface flow into, or rainfall onto, the reservoir will be released through the spillway. This flow will be directed to the remaining lower portion of Pond Hill Creek. The replacement of approximately 39% of the upper drainage area of the stream with a reservoir will increase the flow at the spillway during moderate storms. However, during severe storms, the discharge will be limited by the cross-sectional area of the spillway. The excess inflow to the reservoir will be accommodated by a rise in water level.

The applicant analyzed the system response during a 1% chance flood (100-year recurrence flood). The analysis indicated that under natural conditions the peak stream discharge would be about 49.7 m^3/s. The calculated peak inflow (overland flow into and rainfall onto) to the reservoir was estimated to be about 60.8 m^3/s. However, the peak discharge through the spillway was calculated to be only 0.84 m^3/s. The reservoir, therefore, will serve to considerably attenuate the effects of the flood on the downstream portion of the stream.

Normally, with the reservoir at full-pool elevation of 299 m MSL, all inflow to the upper portion of the watershed will pass to the lower portion of the stream via the spillway. The applicant has stated, however, that a minimum flow of 5.7 L/s will be maintained. A section of pipeline, connected to the reservoir-to-pumping plant pipeline immediately downstream of the dam will be used for this purpose. The release point will be between the toe of the dam and the spillway discharge location. The choice of 5 L/s for the minimum flow is based upon the methodology used by DER to estimate the seven-day, ten-year low flow on ungauged streams. Since the natural streamflow probably ceases during drought periods, the proposed conservation release represents a change in the hydrology of the downstream portion of the stream.

A.4.4.2.3 Hydrologic Design of Dam

Since failure of the dam would not result in radioactive releases nor effect the reactor site, the staff did not perform a detailed evaluation of the dam's hydrologic design. The staff did, however, review the hydrologic criteria used and compared these with criteria used for (radiologically) safety-related dams.

The applicant's hydrologic design criteria is a flood series consisting of the 6-hr Probable Maximum Flood (PMF) followed, 48 hr later, by a lesser "Recurrent Flood." Staff's criteria require a PMF preceded by 40 percent of the PMF. In addition, the criteria result in a PMF more severe than that calculated by the applicant. However, the applicant's design flood series, while not as severe as the staff's, is an extremely severe flood event.

The applicant originally proposed a 3-m wide spillway with a crest elevation at 299 m MSL. The maximum reservoir level resulting from this design flood was calculated by the applicant as 300.19 m MSL, 1.18 m above the spillway crest and 1.56 m below the crest of the dam. The staff concluded, however, that its more severe design flood would result in overtopping of the dam. This was due primarily to the fact that the relatively narrow spillway was incapable of passing more than a small fraction of the postulated inflow to the reservoir.

The applicant has recently revised the proposed design of the spillway. The new design calls for the spillway to be 25.91 m wide with a crest elevation at 299.31 m MSL. The 0.30-m difference between the crest elevation and the normal full-pool reservoir elevation will provide additional flood storage.

The applicant routed its design flood through the reservoir with the revised spillway, assuming the initial water level to be at the spillway crest; i.e., no flood storage below the crest available. The maximum reservoir level calculated was 300.21 m MSL, 0.9 m above the spillway crest and 1.54 m below the dam crest.

The applicant also routed the staff's more severe design flood series through the reservoir. The calculated maximum reservoir level was 300.42 m MSL, 1.11 m above the spillway crest and 1.33 m below the crest of the dam.

The applicant's calculations indicate, therefore, that the dam can meet the hydrologic design criteria staff requires for (radiologically) safety-related dams..

A.4.4.2.4 Groundwater Effects

Filling of the reservoir will alter the groundwater conditions within the drainage area of the upper portion of Pond Hill Creek. The groundwater level should rise to at least the level of the reservoir at its perimeter. Since groundwater levels in the ridge north of the reservoir are clearly well above the reservoir level, there should be no effect on the groundwater regime north of the Pond Hill Creek drainage area. The limited information available on the groundwater conditions on the ridge south of the reservoir indicate that groundwater levels are also above the proposed water level in the reservoir. In addition, the applicant has proposed a saddle dam and an impervious cutoff section along the two lowest sections of that ridge. The staff, therefore, concludes that groundwater levels south of the ridge should not be affected by the reservoir.

A.4.5 SOCIOECONOMIC IMPACTS

The following is an assessment of the potential socioeconomic impacts of the construction and operation of the Pond Hill Reservoir on local communities in Luzerne County. Direct and indirect changes to the sociocultural systems of local communities are expected to be a result of the construction work force and related activities and of the presence of a lake in a previously wooded, rural area.

A.4.5.1 Demography

The peak construction work force will contain 125 individuals with 85% (106) of the workers expected to be commuters and 15% (19) in-migrating workers (Response to NRC Question 26). The applicant estimates that fewer than five of the expected in-migrants will bring their families; assuming two children per family, an additional ten school-aged children are expected as a result of this project (Response to NRC Q. 26).

Because of the short duration (two years) of construction and concurrent phasedown of construction at the Susquehanna Plant, the staff believes that induced service personnel will not result from the nineteen additional workers and their families moving into the local area. If these in-migrants are dispersed throughout the impact area, their additional service demands should be met by current staff and facilities.

A.4.5.2 Settlement Pattern

A.4.5.2.1 Housing

Specific information on the housing type and location preferred by the in-migrants is not available. The applicant states that workers at the Pond Hill site are expected to make arrangements for temporary housing--motels, boarding houses--and return home on weekends (Response to NRC Q. 26).

Available housing in communities close to the project area, such as Pond Hill, Mocanaqua, and Shickshinny, is virtually nonexistent. However, the applicant believes that some transient housing would be available in Wilkes-Barre or Nanticoke and additional housing is expected to become available in the Berwick-Bloomsburg area as the SSES work force is reduced.

However, factors such as local scenic qualities, recreational opportunities, gasoline prices, cost of living, etc., may attract more than the projected number of in-migrants. They and their families might choose to seek housing in the immediate area during some parts of the year rather than to commute from larger service centers. In such an event, housing competition may occur.

Operation of this project may also produce a secondary effect on local housing patterns because of the land-use changes brought about by the reservoir. Some residential development may take place in the areas surrounding the reservoir and buffer area. The applicant has provided estimates of the maximum and minimum number of residential development units that may be constructed, 35 and 140 units, respectively.[6] However, future development will depend on a combination of sociocultural factors, including the perceived attractiveness of the area, goals and values of the individuals wanting to build, local planning goals, availability of private land, and attitudes of local landowners.

A.4.5.2.2 Transportation

The construction and operation of the Pond Hill reservoir will impact local transportation systems. During construction, Route 239 and, to a lesser extent, LR 40120 will be affected by increased use for transport of construction-related equipment and materials and commuting workers.[6] In order to minimize traffic impacts in Pond Hill, the applicant will build a new access road to the reservoir site (Response to NRC Q. 8, part b). In addition, Route 239 will be affected by the construction of the pump station, when traffic will temporarily be reduced to one lane. The applicant has studied the cumulative effect of the Pond Hill and SSES projects and concludes that an additional police officer will be needed to facilitate traffic flow so as to avoid major transportation impacts.[6]

During operation, increased traffic volumes are anticipated on township roads because of the recreational facilities that will be available at the reservoir.[6] And, although the construction of a new access road to the site will lessen some of the impacts, the specific magnitude of these increases and their specific locations are not known at this time.

The applicant is committed to cooperation with the local townships to repair roads damaged due to reservoir construction activities.

A.4.5.2.3 Recreation

The applicant has summarized the outdoor recreational areas by owner and acreage for the general region and Conyngham Township (Reference 6, Tables 3.2.8-1 through 3.2.8-3). Forecasts of state recreational demands show a need for more facilities in almost all outdoor recreational activities. The staff believes that some of the projected recreational needs will be met by the Pond Hill Reservoir and associated facilities described in Section 3.3. The Pennsylvania Fish Commission will be asked to stock the lake for warmwater sport fishing. The recreational potential created by these facilities is estimated to be from 7,300 to 10,000 visitor-days per year, not including visitations related to hunting or winter sports.[6]

The applicant has defined five recreational development objectives in order to maintain the ecological characteristics and remote setting of the site and to minimize impacts of operation on the local communities while providing facilities that meet their perceived needs.[1] The staff notes that these objectives were considered in the designs for recreational use and project maintenance particularly to avoid greater use of the site than its intended design capacity.

A.4.5.3 Impacts to the Social System

The applicant states that short- and long-term impacts to the cohesion of local communities near the reservoir site are not expected (Reference 6, Sec. 4.2.4.7). The staff believes that direct impacts to social institutions or cohesion will not be severe because of the small work force and projected number of in-migrants and because the project area does not physically divide a community or separate communities. Potential effects on lifestyle; values; beliefs; and solidarity of local groups, neighborhoods, and communities would be due to indirect operational impacts of induced development. Such impacts could begin during construction. The potential for developmental impacts to the local settlement system were discussed in Section 4.6.2.1 of Reference 6.

A.4.5.4 Social Services

Because of the small work force, short duration of the project, and expectation of few in-migrants, impacts to most kinds of social services are not expected. However, impacts associated with increased traffic may require traffic-control personnel in some local areas.

A.4.5.5 Impacts to the Political System

Direct impacts to the political organization of local communities are not expected. Should indirect impacts occur, such as induced development, planning decisions, increased personnel, financing and zoning, consideration may be required.

A.4.5.6 Impacts to the Economic System

Although the economic impacts of the construction phase of the project will be small, they are expected to be beneficial to the region and to some local businesses. The applicant states that construction cost (50% in materials) will have a multiplier effect on the regional economy.[6] Moreover, many construction materials and equipment may be purchased within Luzerne County; additional spending may result as these industries increase their purchases from other industries and hire more labor.[6]

A.4.6 IMPACTS TO CULTURAL RESOURCES

Archeological investigations at the Pond Hill Reservoir site, limited to the area within the high water mark of the reservoir and a nearby section of the Susquehanna floodplain, disclosed negligible archeological materials.[7]

References

1. "Johnson Screens in Surface Water Intake Systems," Bulletin 1S577. Johnson Division of United Oil Products, Inc. St. Paul, MN, 1977.

2. J. B. Canon et al., "Fish Protection at Steam-Electric Power Plants: Alternative Screening Devices," Prepared for USNRC, Division of Site Safety and Environmental Analysis, under Interagency Agreement DOE 40-544-75 and the USEPA, Region II, Water Facilities, Branch-Energy & Thermal Wastes Section, Water Division, July 1979.

3. "Quality Criteria for Water," U.S. Environmental Protection Agency, Washington, D.C., 1976.

4. E. T. Chanlett, Environmental Protection, New York: McGraw-Hill, 1973.

5. H. B. N. Hynes, The Ecology of Running Water, Toronto: University of Toronto Press, 1972.

6. Tippetts-Abbett-McCarthy-Stratten/Engineers and Architects, "Design Report: Pond Hill Reservoir," prepared for Pennsylvania Power & Light Company, 1979.

7. Commonwealth Associates, "Archeological Investigations at the Susquehanna Steam Electric Station: the Pond Hill Reservoir Site," prepared for PP&L, 1981.

A.5. ALTERNATIVES, NEED FOR FACILITY, AND BENEFIT-COST ANALYSIS

A.5.1 ALTERNATIVES TO CONSTRUCTING A WATER STORAGE RESERVOIR

The applicant has given consideration to two alternative procedures that would not require the construction of an offstream water storage reservoir and would comply with the requirements of the Susquehanna River Basin Commission:

1. Not operate the Susquehanna Steam Electric Station whenever flow in the Susquehanna River fell below the consecutive seven-day low flow expected to occur every ten years (the Q7-10 value).

2. Purchase makeup water from existing reservoirs.

The applicant has submitted the following documents in support of analysis of alternatives:

1. Appendix H, Section 2 to the Environmental Report for SSES.

2. "Assessment of Sites for an Augmentation Reservoir for the Susquehanna Steam Electric Station," Tippetts-Abbett-McCarthy-Stratton, August 1977.

3. Letters from N. W. Curtis, PP&L, to D. E. Sells, NRC, 12 October and 13 November, 1979. Item 3 contains the applicant's response to staff questions on alternatives.

A.5.1.1 No Action Alternative--"River Following"

The applicant could meet SRBC requirements by choosing not to operate SSES during specific periods of low river flow. This mode of operation, called "river following," would require the generation of replacement electrical power from other units within the PP&L or PJM power system, or the purchase of power from other utilities.

Based on the critical flow value, 24.1 m^3/s, the river-following mode of operation would have required the shutdown of SSES for 106 days in 1964, the year of record low flow in the river.

The use of the river-following option would, in some years, require several additional shutdowns and startups of the SSES reactors, and also of the generating units providing the replacement electrical power. This cycling of units would add to maintenance costs and efforts and would probably decrease plant and system reliability.

A.5.1.2 Use of Existing Reservoirs

The applicant has examined the potential for purchasing the required volume of replacement water from an existing (or under-construction) reservoir, including those owned by the Pennsylvania Gas and Water Company (PGW), the U.S. Army Corps of Engineers (COE), and the Soil Conservation Service. Expansion of PGW's Nesbitt Reservoir to hold the required volume of water would entail the construction of a new 64-m high dam and a long refilling pipeline from either the Lackawanna or Susquehanna River. Estimated costs of expanding the Nesbitt Dam would be greater than that of constructing the Pond Hill Reservoir. The staff agrees with the applicant that, due to higher costs and potential for delays, the use of PGW's water storage facilities is not to be preferred over the Pond Hill Reservoir.

COE has two dams under construction in Tioga County, Pennsylvania. The applicant has sent to COE a request to purchase compensation water flow from the Cowanesque Reservoir, scheduled for completion in 1982 (ER-OL, Appendix H). COE has also indicated that congressional action may be required to make water storage an authorized use of the water in Cowanesque Lake (PP&L response to NRC questions). No firm cost values can be assigned to the use of COE-stored water.

A.5.1.3 Summary

The staff agrees with the applicant that the river-following alternative, while a viable one, is less desirable than the construction of Pond Hill Reservoir. The staff also agrees with the applicant that there is the potential for long delays in obtaining the required compensation releases from Cowanesque Lake, making the second option less desirable than the construction of Pond Hill Reservoir.

A.5.2 ALTERNATIVE SITES

The applicant has identified twelve potential alternate locations for the Pond Hill Reservoir (ER-OL, Appendix H, Section 2.4). This analysis is based on a usable water storage requirement of 11.7×10^6 m^3, the volume of water that would be required for a compensation flow of 1.42 m^3/s for 96 days.

The thirteen sites (selected and 12 alternates) were selected in part from a 1970 Susquehanna River Basin Study Coordinating Committee study. In 1977, an engineering consulting firm identified and investigated the technical, economic, and environmental characteristics of each site (Reference 1 and ER-OL, Appendix H, Section 4.2). TAMS's analysis of the 12 alternate sites was based primarily on reconnaissance-level information.

The applicant subjectively rated each site on the basis of eleven environmental engineering factors: number of residential units within the site; number of residential units below the proposed dam site; amount and type of agricultural activity affected; agricultural capability classification of soils within site; length of stream inundated; quality of the affected stream's fishery; water quality of the reservoir's water source (this would directly affect the reservoir's potential water quality); potential impact on pumping source (with particular emphasis on proportion of total flow to be pumped and on fishery quality); a qualitative judgment of the wildlife habitat within the site relative to the other sites studied; length and type of water conduit (i.e., pipeline or tunnel) and character of area that would be traversed by a pipeline; and area exposed by maximum drawdown (directly related to the size and shape of the reservoir).

Factors such as topography, hydrology, geology, and estimated cost of construction were also evolved. Construction impacts, except for the water conduit pipe and route, were considered to be similar for all sites. This analysis showed that the Pond Hill site would be the preferred site.

The staff has reviewed the applicant's site selection procedures and concludes that the methodology used by the applicant is satisfactory and that none of the alternate sites is environmentally obviously superior to Pond Hill Creek. The staff's judgment is based in part on visits to the Pond Hill area and to four alternate sites.

A.5.3 BENEFIT-COST ANALYSIS

A.5.3.1 No Action Alternative--"River Following"

Based on historical river flow, the river flow will be lower than the critical level on an average of 3.3 days per year (ER-OL, Appendix H, Section 1). Under the river-following alternative, the applicant would have to buy replacement energy to make up for the loss of generation due to the shutdown of SSES. The applicant estimated the average annual energy requirement for four days of shutdown (including that for start-up time) to be between 160,000 MWh and 170,000 MWh (response to NRC Q. 33, 12 October 1979). The energy range is due to the difference in length of start-up time associated with cold or hot reactor shutdown conditions. If an equal probability of hot or cold shutdown condition is assumed, the average annual energy requirement, as per the applicant's estimate, would be 165,000 MWh. Staff's estimate of energy loss during the four-day period, assuming 70% capacity factor, is 146,000 MWh. The applicant's and the staff's thirty-year present worth of the average annual replacement energy cost are 117.8 and 104.2 million dollars, respectively (Table A.5.1). In order to make a fairer comparison for benefit-cost purposes, it is important to subtract the cost of operating SSES from the replacement energy cost. It should be noted, however, that there are some advantages (such as improved systems reliability) of operating SSES over and above the difference between replacement energy costs and SSES operating cost.

The applicant's and staff's thirty-year estimate of present worth of the average annual replacement energy cost at the incremental price are 64.3 and 56.9 million dollars, respectively (Tables A.5.1 and A.5.2). The staff's estimate of present value of average annual replacement energy cost falls between $41 million for the best-case (average annual shutdown of three days) and $192 million for the worst-case (average annual shutdown of fourteen days). The probability of shutdown of less than or equal to 3 days and 14 days are 86.1 and 99.1%, respectively (Table A.5.3).

Table A.5.1. Thirty-year Present Worth of the Average Annual Replacement Energy Cost

	Applicant[a]	Staff	Pond Hill Reservoir Cost[b]	
			w/o tax	w/tax
Annual 4-day energy loss (MWh)	165,000	146,000	--	--
30-year present worth at incremental price (M$)[a]	64.3	56.9	48.7	62.3
30-year present worth at replacement price (MS)	117.8	104.2	49.5	63.1

[a]Response to NRC Question 33, 12 October 1979.

[b]Letter from L.E. Schroder, PP&L, to R. Prasad, ANL, 19 November 1979.

Table A.5.2. Staff Estimates of Replacement Energy Cost at the Incremental Price

Year	Replacement Price (mills/kWh)	Nuclear Gen. Price (mills/kWh)	Price Growth (%)	Incremental Price (mills/kWh)
1978	25	--	--	--
1980	35	13.0	--	--
1983	35	15.90	6.96	19.1
1985	40	18.20	6.9	21.8
1990	65	29.5	10.19	35.5
1995	100	45.5	8.99	54.6
1995-over	--	--	5.0	--

Table A.5.3. Shutdown Probabilities[a]

Days	% Probability of Generation Loss	Annual Average Day Loss	Present Worth ($ million)	
			At Replacement Price	At Incremental Price
0	83.00	--	--	--
≤3	86.00	3	75.6	41.2
≤4	89.00	4	100.7	55.0
≤7	90.00	7	176.3	96.2
≤14	94.00	14	352.6	192.4
≤31	99.0	31	780.8	426.1
96	1.0	96	2418.1	1319.8

[a]Source: ER-OL, Vol. 4, pp. 1-4, Table 1.3.2-1.

A.5.3.2 Use of Existing Reservoirs

The applicant has explored the potential for using water supply storage in an existing storage facility to augment the river flow during the low riverflow period to keep SSES operating. Among the projects considered, the applicant, in consultation with COE, found the Cowanesque project to be the most suitable from the point of view of timeliness and availability of water supply storage. But in their recent response they have pointed out many uncertainties regarding the availability of water storage due to congressional approval requirements and the Susquehanna River Basin Commission's comment that Cowanesque Lake cannot presently be considered as a timely alternative for supplying makeup water for SSES (applicant's response to NRC Q. 39, 12 October 1979). The applicant estimates the approximate cost of this alternative to be $12 million over a 30-year period. The staff does not have sufficient information to substantiate the cost.

A.5.3.3 Pond Hill Reservoir

The third alternative considered was the building of a reservoir; this would assure a source of low-flow compensation. The applicant has proposed to build Pond Hill Reservoir for water supply storage. The overall cost of the project is estimated by the applicant as $47 million (in 1983 dollars). The applicant has assumed that the only cost associated with the Pond Hill Reservoir will be the electricity cost of pumping water into the reservoir. They estimate a yearly capacity cost of $40,300 and 2417 MWh (3357 kWh × 30 days × 24 hours of electricity) (personal communication, L. E. Schroder, PP&L, to R. Prasad, ANL, 19 November 1979). The present values of this alternative, over 30 years, are $48.7 and $49.5 million, including incremental and replacement price of electricity. On a purely economic benefit-cost analysis, which treats the tax cost as the transfer payment, these would be the costs of the project. If the property tax (in Pennsylvania the public utility realty tax is 3% of value) were treated as an added project cost, the staff's estimate of $63 million present value of the project would be very close to the replacement energy cost under the river-following alternative. One can also look at the property tax of $1.41 million as a compensation (benefit) for the environmental cost (undetermined) to the community.

A.5.3.4 Discussion and Conclusions

The cost of the river-following alternative is very dependent upon the probability of the occurrence of period length (number of days) of low river flow. From the analysis, it appears that, if low river flow were to occur at an annual average of four days, the cost of the Pond Hill Reservoir alternative would be very close to the replacement cost of electricity under the river-following alternative. But, if the annual average period of low river flow were 25 days (4% probability), the energy replacement cost could be as high as $344 million.

The best economic alternative would appear to be the use-an-existing-reservoir alternative. 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 compensation.

The river-following alternative took into account only the cost of replacement energy; it did not consider the effect of SSES shutdown on system reliability. The effect of shutdown on reserve margin is shown in Table A.5.4. PP&L's projected reserve margin without Susquehanna after year 1985 is significantly lower than its historical margin since 1973. PJM's reserve margin without SSES is projected to be approximately 25%, which is acceptable for the reliable operation of the interchange. PP&L, being a winter-peaking system, is able to operate with a reserve margin of 5%. PP&L could provide reliable service to its customers even during a short interval of shutdown of SSES.

A.5.4 EVALUATION OF UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

A.5.4.1 Land

The 525-ha site will be removed from current uses and dedicated to reservoir uses for the life of the project.

The development of the Pond Hill dam and impoundment sites will result in a long-term commitment of about 146 ha of land area. About 16 ha of this area will be altered during construction of the dam embankment, the spillway, and the overflow channel; 128 ha will be inundated following construction. About 2 ha will be used for the development of ancillary impoundment structures, water pipelines, pumping plant, service facilities, and highway access. Virtually all of the areas to be committed are presently forested land.

Table A.5.4. Effect of Shutdown on Reserve Margin[a]

Projected	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	PJM/PP&L Reserve Margin									
With Susquehanna										
PJM	34	33	34	30	30	31	30	31	29	27
PP&L	29	44	58	53	48	46	42	35	33	30
Without Susquehanna										
PJM	37	30	29	25	25	27	26	27	25	23
PP&L	29	26	23	18	15	13	10	4	2	1

Historical	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
PJM	13	21	22	16	28	39	42	38	40	35
PP&L	1	6	14	34	30	39	27	48	39	35

[a]Response to NRC Question 35, 12 October 1979.

Other principal land areas that will be disrupted or otherwise adversely affected during project construction include a construction staging site and upland tracts excavated to acquire core material for dam construction. An estimated 14 ha of land will be used for construction staging. The areas affected by borrowing activities will be dependent on the amount of core materials available at the various sites; a total of about 45 ha of upland terrain has been designated as primary and reserve source areas for borrow materials. There will be less land available for hunting and hiking.

A.5.4.2 Water

A 128-ha lake will be created in an area now forested. About 2.3 km of Pond Hill Creek will be destroyed and inundated. The lower 1.3-km stretch of Pond Hill Creek will be converted from a free-flowing stream to a regulated one with a minimum flow of 5.7 L/s. Water quality in the lower reaches will be degraded during construction (erosion) and operation of the reservoir.

A.5.4.3 Air

Once the reservoir has been completed, there will be a very minor increase in the frequency of steam fog in the area. Air quality in the construction areas will be decreased during the construction period due to fugitive dust and emissions from construction equipment.

A.5.4.4 Terrestrial Ecology

Construction

Assuming total utilization of all designated borrow areas, about 195 ha of vegetation and, therefore, wildlife habitat will be destroyed or disturbed during land-clearing and construction activities. More than 80% of the vegetation to be affected consists of forest communities. Site reclamation will entail landscaping about 25% of the denuded area, partially mitigating losses of vegetation and wildlife habitat. Some individuals of the less mobile wildlife species will be destroyed during construction; other species will vacate the disturbed areas. The displaced animals will cause increased competition for habitat resources in adjacent areas; however, the consequences will probably be minor in nature and of short duration since habitat conditions similar to those onsite occur extensively in the surrounding area.

Operational

The principal impacts resulting from project operation will occur with the initial filling of the reservoir. Residual vegetation will be inundated. Some additional wildlife will perish by drowning or be displaced from the impoundment site. The end effect of reservoir filling will be the conversion of about 128 ha of terrestrial habitat into an aquatic environment.

A.5.4.5 Aquatic Ecology

About 2.3 km of aquatic habitat along Pond Hill Creek, a healthy, unpolluted, natural stream, will be converted from that of a free-flowing small stream to that of a stagnant reservoir. The reservoir will support a much larger fish population than the area presently supports. There will be some loss of fish and other aquatic life in the Susquehanna River due to impingement and entrainment during periods when water is pumped into the reservoir; these losses are expected to be minimal.

Reference

1. Tippetts-Abbett-McCarthy-Stratton/Engineers and Architests, "Design Report: Pond Hill Reservoir," prepared for Pennsylvania Power & Light Company, February 1979.

APPENDIX 1

Letter from U.S. Fish and Wildlife Service re federally proposed endangered and threatened species in Pennsylvania

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
One Gateway Center, Suite 700
NEWTON CORNER, MASSACHUSETTS 02158

IN REPLY REFER TO:

William H. Regan, Jr., Chief
U.S. Nuclear Regulatory Commission
Environmental Projects Branch 2
Division of Site Safety and Environmental Analysis
Washington, D.C. 20555

Dear Mr. Regan:

This responds to your May 23, 1979, request for information on the presence of Federally listed or proposed endangered or threatened species within the impact area of the proposed 230 acre reservoir to be operated in conjunction with the Susquehanna Steam Electric Station near Berwick, Pennsylvania.

Except for occasional transient individuals, no Federally listed or proposed species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 consultation is required with the Fish and Wildlife Service (FWS). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to endangered species under our jurisdiction. It does not address any other FWS concern or concerns of the National Marine Fisheries Service (NMFS). As the shortnose sturgeon (Acipenser brevirostrum) is under NMFS jurisdiction and may inhabit the project impact area, contact should be made with Mr. Robert Lippson, National Marine Fisheries Service, Oxford Laboratory, Railroad Avenue, Oxford, Maryland 21654, Telephone No. (301) 226-5771.

Lists of Federally listed and proposed endangered and threatened species in Pennsylvania are enclosed for your information. Thank you for your interest in endangered species. Please contact us if we can be of further assistance.

Sincerely yours,

Howard N. Larsen
Regional Director

C002
ES
1/1

Enclosure

FEDERALLY PROPOSED ENDANGERED AND THREATENED SPECIES IN PENNSYLVANIA

Common Name	Scientific Name	Proposed Status	Distribution
Fishes:			
None			
Reptiles:			
None			
Birds:			
None			
Mammals:			
None			
Mollusks:			
None			
Plants:			
Waterweed, Schweinitz's	*Elodea schweinitzii*	E	Northampton (Bethlehem Area) County
Bullrush (Unnamed)	*Scirpus ancistrochaetus*	E	Lackawanna, Lehigh, Clinton, Blair Counties
Pogonia, small whorled	*Isotria medeoloides*	E	Green, Centre, Monroe, Montgomery, Philadelphia, Berks Chester Counties
Mouse-ear Chickweed, (Unnamed)	*Cerastium arvense* var. *villosissimum*	E	Chester, Lancaster Counties
Globeflower, Spreading	*Trollius laxus*	E	Centre, Erie, Bucks Lawrence, Monroe, Northampton, Lehigh Counties

ENDANGERED AND THREATENED SPECIES
IN PENNSYLVANIA

Common Name	Scientific Name	Status	Distribution
FISHES:			
Cisco longjaw	Coregonus alpenae	E	Lake Erie - probably extinct
Pike, blue	Stizostedion vitreum glaucum	E	Deep water of Lake Erie probably extinct
Sturgeon, shortnose*	Acipenser brevirostrum	E	Delaware River and other Atlantic coastal river
REPTILES:			
None			
BIRDS:			
Eagle, bald	Haliaeetus leucocephalus	E	Entire state
Falcon, American peregrine	Falco peregrinus anatum	E	Entire state - re-establishment to former breeding range in progress
Falcon, Arctic peregrine	Falco peregrinus tundrius	E	Entire state migratory - no nesting
MAMMALS:			
Bat, Indiana	Myotis sodalis	E	Entire state
Cougar, eastern	Felis concolor cougar	E	Entire state - probably extinct
MOLLUSKS:			
None			
PLANTS:			
None			

*Principal responsibility for this species is vested with the National Marine Fisheries Service.

APPENDIX 2

ARCHEOLOGICAL SURVEY PLAN FOR THE POND HILL RESERVOIR SITE

Prepared for

PENNSYLVANIA POWER & LIGHT

by

Curtis E. Larsen, Archeologist,
Commonwealth Associates, Inc.
Jackson, Michigan

31 October 1979

INTRODUCTION

The Pond Hill Reservoir Site is a project allied to the construction of the Susquehanna Steam Electric Station near Berwick, Pennsylvania. The purpose of the reservoir is to compensate for water which will be withdrawn from the Susquehanna River by the cooling process for the power plant. Because of differential cooling rates, approximately two-thirds of the water will be lost by evaporation. PP&L is required to augment water lost by the Susquehanna River, especially during low flow periods. The proposed reservoir will meet these requirements by storing river water in the reservoir which can be released to the river during periods of low flow.

The reservoir will be located on a small tributary stream on the east bank of the Susquehanna. This stream is locally referred to as Catfish Creek, but is unnamed on the Nanticoke 7.5 minute USGS quadrangle. The site is approximately seven miles northeast of the Borough of Berwick and one mile south of the village of Mocanaqua. The valley of Catfish Creek is oriented east-west. The reservoir will be created by constructing a dam across the mouth of the valley about one mile upstream from the confluence of Catfish Creek with the Susquehanna. The valley is undeveloped and in places is heavily wooded. The entire area to be included within the reservoir is approximately 150 acres, however the entire area to be affected by the PP&L project is 1300 acres. This total includes both of the valley sides and the upland surfaces of the adjacent ridges. In addition to the reservoir, some of these adjacent areas will provide borrow material for various construction activities others will be used as staging areas for heavy equipment. Because much of the entire 1300 acres will be disturbed in some way, it will be necessary to take an inventory of any historic or archeological resources which may be impacted by the proposed construction. Such assessments are to be made pursuant to 36CFR800, Section 106 of the National Historic Preservation Act of 1966 as amended (16USC470), 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, 1978. This legislation outlines Federal Agency responsibilities with regard to National Register elibible properties and provides for the protection and enhancement of such properties.

To meet these directives, it is necessary to inventory the cultural resources of the project area prior to construction activities. This will require an adequate literature search to determine past historic uses of the area as well as to ascertain the presence of previously recorded archeological sites within the project boundaries. In addition, an on ground survey must be conducted to insure that archeological resources are not endangered by the proposed project. To satisfy these requirements, a plan for survey and literature search must be devised which satisfies the licensing requirements of the Nuclear Regulatory Commission with the participation of the State Historic Preservation Officer acting through the Pennsylvania Archeological Commission. The following plan is submitted to assist PP&L with these requirements.

Cultural Resource Inventory Plan

The cultural resource inventory of the Pond Hill Reservoir Site will consist of two concurrent investigations. The first of these will involve a literature and archival search to determine whether previous historic or prehistoric sites have been recorded for the project area. This will involve a canvass of the records of the State Historic Preservation Officer as well as a visit to the Luzerne County Courthouse in Wilkes-Barre. Should this research identify any previously recorded sites, each of these will be relocated in the field for future testing, if necessary. In addition to records' searches or published references, our staff will investigate the oral histories of the project area through interviews in the communities of Pond Hill, Mocanaqua, and Wapwallopen.

On the ground archeological survey will consist of a thorough canvass of the project area. At the present time, at least seventy-five percent of the valley of Catfish Creek is wooded. Areas of exposed soils are only present along cleared roads installed during test boring operations. Only a few cultivated fields exist within the area. These are located on upland surfaces near the village of Pond Hill. These too are overgrown. Because of difficulties in surface visibility, it will be necessary to shovel test the entire area to verify the presence or absence of archeological evidence. Our survey program will combine the necessary shovel testing with surface examination where, possible, along a series of walked transects across the project area.

The site will be canvassed by walking compass-oriented transects at 30 m intervals across the site. At 30 m intervals, along the transect, a shovel test pit will be excavated to examine the soil beneath the surface debris or vegetation. Each pit will be no larger than 25 cm x 25 cm nor deeper than 25 cm. The soils removed from each pit will be carefully disaggregated and examined for artifacts. Should any indication of an archeological site be encountered, the area will be flagged with survey tape and labeled in a coding system which will allow a site to be identified only by persons with direct responsibilities for archeological resources. This will prevent unauthorized persons from damaging sites. Any sites discovered will then be located on existing base maps. These will supply the client with the necessary site information to plan for the protection or mitigation of cultural resources that may be threatened by the project construction.

The potential incidence of rock-shelters is a major concern for archeological investigation along the Susquehanna River. More specifically, these are overhanging rock ledges which may have offered shelter to past human groups. At the Pond Hill Site, the northern valley slopes display the bedrock configuration for rock-shelter formation. Because of this potential for rock-shelters, the northern valley slopes must be given special attention. The best method for approaching this problem is to locate the outcrop patterns of the pertinent resistant sandstone beds along the valley sides. Then, linear traverses will be made along the base of any such outcrops. Should characteristic overhanging ledges be found, shovel test pits will be excavated below them to check for archeological evidence. Once again, if evidence is found, each site will be flagged and located on base maps.

Analysis and Report

Following field survey and literature search, any archeological collections will be analyzed and described. The results of our survey will then be presented in a written report setting forth our research strategy, methodology and the results of our fieldwork. Should archeological sites be encountered during this survey, recommendations will be made regarding the testing of these sites to ascertain their eligibility for inclusion on the National Register of Historic Places. These recommendations will consist of a Phase II testing program with man-hour estimates for investigating the pertinent sites by hand excavation.

A draft report for the on-ground survey work presented here, will be submitted to PP&L in the spring of 1980. Following client comments, if any, Commonwealth will prepare a final report in the required number of copies for agency review and PP&L record purposes.

APPENDIX B. COMMENTS ON THE DRAFT ENVRIONMENTAL STATEMENTS (June 1979 and March 1980)*

* Comments on Supplement No. 2 to the Draft Environmental Statement published in March 1981 are contained in Section 6.1.6 of this Final Environmental Statement.

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
(21) 596-1672

1950
August 14, 1979

Mr. William H. Regan, Jr.
Environmental Projects Branch 2
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Refer to: Docket No. 50-387, 50-388
Draft Environmental Statement
Operation of Susquehanna Steam
Electric Station, PA

Dear Mr. Regan:

Our Milwaukee Office has forwarded this Statement to us for review and comment, as National Forest lands are not involved.

The proposed use of 2,4,5-T as a weed control agent in rights-of-way is illegal following the emergency order by EPA suspending use of 2,4,5-T on forests rights-of-way, and pastures (Federal Register Vol. 44, page 15874, March 15, 1979). We believe a discussion of alternative weed-control methods should be included in the Final Statement. Formulations of ammonium sulfamate, dicamba or bromacil could be considered.

Discussion of the coal and uranium fuel cycles should include the indirect effect of mining on the landscape. This effect is becoming more severe as the more productive sites are exhausted and more digging is needed for every ton of fuel.

Thank you for the opportunity to review and comment on this Statement.

Sincerely,

DALE O. VANDENBURG
Staff Director
Environmental Quality Evaluation

C002 ES 1/0

7908210409

6200-11 (1/69)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Box 985 Federal Square Station, Harrisburg, Pennsylvania 17108

August 20, 1979

U. S. Nuclear Regulatory Commission
Wasington, D. C. 20555
Attention: Director
Division of Site Safety
and Environmental Analysis

Gentlemen:

This is to comment on the Draft EIS for the Susquehanna Steam Electric Station, Units 1 and 2, Pennsylvania. The document has been reviewed for items within the expertise of the Soil Conservation Service. We feel that two items should be added to the statement.

1. Sediment and erosion control for the land disturbed at the plant site and transmission line location should be discussed in regard to the regulations implementing Section 102 of the Pennsylvania Clean Streams Act and the Pennsylvania Department of Environmental Resources requirements.

2. The project's impacts on prime agricultural lands and farmlands of statewide importance should be displayed.

All other items of concern to the Soil Conservation Service have been adequately addressed.

Graham T. Munkittrick
State Conservationist

cc:
R. M. Davis, Administrator, SCS, Washington, DC
Cletus J. Gillman, Director, NTSC, SCS, Broomall, PA
Director, Office of Federal Activities, U.S. EPA, Room 537 West Tower, Waterside Mall, 401 M Street SW, Washington, DC 20460 (5 copies)

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UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Productivity, Technology, and Innovation
Washington, D.C. 20230
(202) 377-xxxx 4335

P

May 13, 1980

Mr. Donald E. Sells
Acting Branch Chief
Environmental Projects Branch 2
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Sells:

This is in reference to your draft environmental impact statement entitled, "Susquehanna Steam Electric Station, Units 1 and 2, Pennsylvania Power and Light Company, Allegheny Electric Cooperative, Inc." The enclosed comment from the National Oceanic and Atmospheric Administration is forwarded for your consideration.

Thank you for giving us an opportunity to provide this comment, which we hope will be of assistance to you. We would appreciate receiving ten copies of the final statement.

Sincerely,

Bruce R. Barrett

Bruce R. Barrett
Acting Director, Office
of Environmental Affairs

Enclosure Memo from: Robert B. Rollins
National Ocean Survey
NOAA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

APR 2 3 1980

OA/C52x6:JLR

Rec'd PP/EC
30 APR 1980

TO: PP/EC - Joyce M. Wood

FROM: OA/C5 - Robert B. Rollins

SUBJECT: DEIS #8004.01 - Susquehanna Steam Electric Station Units 1 and 2 (Supplement)

The subject statement has been reviewed within the areas of the National Ocean Survey's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION

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

DATE: May 20, 1980

FROM : Consultant (HFX-4)
Bureau of Radiological Health

SUBJECT: Draft Supplement to Draft Environmental Statement, NUREG-0564, March 1980

The Draft Supplement to the Draft Environmental Statement, NUREG-0564, March 1980 has been reviewed by the Bureau of Radiological Health, Food and Drug Administration. We previously commented on March 9, 1973 (copy attached) on the radiological health and safety aspects of the Draft Environmental Impact Statement (DEIS) related to the operations - Susquehanna Steam Electric Station, Units 1 and 2. This draft supplement to the DEIS is limited to a description of the environmental impacts of construction and operation of a water storage reservoir in the Pond Hill Creek drainage basin. We have no applicable comments.

Thank you for the opportunity of reviewing this draft statement.

Charles L. Weaver

Enclosure

cc:
Dr. K. Taylor (HFV-2)

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
PHILADELPHIA AREA OFFICE
CURTIS BUILDING, 625 WALNUT STREET
PHILADELPHIA, PENNSYLVANIA 19106

REGION III
Curtis Building
6th and Walnut Streets
Philadelphia, Pennsylvania 19106

July 31, 1979

IN REPLY REFER TO:
3.2SS

Mr. Paul Leech
Environmental Project Manager
Environmental Project Branch 2
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Leech:

Subject: Draft Environmental Impact Statement
Susquehanna Steam Electric Station, Units 1 and 2

We have completed our evaluation of the subject Draft Environmental Impact Statement, dated June 1979, and have no substantive comments to offer relative to the subject proposal. Further, and to the best of our knowledge, the proposed project does not directly affect any projects sponsored by this Department.

Sincerely,

James R. Treadwell
Environmental Clearance Officer

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

79/632

SEP 10 1979

Mr. William H. Regan, Jr.
Chief, Environmental Projects
Branch 2
Division of Site Safety and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Regan:

The draft environmental statement for Susquehanna Steam Electric Station (SSES) Units 1 and 2 has been reviewed by this Department and we have the following comments. The comments are organized by page number in the document.

Page 2-28 and Page 4-33

We are concerned that the draft statement does not adequately address archeological and historic concerns. There appears to be a need for further investigation of significant properties in the area and identification of their relationship to the project. This applies to properties already on the National Register and any potential properties in the area but not yet evaluated.

On page 4-33, the draft states that "given the present inadequacies regarding cultural resource inventory and data, the staff cannot make a determination to the effect that the plant's operation will have no adverse effects on cultural resources that may be eligible for inclusion in the National Register. However, it is unlikely that the plant's operation will affect resources that are currently listed in the National Register (located in excess of 16 km from the plant property) . . ." The draft is unclear regarding the impact the plant and transmission corridors will have on properties close to the project site. Of particular concern are McClintock Hall, the Denison House, and Catlin Hall.

We urge the NRC to undertake a complete archeological and historic survey of the area in accordance with the requirements of 36 CFR 800 and Executive Order 11593. Names of persons qualified to undertake this survey may be obtained by contacting the State

Historic Preservation Officer (SHPO) for Pennsylvania, Edward Weintraub, Executive Director, Historical Museum Commission, P.O. Box 1026, Harrisburg, PA 17120. Results of the survey should be included in the final document. Also in consultation with the SHPO the NRC should determine if any of those properties identified in the survey are eligible for listing in the National Register. If they are determined to be eligible, the procedures and process of 36 CFR 800.4 and 5 must be followed to completion.

Page 3-8

Sulfuric acid will be used to control scale formation. As noted in the statement the system will be operated at a positive saturation index to minimize the addition of acid. Without this control on acid usage, the discharge could carry over four times the sulfate concentration of the receiving waters. This could aggravate an already stressed situation since the Susquehanna exhibits high and variable sulfate concentrations.

In the same manner that alternative levels of acid addition have been discussed, we suggest that alternate methods of scale and corrosion control should be looked at. The final statement should present an environmental evaluation of such methods as organic or hydrochloric acids or mechanical means.

Page 4-9

Since the intake structures for this plant have been constructed, the final statement should discuss what sampling program is proposed and when it would be implemented to determine levels of entrainment and impingement, during all expected flow conditions, of Susquehanna River fish and aquatic invertebrates. Further, the final statement should include a discussion of the possible actions the licensees will take to modify the project to protect such aquatic resources in the event significant adverse impacts occur from entrainment, impingement, or streamflow diversion for consumptive use (50 cfs average).

Page 4-12

The staff concludes that no adverse environmental impacts, other than atmospheric plumes and snowfall, will occur as a result of the operation of the cooling towers at the SSES. The licensees propose to construct a reservoir (Pond Hill) to provide makeup water during low flow conditions in the Susquehanna River. The final statement should be revised to indicate some adverse environmental impact will occur with the operation of the cooling towers and related reservoir. Construction of the dam and reservoir will destroy terrestrial wildlife habitat and reservoir filling operations will impact Susquehanna River aquatic invertebrate and fish populations through impingement, entrainment, streamflow regulation, and consumptive use of such flows.

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.

Page 6-4

The conclusion that "the environmental risks due to radiological accidents are exceedingly small and need not be considered further" ignores the probability and the consequences of core-melt accidents (p. 6-4, par. 1). As was explained in the environmental statement for the Palo Verde Nuclear Station (NUREG-0522, 1979), this "realistic analysis" is based on procedures in the Proposed Annex to Appendix D, 10 CFR Part 50, which specifically exclude the evaluation of core-melt accidents. Environmental damages resulting from a core-melt accident can be devastatingly severe and conclusions concerning environmental risks that ignore these accidents must be questioned. We believe that site-specific evaluations of the full range of potential accidents should be a part of the site selection process for nuclear power stations.

The section on Postulated Accidents Involving Radioactive Materials enumerates "Several of the more significant findings" of the Lewis Report (p. 6-3). The three findings summarized exclude the final finding of that report:

> There have been instances in which WASH-1400 has been misused as a vehicle to judge the acceptability of reactor risks. In other cases it may have been used prematurely as an estimate of the absolute risk of reactor accidents without full realization of the wide band of uncertainties involved. Such use should be discouraged. (NUREG/CR-0400, p. x).

A footnote to table 6.2 states that "These calculations do not take into consideration the experience gained from the accident at the Three Mile Island site on March 28, 1979" (p. 6-3, footnote A). However, this provides no guidance on the possible magnitude or even the direction of the errors that may exist in the radiological consequences that are shown in the table. The largest

estimated dose to population in a 50-mile radius from any accident shown in the table is 37 man-rem. Until such time as the table can be revised, it might be helpful to note that the estimated dose to the population within a 50-mile radius of the Three Mile Island site was calculated to be 3,300 man-rem (NUREG-0558), p. 2, par. 2). The populations within that radius are not greatly different for the two sites, being 2,164,000 people in the case of the Three Mile Island site and projected to be 1,517,123 people within 50 miles of Susquehanna Steam Electric Station in the year 1980 (ER, table 2.1-8).

Page B-5

Table B.2 (page B-4) shows that 1,236 acres of forest and farmland will be required as rights-of-way for construction of a new transmission line system. The forested area could be managed effectively for wildlife if preferred vegetation and cover for grazing wildlife species were planted. Their feeding activities would help control revegetation of nuisance woody vegetation and reduce the need for clearing and herbicide applications. We recommend that Appendix B discuss the possibility of using plantings recommended by the Pennsylvania Game Commission for all forested areas cleared during transmission line construction.

We hope these comments will assist the preparation of the final.

Sincerely,

Larry E. Meierotto
Assistant SECRETARY

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 80/284 MAY 2 5 1980

Mr. Donald E. Sells
Acting Branch Chief
Environmental Projects Branch 2
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Sells:

The Department of the Interior has reviewed the draft supplement to the environmental impact statement related to the operation of the Susquehanna Steam Electric Station, Units 1 and 2, Luzerne County, Pennsylvania. We have the following comments.

We find that the supplement adequately describes existing fish and wildlife resources and impacts on those resources from construction of the proposed impoundment. Provided that the Pennsylvania Power and Light Company implements the management plans to be submitted by the applicant in consultation with the Pennsylvania Fish and Game Commissions (page 4-3 of the draft supplement), we have no objection to construction of the project as proposed.

We recommend that the following be stipulated in any operating license issued by the Nuclear Regulatory Commission for this project.

> "That the Licensee implements the fish and wildlife management plan to be developed in consultation with the Pennsylvania Fish Commission, the Pennsylvania Game Commission, and the U.S. Fish and Wildlife Service."

The proposed spillway capacity was found by the NRC staff to be insufficient to pass a probable maximum flood. The dam would be overtopped in such a flood and might fail (p. 4-11, item 4.4.2.3). The applicant's spillway design flood, based on the 6-hour probable maximum precipitation, apparently was calculated without consideration of the effects of potential antecedent storm runoff. Although the drainage area above the dam is small, the amount of water

to be stored as well as the dam's height are significant and, as indicated, failure could lead to loss of life (p. 4-11, par. 8). The spillway design flood should be reevaluated.

Item 3(1) on page ii of the Summary and Conclusions section states that certain lands will be converted to recreational uses. No discussion is given, however, to the possible environmental effects of this proposed action. Also, there is no mention of a need to survey this land to identify and evaluate cultural resources that may be impacted. At the request of the NRC, the Interagency Archeological Service Atlanta Office prepared a survey plan and cost estimate for a proposed recreational area along the Susquehanna River. This was provided to NRC on December 19, 1979. The NRC should reference the requirement to survey the proposed recreational areas as well as the proposed Pond Hill Reservoir Site.

The discussion of Impacts to Cultural Resources (p. 4-14), should recommend an appropriate management program to be developed only for those sites that meet National Register of Historic Places criteria. Identification and evaluation studies and management programs must be developed in accordance with 36 CFR 800, including consultation with the State Historic Preservation Officer (SHPO). For Pennsylvania, the SHPO is Edward Weintraub, Executive Director, Historical Museum Commission, P.O. Box 1026, Harrisburg, Pennsylvania 17120.

The Archeological Survey Plan for the Pond Hill Reservoir Site (Appendix B) does not clearly indicate whether the acreage to be surveyed under the Commonwealth Associate, Inc. proposal is the approximately 150 acres within the reservoir, or would cover the approximately 1300 acres of the entire project area. All areas to be affected, including transmission line corridors, borrow areas, and recreation facilities, should be surveyed to insure that all cultural resources that may be affected by the undertaking are identified.

Commonwealth Associates proposes that transects spaced at 30 meter intervals will be walked, but does not justify why a 30 meter interval was chosen. This may be sufficient for uplands and slopes but not sufficient in other areas such as terraces. There is no indication of what the interval for shovel testing will be along the transects. Also, testing to a depth of 25 centimeters may be inadequate depending on the depth of the plow zone or fill. We suggest that shovel tests be taken to a depth approximately 20 centimeters below the plow zone or fill, and to search below cultural deposits.

We hope these comments will be of assistance to you.

Sincerely,

James H. Rathlesberger
Special Assistant to
Assistant SECRETARY

U.S. DEPARTMENT OF TRANSPORTATION
REGIONAL REPRESENTATIVE OF THE SECRETARY
434 WALNUT STREET
PHILADELPHIA, PENNSYLVANIA 19106

August 9, 1979

MEMORANDUM TO: U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attn: Director, Division of Site Safety and Environmental Analysis

SUBJECT: Draft Environmental Impact Statement - Susquehanna Steam Electric Station, Units 1 & 2

We have reviewed the subject draft EIS and offer the following comments.

From a transportation point of view, the statement did not discuss the impacts to existing highways in the area by traffic traveling to and from the plant. The transportation of nuclear fuels and the crossing of highways with power transmission lines has been mentioned. While there should be no significant impacts, the statement could answer the following questions:

1. Have the access points been designated and coordinated with the Pennsylvania Department of Transportation?

2. Would the travel trips by the 400 employees affect the level of traffic service on the existing highways?

We appreciate the opportunity to comment on this document.

Sally H. Cooper
Regional Representative
of the Secretary

8005070522

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DEPARTMENT OF TRANSPORTATION
REGIONAL REPRESENTATIVE OF THE SECRETARY
434 WALNUT STREET
PHILADELPHIA, PENNSYLVANIA 19106

REGION III

April 28, 1980

Donald E. Sells
Acting Branch Chief
Environmental Projects Branch 2
Divison of Site Safety & Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Draft Supplement to the DEIS related to the operation of the Susquehanna Steam Electric Station, Units 1 & 2 Docket Nos.: 50-387 and 50-388

The draft supplement to the DEIS covering the proposed construction of the Pond Hill Creek storage reservoir for the Susquehanna Steam Electric Station has adequately addressed the probable impacts to highway facilities. However, the supplement still lacks evidence of coordination with the Pennsylvania Department of Transportation. Since the pump station construction will affect Route 239 (pg. 4-12) and an access road will be added for the reservoir construction, we repeat our comment of August 9, 1979, recommending coordination with PA DOT.

Sally H. Cooper
Regional Representative
of the Secretary

SPEED LIMIT 55
It's a law we can live with.

R.D. #1, Box 4
Winfield, Pa. 17889
August 29, 1979

Mr. Daniel Muller, Director
Division of Site Saftey and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Muller:

Thank you for the opportunity to comment on the "Draft Environmental Statement related to Operation of Susquehanna Steam Electric Station, Units 1 and 2 Pennsylvania Power and Light Company, Allegheny Electric Cooperative, Inc." Dockets Nos. 50-387, and 50-388, June 1979. Since no suspense date was mentioned in the document, it can be assumed that comments are still being accepted.

My comments will be very brief due to the limited amount of time available to review the document. Despite being published in June, not all of the public in the area affected by the plant were made aware of the document. Efforts by local environmental groups to alert the public, such as myself, were successful, but that did not occur until mid August. The apparent efforts of the NRC were the minimum that is required to do in order to seek input. This symbolizes NRC's attitude in the entire "public input" process- do the minimum required just to satisfy a section of the law. The public be damned for the convenience of the NRC and utilities. Hopefully this attitude will not carry over into the operation and regulation of a nuclear power plant.

Reguarding the document itself, it is unconscionable that an environmental impact statement on a nuclear power plant published after April 1979, does not include specific analysis of the potential similar problems as occured at the Three Mile Island nuclear facility. Plant design differences aside, there are many generic issues such as emergency preparedness that should be factored into the impact of SESS. Emergency preparedness for an 80 km radius area costs a lot of money and time, and such costs should be factored into any cost/benifit discussion of SESS. The impact on the residents of the TMI area(16km,not just the 8km under study) of radiation exposure, stress and its related effects, and other health consequences should be carefully evaluated before SESS is permitted to continue in the licensing procedure.

General comments on specific sections of the document are as follows. On page 4-2, the possible effects of low river flow and excess river flow (floods) make one concerned about the assumptions used to draw the conclusion that the plant would need to be shut down only four days per year. An adequate water supply is crucial to reactor saftey, therefore the assumptions should be more fully explained.

Muller, 8/29/79
Page 2

Table 4.12 on page 4-21 indicates that the nearest sport fishing location is 24 hr. transit time away. Fishermen can be found at most points along the river from 0.1 hr. away on to the Chesepeak. Perhaps the problem is definitional.

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.

Table 6.2 should be revised to reflect the experiences gained from TMI. Class 9 postulated accidents should be considered in calculating the costs and benifits of the plant to the people in the area. Their chance may be small in the NRC's opinion, but the consequences are real and the price must be paid if a class 8 or 9 accident occurs.

Section 7 "Need for Plant" fails to document the need for the plant other than to provide excess capacity. The reserve margin far exceeds recommended levels. The projections probably fail to consider recent shifts to conservation and selected solar hot water projects due to the high costs of electricity. Such trends, including residential winterization, will continue as the costs of electricity increase. Therefore, building a plant to provide increasing excess capacity escapes logic. The need for the plant is not documented by this analysis.

Section 8.41 "Health Effects", comparing nuclear and coal fired plants failed to include, as previously mentioned, the effects of a class 9 accident. We now realize after TMI, that serious accidents are in fact a possibility and should be considered.

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 many 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.

Section 8.4.4 mentions that there have been no serious accidents in a nuclear plant with which to study morbibity and mortality. As mentioned previously, TMI has taken the first painful step towards this experience. That experience should be carefully studied before the nuclear process continues.

Section 8.5 fails to take into consideration a reported recent GAO study indicating that DOE may be off by as much as twenty percent in their estimates because of production losses and the declining quality of the ore were not considered. This section should be revised in light of the GAO report.

Muller, 8/29/79
Page 3

Section 8.6 "Decomissioning" is treated lightly considering the tremendous impact a non functioning radioactive plant can have on the environment. Storage for thousands of years with unproven technologies deserves more consideration in an environmental impact statement. Along with decomissioning, waste storage and disposal deserve more detailed analysis as the have a direct impach to the health of the people in the area.

In conclusion, the need for the plant versus the impact of the plant does not justify that any further work be done at SESS. When need is documented, and the alternatives for northeast Pennsylvania better examined (conservation, solar projects, biomass, small hydro projects, etc.) then a better and more complete environmental impact statement should be prepared. At that point in time, and not before, nuclear power should be considered as an alternative.

Thank you.

Sincerely,

Thomas R. Duck

cc: Senator Schweiker
Senator Heinz
Representative Flood
Representative Ertel

economic development council of northeastern pennsylvania
proximity to market . . . a compelling edge.

August 27, 1979

Mr. Paul Stewart, Manager
Consumer & Community Affairs
Pennsylvania Power & Light Co.
344 South Poplar Street
Hazleton, Pennsylvania 18201

Dear Paul:

At the most recent meeting of the Policy Committee of EDCNP, a recommendation was made to defer action on the Nuclear Regulatory Commission's Draft Environmental Statement related to operation of the Susquehanna Steam Electric Station, Units 1 and 2, published June 1979, pending the receipt of a response to this letter. The Executive Committee confirmed this action at the August 23, 1979 meeting.

As you know, the PNRS Committee and staff spent considerable time evaluating the findings of the Draft Environmental Statement, at least those sections which the Council felt some competency to review and comment.

With respect to the review and comment, the Council's Policy Committee and Executive Committee requests additional background and the latest status report on the following elements which were noted in the Draft Environmental Statement:

1. With respect to water withdrawal from the Susquehanna River or with respect to a new water related project such as construction of a reservoir, please outline what actions will be taken to meet all water related needs relative to the Nuclear Power Facility at Berwick. The Council's Executive Committee is vitally concerned that the water related facility concerning the operation of the Nuclear Power Facility be on line at the time that the facility is officially opened.

2. The Draft Environmental Statement notes that flood plain consideration has been taken into account at least as far as the 100 year flood plain is concerned. Since the Pennsylvania Department of Community Affairs has noted that flood plain mapping may now be available for sections of the general area relative to the Nuclear Power Facility, the Council would appreciate the latest information being analyzed by PP&L concerning the impact of any potential flooding which may some time occur. Flood plain analysis for flooding substantially

above the 100 year flood plain level would also be appreciated, if such analysis has been accomplished.

3. The Draft Environmental Statement notes special consideration for the Berwick Hospital. The Policy and Executive Committees believe that other hospitals should be involved in evacuation or emergency plans and would appreciate any details you might be able to supply concerning plans involving hospital facilities other than Berwick.

4. The Draft Environmental Statement notes that a Safety Evaluation Report (SER) is in the process of being prepared. The Council would like the opportunity of obtaining this document when available and would also appreciate your outlining the schedule for completion.

The Council has other elements which it would like to bring to the attention of the Nuclear Regulatory Commission concerning economic affects of the Susquehanna Steam Electric Station, Units 1 and 2, but the above four elements represent some of the major factors for which the Policy and Executive Committees would appreciate a response.

Please feel free to contact me if you need any further background concerning this request. In order to expedite the Review and Comment process, it would be helpful to receive some type of response by September 15, 1979.

Yours truly,

Howard

Howard J. Grossman
Executive Director

HJG:mjc

economic development council of northeastern pennsylvania

proximity to market . . . a competitive edge.

September 26, 1979

Mr. Donald E. Sells, Acting Branch Chief
Environmental Projects Branch 2
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Sells:

This letter is being sent to you to formally notify you that the Executive Committee of the Economic Development Council of Northeastern Pennsylvania (EDCNP), at its regularly scheduled meeting on September 20, 1979, affirmatively reviewed the Nuclear Regulatory Commission's draft environmental statement relative to the operation of the Susquehanna Steam Electronic Station, Units 1 and 2. Attached you will find several attachments which outline the Council's A-95 review process, its major comments on this draft environmental statement, and other related correspondence which the Council utilized in arriving at its conclusion on this proposal.

The Council trusts the attached material will help you finalize a decision on this matter. If additional clarification is desired, please contact me at your earliest convenience.

Yours truly,

Howard J. Grossman
Executive Director

HJG:sma

Attachments

CC: Rick Heiss, A-95 State Clearinghouse
Luzerne County Planning Commission
Lackawanna County Planning Commission
SEDA-COG
Paul Stewart, PP&L
File

VIVIAN F. EDWARDS, PRESIDENT
HOWARD J. GROSSMAN, EXECUTIVE DIRECTOR

P.O. BOX 777 / AVOCA, PA. 18641 / TEL. 717-655-5581

PNRS REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT RELATED TO THE SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 & 2 BY THE ECONOMIC DEVELOPMENT COUNCIL OF NORTHEASTERN PENNSYLVANIA (EDCNP)

Background

On June 28, 1979, the EDCNP received a copy of the Draft Environmental Statement (EIS) on the Susquehanna Steam Electric Station, Units 1 & 2 from the U.S. Nuclear Regulatory Commission.

Upon receiving this EIS, the EDCNP notified the following agencies that it had the report; they could review the report in its offices during regular working hours; and they had until August 12, 1979, to forward their comments on the report to the EDCNP.

1. Lackawanna County Planning Commission
2. Schuylkill County Planning Commission
3. Monroe County Planning Commission
4. Susquehanna Economic Development Association Council of Governments (SEDA-COG)

The EDCNP's Deputy Director orally told the Executive Director of the Luzerne-Lackawanna Environmental Council (Lu-Lac) that the EDCNP had the report and that it could be reviewed in our office. The Council did not notify the Luzerne County Planning Commission since it was its understanding, based upon the cover letter it received from the NRC, that the Luzerne County Planning Commission received a copy of the report in the mail.

Upon receiving the report, the Council's staff immediately began to review the report. While this review was taking place, the staff also reviewed various A-95 reports and circulars to ascertain how such an EIS should be reviewed and its purviews under the A-95 Process. The staff, also, contacted the State Clearinghouse and the National Association of Regional Councils (NARC) to ascertain if any other agencies had performed similar reviews; and also, to alert them of our proposed actions. They both told us that they believed we were one of the first regional agencies, to the best of their knowledge, to review an environmental impact statement for a nuclear power plant under the A-95 System and believed we were going about it in a responsible way.

The staff, realizing this review was on a potential controversial project, brought the matter before the Council's Policy Committee for policy guidance. The Policy Committee told the Executive Director that the staff should handle the project like any other important PNRS project generated in the region.

As such, the staff, in addition to reviewing the draft EIS, also read for background information, the following publications in addition to the Draft EIS:

(1) The Final Report on a Study of the Effectiveness of A-95 Procedures and Their Administration with Regard to HUD Programs, dated March 1979 by Peat, Marwick, Mitchell & Co.

(2) Effects of Nuclear Power Plants on Community Growth and Residential Property Values by H.B. Gamble, R. H. Downing, and O.H. Sauerlender, dated November 15, 1978, for the U.S. Nuclear Regulatory Commission.

(3) A Review and Study of the Environmental Impact and Socio-Economic Impact of the Proposed Philadelphia Electric Company Limerick Generating Station Units 1 and 2 by the University City Science Center for the Montgomery County Planning Commission, dated March 14, 1974.

(4) Areas Around Nuclear Facilities Should Be Better Prepared for Radiological Emergencies - A Report to Congress by the Comptroller General, dated March 30, 1979, and several other newspaper articles and speeches on this and related subjects.

In addition to reviewing these documents, the staff also talked to Jane Kenney, the Executive Director of the South Eastern New Hampshire Regional Planning Commission on its involvement in the siting, licensing, and monitoring of the "Seabrook Nuclear Power Plant."

The following comments on this EIS are a direct outgrowth of these reviews and conversations:

> The Council's staff did not believe it had sufficient time nor the breadth and level of expertise to review and comment on many of the technical aspects of the EIS and its attachments. However, the Council's staff believed it had sufficient expertise and time to comment on the following items which were discussed with the Council's PNRS Committee, its Policy Committee, its Executive Committee and Board of Directors.

Summary of EDCNP's Comments

General Comments on History of the Project (Chapter I)

This EIS is an update of previous reports filed with the Nuclear Regulatory Commission.

A Safety Evaluation Report (SER) will be issued after the review and approval of this EIS and PP&L's Final Safety Analysis Report (FSAR).

Therefore, many of the concerns which the Council and other citizen groups may have on safety related issues associated with this plant (especially in light of the Three Mile Island (TMI) Accident) will be evaluated and commented upon at a later date if the Council is involved in that SER review.

General Comments on the Site (Chapter II)

The EDCNP staff believes a considerable amount of data has been assembled and adequately analyzed relative to the site, the general environs (Luzerne County), and the various public facilities and utilities in the area.

However, there are some recent reports, events, and new institutional relationships which might be evaluated prior to the Units coming on line. These include:

(1) Several state hospitals (Nanticoke, Hazleton, Pittston, etc.) may be either phased out or merged under the NPW proposal. It might be prudent to initiate programs similar to the one currently being undertaken between PP&L and the Berwick Hospital with other hospitals in the area (for example, Geisinger or the newly proposed NPW complex in the Wilkes-Barre area which is currently under construction).

Furthermore, more detailed evacuation plans should probably be worked out with the various local County and State Civil Defense and Emergency Medical Services (EMS) Agencies. The recent report issued by the Office of the Controller entitled A Report to Congress - Areas Around Nuclear Facilities Should Be Better Prepared for Radiological Emergencies, March, 1979, should be reviewed to ascertain potential roles and responsibilities of various public and private agencies in these efforts.

Furthermore, the EDCNP believes the most recent Section 208 Comprehensive Water Quality Management Program (COWAMP) reports for the Lower Susquehanna River Basin should be evaluated in light of any potential impact the plant and its ancillary facilities will have on current water and severage facilities and other water matters.

Also, the Council believes more information on the plant's location relative to the flood plain should be explained in more detail. It is difficult to ascertain if any of the proposed facilities are in the 100 year flood plain and/or if the construction of the Tioga Hammond Dams will affect the site and facilities in question (i.e. the intake and sewage treatment plant). The staff realizes this topic is discussed in more detail in Chapter 4; but believes this item should be thoroughly coordinated with the Susquehanna River Basin Commission. (SRBC).

Another item which needs attention is the preparation of a systematic survey of historic, ethnohistoric, and prehistoric cultural resources at the plant site and along the proposed transmission corridors. The Council believes a joint State - County - Utility study of these potential resources should be undertaken as soon as possible. Potential sources of funding might include: the Pennsylvania Historical & Museum Commission, the Pennsylvania Endowment for the Arts, the National Endowment of the Arts, the Appalachian Program, and possibly other local foundations. This program and any findings could conceivably become a part of the proposed recreation area and/or part of the programs of local colleges (Wilkes, Luzerne County Community College, Bloomsburg State College, and Bucknell.

General Comments on the Plant (Chapter III)

Based upon the data presented in the EIS, it appears the Susquehanna River Basin Commission will not permit PP&L to withdraw the necessary volume of water from the river during periods of low flow.

Apparently PP&L is considering the construction of a reservoir or an alternate water source. The Council trusts that this reservoir will be capable of not only supplying the water needs at the proposed plant, but also be of sufficient size to augment the flow of the river to insure an adequate water supply for the water intakes on the river for the Cities of Danville, Berwick, and Bloomsburg. The Council would appreciate receiving a copy of this report on the proposed reservoir from either the utility or NRC.

It, also, appears that the proposed river intake structure will only be .3 of a meter (approximately 1 foot) above the Standard Project Flood (SPF). The placement of this facility should be closely evaluated in light of the region's experience in 1972 during Tropical Storm Agnes and the amount of protection, if any, which the proposed Tioga Hammond Dam will have on an area this far downstream from the above mentioned dam. Also, the construction of the riprap at this site should be carefully evaluated in terms of the potential force of the "flood way" during a 100 year or greater flood.

General Comments on the Environmental Effects of Station Operation (Chapter IV)

The Council's staff believes more study is necessary on the impact of this facility on public expenditures for police, fire, and other special emergency equipment which may be needed not only in the immediate areas but also for backups in the event of a serious radiological accident.

Also, the NRC staff notes there might be additional land use impacts and that PP&L should take these items into consideration in its socio-economic monitoring programs, but the NRC staff does not point out who will have the responsibility to implement the anticipated programs which might be necessary to mitigate the effects relative to adverse land uses.

The Council encourages PP&L to finalize its replacement water plans as soon as possible and coordinate those plans with the Luzerne County Planning Commission, the EDCSP, the Pennsylvania Department of Environmental Resources (DER) and the SRBC.

The Council also believes the Luzerne County Planning Commission should submit an application to the U.S. Environmental Protection Agency under the Quiet Communities Program to secure the necessary funding to buy the noise monitoring equipment and to acquire the necessary expertise to develop a history of the noise level generated at and near the plant.

The Council also strongly encourages PP&L to perform the appropriate studies on the operation of the intake as currently styled and designed, since it appears it will have an adverse effect on the acquatic life within the vicinity of wing walls and riprap. These are crucial, since shad may be reintroduced in the lower reaches of the Susquehanna River and various fish ladders are being contemplated on some of the dams downstream from this proposed facility.

Also, it appears there are some inconsistencies in the evaluations on whether the shad will remain in the main channel or use the pool areas for resting. If the shad decide to rest in the pool near the intake, this may have significant negative results as they migrate up and down the river. In essence, the Council's staff believes the potential shad problem should be studied in more detail and solutions found as soon as possible to assist in the reintroduction of shad in the Susquehanna River.

The Council applauds PP&L for its proposed recreation centers around the plants, however, it wonders if PP&L also plans to permit public recreational use around its proposed low flow augmentation reservoir.

The Council again believes it is important to stress that the local communities should receive sufficient taxes or payments in lieu of taxes to cope with the increased level of services and manpower (police, fire, etc.) which will be required due to the impact of this facility. The Council believes the Luzerne County Planning Commission or Salem Township should submit an application to HUD or NRC to more fully ascertain these fiscal impacts and also to develop appropriate implementation strategies.

Also, the Council believes a survey of cultural resources (Indian relics, etc.) in the vicinity of the plant should be made as soon as possible in order to quantify the extent and value of these resources in the area of the plant.

The Council staff also found it interesting that approximately 80 percent of operational work force which was hired by November, 1978 were in-migrants rather than local workers. The Council believes PP&L should investigate the development of training/employment programs (for example, under PIC or OJT) with local CETA agencies such as the Luzerne County Human Resources Agency in order to encourage the hiring of more "local" people.

Although the total tax bill for the two Susquehanna units will be about $5.5 million very little of this will be distributed locally. ($55,000 to Luzerne County and $10,000 to Columbia County due to current state law.

The Council's staff believes some more equitable formula should be pursued, even if it means possible amendments to the Pennsylvania Public Realty Tax Law.

General Comments on the Environmental Monitoring of the Plant Site (Chapter 7)

The Council's staff concurs with NRC findings and recommendations in this Chapter and strongly urges PP&L to expedite many of them (i.e., the noise monitoring program mentioned earlier).

General Comments on the Environmental Impact of Postulated Accidents (Chapter VI)

The Council's staff believes the current EIS is deficient in that it did not note the TMI accident. The Council staff believes that since an accident such as TMI is possible, it believes it would be prudent for PP&L and/or the NRC to develop a plan for a Class 9 failure at this facility, especially since an accident of this magnitude was not considered in this EIS.

Again, the Council's staff recommends that NRC and PP&L review the Office of the Controller's report and the other publications noted earlier on this subject.

General Comments on the Need for the Plant (Chapter VII)

The Council's staff found this Chapter very informative and generally concurs that there is a need for the plant even though some may question the need to have the plant since PP&L would still have a 24 percent reserve margin in the summer without it in 1985; and a 30 percent reserve margin in the winter without it. Although the margins are significantly above the 5 percent reserve margin assigned to PP&L as its responsibility in the PJM interconnection; it appears PP&L acted in good faith in the late 1960's and early 1970's when it made the decision to go ahead with the facility, since it was assigned a 20 percent reserve margin at that time. Also, PP&L expected considerably more growth in its service area and the interconnection at that time. Furthermore, it now appears the State and the interconnect are indeed fortunate that PP&L is a winter peaking utility and has this reserve margin in light of the potential closing down of GPU's Three Mile Island plant, and also, the increasing need for energy in the United States due to the OPEC oil crisis in 1973-74 and 1978-79.

Furthermore, the Council's staff believes this reserve margin is a plus in the region's attempts to revitalize the economy of the region which to date has experienced high unemployment rates and little economic growth and diversification.

In essence, the Council's staff believes the additional reserve margin which the Susquehanna plant will provide (47 percent reserve margin in winter and 29 percent reserve margin in summer) by 1985 is a plus to the economy of the State and our region.

General Comments on the Evaluation of this Proposed Action (Chapter VIII)

Anthracite did not appear to be considered as an alternative. It may be a more viable fuel in the future in that it is exempt from the most recent SO_2 requirements promulgated by EPA. Other data was very technical and out of the Council's staff expertise or not directly related to the EIS statement.

General Comments on the Benefit Cost Analysis (Chapter IX)

The Council's staff generally concurs with the "bottom line" of this Chapter and the Council's staff believes that it would be possible to operate the station with only minimal environmental impacts if the applicant (PP&L and Allegheny Electric Cooperative, Inc.) follow through with the recommendations noted by the NRC staff in the EIS and the comments of the EDCSP which are noted in this review.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

AUG 17 1979

Mr. Voss A. Moore
Assistant Director
Environmental Projects
Nuclear Regulatory Commission T-518
Washington, DC 20555

Dear Mr. Moore:

We have completed our review of the Draft Environmental Impact Statement concerning the Susquehanna Steam Electric Station, Units 1 and 2, Luzerne County, Pennsylvania.

On the basis of our review and concerns we have classified the document and proposal ER-2. This means we have environmental reservations concerning the project and we do not believe the impact statement has sufficient information to assess fully the environmental impact of the action. We have enclosed our comments.

The EPA classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our review on proposed actions under Section 309 of the Clean Air Act.

Sincerely yours,

John R. Pomponio
Chief
EIS & Wetlands Review Section

Comments

Draft Environmental Impact Statement

Susquehanna Steam Electric Units 1 & 2

Luzerne County, Pennsylvania

Radiological Issues

Iodine

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. 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.

Reactor Accidents

The EPA has examined the NRC's assessment of accidents and their potential risks. The assessments were developed by NRC in the course of its engineering evaluation of reactor safety in the design of nuclear plants. Since these issues are common to all nuclear plants of a given type, EPA concurs with NRC's generic approach to accident risk evaluation. The NRC is expected to continue to ensure safety through siting, plant design and accident assessments in the licensing process on a case-by-case basis.

In 1972, the AEC initiated an effort to examine reactor safety and the resultant environmental consequences and risks on a more quantitative basis. The final report of this effort was issued in October 1975 by the U.S. Nuclear Regulatory Commission as the Reactor Safety Study, WASH-1400 (NUREG/75/014). The EPA's review of the study included in-house and contractual efforts, and our comments were released in a report in June 1976.

In July 1977 the NRC chartered the Risk Assessment Review Group to provide advice and information to the NRC on WASH-1400 in response to letters from Congressman Udall expressing misgivings about the report and in particular about the Executive Summary published with the report. The Risk Assessment Review Group issued its findings in September 1978 and the NRC accepted the findings during January 1979. The NRC also withdrew any explicit or implicit past endorsement of the Executive Summary, among other specific actions. EPA agrees with the NRC's position in this matter. We also concur with the NRC's continued support for the use of probabilistic risk assessments in regulatory decisionmaking, with the admonishment that such decisions be based on several factors encompassing social, technical and economic issues in addition to accident risk assessments.

The reactor accident at the Three Mile Island-2 reactor on March 28, 1979 has focused attention on the great need for a thorough reexamination of reactor safety. We are concerned about the effectiveness of the procedures by which reactor operating experience is translated into improved reactor designs or operational practices. We believe it incumbent on the NRC to carefully review its current procedures for identifying, assessing and acting on potential accident sequences as operating experience with reactors increases.

Consideration of accident scenarios should of course include Class 9 accidents, because their existence was demonstrated at TMI. The SSES statement does not consider such accidents. As SSES is on the Susquehanna, upstream from Three Mile Island, and 75 miles away, the statement should review the possible cumulative effects of a second Class 9 accident in central Pennsylvania.

Population Dose Commitments

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 the projected releases over the lifetime of the facility (rather than just the annual release), (2) extend to several generations beyond the period of release, (3) consider, at least qualitatively or generically, the world-wide influences on the total environmental impact or specify the limitations of the model used.

Fuel Cycle and Long-Term Dose Assessments

EPA is responsible for establishing generally applicable environmental radiation protection standards to limit unnecessary radiation exposures and radioactive materials in the general environment resulting from normal operations of facilities that are part of the uranium fuel cycle. The EPA has concluded that environmental radiation standards for nuclear power industry operations should take into account the total radiation dose to the population, the maximum individual dose, the risk of health effects attributable to these doses (including the future risks arising from the release of long-lived radionuclides to the environment), and the effectiveness and costs of effluent control technology. EPA's Uranium Fuel Cycle standards are expressed in terms of dose limits to individuals members of the general public and limits on quantities of certain long-lived radioactive materials released to the general environment.

A document entitled "Environmental Survey of the Uranium Fuel Cycle" (WASH-1248) was issued by AEC in conjunction with a regulation (10 CFR 50, Appendix D) for application in completing the cost-benefit analysis for individual light-water reactor environmental reviews (39 F.R. 14188). This document is used by NRC in draft environmental statements to assess the incremental environmental impacts that can be attributed to fuel cycle components which support nuclear power plants.

Recently the NRC decided to update the WASH-1248 survey. We believe this is a prudent step and commend the NRC on initiating this update. In providing comments to the NRC on this subject, dated November 14, 1978, we encouraged NRC to express environmental impacts in terms of potential consequences to human health, since for radioactive materials and ionizing radiation the most important impacts are those ultimately affecting human health. We believe that presentation of environmental impact in terms of human health impact fosters a better understanding of the radiation protection afforded the public.

A second major concern of EPA deals with the discharge and dispersal of long-lived radionuclides into the general environment. In the areas addressed in WASH-1248, there are several cases in which radioactive materials of long persistence are released into the environment. The resulting consequences may extend over many generations and constitute irreversible public health commitments. This long-term potential impact should be considered in any assessment on health impact. EPA has consistently found inadequate the NRC's estimates of population doses for these persistent radioactive materials. In particular, the NRC has generally limited their analyses to the population within 50 miles of a facility, or in rare cases, to the U.S. population and to doses committed for a 50-year period by an annual release. These limitations produce incomplete estimates of environmental impacts and underestimate the impact in some cases, such as from releases of tritium, krypton-85, carbon-14, technetium-99 and iodine-129. The total impact of these persistent radionuclides should be assessed, qualifying such estimates as appropriate to reflect the uncertainties. In this regard, we note that the Nuclear Energy Agency is addressing this approach in making assessments and that the NRC is represented in this effort.

Another major consideration in updating WASH-1248 is the health impact from radon-222 from the uranium mining and milling industry. Estimates made by EPA among others indicate that radon-222 contributes the greatest fraction of the total health impact from nuclear power generation. In preparing an updated WASH-1248, we believe NRC should:

a. Include the radon-222 contribution from both the uranium mining and milling industries.

b. Determine the health impact to larger populations than only the local population.

c. Recognize the persistent nature of the radon-222 precursors (Th-230 and Ra-226) by estimating the health impact for a period reflecting multi-generation times.

High-Level Waste Management

The techniques and procedures used to manage high-level radioactive wastes will have an impact on the environment. To a certain extent, these impacts can be directly related to the individual projects because the reprocessing of spent fuel from each new facility will contribute to the total waste. The AEC, on September 10, 1974, issued for comment a draft statement entitled "The Management of Commercial High-Level and Transuranium-Contaminated Radioactive Waste" (WASH-1539). In this regard, EPA provided extensive comments on WASH-1539 on November 21, 1974. Our major criticism was that the draft statement lacked a program for arriving at a satisfactory method of "ultimate" high-level waste disposal.

DOE issued a draft EIS, "Management of Commercially Generated Radioactive Waste," during April of 1979. EPA is conducting a comprehensive review of this EIS, and will submit comments to DOE upon completion of the review.

EPA is cooperating with both NRC and DOE to develop an environmentally acceptable program for radioactive waste management. In this regard, EPA has published proposed environmental radiation protection criteria for the management of all radioactive waste and will establish environmental radiation protection standards for high-level waste in 1979. We have concluded that the continued development of the Nation's nuclear power industry is acceptable from an environmental point during the period required to satisfactorily resolve the waste management question.

Transportation

In its earlier reviews of the environmental impacts of transportation of radioactive material, EPA agreed with AEC that many aspects of this program could best be treated on a generic basis. The NRC has codified this generic approach (40 F.R. 1005) by adding a table to its regulations (10 CFR Part 51) which summarizes the environmental impacts resulting from the transportation of radioactive materials to and from light-water reactors.

The impact value for routine transportation of radioactive materials has been set at a level which covers 90 percent of the reactors currently operating or under construction. The basis for the impact, or risk, of transportation accidents is not as clearly defined. At present, EPA, DOE and NRC are each attempting to more fully assess the radiological impact of transportation risks. The EPA will make known its views on any environmentally unacceptable conditions related to transportation. On the basis of present information, EPA believes that there is no undue risk of transportation accidents associated with the SSES.

Decommissioning

The NRC has published a proposed rulemaking of Decommissioning Criteria for Nuclear Facilities in the Federal Register on March 13, 1978. EPA comments were sent to NRC on July 5, 1978, dealing with the decommissioning issues.

In summary, we believe that one of the most important issues in the decommissioning of nuclear facilities is the development of standards for radiation exposure limits for materials, facilities and sites to be released for unrestricted use. We have included the development of such standards among our planned projects. The work will require a thorough study to provide the necessary information, including a cost-effectiveness analysis for various levels of decontamination.

The development of standards for decommissioning must, of course, include consideration of the many concurrent activities in radioactive waste management and radiological protection. EPA has developed proposed Criteria for Radioactive Waste for management of all radioactive wastes which will provide guidance for decommissioning standards. From the decommissioning view probably the most important criterion is that limiting reliance on institutional controls to a finite period. EPA believes that the use of institutional control to protect the public from retired nuclear facilities, until they can be decontaminated and decommissioned, should be limited at the most to 100 years and preferably less than 50 years. This includes nuclear reactors shut down and moth-balled or entombed for a period of time under protective storage. After the allowable institutional care period is over, the site will have to meet radioactive protection levels established for release for unrestricted use. We believe EPA's proposed criteria would be directly applicable, as above, to decommissioning of nuclear facilities and should be given serious consideration by the Nuclear Regulatory Commission (NRC).

The availability of adequate funds when the time to decommission arrives is also most important; it should be the responsibility of the NRC to assure that such provisions are made. We recognize the great complexity of providing funds for such activities at some time in the future, particularly where utilities are involved due to the controls imposed by State and local utility commissions. However, if it can be firmly established that the total cost of decommissioning in current dollars is a very small fraction of initial capital costs, provision of escrow funding may not be necessary. Therefore, we urge the NRC to conduct the necessary studies and assessments to determine unequivocally the costs of decommissioning and to compare such costs to initial capital costs. It is only through a definitive analysis, and perhaps through realistic demonstration, that this issue can be resolved.

Direct Radiation From Nitrogen-16

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. It is also stated that Monte Carlo techniques were used to calculate direct radiation and skyshine dose rates on the order of 20 mrem/year per unity at a typical site boundary distance of 0.6km from the turbine building. It is noted that the direct radiation dose is not listed on Tables 4.9 and 4.10, that there are residences at 610 m and 756m from the plant, and that the SE sector with the residence at 610m also has a garden and meat animal at 644m. These factors could serve to maximize doses in these sectors and therefore should be more fully discussed in the final EIS.

Health Risk Conversion Factors

The health risk conversion factors listed 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.

Comments Relating to Water Quality

1. Page 2-12, Figure 2.3

Figure 2.3 depicts the Water Use Diagram for Susquehanna Units 1 and 2; however, a water balance cannot be calculated for many of the unit processes shown on the diagram due to insufficient information. For example, it is impossible to determine the makeup of the waste treatment discharge since the flow rates of the dimineralizer and raw water treatment plant discharges are not indicated.

For purposes of clarity and future permitting, a revised diagram should be submitted which clearly shows all discharge points and includes a complete water balance. This treatment scheme could also be better utilized if it were included in Section 3.2.4 entitled Chemical, Sanitary, and Other Waste Treatment.

Paragraph 2.3.4 relates that the Susquehanna at the plant site meets water quality standards for all parameters except iron. In describing the discharge, on pages 4.4 and the pages following, the impression is given that the discharge will degrade the river beyond water quality limits for several contaminants. Table 4-3 shows that the chloride ion is extraordinarily high. The quantity of the ion is not the major concern but its nature is, particularly when you consider the stoichiometry of the various ions that are on the list of the State's water quality parameters, those making up the effluent of the plant and those ions and compounds not included but may be present in the list of water quality parameters.

Figure 2-3 does not clearly illustrate whether the sewage treatment plant effluent is discharged into the Susquehanna River. The plant is not described in sufficient detail. The lack of design or operation mode does not give the necessary assurance that it will operate efficiently at 1/3 capacity without adverse impacts upon the river. Many treatment systems fail when they are not operated at capacity.

2. Page 2-17, Table 2.8

Table 2.8 lists specific Water Quality Criteria applicable to fecal coliform, total iron, manganese, dissolved oxygen, pH, and total dissolved solids but has not included the applicable criteria for temperature. Specific temperature criteria for zone 03.010, North Branch Susquehanna River, are as follows:

> Not more than a 5°F rise above ambient temperature or a maximum of 87°F, whichever is less; not to be changed by more than 20°F during any one hour period.
>
> This information can be found in Pennsylvania's Water Quality Criteria, Pennsylvania Code, Title 25, Part I, Environmental Resources, Chapter 93, Water Quality Criteria Amended September 16, 1976; Effective October 11, 1976.

3. Page 3-3, 3.2.2.2

Section 3.2.2.2 describes the intake structure which will be employed at the plant. A comparison of this intake and intake designs illustrated in EPA Document 660/2-73-016 Reviewing Environmental Impact Statements - Power Plant Cooling Systems Engineering Aspects shows the design of the plant's intake as generally unsatisfactory. The document states that travelling screens with continuous movement are preferred to those with intermittent movement. In addition, it is recommended that stationary louvers for fish by pass or collection and removal facilities should be provided in the Screenwell. These two modifications to the proposed intake structure at SSES should be considered in the final design, especially in light of the NRC staff's concern of adverse affects to the aquatic community within the immediate vicinity of the wing walls and associated rip-rap. It should also be noted that Section 316(b) of the Clean Water Act of 1977 requires the location design construction and capacity of cooling water intake structures reflect Best Available Technology for minimizing adverse environmental impact by July 1, 1984.

Table 3-1 reveals that the average annual intake from the river exceeds the maximum monthly intake. These figures are confusing and should be clarified.

4. Page 3-8, Section 3.2.4.1

The first paragraph of Section 3.2.4.1, Industrial Wastes, states that sulfuric acid added to the circulating water system is the major source of industrial chemical waste and of potential impact to the aquatic environment. This section does not discuss what measures or treatment the applicant has employed to eliminate or minimize this impact. This section should be expanded to address this point.

The second paragraph of this section states that wastes from raw water treatment will be discharged with roof drains, etc. to the holdup pond in the parking lot. No indication is made, however, if any additional treatment will take place in this pond. If so, any proposed treatment should be outlined. If not, the applicant will most likely have to clean out the pond as a result of the build up of suspended solids. In this case, the disposal of these solids should be addressed.

5. Page 4-6, Section 4.3.4

Section 4.3.4, EPA Effluent Guidelines and Limitations states the station shall achieve effluent limitations requiring the application of BPTCA according to P.L. 92-500. It should also be noted that amendments to this law (Clean Water Act of 1977, P.L. 95-217) will require the station to achieve effluent limitations which require the installation of Best Conventional Technology no later than July 1, 1984; Best Available Technology for non-conventional pollutants by July 1, 1984 or three years after limitations are established, whichever is later, but never later than July 1, 1987; and Best Available Technology for those 129 toxic pollutants which appeared at 43 Federal Register 4108 no later than July 1, 1984, as applicable.

6. Page 4-9

It is questionable as to the practicability of reintroducing shad to the river. Due to the number of dams between Conowingo and the Susquehanna Steam Electric site, it does not appear that this anadromous fish could survive. The cost of getting the migrating fish over the dams would be exorbitant and difficult to justify.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
6TH AND WALNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

MAY 30 1980

Director, Division of Site
Safety & Environmental Analysis
Attn: Mr. S. Singh Bajwa
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Bajwa:

Thank you for granting us a short extension on the deadline for submitting comments on the Draft Supplement to the Draft EIS related to operation of SSES, Units 1 and 2, specifically the Pond Hill Creek Reservoir.

Our comments are attached and if any questions arise in relation to them please contact us on FTS 597-7188.

Sincerely yours,

Robert S. Davis

Attachment

Below are comments on Draft Supplement EIS SSES for the Pond Hill Reservoir pumped storage facility. We believe an ER-2 rating is justified relative to this document. Please find attached a copy of our system for commenting on EIS's. The ER stands for Environmental Reservations and the 2 indicates Insufficient Information.

Information regarding floods and flooding is sparse. In addition, the map on page 2-7 does not adequately depict the Pond Hill Creek floodplain nor the Susquehanna River Floodplain. No doubt some changes will take place in these areas as a result of the project and such changes should be addressed.

With regard to flooding, our information does not agree with either the applicant's or the NRC's. Calculations based upon the maximum storm of recent years, i.e. hurricance Agnes, indicates a 686 mm precipitation event. It is our belief that this impoundment would be topped in such a storm and, depending upon dam construction, may wash out and compound the downstream damages due to flooding. In addition, thorough information should be presented regarding other effects of storms of lesser intensity so that a complete analysis can be made.

The flooding impact potentials as well as the floodplain effects may in themselves indicate that the impoundment should not be built; however, one other point should be more thoroughly presented. This is the frequency analysis of low flows that would interrupt the operation of the power station. In this context, the use of such terminology as "... in some years..." and "... require several shutdowns..." is too inspecific for adequate evaluation. The reasons for not using the river follow alternative, then, based upon information here, are inadequate.

Around the saddle from the "top of the ridge", where a dike is to be placed, is another saddle. This second saddle appears to be within the same contour lines as the "saddle" to be diked yet no mention is made either of its potential as an "accidental" spillway in times of severe flooding or of the necessity of a dike in this area. (Re. fig. 3.2, p 3-3). Furthermore, no mention is made of the severe flooding potential associated with the Lily Lake; a very low saddle between these two sites indicates a possible spill over into Pond Run watershed during severe storm periods.

The discussions on wildlife resources is acceptable, but shows some deficiencies with regard to periodicities exhibited by some animals. For example, it is stated with far too much assurance that the eastern cottontail is of minor importance. However, this animal is currently near or at the low point in its seven year cycle. (p 2-11). As the cottontail is a major component of the food web further decreases in its population may be significant.

The operational parameters discussed on pages 3-4 and 4-10 & 11 fail to describe adequately the frequency of intakes and releases and their effects on the reservoir itself and upon the Susquehanna River. For example, this reservoir may have multiple uses among them being recreation. The worst possible case should be described when the level is dropped to an extreme where such activities are curtailed. Also, during these low levels what will the effects be upon the Susquehanna at the point where reduced flows in the river are augmented by the maintenance from the reservoir?

During low flow periods, when the reservoir intake cannot be used, and the river must be augmented by flows from the impoundment, will evaporative losses be significant? Evaporative losses during hot weather are large. These losses coupled with drawdown may indicate a shorter useful storage capacity than is indicated in the document.

In sum, this supplementary document does not adequately discuss alternative measures other than providing flows from the river itself or other reservoirs. Alternative sites to the one presented here are given only cursory attention. Under the new CEQ guidelines, such documents as this are supposed to describe the decisionmaking process and not merely represent the most favorable arguments for choosing this alternative.

Environmental Impact of the Action

LO--Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement or suggests only minor changes in the proposed action.

ER--Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to reassess these aspects.

EU--Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1--Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2--Insufficient information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3--Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the draft statement.

If a draft impact statement is assigned a Category 3, ordinarily no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

Figure 3-1. Notification of EPA's Classification of Comments
Page 2 of 2

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

In Reply Refer To:

OEPR-ORB
Cooperative Studies
Draft Supplement to DEIS
Susquehanna Steam-Electric
Station Units 1 and 2

JUN 10 1980

Darrel G. Eisenhut, Director
Division of Licensing
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

This is in response to your recent request for comments on the draft supplement to the draft environmental impact statement for the Susquehanna Steam-Electric Station (SSES) Units 1 and 2, Pennsylvania.

The draft supplement addresses the subject of low flow augmentation required to supply water to the Susquehanna River to replace water consumptively used by the SSES during periods of very low streamflow. The average consumptive use at the SSES would be about 1.4 cubic meters per second or approximately 6 percent of the seven consecutive day, 10-year frequency low flow of 22.7 cubic meters per second at the Wilkes-Barre gage. When the discharge at the gage is below this level, Pennsylvania law prohibits water withdrawals from the river. This would result in SSES being shutdown for the duration of the streamflow deficiency.

The applicants, Pennsylvania Power and Light Company and the Allegheny Electric Cooperative, Inc., have studied two alternatives for providing low flow augmentation — one, a new single-purpose reservoir and another, which would utilize storage from an existing reservoir. Another option would be to "river follow" or accept and accommodate the occasional shutdowns necessary during low streamflow. The applicants have recommended construction of the Pond Hill low flow augmentation reservoir. The proposed single-purpose reservoir would be located on a headwater tributary to the Susquehanna River, with insufficient natural streamflow for its intended purpose. Consequently, pumping energy amounting to about 2,417 megawatt-hours per year would be required to maintain its required inflow. This is equivalent to the amount of electricity that could be generated from using about 4,000 barrels of oil.

The report recognizes that the most economic alternative to augment low flows would be the modified operation of an existing upstream reservoir. However, we believe that the draft supplement did not adequately explore that opportunity, which appears to us to be the most practical alternative. The primary project

considered is the U.S. Army Corps of Engineers' Cowanesque project, presently under construction and scheduled for completion in June 1981. The report states that the Corps of Engineers pointed out uncertainties regarding the availability of storage due to the need for Congressional approval for reallocation of storage capacity, and according to the Susquehanna River Basin Commission, the Cowanesque project cannot be considered as a timely alternative. The report implies that the Pond Hill project could be designed, constructed, and placed in operation in less time than the Congress could effect changes in the Cowanesque project operations. We question this implication.

According to the Corps of Engineers, the pre-construction planning of the Cowanesque project included approximately 31,000 acre-feet of storage for water supply but it was not included as a project purpose due to lack of local support at the time. However, we have been informed by the Corps that a detailed $600,000 plus study is currently underway to determine the availability of storage in the Cowanesque project for supply make-up water for the Susquehanna Steam-Electric Station. This extensive study, initiated in March 1979, is scheduled for completion in early 1982.

Based on our review of the draft supplement report and consultation with the Corps of Engineers, it appears that the use of the Cowanesque project, now under construction, instead of the proposed Pond Hill project would: save an equivalent of 4,000 barrels of oil annually, avoid the environmental effects normally associated with dam construction, eliminate possible objections from local residents or property owners, increase benefits to recreation and fish and wildlife resources during low flow conditions, and perhaps provide the low flow regulation sooner than Pond Hill. Therefore, it appears to be in both the ratepayers' and taxpayers' interests to include storage in the Corps of Engineers' project (under construction) rather than build a new reservoir.

Sincerely,

William W. Lindsay

William W. Lindsay, Director
Office of Electric Power Regulation

Thomas J. Halligan
P.O. Box 5
Scranton, Pa. 18501
August 18, 1979

Director
Div. Site Safety & Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Director:

Reference -- Draft Environmental Statement
NUREG--0564, June, 1979
Related to the operation of the
Berwick Atomic Power Plant
(Susquehanna Units 1 & 2)
NRC Docket Nos. 50-387/388

The following comments are submitted on behalf of the Citizens Against Nuclear Dangers, Berwick, Pennsylvania, interveners before the NRC Atomic Safety and Licensing Board in the above proceedings.

The Applicants, who are responsible for the preparation of the Draft Environmental Statement (DES), have failed to satisfy certain requirements of the National Environmental Policy Act (NEPA) and thereby place in jeopardy the validity of the DES in its present form.

The Applicants are attempting to circumvent NEPA be piecemealing their assessment of the Berwick atomic plant's overall impact on the human environment. The Applicants are preparing a separate DES for the so-called Pond Hill Flow Augmentation Reservoir, which is a transparent attempt to circumvent NEPA. The submission of a separate DES by Allegheny Electric on sections of the UHV transmission lines from Berwick is another example of piecemealing. The Applicants will know doubt, at some latter date, prepare other DES's, piecemealing such integral projects as the uranium fuel cycle, on-site storage, decommissioning of the atomic plant, and more.

C002 ES 1/0

7908230488

Recent decisions of the Federal Courts have held that the piecemealing of a major project, such as Berwick, for purposes of environmental assessment, is not permissible under NEPA. You are advised that the DES (NUREG--0564) cannot be considered a comprehensive assessment of Berwick unless and until it takes into account the cumulative effects of all related actions. In order to be acceptable, NUREG--0564 must address the impacts of the proposed "Flow Augmentation Reservoir" and all other projects inextricably linked to the Berwick atomic power plant, but which have not been included in the Applicants DES to date. These piecemealed projects may seem individually limited, but they are cumulatively significant! Piecemealing of a DES is illegal!

Failure on the part of the NRC to rectify this fundamental defect in the DES may invite a lawsuit in Federal District Court to halt the process of environmental review by the NRC until the Applicants comply with NEPA as it relates to piecemealing violations.

Yours truly
Thomas J. Halligan
Correspondent

Director,
Division of Site Safety and
Environmental Analysis,
Nuclear Regulatory Commission
Washington D.C. 20555

Aug. 11, 1979

Dear Director,

I would like to comment on the draft environmental statement concerning the nuclear Susquehanna Steam Electric Station, Luzerne County, Pennsylvania.

The booklet you sent me was very impressive. However it was equally unreadable.

I feel that we here in Pennsylvania already have too many nuclear power plants, contributing more and more radioactivity to the air and the Susquehanna river through normal operations let alone accidents like TMI. It's been said that any dose of radiation is an overdose, so I can't see how this new plant will contribute anything to our health and safety here in Pennsylvania.

Also considering the fact that the NRC as of now has no final plans for waste disposal, I don't feel that the on-site accumulation of these wastes will be beneficial to the residents of our state.

I strongly disapprove the issuance of any license to operate the Susquehanna plant until you have:
-a way to dispose the wastes safely
-can operate the plant without adding more low level radioactivity to our environment
-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.

Sincerely,

Michael L. Hershey
626 N. Pine St.
Lancaster, Pa. 17603

RE: Mike Huntington
Rd#1
Hunlock Creek, Pa.
18621

8-19-79

Sirs,

I am writing in response to your request for my input on the Draft Environmental Statement for the Steam Electric Station at Berwick, Pa. Well, much as I have tried to plow through the voluminous information that it contains, the short amount of time that I have been allowed for this task makes me skeptical of the N.R.C's sinserity about being genuinely interested in my in-put. The advertisement of the availability of this report was made only approxiamtely 1 1/2 months ago in our local paper
over

since it does take time to recieve one through the mail, the amount of time to assess this mass of data has been severly limited. I am not an expert on these matters and dealing with so much unfamiliar territory does not make for quick progress either. But just because I am not overly qualified in areas of Nuclear science or ecological balance does not mean that my opinions and observations are with out value. I live less than 10 air miles from this proposed facility and work practically within the shadow of it's cooling towers. I also used to live about 15 miles from T.M.I. but evacuated from there and did not feel very thrilled to returning to a town that gets a good portion of it's drinking water from the Susquehanna River —

at a point below TMI. I don't want to have to leave my home ever again because of fears of my safety due to Nuclear radiation! Since TMI, I have looked deep and hard into the area of nuclear power. I am convinced that we do not at the present time have the technology to deal with the requirements of infalibility that it demands. I am also of the opinion that the N.R.C. has failed in it's responsibility to look first after the better interests of the U.S. public. With specific reference to the Environmental statement mentioned, the amount of it that I have had the time to study, I have several observations: P.P+L is basing it's cost benefit analysis on a 60% to 70% efficiency factor. Our

Generally, the performance of the nuclear industry has in fact been much much lower — "the cumulative to date capacity factor for all plants from the first year of operation through 1976 was 53.7 %. Moreover, the plants show a decline in performance as they get older. During the first two years of commercial operation, they average 54%, rise to an average of 63% during the next 6 years, and thereafter decline to an average of 39%", ...

* The Silent Bomb
Peter Faulkner

P.P.+L is not telling the truth to their rate payers as to the true economics of this plant.

The Environmental Statement is also invalid due to a shocking lack of consideration of the events at Three Mile Island — I saw one footnote that regarded some data as pending! This is outrageous! T.M.I has not even been fully assessed, yet the significance of any findings from this event seem to be regarded as having little relation to already established findings for this specific environmental statement.

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. Acceptable to whom I ask? The N.R.C. 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 T.M.I. Now, surely the Susquehanna Steam Electric Station is going to require an equally substantial amount of fuel for its operation too.

are we to be asked to define as "acceptable" the premature deaths of another group of 1.2 million people per year in this situation too?!

Something not found in this report is very good coverage of alternatives —and their impact on the environment— to the S.S.E.S. No mention of solar energy, conservation, cogeneration, bio mass, etc. Coal was not treated fairly or totally. The benefits that a coal-fired S.S.E.S. would have on the local economy is vastly underrated.

Other points that I highly object ~~to~~, which probably should be headed under the cost/benefit analysis, are the areas of waste disposal and insurance coverage. I resent being called upon as a U.S. tax payer to support P.P.&L along with all of the other nuclear utilities, with responsibility for disposal of rad waste and absolutely unjust insurance limitations —also at my expense— under the Price Anderson act. If P.P.&L were held responsible —as they should be— for the permanant and safe disposal of the mill tailings, rad waste, and worn out reactor [when they are through with it] the economics would be alittle different. If they were only required to pay their own insurance —without unrealistic limitations such as 560 million ceilings on liability claims— the economics of this plant would be prohibitive. I do not want any part of subsidizing these aspects of the nuclear industry. They have created a false state of economy for the utilities and as a free citizen, I feel that my own freedom of choice has been trampled upon. The N.R.C has a dismal record of putting the Public's health, safety, and welfare ahead of the profit schemes of Power utilities. It is time for a turn around from this stance — past time! I charge you with the task of fulfilling the duties as public protectors that you have been established for.

In total opposition to
Nuclear generated electricity

Michael J Huntington

---

803 North Street
Weatherly, PA 18255
August 8, 1979

Director, Division of Site Safety
and Environmental Analysis
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear sirs:

We want to strongly protest your Draft Environmental Statement recommending that Pennsylvania Power & Light Co. be granted an operating license for the Berwick, PA. nuclear plant. In Section 6, "Environmental Impact of Postulated Accidents," you state that the environmental risk from a Class 9 accident need not be considered, because the probability of a major accident is far too low.

The low probability, as you are aware, did not prevent the accident from happening at Three Mile Island on March 28 in Harrisburg. That accident brought out the potential for human and mechanical error in any nuclear plant, no matter how carefully built, and we feel that no one should have to live with the fear of another accident. We advocate increased use of our own abundant Pennsylvania coal, and the development of synthetic and solar sources of energy to combat our energy crisis.

We have been active in the Hazleton Branch of the Susquehanna Alliance in protesting the licensing of the Berwick plant. We will continue to voice our concern. In speaking to others, we find that the majority of the people in our area are against the operation of the plant, unless it is converted to another source of energy.

Very truly yours,

Mr. and Mrs. Harold C. Jeppsen

In reference to the Susquehanna Nuclear Power plant owned by PP&L.

According to what I understand in the Environmental Statement related to PP&L, there is not such a great need for this plant. PP&L is only adding to their output energy not replacing what they are now using.

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.

I feel you should stop being so bias and let some real sincere people draw up another environmental statement! You make it so complex for the average person to understand. No wonder most americans in our country know the real truth about nuclear power.

104 Davey Laboratory
Penn. State University
University Park
Pa., 16802

19 August 1979

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

Gentlemen:

Enclosed are my comments on the Draft Environmental Statement for the Susquehanna Steam Electric Station Units 1 and 2, NUREG-0564 (Docket Nos. 50-387 and 50-388). Please note that the information presented is my own and not necessarily the position of The Pennsylvania State University, which affiliation is given for identification purposes only.

My comments consist of one page of main text (beyond this page) and ten pages of appendix, which I would like to have considered in entirety.

Sincerely,

William A. Lochstet

Wm. A. Lochstet

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 enviremental 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 0.8GWy(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)

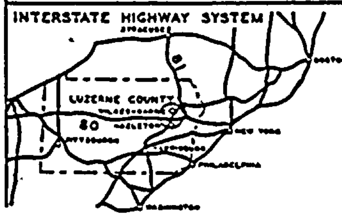
5 M. Eisenbud, and H.G. Petrow," Radioactivity in the Atmospheric Effluents of Power Plants that Use Fossil Fuels," Science 144,:288-289 (1964)

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

LUZERNE COUNTY PLANNING COMMISSION



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August 10, 1979

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Director, Division of Site Safety and Environmental Analysis.

Gentlemen:

The Susquehanna Steam Electric Station is located in Luzerne County. The Draft Environmental Statement (NUREG-0564) of the U. S. Nuclear Regulatory Commission was reviewed by the Luzerne County Planning Commission on August 9, 1979, at its regular monthly meeting at which a quorum was present.

After due consideration, a motion was made, seconded, and unanimously carried to make two (2) recommendations to the U. S. Nuclear Regulatory Commission:

1. That an Emergency Evacuation Plan be completed by the Luzerne County Civil Defense Agency before the Susquehanna Steam Electric Station goes into operation; and