ATTACHMENT 2

DOCKET-50-320--38

Final

environmental statement

related to operation of

THREE MILE ISLAND NUCLEAR STATION UNITS 1 and 2

METROPOLITAN EDISON COMPANY
PENNSYLVANIA ELECTRIC COMPANY
JERSEY CENTRAL POWER AND LIGHT COMPANY

DOCKET NOS. 50-289 and 50-320

December 1972

UNITED STATES ATOMIC ENERGY COMMISSION
DIRECTORATE OF LICENSING

MASTER

1108 263

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

POOR ORIGINAL

7910050 020

6

VI. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A. PLANT ACCIDENTS

A high degree of protection against the occurrence of postulated accidents in the Three Mile Island Nuclear Station, Unit 1 and Unit 2, is provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system as will be considered in the Commission's Safety Evaluation for each unit. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely; and engineered safety features are installed to mitigate the consequences of these postulated events.

The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using best estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the Staff safety review, extremely conservative assumptions were used for the purpose of comparing calculated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those that will be presented in the Staff Safety Evaluations.

The Commission issued guidance to Applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The Applicants' response is contained in "Environmental Report - Operating License Stage" for the Three Mile Island Nuclear Station, Unit 1 and Unit 2, dated December 10, 1971.

The Applicants' report has been evaluated using the standard accident assumptions and guidance issued as a proposed Annex to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious are identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate, and those at the low potential consequence end have a higher occurrence rate. The examples selected by the Applicants for these classes are shown in Table 20. The examples selected are reasonably homogeneous in terms of probability with no exceptions. It was considered to be more appropriate to classify (1) the failure of the waste gas decay tank as an accident in Class 3 (Applicants use Class 8) and (2) the steam generator tube rupture as an accident in Class 5

(Applicants use Class 8). The following assumptions made by the Applicants are questionable: (1) no steam generator tube leaks prior to the steam generator tube rupture are considered, (2) the primary coolant activity is based on 0.1% failed fuel, and (3) the consequences of various releases are evaluated based on release rates applicable for specified times. However, the use of alternative assumptions does not significantly affect overall environmental risks.

The postulated occurrences in Class 9 involve failures more severe than those required to be considered for the design basis of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

Staff estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table 20. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 20. The man-rem estimate was based on the projected population around the site for the year 2014. The estimates presented in Table 20 refer to a single unit.

To rigorously establish a realistic annual risk, the calculated doses in Table 20 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operation and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during plant operation; but events of this type could occur sometime during the 40-year plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table 20 are weighed by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design basis of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture and operation,

continued surveillance and testing, and conservative design all are applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain sufficiently small in probability that the environmental risk is extremely low.

Table 20 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within or comparable to the Maximum Permissible Concentrations (MPC) of Table II of 10 CFR Part 20. The table also shows that the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident would be orders of magnitude smaller than that from naturally occurring radioactivity, which corresponds to approximately 394,000 man-rem/yr based on a natural background level of 130 mrem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

B. TRANSPORTATION ACCIDENTS

1. New Fuel

Under accident conditions other than accidental criticality, the pelletized form of the nuclear fuel, its encapsulation, and the low specific activity of the fuel limit the radiological impact on the environment to negligible levels.

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel assemblies under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within a radius of about 100 feet from the accident might receive a serious exposure but beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat

TABLE 19

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Class	AEC Description	Applicant's Example(s)
1	Trivial Incidents	None
2	Small Releases Outside Containment	Spill in Sample Hood
3	Radwaste System Failure	Inadvertent Release of Waste Gas Decay Tank
4	Fission Products to Primary System (BWR)	Not applicable
5	Fission Products to Primary and Secondary Systems (PWR)	One day Operation with Primary System Leak to Reactor Building Normal Operation with Steam Generator Tube Leak and Release from Condenser
6	Refueling Accidents	Drop of Fuel Assembly or Drop of Heavy Object on Fuel Assembly
7	Spent Fuel Handling Accident	Drop of Fuel Assembly
8	Accident Initiation Events Considered in Design Basis Evaluation in the Safety Analysis Report	Uncompensated Operating Reactivity Changes Startup Accident Rod Withdrawal Accident Cold Water Accident Loss of Coolant Flow Accident Stuck-Out, Stuck-In, or Dropped Control Rod Accident Loss of Electric Load Accident Steam Line Failure Steam Line Leakage Steam Generator Tube Failure Rod Ejection Accident Loss of Coolant Accident Waste Gas Tank Rupture
9	Hypothetical Sequences of Failures More Severe Than Class 8	None

TABLE 20

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

(Single Unit Only)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary 1/	Estimated Dose to Population in 50 Mile Radius, man-rem
1.0	Trivial incidents	2/	2/
2.0	Small releases outside containment	2/	2/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.073	10
3.2	Release of waste gas storage tank contents	0.29	40
3.3	Release of liquid waste storage tank contents	0.003	0.47
4.0	Fission products to primary system (BWR)	N.A.	N.A.
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	2/	2/
5.2	Off-design transients that induce fuel failure above the expected and steam generator leak	.002	0.23
5.3	Steam generator tube rupture	0.096	13

POOR ORIGINAL

1108 268

TABLE 20 (cont'd)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[1/]	Estimated Dose to Population in 50 Mile Radius, man-rem
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.015	2.1
6.2	Heavy object drop onto fuel in core	0.26	36
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.01	1.3
7.2	Heavy object drop onto fuel rack	0.038	5.3
7.3	Fuel cask drop	N.A.	N.A.
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents		
	Small Break	0.16	40
	Large Break	1.2	1000
8.1(a)	Break in instrument line from primary system that penetrates the containment	N.A.	N.A.
8.2(a)	Rod ejection accident (PWR)	0.12	100
8.2(b)	Rod drop accident (BWR)	N.A.	N.A.
8.3(a)	Steamline breaks (PWR's-outside containment)		
	Small Break	<0.001	<0.1
	Large Break	<0.001	0.13

TABLE 20 (cont'd)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary 1/	Estimated Dose to Population in 50 Mile Radius, man-rem
3.3(b)	Steamline breaks (BWR)	N.A.	N.A.

1/ Represents the calculated fraction of a whole body dose of 500 mrem or the equivalent dose to an organ.

2/ These releases will be comparable to the design objectives indicated in the proposed Appendix I to 10 CFR Part 50 for routine effluents (i.e., 5 mrem/yr to an individual from either liquid or gaseous effluents).

nerated in the reaction would probably separate the fuel elements so that e reaction would stop. The reaction would not be expected to continue r more than a few seconds and normally would not recur. Residual radiation vels due to induced radioactivity in the fuel elements might reach a few entgens per hour at 3 feet. There would be very little dispersion of dioactive material.

2. Irradiated Fuel

Effects on the environment from accidental releases of radioactive aterials during shipment of irradiated fuel have been estimated for the ituation where contaminated coolant is released and the situation where ases and coolant are released.

(a) Leakage of contaminated coolant resulting from improper closing f the cask is possible as a result of human error, even though the shipper s required to follow specific procedures which include tests and examination f the closed container prior to each shipment. Such an accident is highly nlikely during the 40-year life of the plant.

Leakage of liquid at a rate of 0.001 cc per second or about 80 rops/hour is about the smallest amount of leakage that can be detected by isual observation of a large container. If undetected leakage of contaminated iquid coolant were to occur, the amount would be so small that the individual xposure would not exceed a few mrem and only a very few people would receive such exposures.

(b) Release of gases and coolant is an extremely remote possibility. In the improbable event that a cask is involved in an extremely severe accident such that the cask containment is breached and the cladding of the fuel assemblies penetrated, some of the coolant and some of the noble gases might be released from the cask.

In such an accident, the amount of radioactive material released would be limited to the available fraction of the noble gases in the void spaces in the fuel pins and some fraction of the low level contamination in the coolant. Persons would not be expected to remain near the accident due to the severe conditions which would be involved, including a major fire. If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected. Persons in the downwind region and within 100 feet or so of the accident might receive doses as high as a few hundred millirem. Under average weather conditions, a few hundred square feet might be contaminated to the extent that it would require decontamination (that is, Range I contamination levels) according to the standards of the Environmental Protection Agency.

3. Solid Radioactive Wastes

It is highly unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the 40-year life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant. Other solid radioactive wastes will be shipped in Type B packages. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either case, spread of the contamination beyond the immediate area is unlikely and, although local clean-up might be required, no significant exposure to the general public would be expected to result.

4. Severity of Postulated Transportation Accidents

The events postulated in this analysis are unlikely but possible. More severe accidents than those analyzed can be postulated and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages ensure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

5. Alternatives to Normal Transportation Procedures

Alternatives, such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel recovery and fabrication plant on the site rather than shipping fuel to and from the station, have been examined by the Staff on a generic basis. The impact on the environment of transportation under normal or postulated accident conditions is not considered to be sufficient to justify the additional effort required to implement any of the alternatives.

References For Section VI

1. Federal Radiation Council Report No. 7 "Background Material for the Development of Radiation Protection Standards; Protective Action Guides for Strontium 89, Strontium 90 and Cesium 137." May 1965.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PUBLIC SERVICE ELECTRIC AND GAS COMPANY, et al.	)	Docket No. 50-272
	)	(Proposed Issuance of
	)	Amendment to Facility
(Salem Nuclear Generating Station, Unit 1)	)	Operating License
	)	No. DPR-70)

CERTIFICATE OF SERVICE

I hereby certify that copies of "Licensee's Response to the Atomic Safety and Licensing Board's Question 4," dated August 24, 1979, in the captioned matter, have been served upon the following by deposit in the United States mail, this 24th day of August, 1979:

Gary L. Milhollin, Esq.
Chairman, Atomic Safety and Licensing Board
1815 Jefferson Street
Madison, Wisconsin 53711

Mr. Frederick J. Shon
Member, Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. James C. Lamb, III
Member, Atomic Safety and Licensing Board Panel
313 Woodhaven Road
Chapel Hill, N.C. 27514

Chairman, Atomic Safety and Licensing Appeal Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Chairman, Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Barry Smith, Esq.
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Richard Hluchan, Esq.
Deputy Attorney General
Department of Law and Public Safety
Environmental Protection Section
36 West State Street
Trenton, N.J. 08625

POOR ORIGINAL

1108 274

Richard Fryling, Jr., Esq.
Assistant General Solicitor
Public Service Electric
& Gas Company
80 Park Place
Newark, N. J. 07101

Keith Onsdorff, Esq.
Assistant Deputy Public Advocate
Department of the Public Advocate
Division of Public Interest
Advocacy
Post Office Box 141
Trenton, N. J. 08601

Sandra T. Ayres, Esq.
Department of the Public Advocate
520 East State Street
Trenton, N. J. 08625

Mr. Alfred C. Coleman, Jr.
Mrs. Eleanor G. Coleman
35 "K" Drive
Pennsville, New Jersey 08070

Carl Valore, Jr., Esq.
Valore, McAllister, Aron
& Westmoreland
Mainland Professional Plaza
P. O. Box 175
Northfield, N. J. 08225

Office of the Secretary
Docketing and Service Section
U.S. Nuclear Regulatory
Commission
Washington, D. C. 20555

June D. MacArtor, Esq.
Deputy Attorney General
Tatnall Building, P. O. Box 1401
Dover, Delaware 19901

Mark J. Wetterhahn

Mark J. Wetterhahn

POOR ORIGINAL

1108 275