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Docket Nos. 50-397

MEMORANDUM FOR: W. H. Regan, Jr., Chief, Environmental Projects Branch No. 2, DSE

FROM: D. F. Bunch, Chief, Accident Analysis Branch, DSE

SUBJECT: REALISTIC ACCIDENT ASSESSMENT

PLANT NAME: Washington Nuclear Plant Unit No. 2
LICENSING STAGE: OL
DOCKET NUMBERS: 50-397
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RESPONSIBLE BRANCH: EPB No. 2
PROJECT MANAGER: R. Boyle
REQUESTED COMPLETION DATE: September 9, 1977
REVIEW STATUS: AAB Input Complete

The Accident Analysis Branch has enclosed Chapter 7 of the Washington Nuclar Plant Unit No. 2 Draft Environmental Statement. This section was prepared by P. Tam, Nuclear Engineer, Accident Analysis Branch.

/S/
D. F. Bunch, Chief
Accident Analysis Branch
Division of Site Safety and Environmental Analysis

Enclosure:
Chapter 7 of Washington Nuclear Plant Unit No. 2

cc: See next page

Dup 2

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DATE	9/9/77	9/9/77	9/7/77		

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ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A high degree of protection against the occurrence of postulated accidents in the Washington Nuclear Plant Unit No. 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. System transients 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, even though they may be extremely unlikely; and engineered safety features will be installed to mitigate the consequences of those postulated events which are judged credible.

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 our safety review, extremely conservative assumptions are 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. Realistically computed doses that would be received by the population and environment from the accidents which are postulated are significantly less than those presented in the Safety Evaluation Report.

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 applicant's response was contained in the Environmental Report.

The applicant's report has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment 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 were identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate and those on the low potential consequence end have a higher occurrence rate. The examples selected by the applicant for these cases are shown in Table 7.1. These examples are reasonably homogeneous in terms of probability within each class.

Our 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 7.2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 7.2. The man-rem estimate was based on the projected population within 50 miles of the site for the year 2000.

To rigorously establish a realistic annual risk, the calculated doses in Table 7.2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operations; 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, 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 7.2 are weighted 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 bases of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is judged 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 a 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.

The NRC has performed a study to assess more quantitatively these risks. The initial results of these efforts were made available for comment in draft form on August 20,1974 and released in final form on October 30, 1975. This study, called the Reactor Safety Study, is an effort to develop realistic data on the probabilities and consequences of accidents in water-cooled power reactors, in order to improve the quantification of available knowledge related

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"Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, Draft," WASH-1400, August 1974.

"Reactor Safety Study: An Assessment of Accidents Risks in U.S. Commercial Nuclear Power Plants," WASH-1400 (NUREG 75/014), October 1975.

to nuclear reactor accident probabilities. The Commission organized a special group of about 50 specialists under the direction of Professor Norman Rasmussen of MIT to conduct the study. The scope of the study has been discussed with EPA and described in correspondence with EPA which has been placed in the NRC Public Document Room (letter, Doub to Dominick, dated June 5, 1973).

As with all new information developed which might have an effect on the health and safety of the public, the results of these studies will be assessed within the Regulatory process on generic or specific bases as may be warranted.

Table 7.2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary which are less than those which would result from a year's exposure to the Maximum Permissible Concentrations (MPC) of 10 CFR Part 20. The table also shows the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident. Any of these integrated exposures would be much smaller than that from naturally occurring radioactivity. When considered with the probability of occurrence, the annual potential radiation exposure of the population from 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 and need not be considered further.

Table 7.2. Classification of Postulated Accidents and Occurrences

Class	NRC Description	Applicant's Examples
1.	Trivial incidents	Included under routine releases
2.	Small releases outside containment	Included under routine releases
3.	Radioactive waste systems failure	Offgas system leakage
4.	Fission products to primary system (BWR)	Fuel Cladding defects and fuel failures induced by off design transients
5.	Fission products to primary and secondary systems (PWR)	Not Applicable
6.	Refueling accident	Fuel bundle drop
7.	Spent fuel handling accident	Fuel assembly drop on fuel storage pool and spent fuel shipping cash drop
8.	Accident initiation events considered in design-basis evaluation in the Safety Analysis Report	Loss of coolant accident, rod drop accident, steamline break, instrument line break
9.	Hypothetical sequence of failures more severe than Class 8	Not considered

TABLE 7.2

SUMMARY OF RADIOLOGICAL CONSEQUENCES
OF POSTULATED ACCIDENTS

Class	Event	Estimated Fraction of 10 CFR Part 20 limit at site boundary	Estimated Dose to Population in 50 mile radius, man-rem
1.0	Trival Incidents	3/	3/
2.0	Small releases outside containment	3/	3/
3.0	Radwaste System failures		
3.1	Equipment Leakage or malfunction	0.0034	0.32
3.2	Release of waste gas storage tank contents	0.014	1.3
3.3	Release of liquid waste storage contents	< 0.001	0.004
4.0	Fission products to primary system (BWR)	< 0.001	0.13
4.1	Fuel cladding defects	3/	3/
4.2	Off-design transients that induce fuel failures above those expected	< 0.001	0.13

1/ The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials resulting in both a direct and an inhalation dose. Our evaluation of the accident doses assumes that the applicant's environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to a liquid release incident detected by in-plant monitoring) would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure from other potnetial pathways to man.

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

3/ These radionuclide releases are considered in developing the gaseous and liquid source terms presented in Section 3 and are included in the doses in Section 5.

TABLE 7.2 - Continued

Class	Event	Estimated Fraction of 10 CFR Part 20 limit at site boundary	Estimated Dose to population in 50 mile radius, man-rem
5.0	Fission products to primary and secondary systems (PWR)	N.A	N.A
6.0	Refueling accidents		
6.1	Fuel bundle drop	< 0.001	0.0069
6.2	Heavy object drop onto fuel in core	N/A	N/A
7.0	Spend fuel handling accident		
7.1	Fuel assembly drop in fuel rack	<0.001	0.016
7.2	Heavy object drop onto fuel rack	N/A	N/A
7.3	Fuel cask drop	0.008	0.75
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-Coolant Accidents		
	Small Break	<0.001	0.002
	Large Break	0.005	3.8
8.1(a)	Break in instrument line from primary system that penetrates the containment	<0.001	<0.001
8.2(a)	Rod ejection accident (PWR)	N/A	N/A
8.2(b)	Rod drop accident (BWR)	<0.001	0.16
8.3(a)	Steamline breaks (PWR's outside containment)	N.A.	N.A.
8.3(b)	Steamline break (BWR)		
	Small Break	<0.001	0.042
	Large Break	0.002	0.22