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G. W. Knighton, Chief, Project Branch No. 1, DREP

INDIAN POINT 2 REALISTIC ACCIDENT ASSESSMENT

Enclosed is a mark-up of the Realistic Accident Section for the Indian Point 2 draft Environmental Statement. There are a number of minor revisions to the dose table due to a refinement of the dose calculations performed by E. G. Adensam. However, our opinion that the environmental risk remains extremely low has not changed.

A copy of the enclosure was loaned to M. J. Oestmann on March 28, 1972.

Brian Grimes, Chief Accident Analysis Branch Division of Reactor Licensing

Enclosure: (As Stated)

cc: K. Kniel (w/enclosure)
 M. J. Oestmann (w/enclosure)
 D. Muller (w/o enclosure)
 H. R. Denton (w/o enclosure)
 R. DeYoung (w/o enclosure)
bcc: E. Adensam (w/enclosure)

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4. Environmental Impact of Accidents

A high degree of protection against the occurrence of postulated accidents at Indian Point 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 stated in the Commission's Safety Evaluation dated November 16, 1970. 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 our 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 calculated doses that would be received by the population and environment from actual accidents would be significantly less than those presented in our Safety Evaluation. 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 "Supplement No. 2 to the Environmental Report", dated October 15, 1971.

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The applicant's 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 have been identified by the Commission. Each class can be characterized by an occurrence rate and set of consequences. In general, accidents in the high consequence end of the spectrum have a low occurrence rate. The examples selected by the applicant for these classes are shown in Table 3. The examples given are reasonably homogeneous in terms of probability with each class, although we consider steam generator tube rupture and the release of the waste gas decay tank contents as more appropriately in Classes 5 and 3, respectively.

Certain assumptions made by the applicant do not exactly agree with those in the proposed Annex to Appendix D, but the use of alternative assumptions does not significantly affect overall environmental risks. "To rigorously establish a realistic annual risk, the calculated doses in Table 22 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 steem 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 & accidents is very small. Therefore, when the consequences indicated in Table & are Weighted by probabilities, the environmental rick is very low."

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Table 4 reflects the types of accidents described in the proposed amendment to Appendix D, 10 CFR Part 50, published in the Federal Register on December 1, 1971, for comment and interim guidance.

Our estimates of the dose which might be received by an assumed individual standing at the site boundary in the windward direction, using the moment assumptions in the proposed Annex to Appendix D, are presented in Table 4. Our estimates of the integrated annual exposure that might be delivered to the population within 50 miles of the site are also presented in Table 4. The man-rem estimate was based on the projected population around the site for the year 2000.

To establish a realistic annual risk, the calculated annual doses in Table 4 must be multiplied by estimated probabilities. In general, we consider the events in Classes 2 through 5 as improbable, and not likely during the 40-year life of the plant. Accidents in Classes 6 through 7 are relatively less probable, but still are possible. The probability of occurrence of Class 8-accidents is very small # The The occurrences in Class 9 involve sequences of postulated successive failures more severe than those postulated 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.

Table 4 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 the Maximum Permissible Concentrations of Table II of 10 CFR Part 20. The table also shows that the estimated annual integrated exposure for each postulated accident would be orders of magnitude smaller than that from the naturally occurring radioactivity, which corresponds to approximately 2,100,000 man-rem/yr based on a natural background level of 100 mrem/yr. When multiplied by 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 well within naturally occurring variations. It is concluded from the results of this analysis that the realistic environmental risks due to postulated accidents are exceedingly small.

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TABLE 3

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CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Class	AEC Description	Applicant's Example(s)
1.0	Trivial incidents	Not considered
2.0	Small releases outside containment	Small valve or pipe leak in the auxiliary building
3.0	Radwaste system failures	Waste gas decay tank valve leak, inadvertent discharge of the contents of a waste liquid tank or waste gas decay tank
4.0	Fission products to primary system (BWR)	Not applicable
5.0	Fission products to primary ans secondary systems (PWR)	Normal operation with fuel failures and steam generator leaks
6.0	Refueling accidents	Dropped fuel assembly inside containment
7.0	Spent fuel handling accident	Dropped fuel assembly outside containment
		Onsite transportation accident

Loss of coolant, rupture of waste gas decay tank, control rod assembly ejection, steam line break, steam generator tube rupture

9.0

8.0

Hypothetical sequence of failures more severe than Class 8

Accident initiation events

considered in design basis

evaluation in the SAR

Not considered

TABLE 4

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

	of locfr	Fraction Estimated Maximum Annual Dose at, Site	Estimated Annual Dose to Popula- tion in 50 Mile
<u>Class</u>	Event	Boundary, mrem 1	Radius man-rem
1.0	Trivial incidents	<u>2</u> /	<u>2</u> /
2.0	Small releases outside containment	<u>2</u> /	<u>2</u> /
3.0	Radwaste system failures		•
3.1	Equipment leakage or malfunction	0.095 #:	49 🚭
3.2	Release of waste gas storage tank contents	0.37 	190 26 .
3.3	Release of liquid waste storage tank contents	0.004 Nog .	2,3
4.0	Fission products to primary system (BWR)		
4.1	Fuel cladding defects	N. A.*	N. A.*
4.2	Off-design transients that induce fuel failures above those expected	N. A.*	N. A.*
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	<u>2</u> /	<u>2</u> /
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	0.002	1.1 9772 65
5.3	Steam generator tube rupture	40 .	
		and the second	

	071	OCFR PATION	Praction Maximum Se at 19ite	Estimated Annual Dose to Popula- tion in 50 Mile
<u>Class</u>	Event	Boundary ₅		Radius, man-rem
6.0	Refueling accidents	0.02		10
6.1	Fuel bundle drop	<i>C</i> , <i>C L</i>	-	
6.2	Heavy object drop onto fuel in core	0.34 357	• •	180 🚓
7.0	Spent fuel handling accid	ent		2
7.1	Fuel assembly drop in f rack	uel 0.012- 42:	• •	6.5
7.2	Heavy object drop onto rack	fuel 0.05	-	26
7.3	Fuel cask drop	N.A	.*	N. A.*
8.0	Accident initiation event considered in design basi evaluation in the safety analysis report	S S		
8.1	Loss-of-coolant acciden	its 0.2	/	190
	Small Break		•	5800
	Large Break	-200.		270
8.1(a)	Break in instrument lir from primary system that penetrates the containm	ne at ment N.A	.*	N. A.*
8.2(a)	Rod ejection accident ((PWR) 14.8	/8	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
8.2(b)	Rod drop accident (BWR)	N. A	*	N. A.*
8.3(a)	Steamline breaks (PWR's outside containment)) / D.	001	034
	Small Break	2=08	-	
	Large Break	0.0	100	49
		φ1	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	

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	Parte	Praction Procee Proc	Estimated Annual Dose to Popula- tion in 50 Mile
<u>Class</u>	<u>Event</u>	Boundary, mrem-	Radius man-rem
8.3(b)	Steamline breaks (BWR)		
	Small Break	N. A.*	N. A.*
	Large Break	N. A.*	N. A.*

Represents the relevalated fraction of a whole body doce of 500 minen of the equivalent doce to an organ;

2/ These releases are expected to be in accord with proposed Appendix I for routine effluents (i.e., 5 mrem/yr to an individual from all sources).

* N. A. means not applicable.

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