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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

Enclosure

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
REGARDING THE FUEL HANDLING ACCIDENT INSIDE CONTAINMENT
RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1
SACRAMENTO MUNICIPAL UTILITY DISTRICT
DLCKET NO. 50-312

Introduction

By letter dated January 17, 1977, the staff requested the Sacramento Municipal Utility District (the licensee) to evaluate the potential consequences of a postulated FHAIC at Rancho Seco Nuclear Generating Station, Unit 1 (Rancho Seco 1). The potential consequences of an accident involving the handling of spent fuel in containment had not been evaluated previously in a Safety Evaluation for Rancho Seco 1. The licensee submitted, in a letter dated March 21, 1977, an evaluation of this accident. The licensee stated that the potential consequences of the accident are .275 Rem thyroid and .002 Rem whole body at the (EAB). The licensee concluded that these doses are well within the guidelines of 10 CFR Part 100.

Evaluation

We have completed our review and evaluation of the licensee's March 21, 1977, submittal which addresses the potential consequences of a postulated FHAIC.

There are differences between the staff's and licensee's assumptions which were used to calculate the potential consequences of an FHAIC. The licensee used an accident X/Q value of 8.51×10^{-5} sec/M³, and the staff used an X/Q value of 3.6×10^{-4} sec/M³. The licensee assumed that the gases released from the pool surface would mix with the entire reactor building volume during the period of exhaust; however, we concluded that the possible mixing of radioactivity inside containment during the FHAIC from damaged fuel in the core is poor. We, therefore, have given no credit for mixing of the radioactivity inside containment during the FHAIC.

We have performed an independent analysis of the potential consequences of the FHAIC. Our assumptions and the resulting potential consequences at the Exclusion Area Boundary (EAB) are given in Table 1. The potential consequences of this postulated accident at the Low Population Zone (LPZ) are less than those given for the EAB in Table 1.

We have required that the potential consequences of the postulated FHAIC be appropriately within the exposure guidelines of 10 CFR 100. Appropriately within the guidelines of 10 CFR Part 100 has been defined as less than 100 Rem to the thyroid. This is based on the probability of this event relative to other events which are evaluated against 10 CFR Part 100 guidelines. Whole body doses were also examined, but they are not controlling due to decay of the short-lived radioisotopes prior to fuel handling.

Sacramento Municipal Utility
District

cc w/enclosure(s):

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

Atomic Safety and Licensing Appeal
Board Panel
U. S. Nuclear Regulatory Commission
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California Department of Health
ATTN: Chief, Environmental
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Radiological Health Section
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We have calculated that the potential consequences of the FHAIC for Rancho Seco 1 is 104 Rem thyroid at the EAB. We have concluded, taking into account the conservative assumptions used in calculating the EAB thyroid dose, that the potential consequences of the postulated FHAIC for Rancho Seco 1 are sufficiently close to the required 100 Rem thyroid dose to be considered appropriately within the exposure guidelines of 10 CFR Part 100 and are, therefore, acceptable. The conservatism in the staff's calculations is discussed later in this evaluation.

A recent study¹ has indicated that dropping a spent fuel assembly into the core during refueling operations may potentially cause damage to more fuel pins than has been assumed for evaluating the Fuel Handling Accident Inside Containment. This study has indicated that up to all of the fuel pins in two spent fuel assemblies, the one dropped and the one hit, may be damaged because of the embrittlement of fuel cladding material from radiation in the core.

The probability of the postulated fuel handling accident inside containment is small. Not only have there been several hundred reactor-years of plant operating experience with only a few accidents involving spent fuel being dropped into the core, but none of these accidents has resulted in measurable releases of activity. The potential damage to spent fuel estimated by the study was based on the assumption that a spent fuel assembly falls about 14 feet directly onto one other assembly in the core; an impact which results in the greatest energy available for crushing the fuel pins in both assemblies. This type of impact is unlikely because the falling assembly would be subjected to drag forces in the water which should cause the assembly to skew out of a vertical fall path.

Based on the above, we have concluded that the likelihood of a spent fuel assembly falling into the core and damaging all the fuel pins in two assemblies is sufficiently small that refueling inside containment is not a safety concern which requires immediate remedial action.

We have, however, conservatively calculated the potential radiological consequences of a fuel assembly drop onto the reactor core with the rupture of all the fuel pins in two fuel assemblies. We have also assumed for this postulated accident that the source term for both spent fuel assemblies is that given in Regulatory Guide 1.25. This is conservative because (1) these two assemblies should not have the power peaking factor and clad gap activity recommended in Regulatory Guide 1.25 and (2) the pool decontamination factor for inorganic iodine should be greater than that recommended in Regulatory Guide 1.25. The calculated potential radiological consequences at the exclusion area boundary and low population zone for the complete rupture of fuel pins in two assemblies are twice the values given in Table 1. Because these potential consequences are within the guidelines of 10 CFR Part 100 using the conservative assumptions of Regulatory Guide 1.25, we have concluded that the potential consequences of this postulated accident are acceptable and no additional restrictions on fuel handling operations and plant operating procedures are needed.

¹J. N. Singh, "Fuel Assembly Handling Accident Analysis," EG&G Idaho Technical Report RE-A-78-227, October 1978.

Environmental Considerations

The environmental impacts of an accident involving the handling of spent fuel inside containment have been addressed in Section 6.1 of the Final Environmental Statement dated March 1973 for the operation of Rancho Seco 1.

Conclusion

As discussed above, the staff has evaluated the licensee's analysis of the postulated FHAIC. After performing an independent analysis of the radiological consequences of an FHAIC to any individual located at the nearest exclusion boundary, the staff concludes that the doses for one assembly failure are appropriately within the guideline values of 10 CFR Part 100 and for failure of two assemblies are within the guideline values of 10 CFR Part 100 and are, therefore, acceptable.

Table 1

ASSUMPTIONS FOR AND POTENTIAL CONSEQUENCES OF THE POSTULATED
FUEL HANDLING ACCIDENTS AT THE EXCLUSION AREA BOUNDARY
RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1

Assumptions:

Guidance in Regulatory Guide 1.25		
Power Level	2928 Mwt	
Fuel Exposure Time	3 years	
Power Peaking Factor	1.7	
Equivalent Number of Assemblies Damaged	1	
Number of Assemblies in Core	177	
Charcoal Filters	none	
Decay Time Before Moving Fuel	72 hours*	
0-2 hours, X/Q Value, Exclusion Area Boundary (ground level release)	3.6×10^{-4} sec/m ³	
	<u>Doses, Rem</u>	
	<u>Thyroid</u>	<u>Whole Body</u>
Exclusion Area Boundary (EAB) Consequences from Accidents Inside Containment	104	0.4

*Technical Specification 3.8.11