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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
REGARDING THE FUEL HANDLING ACCIDENT INSIDE CONTAINMENT
PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 AND UNIT 2
NORTHERN STATES POWER COMPANY
DOCKET NOS. 50-282/306

Introduction:

By letters dated January 17, 1977 and January 3, 1979, the staff requested the Northern States Power Company (the licensee) to evaluate the previously unevaluated potential consequences of a postulated Fuel Handling Accident Inside Containment (FHAIC) at Prairie Island Nuclear Generating Plant Units 1 and 2 (Prairie Island 1/2). The licensee submitted the evaluation of the FHAIC by letters dated March 21, 1977 and January 12, 1979. The licensee's evaluation of an FHAIC states that either the low volume purge with safety grade charcoal filters or the high volume purge without charcoal filters could be used during refueling.

Evaluation:

We have completed our review of the licensee's March 21, 1977, and January 12, 1979 submittals which address the potential consequences of a spent Fuel Handling Accident Inside Containment (FHAIC). In our review, we concluded that the possible mixing of radioactivity inside containment during the FHAIC from damaged fuel in the core cannot be determined adequately. We, therefore, have given no credit for mixing of the radioactivity inside containment during the FHAIC.

We have performed an independent evaluation of the FHAIC. Our assumptions and the resulting potential consequences at the Exclusion Area Boundary (EAB) are given in Table 1. Table 1 is based on fuel handling operations within 100 hours after shutdown as required by the Technical Specifications and no credit is given for the charcoal filters. Table 1 shows that the dose at the EAB as a consequence of the FHAIC is 102 rem thyroid while the licensee stated 82 rem thyroid for this postulated accident. This difference between the licensee's results and our evaluation of the FHAIC is the X/Q value. The licensee used an X/Q of 3.85×10^{-4} sec/m^3 based on the model taken from Regulatory Guide 1.25. The staff used an X/Q of 4.7×10^{-4} sec/m^3 based on data acquisition of the onsite meteorological data from April 1977 through March 1978.

The 10 CFR Part 100 recommended reference dose level for an individual located at exclusion area boundary is a total radiation dose to the whole body less than 25 rem or a total radiation dose to the thyroid from iodine of less than 300 rem. Based on the results of our evaluation we agree with the licensee that the guidelines of 10 CFR Part 100 are not exceeded for doses to the thyroid. The whole body dose was also examined, but was found not to be controlling due to decay of the short-lived radioisotopes prior to fuel handling. Our results for the whole body dose are also given in Table 1 (.36 rem) which is well below the reference doses in 10 CFR Part 100.

A recent study[1] 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 indicates that 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 remedial action.

We have, however, conservatively calculated the potential radiological consequences of a fuel assembly dropped 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 would 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 would be greater than that recommended in Regulatory Guide 1.25. The calculated potential radiological consequences at the exclusion area boundary for 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.

Conclusion:

Based on the above evaluation, we conclude that the doses for one or two failed fuel assemblies due to a postulated fuel handling accident inside containment are sufficiently smaller than the guidelines of 10 CFR Part 100. Therefore, we find that the Technical Specifications, plant operating procedures and plant equipment provide acceptable protection to the public against the potential consequences of this postulated accident.

Principal Contributors:

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

Table 1

ASSUMPTIONS FOR AND POTENTIAL CONSEQUENCES OF THE POSTULATED FUEL HANDLING ACCIDENTS AT THE EXCLUSION AREA BOUNDARY FOR PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 AND UNIT 2

Assumptions:

Guidance in Regulatory Guide 1.25		
Power Level	1722 MWt	
Fuel Exposure Time	3 years	
Power Peaking Factor	1.65	
Equivalent Number of Assemblies Damaged	1	
Number of Assemblies in Core	121	
Charcoal Filters Low Volume Purge Elemental and Organic Combined	0%	
Decay Time Before Moving Fuel	100 hours*	
0-2 hours X/Q Value, Exclusion Area Boundary (Ground Level Release)	4.7×10^{-4} sec/m^3	
	Doses, Rem	
	Thyroid	Whole Body
Exclusion Area Boundary (EAB) Consequences from Accidents Inside Containment	102.0	0.36

*Technical Specification 3.8.A.10