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4.0 Consequences of a Severe Spent Fuel Pool Accident

Spent fuel pool accidents involving a loss of coolant have the potential for leading to significant fuel heatup and resulting release of fission products to the environment. Such an accident would involve decay heat raising the fuel temperature to the point of exothermic cladding oxidation, which would cause additional temperature escalation to the point of fission product release. These fission product releases have the potential to be of a similar magnitude to releases from severe reactor accidents. An earlier study by Brookhaven National Laboratory (Reference 1) provided an estimate of fission product release magnitudes from a severe spent fuel pool accident. These fission product release magnitudes are shown in Table 1.

Noble Gases	Iodine	Cesium	Tellurium	Strontium	Ruthe-nium	Lantha-num	Cerium	Barium
1	1	1	$2x10^{-2}$	$2x10^{-3}$	$2x10^{-5}$	$1x10^{-6}$	$1x10^{-6}$	$2x10^{-3}$

Table 1. Fraction of fission product inventory released in a severe spent fuel pool accident.

Assessments were made of the consequences of a severe spent fuel pool accident using the MACCS2 code (Reference 2). One of the objectives of this analysis was to provide estimates of offsite consequences to multiply with the estimated frequency of a severe spent fuel pool accident (see Section 3) to calculate the total risk from severe spent fuel pool accidents. Another objective of this analysis was to assess the effect of extended storage in a spent fuel pool, and the resulting radioactive decay, on offsite consequences. This analysis was performed using the radionuclide inventory data in Reference 1. Reference 1 gives radionuclide inventories for decay times of 30 days, 90 days, and 1 year after transfer of 11 batches of spent fuel to the spent fuel pool. Representative numerical results from this analysis are shown in Table 2. The results in Table 2 are for a constant population density of 100 persons per square mile. The results in Table 2 are also based on evacuation of 95% of the population in the Emergency Planning Zone three hours before the fission product release begins, with the remainder of the population relocating based on specific dose criteria. The remaining MACCS modeling used is similar to that of the Surry MACCS calculations performed for final NUREG-1150 (Reference 3). Additional numerical results and a more detailed description of the MACCS modeling used are given in Appendix A.

Table 2 indicates that the effect of radioactive decay of up to a year prior to a severe spent fuel pool accident is small and mainly seen in a reduction in prompt fatalities (30% reduction), because the societal dose and cancer fatalities are dominated by long-lived isotopes. Extended storage in a spent fuel pool, and the resulting radioactive decay, is more likely to have a significant effect on the time after which a loss of coolant would not be able to heat up the fuel to the point of damage.

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Time After Final Discharge to the Spent Fuel Pool	Distance (miles)	Prompt Fatalities	Societal Dose (person-Sv)	Cancer Fatalities
30 days	0-100	.96	48,300	2,260
	0-500	.96	449,000	20,200
90 days	0-100	.83	47,500	2,220
	0-500	.83	460,000	20,700
1 year	0-100	.67	46,700	2,180
	0-500	.67	473,000	21,300

Table 2. Offsite consequences for different decay times prior to the accident.

4.1 References

1. NUREG/CR-4982, Severe Accidents in Spent Fuel Pools in Support of Generic Safety Issue 82, July 1987

2. NUREG/CR-6613, Code Manual for MACCS2, May 1998

3. NUREG-1150, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants, December 1990