From: Jason Schaperow *RES*
To: Pmm1
Date: Mon, Oct 23, 2000 8:33 AM
Subject: Spent Fuel Pool Writeup

George,

Per your request, attached is my revised writeup on spent fuel pool accident consequences. It is on my Branch Chief's desk for review.

Jason

CC: George Hubbard, John Flack

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MEMORANDUM TO: Gary M. Holahan, Director
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

FROM: Farouk Eltawila, Acting Director
Division of Systems Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

SUBJECT: RADIOLOGICAL CONSEQUENCES OF SPENT FUEL POOL ACCIDENTS OCCURRING UP TO 10 YEARS AFTER FINAL REACTOR SHUTDOWN

As part of its effort to develop generic, risk-informed requirements for decommissioning, NRR requested (Reference 1) that RES evaluate the offsite radiological consequences of beyond-design-basis spent fuel pool accidents. In response to that user need, RES completed an in-house analysis (References 2 and 3) using the MACCS code (Reference 4). The focus of that work was estimation of consequences of accidents occurring between 30 days and 1 year after final reactor shutdown. Recently, NRR requested (References 5 and 6) that RES extend the consequence evaluation to accidents occurring up to 10 years after final shutdown.

RES performed the requested calculations using the release fractions in Table 1 and the fission product inventories at 30 and 90 days and 1, 2, 5, and 10 years after final shutdown. The release fractions in the first row of Table 1 are the sum of the in-vessel and ex-vessel release fractions in NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*, February 1995 (Reference 7). NUREG-1465 has received significant peer review and is representative of a low pressure core-melt accident. The release fractions in the second row of Table 1, other than those for ruthenium and fuel fines, also are from NUREG-1465. In this case, the ruthenium release fraction is that for a volatile fission product, and the fuel fines release fraction is that from the Chernobyl accident (Reference 8). The results of the RES calculations for the population within 50 miles and within 100 miles (consistent with the distance used in earlier RES analysis for NRR on spent fuel pool accidents) are given in Tables 2 and 3.

Table 1 Fission Product Release Fractions

Source Term	Release Fractions							
	Xe,Kr	I	Cs	Te	Sr	Ba	Ru	La	Ce
NUREG-1465	1	.75	.75	.31	.12	.12	.005	.0052	.0055
NUREG-1465 (modified)	1	.75	.75	.31	.12	.12	.75	.035	.035

Table 2 Results based on NUREG-1465 Source Term

Case	Decay Time	Mean Consequences (Surry population, 95% evacuation)			
		Within 100 Miles			Within 50 Miles
		Early Fatalities	Societal Dose (rem)	Cancer Fatalities	Societal Dose (rem)
77a	30 days	2.21	$7.15x10^6$	4540	$5.58x10^6$
77b	90 days	1.37	$6.99x10^6$	4420	$5.43x10^6$
77c	1 year	.736	$6.81x10^6$	4190	$5.28x10^6$
77d	2 years	.481	$6.65x10^6$	4020	$5.12x10^6$
77e	5 years	.192	$6.47x10^6$	3800	$4.90x10^6$
77f	10 years	.0778	$6.26x10^6$	3620	$4.72x10^6$
78a[a]	30 days	.0720	$5.69x10^6$	3240	$4.12x10^6$
78b[a]	90 days	.0461	$5.58x10^6$	3150	$4.02x10^6$
78c[a]	1 year	.0301	$5.48x10^6$	3020	$3.95x10^6$
78d[a]	2 years	.0208	$5.40x10^6$	2930	$3.87x10^6$
78e[a]	5 years	.00882	$5.33x10^6$	2820	$3.77x10^6$
78f[a]	10 years	.00400	$5.24x10^6$	2730	$3.69x10^6$

[a]Based on early evacuation.

Table 3 Results based on NUREG-1465 (modified) Source Term

Case	Decay Time	Mean Consequences (Surry population, 95% evacuation)			
		Within 100 miles			Within 50 miles
		Early Fatalities	Societal Dose (rem)	Cancer Fatalities	Societal Dose (rem)
79a	30 days	192	$2.62x10^7$	21100	$2.37x10^7$
79b	90 days	162	$2.49x10^7$	20000	$2.25x10^7$
79c	1 year	76.9	$2.15x10^7$	17400	$1.93x10^7$
79d	2 years	19.2	$1.90x10^7$	15400	$1.69x10^7$
79e	5 years	1.34	$1.66x10^7$	12600	$1.45x10^7$
79f	10 years	.360	$1.53x10^7$	11400	$1.34x10^7$
80a[a]	30 days	6.65	$1.60x10^7$	15400	$1.35x10^7$
80b[a]	90 days	3.95	$1.52x10^7$	14300	$1.29x10^7$
80c[a]	1 year	.951	$1.34x10^7$	11500	$1.12x10^7$
80d[a]	2 years	.149	$1.20x10^7$	9480	$9.93x10^6$
80e[a]	5 years	.0162	$1.07x10^7$	7620	$8.69x10^6$
80f[a]	10 years	.00601	$1.00x10^7$	6490	$8.13x10^6$

[a]Based on early evacuation.

References:
1. Memorandum from G. Holahan to T. King dated March 26, 1999
2. Memorandum from A. Thadani to S. Collins dated November 12, 1999
3. Memorandum from F. Eltawila to G. Holahan dated August 25, 2000
4. Code Manual for MACCS2, NUREG/CR-6613, May 1998

5. Memorandum from R. Barrett to J. Flack dated August 25, 2000
6. Memorandum from S. Collins to A. Thadani dated September 11, 2000
7. *Accident Source Terms for Light-Water Nuclear Power Plants*, NUREG-1465, February 1995
8. *Chernobyl Ten Years On, Radiological and Health Impact, An Appraisal by the NEA Committee on Radiation Protection and Public Health*, November 1995

cc: T. Collins
R. Barrett
J. Hannon
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G. Hubbard

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