From: Jason Schaperow RES
To: George Hubbard, Robert Palla
Date: Thu, Oct 26, 2000 2:18 PM
Subject: SFP accident consequence memo - signed copy

Attached is the signed and dated copy of my memorandum on consequences of SFP accidents occurring as late as 10 years after final shutdown.

CC: Angela Lowery, John Flack

I-49

October 26, 2000

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

FROM: Farouk Eltawila, Acting Director **(Original signed by)**
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). Results of the RES calculations for distances of 1, 10, and 50 miles 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

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Table 2 Results based on NUREG-1465 Source Term

Case	Decay Time	Mean Consequences[a] (Surry population, 95% evacuation)			
		Individual Risk of Early Fatality (within 1mile)	Individual Risk of Cancer Fatality (within 10 miles)	Societal Dose (rem) (within 50 miles)	Early Fatalities (within 10 miles)
77a	30 days	1.27×10^{-2}	1.88×10^{-2}	5.58×10^{6}	2.21
77b	90 days	9.86×10^{-3}	1.82×10^{-2}	5.43×10^{6}	1.37
77c	1 year	7.13×10^{-3}	1.68×10^{-2}	5.28×10^{6}	.736
77d	2 years	5.64×10^{-3}	1.58×10^{-2}	5.12×10^{6}	.481
77e	5 years	3.18×10^{-3}	1.43×10^{-2}	4.90×10^{6}	.192
77f	10 years	1.63×10^{-3}	1.29×10^{-2}	4.72×10^{6}	.0778
78a[b]	30 days	8.36×10^{-4}	9.92×10^{-4}	4.12×10^{6}	.0720
78b[b]	90 days	6.83×10^{-4}	9.62×10^{-4}	4.02×10^{6}	.0461
78c[b]	1 year	5.44×10^{-4}	9.09×10^{-4}	3.95×10^{6}	.0301
78d[b]	2 years	4.41×10^{-4}	8.71×10^{-4}	3.87×10^{6}	.0208
78e[b]	5 years	2.54×10^{-4}	8.14×10^{-4}	3.77×10^{6}	.00882
78f[b]	10 years	1.47×10^{-4}	7.70×10^{-4}	3.69×10^{6}	.00400

[a]Accident frequencies approximately 10^{-6}/year or less.
[b]Based on early evacuation.

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

Case	Decay Time	Mean Consequences[a] (Surry population, 95% evacuation)			
		Individual Risk of Early Fatality (within 1 mile)	Individual Risk of Cancer Fatality (within 10 miles)	Societal Dose (rem) (within 50 miles)	Early Fatalities (within 10 miles)
79a	30 days	4.43×10^{-2}	8.24×10^{-2}	2.37×10^{7}	191
79b	90 days	4.19×10^{-2}	8.20×10^{-2}	2.25×10^{7}	162
79c	1 year	3.46×10^{-2}	8.49×10^{-2}	1.93×10^{7}	76.9
79d	2 years	2.57×10^{-2}	8.42×10^{-2}	1.69×10^{7}	19.2
79e	5 years	8.96×10^{-3}	7.08×10^{-2}	1.45×10^{7}	1.34

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79f	10 years	4.68×10^{-3}	6.39×10^{-2}	1.34×10^{7}	.360
80a[b]	30 days	2.01×10^{-3}	4.79×10^{-3}	1.35×10^{7}	5.38
80b[b]	90 days	1.87×10^{-3}	4.77×10^{-3}	1.29×10^{7}	3.61
80c[b]	1 year	1.50×10^{-3}	4.33×10^{-3}	1.12×10^{7}	.951
80d[b]	2 years	1.12×10^{-3}	3.70×10^{-3}	9.93×10^{6}	.149
80e[b]	5 years	3.99×10^{-4}	2.93×10^{-3}	8.69×10^{6}	.0162
80f[b]	10 years	2.05×10^{-4}	2.64×10^{-3}	8.13×10^{6}	.00601

[a]Accident frequencies approximately 10^{-6}/year or less.
[b]Based on early evacuation.

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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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