From: Jason Schaperow RES
To: Robert Palla
Date: Mon, Oct 23, 2000 1:43 PM
Subject: Re: Final memo on SFP consequence calculations

Please take a look at the attached draft memo on SFP consequence calculations, to ensure it includes the results you need.

>>> Robert Palla 10/23 11:49 AM >>>
Your draft memo on SFP consequences at various times after shutdown (30 days to 10 years) did not include results for "individual risk of early fatality at 1 mile" and "individual risk of latent cancer fatality". You provided that info in a separate e-mail on 9/19/2000 (attached). We are relying on the tabulated results of the aforementioned parameters for our comparisons to the safety goals. Thus, we request that you incorporate these consequence results in the final version of the memo, which will be Appendix 4B of the report. The plots of these results need not be included in the memo.

CC: George Hubbard

10/23/00 at 2:00 p.m.
E-mailed to R Palla and put in typing.

I-83

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). Results of the RES calculations for distances of 1, 10, 50, and 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)					
		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 100 miles)	Societal Dose (rem) (within 100 miles)	Cancer Fatalities (within 100 miles)
77a	30 days	1.27×10^{-2}	1.88×10^{-2}	5.58×10^{6}	2.21	7.15×10^{6}	4540
77b	90 days	9.86×10^{-3}	1.82×10^{-2}	5.43×10^{6}	1.37	6.99×10^{6}	4420
77c	1 year	7.13×10^{-3}	1.68×10^{-2}	5.28×10^{6}	.736	6.81×10^{6}	4190
77d	2 years	5.64×10^{-3}	1.58×10^{-2}	5.12×10^{6}	.481	6.65×10^{6}	4020
77e	5 years	3.18×10^{-3}	1.43×10^{-2}	4.90×10^{6}	.192	6.47×10^{6}	3800
77f	10 years	1.63×10^{-3}	1.29×10^{-2}	4.72×10^{6}	.0778	6.26×10^{6}	3620
78a[a]	30 days	8.36×10^{-4}	9.92×10^{-4}	4.12×10^{6}	.0720	5.69×10^{6}	3240
78b[a]	90 days	6.83×10^{-4}	9.62×10^{-4}	4.02×10^{6}	.0461	5.58×10^{6}	3150
78c[a]	1 year	5.44×10^{-4}	9.09×10^{-4}	3.95×10^{6}	.0301	5.48×10^{6}	3020
78d[a]	2 years	4.41×10^{-4}	8.71×10^{-4}	3.87×10^{6}	.0208	5.40×10^{6}	2930
78e[a]	5 years	2.54×10^{-4}	8.14×10^{-4}	3.77×10^{6}	.00882	5.33×10^{6}	2820
78f[a]	10 years	1.47×10^{-4}	7.70×10^{-4}	3.69×10^{6}	.00400	5.24×10^{6}	2730

[a]Based on early evacuation.

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

Case	Decay Time	Mean Consequences (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 100 miles)	Societal Dose (rem) (within 100 miles)	Cancer Fatalities (within 100 miles)
79a	30 days	4.43×10^{-2}	8.24×10^{-2}	2.37×10^{7}	192	2.62×10^{7}	21100
79b	90 days	4.19×10^{-2}	8.20×10^{-2}	2.25×10^{7}	162	2.49×10^{7}	20000
79c	1 year	3.46×10^{-2}	8.49×10^{-2}	1.93×10^{7}	76.9	2.15×10^{7}	17400
79d	2 years	2.57×10^{-2}	8.42×10^{-2}	1.69×10^{7}	19.2	1.90×10^{7}	15400
79e	5 years	8.96×10^{-3}	7.08×10^{-2}	1.45×10^{7}	1.34	1.66×10^{7}	12600
79f	10 years	4.68×10^{-3}	6.39×10^{-2}	1.34×10^{7}	.360	1.53×10^{7}	11400
80a[a]	30 days	2.01×10^{-3}	4.79×10^{-3}	1.35×10^{7}	6.65	1.60×10^{7}	15400
80b[a]	90 days	1.87×10^{-3}	4.77×10^{-3}	1.29×10^{7}	3.95	1.52×10^{7}	14300
80c[a]	1 year	1.50×10^{-3}	4.33×10^{-3}	1.12×10^{7}	.951	1.34×10^{7}	11500
80d[a]	2 years	1.12×10^{-3}	3.70×10^{-3}	9.93×10^{6}	.149	1.20×10^{7}	9480
80e[a]	5 years	3.99×10^{-4}	2.93×10^{-3}	8.69×10^{6}	.0162	1.07×10^{7}	7620
80f[a]	10 years	2.05×10^{-4}	2.64×10^{-3}	8.13×10^{6}	.00601	1.00×10^{7}	6490

[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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