November 25, 2013

C O R R E C T I O N   N O T I C E

TO ALL HOLDERS OF

COMSECY-13-0030 - STAFF EVALUATION AND RECOMMENDATION FOR JAPAN LESSONS-LEARNED TIER 3 ISSUE ON EXPEDITED TRANSFER OF SPENT FUEL

Please replace the following indicated pages in Enclosure 1 to COMSECY-13-0030 with the attached corrected pages.

Page 17 - Table 2 – corrected liner fragility values (in the assumptions table) to be consistent with the values stated in Table 39 and reflects actual values used in analysis;

Pages 38-40 - Table 10 – corrected base case benefit values (in the summary table) to be consistent with those used in analysis;

Page 90 - Table 44 – revised dose values for SFP groups 2, 3, and 4 (in the seismic initiator frequency sensitivity table) to reflect correct dose values consistent with the values stated in Table 4;

Page 101 - Table 56 – corrected dose value for SFP group 1 (in the consequences beyond 50 miles sensitivity table) to reflect actual values used in analysis;

Page 104 - Table 60 – revised dose values for SFP groups 1, 2, 3, and 4 (in the habitability criteria sensitivity table) to reflect precise numbers and to correct dose values for SFP groups 2, 3, and 4 consistent with the values stated in Table 4;

Page 108 - Table 64 – corrected dose values for SFP groups 2, 3, and 4 (in the uniform fuel pattern sensitivity table) to reflect actual values used in analysis;

The Agencywide Documents Access and Management System (ADAMS) version of COMSECY-13-0030, Enclosure 1 (ADAMS Accession No. ML13273A628) will be updated to reflect these changes.

Attachment:
As stated

THE SECRETARIAT

Topical Area	Major Assumption	Comment
	because it was the most recent and readily available hazard model for the central and eastern U.S. plant sites. Hazards for the western sites will be evaluated when the updated model is complete.	available at the start of this analysis. In addition, the GMPE update is still in progress. Furthermore, the NRC is currently developing an independent probabilistic seismic hazard assessment (PSHA) computer code to incorporate part (1) and part (2) when complete.
Earthquake Frequency	Earthquake frequencies are based on hazard curves developed from 2008 USGS data for two bins having peak ground accelerations of 0.7g and 1.2g, respectively. Large earthquakes with frequencies on the order of a few occurrences every 100,000 years to once every 1,000,000 years have the potential to damage the SFP structure.	The USGS data provides a consistent method of quantifying earthquake frequency east of the Rockies. The low and base cases use the seismic hazard estimate for the SFPS reference plant, which results in higher earthquake frequency estimates than the USGS model for most plants. The high case uses the USGS model results for the site within each group with the highest earthquake frequency.
Cask Drop Frequency	A cask drop frequency of $2x10^{-7}$ per year is used for each SFP.	This value is drawn from an evaluation in NUREG-1738 and represents the potential for cask drops during routine transfer activities to maintain assumed SFP storage inventory. Additional cask movements associated with achieving low-density SFP storage are conservatively not evaluated.
AC Power Fragility	AC power is conservatively assumed to fail during earthquake and cask drop initiators to reflect loss of installed forced cooling and coolant makeup systems.	This assumption results in loss of forced cooling and other minor coolant leaks progressing to uncover the stored fuel unless mitigation is effectively deployed.
Liner Fragility	The values conservatively selected for the base case are: • 0.7g PGA earthquake - 10% for BWRs with elevated pools (SFPS) and 5% for all other groups • 1.2g PGA earthquake - 100% for BWRs with elevated pools and 50% for all other groups • Cask drop event - 100%	Liner Fragility represents the conditional probability of leakage from the SFP at locations that uncover the stored fuel, given an earthquake or cask drop occurs. The high case uses 100% for all initiators.
Other Initiating Event Frequencies	Loss of forced cooling and loss of coolant inventory events are conservatively represented by a total initiating event frequency of $2.37x10^{-7}$ per year.	Individual initiating events affecting loss of forced cooling, loss of AC power, loss of coolant inventory, and seal failures were drawn from NUREG-1738 and NUREG-1353.
Unavailability of	The conservative values selected for	Unavailability of natural circulation

Table 10 Summary of Totals for Alternatives

Net Monetary Savings (or Costs) – Total Present Value	Sensitivity Studies	Qualitative Benefits and (Costs)
Regulatory Baseline – Maintain the Existing Spent Fuel Storage Requirements		
$0	None	None.
Expedited Transfer Alternative – Low-density Spent Fuel Pool Storage		
Group 1 – BWR Mark I and Mark II with non-shared SFPs		
Group 1 Industry (Costs): *Base case* ($52 million) using a 7% discount rate **NRC (Costs):** Not calculated **Benefits:** *Base case* $7 million using a 7% discount rate **Group 1 Net Benefit = Benefits + (Costs)** **Base case: $7M + ($52M) = ($45M)** **Conclusion: Not cost beneficial**	**Group 1 Sensitivity Studies** **Industry (Costs) Sensitivity Studies** ($53 million) using a 2% discount rate ($55 million) using a 3% discount rate **Benefit Sensitivity Studies** *Low estimate* $0.2 million using a 2% discount rate $0.2 million using a 3% discount rate $0.1 million using a 7% discount rate *High estimate* $123 million using a 2% discount rate $109 million using a 3% discount rate $73 million using a 7% discount rate **Net Benefit Sensitivity Studies** *Low estimate* ($52.8M) using a 2% discount rate ($54.8M) using a 3% discount rate ($51.9M) using a 7% discount rate *High estimate* $70 million using a 2% discount rate $54 million using a 3% discount rate $21 million using a 7% discount rate	**Qualitative Benefits and (Costs)** **Qualitative (Costs):** Cost Uncertainties (Repackaging Costs) **Qualitative Benefits:** Modeling Uncertainties. (Cask Handling Risk) Mitigating Strategies
Group 2 – PWR and BWR Mark III with non-shared SFPs		
Group 2 Industry (Costs): *Base case* ($51 million) using a 7% discount rate **NRC (Costs):** Not calculated **Benefits:** *Base case* $6.4 million using a 7% discount rate **Group 2 Net Benefit = Benefits + (Costs)** **Base case: $6.4M + ($51M) = ($45M)** **Conclusion: Not cost beneficial**	**Group 2 Sensitivity Studies** **Industry (Costs) Sensitivity Studies** ($51 million) using a 2% discount rate ($54 million) using a 3% discount rate **Benefit Sensitivity Studies** *Low estimate* $0.3 million using a 2% discount rate $0.3 million using a 3% discount rate $0.2 million using a 7% discount rate *High estimate* $137 million using a 2% discount rate $121 million using a 3% discount rate $77 million using a 7% discount rate	**Qualitative Benefits and (Costs)** **Qualitative (Costs):** Cost Uncertainties (Repackaging Costs) **Qualitative Benefits:** Modeling Uncertainties. (Cask Handling Risk) Mitigating Strategies

Net Monetary Savings (or Costs) – Total Present Value	Sensitivity Studies	Qualitative Benefits and (Costs)
	Net Benefit Sensitivity Studies *Low estimate* ($50.7M) using a 2% discount rate ($53.7M) using a 3% discount rate ($50.8M) using a 7% discount rate *High estimate* $86 million using a 2% discount rate $67 million using a 3% discount rate $26 million using a 7% discount rate	
Group 3 – New reactor SFPs		
Group 3 Industry (Costs): *Base case* ($17 million) using a 7% discount rate **NRC (Costs):** Not calculated **Benefits:** *Base case* $4.6 million using a 7% discount rate **Group 3 Net Benefit = Benefits + (Costs)** **Base case: $4.6M + ($17M) = ($12M)** **Conclusion: Not cost beneficial**	**Group 3 Sensitivity Studies** **Industry (Costs) Sensitivity Studies** ($42 million) using a 2% discount rate ($36 million) using a 3% discount rate **Benefit Sensitivity Studies** *Low estimate* $0.3 million using a 2% discount rate $0.3 million using a 3% discount rate $0.1 million using a 7% discount rate *High estimate* $108 million using a 2% discount rate $81 million using a 3% discount rate $34 million using a 7% discount rate **Net Benefit Sensitivity Studies** *Low estimate* ($41.7M) using a 2% discount rate ($35.7M) using a 3% discount rate ($16.9M) using a 7% discount rate *High estimate* $66 million using a 2% discount rate $45 million using a 3% discount rate $17 million using a 7% discount rate	**Qualitative Benefits and (Costs)** **Qualitative (Costs):** Cost Uncertainties (Repackaging Costs) **Qualitative Benefits:** Modeling Uncertainties. (Cask Handling Risk) Mitigating Strategies
Group 4 – Reactor units with shard SFPs		
Group 4 Industry (Costs): *Base case* ($46 million) using a 7% discount rate **NRC (Costs):** Not calculated **Benefits:** *Base case* $7.3 million using a 7% discount rate **Group 4 Net Benefit = Benefits + (Costs)**	**Group 4 Sensitivity Studies** **Industry (Costs) Sensitivity Studies** ($49 million) using a 2% discount rate ($50 million) using a 3% discount rate **Benefit Sensitivity Studies** *Low estimate* $0.3 million using a 2% discount rate $0.3 million using a 3% discount rate $0.2 million using a 7% discount rate *High estimate* $205 million using a 2% discount rate	**Qualitative Benefits and (Costs)** **Qualitative (Costs):** Cost Uncertainties (Repackaging Costs) **Qualitative Benefits:** Modeling Uncertainties. (Cask Handling Risk) Mitigating Strategies

Net Monetary Savings (or Costs) – Total Present Value	Sensitivity Studies	Qualitative Benefits and (Costs)
Base case: $7.3M + ($46M) = ($39M) **Conclusion: Not cost beneficial**	$182 million using a 3% discount rate $120 million using a 7% discount rate **Net Benefit Sensitivity Studies** *Low estimate* ($48.7M) using a 2% discount rate ($49.7M) using a 3% discount rate ($48.8M) using a 7% discount rate *High estimate* $156 million using a 2% discount rate $132 million using a 3% discount rate $74 million using a 7% discount rate	

4.4.1.2 Implementation and Operation Costs–Low- Density Spent Fuel Pool Storage Alternative

4.4.1.2.1 Spent Fuel Pool Group 1 – BWR Mark I and Mark II reactors with non-shared spent fuel pool

Table 11 Summary of Total Implementation and Operation Costs for Low-Density Spent Fuel Pool Storage—Spent Fuel Pool Group 1

Attribute	Costs per SFP (2012 dollars in millions)		
	2% NPV	3% NPV	7% NPV
Occupational Health (Routine)	$0.03	$0.03	$0.03
Industry Implementation	$52.61	$55.17	$52.28
Industry Operation	nc	nc	nc
NRC Implementation	nc	nc	nc
NRC Operation	nc	nc	nc
Total per pool	$52.64	$55.20	$52.31
Total for 31 pools	$1,632	$1,711	$1,622

nc = not calculated

The low-density SFP storage alternative for BWR Mark I and Mark II reactors with a non-shared SFP total implementation and operation costs is the summation of those costs for the industry and the NRC. As shown in Table 11, the total estimated costs for a single Group 1 SFP to achieve and maintain a low-density SFP loading ranges from $52.64 million (2 percent net present value), to $55.20 million (3 percent net present value), and to $52.31 million (7 percent net present value). The total cost for all 31 SFPs in this group is approximately $1.6 billion. These costs are dominated by the capital costs for the DSCs and the loading costs for the storage systems to achieve low-density storage in the SFP than that required for the regulatory baseline.

Table 43 Total Release Frequency by Spent Fuel Pool Group

SFP Group	Seismic Bin	Bin Frequency (per year)	Liner Fragility	Fraction Not Air Coolable	Seismic Release Frequency (per year)	Non-Seismic Release Frequency (per year)	Total Release Frequency per Group (per year)
Low Estimate							
1	3	1.65×10^{-5}	10%	8%	1.35×10^{-7}	2.53×10^{-7}	1.12×10^{-6}
	4	4.90×10^{-6}	50%	30%	7.35×10^{-7}		
2,3,4	3	1.65×10^{-5}	2%	8%	3.30×10^{-8}	2.83×10^{-7}	5.51×10^{-7}
	4	4.90×10^{-6}	16%	30%	2.35×10^{-7}		
Base Case							
1	3	1.65×10^{-5}	10%	8%	1.35×10^{-7}	4.37×10^{-7}	5.47×10^{-6}
	4	4.90×10^{-6}	100%	100%	4.90×10^{-6}		
2,3,4	3	1.65×10^{-5}	5%	100%	8.25×10^{-7}	4.67×10^{-7}	3.74×10^{-6}
	4	4.90×10^{-6}	50%	100%	2.45×10^{-6}		
High Estimate							
1	3	2.24×10^{-5}	100%	100%	2.24×10^{-5}	4.37×10^{-7}	2.99×10^{-5}
	4	7.09×10^{-6}	100%	100%	7.09×10^{-6}		
2	3	4.92×10^{-5}	25%	100%	1.23×10^{-5}	4.67×10^{-7}	2.79×10^{-5}
	4	1.51×10^{-5}	100%	100%	1.51×10^{-5}		
3	3	2.95×10^{-5}	25%	100%	7.38×10^{-6}	4.67×10^{-7}	1.69×10^{-5}
	4	9.10×10^{-6}	100%	100%	9.10×10^{-6}		
4	3	5.64×10^{-5}	25%	100%	1.41×10^{-5}	4.67×10^{-7}	3.46×10^{-5}
	4	2.00×10^{-5}	100%	100%	2.00×10^{-5}		

C.2.1 Seismic Initiator Frequency Assumptions Sensitivity

As illustrated in Table 44, the combination of conservative seismic initiator modeling assumptions with the bounding seismic source zone characterization for any spent fuel pool located in the CEUS results in public health (accident) benefit values increasing by a factor between 4.5 and 9.3 times the averted public health (accident) dose calculated for the base case.

Table 44 Sensitivity of Public Health (Accident) Benefits within 50 Miles to Changes in Seismic Initiator Frequency Assumptions

SFP Group	Seismic Initiator Case	Dose (averted person-rem per pool)	Benefits (2012 million dollars)		
			2% NPV	3% NPV	7% NPV
1	Base Case	1,740	$2.72	$2.42	$1.62
	High Estimate	9,510	$14.86	$13.25	$8.87
2	Base Case	1,630	$2.45	$2.15	$1.38
	High Estimate	12,100	$18.23	$16.02	$10.25
3	Base Case	3,020	$3.14	$2.37	$0.99
	High Estimate	13,650	$14.21	$10.75	$4.49
4	Base Case	1,690	$2.62	$2.33	$1.54
	High Estimate	15,660	$24.23	$21.53	$14.24

Table 56 Sensitivity of Public Health (Accident) Benefits for Expedited Transfer Alternative–Low-density Spent Fuel Pool Storage extending beyond 50 miles (Base case with $2,000 and $4,000 per person-rem)

SFP Group	Case	Dose conversion factor ($/person-rem)	Dose (averted person-rem per pool	Benefits (2012 million dollars)		
				2% NPV	3% NPV	7% NPV
1	Alternative 2 - Low-density storage	$2,000	11,120	$17.37	$15.49	$10.37
		$4,000		$34.73	$30.98	$20.73
2	Alternative 2 - Low-density storage	$2,000	13,680	$20.61	$18.10	$11.58
		$4,000		$41.22	$36.21	$23.17
3	Alternative 2 - Low-density storage	$2,000	22,730	$23.67	$17.90	$7.47
		$4,000		$47.33	$35.80	$14.94
4	Alternative 2 - Low-density storage	$2,000	15,880	$24.57	$21.83	$14.44
		$4,000		$49.14	$43.66	$28.88

Sensitivity of Offsite Property Cost Offset Results to Population Demographics

Certain metrics such as property use, the number of displaced individuals (either temporarily or permanently), and the extent to which such actions may be needed are affected by the population size and the amount of economic activity in the vicinity of the postulated accident.

This section provides a basis for understanding the nature and the extent of the relationship between population densities, distributions characteristics, and property values near spent fuel pool sites. This examination provides a perspective on how important changes to these site demographic variables are for this regulatory analysis. The base case and the three additional site population densities, distributions, and economic characteristics near spent fuel pool locations are discussed above. These population and economic characteristics were used as additional inputs into the MACCS2 calculations that otherwise still used the SFPS reference plant specific values. Although the results provided in Table 57 provide insight into the analysis sensitivity to site population demographics in the U.S., the results are not representative of any specific site because site specific meteorology for these additional sites is not used. These measures are also subject to large uncertainties, as it is difficult to model the impact of disruptions to many different aspects of local economies, the loss of infrastructure on the general U.S. economy, or the details of how long-term protective actions would be performed.

Table 59 Long-Term Habitability Criterion

Case[30]	Long-Term Habitability Criterion	Protective Action Basis
Low Estimate	500 mrem annually	Pennsylvania dose limit to the public
Base Case	2 rem in the first year and 500 mrem each year thereafter	EPA intermediate phase PAGs
High Estimate	2 rem annually	EPA intermediate phase PAG: first year

MACCS2 computer runs were run for each of the protective action levels listed in Table 59 to calculate averted dose and offsite property damage using the representative plant site demographics listed in Table 53.

Different habitability criteria given the underlying assumptions stated above has the following net change on the averted public health (accident) attribute as summarized in Table 60.

Table 60: Sensitivity of Public Health (Accident) Benefits to Habitability Criteria (within 50 Miles)

SFP Group	Habitability Criteria	Dose (averted person-rem per pool)	Benefits (2012 million dollars)		
			2% NPV	3% NPV	7% NPV
1	Low (500 mrem annually)	770	$1.21	$1.08	$0.72
	Base Case (4rem / 5years)	1,740	$2.72	$2.42	$1.62
	High (2 rem annually)	1,980	$3.09	$2.75	$1.84
2	Low (500 mrem annually)	900	$1.36	$1.20	$0.77
	Base Case (4rem / 5years)	1,630	$2.45	$2.15	$1.38
	High (2 rem annually)	2,480	$3.74	$3.29	$2.10
3	Low (500 mrem annually)	1,580	$1.64	$1.24	$0.52
	Base Case (4rem / 5years)	3,020	$3.14	$2.37	$0.99
	High (2 rem annually)	4,180	$4.36	$3.29	$1.37
4	Low (500 mrem annually)	960	$1.49	$1.33	$0.88
	Base Case (4rem / 5years)	1,690	$2.62	$2.33	$1.54
	High (2 rem annually)	2,730	$4.23	$3.76	$2.49

The use of these habitability criteria also affects the values of offsite property damage used in this analysis. Certain metrics such as offsite property damage, the number of displaced individuals (either temporarily or permanently) and the extents to which such actions may be needed are inversely proportional to changes in collective dose resulting from changes in habitability criteria.

30 Cases are defined as low and high estimate based on the effect that different long-term habitability criteria have on averted radiation exposure.

For the offsite consequence analysis, the sequences with recently discharged fuel in a uniform configuration were binned in a similar manner to the low-density and high-density (1x4) loading scenarios. Because licensees are required to move their recently discharged fuel to a more favorable configuration after a certain amount of time, this sensitivity assumes that the high-density uniform case becomes identical to the high-density (1x4) case by the end of operating cycle phase 2 (OCP 2) or within 25 days.

Table 64 provides a comparison of the effect on the public health (accident) attribute if a plant operator initially places discharged spent fuel in a uniform pattern and achieves the 1x4 pattern by the end of OCP 2 (i.e., within 25 days) versus placing the fuel directly into the 1x4 pattern.

Table 64: Sensitivity of Public Health (Accident) Benefits (within 50 Miles) to Initial Loading Pattern of Discharged Fuel

SFP Group	Initial Loading Pattern of Discharged Fuel	Dose (averted person-rem per pool)	Benefits (2012 million dollars)		
			2% NPV	3% NPV	7% NPV
1	Base Case - 1x4	1,740	$2.72	$2.42	$1.62
	Uniform fuel pattern	2,040	$3.18	$2.84	$1.90
2	Base Case - 1x4	1,630	$2.45	$2.15	$1.38
	Uniform fuel pattern	1,840	$2.77	$2.44	$1.56
3	Base Case - 1x4	3,020	$3.14	$2.37	$0.99
	Uniform fuel pattern	3,310	$3.45	$2.61	$1.09
4	Base Case - 1x4	1,690	$2.62	$2.33	$1.54
	Uniform fuel pattern	1,980	$3.07	$2.73	$1.80

The placement of the discharged fuel directly into a 1x4 pattern reduces the estimated averted dose within 50 miles of the site between 10 percent and 17 percent discounted at 7 percent compared to the cases when achieving this fuel pattern is delayed for up to 25 days at the end of OCP 2. These effects are bounded by the assumption of the unavailability of natural circulation air cooling for the base case and high estimate.

Offsite Property Cost Offset Sensitivity

Table 65 provides a comparison of the effect on the offsite property cost offsets if a plant operator initially places discharged spent fuel in a uniform pattern and achieves the 1x4 pattern by the end of OCP 2 (i.e., within 25 days) versus placing the fuel directly into the 1x4 pattern.

Table 65 Sensitivity of Offsite Property Cost Offsets within 50 Miles to Initial Loading Pattern of Discharged Fuel

SFP Group	Initial Loading Pattern of Discharged Fuel	Offsite Property Cost Offsets (2012 million dollars)		
		2% NPV	3% NPV	7% NPV
1	Base Case - 1x4	8.96	7.99	5.35
	Uniform fuel pattern	9.86	8.80	5.89
2	Base Case - 1x4	9.03	7.93	5.08
	Uniform fuel pattern	14.82	13.02	8.33
3	Base Case - 1x4	11.45	8.66	3.61
	Uniform fuel pattern	15.56	11.77	4.91
4	Base Case - 1x4	9.81	8.71	5.76
	Uniform fuel pattern	18.50	16.44	10.87