NEI Meeting

good, quick point estimate

Spent Fuel Pool Risk at Decommissioned Plants

- It is commonly believed that the risk at decommissioned reactors must be very low compared to operating reactors.

2 months review
much more than NEI that only looked at seismic

- The staff performed a broad analysis of the risk that spent fuel pools at decommissioned plants represent to the public. The analysis considered a wide range of initiating events.

- We found that previous analyses (ours) had underestimated the effect of denser spent fuel pool reracking and ~~,~~ higher burnup, ~~and~~ equipment removal/abandonment under the 50.59 process.

not modeled

4/36

Spent Fuel Pool Risk at Decommissioned Plants (Cont.)

- Risks from spent fuel pool accidents are comparable to those in operating reactors for the first three to five years after last fuel transfer, while operating reactors are at risk for 40 to 60 years.

- Risk is driven by lack of redundancy and diversity of spent fuel pool cooling capability at spent fuel pools.

Visited Rancho Seco, Trojan, Dresden 1,
Maine Yankee
Good operators, cameras on pool, limited equipment.
Plants had been stripped bare.
Shed mounted pumps + heat exchangers
No DGs, No RHR, No SW, no batteries
for uninterruptable power. All equipment on one bus,
Limited makeup capability
We plan to question NEI on their process + basis for eliminating equipment at decommissioned plants.

Scenarios Evaluated in the Risk Analysis

Case 1 - The spent fuel pool and its cooling system are configured and operated in a manner similar to that found by the staff in its site visits. Last fuel transferred one year previously.

Case 2 - Same configuration as Case 1, but the last fuel was transferred one month previously.

Case 3 - The spent fuel pool and its cooling system are configured slightly better than the minimal allowed by NRC regulations. Last fuel transferred one year previously.

Frequency of Fuel Uncovery (per year)

INITIATING EVENT	CASE 1	CASE 2	CASE 3
Loss of Offsite Power - Plant centered and grid related events	1.3E-06	4.2E-06	8.0E-05
Loss of Offsite Power - Events initiated by severe weather	1.4E-06	9.4E-06	1.4E-05
Internal Fire	4.2E-06	5.2E-06	4.5E-05
Loss of Pool Cooling	1.5E-07	2.4E-07	2.3E-05
Loss of Coolant Inventory	2.9E-06	6.0E-05	1.3E-04
Seismic Event	2.0E-06	2.0E-06	2.0E-06
Cask Drop	2.5E-06	2.5E-06	1.5E-05
Aircraft Impact	4.0E-08	4.0E-08	4.0E-08
Tornado Missile	5.6E-07	5.6E-07	5.6E-07
Total	1.5E-05	8.4E-05	3.1E-04

low CDF

higher CDF

Some numbers have ranges. We have chosen
Point estimates we believe best represent risk.

Spent Fuel Pool Risk

Δ Time ↑ decay heat ↓ recovery time

	CASE 1	CASE 2	CASE 3
Risk Totals			
Early Fatalities	1.0E-5	8.1E-5	2.1E-4
Latent Cancers	3.3E-2	1.9E-1	6.8E-1
Initiator	% of Risk from initiator	% of Risk from initiator	% of Risk from initiator
Loss of Offsite Power - Plant centered and grid related events	9	5	26
Loss of Offsite Power - Events initiated by severe weather	9	11	5
Internal Fire	28	6	15
Loss of Pool Cooling	1	0.3	7
Loss of Coolant Inventory	19	71	42
Seismic Event	13	2	0.6
Cask Drop	17	3	5
Aircraft Impact	0.3	0.05	0.01
Tornado Missile	4	0.7	0.2

CONTRIBUTION SPREAD OUT

Δ equipment/manning
less equipment
worse reliability

Spent Fuel Pool Cooling Risk Analysis
Risk from Spent Fuel Pool Accidents at Decommissioned Plants
(Distance in miles = 0-100)

INITIATING EVENT	CASE 1		CASE 2		CASE 3	
	Early	Late	Early	Late	Early	Late
Loss of Offsite Power - Plant centered and grid related	8.7E-7	2.8E-3	4.0E-6	9.5E-3	5.4E-5	1.7E-1
Loss of Offsite Power - severe weather	9.4E-7	3.1E-3	9.0E-6	2.1E-2	9.4E-6	3.1E-2
Internal Fire	2.8E-6	9.2E-3	5.0E-6	1.2E-2	3.0E-5	9.8E-2
Loss of Pool Cooling	1.0E-7	3.3E-4	2.3E-7	5.4E-4	1.5E-5	5.0E-2
Loss of Coolant Inventory	1.9E-6	6.3E-3	5.8E-5	1.4E-1	8.7E-5	2.8E-1
Seismic Event	1.3E-6	4.4E-3	1.9E-6	4.5E-3	1.3E-6	4.4E-3
Cask Drop	1.7E-6	5.5E-3	2.4E-6	5.7E-3	1.0E-5	3.3E-2
Aircraft Impact	2.6E-8	8.7E-5	3.8E-8	9.0E-5	2.7E-8	8.7E-5
Tornado Missile	3.8E-7	1.2E-3	5.4E-7	1.3E-3	3.8E-7	1.2E-3
Total	1.0E-5	3.3E-2	8.1E-5	1.9E-1	2.1E-4	6.8E-1

The "early" columns list mathematically calculated expected early fatalities. The "late" columns list mathematically calculated expected latent fatalities.

Insights

- The interim risk assessment shows spent fuel pool risk at decommissioned plants to be comparable to operating reactor risk for the first 3 - 5 years.

- The interim results are driven by modeling assumptions on initiating event characteristics, plant configuration, and operator recovery actions. A more detailed investigation of a "generic" plant would be driven by similar assumptions.

- Land interdiction costs as a result of any zircaloy cladding fire in the spent fuel pool would be high. This does not affect Emergency Preparedness (EP), but does affect indemnity insurance.

Insights (cont)

- There appears to be sufficient time to respond to most initiators so that the existence or non-existence of emergency preparedness planning would make little difference to the population. This is not necessarily true for heavy load drop, aircraft crash, and very large seismic events that have the potential to rapidly drain the spent fuel pool and uncover the fuel. If one of these initiators were to occur during the first year or two after the last fuel was transferred from the reactor to the spent fuel pool, it appears that there would be only five to seven hours available for ad hoc emergency response. This might be too short for effective ad hoc evacuation.

- The staff is developing a list of criteria and recommendations for what would be necessary (i.e., what a utility and what NRC would need to do) to have a more uniform exemption process for decommissioned spent fuel pool requirements.

How do you get a risk-informed exemption for EP?

Prob $>10^{-6}$ in fact $>10^{-5}$

Consequences (no zirc fire) 3-5 yrs

long lead time 2-3 yrs for 10 hours