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Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation

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General Comment

This comment supplements a previous one I made, urging NRC to include in the scope of its EIS the findings and conclusions contained in a Jan. 2003 report by Alvarez et al. entitled "Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States." This report is attached here.

At pages 17 to 18, the report states:

"In 2001, the NRC staff summarized the conclusions of its most recent analysis of the potential consequences of a loss-of-coolant accident in a spent fuel pool as follows:

'[I]t was not feasible, without numerous constraints, to establish a generic decay heat level (and therefore a decay time) beyond which a zirconium fire is physically impossible. Heat removal is very sensitive to...factors such as fuel assembly geometry and SFP [spent fuel pool] rack configuration...[which] are plant specific and . . . subject to unpredictable changes after an earthquake or cask drop that drains the pool. Therefore, since a non-negligible decay heat source lasts many years and since configurations ensuring sufficient air flow for cooling cannot be assured, the possibility of reaching the zirconium ignition temperature cannot be precluded on a

generic basis.' "

The authors provided the citation for the NRC study as: Technical Study of Spent Fuel Pool Accident Risk at
Decommissioning Nuclear Power Plants, NRC, NUREG-1738, 2001.

Elsewhere in the report, the authors explain that a refueling atomic reactor will often remove the entire core of thermally hot irradiated nuclear fuel into its storage pool. Whereas a pool would typically take up to 10 days, upon loss of water circulation, to boil down to the tops of the stored irradiated nuclear fuel, such a full core offload of thermally hot fuel directly from a just-operating reactor core into a storage pool could lower than boil down time to a single day. Once the tops of the fuel assemblies are exposed to air, they could quickly overheat and catch fire, unleashing catastrophic amounts of radioactivity.

Attachments

11_1Alvarez

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General Comment

This comment supplements my previous ones.

The study by Alvarez et al., "Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States," Jan. 2003, goes on (page 10) to report:

"It will be seen in Table 1 that, for the 3.5 MCi release, the area calculated as contaminated above 100 Ci/km2 are 5–9 times larger than the area contaminated to this level by the 2 MCi release from the Chernobyl accident. The reasons are that, at Chernobyl: 1) much of the Cs-137 was lifted to heights of up to 2.5 km by the initial explosion and the subsequent hot fire and therefore carried far downwind; and 2) the release extended over 10 days during which the wind blew in virtually all directions. As a result, more than 90 percent of the [Cs-137] from Chernobyl was dispersed into areas that were contaminated to less than 40 Ci/km2.

In contrast, in the wedge-model calculations for the 3.5 MCi release, about 50 percent of the [Cs-137] is deposited in areas contaminated to greater than this level.

The projected whole-body dose from external radiation from [Cs-137] to someone living for 10

years in an area contaminated to 100 or 1000 Ci/km2 would be 10–20 or 100–200 rem, with an associated additional risk of cancer death of about 1 or 10 percent respectively. A 1 or 10 percent added risk would increase an average person’s lifetime cancer death risk from about 20 percent to 21 or 30 percent."

The validity of Alvarez et al.'s findings were confirmed by no less than the National Academy of Science. NAS's Public Report, “Safety and Security of Commercial Spent Nuclear Fuel,” was dated April 6, 2005. A copy of the full NAS report is posted online at http://www.nirs.org/reactorwatch/security/securityhome.htm under its chronological date.

NAS's study put to rest any doubts about the danger we all face: nuclear waste stored in pools at nuclear power plants is vulnerable to attack. NAS also pointed out that current dry storage is not without its own vulnerabilities to attack.

Attachments

11_1Alvarez

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General Comment

This comment is a supplement. Alvarez et al.'s Jan. 2003 study, in a section entitled "Inventories of Cs-137 in Spent-Fuel Storage Pools" (pages 7-10), reports:

"The spent-fuel pools adjacent to most power reactors contain much larger inventories of [Cs-137] than the 2 MegaCuries (MCi) that were released from the core of Chernobyl 1000-Megawatt electric (MWe) unit #4 or the approximately 5 MCi in the core of a 1000-MWe light-water reactor. A typical 1000-MWe pressurized water reactor (PWR) core contains about 80 metric tons of uranium in its fuel, while a typical U.S. spent fuel pool today contains about 400 tons of spent fuel...(In this article, wherever tons are referred to, metric tons are meant.) Furthermore, since the concentration of [Cs-137] builds up almost linearly with burnup, there is on average about twice as much in a ton of spent fuel as in a ton of fuel in the reactor core. For an average cumulative fission energy release of 40 Megawatt-days thermal per kg of uranium originally in the fuel (MWt-days/kgU) and an average subsequent decay time of 15 years, 400 tons of spent power-reactor fuel would contain 35 megaCuries (MCi) of Cs-137. If 10–100% of the [Cs-137] in a spent-fuel pool, i.e., 3.5–35 MCi, were released by a spent-fuel fire to the atmosphere in a plume distributed vertically uniformly through the atmosphere's lower "mixing layer" and dispersed downwind in a "wedge model" approximation under median conditions (mixing layer thickness of

1 km, wedge opening angle of 6 degrees, wind speed of 5 m/sec, and deposition velocity of 1 cm/sec) then 37,000– 150,000 km2 would be contaminated above 15 Ci/km2, 6,000–50,000 km2 would be contaminated to greater than 100 Ci/km2 and 180–6000 km2 to a level of greater than 1000 Ci/km2...This corresponds to fire durations of half an hour and 5 hours, respectively for fires that burn 10 or 100 percent of 400 tons of spent fuel. Similar results were obtained for slower-burning fires with powers of 5 MWt."

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General Comment

I urge NRC to incorporate by reference all of the findings and conclusions, as well as the empirical data, contained in the report by Robert Alvarez of Institute for Policy Studies entitled "Spent Nuclear Fuel Pools in the US: Reducing the Deadly Risks of Storage." This report is dated May 2011. A copy of the report, as well as a summary fact sheet, is attached.

The report shows that US irradiated nuclear fuel pools contain much larger quantities of hazardous highly radioactive waste than do comparable storage pools in Japan. As but a few comparisons, Fermi 2 in Michigan and Pilgrim in Massachusetts -- both General Electric Mark I Boiling Water Reactors, just like Fukushima Daiichi Units 1 to 4 in Japan -- each contain more than 600 tons of irradiated nuclear fuel in their "rooftop" storage pools, as compared to "just" 135 tons in the storage pool at Fukushima Daiichi Unit 4. In fact, Fermi 2 and Pilgrim's pools currently store all the irradiated nuclear fuel that has ever been generated at those sites.

However, despite containing significantly less waste than pools in the US, Fukushima Daiichi Unit 4's pool is a case study in potential global cataclysm. The entire reactor building, damaged by exposure to the 9.0 earthquake, the 45 foot tall tsunami, and a massive hydrogen gas explosion, is badly damaged. In fact, the entire building is listing. Bulges have appeared in the walls. The floor

of the pool has had to be propped up with steel jacks. A large enough earthquake, perhaps as low as Magnitude 7.0, may be the straw that breaks the camel's back. If the building, and its pool, collapses, the pool's cooling water will drain away. The 135 tons of waste could then catch fire.

Alvarez has stated that as much as 10 times the Cs-137 released by the Chernobyl catastrophe is contained in Fukushima's Unit 4 pool. Arnie Gundersen of Fairewinds has estimated that Fukushima has unleashed half the Cs-137 of Chernobyl. Thus, a pool fire at could dwarf 2011's releases.

Attachments

spent_nuclear_fuel_pools_in_the_US[1]

IPS-RA-Report-FactSheet-web[1]