Fukushima nuclear accident is 'wake-up call' for US to improve monitoring of spent fuel pools

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The 2011 Fukushima Daiichi nuclear accident should serve as a wake-up call to nuclear plant operators and regulators on the critical importance of measuring, maintaining, and restoring cooling in spent fuel pools during severe accidents and terrorist attacks, says a new report from the National Academies of Sciences, Engineering, and Medicine. This report is the second and final phase of a congressionally mandated study on what lessons can be learned from the Fukushima Daiichi nuclear accident. The report from Phase 1 of this study was released in July 2014. The Phase 2 report provides findings and recommendations for improving U.S. nuclear plant security and spent fuel storage as well as re-evaluates conclusions from previous Academies studies on spent fuel storage safety and security.

The committee that carried out the study and authored the Phase 2 report found that spent fuel storage facilities—both spent fuel pools used to store fuel under water and casks used to dry-store fuel—at the Fukushima Daiichi nuclear plant maintained their containment functions during and after the March 11, 2011, Great East Japan Earthquake and tsunami. However, one of the two gates separating the Unit 3 spent fuel pool from the adjacent reactor well was damaged during the accident. Also, water appeared to have leaked around the gate seals in the Unit 4 spent fuel pool, allowing water to flow into the pool from the reactor well.

This water leak was accidental but also fortuitous, because it replenished water lost from the Unit 4 pool by evaporation, likely preventing water levels from dropping to the tops of the racks where the spent fuel was being stored. Keeping the fuel covered with water is essential for cooling and radiation shielding. Uncovery of the fuel would have substantially increased radiation levels above and around the pool, limiting personnel access to the pool and nearby areas, and could have resulted in severe damage to the fuel, increasing the potential for large radioactive material releases into the environment.

The committee recommended that the U.S. nuclear industry and the U.S. Nuclear Regulatory Commission (USNRC) improve the ability of plant operators to measure real-time conditions in spent fuel pools and maintain adequate cooling of stored spent fuel during severe accidents and terrorist attacks. These improvements should go beyond the current, post-Fukushima response to include hardened and redundant physical surveillance systems such as cameras, radiation monitors, pool temperature and water-level monitors, and means to deliver makeup water or sprays to the pools, even when physical access is limited by facility damage or high radiation levels.

Extreme external events and severe accidents can cause widespread and long-lasting disruptions to security infrastructure, systems, and staffing at nuclear plants, the committee concluded. Such disruptions can create opportunities for malevolent acts and increase the susceptibility of critical plant systems to such acts. Therefore, the committee recommended, nuclear plant operators and their regulators should upgrade and/or protect nuclear plant security infrastructure and systems and train security personnel to cope with extreme external events and severe accidents. Such upgrades should include redundant and protected power sources dedicated to plant security systems that function independently if safety systems are damaged, as well as diverse and flexible approaches for coping with and reconstituting plant security

infrastructure, systems, and staffing during and following extreme external events and severe accidents.

The committee determined that the USNRC has implemented most of the recommendations from previous Academies reports on spent fuel safety and security. However, two recommendations from those reports have not yet been implemented, the committee found. The first was to analyze the vulnerabilities of spent fuel pools to specific terrorist attack scenarios described in the 2004 Academies report, and the second was to carry out an independent examination of surveillance and security measures for protecting stored spent fuel. This independent examination should address the effectiveness of the USNRC's security and surveillance measures for addressing the insider threat, the committee said. It also recommended that the USNRC and nuclear industry strengthen their capabilities for identifying, evaluating, and managing the risks from terrorist attacks and that the USNRC sponsor a spent fuel storage security risk assessment of sufficient scope and depth to explore the benefits of this methodology for enhancing security at U.S. nuclear plants.

The committee reviewed technical analyses carried out by the USNRC to inform a regulatory decision on whether to expedite the transfer of spent fuel from pools to dry casks to reduce storage risks. Although these analyses are valuable technical contributions to understanding the consequences of spent fuel pool accidents, they are of limited use for assessing spent fuel storage risks because they do not consider sabotage risks, dry cask storage risks, or certain health consequences that would likely result from a severe nuclear accident. It is also difficult to make valid comparisons between pool and dry cask storage risks because of the way the analyses were carried out. The committee recommended that the USNRC perform a spent fuel storage risk assessment that addresses both accident and sabotage risks for both pool and dry cask storage. USNRC staff informed the committee that it is already thinking about

how to expand its risk assessment methodologies to include sabotage risks.

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