Union of Concerned Scientists

Spent Nuclear Fuel Storage

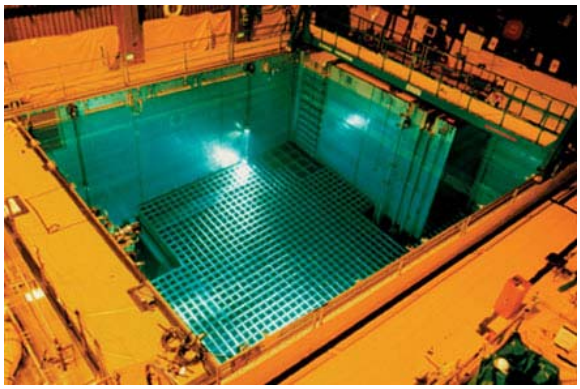
FACT SHEET

QUICK FACTS ABOUT SAFER STORAGE OF SPENT NUCLEAR FUEL

A by-product of nuclear power production is highly radioactive spent nuclear fuel which must be cooled and prevented from interacting with the environment. In the United States, this fuel is stored at all 104 operating nuclear reactors and a number of non-operating reactor sites, in either spent fuel pools or dry casks. As of December 31, 2010, 49,620 metric tons of spent fuel was stored in spent fuel pools with another 15,573 metric tons stored in dry casks.[i]

What is a spent fuel pool?

When fuel rods in a nuclear reactor are "spent," they are still highly radioactive and thus continue to generate high heat levels for years. The spent fuel assemblies, which consist of hundreds of fuel rods each, are moved to pools of water to cool. They are kept in racks in the pool, and water is continuously circulated to draw heat away from the rods.



Though the spent fuel pools at U.S. nuclear power plants contain more fuel than the reactor cores, protective measures for spent fuel are significantly weaker than those provided for fuel in the reactor core. Most reactor containment structures, for example, are built with steel-lined, reinforced concrete walls, whereas spent fuel containment buildings consist simply of reinforced concrete or mere sheet metal siding that are not designed to be resistant to high pressures.

Since no permanent repository for spent fuel exists in the US, nuclear reactors across the country must store spent fuel on site and have been allowed by the Nuclear Regulatory Commission (NRC) to increase the amount in their storage pools to as much as five times what they were designed to hold. This mismanagement of spent fuel poses significant risks in the event of a plant accident where cooling may be compromised. Overstocked and under-protected, a typical spent fuel pool in the United States holds hundreds of tons of fuel and lacks adequate protection from terrorist attack or severe accidents.

Spent Fuel Pool Structures

The spent fuel pool is a 45-ft deep reinforced concrete pit. Spent fuel pools at plants with pressurized water reactors are generally located in standard, industrial grade structures adjacent to the reactor, although they are often below grade where they are less vulnerable to attack. However, pools of most U.S. boiling water reactors are located on an upper story of the same building housing the reactor, which presents additional risks. This was the case at the reactors at Fukushima Daiichi, where hydrogen explosions ruptured the "secondary containments" enclosing the pools at four reactors, exposing them to the atmosphere and causing structural damage that raised the risk they might collapse.

If the spent fuel pool is severely damaged as the result of a large earthquake or terrorist attack, water could rapidly flow from the pool, and the temperature of the rods will increase, eventually causing the remaining water in the pool to boil. If the displaced water cannot be refilled quickly enough, the exposed fuel rods could become hot enough to rupture and eventually catch fire and melt. Such an incident could release large amounts of radioactive materials, such as cesium-137, into the environment. Release of ten percent of the cesium in a typical U.S. spent fuel pool could result in far more extensive land contamination than what has occurred at Fukushima.

Advantages of Dry Cask Storage

After five years in a spent fuel pool, the spent fuel is cool enough to be placed in dry casks made of steel and concrete. These casks are stored outdoors on concrete pads and cooled by natural convection. The risks posed by spent fuel can be drastically reduced by this measure.

More spent fuel in dry casks, and less fuel in the pool means that:

- Workers will have more time to cope with a cooling malfunction or water leakage from the pool; since the amount of heat decreases with the amount of fuel, it will take longer for the water to reach temperatures at which rapid evaporation and boiling can take place.
- Fuel can be spread out more, making it easier for water to circulate and cool the fuel.
- If workers are unable to prevent an accident, the amount of radioactive material emitted from the pool will be much lower than it would be otherwise.

In contrast to the large amount of fuel in a single spent fuel pool, each dry cask only holds about 15 tons of spent fuel. Thus, it would require safety failures at many dry casks to produce the scale of radiological release that could result from a safety failure at one spent fuel pool. An attack on a dry cask storage area would, in most circumstances, result in a much smaller release of radioactivity than an attack on a single storage pool.

UCS Recommendations

- All spent fuel should be transferred from wet to dry storage after five years of discharge from the reactor core. This can be achieved with existing technologies.
- The NRC should upgrade existing regulations to require that dry cask storage sites be made more secure against a terrorist attack.
- The NRC should significantly upgrade emergency procedures and operator training for spent fuel pool accidents.

[i] Robert Alvarez, *Spent Nuclear Fuel Pools in the U.S.: Reducing the Deadly Effects of Storage,* May 2011.