Union of Concerned Scientists

SPECIAL REPORT

Nuclear Power Safety in North Carolina

North Carolina hosts five operating nuclear power reactors: Brunswick Units 1 & 2, McGuire Units 1 & 2, and Shearon Harris Unit 1. These account for nearly 32% of electricity generation in the state.

The Nuclear Regulatory Commission (NRC), the federal agency that oversees the U.S. commercial nuclear fleet, is aware of safety shortfalls at these plants but has no plans to resolve them any time soon. As a result, North Carolina's citizens are exposed to unnecessarily high risks from these plants.

Much is at stake for residents. While local and state officials can monitor the reactors, they have no control over safety at the plants. Federal law grants that authority exclusively to the NRC. But local and state officials, as well as state residents, can take steps to compel the NRC to ensure adequate protection.

McGuire Nuclear Station

Spent Fuel Storage Hazards

Spent fuel refers to nuclear fuel rods that have been removed from a reactor core after producing power. Today more than 3,400 metric tons of spent fuel is stored in North Carolina. Over 85% of that spent fuel is stored in large pools of water called spent fuel pools, which are equipped with systems to cool the water that surrounds the hot fuel rods.

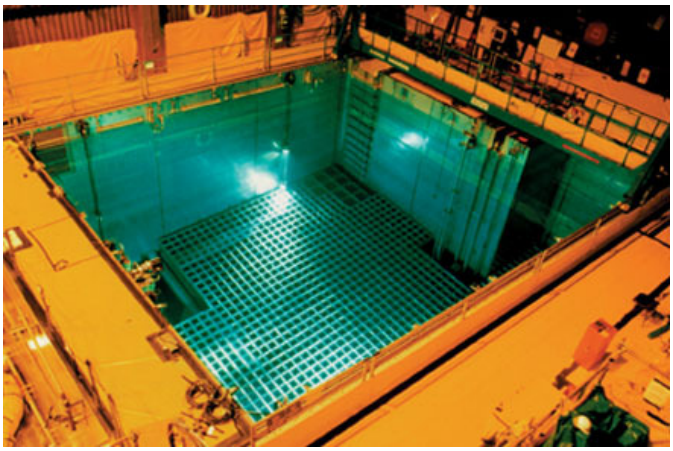
While concerns about nuclear power safety often focus on the fuel in the reactor core, spent fuel stored in pools also can be a major source of radioactivity during an accident. If water drains from the pool for even a few hours or the cooling system is interrupted for several days, the spent fuel could overheat and its cladding could break open, releasing radioactive material. And because the pools are located outside the thick, concrete containment walls, it is more likely that this radioactive material would reach the environment.

Safer Storage of Spent Fuel

Plant owners can reduce the risks associated with spent fuel pools by removing older fuel from the pools and placing it in large containers called dry casks, which are made of steel and concrete and cooled by natural convection (i.e. the "chimney effect").

Although spent fuel is usually cool enough to be transferred to casks after about five years, many plants, including those in North Carolina, allow their spent fuel pools to fill to near capacity and only transfer spent fuel to dry casks when extra storage space is needed. As a result, most pools contain many times as much fuel as the reactor cores themselves.

Spent Fuel Pool



Part of the fuel in the reactor core is moved to the spent fuel pool and replaced by fresh fuel every 18 to 24 months, so that the entire core is replaced every six years. Since spent fuel is cool enough to remove from the pool after five years, pools should not have more than a core's worth of fuel from each reactor at any time.

The safety and security risks associated with spent fuel can be reduced by transferring the fuel from pools to dry casks. The less fuel remaining in a pool, the longer it would take for the water to heat up and boil away if cooling is lost, thus giving workers more time to solve the problem and restore cooling. And if an accident did occur that led to a radioactive release, less would be emitted than if the pool were full. Unfortunately, the NRC has not required plant owners to transfer their spent fuel to dry casks.

Spent Fuel Stored in Dry Casks

Spent Fuel in North Carolina

North Carolina has five operating reactors and more than 3,000 tons of spent fuel stored in pools at reactors sites and 550 tons of spent fuel is stored in dry casks, as shown in Table 1.

Reactor	Pool Storage (MT)	Pool Storage (Cores)	Dry Storage (MT)	Fraction in dry storage
Brunswick 1	300	3	49	14%
Brunswick 2	347	3	49	12%
McGuire 1	531	6	224	30%
McGuire 2	529	6	222	30%
Shearon Harris 1	1,311	19	0	0%
State total	3,018	–	544	15%

Table 1: This table shows the amount of spent fuel stored in pools and dry casks for each reactor as of the end of 2011. The third column expresses the amount of spent fuel in the pools in terms of how many cores of material that represents; this number should be no larger than 1. The Harris plant has one reactor and four pools since three planned reactors were not built. Those additional pools now store spent fuel from other reactors.

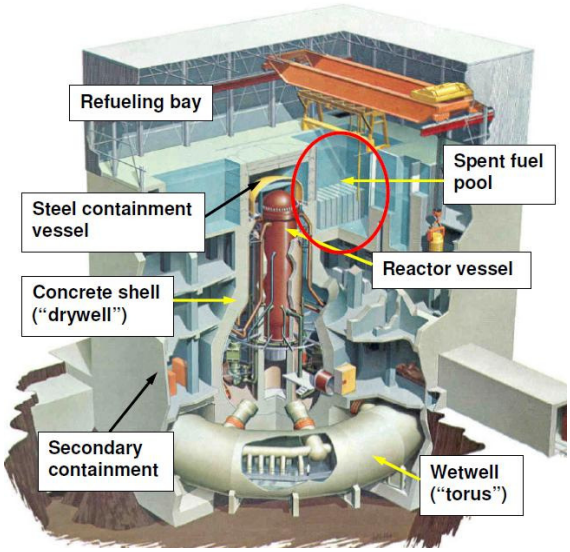
All of the nuclear reactors in North Carolina would benefit from moving spent fuel to dry casks, but the reactors at Brunswick would benefit the most. At this plant, the spent fuel pools are located on the upper floor of the building surrounding the reactor. Their design is similar to four of the reactors at the Fukushima Daiichi nuclear facility in Japan. (The spent fuel pools at the other reactors are located below ground level.) The pool's elevated location increases risk because, if a hole or crack were to form in the wall or floor of the pool, water likely would drain more rapidly than from a similar hole in a below ground-level pool. Likewise, as the videos from the Fukushima accident demonstrated, refilling elevated spent fuel pools is more difficult than below ground-level pools. In the latter case, a hose can simply be run across level ground and its nozzle can be dropped into the pool.

Fire Hazards

Neither the Brunswick nor the McGuire nuclear power plants complies with NRC fire protection regulations and they therefore pose an increased risk of accident. Because a fire can destroy a nuclear plant's main and backup emergency systems, it is the most likely way a reactor core can be seriously damaged and release radioactivity. Fire poses a threat roughly equal to all other threats combined. According to the NRC, "Approximately one-half of the core damage risk at operating reactors results from accident sequences that initiate with fire events."[1]

Fire can defeat what is called the "defense-in-depth" approach to nuclear safety. Defense-in-depth relies on redundancy and diversity of emergency systems as well as multiple barriers between radioactive material and the environment. A fire can

Spent fuel storage at the Brunswick plant



damage electrical cables that power and control primary systems and their backups, rendering them useless. Likewise, a fire can disable systems that cool the reactor core and prevent releases of radiation.

A disastrous fire that erupted at Alabama's Browns Ferry Nuclear Plant in 1975, for example, disabled all of the reactor's emergency core cooling systems. Workers were forced to take heroic actions to temporarily re-power the equipment to avoid a meltdown. To lessen the chances of another Browns Ferry, or worse, the NRC adopted stricter fire protection regulations in 1980.

NRC Revision of Fire Regulations

To minimize damage caused by a fire, the NRC's 1980 fire regulations stipulate that electrical cables in primary systems and their backups must either be physically separated (by at least 20 feet) or one of the cables must be wrapped in fire-retardant material that will protect it long enough for the plant's fire suppression systems to extinguish a fire. The intent of the regulations was to build fire protection into the design of the plant while retaining worker actions as a safety net.

Fire poses a threat roughly equal to all other threats combined.

Brunswick and McGuire are not in compliance with NRC fire protection regulations.

Twenty years later, the NRC discovered that dozens of reactors failed to meet those regulations and were therefore being operated with undue risk of serious damage from fires. In response, the NRC adopted an alternative set of fire protection regulations in 2004. The 1980 regulations remained on the books, so plant owners had the option of meeting either the 1980 or the 2004 fire protection regulations. While the 1980 regulations provide uniform rules for compliance, the 2004 regulations rely on computer modeling of fires inside nuclear power plants to allow plant owners to develop site-specific fire protection measures.[2]

Brunswick and McGuire Not in Compliance

Owners of 51 U.S. nuclear reactors, including the two at Brunswick and two at McGuire, have notified the NRC they intend to comply with the 2004 regulations, but only four reactors have taken the steps to do so. The remaining 47 reactors, including those at Brunswick and McGuire, still do not comply with either set of regulations more than 30 years after the regulations were first put on the books. Moreover, the NRC is giving them even more time: In June 2011, four of the five NRC commissioners voted to extend the deadline for compliance until 2016.

Known Solutions

Measures to reduce fire and spent fuel risks are known, but not employed at many plants. The NRC has two separate sets of fire protection regulations (i.e. the ones adopted in 1980 and the 2004 alternatives) intended to reduce fire hazards to an acceptably low level. Currently, the reactors in at Brunswick and McGuire do not meet either set of regulations. Consequently, North Carolina residents are not adequately protected from the fire hazard risk at the nuclear plants in their backyards. **The NRC should ensure that plants take steps to comply with fire regulations now.**

The NRC knows that spent fuel stored in dry casks is safer and more secure than that stored in pools. Most of the spent fuel in North Carolina is stored in pools, exposing citizens to unnecessarily high risk. **The NRC should require plants to move spent fuel to dry casks once it is cool enough to do so.**

Only the NRC can compel reactor owners to address these known hazards. Local and state officials should write or call the NRC to urge the agency to resolve these known safety threats as quickly as possible. North Carolina citizens can send letters to the editors of their local newspapers, their local and state officials, and the NRC to urge action on these issues.[3]

For additional information on these safety issues, and others, please check out UCS's Nuclear Power Information Tracker online at http://www.ucsusa.org/nuclear_power/reactor-map/embedded-flash-map.html

Notes

[1] Transcript of Nuclear Regulatory Commission Briefing on Fire Protection Issues, July 17, 2008. Statement of NRC manager John Grobe, page 58 line 22 to page 59 line 1. Available online at: http://www.nrc.gov/reading-rm/doc-collections/commission/tr/2008/20080717.pdf

[2] The 2004 NRC fire regulations rely on computer modeling to develop estimates of how long fires will last and how much equipment will be damaged. The regulations are satisfied when the results indicate that sufficient equipment survives these hypothetical fires to ensure adequate cooling of the reactor core.

[3] Names and contact information for the NRC's Chairman and Commissioners is available online at http://www.nrc.gov/about-nrc/organization/commfuncdesc.html

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