Union of Concerned Scientists

EXECUTIVE SUMMARY

U.S. Nuclear Power Safety One Year after Fukushima

THE MARCH 11, 2011, disaster at Japan's Fukushima Dai-ichi nuclear plant was triggered by a massive earthquake and tsunami far more destructive than those it was designed to withstand. The earthquake seriously damaged the electrical grid around the plant, thereby cutting off its normal source of AC power and disabling the equipment needed to keep the plant's radioactive reactor cores from overheating. And the tsunami overwhelmed a nominally protective sea wall, flooded the site, and disabled the backup AC power source as well as other critical electrical equipment. This one-two punch plunged the plant into a "station blackout"—with the only remaining electrical source being DC power supplied by banks of batteries, which could only last several hours at best and in actuality did not perform consistently.

The plant's workers valiantly tried to rise to the challenge. They pulled batteries from vehicles in the parking lot and carried them into areas of the reactor buildings that were dark, hot, and increasingly radioactive. They searched for electrical panels that were still functional. And in an attempt to inject water into the overheating cores, they manually operated valves and jury-rigged alternate cooling systems using hoses and diesel-powered fire pumps.

But these heroic efforts ultimately proved futile in the face of such extreme conditions. Like nuclear dominoes, the cores of Units 1, 3, and then 2 overheated and melted, producing large quantities of radioactive steam and hydrogen gas, some of which leaked into the buildings surrounding the reactor containment structures. When the hydrogen detonated, the roofs and upper walls of the Unit 1, 3, and 4 reactor buildings were blown apart, and there is evidence that the Unit 2 containment structure was breached as well. As a result, large amounts of radiation were released into the atmosphere, countryside, and ocean. The area within 12 miles of the Fukushima site remains so contaminated that the approximately 80,000 people who lived there have been unable to return to their homes, and hot spots as far as 25 miles away from the plant site have also been evacuated.

A year later, what are the implications for U.S. nuclear power safety? To its credit, the Nuclear Regulatory Commission (NRC) swung into action immediately after the accident and has been engaged ever since. Many of its proposals to safeguard against such a

The San Onofre plant in California.

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The NRC conducting an emergency preparedness exercise. © NRC

calamity here are good in principle, but their effectiveness will depend on how well they are implemented, and how quickly. It took 10 years for the agency to fully implement safeguards prompted by the 9/11 terrorist attacks, and it will take at least five years to institute changes in response to Fukushima. However, speed is not always a virtue. The nuclear industry is acting too hastily by launching a voluntary program before the NRC has had the opportunity to specify what measures are needed to adequately protect the public.

Fukushima Reactors Were Similar to Ours

The designs of the Fukushima reactors closely resemble those of many U.S. reactors, and the respective emergency response procedures are comparable as well. But while most U.S. reactors may not be vulnerable to that site's specific earthquake/tsunami sequence, they are vulnerable to other severe natural disasters. Moreover, similarly serious conditions could be created by a terrorist attack.

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While Fukushima had a hardened vent system, as do 23 similarly designed U.S. reactors, to reduce heat and pressure within the containment during an accident, this system did not work effectively because it required electrical power to operate. As at Fukushima, most U.S. reactors also lack instrumentation that would allow operators in the control room to monitor key parameters, such as the level and temperature of the water in the spent fuel pools. In Japan and the United States alike, the possibility of an accident affecting more than one reactor at a multiunit site has simply been ignored in present accident mitigation and emergency response strategies. And while U.S. reactors, like Japanese reactors, are required to have plans to cope with a station blackout, these plans would have been useless under the conditions experienced at Fukushima.

NRC Swings into Action

The initial response of the NRC to the Fukushima tragedy was commendable. As the disaster evolved, the agency fielded

a large number of inquiries—from the media, the American public, and Capitol Hill—in a timely and responsive manner. Based on the very limited information available at the time, the NRC recommended that the federal government advise U.S. citizens located within 50 miles of Fukushima to evacuate. While the radiological release is now believed to have been smaller than what the NRC assumed in developing this advisory, it was the proper call based on the scant information available at the time.

Just a few weeks later, the NRC announced the formation of a Near-Term Task Force to review the accident and identify measures to reduce vulnerabilities at U.S. reactors. In its report released July 12, 2011, that task force made 12 recommendations, some with multiple parts. The NRC later placed all but one of these recommendations into three categories of priority: Tier 1 items, which are expected to be handled largely by means of orders issued to plant owners before the first anniversary of the accident; Tier 2 items, to be addressed through rule making within five years of the accident; and Tier 3 items, to be dealt with through means and a schedule to be outlined by September 2012. Thus the NRC settled on a subset of recommendations for near-term implementation, and it put the remaining ones on the back burner. Even for the Tier 1 recommendations, however, the commission would not require licensees to fully implement changes for nearly five years from now.

Leaving the Most Important Recommendation for Last

A major flaw in the NRC's approach is that it has relegated the task force's first and primary recommendation to last in line (beyond even the Tiers 1, 2, and 3 in which the other 11 recommendations were placed). In Recommendation 1 the task force proposed that the commission clarify its "patchwork" regulatory framework for severe ("beyond-design-basis") accidents such as the one at Fukushima; because many of the other 11 recommendations involve measures to address such severe accidents, Recommendation 1 would be basic to their implementation.

At present it is only required that reactors be designed to handle some types of accidents—so-called "design-basis" accidents—but not most "beyond-design-basis" accidents such as the one at Fukushima. Thus the NRC regulations governing such severe accidents are fragmented and uneven—there are some NRC requirements that apply to some types of beyond-design-basis events, but not others. The task force aimed, through Recommendation 1, to fundamentally address this inconsistency, but the NRC has significantly impaired the reform process by moving the task force's key recommendation

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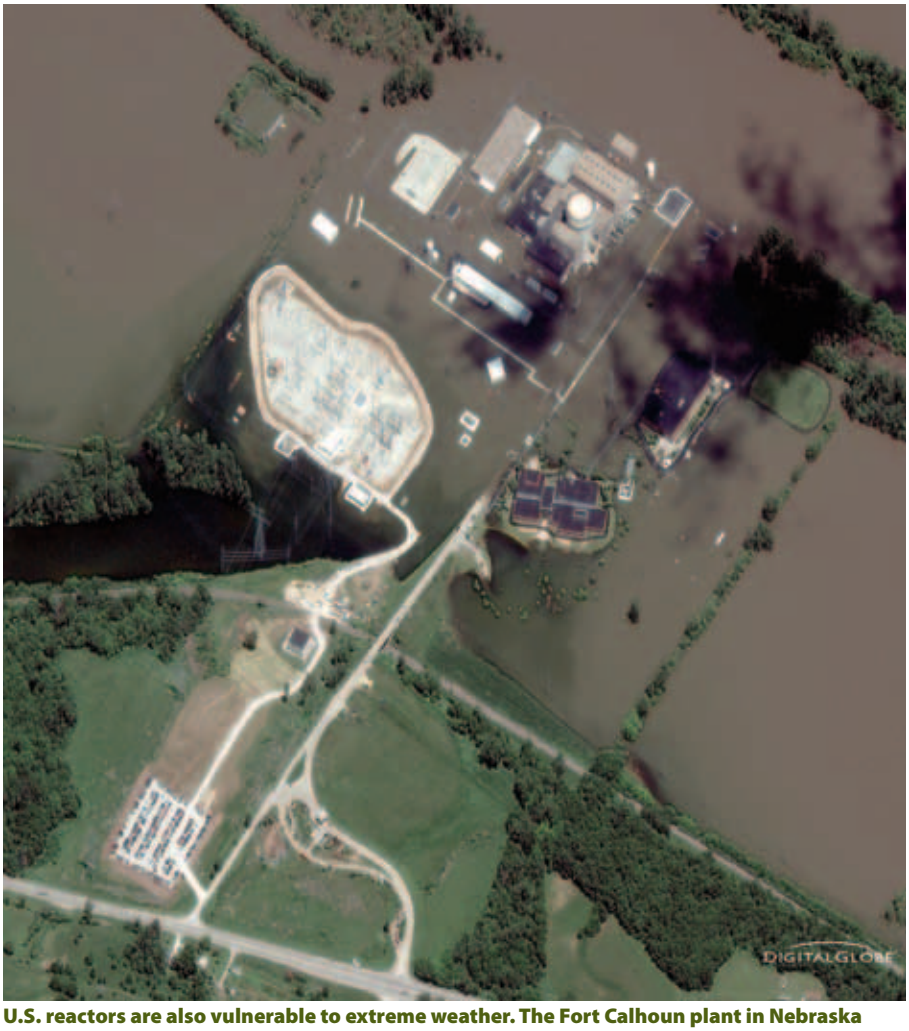

U.S. reactors are also vulnerable to extreme weather. The Fort Calhoun plant in Nebraska survived a severe flood in 2011. © DigitalGlobal

out of sequence, thus introducing major uncertainties about the other 11 recommendations' implementation.

For example, one of those recommendations is that plant owners be required to implement measures that allow plant workers to better cope with a station blackout. The precedent is that after 9/11, the NRC required plant owners to install equipment such as portable diesel-fueled pumps and generators to protect their facilities from events such as prolonged station blackouts caused by aircraft attacks. However, because aircraft attacks are defined as beyond-design-basis events, the NRC consequently did not require that this equipment meet high standards of quality or reliability or be protected from earthquakes, flooding, or other natural disasters. Indeed, this equipment was never intended for use after natural disasters, and inspections post-Fukushima have confirmed that at many sites some of the equipment would not survive earthquakes or floods.

Nuclear Industry Jumping the Gun

As the NRC systematically develops its preferred course of action, the nuclear industry has jumped into the breach by proposing a program called Diverse and Flexible Coping Capability, or FLEX, as the foundation of its Fukushima response. Under the FLEX approach, the 9/11-inspired equipment would be supplemented and relocated so that it might also help in the event of a severe natural disaster. This equipment would not be hardened, which is costly to achieve, but instead would be dispersed to numerous locations, both on and away from reactor sites. The industry's hope is that enough equipment would be scattered around so that at least some of it would be available after catastrophic events.

The NRC has a plan to reduce the vulnerability of U.S. reactors to Fukushima-like disasters, but must proceed more expeditiously.

But without clearly defined ground rules for these efforts, it is hard to gauge how much additional protection they would actually provide. For instance, the NRC is proposing that licensees provide "reasonable protection" for emergency equipment, but has not yet defined how such a requirement could be met. Further, a major procedural problem is that the industry has already started purchasing FLEX equipment before the NRC has had the opportunity to develop such guidelines—these purchases would make it politically difficult for the NRC to later institute requirements on industry to replace equipment already procured. By failing to first address the fundamental requirements for such equipment in a consistent manner, the NRC has created a policy vacuum. Meanwhile, and in contrast, regulators in France are moving to require that French reactor operators develop a so-called "hard core" of safety equipment designed to survive beyond-design-basis events.

NRC Deferring Action on Key Issues

The Union of Concerned Scientists (UCS) released its own recommendations for improving reactor safety and protection of public health in July 2011. Three of them—enlargement of emergency evacuation zones, expansion of potassium iodide distribution, and accelerated transfer of spent fuel from pools to dry casks—were later chosen by the NRC staff for further evaluation. However, the NRC placed these recommendations into the Tier 3 category, thereby deferring action for an as-yet-unspecified period of time. Moreover, the staff has "determined that the current regulatory approaches to these issues are acceptable" and will "review new information that becomes available as a result of specific ongoing activities to confirm this conclusion and gain additional insights."

Meanwhile, U.S. reactors remain vulnerable to Fukushima-like severe disasters. The NRC does have a plan to reduce these vulnerabilities, but it must proceed more expeditiously to fully implement the lessons learned from Fukushima. Unless the NRC strengthens measures to prevent and mitigate such "beyond-design-basis" accidents, it may be only a matter of time before a similar disaster happens here.

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

Printed on recycled paper using vegetable-based inks

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

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The full report is available online (in PDF format) at *www.ucsusa.org/nuclear_power.*

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