FRED UPTON, MICHIGAN
CHAIRMAN

HENRY A. WAXMAN, CALIFORNIA
RANKING MEMBER

ONE HUNDRED TWELFTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON ENERGY AND COMMERCE

2125 RAYBURN HOUSE OFFICE BUILDING

WASHINGTON, DC 20515–6115

Majority (202) 225–2927
Minority (202) 225–3641

SUPPLEMENTAL MEMORANDUM

April 6, 2011

To: Democratic Members of the Subcommittee on Oversight and Investigations

Fr: Democratic Staff of the Committee on Energy and Commerce

Re: NRC Modeling of Severe Reactor Accident Scenarios at U.S. Nuclear Plants

This morning, the Subcommittee on Oversight and Investigations will hold a hearing on the nuclear crisis in Japan. Nuclear Regulatory Commission (NRC) staff recently briefed the Democratic staff of the Committee regarding NRC's modeling and simulations of severe reactor accident scenarios for a U.S. plant of the same design as the Fukushima reactors in Japan. A draft NRC report found that in a complete loss of power scenario the reactor would come to within one hour of core damage.

These findings may actually understate the risk of core damage at a U.S. nuclear power plant because of the scope and assumptions of the study. This memo discusses the information NRC recently provided to Committee Democratic staff regarding its modeling and simulations and the issues raised by this information.

NRC's State-of-the Art Reactor Consequence Analyses (SOARCA)

The objective of the NRC's State-of-the Art Reactor Consequence Analyses (SOARCA) project is "to analyze the realistic outcomes of postulated severe reactor accidents, even though it is considered highly unlikely that such accidents could occur."[1] According to NRC staff, the SOARCA analyses aim to account for the findings of research that has been conducted during the last 25 years as well as significant plant changes and updates that were not factored into earlier assessments.

[1] Nuclear Regulatory Commission, Overview of the SOARCA Project (Nov. 2, 2010) (online at: http://www.nrc.gov/about-nrc/regulatory/research/soar/overview.html).

The SOARCA project analyzes two plants: the Peach Bottom GE Mark 1 boiling-water reactor (BWR) near Lancaster, Pennsylvania – co-owned by Exelon and PSEG, whose President and Chief Operating Officer is testifying today – and the Surry pressurized-water reactor (PWR) near Newport News, Virginia. The Peach Bottom reactor is of the same design as the Fukushima Daiichi reactors in Japan. In the United States, 35 boiling water reactors are in operation and 23 of these reactors were constructed with the Mark 1 containment system.

According to NRC staff, NRC modeled three scenarios for the Peach Bottom BWR reactor. Under the "long-term station blackout" scenario, the plant is assumed to lose offsite AC power and its backup diesel generators, but the battery backups operate safety systems for about four hours until the batteries are exhausted. Under the "short-term station blackout" scenario, "the site loses all power (even the batteries) and, therefore, all of its safety systems quickly become inoperable in the 'short term.'"[2] Both of these scenarios are supposed to reflect the effects of an extreme external event, such as an earthquake, flood, or fire. The third scenario was the random failure of a vital power cable connection. NRC's modeling showed that the third scenario did not result in core damage because the unaffected safety systems were adequate to keep the core cool.

For each of the two station blackout scenarios, NRC modeled two sub-scenarios: one that assumed the presence and utilization of new equipment and procedures introduced since the September 11 attacks and one that did not account for the new equipment and procedures.

Draft Results of SOARCA

In the more severe "station blackout" scenario in which all power was lost, the operator was able to take mitigation measures to prevent core damage for the first two days after the loss of power. However, under this scenario, the Peach Bottom BWR reactor came within one hour of core damage. NRC staff explained that a simulated meltdown was narrowly averted through the manual turning of steam valves to activate the reactor core isolation cooling system, which does not require AC power and is driven by steam. According to NRC staff, the simulation was structured to end after the two-day period based on the assumption that interventions would only get more numerous and effective after that time.

In the less severe loss of power scenario, in which the plant was assumed to have operational battery backup power for four hours, core damage was prevented. Because modeling showed that it would take the fuel rods ten hours to rupture from overheating, there was adequate time to employ mitigation measures.

Both of these scenarios assumed the Peach Bottom BWR used the new equipment and procedures introduced since the September 11 attacks. Without the new equipment and procedures, both simulated "station blackout" scenarios led to core damage and the release of radioactive contamination within two days. NRC staff explained that the radioactive fuel in the reactor core melts, tears through the reactor vessel, and then ruptures the primary containment

---

[2] Nuclear Regulatory Commission, SOARCA Process, Step 2 (Nov. 2, 2010) (online at: http://www.nrc.gov/about-nrc/regulatory/research/soar/soarca-accident-progression.html).

drywell if there is no water covering the floor of the drywell. NRC staff noted that most of the radioactive contamination was projected to be contained in the suppression pool and emphasized that the meltdown progressed more slowly than previous calculations from the 1980s would suggest, providing time for nearby residents to evacuate.

Internal NRC emails obtained by the Union of Concerned Scientists indicate that NRC analysts disagreed as to whether the new equipment and procedures (known as B5b measures), which allowed Peach Bottom to narrowly avoid core damage in the complete loss of power scenario, would be effective. According to a memo the Union of Concerned Scientists is releasing today, a July 28, 2010, NRC staff e-mail summarized concerns of NRC senior reactor analysts (SRAs) who work in NRC's regional offices as follows:

> One concern has been that SOARCA credits certain B5b mitigating strategies (such as RCIC operation w/o DC power) that have really not been reviewed to ensure that they will work to mitigate severe accidents. Generally, we have not even seen licensees credit these strategies in their own PRAs [probabilistic risk assessments] but for some reason the NRC decided we should during SOARCA.
>
> My recollection is that RI [Region I] SRAs in particular have been vocal with their concerns on SOARCA for several years, probably because Peach Bottom is one of the SOARCA plants.

This e-mail specifically references concerns about operating the Reactor Core Isolation Cooling (RCIC) system without battery power. According to NRC staff, this is the specific system and mitigation strategy that allowed Peach Bottom to narrowly avert core damage in the simulated full loss-of-power scenario.

The Union of Concerned Scientists memo quotes a second internal NRC e-mail, which refers to the March 2009 reactor security regulation. The e-mail states:

> The application of 10 CFR 50.54(hh) mitigation measures still concerns a number of staff in NRR [the Office of Nuclear Reactor Regulation]. The concern involves the manner in which credit is given to these measures such that success is assumed … 10 CFR 50.54(hh) mitigation measures are just equipment onsite that can be useful in an emergency when used by knowledgeable operators if post event conditions allow. If little is known about these post event conditions, then assuming success is speculative.

This e-mail indicates that the NRC reactor analysts responsible for ensuring the day-to-day safety of nuclear reactors in the United States were challenging the SOARCA assumption that the presence of new equipment could be equated with the successful use of such equipment in a disaster scenario.

Issues Regarding Scope and Assumptions of the Draft SOARCA Report

NRC staff explained that the first draft of the SOARCA report was completed in mid-2009 and provided to 11 outside scientific and technical experts for external peer review. NRC staff currently is working to address comments from these outside experts, other NRC personnel, and the operators of the Peach Bottom and Surry plants. Before the crisis in Japan, the plan was to release the report for public comment within the next few months and finalize the report in December. According to NRC staff, this schedule will likely slip by several months due to the pressing focus on events in Japan. This delay could provide NRC with the opportunity to further improve the realism of the SOARCA simulations by accounting for important aspects of a major natural disaster.

The Committee does not know all of the facts about what went wrong at the Fukushima Daiichi reactors, but the events in Japan raise a number of questions about the scope and assumptions of NRC's modeling. First, the SOARCA simulations explicitly do not consider the impact of a disaster event on spent fuel pools. At crucial points in the Japanese response effort, radiation from uncovered spent fuel rods at Daiichi has been a significant impediment to such efforts.

Second, NRC terminated the models two days after the simulated loss of power. Events in Japan demonstrate that the question of whether a reactor will melt down and release radioactive contamination into the environment cannot be definitively answered in the first two days. In the United States, reactors have lost power for more than two days. For example, in August 1992, Hurricane Andrew passed directly over the Turkey Point plant and knocked out offsite power for six and a half days.[3] Five onsite diesel generators also were unavailable due to moisture problems.

Third, SOARCA postulates that the "station blackout" scenarios occur as a result of a major earthquake, flood, or fire. But during the briefing with Committee staff, NRC staff indicated that NRC assumed that loss of power is the only damaging result of the natural disaster. It is not clear whether all of the new onsite equipment intended to address security threats after the September 11 attacks would remain functional after a natural disaster of a magnitude large enough to cause a partial or complete loss of power.

---

[3] Nuclear Regulatory Commission, Regulatory Effectiveness of Station Blackout Rule at F-2 (Aug. 2003).