



2. NUCLEAR: Fukushima crisis worsens as U.S. warns of a large radiation release *(ClimateWire, 03/17/2011)*

Peter Behr, E&E reporter

The top U.S. nuclear regulator, Gregory Jaczko, gave a dire assessment of Japan's nuclear crisis yesterday, saying that lethal radiation from uncovered spent fuel above one of the reactors could force emergency workers to abandon their fight to prevent meltdowns of damaged reactor cores at the Fukushima Daiichi plant.

Jaczko, chairman of the Nuclear Regulatory Commission, said his staff in Tokyo had been told by Japanese utility officials that cooling water that normally covers spent fuel was nearly or totally gone from an uncovered concrete pool above reactor Unit 4. Based upon that assessment, the U.S. Embassy in Tokyo advised Americans living within about 50 miles of the plant on Japan's northeast coast to evacuate farther away. Japan has called for an evacuation within about 12 miles of the plant.

His comments to a House committee were disputed but not explicitly denied by Japanese authorities, exposing an apparently major communications issue between the United States and Japan. If Jaczko's information was correct, the plant's owner, Tokyo Electric Power Co. (TEPCO) may have withheld information about the gravity of the crisis. If not, then a senior U.S. official may have wrongly inflamed fears in a country wracked by tragedy following last Friday's earthquake and tsunami.



Smoke and steam escape from four badly damaged reactors. Photo courtesy of [Flickr](#).

"We can't get inside to check, but we've been carefully watching the building's environs, and there has not been any particular problem," Hajime Motojuku, a spokesman for Tokyo Electric, said Thursday morning in Japan, *The New York Times* reported.

Later Thursday, a spokesman for Japan's Nuclear and Industrial Safety Agency, Yoshitaka Nagayama, said, "Because we have been unable to go the scene, we cannot confirm whether there is water left or not in the spent fuel pool at Reactor No. 4."

Informed of Japanese reaction after his testimony yesterday, Jaczko told reporters, "I understand there is a conflict." He said the conclusions he and the NRC staff reached were based on the best information they had, and that they had chosen "to err on the side of caution." The possibility that fuel in the reactor pools could ignite led to the recommendation on evacuation, he said.

'Nobody knows'

"The problem is that nobody knows," said Thomas Neff, a reactor safety expert affiliated with the Massachusetts Institute of Technology. "If you don't know and you're TEPCO, you probably underplay it. If you're the regulator, you probably see it in a worse light."

"The odds are pretty good that no one has good information," said Peter Bradford, a NRC commissioner at the time of the Three Mile Island accident in 1979. "We sure didn't during the first five days" then.

Japan's Self-Defense Forces dumped water from a helicopter on reactor No. 3 and prepared to repeat the operation on unit No. 4, Japanese news services reported. Water cannons would also be used. Jaczko said the

water cover in the spent fuel storage pool at No. 3 may soon be gone too, boiled away or evaporated by the heat from the spent-- but still radioactive-- fuel rods.

The condition of the spent fuel pools has been a source of rising anxiety and confusion since the crisis began. The earthquake and tsunami knocked out outside power to the reactor complex and the tidal wave also disabled backup diesel generators, whose fuel tanks were swept away. When auxiliary batteries were exhausted, the plant was without power to continue cooling reactor cores and spent fuel pools. Japanese crews have been trying to flood reactors with seawater and restore outside power to the plant.

"There is an enormous amount of radioactivity left in those pools," Edwin Lyman of the Union of Concerned Scientists said. "[I]t's unclear how long workers can stay in that environment without risking grave bodily injury. If they must be permanently evacuated, it's unclear how the extent of the damage that's now occurred can be contained."

The plant's best hope may be restoration of outside power, which could allow workers to restart cooling operations for the reactors and the cooling pools, provided they have not been too severely damaged. NHK TV in Japan said TEPCO hoped to run power lines into the site from another power plant Thursday. TEPCO wants to finish the installation "as soon as possible after reviewing the procedures in order to keep the workers' radiation exposure to a minimum," NHK reported.

The problem of spent fuel storage

Nuclear reactor operators must store spent fuel removed from reactor cores for several years at least, in large pools at reactor sites until the remaining heat from the uranium fuel cools sufficiently. In the United States, much of the fuel units remained stored underwater in pools but some are removed for storage in large casks.

A report to Congress in 2006 by a National Research Council panel investigating terrorist threats to spent fuel storage concluded that "under some conditions," if a pool were partially or completely drained, that "could lead to a propagating zirconium cladding fire and the release of large quantities of radioactive materials to the environment."

The fuel rods in most cases consist of uranium dioxide pellets encased in zirconium alloy tubes or cladding. Heat from uncovered fuel could ignite the zirconium cladding, and the super-heated metal could then oxidize steam, releasing hydrogen and oxygen. Leaks of hydrogen from damaged reactors at units Nos. 1 and 3 is blamed for explosions at the tops of the outer, secondary containment structures, and an explosion within the No. 2 primary containment structure. Officials said hydrogen released from the spent fuel pool at No. 4 may have caused a fire there.

The National Research Council report said that as pool water levels drops, through a leak or other causes, temperatures of the fuel rods increase, accelerating oxidation of the cladding and the production of hydrogen gas. The reactions can become self-sustaining at high temperatures, if there is sufficient water or oxygen present, causing the cladding tubes to rupture. "The result could be a runaway oxidation reaction" and the release of radioactive fission gases" and some of the radioactive fuel material.

The mix of radioactive particles released into the atmosphere would vary with the length of time expired since the fuel units were moved from reactors to the pools. A particular concern is the spread of Cesium-137, which can enter the body or contaminate agricultural products, Lyman said.

Neff said the consequences of exposed spent fuel at the Fukushima Daiichi plant are not clear. If a pool is completely dry, the oxidized fuel units may be lying on the pool's bottom. "I think the zirconium fire [at unit No. 4] is probably over."

'Doomsday' scenarios

But the resulting radiation could be so high, "it would be almost impossible to get anyone in there," to continue supplying water to the damaged reactors, he said. That could put the cores in a meltdown scenario that could lead to an explosion within the core or a leak of puddle fuel from the bottom of the reactor -- "doomsday" scenarios that create the ultimate test of a reactor's designed defenses, he said.

"There is a possibility if the fuel is in the right configuration, has been out of the reactor long enough, and is sufficiently air cooled that a fuel fire would not start," said one U.S. expert. "If there were a fuel fire, the radiation levels off site would go off the charts -- which they have not," he said.

Tom Clements, southeastern nuclear campaign coordinator of Friends of the Earth, said the fuel in pool No. 4 was hotter than in the plant's other pools because it had more recently been transferred into the pool. "So, it may well have boiled faster, and it had more fuel in it."

The Union of Concerned Scientists and other nuclear power "watchdog" organizations or opponents have called on the NRC to require that spent fuel be moved to storage in dry casks when sufficiently cooled. The National Research Council said that action "might be prudent" for some plants whose vulnerabilities were outlined in a classified part of the report.

Jaczo told the Senate Environment and Natural Resources Committee that measures to protect both U.S. reactor operations and the spent fuel pools have been taken on a case-by-case basis for each U.S. reactor since the Sept. 11, 2001, attacks. The NRC considers the storage situation to be safe in this country, but will review it once the staff has a full understanding of the details of the Japanese nuclear crisis, he said.

Energy Secretary Steven Chu, also testifying to Congress yesterday, reiterated confidence in the safety of the 104 U.S. nuclear reactors.

"The American people should have full confidence that the United States has rigorous safety regulations in place to ensure that our nuclear power is generated safely and responsibly. Information is still coming in about the events unfolding in Japan, but the administration is committed to learning from Japan's experience as we work to continue to strengthen America's nuclear industry," Chu said.

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