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Japan three years after: radioactive water still a challenge, appropriate technology and working conditions for decommissioning still lacking

Tuesday 11 March 2014, by Kyodo News, Mainichi Shimbun (Date first published: 8 March 2014).

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_Radioactive water still a challenge three years after Fukushima disaster

Almost three years have passed since the outbreak of the Fukushima No. 1 Nuclear Power Plant disaster, and we have yet to see the 30- to 40-year decommissioning process truly take off. Radioactive water continues to leak from the plant, breeding fears among the public. And while plant operator Tokyo Electric Power Co. (TEPCO) is now removing fuel rods from the No. 4 reactor's spent fuel pool, it has yet to even locate the spent fuel in reactors No. 1, 2 and 3.

Of the 1,000 metric tons of groundwater that passes through the grounds of the Fukushima power plant from the mountain side of the facilities every day, 400 tons come in contact with spent nuclear fuel inside the reactor buildings and turn into radiation-contaminated water. Some of that radioactive water flows into the ocean, and the remainder is held in storage tanks — from which numerous leaks have been reported.

As of Feb. 25, at least 430,000 tons of radioactive water was stored in approximately 1,000 holding tanks. And with the increase in the volume of contaminated water, there has been no end to related problems.

Workers found a total of 58,000 tons of water leaking from seven underground storage tanks in April 2013. In July that year, an estimated 300 tons of contaminated groundwater per day was found to be spilling into the ocean from the embankment. The following month, 300 tons of contaminated water leaked from one of the storage tanks, an incident that Japan's Nuclear Regulation Authority (NRA) ranked level 3, the fifth most serious classification on the International Nuclear Event Scale (INES) of 0 to 7. Then in October there were a series of incidents caused by human error, including one in which workers overfilled a storage tank installed on an incline, causing radioactive water to overflow.

In August 2013, TEPCO set up a task force directly headed by its president, Naomi Hirose, to handle the storage of contaminated water. But in February this year, approximately 100 tons of water with up to 240 million becquerels per liter of radioactive substances such as strontium 90 that emit beta

radiation leaked from the plant. It appears prospects for controlling contaminated water are grim, with Masayuki Ono, acting head of TEPCO's nuclear power and facilities section, apologizing after the latest incident, "We apologize for the trouble we are causing despite the various measures we are taking."

Radioactive water has caused additional related problems.

Highly-contaminated water with at least 240 million becquerels of radioactive cesium per liter (as of November 2013) was detected in parts of a trench — an underground tunnel for cables — that runs from below the reactor buildings and the embankment. In December last year, the installment of storage tanks near the periphery of the plant grounds caused annual radiation exposure doses in the surrounding areas to exceed 8 millisieverts, or eight times the maximum permitted level.

TEPCO is rushing to increase its tank capacity for contaminated water storage to at least 800,000 tons, and has begun work to block groundwater from flowing into reactor buildings to slow the generation of contaminated water. It has plans for a "bypass" of groundwater by pumping water from wells before it is contaminated and dumping it into the ocean. If the plan succeeds, the flow of groundwater into reactor buildings can be cut back by up to 100 tons per day.

The government has decided to inject some 47 billion yen into the construction of a frozen wall in the ground surrounding the No. 1, 2, 3 and 4 reactors to prevent groundwater from coming into contact with spent nuclear fuel, and tests are being run toward its completion in fiscal 2015.

The removal of radioactive substances from contaminated water is crucial in preventing further contamination of the environment and mitigating radiation exposure. The Advanced Liquid Processing System (ALPS), which can remove 62 radioactive contaminants — not including tritium — has the capacity to process a maximum 750 tons of water per day, and is expected to be instrumental in water decontamination. An additional installment of ALPS is set for fiscal 2014, and TEPCO President Hirose has announced plans to decontaminate radioactive water held in storage tanks by the end of March 2015. TEPCO also plans to begin removing contaminated water from the plant's trench to reduce the risk of contaminating the ocean.

However, there have been no previous attempts to create such a large-scale frozen underground wall anywhere in the world. Furthermore, it is still unclear whether the fishing industry, which has grave concerns for the effects of radiation fears on their businesses, will be open to the groundwater "bypass" plan. ALPS has run into technical problems, making the removal of cobalt 60 and three other radioactive contaminants difficult. In addition, tritium removal — which is not possible with ALPS — has yet to be resolved.

Mainichi Shimbun, March 4, 2014

* http://mainichi.jp/english/english/newsselect/news/20140304p2a00m0na011000c.html

_Technology and working conditions for decommissioning process still lacking

Workers at the Fukushima No. 1 Nuclear Power Plant began removing spent nuclear fuel rods from the No. 4 reactor's cooling pool in November 2013. But spent fuel in reactors No. 1, 2 and 3 has

remained untouched, and we still lack technology that can withstand high levels of radiation in the decommissioning process. Considering this is a major undertaking that will take up to 40 years, we have barely taken the first step.

A decommissioning roadmap compiled by the government and Fukushima plant operator Tokyo Electric Power Co. (TEPCO) defines the period until removal of spent fuel rods is begun as period 1; the period until the removal of molten fuel in reactors No. 1-3 as period 2; and the period in which molten fuel removal is completed and the reactor buildings are dismantled as period 3.

Of the 1,533 spent fuel rods that were in the cooling pool of the No. 4 reactor, about one-fourth or 418 rods had been extracted as of March 3. The majority of the fuel rods have remained intact, and TEPCO plans to remove all of them before the end of the year.

The biggest hurdle TEPCO faces is the removal of molten fuel in the No. 1-3 reactors. Effects of the March 11, 2011 tsunami left the three reactors without their cooling capacity, and temperatures in the reactor containment vessels rose at one point to at least 2,000 degrees Celsius. The majority of the reactors' 1,496 fuel rods are believed to have melted.

To remove the fuel, the containment vessels must be filled with water to block radiation. To do so, however, it is essential that working conditions are improved, damage to the vessels is identified and repaired, and more advanced technologies are developed.

If all goes smoothly, fuel extraction will begin in the No. 1 and 2 reactors in fiscal 2020, and in the No. 3 reactor in fiscal 2021. With the Summer Olympics set to be held in Tokyo in 2020, it will be up to the government to prove both domestically and internationally that we are headed toward decommissioning. There are a total 1,573 spent fuel rods in the three reactors' cooling pools, and removal will begin in fiscal 2015 for the No. 3 reactor, and in fiscal 2017 for the No. 1 and 2 reactors at the earliest.

Meanwhile, TEPCO decommissioned the No. 5 and No. 6 reactors on Jan. 31 this year at the behest of the government. The two reactors will hereafter be used as model reactors for decommissioning the No. 1, 2, 3 and 4 reactors. According to Japan Atomic Industrial Forum President Takuya Hattori, the No. 5 reactor is the same type of reactor as the No. 1-4 reactors, and using it for practice could help cut back on the time it takes to decommission the others.

However, it is unclear whether the quantity and quality necessary for upcoming work at the nuclear plant can be maintained. TEPCO calculates that radiation exposure levels among workers by the time spent fuel extraction from the No. 4 reactor's cooling pool is completed will be a maximum 32 millisieverts per person. While the figure falls below the maximum permitted figure of 50 millisieverts per year and 100 millisieverts within a five-year period, radiation levels at reactors No. 1-3 is high, and the success of the decommissioning process relies heavily on whether TEPCO can continue to secure technical staff and other workers.

"From the standpoint of the entire decommissioning process, we are now standing at the foot of the mountain range, where we cannot see the mountaintop. There are going to be steep slopes and dropoffs waiting up ahead, such as the removal of molten fuel," says Nagoya University professor Akio Yamamoto, who was involved in the creation of Japan's new nuclear safety standards. "Those on the ground face excessive burdens, including dealing with contaminated water. We urgently need to improve compensation for workers."

Mainichi Shimbun, March 4, 2014 http://mainichi.jp/english/english/newsselect/news/20140304p2a00m0na012000c.html

_Nuclear society says inadequate safety steps led to Fukushima crisis

TOKYO (Kyodo) — Japan's nuclear academic society said Saturday the Fukushima Daiichi nuclear complex withstood the impact of the huge earthquake in March 2011 but saw a disaster occur due to inadequate preparations against tsunami and severe accidents.

"We think safety functions were not particularly affected by the earthquake (before tsunami waves hit the plant)...the direct cause of the accident was insufficient measures to deal with tsunami, severe accidents and emergencies," an accident investigation panel of the Atomic Energy Society of Japan said in its report.

The report also said nuclear experts had failed to play their part to improve nuclear safety before the Fukushima crisis, as they "locked themselves in their narrow field of expertise" and were not much aware of the risks associated with natural disasters.

"Tsunami issues were discussed by experts on tsunami, and not enough study was made on what kind of risks they could bring to nuclear power plants," the report said.

The document follows four other nuclear accident investigation reports released from a Dietappointed panel, Tokyo Electric Power Co., the operator of the Fukushima Daiichi plant, and others.

Some controversial issues include whether the March 2011 earthquake could have damaged equipment necessary for ensuring safety and that a small-scale coolant loss may have occurred in the plant's No. 1 unit.

But the academic society's panel denied that such a loss of coolant had occurred, based on its data analysis.

The panel is headed by Satoru Tanaka, a professor at the University of Tokyo. For analysis, the panel said it used data announced by the government and TEPCO as well as information included in other accident investigation panel reports.

In the Fukushima nuclear crisis, tsunami waves that followed a magnitude 9.0 earthquake flooded electrical equipment, leading to a loss of power sources as well as the key reactor cooling systems.

The Nos. 1 to 3 reactors suffered meltdowns, making it the world's worst nuclear accident since the 1986 Chernobyl disaster.

Kyodo News, March 8, 2014 http://mainichi.jp/english/newsselect/news/20140308p2g00m0dm037000c.html