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Deposit Tritiated Water in Large Tanks for 100 Years or Longer

Citizens' Commission on Nuclear Energy (CCNE)

1. Recent Moves

Large volumes of radioactive water are accumulated at the Fukushima Daiichi nuclear accident site, as groundwater flowing into the reactor and turbine buildings mixes with the cooling water that surrounds nuclear fuel debris. This is treated using equipments to remove radioactive substances and then stored in makeshift water tanks as "treated water," but it still contains tritium, which the equipments cannot remove. The stored "treated water" has accumulated over the past seven years to the point that total volume exceeds one million cubic meters, and the site is jam-packed with rows of 1,000 m^3 tanks. As a result, space to build more tanks is running out in less than three years[1]. Thus the authorities involved are reportedly making every effort to create a favorable atmosphere so that the society would accept release of the water into the ocean.

This problem has been recognized at an early stage, with the government (Agency of Natural Resources and Energy, METI) organizing a "Tritiated Water Task Force" under the Committee on Countermeasures for Contaminated Water Treatment and publishing the "Tritiated Water Task Force Report" in June 2016[2].

At a meeting to exchange views with representatives of municipalities within Fukushima Prefecture at the end of 2017, Toyoshi Fuketa, who chairs Japan's Nuclear Regulation Authority (NRA), expressed his view that from a scientific standpoint there would be no problem with releasing the treated water into the ocean and that TEPCO should decide on a discharge method within the year[3]. At a regular press conference on January 17, Chairman Fuketa expressed concern that if the decision to discharge the water delayed further, "the decommissioning of the Fukushima Daiichi reactors would come to a standstill."[4]

A telephone poll on Fukushima prefectural residents conducted last February 24 and 25 by Asahi Shimbun Publishing Co. and Fukushima Broadcasting Co., asking whether or not the residents agreed that the treated water accumulated in the tanks at the Fukushima Daiichi nuclear power station should be diluted and released into the ocean. The results showed 67%

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[1] "Treated contaminated water – time for a decision draws near," *Nihon Keizai Shimbun*, Feb. 23, 2018 (in Japanese).

[2] "Tritiated Water Task Force Report," June 2016.
http://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/tritium_tusk/pdf/160603_01.pdf (Japanese) http://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/20160915_01a.pdf (English) An edition with commentary, "Regarding the Tritiated Water Task Force Report," Nov. 11, 2016 http://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/takakusyu/pdf/001_03_00.pdf (Japanese) and others.

[3] "TEPCO urged to discharge or dispose of treated water," *The Denki Shimbun*, Jan. 16, 2018 (in Japanese).

[4] "Judgment required for release of Fukushima Daiichi treated water," *The Denki Shimbun*, Jan. 18, 2018 (in Japanese).

opposed, far outnumbering the 19% in favor[5].

2. Controversy over Toxicity

Because exposure to tritium occurs internally at the cellular level and is frequently simultaneous with exposure to other radioactive substances, epidemiological judgment on its effects on human health is yet to be established. The prescribed concentration limit for oceanic releases is 60,000 becquerel per litter (Bq/L)[6], but this by no means assures proved safety. There are huge differences even in regulatory standards for drinking water, with the WHO saying 10,000 Bq/L; the Canadian government, 7,000 Bq/L (but the Ontario Drinking Water Advisory Council recommending 20 Bq/L)[7]; and 100 Bq/L in EU[8].

3. Evaluating Options for Dealing with Tritiated Water

The above-mentioned "Tritiated Water Task Force Report" refers to five groups of disposal technology and describes conceptual designs and estimated costs for each. None of them, however, appears to us a good solution.

The Citizens' Commission on Nuclear Energy (CCNE) published a special report last December titled, "Settlement After 100+ years of Shielded Isolation" (revised edition 2017, in Japanese)[9]. In this report, tritiated water is proposed to be stored in durable large-volume tanks until thorough investigations and verifications are carried out, rather than rushing to discharge it to the ocean in the middle of the scientific disagreement on the radio-toxicity of tritium.

In concrete terms, if 10 large tanks of the type currently used at Japan's oil stockpile bases with a capacity of 100,000 tons each were built and the tritiated water kept in them for 123 years, the total amount of tritium in the tanks is assured to be reduced to less than 1/1000th of the current amount, because tritium has a radioactive half-life of 12.3 years [i.e. 10 times of that yielding $(1/2)^{10} = 1/1024$]. This amount would be less than the minimum annual amount of oceanic discharge of tritium from the entire Fukushima Daiichi nuclear station during the eight years prior to the March 2011 accident there. What we have proposed is to carry out such long-term storage and wait for sufficient decay of radioactivity. Given a unit construction cost of about 3.0 billion yen and assuming an extra tank is built for conducting internal inspections every 20 years, 11 units would come to about 33.0 billion yen, which

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[5] "66% 'feel anxious' about radioactive substances - Fukushima Prefecture poll," *The Asahi Shimbun*, March 3, 2018 (in Japanese).

[6] Notification No. 187 of the Ministry of Economy, Trade and Industry, "Notification establishing dose limits, etc., based on the stipulations of regulations regarding the establishment, operation, etc. of commercial nuclear power reactors," March 21, 2001 (in Japanese). This gives a concentration limit of 60 Bq/cm3 for tritiated water in Attached Table 2 (i.e., 60,000 Bq/L).

[7] "Report and Advice on the Ontario Drinking Water Quality Standard for Tritium", May 21, 2009

[8] Canadian Nuclear Safety Commission, "Tritium in Drinking Water", August 20, 2009 http://nuclearsafety.gc.ca/eng/resources/health/tritium/tritium-in-drinking-water.cfm

[9] Released on Nov. 11, 2017, p. 7 http://www.ccnejapan.com/?p=7900

differs little from the 34.5 billion yen cost of the plant's "ice wall." Further, the proven engineering at Japan's oil stockpile bases can be applied to design specifications such as construction of dikes around the tanks in case of total leaks. If further reduction of radioactivity is deemed necessary and new storage tanks must be built to replace old ones at the end of their service life, further decay on the order of 1/1000th can be expected by depositing in new tanks for another 123 years.

Regarding safety in the case of earthquakes, building dikes—the same as the currently implemented method—is a realistic approach for protection in case leaks occur. Regarding where to build the tanks, we think it would be possible to use the site reserved for construction of Units 7 and 8 at the Fukushima Daiichi nuclear station. Moreover, the volumetric efficiency of large tanks per unit site area is far higher than that of the smaller 1,000-ton capacity tanks which currently store the tritiated water, so if those smaller tanks are dismantled in order and new large tanks built in turn, we think it would be possible to replace the existing tanks in the area where they now stand.

4. Conclusion

Not everything has been elucidated regarding the toxicity of tritiated water. A fundamental lesson learned from the many years of dealing with serious industrial pollution cases in this country is that toxic substances should not be scattered across the environment, but should be centrally managed and detoxified to the utmost before being released into the environment. The above proposal by the CCNE has a well-proved industrial basis, both in terms of engineering and economy. It is, therefore, the most stable and safe solution.

As mentioned above, a poll in Fukushima found 67% of the residents opposed to sea discharge, and under such circumstances, it would be utterly unacceptable from an ethical standpoint for the Government and TEPCO, who should bear responsibility and liability for the nuclear accident, to make a unilateral decision and release the radioactive water into the ocean.

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