Methods to detect the leakage from contaminated water tanks

In order to detect the leakage from contaminated water tanks installed within the site of the Fukushima Daiichi Nuclear Power Station, Tokyo Electric Power Company (1F), the Sector of Fukushima Research and Development, the Japan Atomic Energy Agency (JAEA), is conducting various kinds of tests in the 1F area using newly developed Plastic Scintillation Fiber (PSF) of 50 m length aiming at the development of leakage monitor and its practical application.

Three years have passed since the accident at the 1F, and there the countermeasures against the contaminated water are urgently required. At present, the contaminated water generated within the nuclear reactor building is tentatively stored in the tanks inside of the 1F site before being treated by radioactive material removal equipment. However, the leakage from contaminated water tanks has been reported by various media since last year. Currently, various countermeasures against the leakage are being implemented, such as raising of the tank weirs, remote monitoring by cameras, and visual confirmation by patrol. However, these methods are time and money consuming. Therefore, it is required to develop a new method that can detect the position of the leakage at real time. Also there is a problem relating to disposal of rainwater accumulating in the tank weirs. While distribution of the radioactivity is currently analyzed by means of sampling, it is required to develop technique for on-site measurement.
For details, refer to the following website of Nuclear Regulation Authority (NRA).
https://www.nsr.go.jp/committee/yuushikisya/tokutei_kanshi_wg/data/0008_02.pdf (in Japanese)

Since the accident of 1F, the Sector of Fukushima Research and Development, JAEA, has been developing methods to measure radiation distributions using Plastic Scintillation Fiber (PSF), and applied it to various fields. This detector employs optical fibers using plastic scintillator that emits light by sensing radiation in the central core part. At the both sides of the optical fiber, optical sensors (photo-multipliers) are installed. The number of radiation rays is counted by these optical sensors. In addition, the light-emitting position in the detection part (the position of the injected radiation) can be specified by measuring the difference in the arriving time of the light detected by the two optical sensors. This detector is superior to ordinary survey meters in that radiation distribution can be measured, and radiation can be measured in water. Thus the detector has been applied to the measurements in a wide area before and after decontamination,

and the measurements of radiation distribution at the bottom of reservoirs, etc.

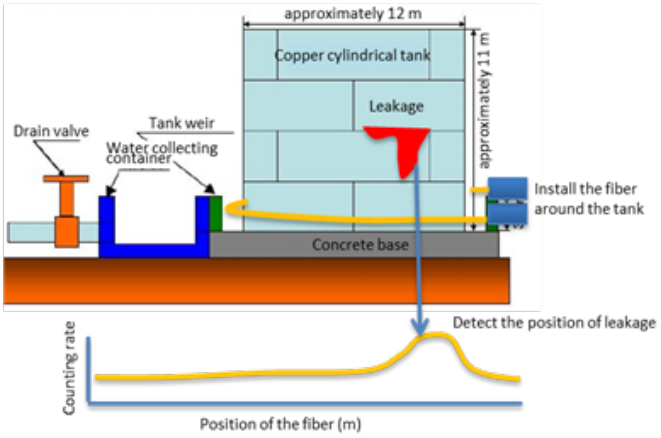
For details, please see the following JAEA's websites.

Measurements before and after decontamination (in Japanese): http://fukushima.jaea.go.jp/initiatives/cat03/pdf/plastic.pdf

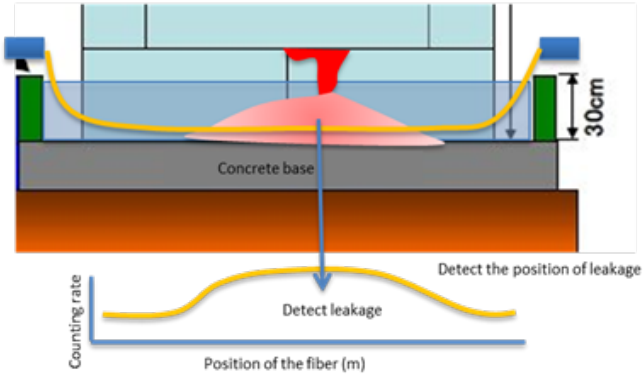
Measurements of radiation distribution at the bottom of reservoirs: http://fukushima.jaea.go.jp/english/topics/pdf/topics-fukushima050e.pdf

Application plans

○ Plan1: Leakage detection around the tank



○ Plan2: Leakage detection in rainwater within weir



This time, JAEA has developed the measurement system available to the leakage monitoring of contaminated water by utilizing the advantage of PSF. In this system, the optical fibers of 50 m length have been newly developed. The length of the fiber is long enough to enclose the contaminated water tanks. The above figures show the schematics of the system. The optical fiber encloses the contaminated water tank, so the leakage from the contaminated water tank can be immediately detected. Also the measured values can be converted to the concentration of the radioactivity. Thus it can measure the radiation concentration of rainwater within the weirs. In order to check the validity of this system, we have confirmed at the laboratory within the site that the radiation can be actually measured using standard samples. At present, we are conducting the tests to verify long-term soundness of the system by employing prototype models around the real tanks. JAEA will contribute to the countermeasures for the contaminated water problem, aiming at the early practical application of the system in cooperation with Tokyo Electric Power Company and related manufacturers.

Dipping the PSF into the sample of contaminated water

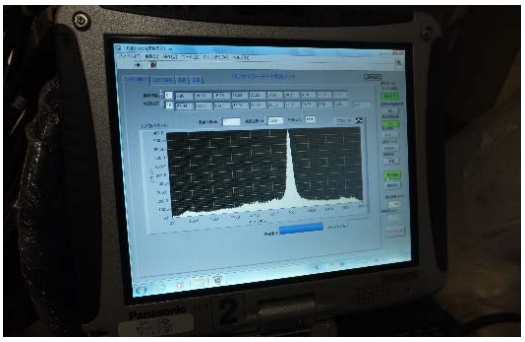


Image of the measurement shown on the display during the dipping of the PSF. The peak corresponds to the position where the PSF is contacted with the contaminated water.

TOPICS Fukushima No.53

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