# Detection of radioactive hotspots inside the Fukushima Daiichi Nuclear Power Station Unit 3 reactor building using an optical fiber radiation sensor based on wavelength-resolving analysis

We have developed a new method for the inverse estimation of incident position of radiation on an optical fiber by utilizing the wavelength dependence of light attenuation within the fiber. Our sensor captures the emission wavelength spectrum of the scintillation light by connecting a spectrometer to the fiber's end. The shape of the wavelength spectrum changes with the light's transmission distance inside the optical fiber. Hence, the incident position of radiation along the optical fiber can be determined by applying an unfolding procedure to the emission wavelength spectrum.

We applied this sensor to examine the distribution of radioactive sources inside the Fukushima Daiichi Nuclear Power Station (FDNPS) Unit 3 reactor building. We fabricated a sensor from plastic scintillation fiber (PSF) encased in a stainless steel tube and attempted to measure the distribution of the beta-emitting radionuclide $^{90}Sr/^{90}Y$, based on the difference in measurements with and without the stainless steel tubing. Fig. 1 shows the sensor installation. PSFs, both with and without stainless steel tubes, were installed near the hydraulic control system (HCU) on the first floor of the Unit 3 reactor building. The scintillation emission from the PSFs was transmitted via a 60 m long quartz optical fiber and detected by a spectrometer in a low dose rate area outside the reactor building. In the presentation, we will discuss the differences in emission intensity and the inverse estimation results of the radioactive source distribution with and without stainless steel tubing.

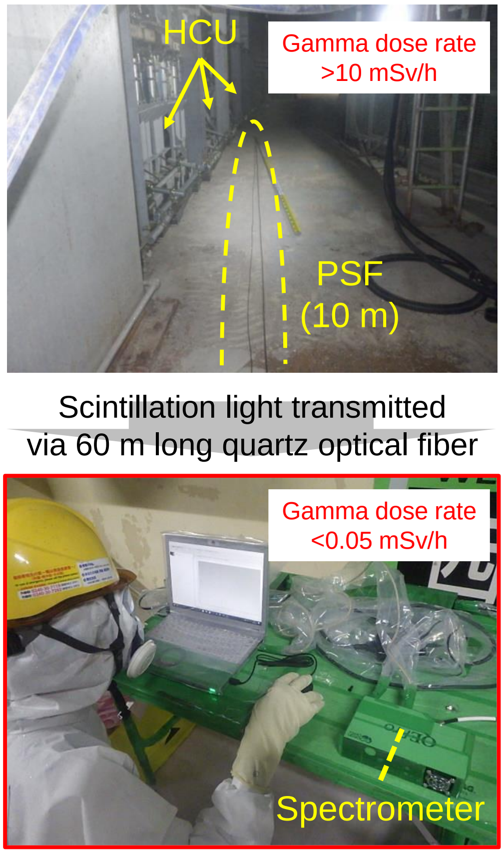


Fig. 1 Sensor installation condition inside the FDNPS Unit 3 reactor building.