Figure 1. Reactor building reproduced in a virtual space. The high-radiation part (hot spot) is shown in red.

Developing technology for visualizing radioactivity inside reactor building

Effective for lowering radiation exposure during 1F decontamination and decommissioning

The Japan Atomic Energy Agency (JAEA) has developed a technology for visualizing the distribution of radioactive materials deposited inside the reactor building of the Fukushima Daiichi Nuclear Power Station (1F), Tokyo Electric Power Company Holdings Inc. (TEPCO). The technology was applied to the measurement of the radiation doses inside of the reactor building at the Unit 1 of 1F. As a result, JAEA succeeded in detecting limited areas with high dose rates (“hot spots”), and visualizing these hot spots on the three-dimensional (3D) model of the reactor building, which was reproduced in a virtual space. This technology is expected to contribute to the reduction of radiation exposure for 1F workers and the establishment of the effective decontamination plans.

Work inside 1F hindered by hot spots

One of the major challenges in 1F is keeping the radiation exposure low for the decommissioning workers. This is a serious problem especially inside the buildings, where radioactive materials are adsorbed on the floor, wall, ceiling, as well as the scattered debris and equipment, thereby the contamination is three-dimensionally spreading. Both direct and reflected/scattered radiation fly in the buildings. Since the dose rate inside the 1F reactor building is particularly high, there still remains areas where workers cannot approach. In addition, it is difficult to identify where the

contamination sources are.

Protect workers from radiation by visualizing radiation

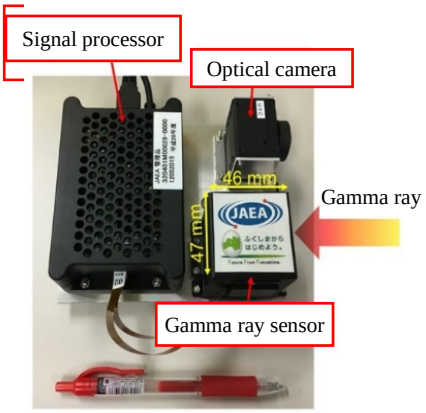

Figure 2. New light-weight compact Compton camera

JAEA has successfully developed a small and light-weight Compton camera for identifying the direction of gamma ray sources and visualizing the distribution of radioactive materials (Figure 2). The new camera was installed on a remote-controlled robot of TEPCO to survey the distribution of radioactive contamination inside the building of the Unit 1. As a result, we succeeded in revealing the hot spots (Figure 3). Moreover, by combining photographs and videos taken at the site, a 3D drawing that shows the exact locations of these hot spots has been created (Figure 1).

The map combined with the drawing (contamination distribution map) can also be displayed using the existing virtual reality (VR) systems. The developed technology can help 1F workers understand where hot spots and contamination sources are, and simulate their woks in advance, leading to less exposure to radiation. It is expected that the technology can also support establishing effective decontamination plans.

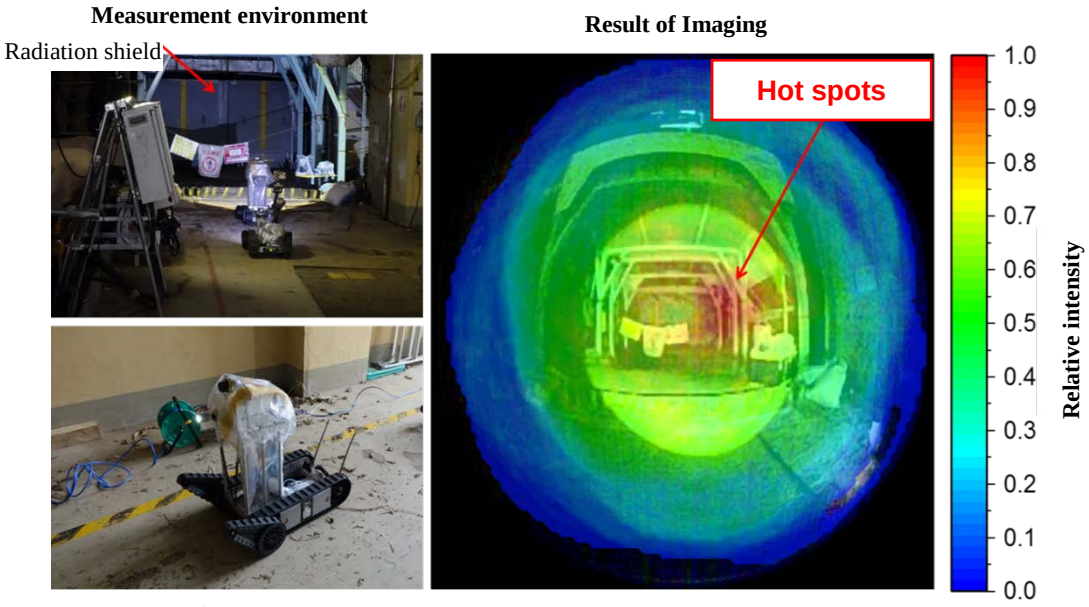

**Figure 3. Left: Demonstration test inside the 1F reactor building.
Right: Hot spot identified in the right side gap of a shield located at the end of the large access door.**

What the researcher says

Dr. Yuki Sato, a researcher at the Collaborative Laboratories for Advanced Decommissioning Science, has been working on this project for two years before the demonstration test inside the 1F reactor building. He talked about the hard works as follows, “This system presenting 3D image for hot spots at the working site was developed by the cooperation among various technologies in different fields. For example, the 3D display system for hot spots inside the building was made by the combination of the different technology. One is to mount new Compton camera on remote-controlled robots. The other is the construction of the 3D model by laser distance meter and photogrammetry*. It was really a series of trial and error.”

Inside the 1F reactor building, there are still many areas where the hot spots remain unidentified. JAEA continues to work in collaboration with TEPCO to develop a highly versatile system for identifying and monitoring hot spots with low cost and easy operation.

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* A technology for building 3D models of objects and landscapes by combining 2D pictures taken from different angles.

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