2-⑩ Development of remote decontamination technology in the reactor building

Project objectives

To enable decontamination of the interior of reach reactor building contaminated by the scattering of radioactive materials without causing excessive radiation exposure to workers, studies were performed on different decontamination methods for different decontamination targets (such as concrete, metal, and resin) and for different types of contamination (such as loose contamination, tightly adhering contamination, and penetrating contamination) was examined. Then, apart from the remotely controlled decontamination machine for low locations surfaces that had already demonstrated its performance in the field, development was performed for remote controlled decontamination machines that can be applied to surfaces in high locations or on the second or upper floor levels as machines that are vitally needed to prepare a proper working environment for decommissioning works.

1. Project details and progress

(1) Development of a decontamination machine for surfaces in high locations **(Fig.1)**

In order to use it for decontamination work at the Fukushima Daiichi NPS, decontamination machine for surfaces in high locations meeting the following performance and functional requirements was developed and demonstration tests were conducted.

- Decontamination performance of the target dose rate (3 mSv/h or less for work areas, 5 mSv/h or less for access areas)
- Remote operability , travel performance, and arm operability
- Recovery function in case of failure, toppling prevention, etc.

(2) Development of a decontamination machine for upper floor levels **(Fig.2)**

In addition to the performance and functional requirements, a decontamination machine was developed and tested for use on the upper floors, which must meet the following design requirements for use on the upper floors.

- Capability to use a general-purpose elevator workbench for round trip with for the upper floor.
- Capability to round trip from upper floor levels as quickly as possible
- Capability to can operate in the structure of the upper floor, equipment layout

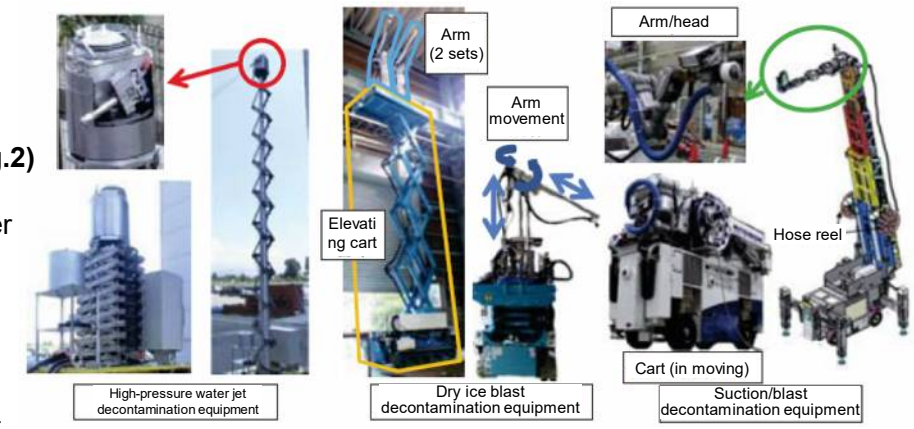

Fig. 1: Decontamination equipment for high places

(3) Examining the concept of decontamination in the basement floor level

If the accumulated water level in the basement decreases because of the retrieval of fuel debris, the implementation of measures concerning contaminated water, or any other reason, the air dose rate may increase due to the scattering of dust and shielding effect by water. Therefore, technical challenges were examined and formulated for attempts toward lowering the air dose ratio in the basement, including the following in the list of items that would require attention.

- Changes in plant conditions (changes in the air dose rate, accumulated water radioactivity concentration, and dust concentration)
- Scenario for environmental improvement including the decontamination of the basement floor
- Combination of different approaches such as decontamination, shielding, and dust collection.

Fig. 2: Upper floor decontamination equipment

Implemented by International Research Institute for Nuclear Decommissioning (IRID) (FY 2013 -)

2. Related projects

The following describes the results of previous related projects.

○ Development of remote decontamination technology in the reactor building (FY 2011 - 2013)

(FY 2011) **(Fig.3)**

- Contamination survey: A field survey plan was produced that involved the determination of survey areas, the preparation of ideas about sampling tools, the listing of analysis targets, and so on.
- Dummy contamination test: A method for preparing a dummy contamination test piece such as a concrete sample was examined.
- Decontamination machine: Technological options were studied by making a public call for technical catalog proposals.

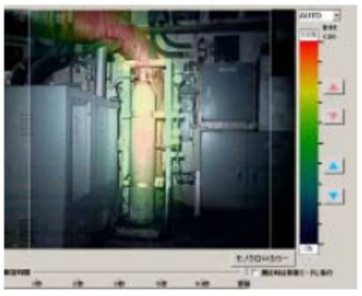

Fig. 3: Investigation result by γ camera in the south side of Unit 1

(FY 2012) **(Fig.4)**

- Collection of basic data: By taking measurements on concrete core samples, it was found that there was no penetration of contamination into the concrete interior, it was confirmed that tightly adhering contamination is in scars produced by the aging degradation of epoxy coating on the surface.
- Verifying the appropriateness of decontamination techniques: Based on the analysis of the collected basic data and the results of decontamination testing performed on dummy contamination samples, it was found that it would be possible to successfully address different types of contamination on different decontamination targets through high-pressure water jet decontamination, dry ice blast decontamination, or blast suction decontamination, and therefore it was concluded that these decontamination techniques were appropriately selected.
- Demonstration of remote controlled decontamination: By in-factory mock-up testing and demonstration testing, it was concluded that it would probably be possible to successfully put a remotely controlled decontamination machine to practical use, and challenges and necessary improvements were identified.

(FY 2013)

- Collecting basic data on contamination: Surveys were conducted on the dose rate at upper floor levels and in high location surfaces in reactor buildings, the distribution of contamination, internal radiation sources, and the penetration of contamination.
- Organization of decontamination techniques and examining decontamination concepts: A basic policy was established for the decontamination machine for surfaces in high locations and the decontamination machine for upper floor levels.

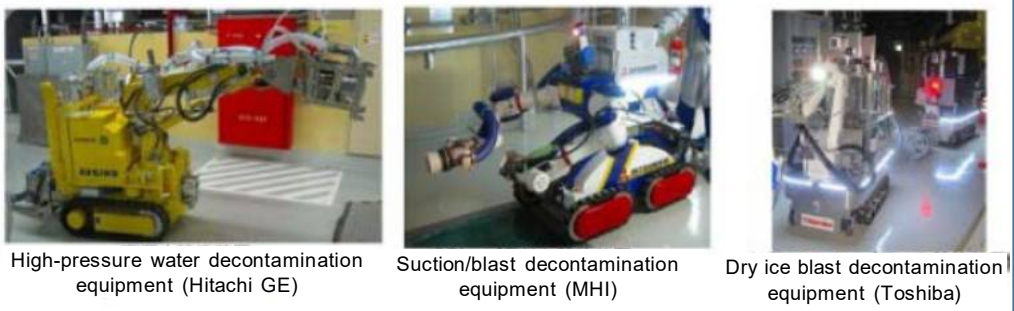

Fig. 4 Decontamination equipment developed in 2012

- Design and fabrication of remotely controlled decontamination machines and demonstrative decontamination testing: Design was performed for the decontamination machine for surfaces in high locations and the decontamination machine for upper floor levels. The decontamination machines that had been fabricated in FY 2012 were modified and put to demonstration testing and performance evaluation.
- Demonstration of the shielding system for practical application: The shielding installation plan for remote controlled was finalized, and the shielding system was put to in-factory demonstration testing and evaluation.

FY2011	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017
Development of remote decontamination technology in the building						
			Development of remote decontamination technology in the reactor building			