日独シンポジウム「原子力施設廃止措置のための技術と教育」

「福島第一原子力発電所の廃炉のためのロボット技術」

Robot Technology for Nuclear Decommissioning of Fukushima Daiichi NPS

April 21, 2015

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Introduction

IRID is the Technology Research Association to develop technologies required for the decommissioning of the Fukushima Daiichi NPS

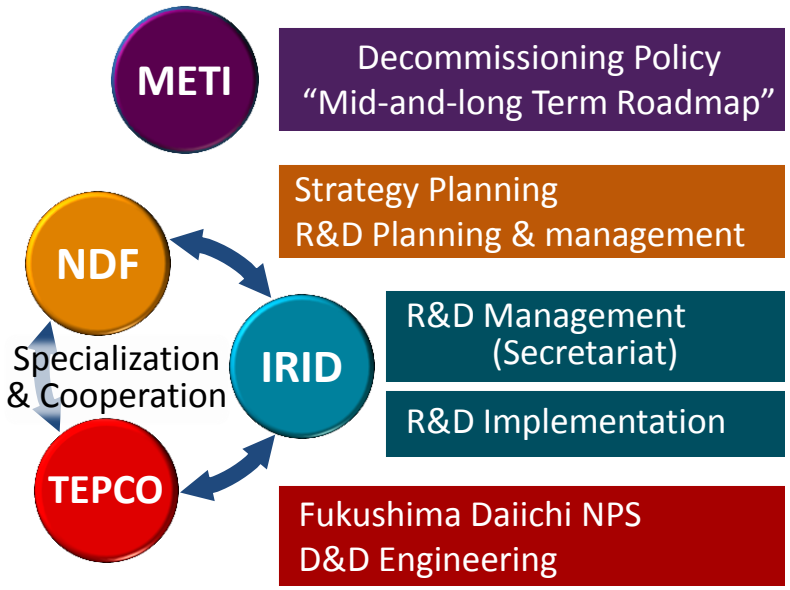
Organization

- R&D Management
  - R&D Management
  - R&D Strategy Planning
  - Administration
- R&D Implementation
  - Over 700 researchers participate in IRID and engage in the R&D projects at their facilities
  - Membership:
    National R&D Agencies(2)
    /Manufacturers(4) / Electric Utilities(12)

Scope of business

- Nuclear decommissioning technology R&D
  - Fuel Removal from Spent Fuel Pool
  - Preparation of Fuel Debris Retrieval
  - Treatment and Disposal of Radioactive Waste
- Promotion of cooperation on nuclear decommissioning with international and domestic organizations
- Human resource development

Relationship Diagram

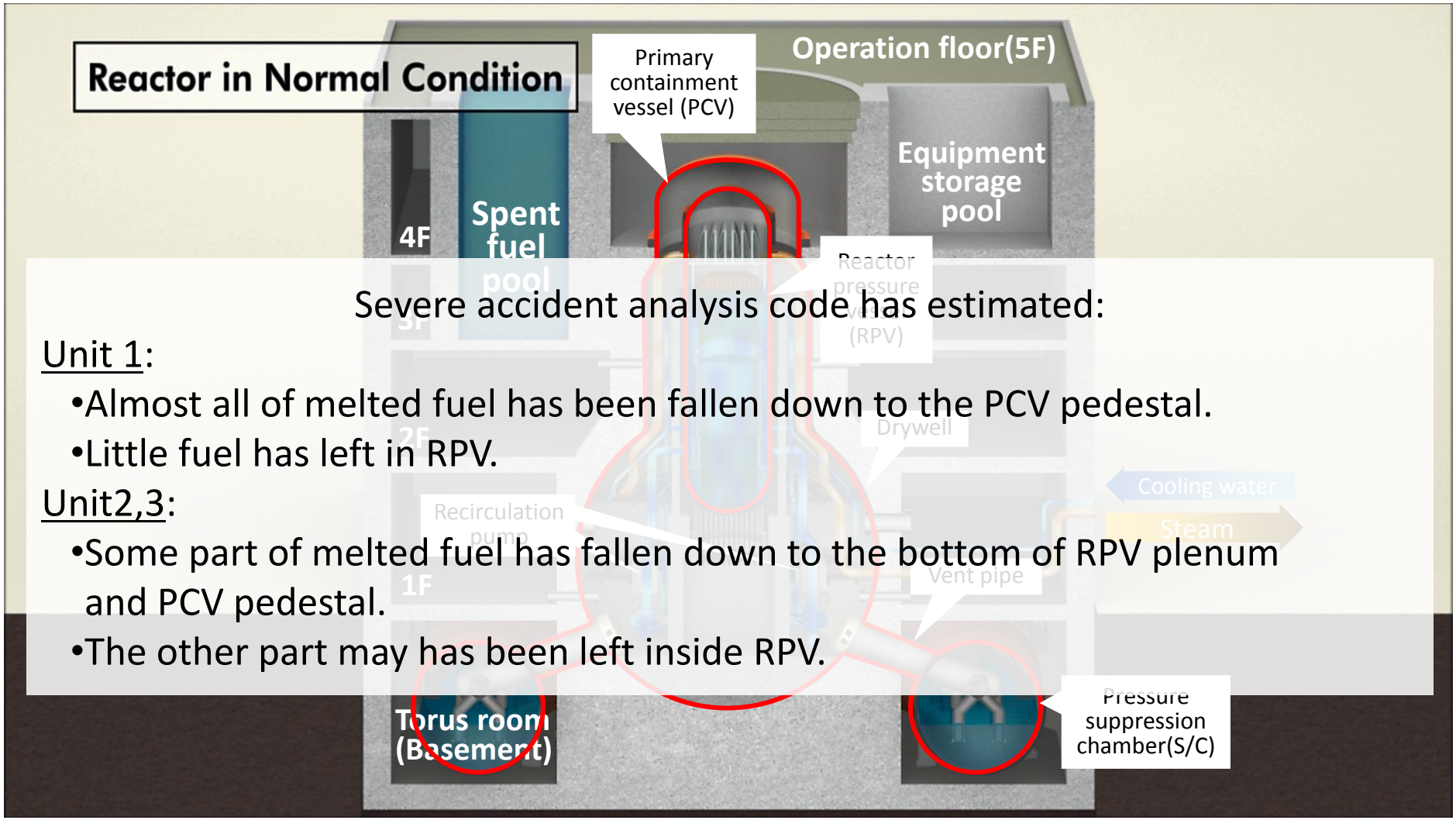


METI: Ministry of Economy, Trade and Industry

NDF: Nuclear Damage Compensation and Decommissioning Facilitation Corporation

For more information >> http://www.irid.or.jp/en

What has happened in the Fukushima Daiichi NPS (estimated)



Severe accident analysis code has estimated:

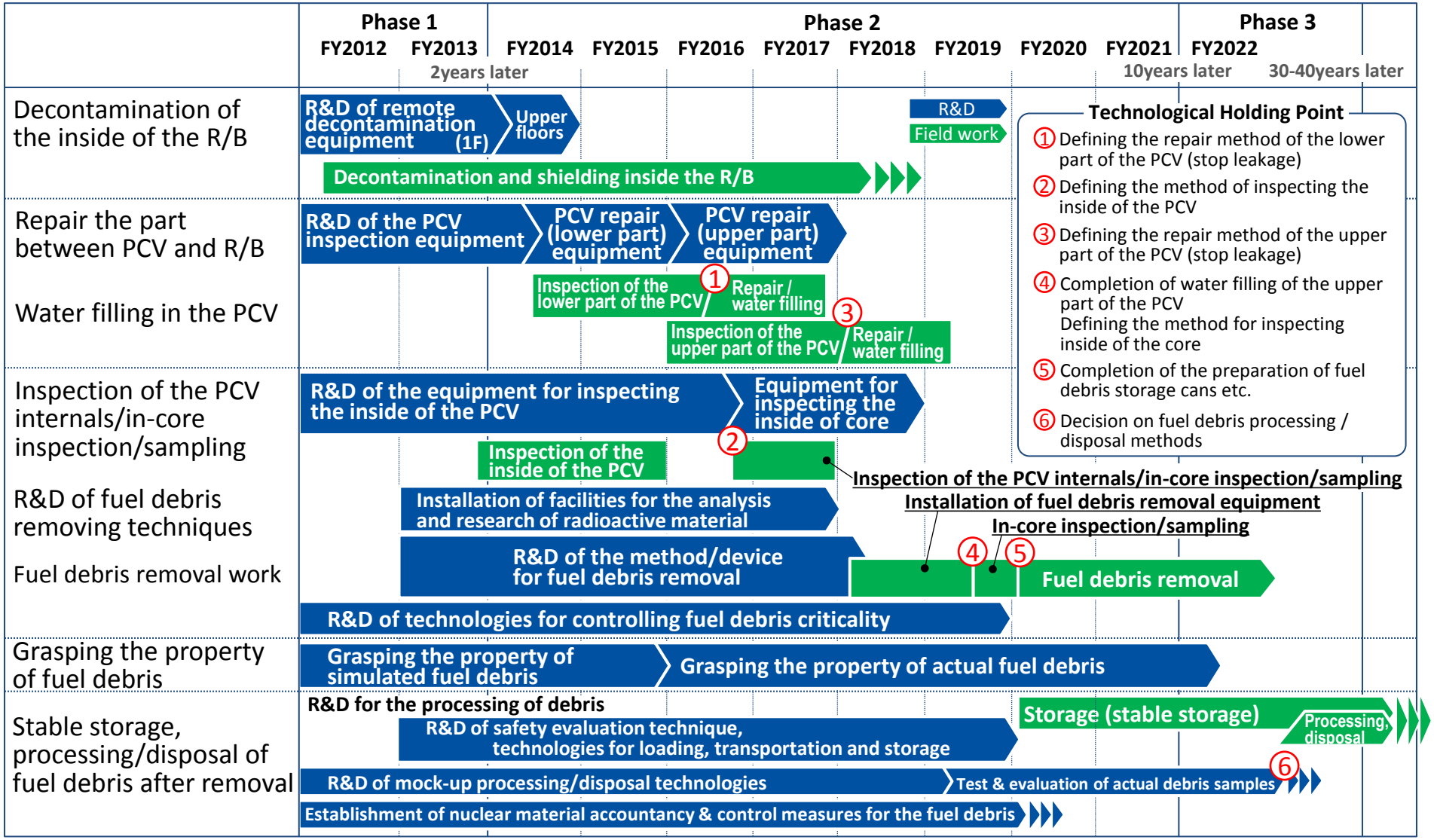
Unit 1:

- Almost all of melted fuel has been fallen down to the PCV pedestal.
- Little fuel has left in RPV.

Unit2,3:

- Some part of melted fuel has fallen down to the bottom of RPV plenum and PCV pedestal.
- The other part may has been left inside RPV.

Fuel debris retrieval plan on Mid-and-Long-Term Roadmap (Unit 2)

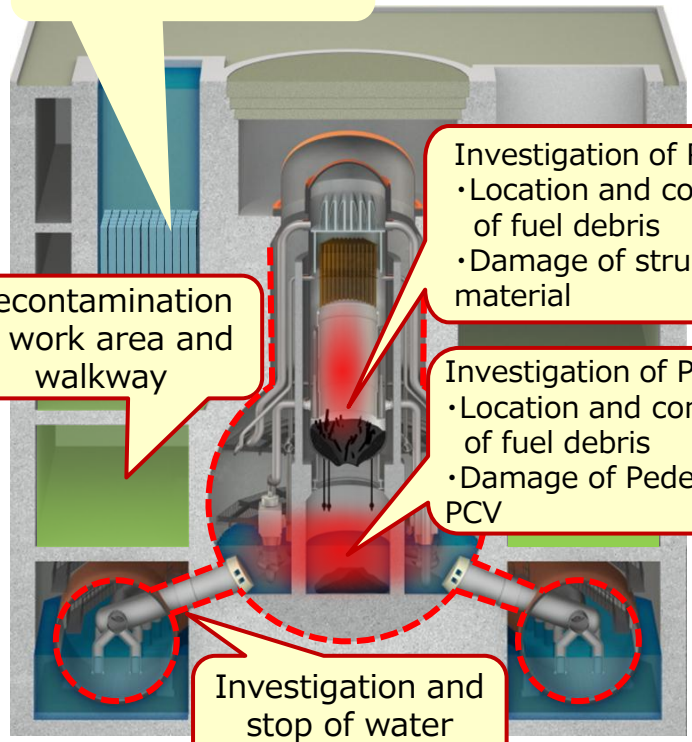


Fuel debris retrieval procedure

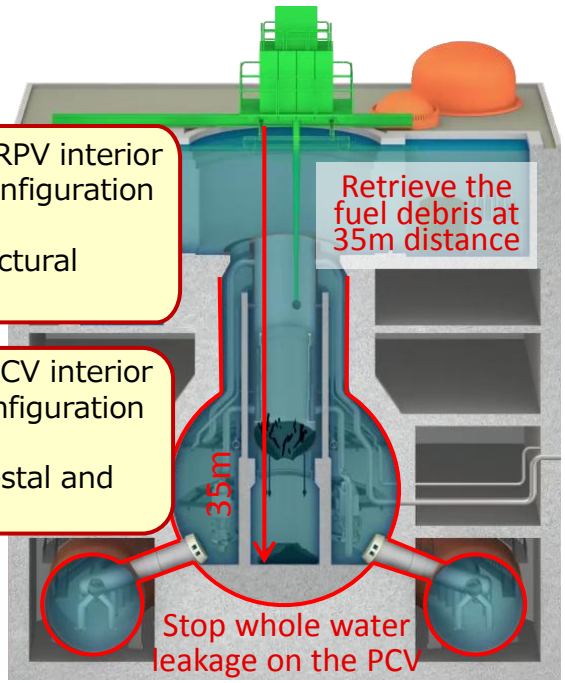
Current

Technology R&D

Fuel Debris Retrieval from 2021

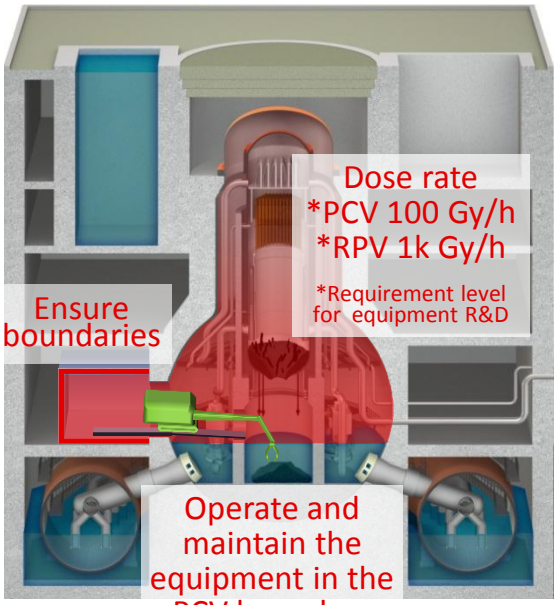


Submersion method



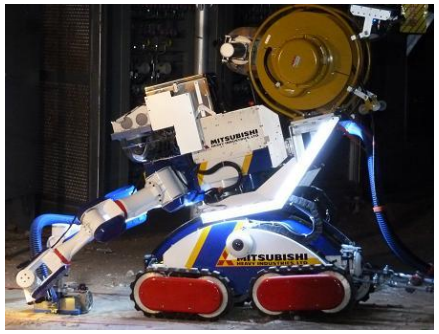
Most favorable approach for minimizing the radioactive exposure of workers

In-air method



Development of technology for remotely operated decontamination in reactor buildings

For Low Places



Suction/blast

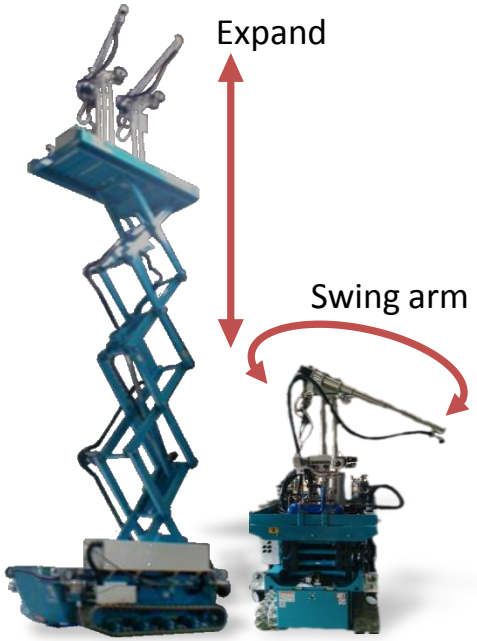
High pressure water jet

Dry ice blast

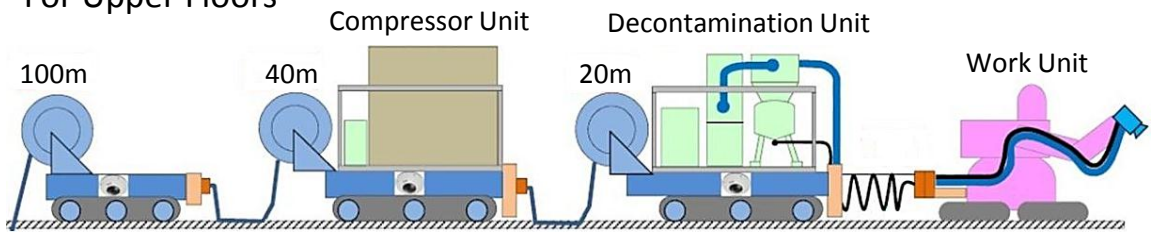
- Contamination condition is the combination of loose material and fixing material
- Dose comes from low place, high place, side wall and hot spot

Ground floor of Reactor Building

For High Places



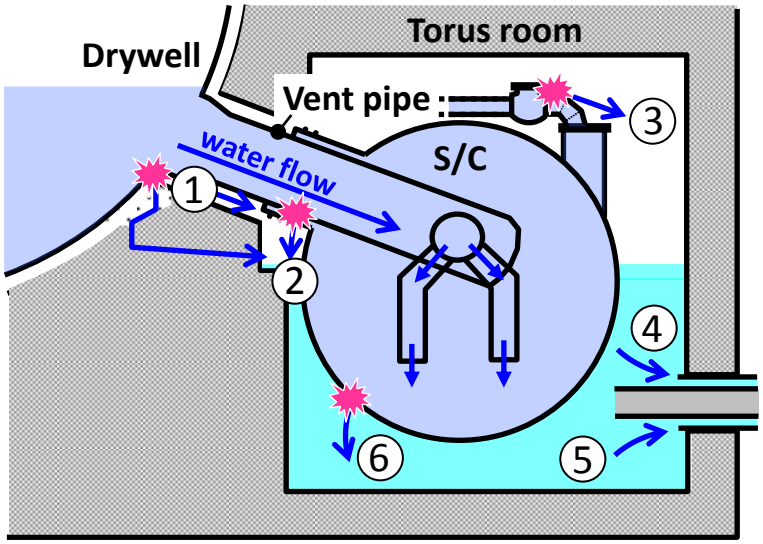
For Upper Floors



Each unit is lifted up to the upper floor with the Lifter in continuity

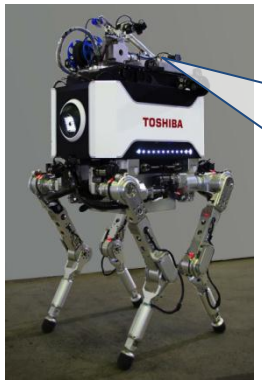
Development of technology to identify leakage points in the PCV

Equipment to investigate leakage from the PCV, etc., that take each environment, including elevated locations, high radiation dose areas, narrow spaces, and areas under water are developed.



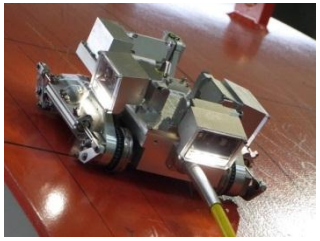
①Exterior surface survey equipment for Vent Pipe

②Quadruped Robot



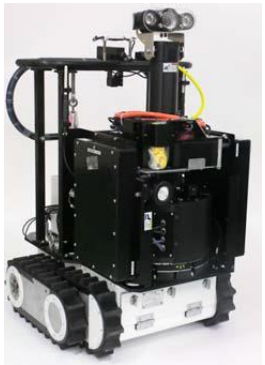
Flat Vehicle

⑥Exterior surface survey equipment for lower part of S/C



⑤Floor traveling robot

③Upper part of S/C survey equipment



④Swimming robot

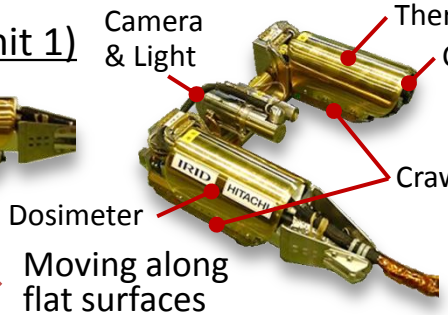
Development of technology for investigation inside the PCV

Investigation methods and remotely operated devices are now under development to identify conditions inside the PCV and determine the situation regarding fuel debris.

Shape-changing crawler (Unit 1)

Moving within pipes

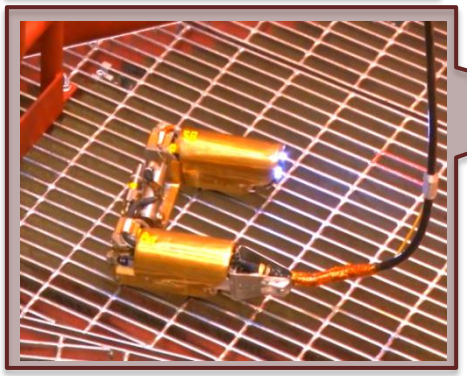
Shape changing

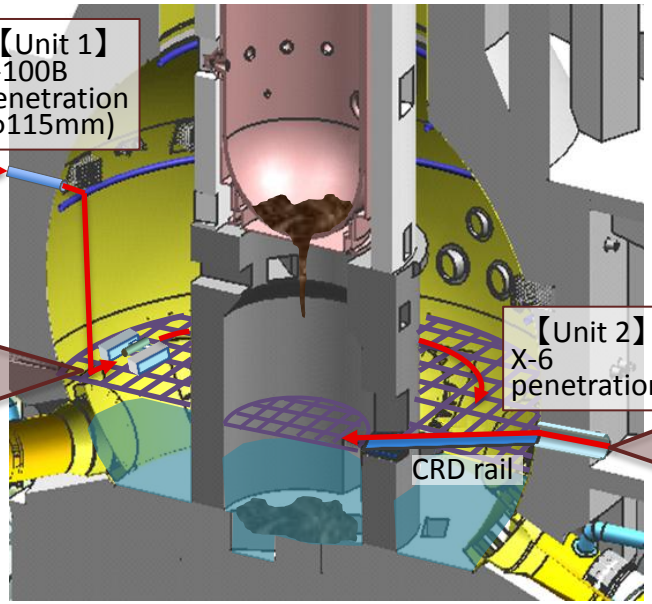


Moving along flat surfaces

Small size crawler (Unit 2)

Coming in the inside of the pedestal via CRD rail



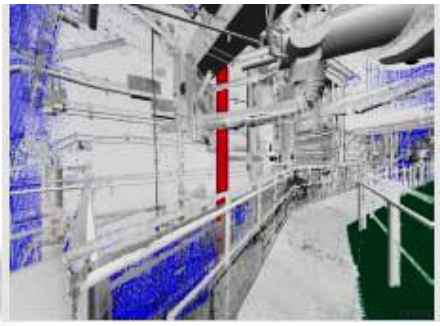


Visualization method beyond camera

■Laser scan makes 3D picture of the Reactor building interior

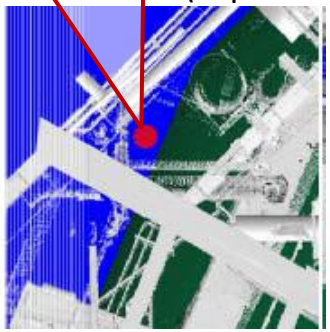
3D laser scanner
40,000,000 points data/10 min

(Horizontal view)



Space to pass the equipment from 1st floor to the torus room can be found

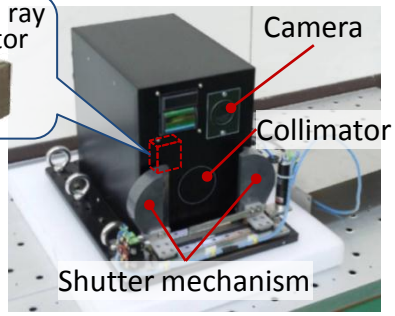
(Top view)



■Gamma camera shows the radiation distribution

Gamma camera

Gamma ray detector



Hot spot in the pipes are observed

■Reactor interior survey using 'Muon Permeation Method'