Overview of IRID R&D
Focusing on Debris Retrieval

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Outline of IRID

1. Name
International Research Institute for Nuclear Decommissioning (IRID)
http://www.irid.or.jp/en/

2. Date of Establishment
August 1, 2013

3. Membership (18 organizations)
   2 Research Institutes
   4 Manufacturers
   12 Electric Utilities, etc.
IRID Research and Development Projects

1. Decontamination and Dose Reduction
   - Technology for remote operation

2. Detection of Fuel Debris
   - Indirect method
     - By analysis
     - Using cosmic ray MUON
   - Direct methods
     - Inside PCV and RPV

3.4. PCV Repair
   - Development of Technology
   - Full-scale test

5. Debris Retrieval
   - Development of fundamental Technology
   - Development of access method and system
   - Development of criticality control method

6. Debris Transfer and Storage
   - Development of technology for collection, transfer and storage of debris
High density material (fuel) is not detected at the area where the reactor core was originally located.
Investigation using MUON at Unit 2

Confirming the high density material shadow that is assumed to be fuel debris at the bottom of RPV.

* 1 pixel size is equivalent to approx. 25 cm of cross-section of the reactor.

Structure of lower part of RPV

Source: Publicized results by TEPCO Holdings, July 28, 2016
Results of Muon Investigation at Unit 2 & 3

- Assuming the high density material that exists at the bottom of Unit 2 RPV.
- Not confirming the high density material at Unit 3 RPV that is assumed to exist at the Unit 2 RPV.

Source: Publicized results by TEPCO Holdings, July 28, 2016
Investigation of inside the PCV using Robots

Investigation of outside the pedestal (Unit 1)

- Shape-changing robot (B1, B2 investigation)

When driving the narrow part
Advancing direction

Crawlers (two units)
Camera for guide pipe advancement

Shape changing

Thermometer

During investigation

Camera for investigation
Dosimeter

(Note) The robot for B1 investigation is shown in the above photos

Investigation of inside the pedestal (Unit 3)

Thruster for up-and-down
Front camera

Investigation of inside the pedestal (Unit 2)

- Remotely operated crawler robot for investigation (A2 investigation)

When driving the narrow part

Shape changing

Thermometer

During investigation

Camera for investigation
Dosimeter

Additional lighting

Rear camera and lighting

Refrigerator

During investigation

Thruster for driving
Light

Submersible Crawling Robot
B2 Investigation at Unit 1 (Videos)
A2 Investigation at Unit 2

Accretion of the grating

Sediments on CRD rail

Crack of platform grating

Deformed platform

Gap between platform and CDR rail
A2 Investigation at Unit 2

Inside the pedestal (upper section of platform, middle-right side)

TIP guide pipe support (28-27) CR34-43 LPRM28-37 CR30-43

Area where PIP cables and LPRM cannot be confirmed

Cable damage appears to be limited

LPRM guide tube

*Image processing: TEPCO Holdings
Investigation of the inside the pedestal at Unit 3

[Investigation route]
(1) **Access from the X-53 penetration.**
(2) Going inside the pedestal.
(3) Checking the access route to the basement floor of pedestal.
(4) Entering the basement floor of the pedestal.

[Investigation Items]
(1) Status of damage on the platform and the lower CRD.
(2) Presence of obstacles at CRD slot opening.
(3) Conditions of debris accumulated at the bottom of pedestal.
(4) Conditions of debris from the access opening for workers to the outside pedestal.
Investigation Device for Unit 3

Submersible Crawling Robot: "Mini-mambo"

- Thruster for up-and-down
- Cable
- Thruster for driving
- Camera
- LED right (2.5W × 12)

Specifications:
- Size: φ125mm,
- Length: ≤300mm
Video images of Underwater ROV at Unit 3
Fuel Debris Retrieval

**Technical issues**
- Confinement of Radioactive dust
- Remote Operation
- Reduction of radiation dose, Prevention of spreading of contamination

**Development of key technology**

**Submersion - Top entry**
- Working cell
  - Upper table
- Lower table
  - SFP

**Dry – Top entry**
- R/B crane
- Working cell
- Shield plug
- D/S pit
  - SFP
  - Access device inside RPV

**Dry – Side entry**
- X6
- Access rail
- Robot arm

**Robot arm**
【PLAN-A】Side Entry : Access Rail Method
Images of Fuel Debris retrieval (Videos)
Safety Function

Safety Function Requirements

1. Cooling down
2. Confinement (control of negative pressure and water level in torus room)
3. Deactivation (protection of fire and explosion)
4. Sub-criticality

Nitrogen supply & exhaust gas treatment system

Nitrogen supply system (RPV deactivation)
PCV gas management system
Negative pressure control, hydrogen scavenging & release
Reactor building gas control system
Mitigation of radioactive release during normal operation

Circulation cooling & criticality control system

Water treatment system
Debris cooling, reduction of radioactivity
Torus room drainage system
Prevention of groundwater reverse, reduction of radioactivity, prevention of criticality

Ventilation system for the building & cell

Exhaust system for building and cell
(Control and release of negative pressure)
Air supply system for building
(Maintaining working environment)
Collection, Transfer and Storage of Fuel Debris

Canister design

⇒ Response to 1F specific requirements

- High fuel exposure and enrichment → high reactivity
- MCCI → hydrogen generation caused by core concrete interaction
- Injecting sea water, melting cable → effects caused by salt and impurities

Transfer (Dry –side access method)

- R/B

Maintenance cell

Storage cell for fuel debris retrieval

Carry-out port (additional)

Handling cell for a storage canister

Transport cell

Fuel debris transport building

Draft

Storage facility

Carrying out a transport cask

Fuel debris retrieval

Storing in canister

Washing a canister

Storing canister in a transport cask

Unit can

Canister

Transport cart

Transport cask

Trailer

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Thank you for your attention!