The 34th JAIF-KAIF Seminar on Nuclear Industry

Overview of IRID R&D Focusing on Debris Retrieval

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International Research Institute for Nuclear Decommissioning (IRID)

This achievement is obtained from the Subsidy Project of Decommissioning and Contaminated Water Management by Ministry of Economy, Trade and Industry (METI).

Outline of IRID

1. Name

International Research Institute for Nuclear Decommissioning (IRID)

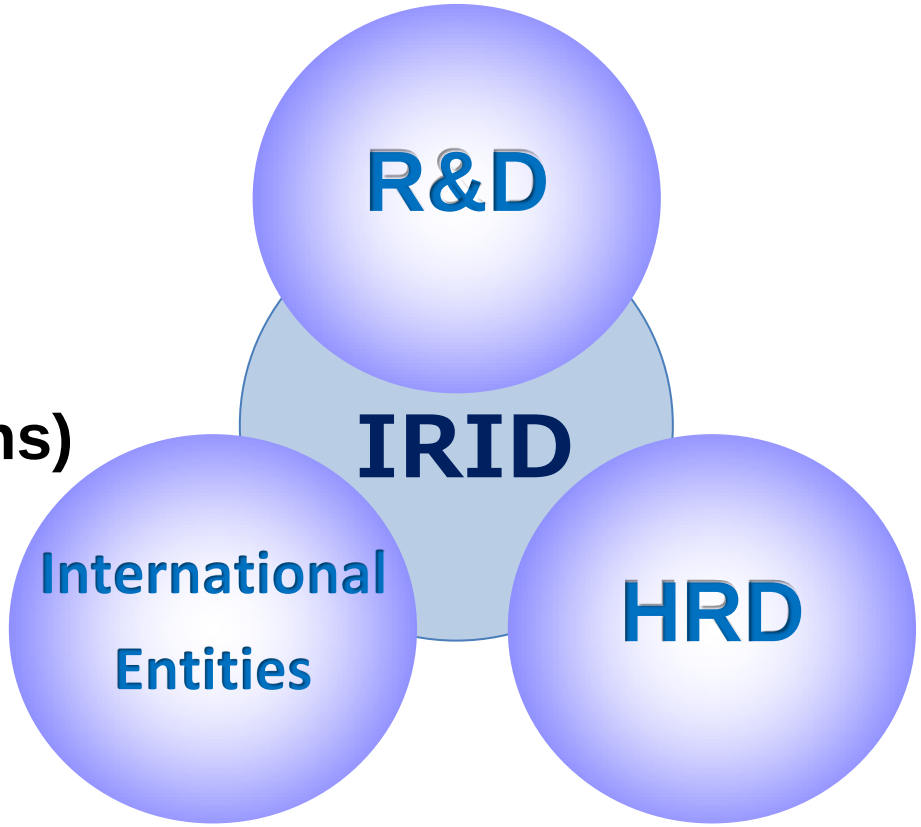
http://www.irid.or.jp/en/

2. Date of Establishment

August 1, 2013

3. Membership (18 organizations)

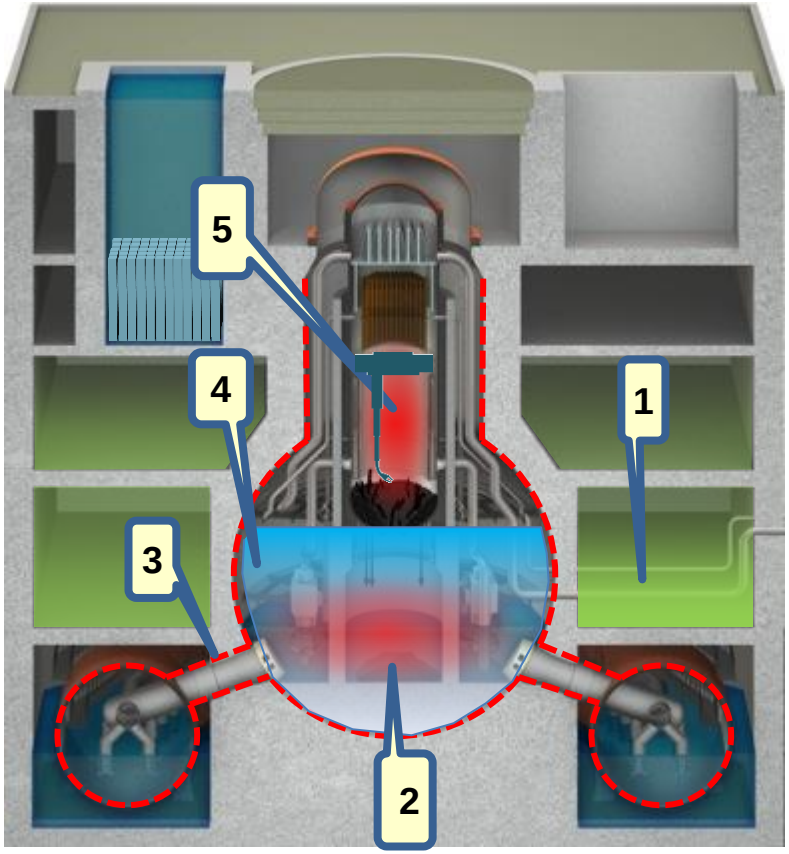
2 Research Institutes
4 Manufacturers
12 Electric Utilities, etc.



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**

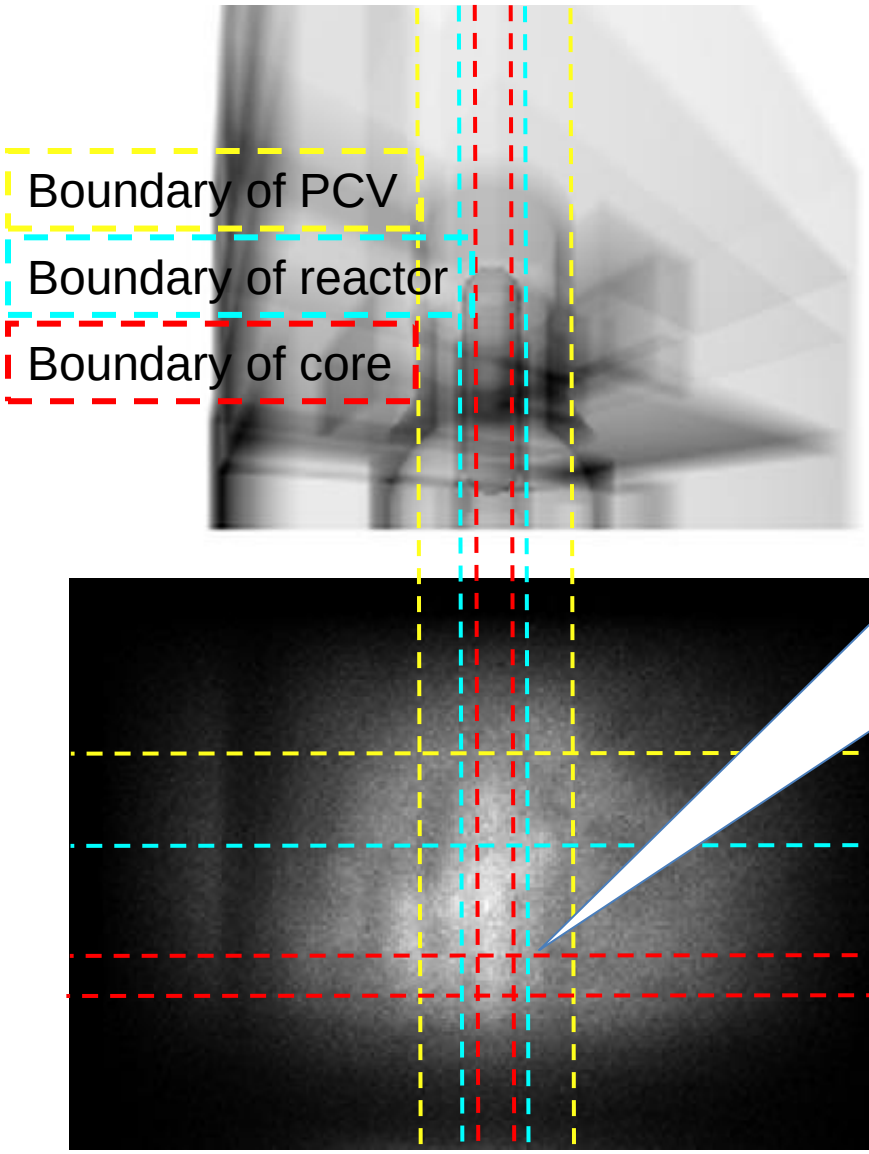
5. Debris Retrieval

- 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

Detection of Fuel Debris using Cosmic Ray MUON at Unit 1

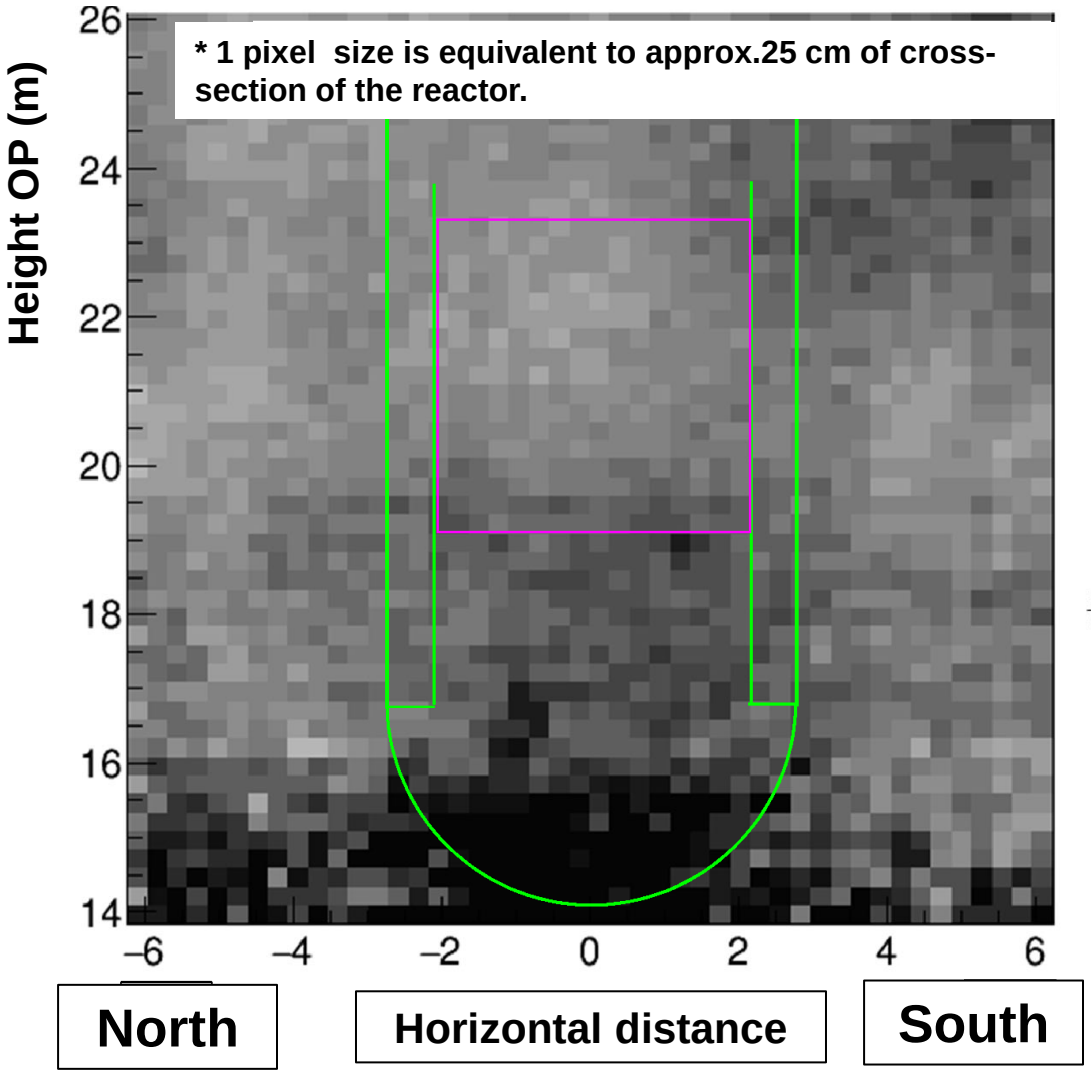


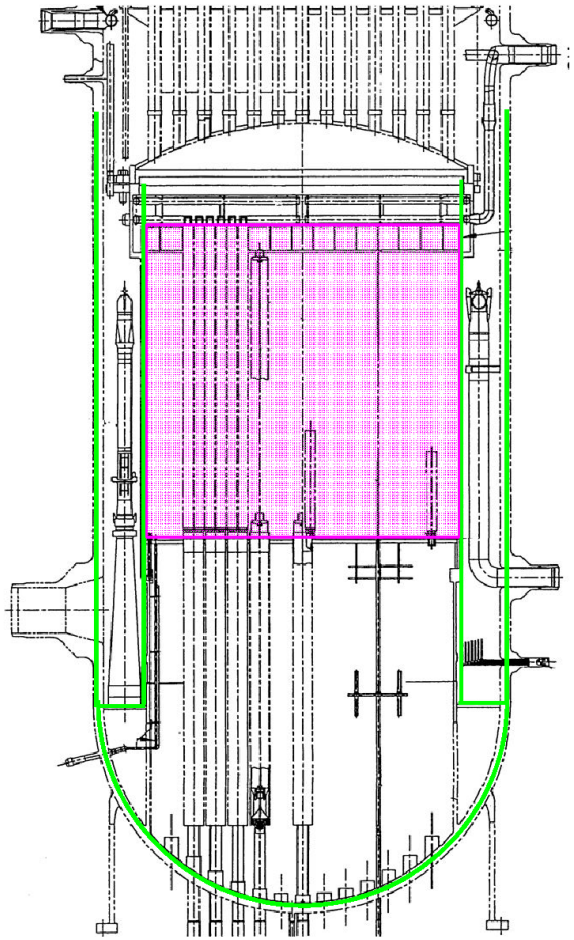
High density material (fuel) is not detected at the area where the reactor core was originally located.

Investigation using MUON at Unit 2

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

(Measurement result: as of July 22, 2016)





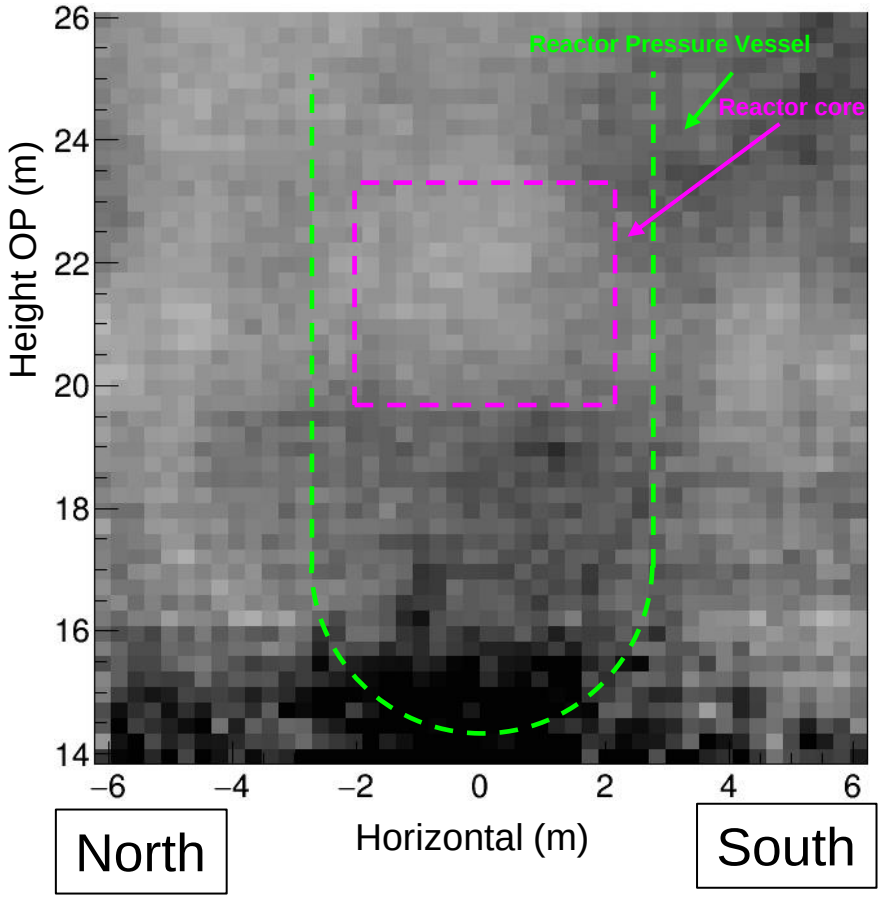
Structure of lower part of RPV

Source: Publicized results by TEPCO Holdings, July 28, 2016

Results of Muon Investigation at Unit 2 & 3

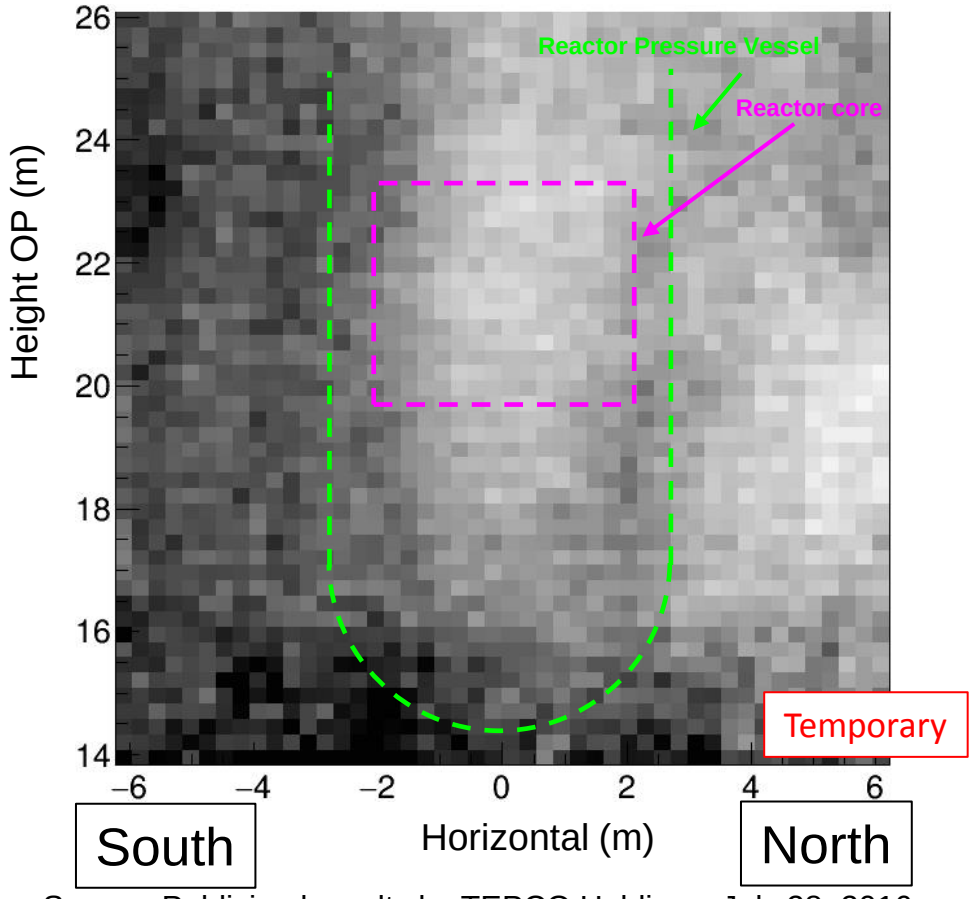
- Assuming the high density material that exists at the bottom of Unit 2 RPV.
- Not confirming the high density material at Unit 3 RPV that is assumed to exist at the Unit 2 RPV.

Unit 2



Unit 3

As of July 20, 2017)



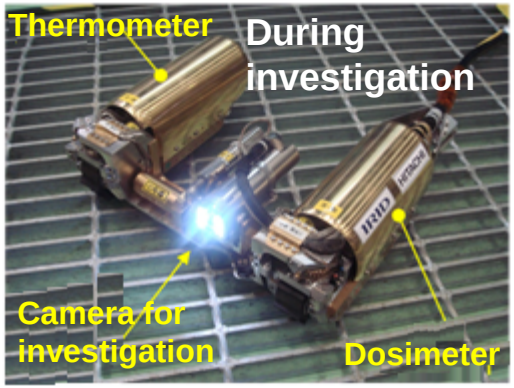
Source: Publicized results by TEPCO Holdings, July 28, 2016

Investigation of inside the PCV using Robots

Investigation of outside the pedestal (Unit 1)

○Shape-changing robot (B1,B2 investigation)

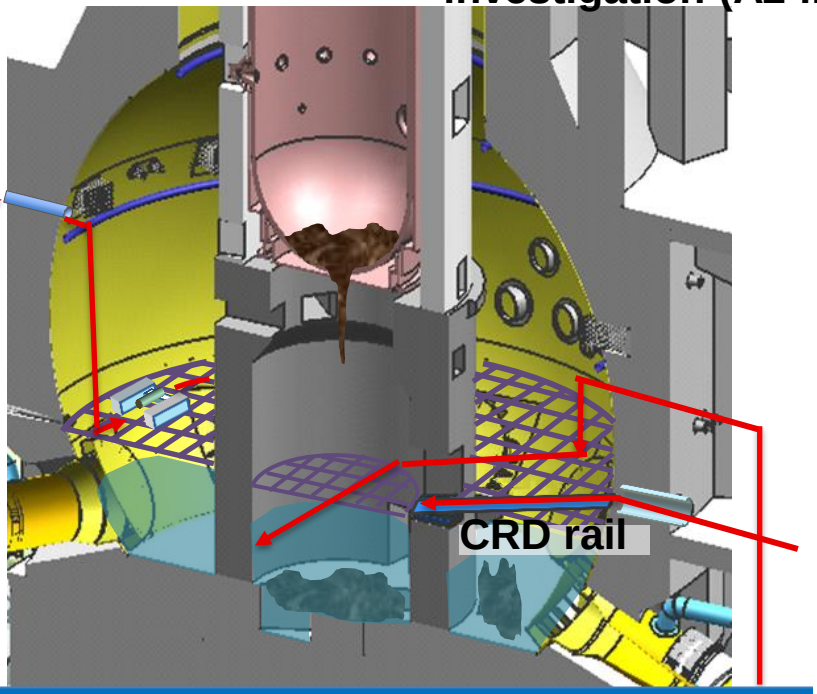
Shape changing



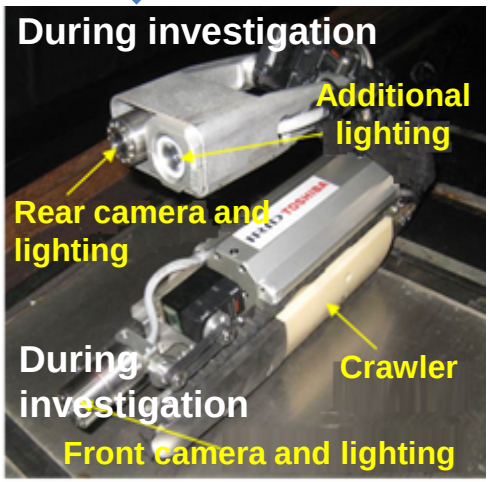
(Note) The robot for B1 investigation is shown in the above photos

Investigation of inside the pedestal (Unit 2)

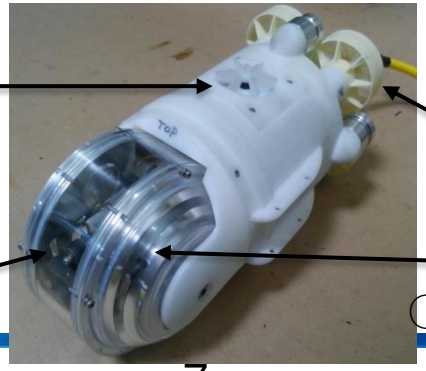
○Remotely operated crawler robot for investigation (A2 investigation)



Shape changing



Investigation of inside the pedestal (Unit 3)

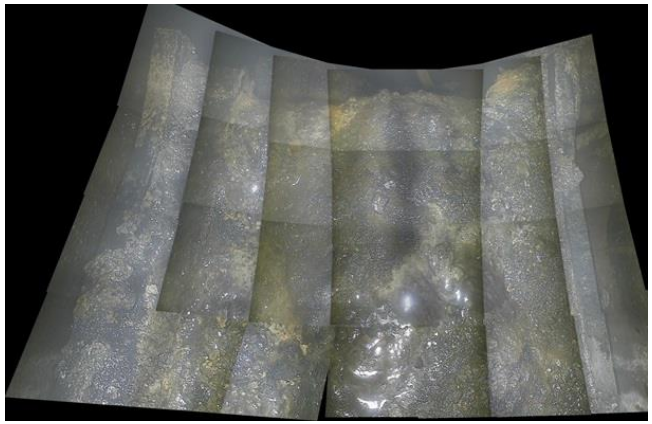


○Submersible Crawling Robot

B2 Investigation at Unit 1 (Videos)

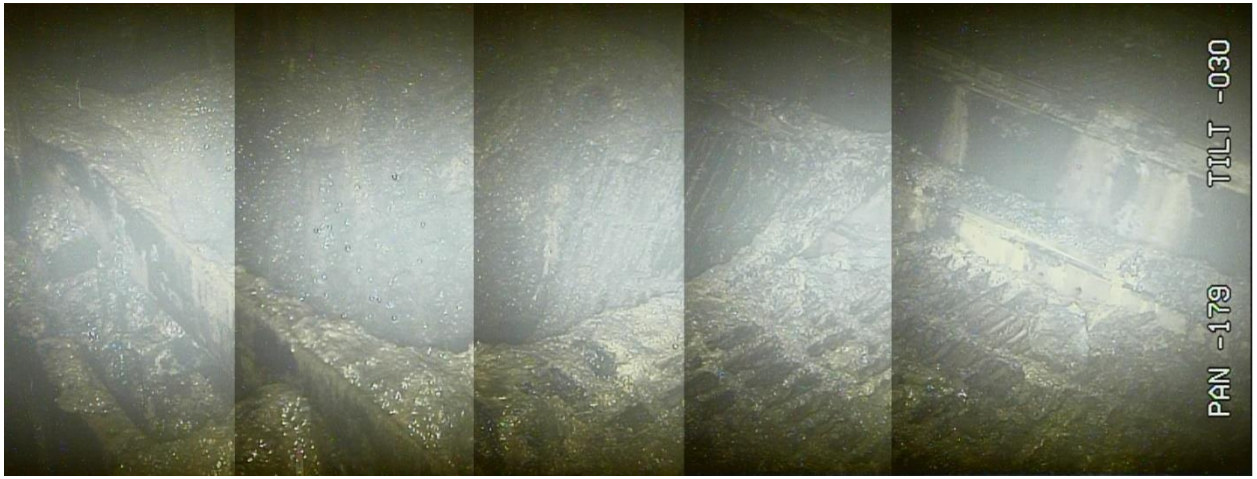
A2 Investigation at Unit 2

Accretion of the grating



Sediments on CRD rail

Crack of platform grating



Deformed platform

Gap between platform and CDR rail

9

A2 Investigation at Unit 2

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

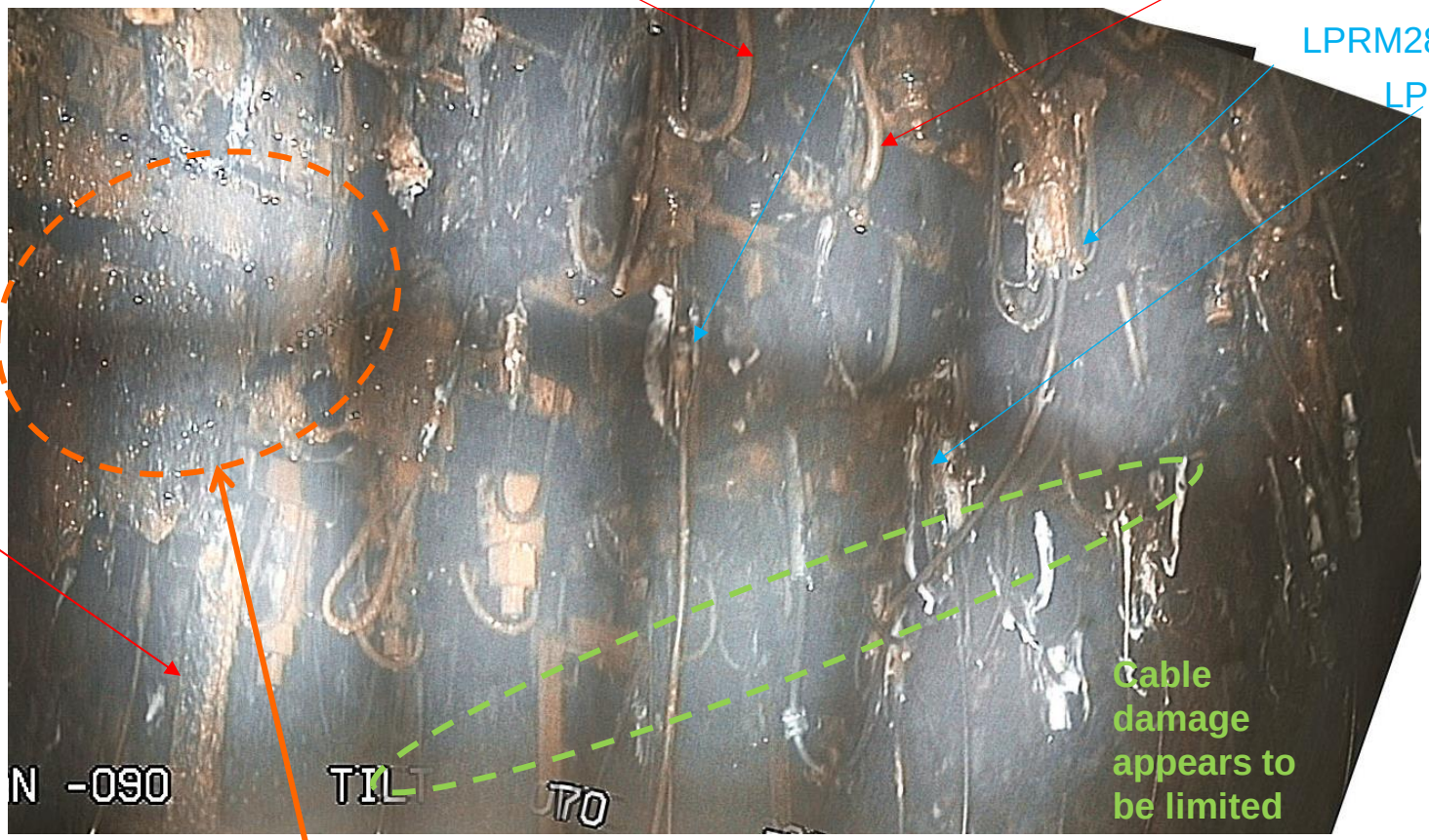
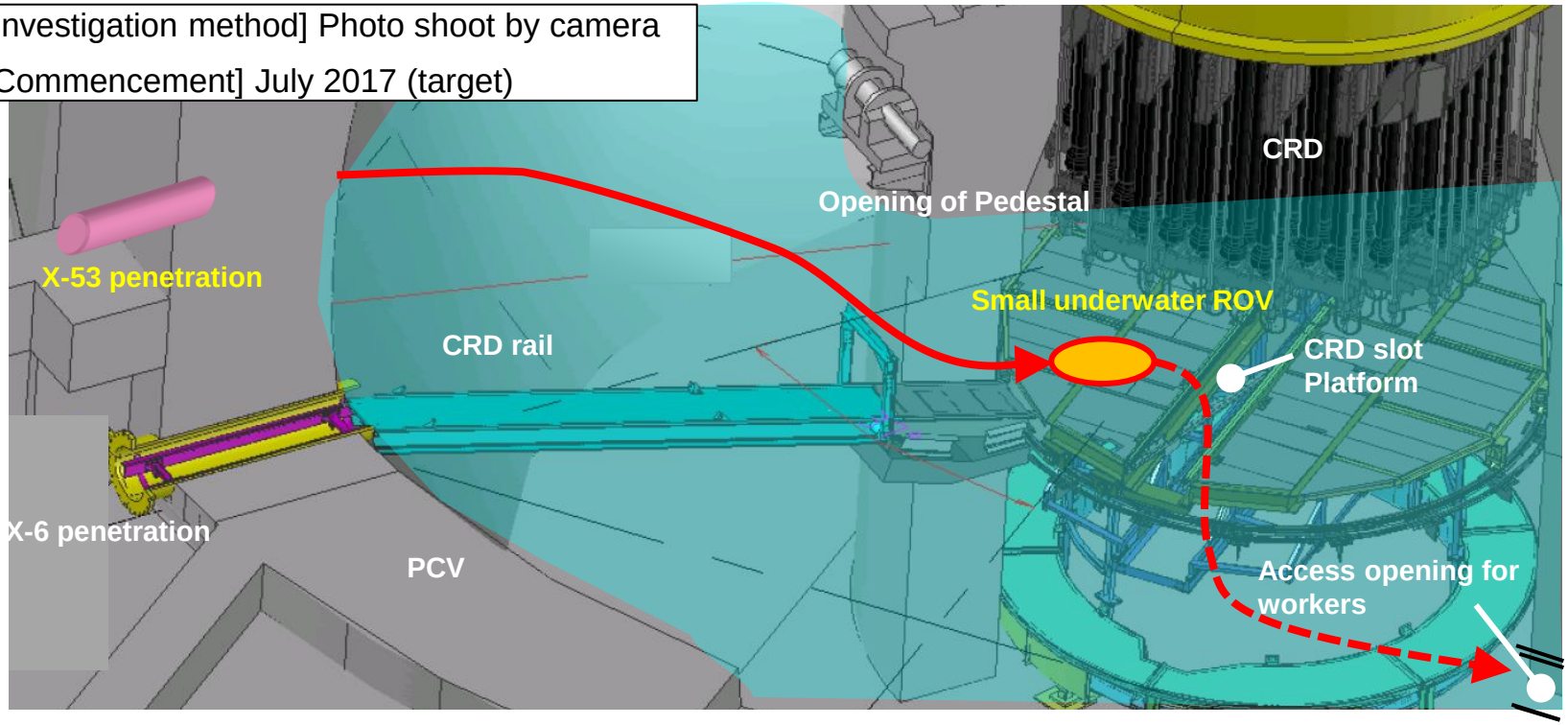


*Image processing: TEPCO Holdings

Investigation of the inside the pedestal at Unit 3

[Investigation method] Photo shoot by camera
[Commencement] July 2017 (target)

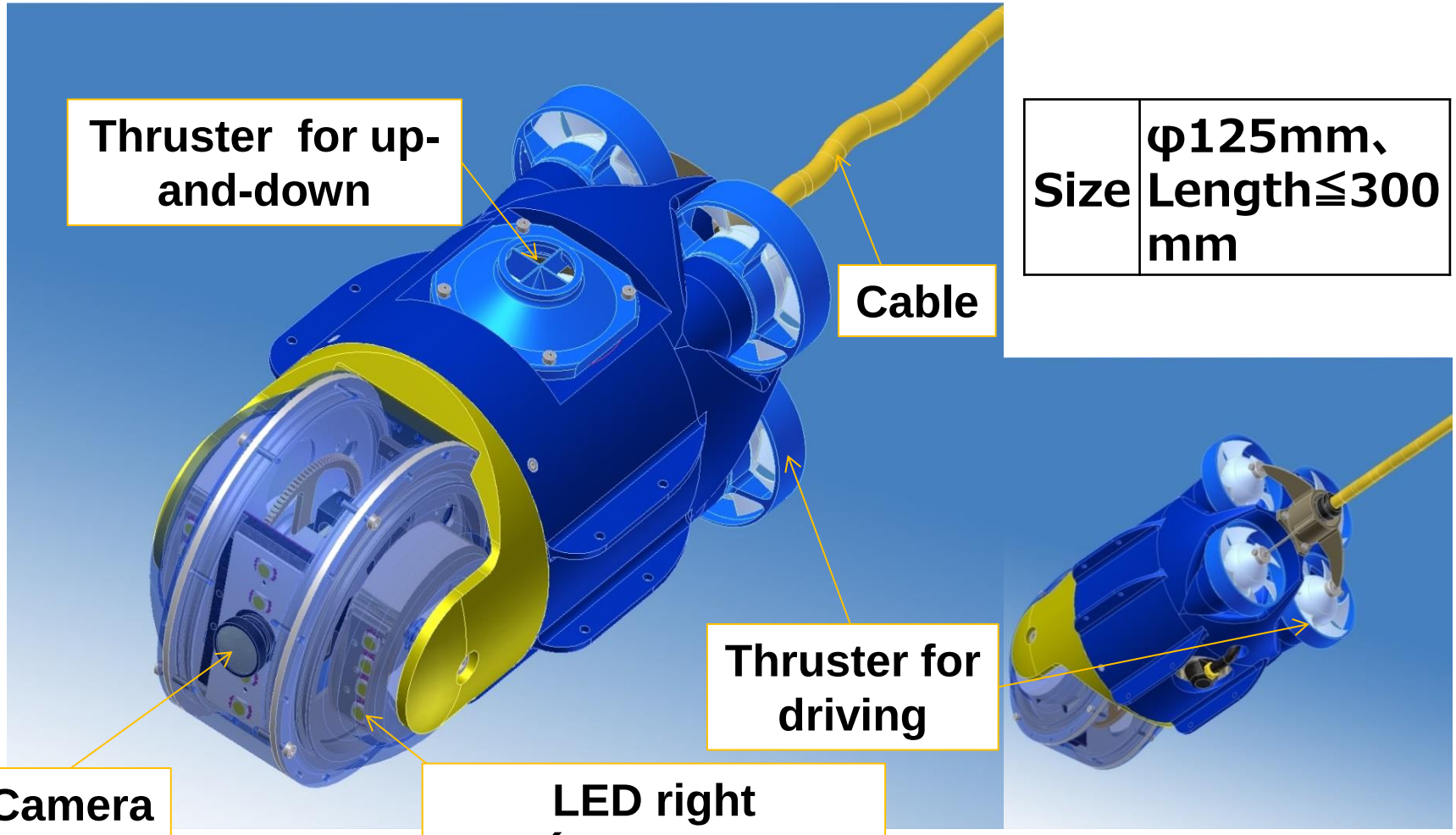


[Investigation route]
(1) Access from the X-53 penetration.
(2) Going inside the pedestal.
(3) Checking the access route to the basement floor of pedestal.
(4) Entering the basement floor of the pedestal.

[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”



Size	φ125mm、Length≦300 mm

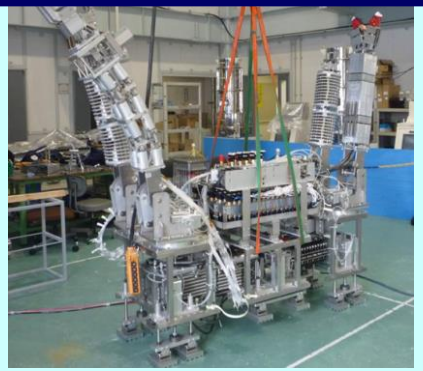
Video images of Underwater ROV at Unit 3

Fuel Debris Retrieval

Technical issues

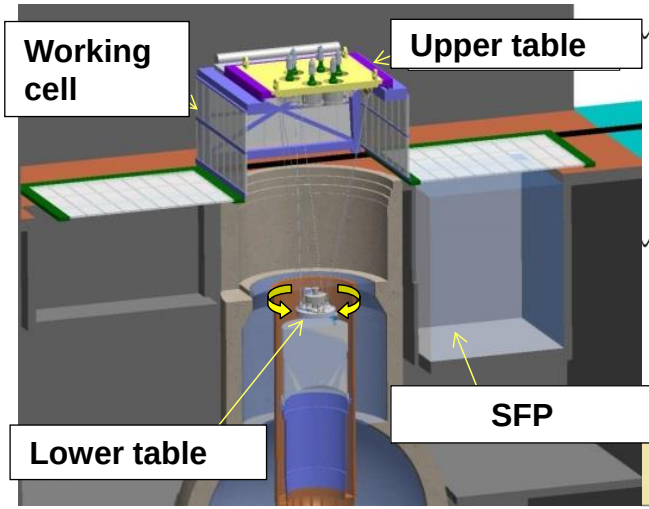
- Confinement of Radioactive dust
- Remote Operation
- Reduction of radiation dose, Prevention of spreading of contamination

Development of key technology

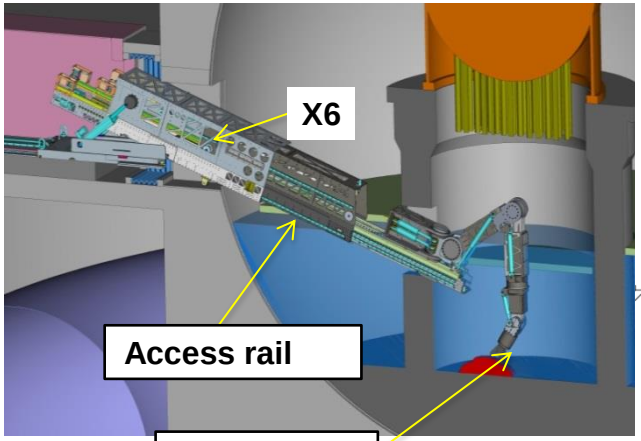


Robot arm

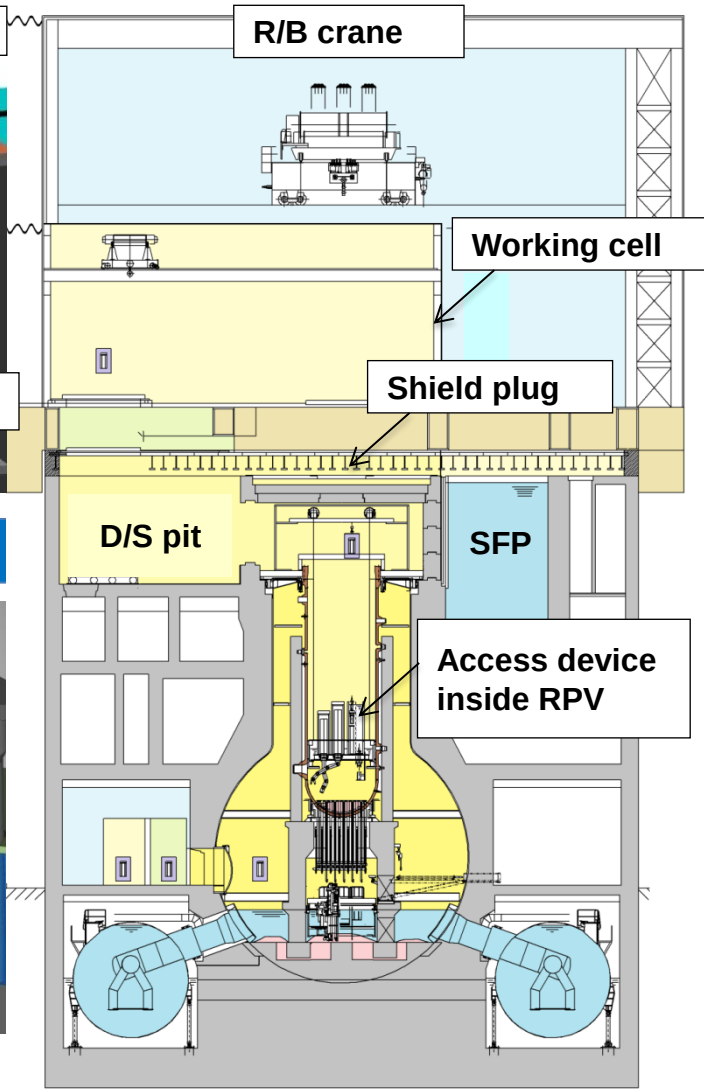
Submersion - Top entry



Dry – Side entry



Dry – Top entry

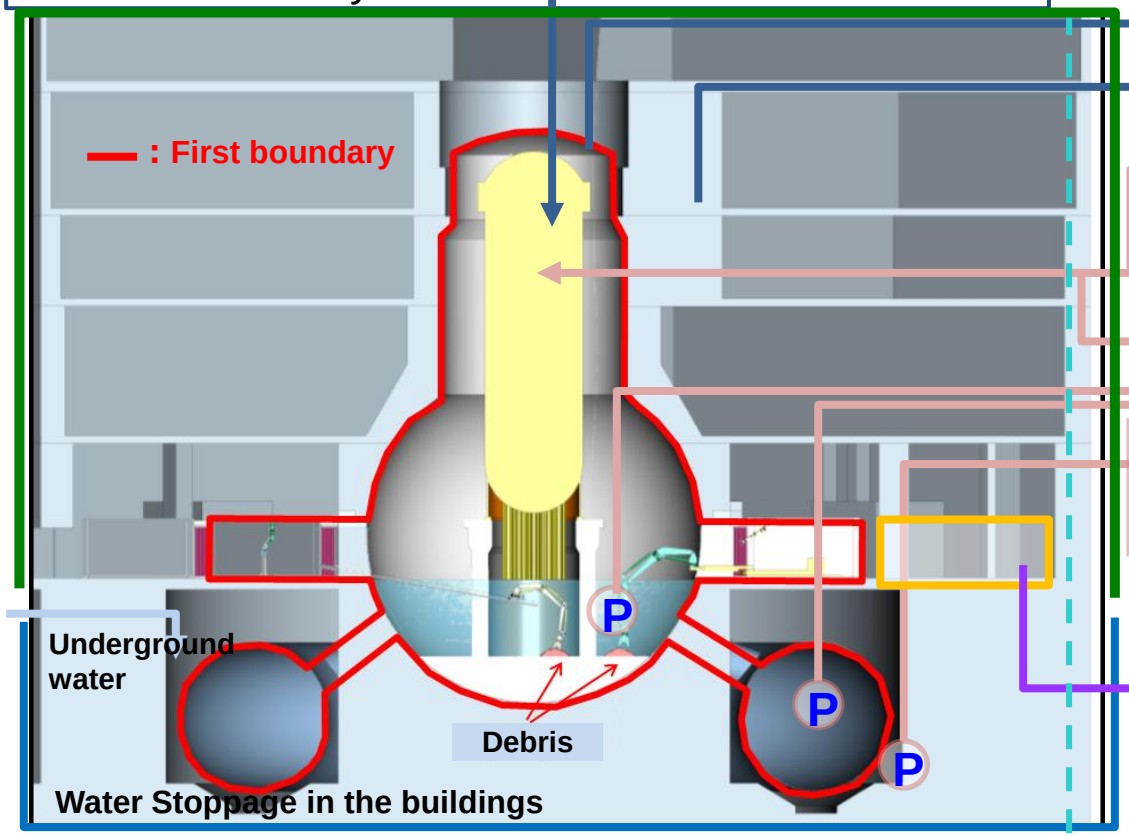


【PLAN-A】Side Entry : Access Rail Method Images of Fuel Debris retrieval (Videos)

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



②Nitrogen supply & exhaust gas treatment system

Nitrogen supply system
(RPV deactivation)

PCV gas management system
Negative pressure control, hydrogen scavenging & release

Cleaning tower

Reactor building gas control system
Mitigation of radioactive release during normal operation

①Circulation cooling & criticality control system

Water treatment system

Boric acid concentration control system

P

Circulation cooling system
Debris cooling, reduction of radioactivity

Torus room drainage system
Prevention of groundwater reverse, reduction of radioactivity, prevention of criticality

③Ventilation 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)

Auxiliary building

: Second boundary(gas) : Second boundary(liquid)

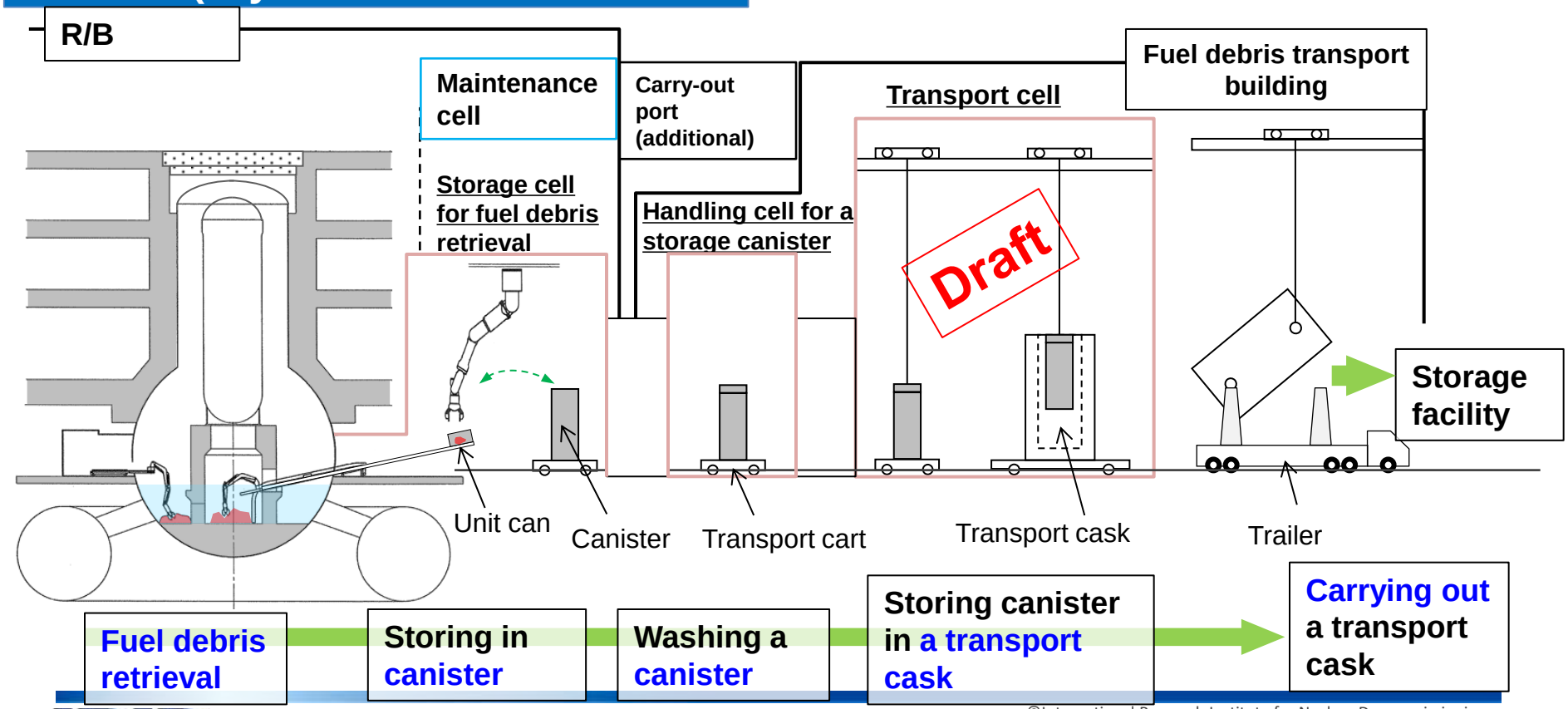
Collection, Transfer and Storage of Fuel Debris

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)



Thank you for your attention!