Restoration work for obstacle and upper core structure in reactor vessel of experimental fast reactor Joyo

December . 7th , 2009

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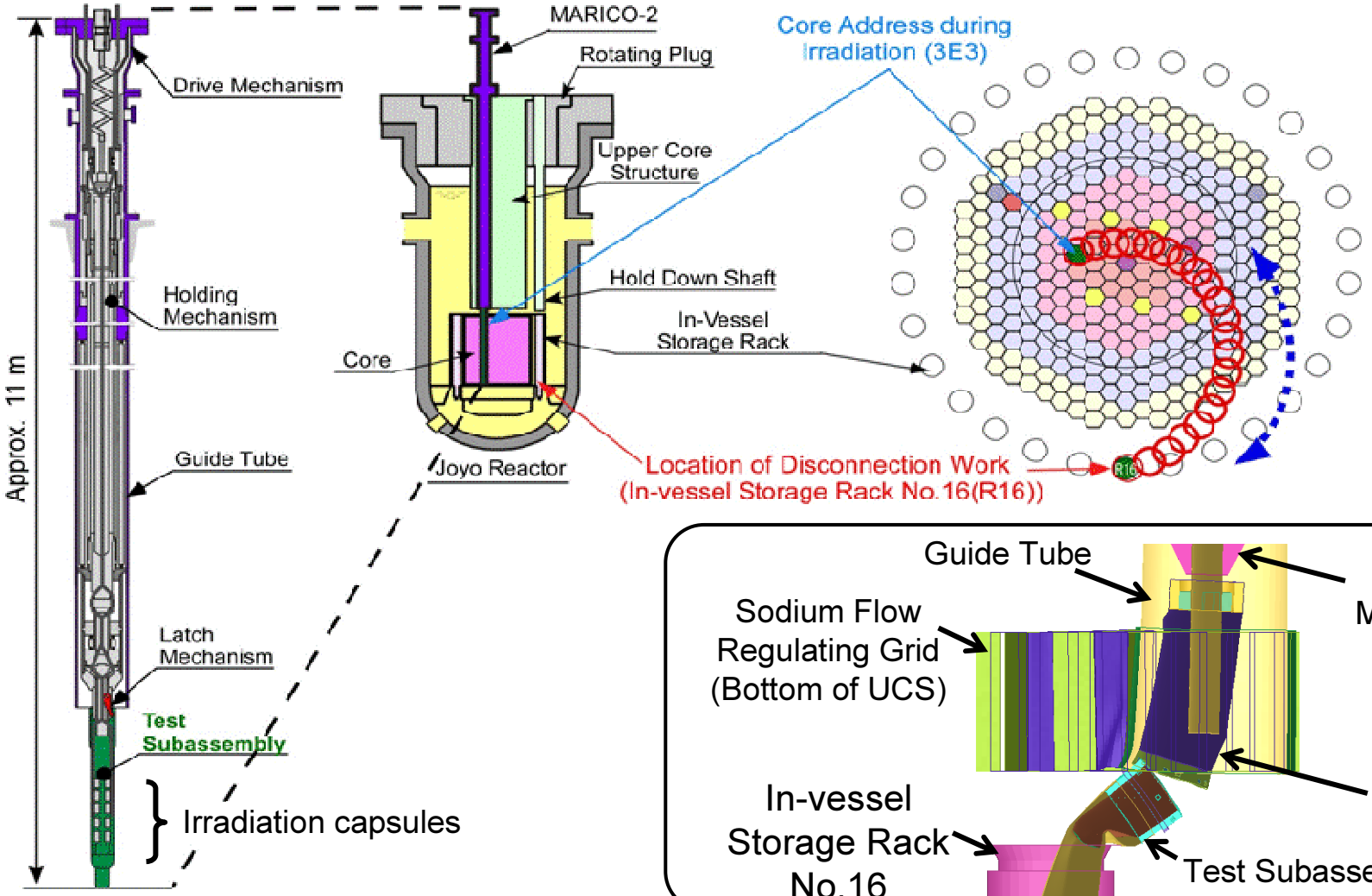
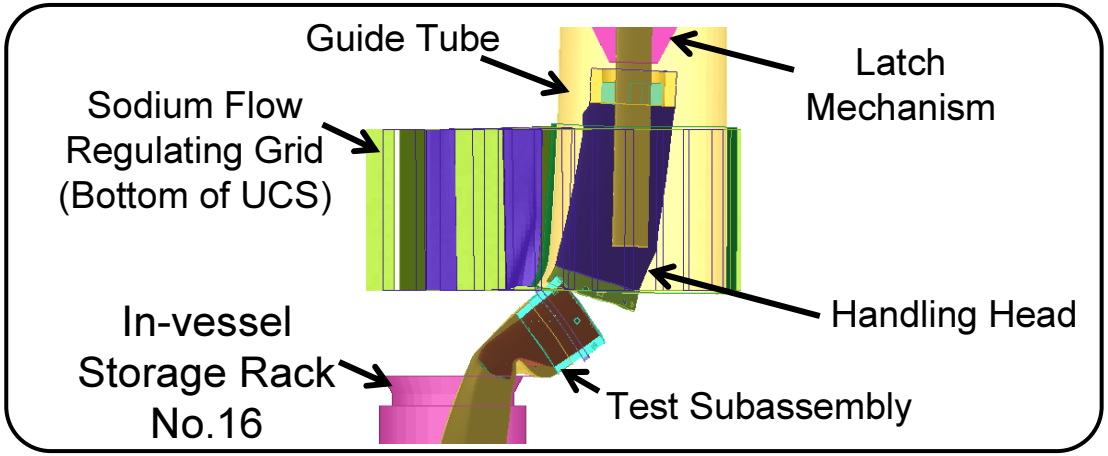
- Summary

Outline of the incident



MAterial testing RIg with temperature COntrol



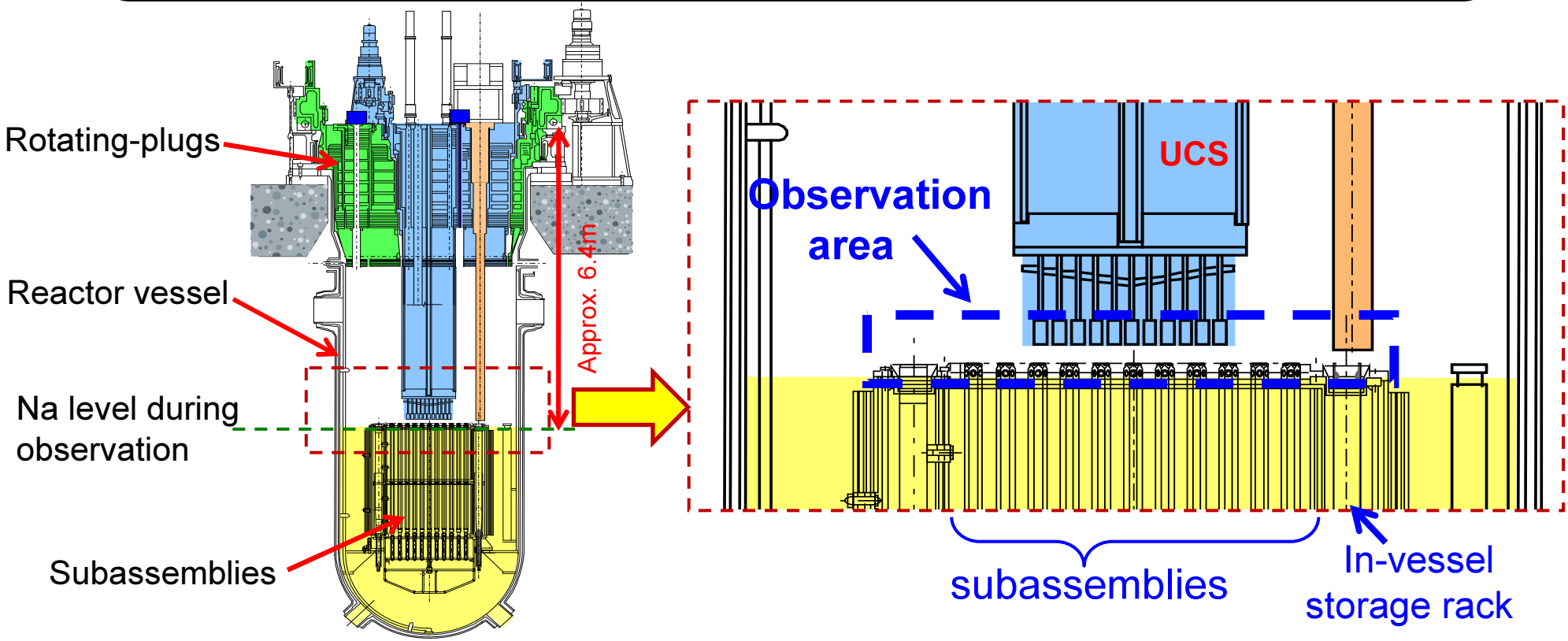
- The test subassembly wasn't disconnected from the holding mechanism.
- Test subassembly was bent on the in-vessel storage rack.

In-vessel visual inspection

The following in-vessel observation were required :

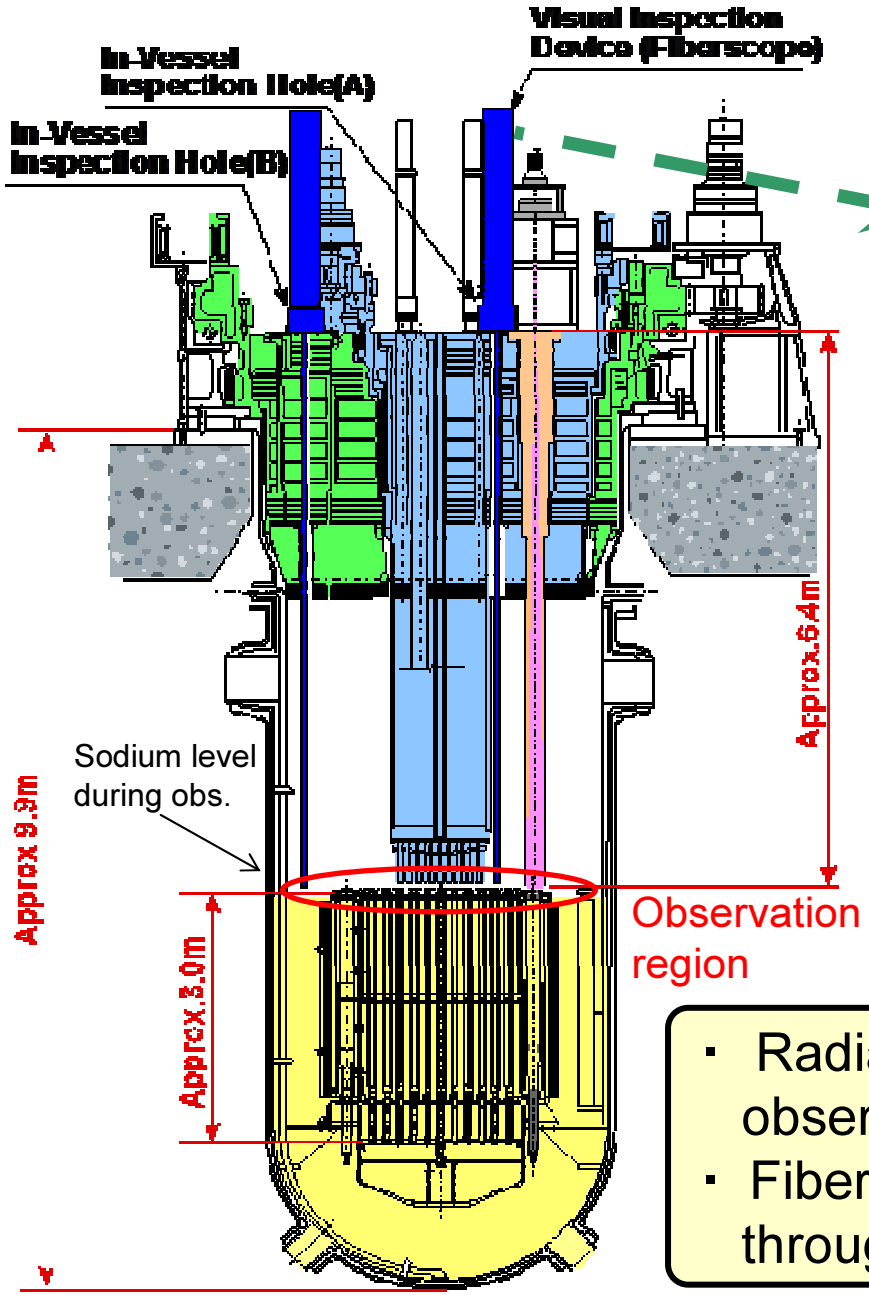
(1) The MARICO-2 on the in-vessel storage rack and top of the subassemblies

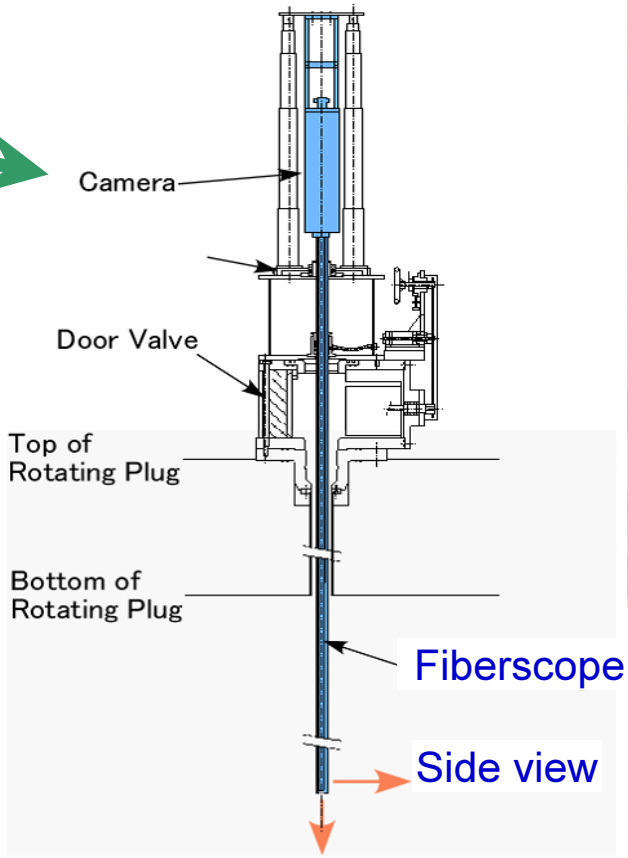
(2) The bottom face of the UCS

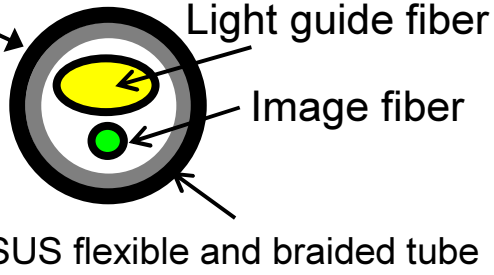


Specific design and development for in-vessel observation techniques

In-vessel visual inspection by fiberscope



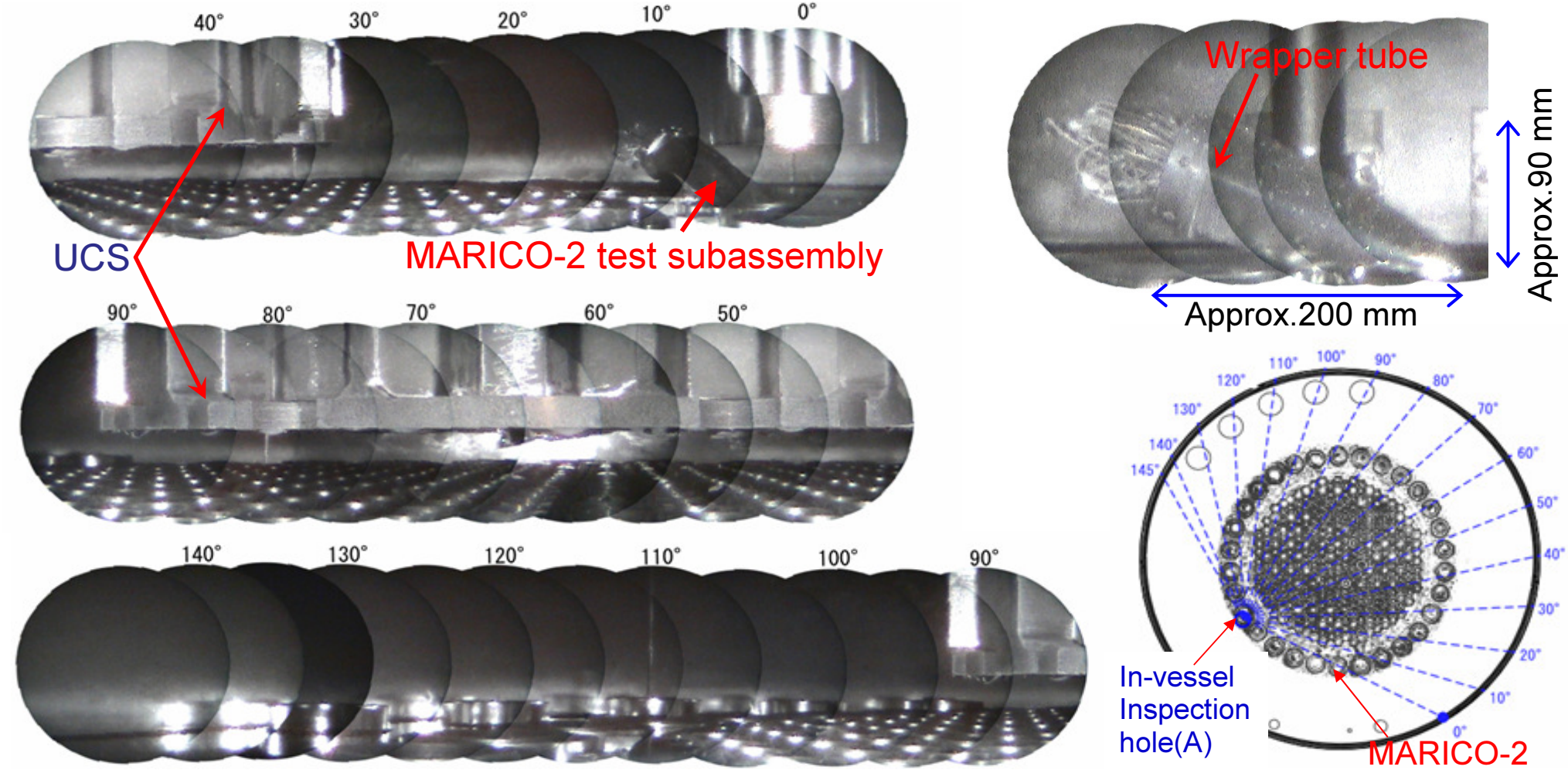




- Radiation resistant fiberscope was applied to observation.
- Fiberscope was inserted in the reactor vessel through the in-vessel inspection holes.

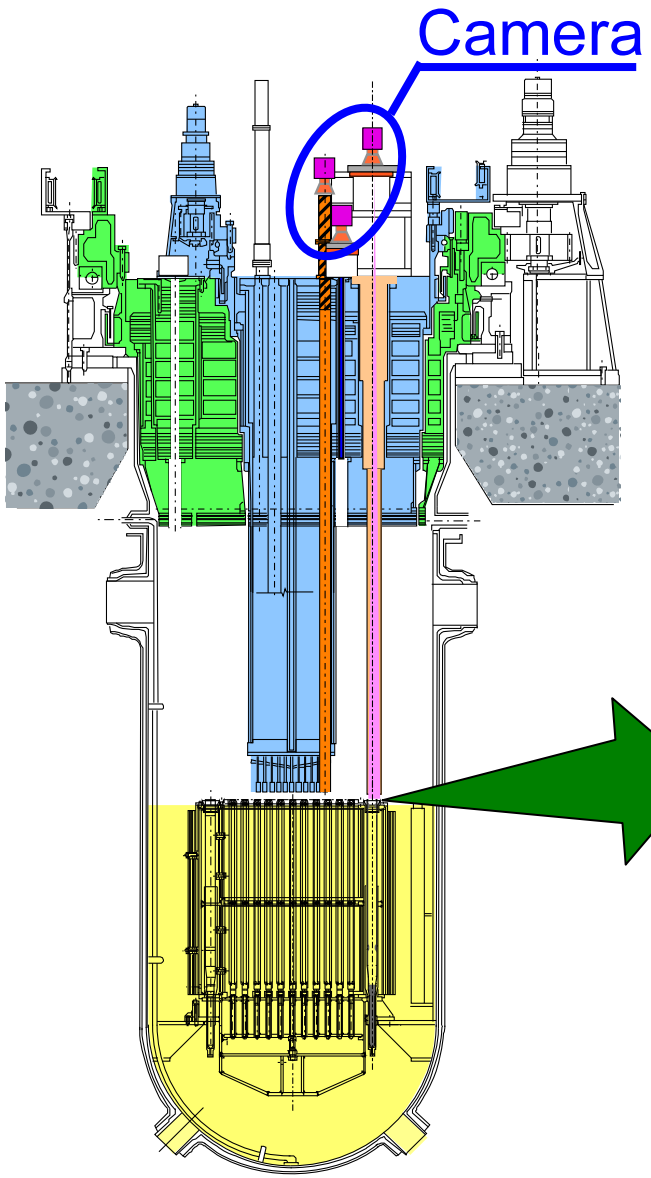
Results of observation by fiberscope

- Clear images were obtained by radiation resistant fiberscope.
- Grasp the condition of the bent MARICO-2.

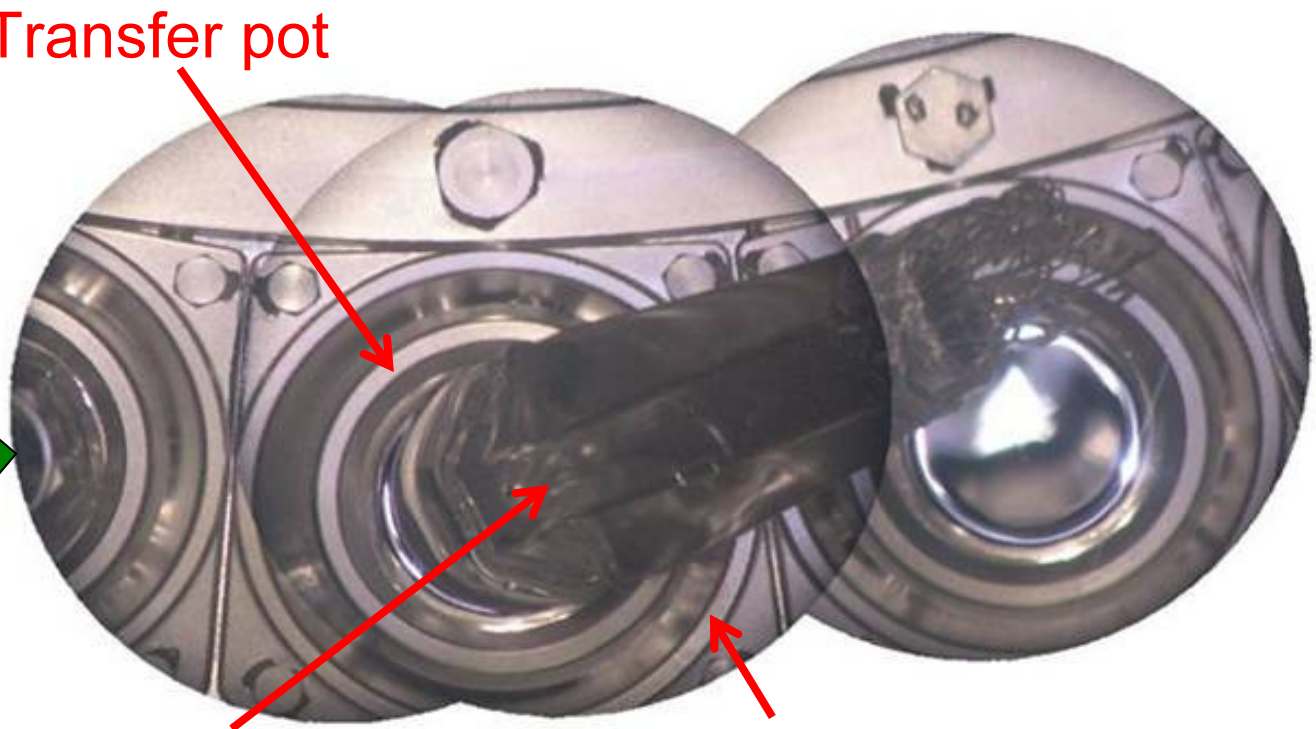


In-vessel visual observation by camera

- Bent MARICO-2 on in-vessel storage rack -



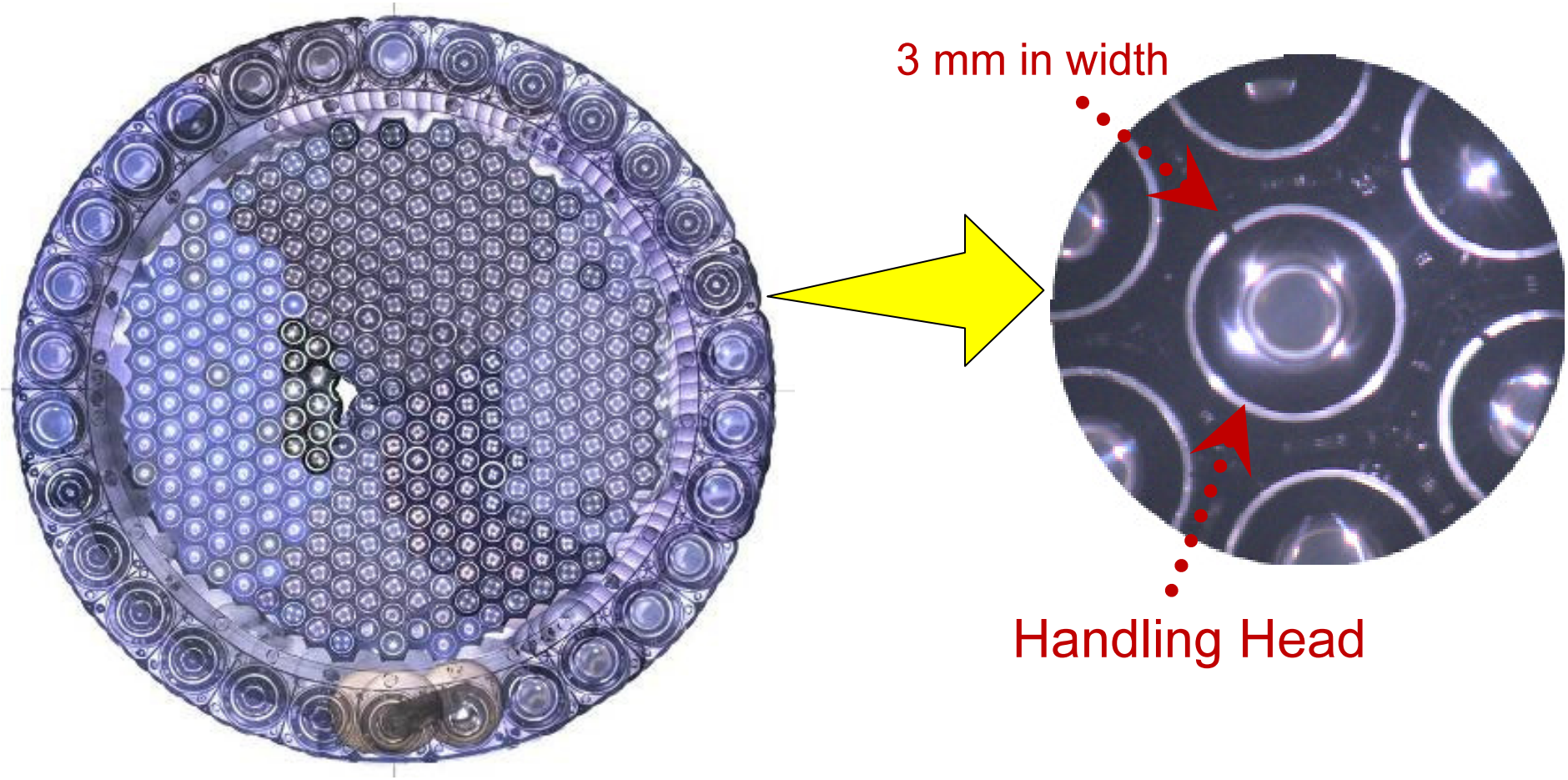
- Grasp the conditions of the transfer pot and the bent MARICO-2.



In-vessel visual observation by camera

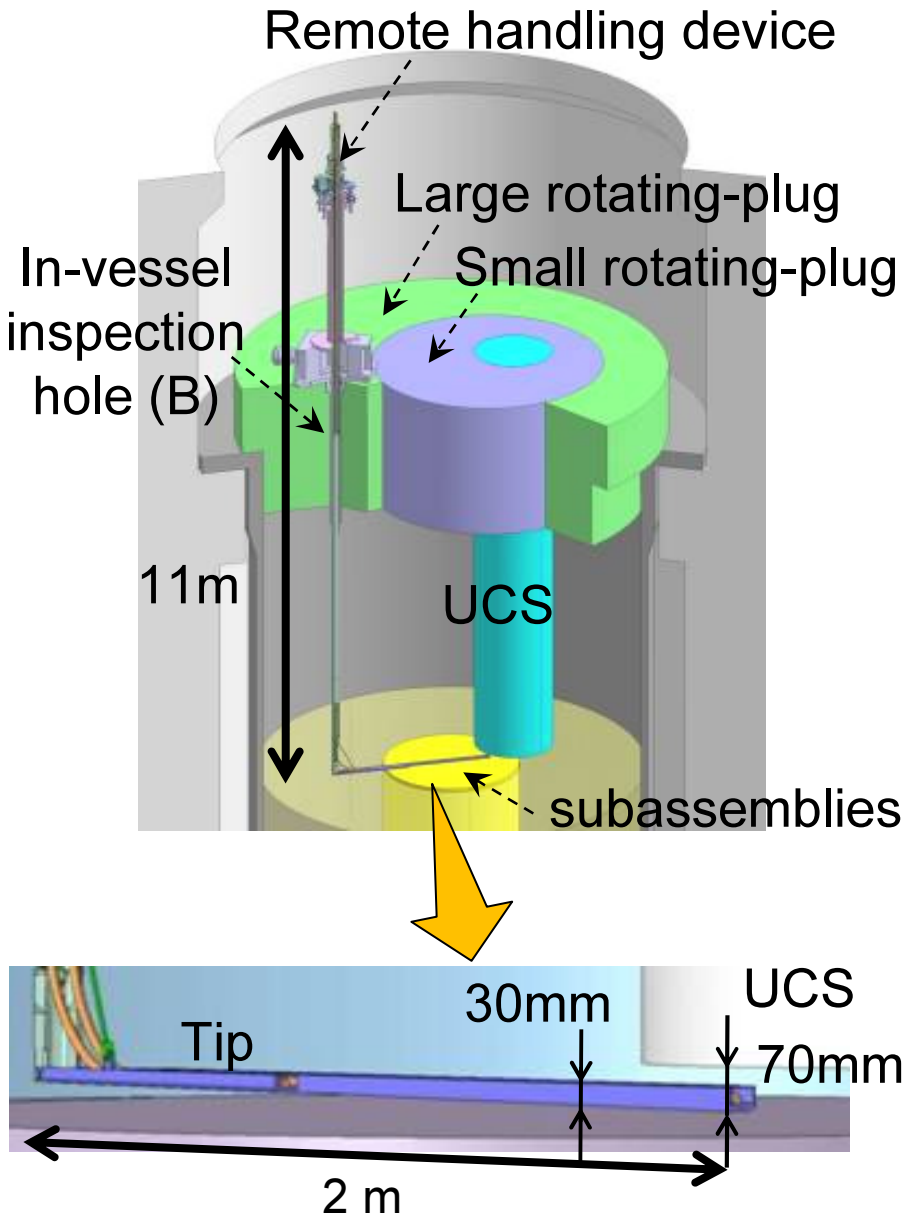
- Top of the subassemblies and in-vessel storage rack-

- No injuries to each handling head of subassembly and in-vessel storage rack

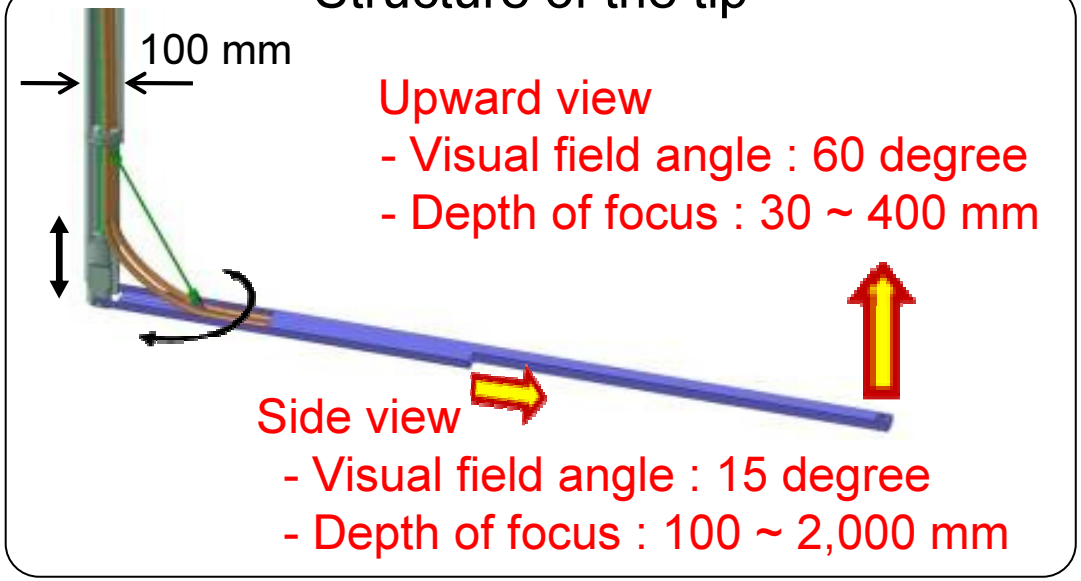


Composite photograph

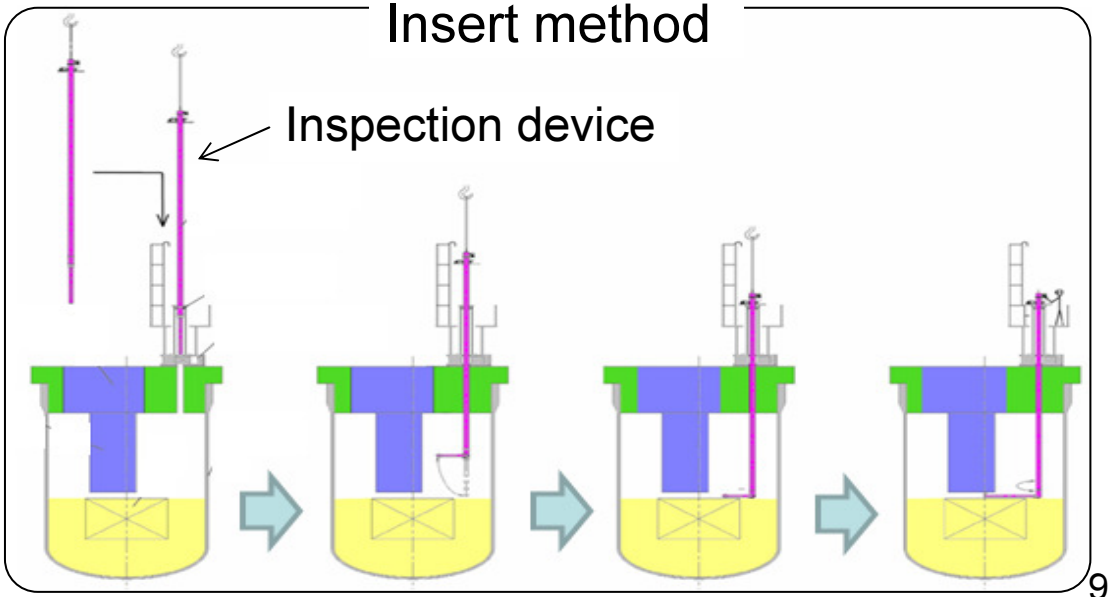
Visual inspection device for UCS bottom



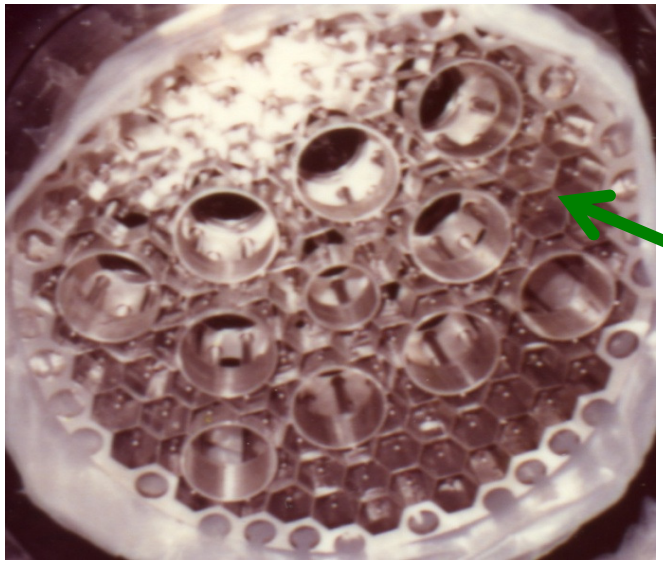
Structure of the tip



Insert method



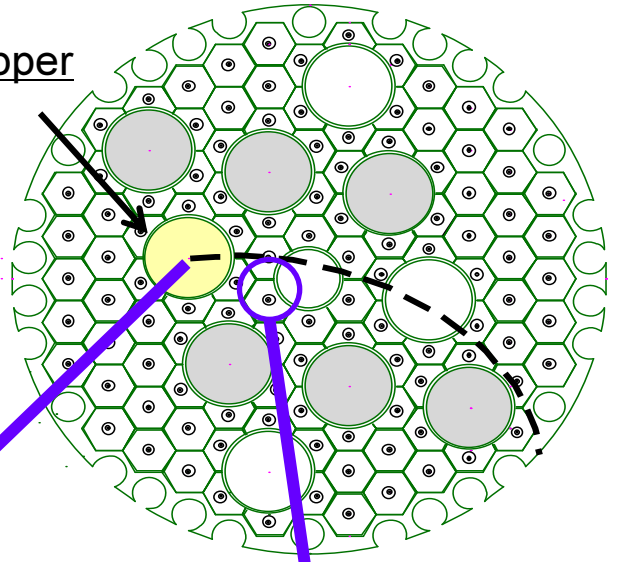
Results of UCS bottom observation

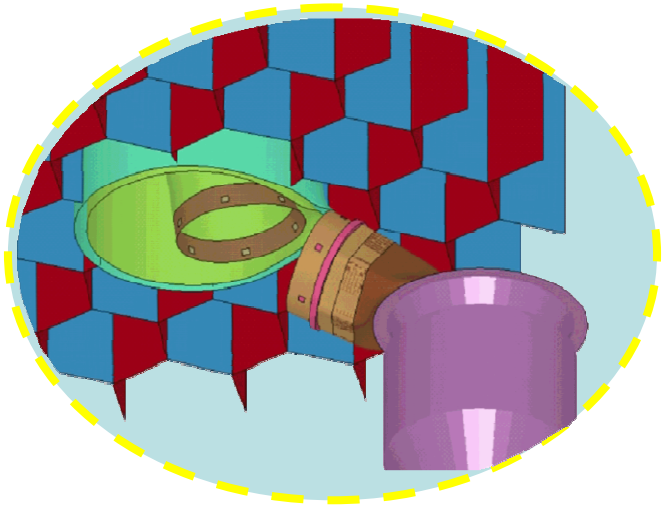


Sodium flow regulating grid

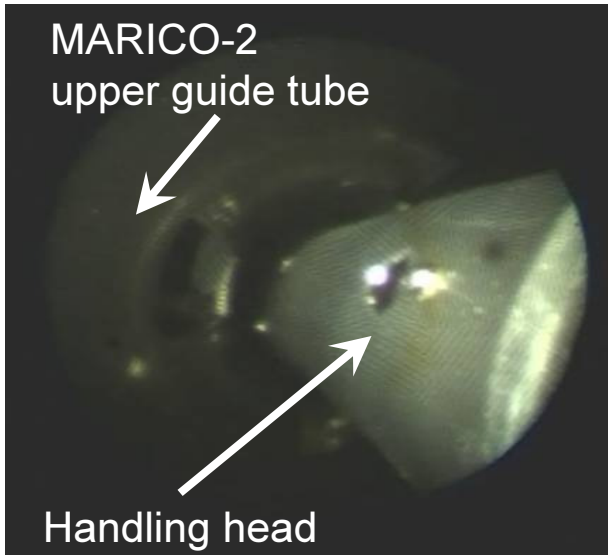
UCS bottom face

MARICO-2 upper guide tube

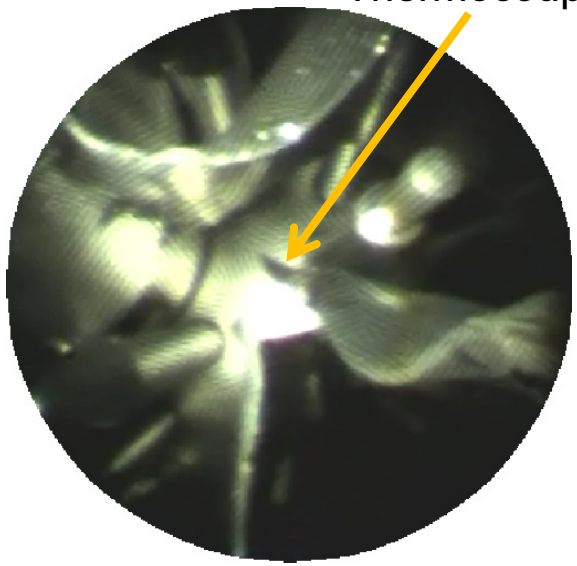




Handling head connected with holding mechanism



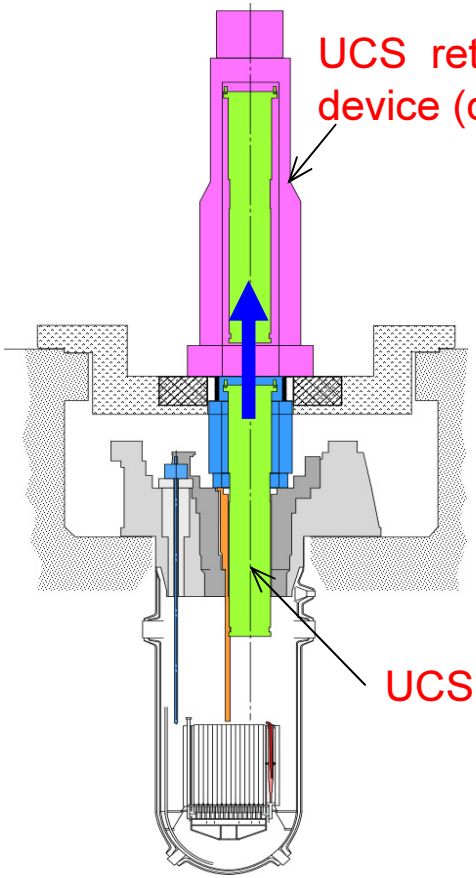
Thermocouple



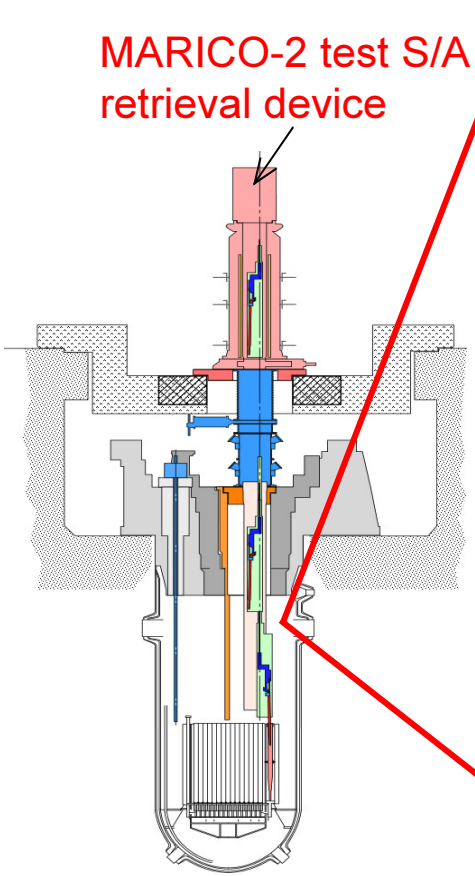
Deformed regulating grid

Replace UCS and retrieve MARICO-2 test S/A

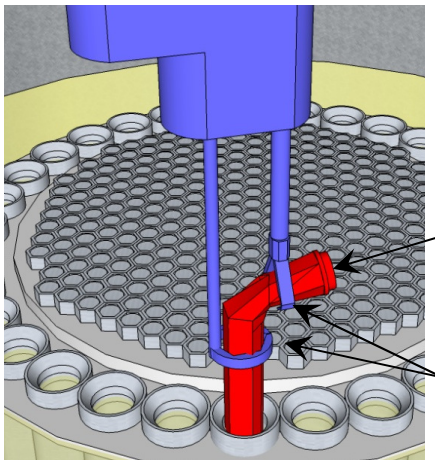
1. Remove the existing UCS
2. Retrieve the MARICO-2 through the hole from which UCS is pulled out
3. Insert new UCS



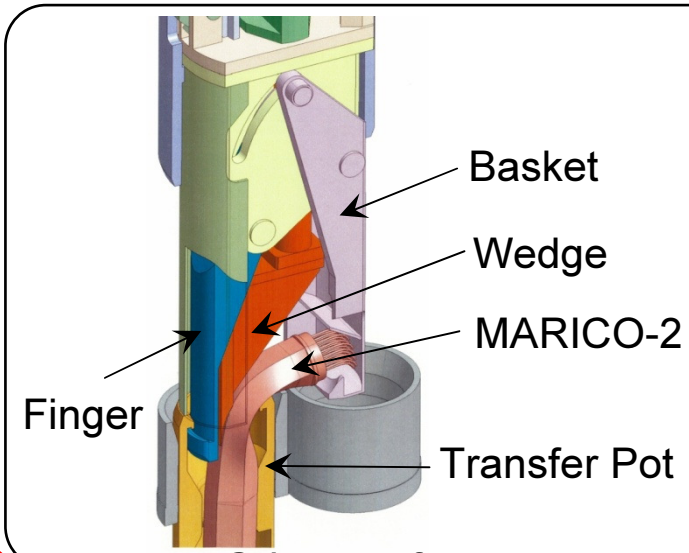
Replace UCS



Retrieve MARICO-2



Grip MARICO-2 wrapper tube



Grip transfer pot

Subject of UCS replacement and MARICO-2 retrieval

Technical subjects and measures

(1) Shielding design of the UCS cask

⇒ Activation of the UCS was evaluated based on the result of gamma dose rate measurement in the reactor vessel.

⇒ Optimize the shielding design.

(2) Prevent impurity ingress to the sodium system

⇒ Control of the cover gas pressure, impurity concentration monitoring etc.

⇒ Experience of cooling system renovation in MK-III modification work.

(3) Sodium deposition between the UCS and small rotating-plug

⇒ Amount of sodium deposition is evaluated from experimental data.

⇒ Sodium deposition is shared by twisting and lifting the UCS.

(4) MARICO-2 retrieval method

⇒ Lifting test of bent MARICO-2 to confirm the condition of the MARICO-2 and transfer pot.

(5) In-vessel observation device for long continuous investigation

⇒ High radiation resistant fiberscope, periscope and lighting device

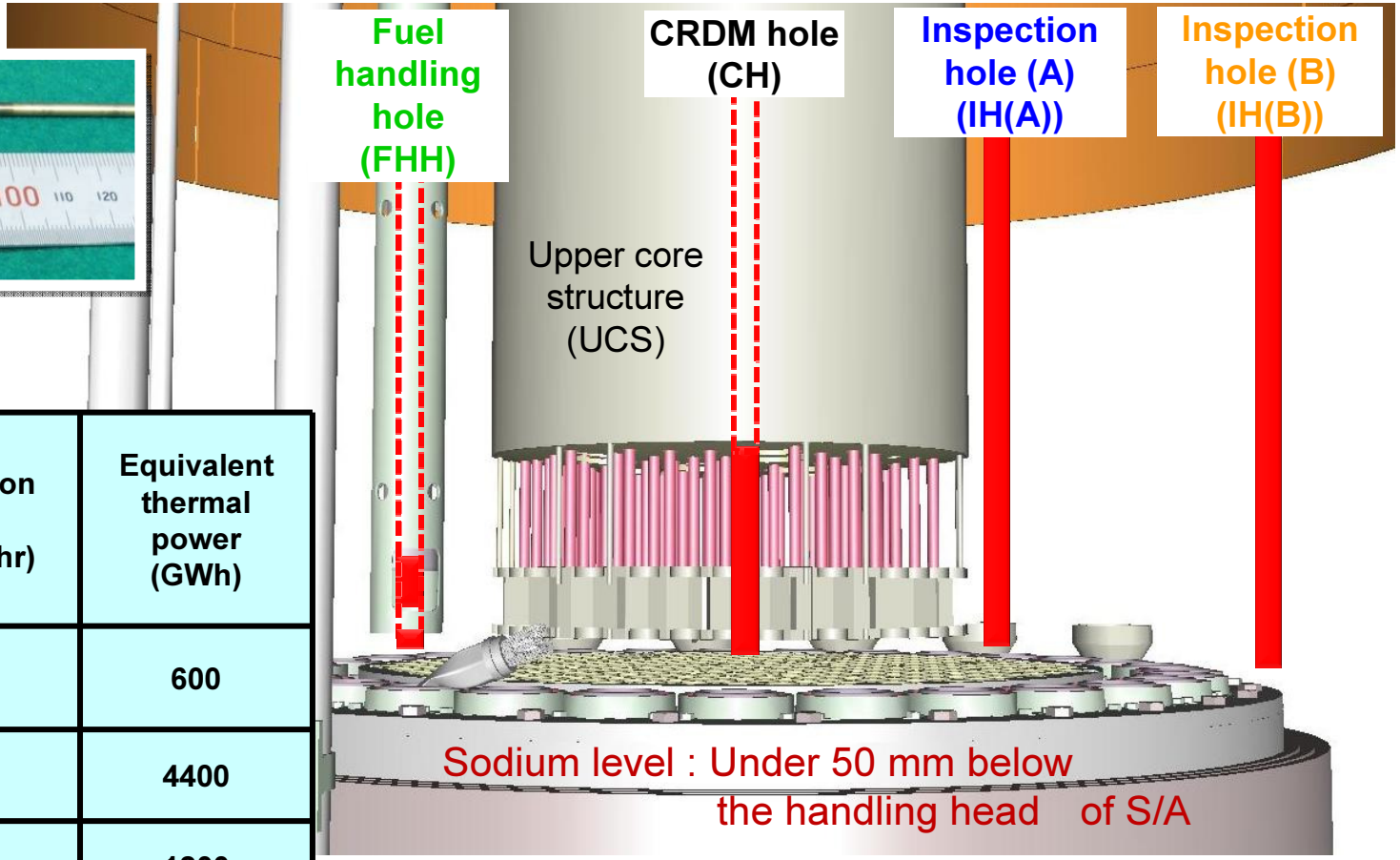
Measurement of gamma dose rate

- Detector insertion position-

Detector

Type ：Ionization chamber (IC)

Range：0.1～1000 Gy/h

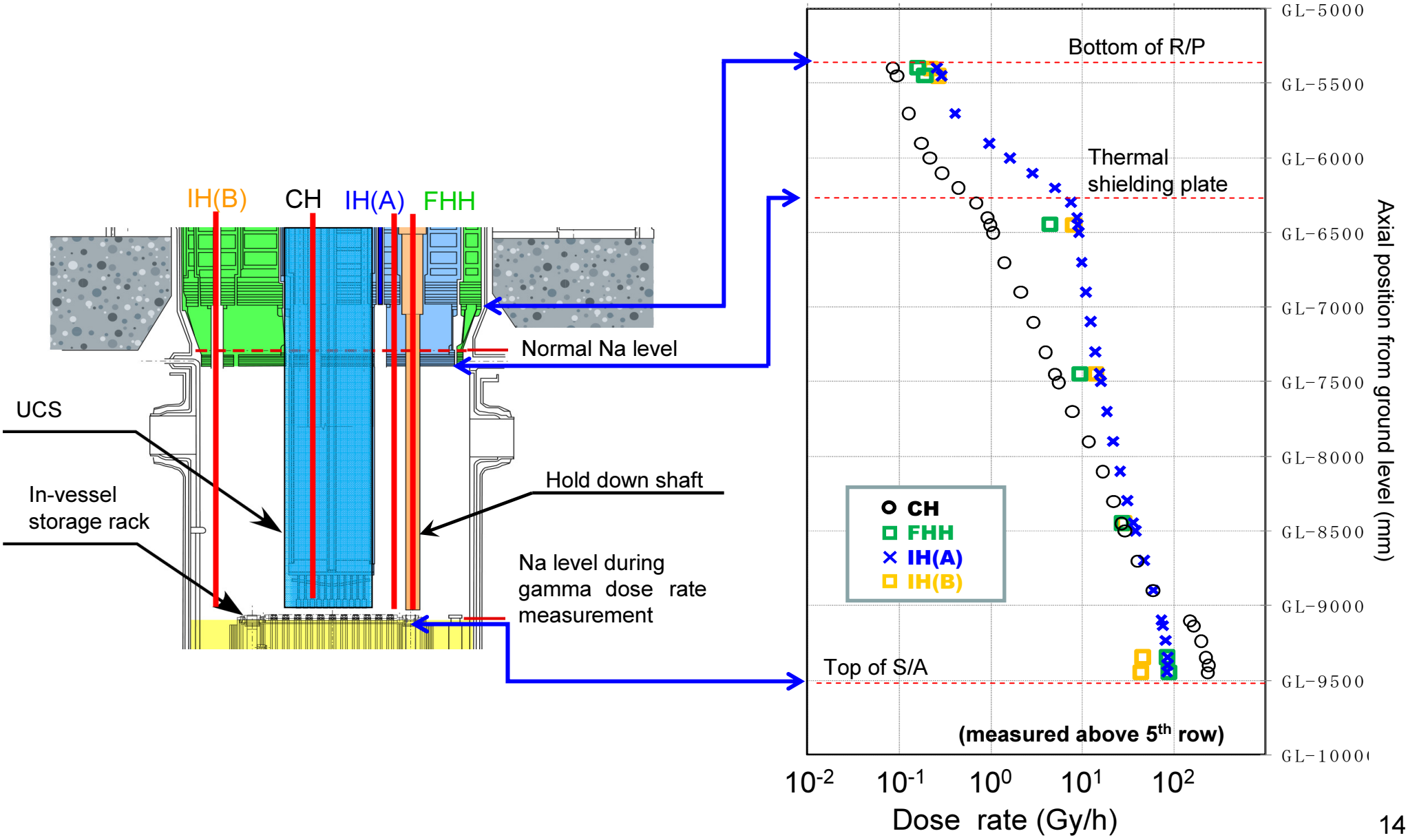


	Thermal power (MWt)	Operation time (x 1000hr)	Equivalent thermal power (GWh)
MK-Ⅰ Core	50 75	13	600
MK-Ⅱ Core	100	48	4400
MK-Ⅲ Core	140	10	1200
Total		71	6200

Measurement : August, 2008~ May, 2009
(Reactor shutdown : May, 2007)

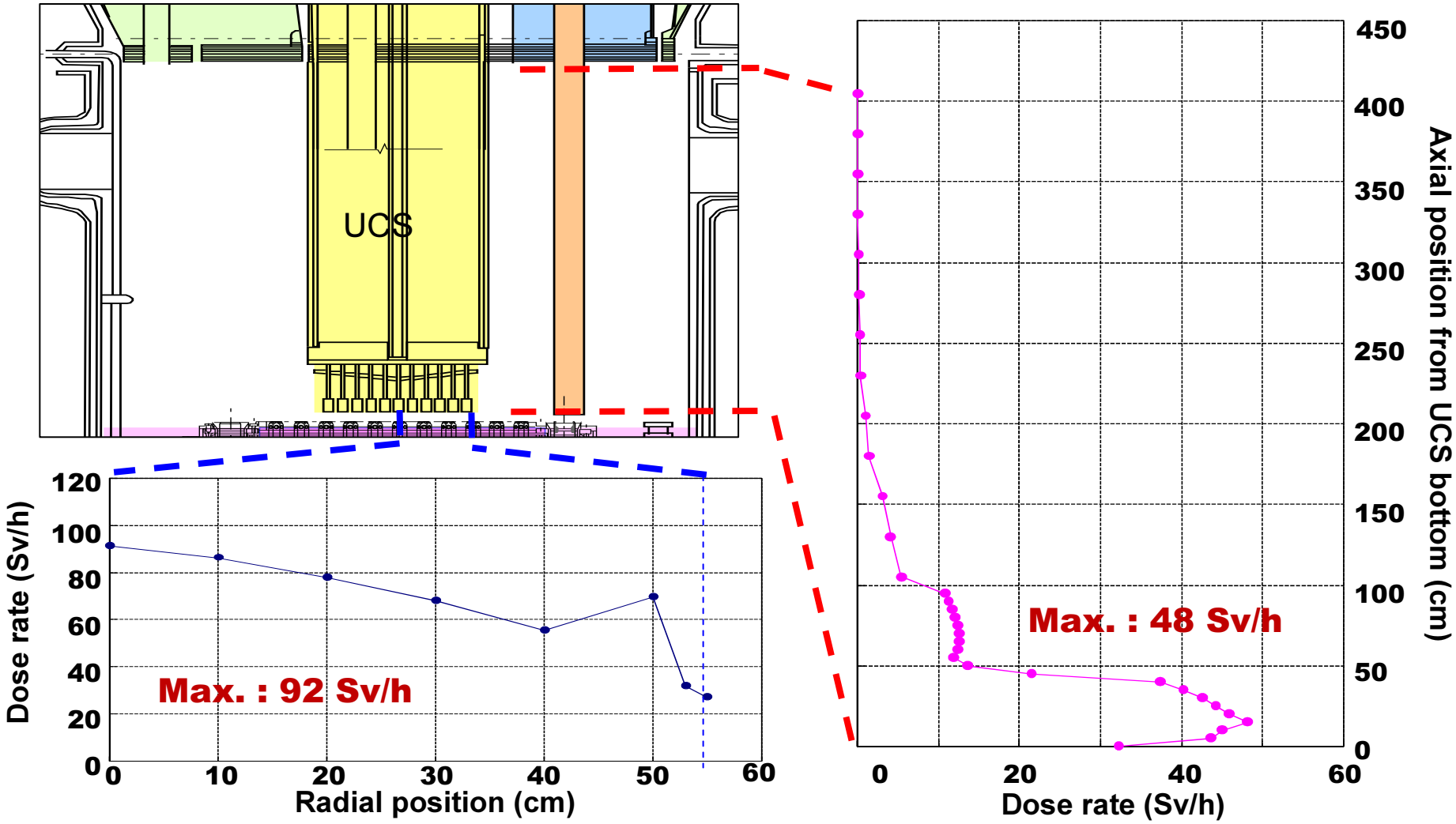
Measurement of gamma dose rate

- Axial distribution -



Measurement of gamma dose rate

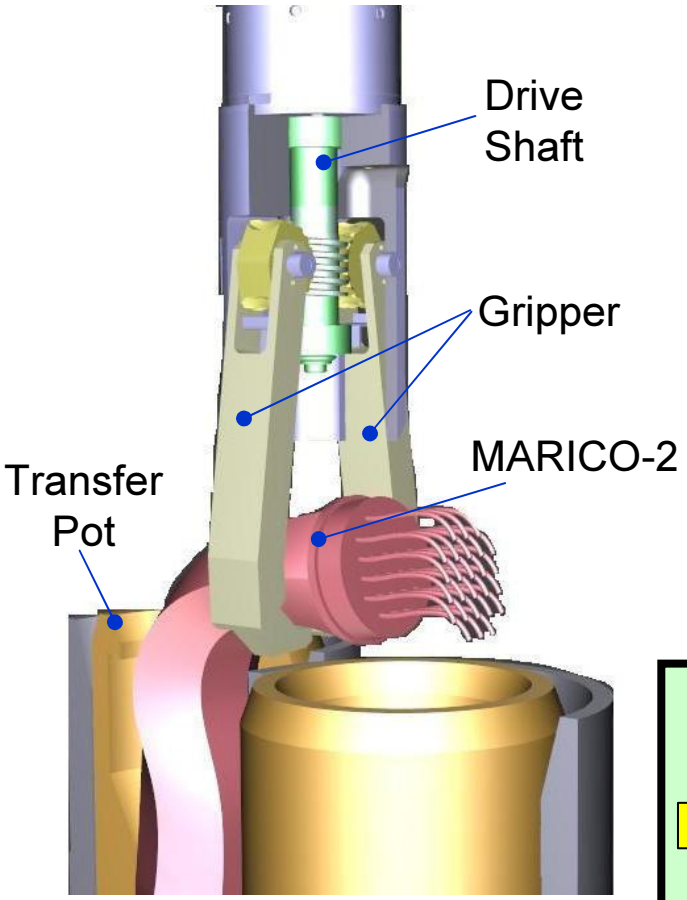
- Evaluated dose rate on the UCS-



Optimize the shielding design of the UCS replacement cask

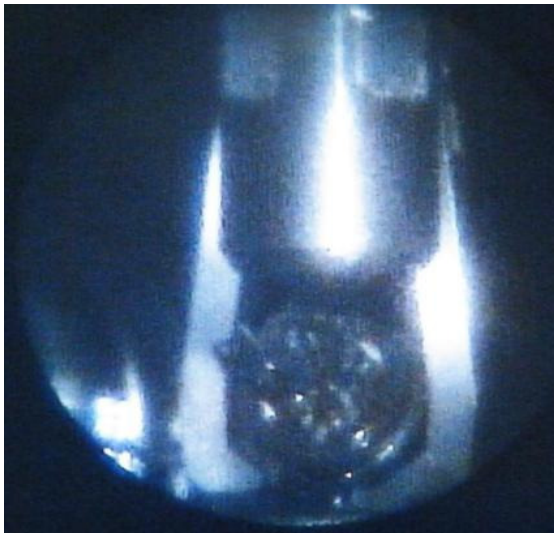
Lifting test of bent MARICO-2

To confirm the condition of the bent MARICO-2 and transfer pot, the bent MARICO-2 was gripped by a simple handling device and was lifted up 40 mm.



Simple handling device

Mock-up test for lifting up



Lifting up test

MARICO-2 was lifted up with the transfer pot. MARICO-2 can be retrieved with the transfer pot.

Summary

- In-vessel visual inspections were successfully conducted by the fiberscope and the camera.
  These results are reflected in the restoration work of Joyo.
- The detail design of the shielding cask and the retrieving device of the bent MARICO-2 are now energetically pushed forward based on the evaluated activation of the UCS and lifting test of bent MARICO-2.
- Valuable experience and data will be obtained through restoration work.