The Commissioning Workshop of ESS-J-PARC collaboration
10-12 October 2022
European Spallation Source ERIC

Moderator commissioning

-including moderator exchange device-

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Topics

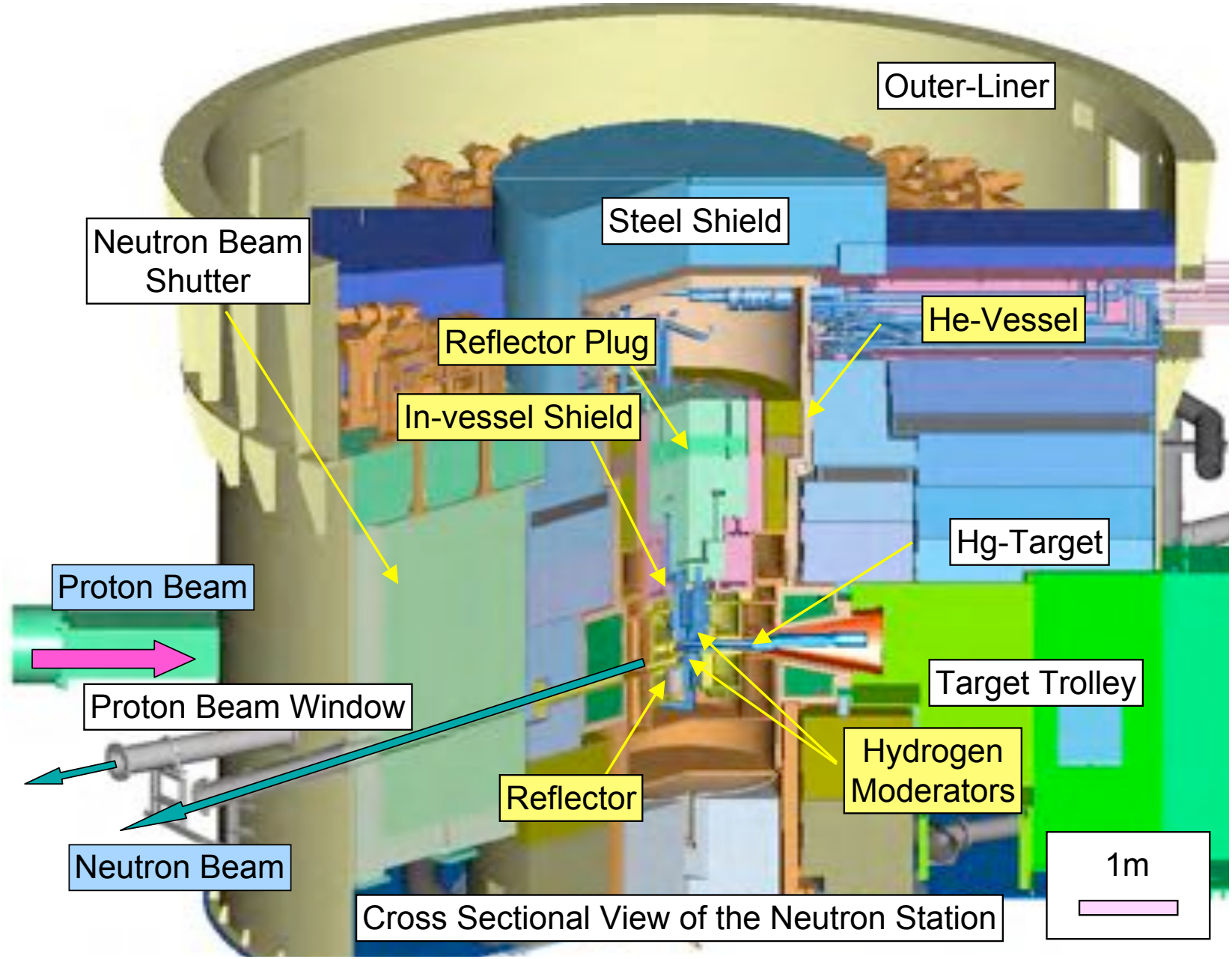
- Moderator commissioning for Day1
- Readiness checklist for moderator and remote handling device
- Progressed based on readiness
- Recent moderator-reflector commissioning

Main reviewed items in N-TAC 6 (Feb. 27th 2008)

- As for readiness, it was reviewed by International Neutron Source Technical Advisory Committee, N-TAC about 3 months prior to Day1 (May 30th 2008).
- One year commissioning period before beam on target

From next slide, the presentation materials at that time are shown.

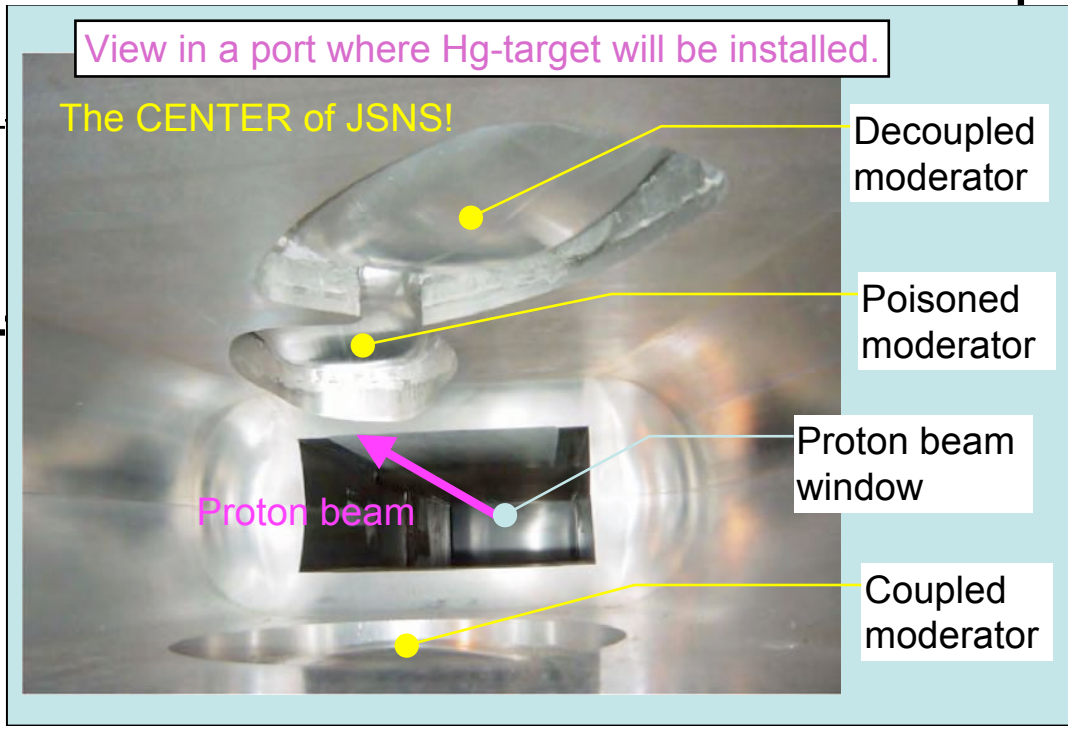
Moderator-related part in commissioning (yellow colored)



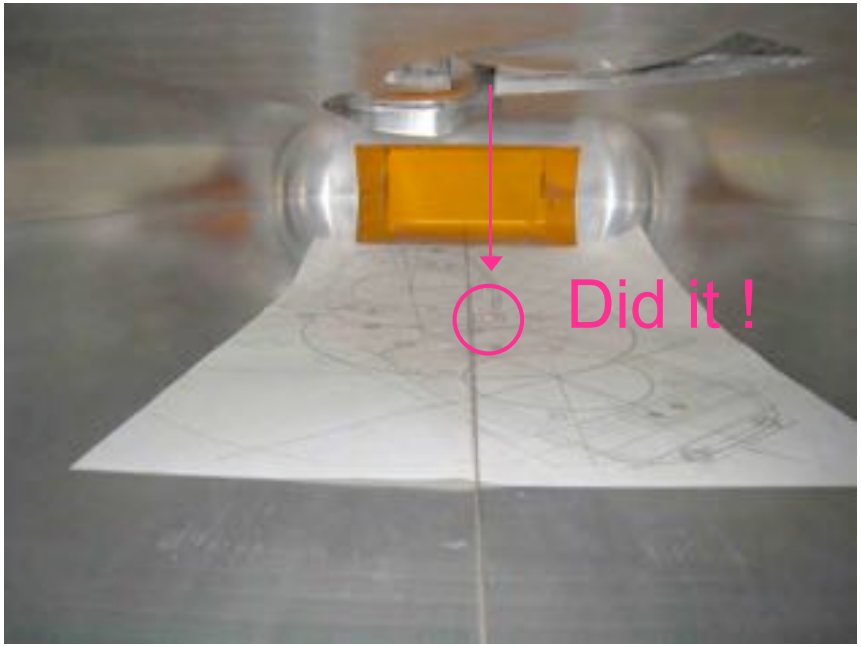
Readiness Checklist for moderator-related (1/5)

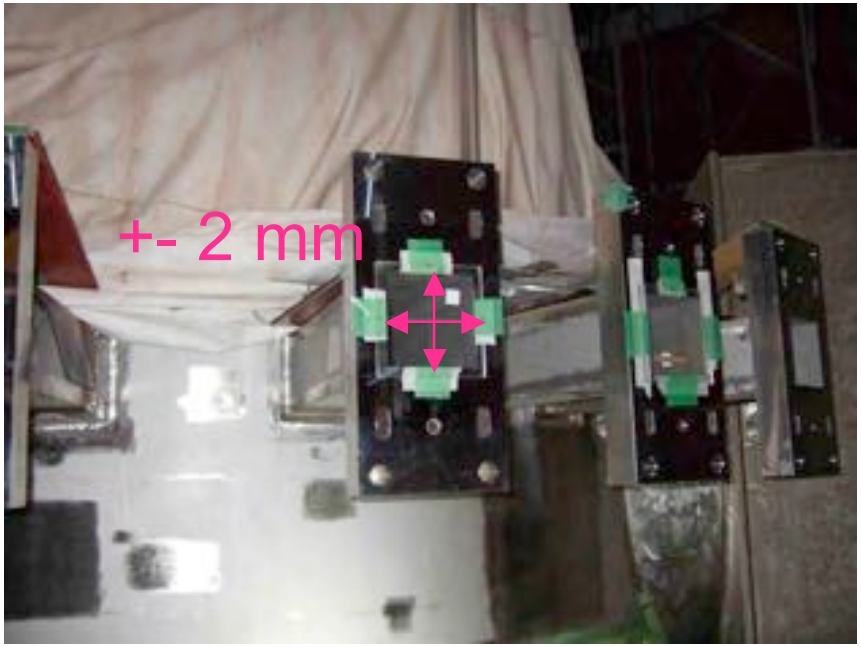
Component	He-v … oderators, Reflector, Reflector-plug, In-vessel shield
Item	Insta…
Acceptanc criteria	… any conflict. c. Moderators can be inserted in the reflector. d. A laser beam for target diagnostics can reach the target. e. Flanges for all 23 neutron extraction ports: +- 2 mm
Necessity	A: indispensable by Day-1 B: preferable by Day-1
Status	A: completed B: conditionally competed C: not yet completed

- Made readiness for all related components
- Shared and checked the progress at weekly progress meeting



Installation



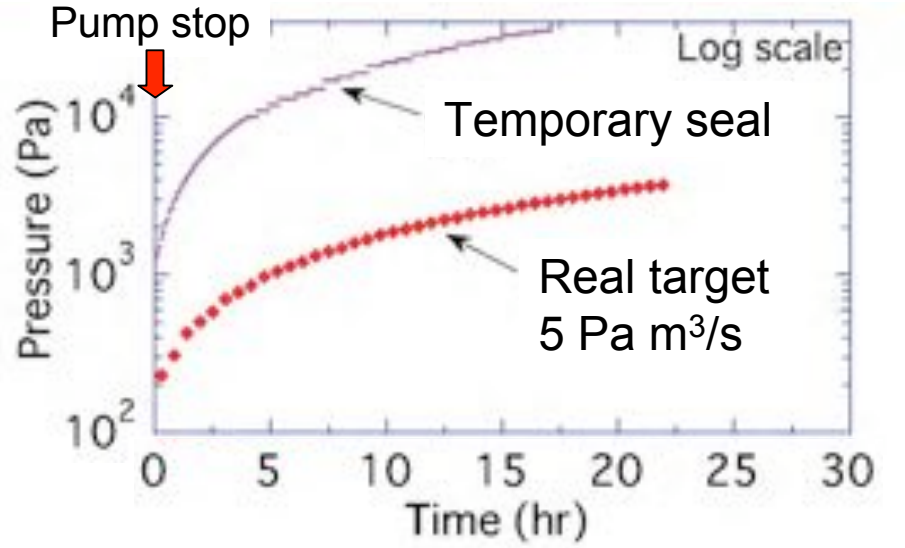


Readiness Checklist (2/5)

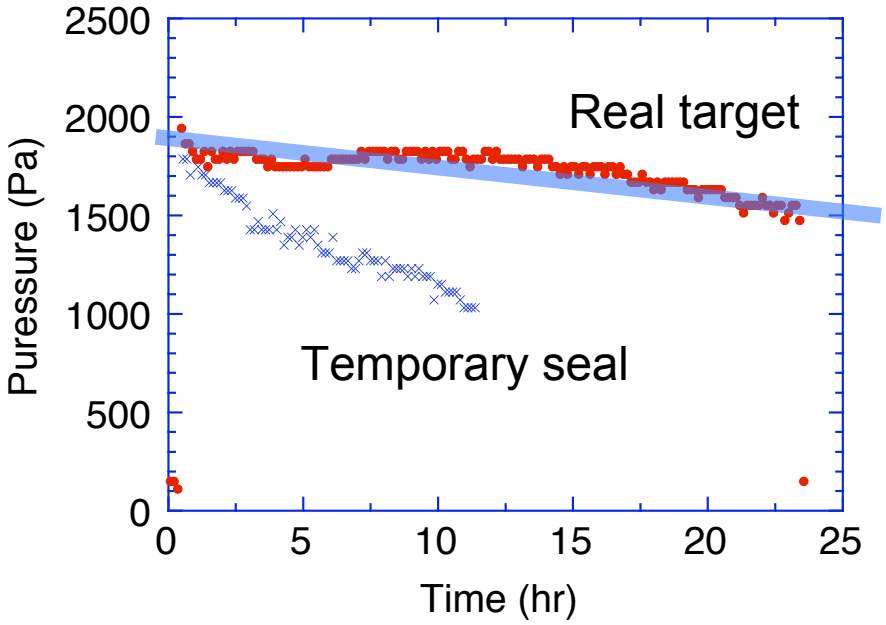
Component	He-vessel
Item	Function: Airtightness
Acceptance criteria	1. The vessel can be evacuated below 1,000 Pa for gas exchange. 2. Slight positive pressure (2~3 kPaG) of He gas can be held to keep purity of the He gas without meaningful leakage.
Necessity	A: indispensable by Day-1 B: preferable by Day-1
Status	A: completed B: conditionally competed C: not yet completed

Airtightness of He-vessel

Evacuation test



Slight positive pressure keeping test



Leak rate: 3×10^{-2} Pa m^3/s
270 days to consume
1 He cylinder (7 m^3)

Temporary seal on the target
trolley insertion port of He-vessel

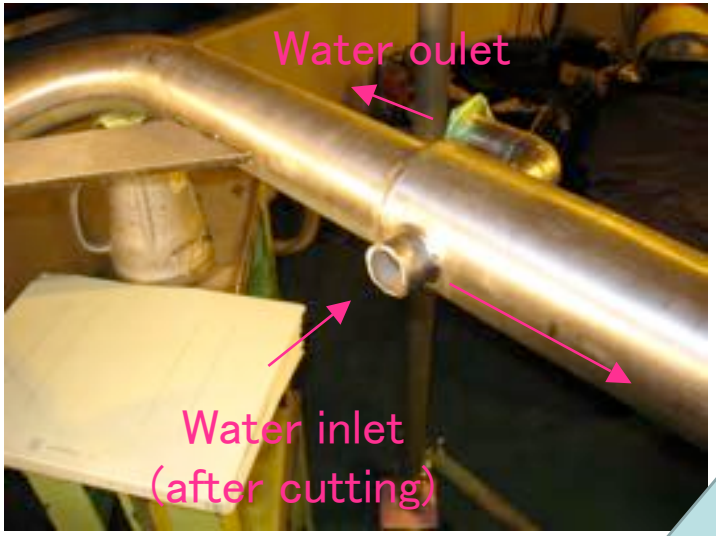
Readiness Checklist (3/5)

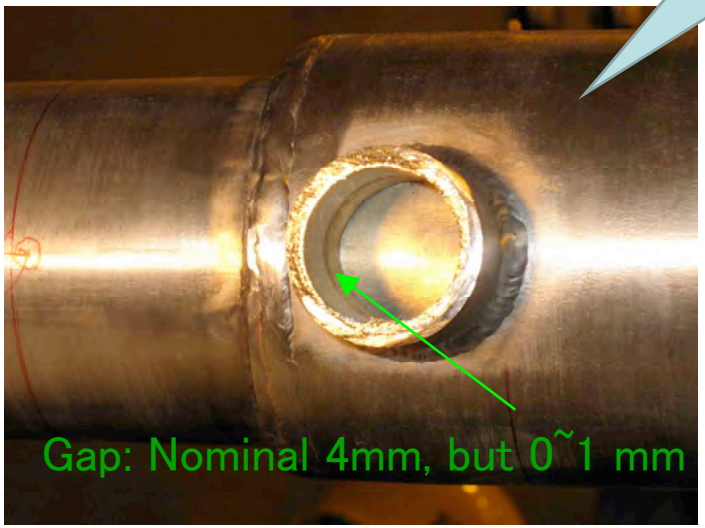
Component	He-vessel, Moderators, Reflector, Reflector-plug, In-vessel shield
Item	Cooling Capability
Acceptance criteria	1. Cooling water can be circulated at rated values. a. He-vessel: 8 m^3/h b. Moderator: 6 x 3 m^3/h c. Reflector: 20 m^3/h d. Reflector plug: 2 x 2 m^3/h e. In-vessel shield: 14 m^3/h 2. Thermocouples a. Continuity test has been passed. b. Temperatures can be monitored at the control room.
Necessity	A: indispensable by Day-1 B: preferable by Day-1
Status	A: completed B: conditionally competed C: not yet completed

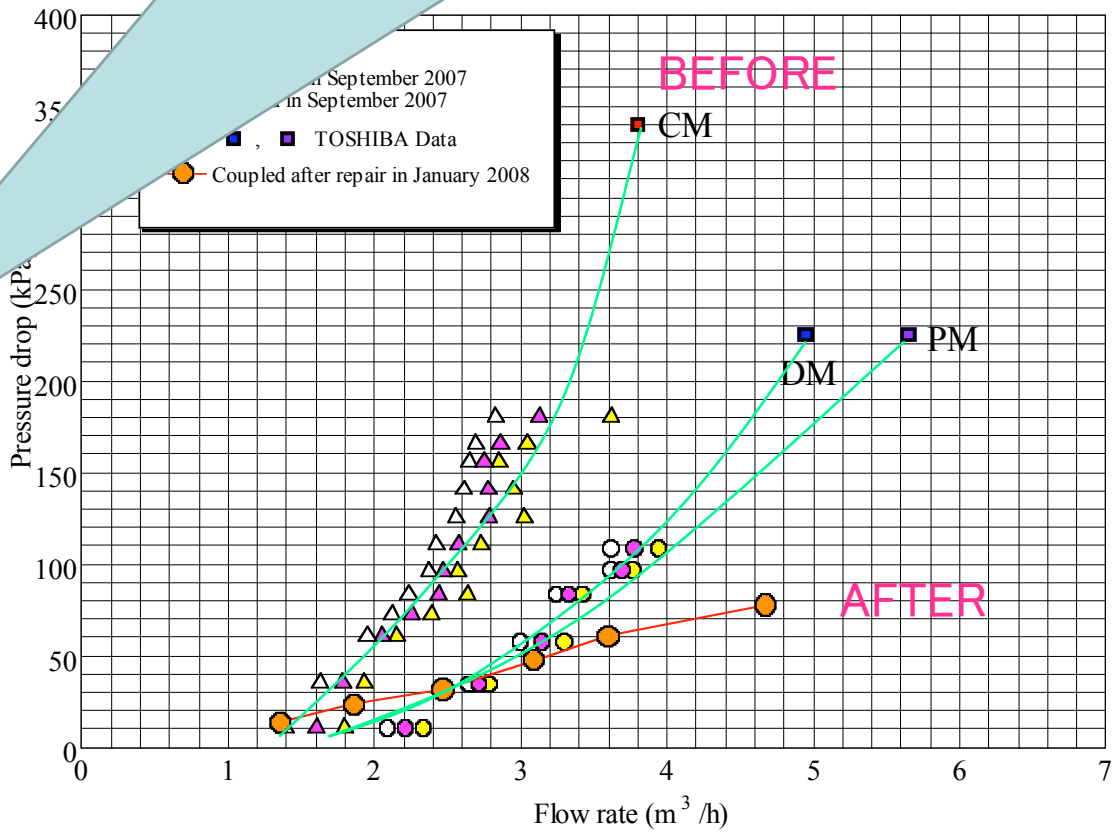
Trouble in CM (coupled moderator)

Pressure drop of cooling water in CM was too high.
It was repaired in Jan. 2008.

The most significant lessons&learned
Flowing and low temperature tests should be ensured at factory, not on-site.
Repairs are quite difficult, especially after installation in activated area.







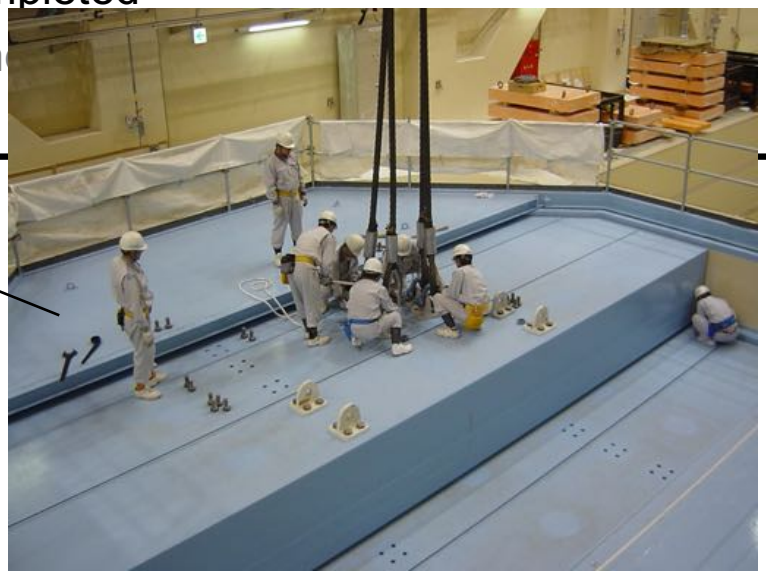
Readiness Checklist (4/5)

Component	Replaceable components (Moderators & Reflector)
Item	Feasibility for replacement
Acceptance criteria	1. Tools for the replacement have been prepared. 2. All the necessary replacement procedure has been established, and demonstrated with using actual components. 3. Templates for spare components have been prepared. 4. Issues found in producing the first components have been solved, and design for the spare components are ready. 5. Disposal method has been established.
Necessity	A: indispensable by Day-1 (No. 1, 2, 3) B: preferable by Day-1 (No. 4, 5)
Status	A: completed (No. 1, 2) B: conditionally competed C: not yet completed (No. 3, 4, 5) Issues in No. 4 are to be mentioned in the presentation 5-06

Readiness Checklist (5/5)

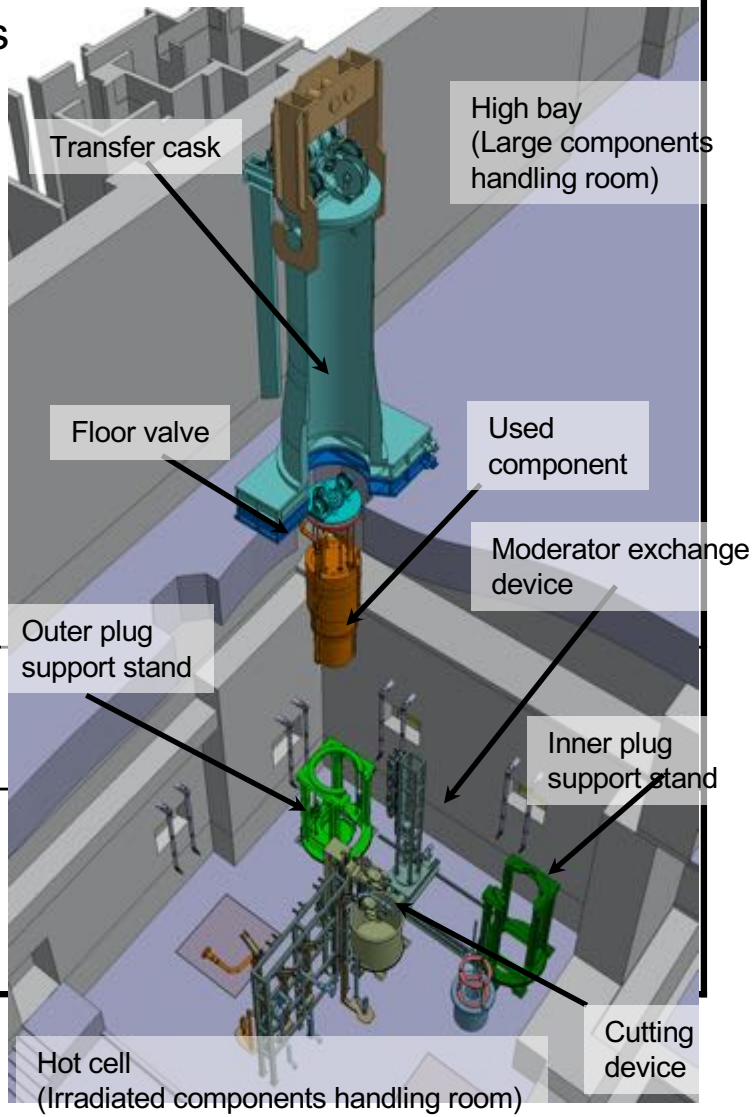
Component	Shield & Top airtight plate
Item	Installation & Airtightness
Acceptance criteria	1. Shield blocks a. All blocks have been installed at the right position. b. Handling methods for movable blocks have been established. 2. Airtightness of the top airtight plate a. Sealing procedure is established. b. No leak is detected by a smoke test.
Necessity	A: indispensable by Day-1 B: preferable by Day-1
Status	A: completed B: con C: not

Top airtight plate



Readiness Checklist for remote device (1/3)

Component	Remote handling devices for moderator reflector and PBW
Item	Stand-alone operation
Acceptance criteria	1. Devices can be set at their right positions a. Floor valves b. Transfer cask, etc. 2. Devices can be remote-controlled and operated as expected. a. Floor valves b. Transfer cask c. Outer/inner plug support stands d. Moderator exchange device e. Cutting device f. Cameras, etc.
Necessity	A: indispensable by Day-1 B: preferable by Day-1
Status	A: completed B: conditionally competed C: not yet completed



Readiness Checklist for remote device (2/3)

Component	Remote handling devices for moderator, reflector and PBW
Item	Combinatory operation
Acceptance criteria	1. Exchanging procedure has been demonstrated with using actual components by semi-remote-handling. 2. Exchanging procedure has been demonstrated with using actual components by full-remote-handling. 3. Operation manual has been prepared.
Necessity	A: indispensable by Day-1 (1, 2) B: preferable by Day-1 (3)
Status	A: completed (1) B: conditionally competed C: not yet completed (2, 3) Full-remote-handling capability will be demonstrated by Day-1.

Readiness Checklist for remote device (3/3)

Component	Remote handling devices for moderator, reflector and PBW
Item	Downstream
Acceptance criteria	1. A complete scenario for disposing used components has been established. a. Components can be dried up. b. Components can be cut by the cutting device. c. Spaces for temporally storing used components have been prepared in the MLF Bldg. d. Spaces for retained wastes outside the MLF Bldg. have been prepared. e. Transfer casks and airtight containers have been prepared. 2. A scenario for PIE has been established.
Necessity	A: indispensable by Day-1 (1-a, -b, -c) B: preferable by Day-1 (1-d, 1-e, 2)
Status	A: completed (1-c) B: conditionally competed (1-a, -b) Moderators can not be dried up with existing devices. Cutting with using actual components has not been tested. C: not yet completed (1-d, 1-e, 2) Big issues in the future!

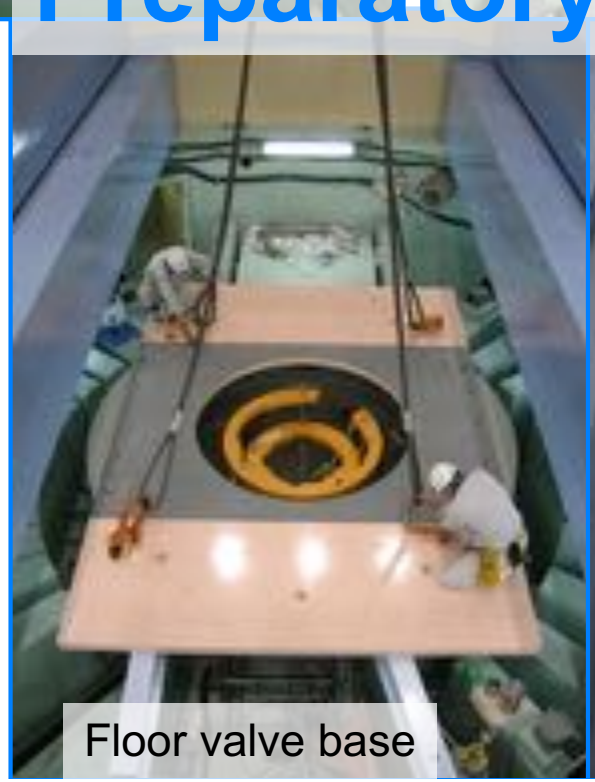
Preparatory work


Disconnection of pipes


Unhappy man

^{3}T:~10^{5}Bq/cm^{3}
at 2022


Hoisting attachment

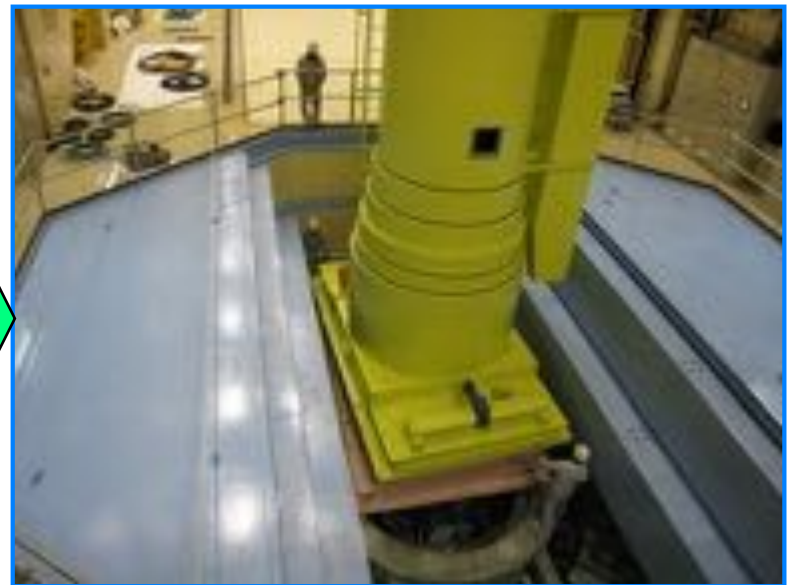

Floor valve base


Floor valve


Transfer cask

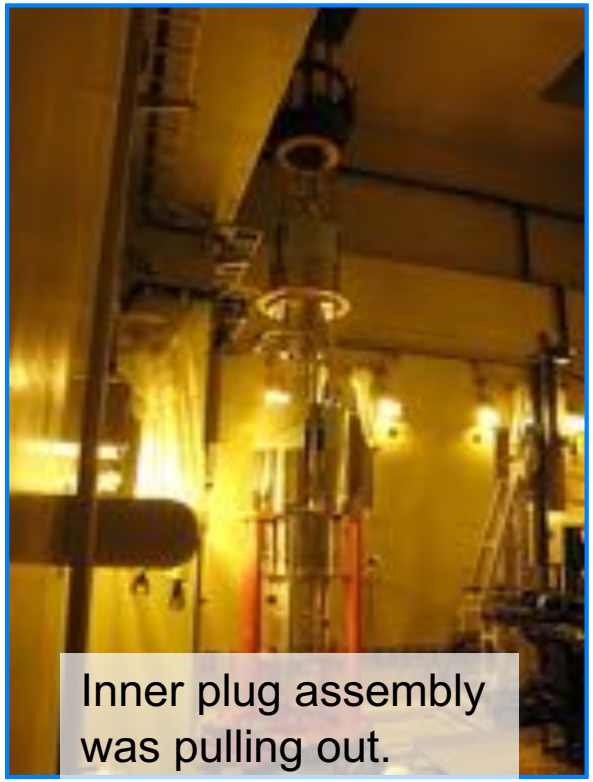
Transfer Cask

The hoisting attachment for the transfer cask.

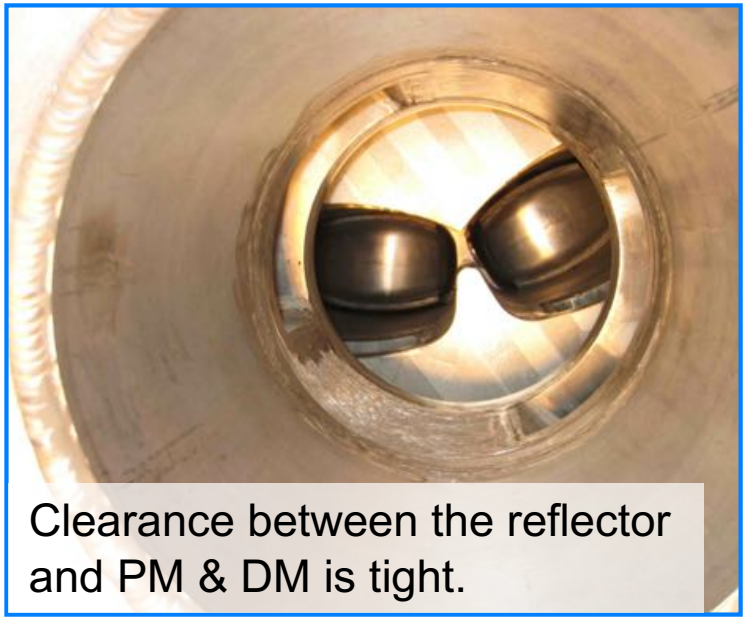


Handling of moderators & reflector

Whole assembly was getting down to the support stand.



Inner plug assembly was pulling out.



Clearance between the reflector and PM & DM is tight.

Moderator position was surveyed very precisely by a laser tracker.

Moderator exchange device was approaching to PM.
(Viewed through a lead glass)

Transfer to the cutting device

Coupled Moderator

Decoupled Moderator

Reflector

Control and operation

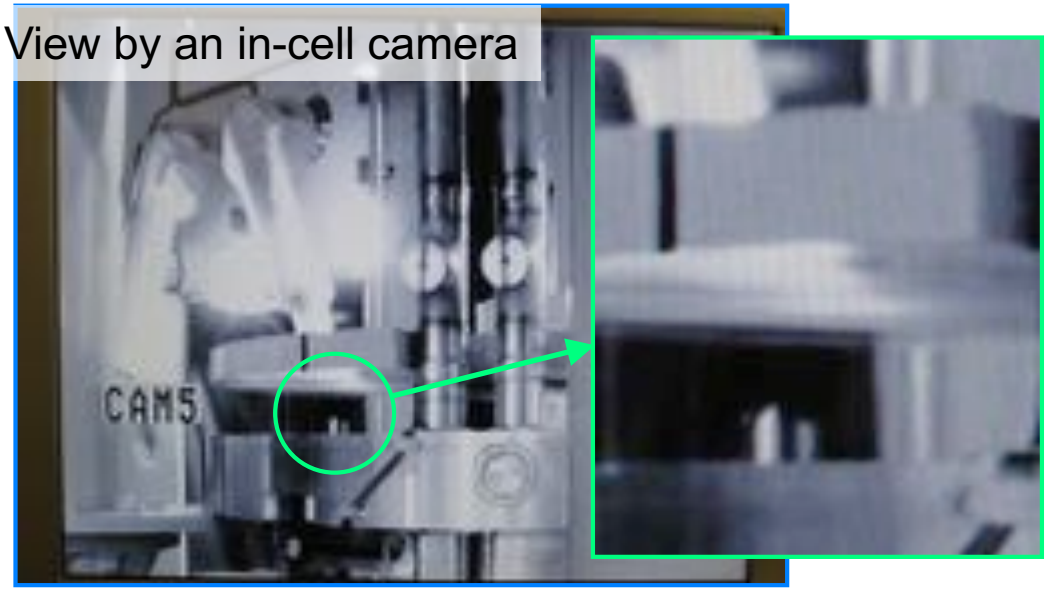
Devices in 3F and B1F can be monitored and operated at 1F.

Controlling in-cell devices.

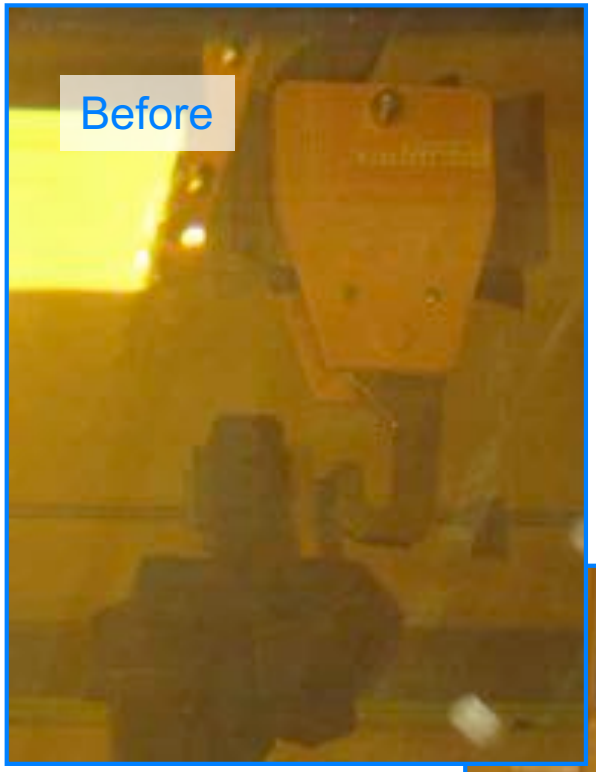
View through a lead glass

Difficulty in visibility (1/2)

Pins can be seen, but holes for the pins can't be.



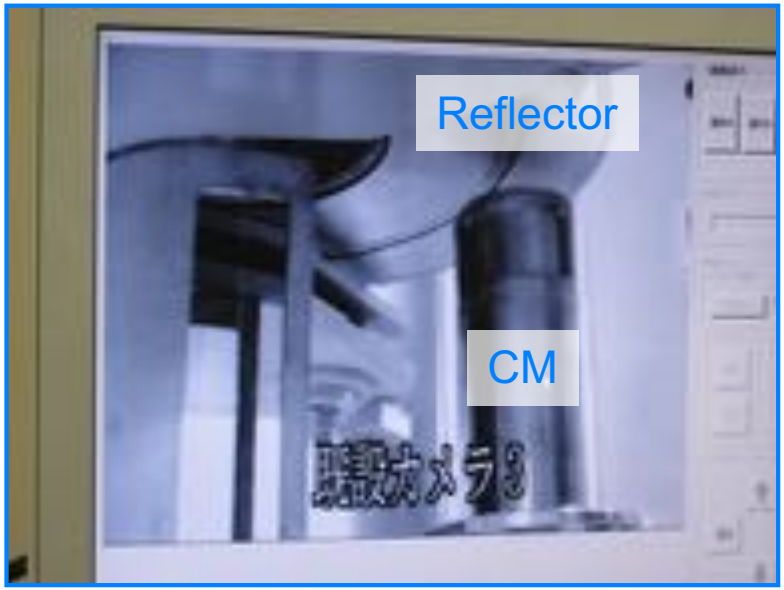
Difficulty in visibility (2/2)



Difficult to judge where is the hock

A window to see

Position of CM to be inserted into the reflector is difficult see by the in-cell camera.



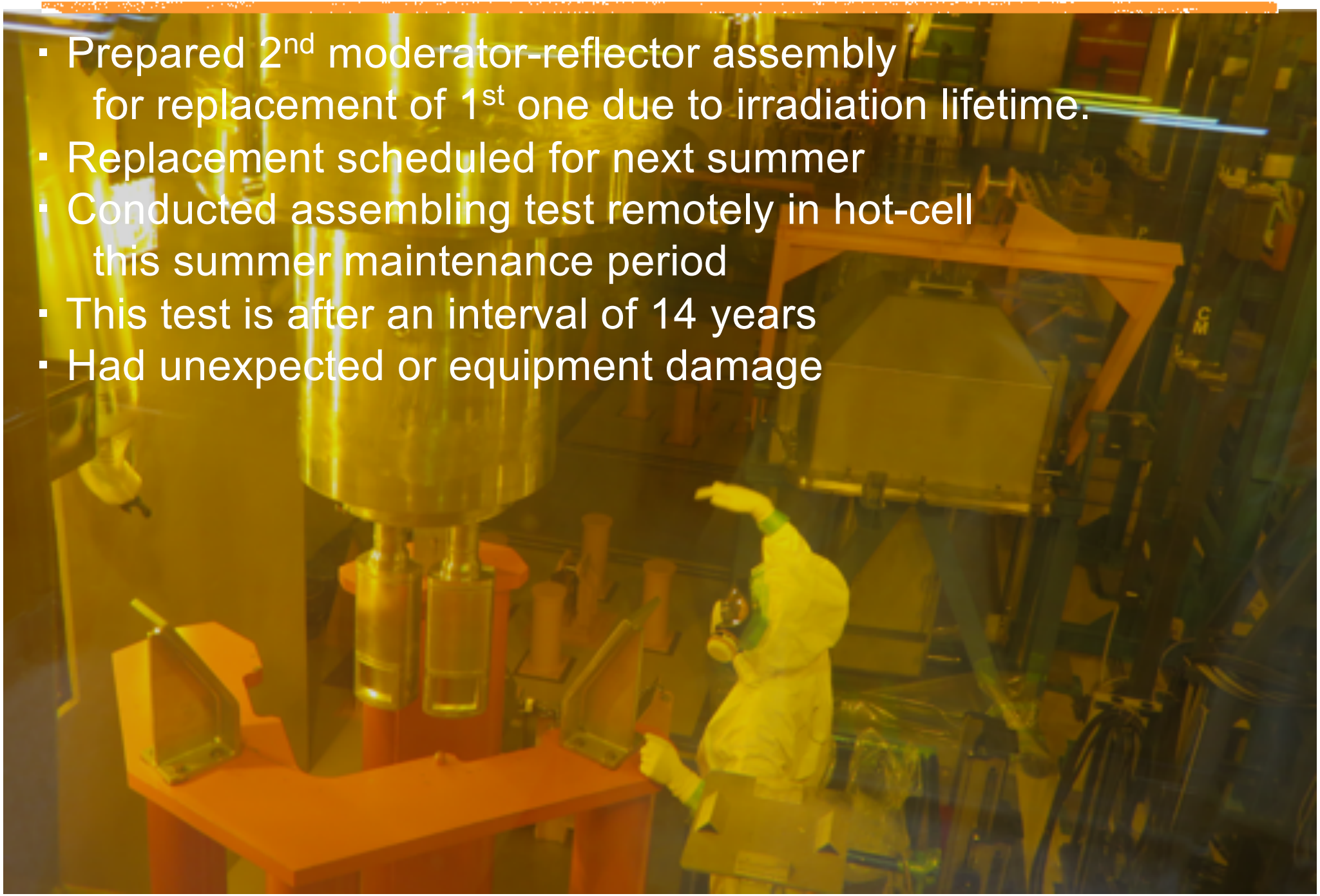
Summary as of Feb. 2008

Most of readiness items were READY.

Issues

1. Hydrogen circulation test for the moderators (scheduled in April)
2. Design review for spare components
3. Establishment of waste disposal
4. Stand-alone operation of the remote-handling devices has been confirmed to be workable.
5. Combinatory operation by full-remote-handling is now under way. We encounter many troubles during the commissioning, and try to solve them one by one.
6. Full-remote-handling capability will be demonstrated by Day-1 although the schedule is very tight.
7. Establishing a disposal scenario of used components, and preparing necessary equipment and facility are big issues still remained.

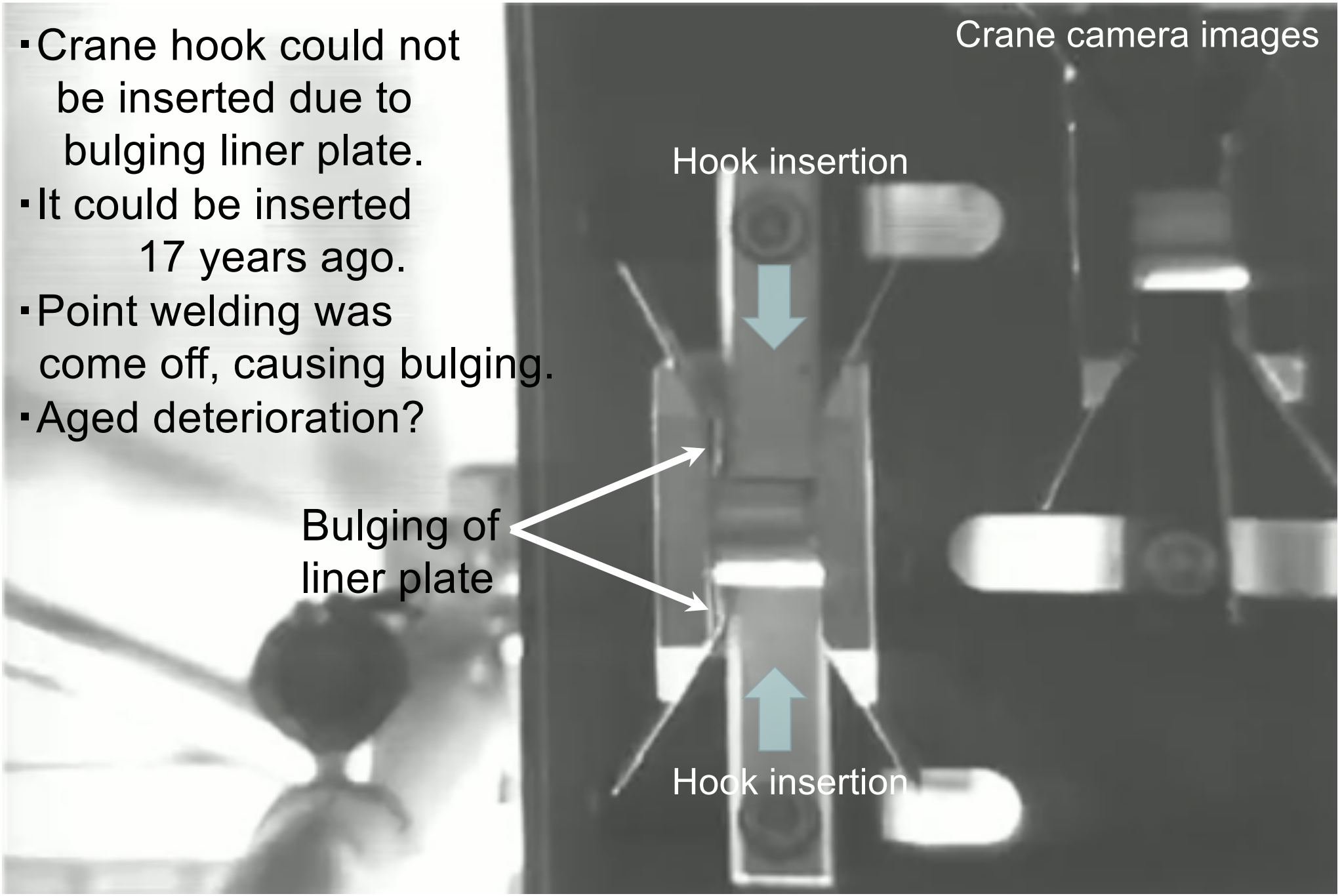
Recent commissioning of 2nd moderator-reflector



- Prepared 2nd moderator-reflector assembly for replacement of 1st one due to irradiation lifetime.
- Replacement scheduled for next summer
- Conducted assembling test remotely in hot-cell this summer maintenance period
- This test is after an interval of 14 years
- Had unexpected or equipment damage

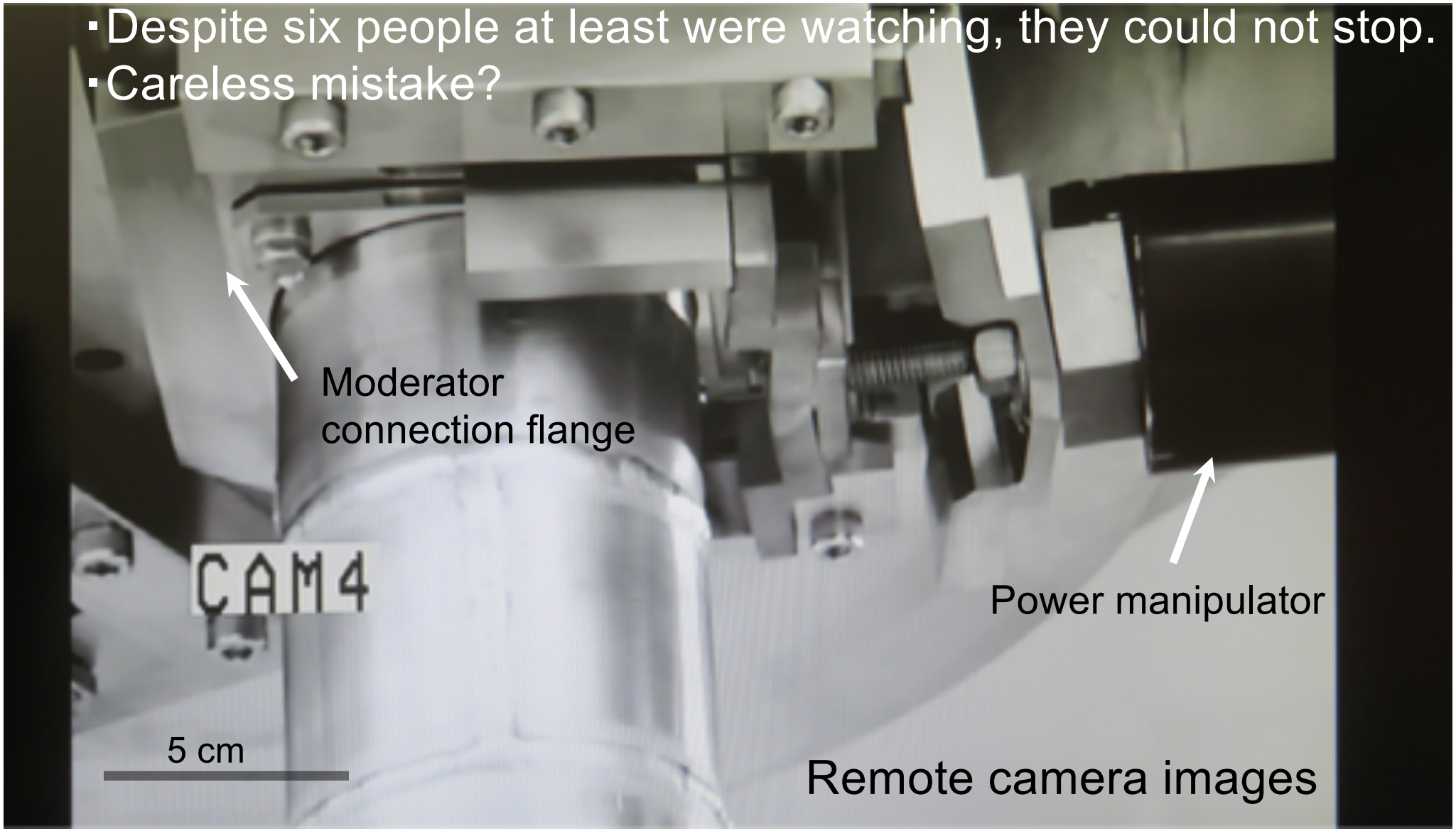
Unexpected event

- Crane hook could not be inserted due to bulging liner plate.
- It could be inserted 17 years ago.
- Point welding was come off, causing bulging.
- Aged deterioration?



Damaged moderator connection flange

- Large deformation of flange parts
- Too many screws turned in the power manipulator.
- Despite six people at least were watching, they could not stop.
- Careless mistake?



Remote camera images