The Commissioning Workshop of ESS-J-PARC Collaboration
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Target system commissioning

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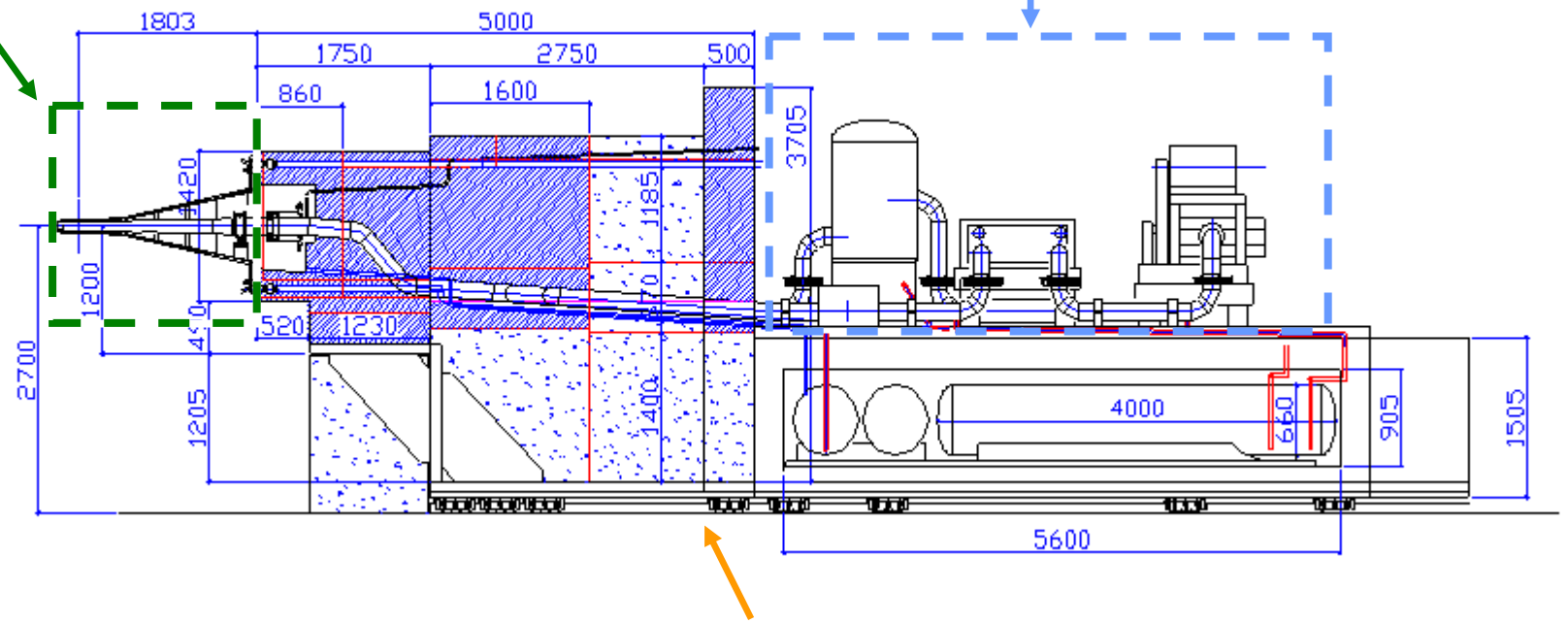
J-PARC center

Mercury target system

Mercury target system consist of 3 subsystems

Mercury target vessel (Mitsui Engineering & Shipbuilding Co., Ltd.)

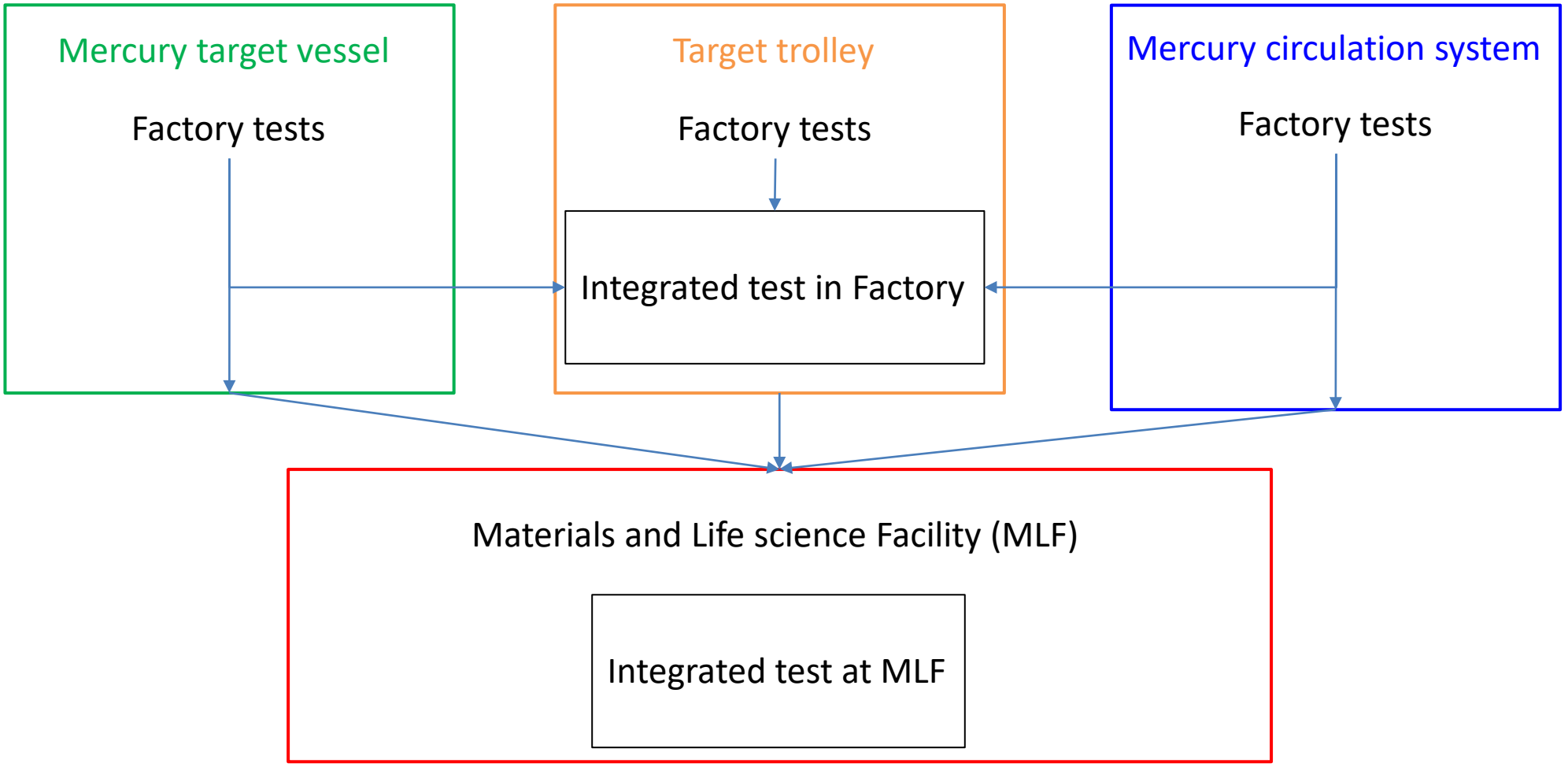
Mercury circulation system (Kawasaki Heavy Industries, Ltd.)



Target trolley (Fuji Electric Systems Co., Ltd.)

Each subsystem was fabricated by different manufacturing companies.

Commissioning flow



After passing factory tests, 3 subsystems were assembled in the factory and integrated test were carried out.
After that, Mercury target system were installed in MLF, and integrated tests were carried out.

Factory tests of subsystems and integrated system

Subsystems

Mercury target vessel

Mercury circulation system

Target trolley

Each manufacturing company carried out subsystem test

Common items

- Visual inspection,
- Material inspection,
- Dimensional inspection,
- Gas leakage test,
- Sensor calibration,
- Exchangeability of the components, etc.

Integrated system test

Check points in the integrated test in factory

- Connection among subsystems
  Dimension, gas leakage, etc.
- Exchangeability of each component
  No interference among subsystems

Integrated system tests in MLF

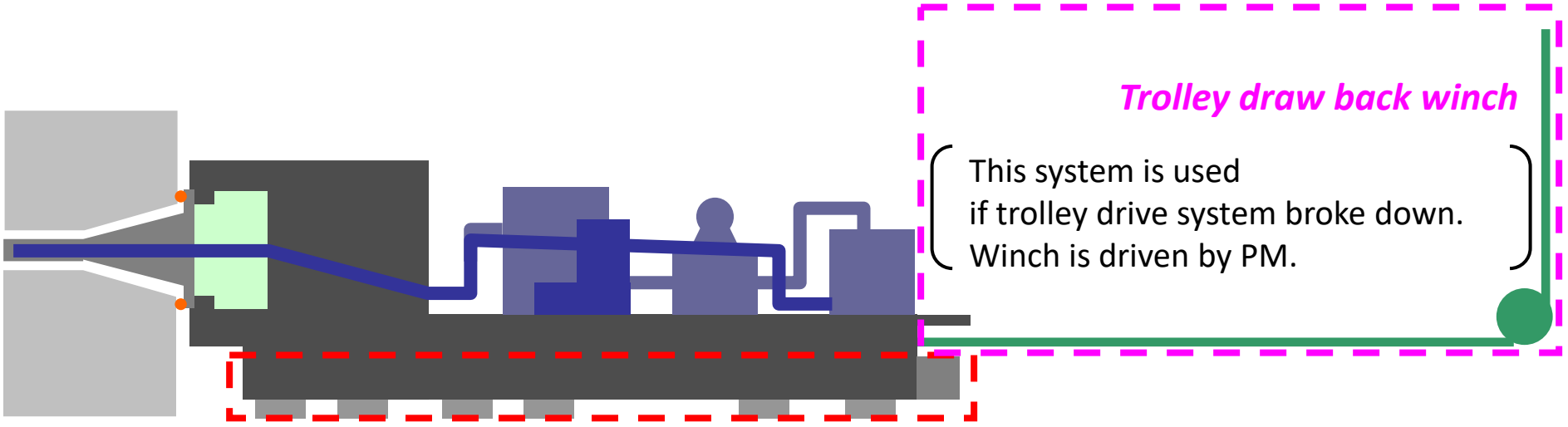
After passing the integration system test in factory,
JAEA carried out all integrated system tests.

Check points in the integrated test in MLF

- Connection among subsystems
  Dimension, seal performance, etc.
- Exchangeability of each component by using the remote handling system in MLF
  No interference among subsystems and remote handling system
- Target trolley operation
- Mercury circulation
- Interlock system

Target trolley tests in MLF

	Item	Check point
Trolley drive mechanism	Motion	Position control of target trolley Motion of cable veyor
	Lock	Work of stopper
Trolley draw back winch	Forced draw back	Possible or not



Trolley drive mechanism

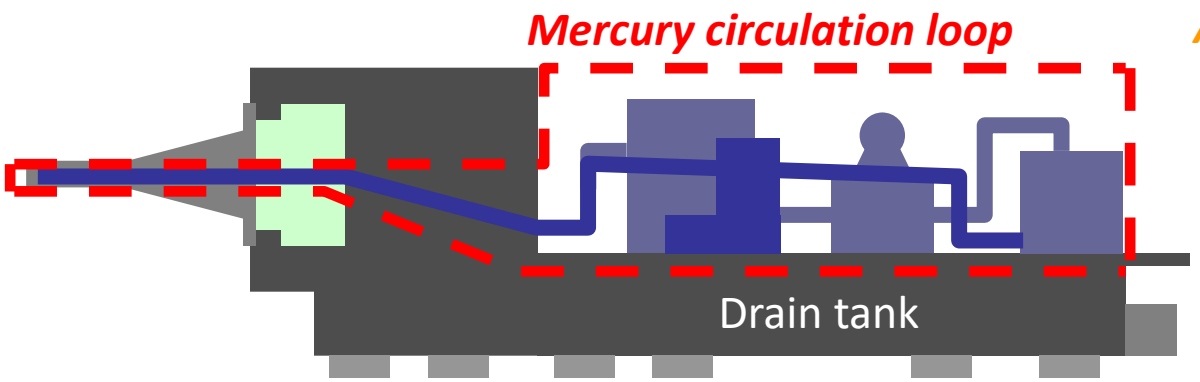
(This system is used at normal operation.)

Associated equipment

- Helium gas supply system
- Compressed air supply system

Mercury circulation test

Item	Check point
Vacuum in the loop	Operation time Degree of vacuum
Filling mercury in the loop	Operation time
Mercury circulation	Flow rate (Max. flow rate : 50 m^3/s) Leak from joint (e.g. mercury pipe connection system)
Emergency stop	Influence of circulation system (e.g. mercury hammer)
Draining mercury to Drain tank	Operation time



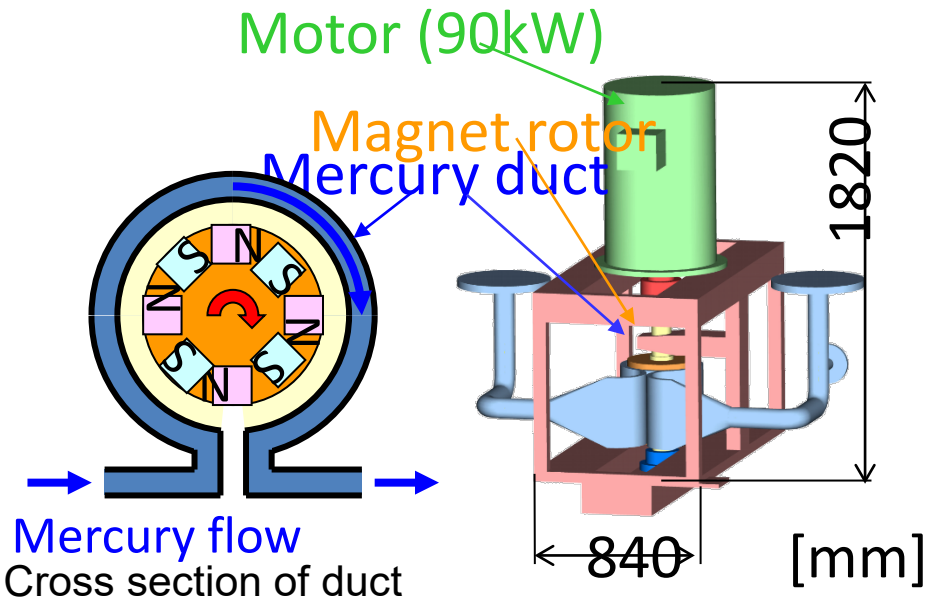
Associated equipment

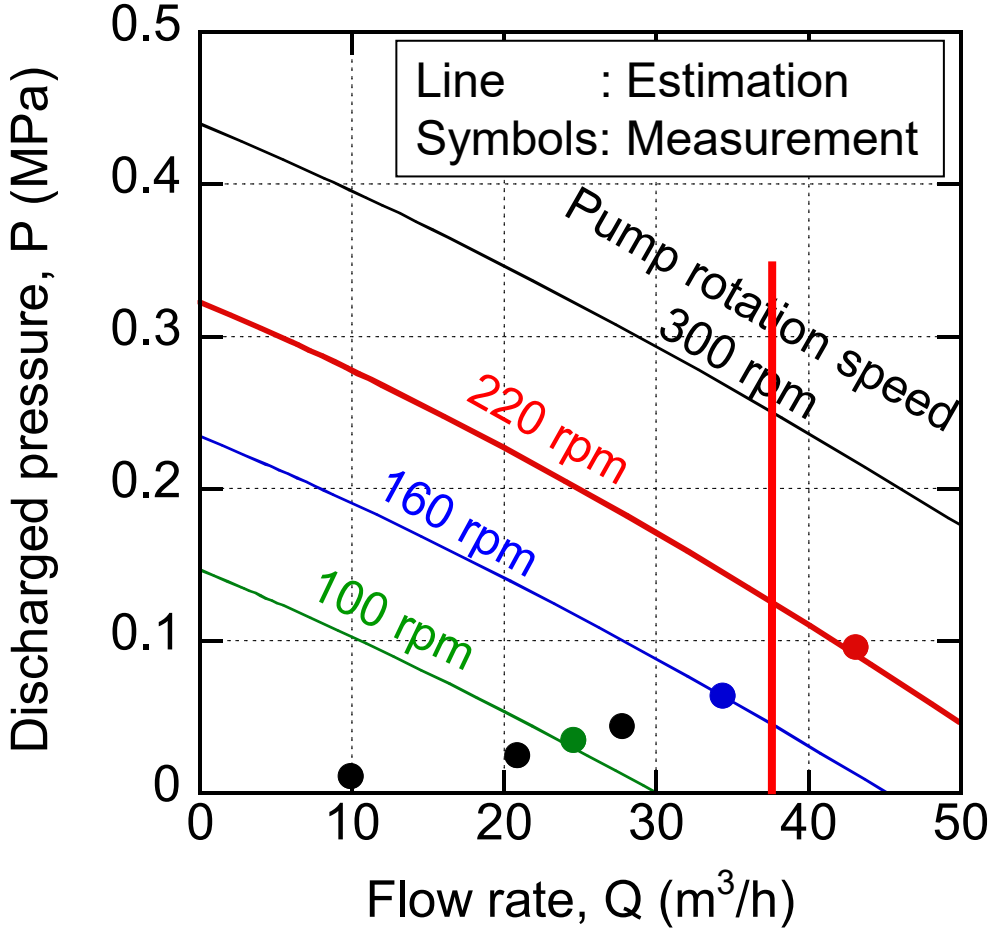
- Helium gas supply system
- Helium gas exhaust system
- Gas waste processing system
- Secondary water cooling system (Mercury heat exchanger)

Mercury circulation

PM pump

Permanent Magnet rotating type induction pump that was changed from gear pump because risk against mercury leakage is the lowest in the PM pump.



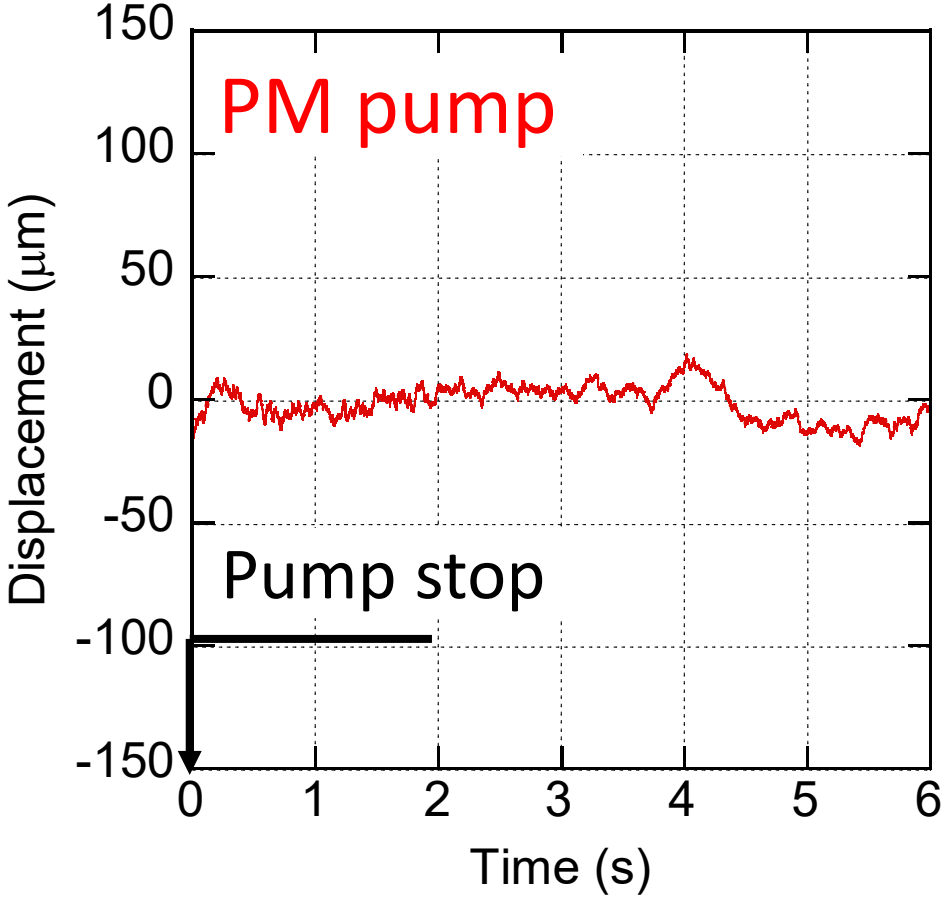


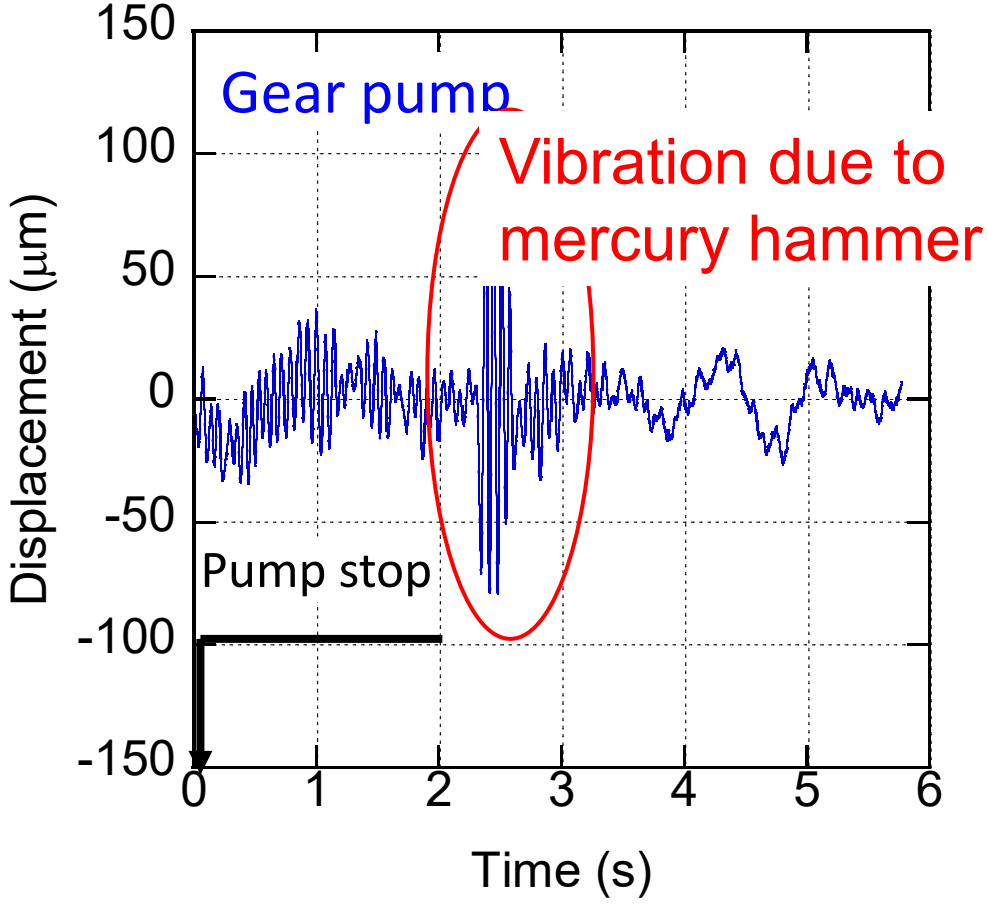
Required flow rate for 1 MW proton beam operation (38 m^3/h)

We confirmed pump ability which was similar with estimation, and PM pump could flow mercury with sufficient flow rate.

Mercury hammer

Vibration of the pipe was measured after pump stop
to investigate mercury hammer when the electric power loss occurs.





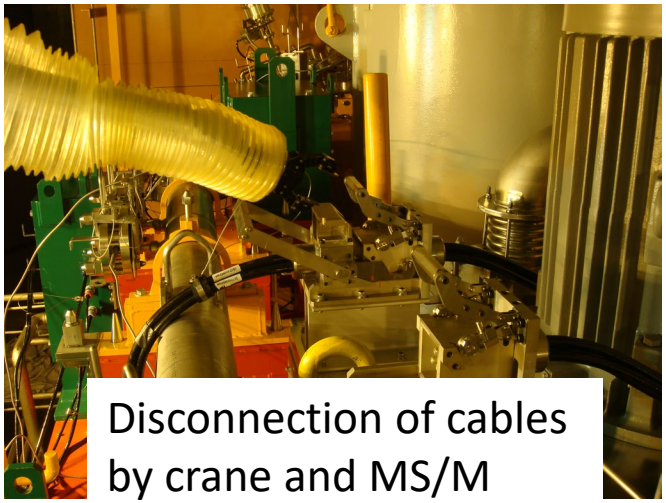
Hammer does not occur in the PM pump because there are no disturbance to flow.

Exchangeability of components

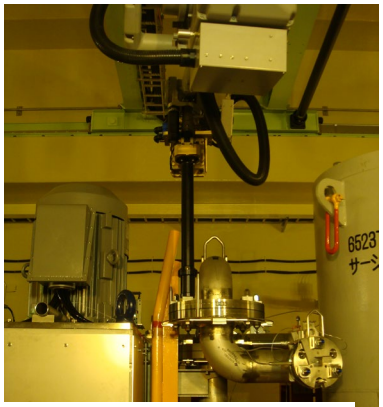
Mercury target vessel, PM pump, heat exchanger, sensors, etc.

Exchanging state of PM pump

Installation of new pump into hot cell

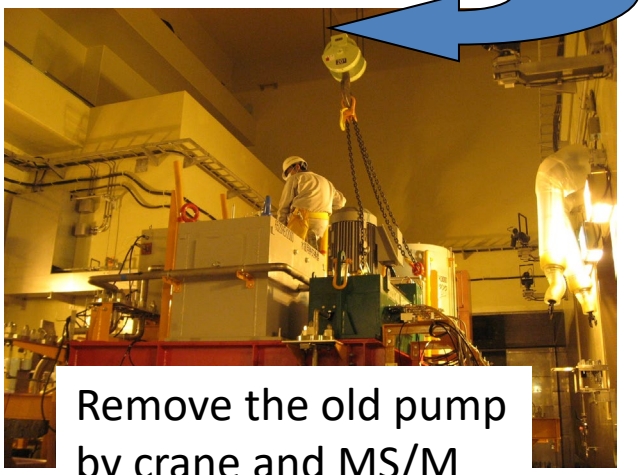


Disconnection of cables by crane and MS/M

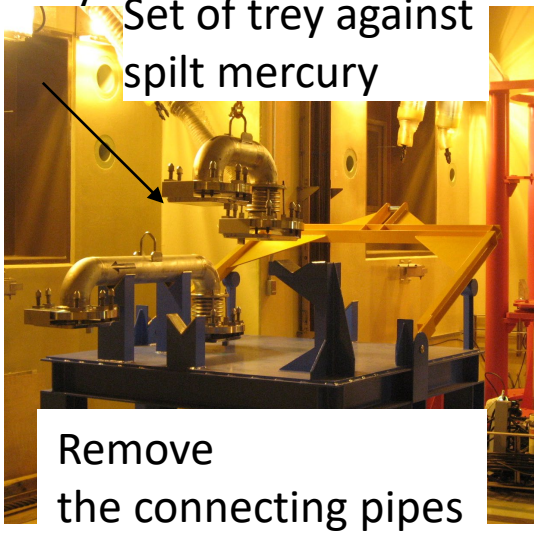


Unfastening bolts by P/M

Set new pump
Set of pipes by crane and MS/M
Fastening bolts by P/M
Connection of cables by MS/M



Remove the old pump by crane and MS/M



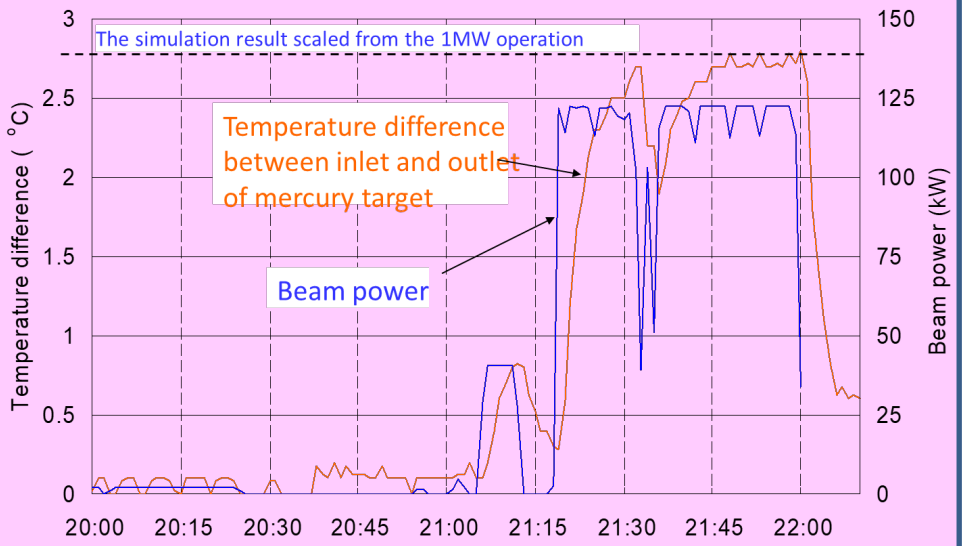
Set of trey against spilt mercury

Remove the connecting pipes by crane and MS/M

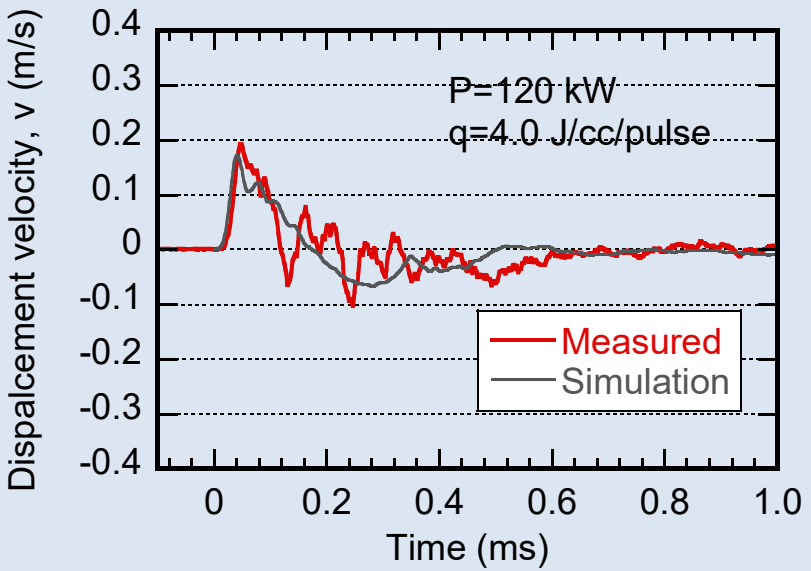
In beam test

- Mercury temperature raise between inlet and outlet of target vessel.
- Vibration of the mercury target vessel due to the pressure waves.

For validation of the simulation that was used for the design



Mercury temperature increased 2.8 °C in 120 kW beam operation.
That agreed with the simulation result which was scaled from 1 MW beam operation.



The measured vibration agreed well with estimation which was obtained by simulation.

Summary

- Mercury target system consists of 3 subsystems.
- Each subsystem was fabricated by different companies.
- After passing subsystem test, subsystems are integrated and the integrated system test was carried out.
- And then, subsystems were assembled in MLF.
- In MLF, we check
  - Connection among subsystems (Dimension, seal performance, etc.)
  - Exchangeability of each component by using the remote handling system in MLF (No interference among subsystems and remote handling system)
  - Target trolley operation
  - Mercury circulation
  - Interlock system etc.
- In in-beam test, we validated the simulation used for the design.