

Ancillary system commissioning including Off Gas system

J-PARC

Neutron Section

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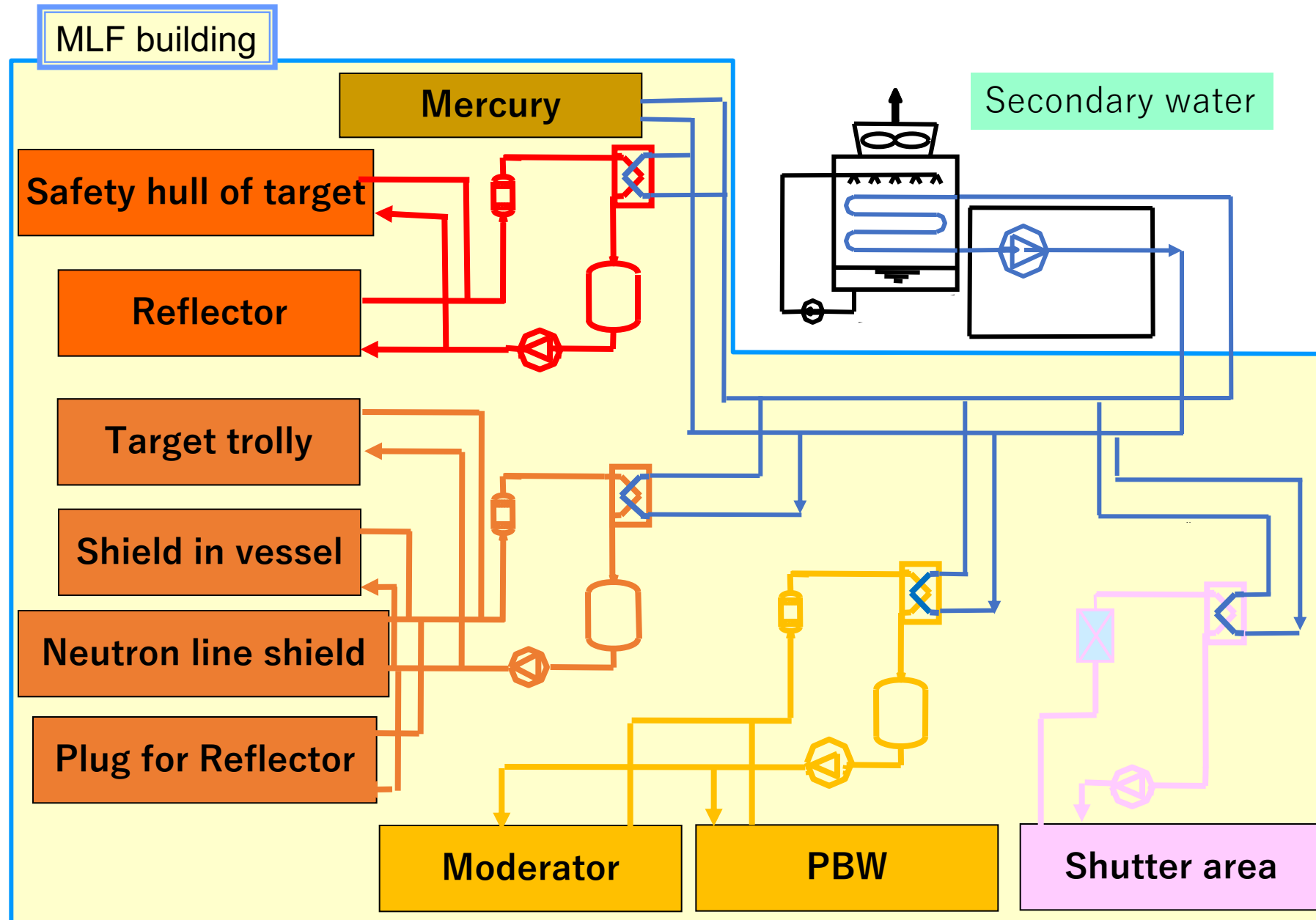
Ancillary Facility

- **Cooling system.**
- **He gas supply and exhaust system.**
- **Power supply system for Neutron source.**
- **Air conditioning system for radiation control area.**

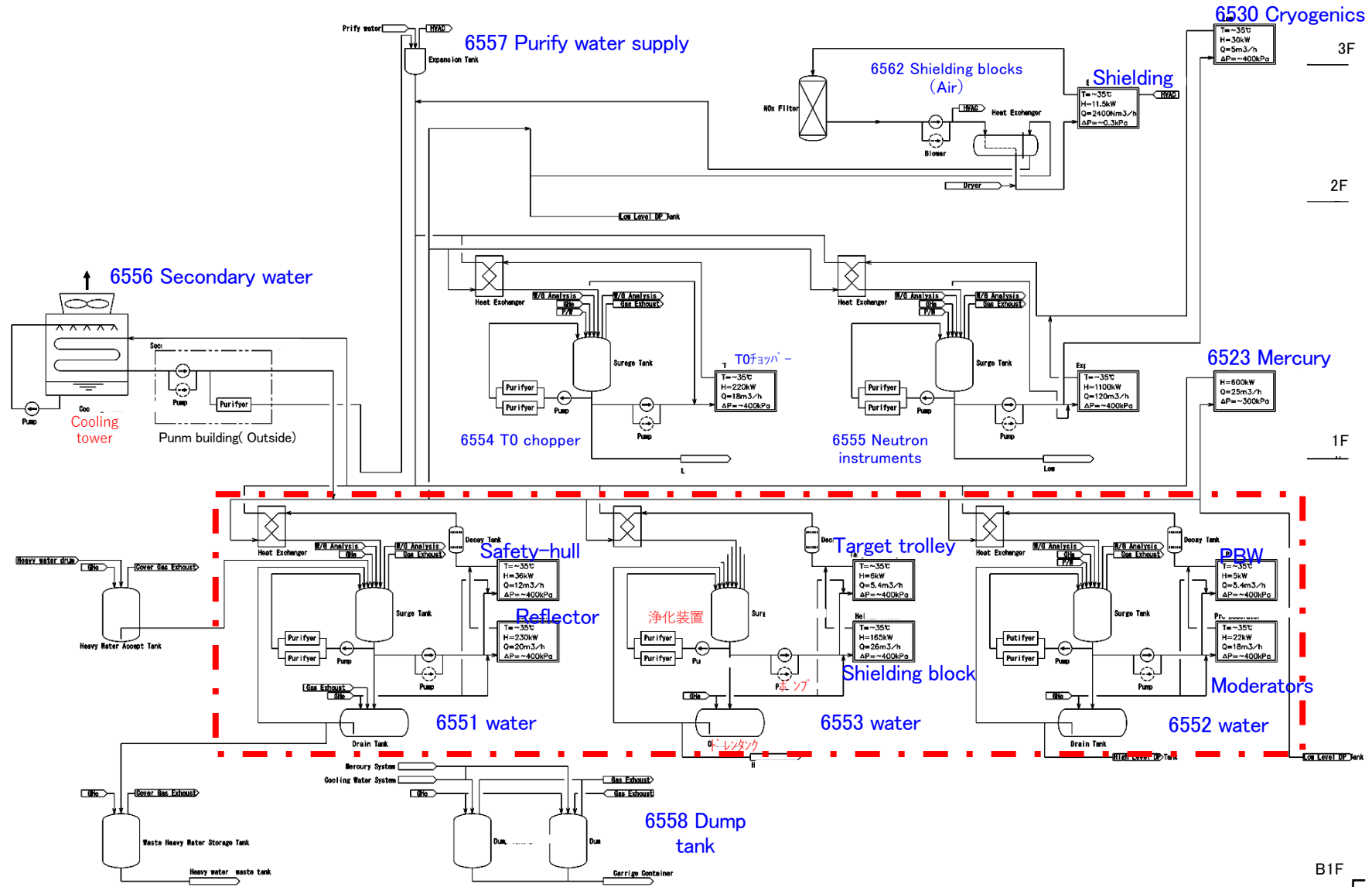
Check Point of Ancillary Facility

- **Flow rate and pressure of cooling system during steady-state operation.**
- **Drain and fill-up of water cooling system.**
- **Pressure control and gas purge of helium gas supply and exhaust.**
- **Capacity and protective coordination of Power supply system.**
- **Negative pressure control by air conditioning system.**

Configuration of Cooling system for neutron source



Detail diagram of cooling system



Readiness of Ancillary Facility 1

Component	Cooling system
Item	Flow rate and pressure
Acceptance criteria	<ol style="list-style-type: none">1. Flow rate is higher than design value for each components.2. Inlet pressure at piping is lower than design value for each components.
Necessity	A: indispensable by Day-1
Status	A: completed

Operation Spec. of Cooling system (1/2)

System	Radiation level	Component	Flow Rate (m ³ /h)		Pressure (MPa)	
			Design	Ope.	Design	Ope.
6551 Heavy water (Light water)	High	Reflector	20.0	22.0	0.47	0.32
		Safety hull	12.0	13.3	0.47	0.32
6552 Light water	High	Proton beam window	5.4	5.7	0.47	0.20
		Premoderators				
		Poison moderator	6.0	5.6	0.47	0.20
		Coupled moderator	6.0	3.7	0.47	0.20
		Decoupled moerator	6.0	4.7	0.47	0.20
6553 Light water	High	Target trolley	2.2	2.3	0.47	0.34
		Helium vessel				
		Inner plug	2.0	2.3	0.47	0.34
		Outer plug	2.0	2.2	0.47	0.34
		Middle section A	4.0	4.3	0.47	0.34
		Middle section B	2.0	2.3	0.47	0.34
		Middle section C	2.0	2.2	0.47	0.34
		Water cooling shielding	14.0	14.5	0.47	0.34

Operation Spec. of Cooling system (2/2)

System	Radiation level	Component	Flow Rate (m ³ /h)		Pressure (MPa)	
			Design	Ope.	Design	Ope.
6554 Light water	Low	T0 chopper	18.0	21.6	0.88	0.39
6555 Light water	No	Experimental hall	120	124.0	0.88	0.19
		Hydrogen system	5.0	5.2	0.88	0.1
6556 Light water	No	6551 Hx.	39.8	40.0		
		6553 Hx.	25.9	26.3		
		6552 Hx.	9.6	9.7		
		Mercury Hx.	25.0	25.0		
		6554 Hx.	32.7	33.0		
		6555 Hx.	165.0	168.0		
		6562 Chiller	12.0	12.2		
6562 Air		Schilding and Shutter	2400	2455		

Readiness of Ancillary Facility 2

Component	Water cooling system (High radiation level)
Item	Drain and Fill-up operation
Acceptance criteria	<ol style="list-style-type: none">1. Water can be drain to drain tank.2. Water can be flushed from the component by helium gas and effluent water from connector is very little when the component is removed from the system.3. Water can be filled up from drain tank to piping and component and remained gas can be removed from vent.4. Water can be circulated constantly without abnormal vibration and noise.
Necessity	A: indispensable by Day-1
Status	A: completed

Readiness of Ancillary Facility 3

Component	Gas supply and exhaust system
Item	Pressure control and gas purge
Acceptance criteria	<ol style="list-style-type: none">1. Pressure of the component (ex. mercury circulation system, helium vessel, etc.) is kept in rated pressure constantly.2. Vacuum level can be kept less than 1000Pa and helium gas can be supplied and kept the design pressure.
Necessity	A: indispensable by Day-1
Status	A: completed

Readiness of Ancillary Facility 4

Component	Power supply system
Item	Cable size and breaker capacity
Acceptance criteria	<ol style="list-style-type: none">1. Allowable current of cable is higher than load current.2. Voltage drop on cable is less than 3%.3. Rated current of breaker is lower than allowable current of cable.4. Cut-off capacity of breaker is higher than short circuit current of cable.
Necessity	A: indispensable by Day-1
Status	A: completed

Readiness of Ancillary Facility 5

Component	Air conditioning system
Item	Negative pressure of radiation control area
Acceptance criteria	Category 1 (Hot-cell, Storage room) ; less than -200Pa <i>Measured (-340~-400Pa)</i> Category 2 (Cooling system room, etc.) ; less than -60Pa <i>Measured (-60Pa)</i> Category 3 (Manipulation room, etc.) ; less than -30Pa <i>Measured (-30Pa)</i> Category 4 (Experimental hall) ; less than -20Pa <i>Measured (-20Pa)</i>
Necessity	A: indispensable by Day-1
Status	A: completed

Problem during Commissioning work for cooling water system

- Water flow rate in moderators were not sufficient with rated condition.

Single flow test for moderator was conducted in MLF.

→ Pressure drop of moderator was relative higher.

→ Moderator's water piping was repaired on site.

∴ In factory test, water flow test had not been conducted.

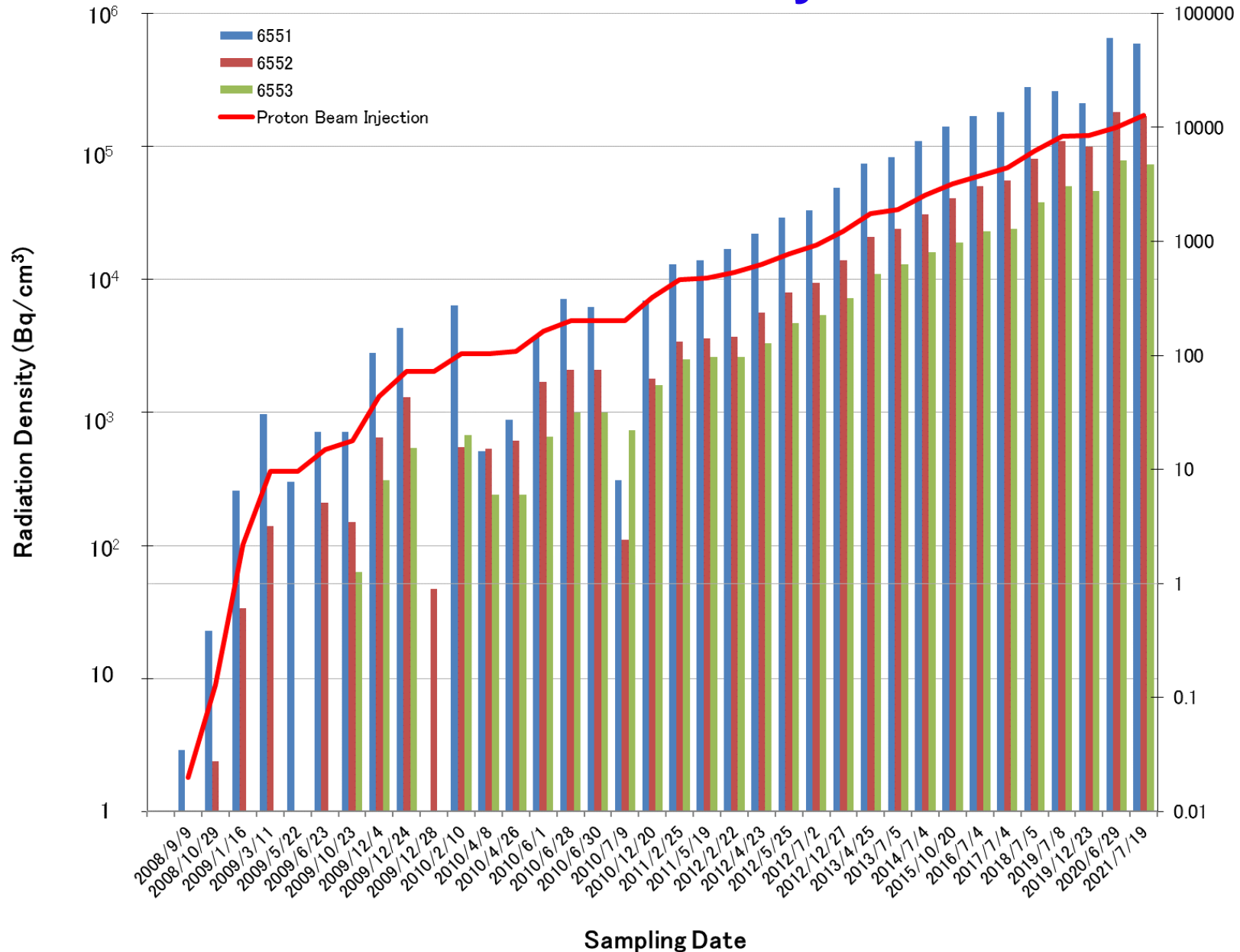
It is necessary to avoid troubles in combination by conducting a single test of equipment to be supplied as closely as possible

Change point after operation start

- By carrying out periodic maintenance for rotating devices and sensors, the operation can be continued without major trouble.
 - Vacuum dry-up before open circulation system.
 - Sampling for gas and water before maintenance work.
- Control system for water cooling system were replaced because of service life of devices
 - PLC : 7 years, Inverter : 10 years
- B system pump and purify system (filter and Ion exchange resin) were added for 3 water circulation systems.
 - Ion exchange resin life time. About 6 years (6551 system).
estimated 7years

Planned operation was conducted from the beginning of the facility, there is no problem at present. We will continue to do maintenance etc. from time to time

Radiation level of Tritium in water cooling system



2021, July

- 6551 4.0m³ 5.9×10^5 Bq/cc
- 6552 2.5m³ 1.7×10^5 Bq/cc
- 6553 5.0m³ 7.3×10^4 Bq/cc

2021,

- 6562 (Air) Dehumidified water $2.7 \sim 4.5 \times 10^3$ Bq/cc



Maintenance requires higher protective measures

Summary of Ancillary system

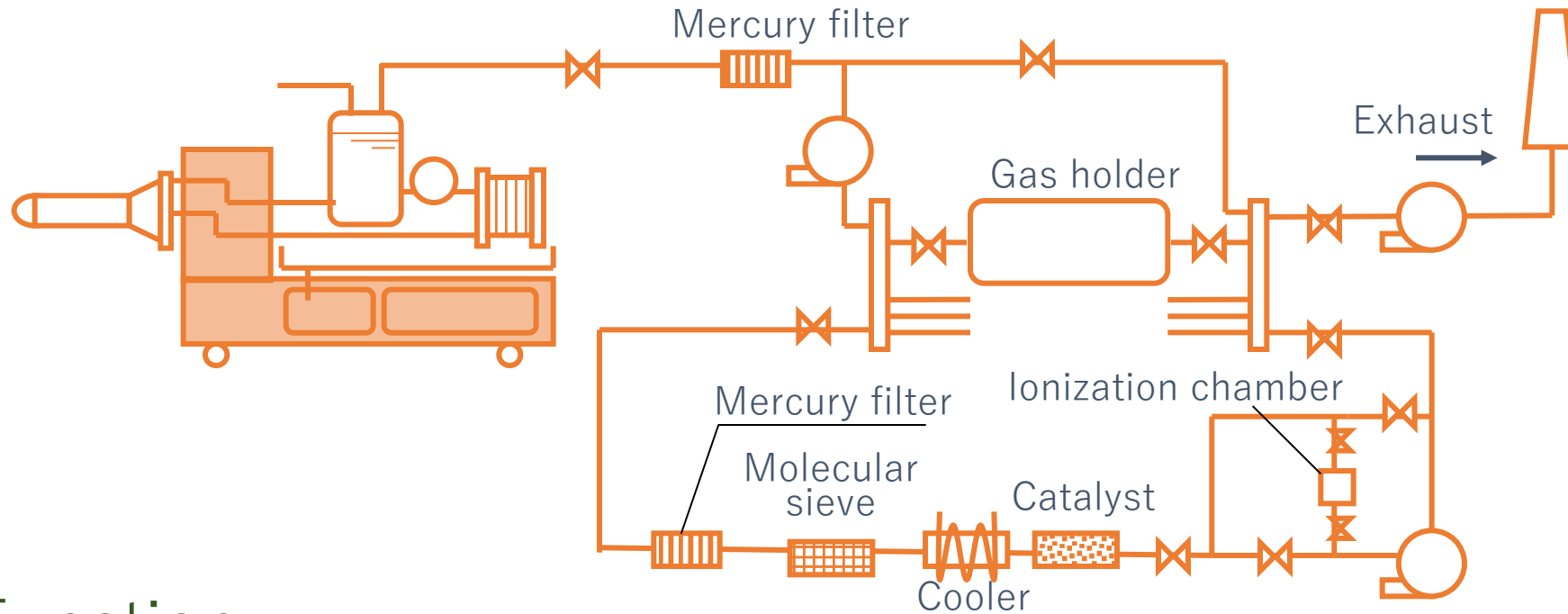
- Commissioning test in order to verify readiness of ancillary facility is completed.

(Cooling system, Electricity, Air Conditioning)

- Equipment deficiencies identified by testing were repaired to sufficient design specifications.
- Commissioning period were about 1 year, after building and components fabrication finished to beam started. Commissioning can be finished in this time.
- After beam operation started, B system pump and purify system were added. The control devices were updated for preventive maintenance due to aged deterioration, etc..
- Radiation level in water are increasing with beam operation, maintenance work. Regarding maintenance, it is necessary to take measures in consideration of safety.

Off gas system

Outline of the system



Function

- Mercury removal
- Tritium removal
- Gas holding
- Radioactivity check

Performance check

- Off-gas transfer process
 - Flow speed control at 30 L/min => OK
 - Depression of surge tank to 100 MPa => OK
 - Mercury filter efficiency => After operation started
- Tritium removal process
 - Flow speed control at 30 L/min => OK
 - Humidity control at > 5% RH => OK
 - Tritium removal efficiency => Checked indirectly
 - Activity measurement => After operation started
- Gas exhaust
 - Flow speed control => OK
 - Depression of the gas holders to < 100 Pa => OK