Conventional Facility, Ancillary, Safety
- Building Layout & Ancillary Design Status

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Building Layout & Ancillary Design
- Content -

- **Building layout overview**
  - ● User area and operation / maintenance area are basically separated.
  - ● All the radiation controlled area have negative pressure in order to prevent release of radioactive emission to the environment.
    - ● Set point of negative pressure are decided as follows.

      Level 1 : – 200 kPa (Hot cells)
      Level 2 : – 80 kPa (Primary cooling system components room, Isolation room etc.)
      Level 3: – 80 kPa (Manipulator operation room etc.)
      Level 4: – 10 kPa (Experimental hall etc.)
  - ● Target station is located inside the containment in order to ensure the safety.
- **Irradiated components storage facility design criteria and layout**
- **Remote-handling facility layout**
- **Water cooling system concept and specification**
- **Off gas process system concept**

Material and Life Science Experimental Facility (Neutron Scattering / Muon Science Facility)

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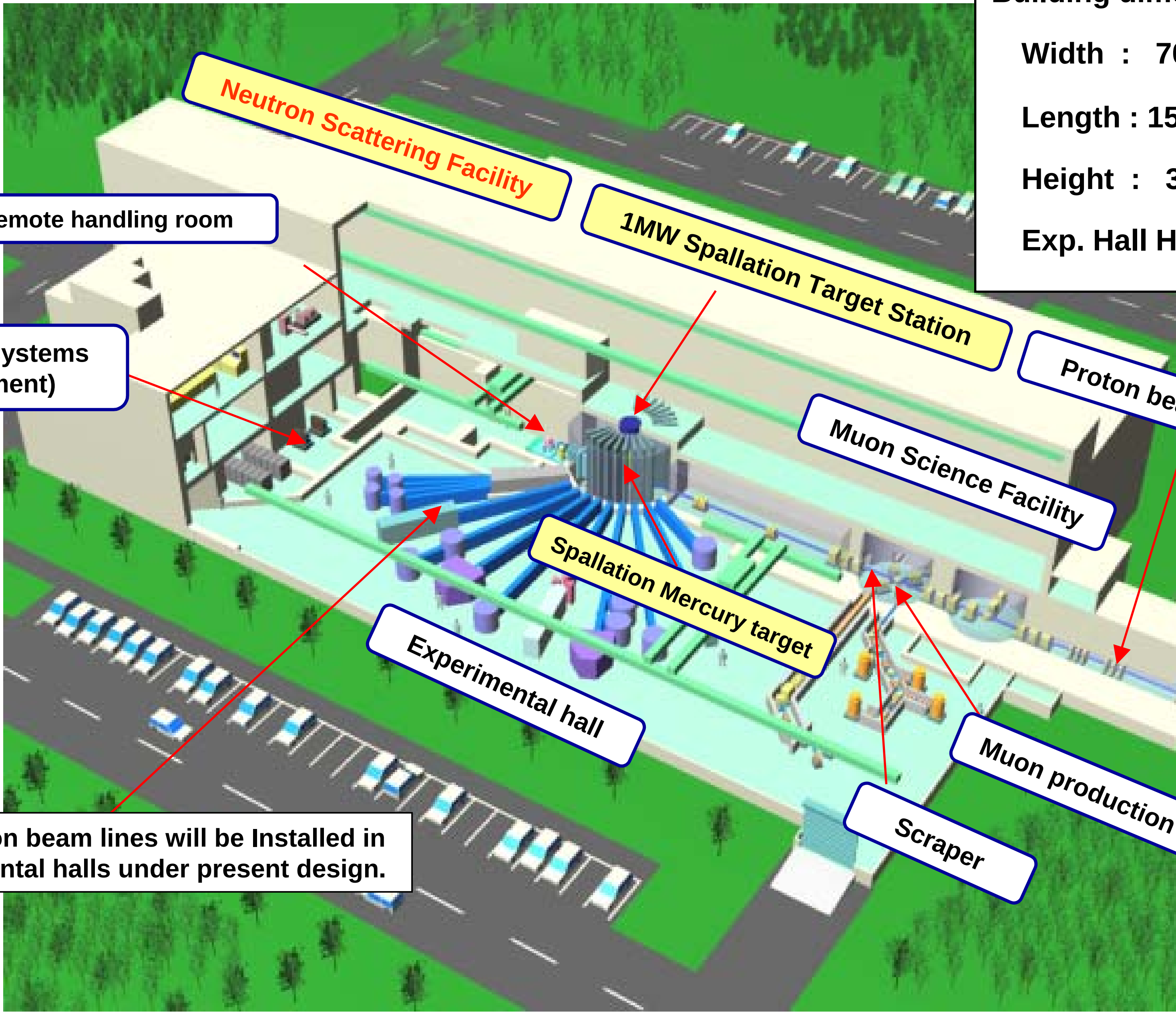
Building dimension :

Width : 70m

Length : 158m

Height : 30m

Exp. Hall Height : 22m



Material and Life Science Experimental Facility - 1st floor (1FL) -

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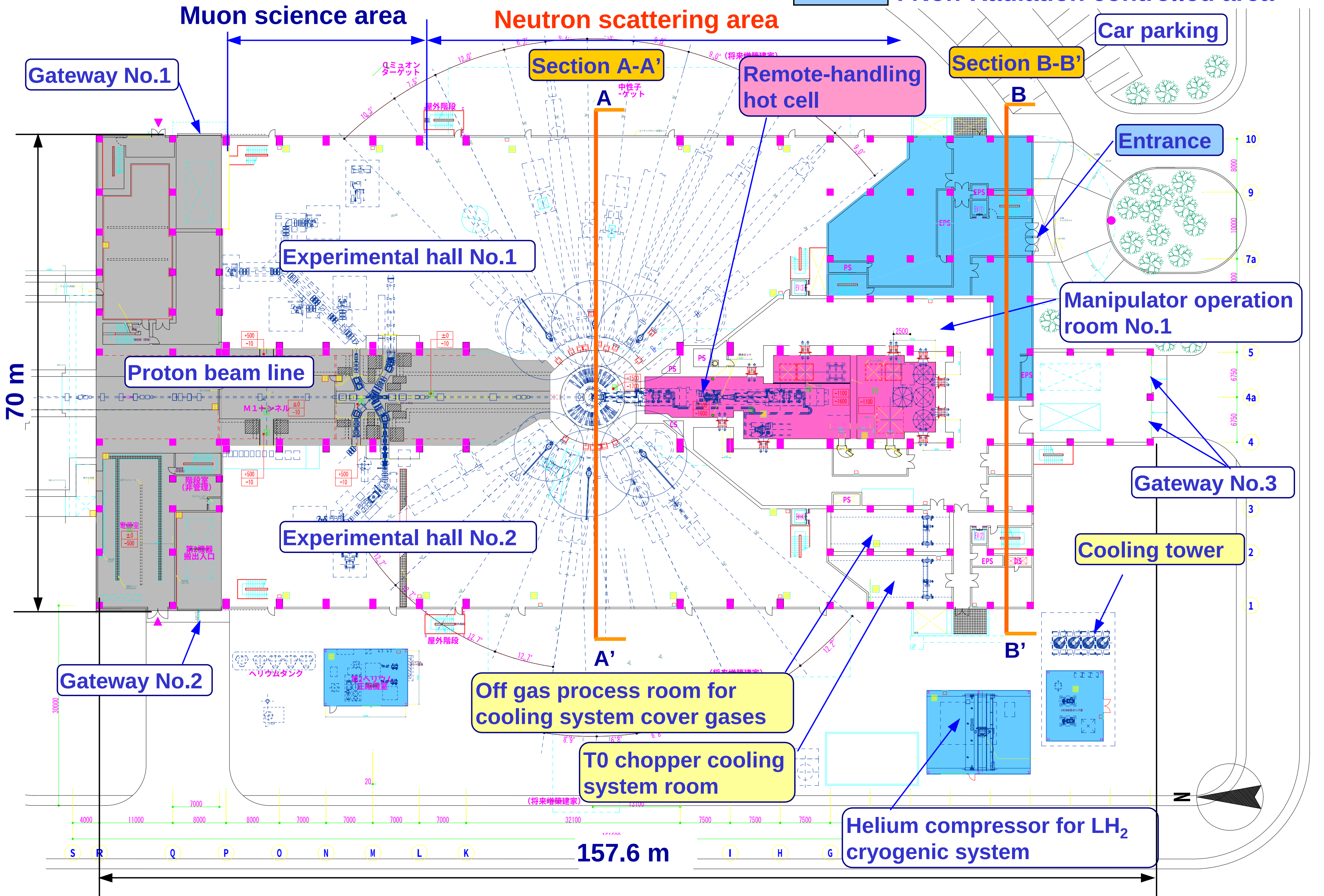
: Non-Radiation controlled area



Material and Life Science Experimental Facility
- Typical cross section of the facility building-

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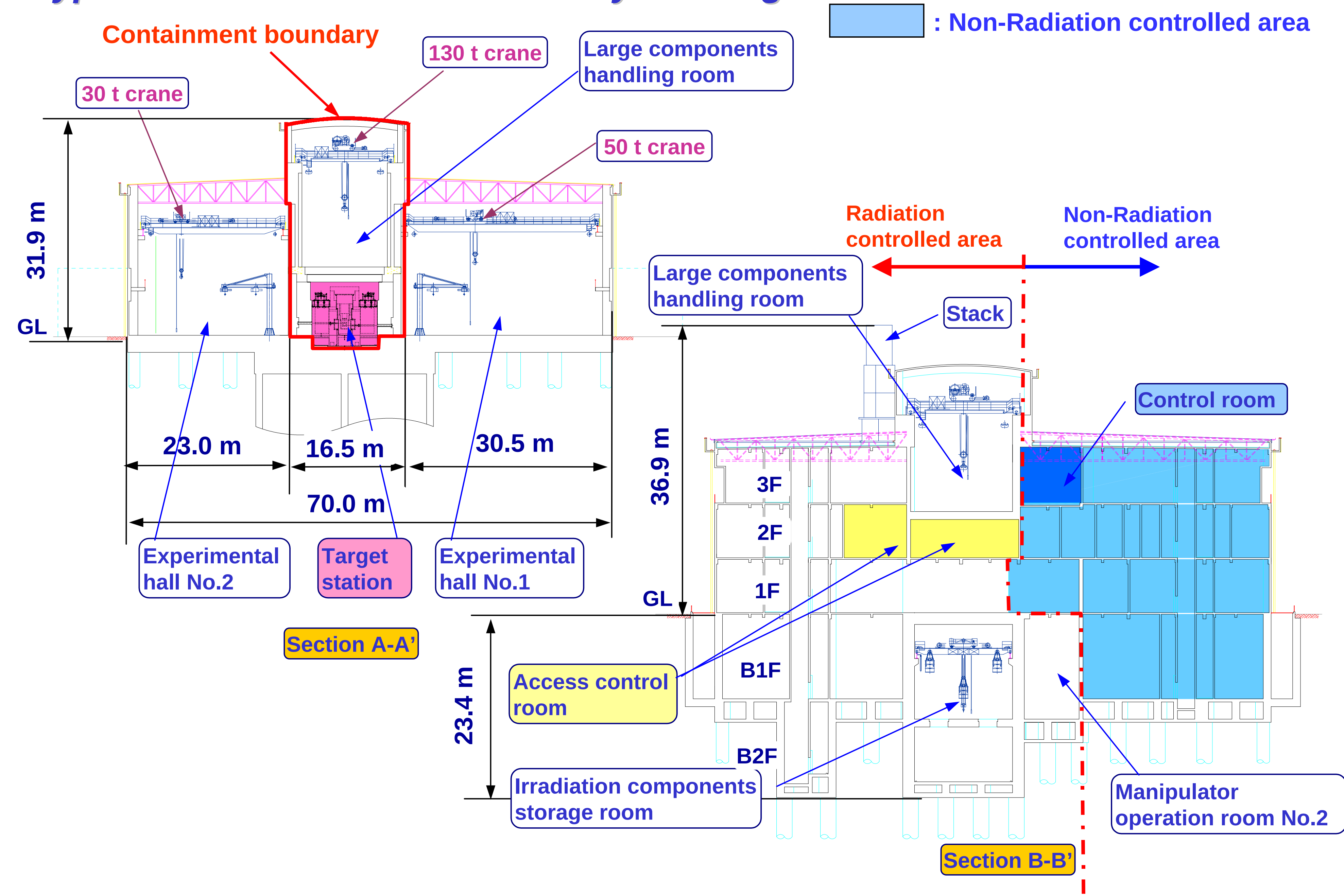

Material and Life Science Experimental Facility - 2nd floor (2FL)-

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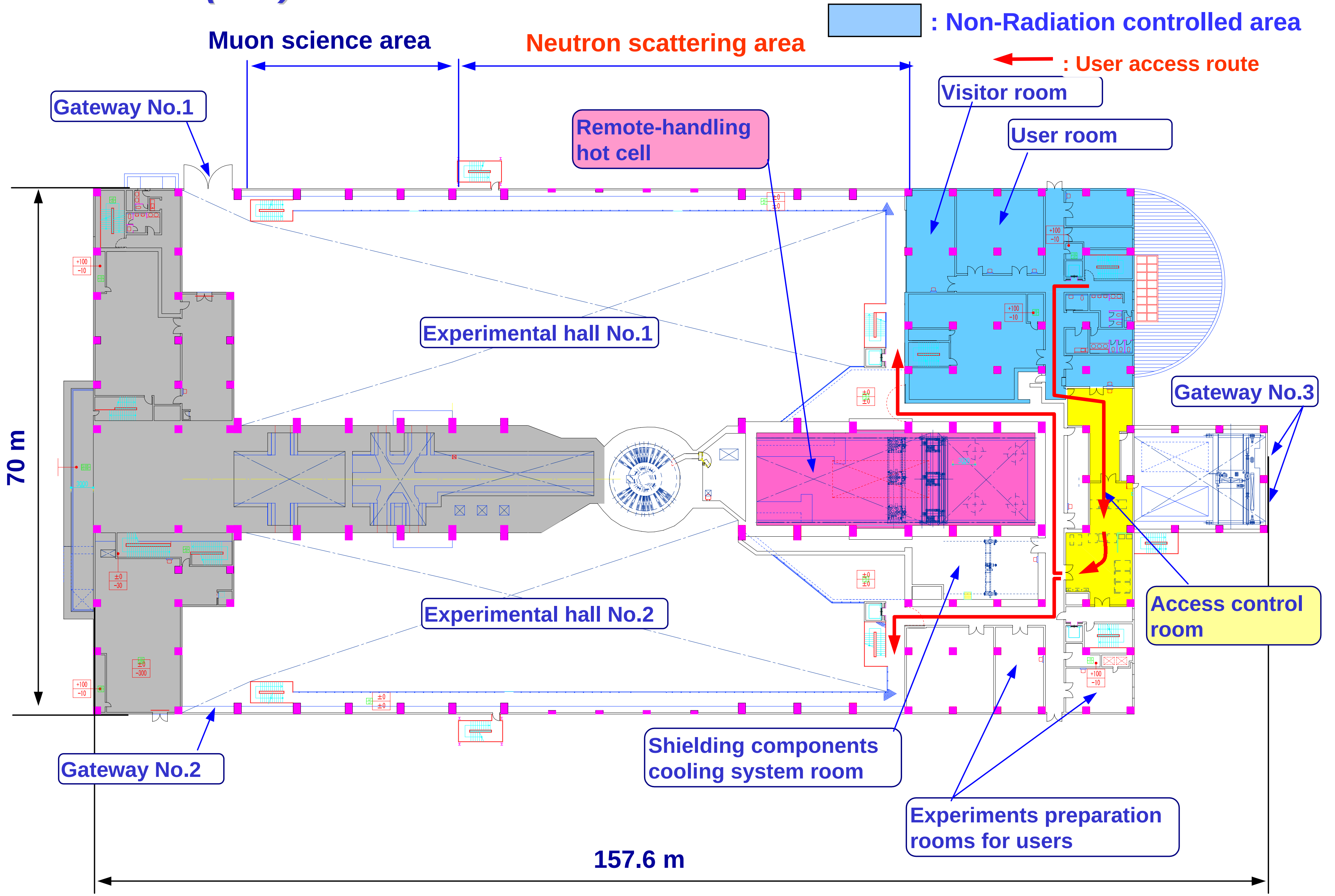

Material and Life Science Experimental Facility
- 3rd floor (3FL) -

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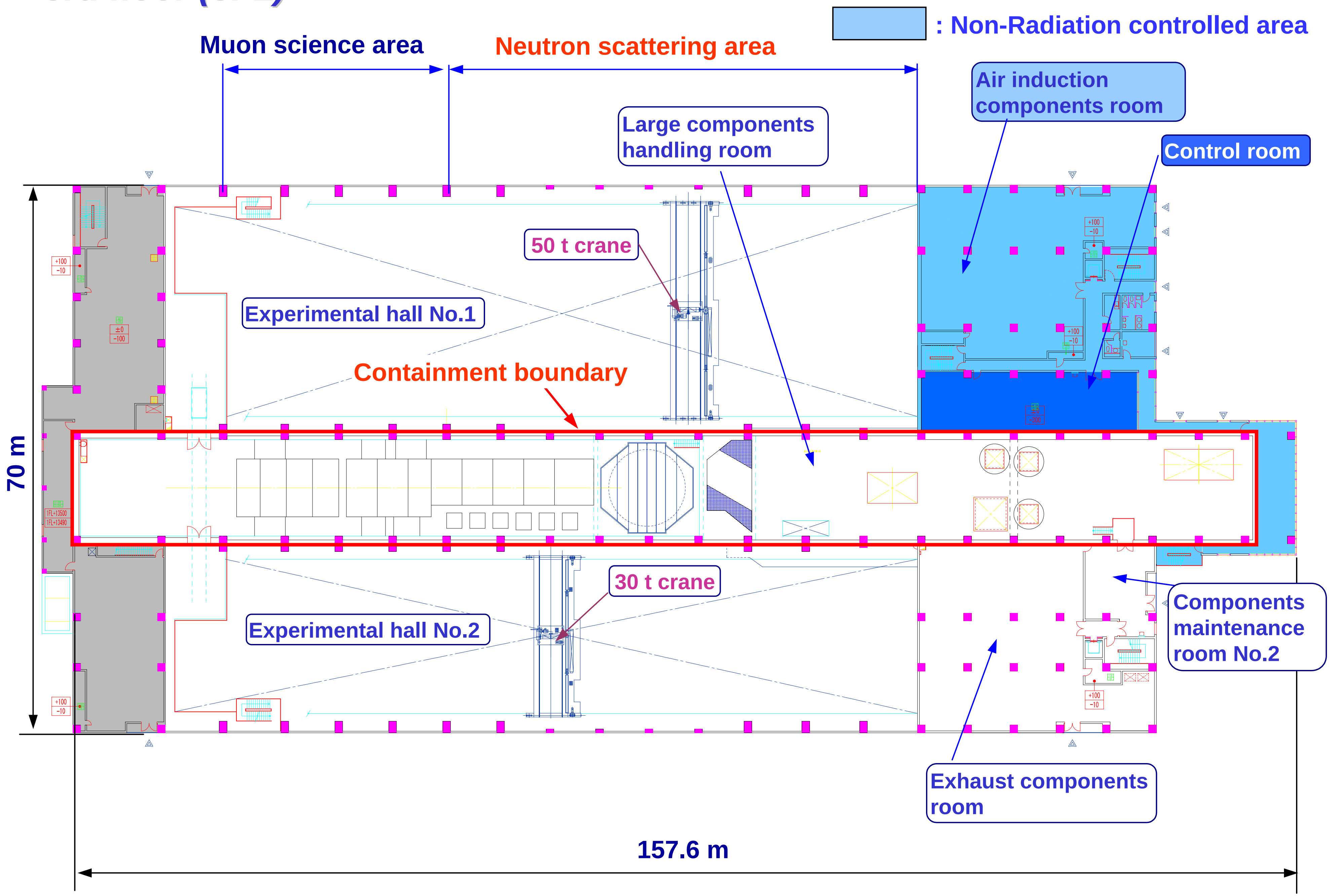

Design criteria for Irradiated components storage facility

♦ Irradiated components designed to be stored in the facility

(1) Irradiated components which have high radiation level
(2) Components used in the mercury cooling system
⇒ Temporary storage in the facility. Permanent storage facility must be considered in near future.
(3) Storage capacity ⇒ For 10 years operation (at least 6 years)
(4) All the components will be stored in atmosphere condition (Low decay heat).
a. Mercury target vessel must be stored in an airtight container
b. The airtight container will not have shielding function because of its weight
⇒ Storage facility must have shielding function, such as shielding hatches.

♦ Restriction for personal access to the facility

- During handling period : Access to the facility is prohibited.
- Other period : Access to the facility is permitted.
⇒ Shielding is required

♦ Shielding design

- Outside the facility (Manipulator operation room) : 12.5 μSv/h
- Inside the facility a. During handling period : No restriction
b. Other period : 100 μSv/h

Material and Life Science Experimental Facility
- Basement floor (B1FL) -

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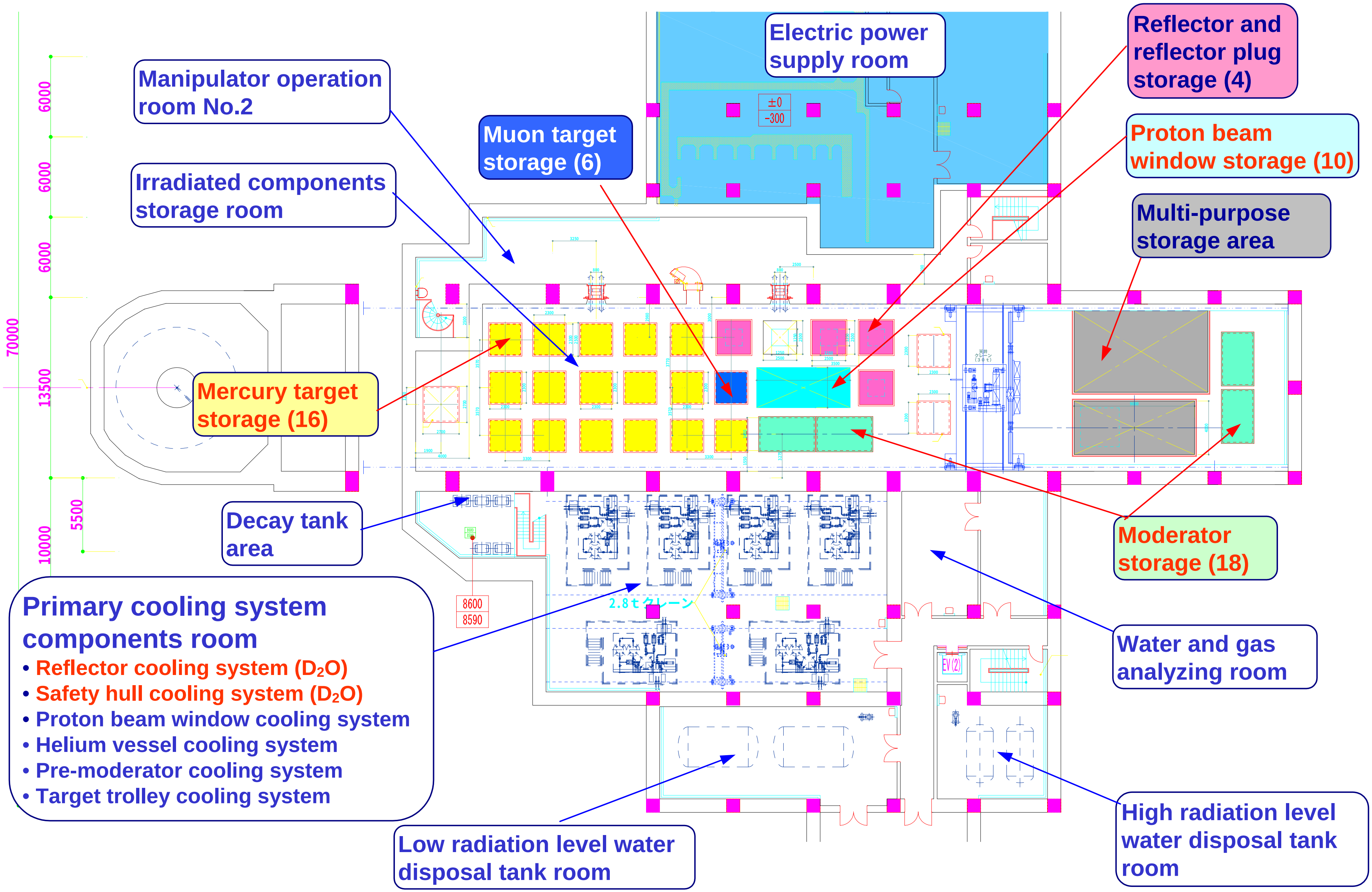
: Non-Radiation controlled area



Material and Life Science Experimental Facility - Target handling room and Irradiated components storage room -

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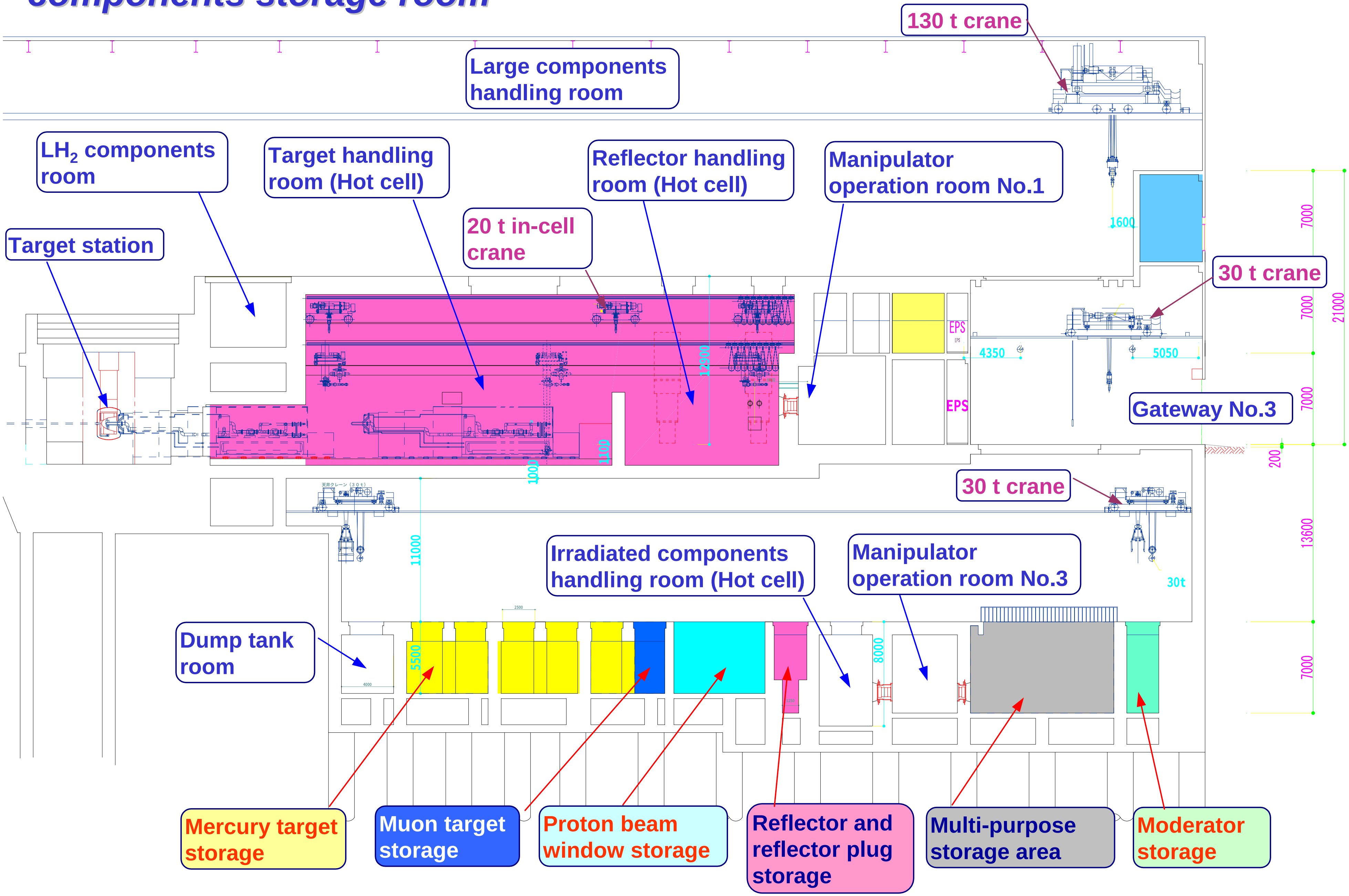
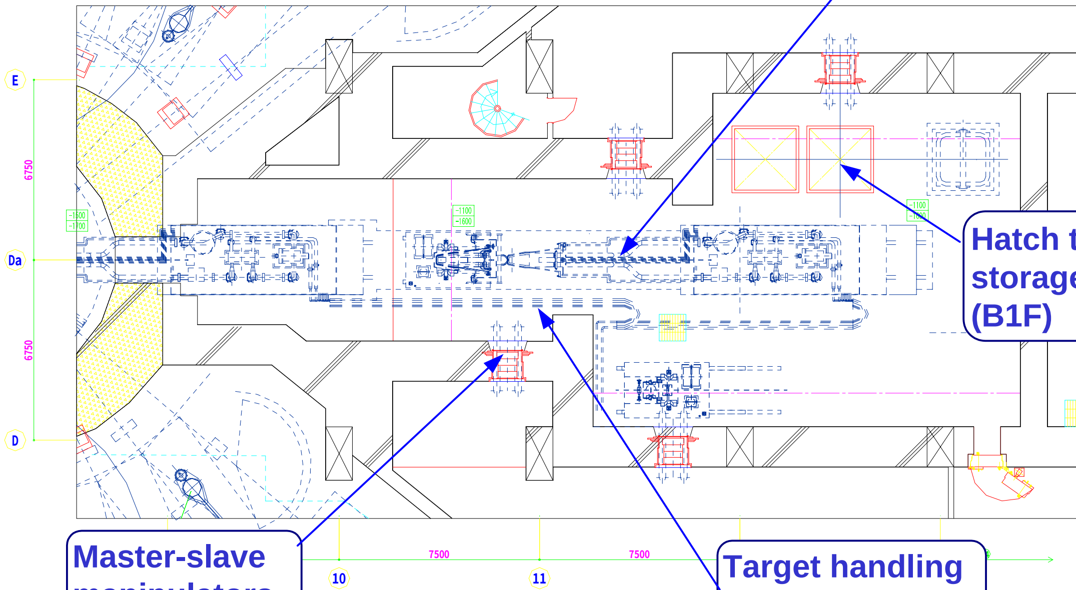
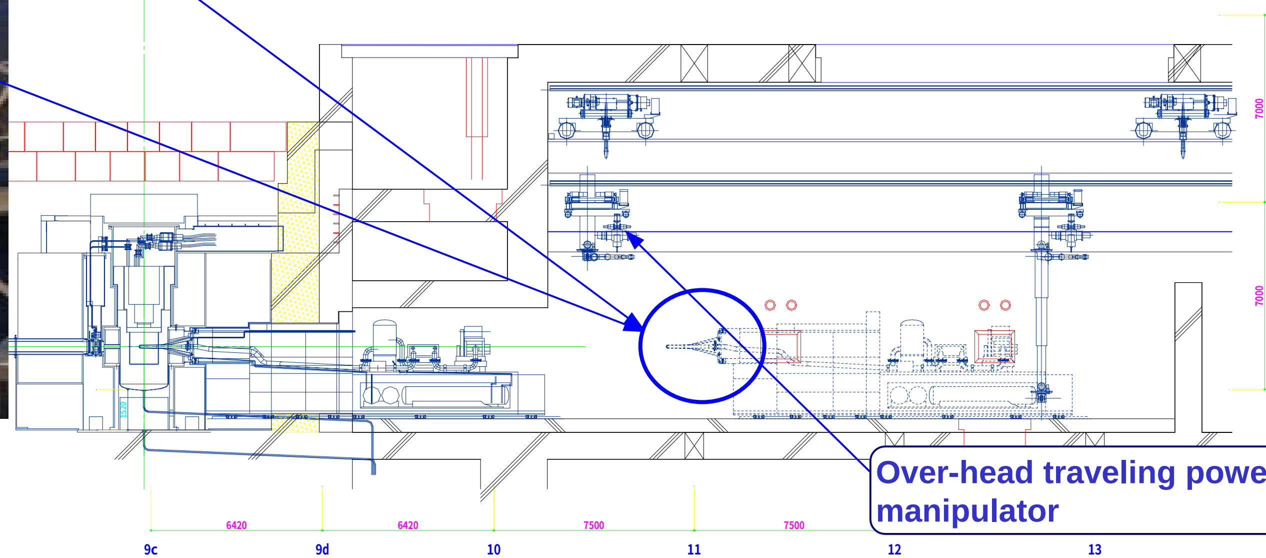


Target handling room (Hot cell) arrangement and remote-handling devices

- Target handling room is designed based on 3D simulation and full scale remote-handling demonstration facility tests.

Remote-handling tests using an over-head traveling power manipulator





Water cooling system concept
- Unit system -

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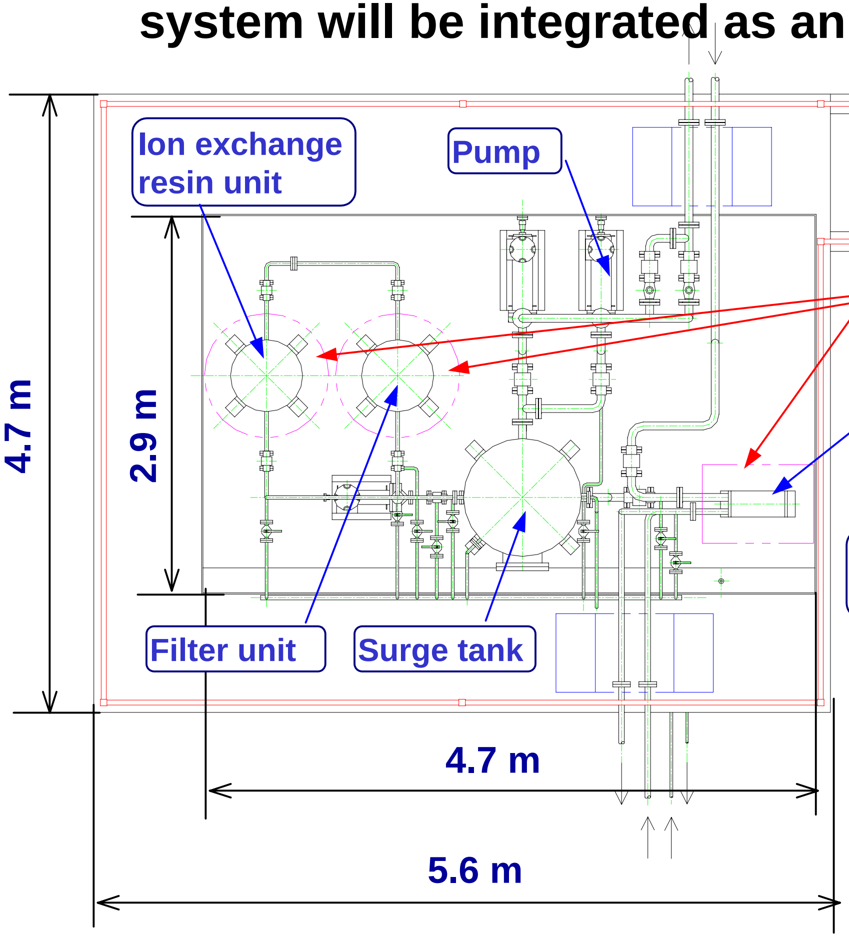
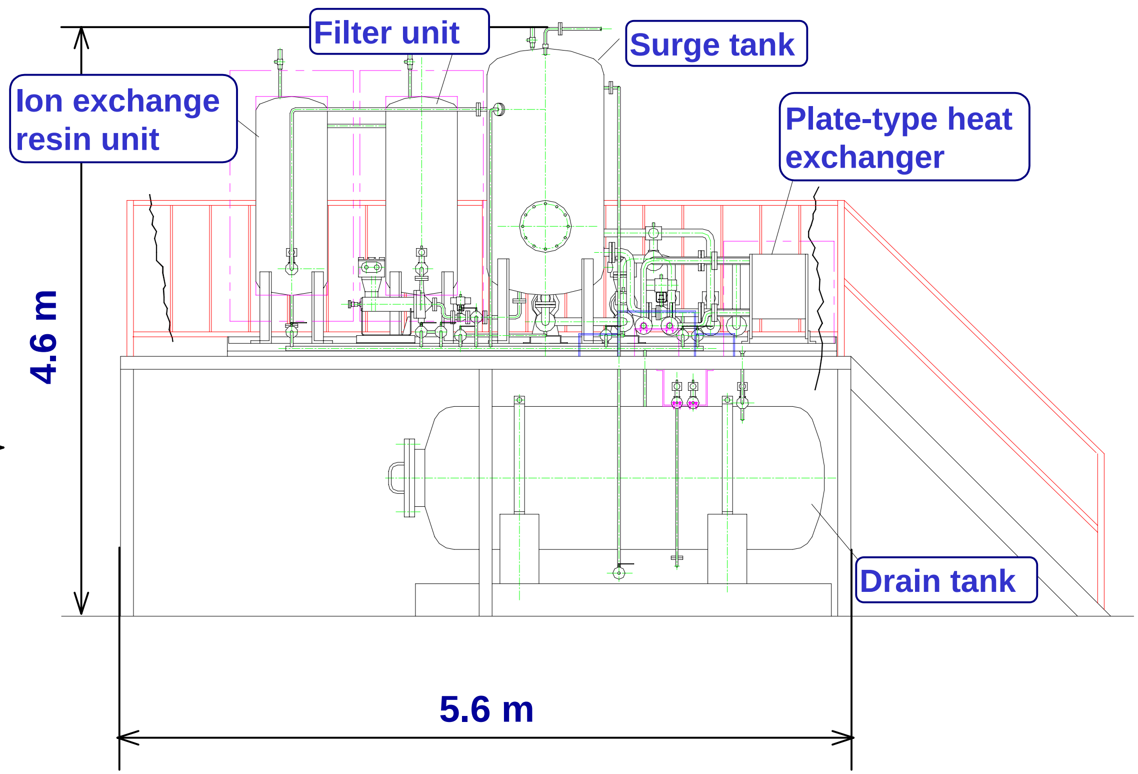
■ In order to reduce on-site work, major components of a water cooling system will be integrated as an unit at a factory.



Primary cooling system unit
- Reflector cooling system (D_2O)
- Safety hull cooling system (D_2O)
- Proton beam window cooling system
- Helium vessel cooling system
- Pre-moderator cooling system
- Target trolley cooling system



Water cooling system specification for the spallation target system

No.	Cooling system		Volume [m^3]	Maximum operating pressure [MPa]	Maximum operating temperature [℃]	Flow Rate [m^3/h]	Heat exchange capacity [kW]	Primary piping [Sch40]	2ndary Piping [Sch40]	Velocity in main piping [m/s]	Heat exchanger inlet / outlet temperature	Pump Head [m]
[1]	Safety hull cooling system (D2O)	Whole System		0.5	50	12/6.5	36	40A	40A	2.50	35/37.3	60m
		Surge Tank	1									
		Delay Tank	0.6									
[2]	Reflector cooling system (D2O)	Whole System		0.5	50	18/38	225	50A	65A	2.29	35/44.6	60m
		Surge Tank	1									
		Delay Tank	0.6									
[3]	Target trolley cooling system (H2O)	Whole System		0.5	50	5.4/1	6	25A	15A	2.58	35/36.0	60m
		Surge Tank	0.5									
[4]	Helium vessel cooling system (H2O)	Whole System		0.5	50	18/30	150	50A	65A	2.29	35/42.2	60m
		Surge Tank	1									
		Delay Tank	0.6									
[5]	Proton beam window cooling system (H2O)	Whole System		0.5	50	5.4/1	5	25A	15A	2.58	35/35.8	60m
		Surge Tank	1									
		Delay Tank	0.2									
[6]	Pre-moderator cooling system (H2O)	Whole System		0.5	50	18/4	20	50A	40A	2.29	35/36	60m
		Surge Tank	0.25									
		Delay Tank	0.6									
[7]	T0 chopper cooling system (H2O)	Whole System		0.5	50	18/38	220	50A	65A	2.29	35/45.6	60m
		Surge Tank	0.6									
[8]	Neutron station cooling water supply system	Whole System		0.5	50	120/180	1100	125A	150A	2.65	35/43.0	60m
		Surge Tank	2									
[9]	Bio-shielding air circulation systemt	Whole System		0.3	60	2400/1	12	250A Sch20	25A	10.93	40/59.6	60m
		Blower										
[10]	Secondary cooling system (H2O)	Whole System		0.8	50	400	2500		250A	2.29	30/35.2	60m
		Surge Tank	2									
		Cooling Tower				400	2500		250A			

Annual Emissions of Radioactive Nuclides from Material and Life Science Experimental Facility

- *Major nuclides considered for emissions from exhaust stack*
  - Tritium
  - Rare noble gases
  - Iodine
  - Radioactive mercury vapor
  - Others (Air activation)

- *Following nuclides were not considered for emissions*
  - Beryllium generated in coolant
  - Carbon generated in coolant
  - Radioactive nuclides generated in mercury other than listed in the left table
- Above nuclides were assumed to remain in coolant (H_2O, D_2O or mercury) and were not released as emissions.

- *Annual emissions of radioactive nuclides were evaluated based on radioactive nuclides generated in the air, coolant and structural materials under the conditions of 1MW, 1 year operation. (Radioactive nuclides generated in the mercury were evaluated under the condition of 1MW, 30 years continuous operation.)*

Radioactive emissions	Source	Collection or separation equipment	Decontamination factor	Notes
Tritium	Tritium generated in mercury H_2O, D_2O, structural material and air	Tritium collection system using molecular-sieve	**1000**	Tririum generated in 3GeV-BT tunnel were asummerd to exhaust 100%
Rare noble gases	Rare noble gases generated in mercury H_2O, D_2O, structural material and air	Ar : Hollow-fiber membrane	**50**	Rare noble gases generated in 3GeV-BT tunnel were asummerd to exhaust 100%, after 8 hours of decay time
		Xe, Kr :Cryogenic distilation column	**100**	
Iodine	Iodine generated in mercury	Iodine adsorption filter	**2000**	1/1000 of total amount of Iodine was assumed to release from mercury
Radioactive mercury vapor	Radiactive mercury	Mercury vapor collection system	**10000**	1/1000 of total amount of mercury was assumed to release
Others (air acitivation)	Other radioactive nuclides generated in air		**1**	Other radioactive nuclides generated in 3GeV-BT tunnel were asummerd to exhaust 100%, after 8 hours of decay time

Concept for an off gas process system in order to decrease annual emissions of radioactive nuclides

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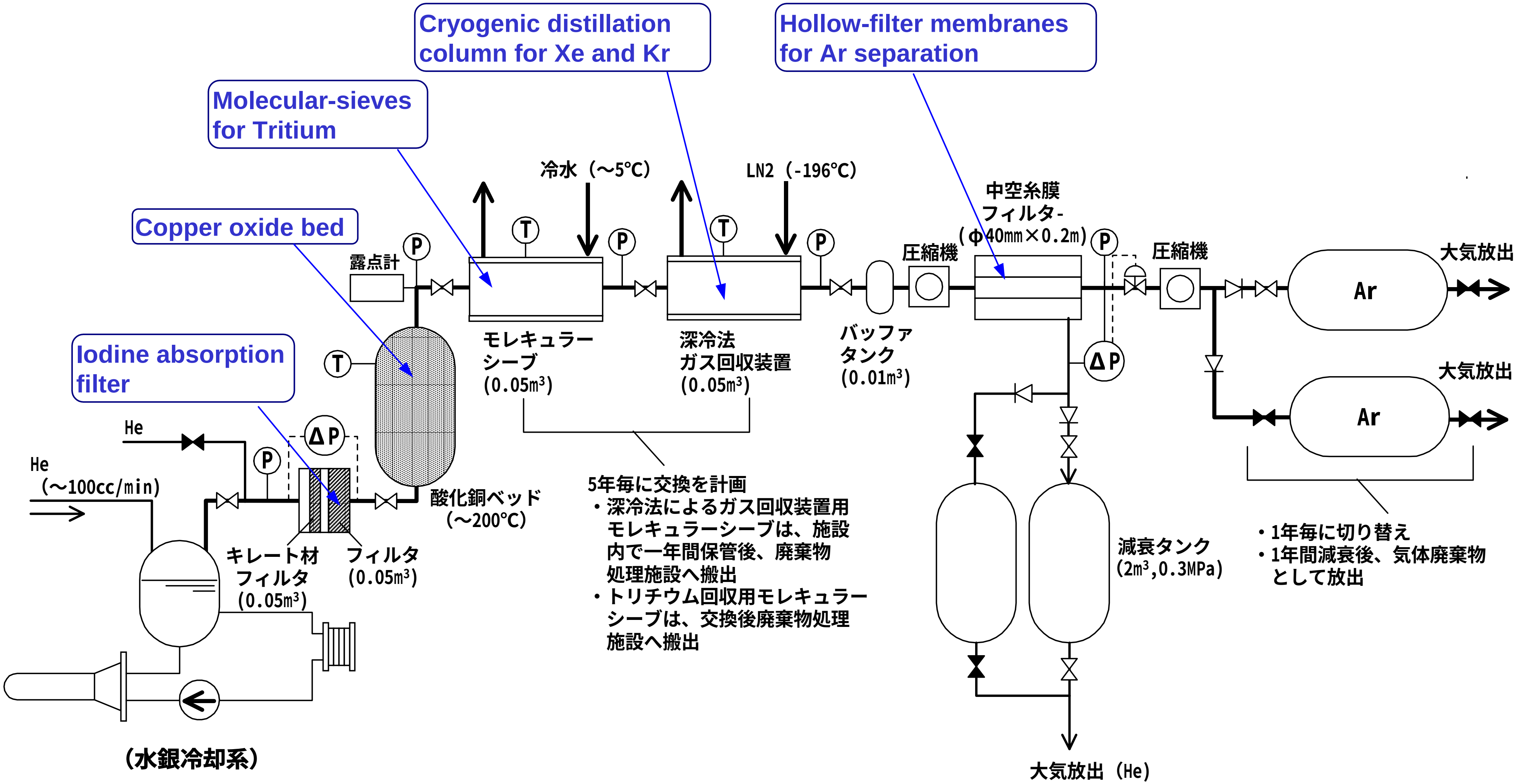

Building Layout & Ancillary Design
- Concluding remarks -

- **The design of the Material and Life Science Experimental Facility (MLF) building is intensively in progress to start its construction from FY2003.**

- **The detail design of its conventional facility and ancillary facilities is also in progress. Especially, arrangements of remote-handling devices and spent components storage facility are almost completed.**

- **In the facility, an off gas process system in order to reduce annual emission of radioactive nuclides will be installed for 1MW operation. The detail design of the system will start soon.**

Outline of Target Station, Remote-Handling Facility and Spent Components Storage Facility

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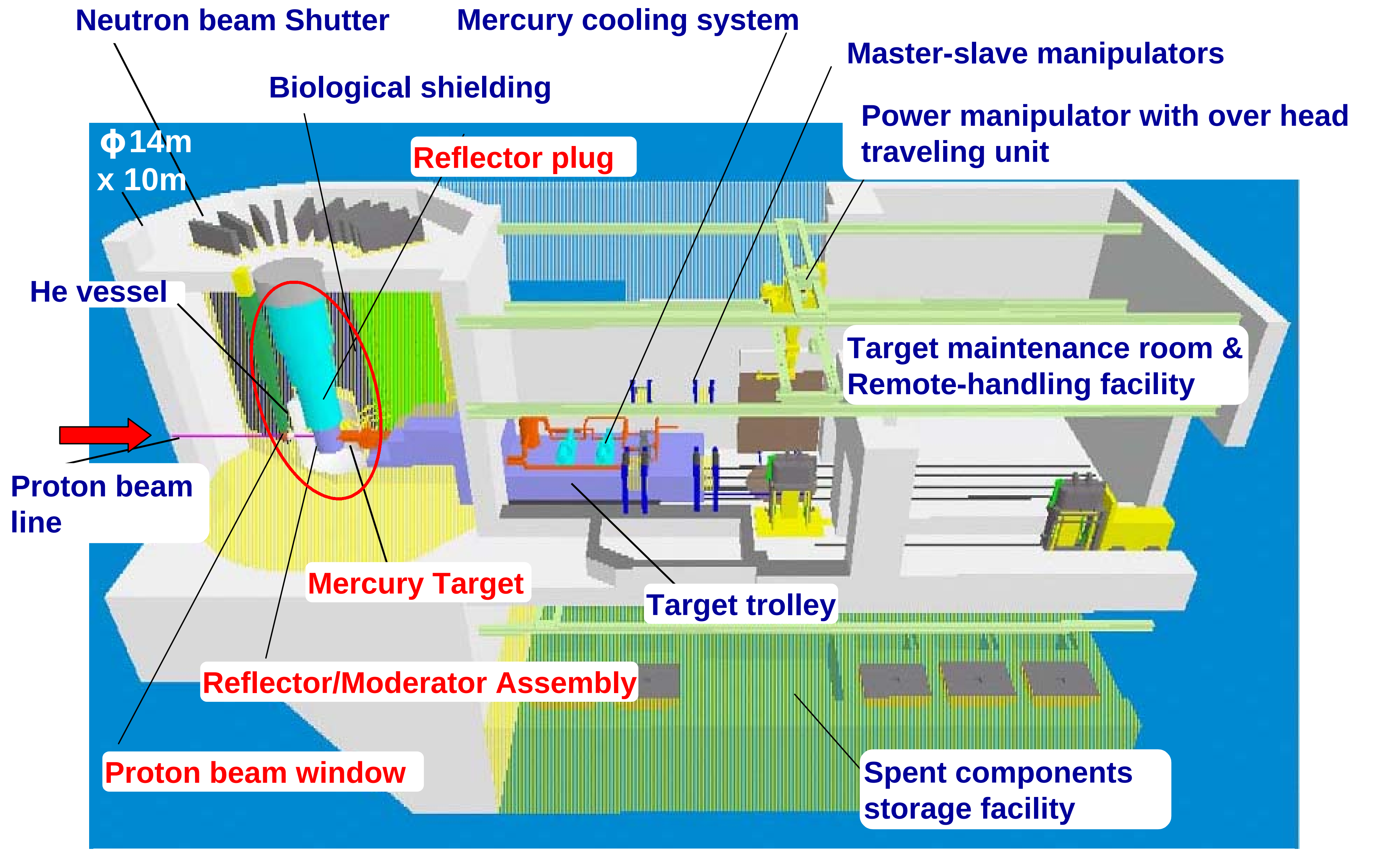

Indicated in red : Major components considered to be stored in the basement.

Capacity of the Irradiated components storage facility

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Irradiated component considered to be stored	Storage capacity	Frequency	Dimension, Weight (Storage container dimension, weight) (mm)、(t)
a. Mercury target vessel	16	2 / year	1150 x 1300 x 2200, about 0.7t Storage container (2100 x 1820 x 3200H、0.5t)
b. Moderator vessel	18	3 / 2year	1400 x 850 x 4400H, 0.25t
c. Proton beam window (with shielding plug)	9	1 / year	860 x 980 □x 4510H, about 10t
d. Reflector (with outer reflector plug)	4	1 / 6year	1900φ x 4785H, about 20t
e. Muon production target (with shielding plug)	6	1 / year	400 □x 3000H, 0.3t (1020 x 1120 □x 3200H, about 10t)
f. Muon scraper (two types)	1 for each	—	950 x 700 □x 2700H
g. Pillow seal	12	2 / year	700 x 80W x 2770H
h. Mercury cooling system components, sensors	—	—	
i. Neutron beam window	3〜4	—	350 x 200 □x 700H
j. Corremeter	3〜4	—	100 □x 2000H
k. Proton beam monitor	4	—	500 □x 500 H
l. Charcoal filter	$30m^3$	$2m^3$ / year	600 □x 300 H

Character in blue : Major components

Material and Life Science Experimental Facility
- First floor (1F)-

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: Non-Radiation controlled area