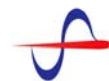


# ***HVAC Concept Design for Proton Target Room Operation***

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**2010. 4. 15**

Gye Po Jeon



***Proton Engineering Frontier Project***

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# Background

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## *1) The IAC recommendation(2007)*

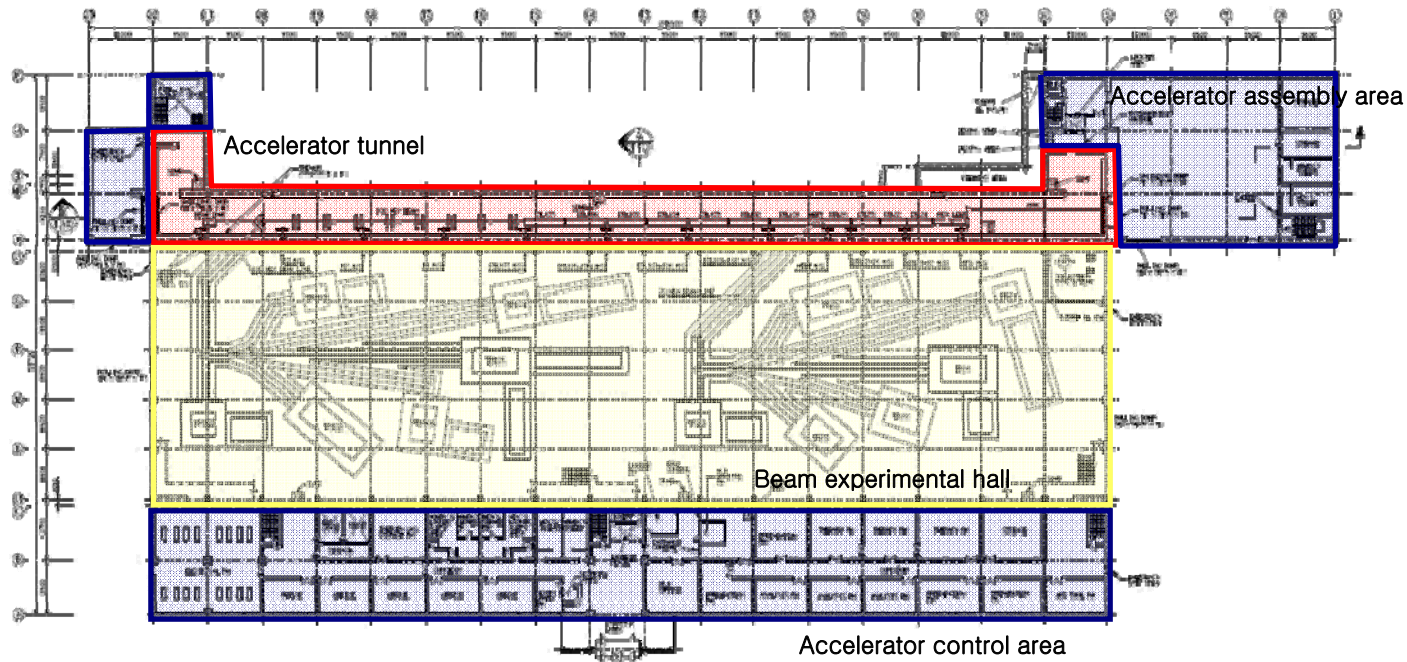
- Redesign the beamlines in which the overall beamline was bent by 180 degree and has tons of shielding material around it.
- There was strong concerns on the shielding issues that the movable concrete blocks have some cracks between them. In addition, there was a recommendation to ensure the evacuation pass in case of emergency.

## *2) PEFP design modification(2007–2009)*

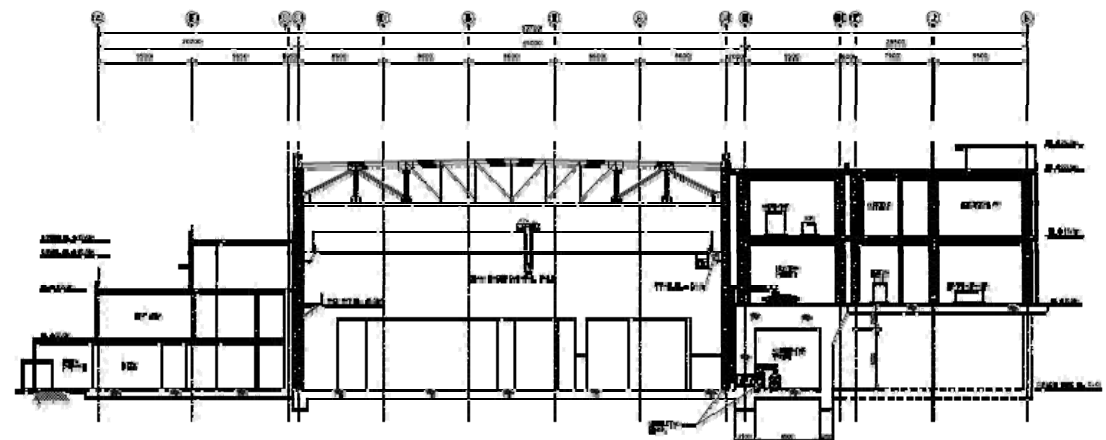
- Reflecting all the issues and recommendations, the PEFP has redesigned the beamline and its target chambers.
  - : All the beamline is in principle 90 degree bending and the removable shielding blocks are replaced by the permanent concrete shielding.
- GA Revision
- Shielding analysis & design modification
- HVAC system design change

# Background

## 1) GA (General Arrangement) : Rev. 0(2007)

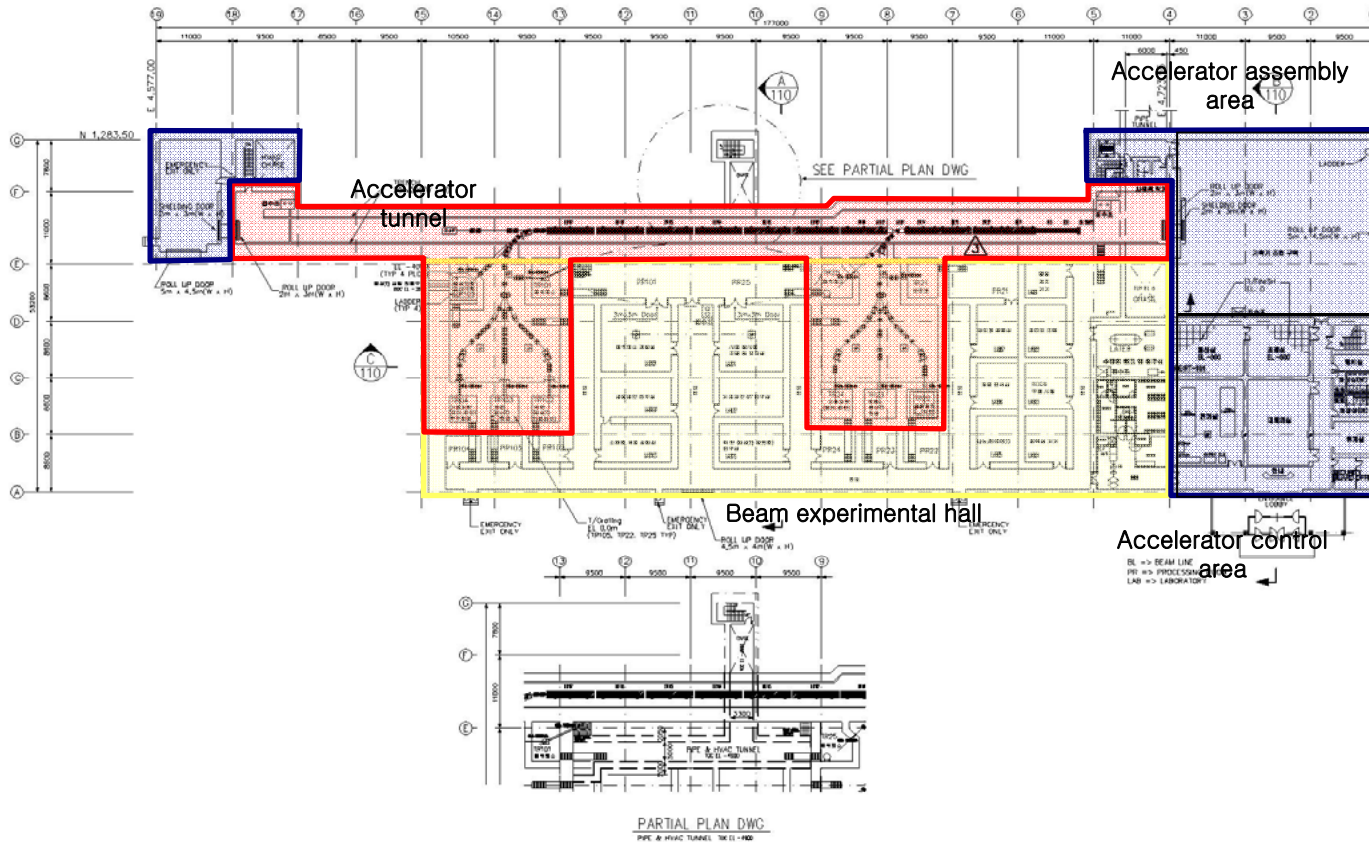


- High Radiation Area :  $DL > 12.5 \text{ uSv/hr}$
- Radiation Worker Area :  $0.25 < DL \leq 12.5 \text{ uSv/hr}$
- Public Area :  $DL \leq 0.25 \text{ uSv/hr}$



# Background

## 2) GA (General Arrangement) : Rev. 3(2009)



facilities	Size(m <sup>2</sup> )		Rate of change
	Rev. 0	Rev. 3	
A/T & klystron gallery	9,899	8,090	-18%
Acc. assembly area	895	848	-5%
Acc. Control Area	2,322	1,877	-19%
Beam experimental hall	5,005	3,610	-28%

- High Radiation Area : DL>12.5 uSv /hr
- Radiation Worker Area : 0.25<DL≤12.5 uSv /hr
- Public Area : DL≤0.25uSv/hr

# Background

## 3) 100 MeV Target Room Shielding Design

Target Room	Wall direction	Additional Shield Material	Wall Thickness [cm]				Calculated Dose Rate [uSv/hr]	Design Limit [uSv/hr]
			Inside Concrete	Iron	Outside Concrete	Total		
TR101	Forward		50	90	60	200	8.096	12.50
	Roof		50	110	110	270	0.229	0.25
	HotCell		50	90	60	200	8.327	12.50
TR102	Forward	10	50	90	60	200	8.367	12.50
	Roof	-	50	40	180	270	0.245	0.25
	Side	-	50	45	105	200	7.434	12.50
TR103	Forward	50	50	90	60	200	8.837	12.50
	Roof	-	50	120	100	270	0.181	0.25
	Side	30	50	90	60	200	11.75	12.50
TR104	Forward	10	50	90	60	200	8.578	12.50
	Roof		50	45	175	270	0.192	0.25
	Side		50	20	230	300	0.194	0.25
TR105	Roof	-	50	90	130	270	0.205	0.25
	Side above ground	-	50	20	230	300	0.173	0.25
	Side below ground	-		70			-	-

## II. HVAC design



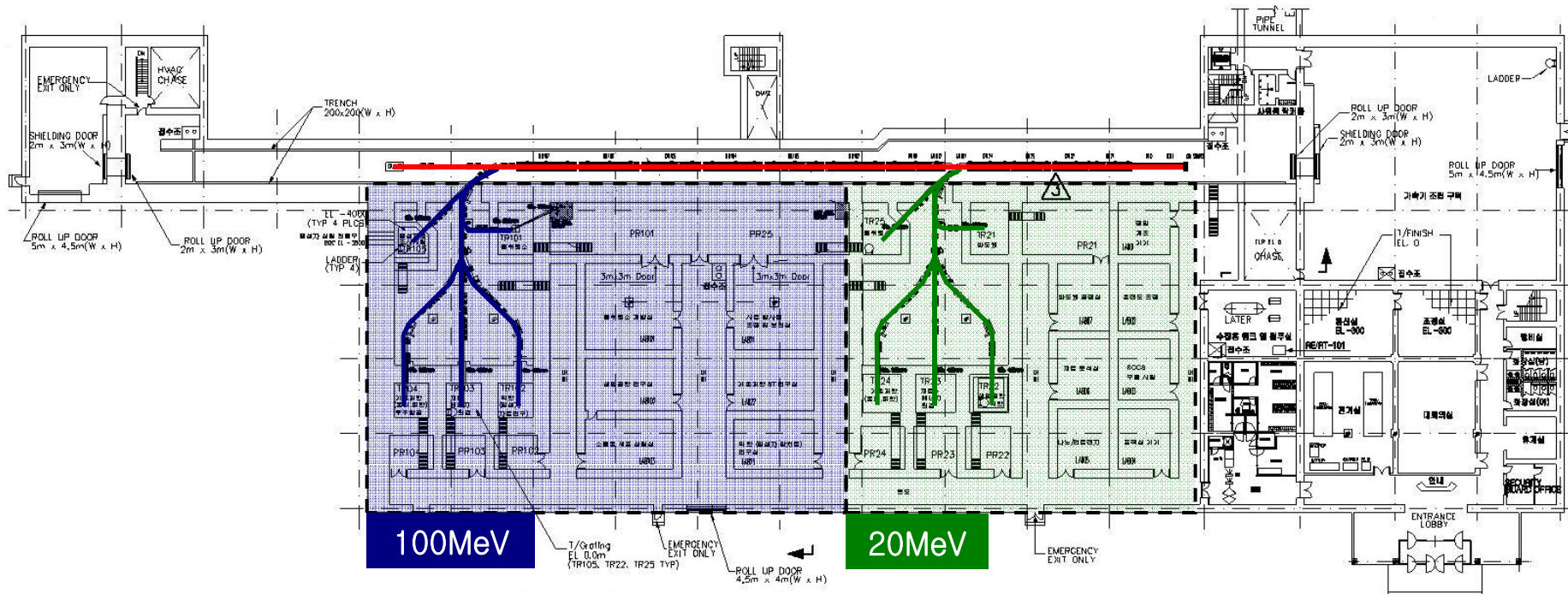
# Target room operation Scenario & Access Mode

## 1) Target room operation Scenario

According to beam current, target materials, beam irradiation, beam time and operation scenario, each target room has its own operation and access mode

– 20MeV and 100MeV beam utilities are not allowed to operate simultaneously.

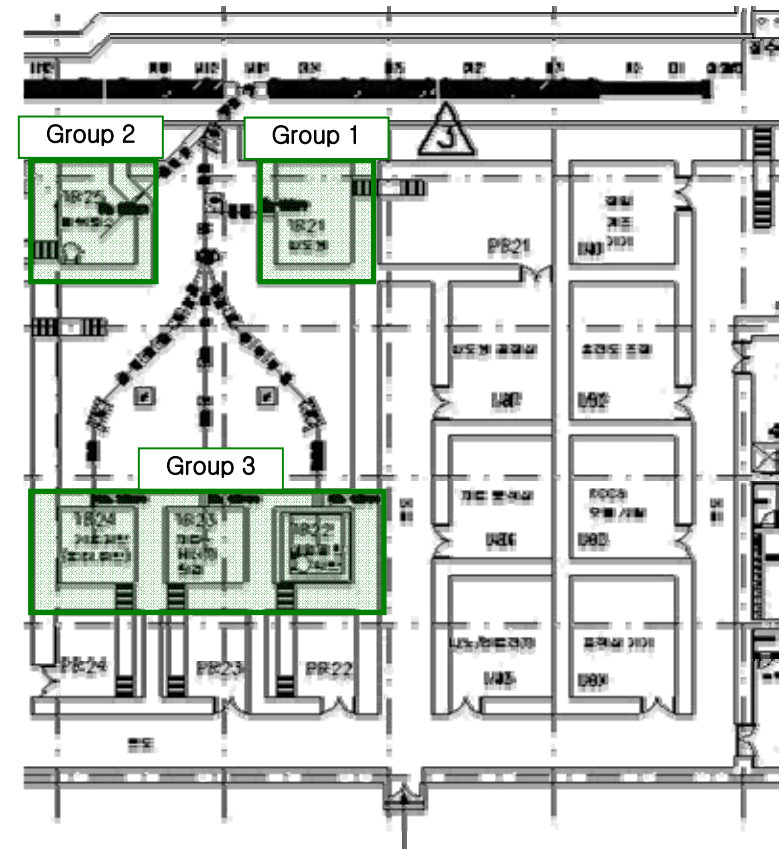
: Exclusive operation mode



# Target room operation Scenario & Access Mode

## 2) In 20MeV target room operation

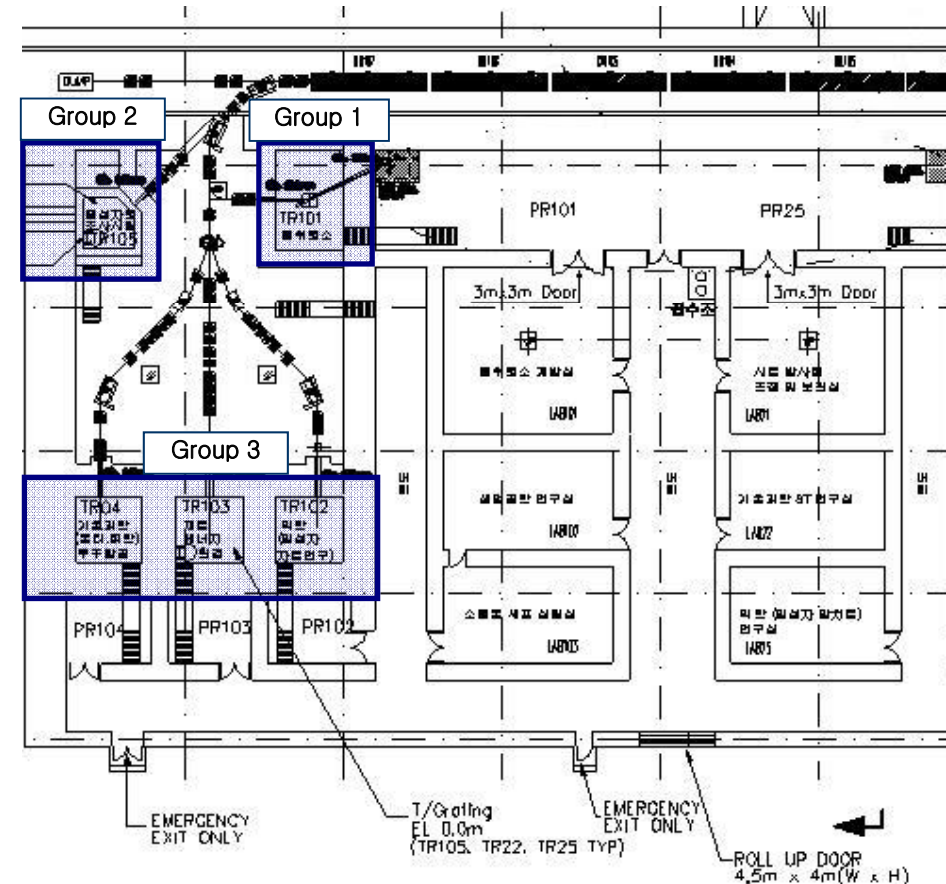
- ◆ Exclusive operation
  - TR 21 and TR 25 can not operate at the same time.
  - Group 1(TR101), Group2(TR105) and Group3(TR102, TR103 and TR104) are also operated exclusively to each other groups.
- ◆ Accessibility
  - After beam shut down, workers can be to access to every 20MeV target rooms at once.



# Target room operation Scenario & Access Mode

## 3) In 100MeV target room operation

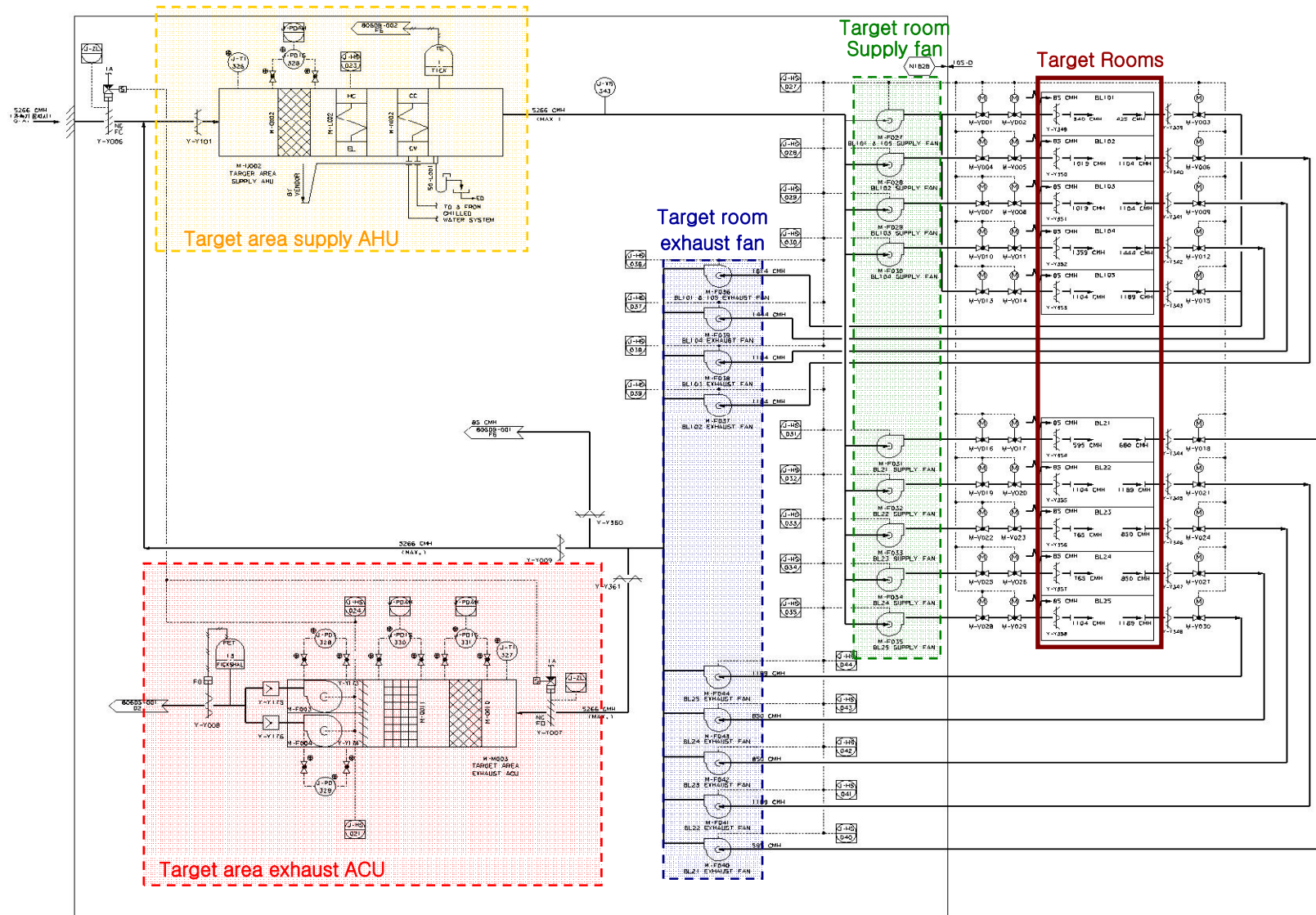
- ◆ Exclusive operation
  - TR 101 and TR 105 can't operate at the same time.
  - When TR 101 or TR 105 is in operation, TR 102, TR103 and TR 104 are not able to operate simultaneously.
- ◆ Accessibility
  - After beam shut down, people are allowed to access to TR102, TR103 and TR104.
  - one of the 100MeV beams being in operation, TR101, TR105 and 100MeV beamline enclosure can not be access to anyone.



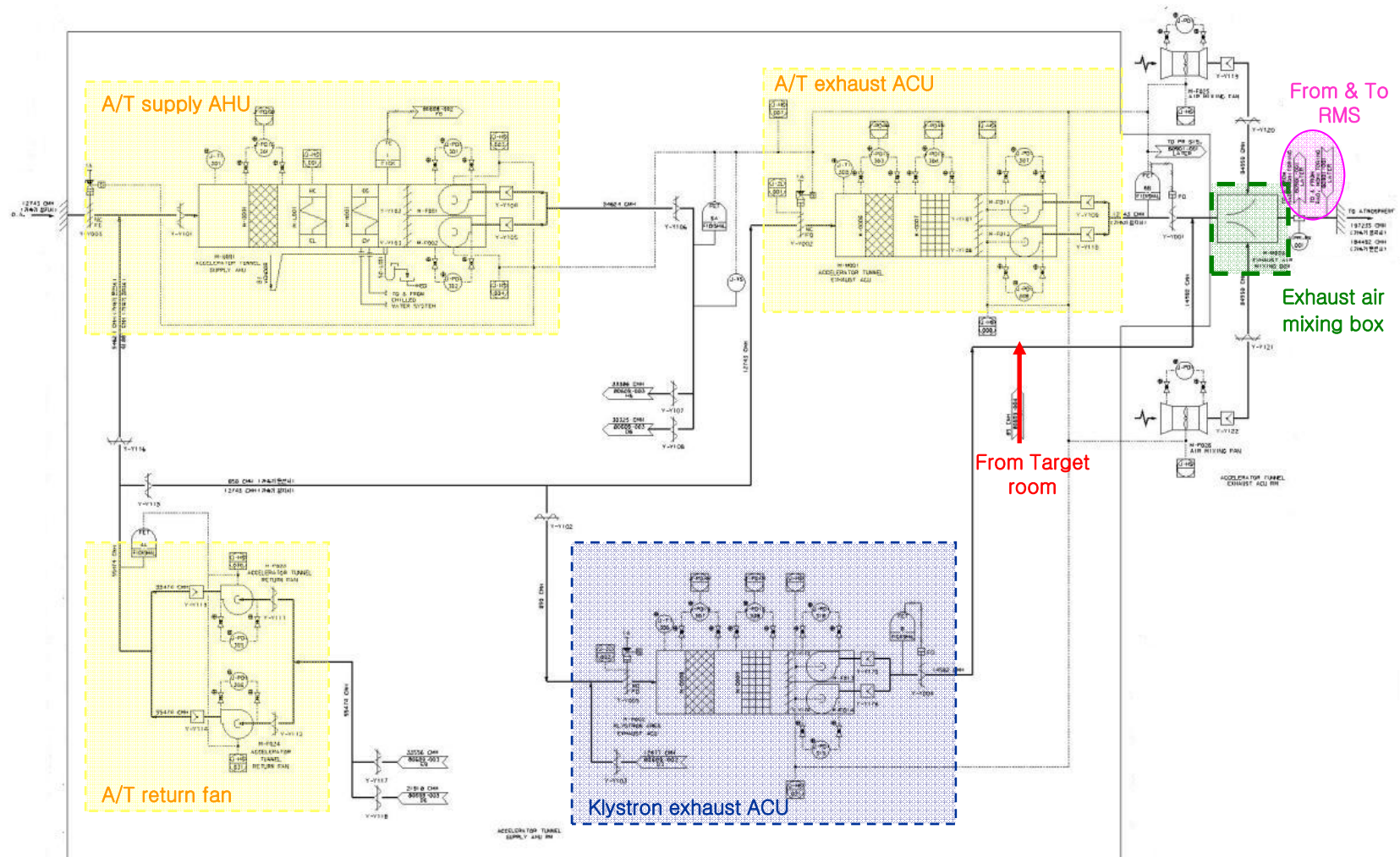
# The condition of accelerator bldg. for HVAC system

Bldg.		Temperature (°C)		Relative Humidity(%)		Remarks
		Min	Max	Min.	Max	
Accelerator bldg.	Accelerator Tunnel	25	27		≤55	Recirculation, Slightly negative pressure
	Klystron gallery	22	27		≤55	Recirculation
	Accelerator assembly area : equipment room	10	40	0	100	
	Accelerator assembly area : office	20	27	30	80	
Beam application bldg.	BTL(20, 100MeV)	25	27		≤55	Recirculation, Slightly negative pressure
	Target room(TR21-25, TR101-105)	25	27		≤55	Recirculation, Slightly negative pressure
	Lab, corridor and target preparation rooms	10	30		55	

# HVAC design configuration – Target Area



# HVAC design configuration – Accelerator building



# HVAC system operation

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## *1) System normal operation scenario*

- HVAC installed in target rooms is operated only in use
- the air released from this area should not be exhausted to outside until it is diluted to meet the requirements of Discharge Control standard.
- The control valves installed in supply and exhaust duct of target rooms should be linked with supply and recirculation fan of it.
- 3-way valves controlling the flow of the cooling coil for the supply AHU should be controlled continuously by temperature monitoring controller to keep the design temperature.

## *2) System in and out of operation scenario*

- Supply fan and recirculation fan for the target rooms in use should operate.
- Operators should check as follows before fans operate
  - ◆ target room door should be closed.
  - ◆ Check the operators be or not be in the target rooms
  - ◆ Open the control valve installed in supply and exhaust duct.
- Supply fan should be operated only if target room control valve opened and recirculation fan operated and be able to be in and out of operation manually.
- Recirculation fans and exhaust fans can be in and out of operation manually.

# HVAC system operation

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## *3) HVAC system Operation procedure of target room*

- In Accelerator operation
  - ◆ check the target room door in use closed
  - ◆ Open the control valve of the target room in use
  - ◆ Operate the supply fan of the target room in use
  - ◆ Transfer the signal to the utility control room
- Out of accelerator operation
  - ◆ stop the supply fan of the target room in use
  - ◆ stop the recirculation fan of the target room in use
  - ◆ close the control valve of the target room in use
  - ◆ Transfer the signal to the utility control room



# HVAC system specifications

## 1) Target room HVAC system component specifications

Components	amount	Capacity	Detail components and reamarks
Supply AHU (Air Handling Unit)	1ea		– Prefilter, Electrical heater, Cooling coil, Electrical steam Humidifier, fan(100% X 2) and so on
Supply Fan	9ea	1,444/1,019/1,019/1,359/510/ 1,104/765/765/1,104 m <sup>3</sup> /hr	– For TR101& 105 : 1ea – For TR102~104 : 3ea – For TR21~25 : 5ea
Recirculation fan	9ea	1,699/1,104/1,104/1,444/595/ 1,189/850/850/1,189 m <sup>3</sup> /hr	– For TR101& 105 : 1ea – For TR102~104 : 3ea – For TR21~25 : 5ea
Exhaust ACU (Air Cleaning Unit)	1ea		– Prefilter, HEPA (High Efficiency Particulate air filter), centrifugal fan(100% X 2) and so on
linked duct and duct accessories			– Dual Control valve, duct and duct accessories

## III. Conclusion & Future works

# Conclusion

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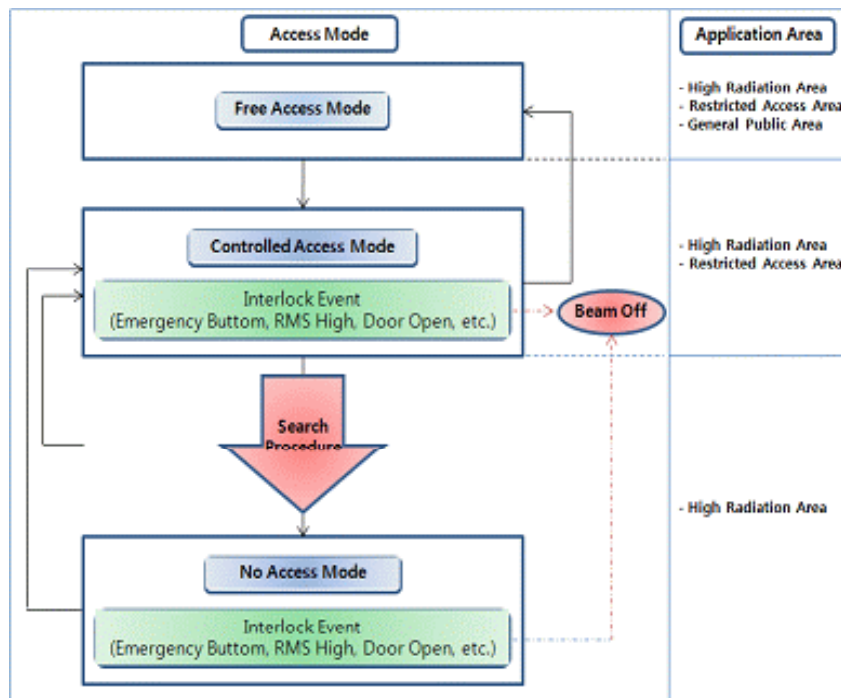
- HVAC system designed to keep dose rate below the ALARA(As Low As Reasonably achievable) objective.
- According to accelerator operation mode and access conditions based on radiation analysis and shielding design, we made the HVAC system configuration of target rooms in the proton accelerator research center.
- Exclusive operation : 20MeV and 100 MeV beam utility are not operated together and Group 1(TR101), Group2(TR105) and Group3(TR102, TR103 and TR104) are also operated exclusively to each other groups.
- Access mode : After beam shut down, people are allowed to access to TR102, TR103 and TR104. and one of the 100MeV beams being in operation, TR101, TR105 and 100MeV beamline enclosure can not be access to anyone.
- HVAC system facilities specification and configuration is decided.
- HVAC system operation scenarios and procedure of target room is completed

# Future Works

## 1) PSIS system design

*The Personnel Safety & Interlock System (PSIS)* in Proton Accelerator Research Center of PEPF controls access to the restricted areas of the research center in order to guarantee the safety and protect the lives of personnel from radiation hazards, abnormal operation, and unexpected accidents.

PSIS is operated in three different access modes (free access mode, controlled access mode, and no access mode) in accordance with the degree of danger and alert system

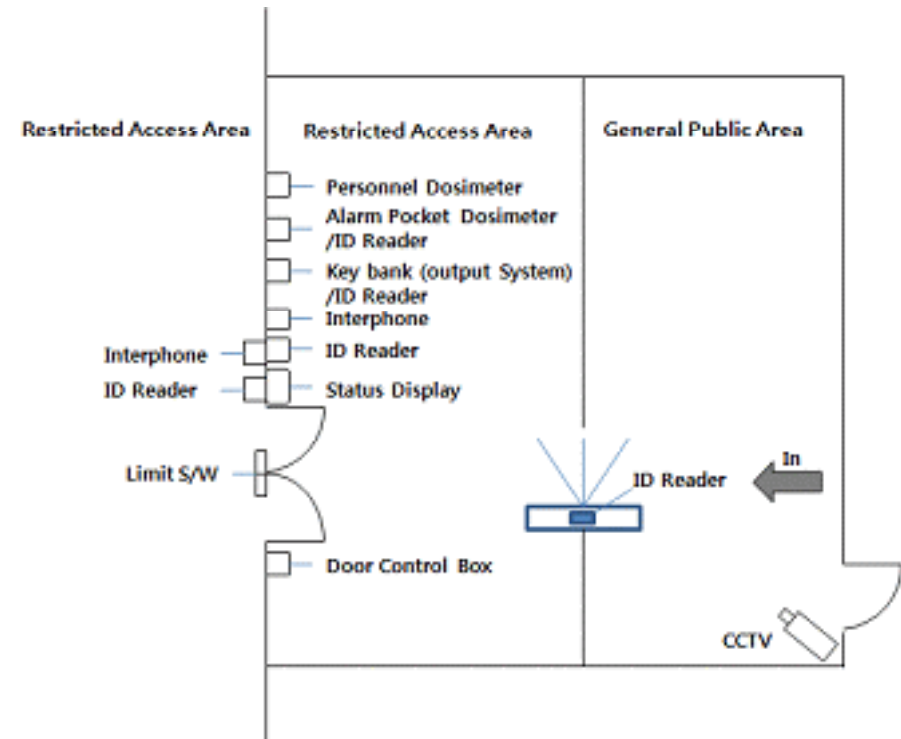


- **Free access mode:** PSIS permits free access to the interlocked area. This mode of access is applied only in special situations requiring all access doors operated by PSIS to be opened such as the initial installation of the accelerator equipments and trial run (in cases which beam is not extracted).
- **Controlled access mode:** the opening/closing of the access doors operated by PSIS is displayed and supervised on the PSI display in the main control room through the surveillance system. This mode allows only the personnel with prior access permission to enter and leave through their designated access door.
- **No access mode:** This mode prohibits access to the high radiation areas such as the accelerator tunnel, beamline compartments (20MeV, 100MeV), and each of the target rooms.

# Future Works

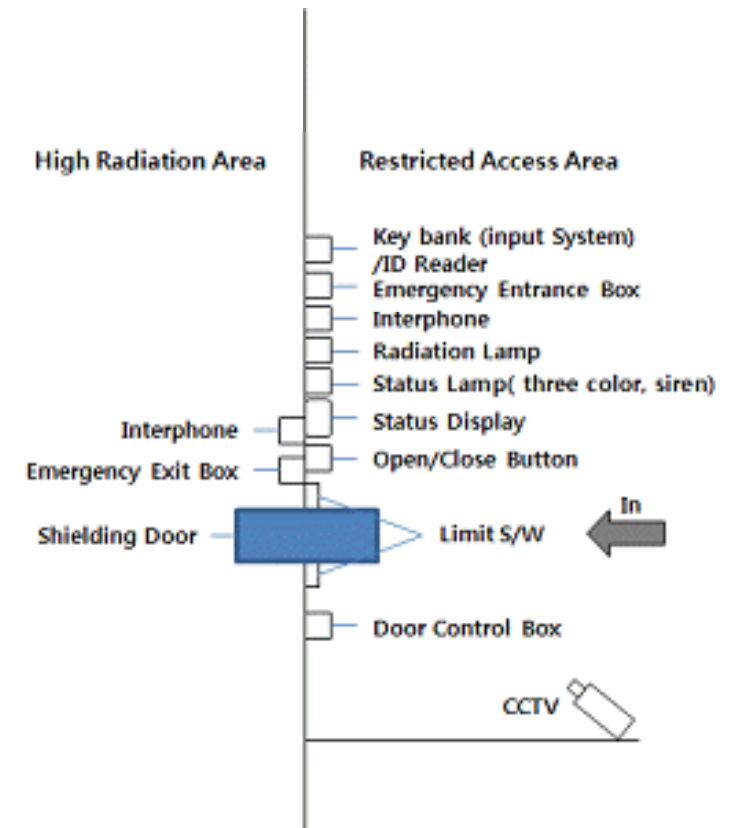
## 2) Access Control

- In order to control access to the radiation controlled area, the access control system is operated in accordance with the pre-established entrance sequence.
- to enter the radiation controlled area, the radiation worker must pass through the access doors. Many instruments are installed at the access door to prove authority of the personnel.
- The Alarm Pocket Dosimeter (APD) system, in linkage with the ID card reader, reads the ID card and connects to PSIS when APD is extracted /inserted so that the identity of the user that extracted/inserted APD and the number of the workers entered can be confirmed on the PSI display at the main control room. In addition, the Key Bank System, provided only to the operating personnel with prior permission to enter the high radiation area, is a system that connects with PSIS in order to survey the number of access to the high radiation area and to provide conditions for the opening and closing of the access door to the area.



# Future Works

- To gain access to the high radiation areas such as the accelerator tunnel, beamline compartments (20 Mev, 100 Mev), and target rooms, the radiation workers must pass through the shielding door which is equipped with numerous access control devices.
- The Key Bank System reads the ID card in connection with the ID card reader, and when a key is inserted/extracted, the system is linked to PSIS so that the identity of the user that inserted/extracted the key and the number of access can be confirmed on the PSI display at the main control room. This system is a part of the open/close condition of the access door.
- **The conditions for opening the access doors**
  - A. the accelerator must be off, the radiation level must be lower than the set point, a key must be inserted that corresponds to a personnel with prior access permission, and the open button must be pressed.
  - B. The access door remains open as long as the key is inserted. The access door closes when a key that corresponds to a personnel with prior access permission is extracted and the Close button pushed.



**Thank you !!**