Developments of RIB Target Module and Remote Handling System at RI SP

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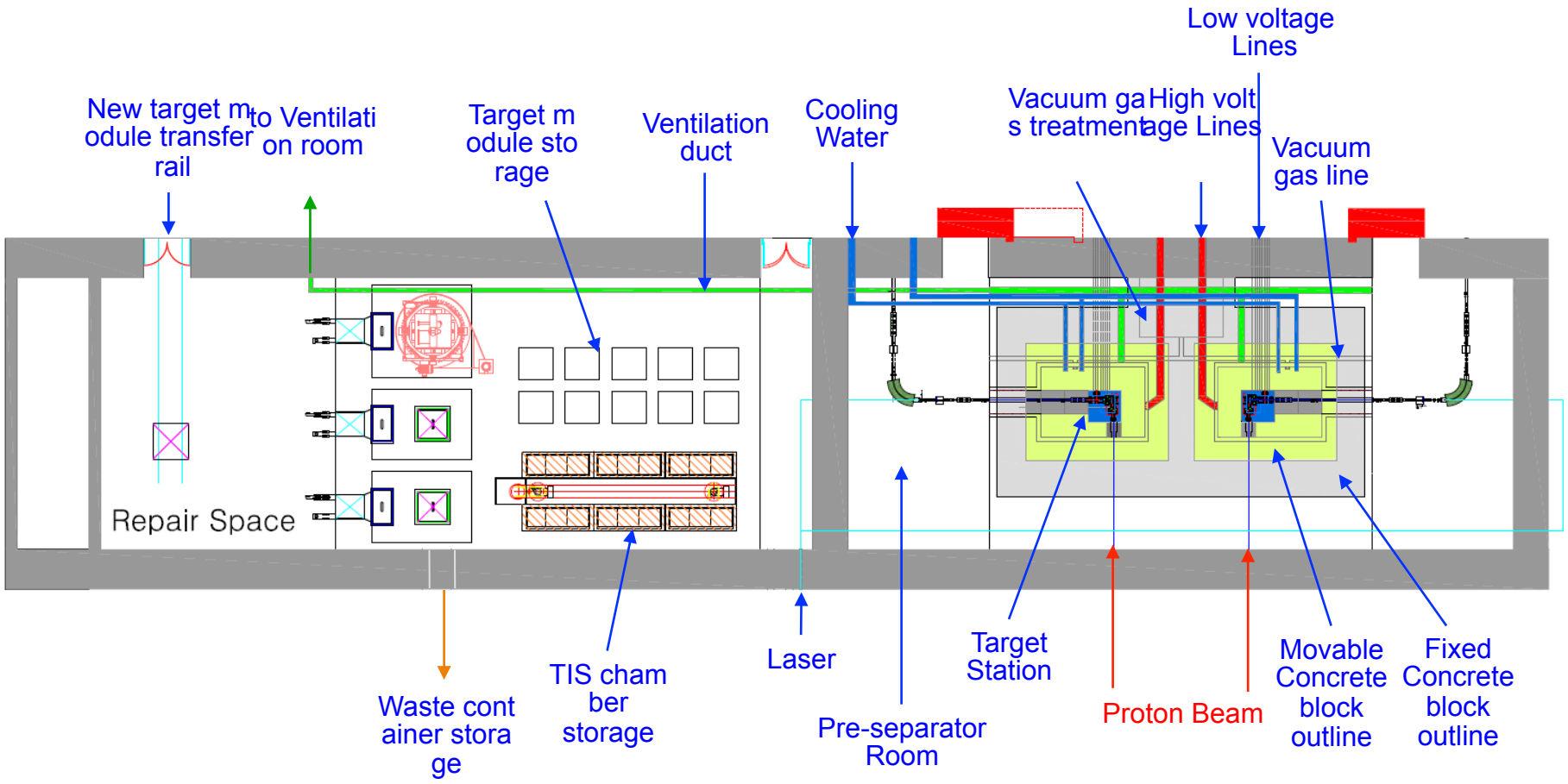
Requirements for ISOL RH System

- 70 kW beam power to the UCx Target (10 kW in RISP)
- Two-stage target station and pre-mass separator
- TIS (Target/Ion Source) and beam line components shall be modular for remo te maintenance
- Target and target module service by remote handling (exchange, repairs, mai ntenance and re-installation) in radioactive area
- Remote device – Lock & Lifting fixtures / Special Couplings, Manipulator tools
- Execution of mock-up test before beam commissioning at on-line site
- Application of Radiation hardness material
- Benchmarking the TRIUNF building and Remote Handling system

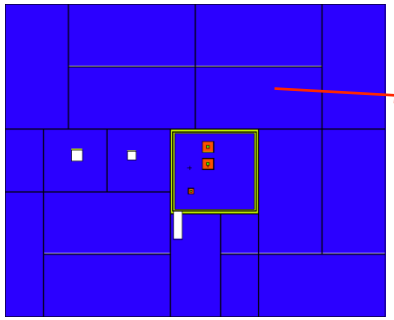
Target Station & Maintenance Hall



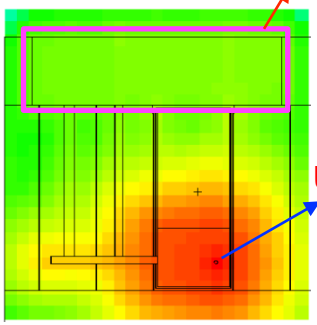
63 m(W) x 11.5 m(L) x 18 m(H)

Residual Radiation Analysis for Service Zone of Target Station

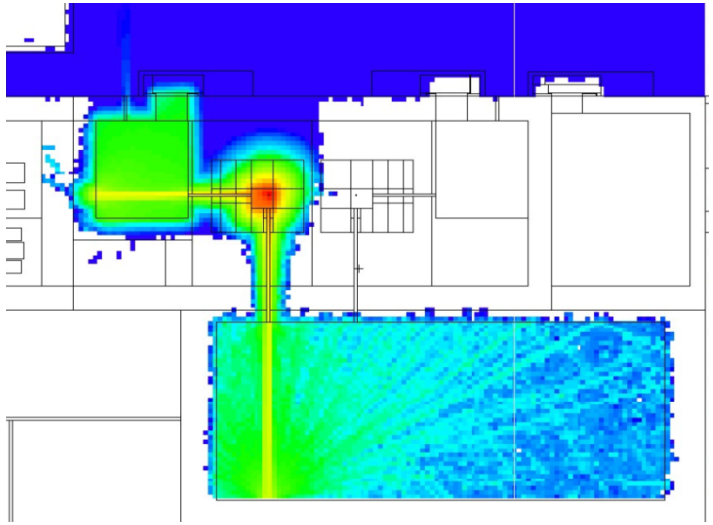
- 70 MeV / 1mA Proton beam with UC_2 Target
- Activation: 14 Day Irradiation with 14 Day Decay, Repeated for 30 year
- Gap between the concrete block : 1 cm
- MCNPX and SP-FISPACT-2010 Code



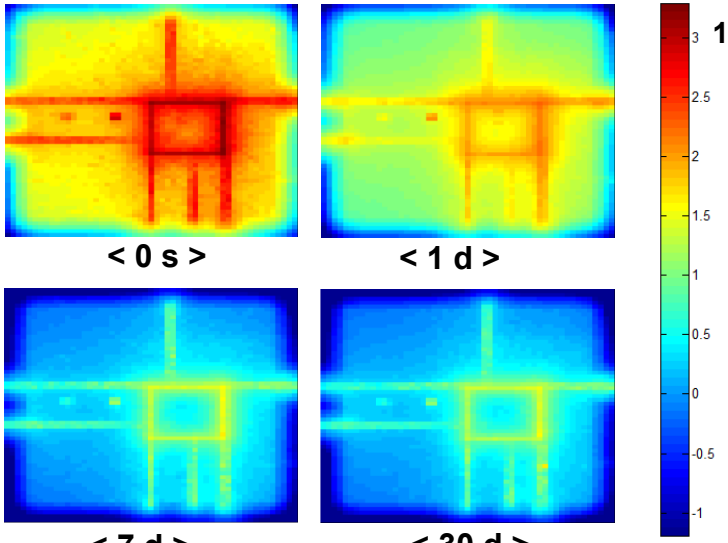
Shielding Blocks (Movable)



MCNP Modeling (XY) Prompt Neutron Distribution (XZ)



< Prompt Neutron Dose Distribution of Target Station Area >



< 0 s > < 1 d >

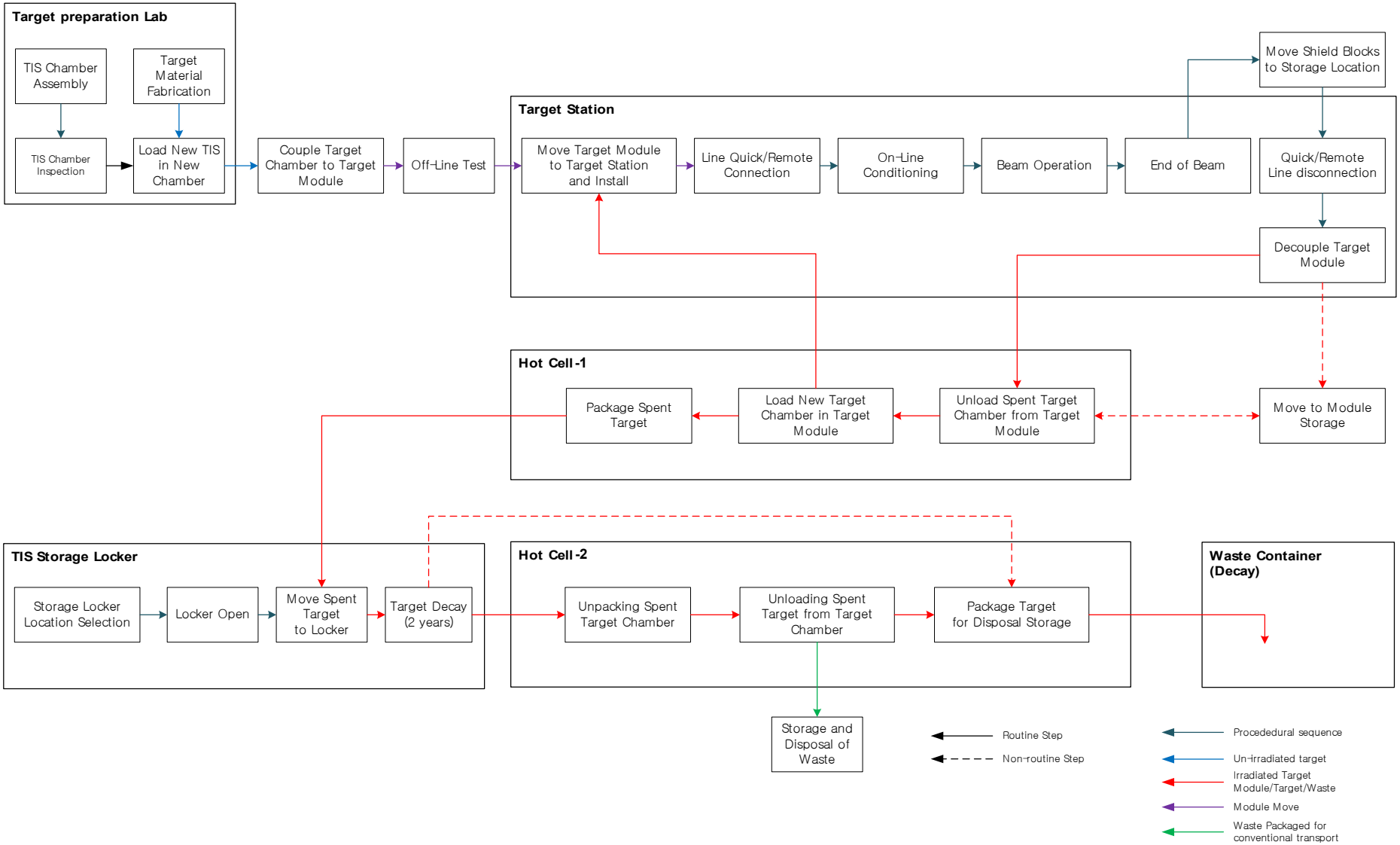
< 7 d > < 30 d >

< Residual Dose Distribution >

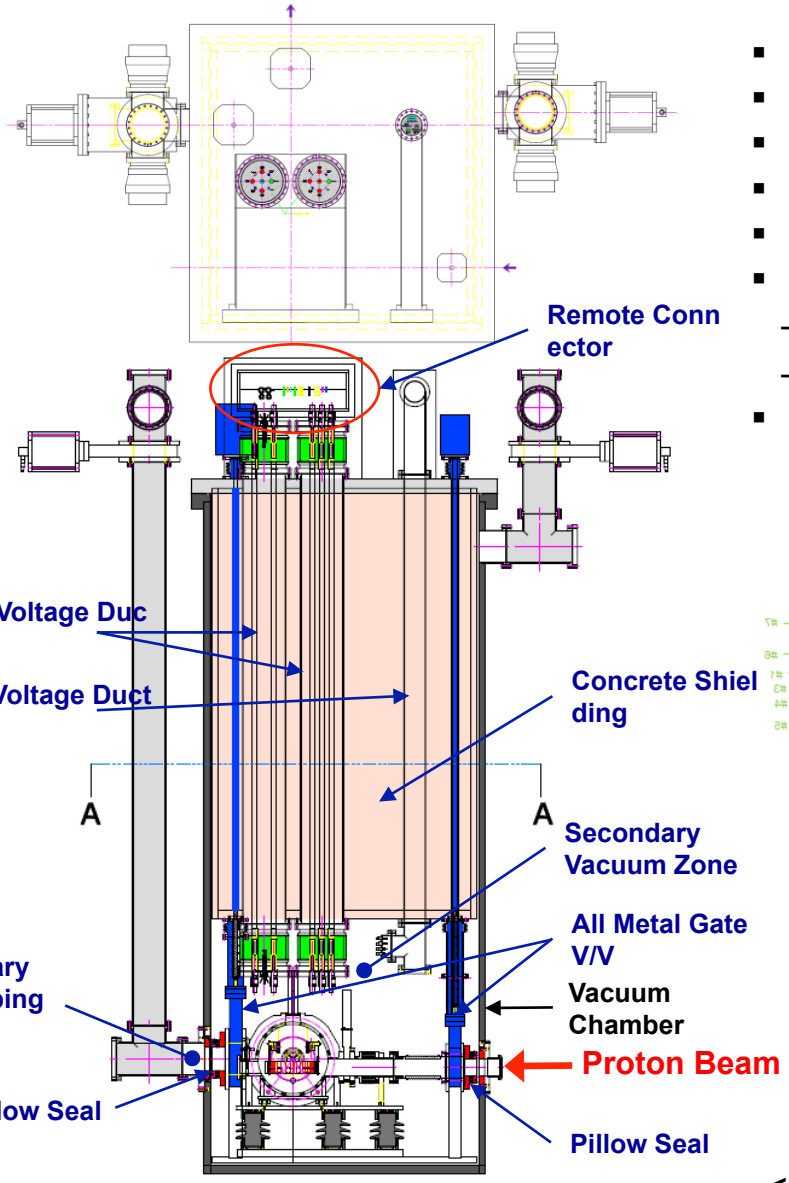
< Maximum Dose in Service Zone of Target Station>

Decay Time	0 Sec.	1 Hour	1 Day
Dose [uSv/hr]	9.256E+02	7.146E+02	1.156E+02
Relative Error	0.031346	0.028189	0.012426
Decay Time	7 Days	30 Days	1 Year
Dose [uSv/hr]	1.952E+01	1.671E+01	7.846E+00
Relative Error	0.097676	0.101224	0.025335

ISOL Target Operation Cycle

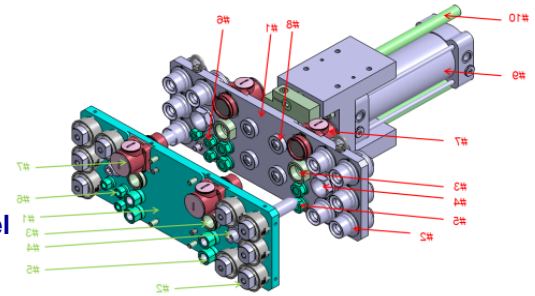


ISOL Target Module

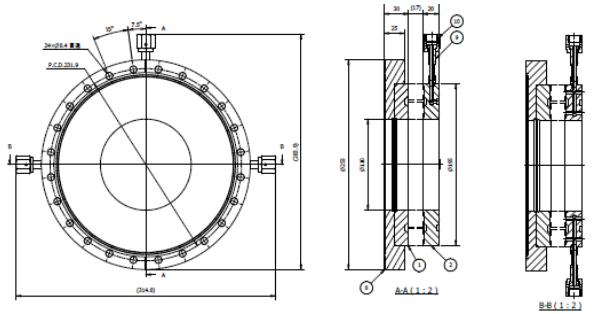


< Target Module, 1.4 m(W) x 1.5 m(L) x 3.3 m(H) >

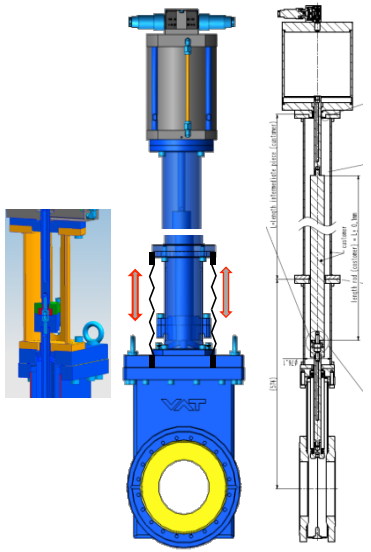
- Vacuum Chamber & Target Module
- Primary Vacuum zone : Target chamber & Beam line
- Secondary vacuum zone : Module external volumes
- Three Special All metal gate valves
- Three Pillow Seals : Inter module connection
- High Voltage Tray
  - Insulation : BN Powder or Arocy L-10 cyanate ester resin
  - Feedthroughs & Quick/Remote connectors
- Shielding Materials : Heavy Concrete Block



< Remote Multi Connection Panel (De signed by STAUBLI) >

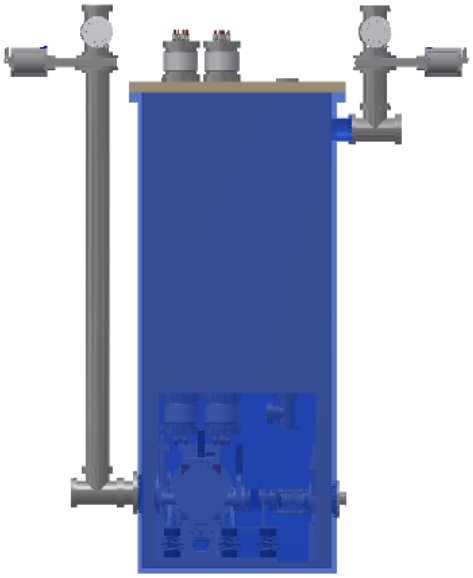


< Pillow Seal (technical assistance by KEK) >

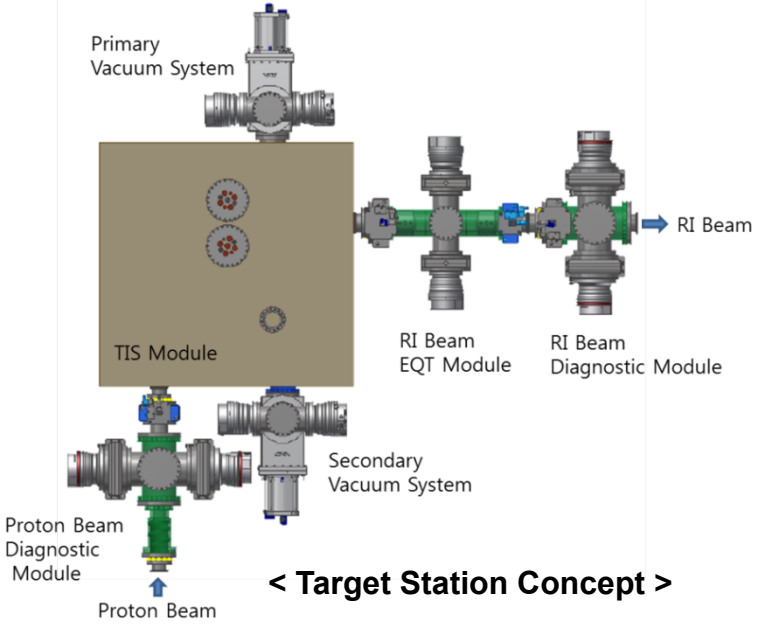


< Extended All Metal Gate Valve >

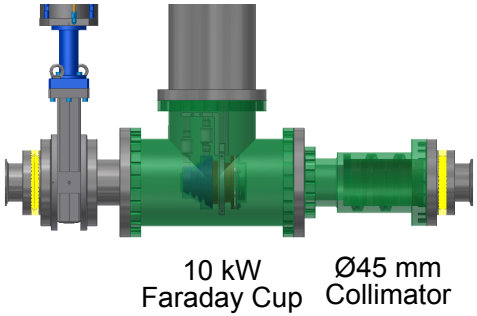
Target Module & Target Station Overview



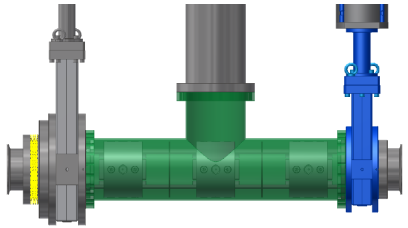
< Vacuum Chamber and TM >



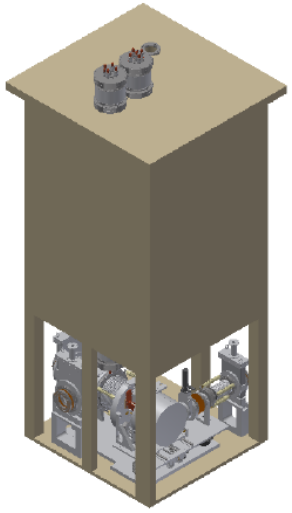
< Target Station Concept >



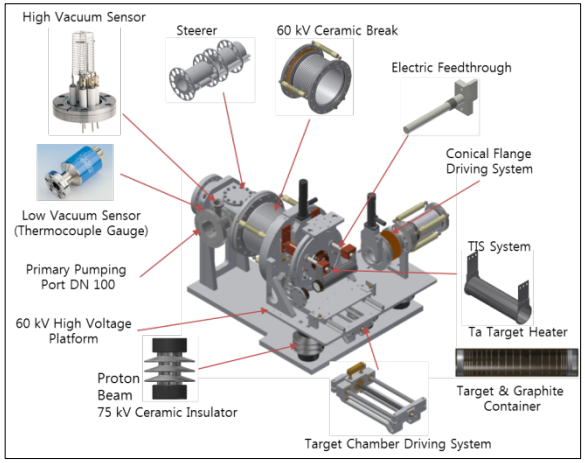
< Proton Beam Diagnostic Module >



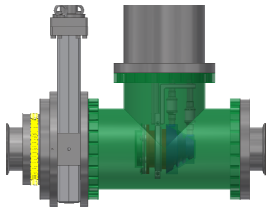
< RI Beam EQT Module >



< Target Module >



< Front-end System component >

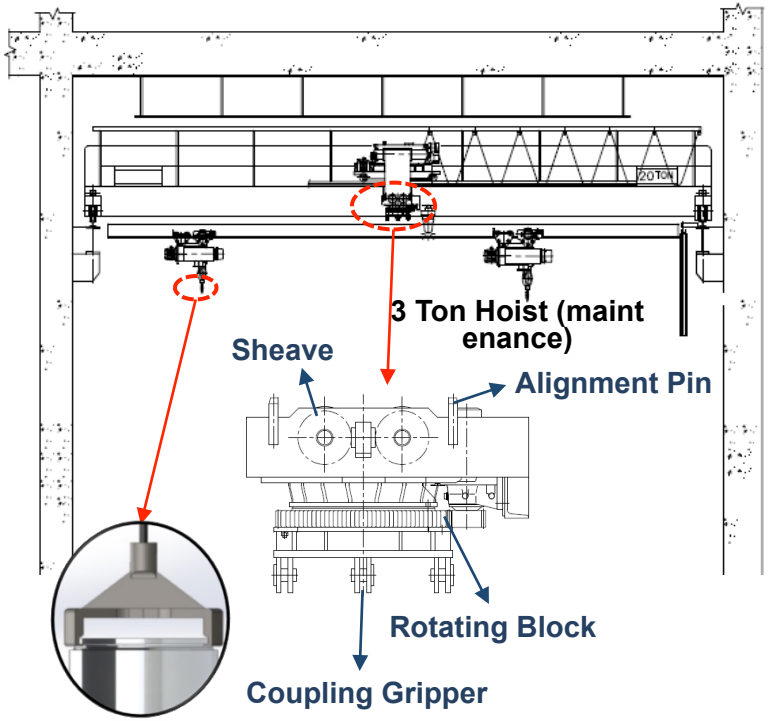


< RI Beam Diagnostic Module >

ISOL Target Hall Remote Crane

Main remote crane use for :

- Target Module & shield block removal / replacen nt
- Target chamber transfer
- Waste target handing
- maintenance

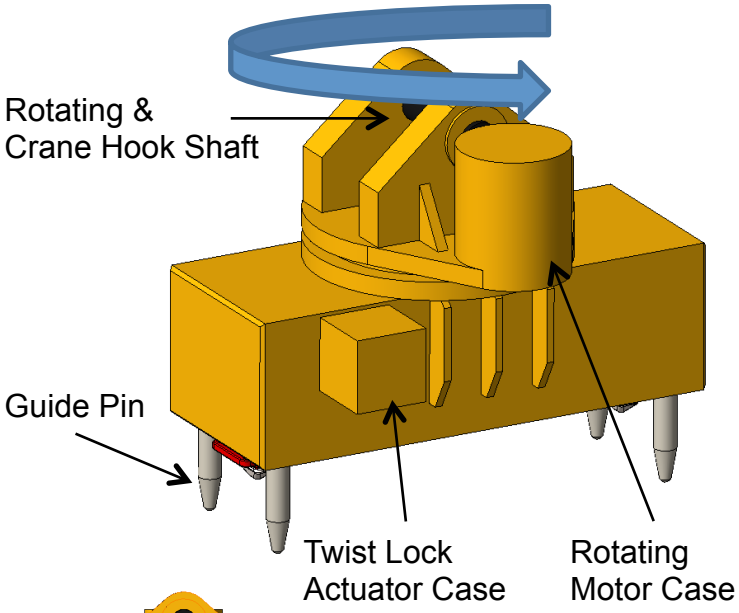


ITEM	SPECIFICATION	REMARK
Lifting capacity	20T / 3T / 3T	
Actual Lift	18/17.2/17.2 m	
Operation Mode	Normal / Emergency	
Lifting speed	1mm/s to 100mm/s	
Control dirve	x-y-z	
Rotation	360°	
Rotation speed	1.2 rpm	
Position accuracy	2mm	Rack Gear
Lifting indicator	20 kg precision	
Emergency capacity	DC motor (with battery)	

Safety & Control :

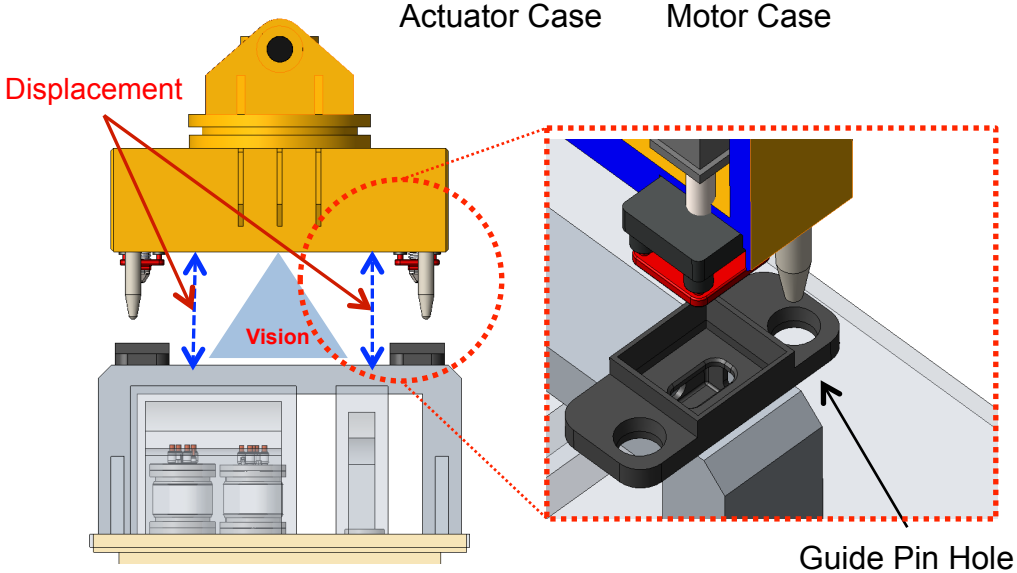
- Auto/ manual/ Semi-Auto (with vision system)
- Snag detection / Auto Centering (Vision system)
- Reverse rotation prevention (hydraulic disc brake)
- Auto switching to DC Motor when motor failure occurs
- Operation Speed variable
- Dual position encoders
- All control devices located outside Target hall

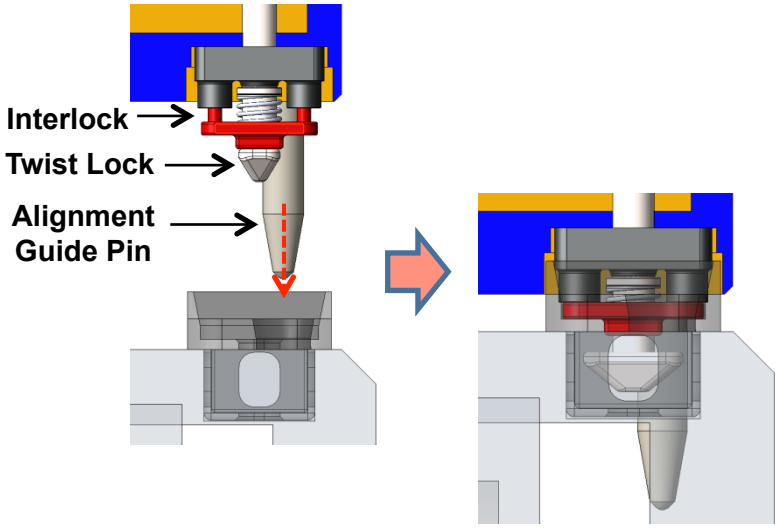
Crane Interface Device



- Remote interface of Target Module & Shield Blocks
- Modularize for all components and prevent from radiation exposure
- Interlock & Safety

1) Alignment check after transfer to Target Module & Shield Block
2) Move to alignment point
3) Move down & combine alignment pin with hole
4) Displacement & interlock sensing
5) Lock on

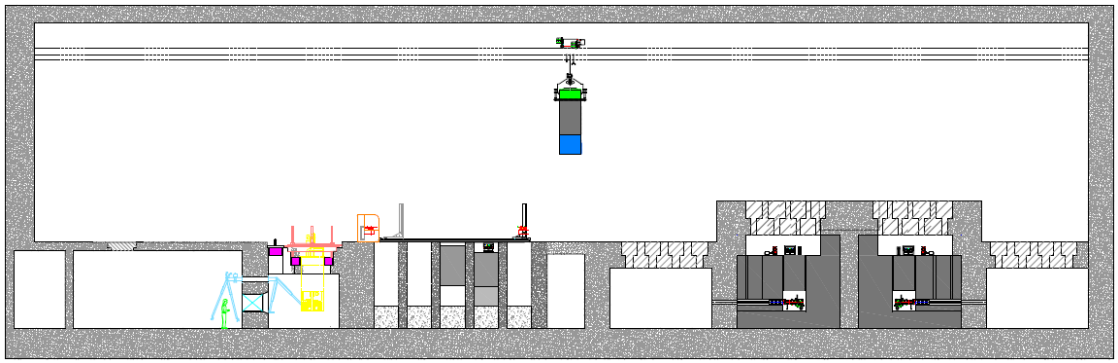


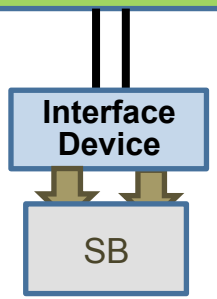


* *Twist rock system used at J-PARC Hadron Facility*

Target Module Remote Removal Concept

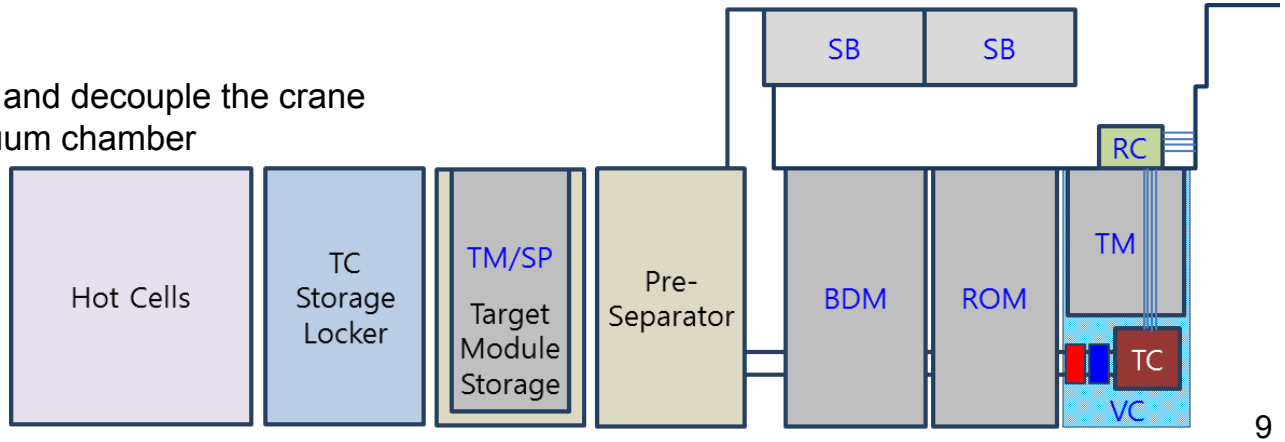
Remote Crane



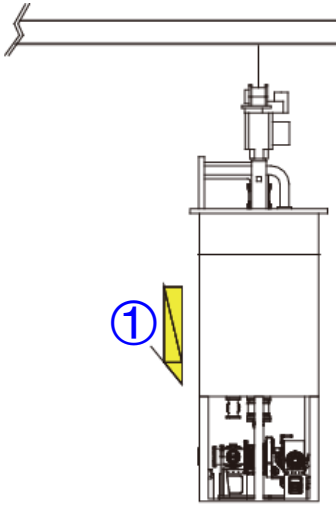


SB : Shield Block
TC : Target Chamber
TM : Target Module
VC : Vacuum Chamber
RC : Remote Connector
ROM : RIB Optics Module
BDM : Beam Diagnostic Module
SP : Shielding Plug
: Pillow Seal
: Gate Valve

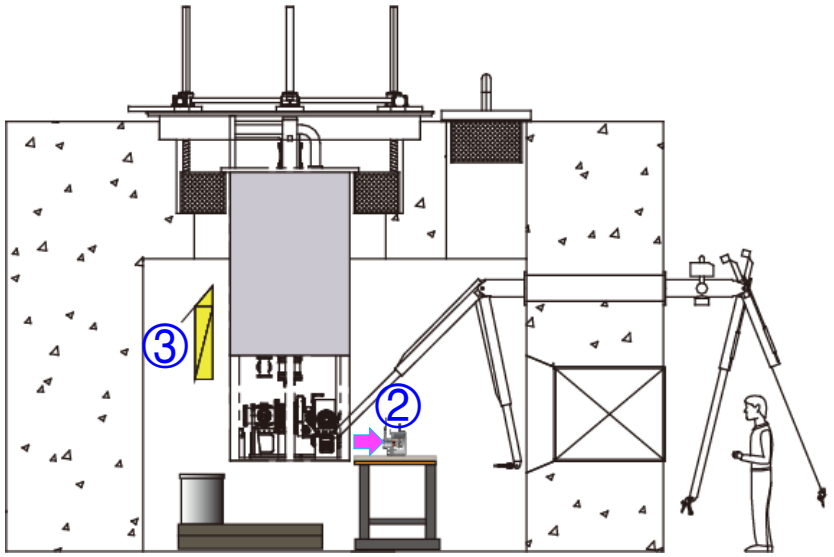
1) Remove shielding blocks of service zone
2) All metal gate valve close
3) Decouple Pillow seals
4) Break secondary and primary vacuum by Ar gas
5) Purge cooling waters from duct
6) Quick/remote disconnect all electric cables, water cooling / gas lines
7) Connect target module to remote crane and unload target module in va cuum chamber
8) Move to hot cell
9) Put the target module in hot cell and decouple the crane
10) Insert a shielding plug into vacuum chamber

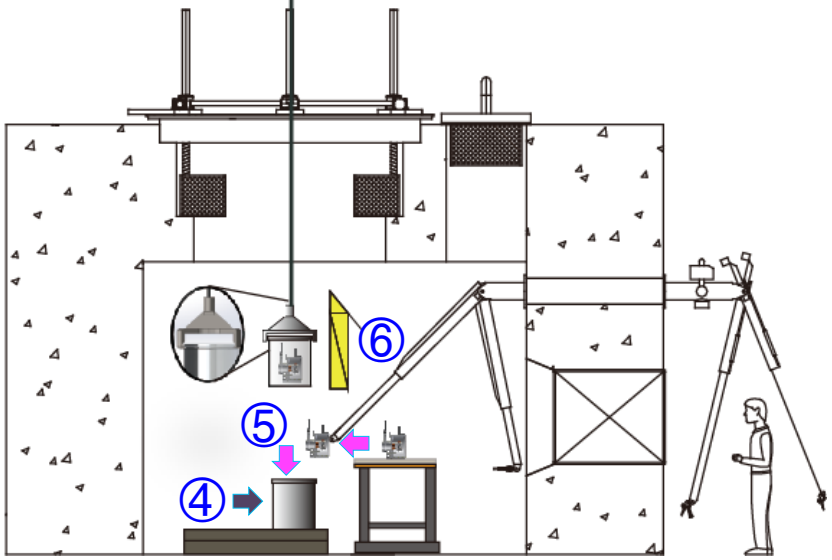


Target Exchange in Hot Cell



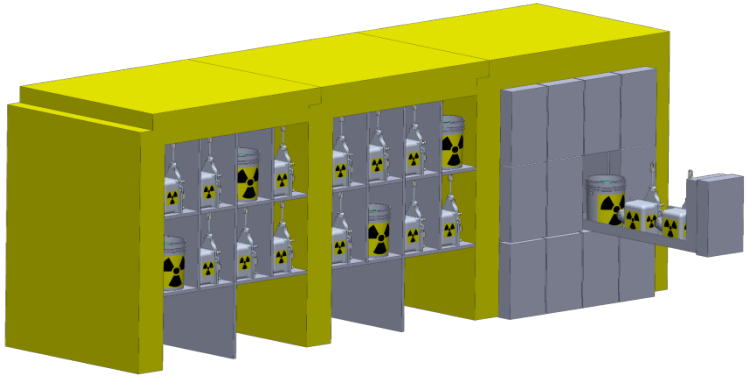
① Target module down to Hot cell-1 by 20 ton crane and position fixing
② Unload spent target chamber from target module by manipulator
New target chamber couple to target module
③ Lift target module
④ Move pail to transfer point along guide line
⑤ Insert spent target chamber in pail by gripping tool connected to manipulator
⑥ Lift pail by gripper(3 ton crane) and move to storage locker



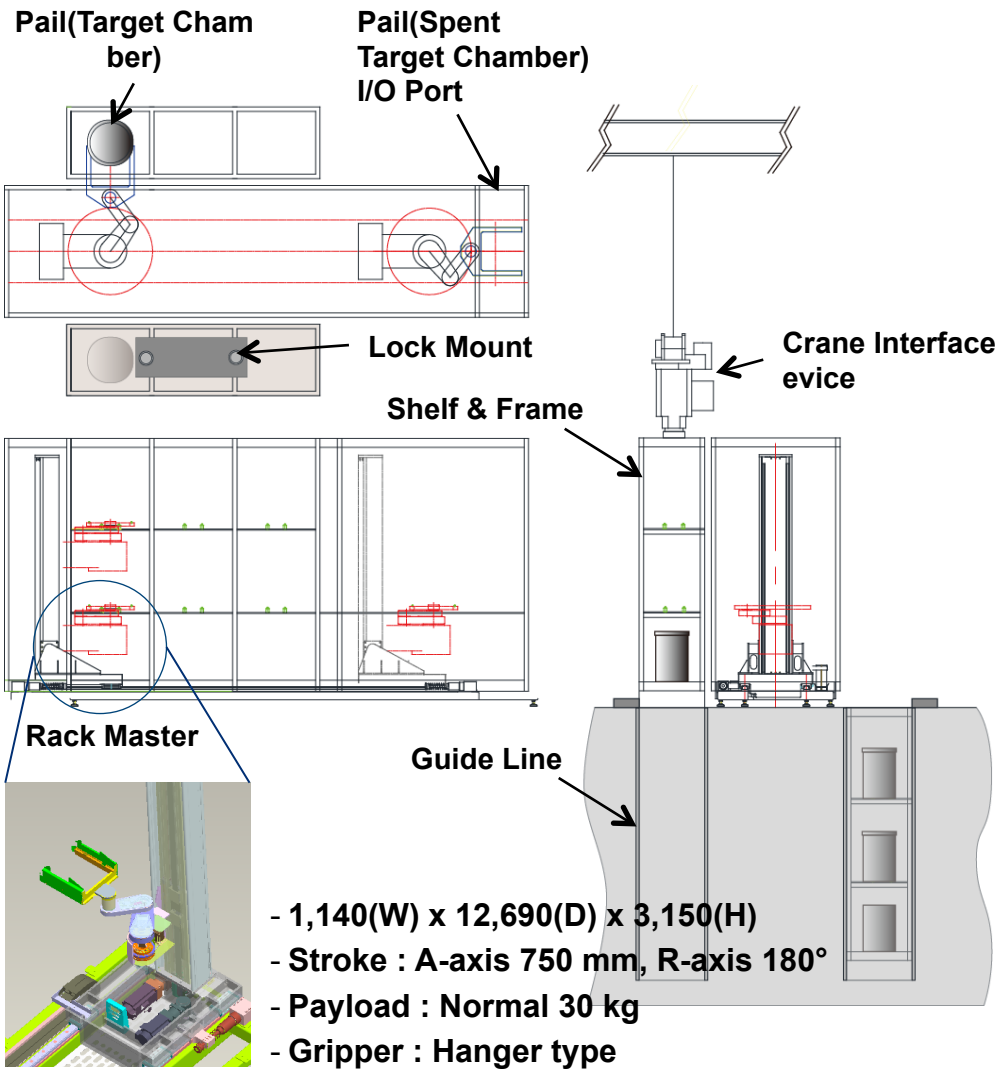


Spent Target Storage

< ISAC/TRIUMF Target Storage Vault >



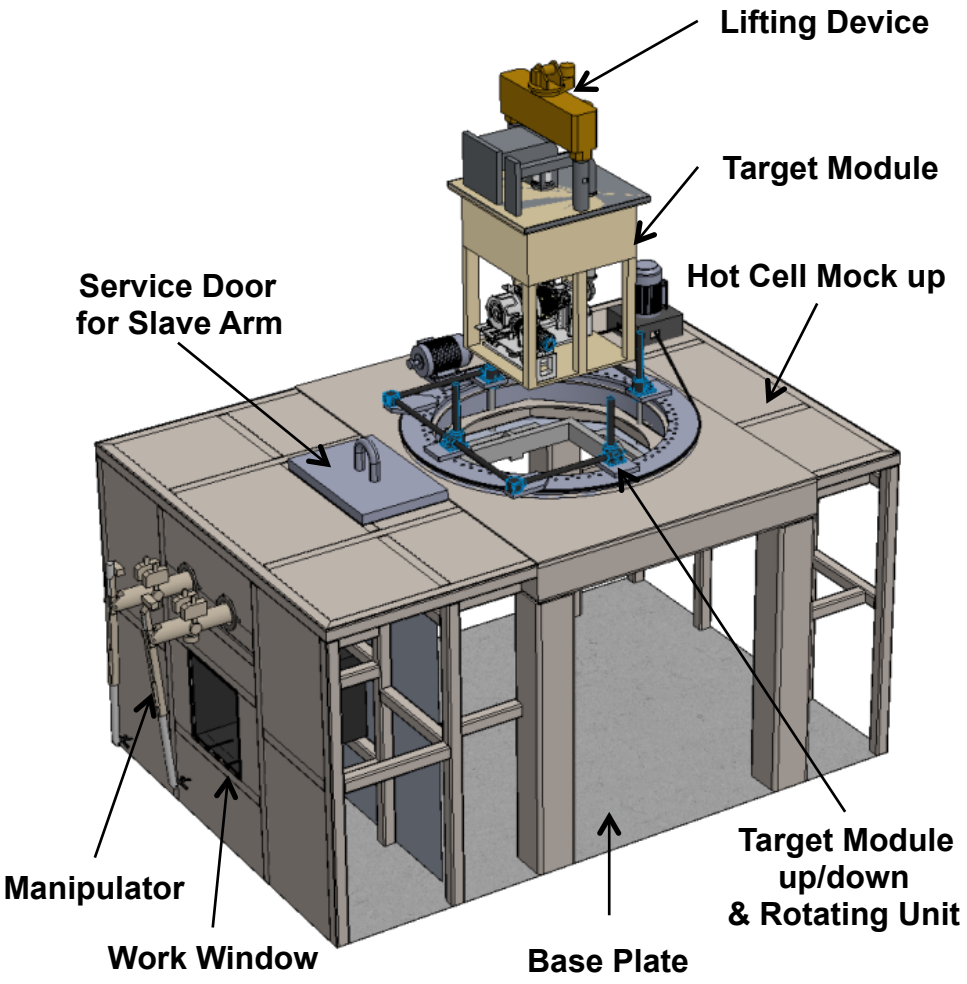
< ARIEL/TRIUMF Target Storage Vault >



- 1,140(W) x 12,690(D) x 3,150(H)
- Stroke : A-axis 750 mm, R-axis 180°
- Payload : Normal 30 kg
- Gripper : Hanger type

< Target Chamber Stocker system >

Target Module & Hot Cell Mock-up



< 4,800mm(W) x 6,852 mm(L) x 4,500 mm(H) >

Target Module Performance Test

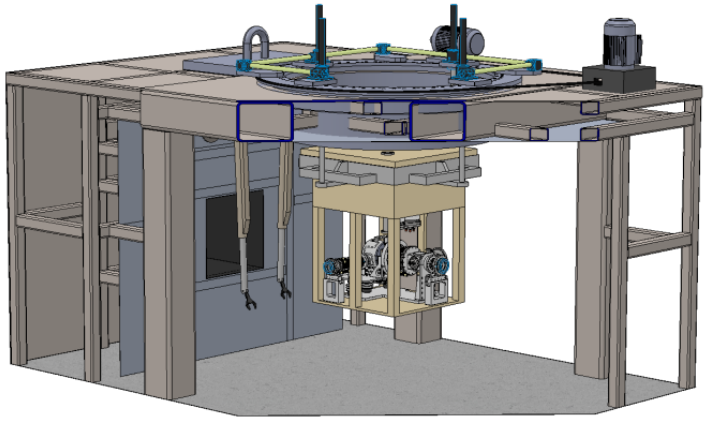
- Primary & Secondary Vacuum Test
- Quick & Remote Connection/Disconnection
- High Voltage Discharge
- Pillow Seal & Special All Metal Gate Valve

Hot Cell Performance Test

- Coupling & Decoupling of Target Chamber in Ta rget Module
- Target Chamber Exchange
- Target Module Moving System (Rot. & Up/Down)
- Manipulator Jig & Tools

Crane Interface Device Performance Test

- Alignment / Twist Locking / Interlock



Summary

- RISP ISOL systems are being developed for providing n-rich RI beam to user facility
- Detail and Engineering Design of ISOL remote handling system includin g infrastructure under way
- Final Goal : 70 kW UCx Target Ion Source system (in RISP 10 kW)
- Start install in 2019, 2021 RI beam providing
- Benchmarked the TRIUNF target module and remote handling system
- Target remote handling scenario defined
- All remote procedures to be mocked-up and tested prior to commissionin g with beam.
- Target module and hot cell mock-up in progress of manufacture

Thank you for your attention !