



EUROPEAN  
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SOURCE

# The Target Station

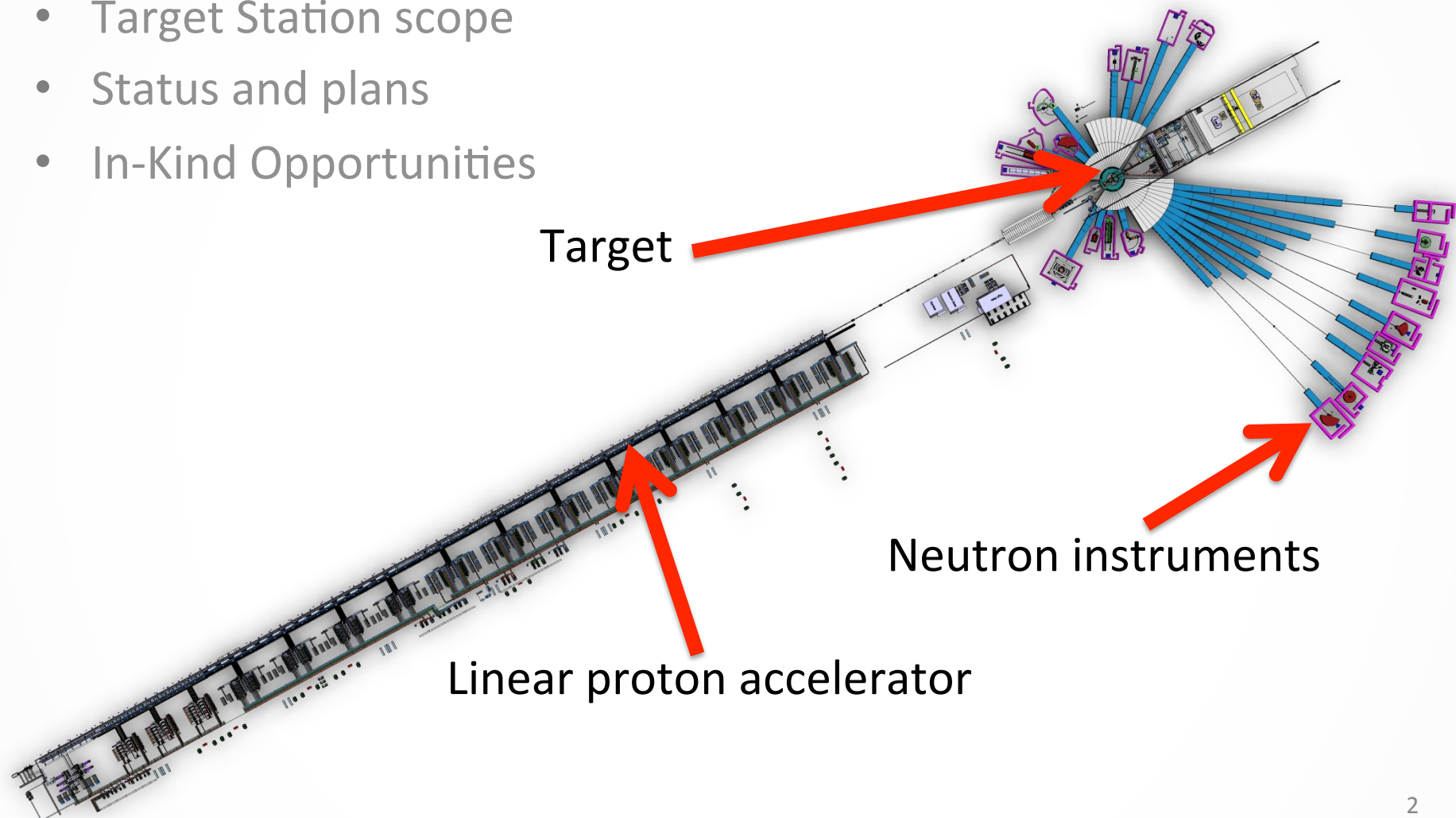
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[www.europeanspallationsource.se](http://www.europeanspallationsource.se)

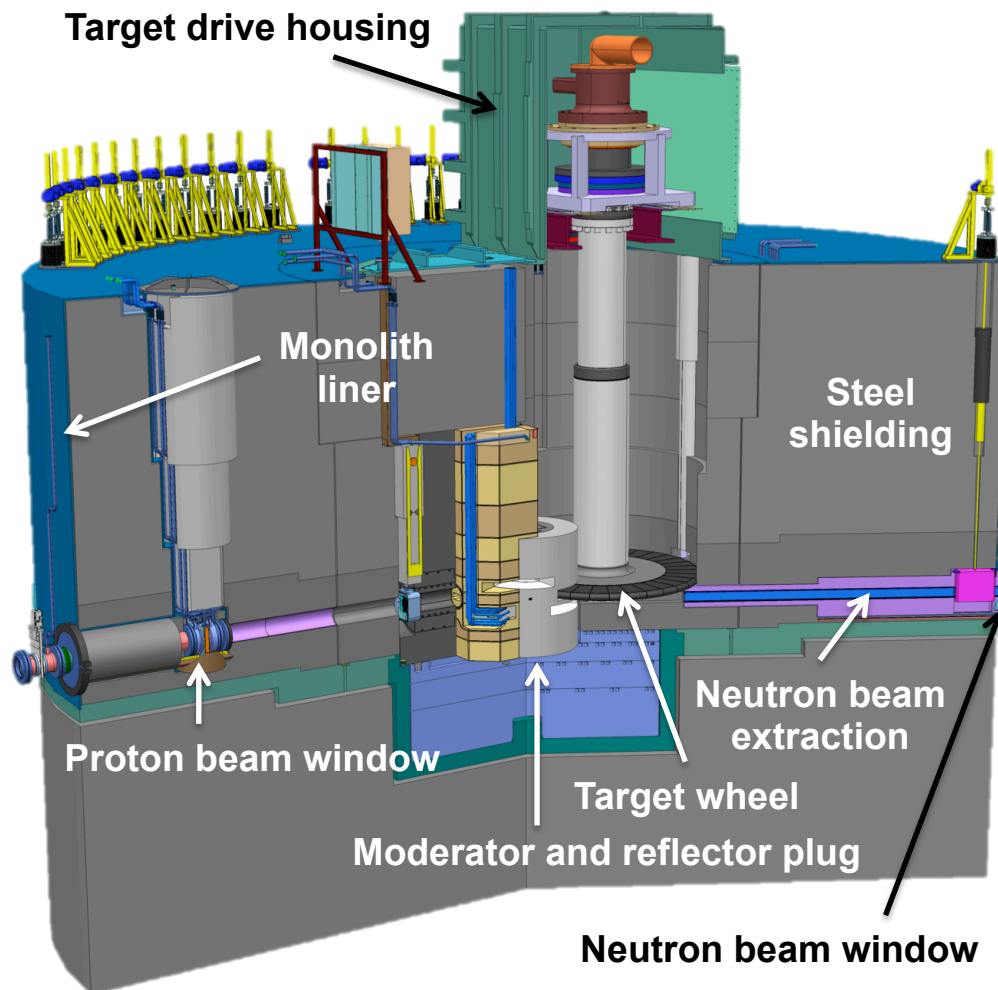
February 7, 2014

# Outline

- Target Station scope
- Status and plans
- In-Kind Opportunities



# Target Station Scope – Monolith



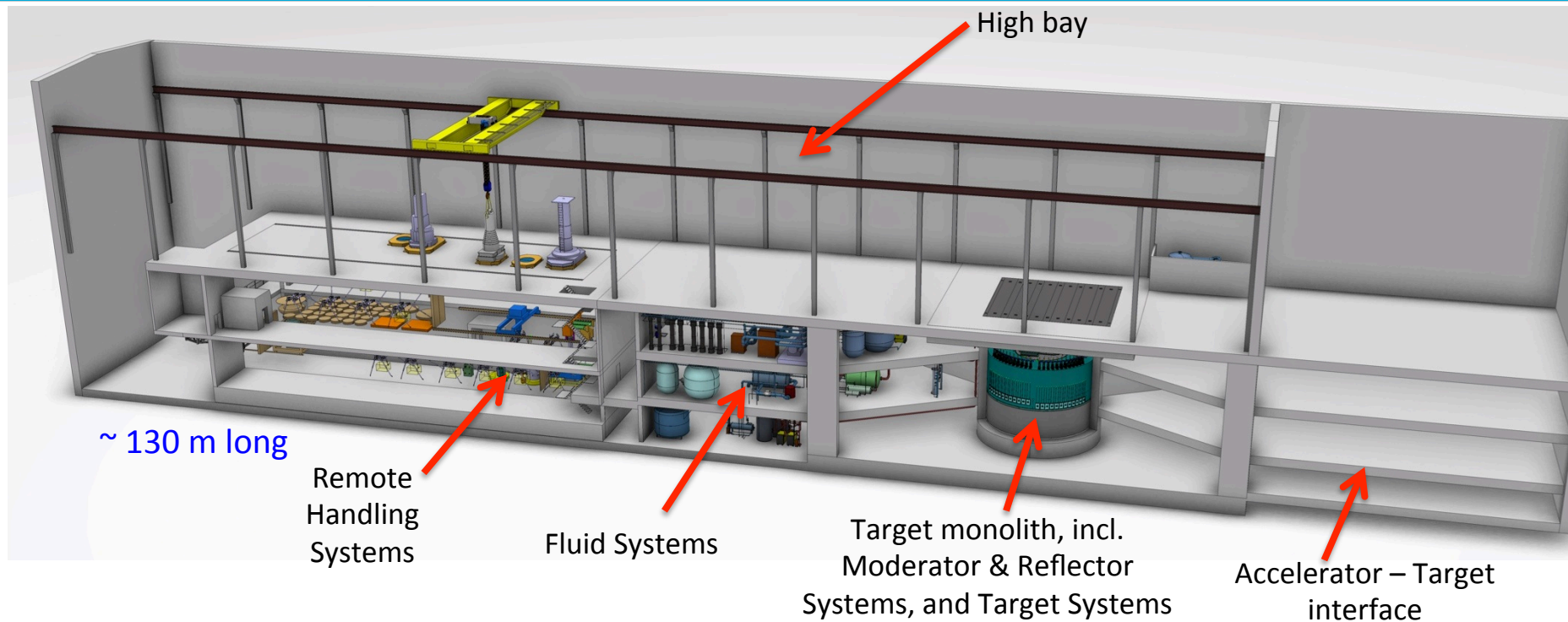
## Requirements:

- Convert protons to neutrons
- Peak brightness ( $E < 10$  meV)  
at 5 MW:  $2 \times 10^{14}$  n/cm<sup>2</sup>/s/sr  
(30 x ILL)
- Heat removal - 5 MW proton beam
- Confinement and shielding

## Unique features:

- Rotating target
- He-cooled W target

# Target Station



- Hot cells plus casks and tooling to transport components from monolith to cells
- Safety credited controls to protect public and environment from radioactive hazard

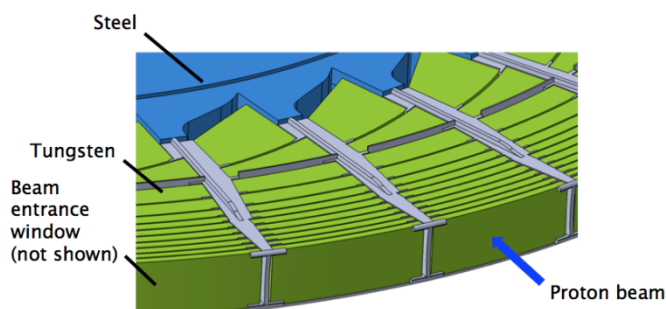
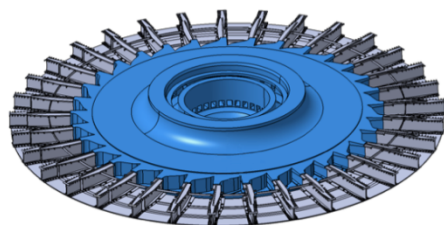
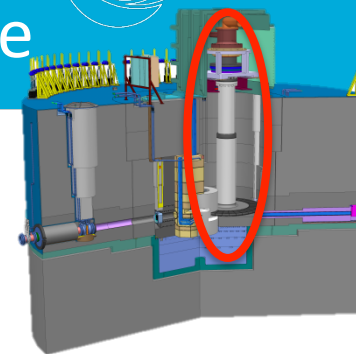
# General Comments on ESS Target Station

## Project Status and Plans

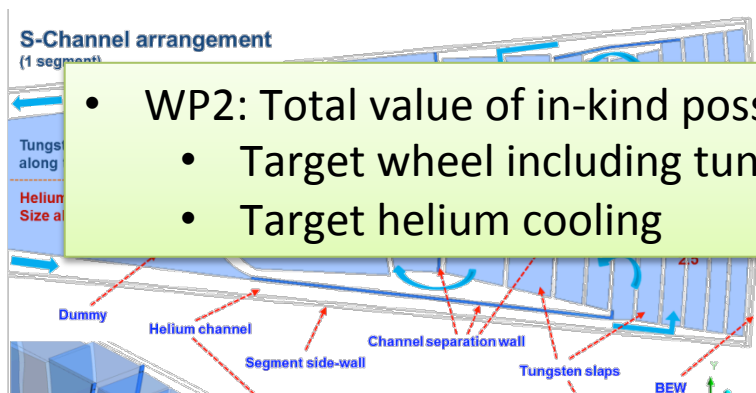


- Design concepts for all Target Station systems have advanced from the TDR (issued in April 2013), but many remain to be fully optimized as part of the completion of Preliminary Design in 2014
- Cost and schedule baseline established
  - Logically driven, resource loaded schedule used to establish funding needs, staffing plan, delivery dates, integrate with other parts of ESS, ...
  - Focused on achieving beam-on-target by the end of 2019 with high confidence (adequate schedule float)
- Two biggest challenges for Target in 2014 are establishing in-kind partnerships and hiring needed staff
  - These two items are closely coupled

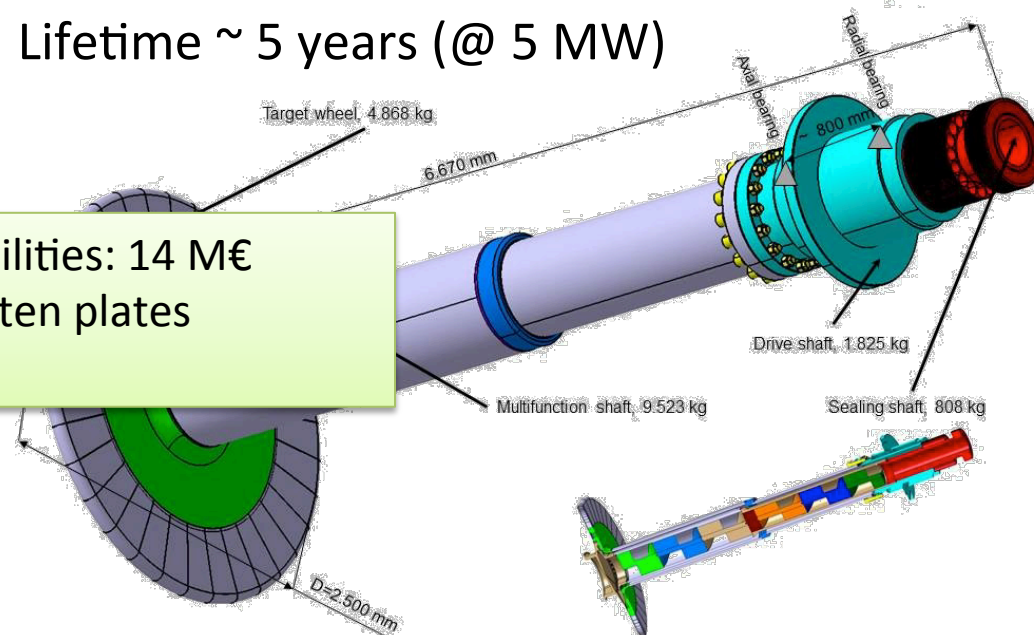
# He-cooled, rotating W target has a long-lifetime and is passively safe



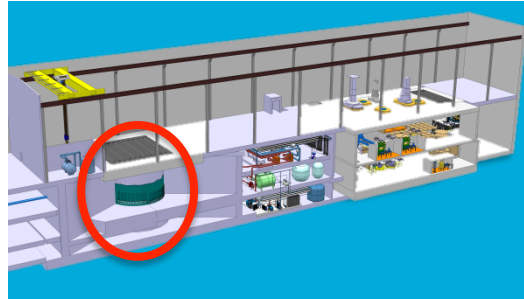
- Tungsten slabs in 33 sectors
- Wheel diameter 2.5 m
- Shaft length > 5 m
- Helium coolant
  - Pressure: 3 atmospheres
  - Inlet/outlet temperatures: 20 °C/220 °C
- Rotational speed 25.5 rpm
- Lifetime ~ 5 years (@ 5 MW)



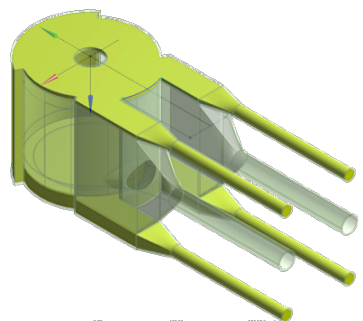
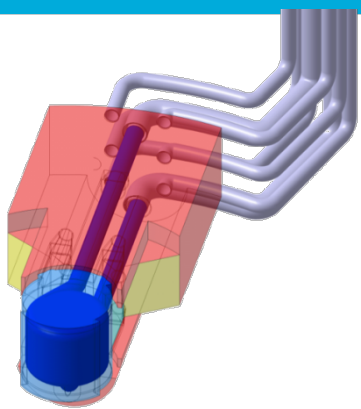
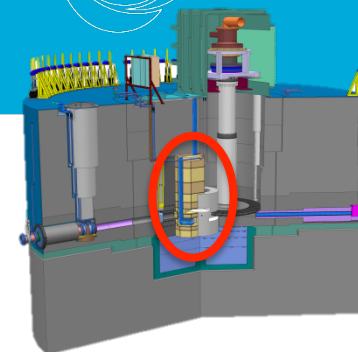
- WP2: Total value of in-kind possibilities: 14 M€
  - Target wheel including tungsten plates
  - Target helium cooling



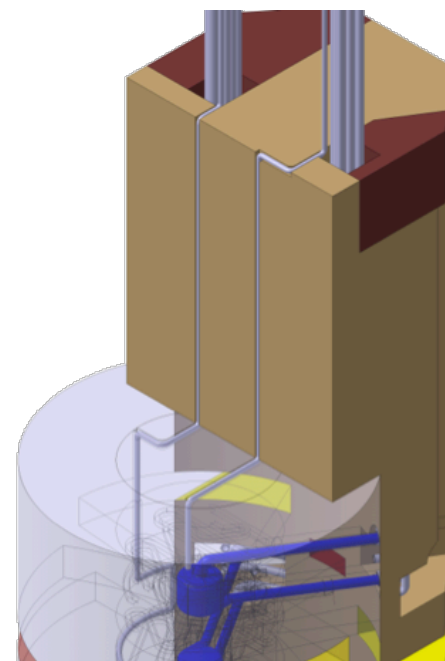




# Moderator and reflector plug integrates two LH<sub>2</sub> moderators within a Be reflector

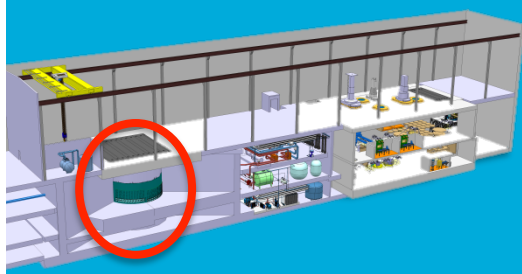


- Cold moderators
  - Supercritical hydrogen at 20 K and 1.5 MPa
  - Aluminium alloy vessel
  - Expected lifetime ~ 1 year @ 5 MW
- Water moderators
  - RT water
  - Extended wings facilitate thermal or bi-spectral beam extraction
  - Expected lifetime ~ 1 year @ 5 MW



- Inner reflector
  - Beryllium
  - Water cooled
- Outer reflector
  - Stainless steel
  - Water cooled

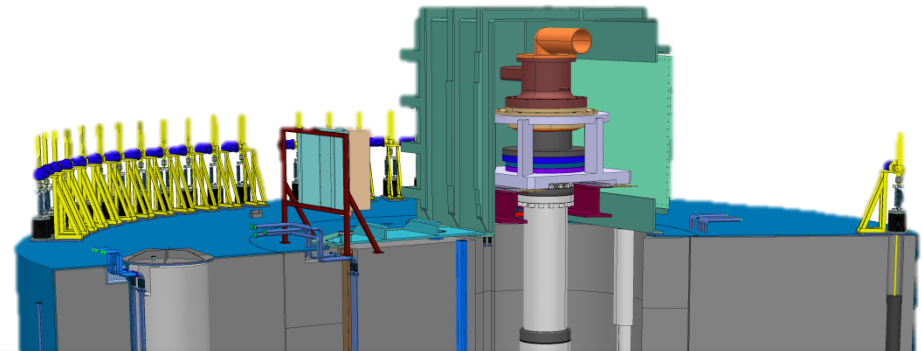
- WP3: Total value of in-kind possibilities: 20 M€
  - Moderator and Reflector Plug
  - He cryoplant for cooling hydrogen
  - Supercritical hydrogen loop



# Monolith Systems serve shielding and confinement functions and facilitate neutron beam extraction



- Shielding systems
  - Internal monolith structures
  - Monolith bulk shielding
  - Monolith removable shielding
- Confinement systems
  - Proton beam window
  - Monolith vessel
  - Neutron beam windows
  - Covers and penetrations
  - Helium atmosphere system
- Enabling systems
  - Target monitoring plug
  - Proton beam instrumentation plug
  - Irradiation module
  - Neutron beam extraction system
- Tuning beam dump



- WP4: Total value of in-kind possibilities: 24 M€
  - Steel shielding
  - Monolith vessel
  - Tuning Beam Dump
  - Target monitoring, irradiation, and proton beam instrumentation plugs
  - Helium atmosphere in the monolith
  - Proton beam window

- Diameter ~ 12 m
- Height ~ 8 m
- Mass ~ 7000 tonnes (mainly steel)



# Fluid Systems provide primary and secondary cooling and process/confine radioactive fluids

## Primary Water Cooling:

- Water Moderators 50 kW
- Reflectors 300 kW
- Shielding and Plugs 1.6 MW

## Intermediate Water Cooling:

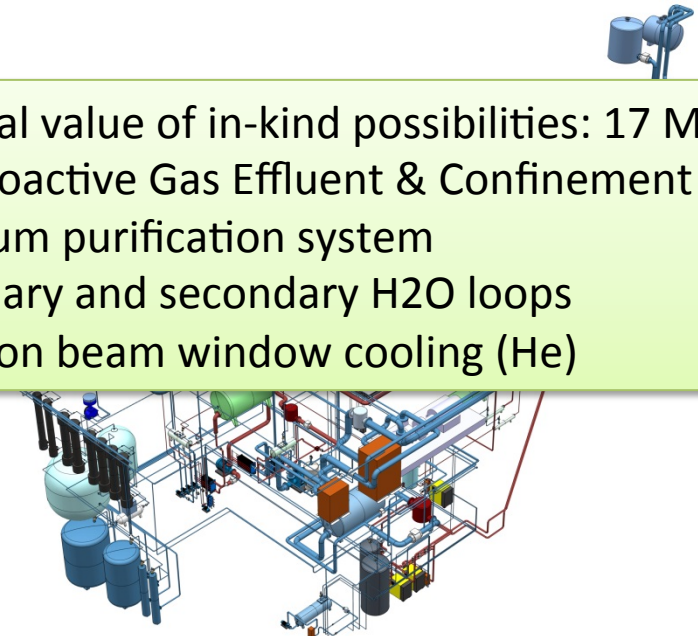
- for Target System 3.8 MW
- for Gas Systems 90 kW
- for Water Systems 2.2 MW

## Rad. Gas Effluent & Confinement (RGEC):

- Target Station Ventilation 110 000 m<sup>3</sup>/h
- Separation Gas for Primary Water
- Radioactivity Monitoring

## Active storage

- Water storage
- Helium storage

- 
- WP5: Total value of in-kind possibilities: 17 M€
    - Radioactive Gas Effluent & Confinement
    - Helium purification system
    - Primary and secondary H<sub>2</sub>O loops
    - Proton beam window cooling (He)

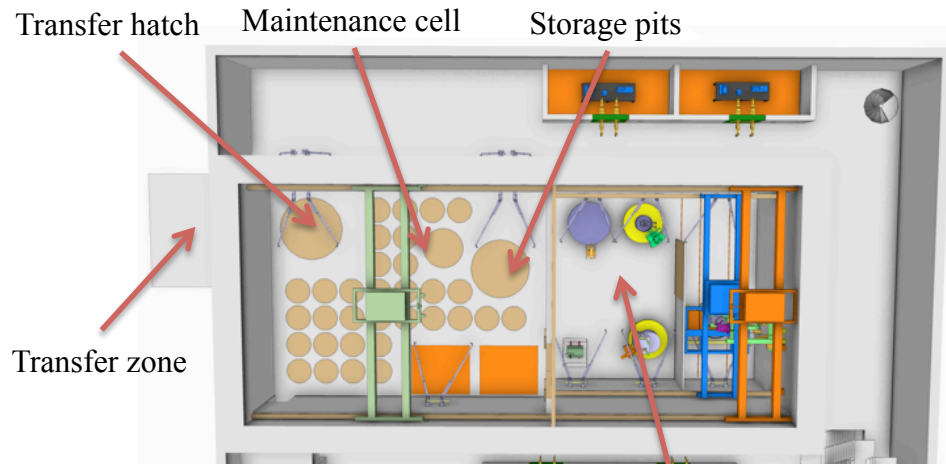
## Auxiliary Helium Systems

- PBW Cooling 5 kW, 200 g/s
- Target Helium Purification 3 g/s
- Monolith Helium Purification 7 g/s

Vacuum, gas and water supplies

# Remote Handling Systems maintain target equipment and package and process waste

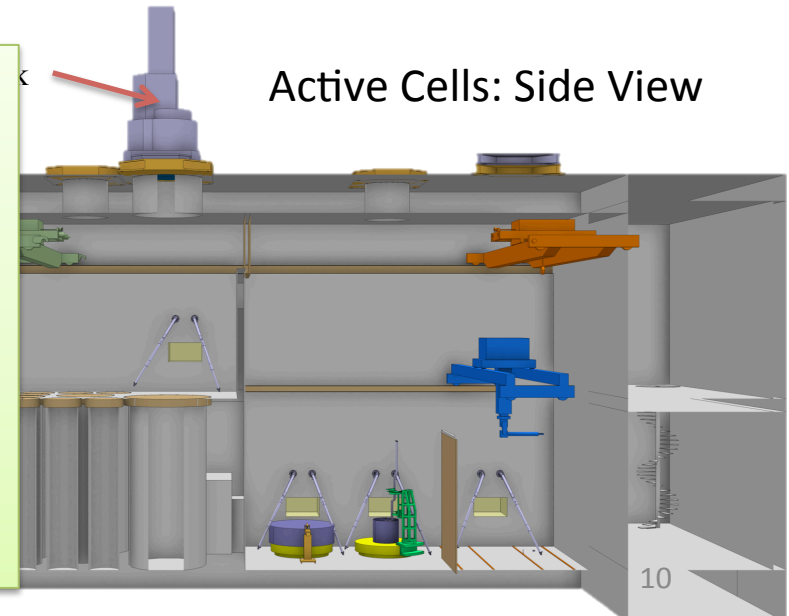
Active Cells: Top View



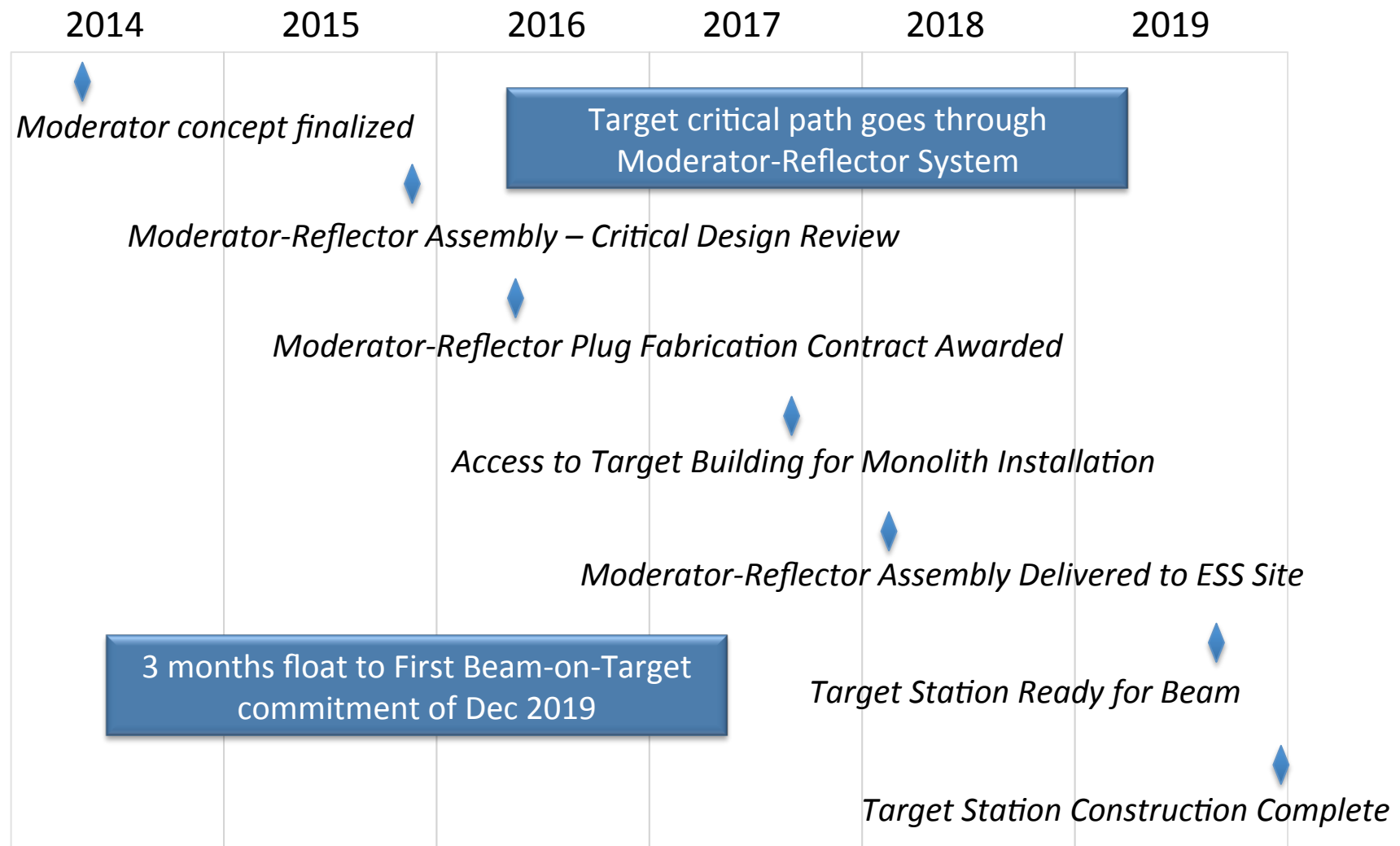
- Active Cells: Hot Cells with connected infrastructure and tooling
- Internal casks and associated handling devices: Radioactive component transport between monolith and active cells
- Mock-ups, test and training facility

- WP6: Total value for in-kind possibilities: 26 M€
  - Confinement items for active cells (windows, doors, lids, hatches etc.)
  - Handling items for active cells (power manipulator, tele-manipulators)
  - Various internal casks
  - Equipment for active cells (welding equipment, saw, shear cutters, etc.)
  - Test of handling procedure

Active Cells: Side View



# Target Station Project Plan Shows Completion by End of 2019



# Examples of Potential Areas for in-Kind Collaboration with France on Target



- He cooling loop for Target Wheel
- Ancillary He systems (filtering, etc.)
- Radioactive Gas Effluent and Confinement System
- Cryo-systems – He cryoplant and liquid hydrogen loop for 20 K moderator
- Remote handling systems