EUROPEAN SPALLATION SOURCE

Status of the Target Program

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www.europeanspallationsource.se
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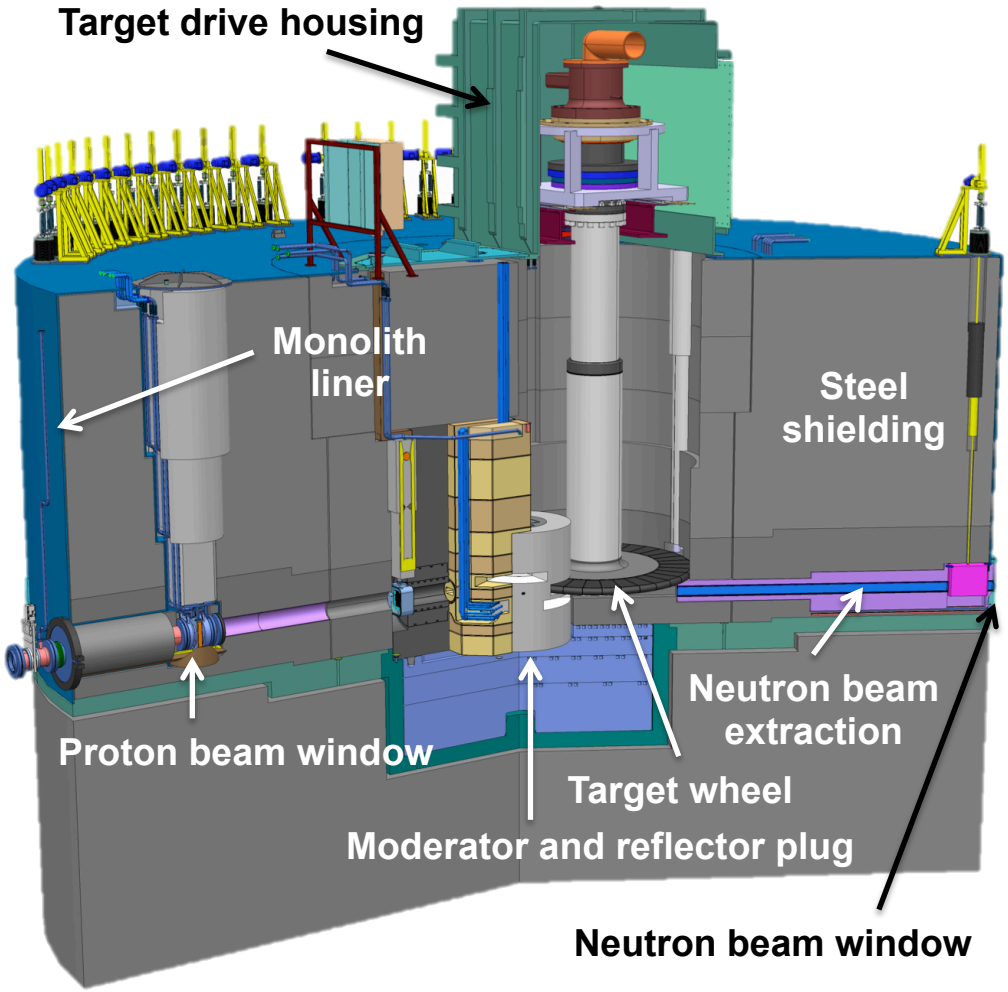
Target Station Scope – Monolith



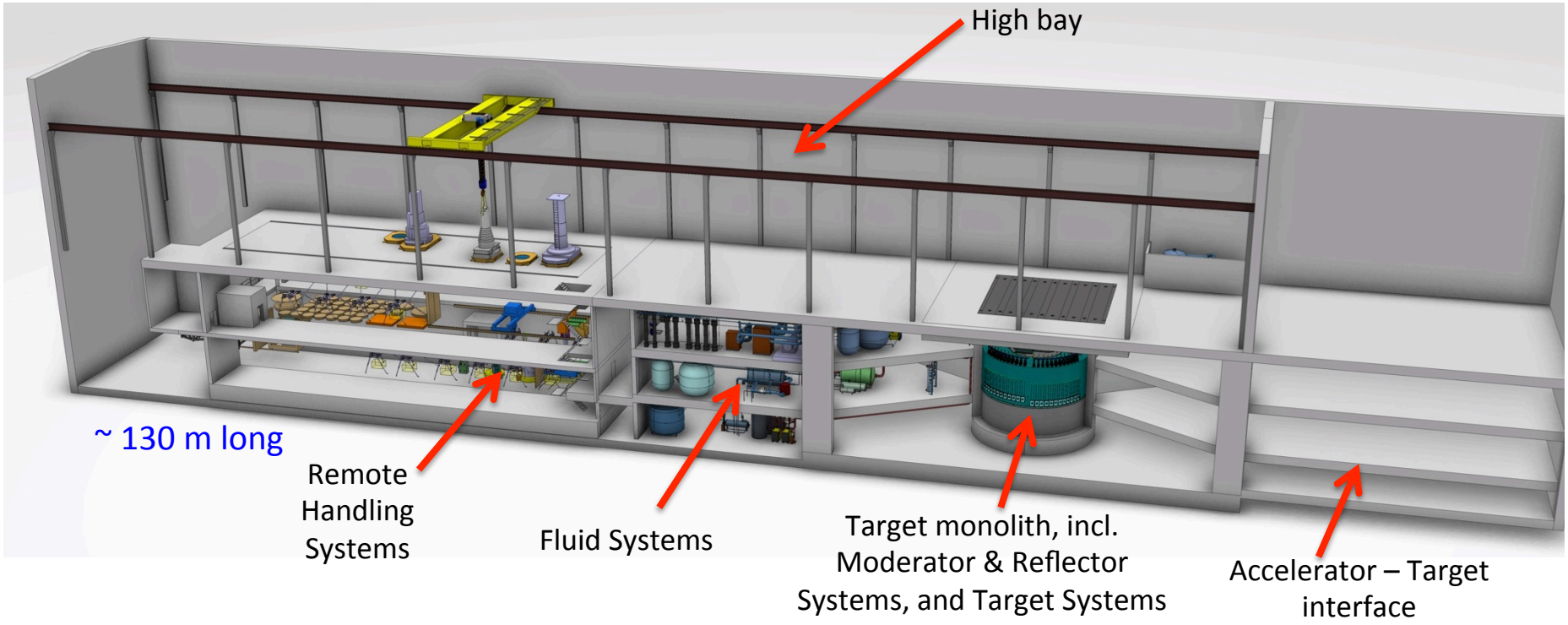
Requirements:

- Convert protons to neutrons
  - Peak brightness (E < 10 meV) at 5 MW: $2x10^{14}$ n/cm^2/s/sr (30 x ILL)
- Heat removal
- Confinement and shielding

Unique features:

- Rotating target
- He-cooled W target

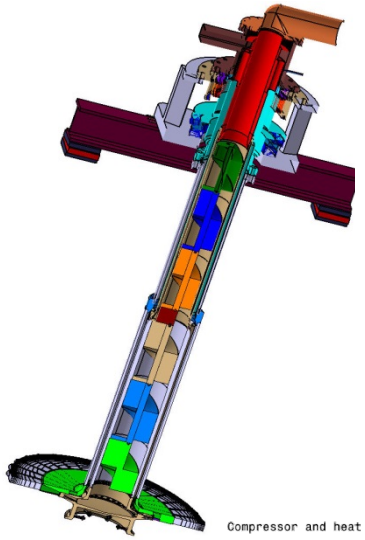
Target Station

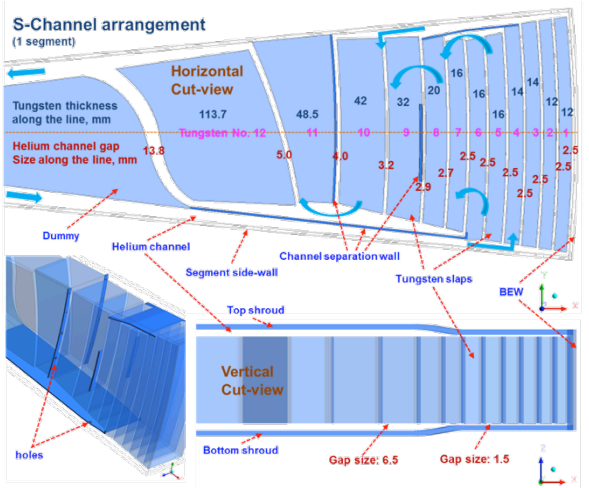


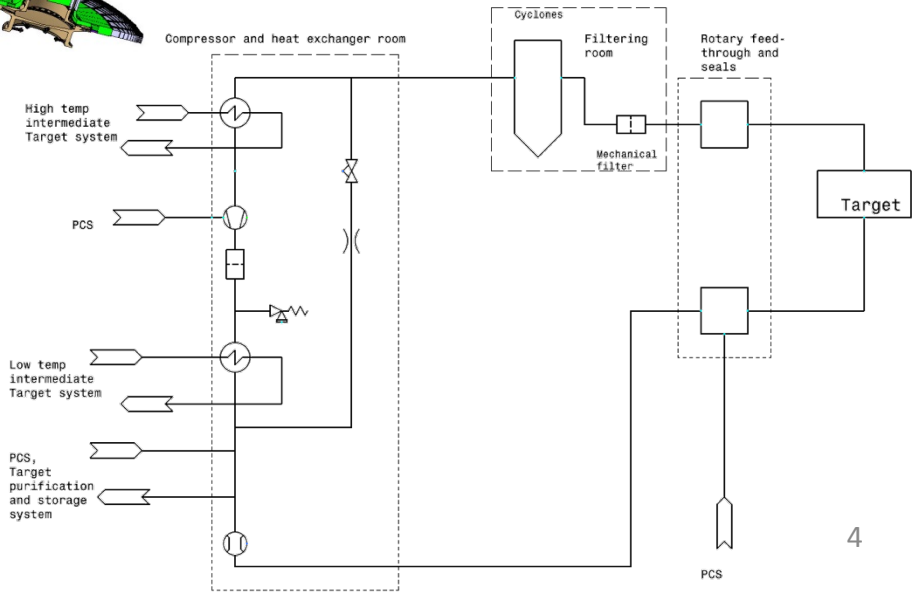
- Hot cells plus casks and tooling to transport components from monolith to cells
- Safety credited controls to protect workers, pubic, and environment from radioactive hazard

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

- Target wheel
  - Spallation material (W)
  - Vessel
  - Internal structures
- Target drive and shaft
  - Shaft including internal shielding
  - Bearing unit
  - Feedthroughs
  - Motive system
- Target helium cooling system
- Water cooling backup option

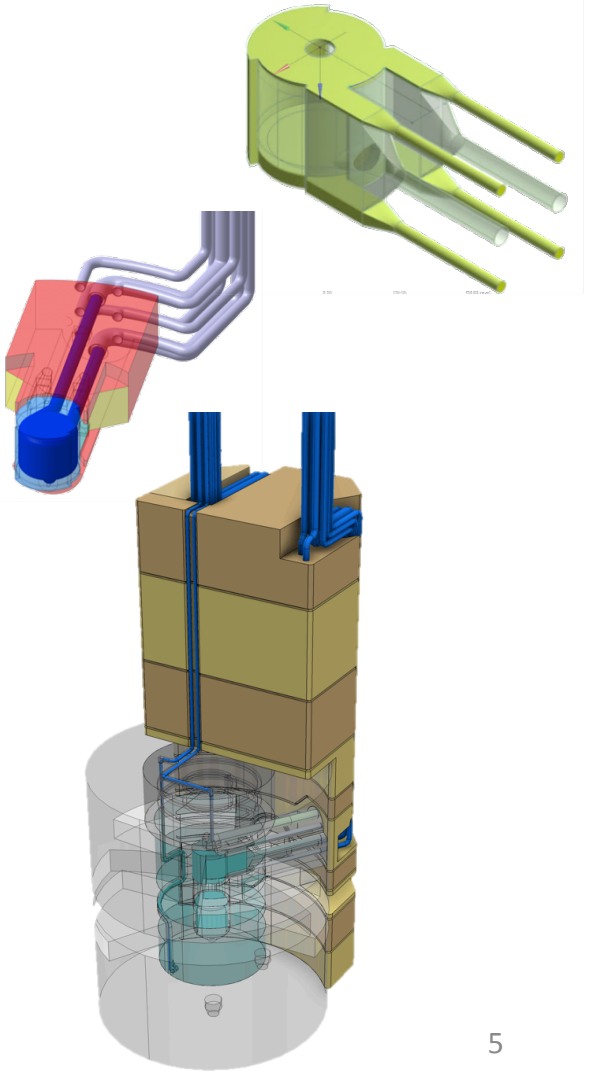






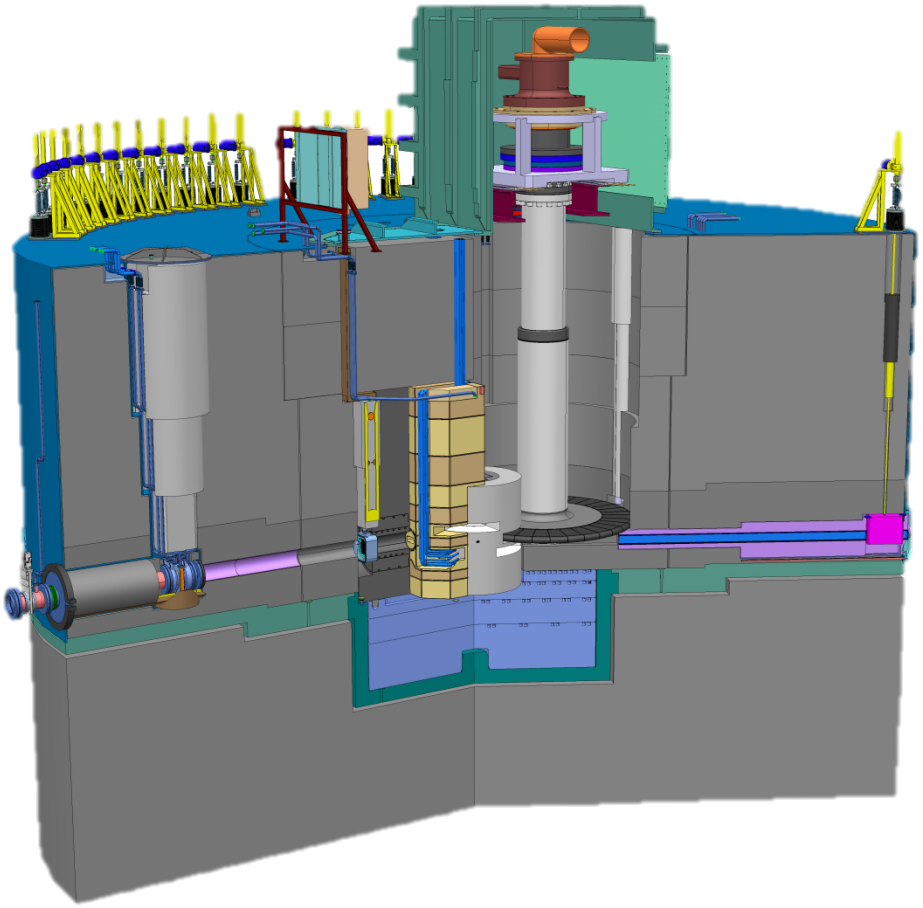
Moderator and reflector integrates two liquid hydrogen moderators (one above and one below target) with a Be reflector

- Moderator and reflector assemblies
  - Cold moderator assembly and vacuum jacket
  - Thermal moderator assembly
  - Reflectors assembly
- Moderator and reflector (MR) plug structure and handling systems
  - MR structural support
  - MR handling system
  - MR shielding
- Cryogenic cooling systems
  - Cryogenic moderator system (LH_2)
  - Cryoplant
  - Vacuum system for insulation



Monolith Systems serve shielding and confinement functions

- 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
  - Beam dump system
  - Beam dump shielding



Fluid Systems provide primary and secondary cooling and confine radioactive fluids

Primary Water Cooling:

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

Intermediate Water Cooling:

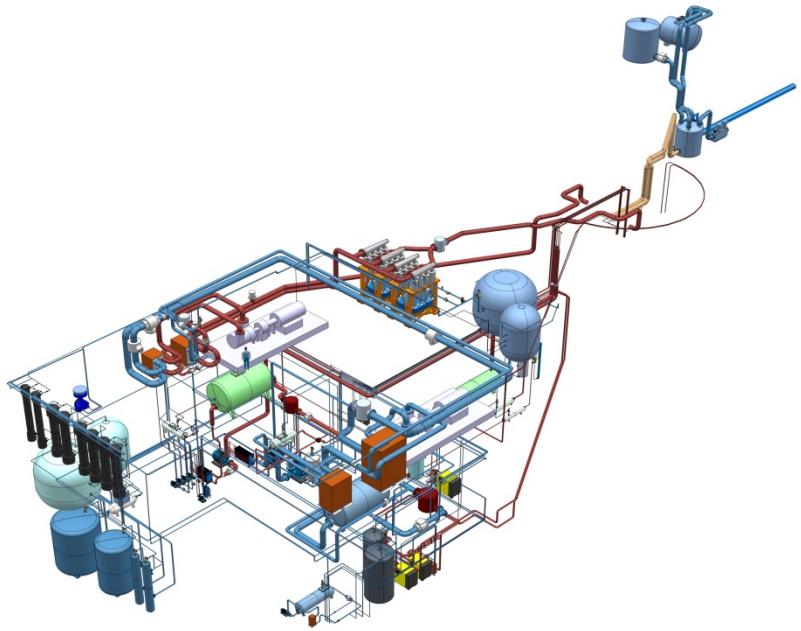
- for Target System 3.8 MW
- for Gas Systems 90 kW
- for Water Systems 2.2 MW

Rad. Gas Effluent & Confinement (RGEC):

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

Active storage

- Water storage
- Helium storage



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

We are pursuing a huge increase in neutron brightness (equivalent to > 15 MW accelerator for some instruments)

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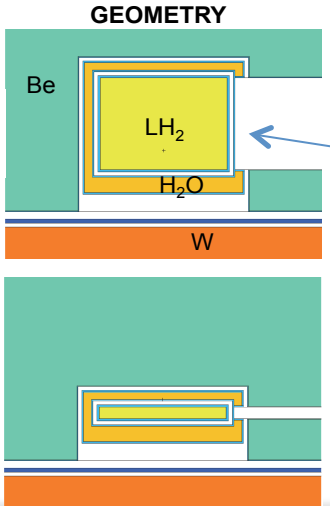
Opportunity: Recently discovered novel "low dimensional" moderator concept: up to an order of magnitude gain in moderator brightness

Facilitating Action:

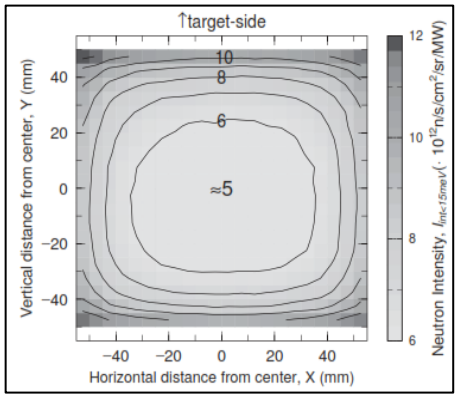
Working with Science Directorate in developing path forward to realize this gain

13 cm high TDR moderator

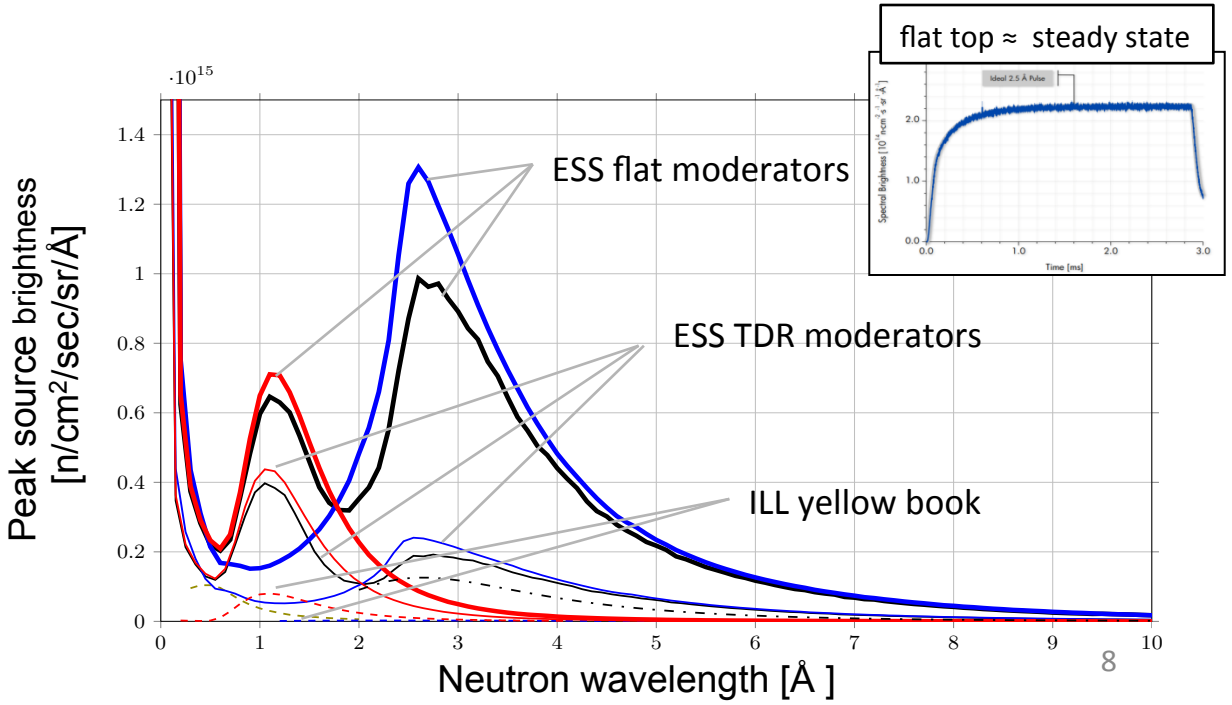
1.5 cm high flat moderator



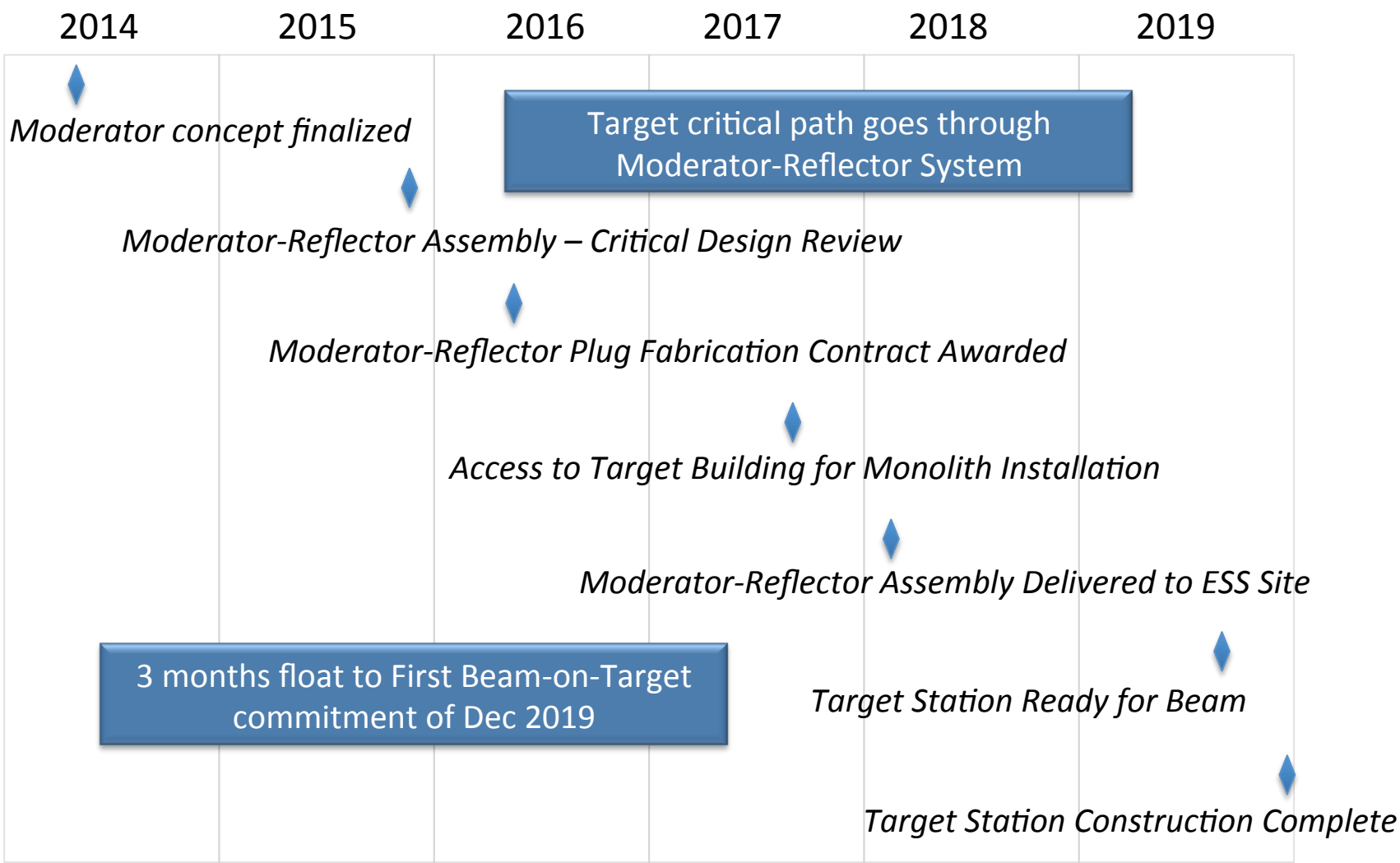
Cooling system: 32 KW at 20 K!!



T. Kai et al. (2004)



Target Station Project Plan Shows Completion by End of 2019



Target Systems (WP2)

- Total value for in-kind possibilities: 15,8M€ (2,3M labor/ 13,5M non labor)
- Breakdown:
  - Spallation Material (Tungsten): Development, procurement, manufacturing and testing of the tungsten plastes. 1,7M€ (0,6M Labor/1,1M Non-Labor)
  - Steel vessel for Tungsten, shielding around wheel, wheel shaft, wheel unit bearing structure, wheel unit motor: Development, procurement, manufacturing and testing of the wheel and shaft unit, not incl the tungsten. 2,9M€ (0,9M Labor/2M Non-Labor)
  - Target Helium Cooling: Development, procurement, manufacturing and testing of the helium cooling equipment. 8,25M€ (0,225M Labor/8M Non-Labor)

Moderator and Reflector Systems (WP3)

- Total value for inkind possibilities: 20,4M€ (2,9M labor/ 17,5M non labor)
- Breakdown:
  - Moderator Engineering Plug: Development, procurement, manufacturing and testing. 5M€ (1,5M labor/3,5M non-labor)
  - Liquid Hydrogen Cooling: Development, procurement, manufacturing and testing. 3,3M€ (1,3M labor/2M non-labor)
  - Target Cryoplan: Development, procurement, manufacturing, testing and installation. 11,7M€ (1,7M labor/10M non-labor)
  - Vacuum units for insulation: Development, procurement, manufacturing and testing. 0,46M€ (0,16M labor/0,3M non-labor)

Monolith Systems (WP4)

- Total value for in-kind possibilities: 24,9M€ (4,15M labor/20,75M non labor)
- Breakdown:
  - Various target monitoring plugs: Development, procurement, manufacturing and testing. 1,5M€ (1M labor/0,5M non-labor)
  - Proton beam window: Development, procurement, manufacturing and testing. 0,8M€ (0,3M labor/0,5M non-labor)
  - Monolith Vessel surrounding the monolith: Development, procurement, manufacturing and testing. 3,5M€ (0,5M labor/3M non-labor)
  - Helium atmosphere in the monolith: Development, procurement, manufacturing and testing. 1,2M€ (0,2M labor/1M non-labor)
  - Monolith various shielding items (removable, permanent): Development, procurement, manufacturing and testing. 15,5M€ (1,3M labor/14,2M non-labor)
  - Tuning Beam dump in A2T zone: Development, procurement, manufacturing and testing. 2,4M€ (0,7M labor/1,7M non-labor)

Fluid Systems (WP5)

- Total value for in-kind possibilities: 13,5M€ (1,7M labor/ 11,8M non labor)
- Breakdown:
  - Target intermediate cooling (H2O): Development, procurement, manufacturing and testing. 1,5M€ (0,1M labor/1,4M non-labor)
  - Proton beam window cooling (He): Development, procurement, manufacturing and testing. 0,8M€ (0,2M labor/0,6M non-labor)
  - Water moderator primary cooling (H2O): Development, procurement, manufacturing and testing. 0,75M€ (0,25M labor/0,5M non-labor)
  - Reflectors primary cooling: Development, procurement, manufacturing and testing. 1M€ (0,2M labor/0,8M non-labor)
  - Shielding primary cooling (H2O): Development, procurement, manufacturing and testing. 1,5M€ (0,2M labor/1,3M non-labor)
  - Intermediate cooling for gas and water (H2O): Development, procurement, manufacturing and testing. 1,5M€ (0,3M labor/1,2M non-labor)
  - Helium purification system: Development, procurement, manufacturing and testing. 6,4M€ (0,4M labor/6M non-labor)

Remote Handling Systems (WP6)

- Total value for in-kind possibilities: 26,4M€ (M labor/20,75M non labor)
- Breakdown:
  - Confinement items for active cells (doors, lids, hatches etc.): Development, procurement, manufacturing and testing. 10,4M€ (1M labor/9,4M non-labor)
  - Handling items for active cells (power manipulator, telemanipulators): Development, procurement, manufacturing and testing. 9,35M€ (1,1M labor/8,25M non-labor)
  - Equipment for active cells (welding equipment, saw, shear cutters, etc.): Development, procurement, manufacturing and testing. 2,7M€ (0,8M labor/1,9M non-labor)
  - Various internal casks: Development, procurement, manufacturing and testing. 3,5M€ (1M labor/2,5M non-labor)
  - EDD for test of handling procedure: Development, procurement, manufacturing and testing. 0,45M€ (0,05M labor/0,4M non-labor)

- **Many thanks** for the excellent in-kind collaboration with German partners in the Design Update phase (2010 – 2013, ~5 M€)
- Looking for a great continuation in the future