Overview of ISIS Moderators

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ISIS Target Design Group
January 2014

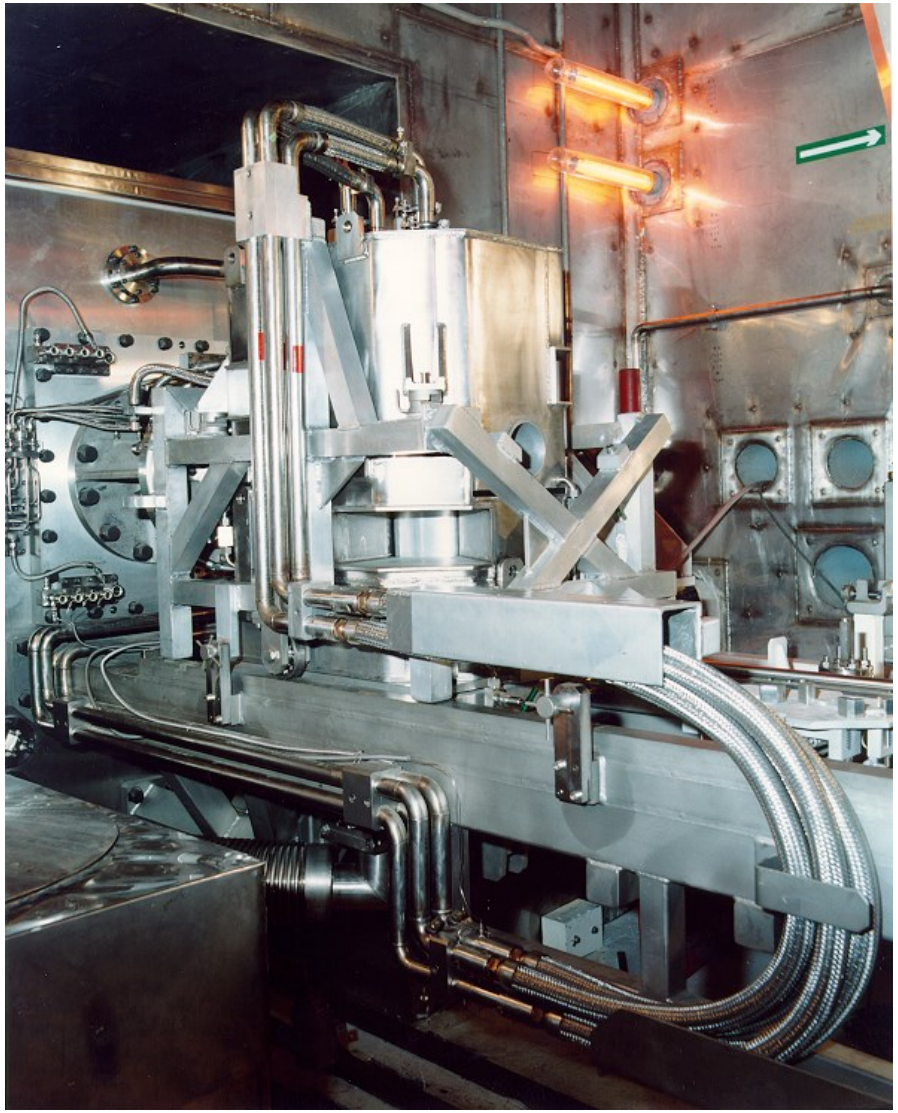
Overview

- ISIS First Target Station (TS1)
  - Two ambient water moderators
  - Two cryogenic moderators
    - One liquid methane at ~110K
    - One liquid hydrogen at ~20K
- ISIS Second Target Station (TS2)
  - Two cryogenic moderators
    - One solid methane at ~40K
    - One liquid hydrogen at ~17K
  - Combined with two ambient water pre-moderators

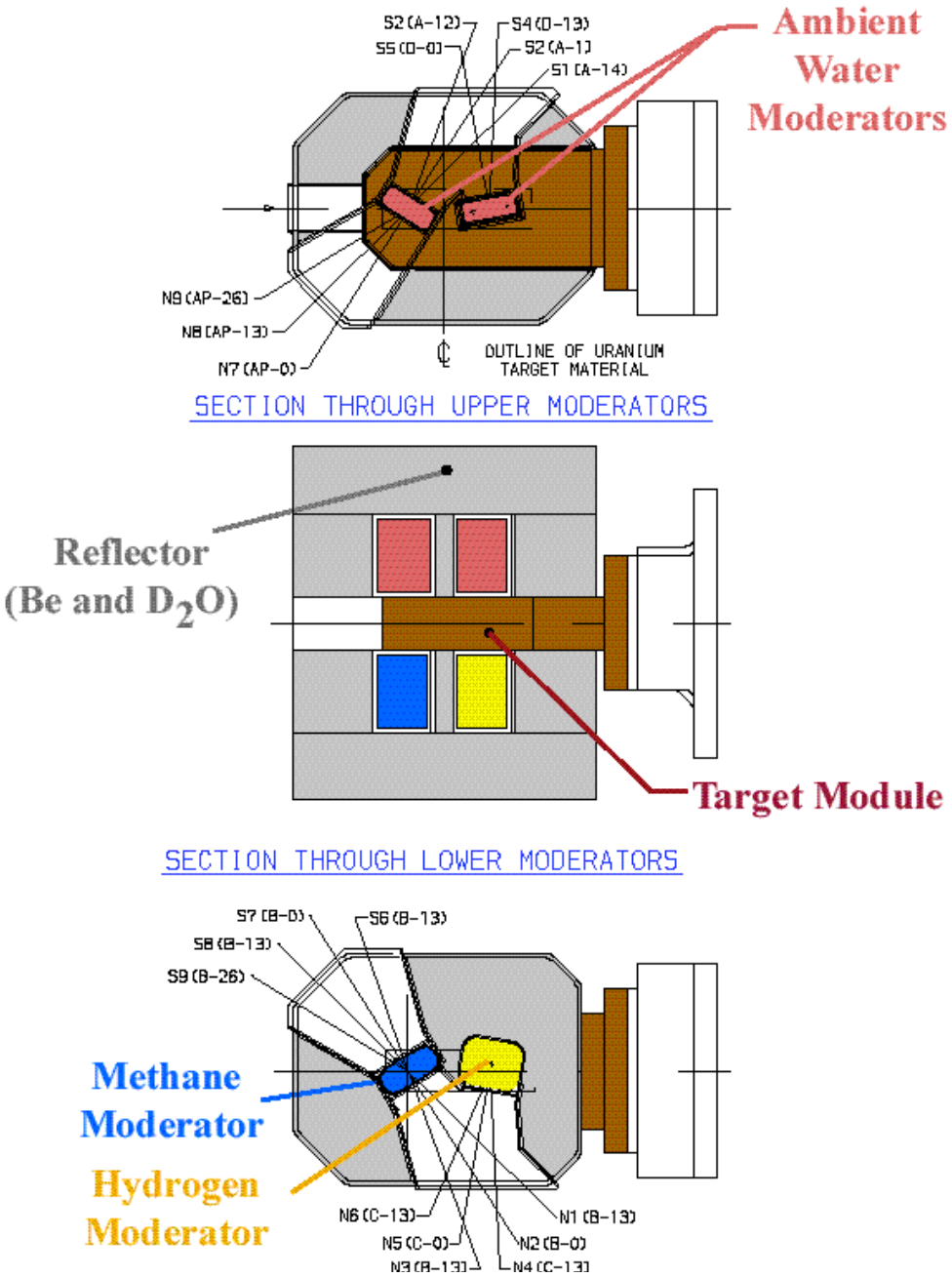
ISIS First Target Station

- In operation for 28 years

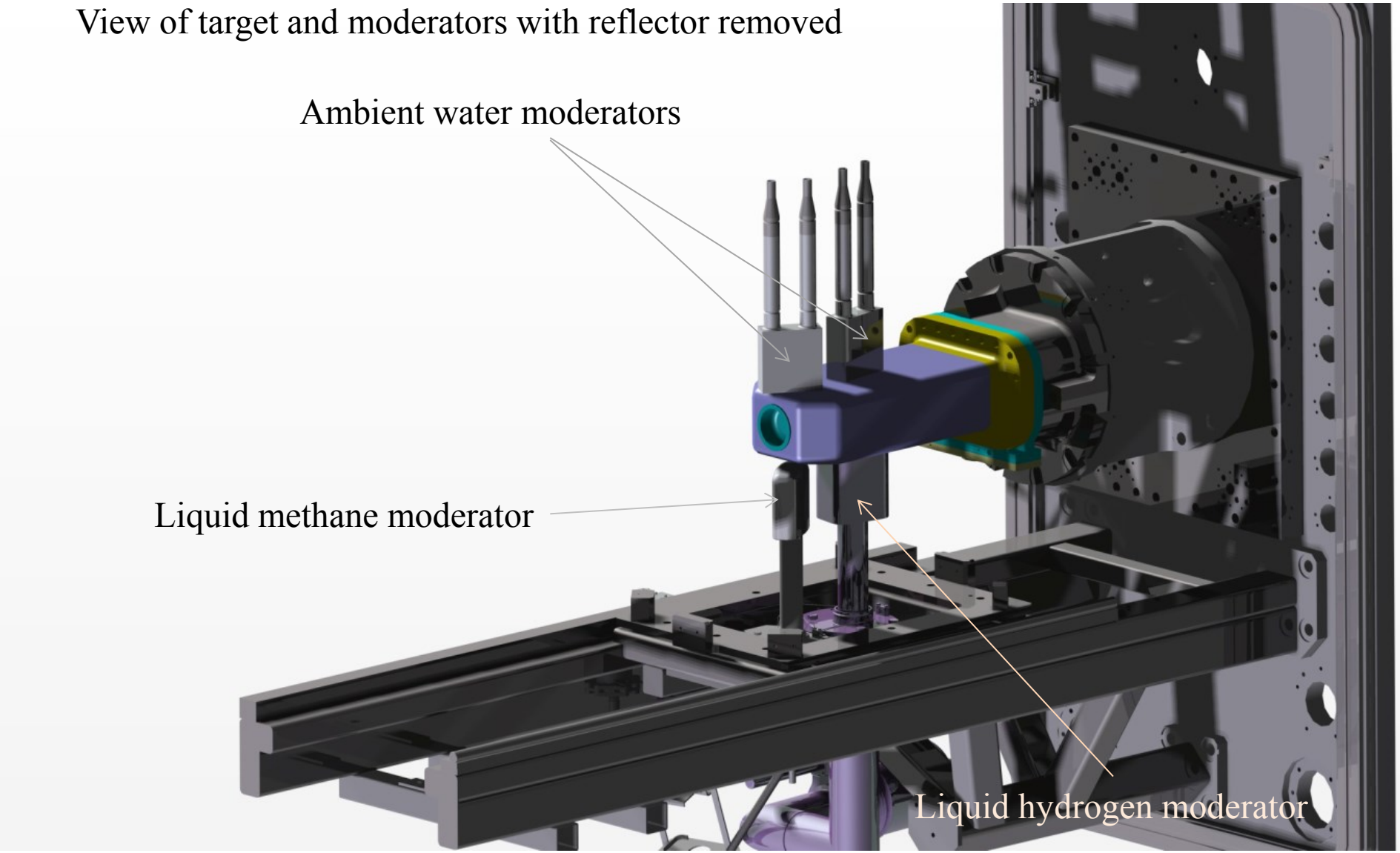
View of the ISIS TS1
Target
Reflector
And
Moderators.



Schematic view of the ISIS TS1 TargetReflectorAndModerators.

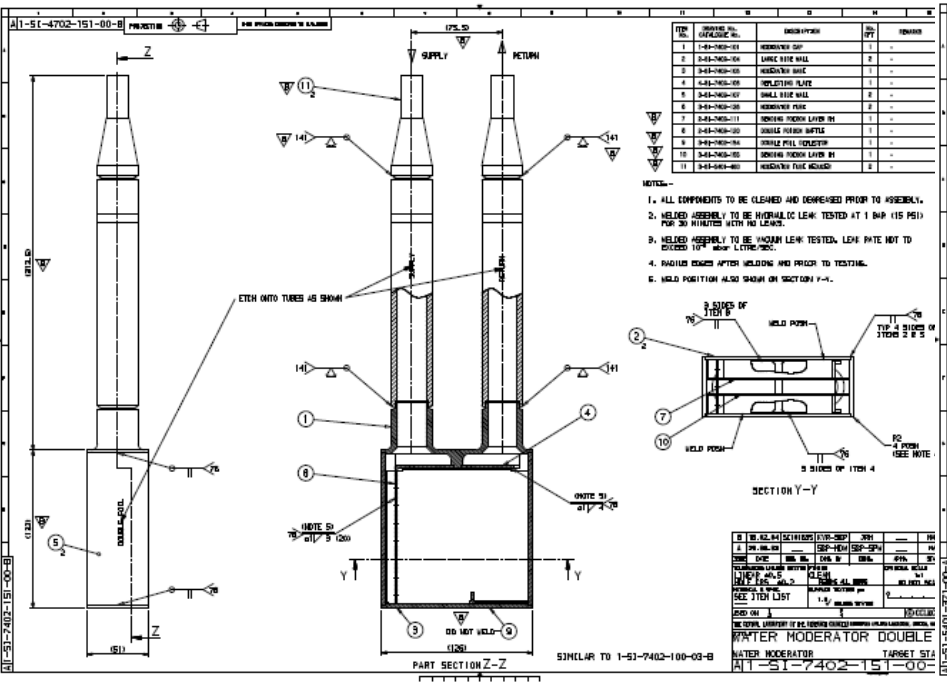


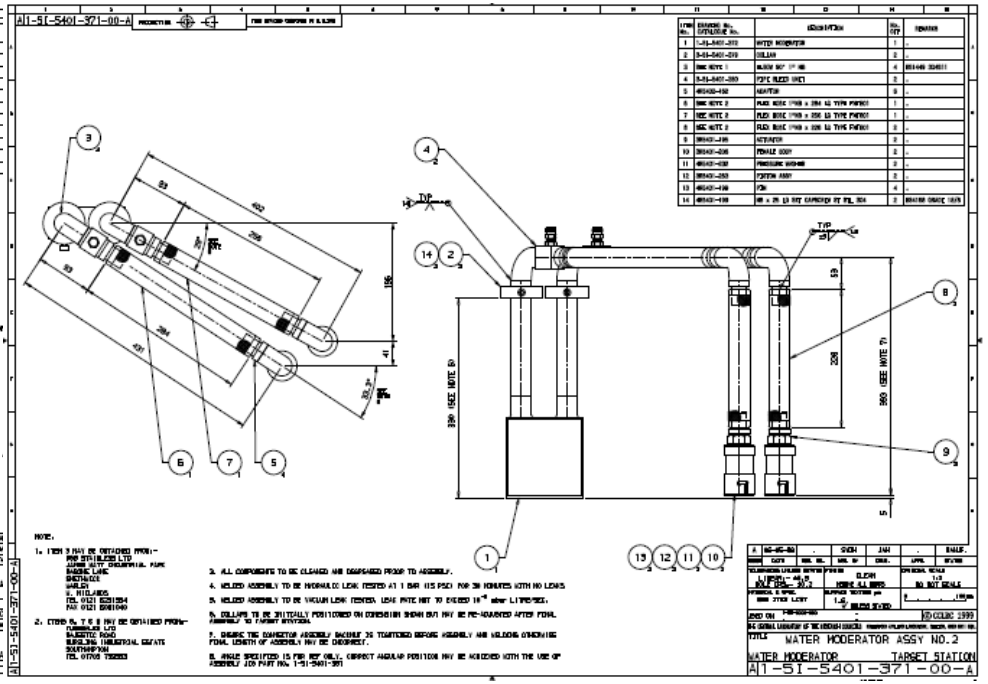
View of target and moderators with reflector removed



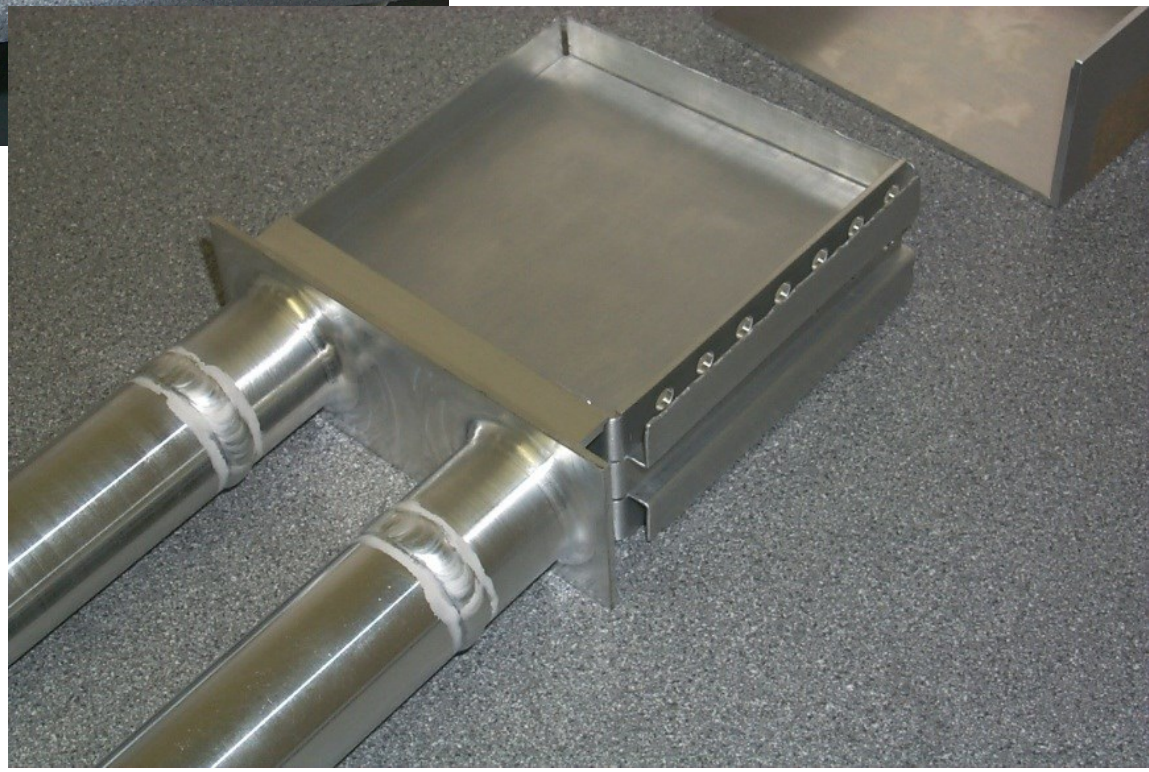
Ambient water moderators

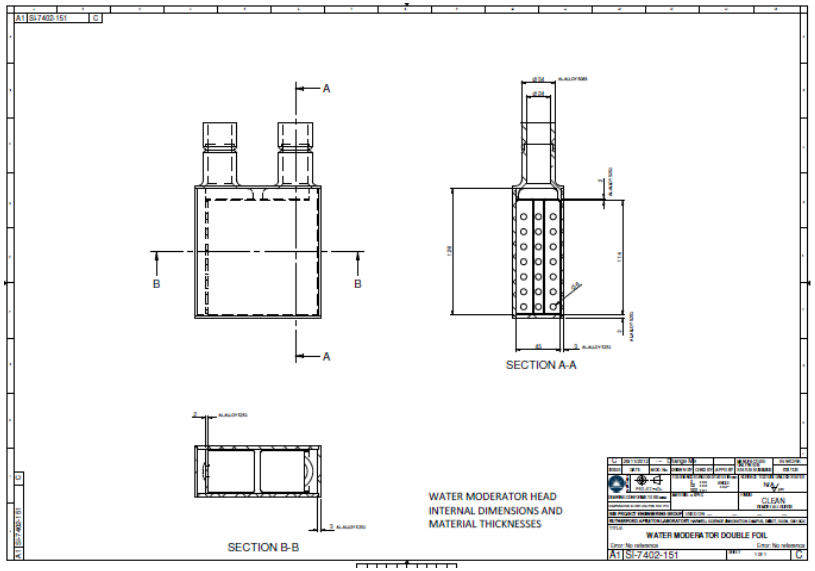
- Typical heat load with 180μA beam 380W
- Typical demin water flow rate of 25 litres/min (6 litres/min at moderator?)

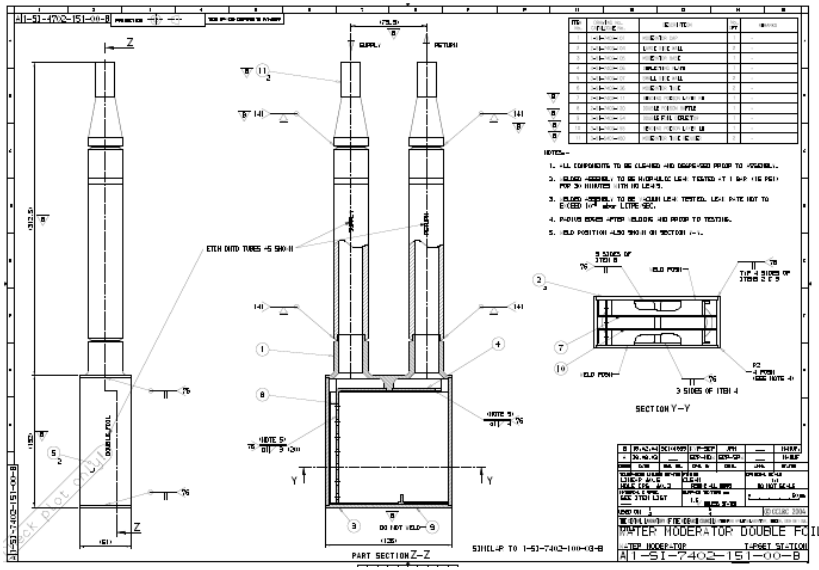




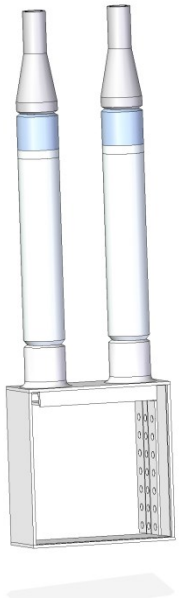
Moderator bodies fabricated from 5000 series Al alloy.
Usual stst to al alloy friction welded joints.

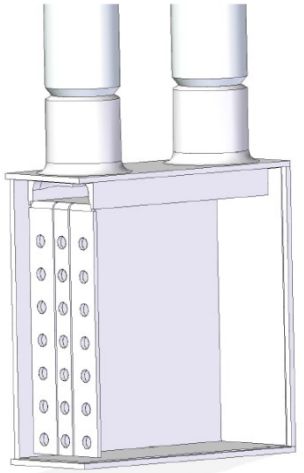






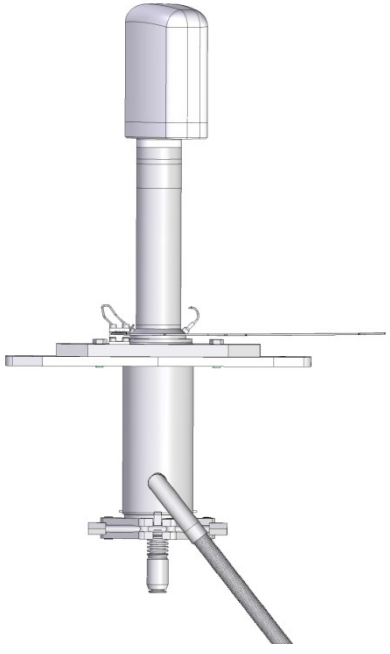
Moderator depth defined
by Al clad Gd poisoning layer.
One moderator has a single Gd layer
And other has a double Gd foil layer.

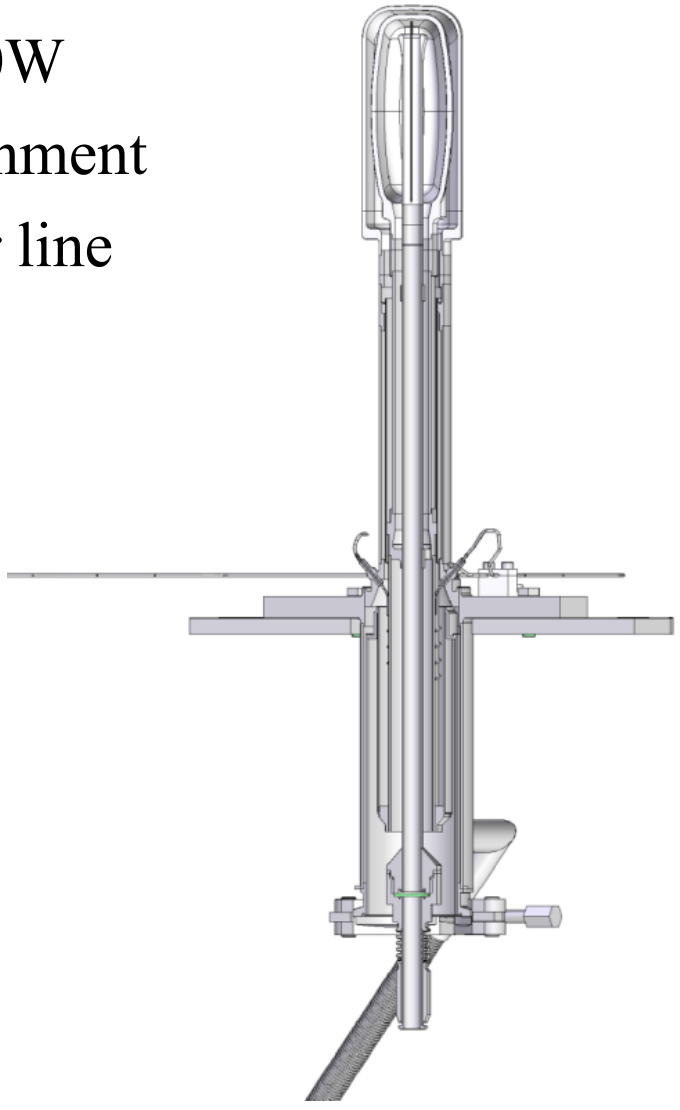




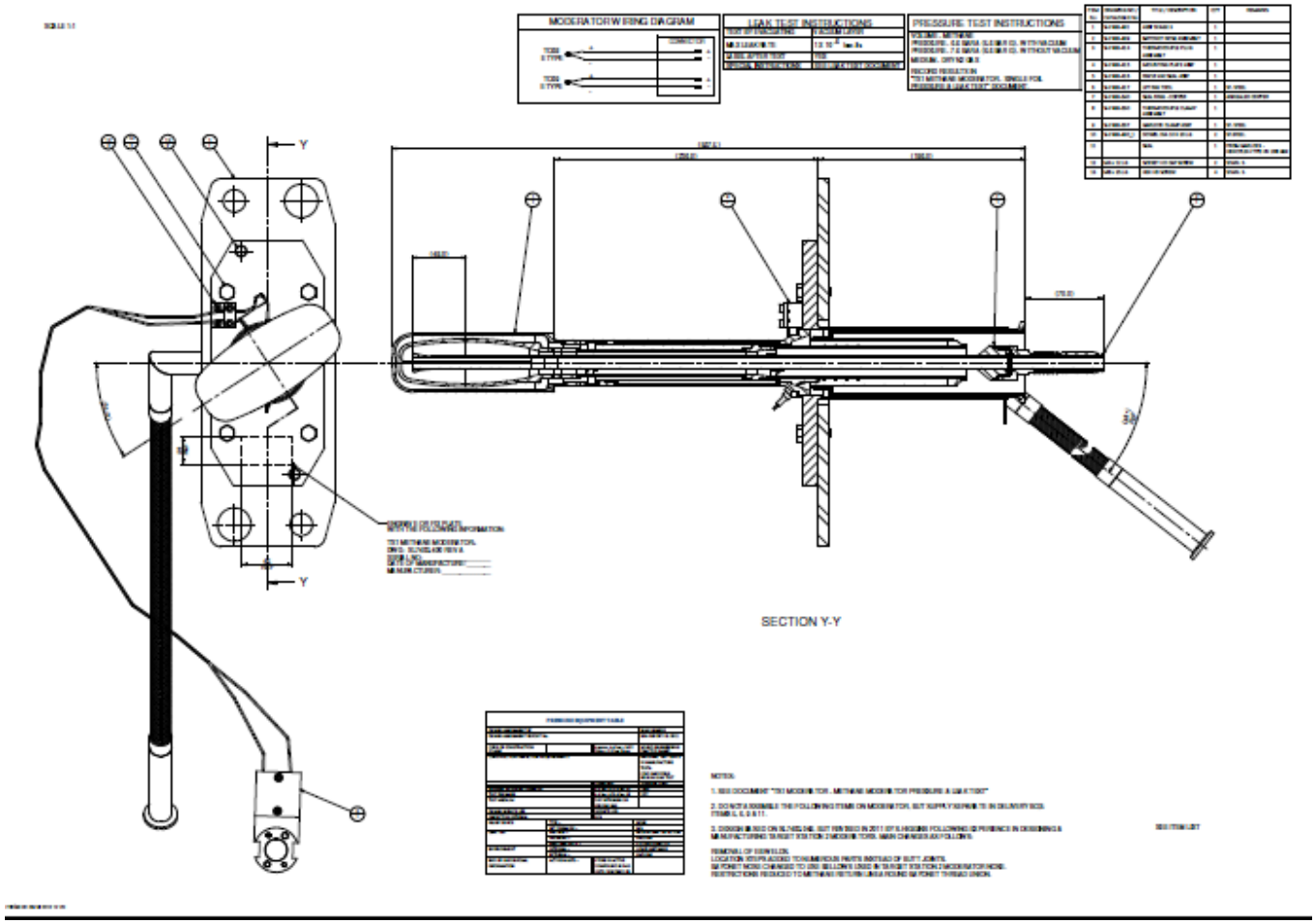
Liquid methane moderator

- Typical heat load with 180μA beam ~200W
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- No tertiary containment layer
- Cold head volume ~0.5litre





Moderator head fabricated from 5083 Al alloy.
Design to spirit of PD5500, allowable stress in Al alloy 83N/mm^2
Ststto al alloy friction welded joints where head is joined to body and bayonet.

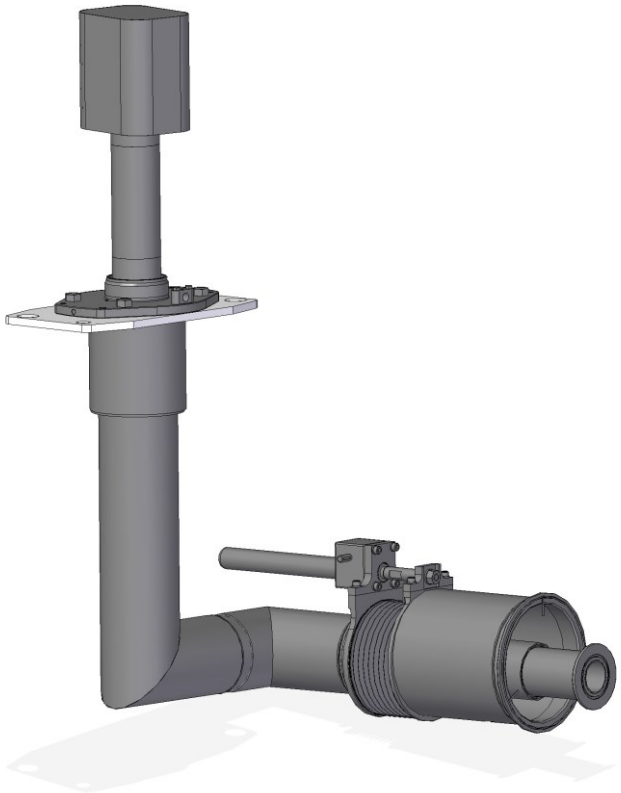


- Change liquid methane charge once every 24 hours as liquid forms a mousse like emulsion.

- Change moderator head every 3 to 4 cycles due to blocking by formation of carbon products.

Liquid hydrogen Moderator

- Typical heat load with 180μA beam ~200W
- Cold head volume ~1 litre
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- Outer tertiary containment layer
  filled with helium.



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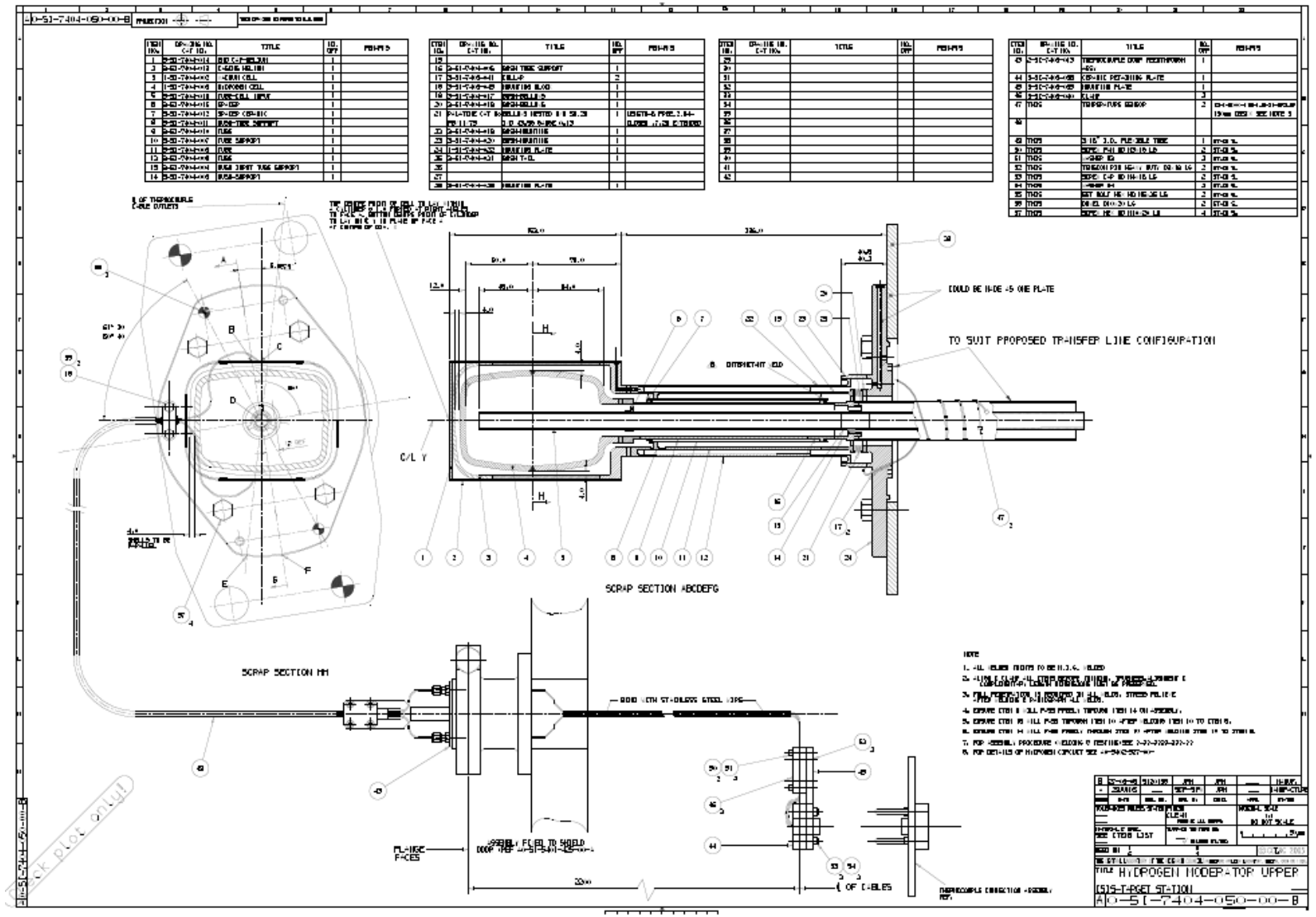
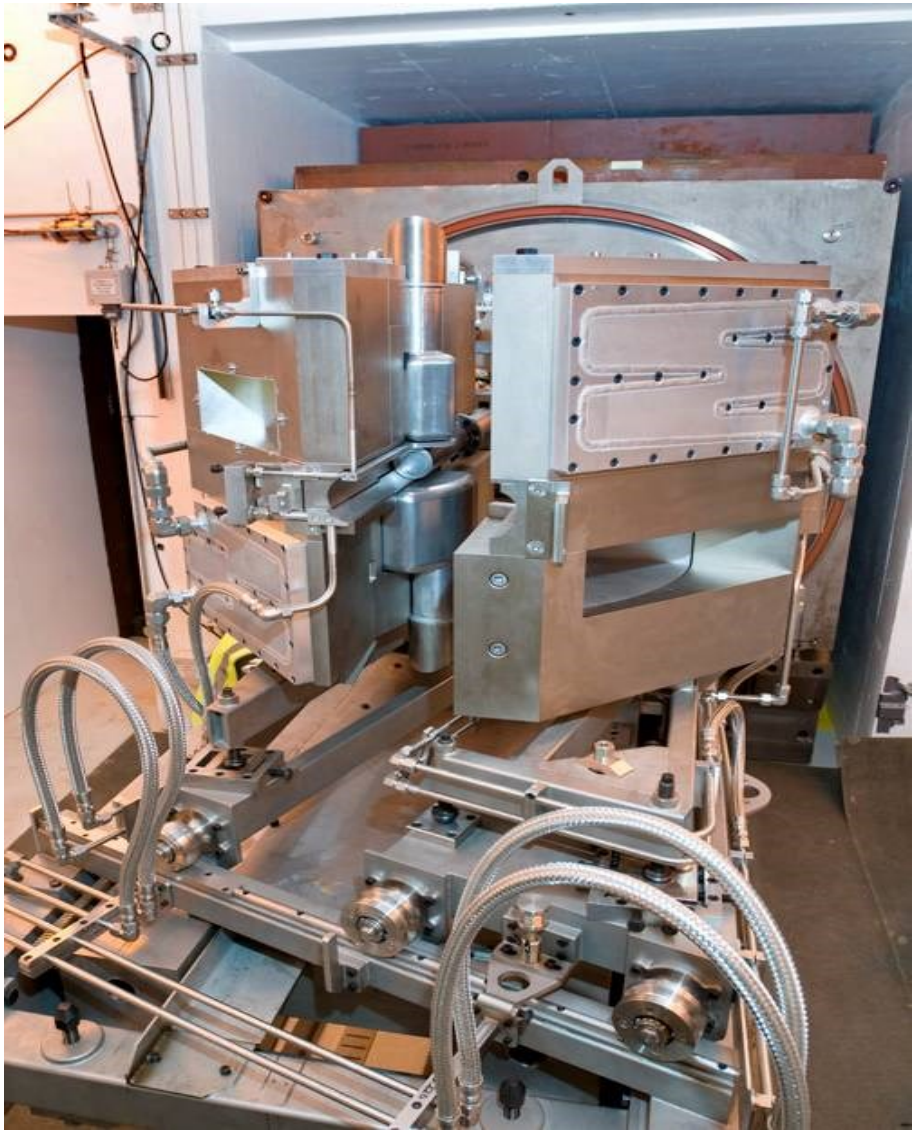


ISIS Second Target Station

- In operation for ~5 years

View of the ISIS TS2
Target
Reflector
And
Moderators
with the edge cooled
beryllium reflector
partially open to reveal
the target and
cryogenic moderators.

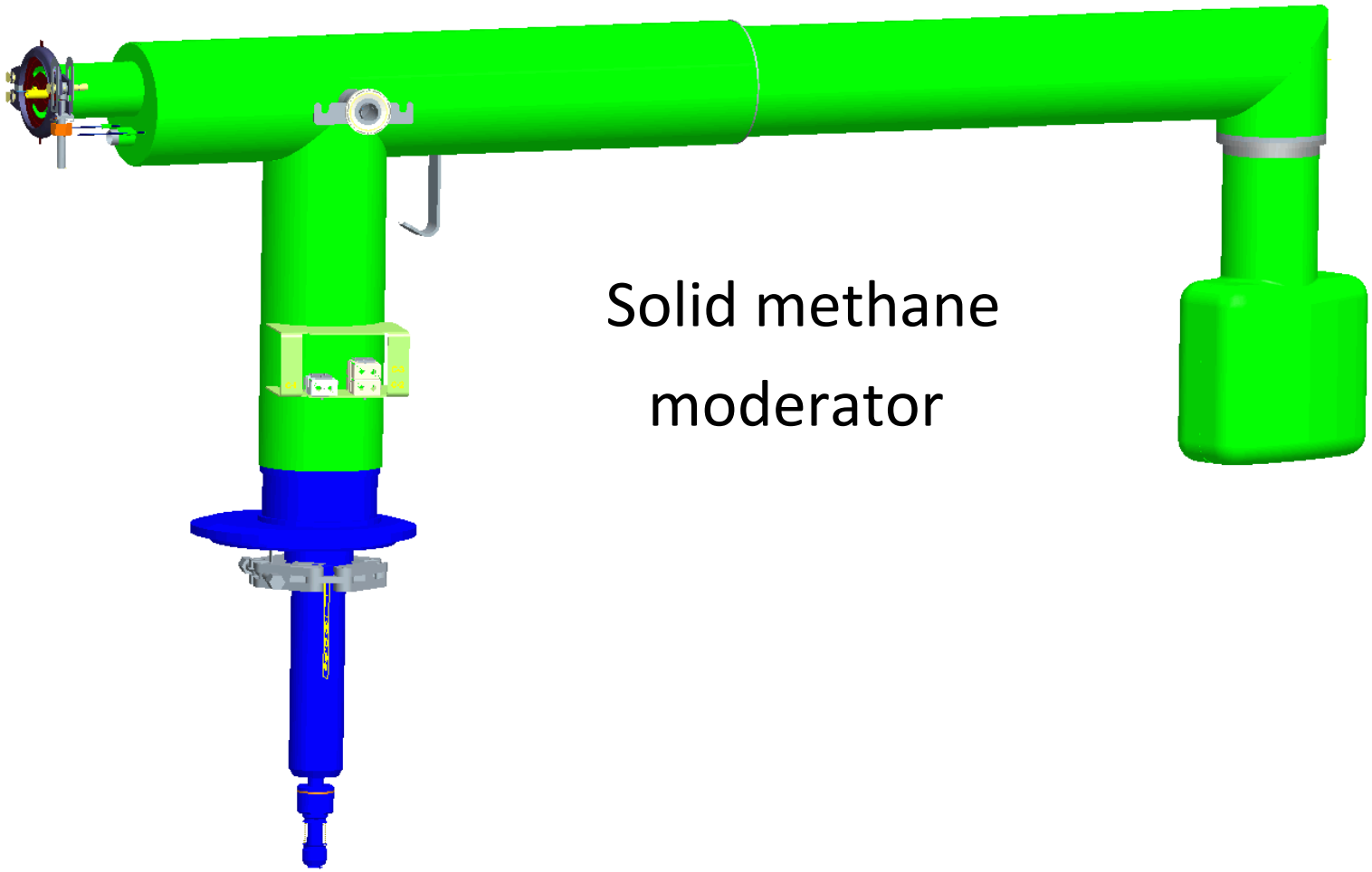


The ISIS TS2 TRAM with the reflector open in maintenance mode and the target and cryogenic moderators revealed.

Decoupled Solid Methane Moderator

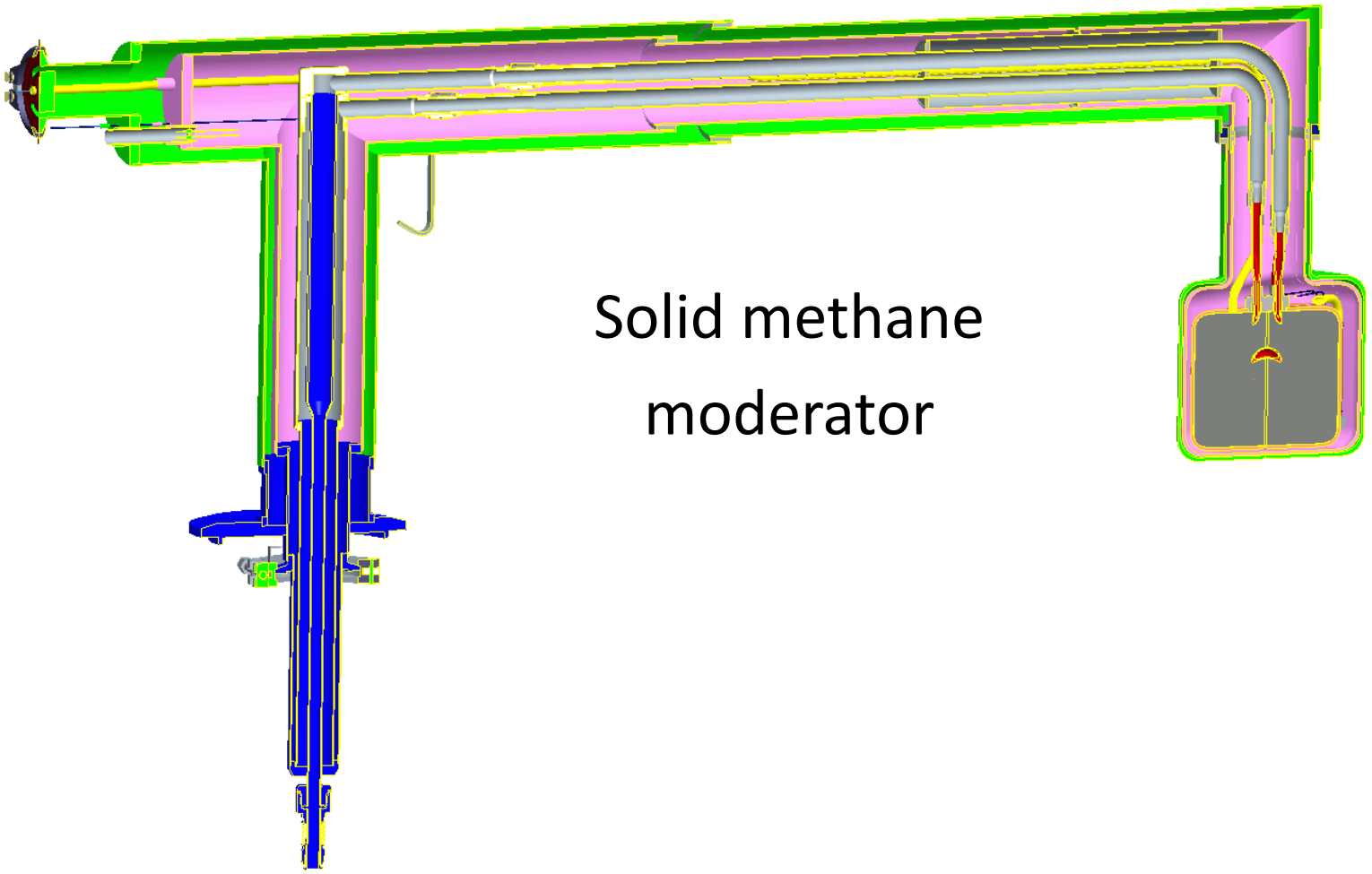
- Typical heat load with 40μA beam ~120W (currently no poisoning)
- Designed to spirit of PD5500, allowable stress in Al alloy 83N/mm^2
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- Outer tertiary containment layer too

Decoupled Moderator



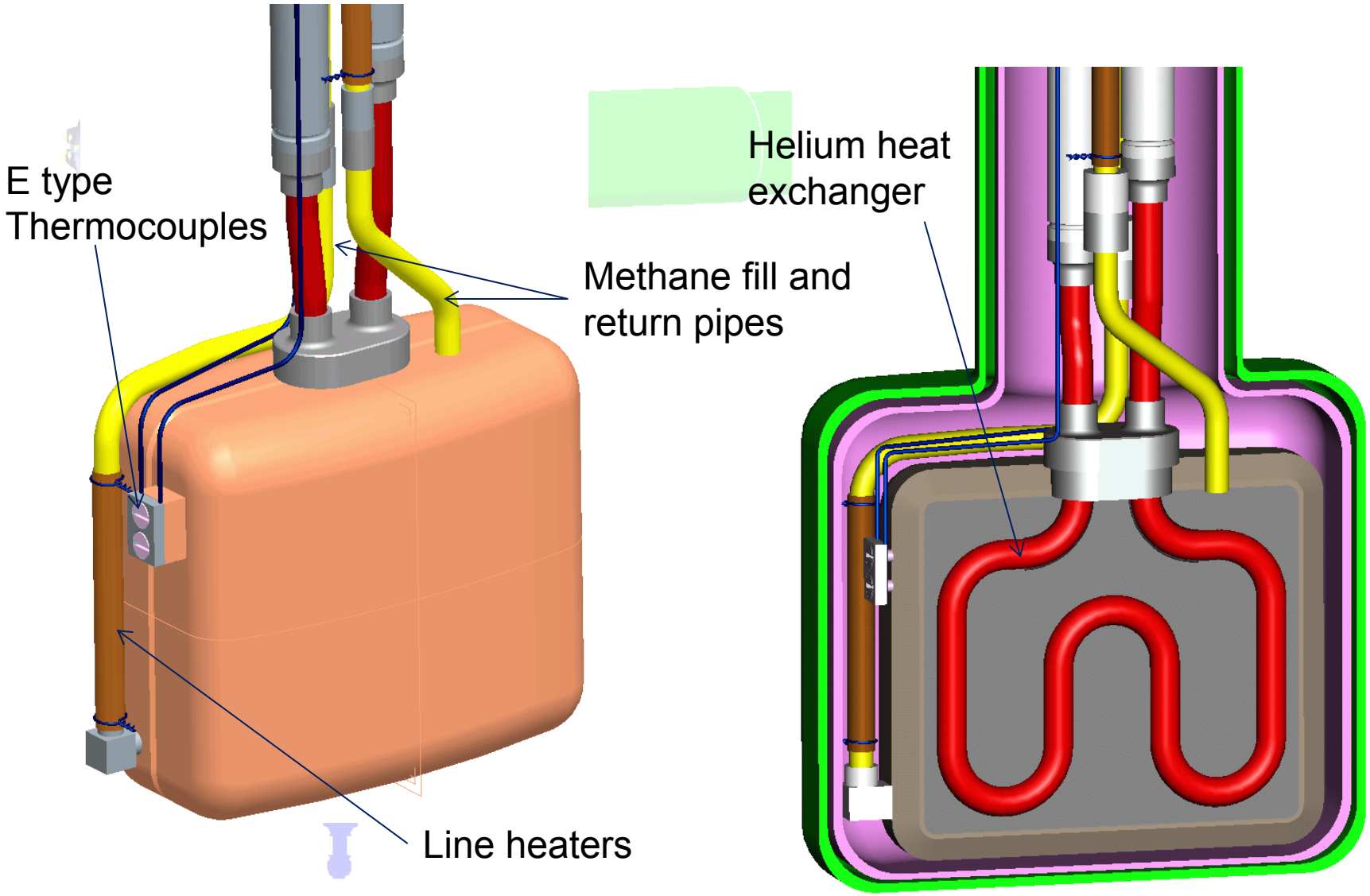
Solid methane moderator

Decoupled Moderator



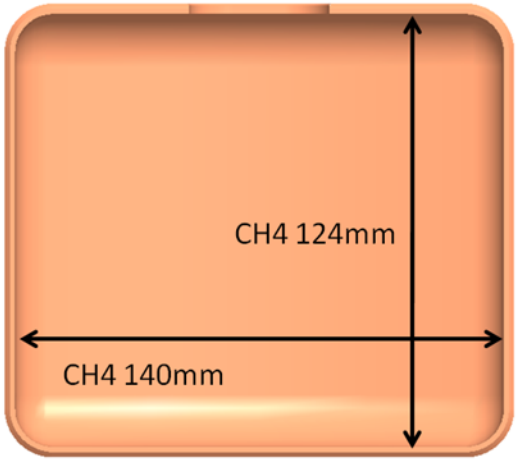
Solid methane moderator

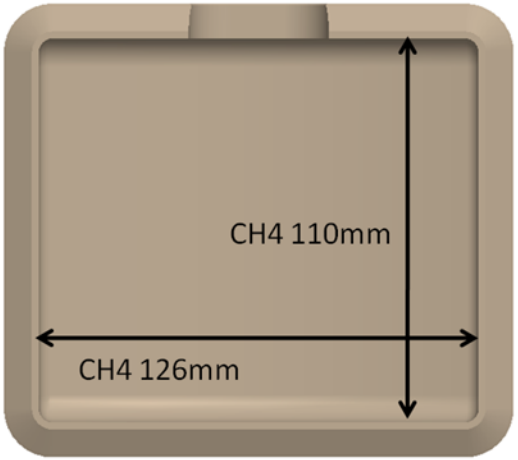
Decoupled Moderator

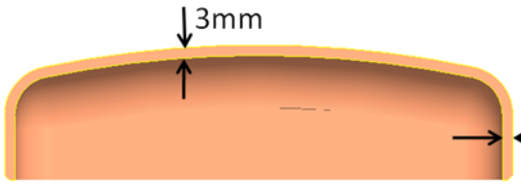


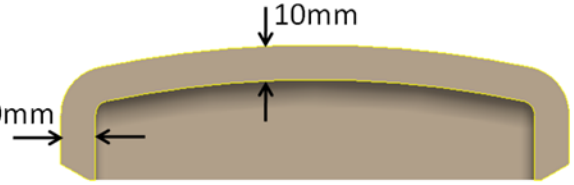
High purity al foam to boost thermal Conductivity.

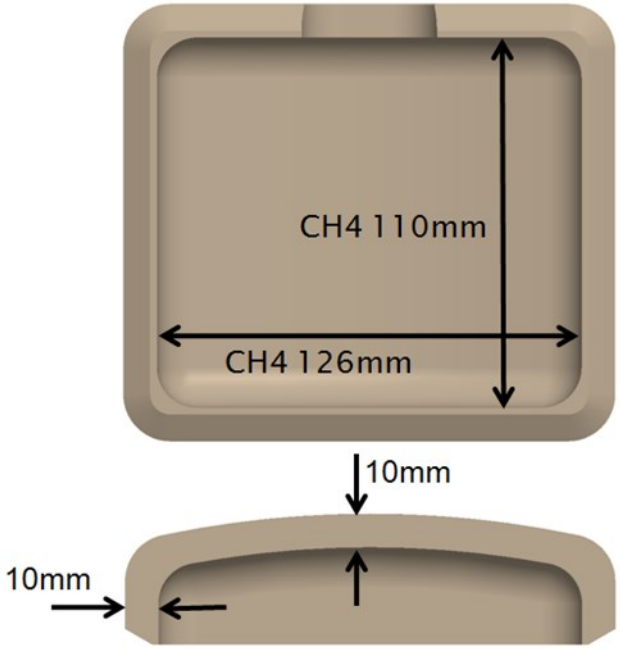
Original moderator volume of ~1 litre











Current methane volume of ~½ litre

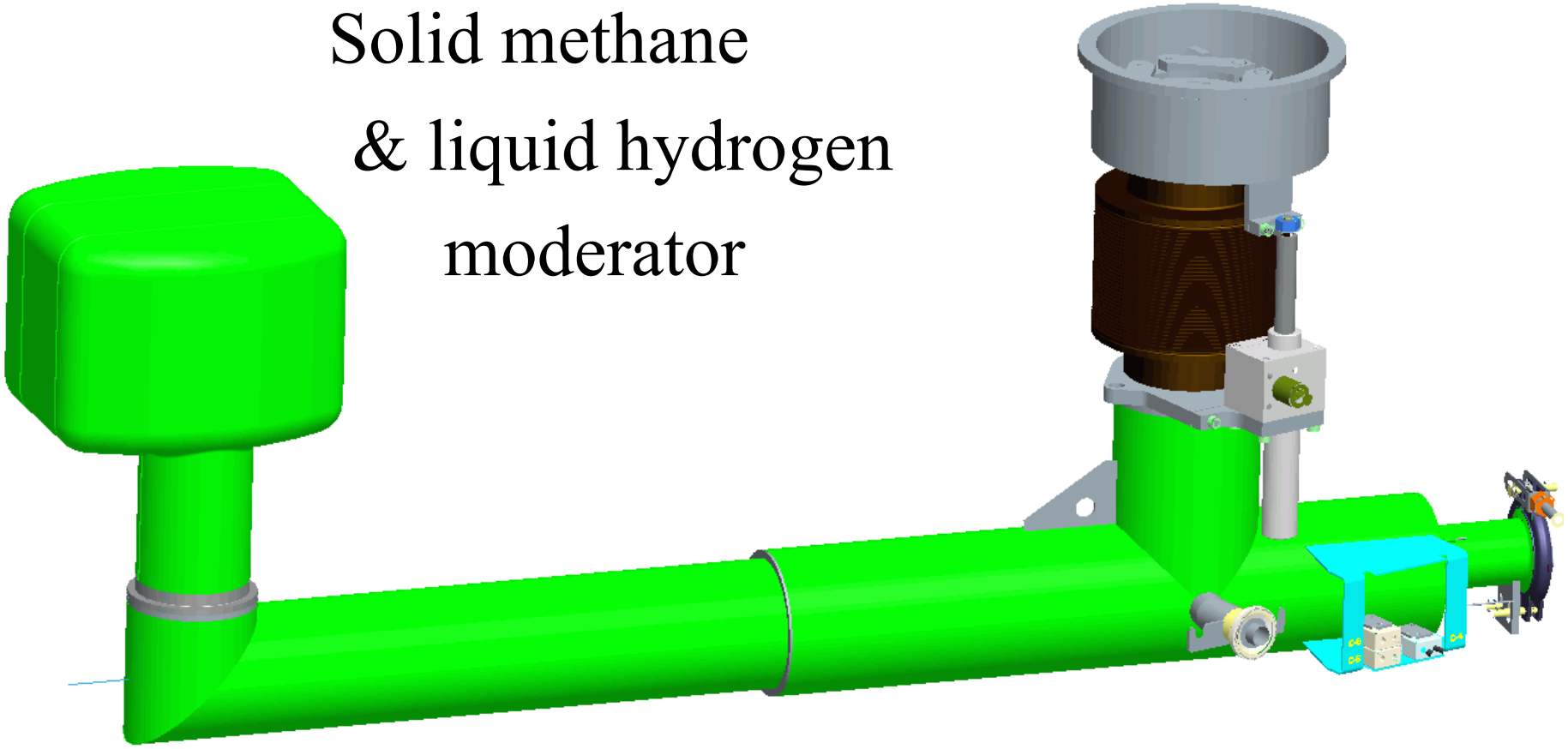
Strain gauges to monitor strain on charge change, typically equiv to 35bar after 17 hours of beam.

Coupled Grooved Moderator

- Typical heat load with 40μA beam ~100W (currently only hydrogen)
- Designed to spirit of PD5500, allowable stress in Al alloy 83N/mm^2
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- Outer tertiary containment layer too

Coupled Grooved Moderator

Solid methane
& liquid hydrogen
moderator

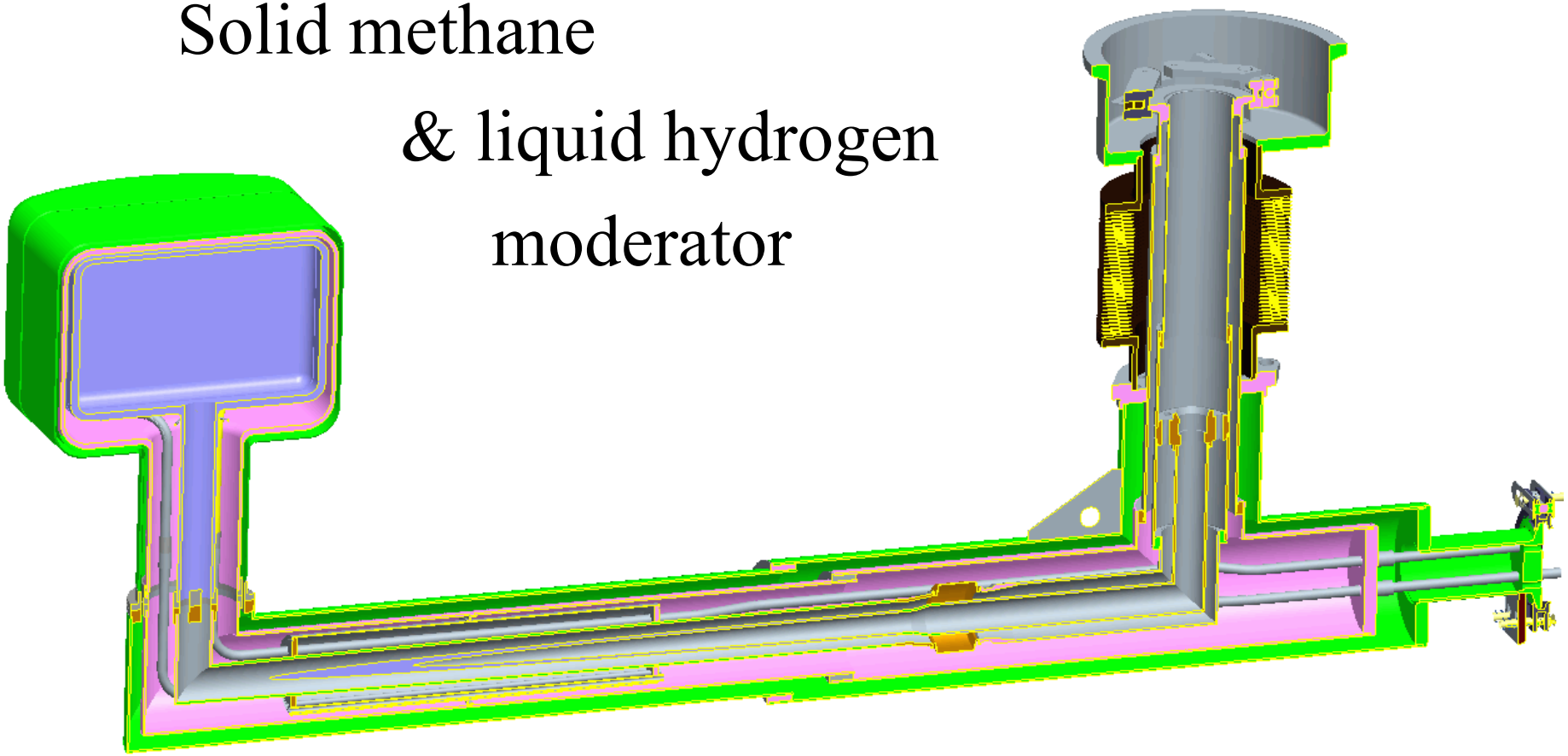


Coupled Grooved Moderator

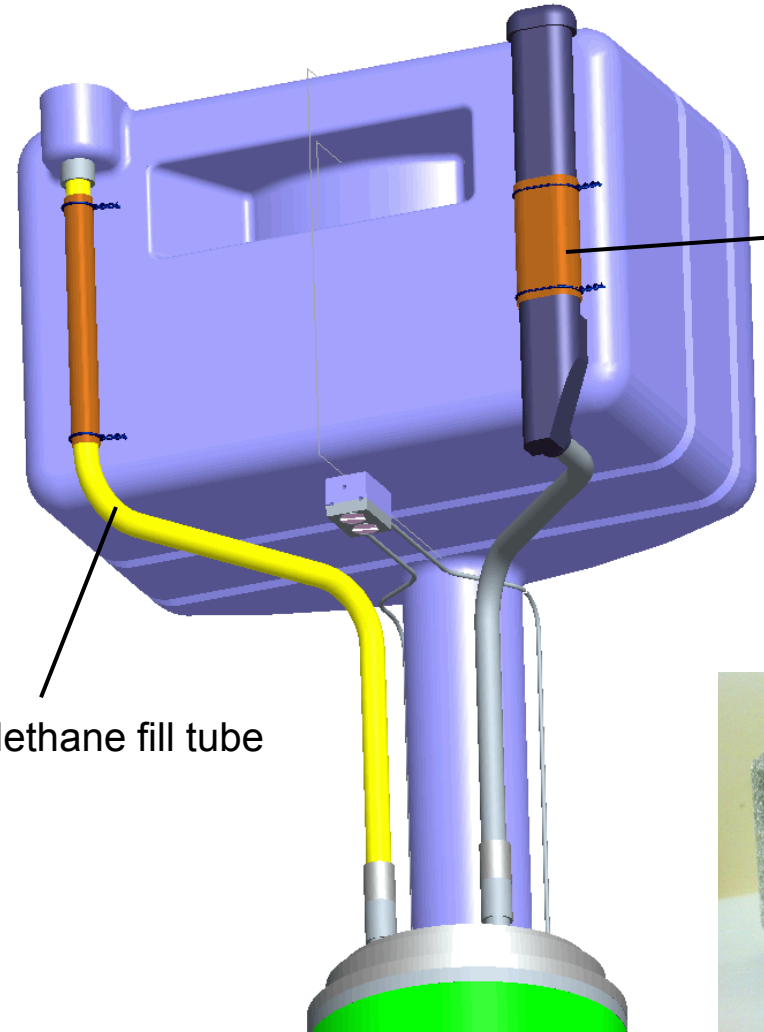
Solid methane

& liquid hydrogen

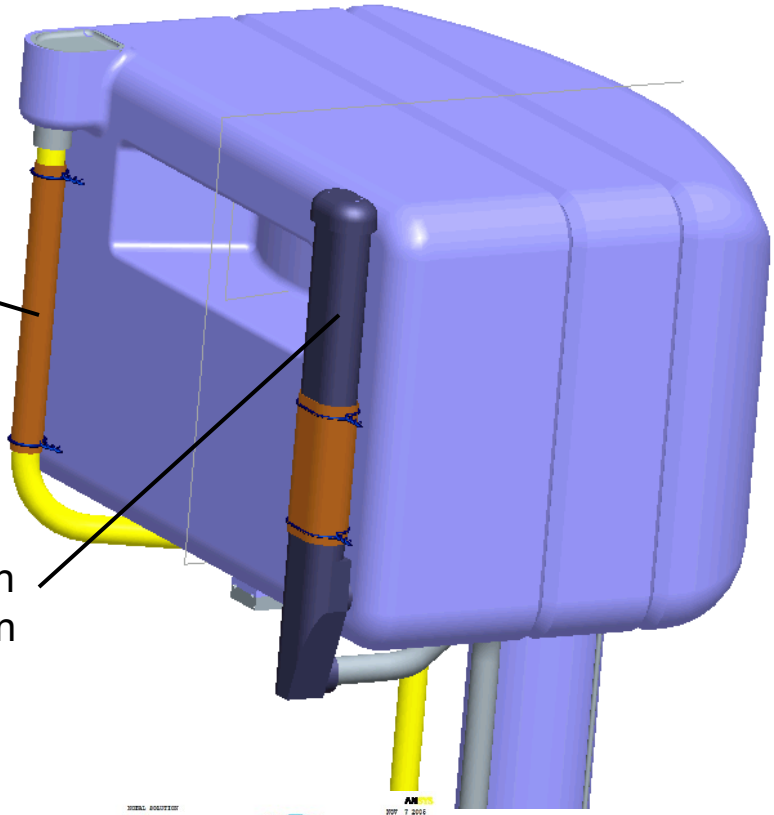
moderator



Coupled Grooved Moderator

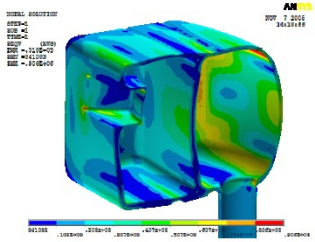


Flexible 'Kapton' heaters

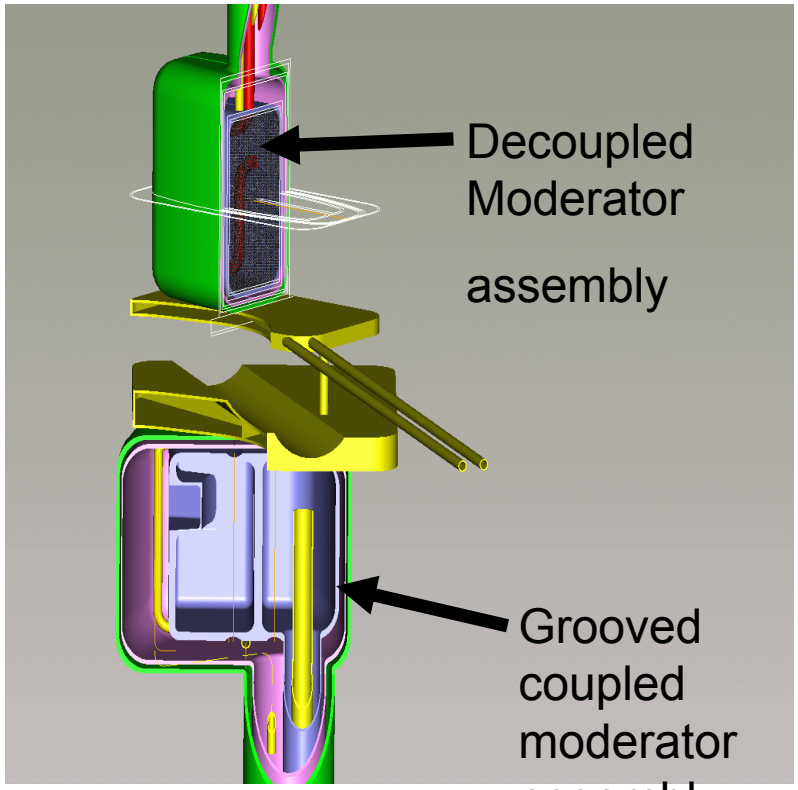


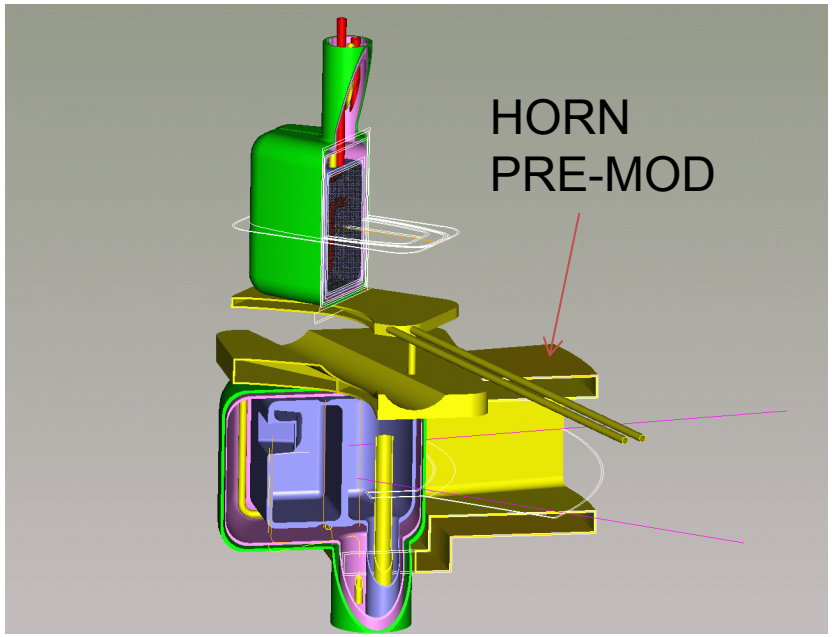
Methane return tube with 'swan neck'

Methane fill tube



TS2 Water Pre-moderators





Decoupled pre-mod heat load ~100W
Coupled pre-mod heat load ~300W

TS2 HORN
PRE-MODERATOR