Preparation for MQXF Short Model Tests

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Existing Vertical Magnet Test Facility (VMTF) at Fermilab will be used for testing 2-m long MQXFS coils and short models

- 4-m long and 0.63-m diameter magnets can be tested at 1.8 K - 4.5 K
- 30 kA power supply available
- External extraction system provides 2 - 120 mOhm dump resistance

Many LARP magnets of TQ, LQ and HQ series were successfully tested previously at VMTF

Test of large aperture MQXF magnets requires modification of some test facility elements at Fermilab

Functional test requirements were developed both for MQXFS and MQXFL magnets

- *See draft, v.6 at https://plone.uslarp.org/Workshops/qxftesting/Update/*

VMTF upgrades already started, work in parallel with ongoing magnet tests: HQ03 test will start soon

For testing MQXFS magnets we need to:

- Design and build new 30 kA Top Plate with 150-mm aperture
- Design and manufacture the Lambda plate with 150-mm aperture
- Design and build “warm finger” assembly for magnetic measurements
- Integrate CLIQ leads

VMTF upgrade will be performed in two steps: the 30 kA top plate and the Lambda plate will be ready for testing MQXFS coil in a mirror structure, while the “warm finger” and CLIQ leads will be available later for testing the very first MQXFS quadrupole

“Warm bore” diameters under discussion, currently searching for the seamless SS tubes of appropriate dimensions

New 30 kA Top Plate status:

- SS top plate available
- Utilize existing power leads, instrumentation tree and connectors
- Work in progress

The Lambda plate made of 5-cm thick G-10 is expected this month

- CLIQ leads feedthrough will be integrated in the Lambda plate now

We will need VMTF for 1-week to prepare and set the epoxy seal for the Lambda plate

New header assembly and the Lambda plate will be ready for MQXFS mirror test in February 2015

BNL LHC Hi-Lumi
QXF Vertical Test Facility Status

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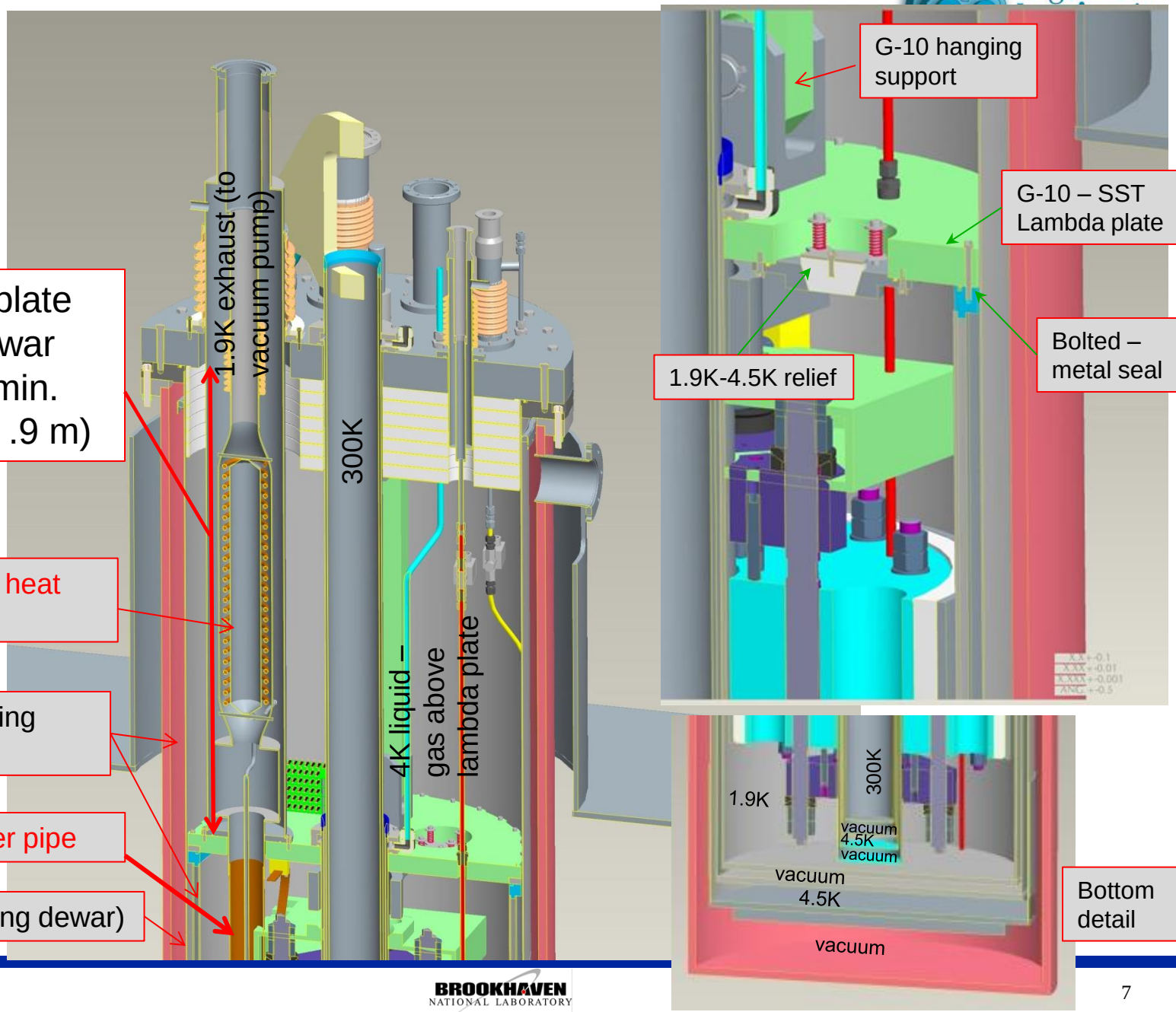
Original Test Facility Upgrade Plan

- Utilize existing “vertical dewar 3” = 6.1 m deep, sits 0.9 m above floor, is 710 mm inner diameter – *as outer 4K heat shield outer vessel*
- Install new vessels within this vessel for vacuum insulation, 1.9K helium volume, etc.
- Plan assumed 4785 mm overall cold mass length per G.A. parameter list

Reference information:

- Crane capacity: double hooks, 30T and 5T
- Hook heights: 7.7 m, 30T; 8.2 m, 5T

Original Dewar Details



Top of lambda plate to bottom of dewar top hat = 1 m (min. LHe distance ~ .9 m)

4.5K-1.9K pre-cool heat exchanger

Inner / outer Insulating vacuum

1.9K heat exchanger pipe

4K heat shield (existing dewar)

Bottom detail

Recent Proposed Changes

- Eliminate inner 4K heat shield:
  - —Saves radial space, allows for quench antennas at coil I.D., > Ø 100 mm measuring coil
  - —Increases heat load, recovery time between quenches (but within cryogenic capacity)
- Redesign dewar to increase magnet length capacity by 200 mm – 300 mm:
  - —Revise outer 4K heat shield configuration to reclaim space from vessel heads at dewar bottom (details next slide)
  - —Reduce distance between lambda plate and 300K top plate, *but only as necessary*

Test Dewar Plan Details

Plan A

New concept for 1.9K dewar system which reclaims "wasted" space at bottom

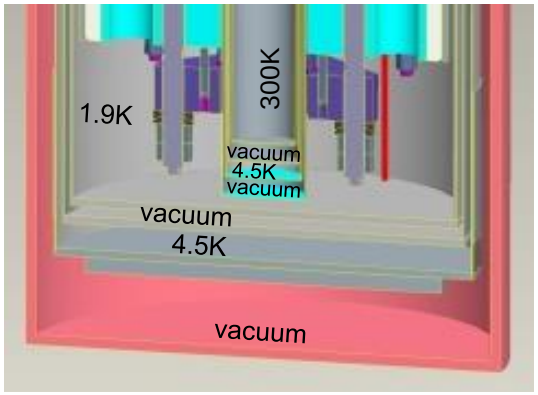
- Relocates Hi–Lumi testing to the other 6.1 m dewar (#2)
- Replaces Ø610 mm vessel with ~ Ø660 mm vessel in existing vacuum vessel
- Benefits:
  - No anticipated cost increase
  - Adds ~ 100 mm length capacity increase

Plan A+

Extend existing vacuum vessel also

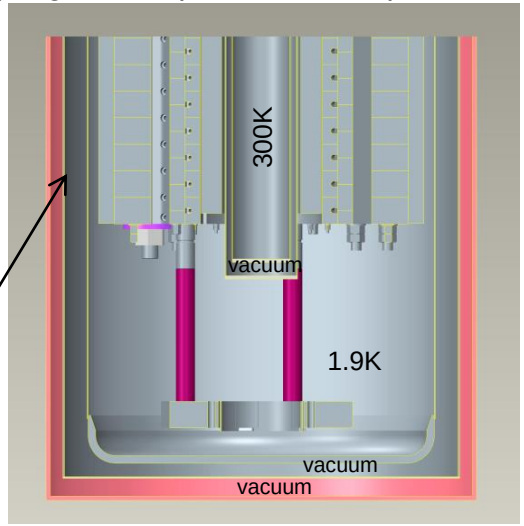
- Benefits:
  - Potential for ~ 1000 mm length capacity increase (crane will limit)
  - Potential for > "4xØ" warm bore beyond magnetic length for integral field measurements
- Penalties:
  - Cost (being investigated)

Original dewar bottom detail



New dewar bottom detail
(magnet end plate extended)

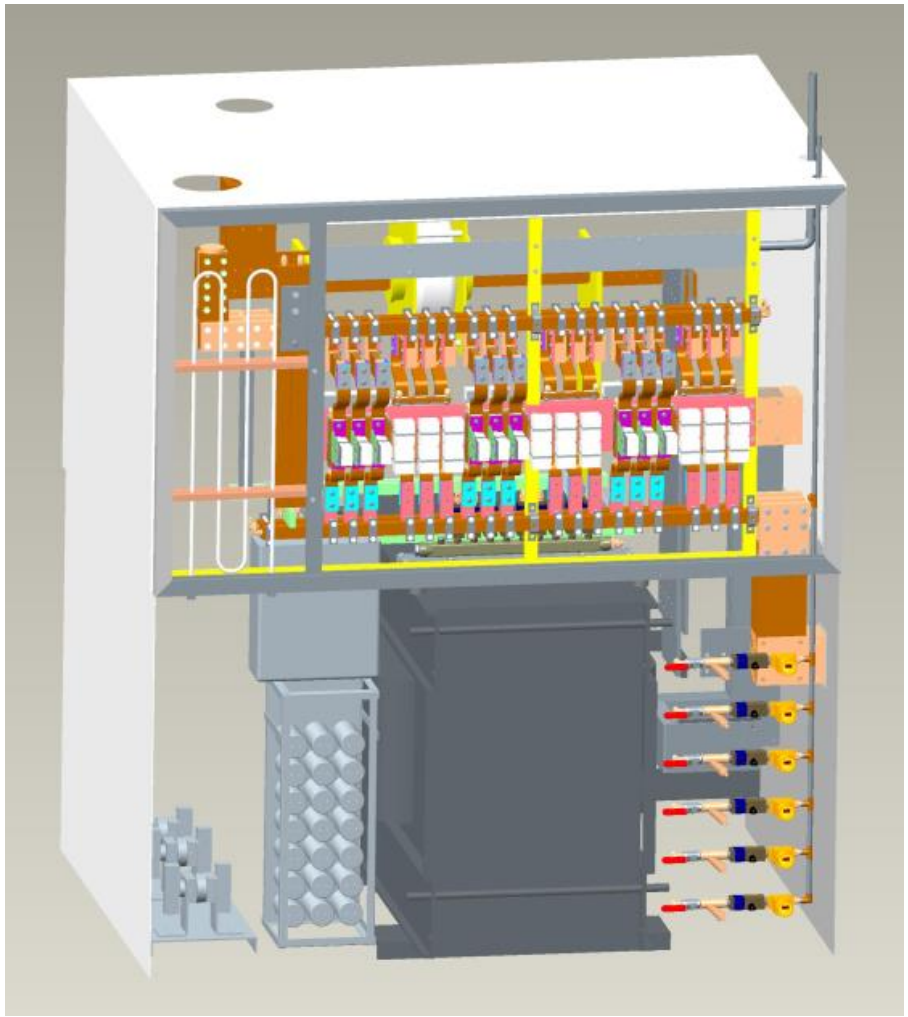
"external" actively cooled 4K heat shield w/ conductively cooled bottom plate



Data Acquisition and Power Supply Upgrade

Use existing 30KA Power Supply, infrastructure:

- Upgrade IGBT based energy extraction switch to 22KA capacity
- Upgrade and configure new dump resistor for energy extraction
- Design and install new 128 channel data logging and digital quench protection system.
- Design and install Spike Detector and Quench Antenna data logging system.
- Extend 30KA water cooled power cables.



Remaining Open Issues to be Resolved

I. Warm Bore diameters (from FNAL)
II. Final magnet length and design, including Splice Box (from LBNL)
III. Measuring coil
    1. Full length integral coil or short coil with precise axial positioning?
IV. Quench Antenna
    1. Number of channels?
V. CLIQ System
    1. Lead configuration
        a. At 300K
        b. At lambda plate
        c. Exiting coils

Test Facility Status / Summary

- Dewar
  - Original Design & drawings complete
  - Redesign for longer magnet:
    - Engineering, models complete
    - Drawings awaiting resolution of open issues
  - Schedule to complete:
    - Decisions on open issues expected by 30 Jan 2015
    - Drawings to be completed/checked/released by 1 Mar 2015
    - Contracts placed / parts ordered by 1 Apr 2015
    - All components received by 1 Oct 2015
    - Assembly / installation complete by 1 Jan 2016
    - Commissioning complete by 1 Feb 2016

Current first long mirror test is 2 Mar 2016* - only 1 month schedule float (with aggressive schedule)

* G. Ambrosio schedule, QXFL_v6 Date: Tue 7/22/14

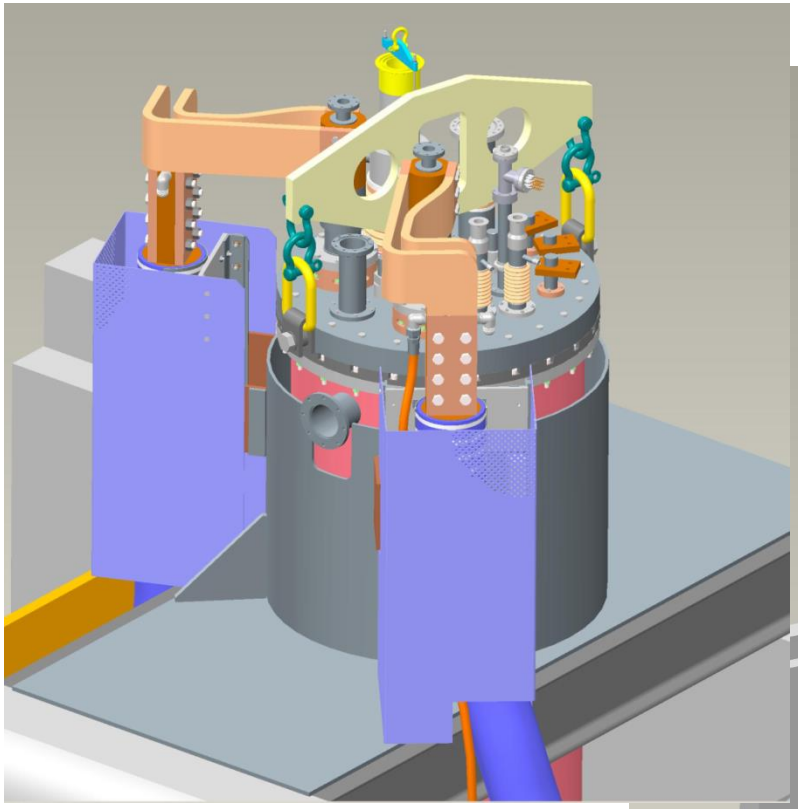
- Data Acquisition & Power Supply
  - Data logging system ordered
  - Most components (IGBT's, shunts) ordered
  - Remaining – snubber capacitors, copper braid – to be ordered Jan 2015
  - Water cooled leads to be ordered Feb 2015
  - Assembly to be completed by Oct 2015

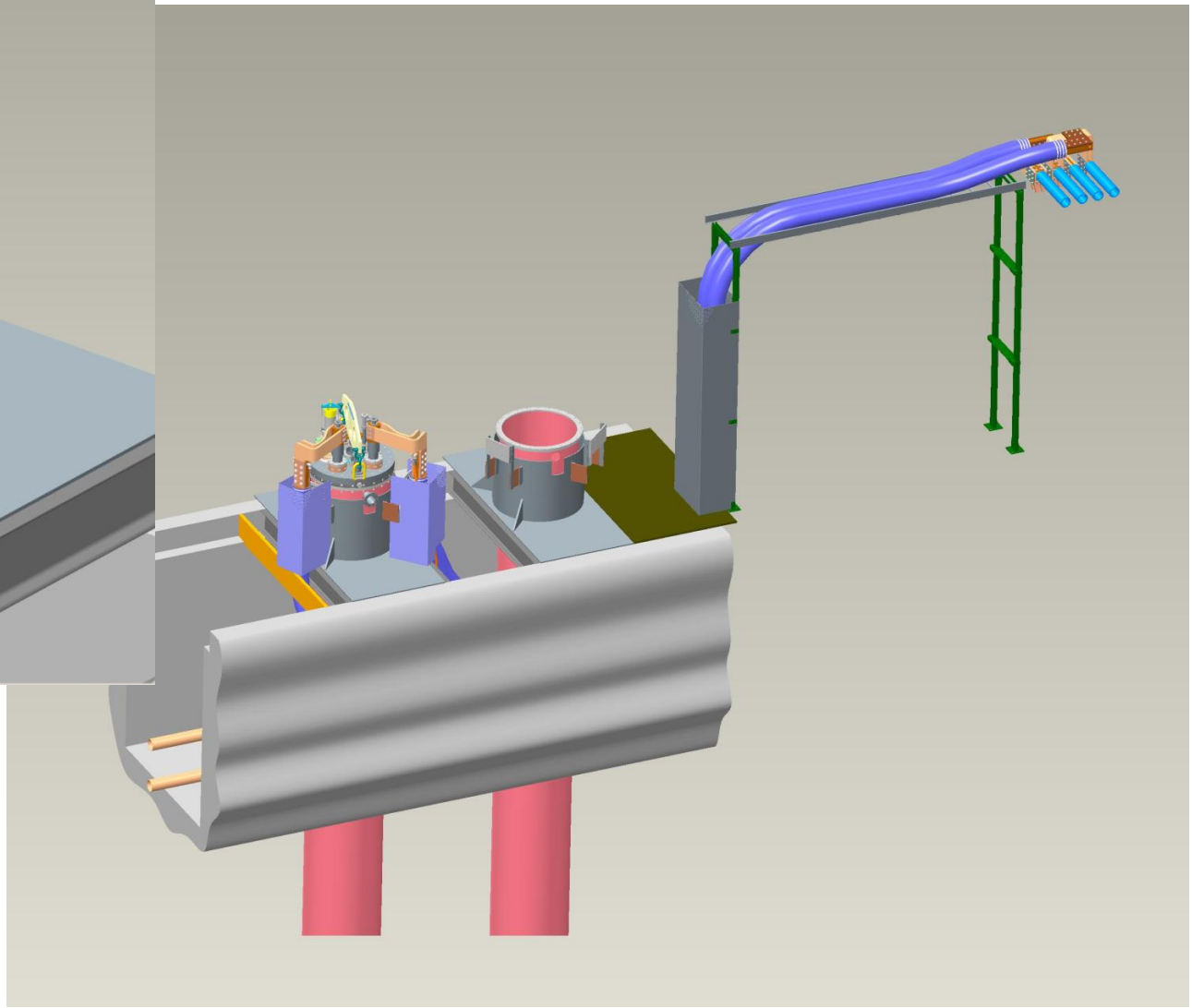
Production Magnet Tests

- US-HiLumi plans to test each magnet (4m) in this vertical test facility before assembly of the Q1/Q3 cold mass
  - ➔ Qualification of each magnet
  - ➔ Opportunity to change a coil if limiting
    - Turn around time is ~3 months

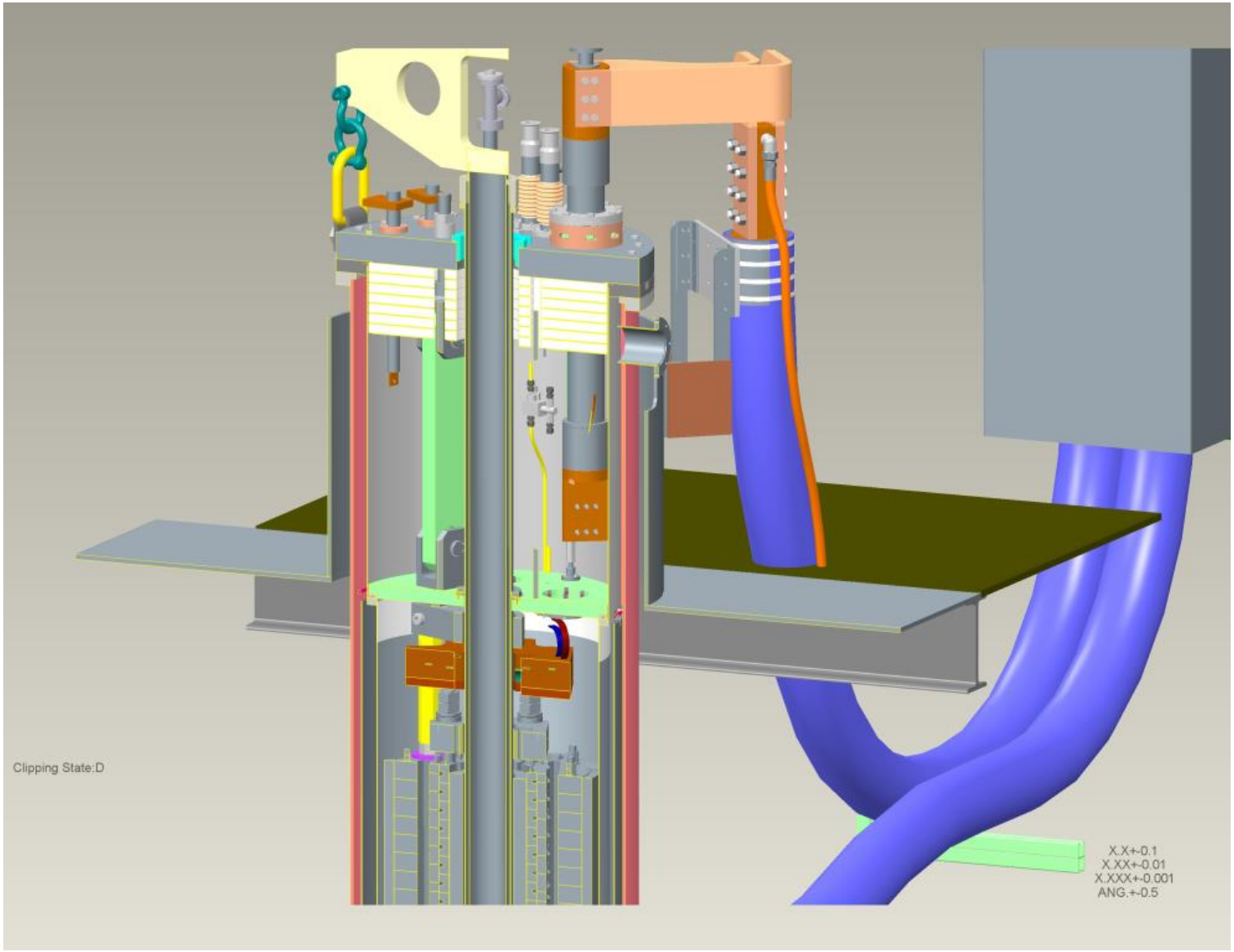
Backup Slides

Dewar Installation





Upper Dewar Details



Power Supply Details