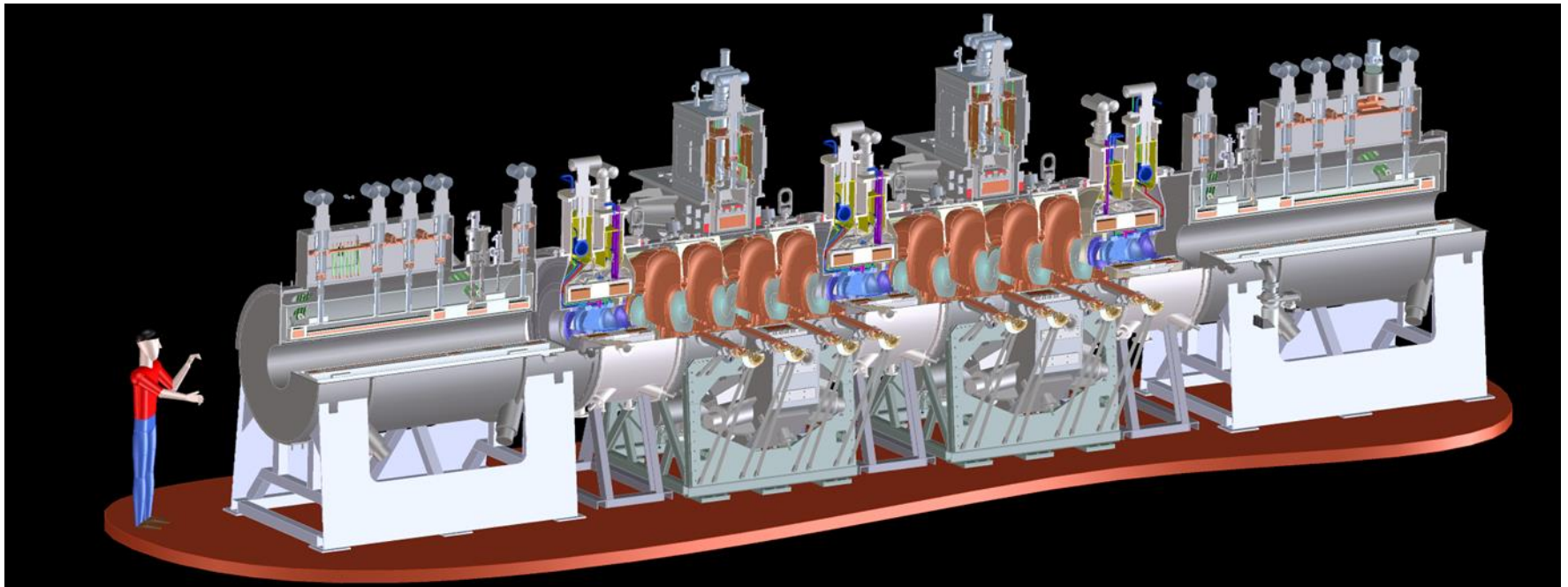




Spectrometer Solenoids & RFCC





Outline



- Spectrometer Solenoids
 - 2 needed for Step IV
- RFCC
 - 2 needed for Step VI
- Magnetic mitigation
 - Overview of procurement



Spectrometer Solenoids



What is wrong with this picture?



Wang NMR



Spectrometer Solenoids



- Both have been completed and shipped to RAL (SS1 en route)
 - Reached full operating current (+2%) in flip and solenoid modes
 - Soak test a full current performed
 - Tested with iron shield in place
 - Minimal re-training
 - Fully mapped with CERN mapper
 - With & with out shield
 - x-check calib. With NMR probe



SS1 leaving Wang NMR



At LHR



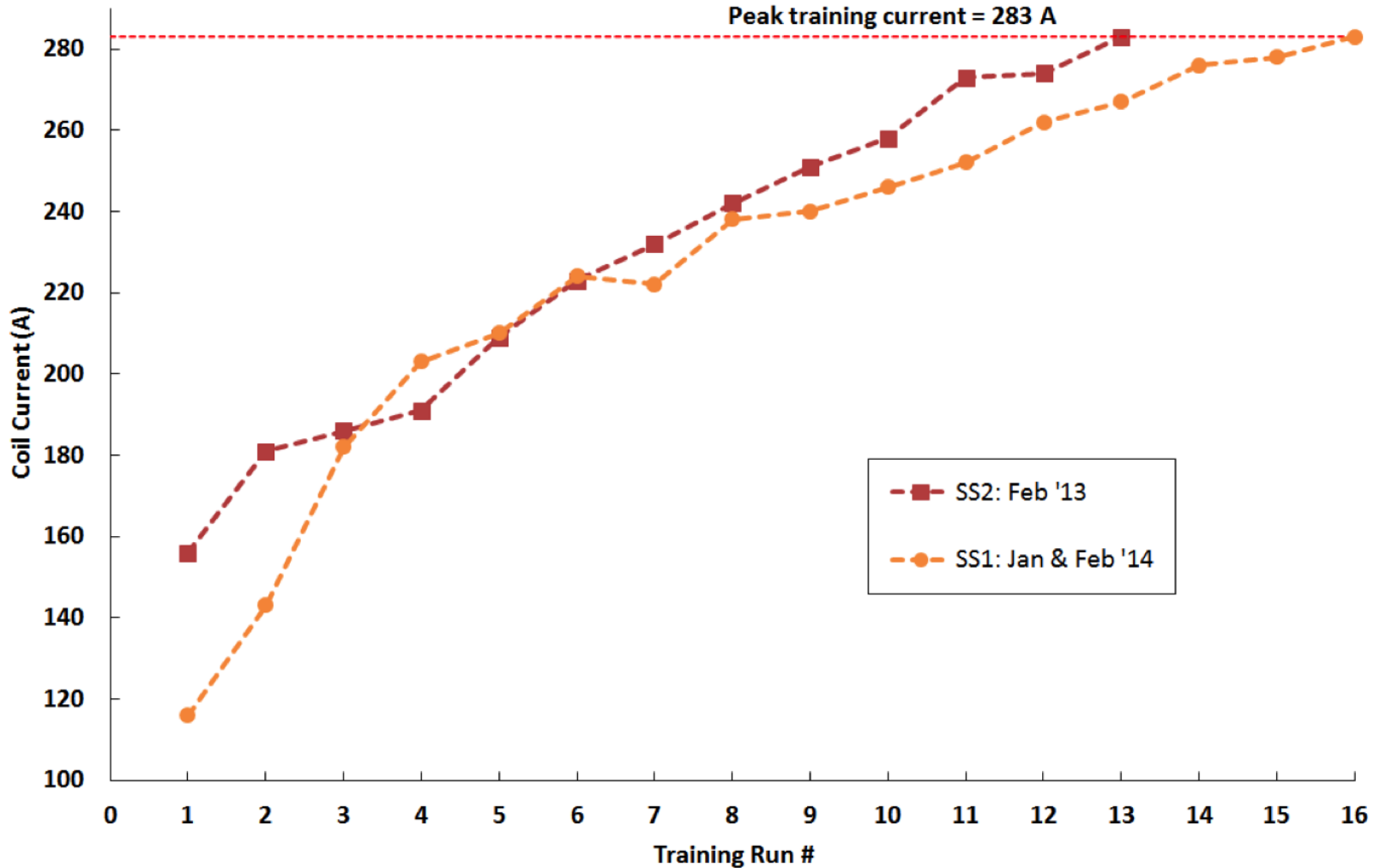


Formal sign-off in UK



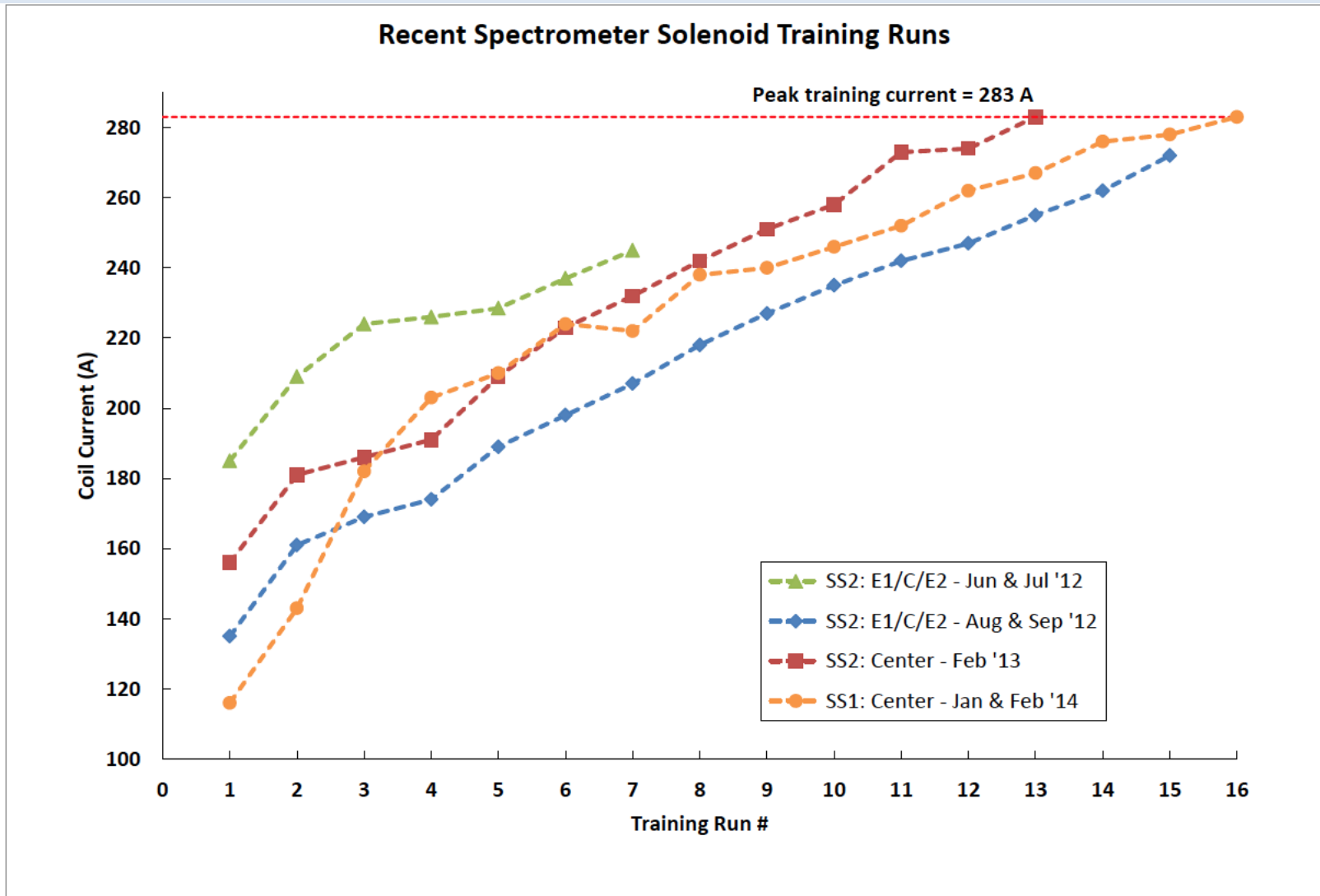


SS1 and SS2 Training





Training history





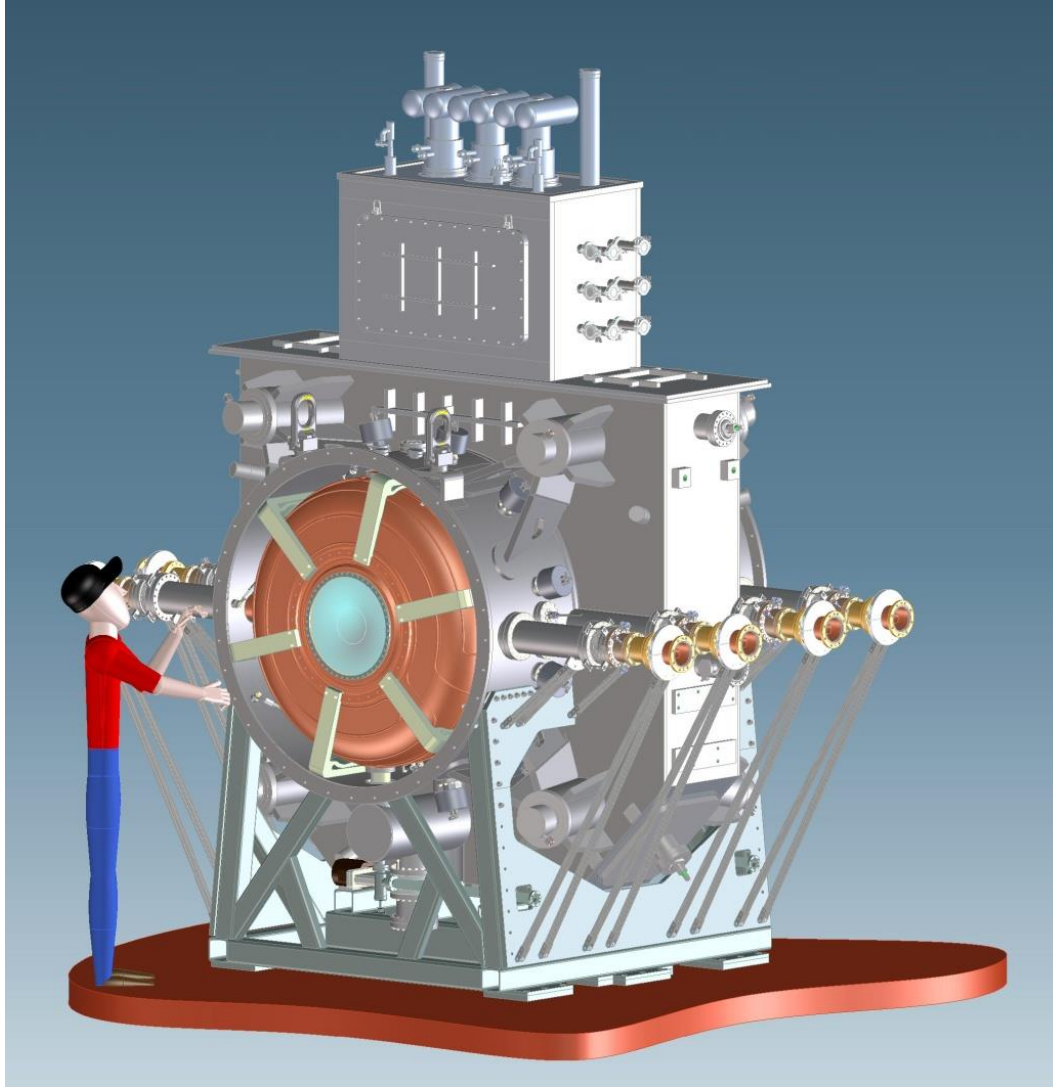
Related SS work



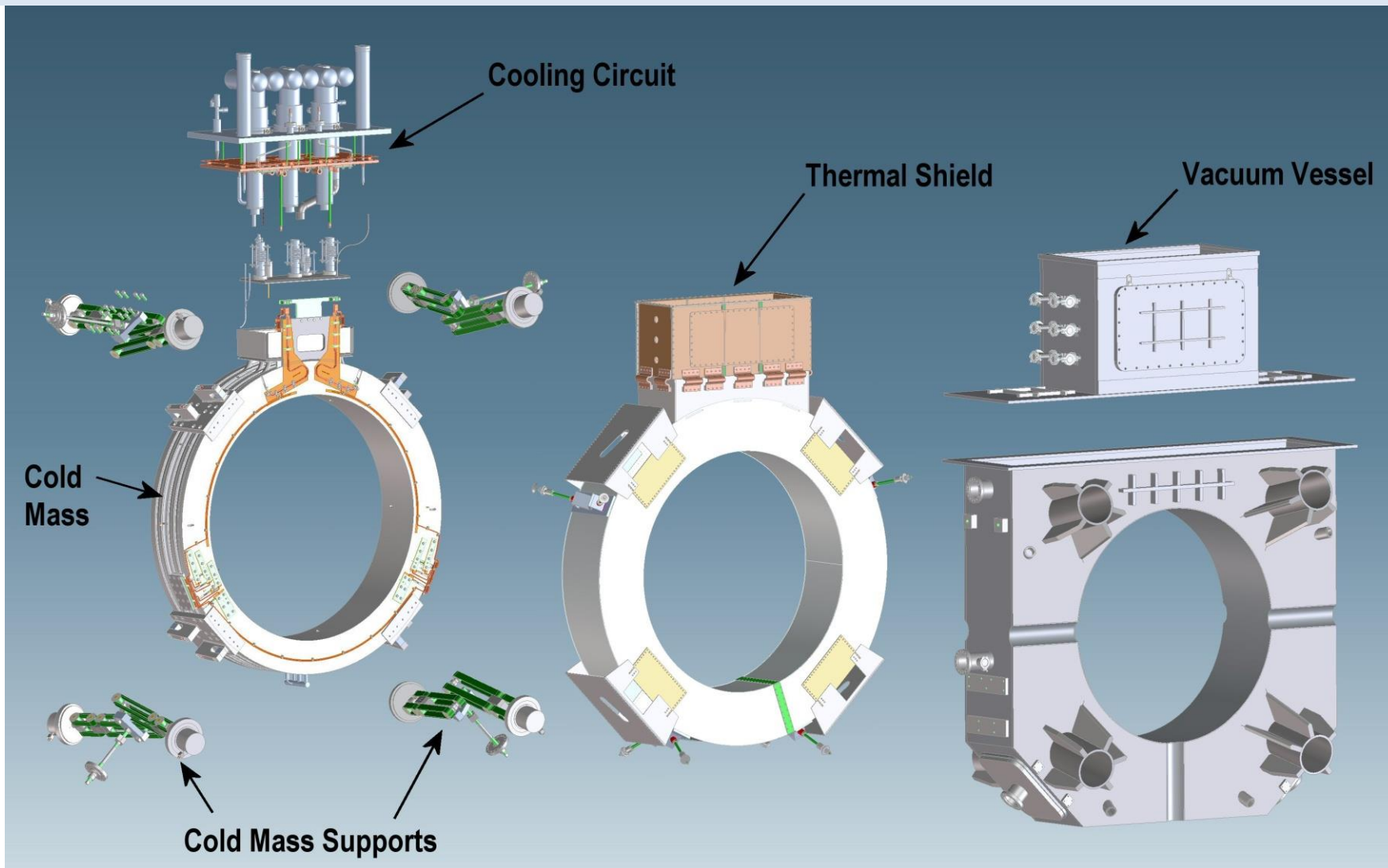
- Several non-training quenches during long-term hold were traced to the PS charging circuit
 - Off line testing without the magnet was used to replicate the problem
 - Further investigation will be carried out soon
- Cryocooler related work to be carried out at LBNL
 - 2 compressors, 1 cooler, 2 hoses are contaminated with air and need to be pumped/purged
 - Various cooler tests will verify performance
- Preparation for 2nd shipment to RAL
 - Cooler systems, racks, vac hdw, LN cooldown system



RFCC



Coupling Coil Magnet (CCM)

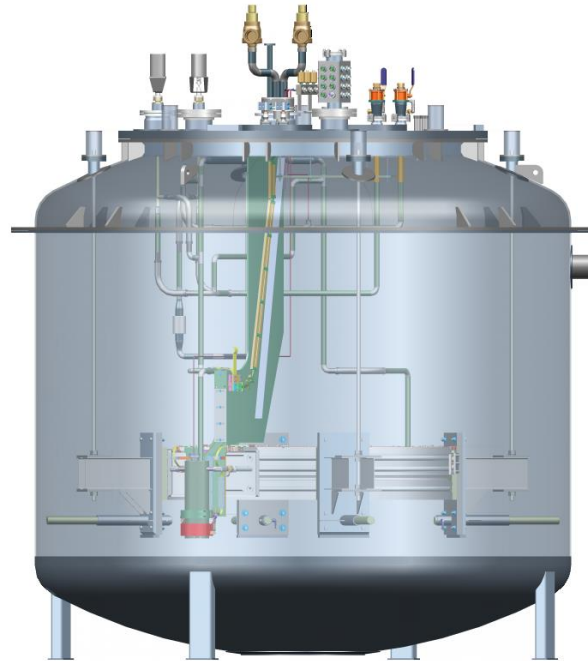




CCM cold mass #1 testing



- The first cold mass is in the Fermilab Solenoid Test Facility
- Baseline:
 - *Total of 3 will be fabricated and tested*
 - *2 CCMs for MICE + 1 for MuCool Test Area (MTA)*

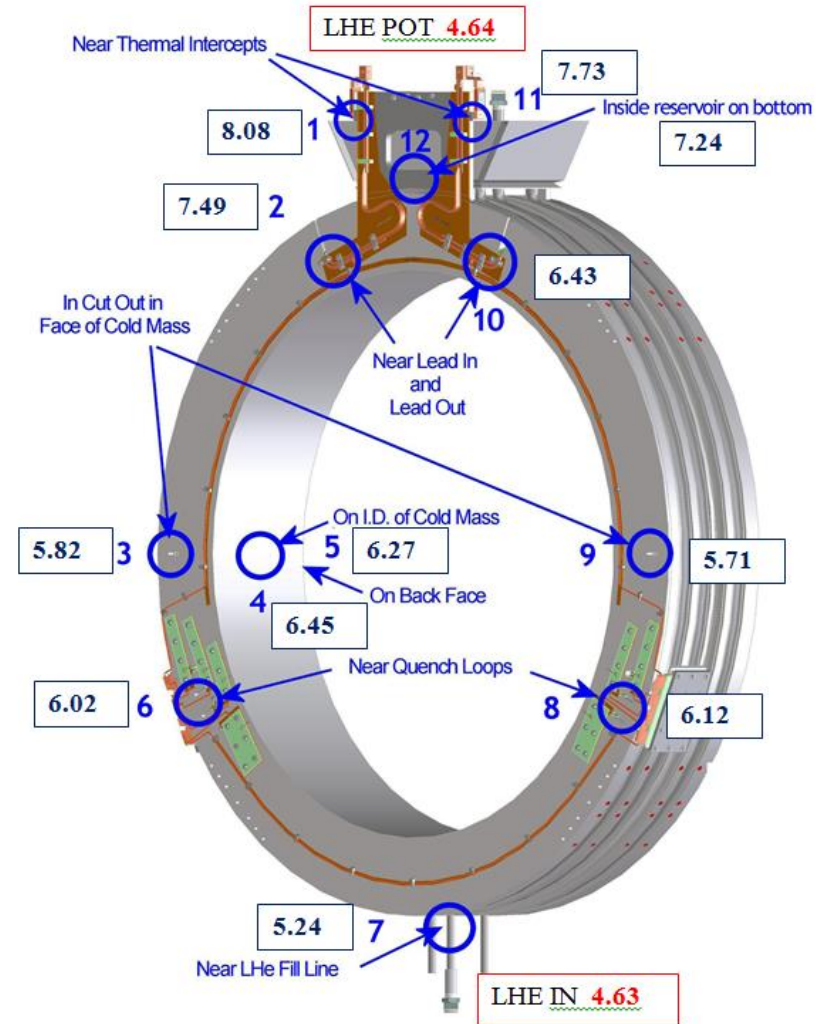




CCM cold mass #1



- Completed cool down week of 9/9/13
- Heat load too high
 - Cooling tube at 4.6K
- Measured heat load ~ 70W
 - Expected 10W
- Insulating vacuum good
 - 10^{-6} Torr

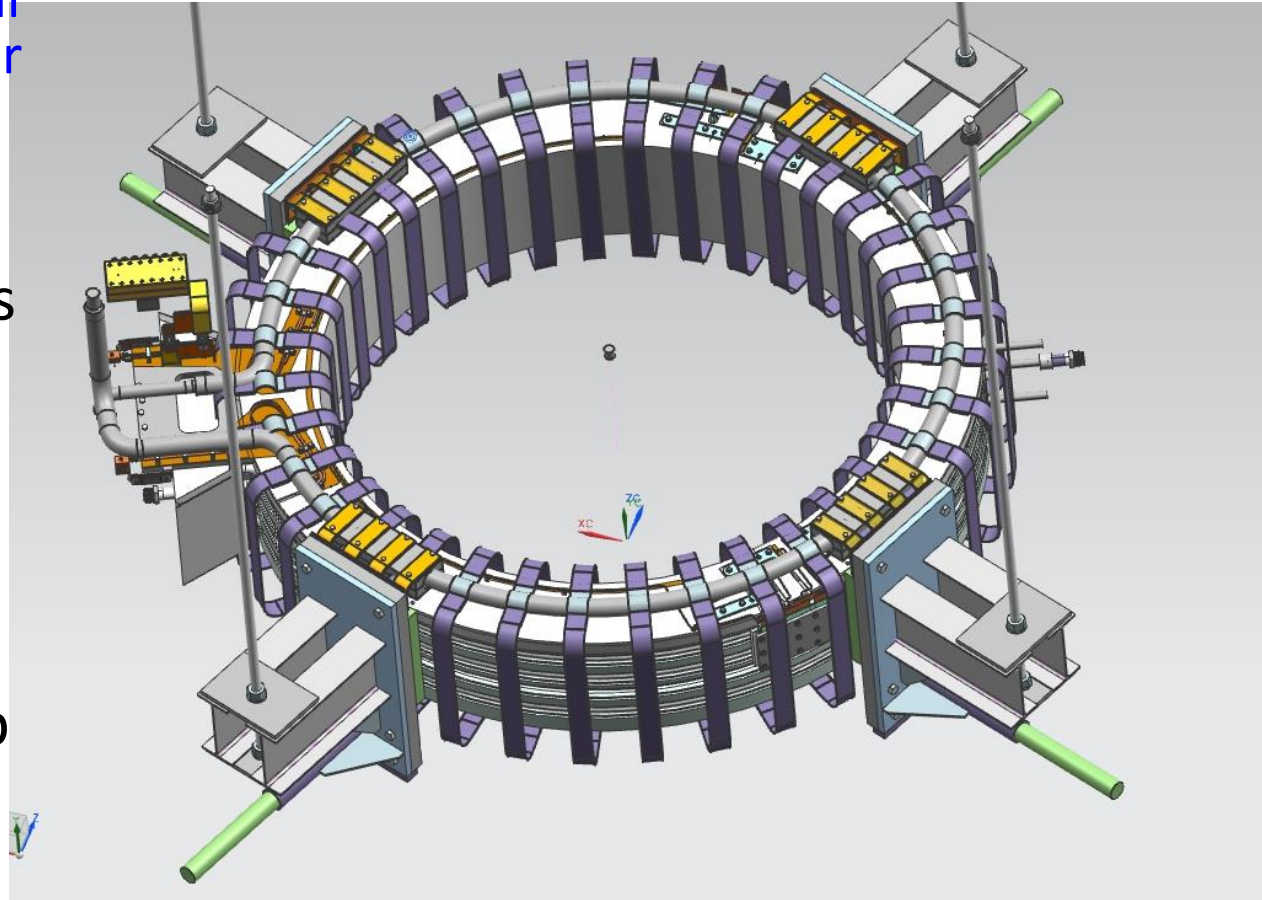




Steps Forward



- Rewrap MLI
 - Blankets & technical support from Meyer Tool
- Introduce thermal intercept for mechanical supports
- Add thermal shield
- Improve insulating vacuum
 - More pumping speed
 - Install RGA
- Add additional temp sensors



Calculated heat load in this configuration $\approx 3W$ with nominal MLI properties



CC Cold Mass #1



- Corrective actions to improve heat load
 - Designed and installed custom thermal shield
 - Improved MLI installation method
 - Placed 400 l/s turbo pump closer to the cryostat
- Expected heat load $\sim 2.5\text{W}$
 - Required heat load is $< 15\text{W}$

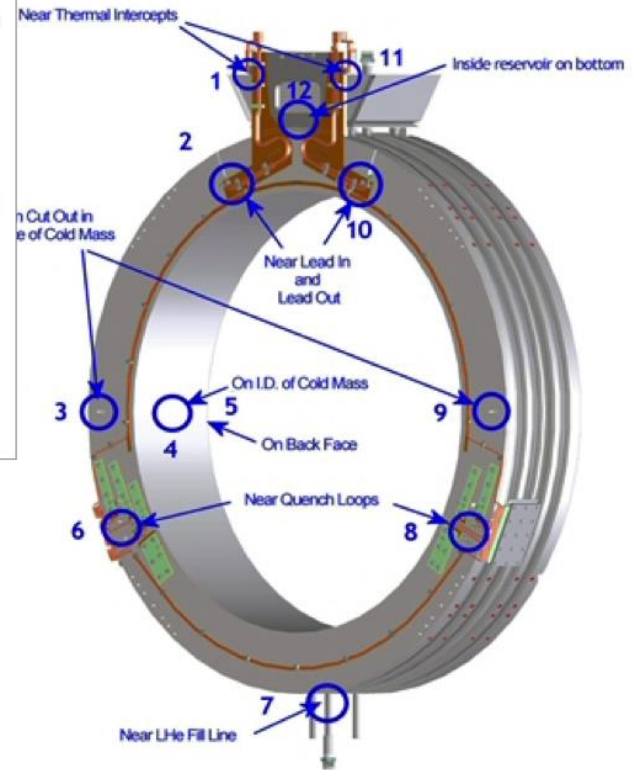
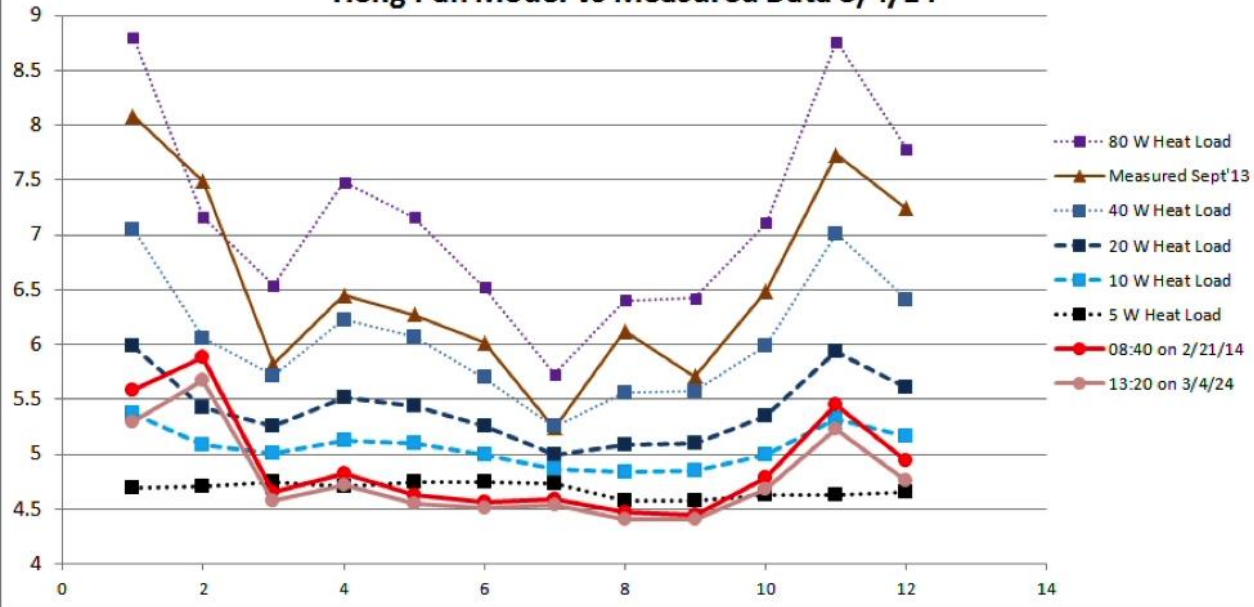


Final MLI installation



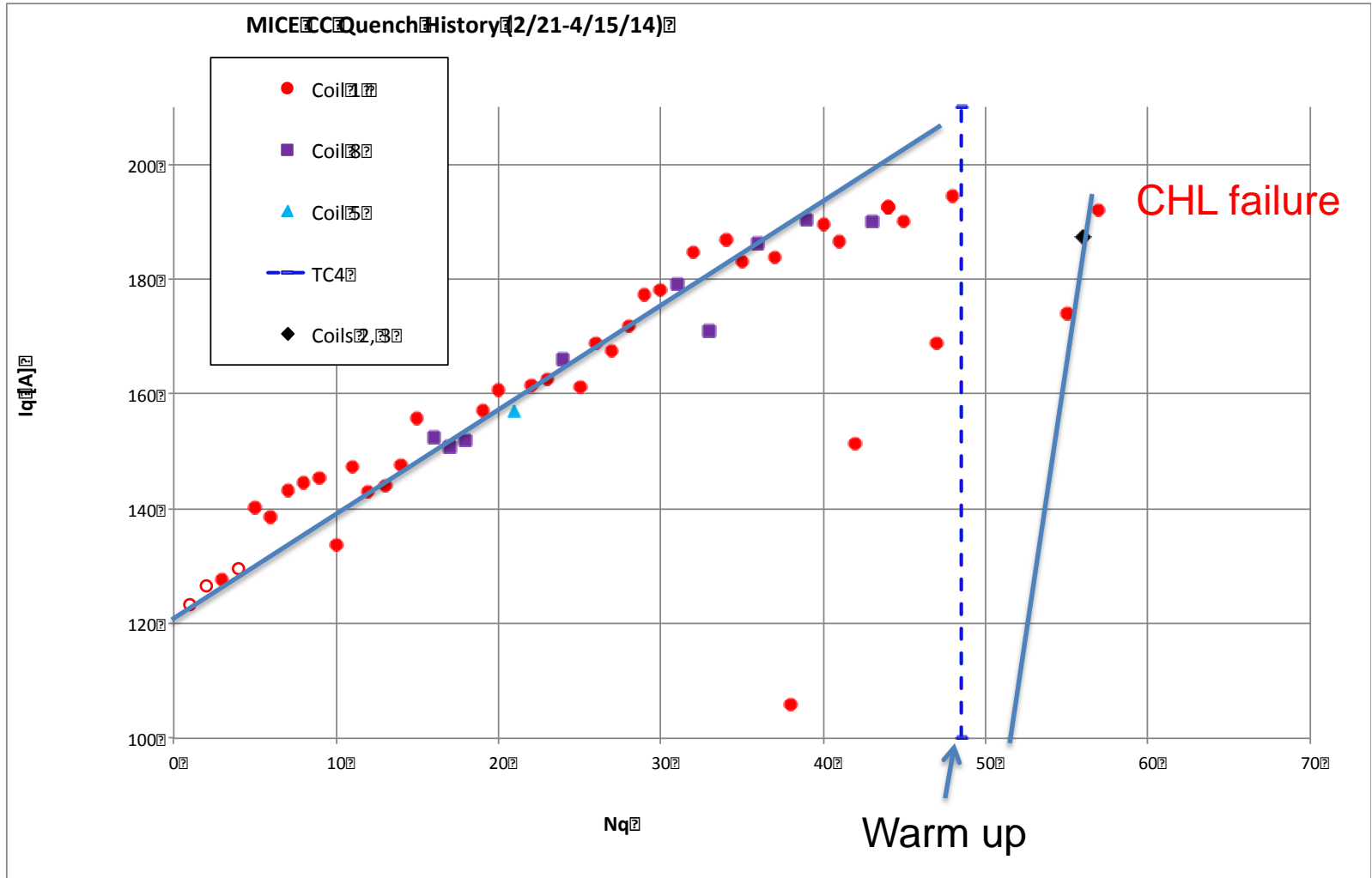
CC cryo performance

MuCool-01 Temperatures
Heng Pan Model vs Measured Data 3/4/14



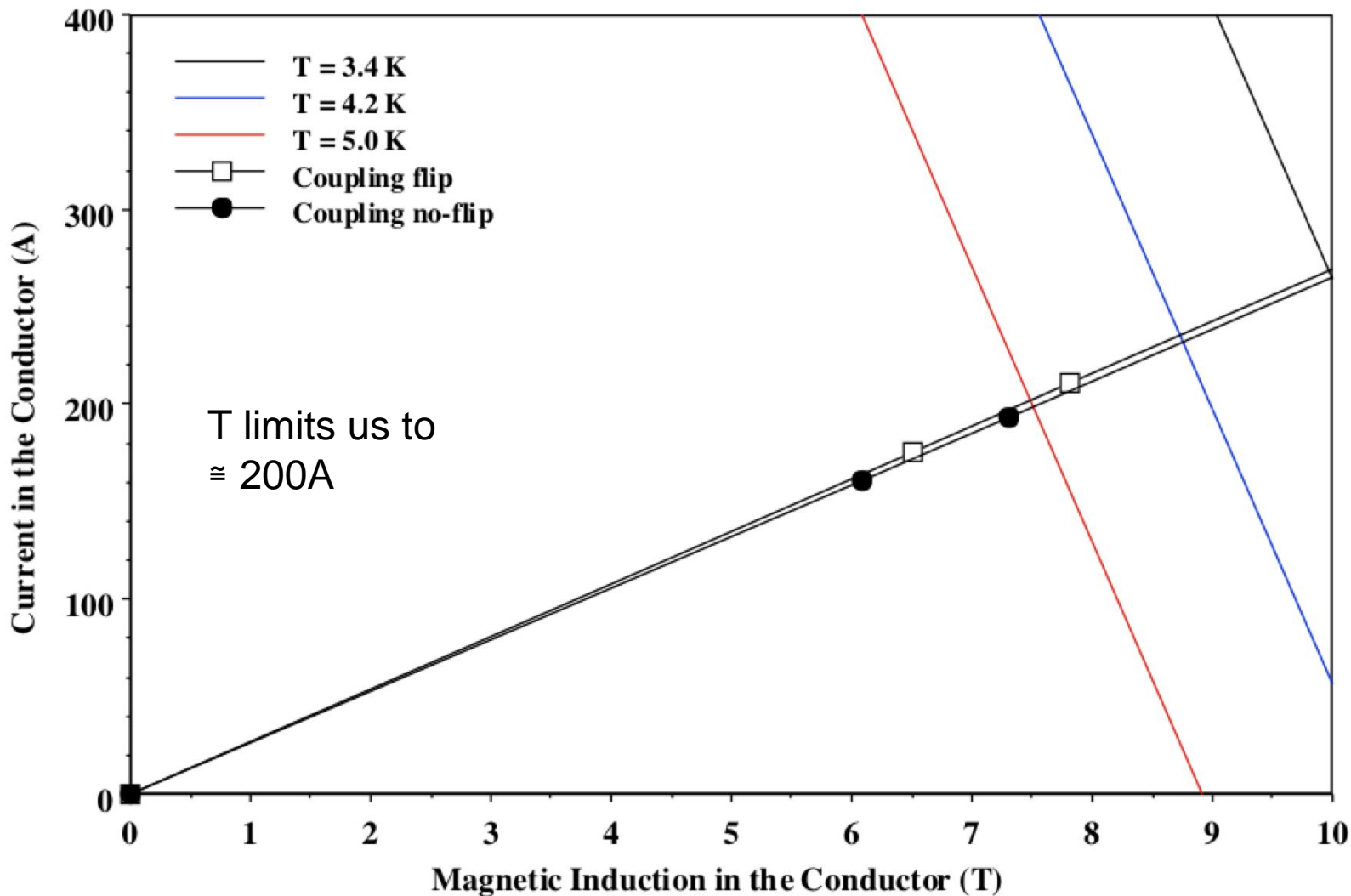


CC quench history





CC SC load line

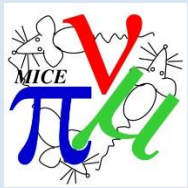




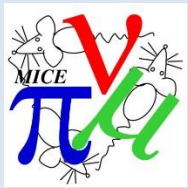
CC Coldmass #1 remaining tests



- After CHL is back up we will cool down again
 - Reverse polarity
 - Quench test at 25A
 - See if all diodes function
 - Proceed with ramp/training
 - Expect limit at ~195-200A
 - Soak test (8 hr.) at 185-190A
 - Warm up
 - Complete



Work towards full Coupling Coil Magnet



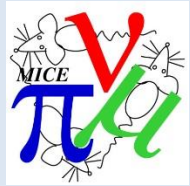
Main Vessel Sealed for Vacuum Check



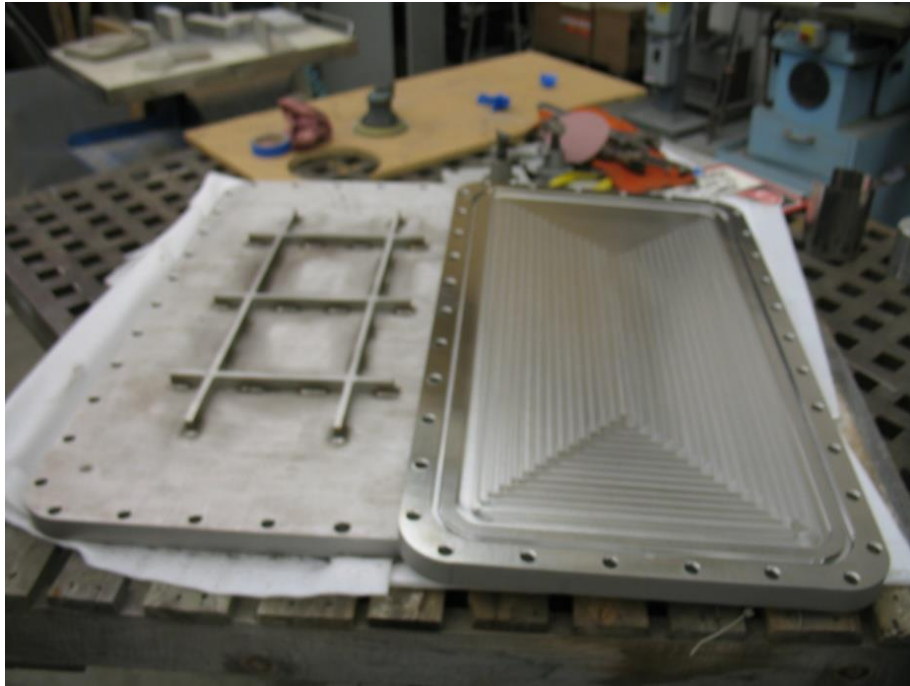
All ports were sealed with plates and vacuum sealing tape.

Vac. Check complete
Tight – ready to go

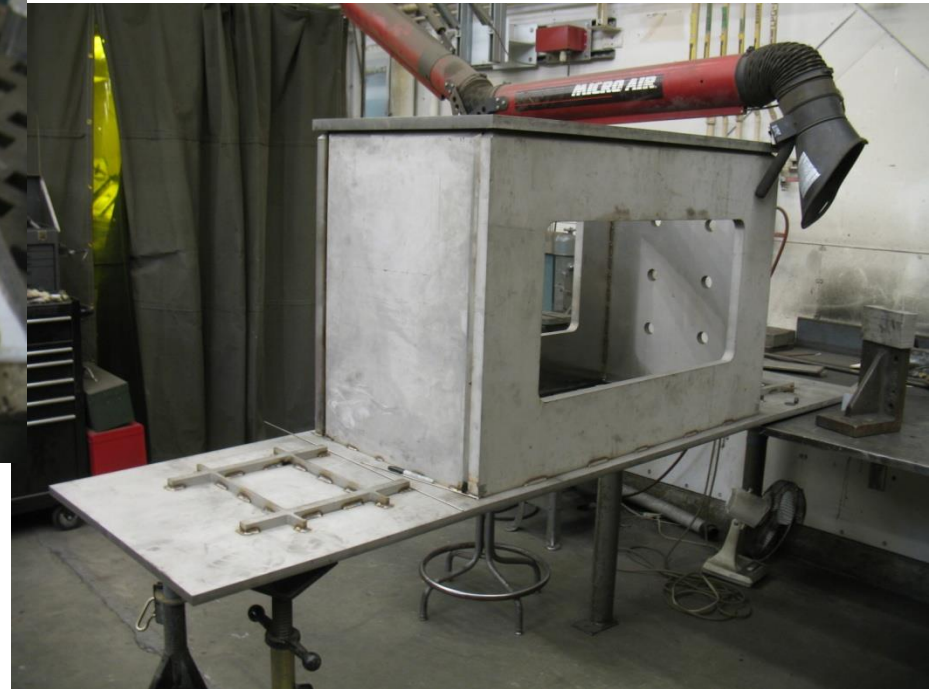




Tower Assembly



Tower main port covers are ready



Tower has been sent out for final machining

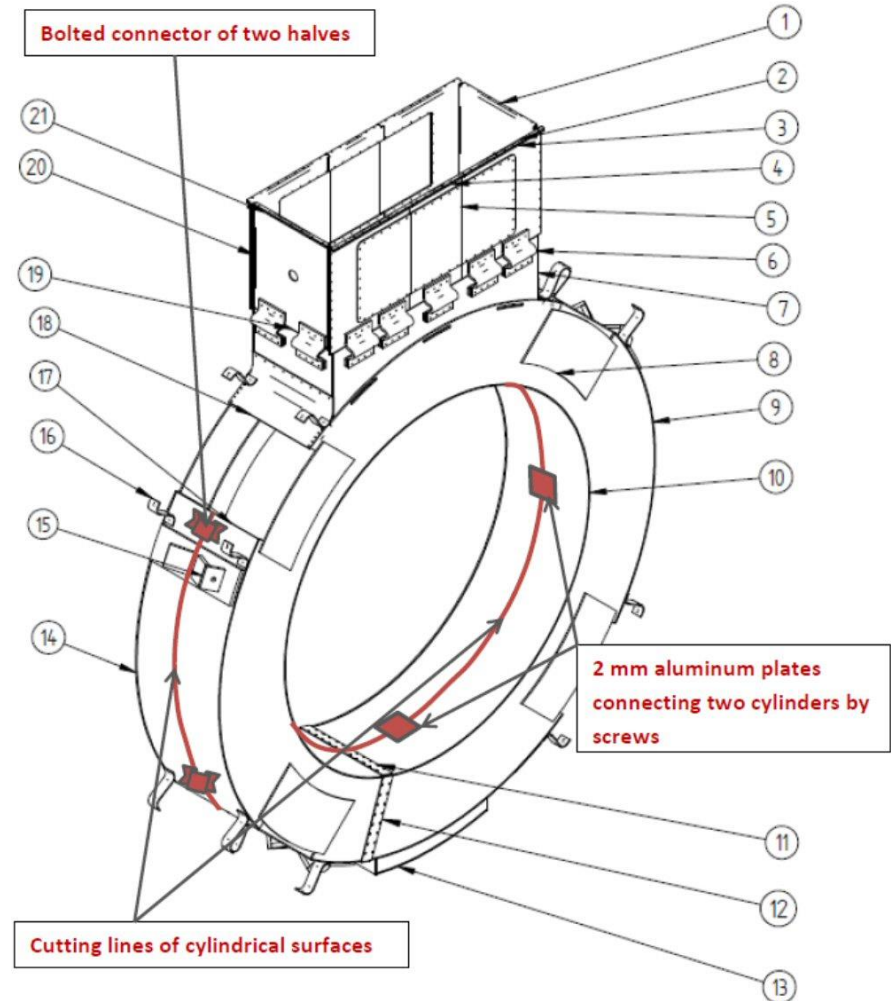
- Finished by April 28th



New Concept For The Thermal Shield



- Design concept from Fermilab shown
- Thermal shield fabricated in two symmetric halves
- Eliminates welding of TS as final assembly step
- Removes the risk of damage to the MLI wrapped around the cold mass
- New model and drawings will need to be generated

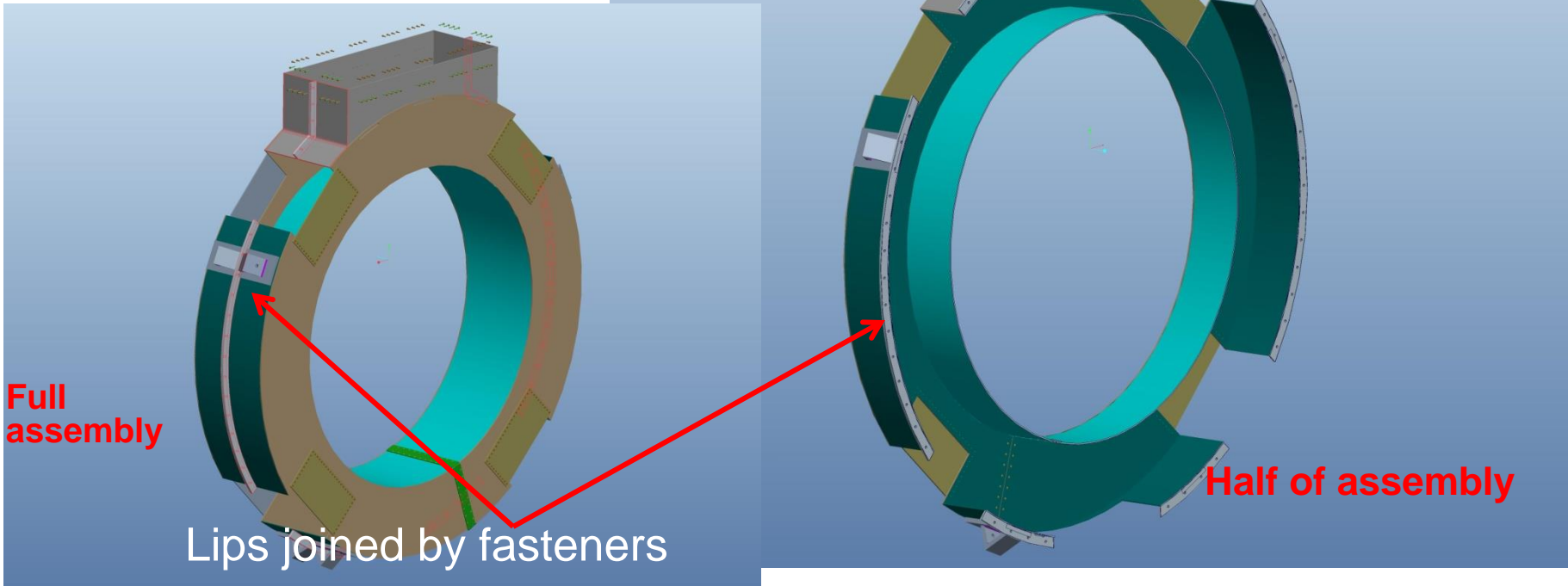




New Concept For The Thermal Shield



- Concept model of split thermal shield with edge lip for fasteners



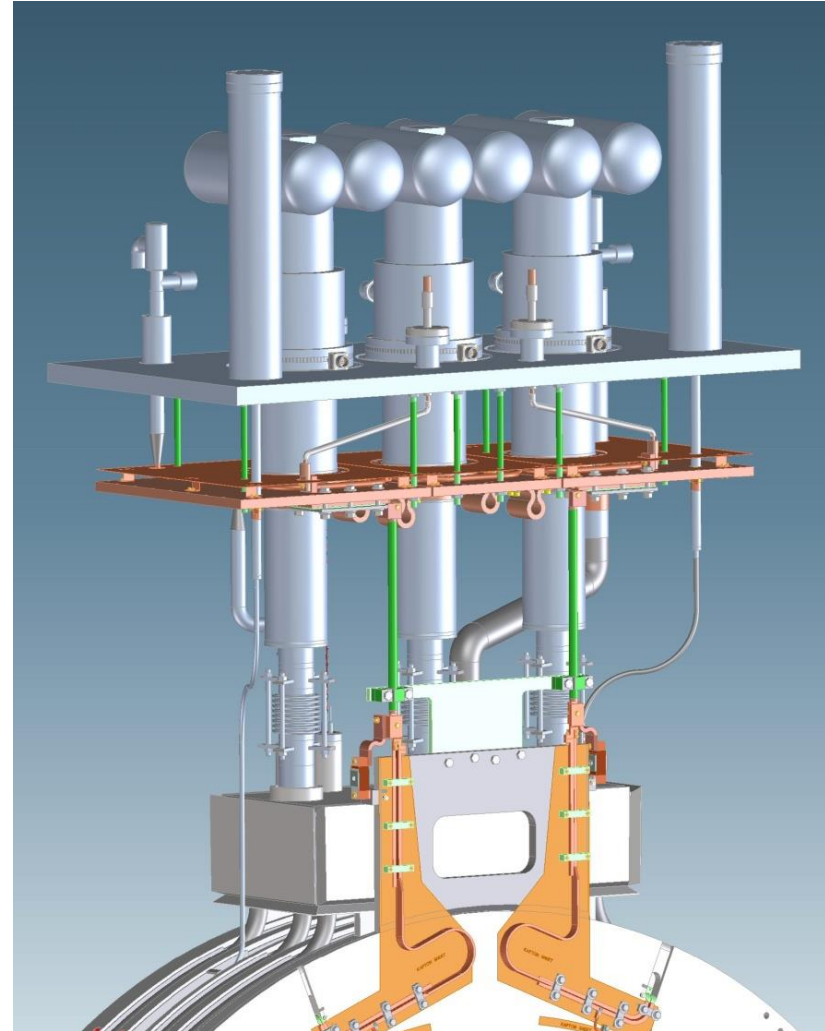


Prototype Cooling Circuit Assembly



Status

- Initial design drawings have been finished and reviewed by the LBNL Superconducting Magnet group
- Revisions required before requesting quotes from outside vendors
- Also requires addition of fiducial target mount points
- LBNL will ship cooling circuit as two sub-assemblies, to be integrated at FNAL in final assembly

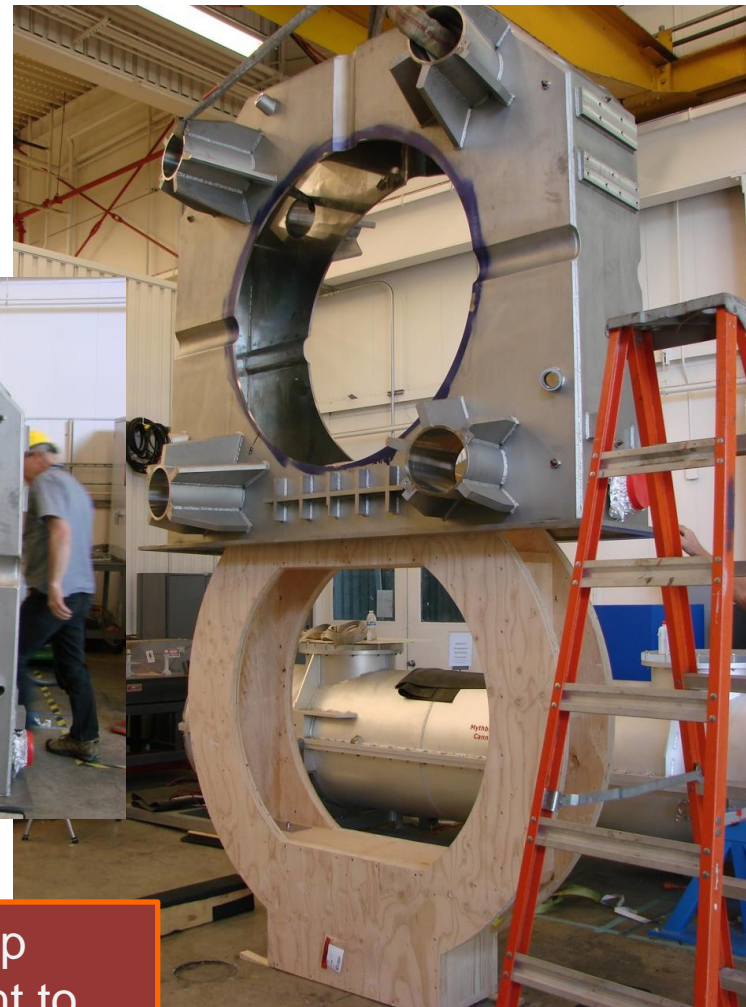
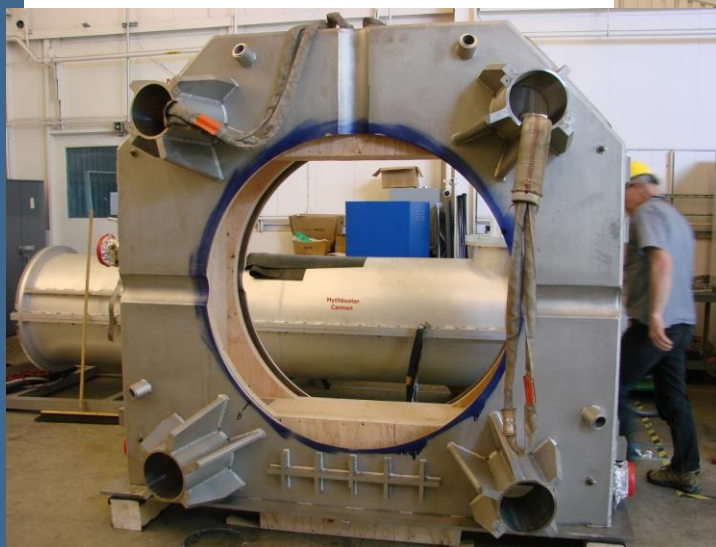
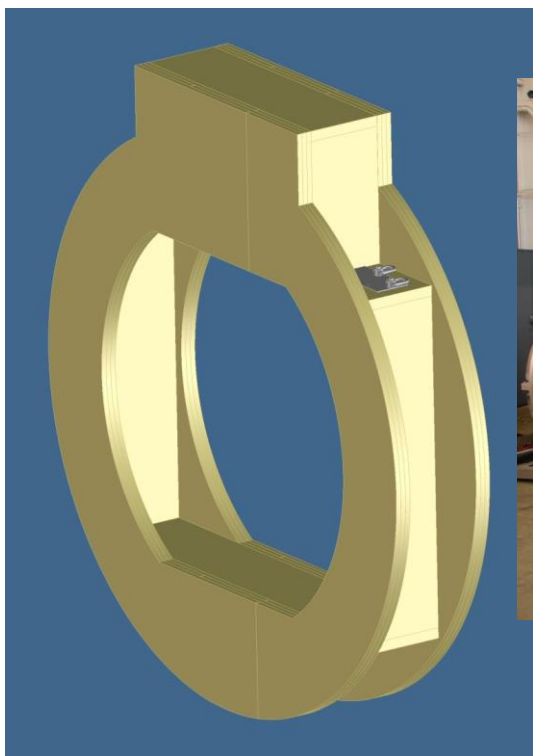




Cold Mass / Thermal Shield Mock-up

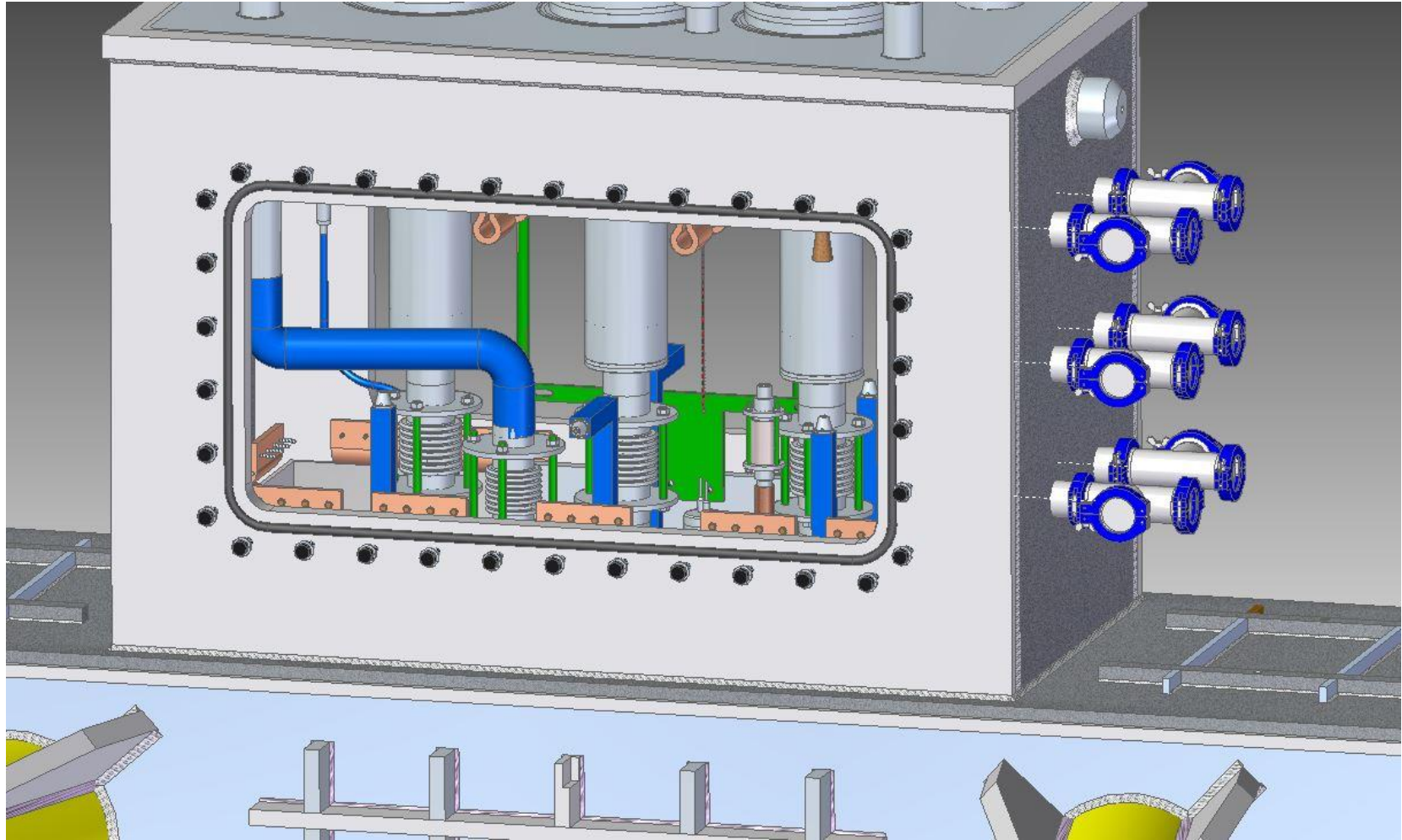


A wood mock-up of the cold mass/thermal shield to assist in defining the coupling coil magnet assembly procedure



Vessel and shield mock-up
being readied for shipment to

Fiducial layout for assembly: positions



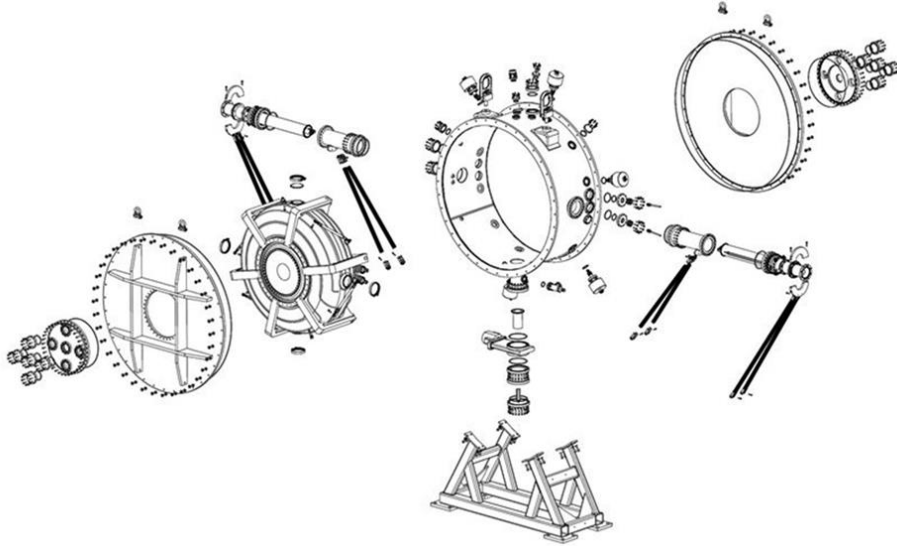


CC Magnet Critical dates

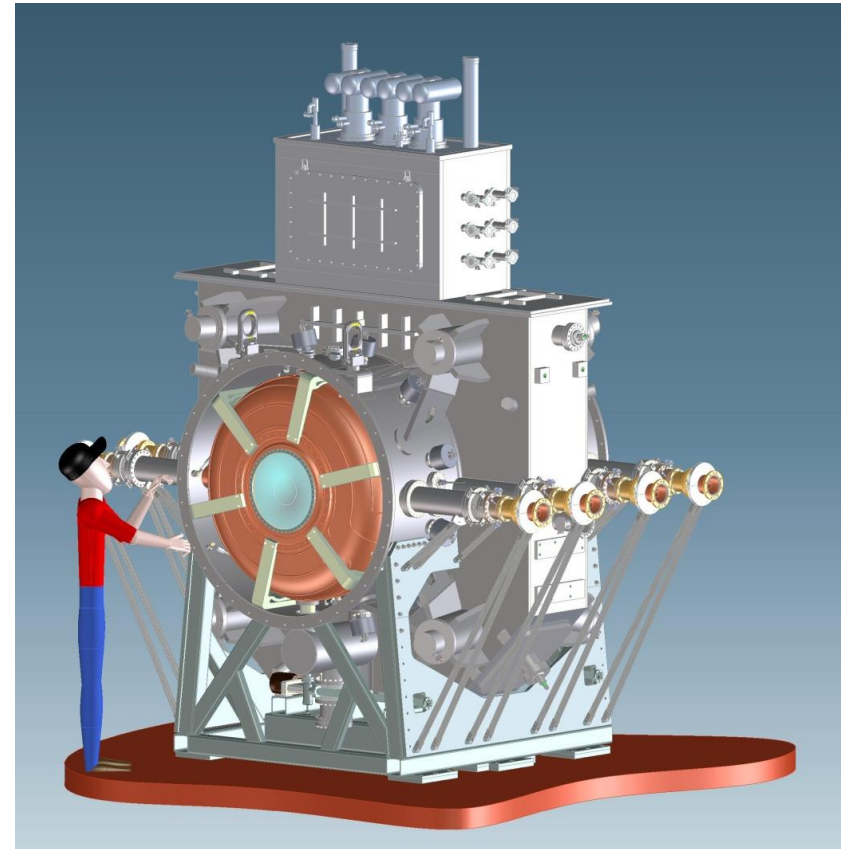


- Cold mass testing complete 5/15/14
- Cryostat ready for shipment to FNAL 6/25/14
- Thermal shield ready for shipment to FNAL 9/3/14
- Cooling circuit ready for shipment 9/29/14
- Final assembly starts **11/20/14**
 - This is a scenario A estimate (see later slide)
- First CCM testing complete 2/15/16
 - Known late start due to FY14 shortfall

RF of the RFCC

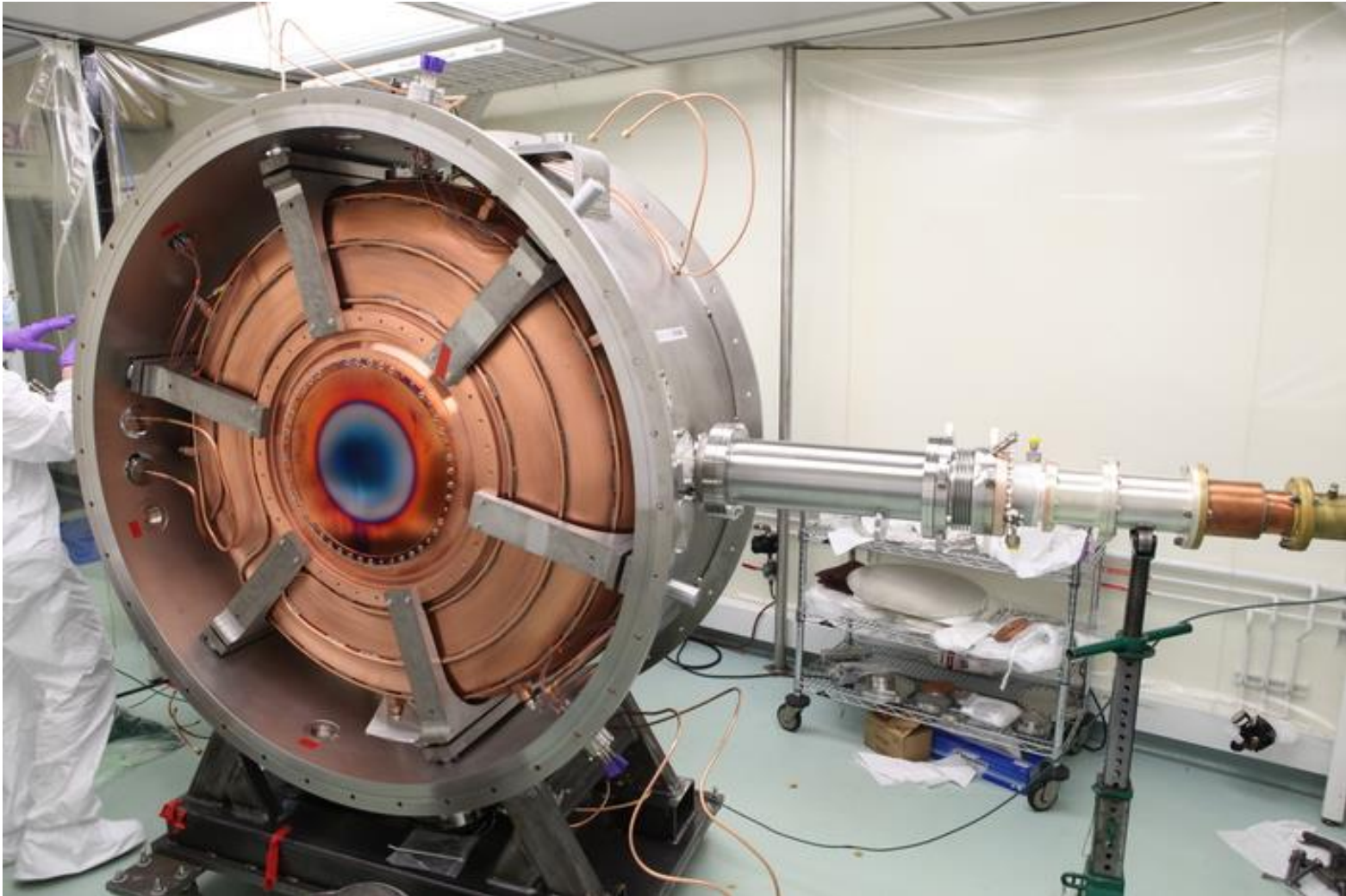


- Production component system test
 - Fixturing
 - Integration/assembly
 - Tuner control testing
 - Vacuum and alignment
 - Basically, a test of all components of final RF module





Single Cavity Test System (SCTS)

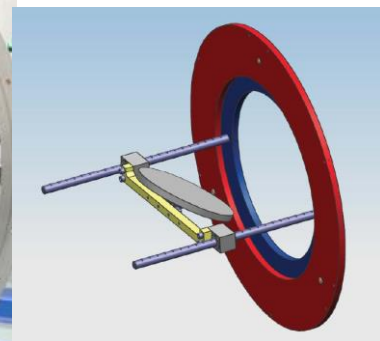
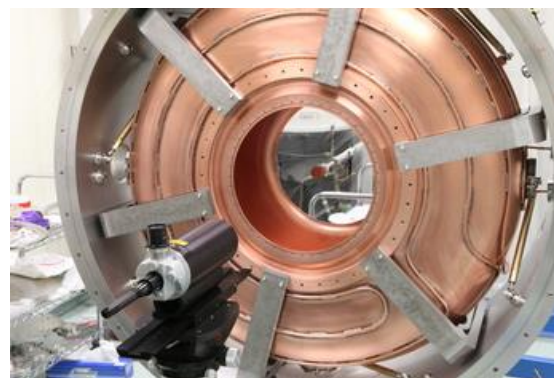
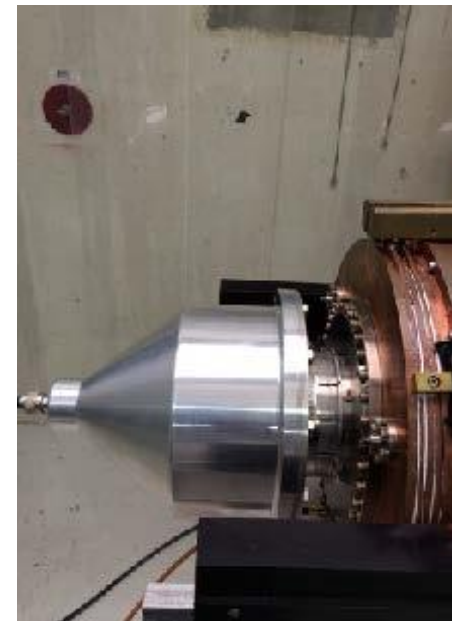




Diagnostics



- Vessel
 - top plate
 - RF pickups (cavity gradient)
 - tube for cavity vacuum
 - optical fibers (breakdown light)
 - acoustic sensors on cavity/windows (spark localization)
 - Vacuum
 - thermocouples on cavity body and windows
 - infrared sensors for Be windows (temperature)
 - Faraday cup (dark current)
- Couplers
 - directional couplers (forward/reflected power)
 - electron pickups
 - Vacuum
 - viewports+fibers
- External
 - air pressure (tuner control)
 - water temperature/pressure
- Inspection system





SCTS - Status



- Major mechanical assembly complete
 - several fixtures built and successfully used
 - cavity installed in vacuum vessel with new struts
- Tuner system installation complete
 - tuner forks trimmed, installed, shimmed on cavity
 - actuators modified/reinstalled
 - transfer function measured
- Coupler fabrication complete at LBNL
 - couplers installed and adjusted on cavity
- Extensive instrumentation for cavity built/being installed
- RF amplifier controls modified, tested
- Hall infrastructure prepared
 - new overhead crane installed for lifting vessel
 - vacuum, air, water, RF plumbing parts in hand
- To be moved into MTA today



SCTS: Schedule



- Initial commissioning June
 - couplers will be conditioned on cavity
 - thick/flat Cu windows, no magnetic field
- Workshop (June 2-3, Fermilab)
 - review lessons learned during assembly, commissioning
 - facilitate broader MICE participation in testing at the MTA
- Inspection after first run
- Follow-up running in other configurations
 - thin curved Be windows
 - in fringe field of solenoid
- Access to RF power source constrained by Fermilab Linac operational needs
- Installation providing valuable experience for MICE RFCC module assembly
 - and possibly some LLRF



RFCC#1: Overall status



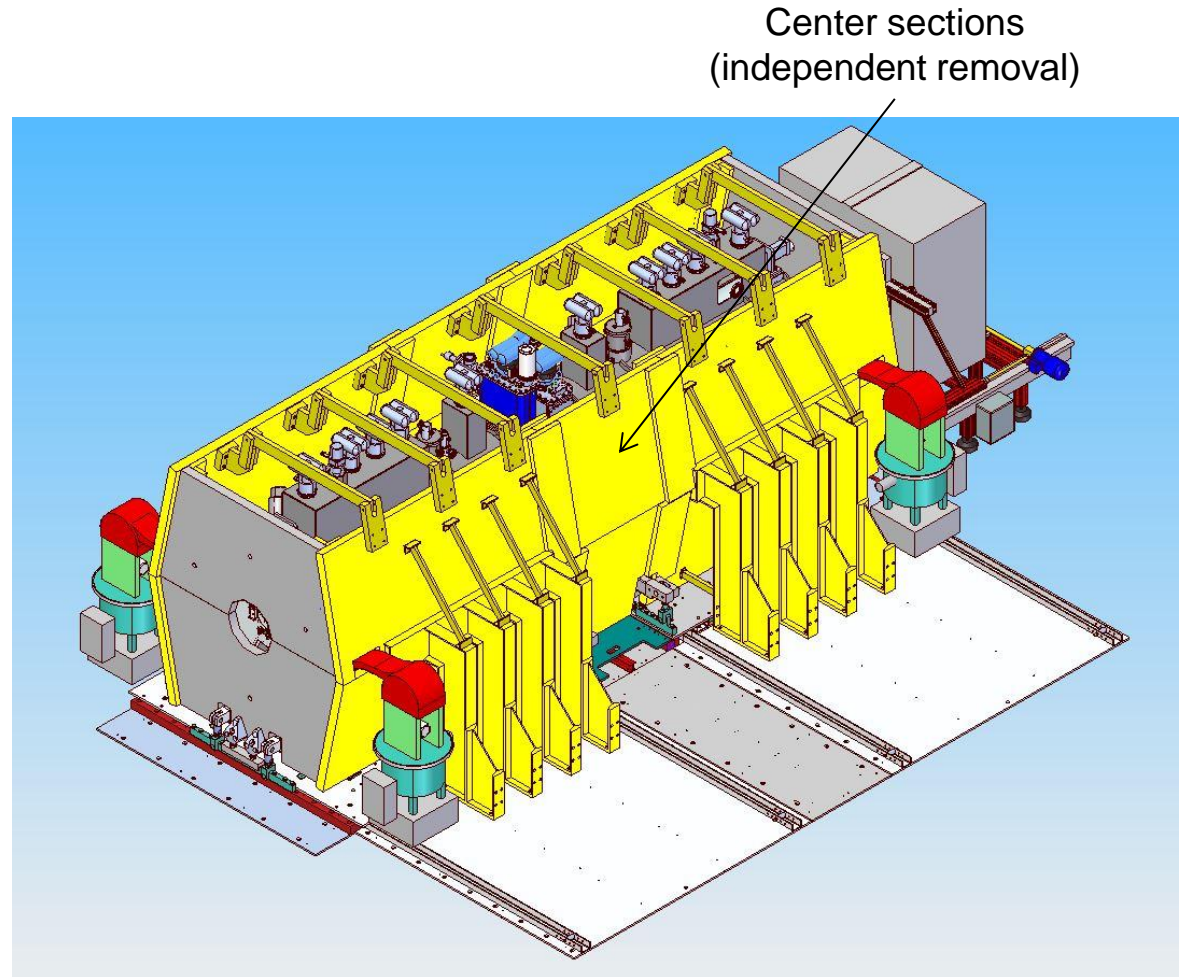
- First winding: essentially ready
 - Very optimistic that it is “good to go”
- Cryostat nearing completion
- Cavity bodies available (11 fabricated)
 - Only final EP needs to be done
- RF tuner arms available
 - Final set (18) of actuators needs to be fabricated
- RF windows available
- RF system test completed by end of fall
 - Need to fabricate 6 additional RF power couplers
- Final assembly to begin in October



Step IV Partial Return Yoke



- Design complete
- Steel order placed
 - Using JFE-EFE steel.
- Fab order in BNL procurement





Critical Dates – Baseline to Step VI

- SS #1 arrives at RAL 5/8/14
- PRY South components at RAL 10/24/14
 - Frame ship first (8/11/14)
- PRY North components at RAL 12/15/14
- CCM Prototype - Complete – Operational 2/5/16
 - Baseline plan has this CCM for MTA
 - Under review
 - The date will slip due to FY14 funding shortfall
 - Stop work order issued last week
- RFCC #1 arrives at RAL 3/6/18
- RFCC #2 arrives at RAL 9/6/19
 - If option to use MTA magnet exercised 7/26/18



Critical dates - Scenario A



This is the fastest and cheapest path to Step V

- SS #1 arrives at RAL 5/8/14
- PRY South components at RAL 10/24/14
 - Frame ship first (8/11/14)
- PRY North components at RAL 12/15/14
- CCM Prototype - Complete – Operational 7/6/16
 - This assumes this CCM for RFCC #1 (not to MTA)
 - Under review
 - This date incorporates our first-pass analysis to the effects of FY14 funding shortfall
 - Stop work order issued last week
- RFCC #1 arrives at RAL 5/10/17
 - vs. 3/6/18
- Step V PRY arrives at RAL 5/11/17
- Cooling demonstration with re-acceleration 2018

Note: this requires explicit agreement with DOE regarding funding profile. A similar agreement with STFC is needed in order to exploit these deliveries.



Conclusions



- Spectrometer solenoids are complete
- First coupling coil winding looks good
 - A few additional tests to do
- Component fabrication for first RFCC is well along
- If we decide not to use a CCM in the MuCool Test Area, we can save over a year on the schedule
- We are also positioned well to build the second RFCC for Step VI
 - Chinese company (Qi Huan) ready to start winding the next CC coil & has the parts for a third.
 - SC for winding 2 is in China, 3&4 at Fermilab