

Status of the Top Plate and Anticryostat for High Field Cable Test Facility at Fermilab

V. Nikolic, G. Velez, R. Bruce, T. Tope, D. Orris, X. Yuan and M. Kifarkis



2PoA04-11

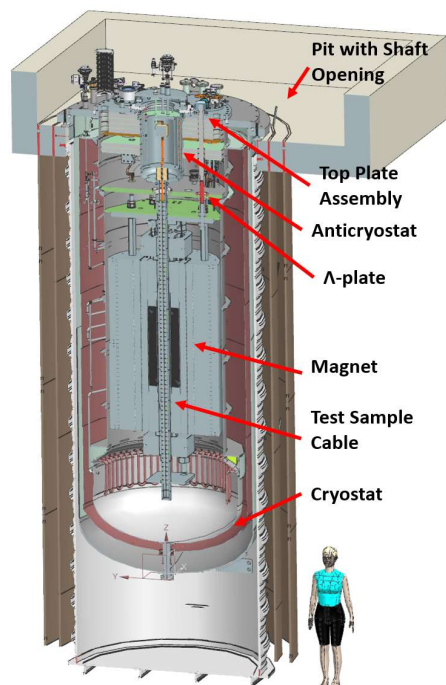
Introduction of High Field Cable Test Facility

The US DOE's Offices of Science are collaborating on a new facility called HFVMTF at Fermilab. This facility will test HTS cables in high magnetic fields. It aims to match or surpass capabilities of European test stands. The HFVMTF will also be crucial for testing high-field magnets (16-20+T) and hybrid magnets using both low and high-temperature superconductors. These magnets are vital for future high-energy colliders. LBNL will provide the background field magnet, currently in construction.

HFVMTF TOP PLATE ASSEMBLY PARAMETERS	
Maximum Weight of Magnet for Background Field	20 US ton
Minimum Length of Magnet for Background Field	3.200 m
Maximum Diameter of Magnet for Background Field	1.375 m
Maximum Current of Magnet with HTS Leads	20kA
Minimal Temperature of Magnet for Background Field	1.9 K
Maximum Anticryostat Diameter (above λ-plate)	500 mm
Maximum Anticryostat Diameter (below λ-plate)	140 mm
Maximum Cable Test Sample in Anticryostat	3.3m
Cable Test Sample Temperature	4.5-50.0 K
Maximum Cable Test Sample Current (direct)	16 kA
Maximum Cable Test Sample Current (transformer)	100 kA

CRYOSTAT STATUS

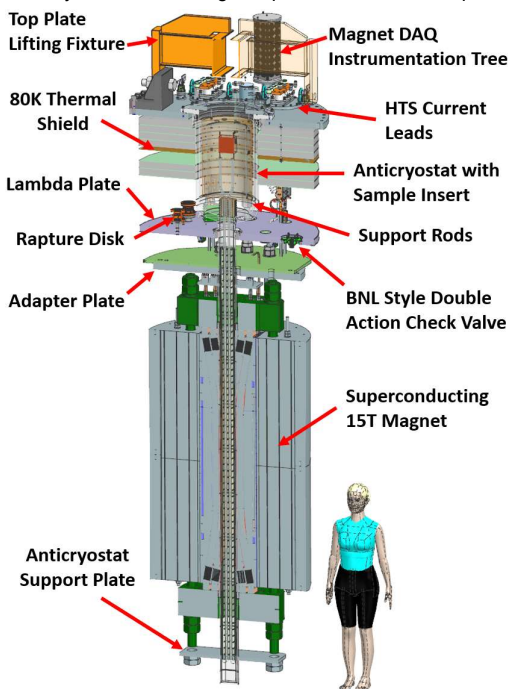
Cryostat fabrication underway. Parameters finalized through MDP and FES collaboration. Design finalized and approved production in Spring 2023. Installation plan developed with Fermilab team after rigging firm interviews. Procurement for installation starts Fall 2023.



TOP PLATE ASSEMBLY DESIGN

The Top Plate Assembly for HFVMTF has reached its final design phase, with vendor search to begin in Fall 2023. Key components include the Top Plate, Support Rods, 80k Shield, Lambda Plate, and Adapter Plate.

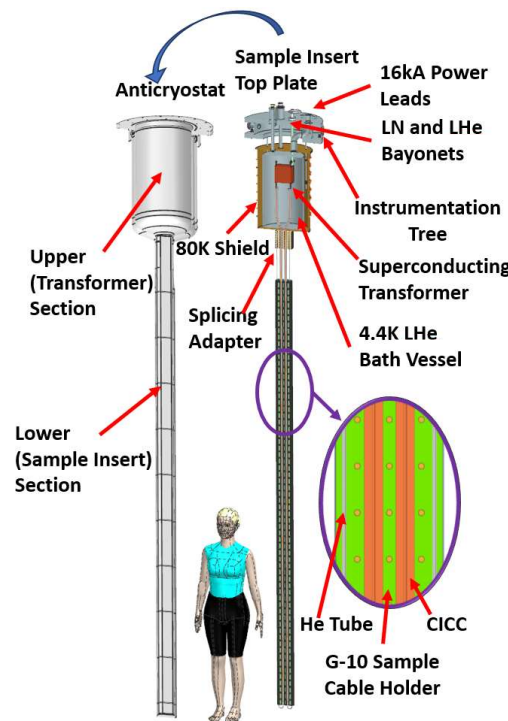
- Top Plate is design per ASME BPVC code
- Specially designed lifting fixture for top plate assembly
- 80K Thermal Shield features LN2 cooled copper plate
- Can accommodate up to 4 30kA power leads
- 2 pairs of 10kA HTS leads for FES cable testing
- Capabilities to use up to 4 CLIQ leads
- 2 instrumentation trees for data acquisition, 1200 channels
- Support system for magnet is 3 point 2" stainless steel rods
- Strain gauges on rods monitor magnet movement.
- Lambda Plate made of stainless steel and G-10
- Spring-energized C-type seal to reduces heat leaks
- Adapter Plate from 2" SS plate and G-10 for insulation
- Anticryostat used in magnet aperture attached to Top Plate



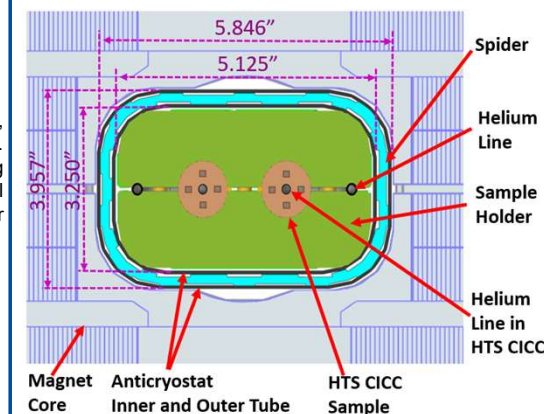
ANTICRYOSTAT AND SAMPLE HOLDER DESIGN

Anticryostat and Sample Holder is in preliminary design stage, finalization after Top Plate Assembly procurement in 2024. Anticryostat holds cable sample with holder, superconducting transformer and process piping. Designed for easy removal without warming magnet, serving as vacuum vessel for controlled test cable sample at 4.5K to 50K.

- 316L stainless steel inner and outer tubes
- Use MLI and spiders to minimizing thermal transfer
- Superconducting transformer in liquid helium bath (4.4K)
- Instrumentation trees for data acquisition and power leads
- Adapter for transformer connection to HTS cable sample
- G-10 material for magnetic and mechanical properties
- Withstands forces up to 340 kips (1.5 MN) at 15 T field
- Sample Holder length adjusted for joint offsets in field
- Capillary tubes (3/16" ID) for forced-flow 4.5K-50K helium
- In R&D, Anticryostat 5" / 2.5" OD like other at Fermilab



CROSS SECTION OF SAMPLE CABLE HOLDER



The Sample Cable Holder shares similarities with the EDIPO sample holder, featuring a rectangular shape reminiscent of a magnet. Its purpose is to precisely position the cable, aligning it with the desired spacing and orientation within the magnetic field.

- G-10 holder is composed of two halves, joined using bolts
- Cable to be hold with or without external pressure/force
- Optimal clearance for insertion to be established
- Cooling of CICC will involve a forced flow of helium
- Cable Holder to accommodate joint offset in the field
- Tubes can be put in parallel/series based on arrangement

TYPICAL CABLES FOR TESTING IN THIS FACILITY

This facility is designed for optimizing and characterizing cables and splices. It accommodates testing of cables such as Rebcu HTS fusion CICC, VIPER and others like, ensuring their peak performance.

