



# MICE/MuCool Coupling Magnet Review

Close-Out Report  
July 29, 2009  
Alan Bross  
*Chair*

*For the Review Committee:*

Elwyn Baynham, Paolo Ferracin, Mike Green, Yuenian Huang, Wing Lau, Derun Li, Soren Prestemon, Ross Schlueter, Steve Virostek, Russ Wells, Mike Zisman

# Preamble



- The Review Committee would like to thank Wang Li for her very complete and well thought out presentations. As the single presenter for this review she did an exceptional job in presenting the status of the coupling coil project
  - She certainly deserves an “Iron-Woman” award for her single-handed effort yesterday.

# General Comments

- Magnet design seems fairly solid.
- Plans to fabricate within the Qi Huan company appears fine in that they have sufficient experience and good controls in place.
- Cryogenic test setup for magnet is an issue. It is overly complicated for the test requirements.

## Charge 1



- Review and comment on plans and schedule for testing coils at ICST, including the large and small test coils, the MuCool coil, and the MICE coils. In particular, comment on the interpretation of the existing test results and on the likelihood that proposed modifications of the ICST cryogenic system will be appropriate and adequate to the task of testing the coils.*

# Charge 1 - Findings/Comments

- Problems still exist with the LHe delivery system at ICST/HIT
  - u Flow capabilities
  - u Vacuum Issues
  - u Temperature Sensors
- It is critically important that this system be available for testing the large test coil and this problem is on the critical path
- It was felt that at present the system is overly complicated and can be simplified

# Charge 1 - Recommendations

- A single design for a simplified system should be developed that presents a high probability for success.
- Develop a systematic plan – fix, problems, get diagnostic(s) of He levels, have plan of steps to determine key problems
  - Calculate steady state flow process – evaluate appropriate areas
  - Consider shorter transfer line test/direct connection to liquefier
  - Consider independent control-load test?
  - Vacuum issues **MUST** be resolved!
  - Reliable thermometry **MUST** be designed and implemented!
- We recommend that a system that feeds the test cryostat/coil directly from the He refrigerator be seriously considered.
- Thermometry for the test system must be updated so that readings are traceable and reliable.

## Charge 2



- Review and comment on plans and schedule to fabricate the MuCool and MICE coils at Qi-Huan Company under HIT supervision. Particularly examine any proposed changes in fabrication techniques that have arisen since the Final Design Review in December, 2008 and evaluate the adequacy of the proposed diagnostics, such as voltage taps and thermometry.*

## Charge 2 - Findings/Comments

- An overview of the capabilities of the Qi Huan company were presented and details of their activities and accomplishments to date were presented.
- Qi Huan has demonstrated many of the requirements needed to fabricate the MuCool/MICE coils and has experts in many areas: mechanical engineering, welding, material properties, and fabrication techniques
- Again No clear picture regarding the Diagnostics such as voltage taps and thermometry was given

## Charge 2 - Recommendations

- We recommend that Qi Huan develop a detailed manufacturing plan/procedures for the coils that explicitly calls out the critical steps and lists milestones and inspection points. At each of these inspection points, HIT personnel should evaluate the status of the coil(s) before Qi Huan proceeds to the next step
- Heat pipe approach - make sure He liquid is brought to bottom; heat introduced on the way down will reduce flow rate, possibly result in vapor plug.
- 3W total 4.2K power appears marginal
- Magnet performance requires good strap design, super-insulation, etc: HIT team must make sure Qi Huan is capable in these areas

## Charge 2 - Recommendations

- The issue of having the mandrels forged as opposed to welded from multiple pieces should be investigated rigorously in light of the problems encountered with annealing/heat treating.
- Need to have fiducials placed, and the fabrication team should have a plan for fiducialization (reference fiducials to coil position).

## Charge 2 - Recommendations

- A complete documented procedure for coil winding should be created and reviewed by the HIT team
- Rigorous change control procedures need to be instituted by Qi Huan and agreed upon by the HIT team. All personnel at Qi Huan must follow these procedures.
- There are still outstanding questions regarding fabrication tolerances and these need to be resolved as soon as possible in consultation with the HIT and LBNL teams
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## Charge 2 - Recommendations

- A Final plan for thermometry for the magnets needs to be development as soon as possible which details
  - u Sensor Types
  - u Sensor positions
  - u Complete mounting procedures
- Qi Huan should prepare an updated sensor list and installation plan for approval by HIT and the LBNL teams
  - u This should be carefully monitored/documentated
    - s Will it be done by Qi Huan?
    - s Require site visit?
- Interface issues for both MuCool and MICE (will be addressed in next review) need to be finalized as soon as possible
  - u Cryo interfaces for cool down
  - u Any outstanding safety code issues
    - s Pressure vessel codes, etc
    - s Lifting fixtures for installation in the MuCool Test Area and the MICE Hall

## Charge 3

- *Comment on the adequacy of the proposed management plan whereby HI T/ICST will monitor and control the work at Qi-Huan while keeping LBNL informed of developments (and obtaining LBNL approval for significant issues or changes).*

## Charge 3 - Findings/Comments

- Qi Huan has the right sort of experience in magnet manufacture
- Overall the coordination/interaction between the HIT team and Qi Huan is functioning well.
- Splitting the work between two organizations will make things more complex, however.
- This requires that the organization of the interfaces between the two groups needs to be very precise
- Funding is still an issue in order to obtain all the required resources needed ensure a successful fabrication of the magnet and to deliver them in a timely fashion
- Funding limitations will affect both the work at Qi Huan and ICST/HIT
  - Technician availability at ICST/HIT will become critical

## Charge 3 - Recommendations

- The committee very highly recommends that Li Wang continue in her role as project manager and primary interface with Qi Huan
  - She is doing an Excellent Job and is key to the success of this project!
- The LBNL team and MICE management will do everything in their power to help resolve the remaining funding and manpower issues.

*“You are either part of the solution or part of the Problem”*