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21 July 2010

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Subject: MICE Committee Recommendations

Steve, Mike, Alan,

Attached please find four appendices, (1) comments from our committee just after the meeting and tour at LBNL / Wang NMR in May; (2) an independent analysis of the Spectrometer Magnet Heat Load from Bob Sanders; (3) a note on potential vacuum system upgrades from Cary Kendziora; and (4) a review of possible electromagnetic failure scenarios by Vladimir Kashikhin. Though a complete set of drawings is not available, LBNL supplied pictures, notes, and other documents to support the efforts in a timely manner.

Currently the disassembly of magnet 2B is ongoing; the magnet is not opened such that the actual failure point of the leads in the last test has been seen, and reassembly and test of the next magnet is not expected before October of this year. It is our belief that the next test of a MICE Spectrometer Magnet must be a success. If no smoking gun is found during the disassembly or through continuing analysis by the MICE group, conservative steps should be taken to ensure that during the next test the magnet can be adequately cooled and protected (including instrumentation to confirm that this is so). In effect the next magnet should be treated as a fully instrumented prototype.

To create this prototype requires a thorough engineering understanding of the design. At this point we do not believe this understanding exists. Without this, the next iteration will continue more in the line of 'trial and error' as opposed to an engineering solution. As such, large contingencies in the cooling system would be required, and a very conservative approach required for the magnet protection. This could easily result in extra work in assembly that later on is discovered to not be needed. We do not believe this is the best course of action. We recommend:

- Implementation of the vacuum pumping system as recommended in attachment 3. Install radiation baffles in the shield to permit adequate vacuum pumping between the shield and the cold mass. Examples are available from CDF and Minerva.
- Create a set of drawings for the current design, and for all future modifications. At absolute minimum the drawings should document the design well enough to allow engineering calculations, and will be needed in any case for the safety review process as a subset of the required documentation.
- Review in detail/redo all calculations of the heat loads on the magnet. The use of cryocoolers makes the heat load analysis critical, given there is no margin to increase capacity after the fact. Though the analysis of Magnet 2 and our analysis basically agree, to move forward without applying a large contingency on the expected heat load would be risky. A more detailed analysis, based on the actual design, is required.

- Review in detail and redo all the electromagnetic calculations of the magnet system for both test and operational conditions.
- Review the instrumentation plan such that the thermal and electromagnetic calculations can be confirmed during the test.
- Complete calculations and documentation demonstrating the mechanical support of the magnet, leads, piping and other internal components are adequate including effects due to motion with cooldown.
- Consider if it is now time to remove the project from Wang NMR and complete the magnets elsewhere. We fully understand that a decision to move along this path has serious implications. However, we feel that this project is beyond the capabilities of Wang NMR and can only be successfully completed there if major engineering and technical resources (beyond the existing LBNL team) are supplied by the MICE collaboration or one of the national labs to assist Wang NMR. We have a concern that even if these additional resources are made available, intellectual property issues may make integration of these additional resources with the Wang NMR team problematic.

Finally in the current plan, the device will be operated at Fermilab and RAL. The MICE team should consult with the safety panels in both locations to confirm that the modifications being undertaken are consistent with end-user requirements, and the documentation required for the safety reviews is available to the respective review panels.