FNAL – LHC Program Report February, 1999

J. Kerby, March 21, 1999

Summary

Magnet HGQ05 was delivered for test at the end of the month, initial results will be available in time for the March technical review. Procurement of the last piece needed for the heat exchanger test, the feed can, has been initiated. Preparation of the requisition package for the Feed Can needed for test of full length quadrupoles at MTF continues and it is expected that this will proceed in March. Practice coils have been made in preparation for the start of HGQ06 in the first week of March. Budget change requests addressing the power leads for the MTF feed can, the heat exchanger test cell, and the extended model magnet program are well into development and should be ready for the March 26 steering committee meeting. Aside from the cold mass program, all other components are proceeding at a pace which will allow for the completion and test of a prototype magnet on the original schedule.

The number of meetings occurring in the April / May time frame occurs as a critical time approaches in the definiton of the inner triplet layout. Considerable work has been done by BNL AP to assess the correction scheme, and the neccessity (or not) of redesign of the KEK cross section, which has brought up the possibility of mixing magnets in each IR, with KEK supplying the Q1 and Q3 cold masses, and FNAL the Q2a/Q2b cold masses. Aside from the perceived advantages for machine optics, which are ultimately the most important factor, there are some simplifications to the cold mass production programs and schedules at FNAL (and, I assume, KEK), and little impact on the cryostat and cryogenic systems. The electrical powering of such a system is still being detailed. There are, however, complications in the prototype test schedule. The original schedule called for a single prototype, of Q1 type, followed by production of the Q1 and Q3 magnets. The Q2a and Q2b cold masses, which are assembled and cryostatted in a single unit, were made only afterwards. The advantage was that if there were issues seen in the prototype, the next magnet in line was another single cold mass, cryostatted solo. With FNAL only constructing the Q2a/Q2b magnets, the fallback positions available from proceeding directly from a single cold mass to a system where 2 cold masses are permanently attached together are being reviewed, and a modification to the prototype program will be considered on the time scale of May after the ramifications are thought through.

In the latest production schedule, there is a mismatch between the delivery of the CERN correction elements to FNAL for insertion into cryostats (in 2001), which will need to be addressed in some timely manner as well.

Upcoming events:

March 18, 1999	HGQ01-05 Magnet Review (FNAL)
March 29, 1999	PAC (NY)
March 31, 1999	Collaring Press Review (FNAL)
April 8, 1999	DOE Review (FNAL)
April 12-16, 1999	AP Beam Beam Workshop (CERN)
April 15-16, 1999	Machine Luminosity Workshop (CERN)
April 21-22, 1999	CERN-KEK-FNAL Meeting (FNAL)
May 6-7, 1999 (tentative)	AP Correction Scheme Workshop (BNL)
July 12-16, 1999	Cryogenic Engineering Conference (Montreal)

WBS 1.1.1 Level 3 IR Quad (A. Zlobin)

Activity in February was focused on the fabrication of HGQ05, R&D activity, preparation to the HGQ program review.

HGQ05 fabrication has been completed by February 24 according to the plan. The test results obtained on the mechanical model #5 have been used to determine the shim sizes required to provide the target prestress ~60/70 MPa in the inner/outer coils. However, the strain gauge readings after collaring indicated that the final room temperature prestress in the inner layer was ~80 MPa which is higher that target and outer layer prestress was ~50 MPa which is slightly lower than target. End cans have been attached to the end plates and bullet load at room temperature was ~2000 lbs per bullet. Production tests were successful. Magnet cold tests will start in March.

The correction of the HGQ short model R&D program and schedule have been done. Additional two models HGQ08-09 have been added. HGQ06-07 will be used to optimize the magnet training and to tune file d quality. Last two models will have the final design and will be used to test the performance and field quality reproducibility. The program to be completed in October 1999.

Several practice coils made of modified inner cable and new G11 end parts have been made. These coils are used to test the new 5-block end part design, to adjust the coil size/modulus and to solve the G11/Kapton adhesion problems. Several inner and outer coils have been fabricated using the pre-baked cables. Cables have been pre-baked at 190C during 0.5 hour in the air atmosphere. These coils have demonstrated much lower shrinkage after curing than coils made of un-prebaked cable.

However, noticeable cable cross-section deformations after pre-baking were observed. To study the problem approximately 60 m long piece of the pre-baked outer cable was sent to LBNL for re-sizing. Pre-baked cable size should be checked and then a half of the length will be re-sized to the nominal size and another half to the size with a mid-thickness reduced by 10 microns. This cable then will be baked again at Fermilab and the cable shrinkage will be measured. A sample (~20-30 m long) of the inner/outer cable made of heat-treated (pre-baked) strands has been also ordered. Strand heat treatment cycle will be 190C during 0.5-1 hour as during cable pre-baking. To study the effect of cable fabrication procedure a short length (~10-30 m) of 45 strand cable made in two passes (first pass with an intermediate cross-section and low packing factor ~ 80% and second pass in the opposite direction with the nominal cross-section) has been ordered at LBNL.

The cable stability R&D program has been started in February in collaboration with BNL and LBNL. Inner and outer cable short samples planned to use in HGQ06-09 will be tested at BNL. The goal of this program to justify the HGQ cable design.

WBS 1.1.5 IR Layout and Integration (M. Lamm)

No report this month.

WBS 1.4.2 Accelerator Physics (T. Sen)

- Influence of the beam-beam interactions on the dynamic aperture.

We started to look at the importance of the beam-beam interactions. The crossing angle of 300micro-radians was chosen in a study done about two years ago. The long-range beam-beam interactions were approximated as all occurring at the same phase advance from the IP and the beam sizes were approximated to be round. Both of these approximations over-emphasize the strength of the long-range interactions. In addition, the field harmonics of the IR quadrupoles at that time were significantly different from the current values. We are now modeling the long-range interactions as precisely as possible with the beam-beam kicks occurring at each of 30 locations in each of the high luminosity IRs and the beam sizes determined accurately. Two different codes are being used: TEVLAT (developed at Fermilab) and SIXTRACK (developed at CERN). The aim is to choose the crossing angle that maximizes the dynamic aperture when both the field harmonics of the IR quadrupoles and the non-linear kicks of the beam-beam interactions are taken into account. This work will be reported at the PAC conference in late March.

- Energy deposition studies.

1) A lot of detailed Monte Carlo simulations on power density, accumulated dose and residual dose rates for the TAS, TAN, inner and outer triplet components in the agreed IP1/IP5 configurations to be presented at the TAS/TAN review at CERN on March 2.

2) Further studies of accidental beam losses in IP5 with emphasis on the machine/detector interface.

WBS 1.5.1 US-LHC Management (J. Strait)
WBS 1.5.3 FNAL-LHC Management (J. Kerby)

Start of preparations for BCRs 07 and 08 (MTF current leads and Heat Exchanger Test Cell) are well underway, with considerable assistance from Doug Fisher and Phil Pfund. Preparation of the base material, including schedule and task list, for BCR010 (extended 2m model R&D program) has begun. Reporting through the CSCS system is in place and working rather well. Only minor corrections were made last month.