SSC DETECTOR SOLENOID DESIGN NOTE #1

TITLE: Rationalization of Some Early Decisions

AUTHOR: R.W. Fast

DATE: Dec 30, 1987

CONDUCTOR--COIL DESIGN

Two general types of conductors were considered: (1) a "hollow" conductor, cooled by an internal flow of liquid helium, and (2) a monolithic, bath-cooled conductor.

Internally Cooled Conductors

Internally cooled conductors have been used for the CERN Vertex Magnet, the SULTAN test facility magnet at SIN and for both the Euratom and Swiss LCT coils. This type of conductor seems well matched to the 4.5 K, 4 atm helium cooling system planned for the SSC ring magnets, which uses a pump to circulate sub-cooled liquid through the magnets. Coils using this type of conductor typically have several, sometimes many, parallel coolant flow circuits, which necessitates the use of insulators ("isolaters" in the CVM). This type of coil does not have a helium vessel and the coils are usually self-supporting, both of which are simplifying features. The stability of coils using such conductors is reasonably well understood (neither of the European LCT coils has quenched).

We have moved away from this type of conductor and coil design primarily because there is no solenoid magnet of this type large enough to serve as a model for extrapolation. The reliability of the isolaters also worried us. We also realized that the detector magnet would probably have its own refrigerator which could have different specifications from the ring refrigerators.

Bath-Cooled Conductors

The Cu/Nb-Ti monolithic conductor has historically been the choice of most designers of large magnets, from the 12-foot Argonne and 15-foot Fermilab bubble chambers to the LCT coils (three of which use this type of conductor) and the MFTF. Modern conductors of this type usually have a Rutherford cable soldered to additional copper stabilizer. For the AMY magnet at KEK, Hitachi developed a Nb-Ti/aluminum/copper composite monolith. The stability of such conductors in coil packs is very well understood, with much theoretical and experimental work done recently for the LCT and MFTF coils.

Although the helium vessel required by a coil made from such a conductor may result in additional cost, it does enhance the modularity of a large magnet. This type of coil can be cooled by a completely passive thermosiphon.

The solenoid coils of the MFTF are 5 m in diameter X 1.6 T. They are cryostable, bath-thermosiphon cooled coils with a simple Nb-Ti/Cu conductor. We believe that some important features of the SSC detector solenoid could be extrapolated from these magnets and so have pretty much rejected internally cooled conductors in favor of bath-cooled ones.

MODULARIZATION

Of Vacuum Vessel

The 16-m long SSC detector magnet will consist of two independent modules. At the present time we conceive each 8-m module as consisting of several coil modules inside a common vacuum vessel. This is a departure from the 1987 Aspen proposal which further modularized the vacuum vessel. We think that the axial forces on the coil will be less if the coil modules are closer together inside a longer vacuum vessel.

Of Coil and Helium Vessel

The length of the coil-helium vessel module will probably be determined by fabrication and transportation considerations.

SUPPORT OF CALORIMETRY

From Inner Vacuum Shell

It seems possible to support the 5000 tons of calorimetry inside the magnet bore from the inner vacuum shell and annular end flanges. This method ties the magnet vessels and the calorimetry together in a way which may be disadvantageous.

Independent of Magnet Vessels

We are presently investigating the concept of supporting the calorimetry directly from the iron yoke, independent of the magnet vessels. This will probably require enlarging the bore of the magnet to accomodate the calorimeter support structure, but the simplicity of a separated-function system may outweigh the disadvantages of the larger magnet. It is not obvious at this point whether this method would be more costly than the alternate.