# Committee Report
# STAR Magnet Coil
# Final Design Review
# February 15, 1994

**Review Committee:** Bill Edwards (LBL, Chair), John Mark (SLAC), Al Pendzick (BNL)

## Introduction

Members of the STAR magnet design team made presentations to a final design review (FDR) committee on February 15, 1994 at BNL. The team discussed the coil detail drawings, specifications and the status of other magnet system elements which interface with the coil operation. The committee charge, review agenda, presentation materials and action items may be found in the Coil FDR binder in the STAR Project Office at LBL. This was the last formal STAR technical review of the magnet coils prior to the release of the request for proposal (RFP) package to potential coil fabricators.

The information provided by the magnet design team enabled the committee to conduct an effective FDR of this major technical procurement. The committee members would like to express thanks to the presenters and the magnet design team for making our job easier.

## Executive Summary

The committee found that the design presented addressed the significant issues necessary for a coil vendor to produce the STAR Magnet Coil. It was felt that the coil design, as specified, will meet or exceed the STAR detector's technical requirements. In fact, the committee members often found themselves asking, "are there alternatives which could make the procurement less expensive while still meeting the technical requirements?"

The "issues and findings" are, therefore, recommendations related to areas in which we think that cost savings may be realized by modifying the specifications. It is believed that by allowing potential coil vendors to use their own tools or methods of fabrication and testing, the vendors would offer standard bid rates for portions of the job, and more vendors would be able to make bids. This list of recommendations is by no means exhaustive. The committee strongly recommends that the magnet team assign someone to simplify or minimize the specifications by asking "what is the benefit, and at what potential cost?"

Additionally, the committee suggests that the magnet team now develop more detailed plans for the ancillary equipment such as the cooling system and the power supplies.

In summary, the committee found no outstanding critical technical issues that need to be addressed prior to releasing the RFP to potential bidders. The rest of this report will identify several areas in which the committee believes bid costs could be lowered by reducing the scope of the technical specifications of the magnet coils.

**Critical Issues/Findings**

In general, all significant issues were addressed by the presented design. If built according to the current drawings and specifications, the coil would meet or exceed the physics requirements of the STAR Magnet System. As stated above, the findings listed here represent areas where the cost of the coils could be reduced.

- Is there significant justification for the 0.020" (0.5mm) flatness specification used on the main and space trim coil drawings? The coil z or beam axis position requirement calls for something less than 1 cm. The committee feels that this will be hard to measure, increase the cost of the fabrication of potting tooling, and has not been sufficiently justified.

- The overall conductor and insulator tolerance stack-up results in a range, as shown on the drawing, of approximately 0.25" in the "z" axis dimension. This does not represent a range of acceptable finished coil assembly thicknesses for all cases of conductor and insulator thicknesses, and is therefore confusing. The committee thinks that the magnet team should add a paragraph to the winding specification stating that this dimension is a function of the measured conductor "z" dimension, and a reasonable assumption of the nominal compressed insulator thickness (+/- a reasonable assembly tolerance).

- Suggest that the magnet group spend more time reviewing the specifications keeping in mind that specs that allow reduced expense may still meet physical requirements.

**Coil Operating Parameters**

The coil operating parameters, listed below, are appropriately conservative.

| | |
|---|---|
| Cooling water $\Delta P$ | = 120 psi |
| Cooling water $\Delta T$ | = 20 °F |
| Cooling water velocity | = 10.5 ft/sec |
| Design current | = 4744 Amps |

Total voltage = 607 Volts
Conductor current density = 1320 Amps/$in^2$

Issues such as coil supports, provisions for thermal expansion, magnetic loading and water conductivity were addressed in the magnet system PDR and have been investigated to the extent that any future changes should not affect the coil design or the coil RFP process.

**Interface w/ Cooling System**

The committee considers the interface of the coil with the cooling system to be straightforward and reliable. The use of a stainless steel fitting connected to the aluminum conductor and sealed with an adjustable O-ring fitting should be leak free for the life of the magnet hoses. The use of an aluminum alloy for the threaded area is commended.

**Interface w/ Power Supplies**

There should not be a power supply issue that will interrupt the coil RFP process. A more detailed power supply design is needed and should be pursued as soon as possible. When this begins, special attention should be paid to the following coil protection issues:

- dumping the coil stored energy in a magnet crash
- ramp up/ramp down circuits
- cooling water flow measurement
- DC power limiting and disconnect device
- coil outlet temperature measurement

Redundancy should be considered in each of these cases.

**Coil Details**

The drawings presented at the review may be sufficient to construct the coils, but it takes considerable study to determine the difference between type A and type B coils. Neither MAG-111 nor MAG-112 details the tapered filler that is required to lead the inner turns to the proper position. This piece should be detailed and its materials included in the spec. The filler pieces for the outer part of the coil are less important, but it is recommended that a drawing be developed for each of these as well.

The material call-outs should be more specific. Referring to insulation material as "paper" (see specs) could be replaced by "0.015 insulation material," "Macallen Polymat 100," "DMD-100," "5-5-5," or an approved equal. It may also help to be more specific about the glass tape for item 3 (i.e. manufacturer and item name and number or equal).

Because the differences between type A and type B coils are slight, it would help ensure correct fabrication if a pictorial representation were developed that shows schematically how the left and right hand turns were connected so that the current flows correctly through the whole assembly.

The coil specifications as modified with the action items we discussed should be sufficient for vendors to develop their proposals.

**Procurement Plan**

Because the coils are well specified and the manufacturing process is well known, the committee would normally suggest a Request for Quote process. But, because the coils are not on the critical path, the Request for Procurement process gives more freedom to choose the most technically appropriate vendor and is therefore a better option.

No mention was made of the pole tip coils. They may be of a similar design and fabrication technique. From an overall cost perspective, it may be advantageous to include them in this RFP if time permits. On the other hand, because these coils are smaller, many more vendors should be able to fabricate them, and the price may be lower if a separate quotation is allowed. Some investigation of the pros and cons of each may be warranted.

**Coil Schedule**

The schedule presented for the coil procurement and installation is appropriate for the long term planning purposes for which it is intended. The committee found it to be as good an estimate of the "on-line" date for the magnet as can be given at this time.

However, the committee suggests that the magnet team now develop more detailed plans for the ancillary equipment such as the cooling system and the power supplies. It is possible that the "slack time" thought to exist in these efforts may by now be insignificant when a realistic schedule is completed. For example, consider the power supply tasks on the magnet schedule. After adding the process of extracting the requirements information from all the involved parties, and the time required to initiate a major procurement, a realistic procurement time and the necessary preparation, installation and check-out tasks, what was thought to be 12 to 18 months of slack may really be 0-6 months.