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Statement-of-Work for the engineering design of the Hall-D Tagging Magnets and Vacuum Chamber system

This statement-of-work is to develop detailed engineering drawings and all required material calculations for the Hall-D Tagging Magnets and Vacuum Chamber system based on the design goals stated in version 5 of 9/xx/07 of the document titled "Hall D Tagged Photon Spectrometer: Technical Description and Specification"[1] and the conceptual design drawings provided by Jefferson Lab, University of Glasgow [2], and Institute for High Energy Physics in Moscow [3].
The scope of this statement-of-work will be detailed in the following section. The separation of engineering design and fabrication is required according to the procurement rules of the U.S. Department of Energy. The contractor for this statement-of-work is allowed to bid for the contract to manufacture the system.

The Hall-D Tagging Magnets and Vacuum Chamber system includes the following parts:
a) Two dipole magnets including coils and cooling system
b) Vacuum box including flanges for thin windows and external supporting structures
c) Quadrupole magnet including coils and table support
d) Strongback support structure for the dipoles and the fixed-array hodoscope. The design of the hodoscope is not part of this contract.

The engineering design includes detailed drawings of all parts of the system such that these design drawings can directly be used to manufacture the parts. A finite elements analysis has to be performed for all parts that are subjected to strong magnetic forces and/or connected to the vacuum box. The goal is in particular an optimization of the number and position of fasteners (bolts and brackets) holding the magnet yokes and pole shoes and vacuum box in place as well as the rib structure for stiffening the vacuum box. The design drawings for dipole magnets shall include two versions: (i) upper and lower magnet yokes made out of one single piece each, (ii) upper and lower magnet yokes assembled out of steel plates.

The magnetic field calculations of the quadrupole and two-dipole magnet system performed at the University of Glasgow shall be used to calculate the forces and to define machining and fabrication tolerances for the magnets and support structure. If additional calculations are needed, these should be requested along with the revised list of drawings that need to be produced.

This statement-of-work requires deliverables in 4 stages. Detailed discussions between designers and Jefferson Lab personnel / Hall-D collaborators are required at every stage.

Stage 1 – evaluation of conceptual design drawings
This assessment includes a list of design drawings, which are part of the conceptual design. Full compliance with the conceptual layout described in references [1] and [2] and the results of the review of this stage are mandatory for further progress.

1. Top level drawings of complete system including quadrupole, two dipole magnets, vacuum system and strong-back support.
2. Vertical section through a dipole showing how the pole shoes and yoke parts fit together.
3. Top view of a dipole showing the numbers, sizes and locations of the bolts required to hold the structure together.
4. Individual drawings for the pole shoes, top and bottom yokes and back yoke, showing details of bolt locations, flatness of surfaces and tolerances - including the vacuum sealing lips round the pole shoes, and pole profiles.
5. Individual drawings of the pole shoes showing where the fixing holes for taking the vacuum tensioning brackets and the coil support brackets are located.
6. Drawings showing the different types of brackets as required by further refinement of design. For example, the brackets which hold the dipole coils in position should extend over the top of the upper coils.
7. Layout of vacuum chamber showing how top and bottom lids, back wall and output flange are welded together. The input port and the photon beam and main electron beam output ports shall also be shown.
8. Individual drawings of the top and bottom lids, and the back-wall of the vacuum chamber showing where the fixing holes for taking the vacuum tensioning brackets are located.
9. Top and side view drawings for the quadrupole magnet and its table support.
10. Top and side view drawings for the strong back support for the dipole magnets and fixed-array hodoscope.
11. Drawings showing assembly and disassembly of magnet, including features which allow this sequence of activities. For example, tapped holes for attaching jacking supports to the dipole yokes for use in the assembly and disassembly of the dipoles have to be added.

Stage 2 – engineering design of the dipole magnet
The complete engineering design of the dipole magnet shall be performed including FEA of the energized magnet. Special care has to be taken for the pole shoe design and the attachment of the vacuum box. The design drawings for dipole magnets shall include two versions: (i) upper and lower magnet yokes made out of one single piece each, (ii) upper and lower magnet yokes assembled out of steel plates.

Stage 3 – engineering design of the vacuum chamber
The complete engineering design of the vacuum box shall be performed including a finite element analysis showing that the rib structure for stiffening the vacuum box is optimized.

Stage 4 – engineering design of the quadrupole and strong back support
The complete engineering design of the quadrupole and strong back support structure shall be performed. The engineering design include as well the table support for the quadrupole. The strong back support has to be extended in order to hold the support structure of the fixed-array hodoscope.

[1] Hall_D_Tagger_Spec_v4.doc (gluex document ….)
[2] AutoCAD drawing: http://nuclear.gla.ac.uk/~yang/HallD/tagger_design.dwg;
Presentations: ….
[3] IHEP AutoCAD drawings ….