

## Study and demonstration of RRP-217 0.85 mm strand for QXF (in collaboration with CDP and LARP)

A.V. Zlobin, L. Cooley

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### 1. Work goals.

The ultimate goal of this work is to demonstrate the performance of the RRP-217 strand 0.85 mm diameter, its readiness for use in a QXF long prototype and, eventually, as a baseline conductor for the QXF magnet production. This work will also contribute to the development and demonstration of QXF coil design and technology including its components such as the cable design and fabrication, the cable insulation, the radiation hard impregnation material, etc.

The work include RRP-217 round and extracted strand study; development, fabrication and test of sub-sized and QXF Rutherford cables including the cable insulation; development, fabrication and commissioning of a quadrupole mirror for the QXF coil tests; fabrication of 1-2 QXF short coils and testing them in a mirror configuration.

The work is planned for FY13-FY15 and will be performed in collaboration with CDP and LARP. CDP and LARP will provide RRP-217 strand in amount sufficient for strand and cable samples, and 2-3 ULs of cable for QXF short coils. LARP will procure QXF coil parts and provide winding-curing-reaction-impregnation tooling for the coil fabrication at Fermilab.

### 2. Work plan:

FY13:

- Study of round and rolled strand samples from the available CDP RRP-217 strand inventory (these are 0.778 mm diameter and smaller). In the future, emphasis will be given to strand diameters of 0.8-1 mm, undertaking development and fabrication of sub-sized cable samples using the 0.85 mm RRP-217 strand and extracted strand test after discussion with CDP about strand availability.
- QXF cable tooling development and procurement.
- Development of the QXF mirror design concept (magnetic and mechanical design and analysis).

FY14:

- Qualification of Fermilab cabling facility for QXF, or full disclosure of previous cabling work (e.g. for 11 T cable) that argues for qualification. One possible qualification route is to fabricate cable per QXF spec with new tooling and RRP-127 strand (which will be available late FY13 / early FY14) or RRP-169 strand.
- Study of round and rolled RRP-217 CDP strand samples with optimized sub-element (Sn content, thicker barrier) after coordination with CDP.
- Fabrication of sub-sized cable samples using the optimized 0.85 mm RRP-217 CDP strand and extracted strand test in Q3, if the strands will be available in April.
- Fabrication of QXF cable samples using RRP-169 and RRP-217 strands and extracted strand test as soon as the cable tooling and the 0.85 mm strand are available.

- Fabrication of 1-2 ULs of QXF cable using optimized RRP-217 0.85 mm CDP strand, round and extracted strand test in Q4.
- SC transformer modification and QXF cable short sample test.
- QXF mirror engineering design and procurement.
- Fabrication of the 1<sup>st</sup> QXF coil using optimized RRP-217 CDP strand and test in the QXF mirror. The opportunity to start with RRP-169 strand cable will be evaluated later in FY14.

FY15:

- Study of round and rolled strand samples with optimized LARP RRP-217 strand (RRR, Cu:nonCu, number of sub-elements).
- Fabrication of 1-2 ULs of QXF cable using optimized LARP RRP-217 0.85 mm strand, round and extracted strand test.
- LARP RRP-217 QXF cable short sample test using SC transformer.
- Fabrication and test of the 2nd QXF coil using LARP RRP-217 strand.
- Data analysis and report writing.

3. Work cost.

The preliminary total estimated cost of the work for Fermilab's GARD is shown in the following table:

	FY13	FY14	FY15	Total
Labor (FTE)	~0.5	~2.5	~2	~5
M&S (k\$)	~20	~130	~150	~300
Total (k\$)	120 k\$	630 k\$	550 k\$	1,300 k\$

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