

LARP

TQ1a-based Studies and Design Optimization

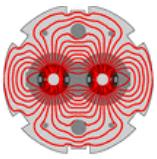
Shlomo Caspi

Port Jefferson

04/05/2005



Superconducting Magnet Group



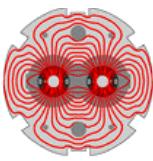
LARP

Three future plans for TQ1a



Superconducting Magnet Group

S. Caspi



TQ1a- future plan - I

LARP

- Fabricate and test a second coil similar to TQ1a (TQ1a-2)
 - Minor changes and perhaps different conductor
 - Assemble and test in existing structure

Motivation

Need additional magnets to demonstrate Nb₃Sn reliability

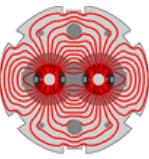
New TQ1a coil		FTE PIE	DIT	Labor	M&S	M&S+G&A	Total
Design & Analysis				\$ -			\$ -
Baseline design		0.05	0.02	\$ 12,000			\$ 12,000
Analysis & optimization							
Assembly drawings							
Tooling (Design, M&S and Ass'y)							
Manufacturing							
Cavities							
Reaction							
Polishing							
Splines							
Ground insulation fixture							
Tooling modifications/optimization		0.02	0.05	\$ 11,100	\$ 5,000	\$ 5,850	\$ 16,950
Parts (design and procurement)							
Shims					\$ 30,000	\$ 35,100	\$ 35,100
Insulation					\$ 3,000	\$ 3,510	\$ 3,510
Coil (wedges, spacers)					\$ 32,000	\$ 37,490	\$ 37,490
Curing epoxy					\$ 2,000	\$ 2,340	\$ 2,340
Splices					\$ 4,000	\$ 4,680	\$ 4,680
Ground insulation					\$ 2,000	\$ 2,340	\$ 2,340
Quartz Heaters and traces		0.04	0.02	\$ 6,000	\$ 1,000	\$ 1,170	\$ 7,170
Impregnation epoxy					\$ 5,000	\$ 5,850	\$ 5,850
Shells							
Voids							
Pads/inserts							
Crucible and plates							
Blades/keys							
Instrumentation, drawings, connectors					\$ 3,000	\$ 3,510	\$ 3,510
Fabrication					\$ 2,000	\$ 2,340	\$ 2,340
Cable fabrication		0.02	0.05	\$ 11,100	\$ -		\$ 11,100
Cable assembly and insulation					\$ 1,000	\$ 1,170	\$ 1,170
Coil winding/tensioning		0.05	0.02	\$ 7,500	\$ -		\$ 7,500
Manufacturing model assembly/test/analyisis		0.10	0.05	\$ 78,000	\$ -		\$ 78,000
Reactions							
Splicing, documentation		0.04	0.20	\$ 37,200	\$ -		\$ 37,200
Post-tensioning					\$ 1,000	\$ 1,170	\$ 1,170
Coil winding/tensioning		0.08	0.24	\$ 46,800	\$ -		\$ 46,800
Sub-Assembly (parts)		0.01	0.02	\$ 4,800	\$ -		\$ 4,800
Sub-Assembly (assembly)		0.01	0.02	\$ 4,800	\$ -		\$ 4,800
Final Assembly (cold mass)		0.02	0.05	\$ 11,100	\$ -		\$ 11,100
Electronics		0.01	0.02	\$ 4,800	\$ -		\$ 4,800
Travelers/Procedures		0.05	0.10	\$ 24,000	\$ -		\$ 24,000
Production support		0.01	0.02	\$ 4,800	\$ -		\$ 4,800
Assembly data analysis		0.05	0.08	\$ 14,400	\$ -		\$ 14,400
Test							
Test preparations		0.05	0.05	\$ 16,500	\$ -		\$ 16,500
Magnet test		0.10	0.20	\$ 48,000	\$ 20,000	\$ 23,400	\$ 71,400
Analysis and reporting		0.10	0.05	\$ 16,000	\$ -		\$ 16,000
Total					\$ 368,500	\$ 126,945	\$ 515,445

(515 k\$)



Superconducting Magnet Group

S. Caspi



LARP

TQ1a- future plan - II

- Investigate parameter range
 - Retest TQ1a with different transverse and axial pre-stress – 162 k\$
 - Coil exchange - Retest Tq1b coils in LBNL structure 262 k\$

Motivation

Parameter impact on magnet performance and training

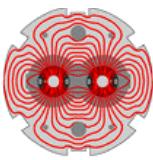
Change pre-load in TQ1a		FTE	DIT	Labor	M&S	M&S+G&A	Total
Design & Analysis							
Modeling							
Analysis & Optimization							
Mechanical drawings							
Tooling (Design, M&S and Ass'y)							
Manufact							
Cavities							
Reaction							
Baffles							
Shims							
Ground insulation fixture							
Parts design and procurement							
Insulation							
Coil (windings, spacers)							
Curing epoxy							
Solder							
Ground insulation							
Coating							
Desoldering and fracas							
Impregnation epoxy							
Solder							
Tote							
Packsheets							
Z-rods, end plates							
Bobbins							
Instrumentation, drawings, connectors							
Packing							
Cable fabrication							
Cable drawing and insulation							
Coil winding							
Mechanical assembly/test/analysis							
Reaction							
Solder							
Potting							
Solder							
Shells/keys Assembly							
Disassembly							
Parasitic reduction/optimization							
Final Assembly (cold mass)							
Electrical test							
Temperature sensors							
Production reports							
Assembly and analysis							
Test							
Test preparations							
Magnet test							
Analysis and reporting							
Total				\$ 129,600	\$ 37,760	\$ 162,360	

TQ2a coils in TQ1a structure		FTE	DIT	Labor	M&S	M&S+G&A	Total
Design & Analysis							
Modeling							
Analysis & optimization							
Mechanical drawings							
Tooling (Design, M&S and Ass'y)							
Manufact							
Cavities							
Reaction							
Baffles							
Shims							
Ground insulation fixture							
Parts design and procurement							
Insulation							
Coil (windings, spacers)							
Curing epoxy							
Solder							
Ground insulation							
Coating							
Desoldering and fracas							
Impregnation epoxy							
Solder							
Tote							
Packsheets							
Z-rods, end plates							
Bobbins							
Instrumentation, drawings, connectors							
Packing							
Cable fabrication							
Cable drawing and insulation							
Coil winding							
Mechanical assembly/test/analysis							
Reaction							
Solder							
Potting							
Solder							
Shells/keys Assembly							
Disassembly							
Sub-Assembly (proto)							
Shell Assembly							
First Assembly (cold mass)							
Electrical test							
Temperature sensors							
Production reports							
Assembly and analysis							
Assembly data analysis							
Test							
Test preparations							
Magnet test							
Analysis and reporting							
Total				\$ 222,000	\$ 39,780	\$ 261,780	



Superconducting Magnet Group

S. Caspi



LARP

TQ1a- future plan - III

Extend TQ1a technology to a 4-layer magnet (2175 k\$)

- Design a new structure and optimize a 4-layer cross-section
- Design new tooling for a outer layer (3-4)
- Wind assemble and test outer layer 3-4 (TQ1b)
- Assemble and test first 4 layer magnet - TQ1a and TQ1b
- Wind assemble and test a optimized inner layer 1-2 (TQ1c)
- Assemble and test a field quality 4 layer magnet - TQ1b and TQ1c

Motivation

Push the gradient above 300 T/m (over 15T)



Superconducting Magnet Group

S. Caspi