US LHC Accelerator Research Program

bnl - fnal- lbnl - slac

LARP Magnet Program

S. Gourlay

LARP Collaboration Meeting

Port Jefferson

April 6, 2005

Directives

DOE Guidance

"It is our firm intention that the LARP activities serve to explore the limits of the technologies described herein. While the end products of LARP will be applied to the LHC, LARP is not intended to be an engineering or construction service organization to that facility."

"The LARP is not intended to replace existing base program support at the various laboratories in superconducting magnet development and other ongoing areas."

Directives

CERN Guidance Letter from Lucio Rossi

"We strongly believe that the major steps in the near term are:"

"Construction of a quadrupole model, full cross-section, with parameters that are really significant for the LHC upgrade : G ³ 250 T/m , f ³ 90 mm (of course the larger the better). "

"Construction of simple systems that may address the long magnets issues."

"The manufacturing of a successful *prototype* for 2009 is real vital to the whole magnet program, on both side of the Atlantic. Year 2009 is crucial since, according to the today plan set by the CERN DG, is when basic decisions on CERN future large projects will be taken . . ."

Ruggiero et al, EPAC 04

"Nb_3Sn technology
- appears to be the only candidate for a substantial improvement
- could open upgrade scenarios such as 'dipole-first'"

"Important issues related to long Nb_3Sn magnets need to be addressed by vigorous R&D"

The effective Nb_3Sn filament diameter (>100 μ) is too large" (Material development required.)

"The choice of the coil aperture is driven more by the power density limit than by the beam acceptance"

"An estimate of the radiation parameters of the magnets requires extensive simulations based on detailed knowledge"

Magnet Program Priorities

- Quads – no short model → no long model
- Long magnet – no long model → no LHC upgrade
- Conductor and Cable support

Target Program

	Length [m]	Aperture [mm]	FY05	FY06	FY07	FY08	FY09
Model Magnets							
Quads							
High Gradient (costheta)	1	90		X X	X	X	
Large Aperture Quad	1	~120			X	X X	X
Field Quality	2						X X
Long Length, High Gradient	4						X
Dipoles							
Open Mid-Plane PoP	1					X	X
Supporting R&D							
Sub-Scale Tests			X X	X X	X X	X X X	X X
Long Coil Tests					X	X X	

Working Budget Distribution

	% of Total	$	6,000
Design Studies	9	$	540
Model Magnets			
Quadrupoles	35	$	2,100
Dipoles	5	$	300
Supporting R&D			
Long Magnet Development	18	$	1,080
Sub-Scale R&D	5	$	300
Materials			
Conductor and Cable R&D	10	$	600
Conductor Procurement	10	$	600
Program Management*	8	$	480
Total	100	$	6,000

Program Elements and Timeline

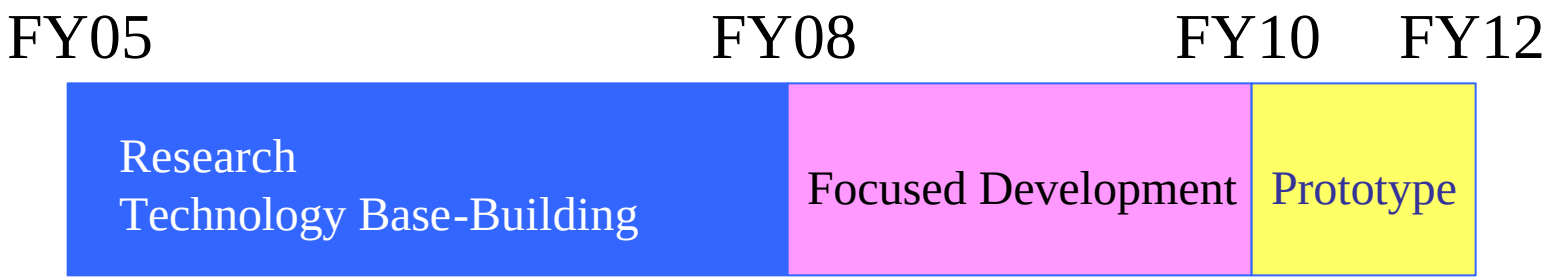
"Three-year plan" to focus initial effort (FY05 – FY07)

Must include development of technology for future US projects

But . . . be conservative and focused enough to meet LHC goals.

Start aggressively

evaluate status and the challenge ahead



Program Distribution

Meet program priorities

Performance/capabilities

Schedule

Cost

FY05 Accomplishments and Status

SQ-01, SQ-01b

- Racetrack quad

TQ1a, TQ2a in process

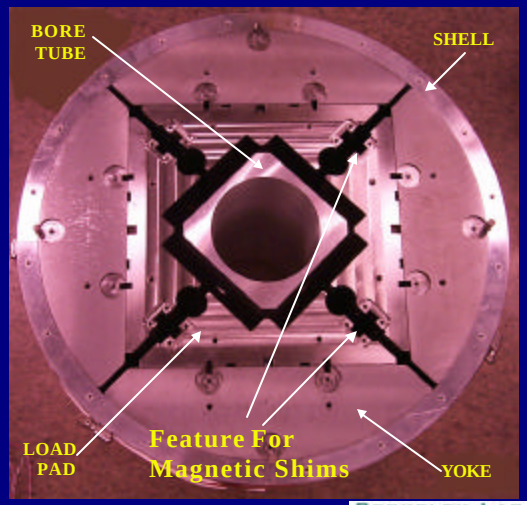
- 90 mm, 220 – 250 T/m
- Investigate support structure options

Design studies

Cable R&D focused on TQ's

SQ-01 Fabrication and Test

Magnet components



SM Quadrupole

- **6061-T6 Aluminum Shell**
- **1018 Steel Yokes**
- **316 Stainless Steel Load Pads**
- **6061-T6 Bore Tube**
- **Feature for Magnetic Shims in Load Pads**

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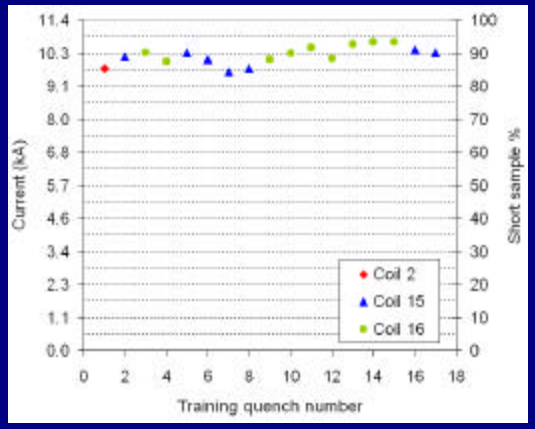
10/19/2004 Superconducting Magnet Group Scott Bartlett

Quench performance



- 4 low LHe quenches
- 17 training quenches
  - **First**: 85 % I_{ss}
  - **Peak**: 93 % I_{ss}
- All quenches but one in **SC15** and **SC16**
- All training quenches triggered by **conductor motion**

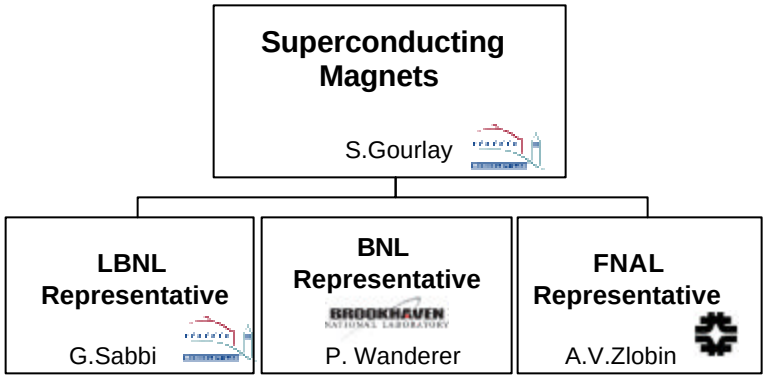
BERKELEY LAB

10/19/2004 Superconducting Magnet Group Paolo Ferracin

Retested at Fermilab this year

Improved preload
2.2 K

Organization



Lab representatives oversee tasks/sub-tasks at host laboratory

Four Working Groups –

Design Studies – A. Zlobin
Model Magnet R&D – G.L. Sabbi
Supporting R&D – G. Ambrosio
Materials – A. Ghosh

Magnet Steering Committee (MSC)

– Define program, identify tasks and assign task managers

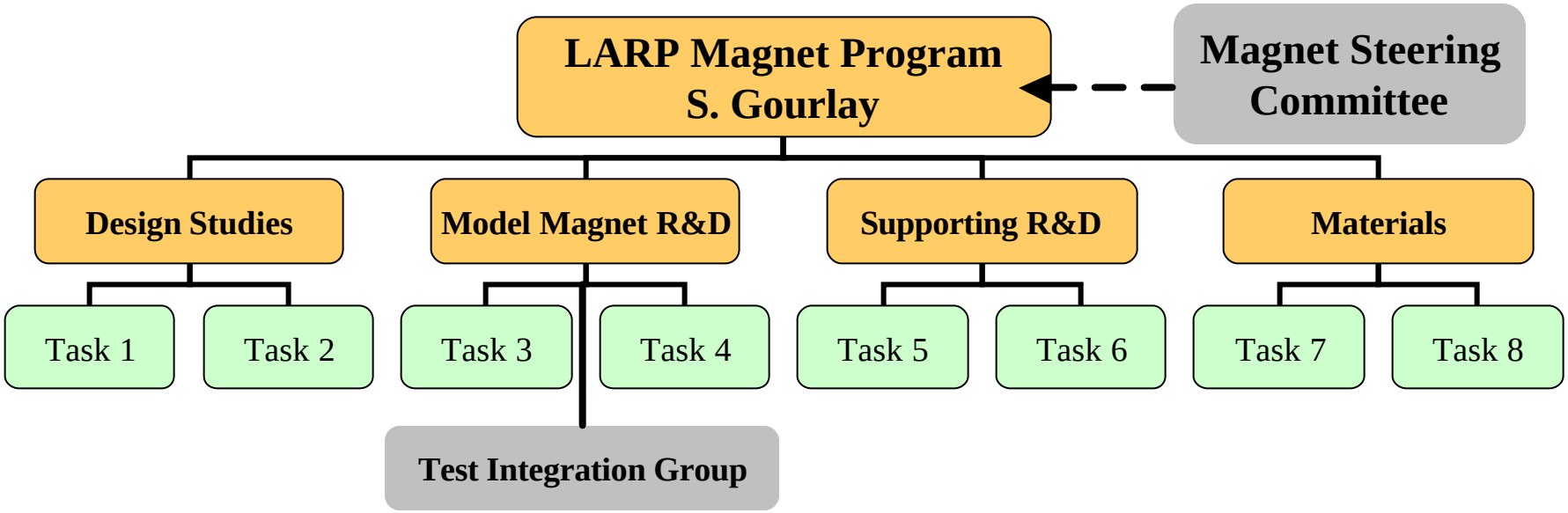
Lab Representatives

G. Sabbi, P. Wanderer, Z. Zlobin

Lab Management Representatives

S. Gourlay, M. Harrison, R. Stanek

Management Structure



Some issues for this meeting

Start the process of developing a more aggressive, integrated program

Long magnet scale-up

Quad program flavor and direction

- 4-layer
- 3-layer
- both?

Bottoms-up cost estimate, realistic scope - defend the budget

Increase frequency of face-to-face meetings

Base Program

Diversity

Development of engineering tools

Conductor development

Adds breadth, depth – take risks

Full FTE capture – mutually beneficial

Provides Infrastructure

Summary

CERN creates context and justification for LARP

DOE funds us

The LARP collaboration needs to develop a program (in the next few weeks) that I can defend to both