BNL -FNAL - LBNL - SLAC

LARP DOE Review
June 12-14, 2006

2.4.2 Conductor Procurement

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Main Goals

- Provide “baseline” material for the magnet program
- Ensure an adequate supply of conductor is always on hand for cable fabrication and coil winding

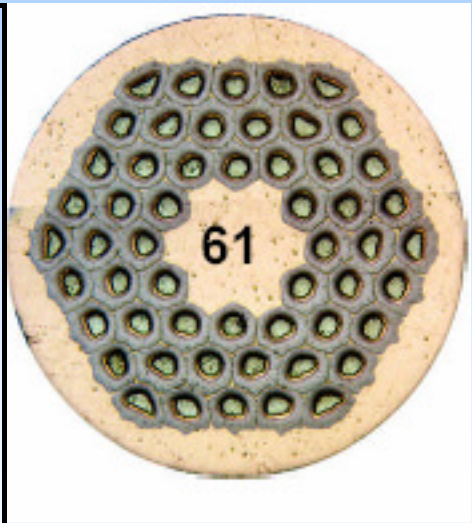
Conductor Procurement Strategy

- Implement plan for conductor that ensures that there is sufficient "production" strand in the pipeline from wire manufacturer for all the magnets to be fabricated in FY06 through FY09.
- Take advantage of the Conductor Development Program to advance the higher risk strand from being an R&D conductor to a "production" strand.
  - Core program R&D

"Baseline Strand"- Specs.

- Use high J_c production wire from Oxford Superconducting Technology, OST
- **R**od **R**e-Stack **P**rocess, RRP 54/61 Design

Process	Ternary RRP Nb_3Sn
Strand Diameter, mm	0.7 ± .003
Jc(12 T) at 4.2 K, A/mm^2	≥ 2400
D_{eff}, µm (based on billet design)	< 70
I_S, A	> 1000 A
Cu-fraction, %	47 ± 2
RRR (after full reaction)	≥ 100
Twist Pitch, mm	14 ± 2
Twist Direction	right-hand screw
Minimum Piece length, m	350
High temperature HT duration, h	≥ 48



Target Program

Model Magnets		Type	Length (m)	Gradient (T/m)	Aperture (mm)	FY05	FY06	FY07	FY08	FY09
Series	Description									
TQ	**Technology Quad**	Cos-2theta	1	> 200	90		$2_N + 1_R$	$2_N + 3_R$	2_N	
LQ	**Long Quad**	Cos-2theta	4	> 200	90				1_N	1_N
HQ	**High Gradient Quad**	Cos-2theta	1	> 250	90					2_N
Supporting R&D		**Type**	**Length (m)**	**Peak Field (T)**	**Aperture (mm)**	**FY05**	**FY06**	**FY07**	**FY08**	**FY09**
Series	Description									
SQ	**Sub-scale**	block	0.3	10 – 11	110	$1_N + 1_R$	$1_N + 1_R$	$1_N + 1_R$	1_N	
SR	**Short Racetrack**	block	0.3	10 – 12	N/A		1_N	1_N	1_N	
LR	**Long Racetrack**	block	4	10 - 12	N/A			2_N		
N = New Magnet										
R = Revised Magnet using existing coils										

Total Conductor Estimate

UL=Unit Length for coil

0.7 mm ➢ 290 m/kg

TQ/LQ 27-strand cable ➢10.4 m/kg

SQ/SR/LR 20-strand cable ➢ 14 m/kg

Series	# of Magnets	Kg/Magnet	# of UL/Magnet	Total
TQ	6	40	6	240
LQ	2	165	7	330
HQ	2	90	14	180

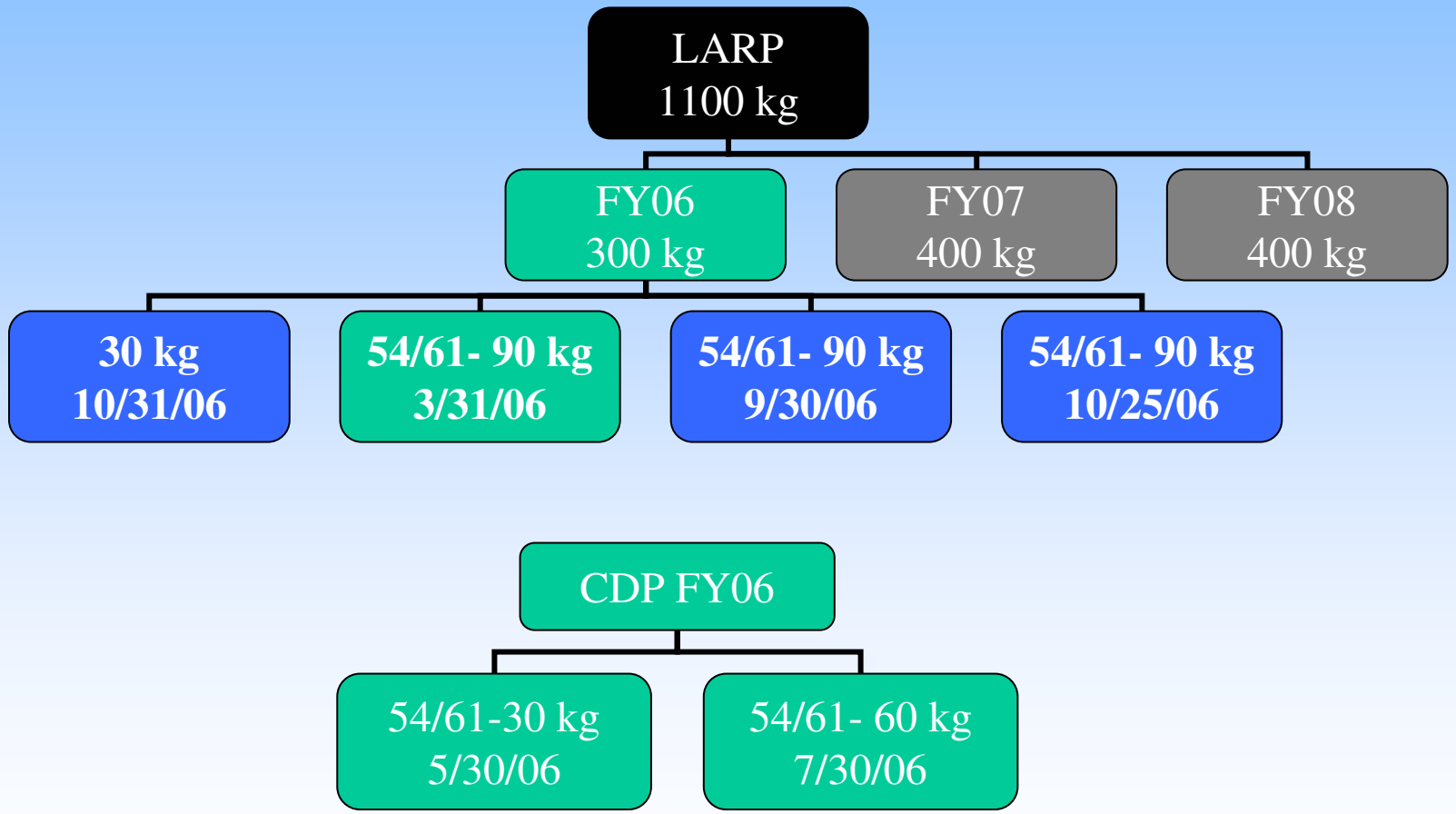
Total Required 1023 kg

Plan for 1100 kg

TQS01/TQC01/SQ02 used
MJR (85 kg from FNAL)

Series	# of Magnets	Kg/Magnet	# of UL/Magnet	Total
PC	2	25	1	50
SQ	4	10	6	40
SR	3	7	3	21
LR	2	81	3	162

3-yr Procurement Plan
Status as of 5-30-06



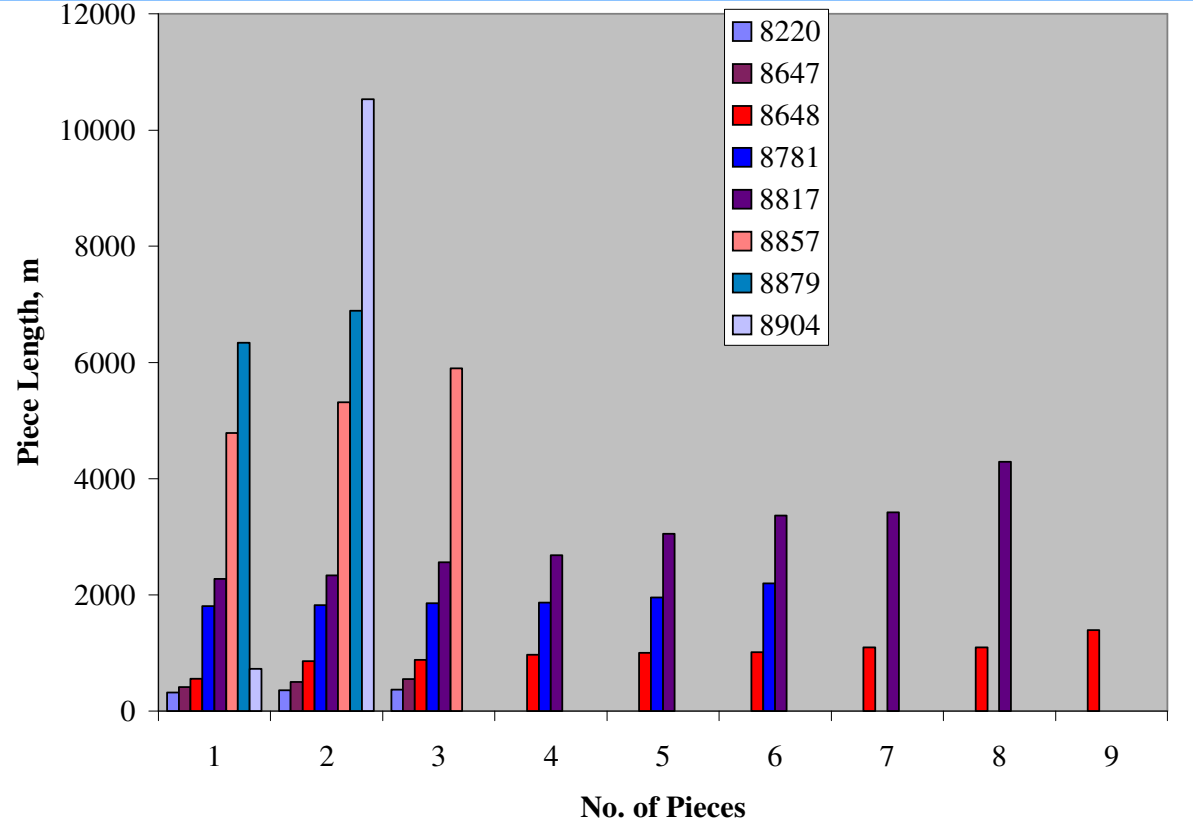
Strand Orders- CDP and LARP

Order Date	Ship Date	Adjusted Ship Date	Quantity	Completed	PO	Program	Billets
	4/1/2005	5/30/2005	30	36.5		CDP	8220
2/28/2005	9/15/2005	11/30/2005	70	72	6720228	CDP	8647, 8648
8/29/2005	3/30/2006	5/7/2006	90	13.6	6802116	CDP	8817
"	"			38.2			8879
				38.4			8904
			190			**CDP**	
11/7/2005	7/2/2006	3/30/2006	90	37.4	6803608	LARP	8781
				16.1			8817
				36.5			8857
1/20/2006	9/6/2006	9/6/2006	90		6804489	LARP	
2/23/2006	11/30/2006	10/25/2006	90		6805346	LARP	
5/31/2006	10/31/2006		30			LARP	
			300			**LARP**	

In FY07 and FY08, the plan is to place an order for 400 kg at the beginning of the fiscal year.

RRP 54/61 –CDP, LARP Production

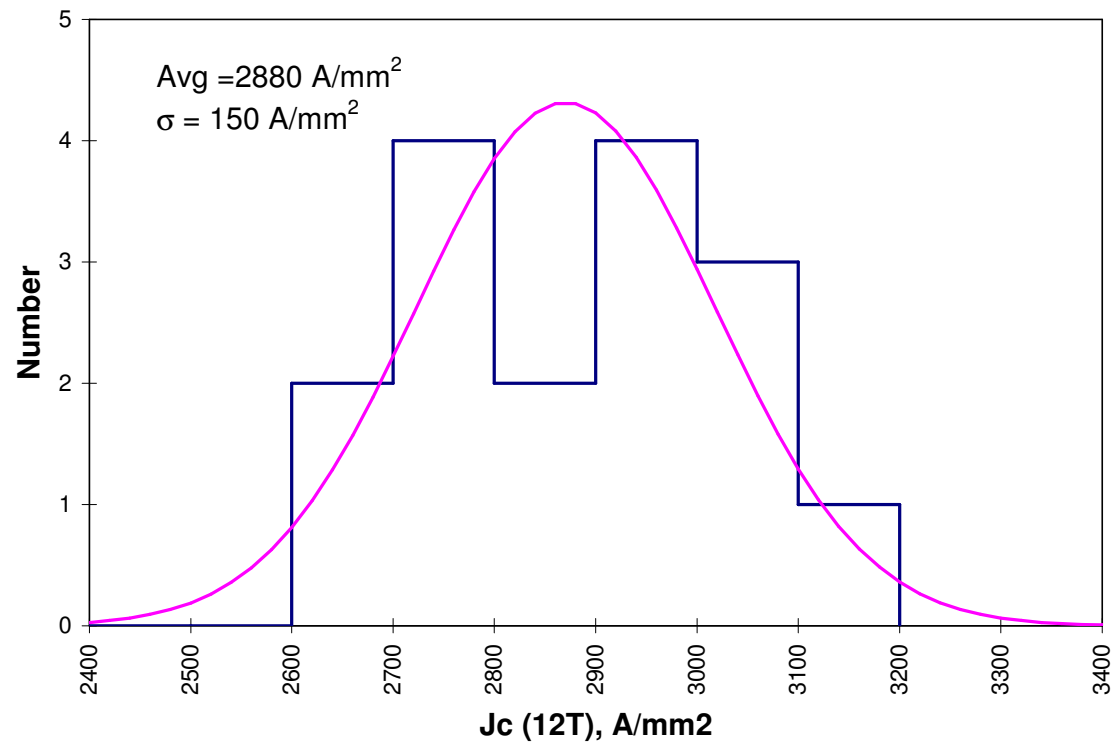
- 296 kg of wire produced for LARP and CDP in the last 12 months, single billet yield is ~ 35kg
- 93 % in lengths >1Km, 62% in lengths >3 km, 12% >10 km



Long lengths ▸ sign of process control and stable production

Wires produced Meets Specifications

- OST Meas. HT 665 ^{o}C/50 hrs
- Average J_c(12T)=2880 A/mm^2
- Average RRR= 189

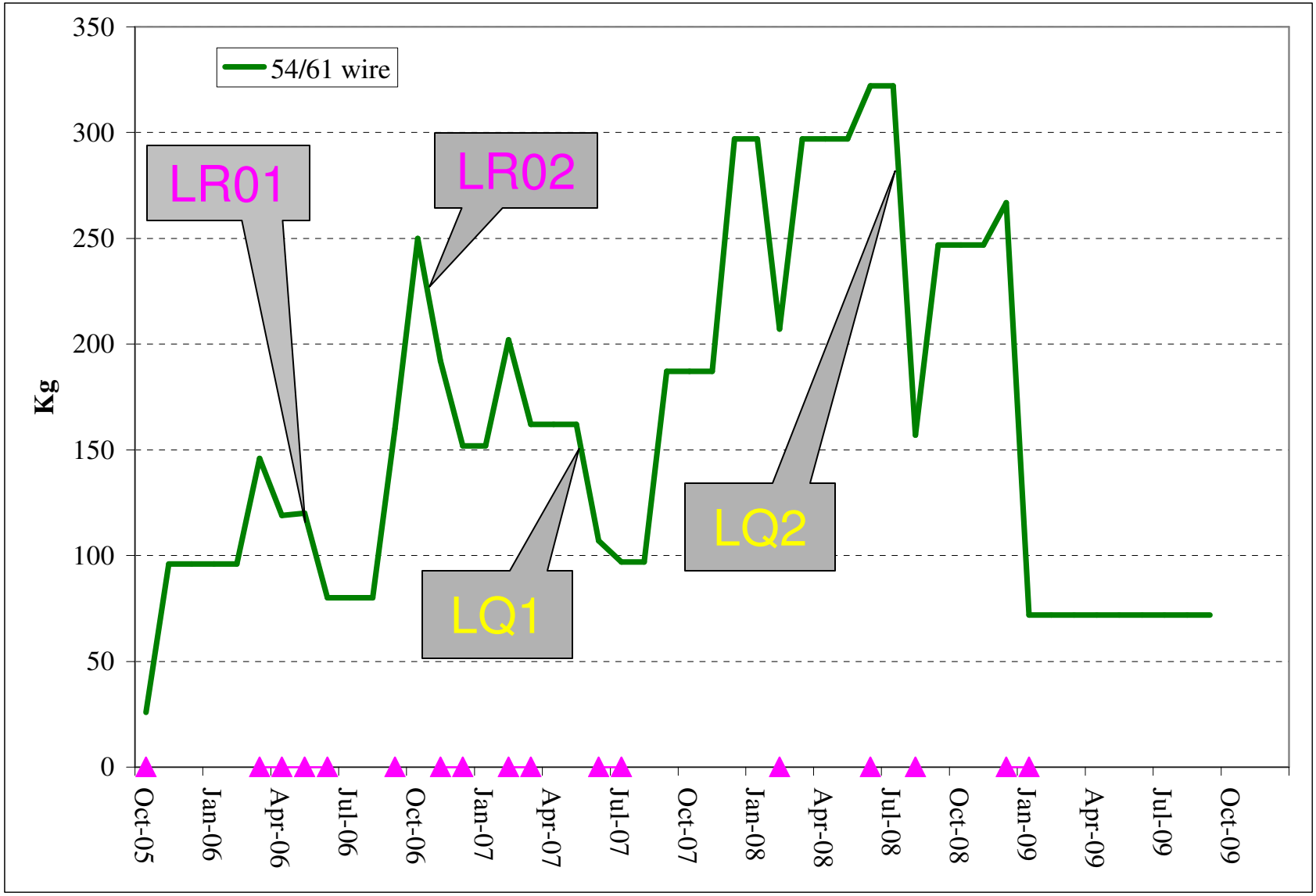


- LARP Stability Meas.
  - For 650C/48h,
    - Is > 1000 A

Projected Inventory

	CDP kg	LARP kg	MAGNET	Strand Req. kg	Inventory of strand kg		CDP kg	LARP kg	MAGNET	Strand Req. kg	Inventory of strand kg
Oct-05	33		SR01	7	26	Oct-07					187
Nov-05	70				96	Nov-07					187
Dec-05					96	Dec-07		110			297
Jan-06					96	Jan-08					297
Feb-06					96	Feb-08			HQX01	90	207
Mar-06		90	TQC02	40	146	Mar-08		90			297
Apr-06			LR01	27	119	Apr-08					297
May-06	90		LR01, TQC02-R	89	120	May-08					297
Jun-06			TQS02	40	80	Jun-08		110	FNAL	85	322
Jul-06					80	Jul-08					322
Aug-06					80	Aug-08			LQX02	165	157
Sep-06		90	SQS03	10	160	Sep-08		90			247
Oct-06		90			250	Oct-08					247
Nov-06		30	SRS02, LR02	88	192	Nov-08					247
Dec-06			PCX01	40	152	Dec-08		110	HQX02	90	267
Jan-07					152	Jan-09			CDP	195	72
Feb-07		90	TQS03	40	202	Feb-09					72
Mar-07			TQC03	40	162	Mar-09					72
Apr-07					162	Apr-09					72
May-07					162	May-09					72
Jun-07		110	LQX01	165	107	Jun-09					72
Jul-07			SQS04	10	97	Jul-09					72
Aug-07					97	Aug-09					72
Sep-07		90			187	Sep-09					72

Inventory Profile



Summary

- Strand procurement of RRP 54/61 is proceeding on schedule.
- OST strand fabrication process is stable
- The strand properties exceeds specification
- There is sufficient conductor on hand for fabricating cable for the magnets.
- In FY07, a 400kg order will be placed in Oct'06.