LARP Cabling --
Effort and Status

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April 8, 2009

Napa, CA
Outline

• LQ and HQ
  – Cable fabrication
  – Strand Inventory

• Cable Issues
  – HQ cable
  – Re-rolled cabled
  – Cored and annealed cables

• Insulation
LARP Cable Plan FY-09
Presented at CM11

- 6 UL of LQ
  - 2 UL Oct. 2008
  - 2 UL Nov. 2008
  - 2 UL Jan. 2009

- 6 UL of HQ
  - 2 UL Dec. 2008
  - 2 UL Feb. 2009
  - 2 UL Mar. 2009

- Time window for possible relocation of cabling facility
  - April-June 2009

- Ready to fabricate cable contingency
  - July or August 2009

New schedule to be shown in the following slides
Present Cable Plan -- LQ

- 6 UL of LQ
  - 2 UL Oct. 2008
  - 2 UL Nov. 2008
  - 2 UL Jan. 2009

- Spools on the machine, start cabling April 13

- Ship 4UL of insulated cable to FNAL by May 8.
Strand Maps for 4 UL of LQ Cable

**LQ UL # 12 & 13**  
Respooled for Cable 993

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**LENGTH SUM** = 22765  
**SUM / No. STRANDS** = 843.1481

Est. Final Cable = 524 m

**LQ UL # 14 & 15**  
Respooled for Cable 994

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**LENGTH SUM** = 22765  
**SUM / No. STRANDS** = 843.1481

Est. Final Cable = 513 m

2 UL of LQ = 480m

First time to mix 2 billets of RRP for LQ

All TQ01 mixed 3 MJR billets

All TQ02 coils unmixed RRP billets

Unmixed more uniform: Mechanically Jc
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**4 UL in 2 cable runs**

April 2009

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**2.6 UL**
Present Cable Plan -- HQ

- End of FY08 -- Lost first production cable due to hardware issue with powered rolls of the Turks head

- 6 UL of HQ
  - 2 UL Dec. 2008
  - 2 UL Feb. 2009
  - 2 UL May 2009

  CM12
  - 1 UL 991R Feb. 2009
    (108/127)
    First cable run with new roll universal joints
  - 2 UL 992R Mar. 2009
    (New 54/61 Hi-Cu)
  - 3.5 UL 99xR May 2009
    (combine two billets of the new 54/61)
Issues with HQ Cable

• New RRP 54/61 cabling behavior is more unstable than standard RRP 54/61
  – Assumed new 54/61 with more Cu between sub-elements would behave the same as standard 54/61.
  – Next HQ cable run may clarify if it is a billet specific issue or strand design and processing issue.
Issues with HQ Strand Inventory

- After the next HQ cable run of 3 ½ Unit Lengths in May
  - No more 54/61 strand with a diameter of 0.80mm in LARP inventory
    - This is an issue if there is problem with cable

- Next delivery of 75 kg of new 54/61 with extra Cu due in August 2009 [4.2 Production Unit Length (P-UL)]
  - Too late for cable production before machine shut down

- Back-up conductor for HQ (Need ~18kg per P-UL)
  - 90 kg (5 UL) of RRP 108/127 strand in LARP inventory has been shipped to Oxford to be processed to 0.8 mm diameter
Need More Cabling Resources

- Need more HQ cable
  - Cable at least 2 UL of 108/127 in June, prior to machine shut down
- Funds for testing -- Need to confirm cable Ic
  - Extracted strands
  - Cable tests – **Funds need to be reserved**
    - NHMFL (Jc -- Strain at 4.2K and field)
      - First test campaign April 22, 2009 – If successful
    - CERN (Jc -- Field & Strain at room temperature + cool-down)
      - Fall 2009
HQ Cable Issues

• Short lengths prototype cables suggests that parameters are OK
  – Standard 54/61 used in prototyping

• Issues
  – Cables 991R and 992R both seem a little mechanically unstable
  – Not clear if this is due to billet-to-billet variation or due to more Cu between the sub-elements

• Need more HQ cable and characterization resources
More Testing Resources Needed

• Funds for testing -- Need to confirm cable \( I_c \)
  – Extracted strands
    • Short sample
    • “ITER” style barrel
  – Cable tests – Funds need to be reserved for more tests later this fiscal year
    • NHMFL -- Jc (Strain at 4.2K, B)
      – First test campaign April 22, 2009
    • CERN -- Jc (Cool-down strain, B)
      – Summer or Fall 2009
Issues with Re-rolling of Cable

• Present cabling process:
  – Fabricate-Anneal-Re-roll
  – Annealing step removes contraction of 0.25%
  – **Can not add stainless steel core 0.025mm thick**

• Possible concentration of deformation during re-rolling
  – Plan to anneal stand prior to cable
  – Make cable in one pass
  – Save ~8 man-days of labor

• Propose using quarantined strand for this study: FY-10
Cables with Cores

• End of Cable 987 cores introduced
  – Two core material experiments for annealed cables
    • MgO paper tape
    • S-glass woven tape
  – Cable sections have been annealed
  – Ready to be re-rolled

• Stainless Steel Core
  – Can not anneal and re-roll cable
  – Need annealed strand
  – Propose using quarantined TQ/LQ strand for this study
  – Coil winding issues?
Braid Insulation onto Cable

• Can save $10K per insulation run.
  – Save ~1 man-week of labor

• Need more strand and cable in inventory

• Can not braid directly on to cable due to low mechanical stability

• Work has been done by A.D. McInturff at TAMU
  – Used LBNL slotted mandrel to braid insulation onto mandrel while cable slides along the slot into the sleeve
Summary

• Need to make more HQ cable in FY09

• Need more stand in the LARP inventory

• Need to begun the following studies:
  – Cabling annealed strand in one pass
  – Adding cores to cable
  – Braiding insulation on cables