

Notes from a meeting of the CERN-KEK review of the Nb₃Al conductor and magnet development program held on December 10th, 2010;

Participants:

CERN: Luca Bottura, Luc Oberli, Gijs de Rijk, Lucio Rossi, Ezio Todesco

NIMS: Akihiro Kikuchi, Takao Takeuchi

Hitachi Cable: Kazuhiko Nakagawa

KEK: Xinzhe Jin, Tatsushi Nakamoto, Toru Ogitu (video), Kiyosumi Tsuchiya, Qingjin Xu, Akira Yamamoto

Agenda

09:30 - 09:40	welcome	Lucio Rossi (CERN)
09:40 - 10:00	Overview of HL-LHC	Ezio Todesco (CERN)
10:00 - 10:25	Introduction, history of Nb ₃ Al R&D program towards LHC upgrade Akira Yamamoto (KEK)	
10:25 - 10:55	General overview of Nb ₃ Al material	Takao Takeuchi (NIMS)
11:10 - 12:10	Progress and summary of Nb ₃ Al SC development at KEK/NIMS Tatsushi Nakamoto (KEK)	
12:10 - 12:50	Proposal of new program for next years	Tatsushi Nakamoto (KEK)
Afternoon:	discussion and recommendations	

Technology status

The present status of the Nb₃Al conductor development is non-Cu $J_c = 800 \text{ A/mm}^2$ @15 T in a 1 mm diameter strand. The non-Cu diameter is 0.7 mm with filaments of 35 μm diameter. The effective diameter as determined by magnetization measurements is $\sim 50 \mu\text{m}$. The maximum piece length achieved is 1 km. The Cu ion plating achieves speeds of 240 m/h while the bottleneck in the production is the Cu electroplating at 7 m/h. Development work is ongoing to improve the production speed.

Remarks and recommendations

1. CERN generally encourages KEK's to extend efforts to high field magnet development to contribute to the CERN LHC HL upgrade.
2. CERN and KEK confirm that the R&D should go further than conductor development and step into magnet technology development. However the present KEK situation in personnel and material budget severely limits its capacity: therefore it may require more cooperative work for the practical magnet fabrication and test (with CERN).
3. CERN encourage KEK/NIMS to extend efforts to develop a Nb₃Al conductor having a Nb matrix with a Ta sheet as barrier for magnetization and the strand surrounded by either a Nb or Ta layer. The effort should be aimed at a strand and cable sufficiently long enough to develop

a model coil, this may require drawing work on a billet (~ 14 cm dia. x 45 cm long) with a 4000 t press.

4. CERN and KEK agree to seek for two possible magnet R&D plans of
 - a. A race track coil motivated towards 'react and wind' technology,
 - b. A large aperture cos-theta dipole with an aperture of 120 mm diameter (or a little larger), intended for the D1 of HL-LHC upgrade.
5. CERN-KEK will organize another technical review meeting, in the middle of 2011, (within a period of June through September) to review the progress on the Nb₃Al strand development (at least 4 small billets with a 100 t press). It should be shown that strand can be made in sufficient length pieces. If this is met, the next slice of budget could be attributed in JFY2011. This in preparation for the readiness decision of Nb₃Al technology in the 2013-2015 period.
6. The CERN-KEK committee should discuss this possibility in the meeting on Dec. 14th, to prepare for the JFY2011 budget plan. It will also include major discussion on the technical direction of the magnet design and R&D to be carried out at KEK.
7. CERN and KEK/NIMS will scope the Nb₃Al conductor to be the primary candidate for the CERN-KEK/NIMS R&D program for the D1 (or other magnets) for the HL-LHC upgrade R&D. However, CERN and KEK agree that Nb₃Al and other alternate advanced conductor technology should be within their scope as an alternative for the HL-LHC work depending on the Nb₃Al progress and other research progress.
8. CERN would like to encourage KEK to work on magnet technology applicable for both Nb₃Al and Nb₃Sn conductors so as to be ready for the HL-LHC applications. CERN and KEK should collaborate on these technologies.
9. Nb₃Al with Cu matrix in combination with a double stack procedure would be an interesting solution for more possibilities with 'react and wind approach'.
10. On the other hand, Nb₃Al with purely Nb matrix can be a quickest approach for a simple model coil R&D to be realized as soon as possible.
11. CERN expressed interest for irradiation tests at JPARC for conductors and insulators.
12. CERN indicated that a (second) Fresca2 structure can be made available for D1 style coil tests.
13. CERN would like to encourage KEK to define a draft program for a D1 contribution for the HL-LHC based on the above stated technologies. The financing of the only very first part of such a program can be covered by the present budgets. Further coverage should then be sought later.

Budget and planning

KEK proposed to re-evaluate small scale conductor fabrication R&D, in the coming half year, prior to a major fabrication of Nb₃Al conductor/strand to develop a model coil in coming few years using the remaining budget in the CERN account (with a level of 20 + 60 MJYen, corresponding to ~ 950 KCHF including the budget for JFY-2011).

(Note: 80 ¥ ≈ 1 CHF. The JFY starts in April).