

26th Meeting of the LHC Resource Review Boards (RRB)
14th April 2008

1. Welcome *J. Engelen, Research Director*

J. Engelen welcomed delegates to the 26th meeting of the RRB. The minutes of the October 2007 (25th) Plenary Session CERN-RRB-2007-118 were approved without comment. He announced that, in the absence of L. Evans, R. Saban would present the Status of the LHC machine.

2. CERN Status and News *R. Aymar, Director General*

R. Aymar proposed to concentrate on three points:

- The CERN open day
- LHC Installation and commissioning
- Financial support

The public open day on the 6th of April was a great success. Over 50'000 people visited CERN and many different aspects of CERN were presented. R. Aymar expressed his gratitude to the 1500 staff who volunteered to present the LHC machine and the experiments to visitors.

The LHC experiments and the machine are almost at the same level of preparation. All machine sectors should be cooled down at the end of June and the experiments will be ready. The schedule is tight but commissioning should be able to start on schedule.

During powering tests in Sector 45, 3 of the dipoles quenched naturally at a current lower than the current they had reached during the first tests where they had been trained up to 9T. Unexpectedly, these three magnets showed a tendency to "de-train" i.e. they lost their capacity to operate at a high magnetic field without 're-training'. After consultation with the spokespersons of the experiments, a decision was taken to run at an energy which was useful for the experiments but which minimised the number of training quenches. The proposal, which will be confirmed before the end of April, is for 10TeV in the centre of mass instead of 14TeV. This will allow LHC to reach the objective of useful collisions for the experiments in the summer of 2008.

Council has agreed to provide extra financial support of 240MCHF over the next 4 years. These are voluntary contributions; half is paid by the Host States and half by the Member States. This will allow CERN to repay the loan taken for the construction of the LHC, at about 300MCHF/year for 4 years, from the normal budget. The extra budget of 60MCHF/year will be devoted to the two main priorities of the European program agreed by Council in 2006. First, improve the reliability and running capacity of LHC by improving the injection line, power supplies for the PS and new PS beam handling, and complete the four experiments to their nominal capabilities. Second, prepare for the extension of the LHC, the Super LHC. The improvements will be performed in two steps: start to build LINAC 4, which is front end of the new injector line; and start to build new focussing quadrupoles with larger aperture for interactions at Points 1 and 5 to obtain a first phase increase of the LHC luminosity, prepare for design of a replacement of the PS (PS2) and prepare for replacement of the Booster by a superconducting proton LINAC between LINAC 4 and PS2.

Consequences on the detectors from the luminosity increase should be considered in a planned R/D effort.

To close, R. Aymar stated that CERN would welcome collaboration with groups outside CERN who would be interested in participating in upgrades to the accelerators and for research and development of new detectors.

Questions and discussion

T. Ferbel (US, DOE) stated that agencies need, as soon as possible, concrete proposals of upgrades of accelerators and detectors in order to plan and request funding.

R. Aymar replied that the process towards concrete proposals had been launched at the start of 2008 and a plan exists for organisation inside Europe. From a physics viewpoint, there have been several conferences and workshops to study the benefits of increased luminosity. Concrete proposals should be ready by the middle of 2008. The statement at this meeting was in the nature of a general invitation to join the process of defining the upgrades, with a view to later technical contribution.

3. LHC Machine Status *R. Saban, Head of LHC commissioning team* (Transparencies are available on the LHC RRB Indico pages)

R. Saban presented the current status of the LHC. He showed the sectors with colour coding to identify the temperatures of the sectors (this can be followed at http://lhc.web.cern.ch/lhc/Cooldown_status.htm). In summary, over half the machine is cold or being cooled down.

The detailed status of the sectors on 14 April was:

Sector 12	Currently being flushed with helium, cool down in week 19
Sector 23	Cool down just started
Sector 34	Currently being flushed with helium, cool down week 17
Sector 45	Consolidation; connection of inner triplet and minor repairs. Cool week 17
Sector 56	Between 4.5 and 1.9K; powering tests on sc circuits. A team will remain to train the dipole, to determine the time needed to achieve 7TeV
Sector 67	Cool down just started
Sector 78	Now at 1.9K. Starting insulation test before powering tests
Sector 81	Cooling (4K on 23.04.08)

It was found that cooling from 300K to 2K took about 6 weeks. A further 3 weeks was required to stabilise at 1.9K for tests.

The objectives of the powering tests are:

1. Validation of the protection strategies under the different failure scenarios
2. Evaluation of the behaviour and of the performance of
 - the magnet chain
 - the current leads
 - the power converters

A procedure has been written for each type of circuit. This document defines the steps for performing the powering procedure and the acceptance criteria. In the 8 sectors there are 812 circuits at or above 600A and 752 60A circuits.

Considerable experience had been gained from the commissioning of sector 45. The main highlights were:

- All but the inner triplet circuits were commissioned.
- The main dipole circuit was taken without any quench to 9.5 kA at which current it could steer beams of 5.5 TeV. After three training quenches the circuit was taken to 10.2 kA (equivalent to 6.1 TeV).
- Almost all the circuits, including the correctors, were taken to a current equivalent to 6 TeV.
- This was achieved in 8 weeks. A review, which was organized following the campaign, indicates that less time will be required for the following sectors. This is estimated at about 5 weeks, but remains to be confirmed.

R. Saban also showed several slides detailing the ramp-up of 138 power convertors for Sector 45, test of warm magnets, commissioning of the RF system and the control and diagnostic software.

The LHC access system was commissioned during the first week of January 2008. This was a successful collaboration between the team which designed and procured the system, the team in the control centre which will operate the system and the supplier's team. The three objectives of the tests were:

1. Test the Access System when doing a patrol of all the LHC points
2. In « Access Mode », test the correct system behaviour when one or more Elément Important de Sûreté (EIS) becomes unsafe
3. In « Beam Mode », test the triggering of all the « EIS-BEAM» and external interfaces (BI, LBDS) in case of intrusion, door opening inside the LHC or Emergency stop

All sectors of the LHC which are being commissioned are now using the system.

In summary

Several teams, working in parallel and well coordinated, are commissioning the technical systems of the LHC – the superconducting magnets, the warm magnets, the RF, the injection system, the collimators, the beam dumping system, the access safety and control, the infrastructure systems, the software, etc.

- A strategy, where the initial beam energy is at least 5 TeV is proposed to gain time with the re-training of magnets and meet the summer deadline.
- Recent results, obtained while commissioning Sector 45, indicate that this is feasible.

Questions and discussion

T. Ekelöf (Sweden, Uppsala University) enquired about the time required to take the dipole circuit to the nominal current for beams at 7 TeV. R. Saban replied that following the imminent completion

of the commissioning of Sector 56 a training quench campaign was planned to assess the time required.