

## **24<sup>th</sup> Meeting of the LHC Resources Review Board RRB** **Held at CERN on 23<sup>rd</sup> April 2007**

### **1. Introduction - J-J. Blaising, rep. Chief Scientific Officer**

J-J. Blaising, replacing J. Engelen whose plane was delayed, welcomed RRB delegates to this 24<sup>th</sup> session. The minutes of the October 2006 Plenary Session, CERN-RRB-2006-124, were **approved** without comment.

J-J. Blaising explained that, in each of the experiment RRBs, they would address the issue of extensions of the validity of the MoUs covering the construction of the experiments, which would otherwise expire at the end of 2007. These extensions until the end of 2010 were proposed in order to keep the same organisational and administrative framework until the completion of the design luminosity detectors.

This plenary session would include two talks, one by the Director General and one by the LHC Project Leader.

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

R. Aymar noted that in this RRB there would be a detailed presentation on the LHC machine itself, and that during the individual RRBs there would be considerable information of the status of the experiments and computing. He would address here the points that he considered to be of the most importance.

Progress in the last six months for the detectors and computing had been very large. Each experiment had its own difficulties but these were being solved. It was very important that the planning of the schedules of the experiments and of the LHC machine should be done in close cooperation such as to produce an optimised agreed schedule for physics running. The financing of the individual experiments had been an important issue at the previous RRBs, and progress had been made in the meantime. He urged the spokespersons of the experiments to establish as clear a position as possible on the financing at this stage.

R. Aymar noted that for the LHC machine he would mention three points in particular. Firstly all components of the machine, except a few that were of minor importance, had been made available in time and that installation of all big components such as magnets had been finished by the end of March as planned. The real issue currently was the interconnections between these thousands of magnets and this was a task that required considerable care and quality control.

The cooling of the first large sector 7-8, consisting of cryogenic line and magnets but not the triplets, had taken time but the problems had now been solved, and this was a considerable achievement. The full sector was cooled to 1.9° K under stable conditions and testing of electrical power connections was just starting. This illustrated the difference between installation and commissioning, inasmuch as installation could be speeded up within limits by adding more teams, whilst commissioning necessitated finding a solution for the issues that arose.

During the first pressure test of a triplet, a heat exchanger had collapsed at a value which was much lower than that specified. This was a design error which had been rather quickly corrected with the cooperation of Fermilab. The second problem arose when pressure testing a second triplet and trying to increase the pressure to 25 bar. The cold mass did not withstand the longitudinal forces and moved. A team was working on the best solution to the problem and this would have to be applied to all triplets. The broken triplet itself would have to be removed from the tunnel for

repair. They were reviewing the consequences on the schedule since some sectors would have to be cooled for testing without the triplets and then warmed up again for insertion of the triplets.

R. Aymar moved on to the CERN budget, known as the medium term plan, for the four years 2008-2011 and the perspective beyond that. They had proposed two positions to the Council in October 2006. The first of these maintained the budget at the present level. However, the outstanding bank loans had to be reimbursed during this period. For 2007 this repayment would amount to 130 MCHF, and 2011 would be similar. However for the years 2008-2010 the annual re-imburement was in the range 300 to 350 MCHF. Given this constraint, the money available for the Laboratory would be only just sufficient to run the LHC, with no new activity of any form, and the manpower would have to be reduced from 2600 to 2000 in order to be able to pay. They had told the Council that this was not appropriate given the considerable investment that had been made, and that the Member States should consider providing additional resources in order to allow the laboratory to breath.

They had provided a plan linked to activities. The highest priority was to provide the LHC with its full potential and reliability, and the second priority was to perform the R&D necessary for an upgrade of the LHC (SLHC) to a higher luminosity in 2015/2016. This included a new injection line to provide reliability, given the ageing components such as Linac 2, Booster and PS. This proposal to the Council included the minimum resources necessary to carry this out. This minimum was 240 MCHF, assuming that 10% would be provided in-kind by Member States or others such as non-Member States or the European Commission. This plan included salaries in order to avoid the reduction from 2600 to 2000, and to plateau instead at 2250, which was the minimum necessary in order to provide the competence needed and the services expected. In March they had been given permission to prepare this plan for presentation to the Council in June 2007. Early indications were that this plan would be more acceptable if the 240 MCHF were spread over 4 years rather than 3. The two host Members States had indicated that they would consider making larger than 'pro rata' contributions. He hoped that in June they would have the full agreement of Council for this plan.

R. Aymar came to his last point which was Open Access Publishing. They were building a new business model which would allow peer-reviewed publications to be available free of charge worldwide electronically. A Task Force, started in November 2006, had provided a report dated 19<sup>th</sup> April 2007. There would be a meeting this week, on the afternoon of Wednesday 25<sup>th</sup> April from 14:00 until 15:30 in order to inform you of this business model and the next steps to be taken. It was hoped to start this process at the beginning of 2008.

## **Discussion**

In response to J-J. Blaising's request for any questions, T. Ferbel asked for further clarification as to ideas for a possible involvement of non-Member States in this proposed Mid-Term Plan. R. Aymar replied that for some of the activities in this plan they knew that they already had connections with laboratories which were carrying out relevant R&D. For example in the States they were looking at a design for the triplets which would be necessary for increased luminosity. Other laboratories were looking at other aspects, for example a new Linac 4. This plan assumed that these contributions were at the level of 10%.

## **3. LHC Machine Status Report – L. Evans, LHC Project Leader**

L. Evans presented, (transparencies available on the LHC RRB Indico pages), the current status of the LHC machine and the progress made since the previous meeting of the RRB in October 2006. He began with a photo of the LHC installed in the tunnel. All 2000 or so magnets were now installed except for 16 inner triplet magnets. He showed the LHC Dashboard overview of five years of production and installation of the cryodipoles. This represented 35 000 tons of equipment safely installed in the tunnel. The next step was to finish the interconnect work which was a

complicated set of activities for each interconnection. This was on-going all around the ring and with the most serious quality control.

He reviewed the history of the cooldown of sector 7-8 which was now cold. Sector 8-1 was coming closely behind, as was sector 4-5 and sector 3-4. As resources were liberated from finished sectors, they were deployed in order to speed up on other sectors. He was confident that they had now isolated and understood the cause of the instability which had given so much trouble in sector 7-8. This was a big step forward.

Another source of difficulties were the distribution feed boxes. There were 44 of them and they were quite complicated. The problems had been resolved such that the DFBs were being installed according to schedule.

L. Evans came to the problems with the inner triplets as the DG had described. The new heat exchangers gave a more than adequate safety pressure margin. Following the resolution of this problem they came to the second structural problems. At 20 bar they had a rupture of the fixed point on the magnet. The longitudinal forces of the tests or of magnet quench caused the rupture as a result of a design error which had not taken them sufficiently into account. There had been noise in the Press of conspiracy theories and he wished to emphasize that this was complete nonsense. There would be a complete review in the next two days, to assure that there were no other hidden defects and to agree the repair procedure in which the fixed points were reinforced. The broken triplet had to be taken up to the surface but it was hoped to modify the other triplets *in situ*.

This situation had consequences on the schedule and some decisions had to be made. Before the inner triplet problem, they had been about 5 weeks behind schedule. Once the full extent of the damage was properly known and the *in situ* repair validated, they would publish a new schedule. It now looked unlikely that the engineering run could occur at the end of the year but all effort would be made to maintain a physics run in 2008 as foreseen.

## Discussion

R. Wade was surprised that the solution to the triplet structural problems had been so straightforward. L. Evans replied that the solution was to reinforce a fix point which was 2 metres inside the magnet and that was a challenge in itself. However he considered that the solution proposed was a very clever one. Obviously they would validate this carefully before implementing it but they were quite confident. R. Wade asked whether this would involve any additional heat load in the system and L. Evans agreed that it would. However, the additional heat load was trivial compared with the heat load that the inner triplets had to take normally in the high luminosity insertions. The cryogenics had already been suitably dimensioned.

J. O'Fallon noted that the engineering run would probably not occur in 2007. Would this imply that the beam pipe would not be closed up in 2007? L. Evans replied that the beam line would be closed up. The difficulty was that they now had two sectors which they had to cool down and then to warm up again, 8-1 and now 4-5. This meant that they had 10 sectors to commission instead of 8 which made the schedule very tight. The idea of the engineering run was convenient insofar as there would be a shutdown following it in which problems could be fixed. If this was not possible and they had to go straight into the main run, and if there were problems, they would have to stop to fix them. For the moment the pressure was still on the detectors to be ready for the proposed engineering run.

J-J. Blaising asked when they intended to cool down sector 4-5. L. Evans replied that the pressure test on 4-5 would be done on the 11<sup>th</sup> May. They then had a decision to make whether to cool down immediately or to wait for the inner triplet repair.

R. Wade suggested that there were additional costs for the experiments in trying to speed up in order to meet the original date for closing the beam line. At what point might there be a relaxation

of this constraint? L. Evans considered that the experiments had all the information available at present and they seemed happy with this. Obviously there would have to be a decision on this important point in the next few weeks.

## **5. Summary**

In his summary, J.-J. Blaising considered that the cooling down of the sector 7-8 had been a major achievement. There had been recent incidents in the machine and also in the experiments which necessitated a reconsideration of the schedule. Nonetheless, the main objective remained to have a full physics run in 2008.

The extra resources explained by R. Aymar were absolutely essential to the full exploitation of the LHC potential.

There were no further questions and J.-J. Blaising closed the meeting.

C. Jones  
May 2007