LARGE HADRON COLLIDER COMMITTEE

Minutes of the ninety-first meeting held on
Wednesday and Thursday, 21-22 November 2007

OPEN SESSION

1. Report from the Topical Workshop on Electronics for Particle Physics: François Vasey
2. LHCb Status Report: Roger Forty
3. RD39 Status Report: Jaakko Haerkoenen
4. RD50 Status Report: Michael Moll

CLOSED SESSION:


* part-time
** for item 11

Apologies:   J. Haba

1. PROCEDURE
   The minutes of the ninetieth LHCC meeting (LHCC 2007-027 / LHCC 90) were approved.

2. REPORT FROM THE CHIEF SCIENTIFIC OFFICER
   The Chief Scientific Officer (CSO) reported on the status of the LHC machine. He reported good progress on the LHC machine installation and commissioning. All interconnections in the LHC tunnel have been completed and commissioning of the various LHC systems is well underway. T12, the second of the SPS-to-LHC transfer lines to be tested and that will carry beams in to the LHC in the clock-wise direction has been commissioned to nominal beam intensity at the first attempt at the end of October 2007. Sector 4-5 is currently been cooled down and several additional sectors are being prepared for cool down.

3. REPORT FROM THE ALICE REFEREES
   The LHCC heard a report from the ALICE referees, concentrating on the status of the sub-systems and on the installation and commissioning of the experiment.
   The referees reported on the status of the ALICE sub-detectors. Installation of the sub-detectors is proceeding essentially according to schedule. The repair of the bus bars of
the Time Projection Chamber (TPC), following a voltage drop due to a bad connection between the bus bars and the front-ends, is on track and is expected to be completed by early December 2007 in time for the full commissioning of the detector in February 2008. Installation of the support structure for the Electromagnetic Calorimeter (EMCAL) is complete. Good progress was reported on the installation and commissioning of the Muon System and the higher-than-expected noise levels in Tracking Stations 3, 4 and 5 are under investigation. Installation of modules of the Time-of-Flight (TOF) and Transition Radiation Detectors (TRD) is advancing well. Commissioning of the High Momentum Particle Identification Detectors (HMPID) is advancing well, and the reported loss in acceptance due to trips of the high voltage does not deteriorate significantly the performance of the detector. The Photon Spectrometer (PHOS) has encountered problems with the stability of the read-out electronics and the detector’s installation is delayed to March 2008. The Trigger and DAQ is currently being used in stand-alone mode for individual sub-detectors and a combined Trigger/DAQ test is scheduled for December 2007.

The LHCC took note of the ALICE schedule. The initial working ALICE detector is expected to be in place by March 2008 and a series of three cosmic runs, in December 2007 and in February and April 2008, will allow ALICE to exercise the complete Trigger/DAQ system.

4. REPORT FROM THE ATLAS REFEREES

The LHCC heard a report from the ATLAS referees, concentrating on the general status, an update of the Inner Detector (ID) and a report on the commissioning of the experiment.

The Committee took note that two new institutes – Universidad Antonio Nariño from Colombia and a joint team from Chile, formed by members of Pontificia Universidad Católica de Chile and Universidad Técnica Federico Santa María – have been admitted to the ATLAS Collaboration.

The referees reported on the status of the various ATLAS sub-systems. The three toroid magnets – Barrel and the two End-caps – are being tested separately and a joint magnet test is scheduled for spring 2008 following the closure of the ATLAS detector. Modifications to the heaters of the evaporative cooling system of the ID are complete but a further problem has arisen in regard to faulty solder joints of the heat exchangers. The repair is in progress in the CERN workshops but the problem has resulted in a 5-week delay and the schedule to complete the ID is tight. Operation of about 30% of the Transition Radiation Tracker (TRT) is in progress and the commissioning is limited by the availability of the Read Out Drivers (RODs). The observed noise in the TRT is under investigation. All three cryostats for the LAr calorimeters have been filled with LAr, are cold and are being operated since spring 2007. All of the low voltage power supplies for the LAr calorimeters have been retro-fitted and the repair of the front-end boards as a precautionary measure is well underway following the observation of errors in April 2007 which would reduce the boards’ lifetime. The Tile Calorimeter has been in operation for several months. All its low voltage power supplies have been refurbished and are operational while the refurbishment of the electronics drawers is well underway. Installation of the Forward Muon Spectrometer Big Wheels is essentially complete and the Small Wheels are scheduled to be installed in the next two months, but their installation is on the critical path. Delivery of the CAEN power supplies for the Muon System is due to be completed in mid-May 2008.

Commissioning of the ATLAS experiment is continuing with cosmics. These runs achieve many aims, including exercising the trigger, DAQ, calibration and alignment systems and help in improving the experiment operational stability, training of members of the Collaboration and in the development of procedures. The upcoming Full Dress Rehearsal will make use of the overall ATLAS read-out chain and the LHCC considers it essential that a large section of the ATLAS Collaboration will participate in this event. ATLAS has taken the decision to base the data-handling
model on inclusive streaming, whereby inclusive raw physics streams will be used at the output of the online.

5. REPORT FROM THE CMS REFEREES

The Committee heard a report from the CMS referees, concentrating on the status of the detector construction, installation and commissioning and on the proposal for a spare Electromagnetic Calorimeter Supermodule.

The referees reported on the status of the various CMS sub-systems. Commissioning of the Inner Tracker is complete on the surface and the detector will be transported to Point 5 in December 2007, following which the connections to the services check-out and commissioning is scheduled for the first two months of 2008. Installation of the Pixel Detector is scheduled for March 2008 and is being integrated together with the installation of the CMS experimental beam pipe. Installation of the Barrel Electromagnetic Calorimeter (EB) is complete. The prototype for the Electromagnetic Calorimeter trigger concentration cards has been delivered and CMS aims to place the order for the series production in December 2007, with the full delivery scheduled for June 2008 as expected. All barrel yoke elements (YBs) have been lowered into the CMS experiment cavern and the installation of services on the central YB module (YB0) has been completed, albeit after taking much longer than expected due to the elevated complexity of the task. Mounting of the End-cap Electromagnetic Calorimeter (EE) Dee1 is complete and the mounting of Dee2 is expected in December 2007. The first EE is expected to be ready for installation in March 2008 and the second EE in May 2008. The LHCC took note that the recent CMS Engineering Design Report for the CASTOR calorimeter provided conditional approval within the CMS Collaboration to proceed with the construction of the detector and endorsed the purchase and preparation of materials. Progress will be reviewed in early 2008.

The Committee took note of the proposal from CMS for the construction of a spare EB Supermodule. Such a Supermodule was originally foreseen and would serve as a fast replacement in case one of the installed Supermodules is malfunctioning and could also be used as a control element in test beams. The LHCC asked CMS to make further considerations regarding this proposal, including the likely failure scenarios of an installed Supermodule, the benefits of beam test arguments and the funding mechanism.

The LHCC heard a report on the CMS schedule. The main aim is to close CMS by April 2008 and to run through a cosmic run with the nominal magnetic field in the solenoid. The schedule includes an overall contingency of about one month prior to first LHC beams in May 2008.

6. REPORT FROM THE LHCb REFEREES

The LHCC heard a report from the LHCb referees, concentrating on the general status of the experiment, the status of the Outer Tracker and the funding situation for the LHCb experiment.

The referees reported on the status of the LHCb experiment. Installation of the major mechanical structures in the LHCb experiment cavern is essentially complete. Good progress was reported on the installation and commissioning of the various LHCb sub-detectors. The Vertex Locator (VELO) is installed, cabled and is being commissioned, the installation of the Trigger Tracker and Inner Tracker is expected to be complete by the end of 2007, the RICH-2 is complete while RICH-1 is approaching completion, the full Calorimeter system is installed and cabled and the installation of the Muon Stations 2-5 is complete. The LHCC noted that the Muon Station 1 may not be ready for 2008, but as the station is mainly used to improve the $p_T$ resolution in the Level-1 trigger, it is not essential for the 2008 run.

The LHCC also heard a report on the Outer Tracker gain loss. The Araldite glue used in the construction of the chambers has been identified as the cause of the gain loss and LHCb plans to use a heater system warming the chambers to 40 °C together with
flushing to mitigate the gain loss problem. The LHCC reiterated its request for LHCb to consider a replacement detector, including costs, resources and schedule, in order to avoid any limitations to the LHCb trigger.

The Committee took note that the LHCb experiment is now fully funded with the recent contributions from Brazil, Spain, the United Kingdom and the United States. However, additional expenditure is foreseen for replacing the third beryllium experimental beam pipe section and the VELO RF boxes.

The LHCC expressed its appreciation for the work of T. Nakada, whose term as Spokesperson of the LHCb Collaboration is coming to an end in April 2008.

7. REPORT FROM THE TOTEM REFEREE

The LHCC heard a report from the TOTEM referee. All Roman Pots have been installed in the LHC tunnel around Point 5. One of the silicon detector sensors is being assembled in its final configuration and will be tested with cosmics. The radiation hardness of the edgeless silicon detectors has been shown to be good in an irradiation campaign and the detectors have been shown to function up to $10^{14}$ p cm$^{-2}$, which corresponds to an integrated luminosity of around 1 fb$^{-1}$. This detector will be installed in a Roman Pot and will be used for commissioning of the cooling and read-out systems. Production of the Gas Electron Multiplier (GEM) detectors for the T2 Telescope is complete and their testing is well underway. Chamber production for the Cathode Strip Chambers (CSCs) of the T1 Telescope is in progress but their assembly into the first arm by March 2008 is tight. Installation of the T1 Telescope within the CMS detector volume will be discussed in a common meeting in January 2008. Most of the components for the detector read-out electronics are either in the prototype or test phase and the work is distributed throughout the Collaboration. The timely completion of the read-out electronics remains on the experiment critical path.

8. REPORT FROM THE LHCf REFEREES

The LHCC heard a report from the LHCf referees. The beam test campaigns at the SPS have been very successful and show that the energy and position resolutions of the detector arms are adequate for the LHCf physics needs. The LHCf installation schedule in the TAN absorbers at Point 1 has been worked out with the machine groups and the detectors are planned to be installed in early 2008. The study of the co-habitation of the various detectors (LHCf detectors, ATLAS Zero Degree Calorimeters and the BRAN LHC collision rate monitors) in the TAN absorbers show that the detector configuration in the TAN absorbers will be changing repeatedly and that a remote-handling system is required to install and remove the detectors during the LHC exploitation period in order to overcome radiation-safety restrictions coming from the activated material.

9. REPORT FROM THE RD39 REFEREE

The LHCC heard a report from the RD39 referee on the collaboration’s programme concerning the operation of solid-state detectors at low temperatures and in a high radiation environment. The referee summarised the experimental results that RD39 has achieved on the development of such detectors and also described the proposed programme for future work.

The Committee took note of the good progress in the study of such cryogenic devices for applications in future high energy physics experiments. The plan of work for 2007 has been to a large part met or well underway. The studies on Charge Injection Devices (CIDs) and edgeless sensors are well focused and the CID techniques could offer a possible solution for the SLHC. The LHCC considers that the proposed work-plan for 2008, concentrating on the further development of CIDs, its implementation to edgeless detectors and the production of cryogenic modules is reasonable.

In view of the above and given the modest request for resources for further work, the referee recommends that the R&D project be continued in 2008. A status report is expected to be submitted to the LHCC in one year’s time. The Committee reiterates
that it is imperative that the RD39 Collaboration focuses on working towards applying
the developed technology to the LHC experiment upgrade programme. The Committee
agrees to the continuation of the project on this basis.

10. REPORT FROM THE RD50 REFEREE

The LHCC heard a report from the RD50 referee on the collaboration’s programme
concerning the development of radiation hard semiconductor devices for very high
luminosity colliders. The referee summarised the experimental results that RD50 has
achieved on the development of such detectors and also described the proposed
programme for future work.

The Committee took note of the good progress in the study of such devices for
applications in future high energy physics experiments, such as those at an upgraded
LHC. Although there was no significant breakthroughs on new material in the past
year, RD50 has made steady progress in understanding, characterizing and bringing to
practical use radiation-hard silicon sensors, and in particular n-in-p silicon could be a
very promising technology for the SLHC. The Collaboration has also demonstrated the
viability of industrial production of some of its materials. RD50 and the LHC
experiments are working closely in many areas and the former also serves as forum
where the LHC experiments can meet and exchange experiences. The LHCC considers
that the proposed work plan for 2008, which concentrates on developing full detector
systems for the LHC experiments, to be reasonable.

In view of the above and given the modest request for resources for further work, the
referee recommends that the R&D project be continued in 2008. A status report is
expected to be submitted to the LHCC in one year’s time. The Committee agrees to the
continuation of the project on this basis.

11. LHCC DELIBERATIONS ON LHC EXPERIMENT UPGRADES

The LHCC discussed the plan for future reviews of the LHC experiment upgrades.
L. Linssen, S. Stapnes and the LHC experiment spokespersons were invited to
participate in this discussion. A considerable R&D effort is currently underway within
several projects (RD39, RD42, RD50, SLPH-PP and various work in the CERN PH
Department), and within the ATLAS and CMS Collaborations. ALICE and LHCb are
also in the process of planning for the longer-term future. The general consensus is that
the LHCC is the natural body which should review all such activities in the future. The
Committee is considering organizing presentations on the LHC machine upgrade
scenarios and the physics motivation at one of its upcoming sessions.

12. TEST BEAMS

The SPS and PS Co-ordinator, C. Rembser, reported on the 2007 test beams and gave
an outlook on the accelerator schedule for 2008. He reported that the accelerators of
the PS Complex and the SPS, which will also serve as injectors to the LHC, operated
reliably and stably in 2007. Version 2.2 of the LHC Injector Accelerator Schedule for
2008 was also presented. Physics is scheduled to start on
19 May at the PS and on 29 May at the SPS, running in both cases until 10 November.
This schedule will be presented to the November session of the Research Board for
approval. Requests for beam tests at the PS Complex and at the SPS have been
received and the draft user schedule for 2008 is being drawn-up. The Co-ordinator
underlined that such beam tests remain important for the LHC experiments and include
requests for LHC-upgrade-related studies. He also outlined the plans for an upgraded
Gamma Irradiation Facility (GIF) to succeed the present facility.

The Chairman thanked C. Rembser for his work as SPS and PS Physics Coordinator
from which he retires at the end of 2007. His efforts have been essential for the
successful definition and operation of the LHC test beam activities. He will be
succeeded by E. Perez as of 1 January 2008.
13. REPORT FROM THE LHC PROGRAMME CO-ORDINATOR

The LHCC heard a first report from the LHC Programme Co-ordinator (LPC), M. Ferro-Luzzi. The role of the LPC is to provide the co-ordination between those responsible for running the LHC machine and those responsible for running the LHC experiments with the overall aim of optimizing the efficiency of data collection for the LHC physics programme. This will be done by taking into account the status of the LHC machine and the LHC experiments and the priorities in the physics programme. Monthly meetings have started between representatives from the LHC machine and experiments with the current deliberations concentrating on the LHC commissioning period and the period of first data taking.

14. DISCUSSION ON LHCC PROCEEDINGS FOR 2008 AND BEYOND

Given that the emphasis of the LHCC deliberations would be shifting in the coming months to an increasing emphasis on issues related to a) full experiment systems rather than individual sub-systems, b) the running in of the experiments with first beam, c) the interaction between the experiments and between the experiments and the LHC Machine, d) the large scale data processing and distribution and the data physics analysis, and e) the detector upgrades for a higher LHC luminosity, the Committee members continued their discussions on what form the LHCC deliberations should take in the future. Following consultation with the CERN Management and with the LHC experiment spokespersons, a broad consensus was reached whereby mini-reviews over one day to be held twice per year for each experiment will be introduced to replace the Comprehensive Review starting from February 2008. The format will remain flexible to respond to changes in the LHC schedule and will likely evolve during the time leading up to steady data taking. The Open and Closed session formats will be modified to reflect this new format.

15. LCG COMPREHENSIVE REVIEW

The fifth annual LHCC Comprehensive Review of the LHC Computing Grid (LCG) Project took place on 19-20 November 2007. The LHCC referees addressed the following areas: Management, Resources and Collaboration; Mass Storage and Networking; Distributed Fabric; Middleware Development and Deployment; Applications Area and Distributed Databases; and the issues of Services and Experiment Readiness. The LHCC acknowledges the considerable amount of work that has gone into the preparation of the LCG Project Comprehensive Review.

The LCG Project was created by the CERN Council in September 2001 with the aim of prototyping and deploying the computing environment for the LHC experiments. The formal launch of the project was at a workshop held in March 2002. Since that time, the LCG has demonstrated progress towards the realisation of the computing requirements of the experiments in time for LHC operation in 2008.

The LCG Project is a collaboration of the LHC experiments, the Regional Computing Centres, CERN and the physics institutes with the aim of preparing and deploying the computing environment that will be used by the LHC experiments to analyse the LHC data. The project includes support for applications and the development and operation of a computing service.

The LCG Project is divided into two phases. Phase I (2002-2005) had the objective of building a service prototype, based on existing Grid middleware, of running a production Grid service and of producing the Technical Design Report for the final system. Phase II (2006-2008) is building and commissioning the initial LHC computing environment. The LCG is not a Grid development project and it relies on other Grid projects for the middleware development and support.

The LHCC considers that the LCG Project has shown significant progress since the last Comprehensive Review in both the production and analysis phases and that the World-wide distributed LCG (WLCG) is becoming a reality. In particular, considerable progress has been achieved in the stability, usage and interoperability of the Grid infrastructure and in the use of the Grid by the experiments for analysis;
certain of the Tier centres have installed and run successfully the necessary hardware, while the Storage Resource Manager SRM v2.2-compliant services are being deployed, albeit after lengthy delays; the middleware services are in place and focus has shifted to ensuring stability of the installed features. The service level has constantly improved and the nominal data transfer throughput rate for 2008 has been achieved. A number of useful products have also been delivered by the Applications Areas and significant progress has been reported on the monitoring and reporting performance for both generic and experiment-specific issues.

However, the Committee did note some concerns. The Grid infrastructure has been only partially exercised and the analysis models are not yet fully defined. Although site stability and reliability have improved, they are not yet at the desired level and the required support model, especially for 24x7 operations, is not yet fully defined. The deployment schedule for the mass storage management and operation remains one of the most critical issues for the WLCG and its schedule is extremely tight for the upcoming Combined Computing Readiness Challenge CCRC08, which is an important milestone as all the services should be tested in their complete capacity at the same time for all the experiments prior to the start of LHC operations. Finally, it is also important that all pledged resources for 2008 are available for the CCRC08 in order to exercise the full system. The long-term guarantee of resources, both manpower and hardware, for the long-term also remains a concern.

The conclusions and concerns of the LHCC are given below. They will help the Committee to follow up outstanding issues and to monitor future progress of this project in forthcoming sessions of the LHCC.

- Considerable progress has been achieved in the stability, usage, and interoperability of the Grid infrastructure. The LHC experiments routinely use the Grid for production activities, with approximately 20% of the production done at CERN, 40% at the Tier-1 centres, and 40% at Tier-2 centres. Great progress has also been reported in using the Grid for analysis, although the system has only been partially exercised, and the analysis models are not fully defined.

- As part of the system commissioning, the CCRC08 has been planned for 2008, with two windows, in February and in May. The CCRC08 is an important milestone, when all the services should be tested at full capacity at the same time for all the experiments.

- A certain number of the Tier centres have proven to be able to install and run the necessary hardware. Still, the support model, especially for 24x7 operations, is not well defined. Measures have been developed to monitor the site reliability. The improvement is constant, but the site reliability is not yet at the required level. The measure derived from both basic tests and experiment-specific tests should be published to have a better understanding of the site situation. The CERN Tier-0 centre seems to be well equipped to cope with the expected data rates. Operational issues are being addressed, but a full plan is not yet in place. Networking is in general adequate.

- Mass storage management and operation remains one of the most critical issues for the LCG. After many delays, the SRM v2.2-compliant services are being deployed. The experiments have done only limited tests on the new services. The deployment schedule is extremely tight for the CCRC08. The CASTOR2 system has at the end of October 2007 released a new version fixing many issues, but it remains to be seen whether this new version has the required stability and performance. Deployment at remote sites is essential in order to reduce service difficulties. dCache v1.8 deployment has begun well, but its overall schedule remains very tight.

- Basic middleware services are in place and the focus of the past year has been more on stability than on new features. The gLite middleware failed to deliver the computing element software. Development of this has been stopped and replaced with Web-based services (CREAM). The LHCC is concerned by the announced
manpower cuts of European Union funds in the area of middleware development. The real test of the system will only happen with the first data, and it is essential that key experts are retained until then. A continued focus on stability and production quality software is essential for the coming year.

- The Application Area is in general in very good shape. The long-awaited migration from SEAL (Shared Environment for Applications at LHC) to the ROOT interactive tool for analysis is delayed because of unforeseen although not fundamental difficulties. The manpower level is matched to the requirements, but turnover can become a problem if the overlap is not sufficient to ensure proper knowledge transfer. Once again, in the view of the Committee, retention of key experts until the system has been fully exercised with real data would be very prudent. The 3D distributed database project is well on track.

- The service level has constantly improved and the nominal data transfer throughput rate for 2008 has been achieved, although only for short periods. Sustained, stable operation still needs to be achieved. Planning for the CCRC08 requires a strong coordination among all sites, a robust data transfer and management service, and a clear definition of the criticality of the various services as well as a failure recovery mechanism.

- Resources for the WLCG are provided through a Memorandum of Understanding for which, however, some signatures are still missing. Not all the pledged resources have been deployed in time and in particular the scarce disk space has caused significant problems to the production activities. In addition, a large fraction of the Tier-1 and Tier-2 sites have not confirmed the 2008 pledges. It is important that the pledged resources for 2008 are available for the CCRC08 in order to exercise the full system prior to LHC data taking. Up to 2010, the pledged resources match reasonably well the experiments’ requirements, except for ALICE, where a 50% short-fall is still observed. The pledged resources for 2011-2012 are significantly below the experiments’ requirements.

- Communication with remote sites has improved significantly, and a system to plan and track the progress of each site (especially the Tier-1 centres) has been set up. Many level-1 milestones are not being met, including the 24x7 support, the VO boxes support, and the site reliability. Stronger coordination is required to ensure that the sites are ready for CCRC08 and for data taking.

16. REFEREES

The LHCC referee teams are as follows:
ALICE: M. Gonin, J. Haba (Co-ordinator)
ATLAS: F. Forti, V. Kekelidze (Co-ordinator), R. Mankel, P. Mato
CMS: S. de Jong, M. Martinez-Perez, S. Smith (Co-ordinator), R. Yoshida
LHCb: S. Dalla Torre, C. Niebuhr, B. Peyaud (Co-ordinator)
TOTEM: S. Dalla Torre
MOEDAL: B. Peyaud
LHCf: M. Mangano, C. Niebuhr
RD39: S. de Jong
RD42: V. Kekelidze
RD50: R. Yoshida
LCG: F. Forti (Co-ordinator), R. Mankel, M. Martinez-Perez
17. The LHCC received the following documents:
   Minutes of the 90th meeting of LHCC held on Tuesday 25 September 2007
   CERN/LHCC 2007-027 - LHCC90

18. DATES FOR LHCC MEETINGS
   Dates for 2008:
   20-21 February
   7-8 May
   2-3 July
   24-25 September
   19-20 November

Emmanuel Tsesmelis
E-mail: LHCC.Secretary@CERN.CH
Tel. 78949, 164057

LHCC Secretariat: Morna Robillard (Bldg. 3-R-012) Tel. 73224
morna.roillard@cern.ch