CERN/LHCC 2010-010
LHCC 102
22 September 2010

LARGE HADRON COLLIDER COMMITTEE

Minutes of the one-hundredth-and-second meeting held on
Wednesday and Thursday, 7-8 July 2010

OPEN SESSIONS

1. LHC Machine Status Report: Steve Myers
2. ATLAS Status Report: Aleandro Nisati
3. CMS Status Report: Christos Leonidopoulos
4. ALICE Status Report: Paul Kuijer
5. LHCb Status Report: Stephanie Hansmann-Menzemer
6. LHCf Status Report: Oscar Adriani
7. TOTEM Status Report: Mario Deile

CLOSED SESSION:

Present: F. Bedeschi, S. Bertolucci*, J. Blazey, P. Bloch, A. Boehnlein, H. Breuker, C. Cecchi, D. D'Enterria, E. Elsen, M. Ferro-Luzzi, J.-F. Grivaz, C. Hawkes, R. Heuer*, W. Kuehn, D. Macina, M. Mangano, P. Mato, T. Mori, B. Panzer-Steindel, D. Pitzl, R. Roser, E. Tsesmelis (Scientific Secretary), T. Wyatt (Chairman)

*part-time

Apologies: D. Macina, A. Nomerotski

1. PROCEDURE

The minutes of the one-hundredth-and-first LHCC meeting (LHCC 2010-008 / LHCC 101) were approved.

2. REPORT FROM THE DIRECTOR FOR RESEARCH AND SCIENTIFIC COMPUTING

The Director for Research and Scientific Computing reported on issues related to the LHC.

He reported that the start of the 2010 LHC physics run has been very successful and many milestones were passed for the LHC machine, experiments and computing. He reiterated that for 2010-2011 the LHC will be operated in proton-proton mode at 7 TeV centre-of-mass energy, with the aim of reaching an instantaneous luminosity of 10^{32} cm^{-2} s^{-1} and an integrated luminosity of 1 fb^{-1}. Heavy-ion runs are scheduled for the end of both years.

The Director for Research and Scientific Computing also reported on the plan for the LHC for the years until 2020, as detailed in the session with the LHC experiment upgrade referees below (Section 11).

A meeting of the Scientific Policy Committee (SPC) and Finance Committee (FC) will be held at the end of August 2010.These are special sessions to deliberate further on the Organization's medium-term plan.

3. REPORT FROM THE LHC PROGRAMME CO-ORDINATOR

The LHCC heard a report from the LHC Programme Co-ordinator, concentrating on progress in the 2010 LHC run and plans for LHC operation in the short term. He summarized the number of proton-proton interactions delivered by the machine and recorded by the experiments during the initial period of the 2010 LHC run and gave an estimate of the corresponding integrated luminosity. All parameters are considered to be excellent and the data collection efficiencies of the experiments are high. This year is considered to be the period for reaching a peak instantaneous luminosity of 10^{32} cm^{-2} s^{-1} and to consolidate operational experience, while 2011 will be the year for integrating luminosity, with the aim of reaching 1 fb^{-1}. This would also require at least 8×10^{10} protons/bunch with several hundred bunches.

The Co-ordinator also reported on the ALICE request for a low-energy proton-proton run at 2.8 TeV centre-of-mass energy. The run would provide comparison with heavy-ion collisions for many physics studies, particularly for jet quenching where extrapolation between 900 GeV and 7 TeV centre-of-mass energy is inaccurate due to the sharply falling spectrum. The projected time required to set up the machine and for ALICE to collect at least 50 million events would be about one week. The LHCC **recognizes** the importance of such a measurement and **recommends** that the required time should come in part from a reduction in the scheduled length of the heavy-ion run.

4. DISCUSSION WITH ATLAS

The ATLAS detector is working very well and the LHCC **congratulates** the Collaboration. At the time of the LHCC review ATLAS has successfully collected over 90 nb^{-1} of data with excellent data taking efficiency and with only 1-2% dead channels in any given sub-system. In addition, the offline systems and Grid computing systems are working well and the data is being processed in a timely fashion. ATLAS made a decision to show results with only 6-7 nb^{-1} of data. Their strategy was to reprocess the data and focus their immediate analysis efforts on gaining a better understanding of their detector fundamentals like jet energy scale, alignment, and calibration issues rather than to try to approve a set of plots for the LHCC meeting. After discussions with the ATLAS Management, the LHCC referees are confident that ATLAS will be in a strong position at the International Conference on High Energy Physics (ICHEP) in Paris and will have approved results utilizing a significant fraction of the total delivered luminosity for analyses where appropriate.

During the LHCC review process, the LHCC referees went over the current list of outstanding issues and two new issues that need to be kept track of. The first issue has to do with the optical links with the Pixel Detector and Semiconductor Tracker (SCT) and the second is a potential trigger/readout issue with the Cathode Strip Chamber (CSC). A brief description of both is given below.

- Pixel Detector and SCT Optical Links – These links transfer clock and command information to the detector. There are 644 links in total. This hardware has been stable for the past 18 months, but in the few weeks prior to the LHCC review 40 links had failed. These devices are located off-detector so they can be replaced during short detector accesses. The reason for the mortality is still under investigation.
- CSC trigger/readout – The CSC is currently capable of being read out at 66 kHz, up from 48 kHz from the previous LHCC review. During high rate trigger tests using “simulated triggers”, a problem was identified in processing the third trigger decision. This problem has not presented itself during normal data taking operations and will not be a problem until trigger rates increase substantially from where they are today. The problem seems to be related to how the data is transferred from the detector (firmware) but the root cause is still under investigation.

None of the problems identified and documented in previous reviews have been fully eliminated. However, progress has been made in addressing each of them. A brief status of each is presented below.

- Inner Detector Cooling – The plan continues to replace the evaporative cooling system in 2012 with a hybrid system that is both gravity-fed as well as having pumping capability built in. The CERN engineering group is engaged but progress on it is slow. The Resources Review Board has still not given authorization for putting this expense on Maintenance and Operation (M&O) costs. This is now a problem. During this LHCC meeting, information was sent from the LHCC to the RRB Scrutiny Group recommending that they approve this expense so that progress can be sped up in the future.
- LAr Calorimeter OTX Optical Links – There has been no change in the status on this issue. There are now 21 dead channels out of 1528, up from 19 at the previous LHCC review. All 21 are located in the suspicious region with narrow spectrum. The plan will be to access one side of the detector and replace all of the broken links that are accessible during the 9-week technical stop over the 2010-2011 Christmas period. An 11-week technical stop would be required in order to fix both sides. At the moment, there is no plan to lengthen this technical stop.
- Low Voltage Power Supply Reliability for the LAr and Tile Calormieters - There are two separate sub-detectors which have power supply problems. The Tile Calorimeter group plans to rebuild all 256 of its units and install them during the 2012 shutdown. Prototypes of these supplies do exist now and lifetime and stability tests are now being performed. The plan is to install 25-30 prototype supplies during the upcoming Christmas technical stop to see how they perform under running conditions. The LAr Calorimeter power supply problems have to do with redundancy failures. No new supplies have failed since the previous LHCC review. A vendor has been chosen and the order has been placed.
- Solenoid Cryogenics – There have been problems with intermittent ice blockages which prevent cryogenic flow to the solenoid magnet. These blockages occur at the filter. When a blockage occurs, the magnet has to be warmed up sufficiently to melt the ice – this is a multi-day process. There was one occurrence since the previous LHCC review, however it came during a machine studies period and so no data was lost. An air dryer has been procured and will be installed during the 5-day July 2010 technical stop. It is hoped that this should alleviate the problem. During the last few months the helium pump was identified as a single point failure. A second pump has now been installed and can be valved in if there is a problem. A third helium pump now sits on the shelf so there is now sufficient redundancy and this is no longer an issue.
- Beam pipe – ATLAS would like to replace the stainless steel beam pipes in the "forward" regions between the low-β quadrupole magnets and the ATLAS central detector. The engineering and design effort is concentrated on the flanges and the aluminum ion pump. A prototype of the bellows now exists. An aluminum/beryllium composite beam pipe is being considered – but the fallback plan is an all aluminum pipe. This project is still on track for procurement and installation during the 2012 shutdown.
- Insertable B-Layer (IBL) – The ATLAS Collaboration would like to build an Inner Pixel Tracker layer, to be inserted inside the currently-existing Tracker during the shutdown now foreseen for 2016. The technical aspects for the Technical Design Report (TDR) are very advanced. The physics justification has been lagging behind. Since the previous LHCC review, a task force has been established. The goal is to have the studies completed by late August 2010 so that a completed TDR would be available to the LHCC for its September 2010 session.

- Shifts – The staffing of detector shifts is going very well. However, the more general shift positions have proven more difficult to fill. The Collaboration is busy training some general shift experts to help fill an important need. In the time since the previous LHCC review there has been additional progress in reducing the number of detector experts required to collect data. More reduction is planned as operations stabilize and become better understood.
- Non-collision background – ATLAS established a task force to examine this issue and determined that the beam pipe vacuum is excellent and that this is a non-problem for them.

In summary, the ATLAS Collaboration is making excellent progress on all fronts. The detector is working well and the Collaboration is concentrating their analysis efforts on an improved understanding and characterization of detector performance. They will be well prepared for the ICHEP conference at the end of July 2010. ATLAS has made progress on most of the outstanding detector issues though none can yet be crossed off completely from the list as of yet.

5. DISCUSSION WITH CMS

Overall

CMS continues to operate the detector in a very efficient manner. The detector availability is high for all components. CMS is well prepared to adapt to changes of running conditions as exemplified by the response to the luminosity increase over the past weeks. Detector performance is monitored with short delays in feedback. Physics results are extracted almost instantaneously.

The Collaboration is well engaged in all stages of the analysis with many users participating in detailed analyses. There is already an extensive analysis of the data taken and more is to come for the ICHEP conference in July 2010.

Specific Observations

A clear breakdown of the contributors to the residual deadtime was presented at the meeting. Tools are in place to monitor the deadtime contributions of individual detector components and to respond promptly to changes in performance induced by changes of running conditions.

The Collaboration seizes the physics/calibration opportunities. The π^0-trigger is just one example of how a physics signature is used for monitoring the detector performance at the front end.

The detector material budget is well understood as demonstrated by the detailed photon conversion and hadronic interaction data.

Extrapolation to Higher Rates

The trigger rates are well understood at the 10-20% level. This observation made already during the May 2010 meeting of the LHCC still holds after the exponential increase of luminosity over the past few weeks. Pile-up of events has been seen, but does not constitute a problem for trigger nor analysis. However, as luminosity increases the effect is carefully monitored. The varying trigger conditions are recorded transparently in the data and soon thereafter in the run database.

ECAL Spikes and HCAL Noise

The Committee received a thorough analysis of the Electromagnetic Calorimeter (ECAL) spikes and Hadronic Calorimeter (HCAL) noise in a dedicated presentation. The ECAL signals are generated by slow secondaries and occur in cosmic-ray and beam crossings. The analysis showed that both with timing and topological cuts the rates can be effectively reduced by orders of magnitude. This convincing study continues and will be extended to jets for detailed assessment as soon as larger data and simulation samples are available.

The HCAL noise, traced to the Hybrid Photon Detectors (HPDs) and Photomultiplier Tubes (PMTs), has been well characterized and can be eliminated with timing and topological cuts. The PMTs will be replaced during the 2012 shutdown and the HPDs during the envisioned 2015/16 shutdown. The plan to provision for sufficient HPD spares through 2016 is to turn off the Hadronic Outer (HO) second ring now. The physics impact is low. These HO HPDs will be replaced with Silicon Photomultipliers (SiPMs) in 2012.

Physics

A large number of physics analyses has been shown including the di-lepton mass distribution for J/ Ψ and extending to the Y-region. Several detector related analyses together with more than twenty physics analyses are being prepared for ICHEP.

The CMS Collaboration has chosen a reviewing system that requires considerable engagement of the Physics Coordinators and the Management to sign off. Such a system does work for the first year of operation and has proven to be very efficient and productive. Eventually the Collaboration will have to find ways to share the burden of review and responsibility and engage a larger fraction of the collaborators in the review process. Again, it is reassuring that the Management has taken appropriate steps to attract a bigger fraction of the Collaboration into the paper reviewing.

Integration of TOTEM T1 Detector

The Committee is pleased to see that the Engineering Design Review chaired by CMS clearly laid out the technical installation requirements and individual steps for the TOTEM T1 detectors. The LHCC is eager to receive the full report at the next meeting. Given the risks associated with this installation, it is mandatory that all preparatory steps be taken and exercised if possible.

The decision for installation depends on additional criteria that were specified in a common LHCC session with CMS and TOTEM representatives and hence are outside the scope of this assessment (see Section 9 below).

Upgrade

The CMS Collaboration has presented a clear plan for upgrades, which will culminate in a Technical Design Report in autumn 2010. The referees are interested in taking part in the assessment of these plans and would be grateful of receiving a preliminary copy of the report as early as possible to start their own preparation.

Summary

The LHCC **congratulates** the CMS Collaboration for an extremely successful run and analysis. The referees appreciate the open sharing of the information and the responsiveness to questions that the Committee raised earlier. Plans for the September 2010 session of the LHCC include a detailed assessment of the CMS detector status; the readiness of CMS for the heavy-ion run; and a discussion on the CMS upgrade document.

6. DISCUSSION WITH ALICE

The LHCC **congratulates** the ALICE Collaboration for the successful operation of the detector during the current LHC beam period. Most detector components operated smoothly. Six papers have already been published or have been submitted for publication and more publications are in preparation.

The discussion with the Collaboration focused on the following issues, which will require further attention in the future. Firstly, the cooling problem for the Silicon Pixel Detector (SPD) is stable, with 20% of the SPD having been turned off during the LHC run. Due to the inaccessibility of the Inner Tracking System (ITS), any possible solution requires a major intervention which could only take place during a long shutdown period. Secondly, the Particle Multiplicity Detector (PMD) continues to exhibit sparks, resulting in a loss of pedestal information in the front-end electronics. The situation was improved by running the PMD with a reduced high voltage, thereby

reducing the spark probability without significant loss in efficiency. Furthermore, a modification in the front-end electronics will be implemented during the upcoming Christmas technical stop, thereby improving the stability of the electronics when sparking occurs. Moreover, the Committee took note of the shadowing of the ALICE ZDC by collimators of the machine. Also, with increasing beam current, the number of high-voltage trips on the Time Projection Chamber (TPC) read-out chambers is observed to increase. Finally, the loss of data due to a configuration problem of the CASTOR storage management system was reviewed. Fortunately, most of the data could be recovered. A discussion between ALICE and the CERN IT Department is underway on how to secure data from the heavy-ion run.

The Committee discussed the ALICE Dijet Calorimeter (DCal) Addendum to the Electromagnetic Calorimeter (EMCal) Technical Design Report (CERN-LHCC-2010-011; ALICE-TDR-014-ADD-1). The DCal expands the physics capabilities of the EMCal by enabling back-to-back high-p_T correlation measurements. In combination with the EMCal, the DCal forms a two-arm electromagnetic calorimeter. The DCal consists of 6 supermodules of the EMCal design in conjunction with 3 supermodules of the Photon Spectrometer (PHOS) detector. The DCal allows the measurement of hadron-jet and jet-jet correlations at high statistics over a broad kinematic range. Of particular importance is the ability to trigger on high-p_T π^0 in correlation with a recoiling jet. The DCal is technically sound and enhances significantly the physics potential of ALICE. The Committee has no major concerns. The LHCC review of the Addendum was not a detailed review of the engineering or procurement readiness. The LHCC **recommends** general approval of the ALICE DCal Addendum to the EMCal Technical Design Report. The LHCC considers the schedule given in the Addendum to be appropriate. The schedule will be used by the Committee to monitor the future progress of the project.

7. DISCUSSION WITH LHCb

The LHCb detector is working very well and is being operated efficiently by a small shift crew; the analysis is progressing rapidly and several results will be ready for the International Conference in High Energy Physics (ICHEP) in July 2010. The LHCC **congratulates** the LHCb Collaboration for the excellent work done so far. LHCb is in a unique position to complete a significant fraction of its physics potential during the 2010-2011 run, provided the LHC integrated luminosity goal is reached.

The LHCC notes, however, that the luminosity per bunch crossing presently delivered is higher than the experiment was originally designed for. The LHCb Collaboration is now studying the optimal operating conditions for the trigger and the accelerator. After this work has been completed, possibly by September 2010, the Collaboration may request an increase of β^* in their intersection region during 2011.

LHCb has made much progress in the understanding of the aerogel problem and may replace it as early as during the 2010-2011 technical stop. The effect of the aerogel contamination can be mitigated in part by a finer-grained calibration. In the meantime, detailed preparations are being made for the 2012 shutdown, when LHCb will replace parts of the beam pipe and install much of the infrastructure needed for their upgrade.

The LHCb operation model, with a very small crew of people on shift, is functioning well, but requires very experienced personnel. The Committee encourages the LHCb Collaboration to formalize soon the contributions to the operation of the detector with all collaborating institutions.

LHCb has recently taken data with very high luminosity per bunch. This is very useful for planning their running conditions in 2011. It is important that they understand these data well and prove that they can model them closely with their Monte Carlo simulation.

All basic analysis tools are working well, but more work is needed to complete the understanding of the Silicon Tracker resolution and alignment. Micro-DSTs tailored for various analyses are being produced centrally, thus improving the efficiency for production of physics results.

LHCb has one paper on K^0_s production at 900 GeV centre-of-mass energy almost ready for submission for publication. The LHCC is somewhat concerned by the time taken to complete this first paper and encourages the Collaboration to make their publication procedure more efficient for their next results.

The LHCC believes that by autumn 2010 LHCb will have collected sufficient statistics to perform a reliable extrapolation of its physics capabilities for this run. This is a good time for a full review of the experiment. The LHCC referees and the LHCb Management have agreed to hold a review during the November 2010 LHCC meeting. The details will be defined until September 2010.

8. DISCUSSION WITH LHCf

LHCf has essentially completed its initial physics programme. The Collaboration reported on the preliminary results with about 120k shower events collected at 900 GeV centre-of-mass energy combining Arm-1 and Arm-2. This already provides good discriminating power between the various Monte Carlo codes. The data collected at 7 TeV centre-of-mass energy amounts to about 84 nb^{-1} until the time of the LHCC session, with the majority of it having been collected at a crossing angle of 100 μrad, for which the Collaboration is very thankful. The LHCf detector showed good performance and good energy calibration stability ($< \pm 1\%$) using the π^0 peak. Radiation damage effects in the plastic scintillators have been observed and they are in good agreement with the expectations. Very preliminary energy spectra for gamma-like and hadron-like particles have been shown for both the Arm-1 and Arm-2 detectors. Invariant mass plots, showing in addition to the π^0 peak an η peak only visible at low luminosity data (with no pile-up) have also been presented. The Collaboration expressed an interest to collect more η events in order to have a better tool to estimate systematic uncertainties in the energy scale and to check further the validity of the Monte Carlo models. This would require special fill configurations, which will likely not be possible on a short time scale.

The Committee has been impressed by the progress that the LHCf Collaboration achieved in this short time and **congratulates** the Collaboration. The LHCf detectors will be removed from the TAN on 20 July 2010 and they will be calibrated in test beams. The detector will then be upgraded during 2011 to improve its radiation hardness and to be ready to be re-installed in the TAN for the 14 TeV center-of-mass energy run. The Committee took note of the SPS test beam scheduling problem. The currently allocated period during the first week in August 2010 is too close to the detector removal date and does not give sufficient time for all required operations. Any period later in the year will be very well received by the Collaboration, and this request was strongly **supported** by the Committee.

9. DISCUSSION WITH TOTEM

The LHCC referees are pleased with the progress that TOTEM has made since the previous LHCC session, but recognize that a lot of work remains to be done before the detector is ready for physics. The observations of the Committee are the following:

- T1 Telescope Construction: The construction of the remaining T1 quarter was completed on 6 June 2010, and the full T1 detector is now installed on the SPS H8 test-beam line. The first data, with muon and pion beams, have been collected by the complete second arm during the period 6-10 June 2010. More data-taking is scheduled for the remaining SPS running period in 2010. TOTEM's Data Quality Monitoring (DQM) system allowed for rapid assessment of the data-taking, with a hardware performance consistent with expectations.

- T1 Telescope Installation: the T1 installation Engineering Design Review took place on 24 June 2010 and was chaired by the CMS Technical Co-ordinator. The various work-packages and procedures are now identified and documented, and the relevant working groups and tasks assigned. The writing of the final report is being completed. The installation of the negative side can be arranged within the scheduled upcoming technical stop, starting on 6 December 2010 and finishing on 2 February 2011, two days before the restart of LHC operations. Commissioning time is included, and allows for repeated insertions and removals before the beampipe load is transferred back to the permanent supports. Installation of the positive side would add two weeks. Scenarios where the T1 installation would compete with work on CMS are being reviewed as well.
- T2 Telescope Status and Performance: The five faulty planes have been recovered. The detector is still reporting noise levels higher than at the test beam and also lower efficiencies. The T2 Telescope noise is sensitive to the CMS calibration and run conditions. The environment with nominal bunches is considered hostile due to a large number of secondaries and low-p_T loopers. Optimization studies are in progress, and runs with lower bunch intensity would provide better operating conditions. New DAQ and trigger cables are being produced for installation during the upcoming Christmas technical stop.
- Roman Pots: the detectors are in good condition, with only 1% of noisy/dead channels. Latency scans with active triggers have been completed. Absolute positioning studies have started successfully with 450 GeV beams. They will be repeated at 3.5 TeV beams, with the ultimate goal of allowing the Roman Pot insertion during normal "stable beam" operations, possibly down to 15σ or less. Production of the detectors for the Roman Pots at 147m is in progress, and is on schedule for testing in H8 and installation in the tunnel during the upcoming Christmas technical stop.
- Trigger: The trigger system is still being debugged, in particular to address problems with the test procedures. Software activities are focused on the analysis of the commissioning data to provide feedback on detector optimization.
- Running Scenarios for 2010/11: during normal runs, with β^* in the 2-5m range, TOTEM could measure large-t elastic scattering with the Roman Pots positioned at 20σ, and work on the optimization of the T2 performance. Runs with low bunch intensity, 10^{10} protons/bunch, and with the Roman Pots positioned down to 10σ, would allow for more accurate measurements of charged-particle production in the η=[5.2-6.5] region (with T2), elastic scattering in the $-t$=[0.6-5] GeV^2 domain, and measurements of single and central diffractive rates. Runs at β^*=90m would be required for a first determination of the total cross section with 5% accuracy, and to push the measurement of the elastic cross section to $-t$=0.015 GeV^2.

The Committee asks TOTEM to provide a more detailed account of the issues emerging during the commissioning, and of the specific actions taken to address them. Likewise, a comprehensive documentation of the possible running scenarios and physics reach (with the full T1 Telescope, with only the negative-side, and without it) should be made available for the September 2010 LHCC, as supporting material for the discussion on the installation of the T1 Telescope detectors. This should account for the available assessment of TOTEM's performance as emerging from the current data, of the expected running conditions, and should provide a quantitative evaluation of the physics reach in terms of measurement accuracy and of the model-discrimination potential.

10. REPORT FROM THE LCG REFEREES

The LHCC heard a report from the LCG referees. The referees met with Ian Bird (World-wide LHC Computing Grid (WLCG) Project Leader) together with representatives from the experiments on 6 July 2010, and heard reports on the performance of the WLCG and the processing and analysis of LHC data.

Service incidents, caused by power outages, hardware failures, software problems, etc. occur at the Tier-0 and Tier-1 sites at a rate of a few per month and cannot be avoided. All major incidents are followed up with an investigation, leading to a service incident report and an action list designed to mitigate the risk of similar incidents in the future. One major incident in April-May 2010 resulted in a small loss of ALICE data. A configuration error in the CASTOR mass storage system at the Tier-0 centre resulted in raw data being distributed across all available tape pools, instead of to dedicated pools as intended. This included a pool in which tapes were recycled after some time. ALICE, ATLAS and CMS were affected, but only ALICE data files were overwritten, including 1773 files of collision data at 900 GeV centre-of-mass energy that had not yet been copied to the Tier-1 centre. All but 56 of these files were eventually recovered from the tapes. Actions taken include a review of the software change procedure and improved monitoring of CASTOR. For the heavy-ion running a backup copy of ALICE raw data will be stored temporarily at Tier-0, until replication at Tier-1 has been completed.

The electrical power needed by Tier-0 increases over time as more resources are added, although this is partially compensated by the replacement of old equipment with new, more efficient models. The overall power consumption is close to the capacity (2.9 MW) of Building 513, where Tier-0 is located, and is predicted to exceed that limit in 2013. Plans include the consolidation of the existing capacity in Building 513, to give 3.5 MW, and the provision of container-style capacity in 400 kW units on the Prévessin site, although neither of these would be possible before mid-2012. Accommodation of resources outside CERN is also being investigated, with 100 kW already available in Geneva, and a call for proposals has been issued to host some Tier-0 services remotely. The strategy for the evolution of Tier-0 capacity has been an agenda item in LHCC-LCG meetings for at least two years. The referees are concerned about the risk that Tier-0 could become vulnerable, for example during a period of very hot weather when the power required for cooling increases, and recommend that a decision on a long-term solution be taken soon.

The experiments report no major problems with data processing, and generally good performance from the WLCG. They have coped with the peaks in analysis activity in advance of the major summer conferences.

Two workshops have recently been held on future developments of the Grid, one on data access and management and the other on the use of multi-core and virtualization technologies.

11. REPORT FROM THE LHC EXPERIMENT UPGRADE REFEREES

The LHCC heard a report on the LHC experiment upgrades. The report focused on the upgrade plans and shutdown requirements for ALICE, ATLAS, CMS and LHCb until 2020 and the corresponding machine upgrade plans.

The following assumptions were made for the LHC schedule for the coming decade:

- 2010-2011 - 7 TeV centre-of-mass energy proton-proton runs, reaching an instantaneous luminosity of 10^{32} cm^{-2} s^{-1} and an integrated luminosity of 1 fb^{-1}, and with heavy-ions runs at the end of both years.
- 2012 – Shutdown for machine splice consolidation, re-training of main dipole magnets, and work on the collimation system and SPS consolidation.
- 2013 – 13 TeV centre-of-mass energy proton-proton run with intensity limited by collimation system.

- 2014 – 14 TeV centre-of-mass energy proton-proton run (with intensity limited by collimation system) and heavy-ion run.
- Mid-decade – Shutdown for LINAC4 Proton Synchrotron Booster (PSB) and LHC collimation system. This would allow the LHC experiments to carry out their Phase I upgrades.
- Second half of decade – 14 TeV centre-of-mass energy proton-proton runs and heavy-ion runs. The LHC will also be pushing towards its ultimate instantaneous luminosity of 2×10^{34} cm^{-2} s^{-1}, integrating a total of 300-400 fb^{-1}.
- About 2020 – Shutdown for High-Luminosity LHC (HL-LHC) together with experiment Phase II upgrades.

The luminosity of 2×10^{34} cm^{-2} s^{-1} may ultimately be reachable with the present LHC machine after overcoming the bunch intensity limitations in the SPS. This would require the installation of the Phase-2 collimators, some of which will be placed between superconducting magnets. In order to profit from this luminosity, ATLAS and CMS need to prepare accordingly their trigger and DAQ, Pixel Detector occupancy and a higher granularity and redundancy in the accessible systems.

In order to maximize running time, there was a general consensus to have only a single shutdown for the so-called Phase I experiment upgrades in the middle of the decade. The High-Luminosity LHC (HL-LHC), which will have the LHC operating at luminosities of about 5×10^{34} cm^{-2} s^{-1}, will require a machine shutdown in about 2020 and will also include the experiment Phase II upgrades. The detailed discussion for the HL-LHC is deferred to a later session of the LHCC.

In the period leading up to the September 2010 session of the LHCC and the October 2010 meeting of the Resources Review Boards, the Committee will be reviewing the ATLAS Technical Design Report for the Insertable B-Layer, the ATLAS Letter of Intent for the Phase I and Phase II upgrades and the CMS Technical Proposal for all Phase I upgrades.

12. LHCC CLOSE-OUT WITH THE DIRECTOR-GENERAL AND THE DIRECTOR FOR RESEARCH & SCIENTIFIC COMPUTING

The LHCC discussed with the Director-General and Director for Research & Scientific Computing the LHC operation schedule. The LHC operation schedule will be over a two-year cycle, with a short technical stop around Christmas at the end of the first year and a longer shutdown following the end of the second year. Such a schedule is considered to be more efficient for the operation of a superconducting accelerator and the LHCC **supports** such a running strategy.

The LHCC also discussed the schedule for the LHCC meetings for 2011 with the Director-General and Director for Research & Scientific Computing. The number of meetings and their timing in relation to key machine and conference milestones will be reviewed in the coming weeks together with the experiments before the schedule is finalized.

Plans for the September 2010 session of the LHCC include a detailed assessment of the readiness of the LHC machine and experiments for the upcoming heavy-ion run as well as a report on the theoretical aspects of heavy-ion physics at the LHC.

13. REFEREES

The LHCC referee teams are as follows:

ALICE: D. D'Enterria, J.-F. Grivaz, W. Kuehn (Co-ordinator)

ATLAS: C. Cecchi, P. Mato, D. Pitzl, R. Roser (Co-ordinator)

CMS: J. Blazey, A. Boehnlein, E. Elsen (Co-ordinator), T. Mori

LHCb: F. Bedeschi (Co-ordinator), C. Hawkes, A. Nomerotski

TOTEM, LHCf, MoEDAL: C. Cecchi, D. D'Enterria, E. Elsen, M. Mangano, P. Mato

LCG: A. Boehnlein, J.-F. Grivaz, C. Hawkes (Co-ordinator), T. Mori

Experiment Upgrades:
Co-ordinator: D. Pitzl
RD39: D. Pitzl
RD42: A. Nomerotski, J. Blazey
RD50: A. Nomerotski
RD51: W. Kuehn

14. The LHCC received the following documents:

Minutes of the 101st Meeting of the LHCC held on Wednesday 5 and Thursday 6 May 2010
(LHCC-2010-008 LHCC 101)

Discussion with LHCb – 8 July 2010 (paper)

15. DATES FOR LHCC MEETINGS

Dates for **2010**

22-23 September

17-18 November

Emmanuel Tsesmelis
E–mail: LHCC.Secretary@cern.ch
Tel. 78949, 164057

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