LHC@FNAL Requirements for Remote Operations

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LHC@FNAL is an operations centre to be located at Fermilab. The purpose of this centre is to help members of the Large Hadron Collider (LHC) community in North America contribute their expertise to LHC activities at CERN, and to assist CERN with the commissioning and operation of the LHC accelerator and CMS experiment.

As an operations centre, LHC@FNAL has three primary functions. First, it is a place that provides access to information in a manner that is similar to what is available in control rooms at CERN, and it is a place where members of the LHC community can participate remotely in LHC and CMS activities. LHC@FNAL provides a location with hardware and software that is similar, if not identical, to what is available at CERN. For instance, one can imagine that it will be equipped with accelerator consoles that are identical to consoles at the CERN Control Centre (CCC), so that monitoring software that is used at the CCC can be used for long-distance monitoring of components of the LHC accelerator and its subsystems. Furthermore, LHC@FNAL will have safeguards in place to satisfy CERN safety, as well as CERN computing and networking security standards.

The second function of LHC@FNAL is to serve as a communications conduit between CERN and members of the LHC community located in North America. The need for communication is expected to be bi-directional. On the one hand, LHC@FNAL can respond to requests from CERN to locate US-CMS or LHC experts and establish a communications link between these experts and CERN. On the other hand, LHC@FNAL can respond to requests from experts who need access to information that is inaccessible to individuals at home or their home institution. For example, access to some information may require special access privileges or specialized software, or may require verbal communication with someone working at a control room at CERN. LHC@FNAL can provide access to this information, and can relay information to the CCC and CMS control rooms using established communications channels.

The third function of LHC@FNAL is outreach. With accelerator and experiment consoles that replicate systems at CERN and shift operators actively engaged in LHC activities, visitors to Fermilab will be able to see firsthand how research is progressing at the LHC. Visitors will be able to see current LHC activities, and will be able to see how future international projects in particle physics can benefit from active participation in projects at remote locations.

LHC@FNAL is expected to contribute to a wide range of activities as the LHC is readied for operations. For CMS there are test beam activities, the Magnet Test Cosmic Challenge, detector commissioning, and operations. For LHC, activities include training for accelerator physicists so they are familiar with the control system before traveling to CERN, and remote participation in hardware commissioning for U.S. deliverables, LHC beam commissioning, and post-commissioning activities. Post-commissioning activities include remote participation in LHC machine studies; support of U.S. provided deliverables, including continued support from the designers of beam-related equipment during LHC operations; and
work on luminosity upgrades. The following list shows activities that we envision for LHC@FNAL:

- Participate in CMS and LHC shifts
- Participate in CMS and LHC data monitoring and analysis
- Develop and test new monitoring capabilities
- Provide access to data, data summaries, and analysis results
- Provide training in preparation for shift activities at CERN
- Assist in establishing communications between accelerator and detector experts in North America and CERN

An important aspect of LHC@FNAL is that accelerator and detector experts will be in close proximity to each other while participating in activities at CERN. The advantage of this arrangement is an economy of scale. Individuals working together on LHC and CMS activities can use the same resources in their work while sharing their insights on the commissioning and operation of the LHC accelerator and CMS experiment.

To develop requirements for LHC@FNAL we had to make assumptions on how accelerator and detector experts in North America will interact with CERN and CMS staff. These assumptions are presented along with scenarios that were used to develop requirements in a preliminary requirements document:


In this document there are two types of requirements: those that address physical aspects of an operations centre, and those that pertain to agreements and policies that need to be addressed by CERN, Fermilab, CMS, and LARP management. Requirements are presented in four sections. The first two sections list requirements that pertain exclusively to CMS and LHC, respectively. Requirements that are common to CMS and LHC are in the third section, and requirements that are derived from constraints such as safety, security, and software development constraints are in the fourth section. The requirements address general capabilities; access to LHC and CMS data, meetings and other types of information; software and software development; the LHC@FNAL operational environment; and computing, networking, software development, security and safety constraints. The preliminary requirements document was submitted to Fermilab’s Director at the end of July, 2005.

Since the submission of the preliminary requirements document to Fermilab’s Director, the LHC@FNAL task force has visited nine sites to learn about the design and layout of control rooms. Some of these control rooms involve remote operations capabilities. We visited the following sites: remote control room for the Gemini Observatory, control room for Jefferson Lab, Space Telescope Science Institute and NASA’s Goddard Space Flight Center with control rooms for the Hubble Space Telescope, National Ignition Facility, General Atomics, Spallation Neutron Source, Advanced Photon Source, and the European Space Operations Centre.

In addition to site visits the task force has initiated a three-month evaluation of a web collaboration tool (http://webex.com/) that provides easy access to a secure environment for sharing data, documents, presentations, and software applications among remote participants. We believe that this type of collaboration tool improves communication and augments existing forms of communication such as video conferencing, telephone calls, and email.
The site visits and ongoing evaluation of collaboration tools have played an important role in developing a plan for LHC@FNAL. Our current work is focused on completing the requirements document by the end of calendar year 2005, along with a resource loaded schedule for the construction of LHC@FNAL. Work on the physical layout of LHC@FNAL has started. In 2006 we expect to complete the design of the operations centre and look forward to begin the construction phase towards the end of the year.