CHAPTER 1

INTRODUCTION

The aim of this document is to detail the main modifications that have been necessary to the existing CERN facilities in order to accommodate the LHC machine and its experiments. Particular attention is given to the infrastructure and general service requirements including, civil engineering, cooling, ventilation and electrical services.

The underground infrastructure of LEP [1] basically consisted of a 26.7 km long ring tunnel lined with concrete and lying in the limestone strata for about 10% of its length and in the molasse for about 90%. It included experimental areas at four points (2, 4, 6 and 8), each incorporating experimental and service caverns, plus an equipment cavern at Point 1 with injection tunnels connected to allow particle transfer from the SPS machine. At points 2 and 6 additional galleries parallel to the main tunnel were used to house klystrons and their power supplies (Fig. 2.1). On the surface a total of 37 buildings housed all the necessary equipment and services for the LEP machine and experimental operations (Fig. 2.2). The LEP-2 upgrade [2] consisted essentially of the addition of two sets of galleries at points 4 and 8, similar to those existing at points 2 and 6, thus allowing a doubling of the number of klystrons and related power supplies.

For the LHC project, the existing LEP tunnel has been re-used after the complete dismantling of the LEP machine. In addition new structures have been added including experimental and service caverns destined to accommodate two new experiments at points 1 and 5, two transfer tunnels of about 2.5 km each in length and beam dump facilities comprising two sets of straight tunnels and caverns each side of Point 6. 32 new surface buildings of various sizes at all points except 3 and 7 have also been constructed.

After about 11 years of LEP operations and subsequent dismantling, the civil engineering infrastructure was generally in good condition and little refurbishment had to be done, with the exception of the headwalls of the experimental caverns at points 4, 6 and 8, which had been damaged by the swelling of wet molasse behind them.

The cooling and ventilation systems rely heavily on the equipment constructed for the LEP machine and subsequently up-graded for the LEP-2 project (e.g. additional cooling towers). The tunnel ventilation systems have, to a large extent, been re-used with up-dates mainly due to the significant increase of thermal load in the tunnel and the addition of the transfer tunnels. New caverns have obviously been equipped with new ventilation systems. Water cooling plants in the technical caverns of even points will undergo refurbishments to accommodate large alterations in the use of demineralised water; this includes the replacement of the stainless steel pipeline in the LHC tunnel. Chilled water plants and cooling towers as well as other hydraulic networks are, to a large extent, left intact.

Systems which are modified for the LHC automatically receive a technical update. This is, however, not extended to the whole infrastructure, therefore a large part of the equipment will continue to be used after some 20 years of operation and will have to wait until after commissioning of the accelerator for more extensive consolidation.

The power distribution system for LEP, including the 66 kV, 18 kV and 3.3 kV systems as well as the low voltage systems, normal and secured power, will be recuperated for the LHC. The extensions needed for LHC are essentially due to the new large load centres in points 1 and 5, ATLAS and CMS, as well as the new injection tunnels. At the end of LEP operation the power distribution equipment outside the machine tunnel was found to be in generally good condition. The dismantling, the civil engineering works and the fact that the equipment has been partially out of service for a couple of years have however taken their toll and a number of equipment repairs and replacements have been necessary.

The transport and handling equipment such as overhead travelling cranes, lifts and tunnel vehicles that were installed for LEP will form the major part of the logistic chain to install the new material into the tunnel and to allow access. The constant use during the LEP dismantling required a general overhaul of all cranes and lifts in order to re-establish the performance and reliability. A major concern is the conductor line formerly powering the LEP monorail, which will be used for powering the new LHC cryo-magnet tunnel vehicles. The conductor line suffered enormously under the conditions created during the LEP dismantling and the subsequent civil engineering works. The humidity and dust created a mix that damaged large sections of the conductor line, which must now be replaced. This also applies to all electrical equipment for cranes and lifts that could not be removed from the proximity of civil engineering works.

The principles and procedures elaborated for the operation of technical infrastructure during the LEP era will be extended to other services and integrated into a global control room. Particular emphasis will be given to the management of major breakdowns. A technical control room (TCR) will continue to operate on a 24h/365d basis. Its main tasks will be to trigger the intervention of the technical contractors upon reception of technical alarms and to coordinate activities following major breakdowns.

To cope with the new risks of the LHC, fire, flammable gas, oxygen deficiency and evacuation systems will also be installed in the underground areas and surface buildings. The access control systems will also be upgraded.

The aim of this volume of the LHC Design Report is to present the main parameters as well as the status of the numerous varied components concerning the infrastructure and the general services of the project.

REFERENCES

[1] The LEP Design Report, Vol. II: The LEP Main Ring, CERN-LEP/84-1, June 1984.
[2] The LEP Design Report, Vol. III: LEP 2, CERN-AC/96-01 (LEP2), June 1996.