Nota sui lavori di edilizia civile previsti per il progetto HiLumi LHC

Il CERN di Ginevra ha recentemente approvato un progetto di potenziamento del suo acceleratore principale, il Large Hadron Collider (LHC), per il quale si prevede di bandire verso la fine del 2016 o, al più tardi, all'inizio del 2017, una gara per la realizzazione di un notevole insieme di lavori di edilizia civile.
L' entità complessiva degli interventi dovrebbe aggirarsi, come ordine di grandezza, intorno ai 150-200 MChF.

Attualmente è in corso la selezione dell'azienda che sarà incaricata di fornire i servizi di consulenza per la progettazione e la direzione dei lavori, mentre, per la realizzazione degli stessi, il CERN ha intenzione di mettere a gara le opere in due lotti di simile entità, con il vincolo che un'azienda o consorzio potrà aggiudicarsi al più uno dei due.
Il regolamento del CERN[1] prevede che venga prima effettuata una ricerca di mercato, aperta a tutti i soggetti interessati, con la quale vengono qualificate le aggregazioni di imprese che poi, in un secondo momento, sono invitate a presentare l'offerta.
La modalità di aggiudicazione dei lavori sarà probabilmente quella del prezzo più basso.

Nelle pagine seguenti, tratte da un recente documento del CERN, sono riportate alcune indicazioni degli interventi che verosimilmente saranno oggetto della gara per i lavori.

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1 Il CERN, essendo un laboratorio internazionale, non è soggetto al codice degli appalti della CE.

INTRODUCTION

Introduction to CERN

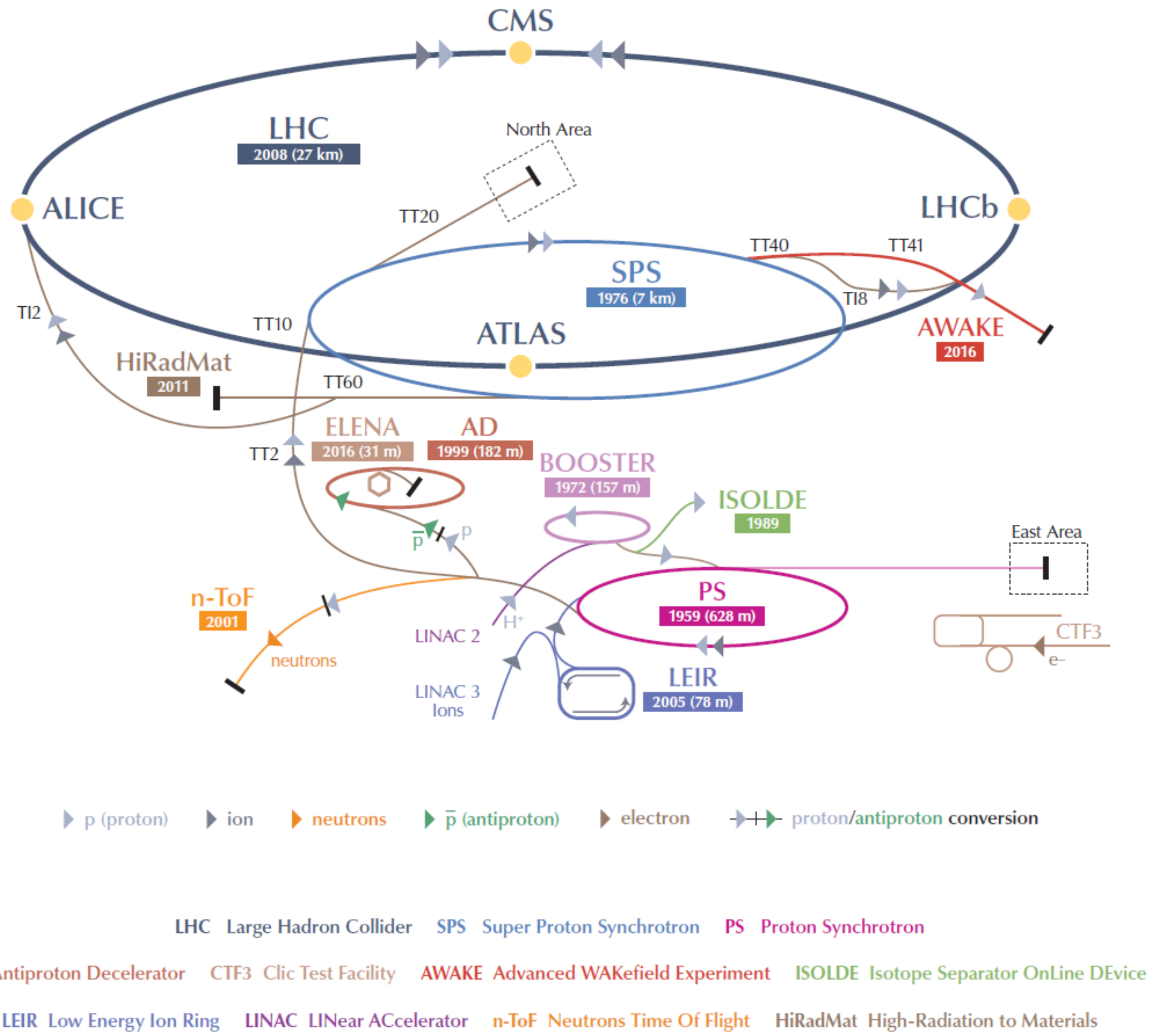
CERN, the European Organization for Nuclear Research[2], is an intergovernmental organization with 21 Member States[3]. Its seat is in Geneva but its premises are located on both sides of the French-Swiss border.

CERN's mission is to enable international collaboration in the field of high-energy particle physics research and to this end it designs, builds and operates particle accelerators and the associated experimental areas. At present more than 10,000 scientific users from research institutes all over the world are using CERN's installations for their experiments.

The accelerator complex at CERN is a succession of machines with increasingly higher energies. Each machine injects the beam into the next one, which takes over to bring the beam to an even higher energy, and so on. The flagship of this complex is the Large Hadron Collider (LHC) as presented below:

2 see. http://cern.ch/fplinks/map.html

3 The CERN Member States are currently Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom. In addition: Pakistan, Serbia and Turkey are Associate Member States and Romania is Candidate for Accession.



CMS
LHC
2008 (27 km)
North Area
ALICE
LHCb
TT20
TT40
TT41
SPS
1976 (7 km)
TI8
TI2
TT10
ATLAS
AWAKE
2016
HiRadMat
2011
TT60
ELENA
2016 (31 m)
AD
1999 (182 m)
TT2
BOOSTER
1972 (157 m)
ISOLDE
1989
East Area
n-ToF
2001
PS
1959 (628 m)
CTF3
e–
neutrons
LINAC 2
H+
LINAC 3
Ions
LEIR
2005 (78 m)
p (proton)
ion
neutrons
p̄ (antiproton)
electron
proton/antiproton conversion
LHC Large Hadron Collider
SPS Super Proton Synchrotron
PS Proton Synchrotron
AD Antiproton Decelerator
CTF3 Clic Test Facility
AWAKE Advanced WAKefield Experiment
ISOLDE Isotope Separator OnLine DEvice
LEIR Low Energy Ion Ring
LINAC LINear ACcelerator
n-ToF Neutrons Time Of Flight
HiRadMat High-Radiation to Materials

Introduction to the High Luminosity LHC (HL-LHC)

The Large Hadron Collider (LHC) is the most recent and powerful accelerator constructed on the CERN site. The LHC machine accelerates and collides proton beams but also heavier ions up to lead. It is installed in a 27 km circumference tunnel, about 100 m underground. The LHC design is based on superconducting twin-aperture magnets which operate in a superfluid helium bath at 1.9 K.

High Luminosity LHC (HL-LHC) is a project aiming to upgrade the LHC collider after 2026 in order to maintain scientific progress and exploit its full capacity. By increasing its peak luminosity by a factor five over nominal value it will be able to reach a higher level of integrated luminosity, nearly ten times the initial LHC design target. To this aim, HL-LHC is exploring new beam configurations and new advanced technologies in the domain of superconductivity, cryogenics, rad-hard materials, electronics and remote handling.

The modifications to the LHC machine will also require a significant amount of construction works that will have to be carried out in the coming years and that are described in the following pages.

DESCRIPTION OF THE WORKS

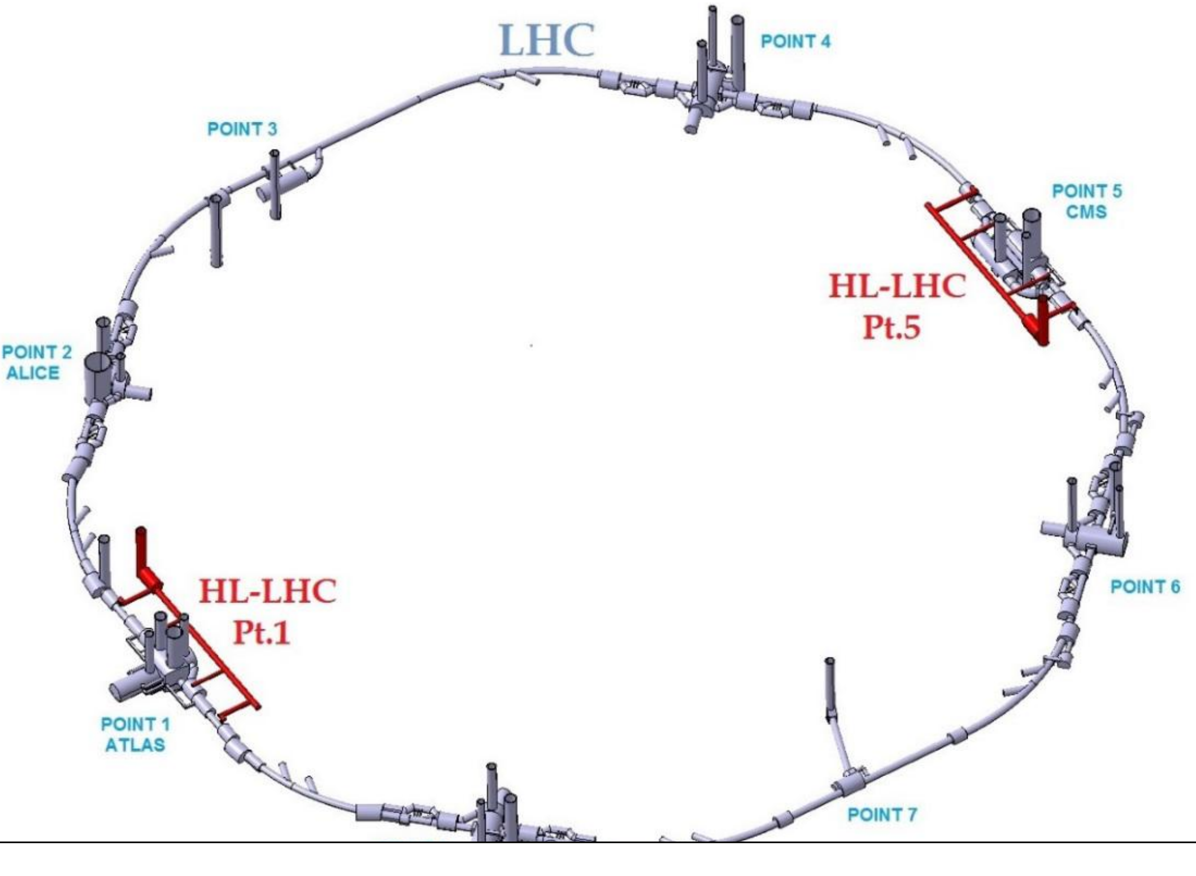
Introduction

The existing infrastructure and civil engineering for the LHC consists of a 27 km circular tunnel with eight sites positioned around the tunnel’s circumference. These sites range from small satellite sites with access shafts and small tunnel openings to very large experimental sites with significant infrastructure on the surface, multiple large diameter shafts and wide-spanning caverns.

Point 1 (ATLAS) and Point 5 (CMS) are the two largest sites, both consisting of a very large experimental cavern as well as a large adjacent service cavern, multiple large diameter shafts and various interconnecting tunnels.

The construction work will be split between two existing experimental sites, Point 1 for the ATLAS experiment, located in Switzerland, and Point 5 for the CMS experiment, located in France, and include underground and surface works at both Points. The underground structures required at each point consist of a new shaft, a cryogenics cavern, radio frequency and power converter caverns, service tunnels and linkage cores to the existing LHC infrastructure, principally in weak sedimentary rock (molasse). New surface buildings and infrastructure will also be required, ranging from small buildings for shaft access to large buildings to house machinery critical for the operation of the upgraded technology.
The underground works can be seen in Fig. 1 next to the existing LHC infrastructure.

Fig.



Works at Point 1 (ATLAS)

Underground works

The underground works foreseen for Point 1 are as follows:

- Shaft – a 12 m diameter shaft will be required at Point 1 for both personnel access and provision of services from the surface to the underground areas. The estimated depth of the shaft is 100 m and is situated in a shallow strata of loose, water bearing moraines at the surface followed by a strata of molasse below;
- Cryogenics cavern – a cavern is required at the bottom of the shaft to house the cryogenics equipment. The dimensions of the cryogenics cavern are 51m . 10m . 10 m (L.W.H);
- Power converter gallery – The power converter gallery will link the cryogenics cavern with the service tunnels and house various equipment. The required length of the power converter gallery is estimated to be 300 m;
- Service tunnels – Four service tunnels are expected to be required from the power converter gallery. The length of each service tunnel is estimated to be 50 m;
- Vertical linkage cores to the existing LHC tunnel – Vertical linkage cores will be required to feed services from the service tunnels to the existing LHC tunnel.

Surface works

The surface works foreseen at Point 1 include multiple buildings, structures and technical galleries. Additionally a car park and landscaping will be required. The buildings and structures currently envisaged at Point 1 are listed in the following table:

Name	**Use**	**Estimated Dimensions (L.W.H)**
SU17	Ventilation building	32m × 20m × 9 m
SU17	Ventilation equipment slab	15m × 4 m (concrete slab)
SE17	Electrical building	30m × 10m × 5 m
SE17	Transformer equipment slab	15m × 4 m (concrete slab)
SD17	Head shaft building	40m × 20m × 15 m
SHM17	Compressor building	50m × 15m × 10 m
SHM17	Compressor equipment slab	15m × 4 m (concrete slab)
SL16/17	New technical gallery	Around 300 m in length
SDH17	Helium unloading towers	30m × 10m × 14 m
SF17	Cooling towers	20m × 20m × 14 m
SHE17	Helium tank platform	33m × 5 m (concrete slab)
SLN17	Nitrogen tank platform	15m × 3 m (concrete slab)

Works at Point 5 (CMS)

Underground works

As with Point 1, a shaft, cryogenics cavern, power converter gallery, service tunnels and linkage cores are foreseen at Point 5. The configuration of these underground elements will also be similar to those at Point 1. However, it is important to note that the exact dimensions, the geological conditions, the site conditions, amongst others, are different to Point 1. The underground works proposed for Point 5 are as follows:

- Shaft – a 12 m diameter shaft will be required at Point 5 for both personnel access and provision of services from the surface to the underground areas. The estimated depth of the shaft is around 100 m and will be excavated through a deep strata of loose, water bearing moraines followed by molasse. Due to this deep strata of moraines, the ground freezing technique was used for the construction of a nearby shafts at Point 5. However, the best method for construction of this shaft shall be determined by the consultant;
- Cryogenics cavern – a cavern is required at the bottom of the shaft to house the cryogenics equipment. The approximate dimensions of the cryogenics cavern are 51 m . 10 m . 10 m (L.W.H);
- Power converter gallery – The power converter gallery will link the cryogenics cavern with the service tunnels and house various equipment. The required length of the power converter gallery is estimated to be around 300 m;
- Service tunnels – Four service tunnels are expected to be required from the power converter gallery. The length of each service tunnel is estimated to be around 50 m;
- Vertical linkage cores to the existing LHC tunnel – Vertical linkage cores will be required to feed services from the new facilities to the existing LHC tunnel.

Surface works

The surface works foreseen at Point 5 are similar to those required at Point 1 and include multiple buildings, structures and technical galleries as well as a car park and landscaping:

Name	**Use**	**Estimated Dimensions (L.W.H)**
SU57	Ventilation building	32m × 20m × 9 m
SU57	Ventilation equipment slab	15m × 4 m (concrete slab)
SE57	Electrical building	30m × 10m × 5 m
SE57	Transformer equipment slab	21m × 4 m (concrete slab)
SD57	Head shaft building	32m × 20m × 15 m
SHM57	Compressor building	50m × 15m × 10m
SHM57	Compressor equipment slab	15m × 4 m (concrete slab)
SL56/57	New technical gallery	Around 300 m in length
SDH57	Helium unloading towers	30m × 10m × 14 m
SF57	Cooling towers	20m × 20m × 14 m
SHE57	Helium tank platform	33m × 5 m (concrete slab)
SLN57	Nitrogen tank platform	15m × 3 m (concrete slab)