



## **HL-LHC (High Luminosity LHC)**

### **Technical needs**

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HL-LHC Configuration, Quality & Sourcing Office  
On behalf of the HL-LHC Project team

Holland@CERN, CERN, June 2019



# The HL-LHC Project

What, when, where, by whom?

# Goal of High Luminosity LHC (HL-LHC) as fixed in November 2010

From FP7 HiLumi LHC Design Study application

The main objective of HiLumi LHC Design Study is to determine a hardware configuration and a set of beam parameters that will allow the LHC to reach the following targets:

A peak luminosity of  $L_{\text{peak}} = 5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$  **with levelling**, allowing:

An integrated luminosity of **250 fb<sup>-1</sup> per year**, enabling the goal of  $L_{\text{int}} = 3000 \text{ fb}^{-1}$  twelve years after the upgrade.

This luminosity is more than ten times the luminosity reach of the first 10 years of the LHC lifetime.

**Ultimate** performance established 2015-2016: with same hardware and same beam parameters: use of **engineering margins**:

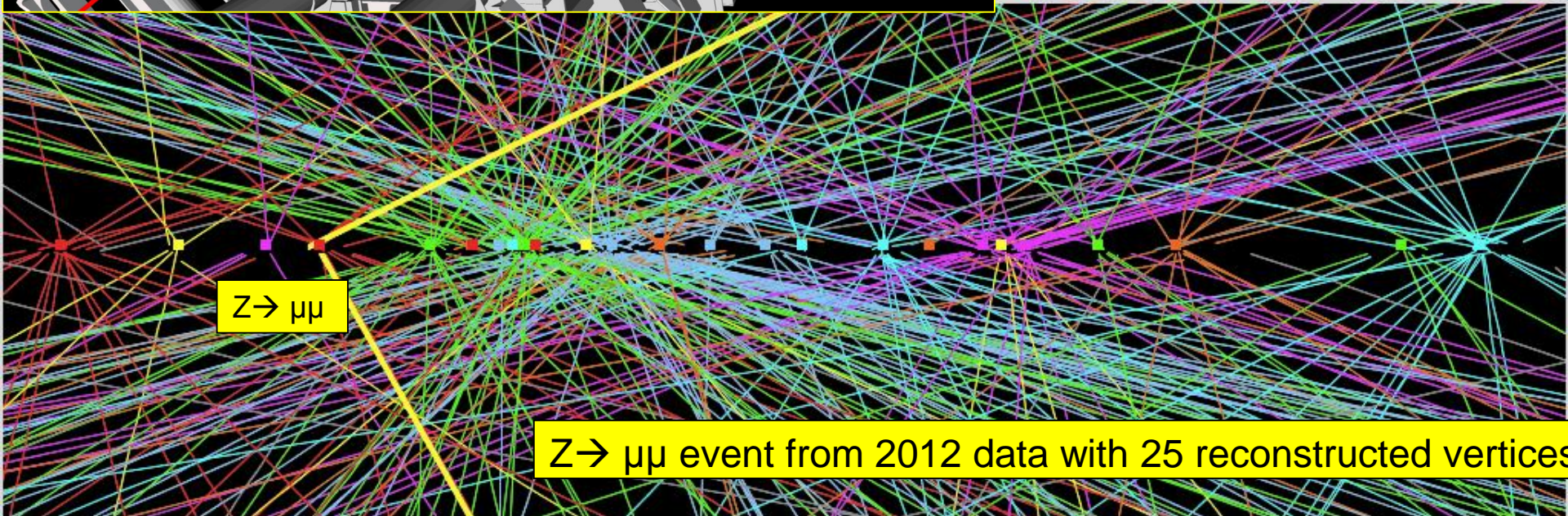
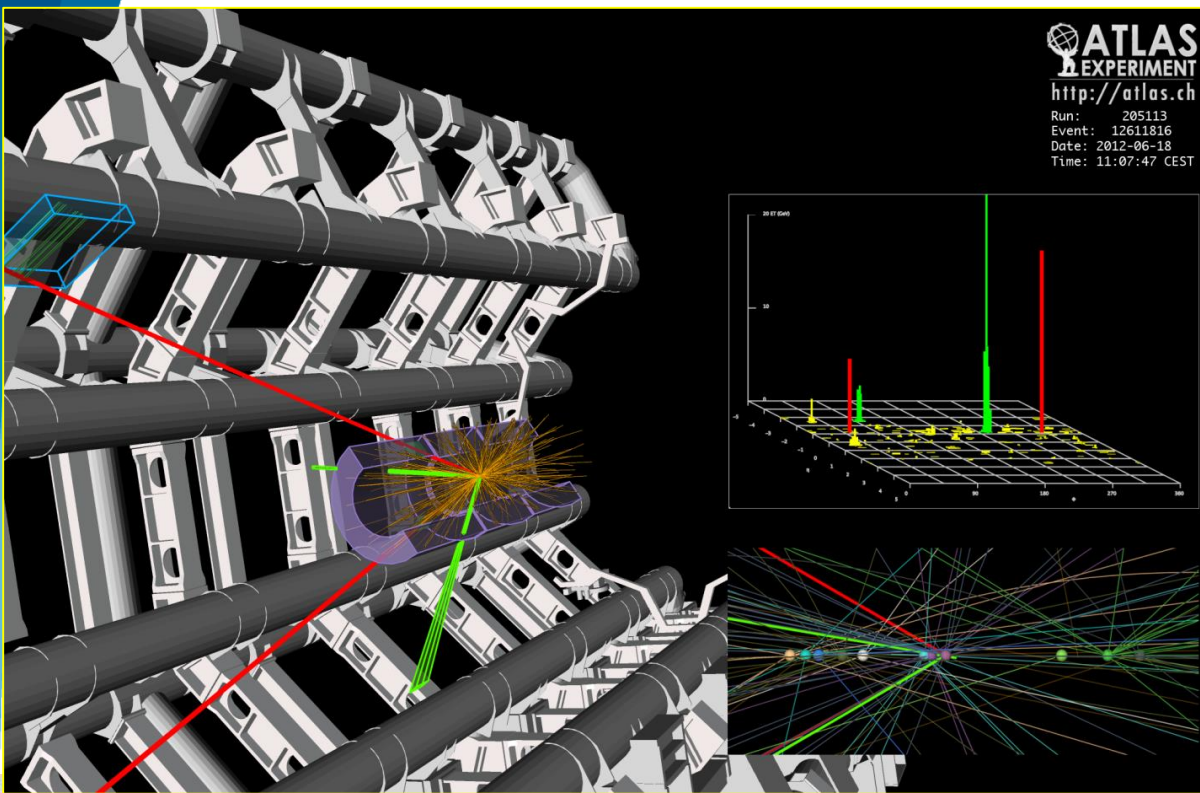
$L_{\text{peak ult}} \cong 7.5 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$  and **Ultimate Integrated**  $L_{\text{int ult}} \sim 4000 \text{ fb}^{-1}$   
LHC should not be the limit, would Physics require more...



More luminosity  
⇒ higher the  
collision rate

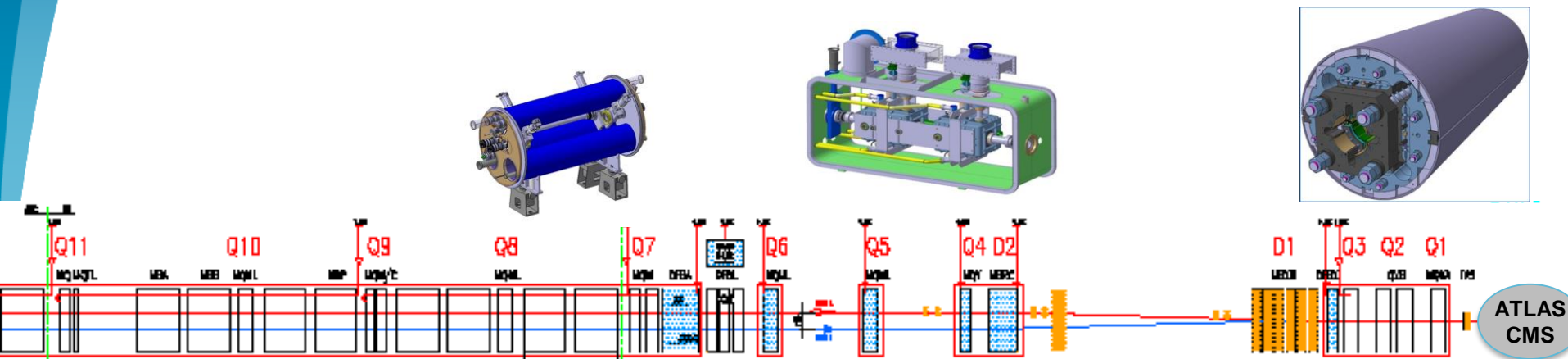
Higgs: the needle in the  
haystack

Picture repeated 40  
millions times each  
second



$Z \rightarrow \mu\mu$  event from 2012 data with 25 reconstructed vertices

# The largest HEP accelerator in construction



## Dispersion Suppressor (DS) in P7

### Modifications

1. In IP2: new DS collim. in C.Cryost.
2. In IP7 new DS collimation with 11 T

Cryogenics, Protection, Interface, Vacuum, Diagnostics, Inj/Extr... extension of infrastr.

## Matching Section (MS)

### Change/new lay-out

1. TAXN
2. D2
3. CC
4. Q4
5. Correctors
6. Q5
7. Q5@1.9K in P6
8. New collimators

## Interaction Region (ITR)

### Complete change and new lay-out

1. TAXS
2. Q1-Q2a-Q2b-Q3
3. D1
4. All Corrector Magnets
5. Heavy shielding (W)

> 1.2 km of LHC !!

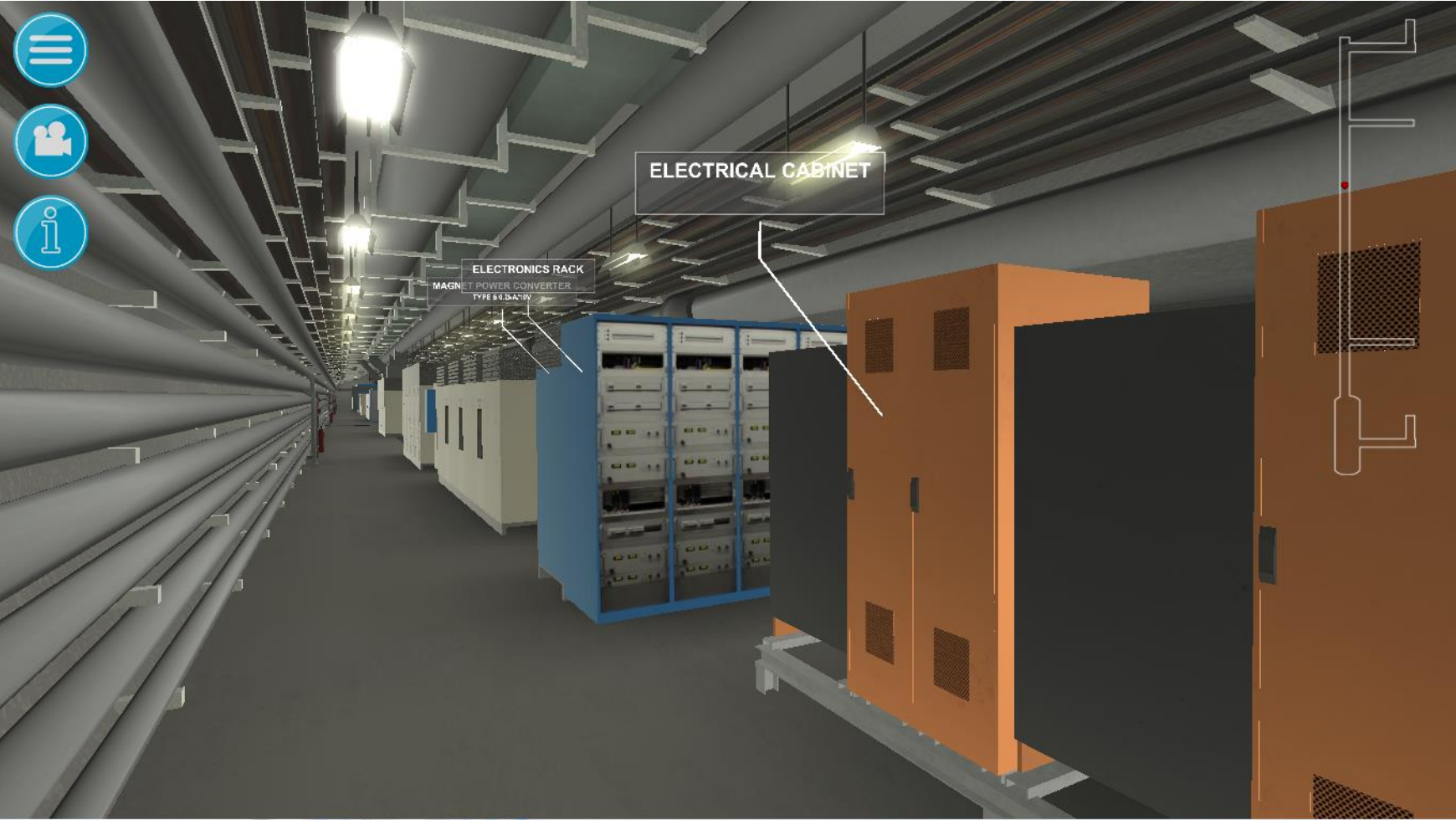


# How it could look like in point 5 (after HL)

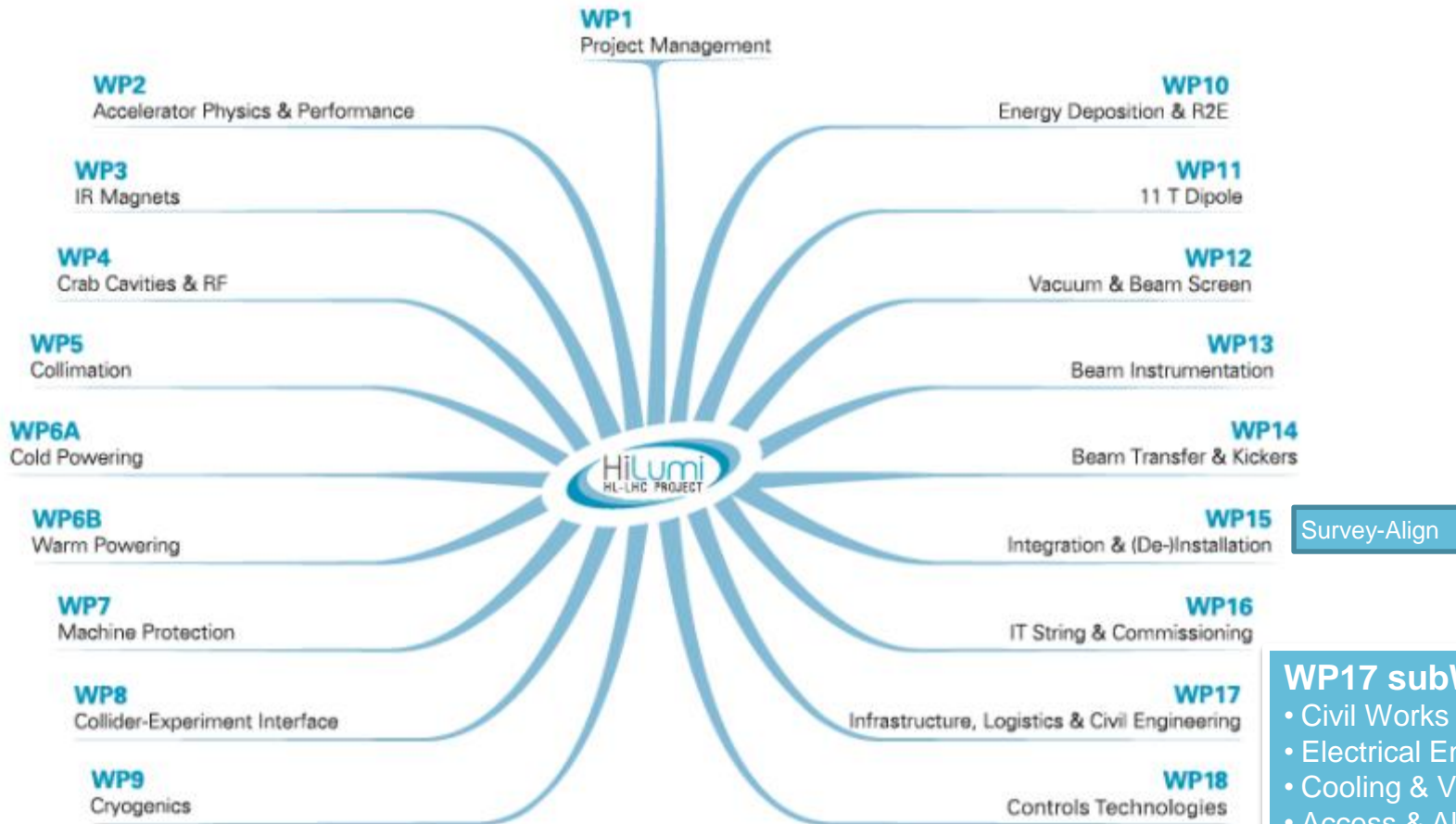


- <https://play.google.com/store/search?q=hilumi3d>

# On the new HL-LHC infrastructures



# Project structure



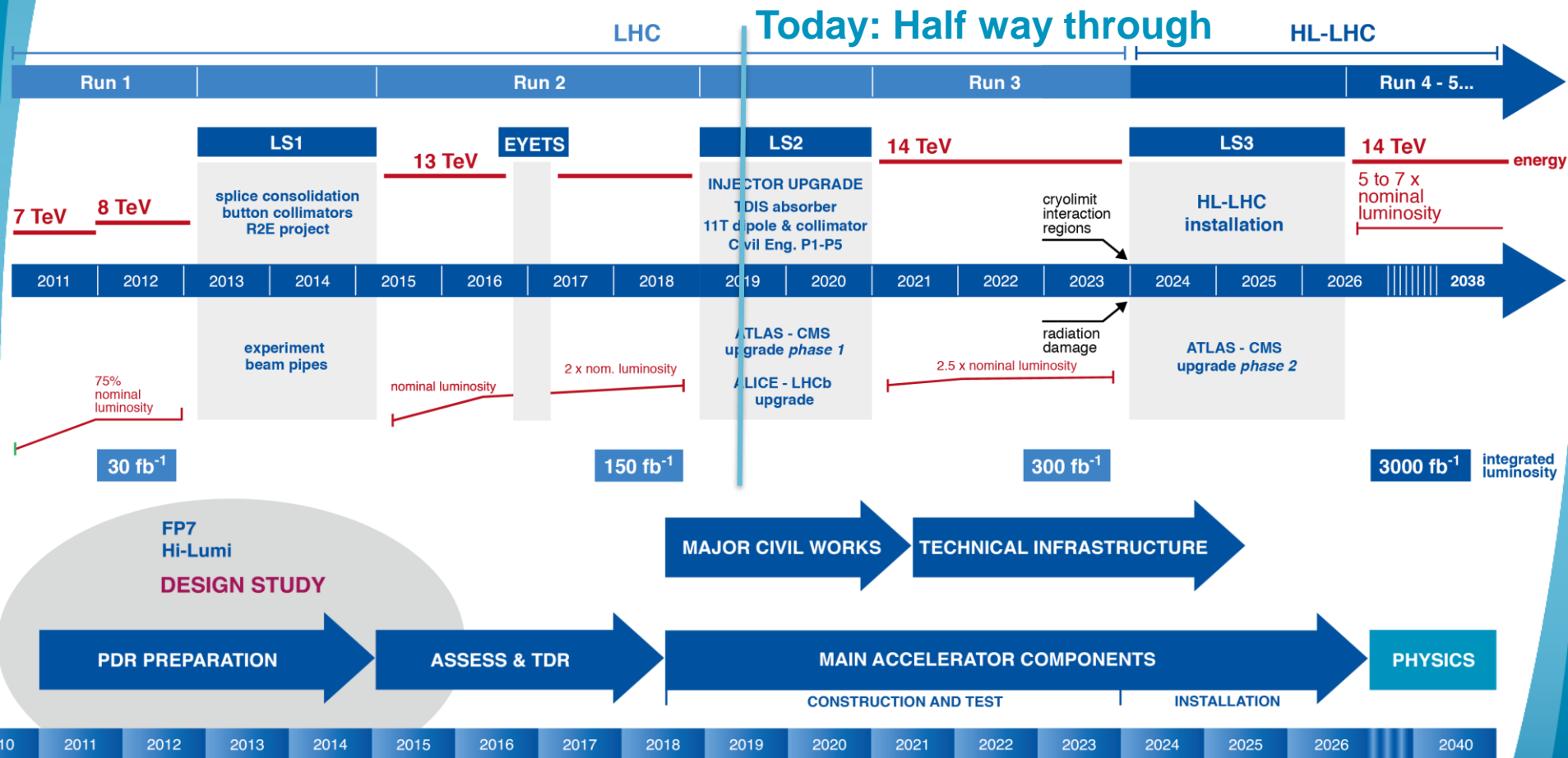
## WP17 subWPs:

- Civil Works
- Electrical Engineering
- Cooling & Ventilation
- Access & Alarms
- Tech Monitoring
- Transport
- Logistics & Storage
- Operational Safety



# High Luminosity: a luminous future for LHC!

## LHC / HL-LHC Plan



# Global collaboration



BNL

Brookhaven National Laboratory



CEA

Commissariat à l'Énergie Atomique



CIEMAT

Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas



CERN

Conseil Européen pour la Recherche Nucléaire



CI

Cockcroft Institute



SOTON

University of Southampton



UNIUPP

Uppsala University



USDOE

United States Department of Energy



STFC

Science & Technology Facilities Council



FNAL

Fermilab



INFN

Istituto Nazionale Fisica Nucleare



KEK

KEK Japan



ULAN

University of Lancaster



LBLN

Lawrence Berkeley National Laboratory



UNILIV

University of Liverpool



UNIMAN

University of Manchester



RHUL

Royal Holloway University



SLAC

National Accelerator Laboratory



BINP

Budker Institute of Nuclear Physics



UDUN

University of Dundee



EPFL

École Polytechnique Fédérale De Lausanne



UHUD

University of Huddersfield



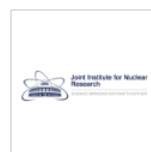
IHEP

Institute of High Energy Physics



JLAB

Jefferson Lab



JINR

Joint Institute for Nuclear Research



LAPIN AMK

Lapland University of Applied Sciences



NCBJ

National Centre for Nuclear Research



ODU

Old Dominion University



TRIUMF

TRIUMF



I. E

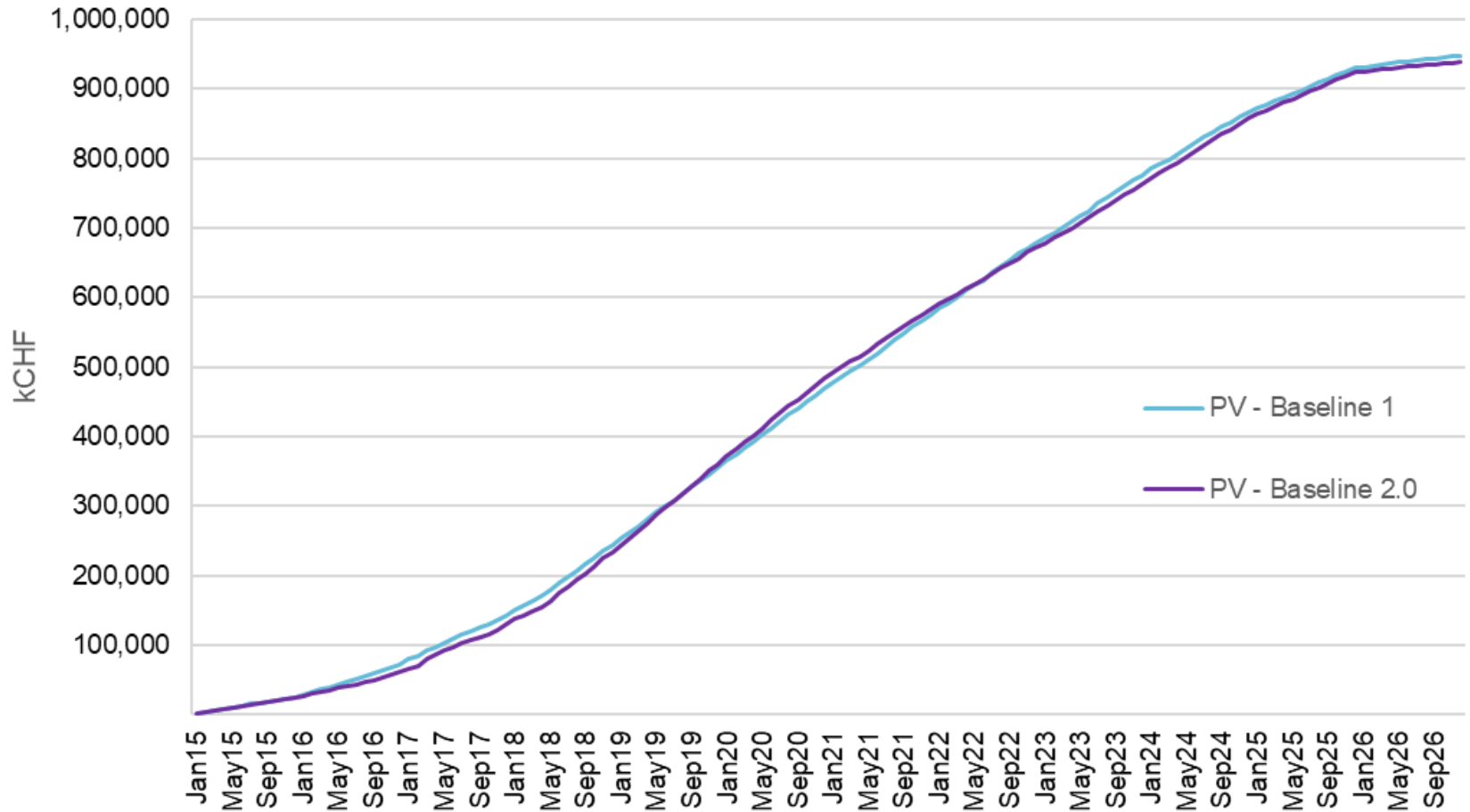
Sourcing Office

# Industry

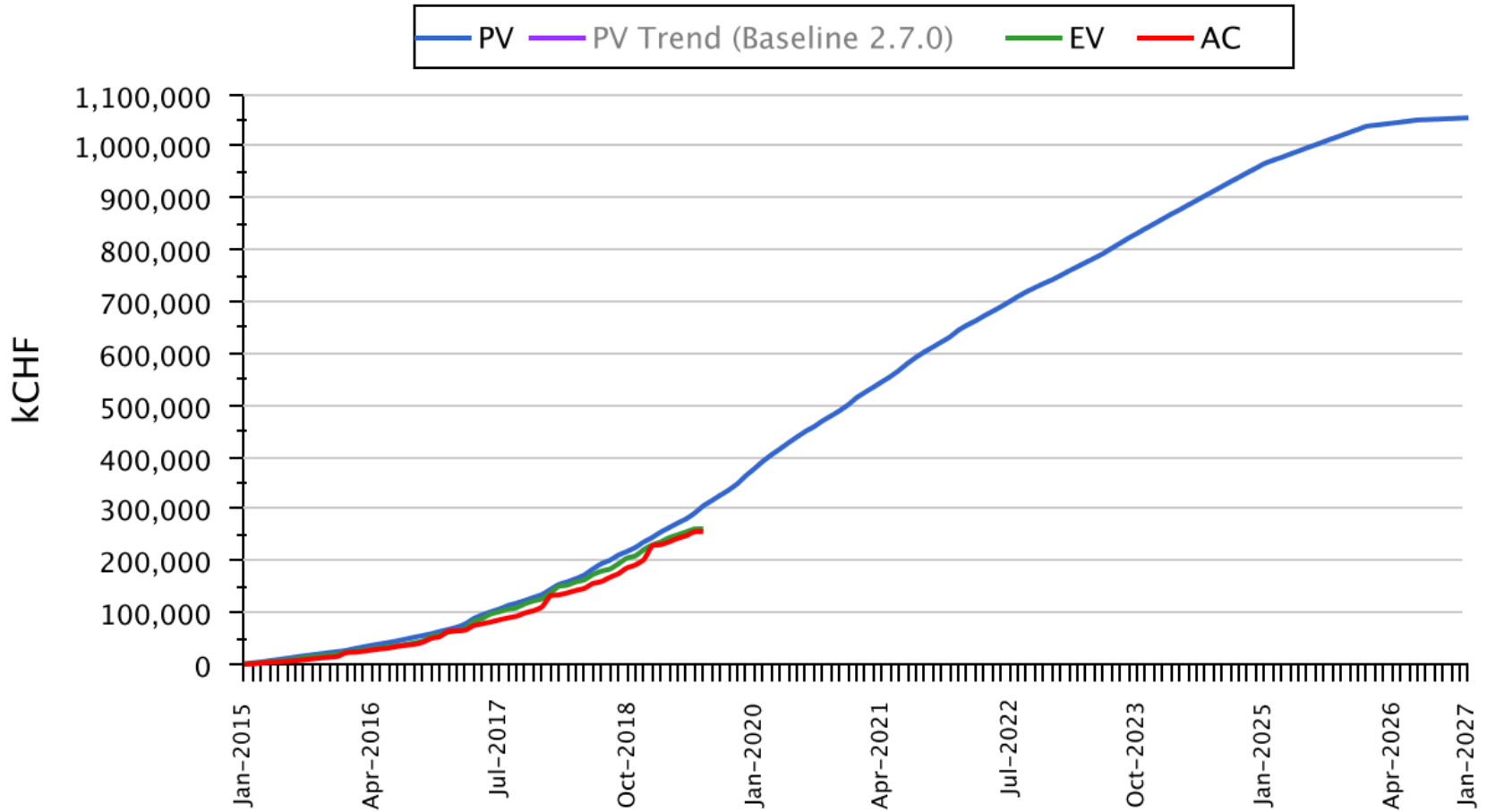
## Procurement for HL-LHC



# COST: 950 MCHF for materials slightly less than 2000 Staff-year



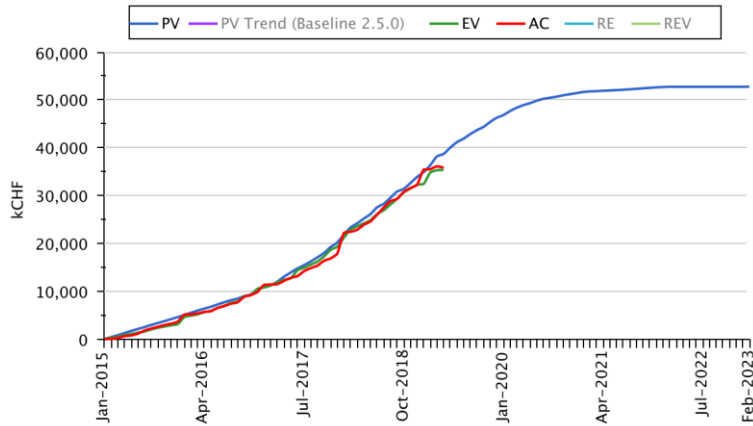
# How we are doing? (Plan versus Actual)



Project: LRD-PRJ  
Baseline: Baseline 2.7.0

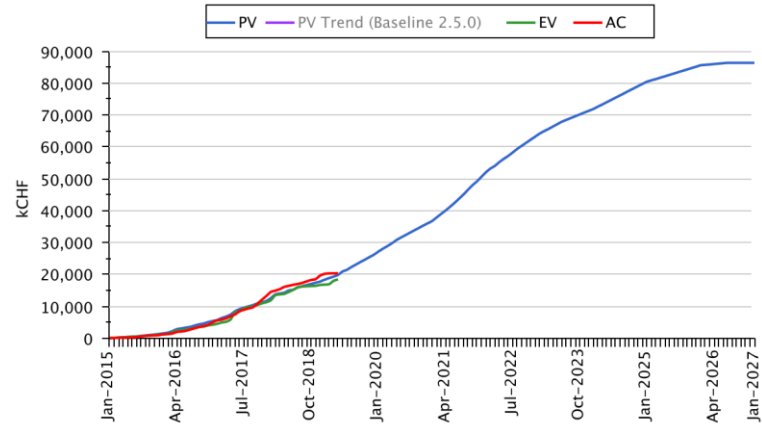
03-Jun-2019 10:49

# On track for all WPs



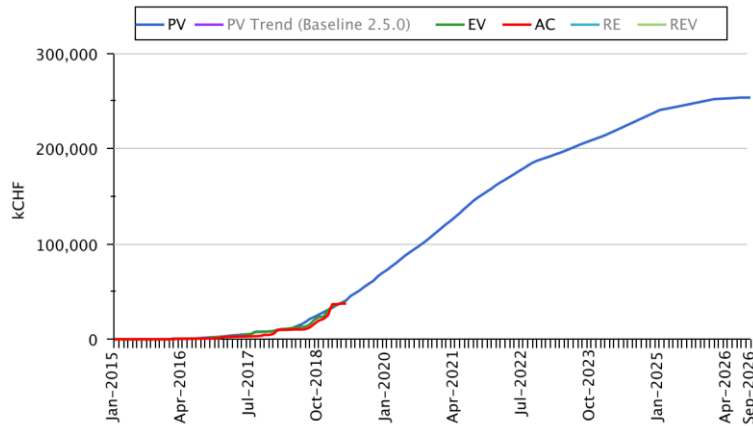
Project: LRD-FR  
Workpackage: HLLHC 11  
Baseline: Trend (Baseline 2.5.0)

07-Mar-2019 17:05



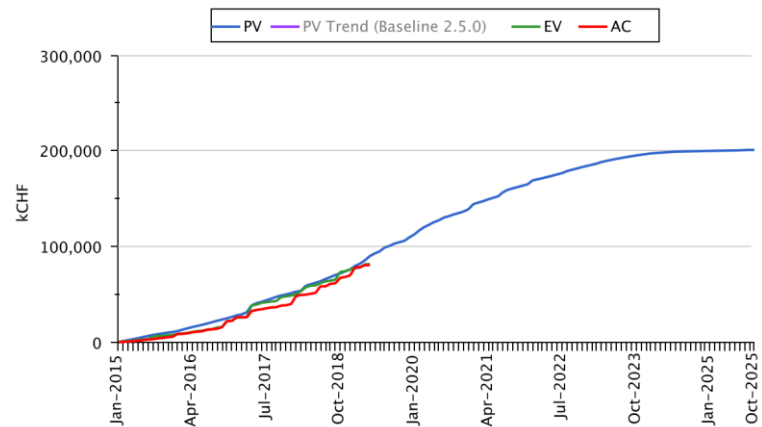
Project: LRD-FR  
Workpackage: HLLHC 4  
Baseline: Trend (Baseline 2.5.0)

07-Mar-2019 17:04



Project: LRD-FR  
Workpackage: HLLHC 17  
Baseline: Trend (Baseline 2.5.0)

07-Mar-2019 17:06



Project: LRD-FR  
Workpackage: HLLHC 3  
Baseline: Trend (Baseline 2.5.0)

07-Mar-2019 17:03

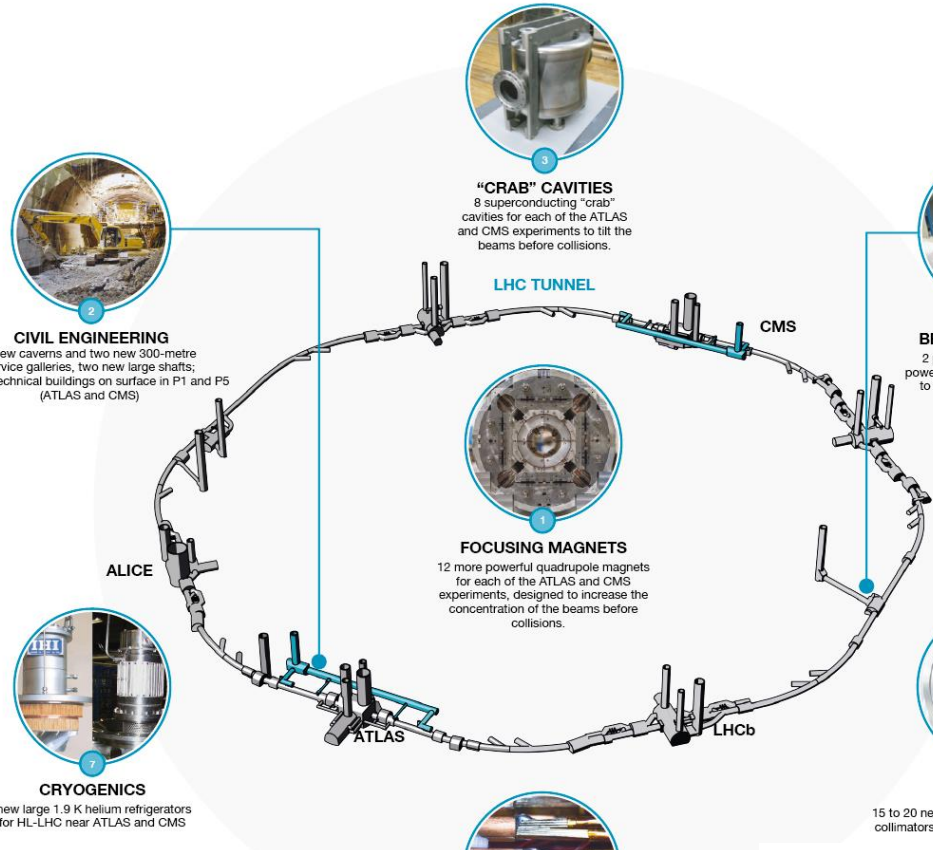




# The HL-LHC Project

Main components, technical services and infrastructure

# The largest HEP accelerator in construction



**“CRAB” CAVITIES**  
8 superconducting “crab” cavities for each of the ATLAS and CMS experiments to tilt the beams before collisions.



**BENDING MAGNETS**  
2 pairs of shorter and more powerful dipole bending magnets to free up space for the new collimators.



**FOCUSING MAGNETS**  
12 more powerful quadrupole magnets for each of the ATLAS and CMS experiments, designed to increase the concentration of the beams before collisions.



**COLLIMATORS**  
15 to 20 new collimators and 60 replacement collimators to reinforce machine protection.



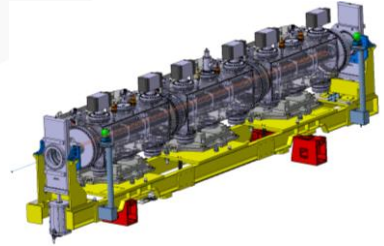
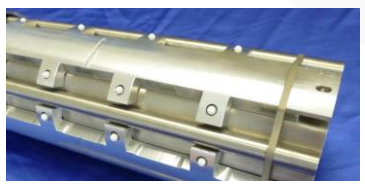
**SUPERCONDUCTING LINKS**  
Electrical transmission lines based on a high-temperature superconductor to carry current to the magnets from the new service galleries to the LHC tunnel.



**CIVIL ENGINEERING**  
2 new caverns and two new 300-metre service galleries, two new large shafts; 10 new technical buildings on surface in P1 and P5 (ATLAS and CMS)



**CRYOGENICS**  
2 new large 1.9 K helium refrigerators for HL-LHC near ATLAS and CMS



# Tendering on-going or already open and checking

- MS-4514: Design and Manufacture of high precision 18kA and 14kA (class 0) DC Current Transformers
- MS-4513: Design and Manufacture of high precision 2kA (class 2) DC Current Transformers
- MS-4512: MLI for cryomagnets
- MS-4500: IPOC Digitizers
- DO-31944: Manufacture of around 9'000 thermal links produced from copper and stainless steel, involving precision machining and welding of OFE copper and stainless steel.
- Manufacture of Pumping Slot Shields for beam screen (high-precision thin walled beryllium-cooper components)



## Still to come....

- Bladders for the Quadrupoles series production
- Cold-warm Transitions
- Expansion Bellows
- Studs to maintain the absorbers on the beam screens
- Semi-rigid, radio frequency cables
- Laser to be used in the FSI (Frequency Scanning Interferometry)
- Hydrostatic Levelling Sensors and Wire Positioning Sensors
- Service contract for Q2 magnet production
- Manufacturing of the Thermal Shields in Al. for cryomagnets
- VAX Supports – Metallic structures
- Cryogenic Plants for P1 and P5
- Mechanical Switches for Energy Extraction Systems
- Electronics for beam instrumentation
- Overhead cranes for P1 and P5 (25t and 20t capacity)
- D2 magnet components (wedges, end spacers, Al ring)
- Service modules for magnets cryostats
- 1 Vacuum vessel for RFD prototype
- Faraday Cage for RF services
- ....and of course we will always need raw materials, tooling and small hardware...

# Main HL-LHC Suppliers from Holland

- 3D METAL FORMING B.V.
- ALDIANCE
- ANDREW GMBH
- BEMO RAIL
- BKB PRECISION
- BOA NEDERLAND BV
- BOAFLEXIBLE SOLUTIONS SAS
- BOSTEC ENGINEERING, LTD.
- BUTRACO
- BV METAALGAASWEVERIJ
- CAPLINQ EUROPE BV
- CBMM EUROPE BV
- CRYOWORLD BV
- CRYOZONE, DH INDUSTRIES BV
- DELTA ELEKTRONIKA B V
- DIM3NSIONS GMBH
- EBV ELEKTRONIK
- EQUIPEMENTS SCIENTIFIQUES
- FALCO SYSTEMS
- FIBERDESIGN
- FMI HighTech Solutions
- GERMEFA BV
- HAZEMEYER
- Horsens Span Teknik
- Hositrad Holland BV
- IGO3D GMBH
- ILSA - INDUSTRIAL LIFTING NV-SA
- JEVEKA
- KUSTERS & BOSCH B.V.
- LIFTEUROP
- MACHINEFABRIEK AMERSFOORT B.V.
- PM SPECIAL MEASURING SYSTEMS B.V.
- SCHULZ ELECTRONIC GMBH
- SERV'INSTRUMENTATION
- THALES NEDERLAND B.V.
- UNIVERSITY OF TWENTE
- LINDE KRYOTECHNIK
- VAN HALTEREN METAAL BV
- VDL ETG
- WILTING

# Industry

Tools to communicate and to get informed



# Information must be dynamic ...

<https://project-hl-lhc-industry.web.cern.ch/>



**HiLumi**  
HL-LHC PROJECT

**HL-LHC Industry**  
Industry Relations and Procurement Website for the HL-LHC project

Search this site Search

Home General Info Procurement Overview Tendering Acquisition Timeline Events Contact

## Building the HL-LHC with the Industry

The HL-LHC Industry website has been specially designed for all those firms that wish to participate in this ambitious project. We want to share all the relevant information in terms of the procurement that will be required to accomplish this major upgrade of the LHC.

The industry will have a crucial role and will be heavily involved within the [HL-LHC Project](#) since it will be the main source to provide the technologies and equipment that are required to successfully achieve the goals of this upgrade of the LHC.

The HL-LHC will collaborate with many types of industries and businesses to pursue its goals. Knowledge and technology to be developed during the HL-LHC project will make a lasting impact on society.



The Large Hadron Collider (LHC) at [CERN](#) at the Franco-Swiss border near Geneva, is the largest scientific instrument ever designed and built for scientific research. It has been exploring the new high-energy frontier since 2010, attracting a global user-community of more than 7,000 scientists spanning more than 60 countries.

After only a little more than one year of operation, on 4th July 2012 the LHC experiments, [ATLAS](#) and [CMS](#), could announce the first major discovery: the long-sought Higgs boson, the cornerstone of the Standard Model (SM) of particle physics. This announcement, heralded by scientists as well as by the media as a giant leap in the understanding of our world and the origin of universe.

**ILOS**  
[ILOS Portal](#)

**HIGHLIGHTS**

**10 Mar 2016**  
[HL-LHC is now part of the ESFRI Roadmap](#)  
The 2016 Roadmap highlights the strong socio-economic impact of research infrastructures as well as their potential to generate innovation through collaboration with industrial partners.  
[More information on the ESFRI Roadmap 2016](#)

**8 Feb 2016**  
[QUACO Open Market Consultation](#)  
CERN, as member of the European pre-competitive procurement (PCP) Instrument QUACO, is pleased to invite you to the Open Market Consultation (OMC) that will take place on 30<sup>th</sup> March 2016.  
[Read more](#)

**1 Nov 2015**  
[High-Luminosity LHC moves to the next phase](#)  
HL-LHC project moves from the design study to the machine construction phase.

# Information must be dynamic ...

- Get in touch with your ILO – He is the key contact between CERN and the Industry of each country
- HL-LHC ILOs Portal (access to ILOs only)  
HL-LHC Procurement Plan provided since 2015.  
What's coming the next (at least) 18 months.  
Next revision soon!!!

- CERN Procurement Website  
All MSs & ITs are announced (Not only HL)  
<https://found.cern.ch/java-ext/found/CFTSearch.do>

Netherlands

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WEBSITE: http://www.bigscience.nl

HL-LHC Industry / ILO LINKS

Website for HiLumi Procurement

Home

Dear ILO this page gives you access to Purchasing statistics, to an space to exchange data on expenditure in your country, to our future equipment needs, and to the list of Price enquiries, Market Surveys and Invitation to Tender in preparation for HL-LHC. You will also find the list of HL-LHC components (PBS) and the domains of activity relevant to the project.

Do not hesitate to indicate us other views you would find interesting. You can always exchange information with us using the special ILO Documents folders.

Present Departmental requests

ID	Reference	WP	Title	Category	Date raised	Date needed	Status
1	DB-6286387/TEHL-LHC	WP12	Co-lamination for HL beam screens	< x <	04.02.2016	01.09.2017	Process finished
2	DR-6210212/TE	WP12	LHV All metal gate valves	> 750.000	17.11.2015	01.09.2016	Process finished
3	DR-6264451/TEHL-LHC	WP3	MCXF, END SPACERS	< x <	22.12.2017	14.01.2016	Process finished
4	DR-6259143/TEHL-LHC	WP3	WP3-Q4 magnet QUACO	> 750.000	12.01.2016	01.12.2016	Process finished
5	DB-6267113/TEHL-LHC	WP13	order 35 pieces work of 1000000000	< 200.000	18.01.2016	18.01.2016	Process finished

ILO Documents

Type	Name	Created	Modified
AT		27/11/2015 02:50 PM	27/11/2015 02:50 PM
BE		27/11/2015 02:50 PM	27/11/2015 02:50 PM
BG		27/11/2015 02:50 PM	27/11/2015 02:50 PM
CH		27/11/2015 02:50 PM	27/11/2015 02:50 PM
CV		13/03/2017 03:48 PM	13/03/2017 03:48 PM
CZ		27/11/2015 02:50 PM	27/11/2015 02:50 PM
DE		27/11/2015 02:51 PM	27/11/2015 02:51 PM
DK		27/11/2015 02:51 PM	27/11/2015 02:51 PM
ES		27/11/2015 02:51 PM	27/11/2015 02:51 PM

## IPT Procurement and Industrial Services Group

### Forthcoming market surveys and calls for tenders

Advance information on forthcoming market surveys and calls for tenders expected to exceed 200,000 Swiss Francs. In the line entitled 'Cost Range', a very rough indication of the cost range of the product to given in the form of letters A, B, C, D. A represents items estimated at less than 750 KCHF, B represents items between 750 KCHF and 5 MCHF, C represents items below 5 MCHF, D represents items above 5 MCHF. The countries of origin of supplies and services shall be CERN Member States, except if provided otherwise in the table below. References marked with "New" have been posted during the last 8 weeks.

Search Menu Links Menu

Type of Contract: All Market Survey dispatched: All

Reference: Call for Tenders scheduled for dispatch: All

Activity Code: Description and/or Specific Condition: All

Requirement: Commercial contact: All

Cost Range: All Publication Date: From To all-rem-yyy

Search Reset

Publication Date	Type of Contract	Reference	Requirement (Activity Code)	Description/Specific Condition
29-05-2019	Supply	IT-4519/SMB	Civil engineering works for the construction of an extension to building 179 on the Swiss part of CERN Meyrin site. (01010300, 01020200, 01020300, 01020500)	CERN intends to place a contract for civil engineering works for ... Interested firms shall have a proven experience and competence in the ... <a href="#">Read More</a>
27-05-2019	Experiments	IT-4519/SMB	Supply of approximately 800 high-quality, radiation-tolerant 3D silicon nitride lenses for the Phase-2 upgrade	CERN intends to place a contract for the supply of approximately ... Interested firms shall <a href="#">Read More</a>

# Our objective

- The High Luminosity project seeks industrial suppliers and collaborations for the current construction phase and make the High Luminosity upgrade.
- CERN aims at fostering R&D collaborations and knowledge exchange also with SMEs, a perfect opportunity to match their capacity with the requirements of HiLumi.
- Understanding our needs is the first step to tender successfully.
- Understanding your capabilities and the know how that could come from industry is the best way to specify equipment that can be built by industry
- Industrial events are always profitable for both parties

# Ready for the challenge?

**Become a CERN supplier to built future accelerators**

Visit us on

**<https://project-hl-lhc-industry.web.cern.ch>**



***Thank you for your attention***

Special Thanks to all HL-LHC WP Leaders

