

# CERN Accelerators Topology Configuration and Change Management



[www.cern.ch](http://www.cern.ch)

Engineering Department  
Thomas Birtwistle, Samy Chemli – EN/MEF/DC

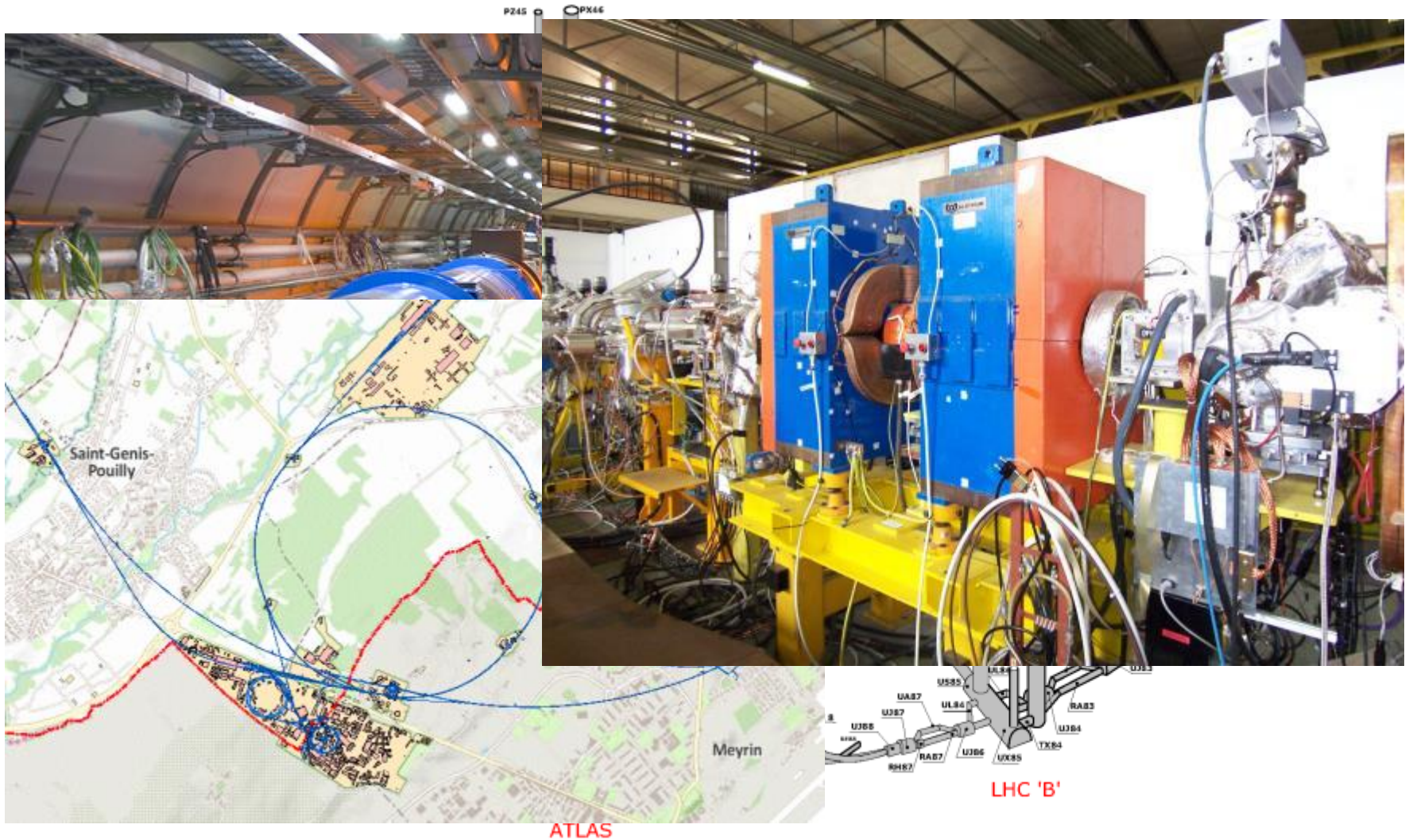
# Contents

- Configuration Management of Accelerators Topology
- Accelerators Hardware Baselines
- Handling Changes in the Baselines and Layouts
- Usage of the Accelerators Naming Service in the Baselines and Layouts
- Managing Accelerator Layouts using the 'Layout Database'
- Current Status
- Summary

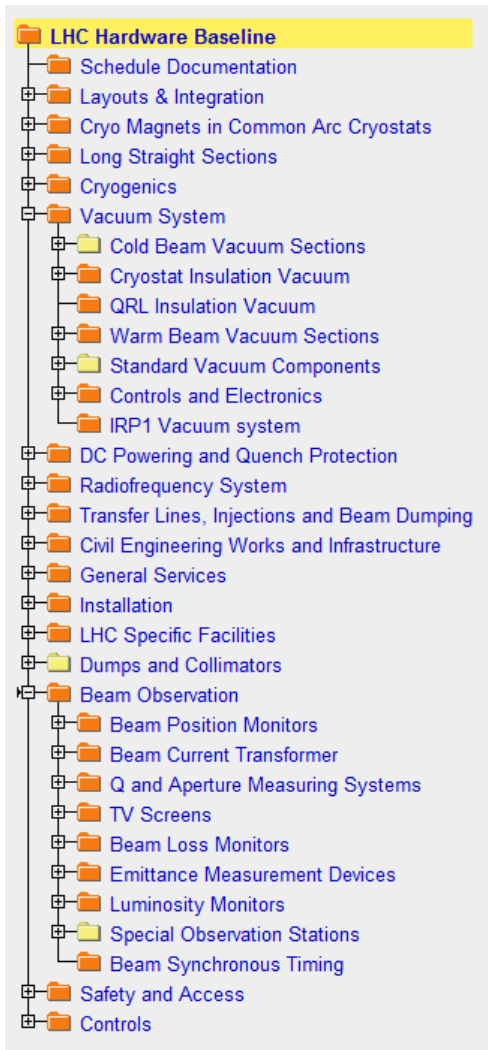
# Configuration Management of Accelerator Layouts

- Provides a clear and coherent picture of the status of a project or machine at a given point in time.
- In order to achieve this, we use three important tools
  - Changes to the machines and transfer lines are documented, circulated and approved in the Hardware Baseline (also known as a Product Breakdown Structure) using EDMS
  - We register the layouts of the accelerators and all changes to them within the Layout Database that has to remain up-to-date.
    - Sequence of functional positions = space management
    - Integration and Installation Drawings match the recorded layout to ensure that envelopes of reserved space still match the physical equipment dimensions
  - Naming is critical throughout the lifecycle of the machines/projects. To store and manage naming, we use the Naming Portal
- Keyword is coherence between the tools.

# Configuration Management of Accelerator Layouts

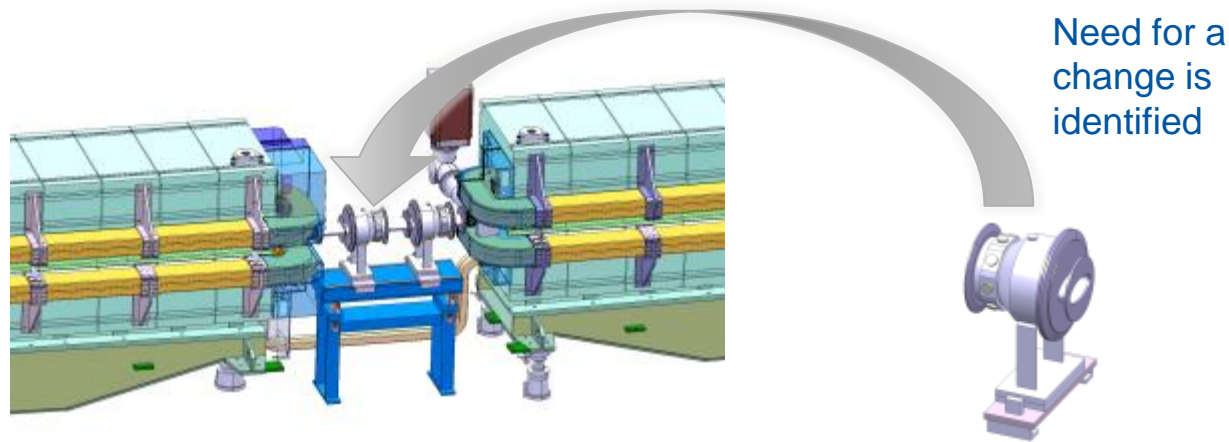


# Hardware Baseline...



- ...is an EDMS (Electronic Document Management System) based tool.
- The hardware baseline contains all the information needed to re-build the machine, including:
  - Engineering Specifications, Drawing Folders, ECR, Procurement Documents (IT, DO, MS...)
  - LHC Baseline was the first to be issued
  - SPS and PS Complex Hardware Baselines are in progress
- Logical structure of nodes, based on hardware types and functions
- Documentation can be linked to multiple locations

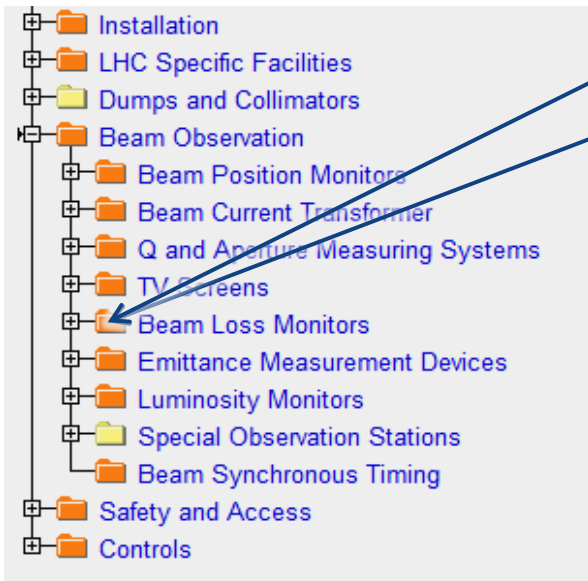
# Handling Changes



- How: using Engineering Change Requests (ECRs)
  - Determine an associated name for the change (equipment, function, layout, service...)
- What for:
  - Inform other stakeholders and get their approval/refusal
  - Impact analysis.
  - Allow all persons concerned the opportunity to comment about the impact of changes on surrounding equipment or general planning.

# Handling Changes

- Where: in the HW baseline for long-term traceability
  - Identify the adequate node in the structure
  - All changes concerning given equipment recorded in the same place in the HW Baseline

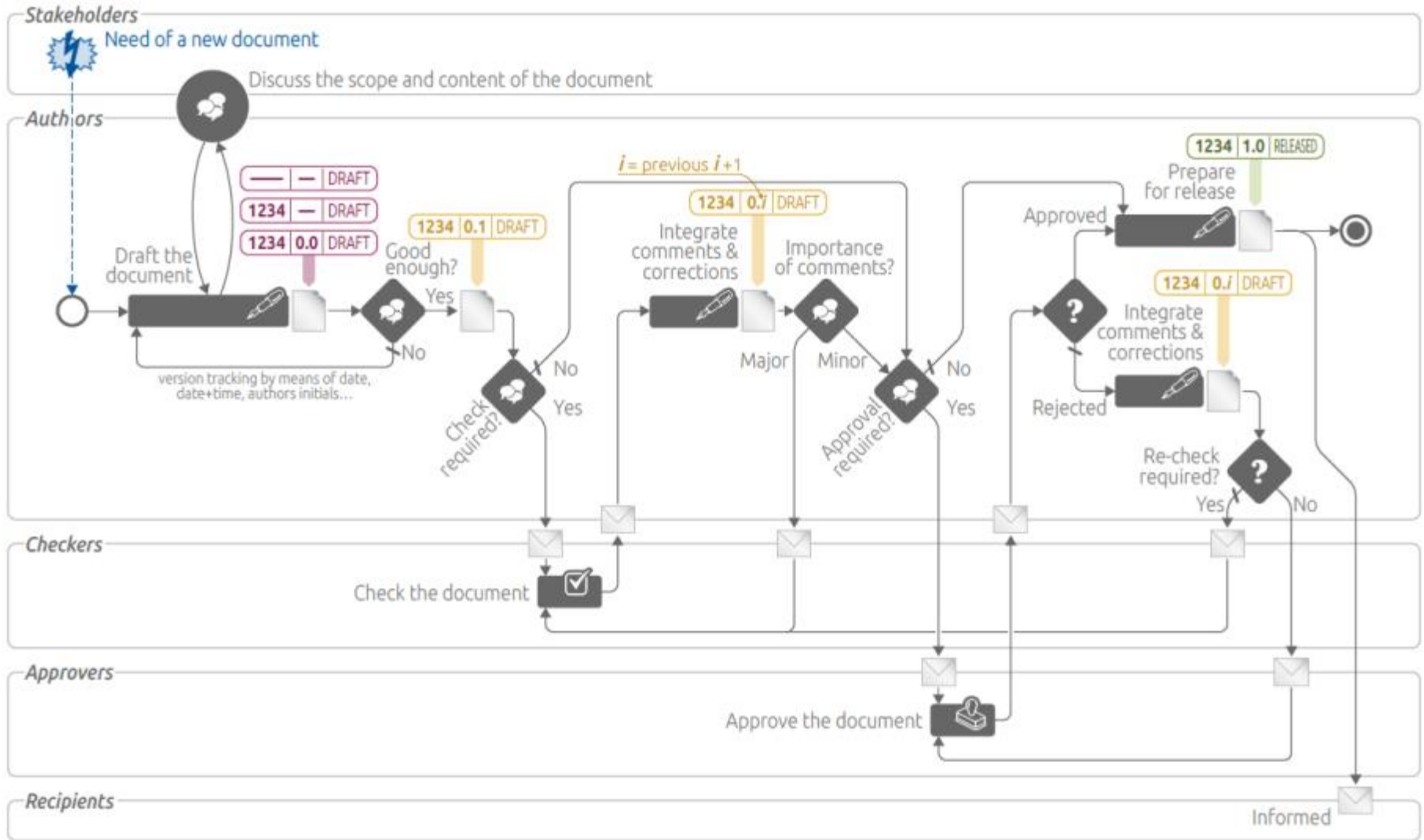


<b>LHC-BLM-ES-0001</b> v.2.0	Measurement of the Beam Losses in the LHC Rings	Released
<a href="#">Doc. page</a>	LHC-BLM-ES-0001-20-00 <a href="#">doc</a> (2 Mb) <a href="#">pdf</a> (825 Kb)	
<b>LHC BLM EC-0001</b> v.1.0	Addition of a Beam Loss Monitor Interlock with Direct Input to the LHC Beam Dump	Accepted
<a href="#">Doc. page</a>	LHC-BLM-EC-0001-10-00 <a href="#">doc</a> (635 Kb) <a href="#">pdf</a> (65 Kb)	

- Machine/Project
- Equipment code/category
- Document type. For example: ES = Engineering Specification, EC = Engineering Change request, TP = Test Procedure etc.

- When: prior to the change taking place
- Resulting action: update the HW Baseline (Engineering Specifications, Drawings...) and the Layout Database.

# Handling Changes





# Usage of the Naming Service

- The naming portal is the source for all codes in EDMS, CDD and Layout.
  - Equipment codes (types) - description of the equipment
    - Includes CDD (CERN Drawing Directory) naming for design office
  - Functional positions for mechanical and electrical layouts – functional naming in the layout database
    - It takes into account optics naming (ABP and OP)
- According to Naming Conventions
  - LHC, SPS, PS Complex
  - QA documents linked within the naming portal

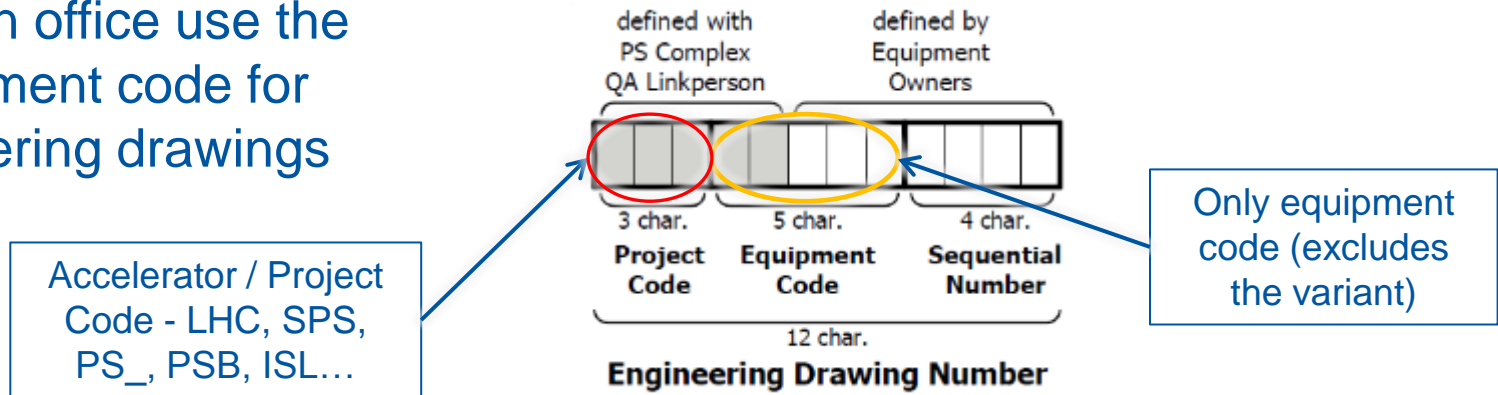
\*Code HM  
 Variant  
 Description  
 \*Main usage Equipment Code  
 \*Parent Equipment Code  
 Responsible Not equipment Code  
 Group  
 Designer  
 Reference  
 Manufacturer  
 \*Status PUBLISHED  
 Requestor  
 Created

Machine Layout code	Functional Equipment code	Equipment design code	Five-character Equipment code
XT00.MQD.4100	MQD	PXMQNLINWP	MQNLI
XT00.MQF.4200	MQF	PXMQNLIINWP	MQNLI
XT00.MCHV.6100	MCHV	PXMCCAZWWC	MCCAZ

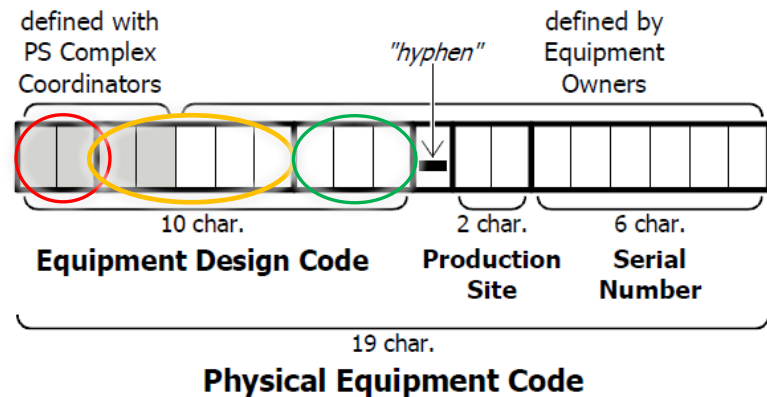
- Machine region / zone
- Variants on equipment type
- Functional description  
 'D' = Defocusing,  
 'F' = Focusing
- 'Convention' reference:  
 PX = PS Complex, SP = SPS, HC = LHC

# Usage of the Naming Service

- Design office use the equipment code for registering drawings

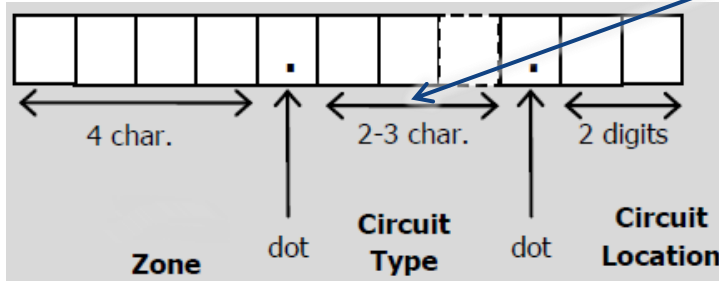


- Manufacturing stage - asset naming
  - Reference for a specific piece of equipment



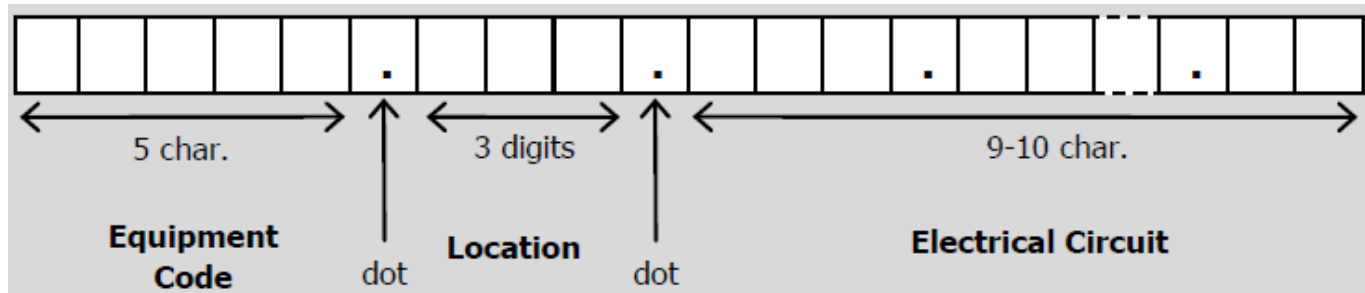
# Naming – Electrical Functional Positions

- Electrical circuit naming:



Electrical circuit type	Functional Equipment code of the load	Function
RBH	MBH, BHZ	Horizontal trajectory bending
RBV	MBV	Vertical trajectory bending
RQ	MQD and MQF in series	Focusing, quadrupolar
RQD	MQD	Defocusing, quadrupolar
RQF	MQF	Focusing, quadrupolar
RCH	MCH	Horizontal trajectory correction
RCV	MCV	Vertical trajectory correction

- Electrical power converter naming:














- All names registered in the naming database, and functional positions with additional attributes declared in the layout database:

CIRCUIT ID	CIRCUIT NAME	DESCRIPTION	LOCATION	POWERING SUBSECTOR	SAFETY SUBSECTOR	CIRCUIT TYPE	QPS CLASS	INTERLOCK CLASS	PIC	QPS CONTROLLERS	QPS DETAILS	P.C. DATA	ELEC OBJECTS	ELEC CONNECTIONS	MORE	VERSION LAYOUT	VERSION CIRCUIT
5338826	BE1.RDHZ.11L1	DHZ Supply circuit	361	PSB-ELEC-CIRCUITS		WARM	NO	WARM			QPS Details	Power Converter	Objects	Connections	Details	STUDY	STUDY
5338827	BE1.RDHZ.4L1	DHZ Supply circuit	361	PSB-ELEC-CIRCUITS		WARM	NO	WARM			QPS Details	Power Converter	Objects	Connections	Details	STUDY	STUDY

# Managing Layouts - Usage of the Layout Database

<https://layout.web.cern.ch/layout/>

- ⊕  Linac 2
- ⊕  Linac 3
- ⊕  Linac 4 Complex
- ⊕  E0 Transfer Line
- ⊕  ITHS Transfer Line
- ⊕  LT Transfer Line
- ⊕  LTB Transfer Line
- ⊕  LBE (Emittance meas.) line
- ⊕  LBS (Spectrometer) Line
- ⊕  BI Transfer Line
- ⊕  PS Booster Rings
- ⊕  BT Transfer Line
- ⊕  BTP Transfer Line
- ⊕  BTM Transfer Line
- ⊕  BTY Transfer Line to Isolde
- ⊖  ISOLDE Complex
  - ⊖  XL
    - ⊖  XLRFQ
      - ⊕  **XLRFQ.BD.0100**
      - ⊖  XLRFQ.ZQP.0400
      - ⊖  XLRFQ.ZQS.0500
      - ⊖  XLRFQ.ZQP.0700
      - ⊖  XLRFQ.ZQP.0800
      - ⊖  XLRFQ.ZQP.0900
      - ⊖  XLRFQ.ZQS.1000
      - ⊖  XLRFQ.ACXRA.1150
      - ⊖  **XLRFQ.MQ.1100**
      - ⊖  **XLRFQ.MQ.1200**
      - ⊖  **XLRFQ.MQ.1300**

- Stores the sequence (layout) of accelerator and transfer line components.
  - Equipment types and details
  - Functional positions for mechanical and electrical layouts
  - Asset names – functional position is exported to MTF database and associated to an asset. Layout just shows the result.
  - Expert name – optional, alternative functional name
- Updated as a result of ECRs - all past layout information is kept for traceability purposes (database is versioned – see following slide)
  - Functional positions become ‘expired’, not deleted
- Accessible to all CERN users (CERN IP address)

# Machine Layout Versioning – Release Notes

- Modifications to the layout of the machines (using ECRs) are buffered and grouped into versions in the Layout Database
- Release notes summarise the modifications between versions done to the layout/optics inside the database
- Triggered by:
  - Technical stops (few days)
  - Extended technical stops (2-3 months)
  - Long shutdowns (e.g. LS1)



EDMS NO.	REV.	VALIDITY
LHC-LJEN-0000	0.1	DRAFT

AUTHOR  
S.CHEBRIENMET

Date: 2012-07-20

**LHC Release Note**  
2011-03 LHC Machine Version

This document summarizes all changes introduced to the LHC Collider layout with this version 2011-03 for both the and **electrical** layouts.  
**Drawings associated** to the layouts can be found in these release notes.  
Please refer to the associated sub-document to find the **MAD Input File** used by AB/ABP to calculate the **optics** of the Collider.

---

**SUMMARY OF CHANGES**

The optics of the Collider has not drastically been changed. Its base is still a version **6.5** for the **mechanical layout** and a version **1.5** for the **electrical layout**. Since the Collider is in operation, the **version name adopted corresponds to its start year/month**. This version is then called 2011-03

- MECHANICAL LAYOUT
- ELECTRICAL LAYOUT
- ASSOCIATED DRAWINGS
- DIFFERENCES WITH THE E.502 VERSION

---

**MECHANICAL LAYOUT**

The changes on the mechanical layout have been classified by categories and domains. Some of the changes are introduced following Engineering Change Orders, some are corrections that were needed when analyzing the vacuum layout continuity or when analyzing the mechanical aperture model of the Collider.

# Layout Database

Navigator with functional position names – logically ordered

Position relative to a defined origin

Equipment type & description from naming service

The screenshot shows the LAYOUT DATABASE interface. On the left is a tree view of the database structure, including sections like SECTOR 01, SECTOR 02, etc., and specific positions like PR.XST101, PR.XST201, PR.QCOMP01, PR.UA01, PR.BHT01, PR.UHV02, PR.DVT02, PR.UA02, PR.BHU02. The main area displays details for a selected position, PR.DVT02. The details include:

- IDENTIFICATION:** ID: 2253320, Machine: PS Ring (PS Complex), Expert Type Name: MCVAAWAP (Type ID: 2253241, naming convention: PX), Description: DVT: Conductor magnet, dipole vertical, type 202, Official Name: PRLDVT02, Links to other databases: PXMCVAAWAP item in EDMS, PRLDVT02 slot in MTF, PXMCVAAWAP-0008602 equipment in MTF, PXMCVAAWAP-0008602 in Norma DB, Related Electrical Objects.
- Classification:** Leg.
- Dimensions:** Length: 0.1250 m, Width: 0.23 m, Height: 0.2750 m, Magnetic Length: 0.20 m.
- POSITION:** Civil work: 260, Location: PR.SD02, REF-POINT, S Start: 7.503185 m, S Middle: 7.503185 m, S Optic Middle: 7.503185 m, Positions (SRAP): S C-1, S C-2, U Start: 0 m, U End: 0 m, V Start: 0 m, V End: 0 m, Rotations: 0°, 0°, 0°, Magnetic Length: 0.20.
- Status:** Responsible: DOMINGUE BODART (TE.MS), Comment: MAD Parent (Used in the ... Ring MAD Sequence file), Concerned plane: PLANE, Plane & Pinouts: V.

Arrows from the text labels point to the following elements in the screenshot:

- The tree view on the left.
- The 'Length', 'Width', 'Height', and 'Magnetic Length' fields.
- The 'IDENTIFICATION' section, specifically the 'Description' and 'Links to other databases'.
- The 'POSITION' section, specifically the 'Locations' table.
- The 'Status' section, specifically the 'Responsible' field.

Dimensions

Links to other information (EDMS, MTF, NORMA...)

# Layout Database

- Layout database linked to GIS portal to show the precise location of functional positions (example: PS-Booster racks)

**361/1-012**

- AY.361.BCER107
- AY.361.BCER431
- BY.361.BCER137
- BY.361.BCER140
- BY.361.BCER141
- BY.361.BCER142
- BY.361.BCER144
- BY.361.BCER165
- BY.361.BCER235
- BY.361.BCER239
- BY.361.BCER240
- BY.361.BCER241
- BY.361.BCER242
- BY.361.BCER243
- BY.361.BCER244
- BY.361.BCER250
- BY.361.BCER251
- BY.361.BCER252
- BY.361.BCER253
- BY.361.BCER254
- BY.361.BCER256
- BY.361.BCER258
- BY.361.BCER258A
- BY.361.BCER258B
- BY.361.BCER259
- BY.361.BCER268
- BY.361.BCER350
- BY.361.BCER351
- BY.361.BCER352
- BY.361.BCER360
- BY.361.BCER366

**Location: 361/1-012, BCER: RACK ÉLECTRONIQUE/ÉLECTRIQUE - Room, Laboratory, Office...**  
**ID: 4792734, Type ID: 1133137, Version: STUDY**  
**361/1-012 Location in MTF**  
**361/1-012 in the CERN Geographic Information System (Patrimony)**

**361/1** Booster technical rooms. Floor 1

**PARENT LOCATIONS**

Photos aériennes Plans officiels Plan IGN Aucun

FLOOR

305 364 833 (TP9) 588

300 80 (TT1) 80 (TT2)

30 (m)

1:500

© CERN, STT

# Current Status

- Defined in Layout database:
  - Accelerators: LHC, SPS, PS-Ring, PS-Booster, LEIR.
  - Linacs: L4
  - Isolde Complex: HIE-Isolde
  - Transfer Lines : TI2, TI8, TD62, TD68, TT2, LT, BI, BTP, BTM, TT10, TT60...
- Defined with a Hardware Baseline:
  - Linac 4, LHC, HIE-Isolde
  - In progress: SPS, PS-Ring, PS-Booster, AD, LEIR, ELENA
- The scope is growing to include new projects and catch up with existing facilities (reverse engineering)



# Summary

- The purpose of Configuration and Change Management of the Accelerators Layout is to provide a clear picture of a project/machine at a given point in time.
- It is achieved through the use of:
  - Hardware Baselines:
    - Store for all information on the hardware installed in a given machine.
    - Only concerns 'hardware' (products), not activities.
  - Handling of Changes:
    - Engineering Change Requests
    - Stored in Hardware Baseline
    - Proper versioning of documents is important
  - Naming:
    - Important at all stages of the project/machine lifecycle
    - Documentation in HWBaseline, Equipment types, Functional positions, Mechanical design, Manufacturing
  - Layout Database:
    - Stores the sequence (layout) of components, including electrical components and circuits.
    - Naming is stored
    - Links to other information sources – GIS portal to visually display functional position locations

# Summary

- Further information:
  - Naming Service: [accelerators-naming.service@cern.ch](mailto:accelerators-naming.service@cern.ch) supported by BE-CO-DA and EN-MEF-DC
  - Naming Portal: <https://cern.ch/service-acc-naming> supported by BE-CO-DA
  - Layout Service: [layout-service@cern.ch](mailto:layout-service@cern.ch) supported by BE-CO-DA and EN-MEF-DC
  - Layout Web Interface: <https://layout.web.cern.ch/layout/> supported by BE-CO-DA
  - EDMS: <https://edms.cern.ch> supported by GS-ASE
  - Configuration and Change Management of the Accelerators Baselines: [ecr-configuration@cern.ch](mailto:ecr-configuration@cern.ch) supported by EN-MEF-DC