



**High
Luminosity
LHC**

HL-LHC Configuration Management

**Keywords : HW Baseline, Naming, Parameters, Layout DB,
Change Control**

HL-LHC Configuration Management

This presentation addresses the configuration management of HL-LHC and places it in perspective of a future merge with LHC. Compatibilities, proposals and issues are presented.

It is structured as follows:

- LHC Project and LHC Machine
- Handling concurrently HL-LHC and LHC
- Names, parameters, layout, slots, HW Baseline
- Activity and HW Baseline/Parameters
- What's next

LHC Project and LHC Machine

LHC Project (prior to its installation) was handled through configuration management to allow

- A clear view on the state of the project – in a HW Baseline, LHC Equipment Catalog for Parameters, Layout DB for MAD/X
- A common view on the state of the project – Approval of parameters and documents (PLC, TCC, LTC, LMC, Maric,...)

LHC Machine (in operation) follows the same rules, with configuration management and change control (ECRs).

- Every step/stop is traced – changes from TS/LS to TS/LS

LHC Project and LHC Machine

Documents were stored in the Hardware Baseline

From Isabel's presentation to HLTC

LHC-MQXA-ES-0001	Inner Triplet Quadrupole MQXA
LHC-MQXA-EP-0001	Parameters for MQXA
LHC-MQXB-EP-0001	Parameters for MQXB
LHC-MQXA-EC-0001	Change of protection and interlock scheme for the main quadrupole ...
LHCMQXA_0002	-- QUENCH HEATER FOR MQXA
LHC-MQXA-ES-0003	Inner Triplet Quadrupole MQXA
LHC-MQXA-EC-0001	Change of protection and interlock scheme for the main quadrupole ...
LHC-MQXA-ES-0001	Inner Triplet Quadrupole MQXA

Handling concurrently HL-LHC and LHC

Several aspects to consider:

- Names
- Parameters of magnets
- Layout drawings
- Functional positions - Slots
- HW Baseline

Names

The Naming portal now covers all accelerators

⊕ <u>MQT</u>	Tuning (or short trim) Quadrupole Corrector in Arc Short Straight Section
⊕ <u>MQW</u>	Twin Aperture Warm Quadrupole Module
⊖ <u>MQX</u>	Inner Triplet Quadrupoles
<u>MQXA</u>	Single Aperture Inner Triplet Quadrupole (Q1, Q3)
<u>MQXB</u>	Single Aperture Inner Triplet Quadrupole (Q2)
⊕ <u>MQXC</u>	120 mm Single Aperture Inner Triplet NbTi Quadrupole for HL-LHC
⊕ <u>MQXD</u>	120 mm Single Aperture Inner Triplet Nb3Sn Quadrupole for HL-LHC
⊖ <u>MQXF</u>	150 mm Single Aperture Inner Triplet Nb3Sn Quadrupole for HL-LHC
<u>MQXFL</u>	150mm Single Aperture Nb3Sn Series Long Magnet (Q2)
<u>MQXFM</u>	150mm Single Aperture Nb3Sn Model Magnet both 1.5m and 4m Long
<u>MQXFP</u>	150mm Single Aperture Nb3Sn Prototype Magnet
<u>MQXFT</u>	150mm Single Aperture Nb3Sn Tooling for Model Prototypes and Series
<u>MQXF</u>	150mm Single Aperture Nb3Sn Short Magnet Series (Q1,Q3)
<u>MQXS</u>	Inner Triplet Skew Quadripole Corrector (a2)
<u>MQX T</u>	Inner Triplet Quadrupole Tooling
<u>MQY</u>	Insertion Region Wide Aperture Quadrupole 3.4 m.

Names

Names have to be compatible with existing ones and properly declared in Naming, e.g. MQXF.

Proposal :

- Use Accelerators-naming.Service@cern.ch address
- Get a reference person in the Magnets group with an overview of all the codes

Issue :

- Might be necessary to update to 8 characters for the equipment codes. QA-WG issue

Parameters

LHC Design - Parameters & Layouts

Reset Set as Top Search Re-login
BEJ&R

- Main Quadrupole
 - Warm Compensators
 - Insertion Region Quadrupoles
 - MQM
 - MQMC
 - MQML
 - MQR
 - MQRL
 - MQY
 - MQXA**
 - MQXB
 - MQWA
 - MQWB
 - Lattice Correctors
 - Orbit Correctors
 - Multipole Correctors
 - Kickers & Septa
 - Hardware Baseline Documentation
 - Magnets for the Injection Lines
 - Powering & Quench Protection
 - Cryogenics
 - Vacuum System
 - Beam Instrumentation
 - Geometry & Alignment
 - Controls & Operational Aspects
 - Injectors & Transfer Lines

MQXA Parameters

MQXA: Inner triplet quadrupole, single aperture, Q1, Q3

Magnetic (at operating temperature)		
Nominal gradient	205	T/m
Nominal current	6450	A
Magnetic length	6.370	m
Operating temperature	1.9	K
Peak field in coil	8.23	T
Working point	80	%
Aperture separation	single	mm
Geometry (at room temperature)		
Overall length	6.68	m
Overall outer diameter	490	mm
Coil length	6.54	m
Coil inner diameter	70	mm
Coil outer diameter	162.2	mm
Yoke inner diameter	184	mm
Overall weight	9600	kg
Powering		
Number of turns per coil	63	
Number of coils per aperture	4	
Stored energy per aperture at nominal current	1887.1	kJ
Inductance per aperture	90.7	mH
Ultimate current	7000	A
Conductor Inner layer		



LHC Equipment Catalogue - by Family

Reset Set as Top Search Re-login
BEJ&R

- MBV
- MBXW
- Main Quadrupole
 - MQ
- Insertion Region Quadrupole
 - MQM
 - MQMC
 - MQML
 - MQWA
 - MQWB
 - MQXA**
 - MQXB
 - MQY
- Lattice Correctors
- Multipole Correctors
 - MCD
 - MCO
 - MCOSX
 - MCOX
 - MCS
 - MCSX
 - MCSX
 - MCTX
- Orbit Correctors
 - MCBH
 - MCBV
 - MCBCH
 - MCBCV

Item Id: LHCABS001584 v.0 MQXA
Eq. code: MQXA
[Go Work](#)

Actions: Set As Top | Excel File

Description
Inner triplet quadrupole, single aperture (Q1, Q3)

Properties

1 - Main Parameters

Nominal Operating Temperature	1.9 K
Magnetic Length	6.37 m
Magnetic Aperture	Single
Inductance per Magnet	90.1E+3 mH

2 - Magnets for Optics and Corrections at 1.9K

Multipole Order n	2
Nominal Current	7.18E+3 A
Nominal Gradient	205 T/m ² *(n-1)
Nominal Field at 77mm	3.465 T
Stored Energy per Magnet (Nom. Current)	2.07E+3 kJ
Peak Field in Coil for Nominal Current	8.23 T
Working Point for Nominal Current	80 %
Ultimate Current	7.18E+3 A

2 - Magnet Mechanical Parameters

Magnet Weight	9.6E+3 kg
Magnet Mechanical Length (end-plates)	6.66 m
Aperture Type	Round

8 - Quench Protection System

Double Length Quench Heaters in Series	2
Heater Rover Supplies / Magnet	2

9 - Contact

Responsible Person R. Ostojic

Context
Context

From Isabel's presentation to HLTC

Parameters

As a reminder, the equipment catalogue is fully integrated into the Layout and actively used today by operations, MAD generation files, ELQA campaigns, HWC tests

Proposal :

- Use the LHC equipment catalogue

Issue :

- Approve the parameters

Layout Drawings

These are conceptual drawings LHCLSX and LHCLSXG, LHCLSS, LHCLSA and electrical drawings LHCLSD, cryogenic P&ID LHCLSQR

These names are the ones of the current LHC machine.

Proposal :

- Use new names for the drawings with a lifetime up to LS3

Issue :

- Maintain several sets of drawings: LHC vs HL-LHC, Multi-branching inside HL-LHC
- Maintain and modify by hand (trial and error), maintain and modify with a DB input (with approval and versioning)

Functional Positions - Slots

Functional Positions, Types, and Regions are going to change heavily. Still some internal mechanisms in the Layout DB help in checking integrity of the data.

Proposal :

- Use the layout DB for defining configuration of assemblies, e.g. LQXDA, functional positions e.g. LQXDA.3R5, regions e.g. 4R5
- Introduce validity dates for all elements handled in the layout DB

Issue :

- Availability of such a modification is mid-LS1 or end-LS1
- Checking and re-checking coherence once data is updated

HW Baseline

The HW Baseline is the place where long-term documents are stored. By long term documents, it is meant

- Procurement (Technical Specifications for MS, IT, PI)
- Engineering Specifications, Change Requests
- Manufacturing (Drawing folders, Assembly Procedures, Test Procedures, Installation Procedures, etc.)

Proposal :

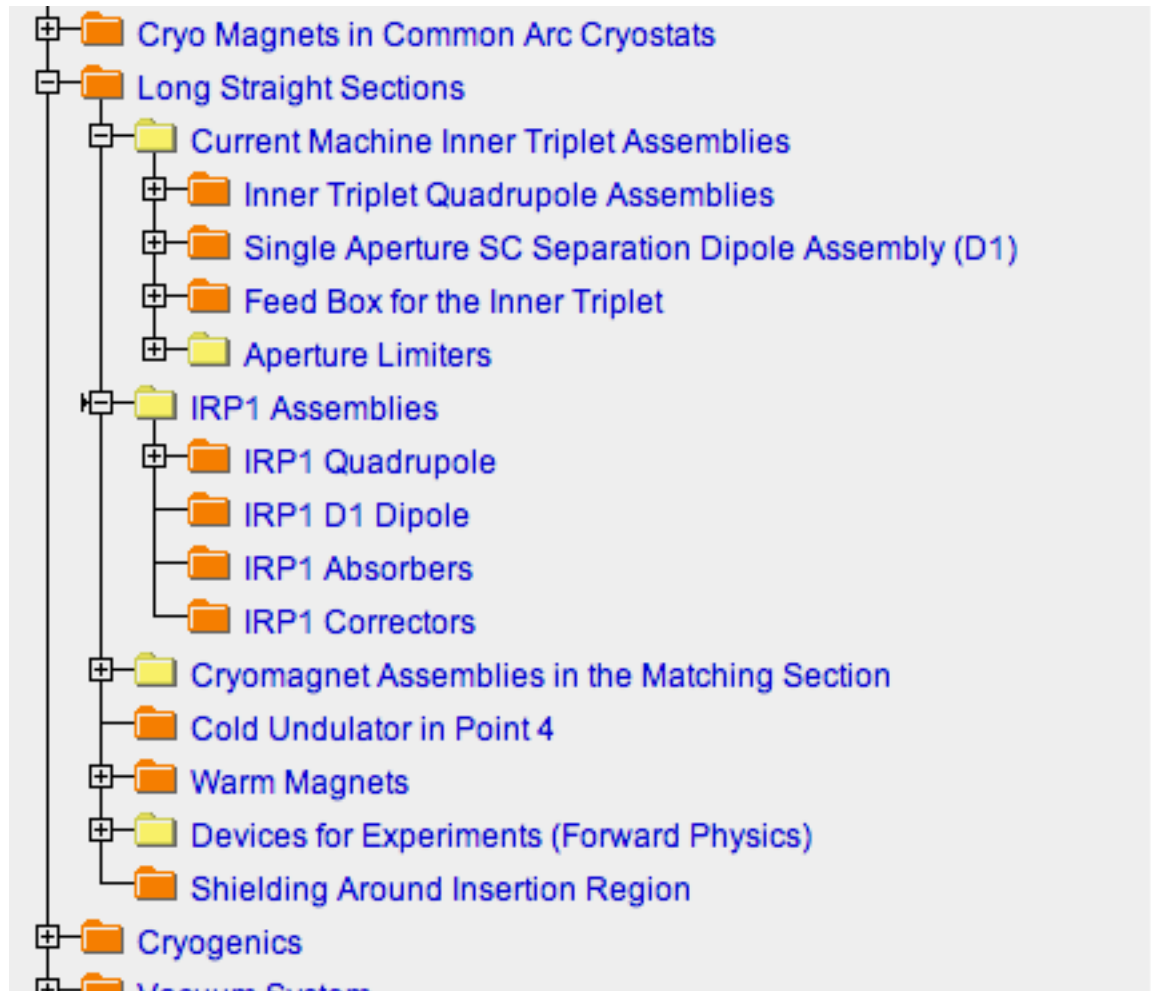
- Rename nodes with a 'Current Machine' prefix
- Duplicate the nodes with 'HL-LHC' prefix
- This eases the attachment to the activity structure (see next slide)

Issue:

- The overall baseline becomes unreadable
- Re-work the baseline to suppress nodes at LS3

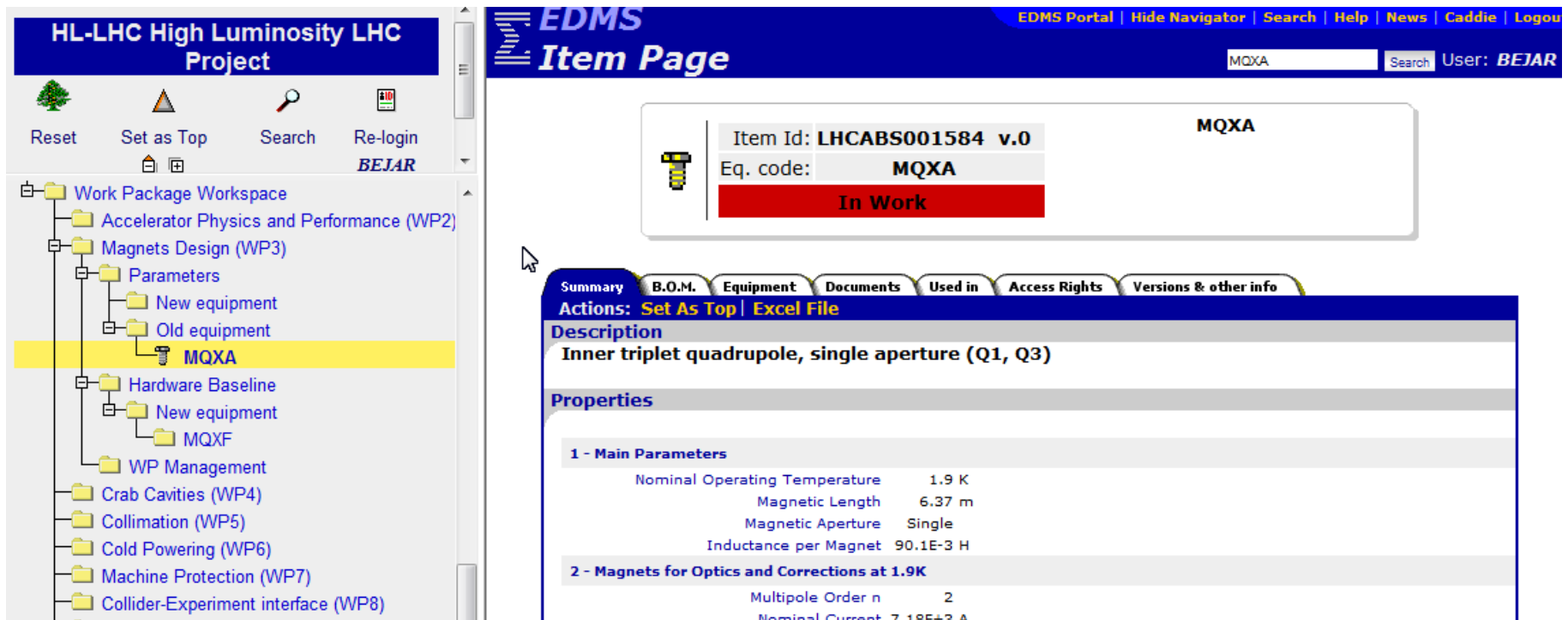
HW Baseline

This is a sample of the HW Baseline with the first upgrade project



Activity and HW Baseline/Parameters

To be able to continue storing information on the official systems but be able to find HL data without navigating



The screenshot shows the EDMS Item Page for the item MQXA. The page is titled "EDMS Item Page" and includes a search bar with the text "MQXA" and a search button. The user is identified as "BEJAR". The item details are as follows:

Item Id:	LHCABS001584 v.0	MQXA
Eq. code:	MQXA	
In Work		

The page also features a navigation menu with tabs for Summary, B.O.M., Equipment, Documents, Used in, Access Rights, and Versions & other info. The main content area is divided into sections: Description, Properties, and Main Parameters.

Description
Inner triplet quadrupole, single aperture (Q1, Q3)

Properties

1 - Main Parameters

Nominal Operating Temperature	1.9 K
Magnetic Length	6.37 m
Magnetic Aperture	Single
Inductance per Magnet	90.1E-3 H

2 - Magnets for Optics and Corrections at 1.9K

Multipole Order n	2
Nominal Current	7.18E+3 A

The left sidebar shows a tree view of the project structure, with the "MQXA" item highlighted under the "Parameters" folder.

From Isabel's presentation to HLTC

Activity and HW Baseline/Parameters

Parameters will be a mirror of the LHC equipment catalogue

Documents will be updated automatically by any document introduced in the hardware Baseline with the same equipment code but you will be able to create documents that are not “compulsory” and that will have a normal EDMS numbering

Item Id: LHCABS001584 v.0
Eq. code: MQXA
In Work

MQXA

Summary | B.O.M. | Equipment | Documents | Used in | Access Rights | Versions & other info

Actions: Set As Top | Excel File

Description
Inner triplet quadrupole, single aperture (Q1, Q3)

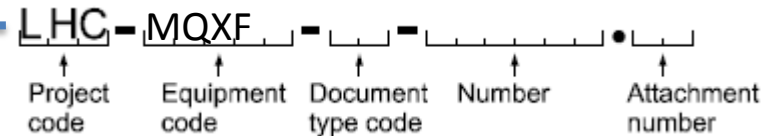
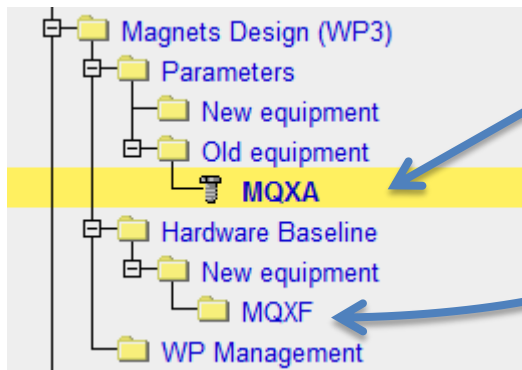
Properties

1 - Main Parameters

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Nominal Current	7.18E+3 A
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Stored Energy per Magnet (Nom Current)	2.07E+3 kJ
Peak Field in Coil for Nominal Current	8.23 T
Working Point for Nominal Current	80 %
Ultimate Current	7.18E+3 A



From Isabel's presentation to HLTC

What's next

- Getting an overview on the needed codes (Naming) : correctors, dipoles, cavities, DFB..., and work with all the link persons from the groups and the PE. Already started with MQXF for example.
- Prepare the HW baseline by separating nodes where adequate
- Prepare the set of drawings handling the conceptual layout. And define methodology with the layout DB.
- Collect the parameters of the magnets approved by the PLC and insert in EDMS



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