HL-LHC 11T Dipole Rack

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8th HL-LHC Collaboration Meeting

17th October 2018

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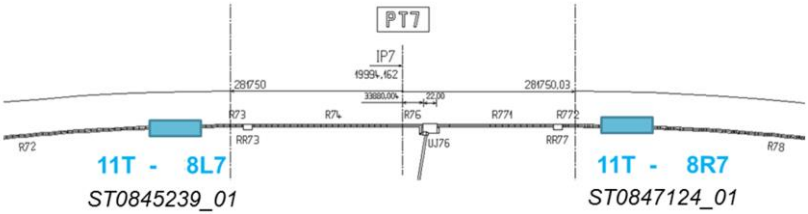
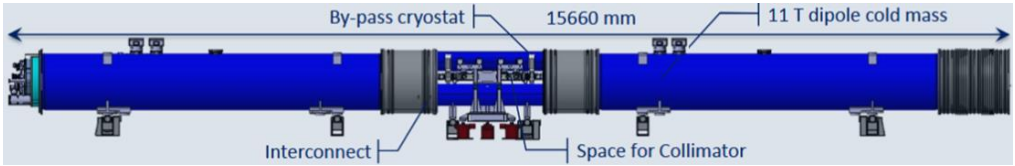
MOTIVATION

The 11T cryo-assemblies are going to replace magnets MBA.B8L7 (circuit RB.A67) and MBB.B8R7 (circuit RB.A78)

The protection of the new 11T dipoles will require an increase of heater strips -> increase on the heater power supplies

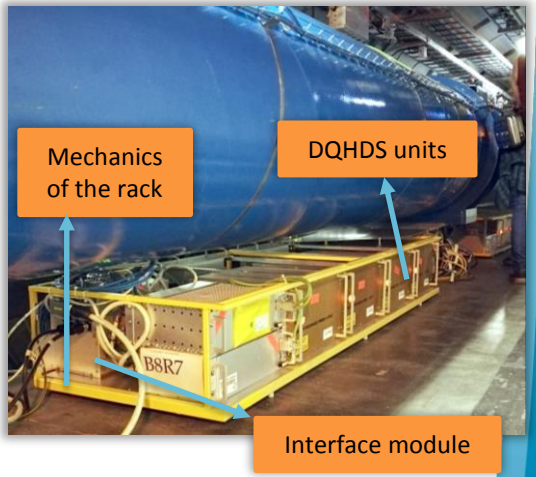


Reduced room below the cryostats is a significant constraint for this project



MOTIVATION (ii)

	Reason	Consequence
1	Increase of DQHDS per dipole (4 -> 16 units)	Rack needs to be bigger
2	The loss of more than 2 DQHDS might compromise the 11T integrity	DQHDS to be upgraded in order to increase reliability*
3	Upgraded Quench Detectors** will not be installed within the DYPB (located in the RRs)	DQLIM needs to be modified (e.g. it will not include voltage tap wires or QD power supplies)



Upgrade needed during LS2

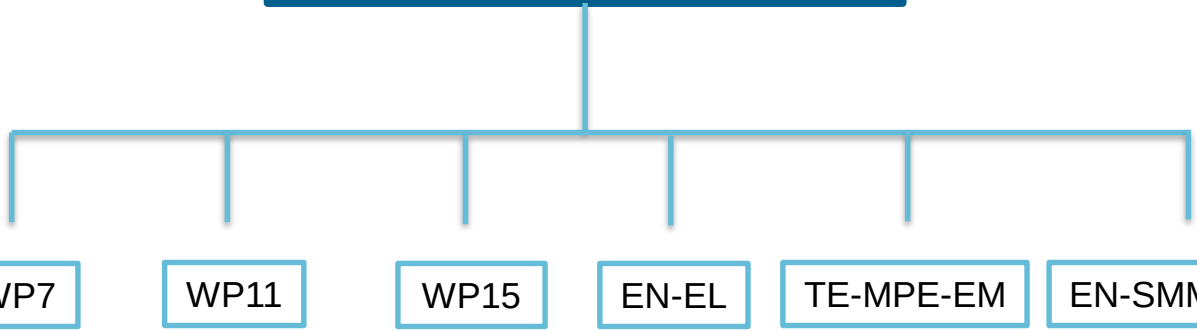
* Reliability requirements to be presented by D. Sollich
** Presented by J. Steckert

NUMBER OF RACKS AND LOCATION

- 16 heater power supplies per 11T dipole cryo-assembly

→ 4 racks in total with 8 heaters power supplies per rack

Many valuable inputs / interfaces



Alain Antoine
Andrea Apollonio
Miriam Blumenschein
Reiner Denz
Surbhi Mundra
Jens Steckert
Daniel Sollich
Jan Uythoven
Daniel Wollmann
…

Susana Izquierdo
Herve Prin
Ludovic Grand-Clement

Paolo Fessia
Marian Gonzalez

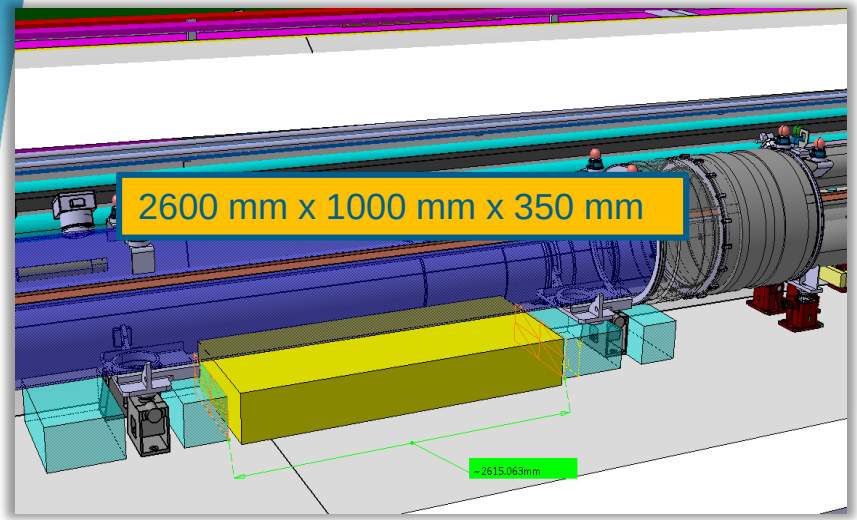
Vincent Chareyre

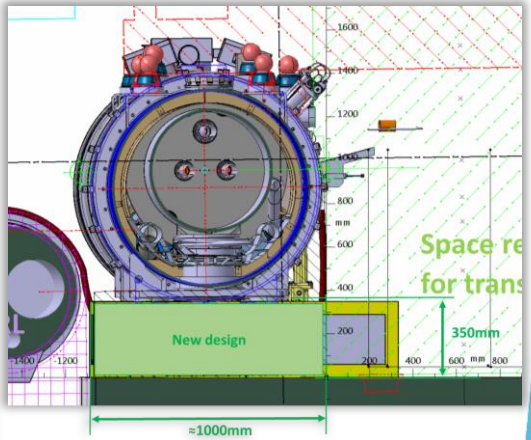
Raphael Berberat
Jean-Marc Wickham
Jeremy Kuhn
Maxime Ricci
William Billereau

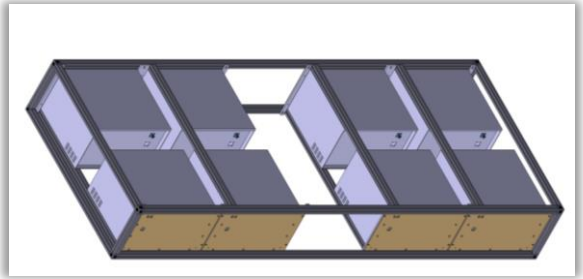
Salvatore Danzeca
Jerome Lendaro
Chiara Cangialosi
Gilles Foucard

STATUS OF THE UPGRADES

RACK - MECHANICS





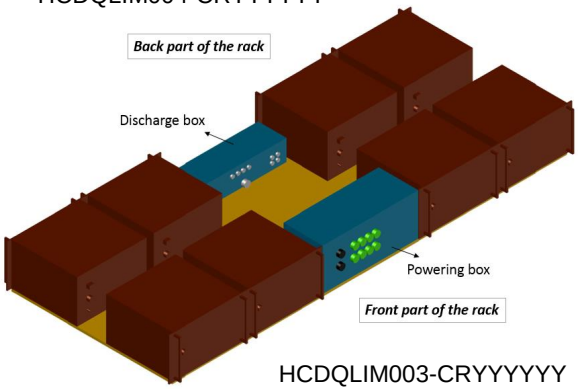


DQLIM UPGRADE

The new interface module will contain a great variety of modifications with respect to the current design for both dipoles and quadrupoles

- Voltage taps will be routed directly from the IFS boxes to the quench detection system located in the RRs
- DQLIM power box to supply DQHDS with both F3 and F4 (redundancy)
- Switches on the front side to turn on/off the eight DQHDS
- For maintenance purposes, the current transformers will be installed inside the DQHDS

HCDQLIM004-CRYYYYYY

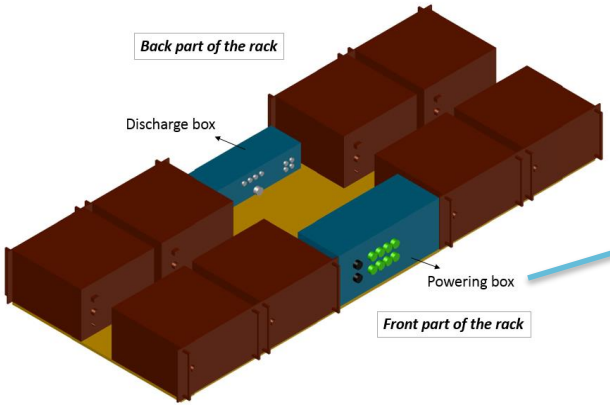


HCDQLIM003-CRYYYYYY

DQLIM UPGRADE (ii)

Having a two-boxed interface module provides the following advantages with respect to one-boxed one:

- There is a central corridor in the layout of the rack allocating a bigger room for positioning and connecting cables properly
- Segregation between mains wires and heater discharge circuits
- Improves the maintainability (dedicated study in labelling to be performed at a later stage of the project)



Status of DQLIM powering box 3D model. Courtesy Maxime Ricci TE-MPE-EM

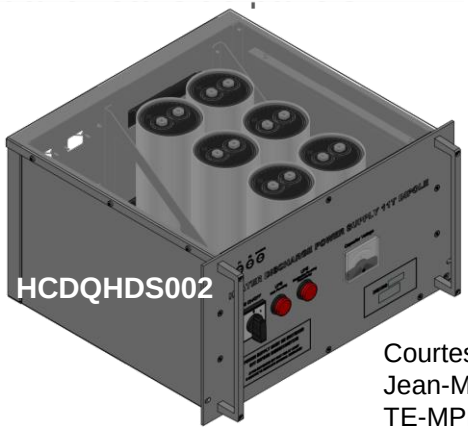
DQHDS UPGRADE

Due to the wide set of requirements to be met, the following modifications will be implemented:

- Redundant powering
- The current transformers will be installed in the heater power supply
- Addition of relays in the internal discharge circuit for safety
- Addition of a voltage indicator

To be reused: Capacitors, frames from DQHDS spares, thyristors, some connectors

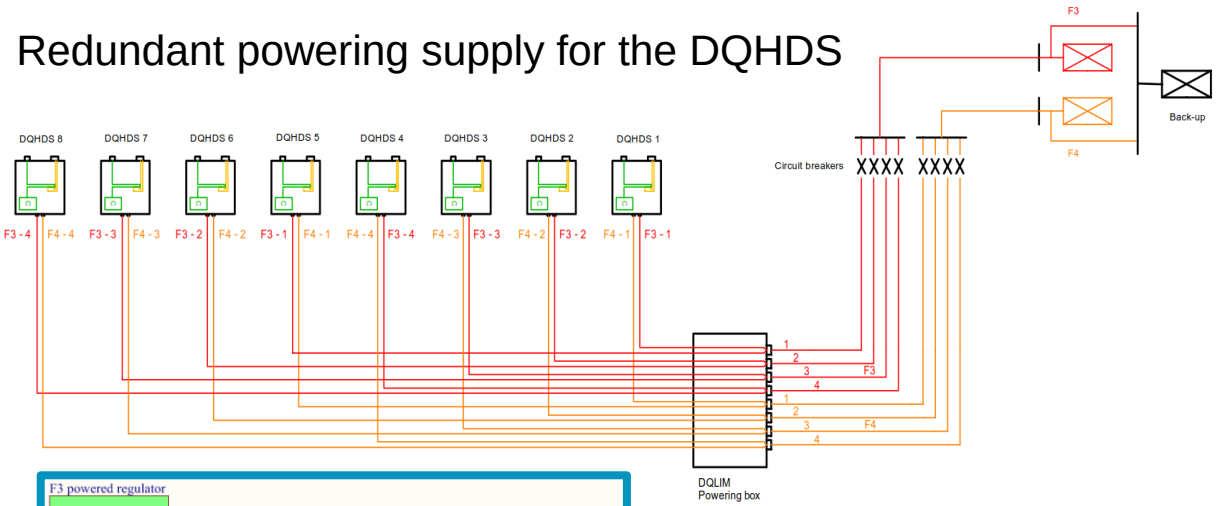
New: PCB, current transformers, front and rear side panels..

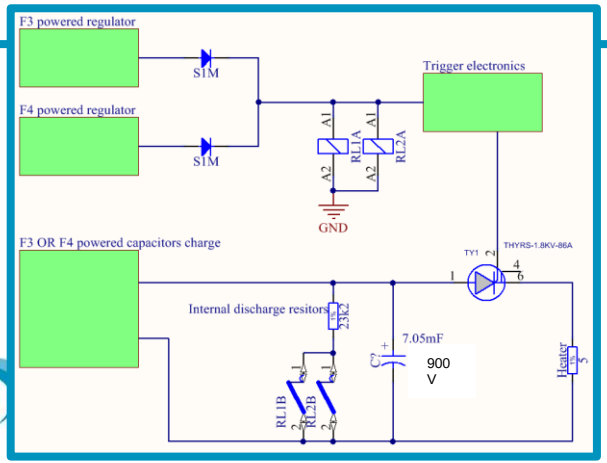


Courtesy
Jean-Marc Wickham
TE-MPE-EM

DQHDS UPGRADE (ii)

Redundant powering supply for the DQHDS

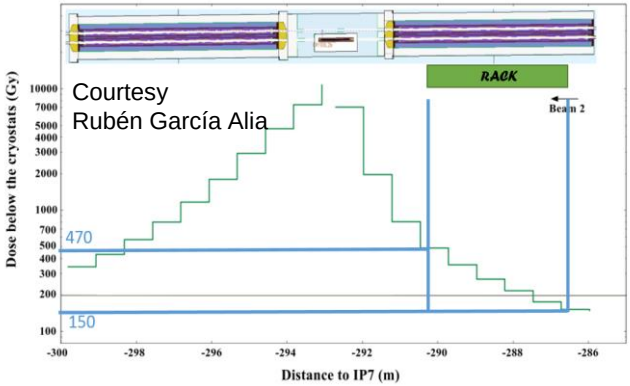




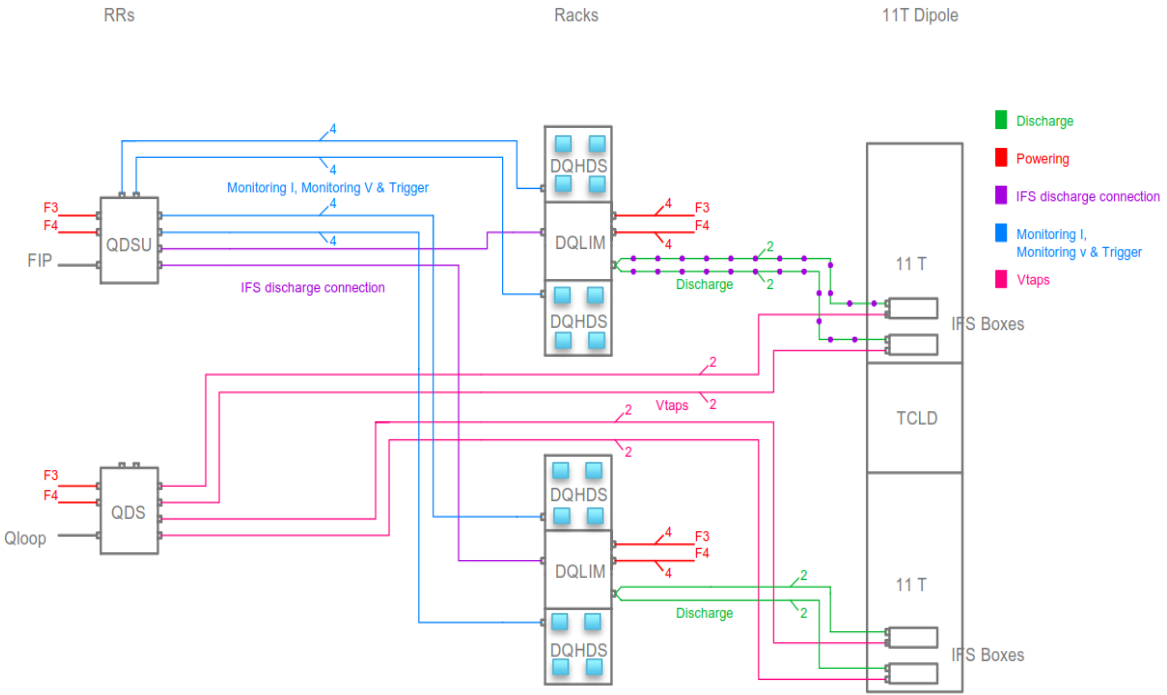
Simplified circuit showing the redundancy in the powering and addition of relays

Irradiation campaign of DQHDS

- Partial side of the rack will be exposed to a radiation up to 400-500 Gy
- Component level tests in PSI up to 500 Gy (EN-SMM-RME)
  - Optocouplers to replace triggering relay (will not be used in the end) (edms reports: 2002397, 2002401, 2002403)
  - Regulator/transistors (edms reports: 2011367, 2029282)
  - Thyristors to be tested
- System level test in CHARM up to 500 Gy
  - DQHDS had a detectable failure (safer for LHC) at ~ 420 Gy and at ~470 Gy
  - Cause of failure yet unknown
- A strategy of replacement or exchange might be put in place during HL-LHC



CABLING


RRs
Racks
11T Dipole
Discharge
Powering
IFS discharge connection
Monitoring I, Monitoring v & Trigger
Vtaps
F3
F4
FIP
QDSU
Monitoring I, Monitoring V & Trigger
IFS discharge connection
DQHDS
DQLIM
DQHDS
Discharge
11 T
IFS Boxes
Vtaps
TCLD
F3
F4
Qloop
QDS
DQHDS
DQLIM
DQHDS
Discharge
11 T
IFS Boxes

DELIVERABLES, SCHEDULE & DOCUMENTATION

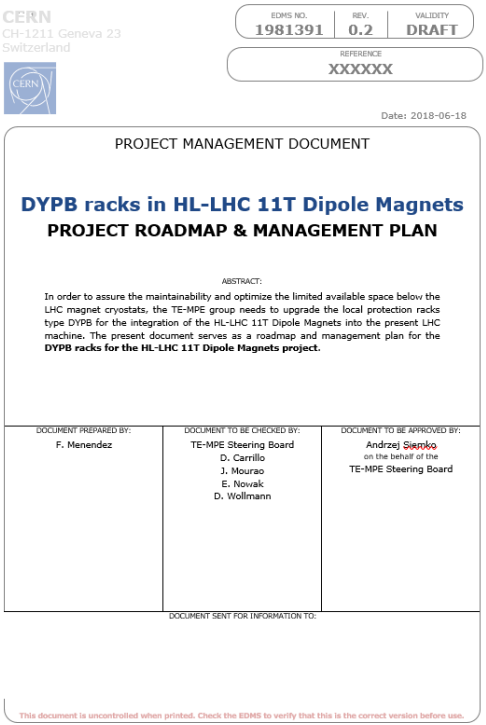
Deliverables

- 4 racks + 1 spare
- 4 DQLIM units + 1 spare
- 32 current transformers + 8 spares
- 32 DQHDS (upgraded) + 8 spares (upgraded)
- Harnesses

Schedule & Milestones

Milestone	Description	Deadline
M1	Conceptual design phase: Definitions and functional requirements of the supply	Jun 2018
M2	Prototype design, procurement and manufacturing	December 2018
M3	Prototype testing and validation, incl. test equipment	January 2019
M4	Final design specifications and orders placement	March 2019
M5	Reception tests, validation, QA	September 2019
M6	Installation LS2	July 2020

Documentation



CERN
CH-1211 Geneva 23
Switzerland

EDMS NO.	REV.	VALIDITY
1981391	0.2	DRAFT

REFERENCE
XXXXXX

Date: 2018-06-18

PROJECT MANAGEMENT DOCUMENT

DYPB racks in HL-LHC 11T Dipole Magnets
PROJECT ROADMAP & MANAGEMENT PLAN

ABSTRACT:

In order to assure the maintainability and optimize the limited available space below the LHC magnet cryostats, the TE-MPE group needs to upgrade the local protection racks type DYPB for the integration of the HL-LHC 11T Dipole Magnets into the present LHC machine. The present document serves as a roadmap and management plan for the **DYPB racks for the HL-LHC 11T Dipole Magnets project.**

DOCUMENT PREPARED BY:	DOCUMENT TO BE CHECKED BY:	DOCUMENT TO BE APPROVED BY:
F. Menendez	TE-MPE Steering Board D. Carrillo J. Mourao E. Novak D. Wollmann	Andrzej Siemko on the behalf of the TE-MPE Steering Board

DOCUMENT SENT FOR INFORMATION TO:

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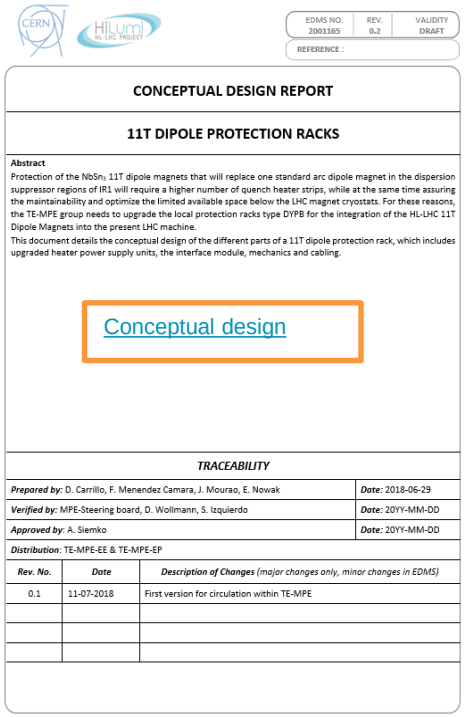

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2001165	0.2	DRAFT

REFERENCE :

CONCEPTUAL DESIGN REPORT

11T DIPOLE PROTECTION RACKS

Abstract

Protection of the Nb_3Sn 11T dipole magnets that will replace one standard arc dipole magnet in the dispersion suppressor regions of IR1 will require a higher number of quench heater strips, while at the same time assuring the maintainability and optimize the limited available space below the LHC magnet cryostats. For these reasons, the TE-MPE group needs to upgrade the local protection racks type DYPB for the integration of the HL-LHC 11T Dipole Magnets into the present LHC machine.

This document details the conceptual design of the different parts of a 11T dipole protection rack, which includes upgraded heater power supply units, the interface module, mechanics and cabling.

Conceptual design

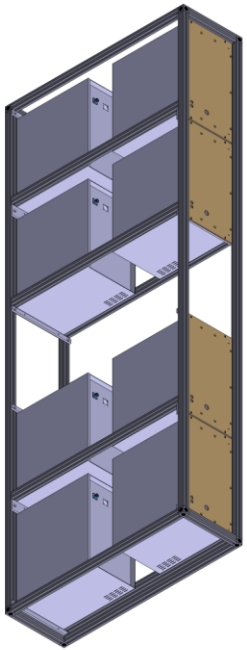
TRACEABILITY

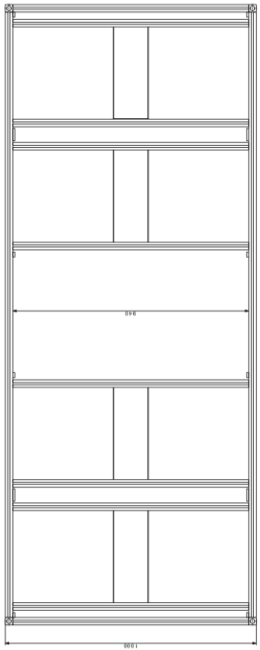
Prepared by: D. Carrillo, F. Menendez Camara, J. Mourao, E. Nowak	***Date:*** 2018-06-29
Verified by: MPE-Steering board, D. Wollmann, S. Izquierdo	***Date:*** 20YY-MM-DD
Approved by: A. Siemko	***Date:*** 20YY-MM-DD
Distribution: TE-MPE-EE & TE-MPE-EP	

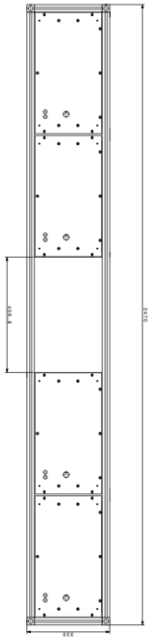
Rev. No.	*Date*	*Description of Changes (major changes only, minor changes in EDMS)*
0.1	11-07-2018	First version for circulation within TE-MPE

Thank you very much for your attention

Rack dimensions







Harnesses

Cable	Function	From	To	Connectors
PH3SJ	Powering (internal)	DQLIM (Powering box)	DQHDS	VDE and IEC connectors
PH2SB	Discharge (internal)	DQHDS	DQLIM (discharge box)	Amphenol socapex serie S 61 connector
NE8	U_HDS, I_HDS, Trigger	DQHDS	QDSU	Harting HAN Module 8
PJ5SJ	Discharge (external)	DQLIM (discharge box)	IFS	Harting Q5 (HAN E)
NE6	IFS discharge connection	DQLIM (discharge box)	QDSU	Harting HAN Module 6
PJ3SJ	Powering (external)	Electrical box (circuit breakers)	DQLIM (powering box)	VDE