

# HL-LHC ACTIVITIES DURING LS2

Paula Álvarez López,  
on behalf of the HL-LHC Project team



**LS2** DAYS

29-30 SEPTEMBER 2015

<http://indico.cern.ch/event/436424/>

# Agenda

- HL-LHC baseline evolution
- Overview of LS2 installation works on the LHC Layout
- LS2 installation works detailed by WP
- Wrap up: summary of all LS2 works for HL-LHC

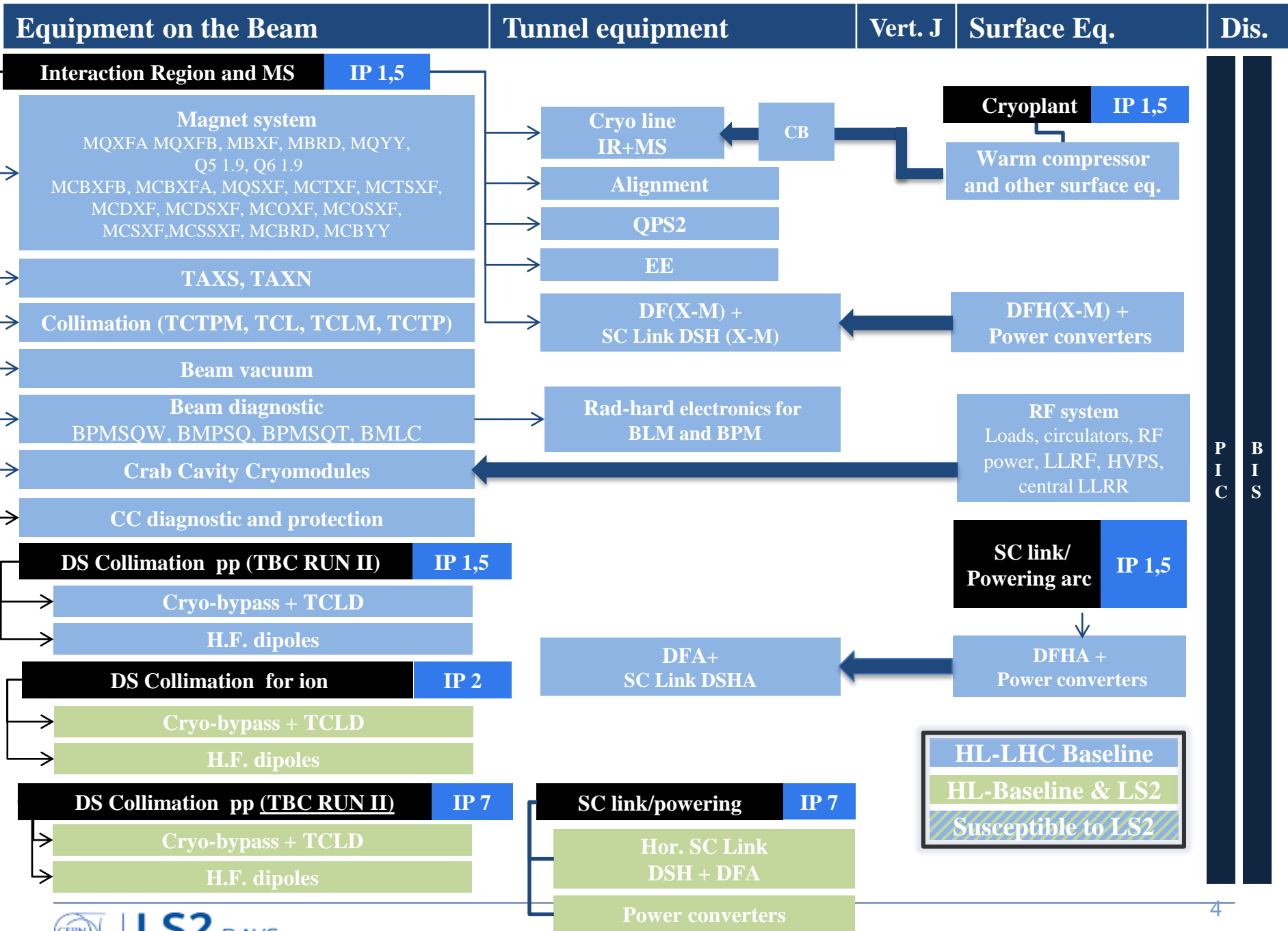
# **BASELINE as of September 2014 (Chamonix Session)**



**LS2** DAYS

29-30 SEPTEMBER 2015

<http://indico.cern.ch/event/436424/>



P  
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<b>Collimation upgrade</b>	
Secondary TCSPM	IP 3, 7
Primary TCP TCP	IP 3, 7
TCSG, TCLA, TCAP	IP 3, 7
TCSP	IP 6
<b>Injection protection</b>	
IP 2, 8	
TDIS	
TCLIA, TCLIB (TBC)	
TCDD TCDDM (TBC)	
TCLIM (TBC)	
MKI (TBC)	
<b>Beam diagnostic</b>	
IP 4	
Fast wire scanners BWSF	
New light extraction line BSRT	
Beam gas vertex detector BGV	
Q5 at point 6	IP 6
<b>Dump (TBC)</b>	
IP 6	
TCDS (TBC)	
MKB, TDE (TBC)	
<b>High rad warm magnets (TBC)</b>	
IP 7	
TAXN for LHCb	IP 8



HL-LHC Baseline
HL-Baseline & LS2
Susceptible to LS2

P I C B I S

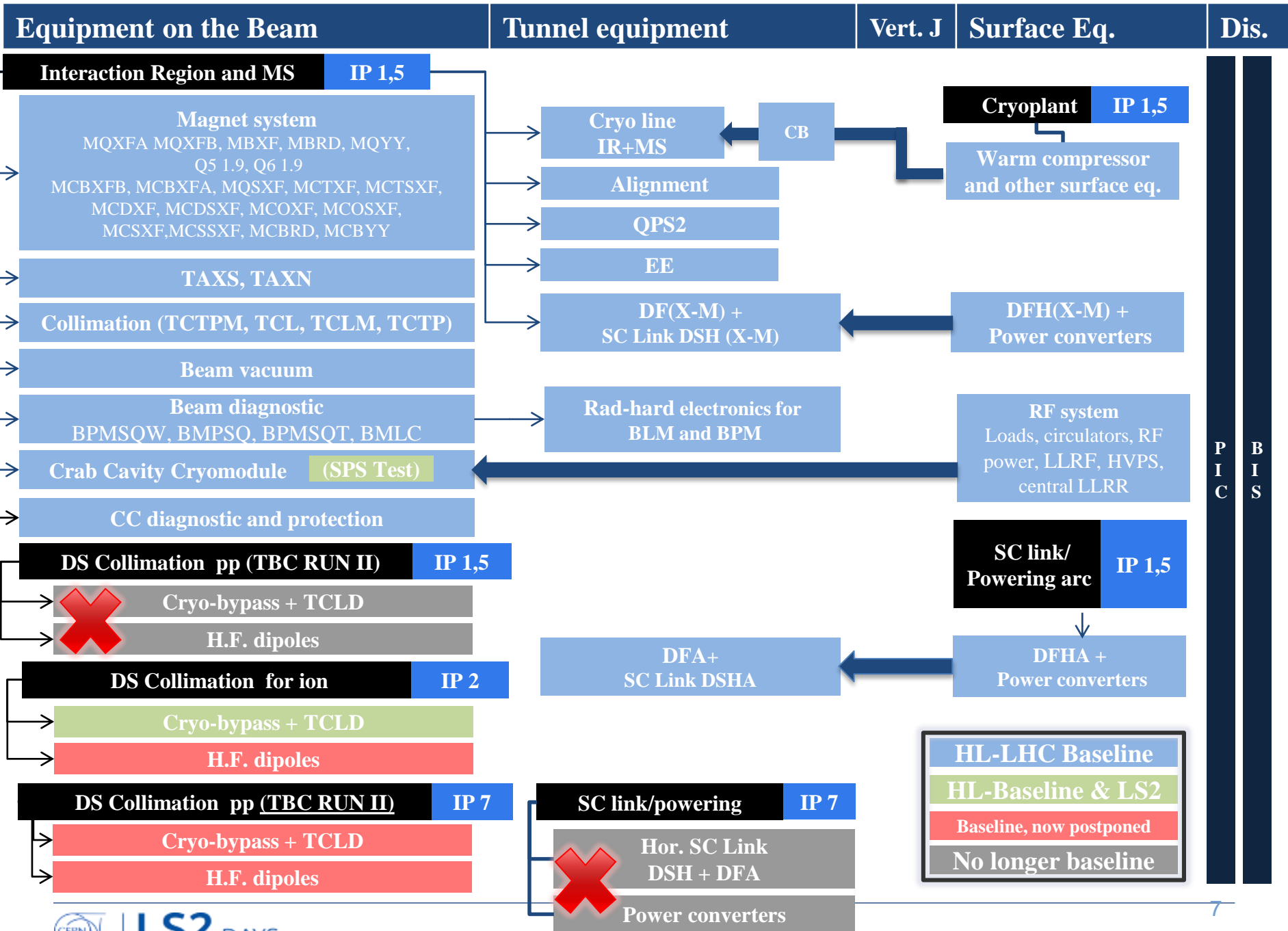
# BASELINE TODAY, SEPTEMBER 2015



**LS2** DAYS

29-30 SEPTEMBER 2015

<http://indico.cern.ch/event/436424/>



Collimation upgrade	
Secondary TCSPM	IP 3, 7
Primary TCP TCP	IP 3, 7
TCSG, TCLA, TCAP	IP 3, 7
TCSP	IP 6

Injection protection	
IP 2, 8	
TDIS	
TCLIA, TCLIB	
TCDD TCDDM	
TCLIM	
MKI prototype	

Beam diagnostic	
IP 4	
Fast wire scanners BWSF	
New light extraction line BSRT	
Beam gas vertex detector BGV	

Q5 at point 6	IP 6
Dump (TBC)	IP 6

TCDS (TBC)	
MKB, TDE (TBC)	

High rad warm magnets	IP 7
TAXN for LHCb	IP 8
Mask for D1	IP 8

Mask for D1

Cryoline for RF      CB

IP 4  
Upgrade of 18kW refrigerator  
New transportable refrigerator

Cryoplant IP 4  
Warm compressor and other surface eq.

HL-LHC Baseline
HL-Baseline & LS2
HL-Baseline but postponed
No Baseline

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# LS2 INSTALLATION OVERVIEW

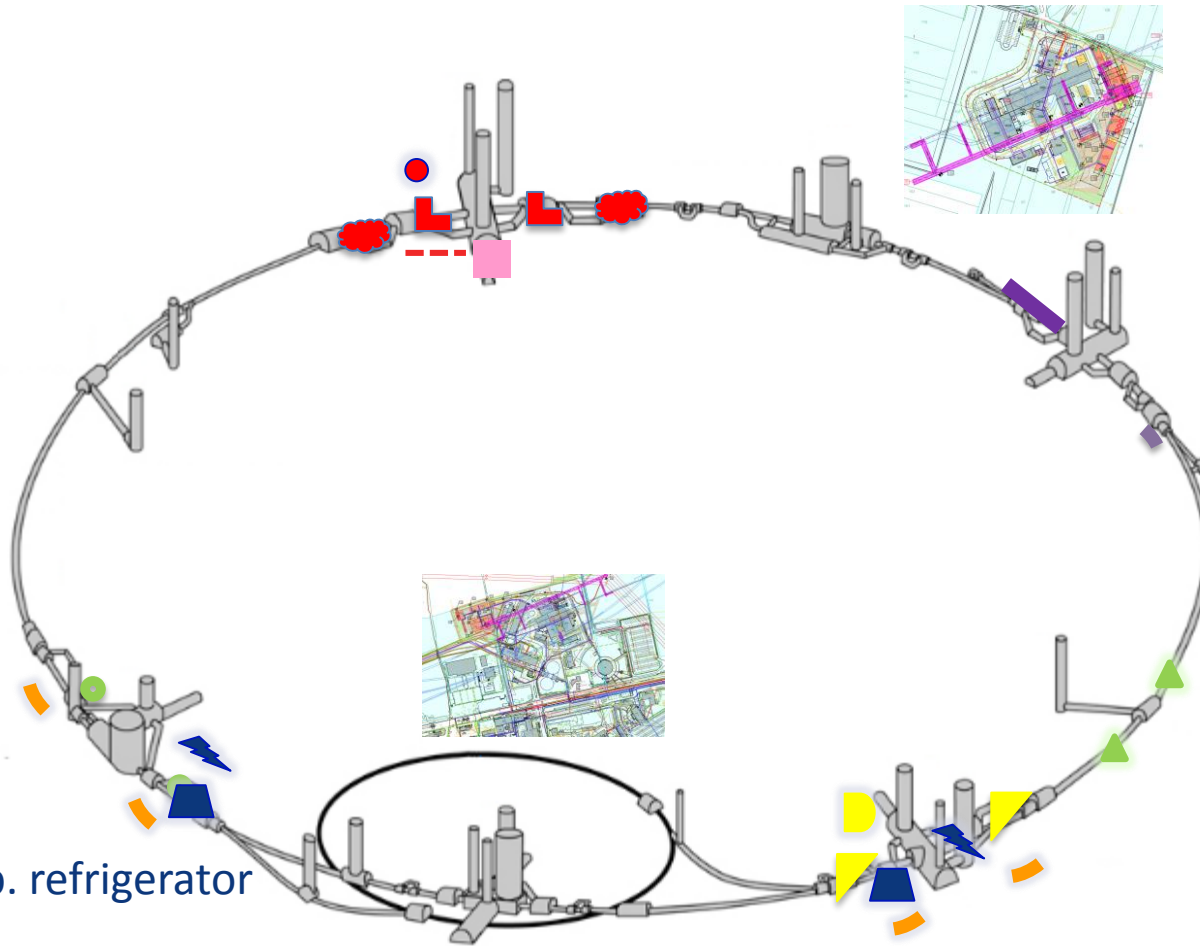


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# Installation Overview for LS2



■ New transp. refrigerator

■ New Q5

▲ TCSPM

● Cryo-bypass+TCLD

▬ In-situ a-C coating

■ Mask for D2

▴ TAXN

● High bandwidth pick-ups

└ Fast wire scanners

● BGV

Prep. works  
halo diagnostic  
systems

▴ TDIS

⚡ Mask for D1

# LS2 INSTALLATION WORKS DETAILED BY WP



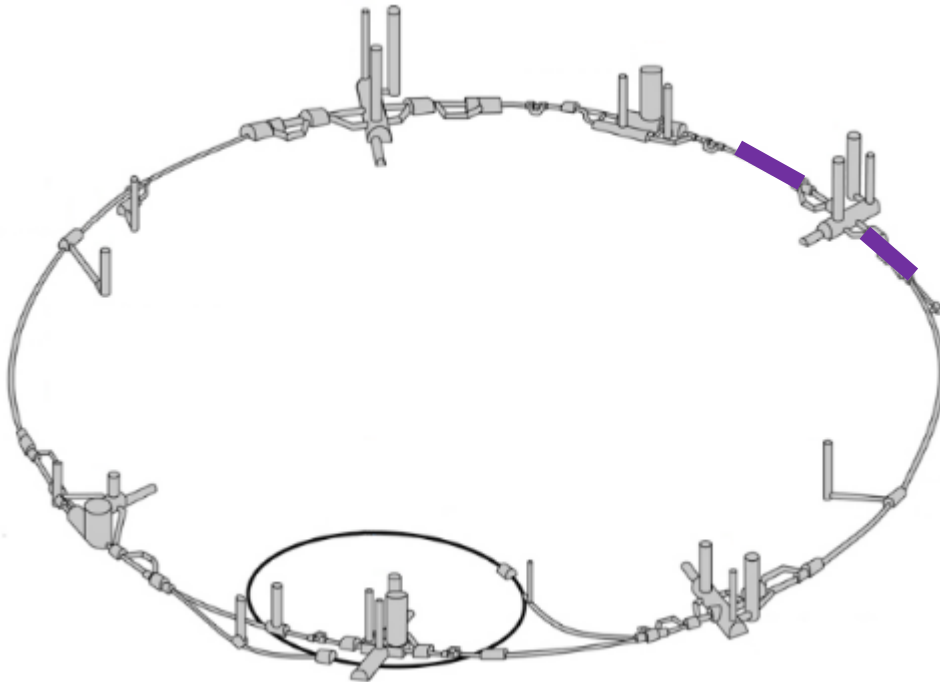
**LS2** DAYS

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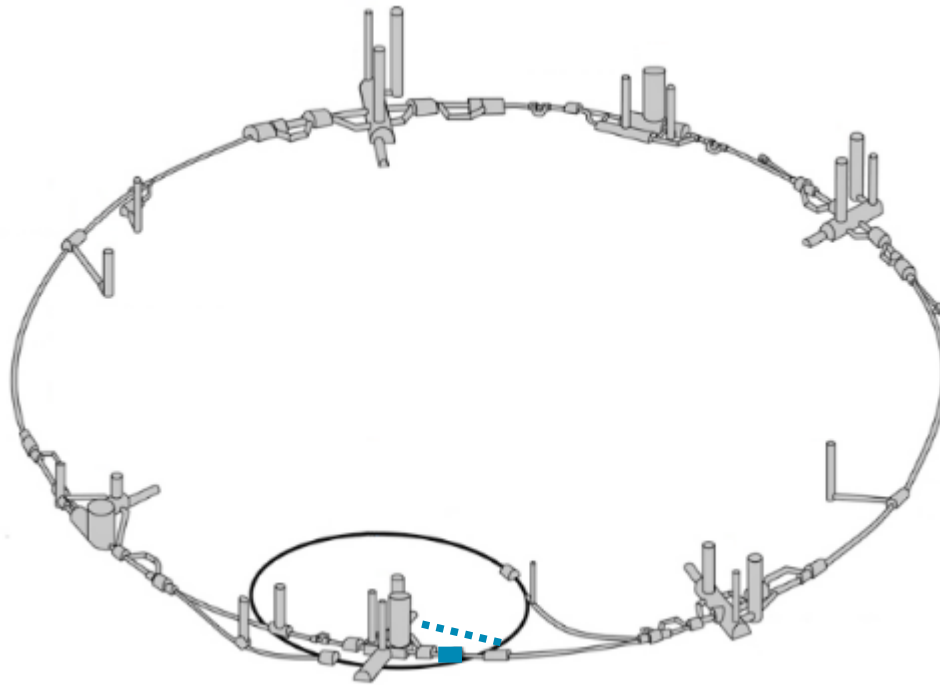
# WP3 – IR Magnets

Equipment	Quantity	Location
Q5	2 units	P6



— Q5

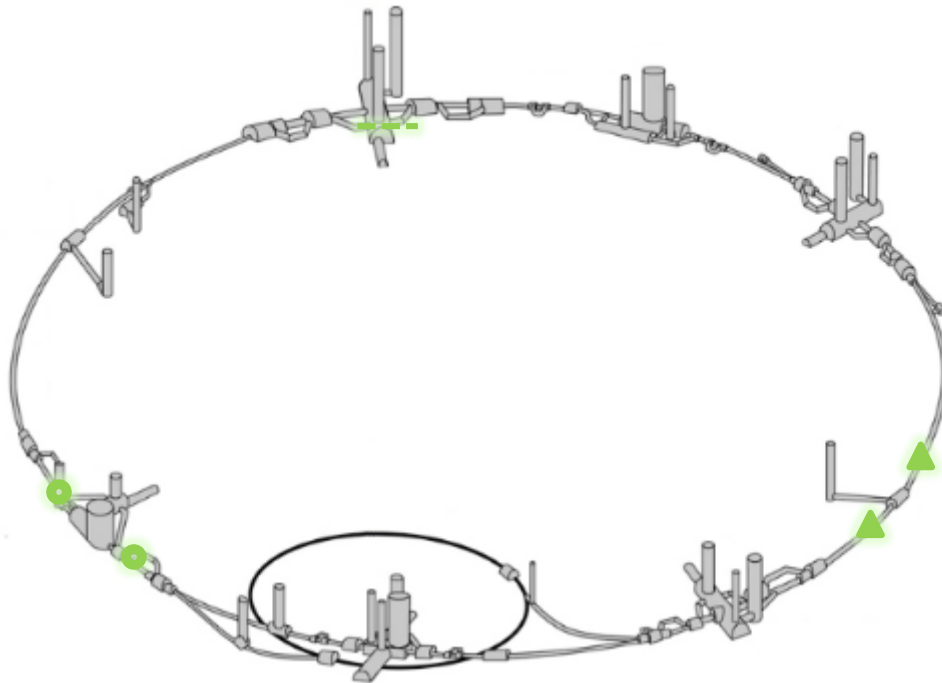
# WP4 – Crab Cavities & RF: SPS Tests



- Crab cavity cryomodule
- ..... RF system

Equipment	Quantity and period	Location
Prep. Works (RF & Cryo lines, movable table)	EYETS 2016	SPS-LSS6
Cryomodule 1	1 proto in YETS 2017	SPS-LSS6
Cryomodule 2	1 proto in LS2	SPS-LSS6
RF system Installation	YETS 2017, LS2	SPS-LSS6

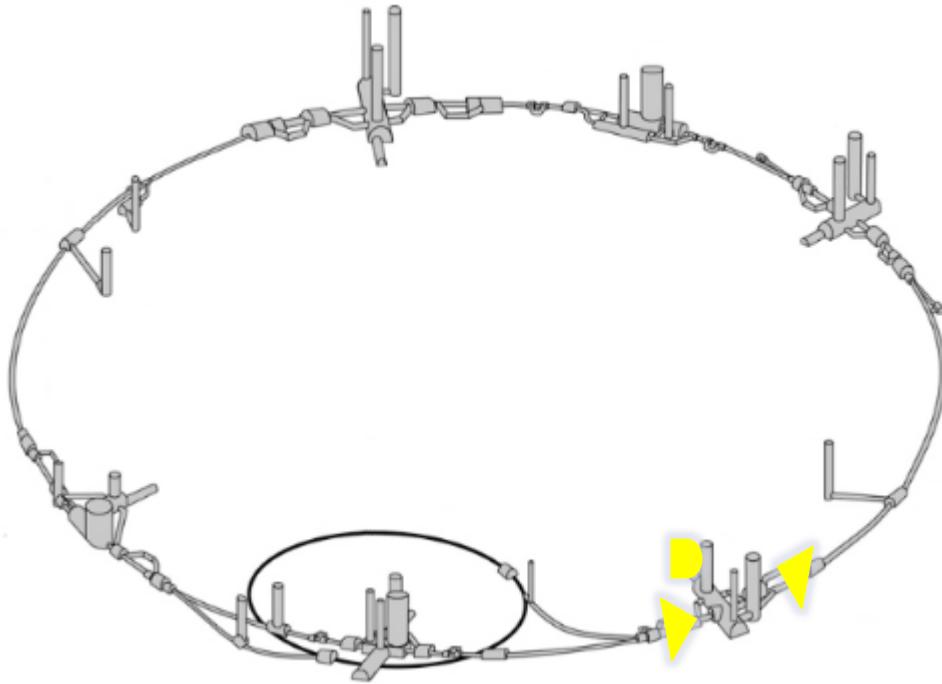
# WP5 – Collimation



- Cryo-bypass+TCLD
- ▲ TCSPM
- Hollow e-lens prep. works

Equipment	Quantity	Location
TCSPM <sup>EYETS</sup> 2016	1 prototype	P7
Wire collim.	Up to 4	P1, P5
Intervention for crystal collimation <sup>YETS</sup> 2017	-	P7
Cryo-bypass + TCLD	2 units	P2
TCSPM	8 units	P7
Hollow e-lenses	Prep. works	P4

# WP8 – Collider-Experiment Interface

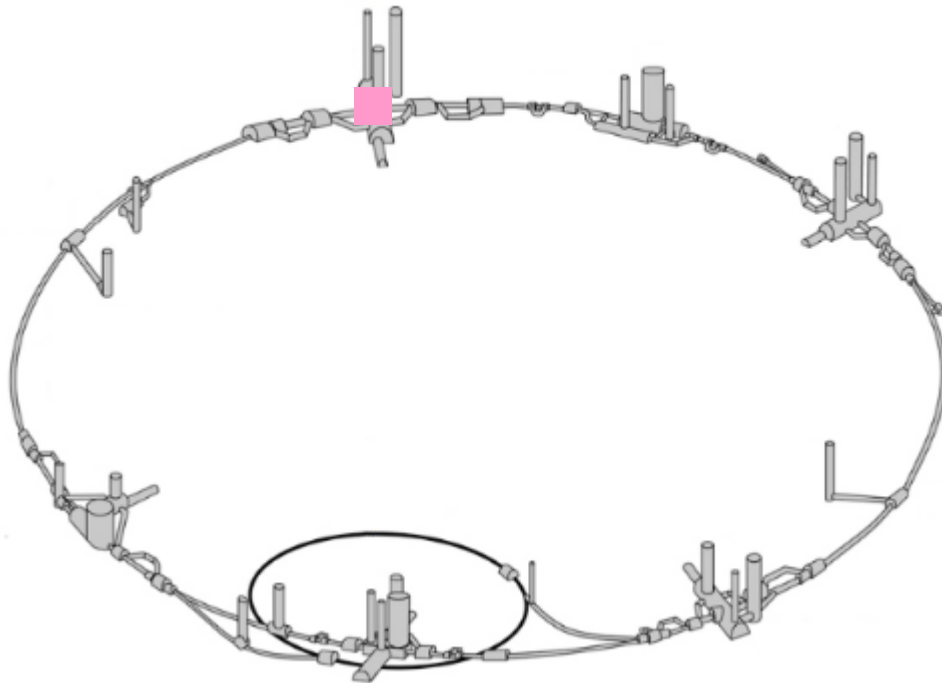


▲ TAXN

● Mask for D2

Equipment	Quantity	Location
TAXN for LHCb	2 units (1 per IP side)	P8
Mask for D2	TBC	P8

# WP9 – Cryogenics

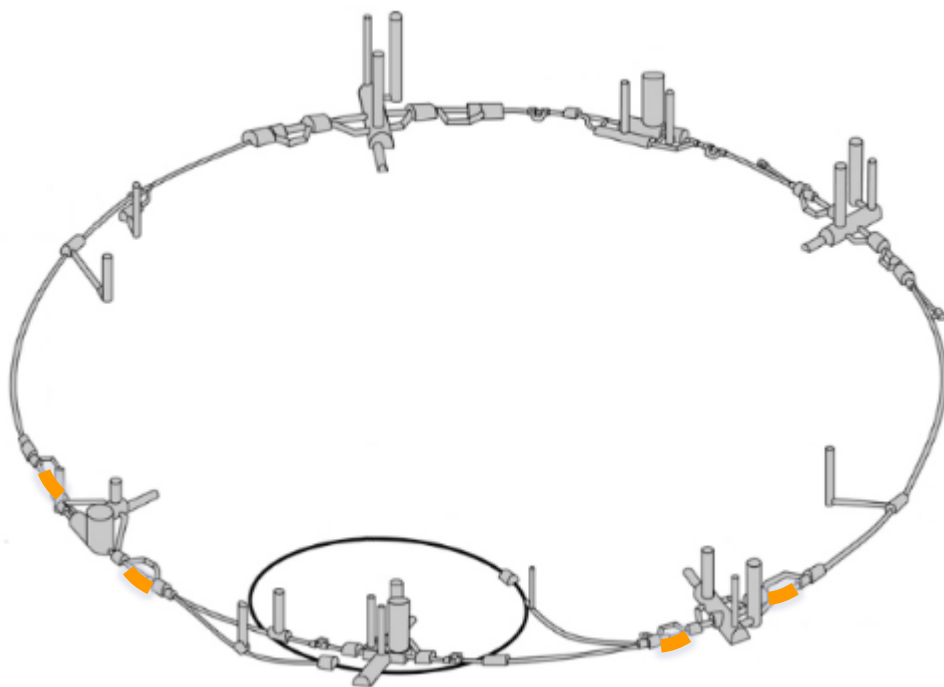


■ New transportable refrigerator

Equipment	Location
Upgrade of 18kW refrigerator	P4
New transportable refrigerator	P4



# WP 12 – Vacuum



— In-situ a-C coating

Equipment	Location
In-situ a-C coating	P2, P8
Works for other WPs <sup>1</sup>	P2, P4, P6, P7, P8

## <sup>1</sup> EQUIPMENT REQUIRING VACUUM INTERVENTION

WP3	Q5	P6
WP5	By-pass collimator + TCLD	P2
WP5	Hollow e-lens	P4
WP5	TCSPM	P7
WP8	TAXN	P8
WP8	Mask for D2	
WP13	Fast wire scanners	P4
WP13	BGV	P4
WP14	TDIS	P2,P8
WP14	Mask for D1	P2, P8

# WP 12 – Vacuum

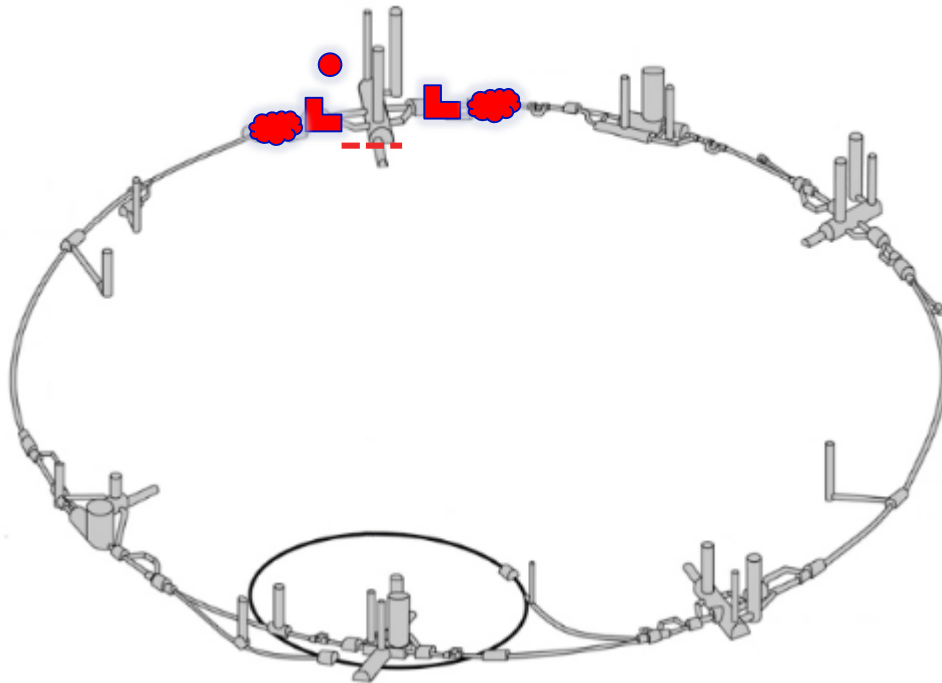
## <sup>1</sup> WPs AND EQUIPMENT REQUIRING VACUUM INTERVENTION

WP3	Upgrade of Q5 in P6	P6
WP5	By-pass collimator + TCLD and Empty Cryostat	P2
WP5	Hollow e-lens & Crystal collimation works	P4
WP5	New secondary collimator TCSPM	P7
WP8	TAXN	P8
WP8	Mask for D2	P8
WP13	Fast wire scanners	P4
WP13	Beam Gas Vertex Detector (BGV)	P4
WP14	TDIS	P2,P8
WP14	Mask for D1	P2, P8

Equipment	Location
In-situ a-C coating	P2, P8
Works for other WPs:	P2, P4, P6, P7, P8

Courtesy:  
V. Baglin

# WP 13 – Beam diagnostics



Equipment	Quantity	Location
Beam gas vertex detector	1 proto.	P4
Fast wire scanners	1 proto.	P4
High bandwidth pick-ups	1 (SPS)+ 2 proto.	P4
Prep. works for halo diagnostic systems on synchrotron light monitor	-	P4

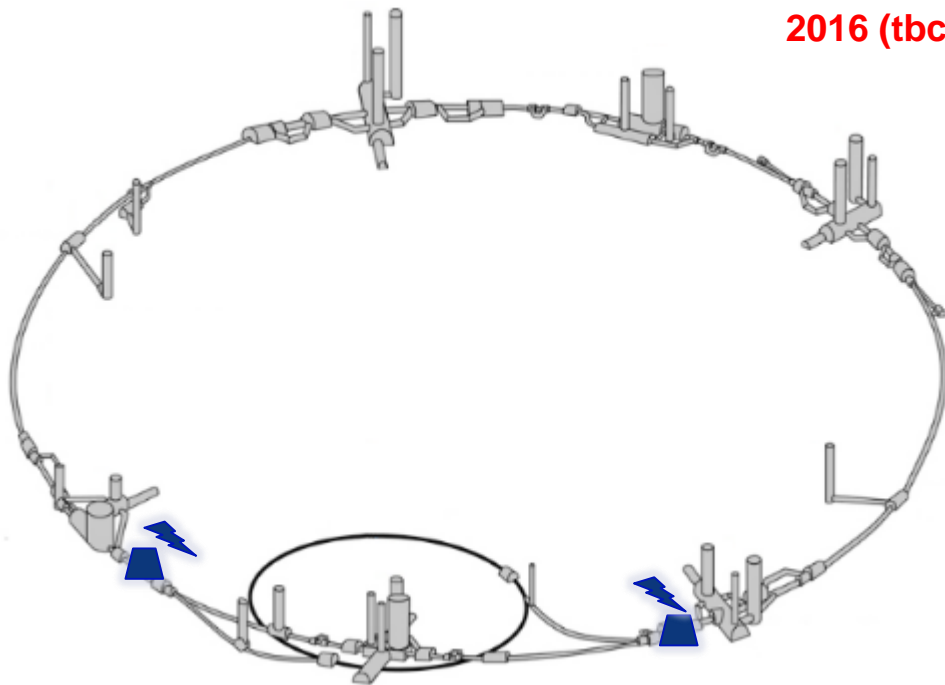
 Fast wire scanners

 BGV

 High bandwidth pick-ups

 Prep. for halo diagnostic systems on synchrotron light monitor

# WP 14 – Beam transfer & Kickers



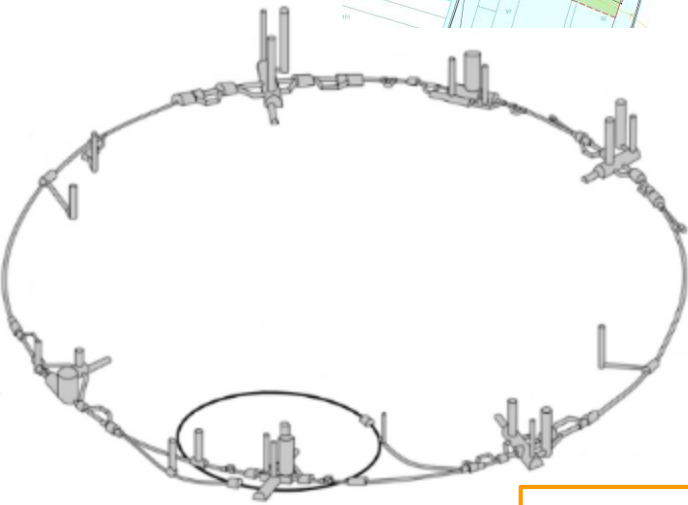
**EYETS  
2016 (tbc)**

Equipment	Quantity	Location
MKI prototype	1	TBC
Injection absorber (TDIS)	6 units	P2, P8
Mask for D1	2 units	P2,P8
Upgrade of control system:		
<ul style="list-style-type: none"> <li>- LBDS</li> <li>- MKD generator upgrade</li> <li>- MKD controls upgrade</li> </ul>		

▲ TDIS

⚡ Mask for D1

# WP 17.1 – Civil Engineering:



Post LS2



Building description	P1	P5	Location
Shaft	PM17	PM57	Pre LS2
RF gallery side 17	UA17	UA57	UNDERGROUND
Cryogenic cavern	US17	US57	
Water cooling station cavern/area	UW17	UW57	
SC cryo-link gallery	UL17	UL57	
Power converter gallery	UR15	UR55	
Personnel/safety gallery	UPR15	UPR55	
SC cryo-link gallery	UL13	UL53	
RF gallery side 13	UA13	UA53	
Helium tank platform	SHE17	SHE57	SURFACE
Ventilation building	SU17	SU57	
Electrical building	SE17	SE57	
Head shaft building	SD17	SD57	
Compressor building	SHM17	SHM57	
Extension to technical galleries	SL11/13	SL5/51	
New technical gallery	SL16/17	SL56/57	
Cooling towers	SF17	SF57	
Helium unloading towers	SDH17	SDH57	
Nitrogen tank platform	SLN17	SLN57	
Rectifier building	SR17	SR57	

# WPs with no installation works during LS2

**WP6A, WP6B:** no installation works foreseen before LS3

**WP11:** Two complete units (15 m long) will be manufactured and tested before LS2. Whether the installation will happen in LS2 or in a subsequent slot (either LS3 or an EYETS during Run3) will be decided in 2016. *Refer to Lucio's presentation.*

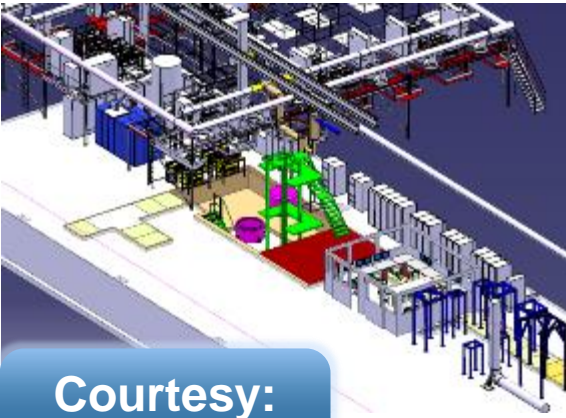
**WP7:** Energy Extaction (EE) and Quench Protection (QDS) systems linked to 11 T and triplets production. Other works (mainly consolidation) are planned for LS3.

# SM18: Timeline for the different tests for HL-LHC magnets



Planning has been kept as last year for what concerns modifications of test benches.

- The first milestone is November 2015 for the model magnet testing.
- The vertical test bench capable to test partially this models will be delivered only in May 2016 and for full test in September 2016 cluster D. (See photo on the civil engineering work that is ongoing in SM18).



Courtesy:  
M. Bajko



# WRAP UP: SUMMARY OF ALL LS2 WORKS





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Description	WP	Period	Location	Risk
Preparation works for Crab Cavity installation	4	EYETS 2016	SPS – LSS6	
Installation of TCSPM prototype	5	EYETS 2016	P7	
Installation of wire collimators	5	EYETS 2016	P1, P5	
MKI Prototype	14	EYETS 2016	TBC	
Installation of CC Cryomodule (DQW) & RF	4	EYETS 2017	SPS – LSS6	
Preparation works for crystal collimation	5	EYETS 2017	P7	
Change of Q5	3	LS2	P6	
Installation of CC Cryomodule (RFD) & RF	4	LS2	SPS – LSS6	
Installation of Cryo-bypass + TCLD	5	LS2	P2	
Installation of TCSPM series	5	LS2	P7	
Preparation works for hollow e-lens	5	LS2	P4	
Installation of TAXN for LHCb	8	LS2	P8	
Installation of Mask for D2	8	LS2	P8	
Upgrade of 18 kW refrigerator	9	LS2	P4	
New transportable refrigerator	9	LS2	P4	
In-situ a-C coating	12	LS2	P2, P8	
Fast wire scanners	13	LS2	P4	
Beam gas vertex detector	13	LS2	P4	
High bandwidth pick-ups	13	LS2	P4	
Prep. Works Halo diagnostic systems on synchrotron light monitors	13	LS2	P4	
TDIS Installation	14	LS2	P2, P8	
Mask for D1	14	LS2	P2, P8	
Upgrade of control system	14	LS2	-	

THANK YOU ALL FOR YOUR  
ATTENTION!



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...and big thank you to all WP  
leaders and engineers for their  
contribution!

# EXTRA SLIDES

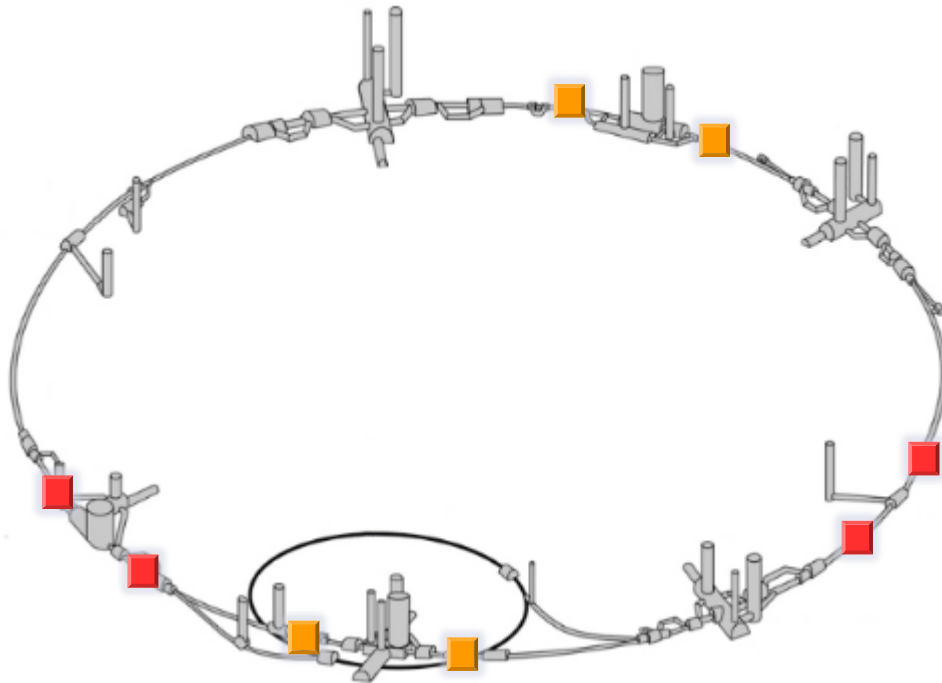


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# WP11 – Current baseline and options for installation:



Location	Installation	Quantity
P2	LS3	2 unit *
P7	LS3	2 or 4 units (tbc)
P1, P5 (Option)	LS4	Max. 8 units

\* 1 unit = 2 MBH + 1 BPC

- LS3 Installation (P2, P7)
- OPTION: LS4 Installation (P1, P5)

# WP Interfaces

	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6A	WP 6B	WP 7	WP 8	WP 9	WP 10	WP 11	WP 12	WP 13	WP 14	WP 15	WP 16	WP 17
WP1		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP2	✓		✓	✓	✓	✓		✓	✓	✓	-	✓	✓	✓	✓	-	-	-
WP3	✓	✓		-	✓	✓		✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓
WP4	✓	✓	-		✓	-		✓	-	✓	-	-	✓	✓	-	✓	?	✓
WP5	✓	✓	✓	✓		?		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP6A	✓	✓	✓	-	?			✓	-	✓	✓	✓	✓	-	-	✓	✓	✓
WP6B																		
WP7	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP8	✓	✓	-	-	✓	-		✓		-	✓	-	✓	✓	✓	✓	-	✓
WP9	✓	✓	✓	✓	✓	✓		✓	-		?	✓	✓	✓	-	✓	✓	✓
WP10	✓	-	✓	-	✓	✓		✓	✓	?		✓	✓	✓	✓	-	-	-
WP11	✓	✓	-	-	✓	✓		✓	-	✓	✓		✓	✓	-	✓	✓	✓
WP12	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	-	-
WP13	✓	✓	✓	✓	✓	-		✓	✓	✓	✓	✓	✓		✓	✓	-	✓
WP14	✓	✓	✓	-	✓	-		✓	✓	-	✓	-	✓	✓		✓	✓	✓
WP15	✓	-	✓	✓	✓	✓		✓	✓	✓	-	✓	✓	✓	✓		-	-
WP16	✓	-	✓	?	✓	✓		✓	-	✓	-	✓	-	-	✓	-		-
WP17	✓	-	✓	✓	✓	✓		✓	✓		-	✓	-	✓	✓	-	-	

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WP1	Management
WP2	Accelerator physics
WP3	Magnets
WP4	Crab cavities
WP5	Collimation
WP6	Cold powering
WP7	Machine protection
WP8	Collider Experiment Interface
WP9	Cryogenics
	Energy Deposition &
WP10	Absorber Coordination
WP11	11-T Dipole Magnets
WP12	Vacuum
	Beam Diagnostics &
WP13	Instrumentation
WP14	Beam Transfer and Kickers
WP15	Integration & (De)-Installation
WP16	Hardware commissioning
	Infrastructure, Logistics and
WP17	Civil Engineering

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Courtesy:  
C. Parente

# WP17 Interface Matrix

	WP 17.1	WP 17.2	WP 17.3	WP 17.4&5	WP 17.6	WP 17.7	WP 17.8	WP 17.9	WP 17.10
WP1	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP2	-	-	-	-	-	-	-	-	-
WP3	-	✓	-	-	✓	✓	✓	✓	✓
WP4	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP5	-	✓	✓	✓	✓	✓	✓	✓	✓
WP6A	✓	✓	-	✓	✓	✓	✓	✓	✓
WP6B	✓	✓	✓	?	-	✓	?	✓	✓
WP7		✓	?	✓	?	-	✓	✓	✓
WP8	-	✓	✓	✓	✓	✓	?	✓	✓
WP9	✓	✓	✓	✓	-	?	✓	✓	✓
WP10	-	-	-	-	-	-	-	-	✓
WP11	-	✓	-	-	✓	✓	✓	✓	✓
WP12	-	✓	✓	✓	✓	✓	?	✓	✓
WP13	✓	✓	-	-	✓	-	?	✓	✓
WP14	-	✓	✓	✓	✓	✓	?	✓	✓
WP15	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP16	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP17.1	P	✓	✓	?	?	✓	?	✓	✓
WP17.2	✓	P	✓	✓	?	?	?	✓	✓
WP17.3	✓	✓	P	-	-	?	?	✓	✓
WP17.4&5	?	✓	✓	P	-	?	?	✓	✓
WP17.6	?	?	-	-	P	?	?	✓	✓
WP17.7	✓	?	?	?	?	P	?	✓	✓
WP17.8	?	?	?	?	?	?	P	✓	✓
WP17.9	✓	-	✓	✓	✓	✓	✓	P	✓
WP17.10	✓	✓	✓	✓	✓	✓	✓	✓	P

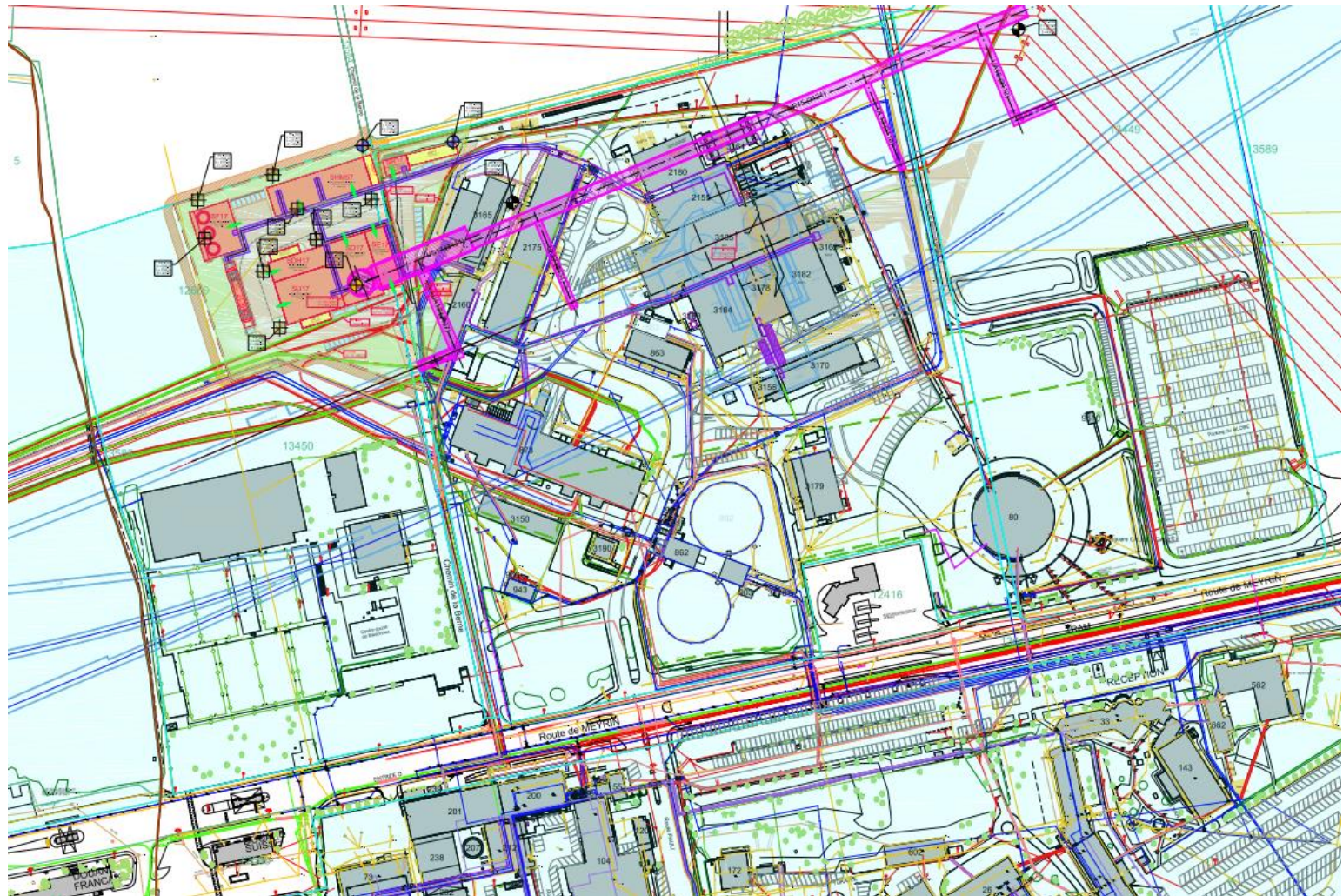
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WP17.1	Civil Engineering
WP17.2	Electrical Distribution Cooling and
WP17.3	Ventilation
WP17.4	Acces & Alarms
WP17.5	Technical Monitoring
WP17.6	Survey & Alignment
WP17.7	Transport Upgrade of Test
WP17.8	Facilities for HL-LHC
WP17.9	Logistics & Storage
WP17.10	Safety

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Source: HL-LHC  
Conceptual Specs.

# P1 Layout



# P5 Layout

