Integration in SPS

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Generalities and Background

Scope

(Executive summary, LHC-CC1 5th Crab cavity Workshop, 2011):

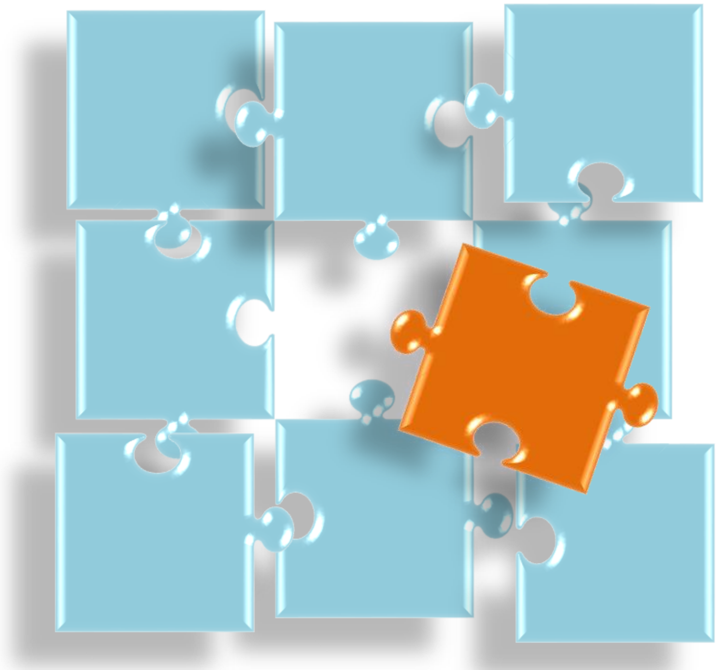
1) Assess the validity of the crabbing mechani... protons;
2) Prove that crab-cavities can be ... to the beam;
3) Gain knowledge on ... ...ure modes.

No installation in LHC without validation test in SPS

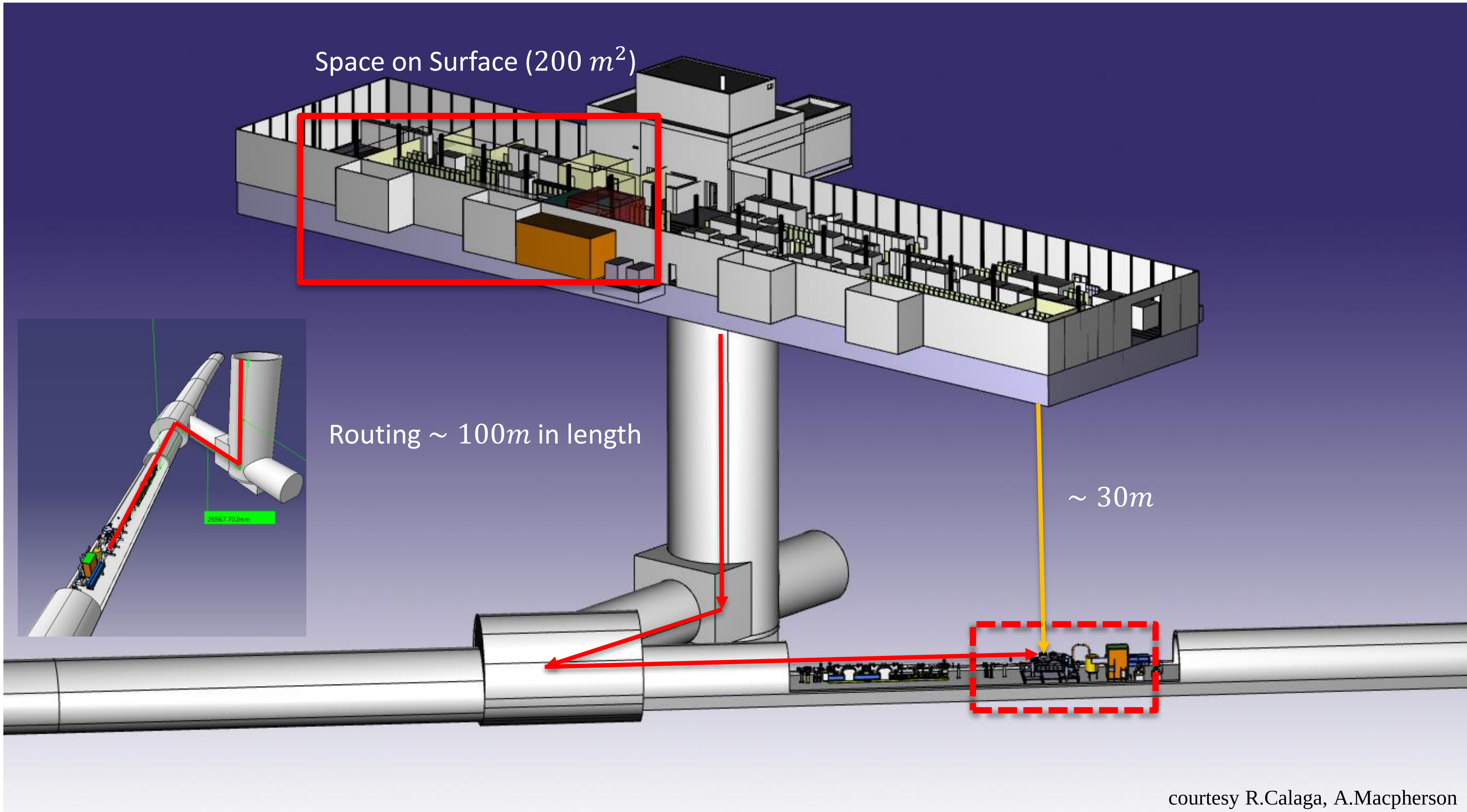
History

2011 → LSS4 proposed, since cryogenics is available here - Coldex facility
Mobile cold-box permits tests in SM18 during shutdown and P4 LHC during cryo shutdown
Jun 2015 → Decision to go in LSS6, with mobile cold-box

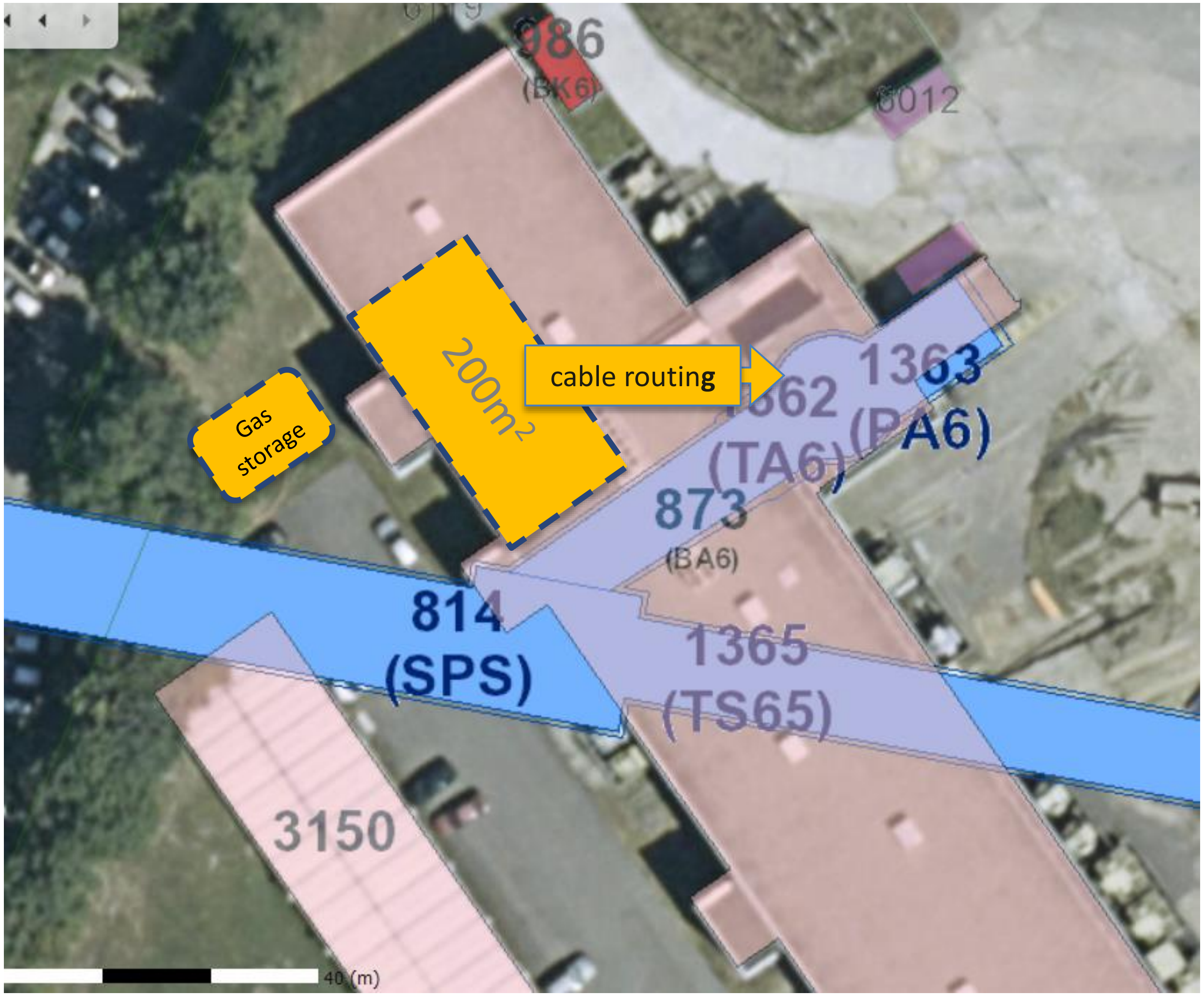
Integration



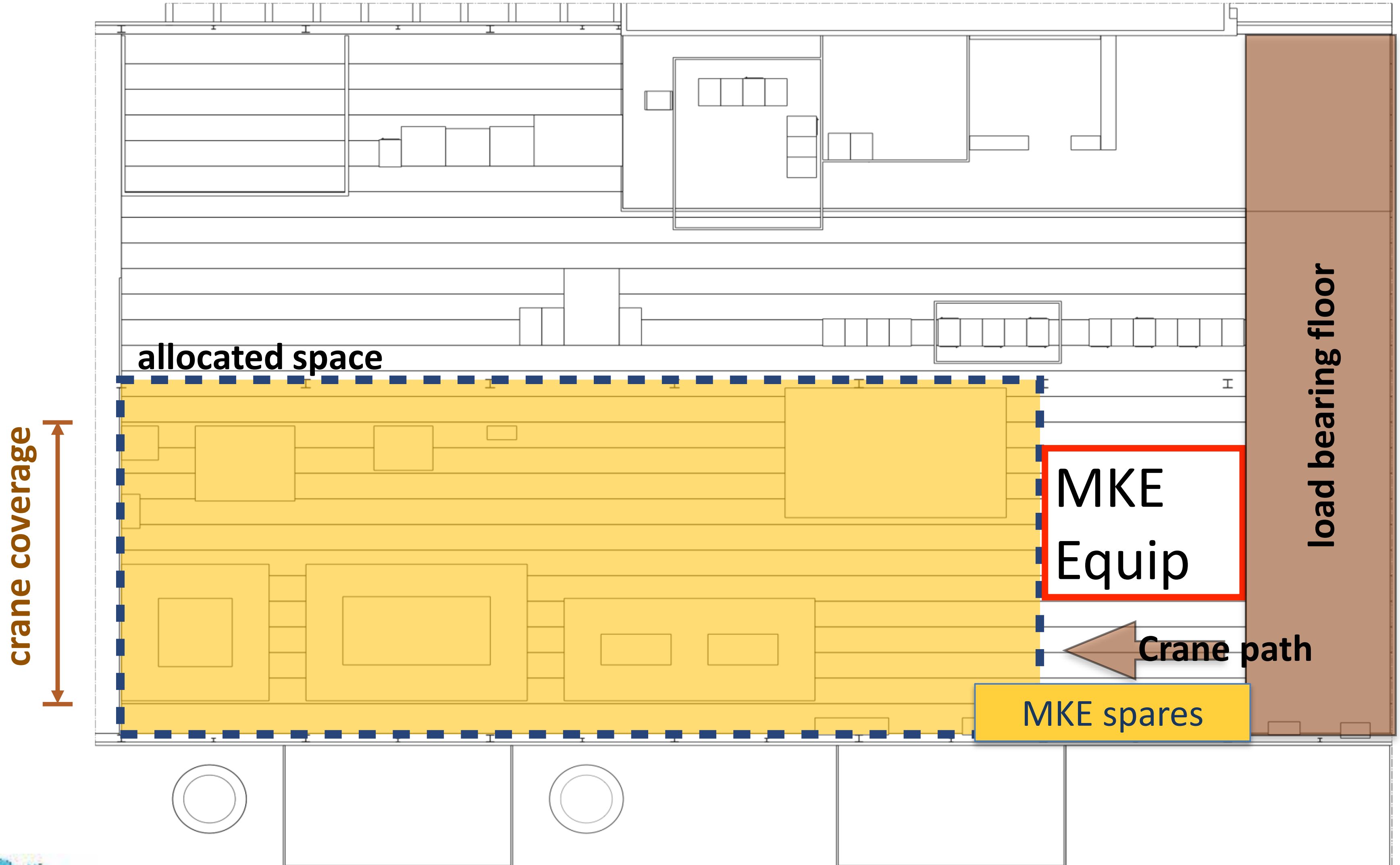
General layout – SPS Point 6



Integration – surface areas, BA6



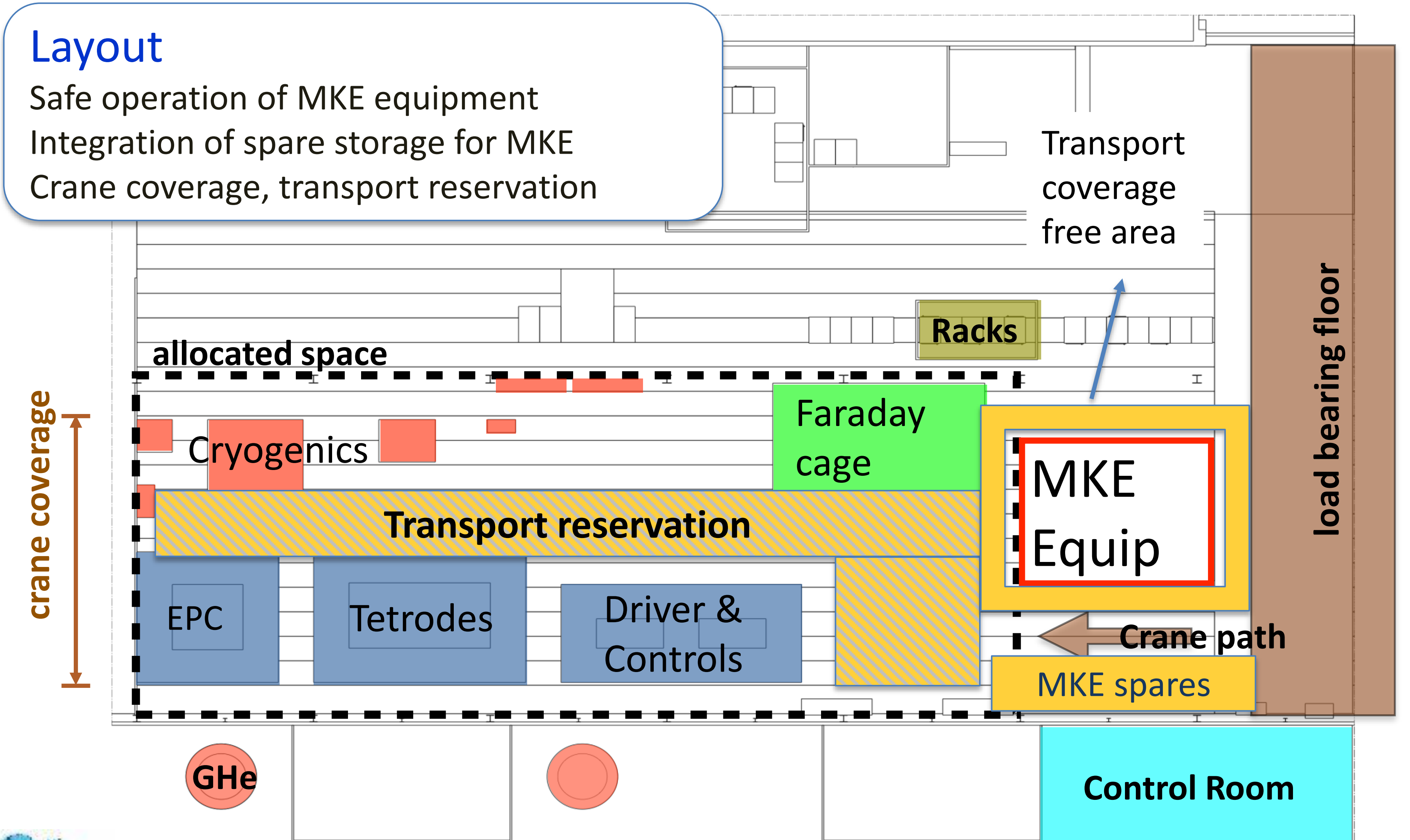
Surface area, equipment zone



Surface area, integration study

Layout

Safe operation of MKE equipment
Integration of spare storage for MKE
Crane coverage, transport reservation



Surface area - status

Storage area TE-ABT, to free

✓ Alternative temporary storage zone found (thanks BE/TE space managers, TE/ABT & TE/MPE)

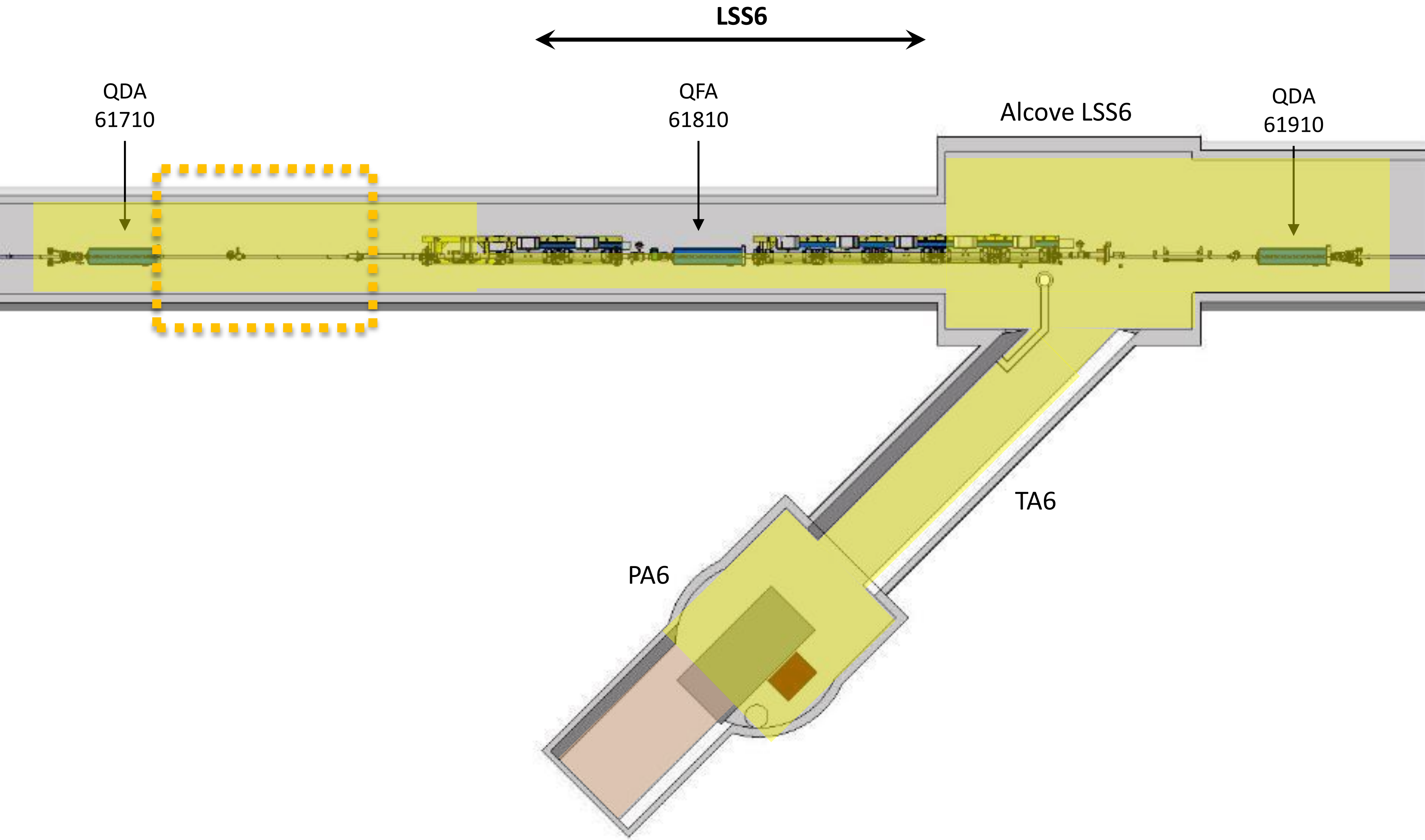
Open issues

- Floor load bearing
- Free space under the false floor for cables and service routing

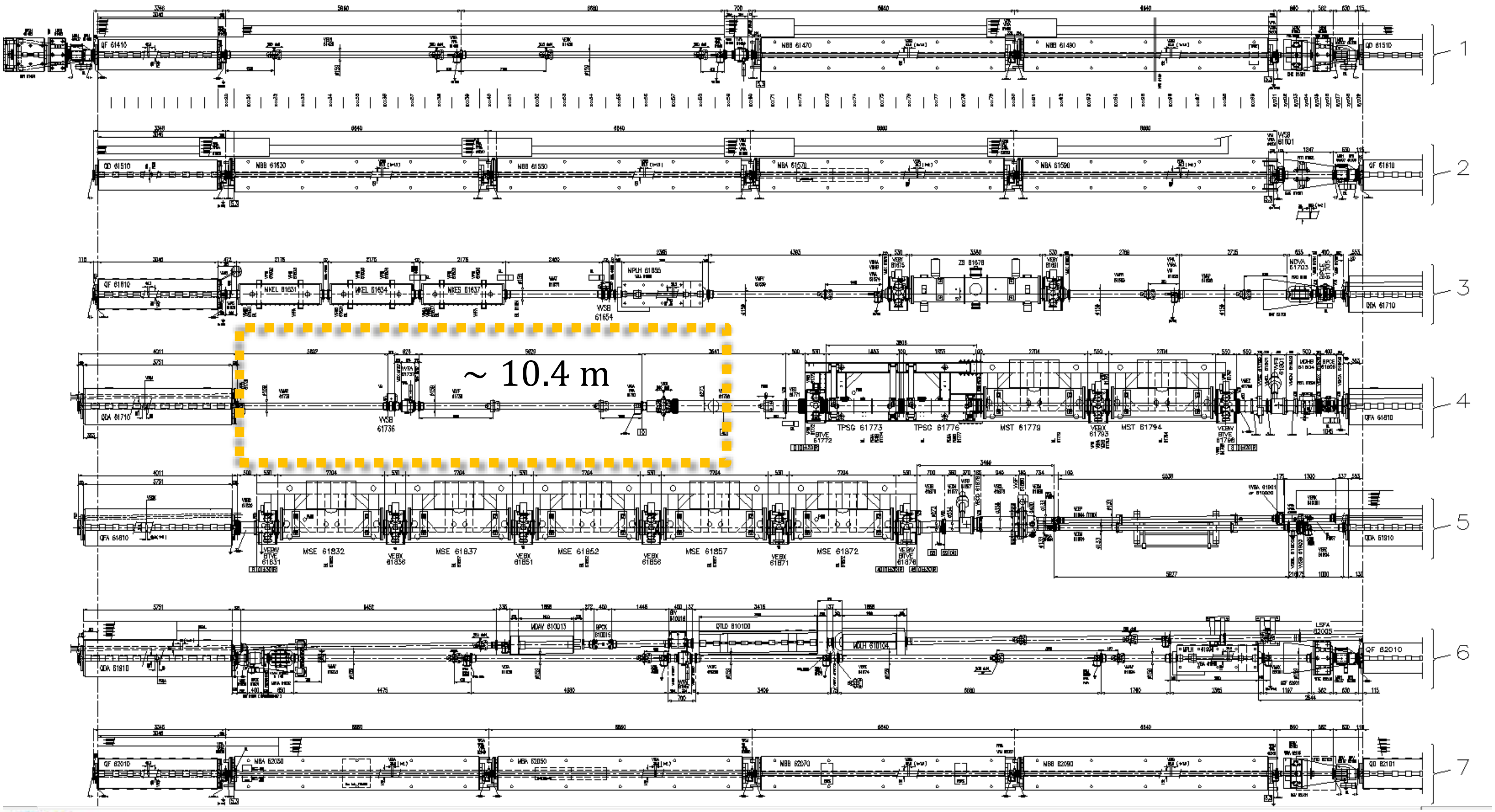
MKE Equip

Load free and suspended charge free area

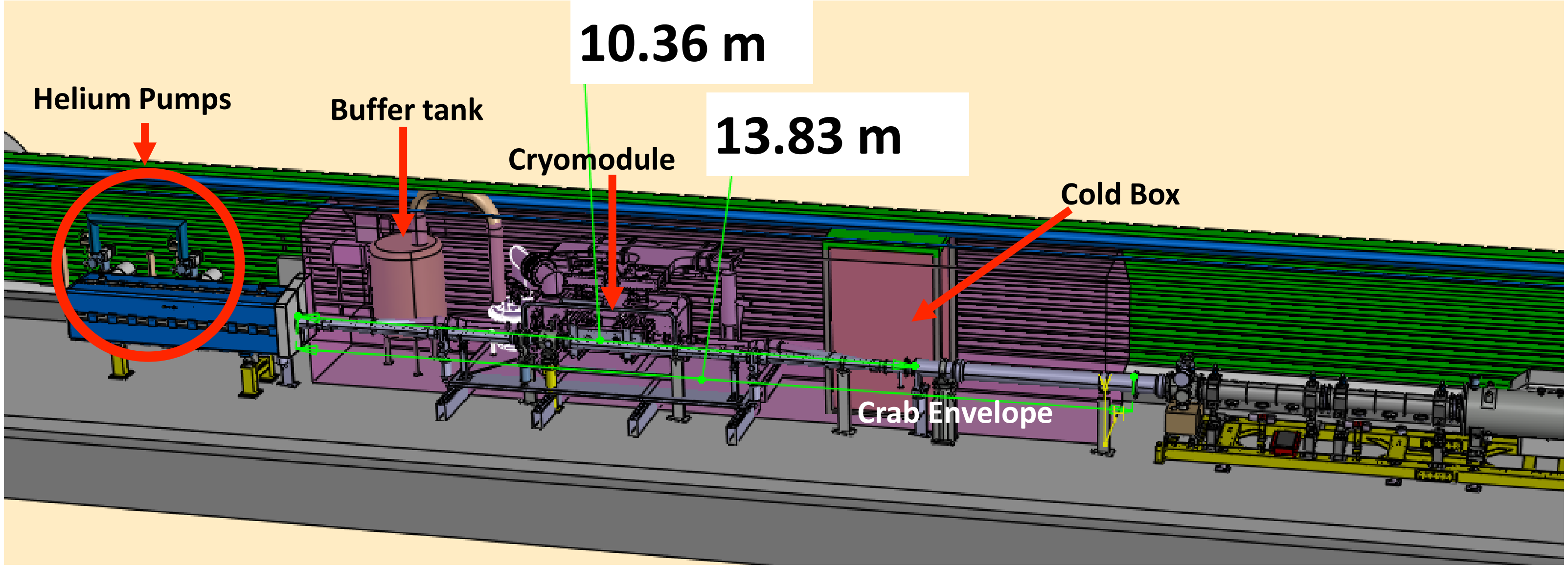
Integration - tunnel



Integration – LSS6 layout



LSS6 Crab cavity envelope - longitudinal

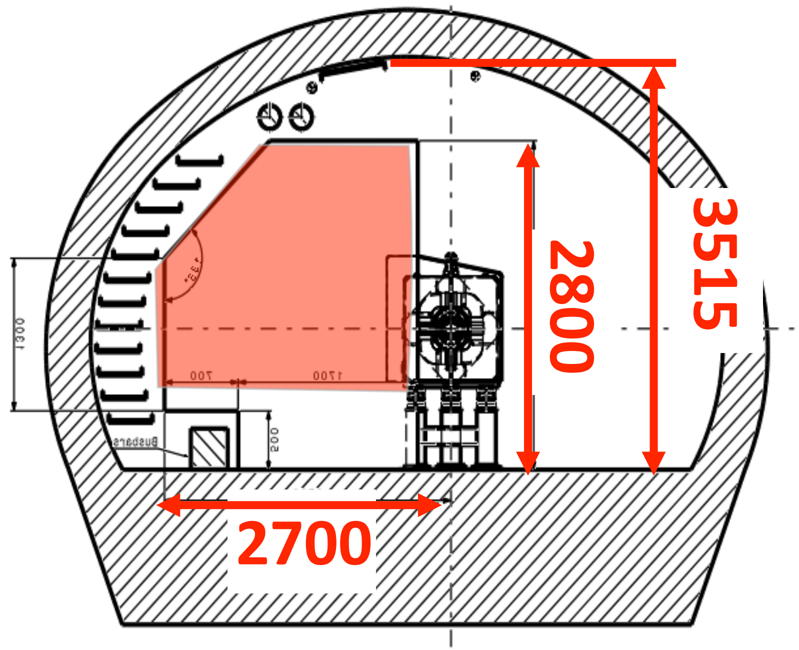


- Between QDA 61710 and TPSG 61773 (graphite mask, for septa protection)
- Length of beam line envelope = 10.4m to 13.8m
- Location of cryo components in the tunnel still to be defined
  - Cold-box is a standard, "off-the-shelf" item
  - It must remain movable within ~1 week

courtesy A.Macpherson

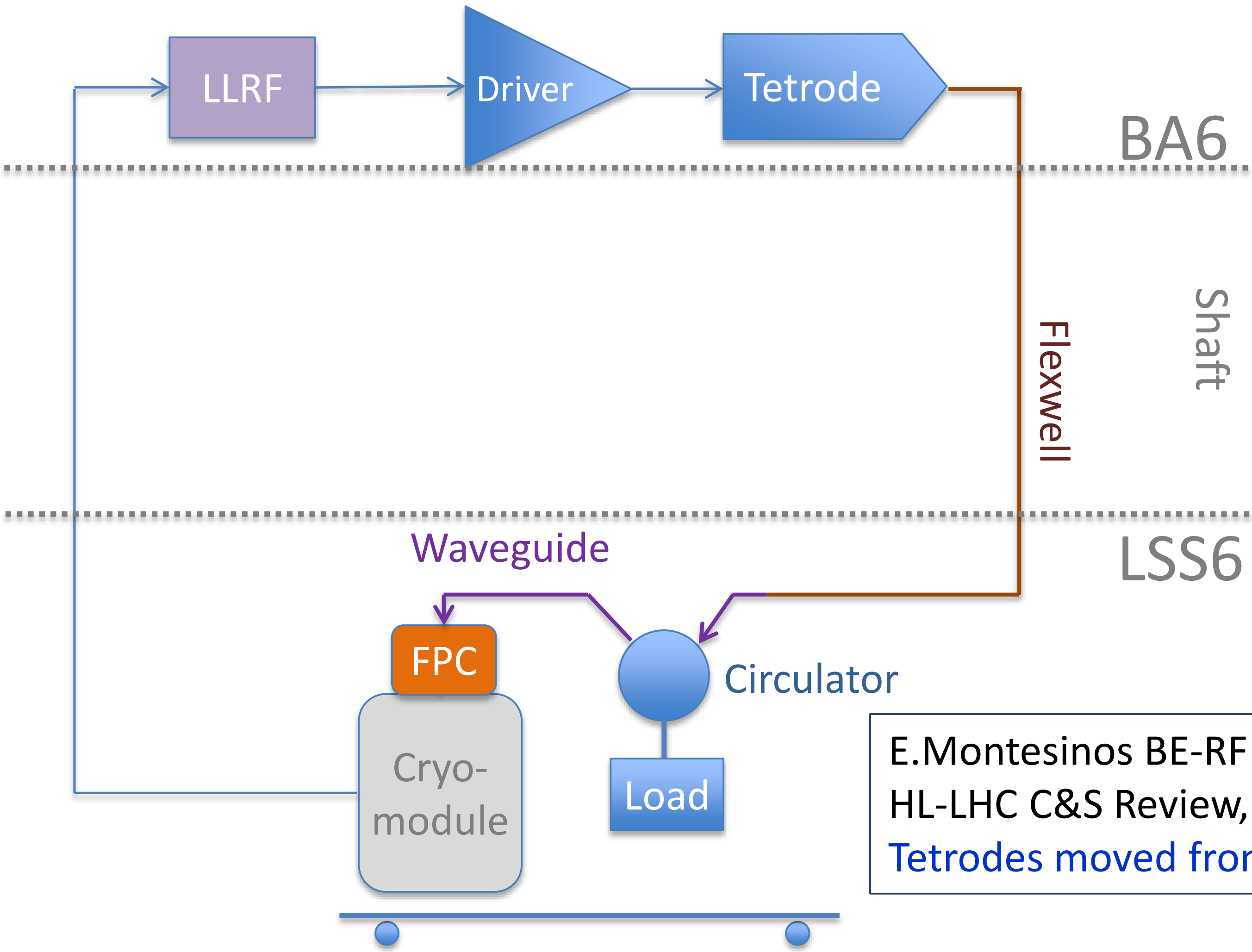
LSS6 Crab cavity envelope - lateral

- More space for CM in LSS6 than in LSS4
- Free space behind beam line



RF power system - architecture

X 2

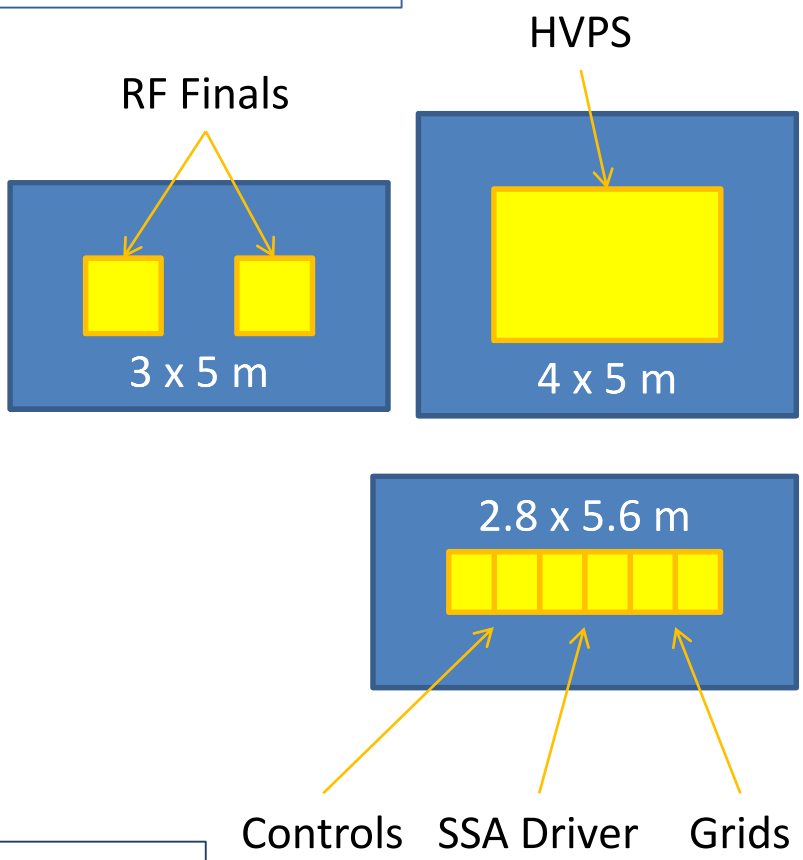


E.Montesinos BE-RF
HL-LHC C&S Review, March 2015
Tetrodes moved from tunnel to surface

SPS tests, RF space request

Need to be restated now, for LSS6?

- Surface
  - 10 racks equivalent Ua
  - (8 racks equivalent RF amplifiers)
  - 2 racks Grids
  - 2 racks SSPA Drivers
  - 2 racks Controls & Monitoring
  - 2 amplifiers
- Tunnel
  - (Space on moveable platform)
  - (~~2 amplifiers +~~ 2 circulators + 2 loads)
  - Water pump
  - Blowers
  - HV filtering box



E.Montesinos BE-RF
HL-LHC C&S Review, March 2015

Integration – tunnel, Cryogenics

Considerable work progress for Cryo in LSS4:
- Installation helium pumps → Displace to BA6 (YETS15-16)
- Installation services (electricity, Ethernet, controls, water)
  → displace or redo LSS6

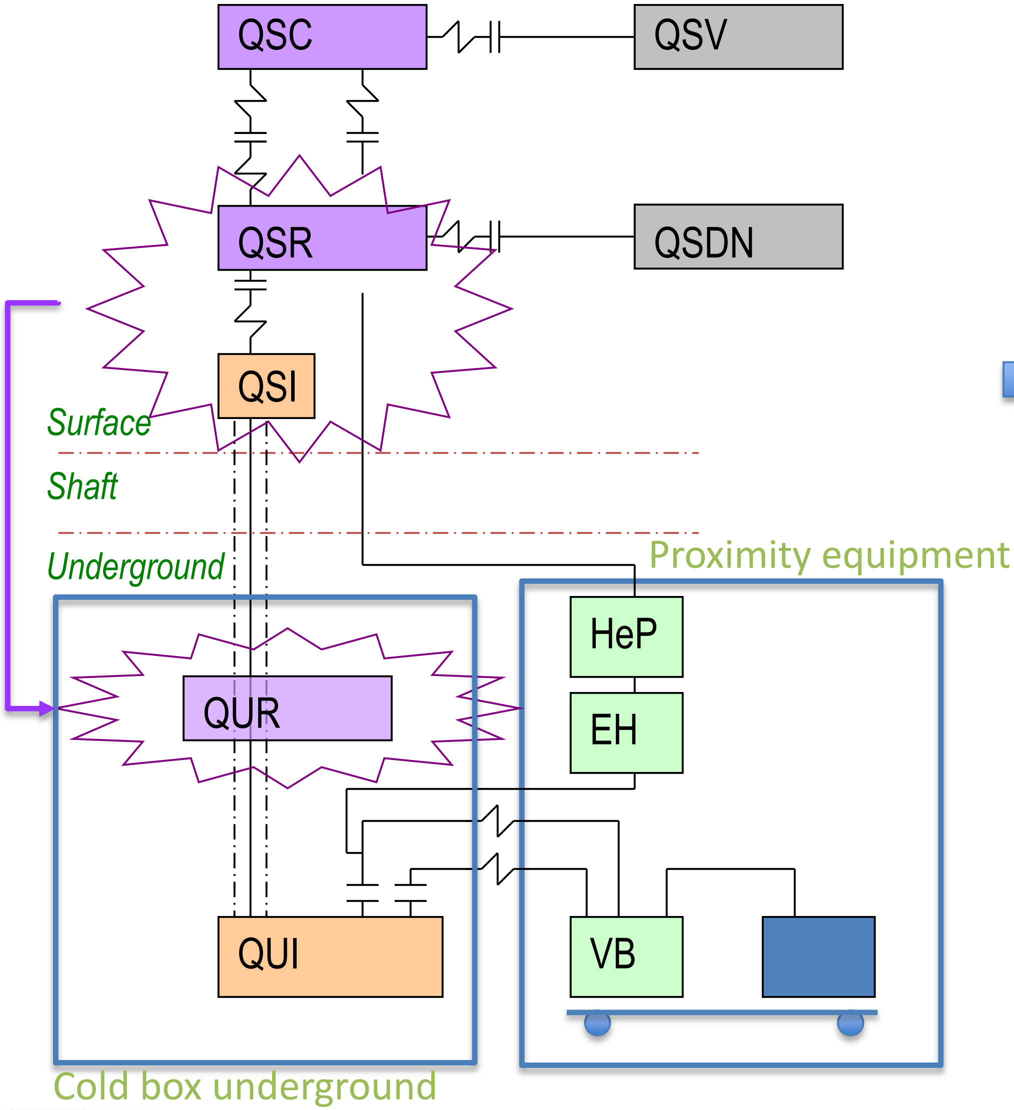
Integration specification: 5th Joint HiLumi LHC-LARP Meeting 2015 [Delprat]
Includes footprint, charge, utilities, space reservations, general architecture

Integration options for cold-box presented today.

Envelope of cold box
L(2.6m) × W(2m) × H(2.6m)

Planning for cryogenics: in work by WP9 → Milestones to integrate in SPS installation planning

Cryogenics layout – cold box in tunnel



Cold box in tunnel: preferred because of horiz transfer lines

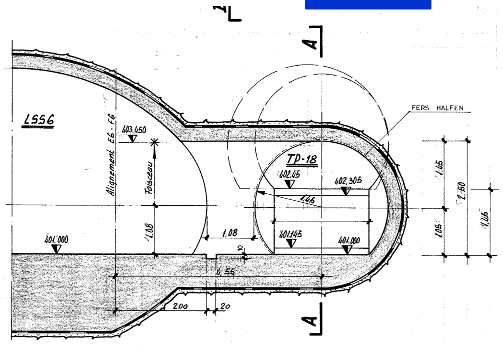
Yet unsolved integration issue: Location of the cold box and installation path

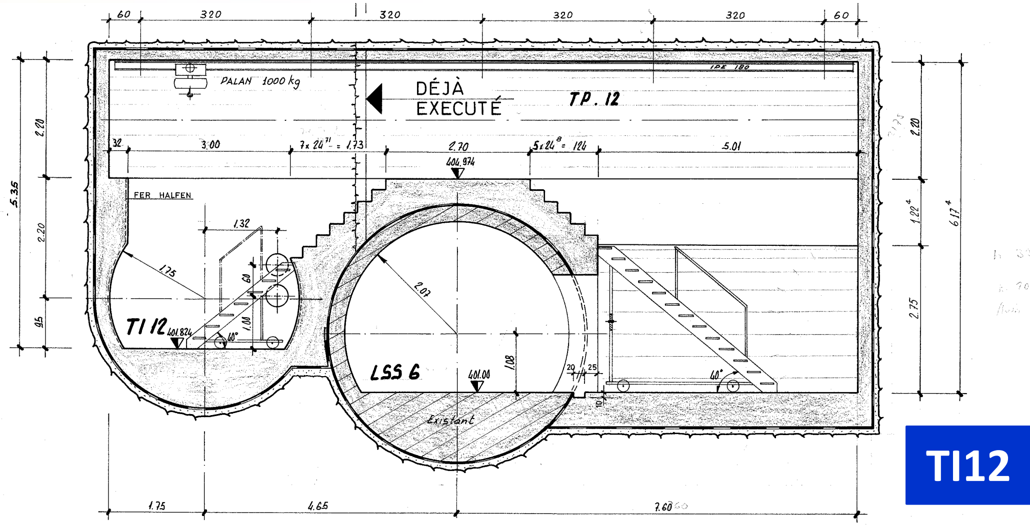
QUR	Cold box
QUI	Phase separator (Dewar)
HeP	2K Helium pumps
EH	Electrical heater
VB	Valve box (service module)

courtesy L.Delprat

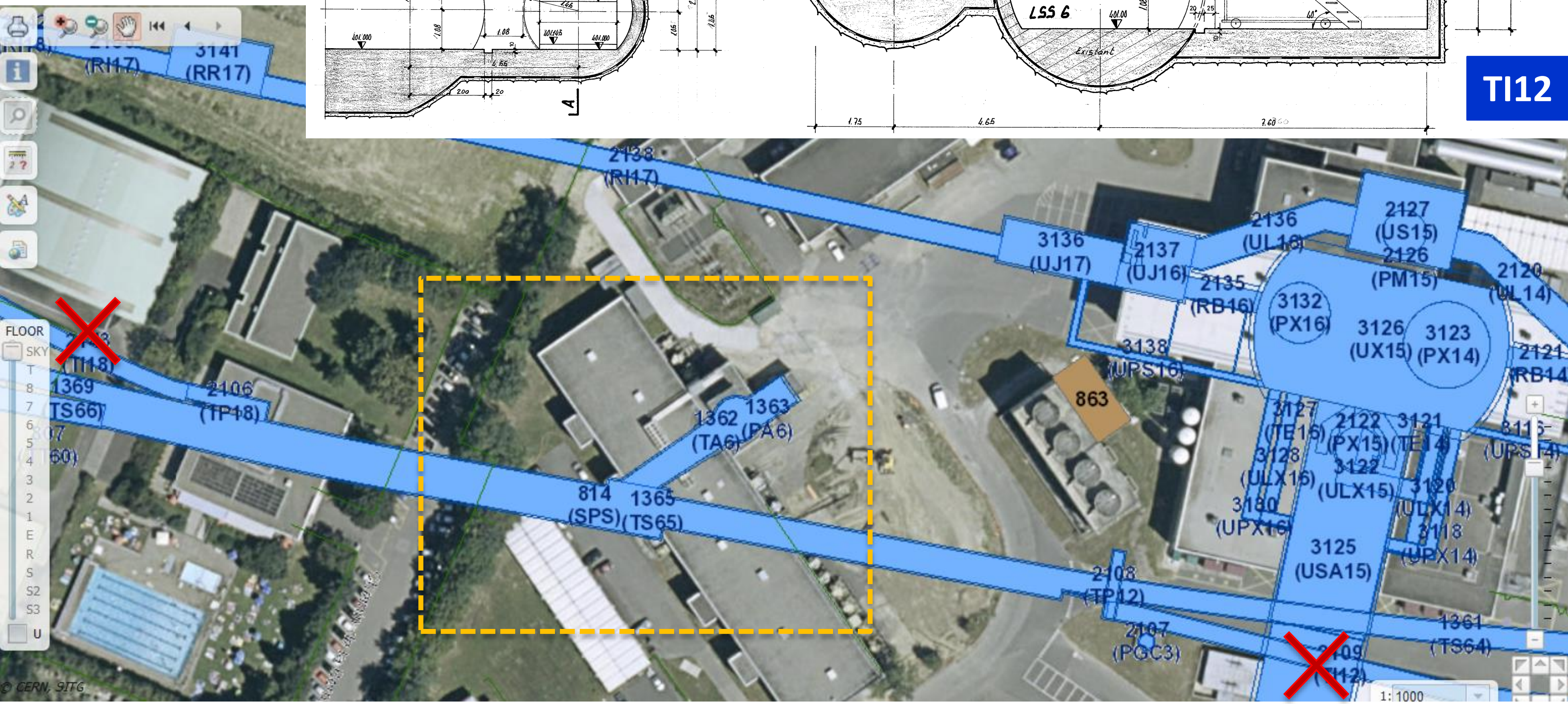
Tunnel areas

TI18

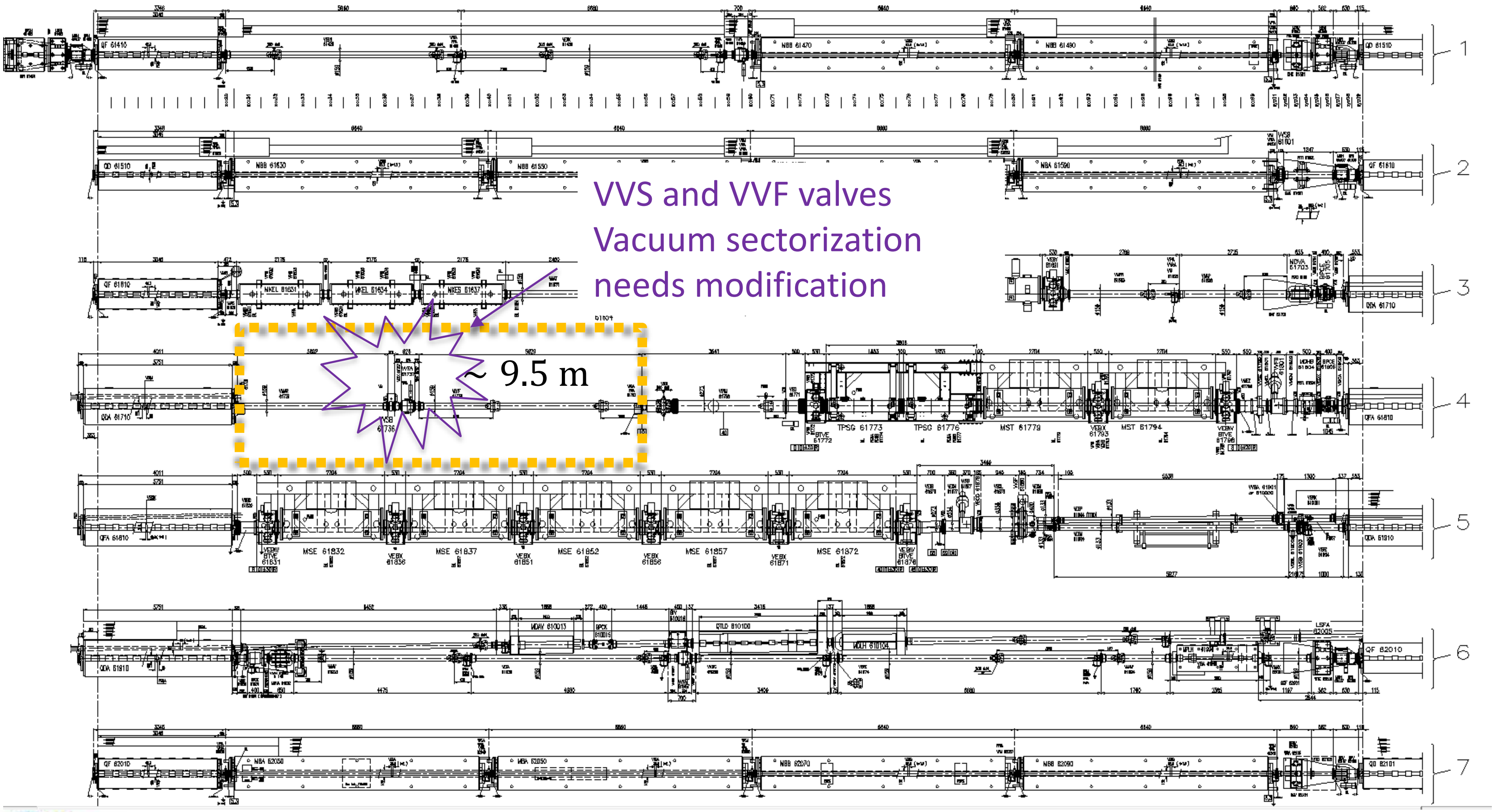




TI12



Integration – LSS6 vacuum layout



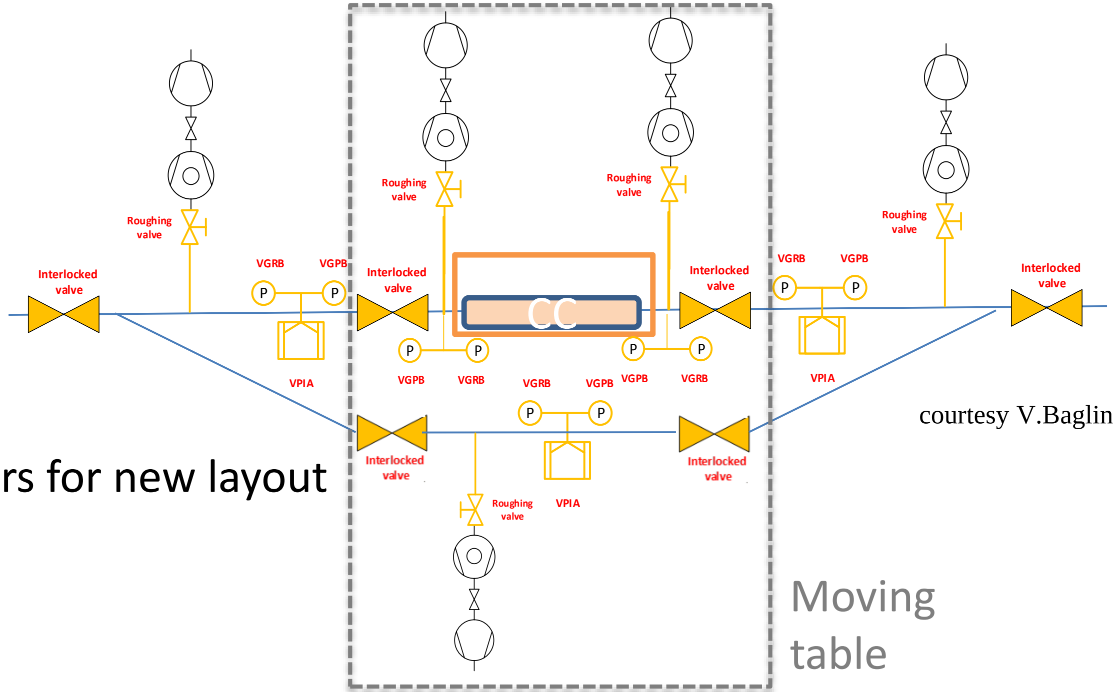
Integration – underground

Vacuum

Layout study presented at 5th Joint HiLumi LHC-LARP Meeting 2015 [Baglin]
Interference of fast and sector valves → VVS 61376 and VVF 61737 to relocate.
Vacuum operation constraints from nearby equipment identified: 3weeks pumpdown TPSG
Necessity for e-cloud study
Local layout study proposed

Vacuum chambers

- Y-chamber
- Bypass chamber
- Modification of vacuum chambers for new layout
- NEG on CC adjacent chambers

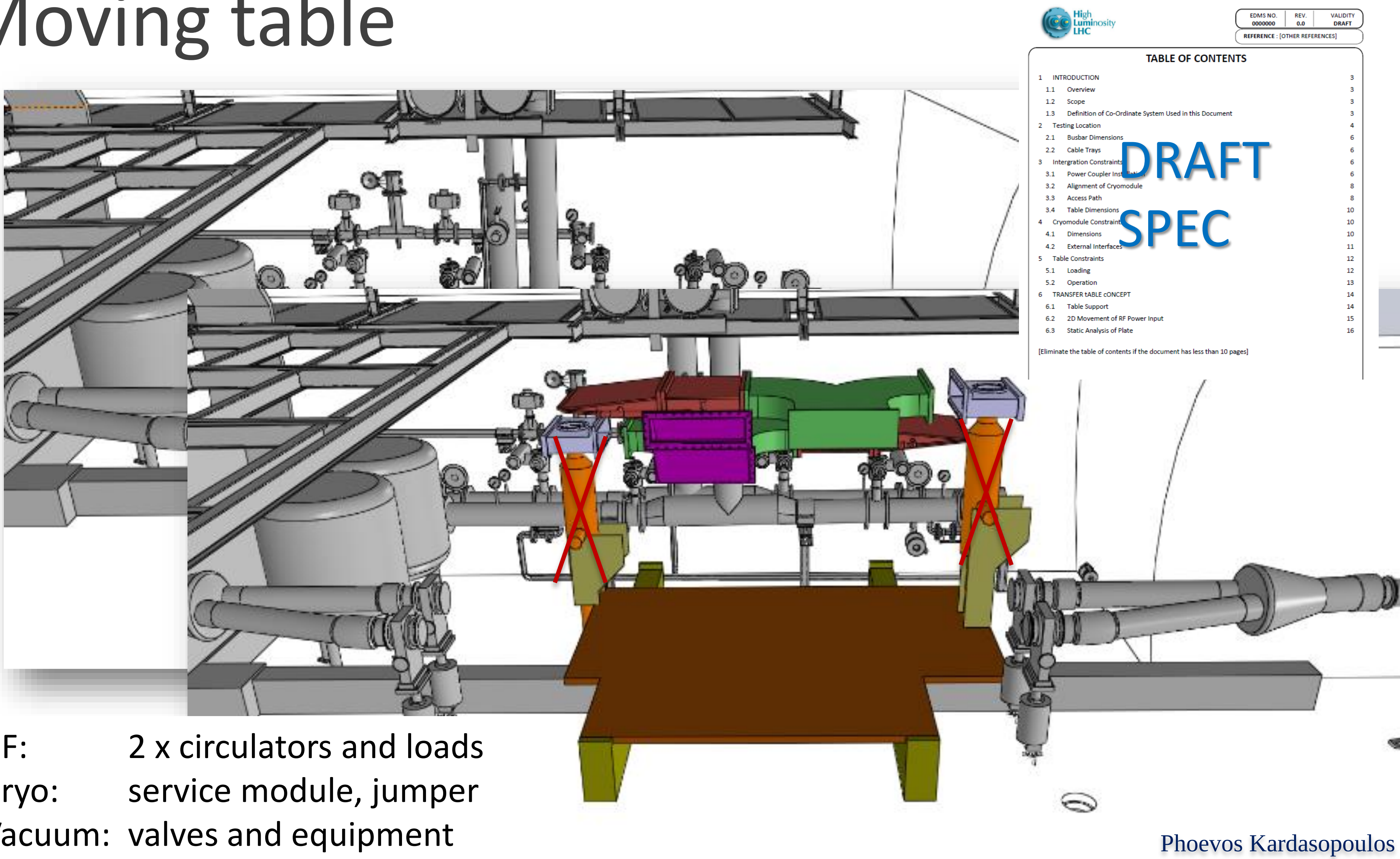


courtesy V.Baglin

Moving table

Planning for vacuum: to be studied by WP12→ Milestones to integrate in SPS installation planning

Moving table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REFERENCE : [OTHER REFERENCES]

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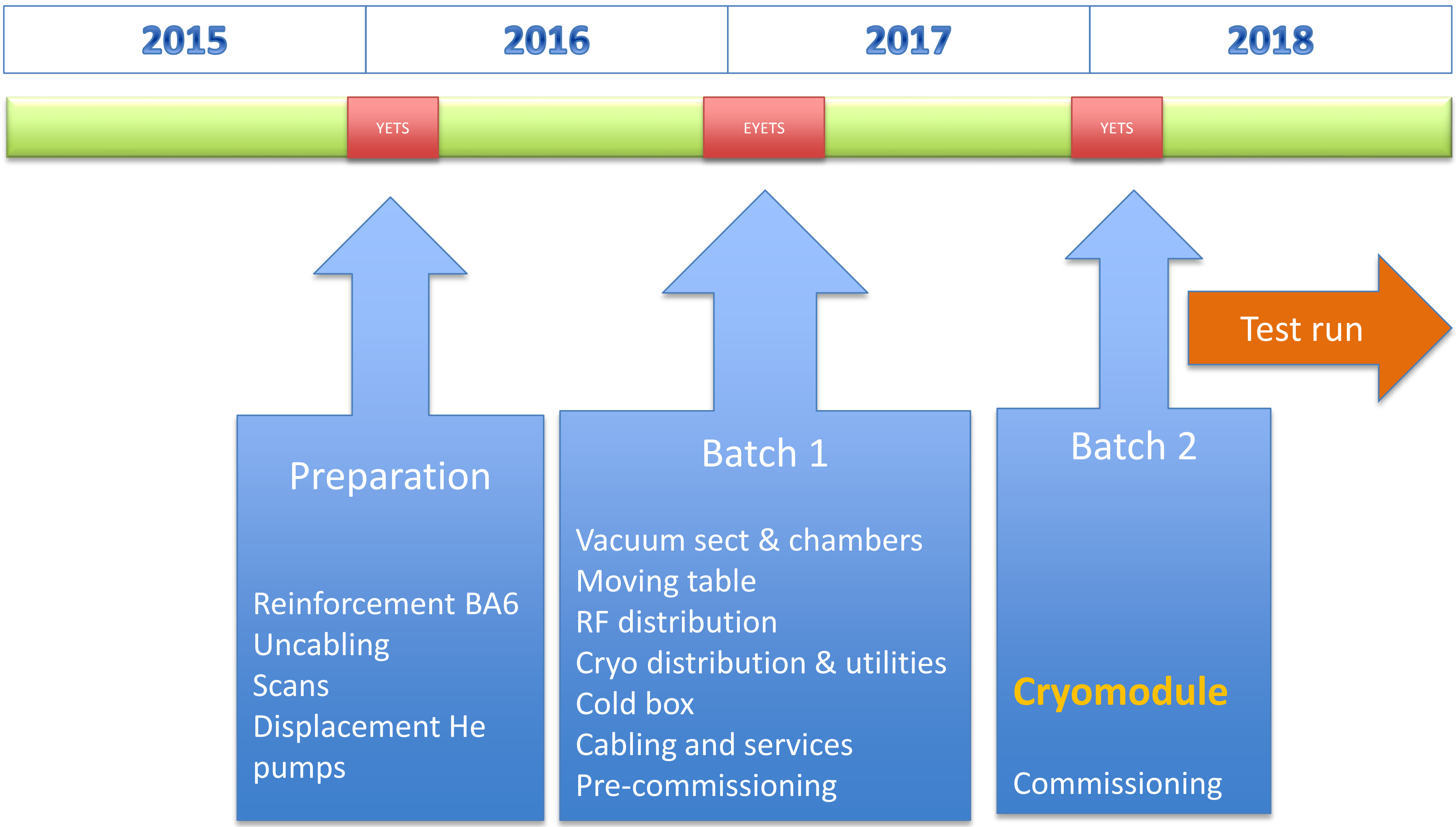
DRAFT SPEC

RF: 2 x circulators and loads
Cryo: service module, jumper
Vacuum: valves and equipment
bypass chamber

Phoevos Kardasopoulos

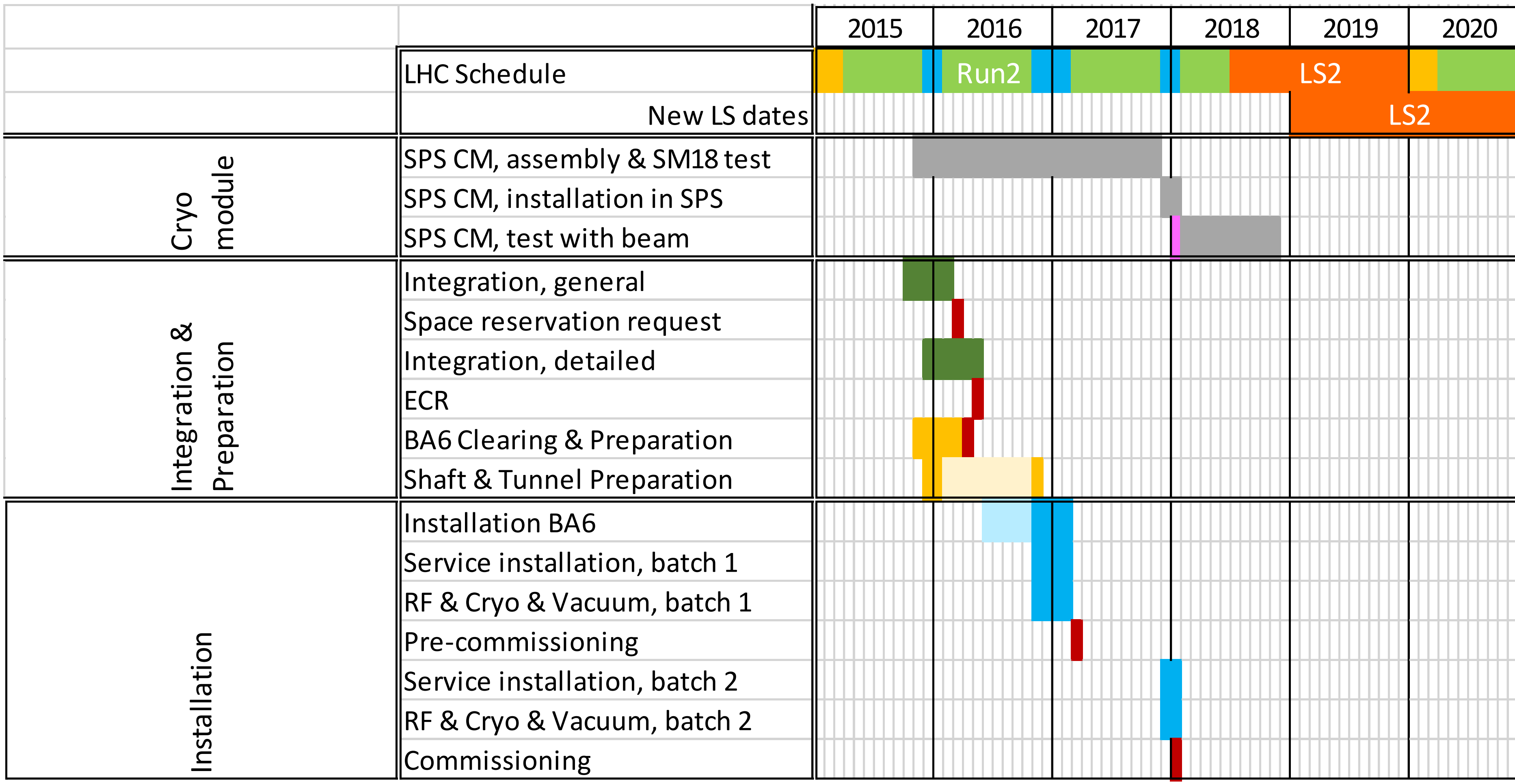
Schedule

General installation scenario



Installation milestones

We will prepare a milestone schedule together with all involved teams



Activities Nov15-Feb2016

Before YETS	YETS15-16
TE/ABT zone clearing; incl green racks	**Pre-inspection Thu12/11**
False floor reinforcement study	Reinforce flooring structures
Assess safety of BA6 worksite	
Tunnel inspection for cold-box integration	Scan BA6, shaft extremities and tunnel areas
"DEC": identification of unused cables	Uncable under false floors Uncable tunnel areas & shaft
Identification of unused pipework	Remove unused pipework
ECR for LSS4	Move 2KHe pumps from LSS4 to BA6

- Detailed planning to be done with SPS Technical Coordination
- IMPACTS to prepare
- ECR for 2K pump displacement
- Space reservation request

Involved teams – see PLAN

Team	Description
BE-OP	SPS tunnel and BA6 activities during beam run
BE-RF	WP4, powering, LLRF, Controls
BE-BI	New BPMs
EN-EL	Un-cable, cable for new equipment
EN-CV	Remove water pipes, install water cooling for RF and Cryo
EN-MEF	Coordination and Planning; Integration; Structural reinforcement; Scans, survey and alignment
EN-MME	Supporting movable table
EN-HE	Transport
TE-CRG	Cryo
TE-VSC	Vacuum layout modification, Y-chamber production and NEG
DGS/SEE	Structural safety; worksite safety
DGS/RP	RP Tunnel

CONCLUSION

Tight integration, with still unsolved issues

Cold box integration and installation path

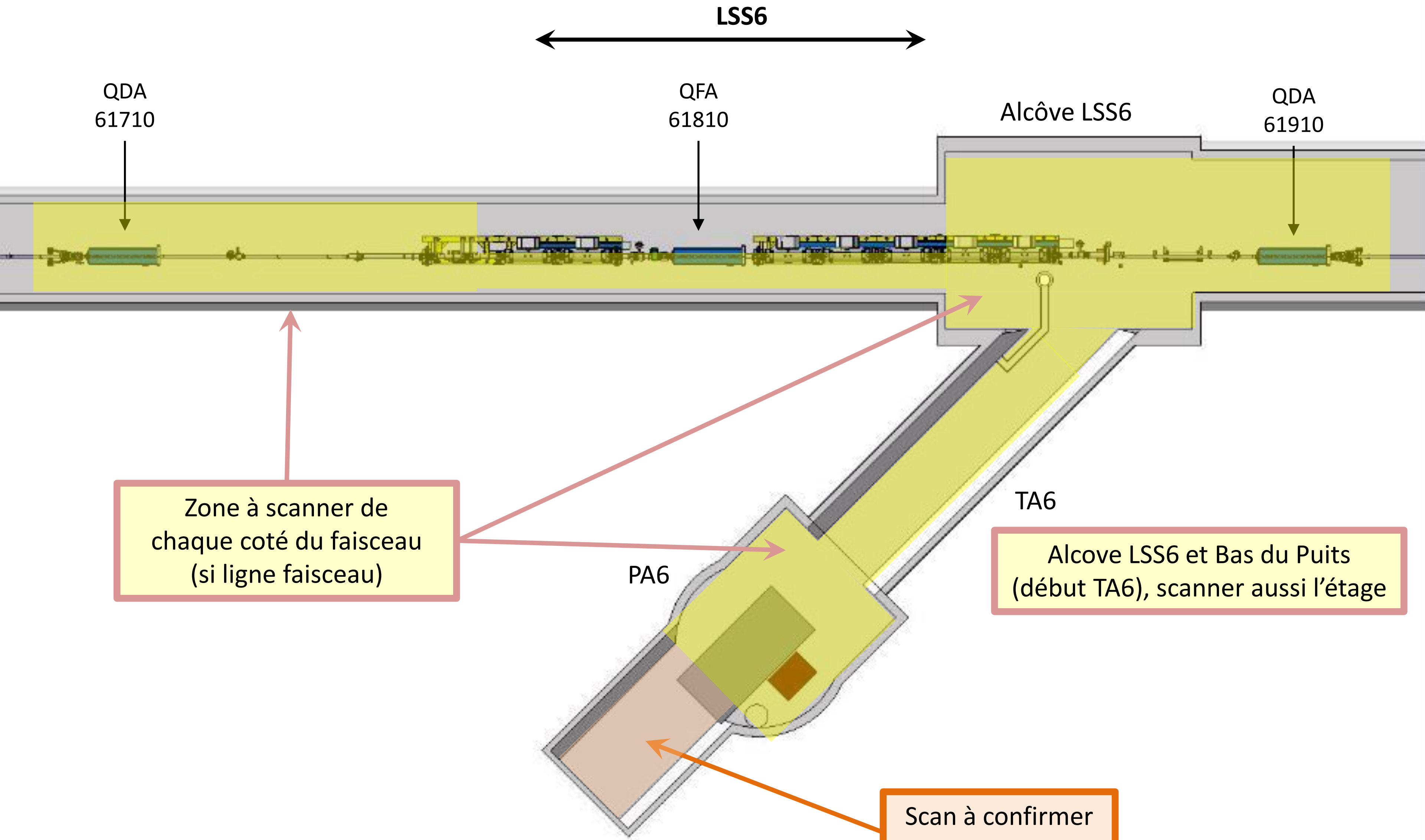
Tight installation schedule, with inter-dependences

Safety of BA6 worksite during beam operation

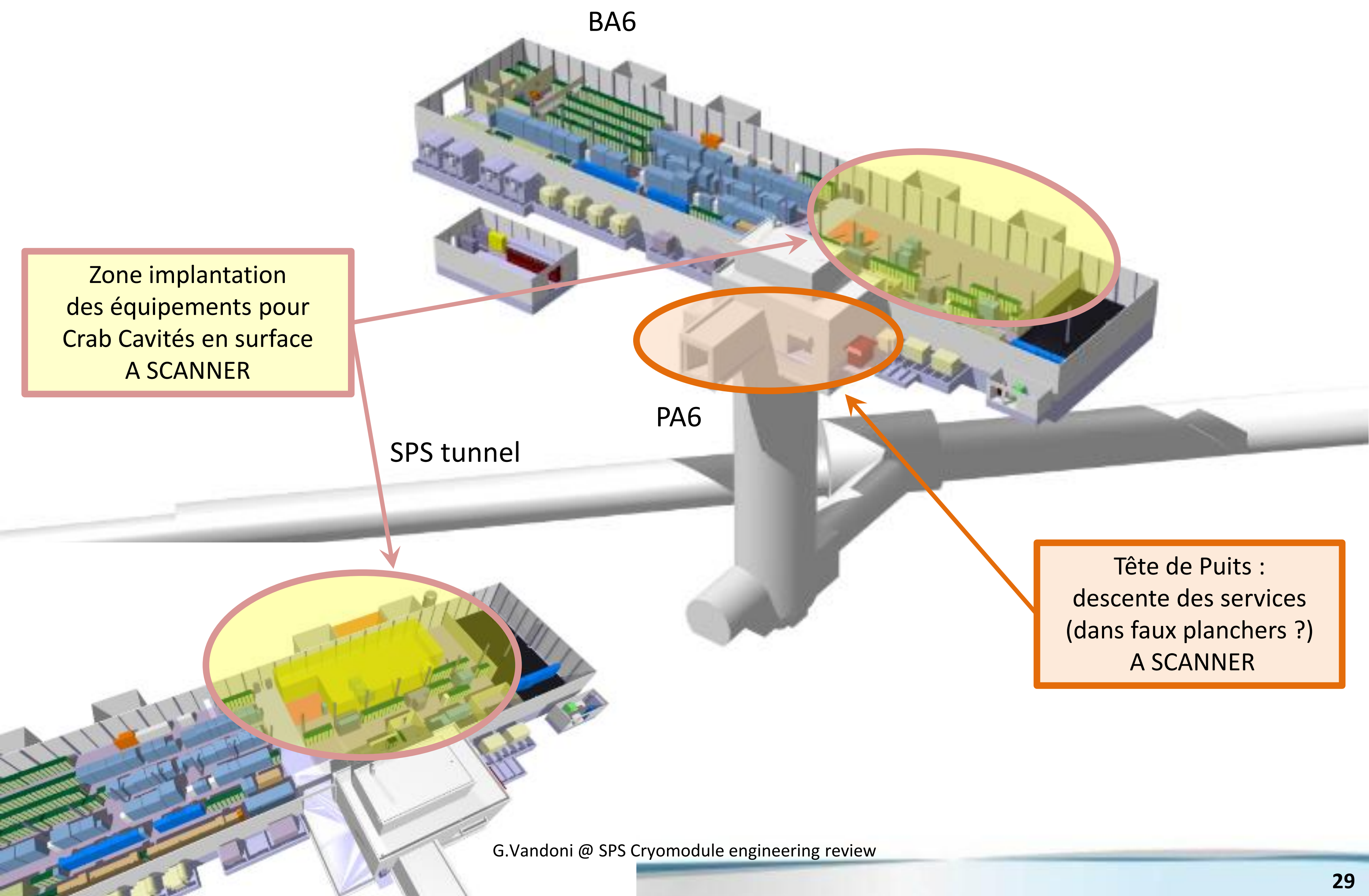
Thank you for your attention.

Back-up slides

LSS6 – Scan pour Projet Crab Cavités



BA6 – Scan pour Projet Crab Cavités



Installation issues for cold box

Lift door : L : 1950mm x H : 2340mm.
Free length in lift: > 6000mm…

PA6, behind lift, height: >5000m
Space reservation for transportation engines

Free height in the access tunnel to LSS6: 2640mm under the pipes, hence more under the structure

Next Immediate Steps

- Define the RF & Services placement needs
  - Conceptual specification (exists), will need update w.r.t to LSS6
- LSS6/BA6 detailed scan (request already launched)
  - Including investigation TI12/18, space reservation
- Cryogenic equipment placement
  - LSS4 equipment movement to ? Fix baseline
- Cabling & Services clean up & installation

RF Cables

RF Power: Cables per amplifier chain

Signal name	description	Cable type
RF Load signal	To RF load	CC50 (x2 – forward/reflected)
Input power signal	Input coupler/waveguide	CC50 (x2 – forward/reflected)
Driver Output signal	Between SS driver and amplifier	CC50 (x2 – forward/reflected)
Amplifier Output signal	Between driver & circulator	CC50 (x2 – forward/reflected)
Spare signal	Coupler to Surface	CC50 (x2 – forward/reflected)
Po,Driver	Forward power, driver to amplifier (surface)	Flexwell, 66mm
Po, Amplifier	Forward power, from Amplifier to circulator (surface to tunnel)	Flexwell, 150 mm (100 kW max)
Po, RF Coupler	Forward power, from circulator to RF coupler (tunnel)	Flexwell, 280 mm (385 kW max) or WR2300
Interlocks/Monitoring signal (RF: cavity, coupler, load, circulator)	Cavity-Coupler to Surface	50 pin (x4)
Interlocks/monitoring signal (PLC)	Temperature, pressure and vacuum readouts	50 pin (x2)
Slow Controls signal	Motor control, readback for frequency tuning	8 pin (x4)
Ethernet	Surface bldg	2(+1 spare) per cavity

LLRF Power

Signal name	description	Cable type
Antenna signal	From Antenna to LLRF rack	7/8” flexwell temp stabilized
Ic,fwd	Forward power, from coupler between cavity and circulator, close to cavity	7/8” flexwell temp stabilized
Ic,rev	Reflected power, from coupler between cavity and circulator, close to cavity	3/8” flexwell
Ig,fwd	Forward power, from coupler between TX and circulator	3/8” flexwell
Ig,rev	Reflected power, from coupler between TX and circulator	3/8” flexwell
TX drive	From LLRF to TX driver	7/8” flexwell temp stabilized
TX spare	From Tx rack to LLRF	3/8” flexwell
Cav spare	From cavity to LLRF	3/8”flexwell
MFB Antenna signal	From LLRF to LLRF across IP	7/8” flexwell temp stabilized
HOM	From cavity to LLRF	4 x 3/8”flexwell

RF Pickup

Signal name	description	Cable type
PU	From PU to LLRF rack	7/8” flexwell temp stabilized

High Luminosity LHC

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