

# East Area Renovation Project

## ***COST AND SCHEDULE REVIEW 3***

### ***LS2 schedule and 2021-operation readiness***

*Sébastien EVRARD      Project Leader, EN-EA    21 November 2019*  
*On behalf of the Project team*

<https://edms.cern.ch/document/2269106/1>



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**EAST AREA RENOVATION**



# Outline



## *LS2 schedule and 2021-operation readiness*

- Introduction
- Project Status
- Energy Savings
- Miscellaneous
- Summary

# Introduction: scope of the project

Main goal: ensure long-term operation of EA beamline and facilities

## • New beam line layout

- better cope with physics requirements (maximum momentum and choice of particle type (e, h,  $\mu$ ))
- minimise dose rates to personnel, and allow faster repair times by improving equipment accessibility
- respect today's norms for radiation protection: new primary area ventilation + new dump system

## • New cycled powering scheme

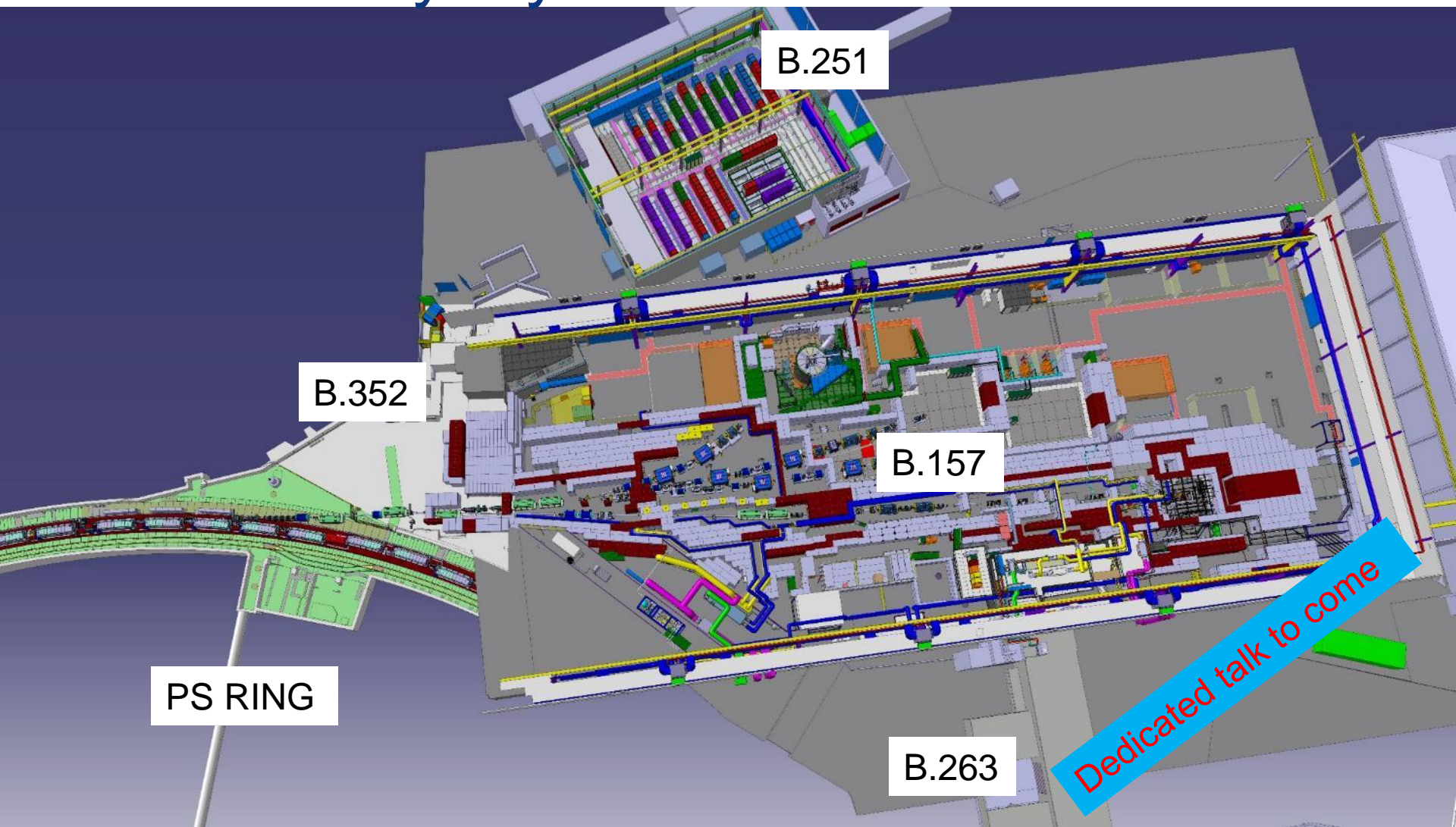
- replace massive magnet yokes by laminated ones to allow cycling them
- new Sirius power converters with energy recovery
- annual energy consumption reduction from 7 to 1.1 GWh

## • Infrastructure Renovation

- upgrade of Building 157 including insulation → annual energy consumption reduction from 3 to 1. GWh
- renewal of wall and roof cladding, asbestos removal

• separation of primary and secondary beams & zones cooling circuits

# New facility layout



Courtesy of M. Lazzaroni & D. Brethoux

# Dismantling activities

- The 2019 objectives covered **full dismantling, CLOUD run and re-construction phase 1**.
  - The renovation work has to adapt to the resources available from other projects having a higher priority
  - **One major accepted constraint is to comply with the PS closure mid-2020.**
- The **dismantling activities** are **completed according to schedule**:
  - Primary and secondary beam lines have been dismantled
  - The de-cabling campaign is completed
- **CLOUD14 run is in progress till 3<sup>rd</sup> of December (w/o beam)**.

Preparations for the T11 area renovation and modifications will start on December, 17<sup>th</sup>.
- **Civil engineering works** are **also completed including a brand new roof**.
- **Re-installation started in B.251 and B. 352**

# A few illustrations



# A few illustrations



Courtesy of A. Ebn Rahmoun

September'19



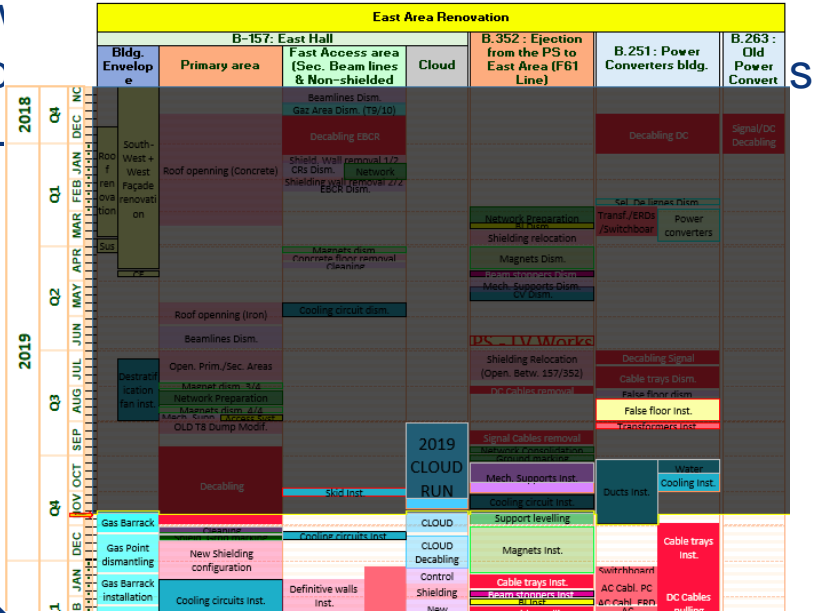
20/11/2019

CSR#3 - Project Status

# Schedule

- The master baseline schedule is properly followed
- Some activities have been anticipated
- Only a few deviations (B.251 mainly)
- Still a long road ahead of us
- Activities located in B.352 (interface with PS ring) and in the primary area are on the critical path
- Hardly completed and L

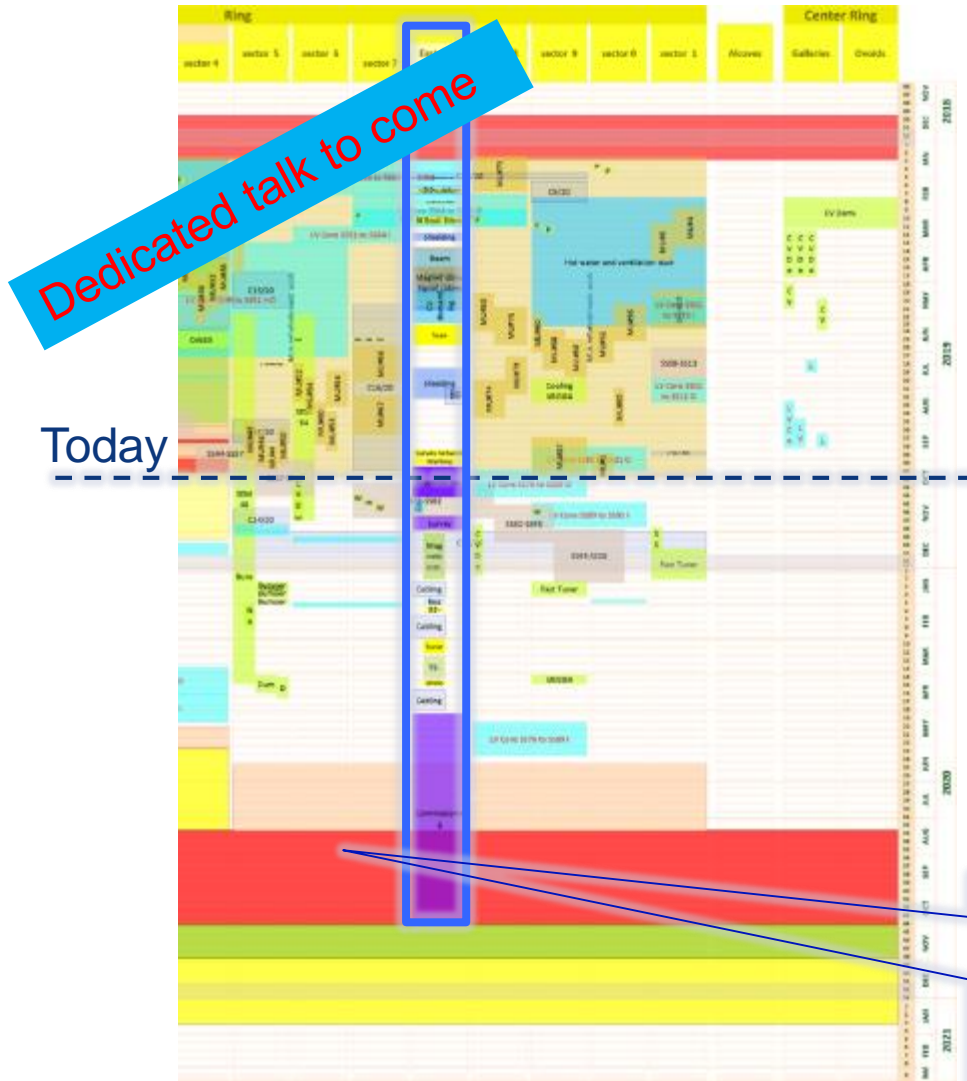
Courtesy of B. Rae



Master baseline schedule & broken line →



# Schedule issue: interface with PS ring commissioning



- Early identification of potential conflicts with PS ring commissioning (F61 beam line)
- Due to early closure of PS ring and B.352 mid 2020, the EA Renovation master schedule has been adapted accordingly → part included in PS planning baseline 1
- Communication with EN-ACE colleagues

Courtesy of F. Pedrosa

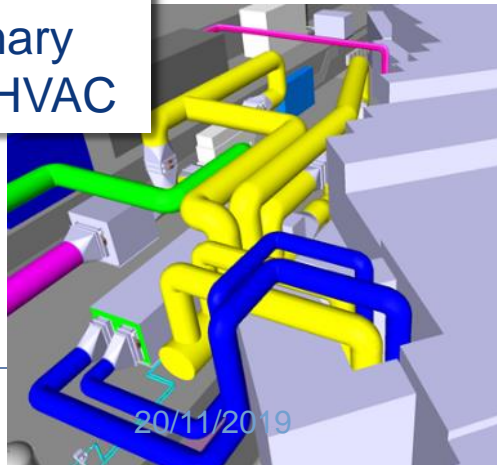
**F61: Weekly meeting with the ATC A. Ebn Rhamoun**

# Items on critical path: Cooling&Ventilation (EN-CV)

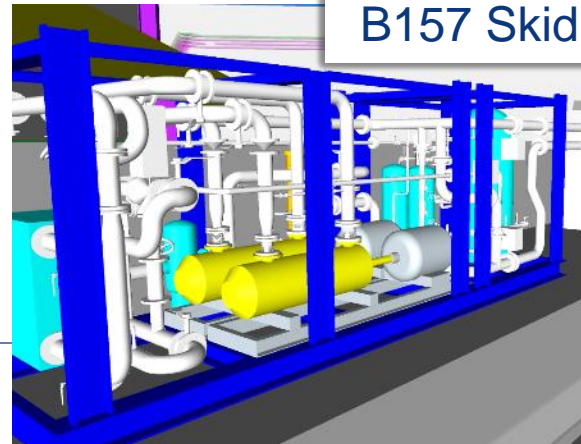
	Design	Contract	Installation	Testing
<b>EAR.10.1 Primary Zone &amp; Mixed Area HVAC</b> Next steps: Contractor's equipment selection and purchase. System ready for July 2020.	✓	✓	🟢	
<b>EAR.10.2 B157 Hall Ventilation</b>	✓	✓	✓	✓
<b>EAR.10.3 Demineralised Water Cooling</b> Next steps: Mechanical and electrical installation. System commissioned by May 2020	✓	✓	🟢	
<b>EAR.10.4 B251 Ventilation</b> Next steps: Air handling unit installation in 2020	✓	✓	🟢	
<b>EAR.10.5 ATEX Ventilation</b> Next steps: Procurement. Installation Aug-Sep 2020	🟢			

Dedicated talk to come

Primary Zone HVAC



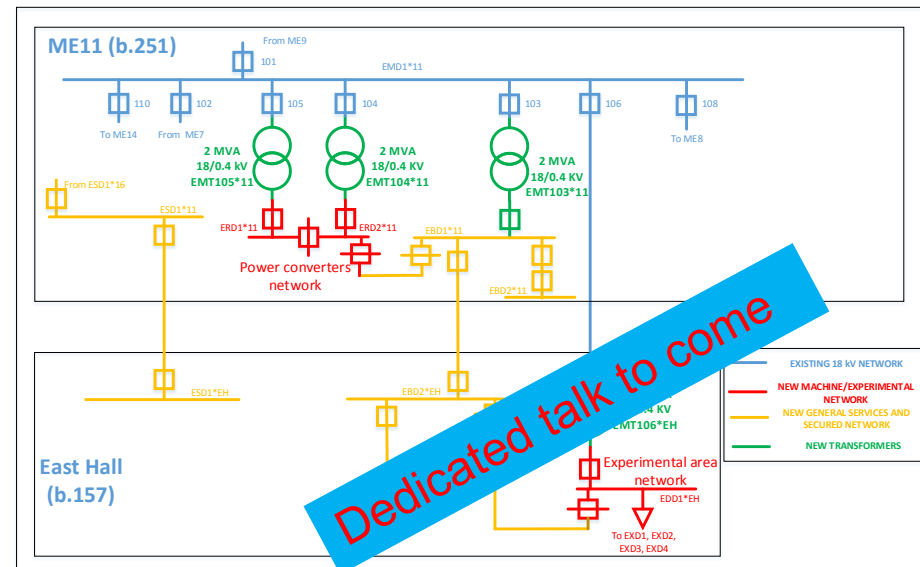
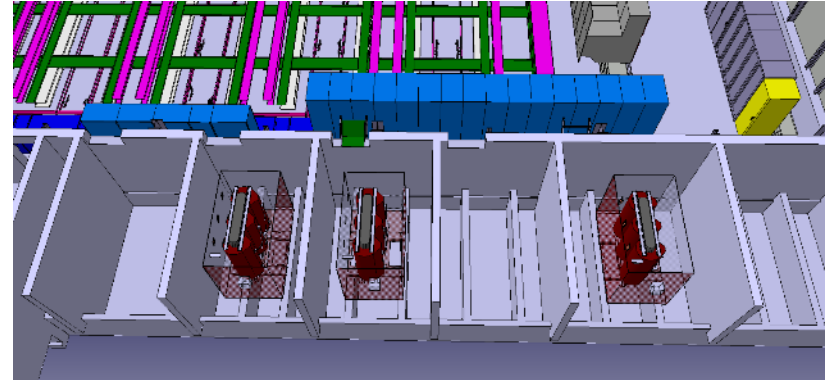
B157 Skid



Courtesy of F. Dragoni

# Items on critical path: Electrical network (EN-EL)

- The main structure network design is completed
- Re-use of DC cables validated by HSE
- The integration of cable trays in B. 157 & 251, transformers in B.251 is achieved
- Procurement in progress for all components
- Installation in 2020

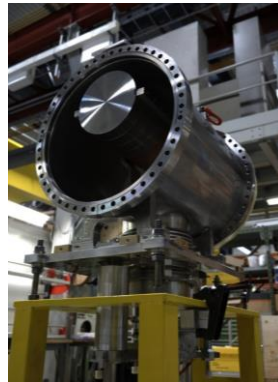
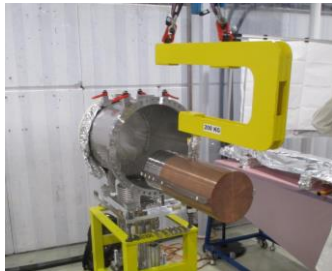
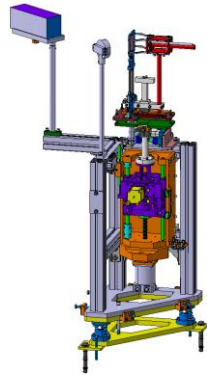


Courtesy of M. Polenghi

# Items on critical path: Beam Intercepting Devices (EN-STI)

- 2 Multi-targets

- Multi-target fully mechanically assembled.
- Control test schedule for 2020



- Beam stoppers & Stopper dumps

- Prototype Beam Stopper mechanically tested 10,000 cycles.
- Prototype Beam Stopper tested 1,000 cycles under vacuum.
- F61 jaw support ready for installation in February 2019.
- Vacuum chamber under production (delivery end of November 2019)
- All the other parts are delivered at CERN and ready for assembly
- Beam Stoppers will be assembled in EN-STI Clean Room.

Courtesy of E. Grenier-Boley

# Items on critical path: Magnets (TE- MSC)

- 12 different magnet families instead of 20 for the actual layout
- 36 new magnets under production in industry (laminated yoke + coils): **33% completed**
- 25 magnets under refurbishment in Preveessin magnet laboratory: **95 % completed**
- Last magnet should be available in June 2020.
- No showstopper up to now, **however some delays on Q120 magnets**
- Online status:

<https://norma-db.web.cern.ch/project/detail/101/>



Courtesy of R. Lopez

# Items on critical path: Power converters (TE-EPC)

- Procurement: 100%
  - 2 MS/IT BE1416 and BE1518 completed
- Manufacture: 80%
  - 63 power converters delivered at CERN
  - 453 Energy Storage units in March 2020 according to planning
- Acceptance tests: 80%
  - All power converters have been accepted
- Measurements: 93%
  - Qualification tests completed, 1.3% with major issues being corrected
- Installation: 0%
  - Transport in March 2020, first hardware tests in Oct 2020



Sirius S, 2P



Sirius 4P

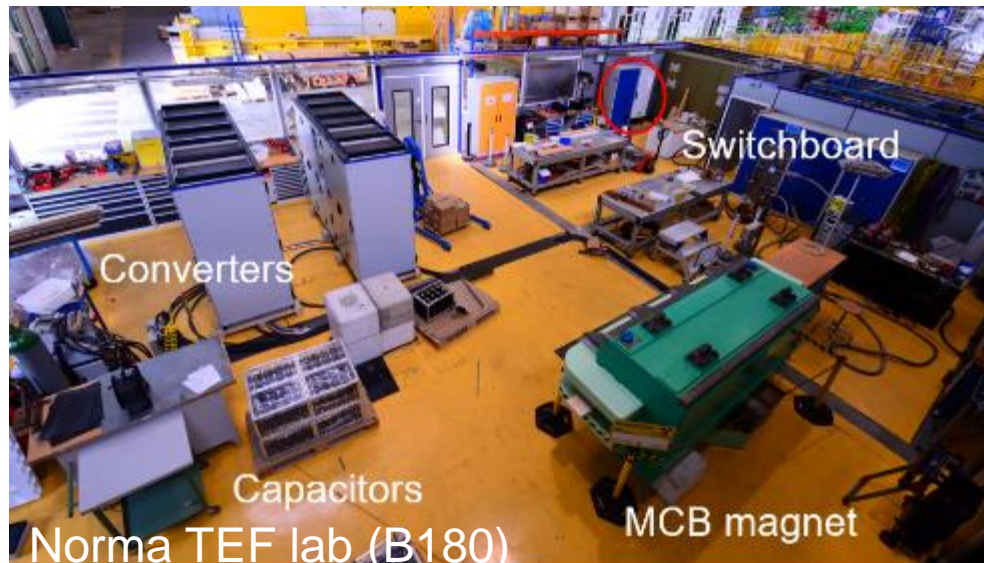


Courtesy of K. Papastergiou

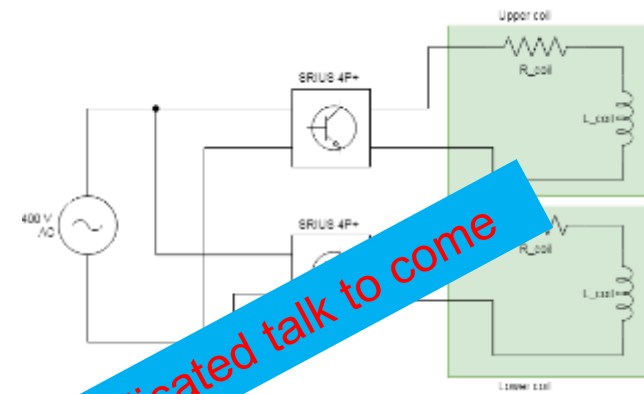
# Pre-commissioning tests

## Goals:

- Complete powering tests of a MCB magnet with Sirius PCs = proof of concept
- Relax hardware commissioning phase
  - ✓ Prove that the MCB with two power converters can follow the EA cycle
  - ✓ Prove that the delay in the field is not going to impact the EA cycle
  - ✓ Study the magnetic coupling of the two converters and find solutions
  - ✓ Demonstrate the energy saving capacity of Sirius converters



## Schematic view:



Courtesy Jaime Renedo

# Summary on items on critical path / with potential of delay

items	Unwanted event	likelihood	Mitigation measure	Recovery plan
<b>Magnets</b>	Late readiness Underperformance	Low Low	Pre-commissioning Qualification tests	Focus on T08 Restart in 2022
<b>Power Converters</b>	Late readiness Underperformance	Low Low	Pre-commissioning Qualification tests	Focus on T08 Restart in 2022
<b>Cooling and ventilation</b>	Late readiness Underperformance	Low Low	Use of framework contract	Accept delay on restart
<b>AC/DC network</b>	Late readiness	Low	Use of framework contract	Accept delay on restart
<b>Safety issue</b>	B.157 ground/galleries not strong enough	Low	Local Reinforcement New shielding design	Accept delay on restart
<b>Safety events</b>	Any new incident	Medium	Prevention /	Accept delay on restart
<b>Commissioning</b>	Teams not available  Conflict with PS com.	High	Pre-commissioning Prepare documentation HC Engineer (M2P) Integration in PS com.	Accept delay on restart

**Dedicated talk to come**



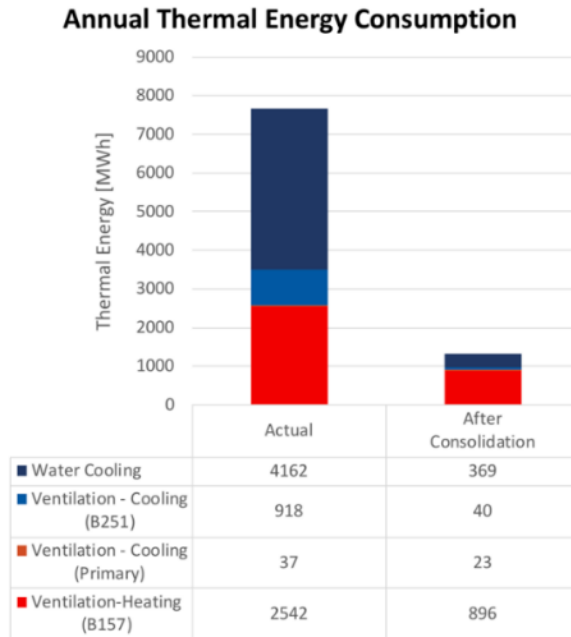
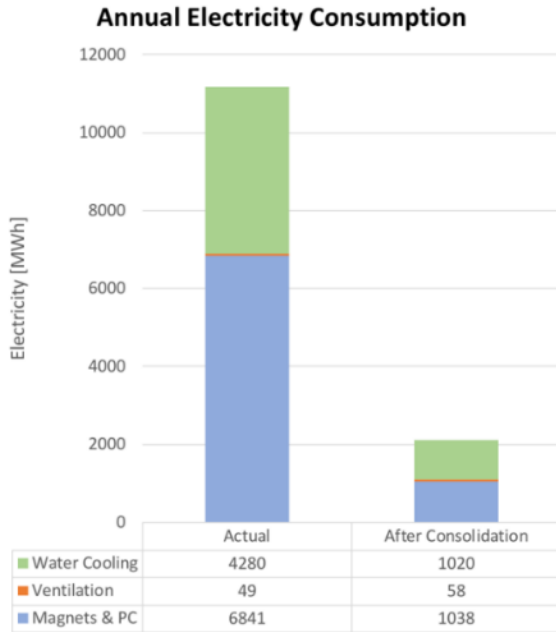
# Energy savings

- Project mandate , Edms No. 1715122

“The renovation project shall also be promoted as a good example of energy optimization and sustainability effort at CERN and shall therefore foresee a final report on energy savings after consolidation.”

- Many project initiatives:
  - ✓ Study a proposal for installing solar panels on B.157 roof → payback > 30 yr
  - ✓ Support SMB to get OCEN incentives for the B.157 thermal insulation upgrade
  - ✓ Complete a thorough energy study
  - ✓ Establish a proposal to get an incentive from OFEN

# Energy savings



- 6-month study completed by B. Lamaille (ECAM, Brussels. Published at IPAC 2019, THPRB087 )
- In line with initial estimates done in 2011
- **Yearly savings of 600kCHF**
- Importance of Demineralized water pumps consumption → replacement of 3 pumps by 2 new pumps added to the scope of the project

System	Energy	Yearly cost (kCHF)		Savings (kCHF)	
		Consumable	Current		Post LS2
Magnet and power converters	Electricity		342	52	290
Water cooling	Electricity		216	54	162
Water cooling	Water		45	4	41
Heating	Gas		152	54	98
<b>TOTAL</b>			<b>755</b>	<b>164</b>	<b>591</b>

# Energy savings : Financial support

## OCEN

Office Cantonal de l'Energie GE

- To support the renovation of B.157 Thermal Insulation

Genève, le 30 AVR. 2018

Concerne : Octroi d'une subvention du Programme Bâtiments 2018  
Projet GE-17-692-01 Isolation thermique de la façade, du toit, des murs et du sol contre terre  
Batiment sis Route de Meyrin 385 à Meyrin

Monsieur,

Par la présente, nous avons le plaisir de vous informer que votre requête en subvention du Programme Bâtiments 2018 est acceptée.

En effet, votre projet répond aux critères d'octroi de subventions en vigueur.

Ainsi, notre département vous octroie une subvention de 637'280.00 F, laquelle est toutefois soumise aux conditions d'exécution que vous trouverez en annexe.

En vous félicitant pour les efforts fournis en faveur de la politique énergétique du canton, nous vous prions de croire, Monsieur, en l'expression de nos meilleurs messages.



Emile Spierer  
Attaché de direction



Cédric Petitjean  
Directeur

## OFEN

Office Federal de l'Energie CH

- Energy efficiency program  
Financial support for measures
  - 1. which would otherwise not be implemented (additionality); and that succeed in an invitation for tenders
  - 2. with the most attractive cost/benefit ratio.

#### IV. Au vu des considérants qui précèdent, l'OFEN décide ce qui suit :

1. Le requérant obtient, pour le projet «EARP-magnets» déposé dans le cadre du 10e appel d'offres public, une contribution de soutien maximale de Fr. 796'497.
2. Si le projet n'atteint pas les gains d'efficacité ou les réductions de consommation prévues, ou si les coûts de mise en œuvre du projet sont inférieurs aux coûts prévus la contribution de soutien mentionnée au point 1 est réduite en conséquence.
3. Le projet doit débiter au plus tôt le 10 mai 2019 et au plus tard le 31 décembre 2019 et doit s'achever au plus tard le 31 décembre 2022.
4. La contribution de soutien est versée après la réalisation du projet.
5. Si le requérant ne remplit pas les exigences mentionnées au chapitre III ou ne les remplit que partiellement, il perd son droit à une contribution de soutien ou voit sa contribution réduite en conséquence.
6. Les conditions pour la soumission des projets 2019 fait partie intégrante de cette décision.

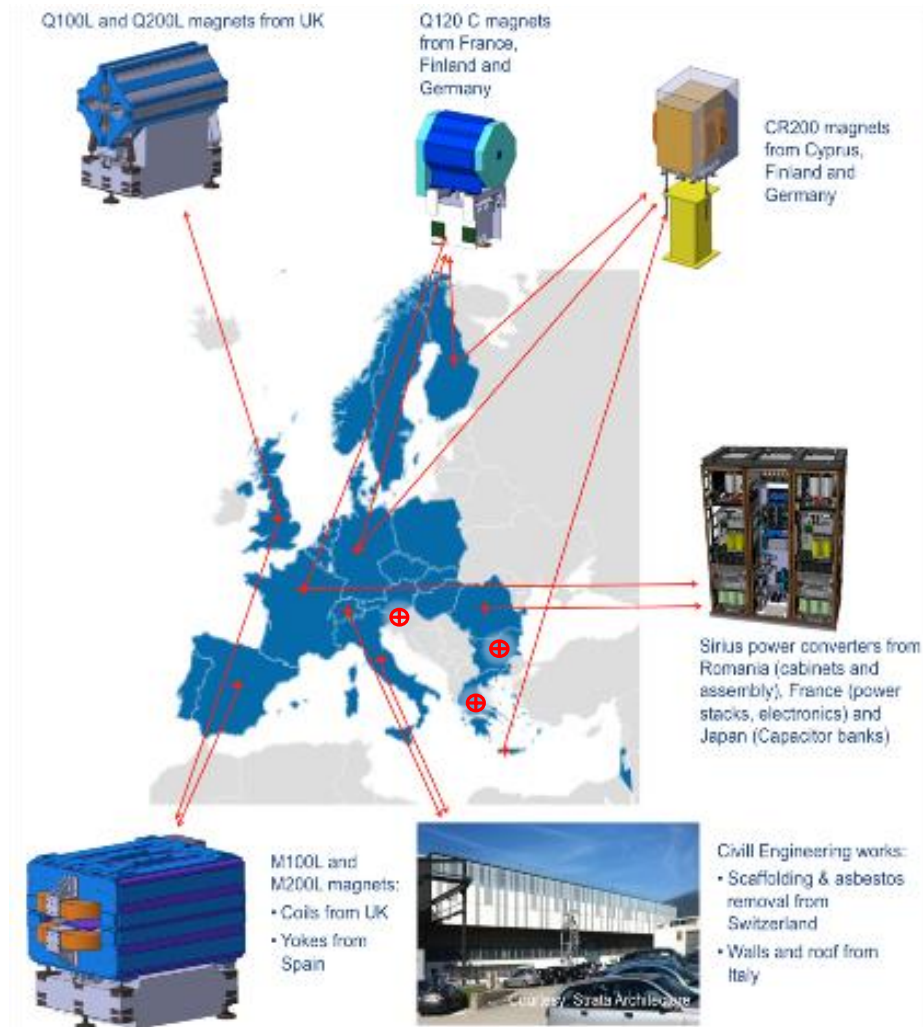
# Project Configuration Management

- TDR ready & is our Project Baseline
  - <https://edms.cern.ch/document/2224589/0.2>
  - TDR to be shortened and reshaped and will be issued as a CERN yellow report early 2020.
- Configuration Management started in 2019 with very good progresses
  - Naming convention
  - Layout database
  - Beatch files

Dedicated talk to come

# Procurement & Manufacture

- All supply contracts ongoing
  - Civil engineering
  - Magnets
  - Power converters
- Manufacture @ CERN
  - Targets and Beam stoppers
  - Collimators and vacuum
- Framework contracts
  - Dismantling & Cleaning, Shielding



# Training & Collaboration

- **Training opportunities:** 6-month internships → MSc dissertation
  - J. Meignan, TCX design, MScEng Degree awarded in June 2017
  - A. Watrigant, Cloud Run in 2019, MScEng Degree awarded in June 2018
  - B. Lamaille, Energy savings, MScEng Degree awarded in June 2018
  - R. Vanhoutte, Plug-in supports, MScEng Degree awarded in June 2018
  - A. Hariri, B.251 Integration and Mechanical supports, Trainee from Lebanon
  - A. Filinis, University of Patras (Greece) – Mechanical Engineering support
- **Collaboration**
  - JINR (Russia) for the mechanical design of the new magnets
  - PAEC (Pakistan) for the design of quadrupole magnets
  - University of Patras (Greece) – Mechanical Engineering support



# Summary

- Civil engineering works completed
- Dismantling activities have been completed according to schedule and installation activities have started.
- Equipment readiness: main beam line components under manufacture (Magnets, power converters, BIDs and targets): about completion. No showstopper for restart of the Experimental Area for physics as from Q3/2021 but still a long road ahead of us
- Very promising pre-commissioning tests (Sirius, MCB & double powering): a proof of concept has been established
- Items on critical path / with potential of delay have been identified, mitigation measures and recovery plan are defined
- Big thank-you to all the technical groups involved

# Acknowledgements

- Many thanks to the project team members:

Henric Wilkens, Lau Gatignon, Marco Polenghi, Roberto Lopez, Jaime Renedo, Robert, Louis-Frederic Andre, Elpida Iliopoulou, Robert Froeschl, Edouard Grenier-Boley, Christophe Brouard, Stewart McIlwraith, Francisco Dragoni, Leszek Borakiewick, Caterina Bertone, Antti Onnela, Michael Lazzaroni, Jerome Lendaro, Konstantinos Papastergiou, Aboubakr Ebn Rahmoun, Damien Brethoux, Vincent Clerc, Jocelyn Tan, Denis Cotte, Richard Morton, Erwan Harrouch, Marco Calviani, Johannes Bernard, Eva Montbarbon, Richard Morton, Maarten Van Dijk, Silvia Grau, Eva Sanchez-Corral Mena, Pawel Burdelski.





# EAST AREA RENOVATION

**Thank you !**



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# Backups



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# CSR2 follow-up

## CSR2 recommendations:

- not to change the CtC before the MTP approval in June 2018. **Done only after 2019 MTP**
- to reduce the scope of two work packages (existing DC cable will be re-used instead of being replaced by new ones and the B.157 ventilation renovation will be postponed to after LS2). **Done**
- to implement further savings in the various existing WP's to cover unfunded or partially funded activities. **Done → new budget baseline implemented → feedback from various WP leaders: these budget reductions impaired severely the correct achievement of their deliverables. Motivation for new budget allocation request in MTP 2019 exercise.**
- The Civil Engineering works and, as well as ventilation & cooling works of building 251 are not in the scope of the project. **With the new MTP2019 budget allocation, ventilation of B.251 is now funded, not the cooling works.**
- The review panel recommends EN-CV and TE-EPC to assess on heat deposition in the air and in water, and make a comparison with the present situation. **Done in parallel to the energy study.**
- The review panel recommends to study the common use of the CLOUD chiller and the cooling of building 251 or to seek for other possible synergies (B. 156,...). **Both options have been investigated but are not technically feasible, unfortunately.**

# Magnet status on Oct. 1<sup>st</sup> 2019

## STATUS SUMMARY - EAST AREA UPGRADE

Design	Specification	Magnets					
		Total	Manufacturing	Stored	Certified	Installed	Rejected
PXMBXHDCWP	✓	7	0	7	6	0	0
PXMQNEFTWP	✓	4	0	4	4	0	0
PXMCXCFHWP	✓	9	8	1	0	0	0
PXMQNEL8WP	✓	6	5	1	0	0	0
PXMQNDCTWP	✓	5	0	5	5	0	0
PXMQNCL8WP	✓	2	2	0	0	0	0
PXMQNEGTWP	✓	9	0	9	9	0	0
PXMBXH FHWP	✓	6	5	1	0	0	0
PXMCXCEHWP	✓	5	4	1	0	0	0
PXMBXGFHWP	✓	2	1	1	0	0	0
PXMQNEVTWP	✓	5	5	0	0	0	0
PXMQNFKTWP	✓	5	5	0	0	0	0