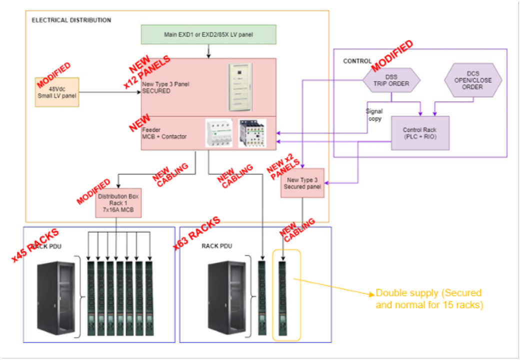
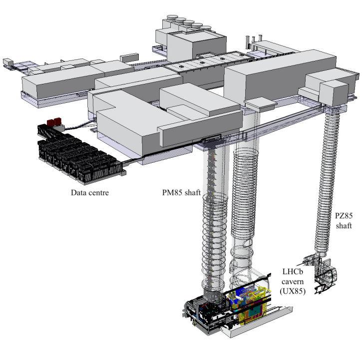
Infrastructure consolidation in LS3

- Backend of the Detector Safety System (DSS) to be replaced (common project for all LHC experiments).
- SNIFFER system to be upgraded/replaced. Different technical solutions being investigated.
- Obsolete LV distribution boards (Hazemeyer TDMs) feeding racks in D1 – D3 and B1 (inherited from LEP) need to be replaced.
- At the same time, improve the granularity of the distribution downstream of the TDM panels (one feeder per rack) and adapt to new D1/D2 rack layout.
- Also on our wish list: dedicated Diesel generator set for critical loads (*e. g.* cooling systems).



DAQ/Online infrastructure

- Due to reach limitations of the optical link, (part of) the event-builder system for Upgrade Ib and II needs to be relocated to UX85.
- This requires refurbishing the D1/D2 barracks (electrical distribution, water cooling, air-conditioning, support beams, new racks).
- First step (removing existing racks from D1) completed during the YETS 2022/23.
- Ongoing integration studies to define new rack layout.
- Routing of optical fibres between detector and D1/D2 and between D1/D2 and the modular data centre also needs to be studied (may require some civil engineering work).



Services: general reminders

- Long-distance services need to be planned well in advance.
- Material cost of detector-specific infrastructure paid by subdetector projects.
- There are no common funds for LS3 enhancements.
  All infrastructure cost needs to be included in the project budgets.

Power, cables, optical fibres

- Contact: Laurent Roy.
- Responsibilities:
  - Integration and installation of long-distance cables and fibres up to the racks/patch panels on the detector side of the cavern: Technical Coordination.
  - Installation of near- and on-detector cables/fibres: subdetector groups.
- Like all other material/equipment, cables and fibres need to be compliant with CERN safety regulations.
  - The relevant safety instruction has recently been revised to align with European standards.
  - Recommendation is nevertheless to procure cables from the CERN store.
  - If you plan to use cables from other sources, please get in touch.
- Need a realistic estimate of the number of optical fibres required for LS3 enhancements by this summer.

Integration

- Contact: Augusto Sciuccati, Olivier Jamet.
- Responsibilities:
  - Detailed design within the subsystem envelopes: subdetector groups.
  - Integration in the global CAD model, long-distance services, design of access/support structures: Technical Coordination (design office).
- Design office can also provide mechanical engineering expertise and support.
- Focus for now has been on magnet chambers (support structures in the magnet and location of front-end crates) and calorimeter.

Cooling

- Contact: Wiktor Byczynski
- Upgrade I cooling plants have been built and are operated by CERN EP-DT (VELO/UT CO_2 cooling) and EN-CV (RICH, SciFi, primary chiller) groups. Both already have substantial commitments for LS3 (ATLAS/CMS).
- Subdetector responsibility for integration/installation typically starts at the near-detector manifolds.
- If we want a new cooling system for LS3, need to converge on a set of specifications by end of this year.
- Will start/resume discussions with individual subdetector groups in the coming weeks.

Fluids

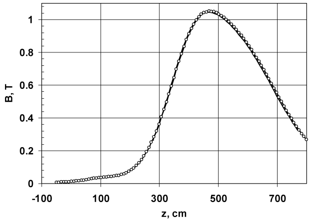
- Fluorinated fluids have been a popular choice for detector coolants.
  - During Run 1/2, RICH and ST were using C_6F_{14} (GWP $\sim$ 10000).
  - RICH is currently using Novec 649, SciFi C_6F_{14} (Novec 7100 being validated).
- Future of these fluids is unclear.
  - 3M announced end of last year that they will phase out Novec fluids and PFCs by 2025.
  - EU is considering a proposal to restrict all PFAS products ("'forever chemicals").
- For new projects, we need to consider other solutions.
  - Impact on primary refrigeration also to be understood.
- Many alternative heat-transfer fluids (silicone oil, ammonia, *etc.*) have issues in terms of flammability, toxicity or corrosiveness.
- Fluid choice needs to be taken into account early on in the detector design (*e. g.* pressure rating in case of CO_2 cooling).

Cryogenic cooling

- SiPMs in Upgrade II RICH and SciFi would need to be kept $< -120\,^{\circ}$ C, entering the domain of cryogenics.
- VELO could potentially also make use of a cryogenic cooling system (passive cooling scheme).
- R&D work package with CERN TE-CRG group is in preparation. Topics include
  - minimum size vacuum insulation solution and optimization strategies (SciFi),
  - design of thermal links,
  - simulation of temperature distribution, material choices,
  - LN_2 flow distribution (subcooled vs. two-phase),
  - ...
- In parallel: feasibility study (cost, integration of an LN_2 plant in UX85).

Bending power	4 Tm
Stored magnetic energy	32 MJ
Nominal current	5850 A
Electrical power dissipation	4.2 MW
Peak field	1.1 T

Parameters of the existing magnet.



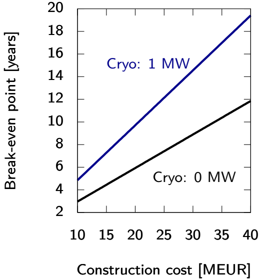
B-field along the beam axis.

Why replacing the magnet with a new (superconducting) one?

- Operational cost and energy saving?
- Global optimization of the detector layout?
- Improved momentum resolution?
- Limited lifetime of the existing magnet?

Operational cost

- The yearly consumption of the existing magnet is $\sim$ 22.5 GWh (average 2015 – 2018).
- Assuming a tariff (post ARENH) of 140 EUR / MWh, operational cost in the Upgrade II era would be $\sim$ 3.15 MEUR / y.
- Cost savings alone unlikely to be enough to justify rebuilding the magnet.

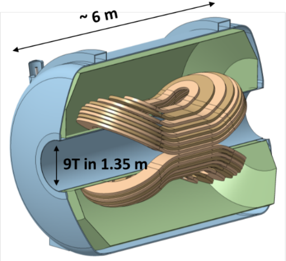


Feasibility

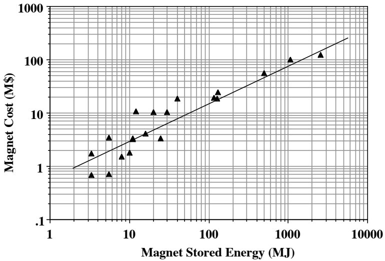
Preliminary feedback from ATLAS/CMS experts:

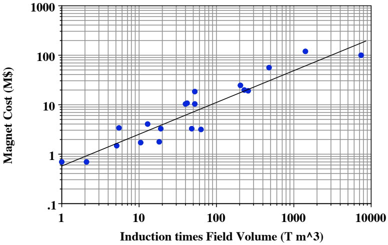
- Timescale is ambitious.
- Dipole magnets are mechanically more challenging than solenoids.
- Operating a superconducting magnet requires significant resources.

Would need to find partners with expertise in magnet design and resources.



MADMAX magnet design (CEA Saclay).

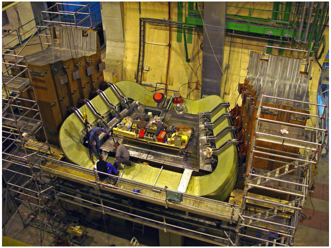




Cost of superconducting detector magnets (in 2007 $), not including refrigeration cost.

M. A. Green and B. P. Strauss, IEEE Transactions on Applied Superconductivity 18 (2008), 248 – 251

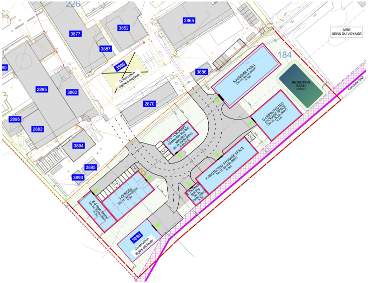
- To move forward with a cost estimate, we should define a basic set of specifications ($\int B dl$, peak B field, length along z, aperture).
- How would we manage stray fields? Can we reuse (part of) the yoke?



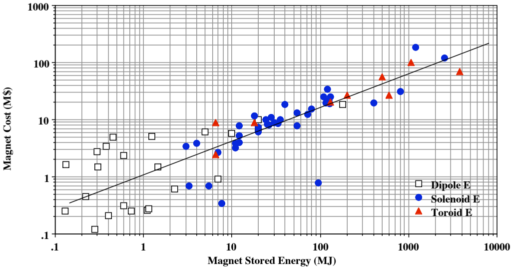
Installation procedure (original installation, beginning of 2003 – mid 2004):
https://indico.cern.ch/event/415470/contributions/998011/

Assembly facilities and temporary storage

- Existing assembly facilities at Point 8 (SXL8 building, “grey room” in SX8) have been fully occupied by SciFi and UT during LS2.
- Mighty Tracker assembly will need at least the same space. Unlike for Upgrade I, other detectors will need significant space on the surface too.
- Expansion of Point 8 site towards the airport would provide space for additional assembly and storage buildings. Timeline is very challenging (buildings to be ready by start of Run 4).



Preliminary layout (CERN SCE department) to support discussions by CERN Host States Relations service with land owners and authorities. Not valid for execution.


1000
100
10
1
.1
Magnet Cost (M$)
.1
1
10
100
1000
10000
Magnet Stored Energy (MJ)
Dipole E
Solenoid E
Toroid E