

Overview of the CSC schedule in LS2

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for the CSC group

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CSC/GEM Workshop

Northeastern



LS2 CSC Upgrade

- Scope of LS2 Upgrades

- ME1/1 72 chambers
 - DCFEB → xDCFEB
- MEx/1 (x=2,3,4) 108 chambers
 - CFEB → DCFEB
 - LVDB
 - ALCT mezzanine
 - TMB → OTMB + DCFEB → OTMB fibers
 - LV Supply + junction boxes
 - Water cooling flow restrictors
- ALCT mezzanine (ME2/2, ME3/2)

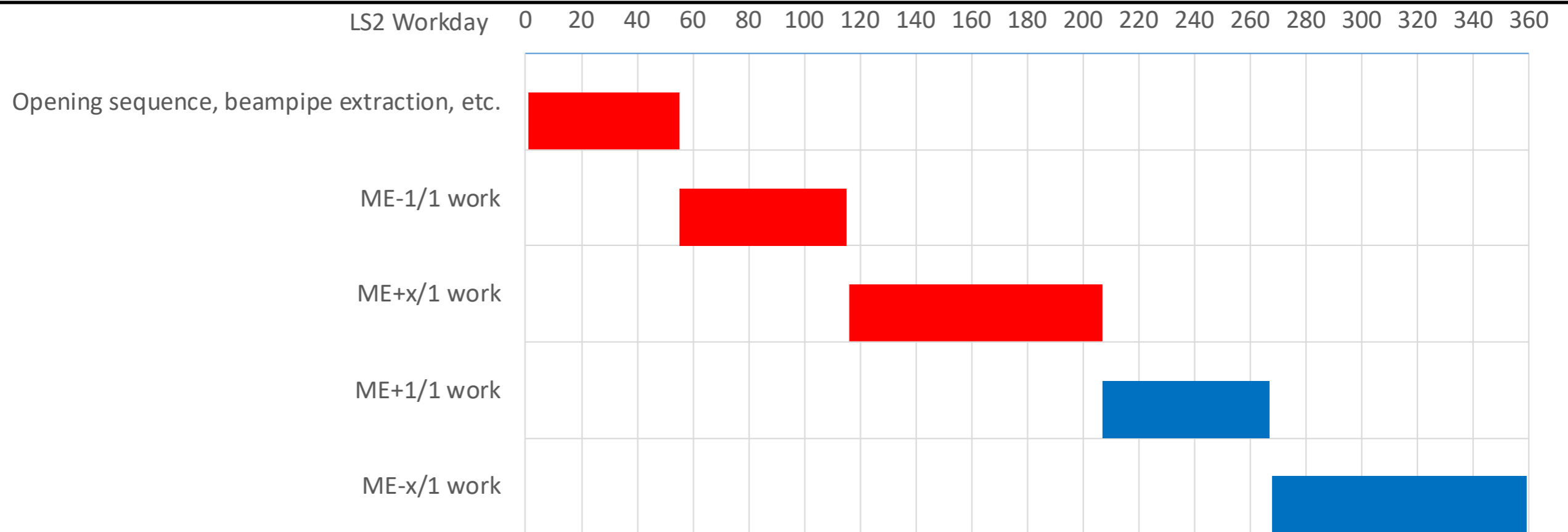
Extraction to surface → storage → refurbishing → initial testing → long-term testing (burn-in) → final testing → storage → reinsertion → commissioning

CSC Schedule Priorities

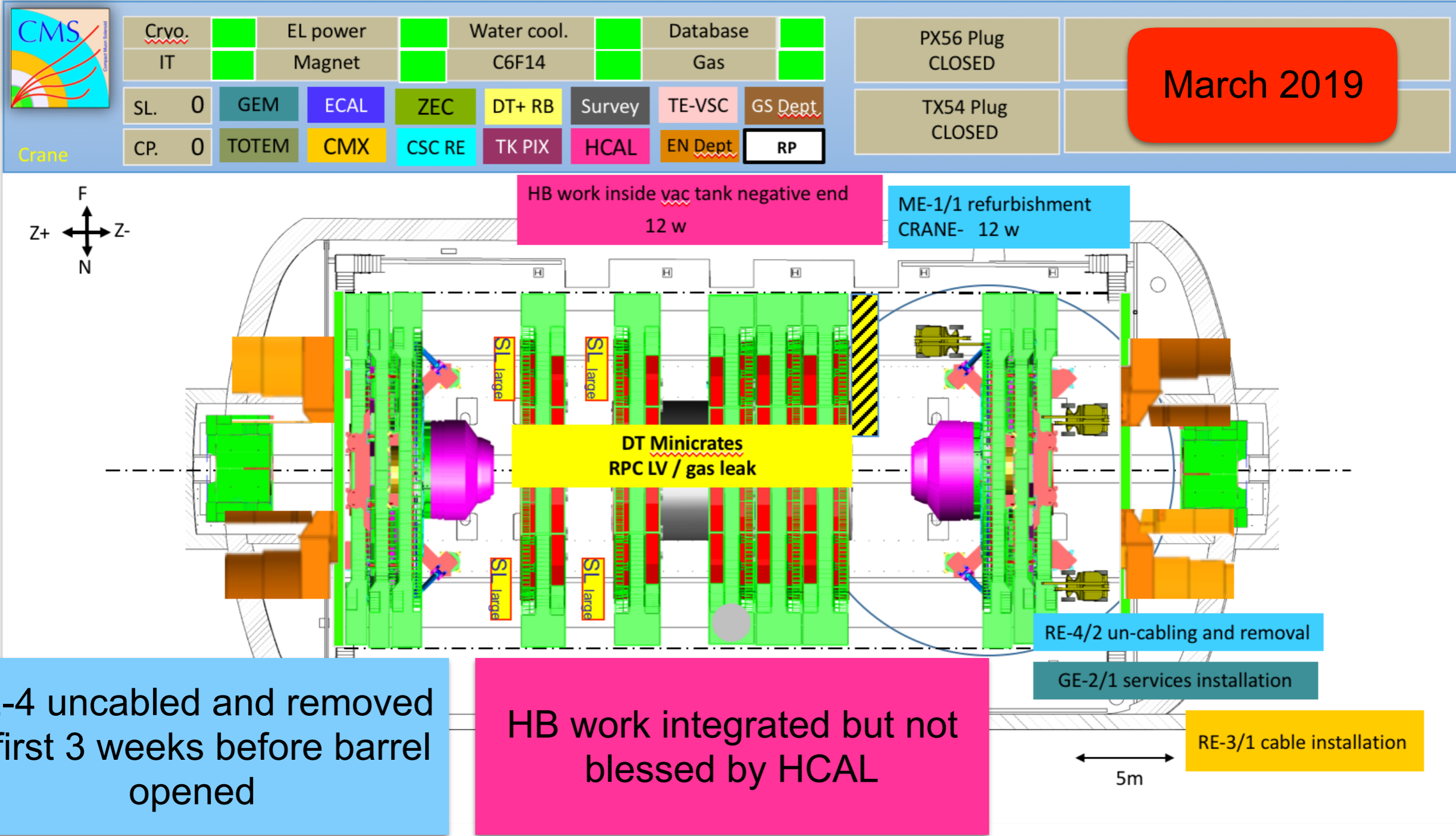
- Safety and integrity of the project
 - Need realistic estimates of all pieces of the timeline
- Flexibility - optimize schedule to
 - leave open possibilities to move to other areas if we work faster than expected
 - provide best chance of success in the event of delays or setbacks
- Coordination with central CMS
 - CSC sets critical path for endcap sequence, HE for barrel

LS2 Schedule

- **CSC work + GE1/1 installation drive LS2 endcap critical path**
 - Extraction to surface → storage → refurbishing → initial testing → long-term testing (burn-in) → final testing → storage → reinsertion → commissioning
- **UXC and surface work parallelized as much as possible**



CSC Sequence 1/4

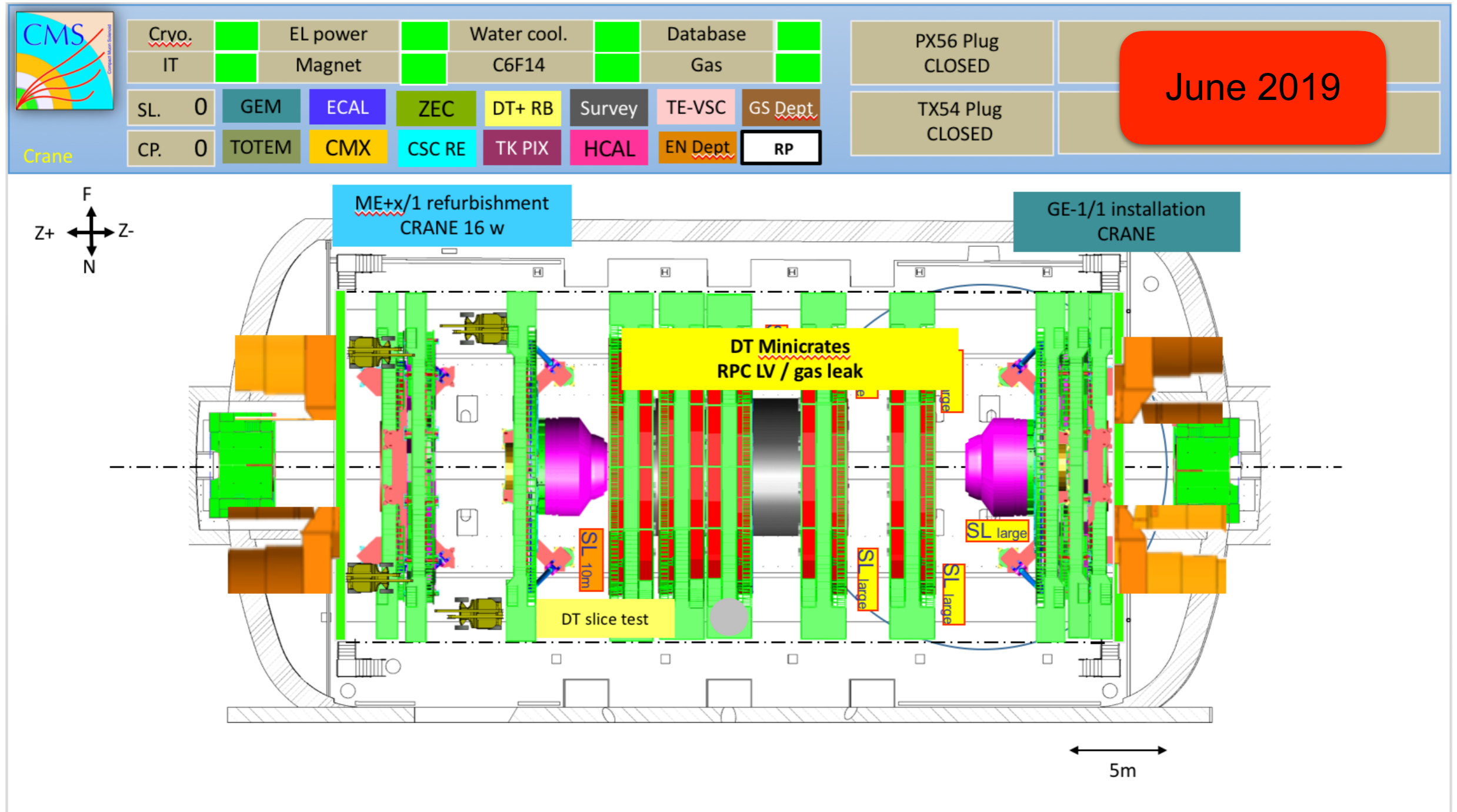


RE-4 uncabled and removed in first 3 weeks before barrel opened

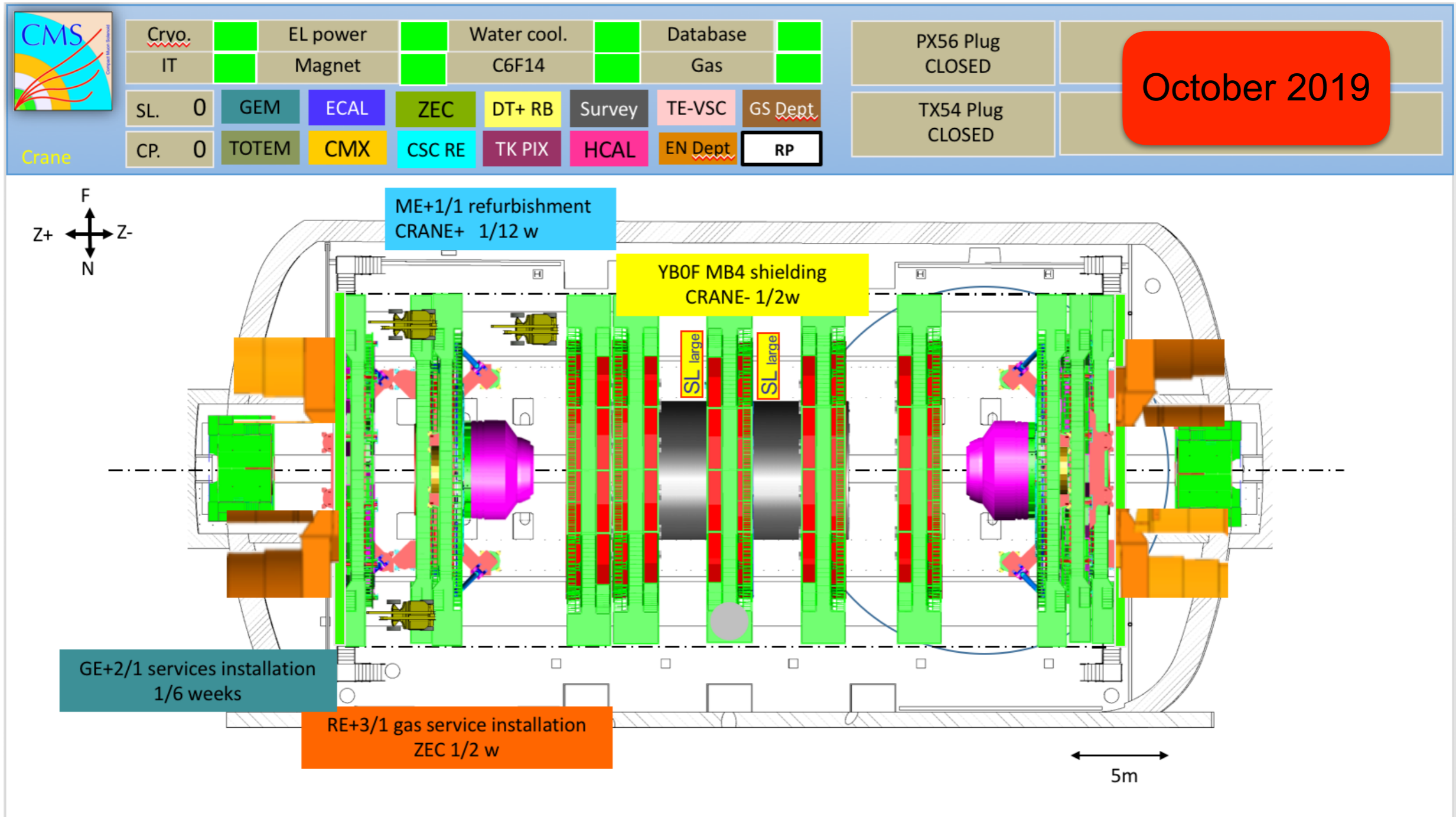
HB work integrated but not blessed by HCAL

First batch DCFEBs needed

CSC Sequence 2/4

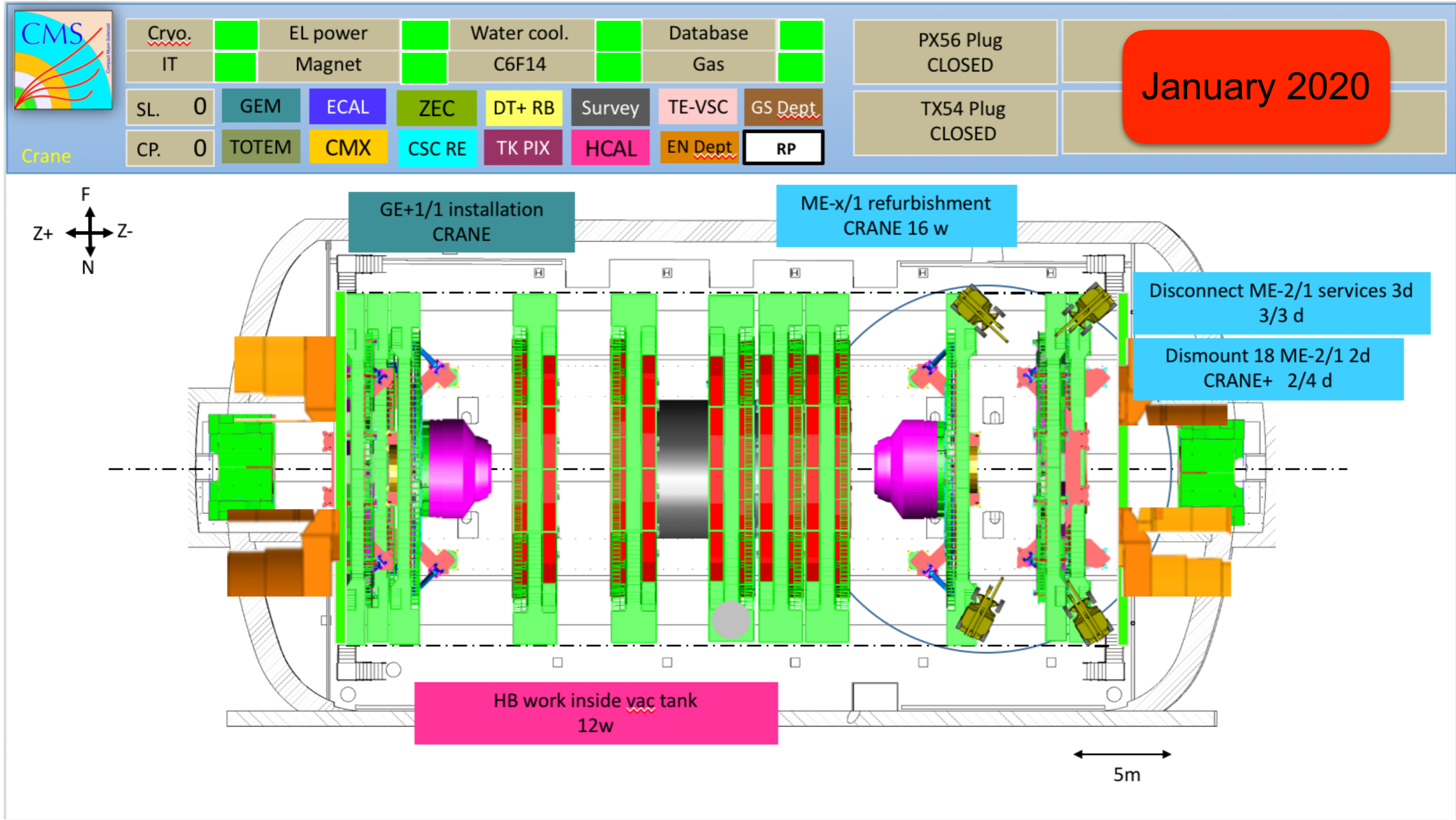


CSC Sequence 3/4



Second batch DCFEBs needed

CSC Sequence 4/4



Refurbishment & Testing - SX5

- Require full test stand with gas and HV for testing (short testing & long term burn-in)
- LS1 ME1/1 refurbishment area at SX5 (~225m²)
 - All required racks, computers, gas + power services, testing sites already available
- Need to use overhead crane due to size and weight of chambers
- Build new supports to store & refurbish chambers to minimize handling and maximize efficiency



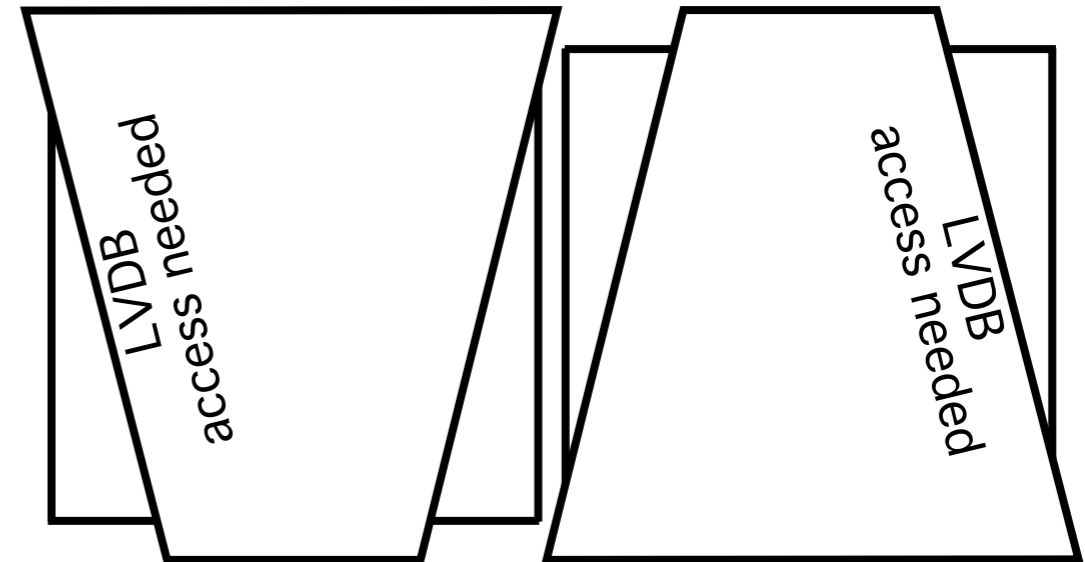
Refurbishment & Testing - SX5

- SX5 area needs to be cleaned up
 - Some boxes of skew-clear cables moved to b904, some unused material moved to trash
 - Target end July for completely emptied area



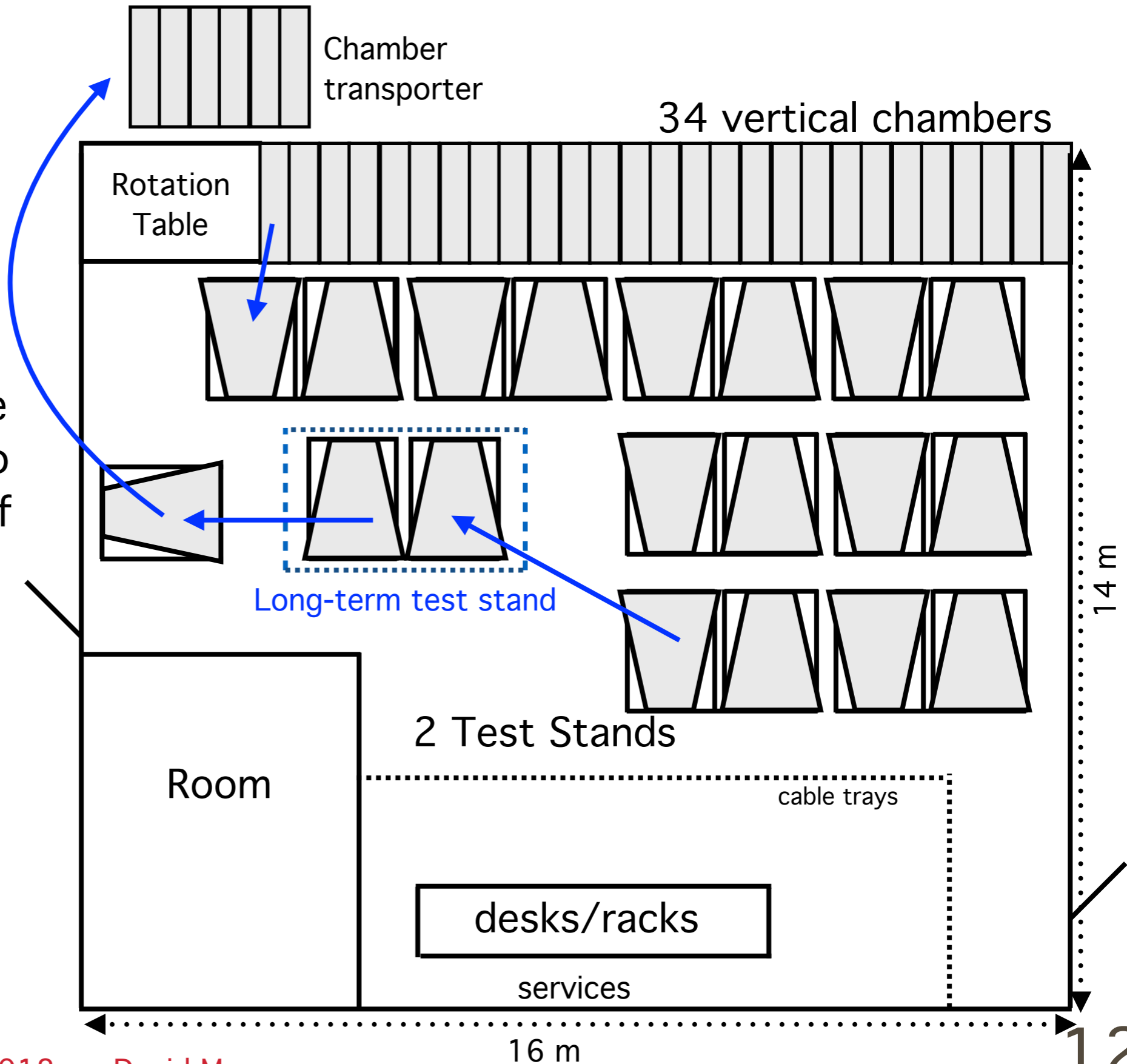
Chamber storage configuration

- Laying as many chambers as possible flat allows easy access to all electronics, minimizes reliance on overhead crane
- Construct multiple 1-chamber moveable tables
- Store removed electronics in bins underneath
- Need to design tables in early summer



SX5 area layout

- 20 chambers laid horizontally on 20 moveable tables, 34 chambers stored vertically
 - Updated plan to have individual table for each chamber to increase flexibility of movement
- Translate tables from refurbishment area to FAST site to LTT to extraction point
- Allows maximum chamber movement without crane



LS2 off-chamber upgrades

- **Optical fibers**

- 2 fiber bundles per chamber, must be run from chamber to peripheral crate at installation. OTMB fibers connected, ODMB fibers connected in LS3.

- **TMB→OTMB**

- **Maraton + junction boxes**

- 12 additional Maraton LV power supplies needed to supply higher current DCFEBs; upgraded OPFC in USC, CANBus in UXC.

- **Cooling**

- Cooling line flow restrictors sit on the periphery of the disk, on the return valves located along the endcap cooling manifolds (3 chambers / cooling loop). They will be changed to increase flow rate to cope with higher current/temperature DCFEBs (2.3→4 l/min).

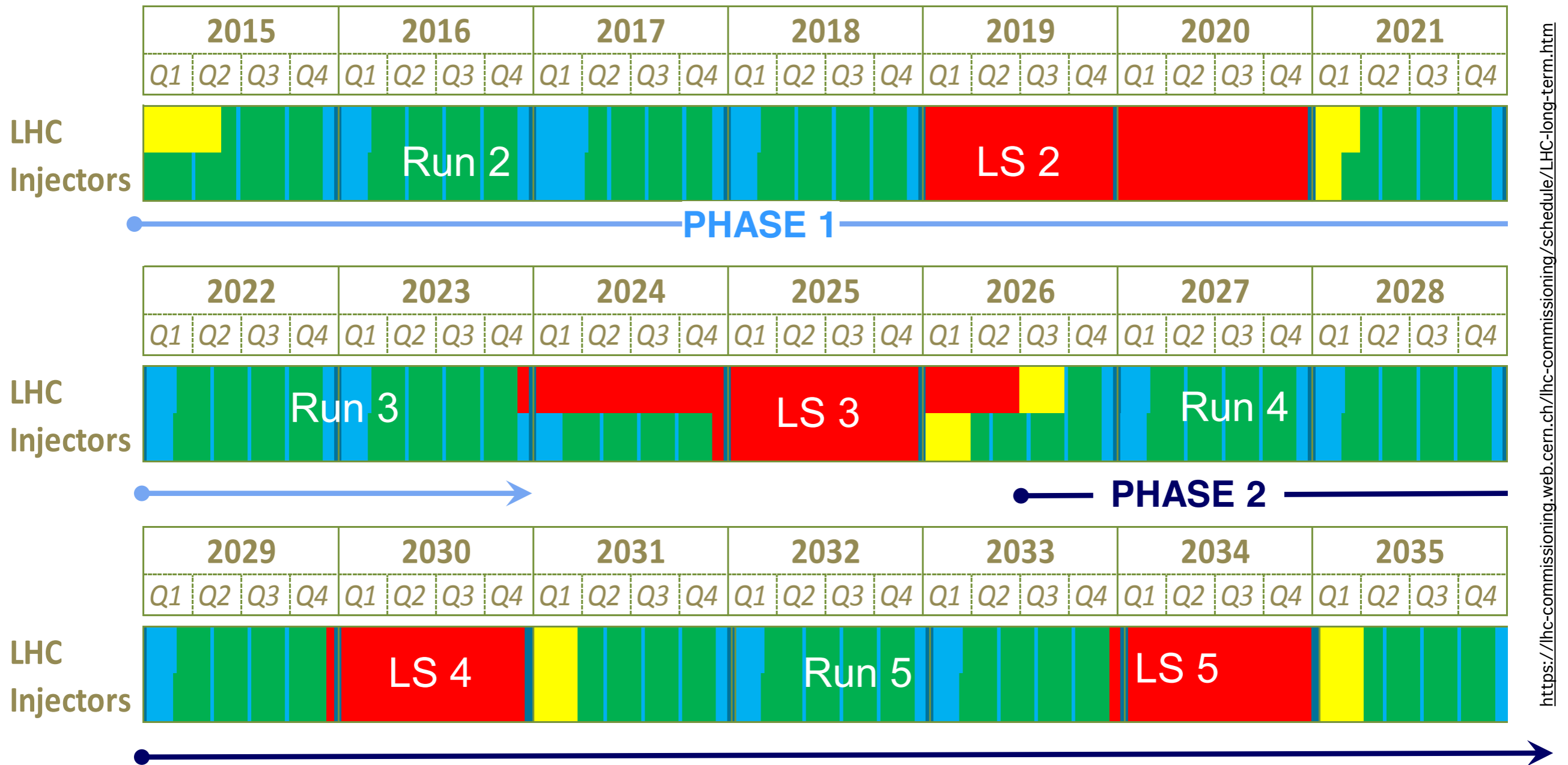
- **Everything except running of optical fibers is independent of CMS configuration.**

Summary

- CSC work optimized to ensure success and provide options in case of problems
- First batch of DCFEBs needed before beginning of March 2019, second batch before October 2019

BACKUP

LHC Timeline



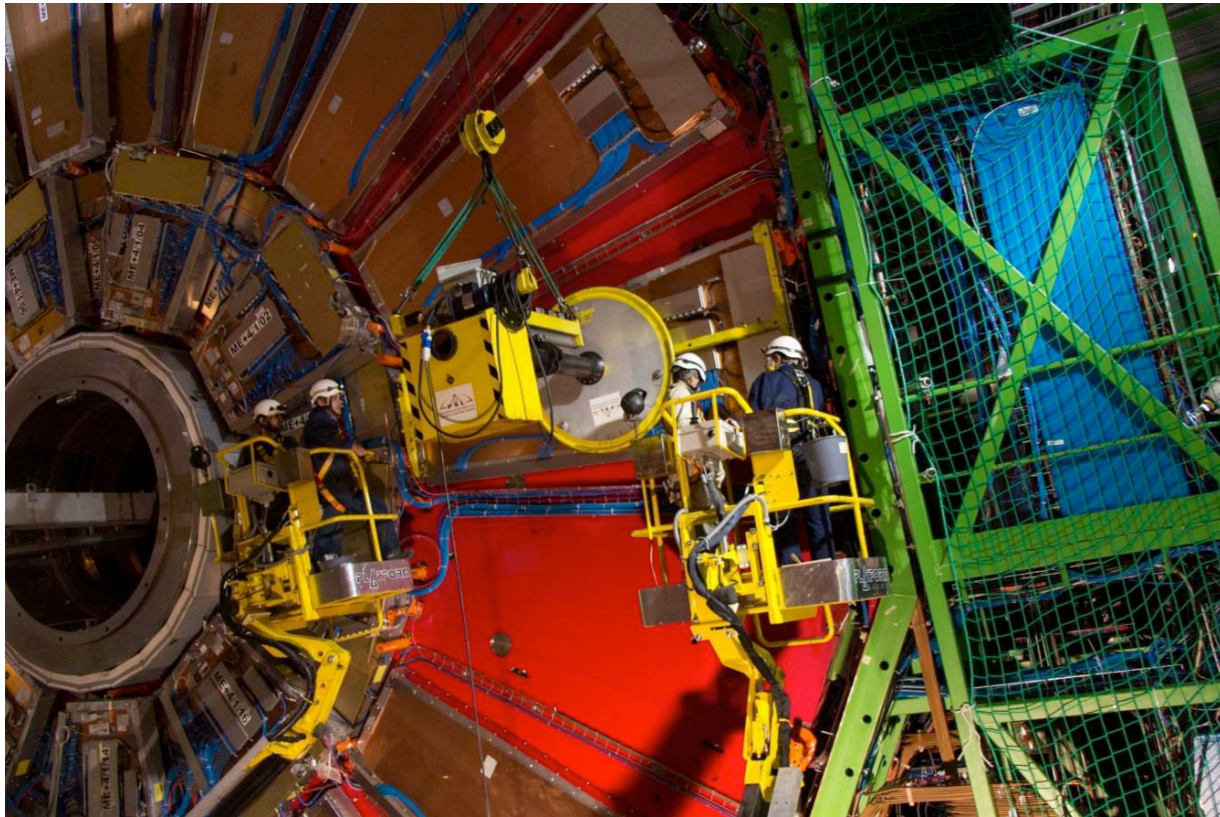
<https://lhc-commissioning.web.cern.ch/lhc-commissioning/schedule/LHC-long-term.htm>

CSC Upgrades for HL-LHC (Run 4 and beyond) will be staged over LS2 and LS3

Extraction

- Extraction of ME4/1 also requires extraction of all RPC chambers on YE3 disk
 - Have experience in this from ME4/2 addition
 - RE4 must be stored safely with access to services
 - Accounted for in LS2 schedule
 - Storage location still undecided

Extraction and transport to SX5



- 72 ME1/1 chambers
- 108 MEx/1 chambers
- Extraction requires 2 cherry pickers and installation fixer
- Can extract 2-5 chambers/day

- Have 2 Chamber transporters, which hold maximum 6 chambers of any type
- Must be serviced in advance of LS2



Reinsertion / Commissioning

- **Reinsertion and commissioning parallelized**
 - Reinsert all ME2/1 first and start commissioning them while other MEx/1 are being refurbished / reinserted
 - Multiple teams of experts dedicated to individual tasks
- All chambers must be fully re-tested in situ
 - Requires cooling and gas services
 - Requires continued access to disks in case of problems