

GE1/1 production for LS2 and GE2/1 production schedule

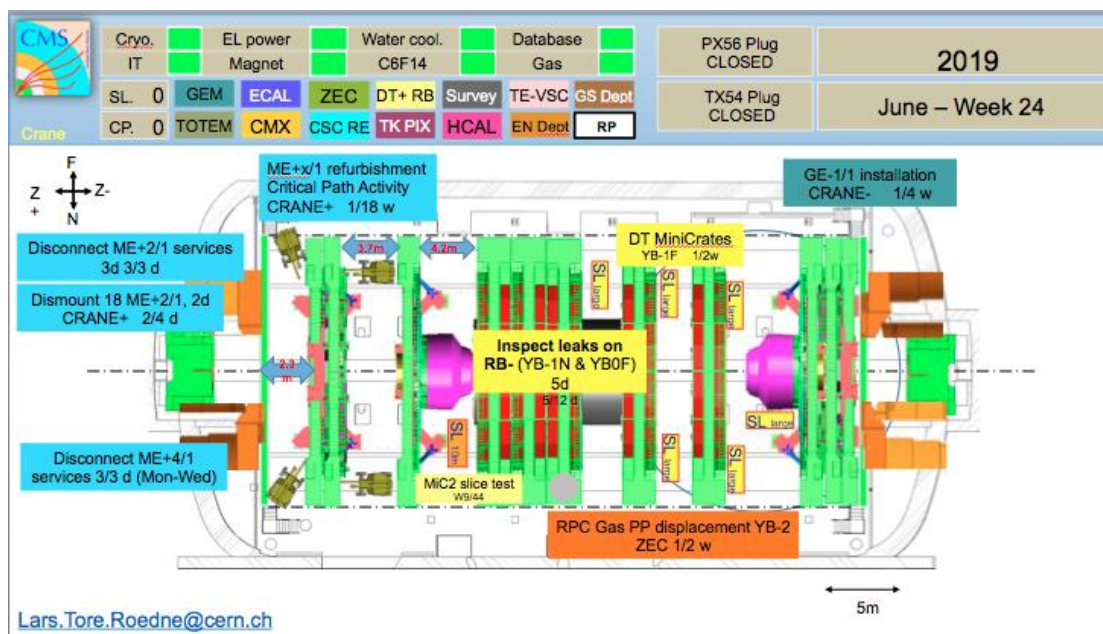
M. Bianco on behalf of the GEM TC

Outline

- GE1/1 Installation Schedule
- GE1/1 SC Integration & QC8 Tests time
- QC8 Test Stand upgrade for GE2/1 (Impact on GE1/1 tests)
- GE2/1-ME0 production sites & module distribution
- GE2/1 (TDR-Merlin) Electronic schedule
- GE2/1 Installation Schedule (Ready for installation)
- GE2/1 Chambers Integration & QC8 Tests time
- ME0 (TDR-Merlin) Electronic schedule

GE1/1 Installation Schedule

- GE1/1 Chambers Installation will proceed in two separate moments:
- Negative EndCap 10th June to 6th 2019 July (4 Weeks – 20 w.d.)
- Positive EndCap 27th Jan to 21st Feb 2020 (4 Weeks – 20 w.d.)



- Negative EndCap: ready for installation End Feb 2018 (No date in Merlin)
- Positive EndCap: ready for installation End Aug 2019 (No date in Merlin)

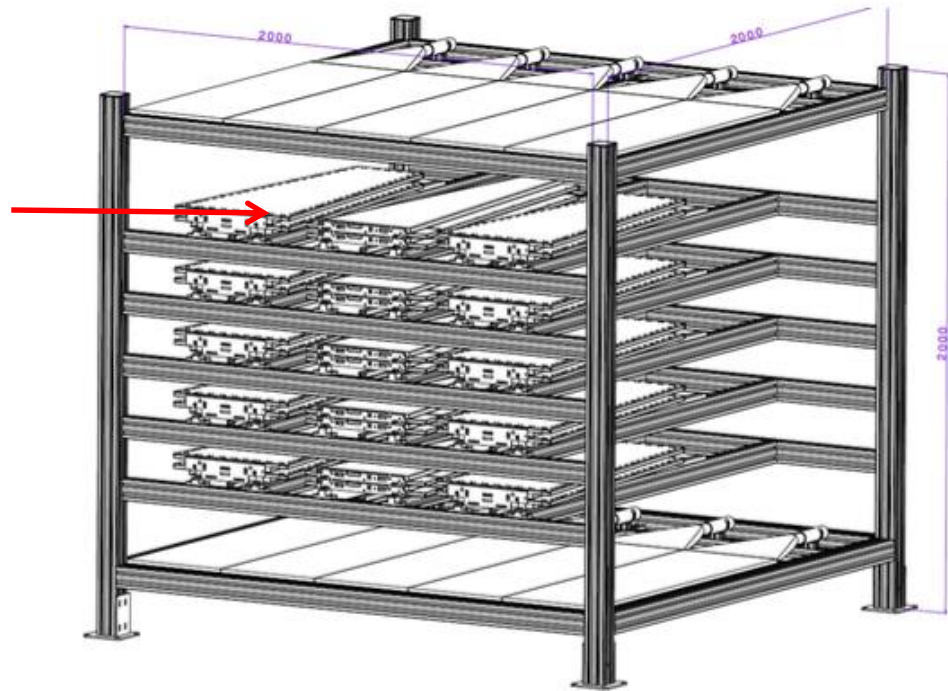
GE1/1 SC Integration and QC8 Tests time

- Expected at CERN by beginning of May:
 - 140 VFAT3
 - 10 GEBv3-S, 6 GEBv3-L and 6 OH
- Expected at CERN in June :
 - 10 pieces of each GEB and 20 OH
 - 1000 VFAT3 Hybrids
- From July
 - Full speed: 10 GEBv3-S, 10 GEBv3-L and 40 OH
- Mechanical assembly will take 2 days for each SC
- Expect to assemble 2 SC + ½ SC by end of May (3rd SC to be completed as soon as the missing VFAT will arrive), than 3 SC in June and 4 SC/month till Aug, from September Full Speed 8 SC/months
- QC8 Test test designed to host up to 15 SC in parallel, to be completed by end of May, during the SC production phase SC can be under QC8 Test up to ~ 2 months
- 38 SC expected to be assembled by Dec 2018, second nose assembled by end of Apr 2019

QC8 Test Stand upgrade for GE2/1

From Apr 2019, QC8 capacity will be reduced to 12 GE1/1 SC to allow for first GE2/1 tests at CERN

Layer of the QC8 test stand to be used for first electronic integration tests at CERN from April 2019



GE2/1 –ME0 modules for production sites

GE2/1 – ME0 assembly module will be distribute between several assembly sites, actually the schedule is built with the assumption of 4 production sites

Each assembly site is expected to take care of 72 GE2/1 modules and 54 ME0 modules

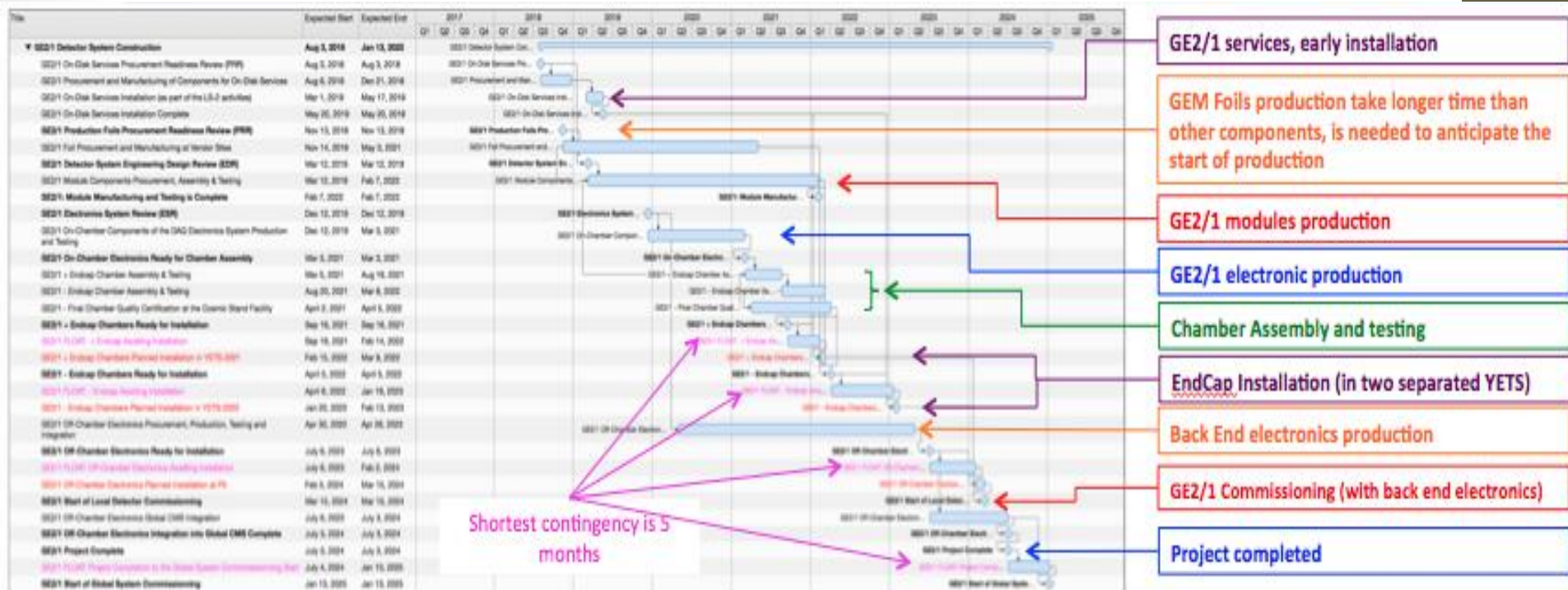
The time allocated in the schedule for the production of each batch of GE2/1-ME0 modules has been tuned on the experience of GE1/1 assembly pace adding the time needed for the shipment of the module components and receive back the assembled module

Additional production site are under evaluation for the production these can speed up the module production rate

Prod site	GE2/1	ME0
#1	M1 (72 modules)	54 modules (1/4 total prod.)
#2	M2 (72 modules)	54 modules (1/4 total prod.)
#3	M3 (72 modules)	54 modules (1/4 total prod.)
#4	M4 (72 modules)	54 modules (1/4 total prod.)

- No overlap in assembly/test phases in all production sites are presents
- The GE1/1 module assembly will end by 2018 Summer, well in advance of the start of GE2/1 module assembly
- GE2/1 assembly modules phase is expected to be concluded by 7th Jan 2022 and the ME0 assembly is expected to start on 3rd June 2022 (4 months of float plus the intrinsic float accounted for each module assembly)

GE2/1 Schedule Overview



2.5.2.5.6.1	GE2/1 Disk 1: Move chambers from 904 to P5	10-Feb-22	2-Mar-22
2.5.2.5.6.2	GE2/1 Disk 1 Chamber Installation	15-Feb-22	7-Mar-22
2.5.2.5.6.3	GE2/1 Disk 1 Chamber Services Connection and Testing	17-Feb-22	9-Mar-22
2.5.2.5.6.4	GE2/1 Disk 2: Move chambers from 904 to P5	17-Jan-23	6-Feb-23
2.5.2.5.6.5	GE2/1 Disk 2 Chamber Installation	20-Jan-23	9-Feb-23
2.5.2.5.6.6	GE2/1 Disk 2 Chamber Services Connection and Testing	24-Jan-23	13-Feb-23

GE2/1 Electronic Schedule

Task (From R&D to ESR)	Start Date	End Data
GE2/1 DAQ Electronics Design and Prototyping	Jun 17, 2016	Dec 14, 2017
GE2/1 Demonstrator DAQ Electronics Production & Testing	Dec 15, 2017	June 4, 2018
GE2/1 Final Demonstrator Production & Testing	May 9, 2018	Mar 6, 2019
GE2/1 Detector System Engineering Design Review (EDR)	Mar 12, 2019	Mar 12, 2019
GE2/1 DAQ Electronics Integration with Final Backend Technology and Testing	Mar 7, 2019	Dec 11, 2019
GE2/1 Electronics System Review (ESR)	Dec 12, 2019	Dec 12, 2019

- GE2/1 Modules design almost completed, (RO boards expected to be finalized one per week)
- Material procurement and components production will start beg. May 2018
- Modules assembly and qualification from July to October 2018
- **First GE2/1 chamber ready at CERN for integration with preliminary FE Electronics Nov 2018**
- **The assembled two GE2/1 working prototype will be used in Apr 2019 for mechanical integration in CMS experiment (strongly suggested by CMS TC)**
- **End of Apr 2019 on working GE2/1 chamber shipped to FIT for electronic test**

GE2/1 ready for installation

Task (Mass Production)	Start Date	End Data
GE2/1 On-Chamber Components of the DAQ Electronics System Production and testing	Dec 12, 2019	Mar 3, 2021
GE2/1 On-Chamber Electronics Ready for Chamber Assembly	Mar 3, 2021	Mar 3, 2021
GE2/1 Endcap 1 Chamber Assembly & Testing	Mar 5, 2021	Aug 19, 2021
GE2/1 - Endcap 2 Chamber Assembly & Testing	Aug 20, 2021	Mar 8, 2022
GE2/1 - Final Chamber Quality Certification at the Cosmic Stand Facility	April 2, 2021	April 5, 2022
GE2/1 1 Endcap Chambers Ready for Installation	Nov 16, 2021	Nov 16, 2021
GE2/1 1 Endcap Chambers Ready for Installation	April 5, 2022	April 5, 2022

- **GE2/1 Modules production expected to start in May/June 2019**
- Possibility to start the GE2/1 integration earlier than what expected in Merlin schedule (Mar 5 2021), middle 2020 is a reasonable date; electronic mass production expected to be launched by Dec 2019, first batches of electronics could be used
- **In the actual schedule only 5 months are considered for the QC8 (cosmic test) of the first EndCap chambers (36 chambers), QC8 for GE2/1 could handle only 5 chambers in parallel in this picture only only ~3 weeks per chamber will be available for the final certification**

ME0 Electronic Schedule

Task (From R&D to ESR)	Start Date	End Data
ME0 DAQ Electronics Principle and Engineering Design and Prototyping	Nov 14, 2016	Aug 21, 2020
ME0 DAQ Electronics for Final Demonstrator Manufacturing & Testing	July 16, 2018	Aug 21, 2020
ME0 Module and Chamber (stack) Prototypes Mechanical Testing	Dec 20, 2018	July 7, 2020
ME0 Final Demonstrator: Full Chamber (stack) Integration & Testing	Feb 2, 2021	Oct 27, 2021
ME0 Detector System Engineering Design Review (EDR)	Oct 28, 2021	Oct 28, 2021
ME0 Electronics System Review (ESR)	Apr 27, 2021	Apr 27, 2021

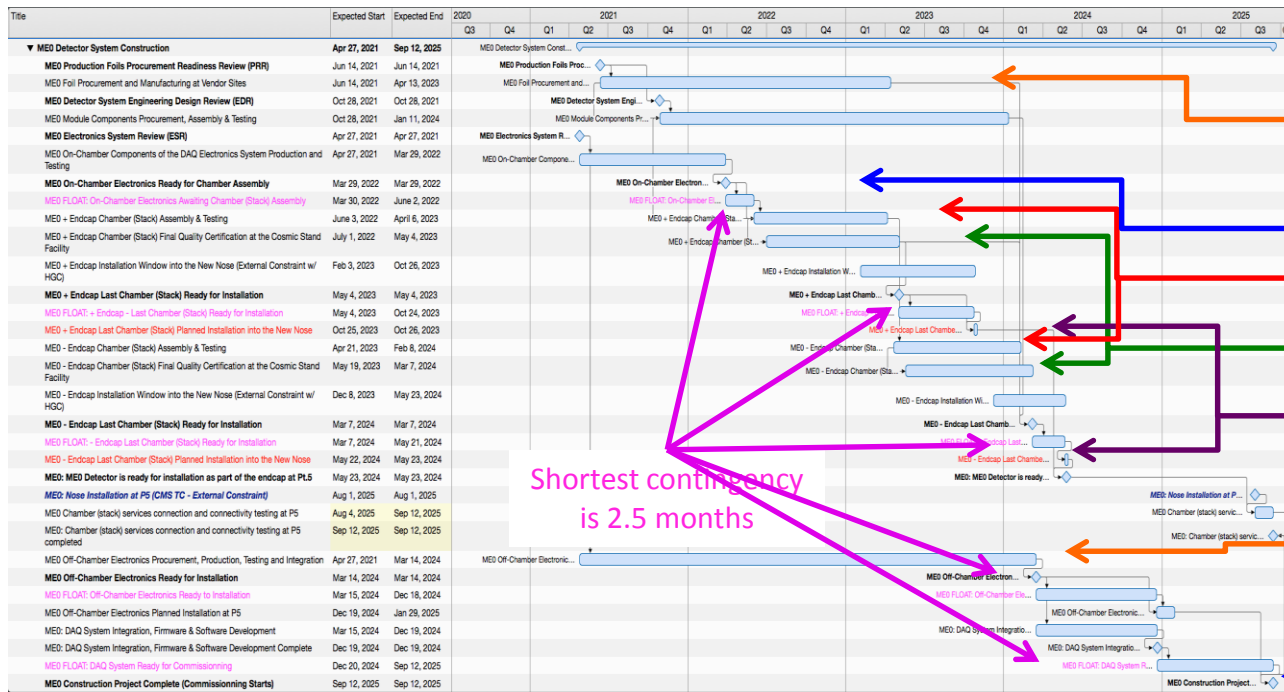
- ME0 Module and Stack mechanical design completed
- ME0 module design will start as soon as the GE2/1 modules design will be completed and validated
- **At least one ME0 module, expected to be ready and available for electronic tests by Nov 2019**

Backup

GE2/1 milestones

W.B.S	Title	Planned End
2.52.10.85	Full Size Chamber Prototype with Partially Instrumented Readout Built, Tested	May 1, 2018
2.5.2.10.106	Chamber Design Optimization Studies Completed, Chamber Design Finalized	May 8, 2018
2.5.2.10.120	PRR for On-Detector Services for Installation in LS2	Aug 3, 2018
2.5.2.10.140	PRR for Foil Production	Nov 13, 2018
2.5.2.10.170	EDR	Mar 12, 2019
2.5.2.10.185	On Disk Services Installation at P5 is Complete	May 20, 2019
2.5.2.10.200	ESR	Dec 12, 2019
2.5.2.10.210	On-Chamber Electronics Manufacturing and Testing Completed	Mar 3, 2021
2.5.2.10.260	Chamber for Disk-1, Assembled, Tested and Ready for Installation	Nov 18, 2021
2.5.2.10.275	Installation data agreed upon with TC Endcap 1	Feb 14, 2022
2.5.2.10.300	Chamber for Disk-2, Assembled, Tested and Ready for Installation	Apr 5, 2022
2.5.2.10.360	Installation data agreed upon with TC Endcap 1	Jan 19, 2023
2.5.2.10.390	Detector Commissioning Starts	Mar 15, 2024
2.5.2.10.400	Global System Commissioning Starts	Jan 13, 2025

ME0 Schedule Overview



- GEM Foils production take longer time than other components, is needed to anticipate the start of production
- ME0 on chamber electronic production
- ME0 modules production
- Stack Assembly and testing
- EndCap Installation
- Back End electronics production
- Project completed

Shortest contingency is 2.5 months

Critical path for the ME0 project:

- Chamber (stack) assembly has to finish in time to allow HCG electronic installation
- Assembly is driven by GEM module production
 - On-chamber electronics production is not on the critical path
- Shortest float is currently 2.5 months for the last stack of the “-” Endcap
 - The pace is driven by the module production, not stack assembly
 - Baseline schedule assumes that module production pace is the same both early and late in the production cycle
 - There is potential to speed up module production if necessary (also tracked in risk register)

ME0 milestones

W.B.S	Title	Planned End
2.5.3.10.75	Chamber (stack) prototype mechanical design completed	Dec 18, 2018
2.5.3.10.85	Chamber (stack) prototype mechanical prototype testing and validation completed	Dec 24, 2019
2.5.3.10.95	On Chamber Electronic prototype manufacturing and testing completed	Aug 21, 2020
2.5.3.10.120	ESR	Apr 27, 2021
2.5.3.10.120	PRR for foils production	Jun 14, 2021
2.5.3.10.140	EDR	Oct 28, 2021
2.5.3.10.170	On chamber Electronics Manufacturing and Testing complete, ready for stack assembly	Mar 29, 2022
2.5.3.10.200	Chamber for Disk-1, Assembled, Tested and Ready for Installation	May 4, 2023
2.5.3.10.210	Off-Chamber Electronics Manufacturing and Testing completed	Jun 8, 2023
2.5.3.10.225	Detector Disk 1 -Need by Date for Insertion into the New Nose	Oct 10, 2023
2.5.3.10.275	Chamber for Disk-2, Assembled, Tested and Ready for Installation	May 9, 2024
2.5.3.10.285	ME0 Detector ready for installation as part of the endcap at Pt.5	May 23, 2024
2.5.3.10.295	Nose Installation at P5	Aug 1, 2025
2.5.3.10.300	Full Detector Commissioning Starts	Sep 12, 2025

M. Bianco UCG Review, GEM Schedule 23 - Jan - 2018

252	GE2/1 Demonstrator DAQ Electronics Production & Testing	Dec 15, 2017	June 4, 2018
253	GE2/1 Final Demonstrator Production & Testing	May 9, 2018	Mar 6, 2019
254	GE2/1 Detector System Engineering Design Review (EDR)	Mar 12, 2019	Mar 12, 2019
255	GE2/1 DAQ Electronics Integration with Final Backend Technology and Testing	Mar 7, 2019	Dec 11, 2019
256	GE2/1 Electronics System Review (ESR)	Dec 12, 2019	Dec 12, 2019