



EP-DT
Detector Technologies

Work package between EP-DT and CMS for the construction, installation and commissioning of the Flushing Gas System for the CMS Phase-2 Dry Gas Upgrade

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EDMS: <https://edms.cern.ch/document/2884256/1>

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Flushing systems in this work package

EDMS: 2884256

- Dry flushing gas system in P5 surface
 - 1 SX5 Dry Air Action Panel
 - 1 SXA5 Dry Air Control Panel
 - 2 Distribution racks for HGCAL and ETL Z+ and Z-
 - 1 Distribution rack for ETL testing Facility in SXA5 Mezzanine
 - 1 Distribution rack for HGCAL cassettes clean room in SXA5 Cleanroom
 - 1 Distribution rack for HGCAL cassettes clean room in SXA5 Cleanroom FabLab
- P5 Endcap + 2 PACL Dry Gas Distribution flushing gas system in USC mezzanine
 - 1 Hypoxic Air Action Panel
 - 1 Dry Air Action Panel
 - 1 2PACL distribution rack for the Phase-2 CO2 cooling
 - 1 Action panel-back-up for the HGCAL and ETL
 - 2 Distribution racks for HGCAL and ETL Z+ and Z-, located in UXC X0
- ~~Refurbishment of the gas room existing racks~~ —> not included in this wp
 - It is part of the Phase-2 Dry gas upgrade and within the scope of activities of EP-DT-FS
 - This refurbishment can take place in LS3 following an analogous configuration to the racks included in this work package but with the possibility of reusing existing infrastructure
 - A second work package will be done later

What is included in the work package

The DT team has not revised any logic of the flushing system in case of shortage of the main supply line or failure of components. This task is left to CMS team.

- **Design**
 - Usually DT gas team takes note of the requests and deliverables and prepares P&ID and logic of the system
 - In this case, CMS Flushing Team decided to directly implement the design of the system by providing the P&ID drawings and by defining the logic for the operation of the system
 - No revision in term of functional analysis and logic has been done by DT Gas Team
- **Implementation**
 - Selection and procurement of the components
 - Purchase of components based on standard gas system materials used by gas team
 - Design of the modules (usually with 3D drawings)
- **Construction**
 - Construction of the different racks in the EP-DT-FS workshop by using FSU team
 - Electrical cables and connectors on sensors. Length of cables to be provided by CMS Flushing Team.
 - No connection to PLC (under CMS Flushing team responsibility).
 - Leak test in EP-DT-FS workshop

What is included in the work package

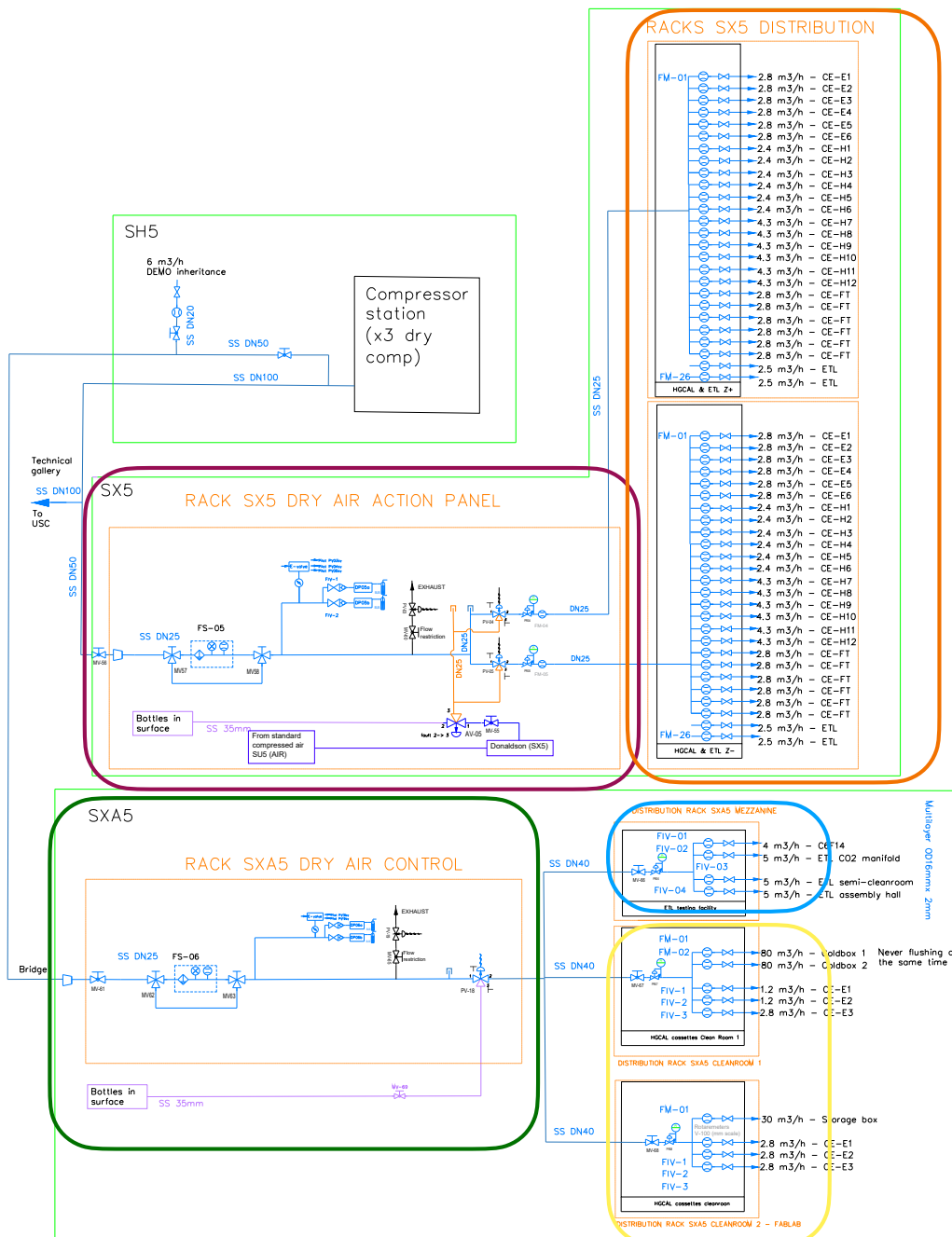
- **Installation and commissioning**
 - Installation in location defined by CMS Flushing Team
 - No connections (electrical and pipes) between the different racks and locations
 - Participation to the commissioning of the flushing system: final leak tightness test, support in case of faulty sensors, connectors, etc.
- **Resources**
 - One physicist staff: B. Mandelli —> supervision of the project under DT gas team responsibility
 - One technical staff: A. D’Auria —> list of material, purchase of material, supervision and help in construction of the system and installation
 - FSU team: one welder, one mechanical and one electrician —> construction of the system —> to be paid by CMS
- **Future operation and maintenance**
 - Operation in responsibility of CMS Flushing Team
 - No piquet foreseen, if needed only intervention during working hours
 - Standard maintenance will be done by EP-DT Gas Team. All material under EP-DT Gas Team maintenance will be in INFOR
 - No maintenance of dew-point analysers

What is not included in the work package

Only the areas in the orange and pink squares in the P&ID are part of this wp agreement

- Control hardware and software: CMS team expressed the willing to completely deal with it.
- DT team will provide only wired cables of each sensor
- Final commissioning of the system is under CMS Team responsibility: I/O checks, check of software logic, etc.
- EP-DT Team will provide support in case of faulty sensors, connectors, etc.
- The preparation of the electrical connection to the general network and/or any secured network requested by CMS.
- All pipes and connectors outside the racks and connections between the different racks are not part of this work-package.
 - The definition of number and type of cables and pipes needed to connect the different racks
 - The definition of the diameter of the pipes
 - Procurement of cables and pipes outside the racks
 - Installation of cables and pipes outside the racks
- The distribution lines to the detector is under CMS responsibility
- Safety valves are present at pressure regulators. The possibility of adding additional safety valves is under discussion with CMS Flushing team
- The dry and hypoxic air supply and back-up supply (N₂)
- Safety implication related to ODH risk have to be evaluated by CMS for the usage of N₂

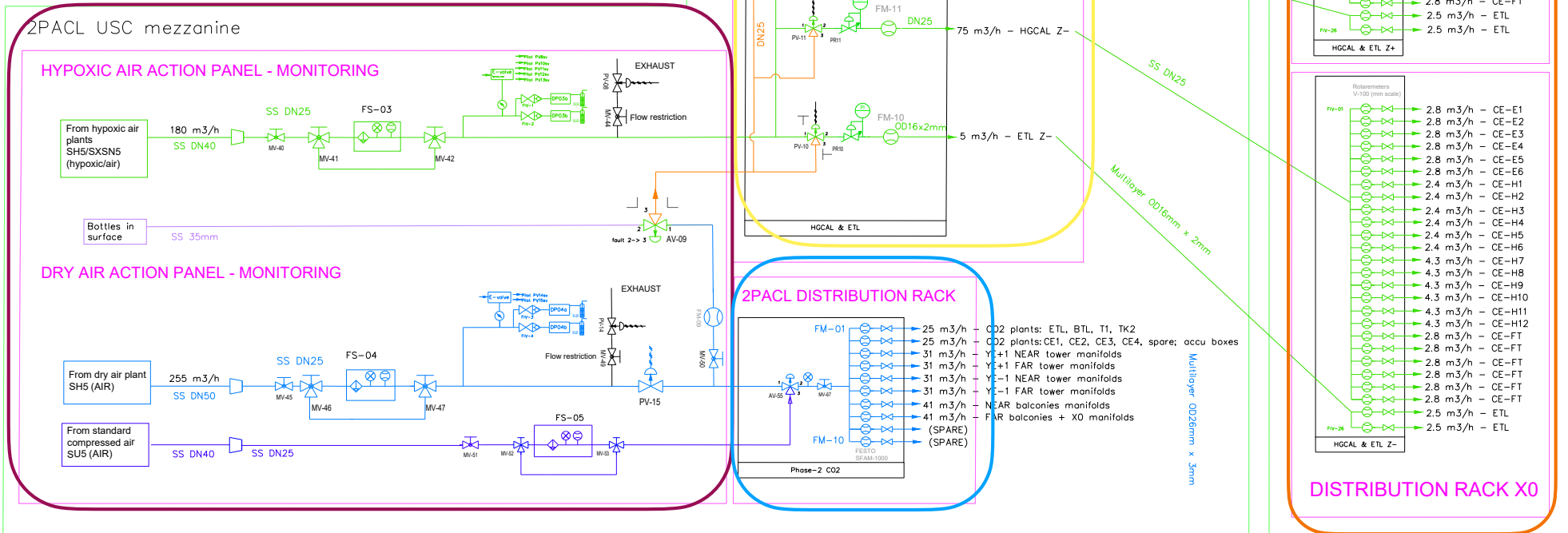
Costs and delivery dates: surface system



- 1 SX5 Dry Air Action Panel
- December 2024
- 16 kCHF
- 1 SXA5 Dry Air Control Panel
- February 2024
- 12.5 kCHF
- 2 Distribution racks for HGCAL and ETL Z+ and Z-
- December 2024
- 35 kCHF
- 1 Distribution rack for ETL testing Facility in SXA5 Mezzanine
- February 2024
- 8 kCHF
- 2 Distribution racks for HGCAL cassettes clean room in SXA5 Cleanroom
- February 2024
- 17 kCHF

Costs and delivery dates: underground system

- 1 Hypoxic Air Action Panel and 1 Dry Air Action Panel
- February 2024
- 21 kCHF
- 1 2PACL distribution rack for the Phase-2 CO2 cooling
- February 2024
- 13 kCHF
- 1 Action panel-back-up for the HGCAL and ETL
- EYETS 24-25
- 12 kCHF
- 2 Distribution racks for HGCAL and ETL Z+ and Z-, located in UXC X0
- Beginning of LS3
- 34 kCHF



Final cost estimations

	Hardware		FSU		FTE	Total
	Mechanical	Electrical	Mechanical	Electrical	(weeks)	(kCHF)
	(kCHF)	(kCHF)	(kCHF)	(kCHF)		
Dry flushing gas system in P5 surface	88.5	5	10	2.5	4	106
P5 Endcap + 2 PACL Dry Gas Distribution flushing gas system in USC mezzanine	81	5	10	2.5	4	98.5

- The material estimates are based on components used on previous DT installations, thus leading to a confidence level of about 10% on the hardware for the gas system.
- A detailed list of the material and cost for each single rack is provided in the excel files Pandl_rack_surface.xlsm and Pandl_rack_USCMezzanine.xlsm in EDMS 2884256.
- Service costs have been calculated on the basis of the current Field Support Unit (FSU PH-02) cost per hour. Existing DT staff is not accounted and will not be charged.
- All costs will be covered by CMS.
- The cost of material must be paid before the purchasing. Manpower cost will be paid at the end of commissioning.
- An additional cost of 6 kCHF will be charged for the rack conception and 3D drawings
- The electrical cost (cables and connectors) is an estimation, final number will be provided after the work

Schedule

Purchase of the material

- DT has already asked all price quotations and it is ready to order material at any time: waiting for confirmation of CMS team to proceed.
 - For some components new price quotations could be necessary

Construction

- Construction of each module can start only when all components will be available.
- The delivery time of some components is up to 6 months: CMS team already notified in March 2023 about this issue.
 - Long delivery time for FESTO modules FS-03, FS-04, FS-05, FS-06 (best expected delivery date November 2023). Therefore, the dry action panels could be delivered at beginning of 2024 (even material ordered now)
- Construction of the distribution modules will be done in summer 2023, provided that the material will be ordered by beginning of May
 - Long delivery time also for rotameters: at least 8 weeks
- Delay in the order of the material could imply to postpone the construction of the modules to end 2023/first trimester 2024 based on the other projects on-going in the DT workshop.

Commissioning

- Pre-Commissioning of each single modules will be done after its construction in order that it can be installed in CMS for the final cabling without waiting the completion of the other modules.
- Final commissioning of the system could be done only when all modules will be installed at P5.

Future operation and maintenance

Operation

- This flushing system will not be part of the work package for the M&O of LHC gas systems
- The operation of the CMS Phase-2 dry gas distribution Upgrade System will be covered by the CMS team.
- No piquet by Gas Team
- Possible interventions only during working hours on best efforts by Gas Team

Maintenance

- Also the maintenance will not be part of the wp for the M&O of LHC gas systems
- We will not ask money for maintenance in the M&O work package
- The maintenance of the system will be done jointly between EP-DT and CMS team
- EP-DT team will cover the regular programmed maintenance of mechanical components
- EP-DT team will try to have all components and sensors in INFOR in order that also flushing team can access the maintenance planning
- Maintenance of dew point sensors will be done by CMS team
- A budget code will be provided by CMS team to cover the annual maintenance