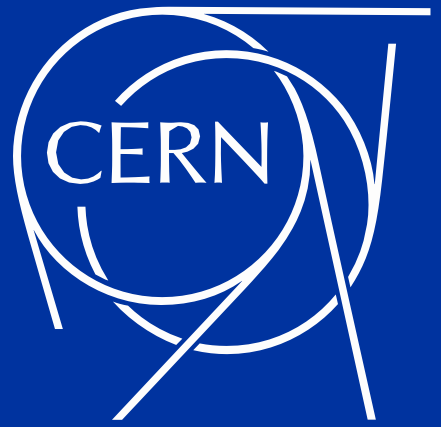


Thematic industry days
19-20 September 2022

EP/DT for ATLAS and CMS 2PACL detector cooling

Speaker: Loïc Davoine

Team: Lukasz Zwalinski, Wojciech Hulek, Szymon Galuszka, Marcin Ciupinski, Daniella Teixeira

Organized by:

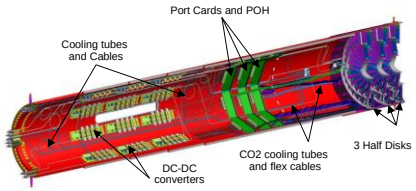
Daniel Schoerling

Introduction

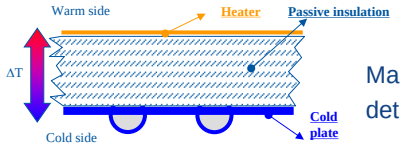
Detector cooling: why?

…many different reasons!

- Dissipate the heat produced by:
  - detector
  - electronics
  - cables



K. Arndt, CMS Phase I Pixel detector EDR (https://indico.cern.ch/event/278220/)

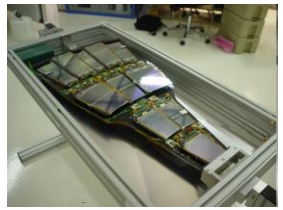


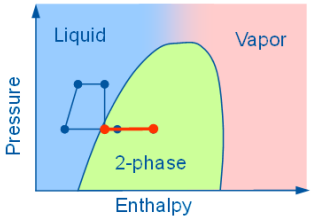
P. Petagna, Thermal enclosures & environmental management, 2008

Maintain a neutral environment between different detectors: active thermal screens

- Guarantee detector lifetime

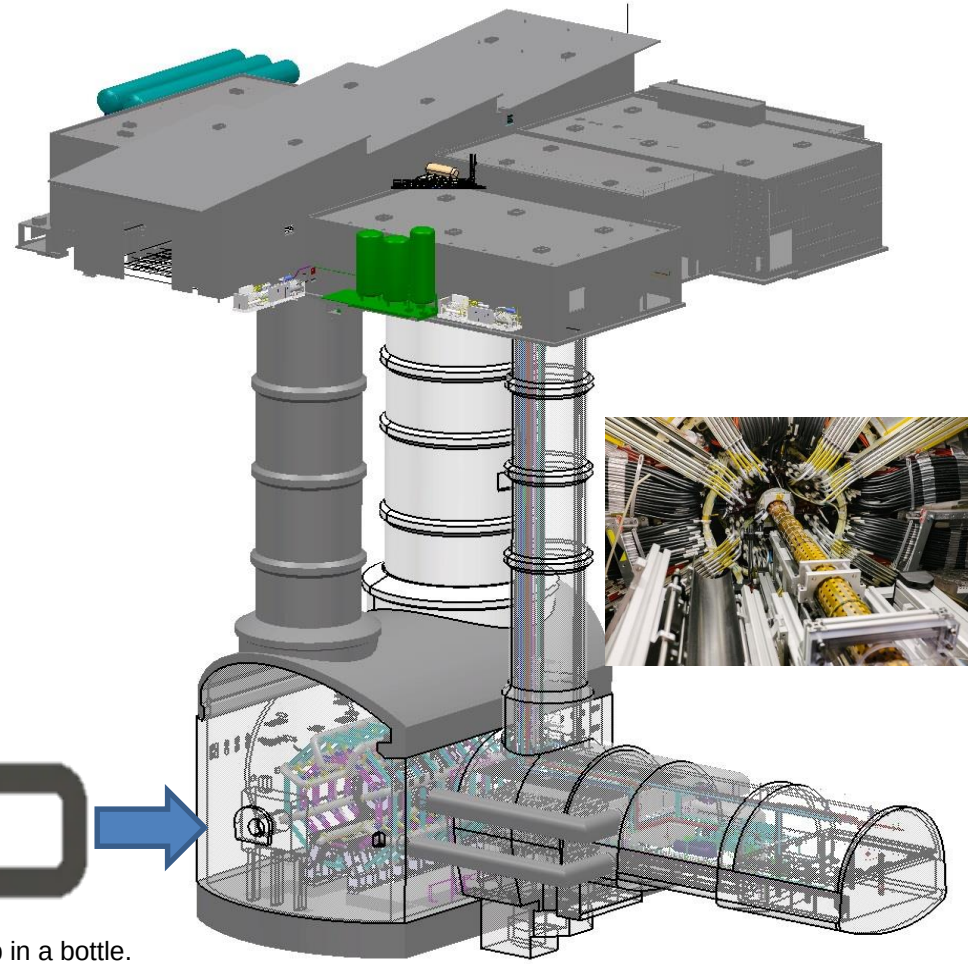
  Silicon detectors
  - Avoid thermal runaway
  - Avoid reversed annealing
  - Tsilicon < -5ºC

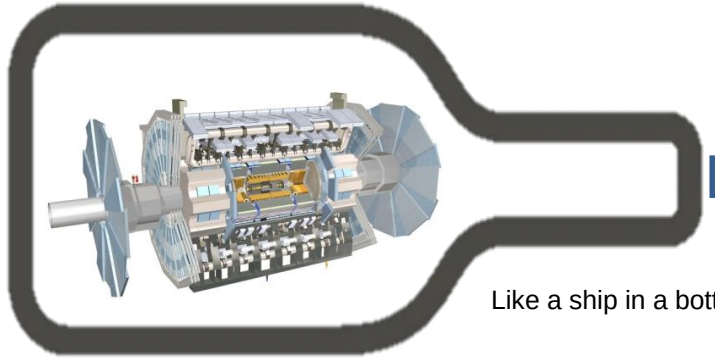




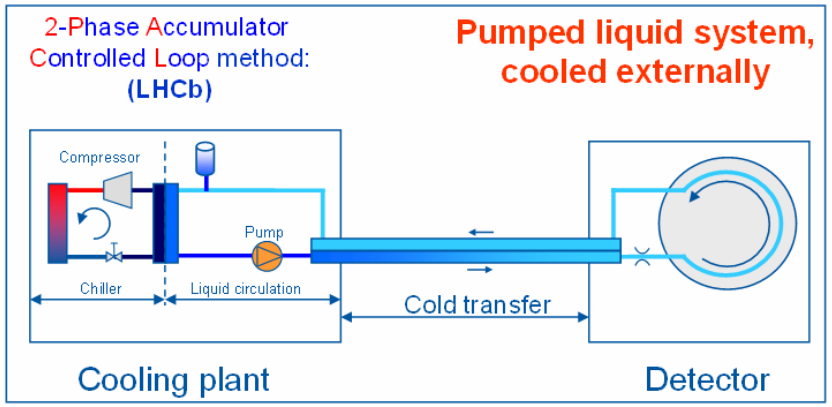
CO2

- **Significant saving of cooling hardware** (material budget) into the detector due to the physical properties:
  - large latent heat of evaporation
  - low liquid viscosity
  - high heat transfer coefficient
  - high thermal stability due to the high pressure
- Very practical fluid to work (environmental friendly, not activated)
- Practical range of the detector application -45^{0}C to +25^{0}C



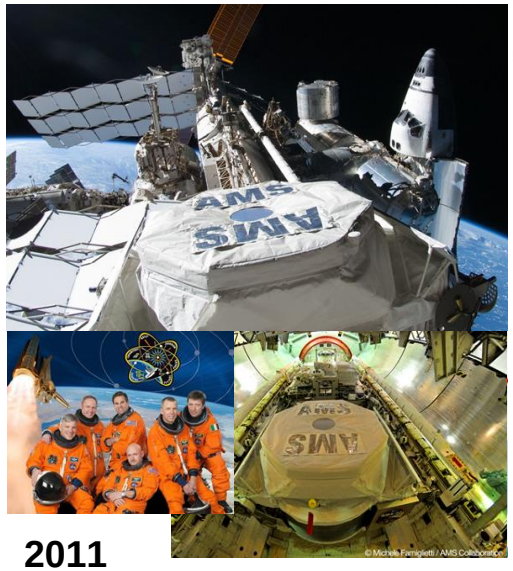


Like a ship in a bottle.



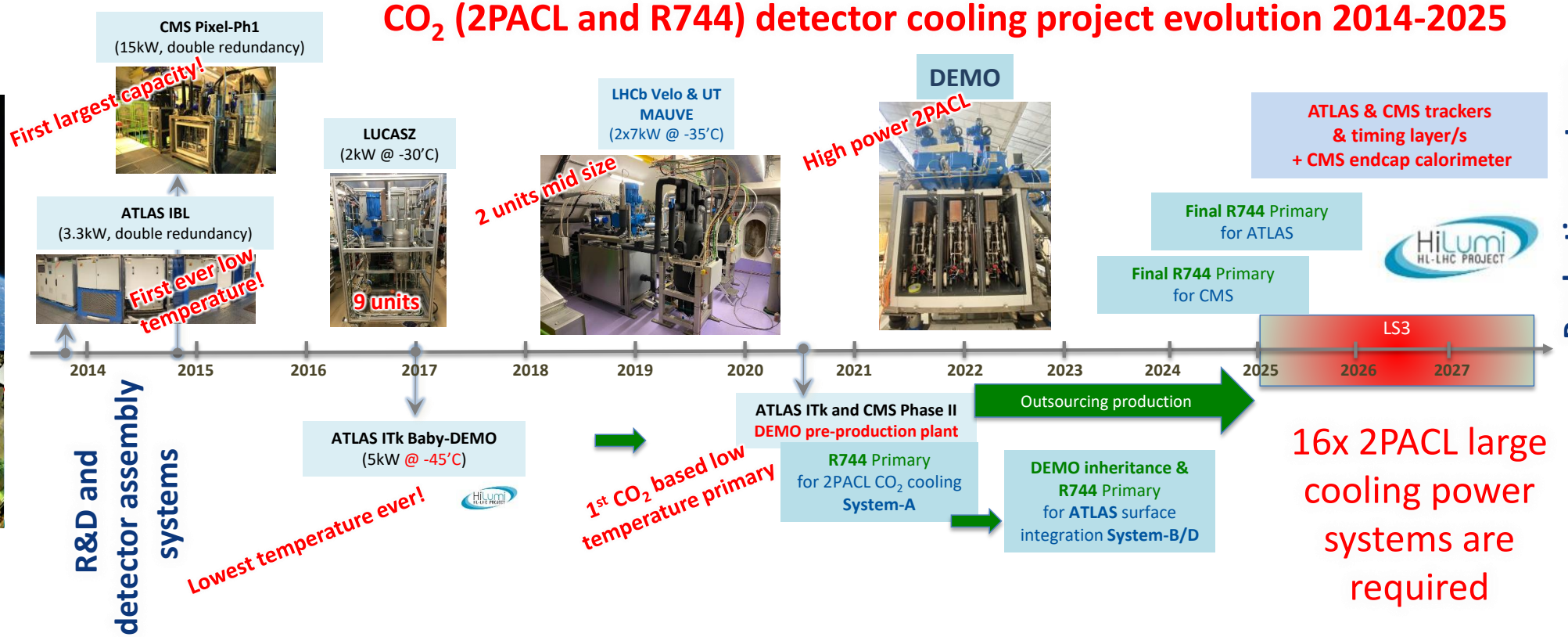
CO_2 cooling project evolution

AMS (Alpha Magnetic Spectrometer) NASA project.



2011
2PACL CO_2 cooling system

CO_2 (2PACL and R744) detector cooling project evolution 2014-2025

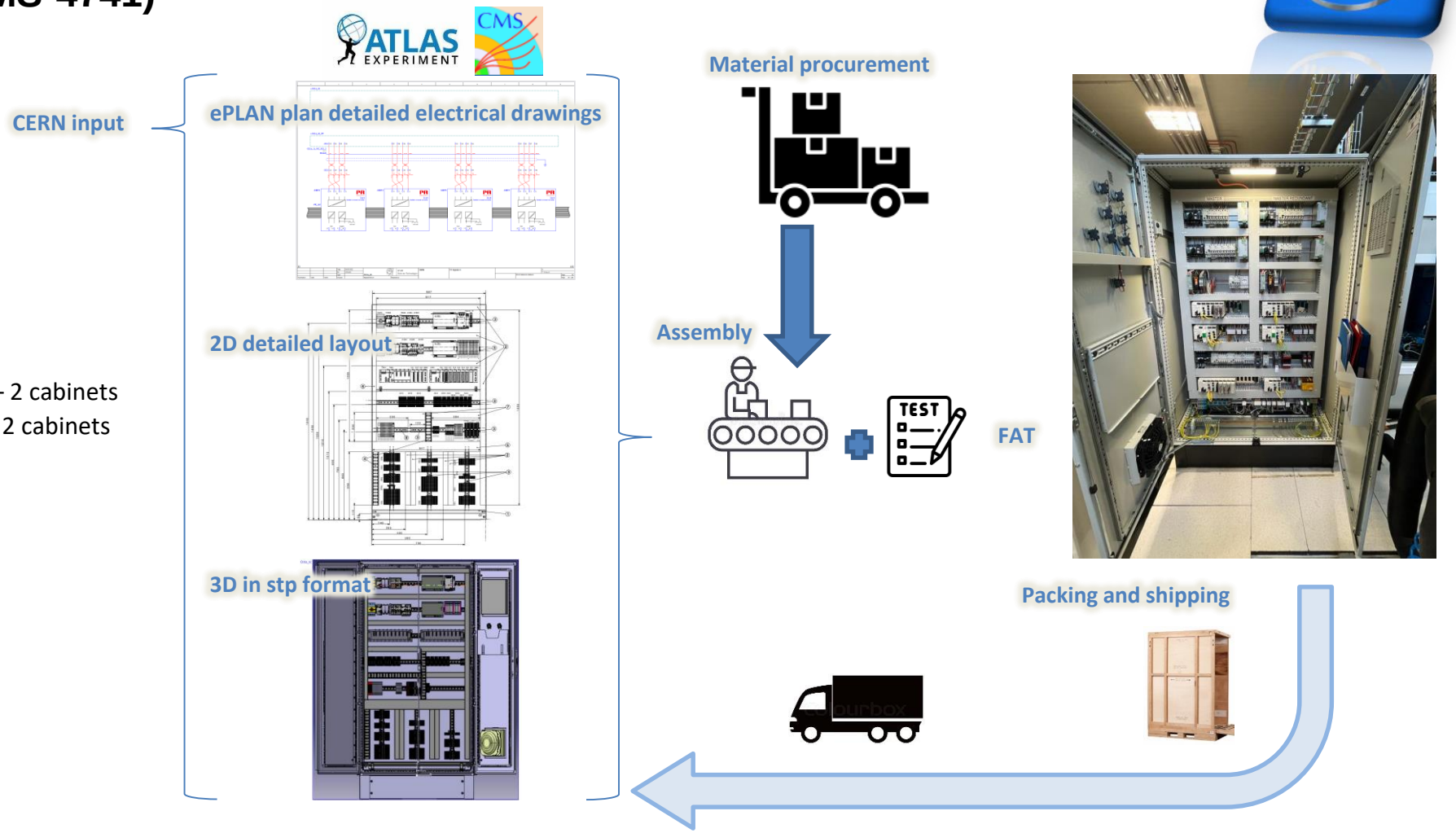


16x 2PACL large cooling power systems are required

ATLAS and CMS 2PACL Phase-II detector cooling - cabinet procurement

Procurement **of 69 controls and power distribution cubicles.**
Market Survey still on-going (MS-4741)

1. PLC cabinet – 2 cabinets
2. Common unit & Surface Storage control cabinet – 2 cabinets
3. Common unit & Surface Storage power cabinet – 2 cabinets
4. 2 head plant control cabinet – 6 cabinets
5. 2 head plant power cabinet – 6 cabinets
6. 3 head plant control cabinet – 4 cabinets
7. 3 head plant power cabinet – 4 cabinets
8. Accumulator control cabinet – 9 cabinets
9. Accumulator power cabinet – 9 cabinets
10. Manifolds HGTD control cabinet – 1 cabinet
11. Manifolds HGTD power cabinet – 1 cabinet
12. CMS manifold control cabinet – 8 cabinets
13. CMS manifold power cabinet – 11 cabinets
14. Common underground power – 2 cabinets
15. Common underground control – 2 cabinets



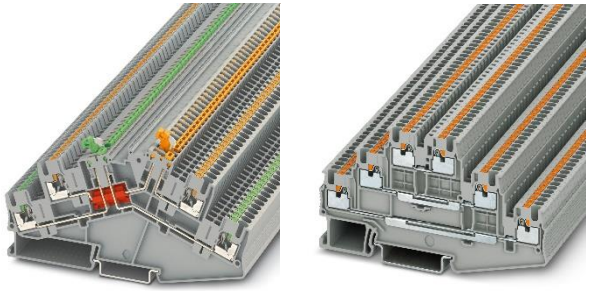
ATLAS and CMS 2PACL Phase-II detector cooling
Cabinets components and system standardization

Control and power cabinets mechanical and assembly/utility.
Components are foreseen to be provided by **Rittal**.

Control system will be developed using **Schneider Electrics** PLC components.

Signal processing for Pt100 sensors, thermocouples and potentiometers will be held by **PR** converters .

Signal and power distribution will be done on **Phoenix Contact** terminals.



Components have been chosen for both **CMS** and **ATLAS** Phase-II cabinets to keep a common design, ease of system development and sufficient spare stock.

ATLAS and CMS 2PACL Phase-II detector cooling – Cabinets summary

Example of CMS cabinets summary

Surface Needs

		Power cabinet							Control cabinet						
		Quantity	Name	Size			Reference		Quantity	Name	Size			Reference	
				Height	width	depth					Height	width	depth		
	PLC A	0							1	CS5a_0a	1800+200	600	400	VX8684.000	ST1552284
	PLC B	0							1	CS5a_0b	1800+200	600	400	VX8684.000	ST1552284
	Common unit & Surface Storage	1	CS5a_0d	1800+200	1000	400	VX8080.000	ST1584511_01	1	CS5a_0c	1800+200	1000	400	VX8080.000	ST1585451_01

Underground Needs

		Power cabinet							Control cabinet						
		Quantity	Name	Size			Reference	Exterior 3D model	Quantity	Name	Size			Reference	Exterior 3D model
				Height	width	depth					Height	width	depth		
Plants	Plant 1: TK1 (3 heads)	1	CU5a_1b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_1a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 2: TK2 (3 heads)	1	CU5a_2b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_2a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 3: BTL (2heads)	1	CU5a_3b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_3a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 4: CE1 (2heads)	1	CU5a_4b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_4a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 5: CE2 (2heads)	1	CU5a_5b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_5a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 6: CE3 (2heads)	1	CU5a_6b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_6a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 7: CE4 (2heads)	1	CU5a_7b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_7a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 8: ETL (3heads)	1	CU5a_8b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_8a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 9: Spare plant (3heads)	1	CU5a_9b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_9a	1800+200	1000	400	VX8080.000	ST1580192_01
Accu	Accu 1: TK1	1	CU5a_1d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_1c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 2: TK2	1	CU5a_2d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_2c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 3: BTL	1	CU5a_3d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_3c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 4: CE1	1	CU5a_4d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_4c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 5: CE2	1	CU5a_5d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_5c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 6: CE3	1	CU5a_6d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_6c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 7: CE4	1	CU5a_7d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_7c	1800+200	1000	400	VX8884.000	ST1576271_01
	Accu 8: ETL	1	CU5a_8d	1800+200	800	400	VX8080.000	ST1580082_01	1	CU5a_8c	1800+200	1000	400	VX8884.000	ST1576271_01
Manifolds	Manifold: TK1	2	CU5a_1f, CU5a_1g	1800+200	800	400	VX8884.000	ST1578854_01	2	CU5a_1e,CU5a_1i	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: TK2	2	CU5a_2f, CU5a_2g	1800+200	800	400	VX8884.000	ST1578854_01	2	CU5a_2e,CU5a_2i	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: BTL	1	CU5a_3f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_3e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: CE1	1	CU5a_4f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_4e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: CE2	1	CU5a_5f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_5e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: CE3	1	CU5a_6f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_6e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: CE4	1	CU5a_7f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_7e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: ETL	2	CU5a_8f, CU5a_8g	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_8e	1800+200	1000	400	VX8080.000	ST1580191_01
Common	Common unit	2	CU5a_0g, CU5a_0h	1800+200	800	400	VX8884.000	ST1585441_01	2	CU5a_0e, CU5a_0f	1800+200	1000	400	VX8080.000	ST1585425_01

Cabinets summary: cabinets names, dimensions, 3D models references.

This table was shared with integration offices to allocate their positions (surface and underground).

ATLAS and CMS 2PACL Phase-II detector cooling - Cables summary

Example of CMS cables summary

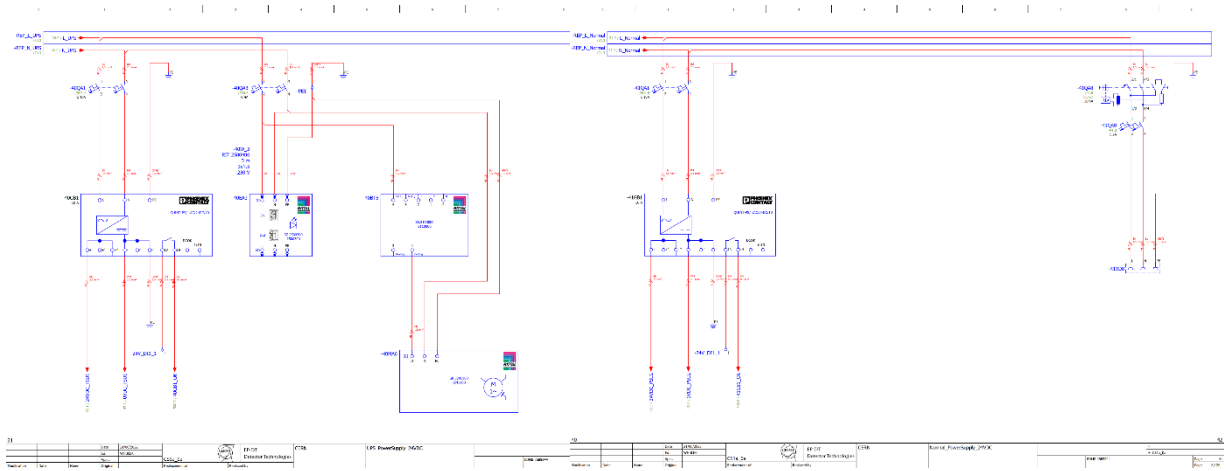
FROM	Descritpion	TO	Descritpion	Cable name	NE4	NE8	NE12	NE18	NE26	NE36	NG4	NG8	NG18	NG28	MCA14	MCA24	MCA36	TCK	PJ2SB
				Cable OD [mm]	8.5	10.5	12	13.5	15.3	18.5	8.7	11.1	16.5	20	9.3	11.2	12.3	7.4	16
				Color	White	White	White	White	White	White	White	White	White	White	Blue	Blue	Blue	Green	Black
				Bending radius [mm]	85	105	120	135	153	185	87	111	165	200	93	112	123	74	160
				Type	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Signal	Power
				Maximum distance [m]	100+	100+	100+	100+	100+	100+	100+	100+	100+	100+	100+	100+	100+	100+	
				Amount of wires and cross section [mm²]	4 x 0.5	8 x 0.5	12 x 0.5	18 x 0.5	26 x 0.5	36 x 0.5	4 x 1	8 x 1	18 x 1	28 x 1	14 x 0.22	24 x 0.22	36 x 0.22	2 x 0.75	2 x 2.5
				Maximum thermal loss per meter [W]															
CU5a_1c	Accu A1 control cabinet	CU5a_A1	Accu A1					1	3				1	1		2		2	
CU5a_1d	Accu A1 power cabinet	CU5a_A1	Accu A1		2	1					1			1					
CU5a_1c	Accu A1 control cabinet	CU5a_1d	Accu A1 power cabinet						2			1							
CU5a_2c	Accu A2 control cabinet	CU5a_A2	Accu A2					1	3				1	1		2		2	
CU5a_2d	Accu A2 power cabinet	CU5a_A2	Accu A2		2	1					1			1					
CU5a_2c	Accu A2 control cabinet	CU5a_2d	Accu A2 power cabinet						2			1							
CU5a_3c	Accu A3 control cabinet	CU5a_A3	Accu A3					1	3				1	1		2		2	
CU5a_3d	Accu A3 power cabinet	CU5a_A3	Accu A3		2	1					1			1					
CU5a_3c	Accu A3 control cabinet	CU5a_3d	Accu A3 power cabinet						2			1							
CU5a_4c	Accu A4 control cabinet	CU5a_A4	Accu A4					1	3				1	1		2		2	
CU5a_4d	Accu A4 power cabinet	CU5a_A4	Accu A4		2	1					1			1					
CU5a_4c	Accu A4 control cabinet	CU5a_4d	Accu A4 power cabinet						2			1							
CU5a_5c	Accu A5 control cabinet	CU5a_A5	Accu A5					1	3				1	1		2		2	
CU5a_5d	Accu A5 power cabinet	CU5a_A5	Accu A5		2	1					1			1					
CU5a_5c	Accu A5 control cabinet	CU5a_5d	Accu A5 power cabinet						2			1							
CU5a_6c	Accu A6 control cabinet	CU5a_A6	Accu A6					1	3				1	1		2		2	
CU5a_6d	Accu A6 power cabinet	CU5a_A6	Accu A6		2	1					1			1					
CU5a_6c	Accu A6 control cabinet	CU5a_6d	Accu A6 power cabinet						2			1							
CU5a_7c	Accu A7 control cabinet	CU5a_A7	Accu A7					1	3				1	1		2		2	
CU5a_7d	Accu A7 power cabinet	CU5a_A7	Accu A7		2	1					1			1					
CU5a_7c	Accu A7 control cabinet	CU5a_7d	Accu A7 power cabinet						2			1							
CU5a_8c	Accu A8 control cabinet	CU5a_A8	Accu A8					1	3				1	1		2		2	
CU5a_8d	Accu A8 power cabinet	CU5a_A8	Accu A8		2	1					1			1					
CU5a_8c	Accu A8 control cabinet	CU5a_8d	Accu A8 power cabinet						2			1							
CU5a_1c	Accu A1 control cabinet	CU5a_P1	Plant 1				1												

Define cables need for each cabinets to allow proper integration with integration offices.

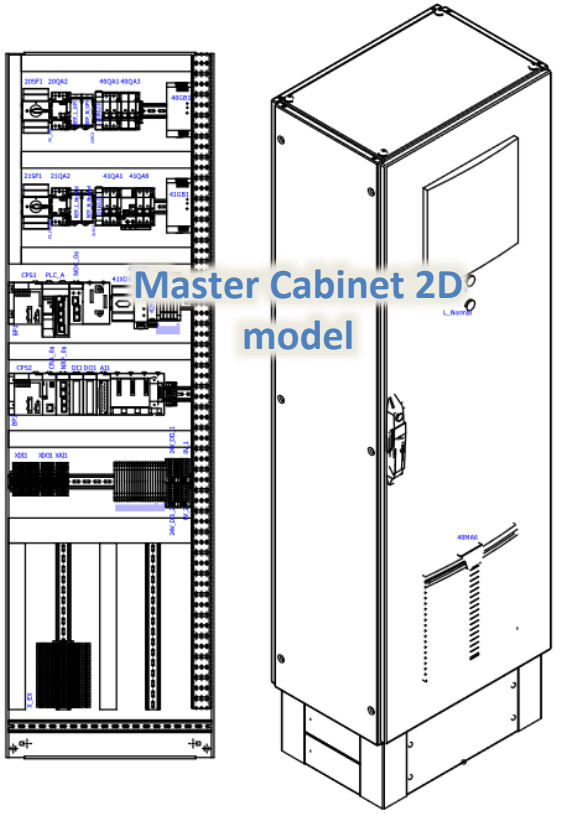
ATLAS and CMS 2PACL Phase-II detector cooling - Master cabinets

Master Cabinets equipped with Schneider M580HSBY Redundant PLC for overall system control.

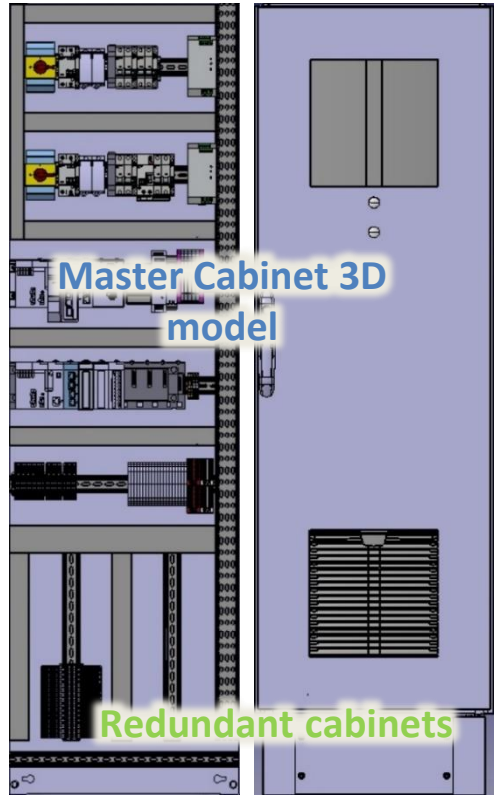
Each Control cabinet has redundant Phoenix 24VDC with individual powering source to ensure constant system monitoring.



Page standarization aproach between schematics.
Homogenize electrical system development.



Master Cabinet 2D model



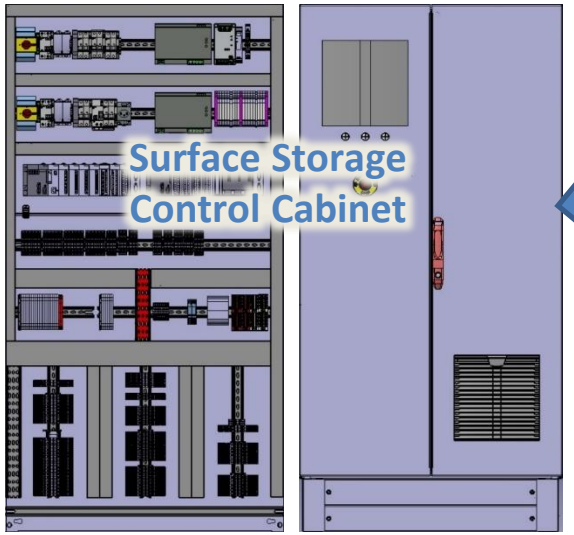
Master Cabinet 3D model

Redundant cabinets

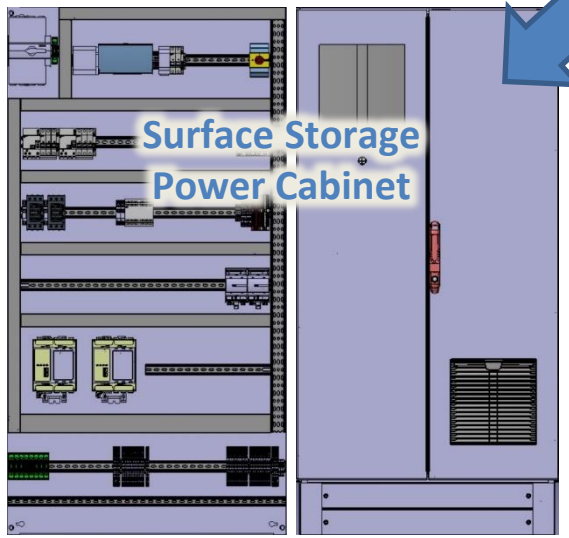
Electrical schematics created using EPLAN P8 software:

- Extensive symbol and parts library
- Simplified schematics creation
- Automatic part list generation

ATLAS and CMS 2PACL Phase-II detector cooling
Surface Storage & Common Underground

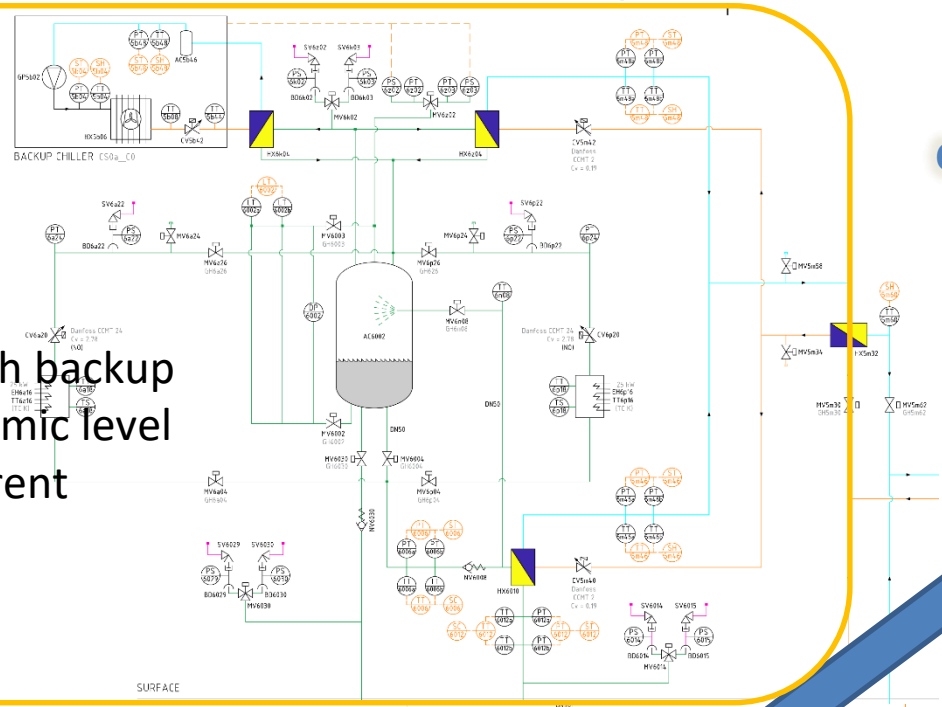


Surface Storage
Control Cabinet

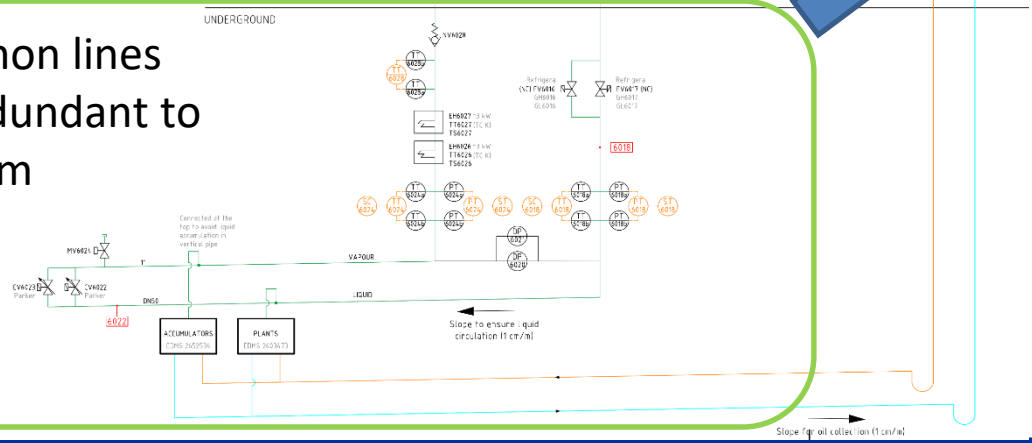


Surface Storage
Power Cabinet

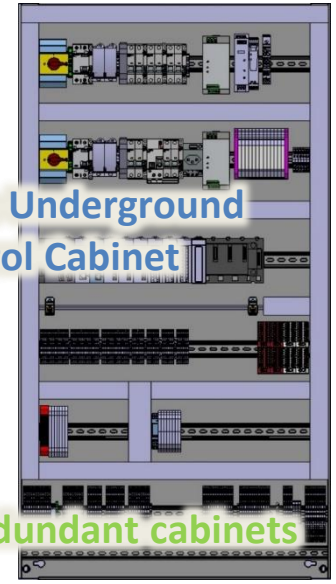
Surface storage with backup chiller for CO_2 dynamic level control in the different Accumulators.



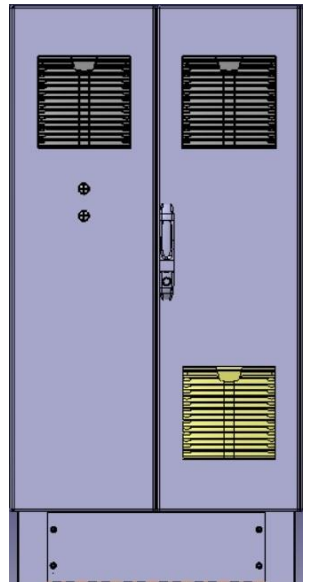
Underground common lines instrumentation redundant to ensure higher system availability.



Common Underground
Control Cabinet



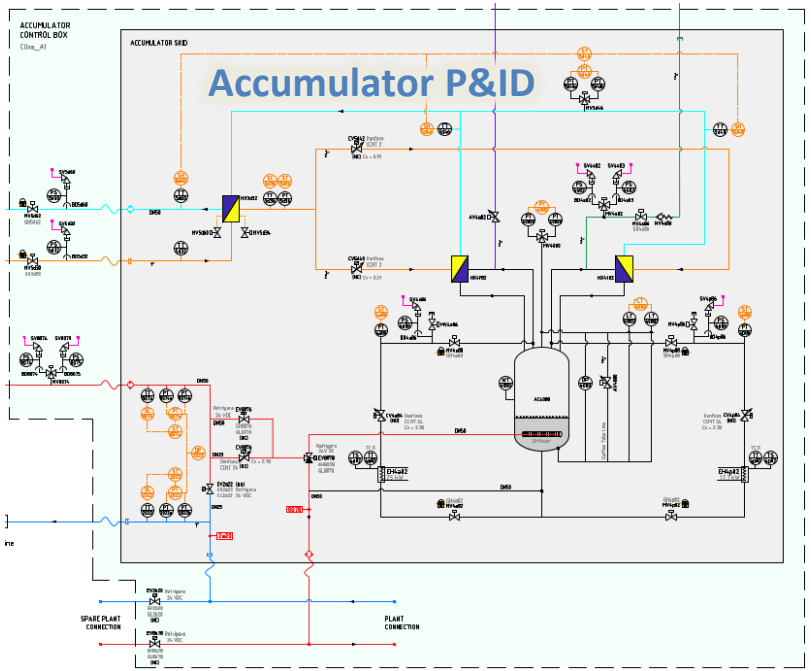
Redundant cabinets

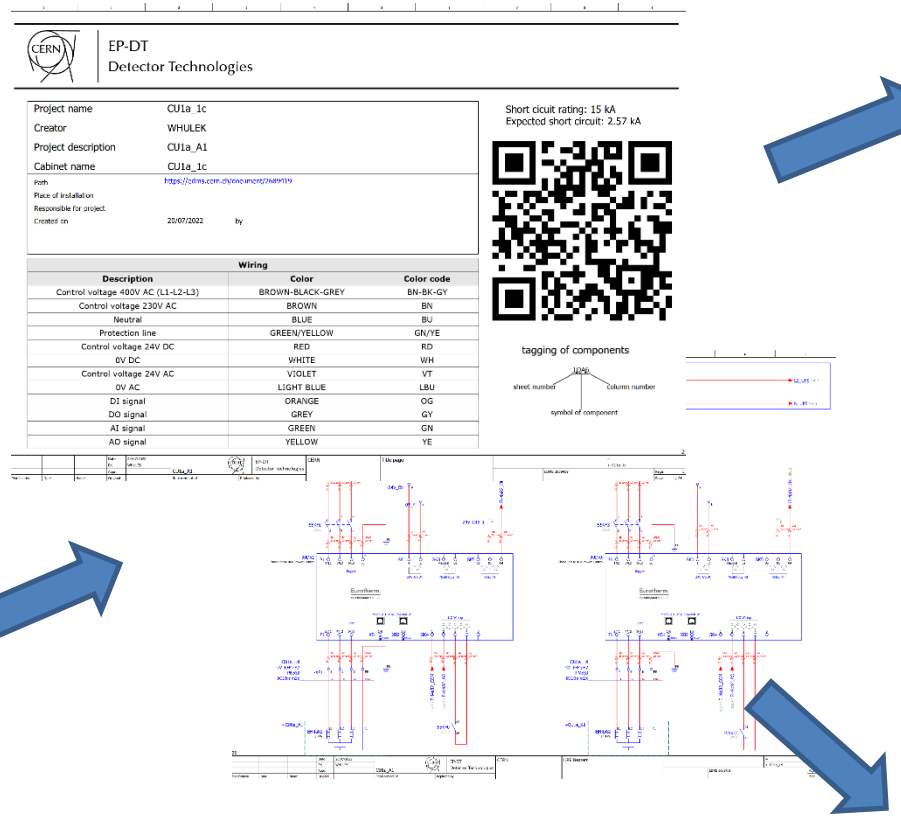


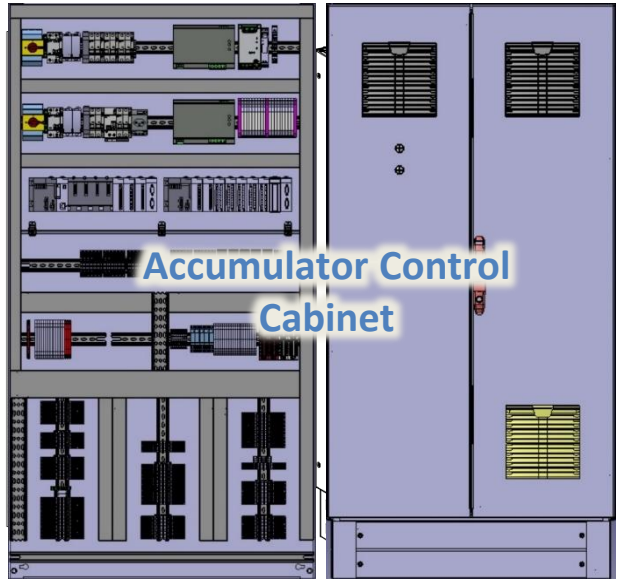
ATLAS and CMS 2PACL Phase-II detector cooling – Accumulator

Accumulator cabinets powers & controls all accumulator skid equipment:

- 25kW + 17kW heaters equipped with TS & TC type K for 3 level protection
- Heater power controller
- 7x TTs (PT100 4W) & 11x pressure transmitter
- Radar level transmitter
- 10x electrical control valves







Documentation created for:

- ATLAS Accumulators 6 Control cabinets
- ATLAS Accumulators 6 Power cabinets
- CMS Accumulators 8 Control cabinets
- CMS Accumulators 8 Power cabinets

ATLAS and CMS 2PACL Phase-II detector cooling – Plant

Phase-II plant cabinets design will be consistent for **CMS** and **ATLAS** experiments

CMS Phase-II project will consist of **9 control** and **9 power** cabinets

		Power cabinet							Control cabinet						
		Quantity	Name	Size			Reference	Exterior 3D model	Quantity	Name	Size			Reference	Exterior 3D model
				Height	width	depth					Height	width	depth		
Plants	Plant 1: TK1 (3 heads)	1	CU5a_1b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_1a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 2: TK2 (3 heads)	1	CU5a_2b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_2a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 3: BTL (2heads)	1	CU5a_3b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_3a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 4: CE1 (2heads)	1	CU5a_4b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_4a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 5: CE2 (2heads)	1	CU5a_5b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_5a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 6: CE3 (2heads)	1	CU5a_6b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_6a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 7: CE4 (2heads)	1	CU5a_7b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_7a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 8: ETL (3heads)	1	CU5a_8b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_8a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 9: Spare plant (3heads)	1	CU5a_9b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU5a_9a	1800+200	1000	400	VX8080.000	ST1580192_01

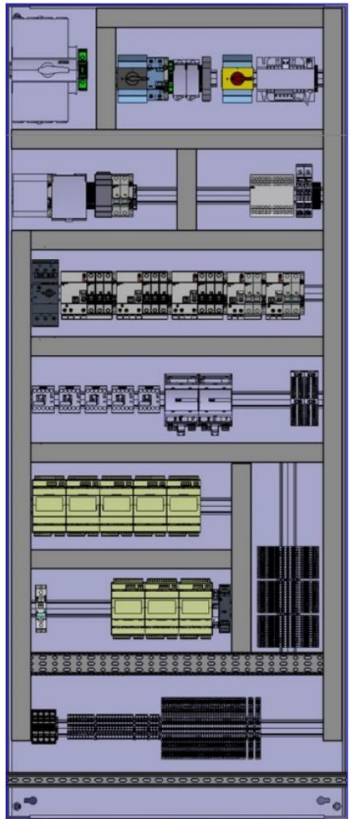
ATLAS Phase-II project will consist of **7 control** and **7 power** cabinets

		Power cabinet							Control cabinet						
		Quantity	Name	Size			Reference	Exterior 3D model	Quantity	Name	Size			Reference	Exterior 3D model
				Height	width	depth					Height	width	depth		
Plants	Plant 1: HGTD (2 heads)	1	CU1a_1b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_1a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 2: SEC, SBR (2 heads)	1	CU1a_2b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_2a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 3: SEC, SBR (2 heads)	1	CU1a_3b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_3a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 4: PEC, POB (2 heads)	1	CU1a_4b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_4a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 5: PEC, POB (2 heads)	1	CU1a_5b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_5a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 6: PXI (1 head)	1	CU1a_6b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_6a	1800+200	1000	400	VX8080.000	ST1580192_01
	Plant 9: spare (3 heads)	1	CU1a_9b	1800+200	800	400	VX8884.000	ST1580095_01	1	CU1a_9a	1800+200	1000	400	VX8080.000	ST1580192_01

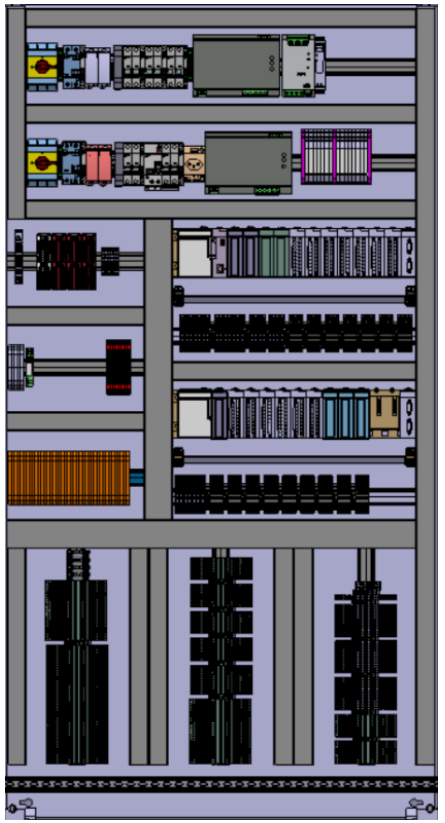
The design is dependent on quantity of pump heads. The number of the heads is defined on detector cooling power need. For both experiments there is foreseen one **Backup plant** (with 3 heads).

CABINETS 3D DESIGN

Power cabinet

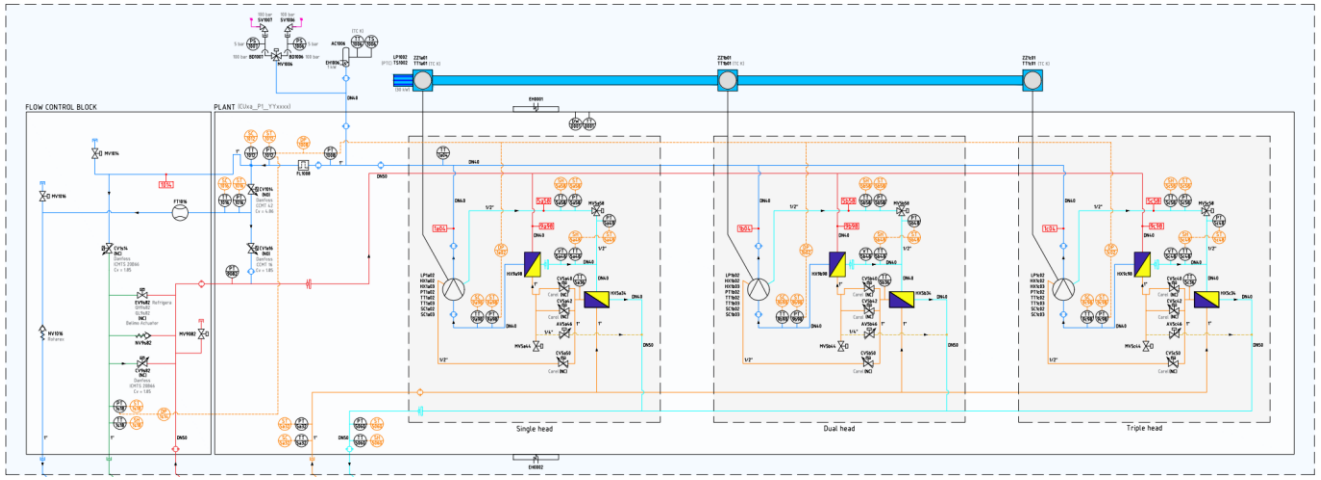


Control cabinet

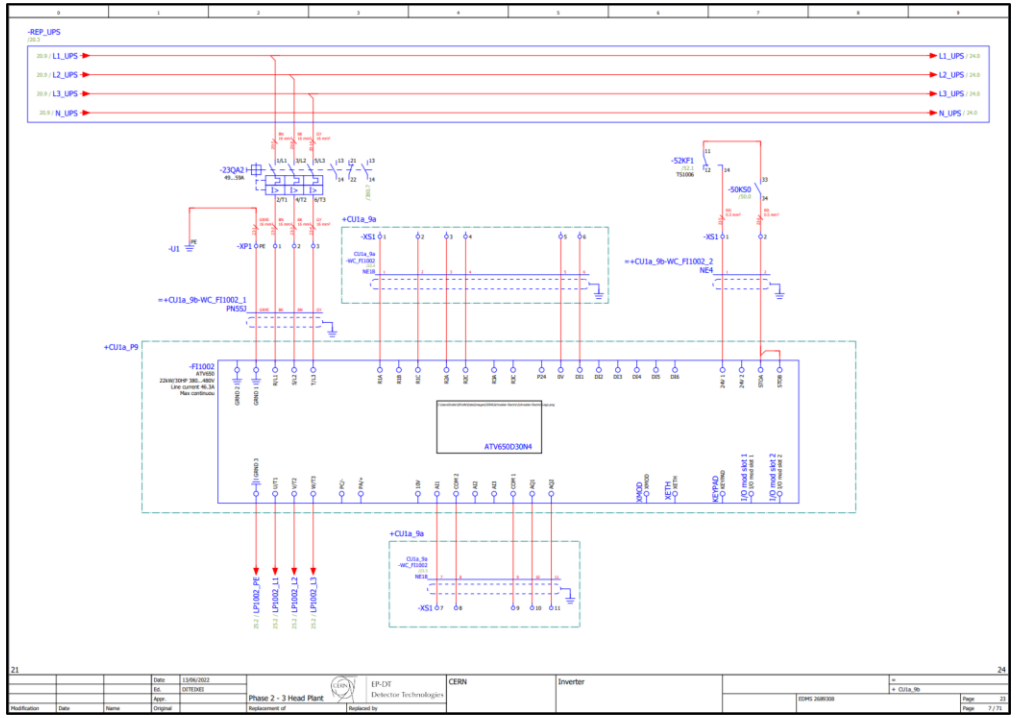


3 heads design

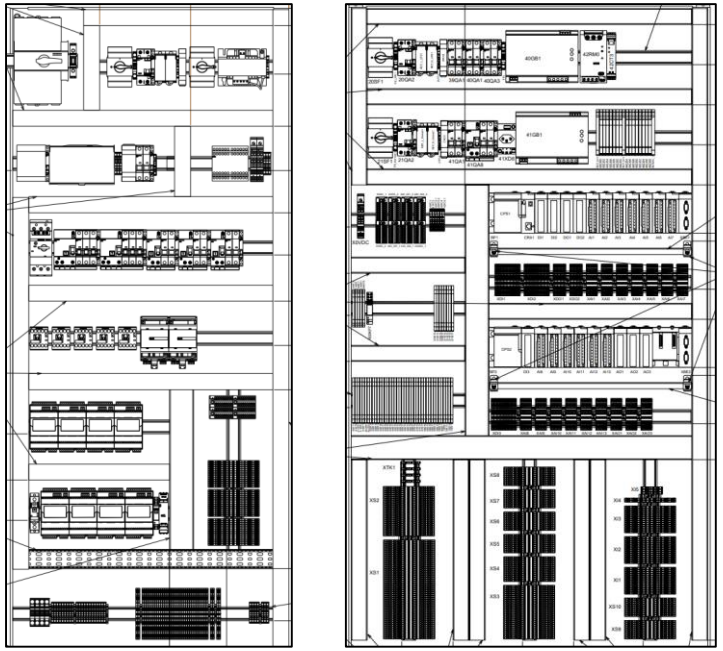
ATLAS and CMS 2PACL Phase-II detector cooling – Plant



Initial electrical schematics prepared for **3 head plant** (eg: Plant 9 - backup plant). It defines a baseline for all the other plants schematics.



Common design for **CMS** and **ATLAS** cabinets.

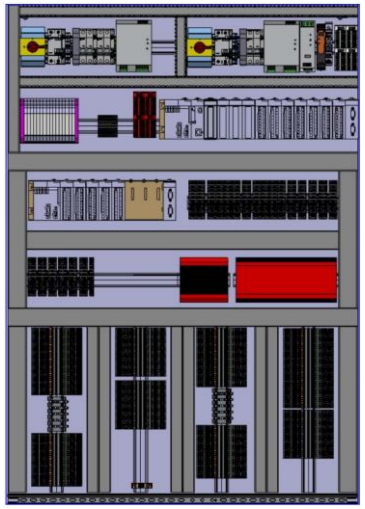


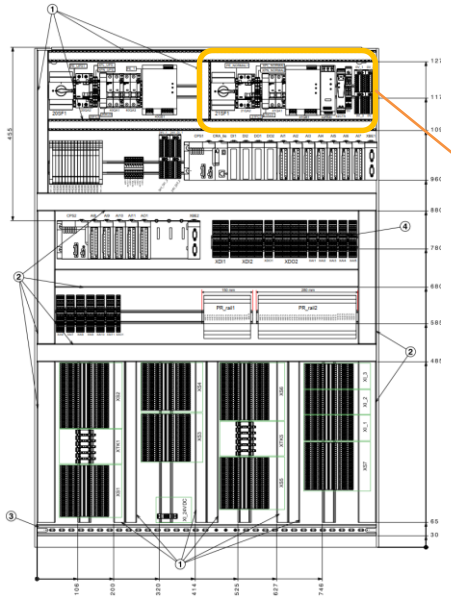
2D layout prepared in accordance to schematics design.

ATLAS 2PACL Phase-II detector cooling – Manifold

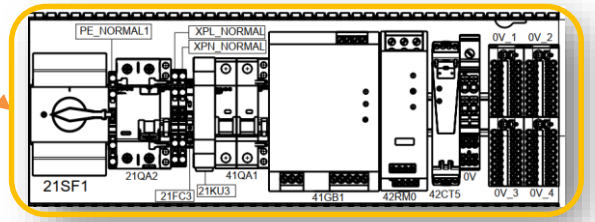
ATLAS Manifolds will need **6 control and 6 power cabinets**

		Power cabinet						Control cabinet						
		Quantity	Name	Size Height	Size width	Size depth	Reference	Exterior 3D model	Quantity	Name	Size Height	Size width	Size depth	Reference	Exterior 3D model
Manifolds	Manifold: HGTD	1	CU1a_1f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU1a_1e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: SEC, SBR	1	CU1a_2f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU1a_2e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: SEC, SBR	1	CU1a_3f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU1a_3e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: PEC, POB	1	CU1a_4f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU1a_4e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: PEC, POB	1	CU1a_5f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU1a_5e	1800+200	1000	400	VX8080.000	ST1580191_01
	Manifold: PXI	1	CU1a_6f	1400+200	800	400	VX8884.000	ST1584086_01	1	CU1a_6e	1400+200	1000	400	VX8080.000	ST1585941_01





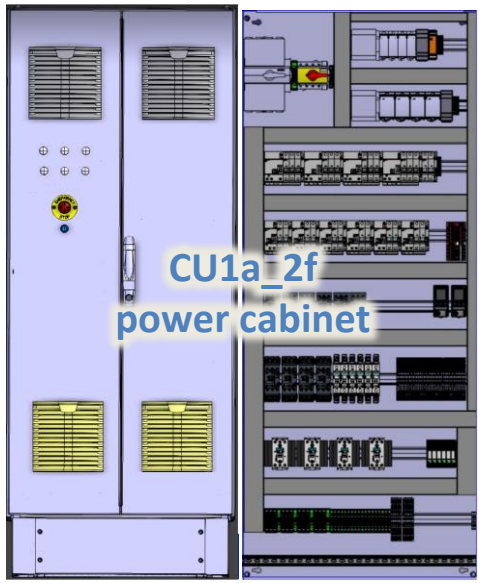
CU1a_6e
control cabinet



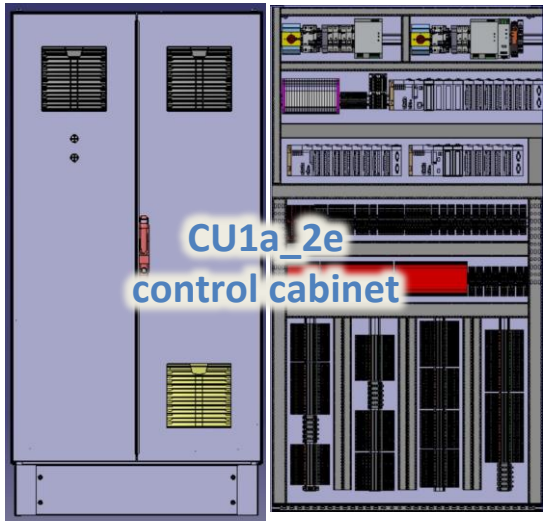
Each component, that refers to schematics is marked on the layout accordingly.

Documentation currently created for:
- 5 Control cabinets
- 5 Power cabinets

Examples:



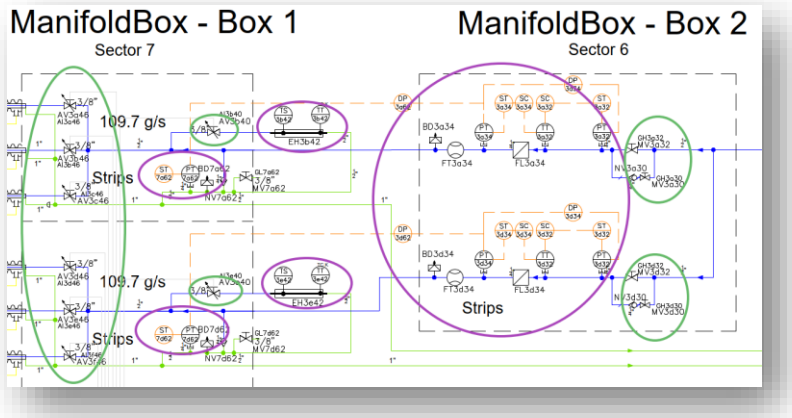
CU1a_2f
power cabinet



CU1a_2e
control cabinet

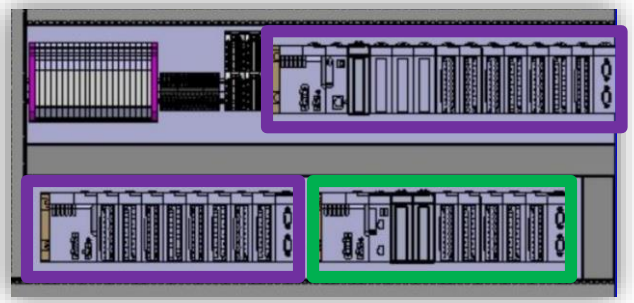
ATLAS 2PACL Phase-II detector cooling – Manifold

Control

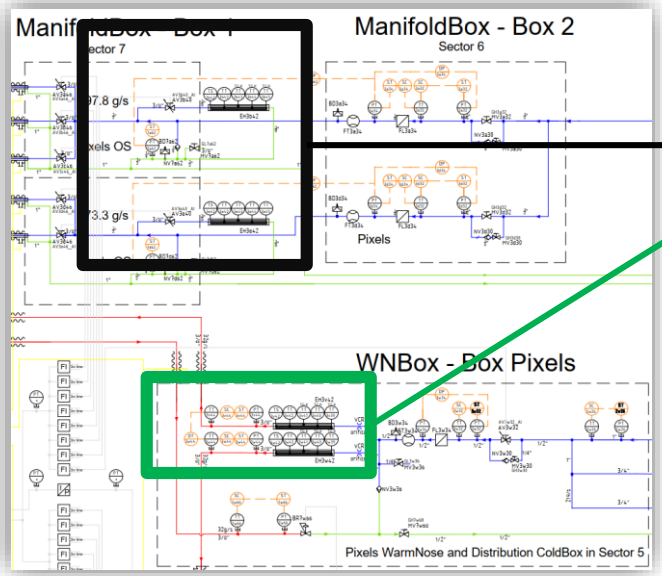


To **optimize memory usage**, reading of the instruments has been divided in the system:

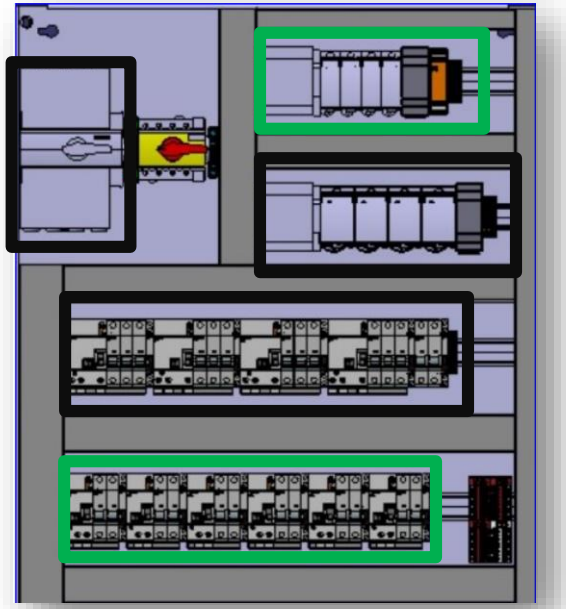
- **Crucial signals** – connected to I/O extension of main, redundant PLC in Master cabinet – Schneider M580
- **Reading signals** – connected to individual PLC – Schneider M340



Power



Dummy Load heaters and Warm Nose heaters are supplied from two different power sources, to limit power coming from UPS:



CMS 2PACL Phase-II detector cooling – Manifold

Phase-II manifolds will need **10 control and 11 power cabinets**

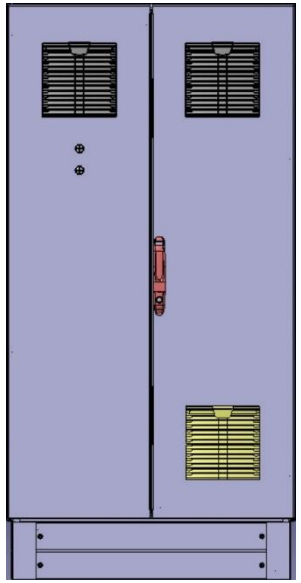
Total cabinet needs for underground manifolds

	Power cabinet							Control cabinet						
	Quantity	Name	Size			Reference	Exterior 3D model	Quantity	Name	Size			Reference	Exterior 3D model
			Height	width	depth					Height	width	depth		
Manifold: TK1	2	CU5a_1f, CU5a_1g	1800+200	800	400	VX8884.000	ST1578854_01	2	CU5a_1e,CU5a_1i	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: TK2	2	CU5a_2f, CU5a_2g	1800+200	800	400	VX8884.000	ST1578854_01	2	CU5a_2e,CU5a_2i	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: BTL	1	CU5a_3f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_3e	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: CE1	1	CU5a_4f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_4e	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: CE2	1	CU5a_5f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_5e	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: CE3	1	CU5a_6f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_6e	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: CE4	1	CU5a_7f	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_7e	1800+200	1000	400	VX8080.000	ST1580191_01
Manifold: ETL	2	CU5a_8f, CU5a_8g	1800+200	800	400	VX8884.000	ST1578854_01	1	CU5a_8e	1800+200	1000	400	VX8080.000	ST1580191_01

Power cabinet

Rittal VX 8884.000
800x400x2000 mm

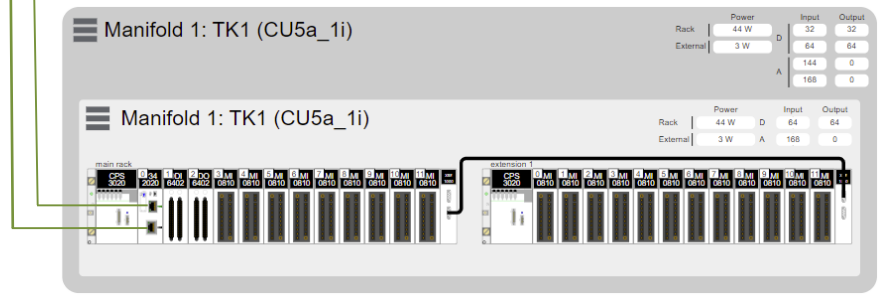
Control cabinet



Rittal VX 8080.000
1000x400x2000 mm

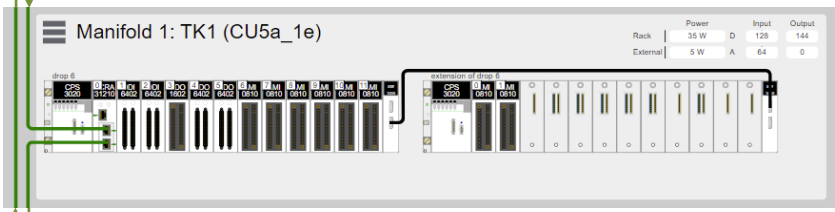
Double power per cabinets are foreseen to optimize load distribution depending of criticality of equipment.

Technical Network



Additional control cabinets will be used for reading of **monitoring signals** only

RIO loop

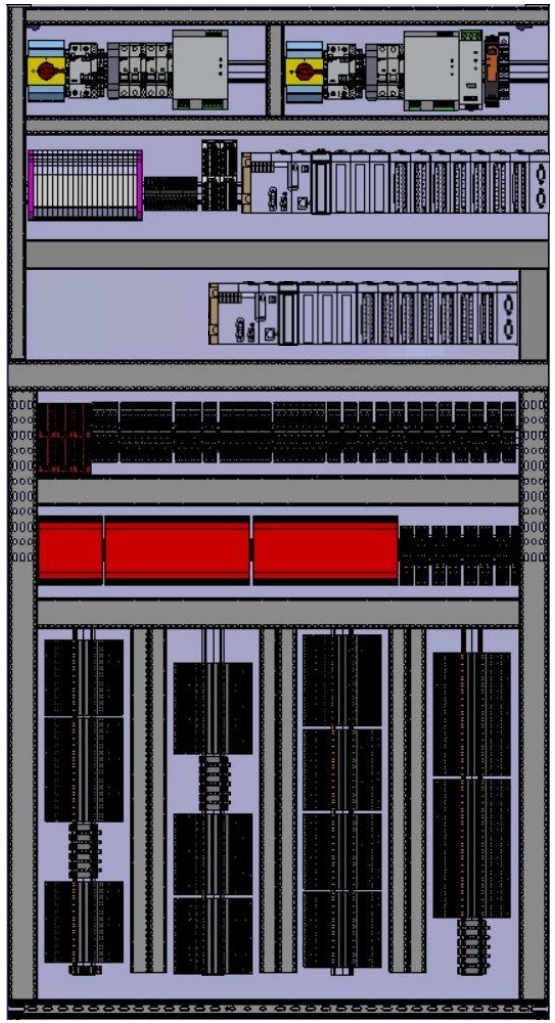


Manifolds meant for reading-wise bigger detectors will need additional control cabinets

RIO loop

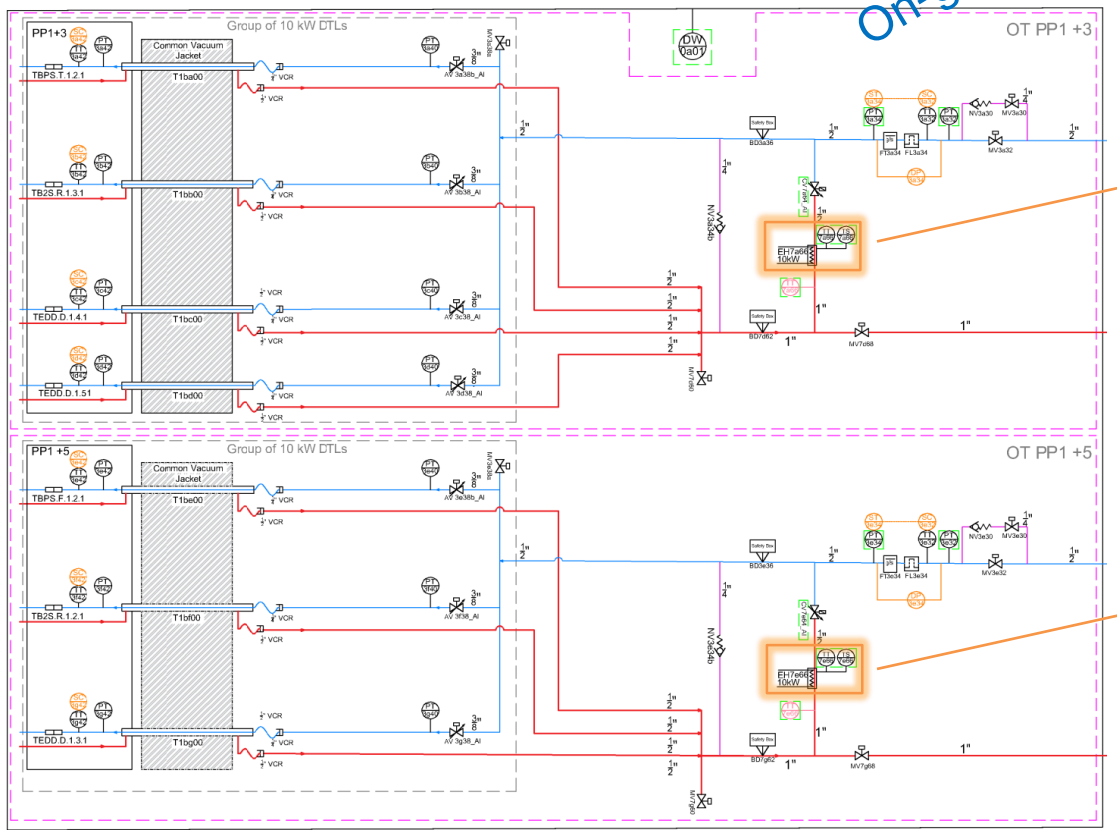
CMS 2PACL Phase-II detector cooling – Manifold

Control cabinets

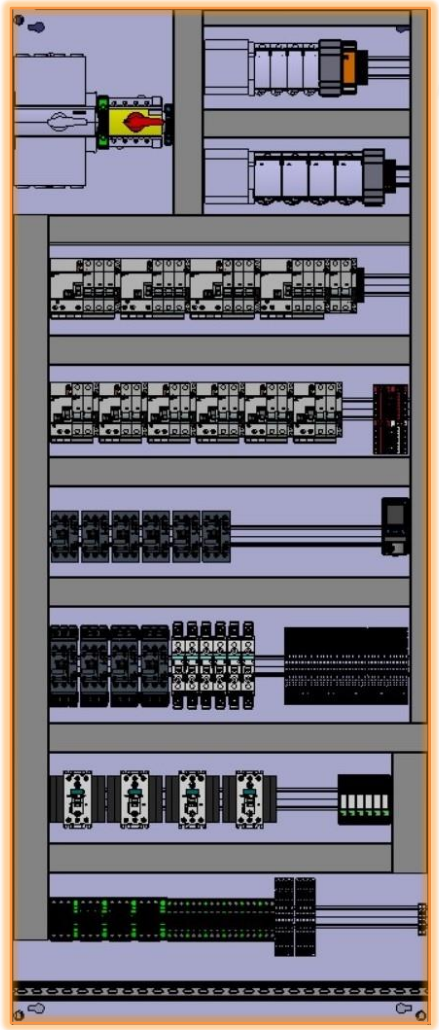


P&ID still under development.
The final quantities of components will be determined as soon as final documentation are released.

On-going

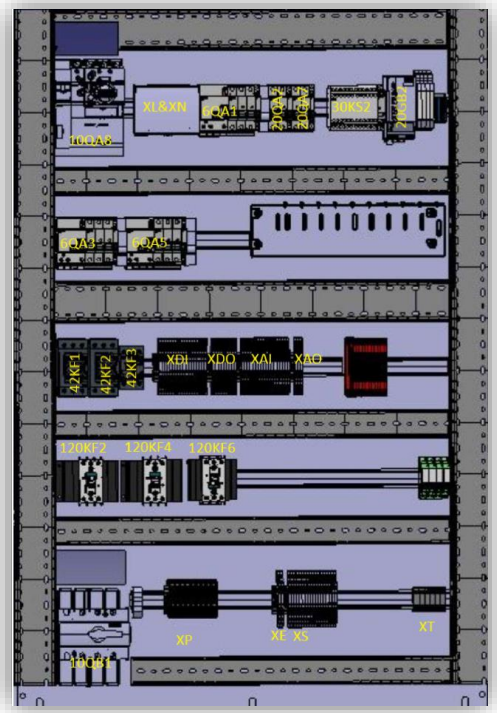


Power cabinets

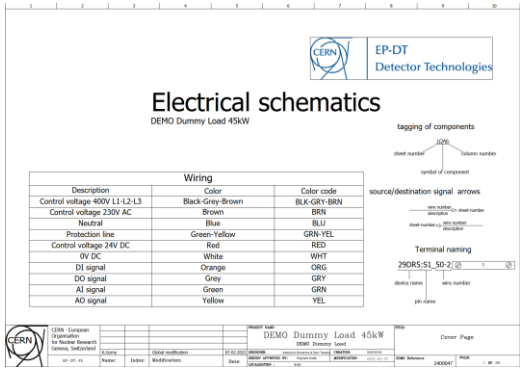


ATLAS and CMS 2PACL Phase-II detector cooling
DEMO Inheritance – Dummy Load

Dummy Load cabinet was created to control **2 x 25kW** Three Phase supplied heaters in order to carry out performance test of **DEMO 2PACL cooling system**.



These cabinets were built up by an external company, after tendering process.



DO-xxxx_DEMO_DL_Annex1_BOM 04/06/2020 13:28
DO-xxxx_DEMO_DL_Annex2_electrical_schematics 04/06/2020 13:28
DO-xxxx_DEMO_DL_Technical_Specification 04/06/2020 14:24
DO-xxxx_DEMO_DL_Tender_Form 04/06/2020 14:26

There will be a need to build another two cabinets in order to commission new future systems.
Documentation prepared in the past will be used for next tendering process.

Thank you for your attention