

Cryogenic system of SPD

Speaker:

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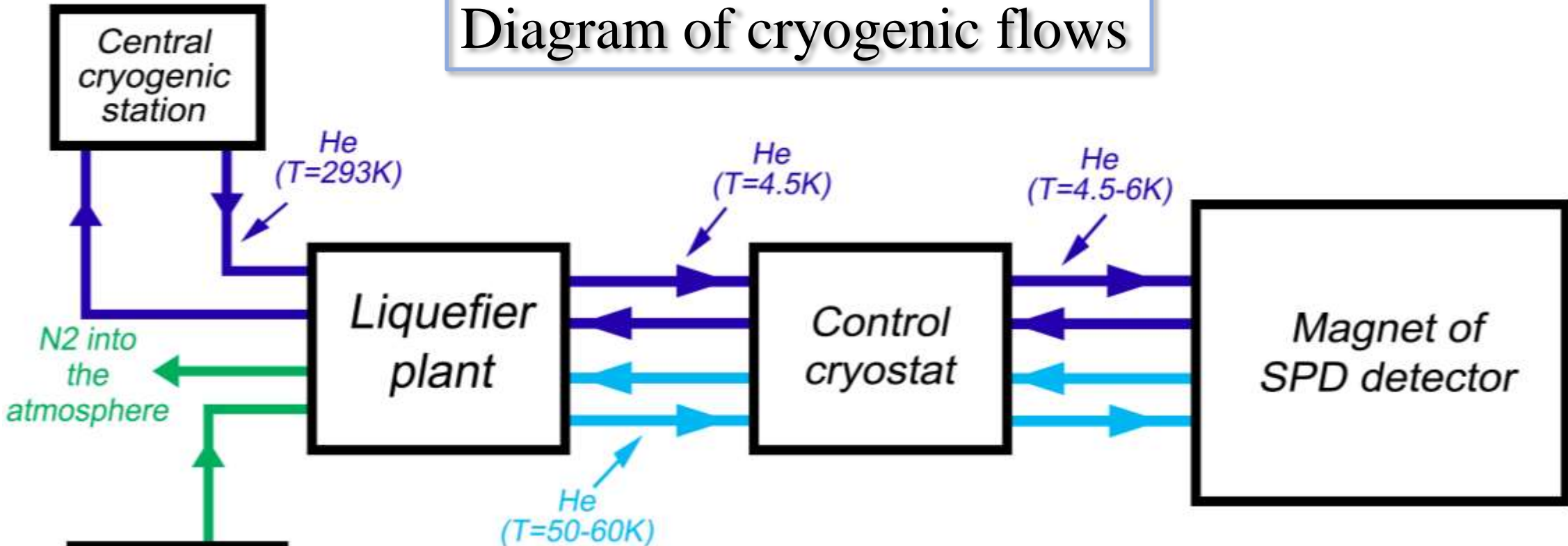
Leader of cryogenic system of SPD:

PhD Dr. Nikiforov Dmitry

Outline

- 1. Cryogenic system**
- 2. Helium system**
- 3. Cryogenic equipment**
- 4. Nitrogen system**
- 5. Cryogenic system control**
- 6. Steps of creation**
- 7. Conclusions**

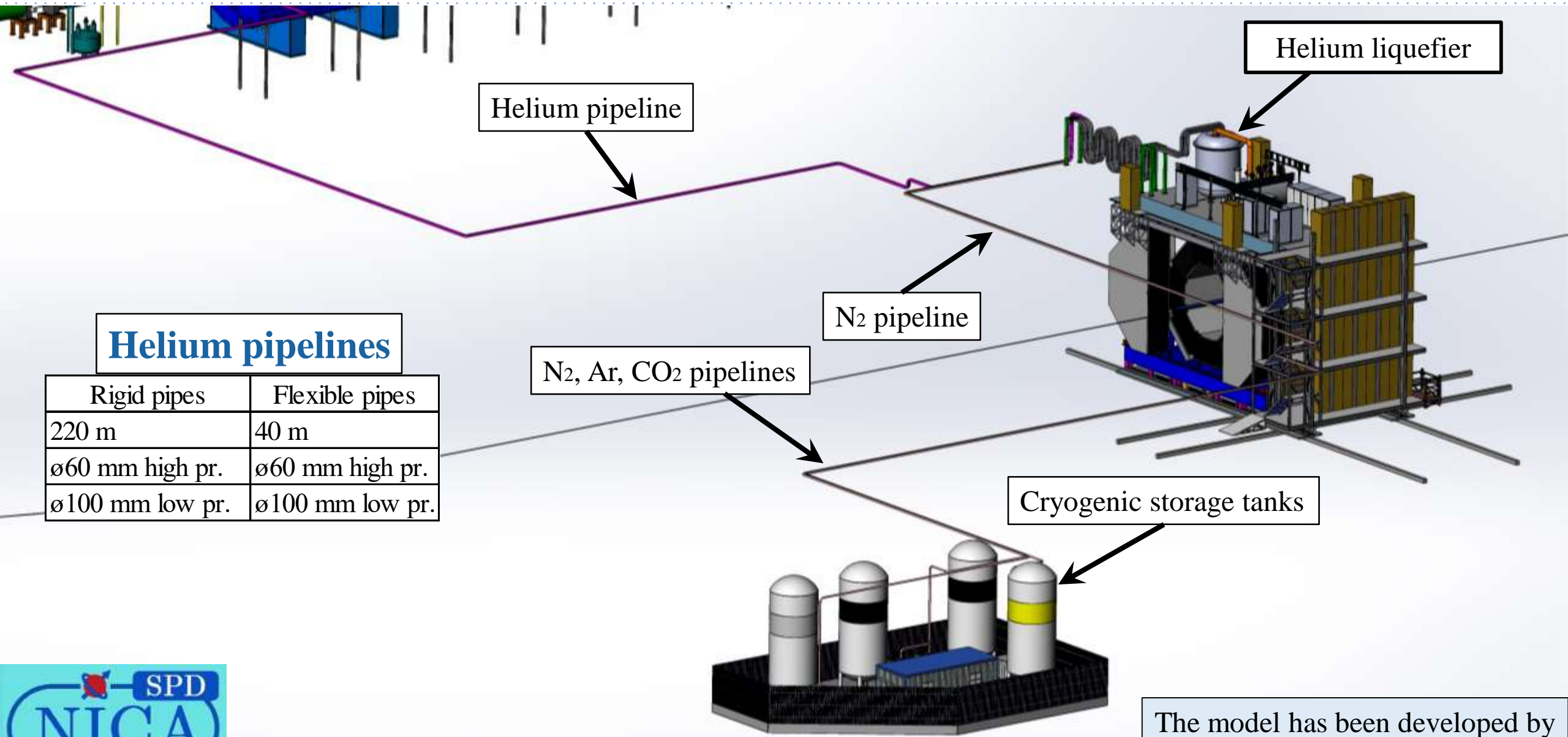
Diagram of cryogenic flows



- ➔ He flow for cooling magnet of SPD detector (4.5-6K)
- ➔ N2 flow for cooling cryogenic plant (~77K)
- ➔ He line for cooling thermal shields (~50K)

Cryogenic system

Cryogenic system



Helium pipeline

Helium liquefier

N₂ pipeline

N₂, Ar, CO₂ pipelines

Cryogenic storage tanks

Helium pipelines

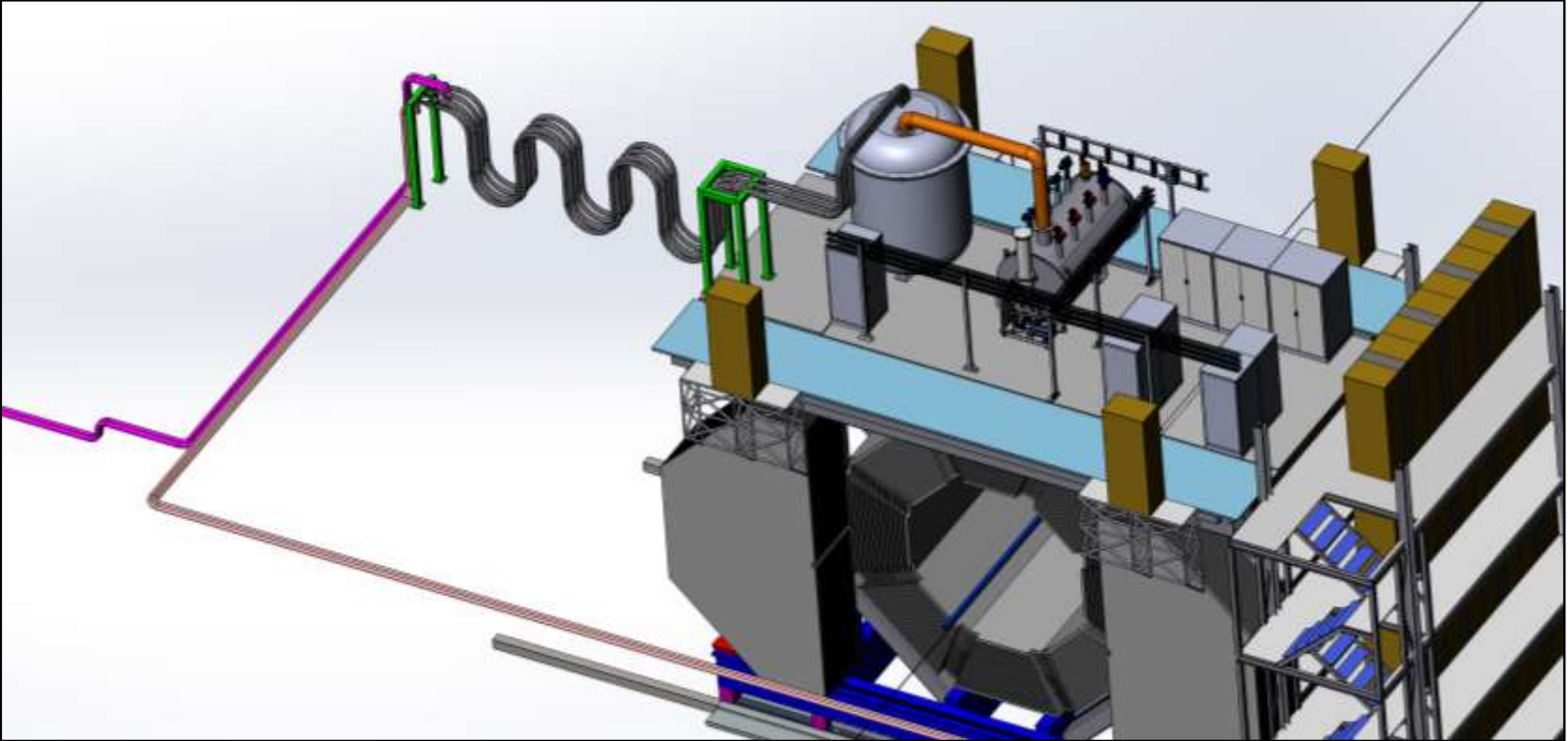
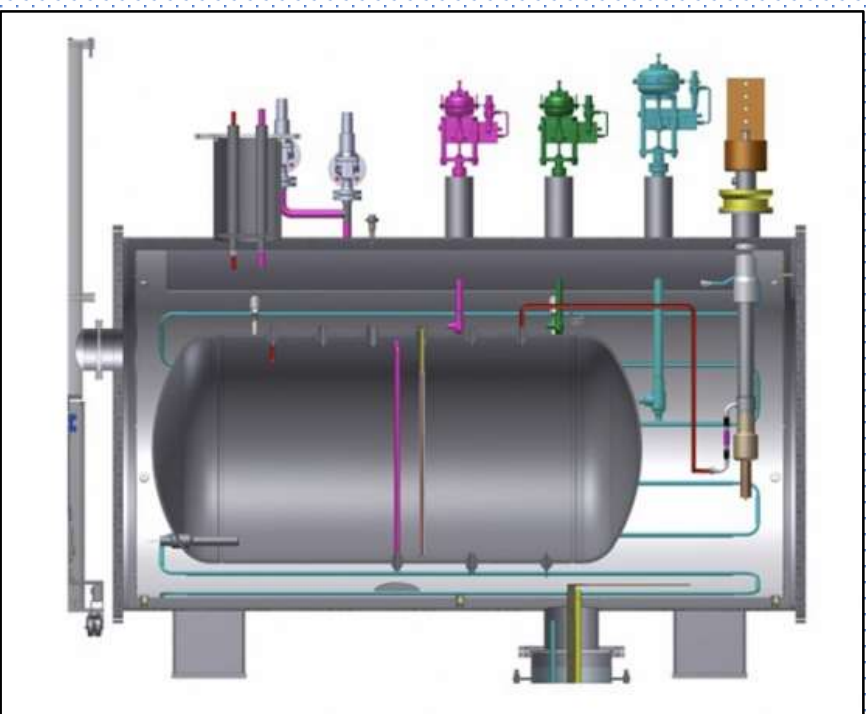
Rigid pipes	Flexible pipes
220 m	40 m
ø60 mm high pr.	ø60 mm high pr.
ø100 mm low pr.	ø100 mm low pr.



The model has been developed by Andrey Ponomarev

Helium system

Control cryostat



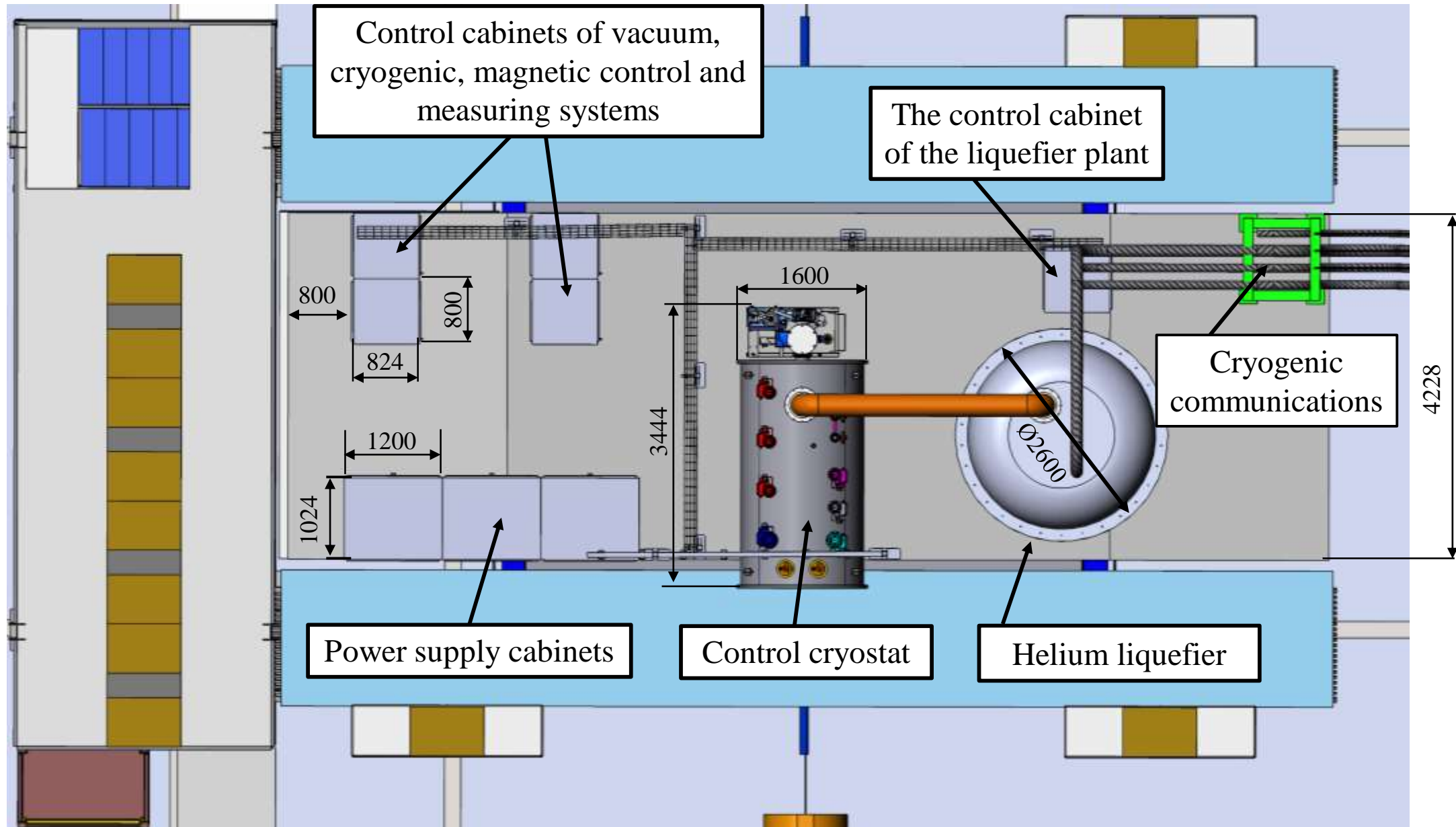
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Helium liquefier

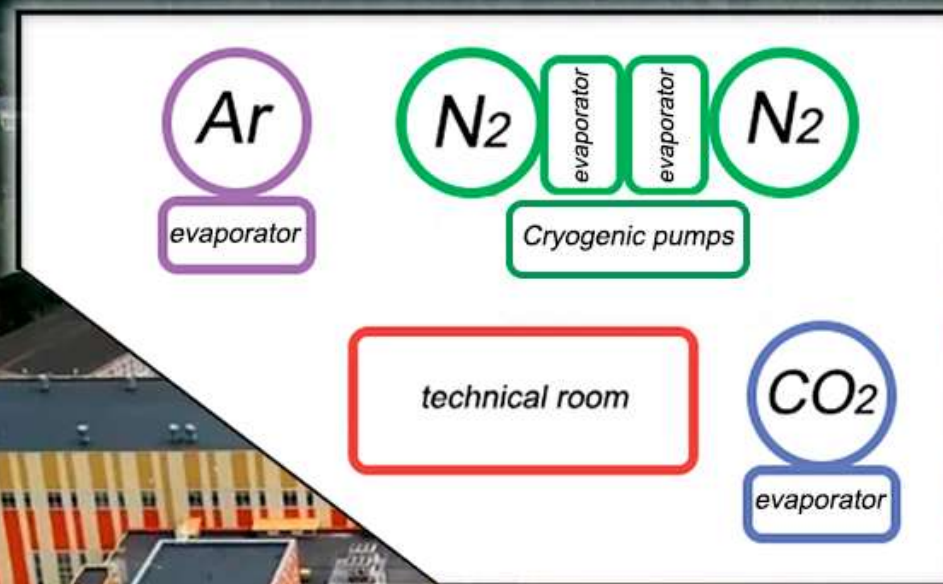
	Operating parameters	Unit
1	Cooling capacity	140 l/h
2	Temperature of outlet flow from the SPD	4.3 K (1.05 bar)
3	Temperature of inlet flow from the SPD	4.5 K (1.15 bar)
4	Hydraulic resistance of the SC coil	0.1 bar
5	Cold weight	3800 kg
6	Maximum pressure in coil	5 MPa
7	Maximum heat load	100 W
8	Equipment Requirement	Maximum reliability, energy efficiency, compactness, automatic mode
9	Interval of repair/regulatory work of the plant	Not more than once a year



Technical platform of cryogenic equipment





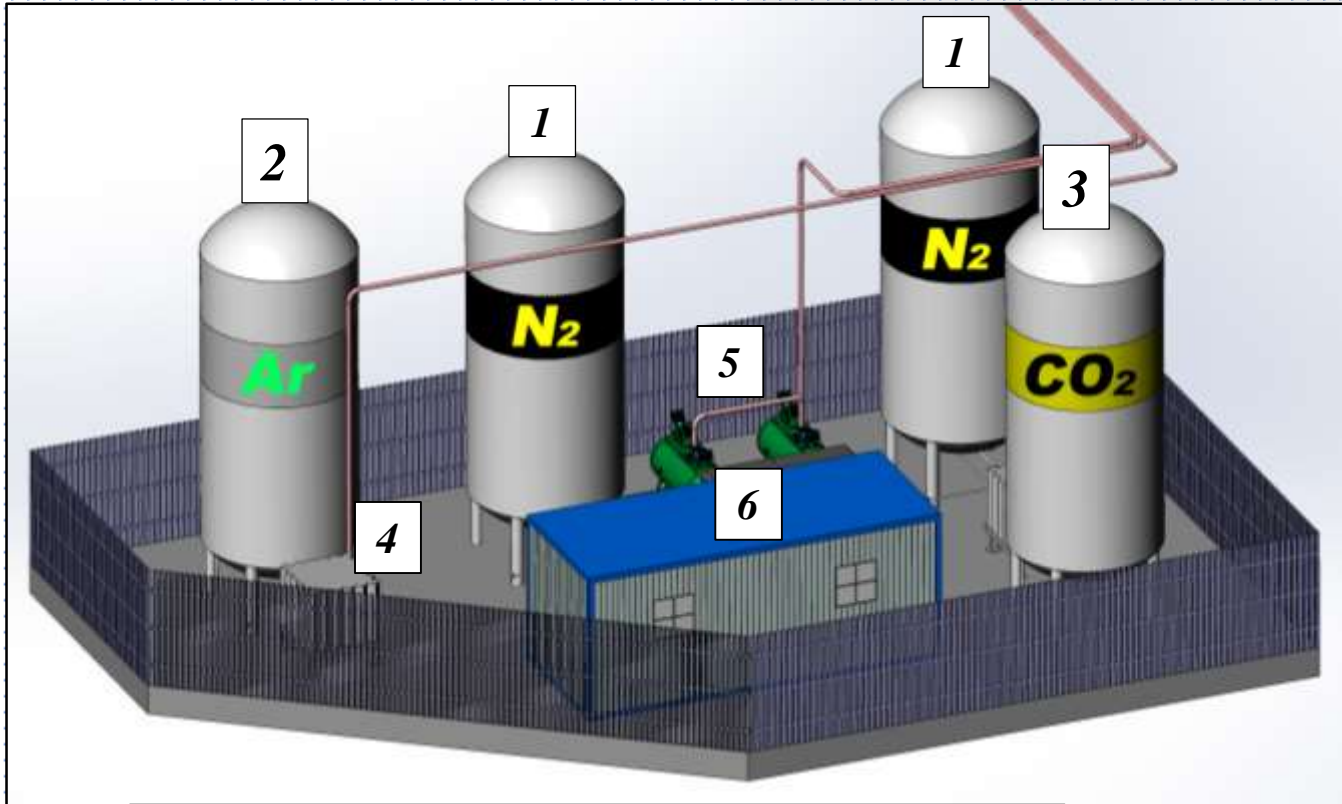


	Operating parameters	Unit
1	Overall volume	20 000 l
2	Maximum daily evaporation rate depending on pressure 100 kPa and ambient temperature 15°C	0.17 %
3	Maximum outlet flow rate (nitrogen)	600 Nm ³ / h
4	Maximum operating pressure	1.8 MPa
5	Operating pressure range	From 1.2 bar to 4.0 bar
6	Minimum permissible wall temperature (inner vessel)	77 K
7	Maximum pressure in vacuum space at T = 293K	10 Pa
8	Interval of repair / regulatory work of the plant	Not more than once a 7 year



Cryogenic tanks platform

Nitrogen system



- 1 – Two storage tanks for LN₂;
- 2 – Storage tank for LAr;
- 3 – Storage tank for LCO₂;
- 4 – Evaporator for LAr;
- 5 – Cryogenic pumps;
- 6 – Equipment room.

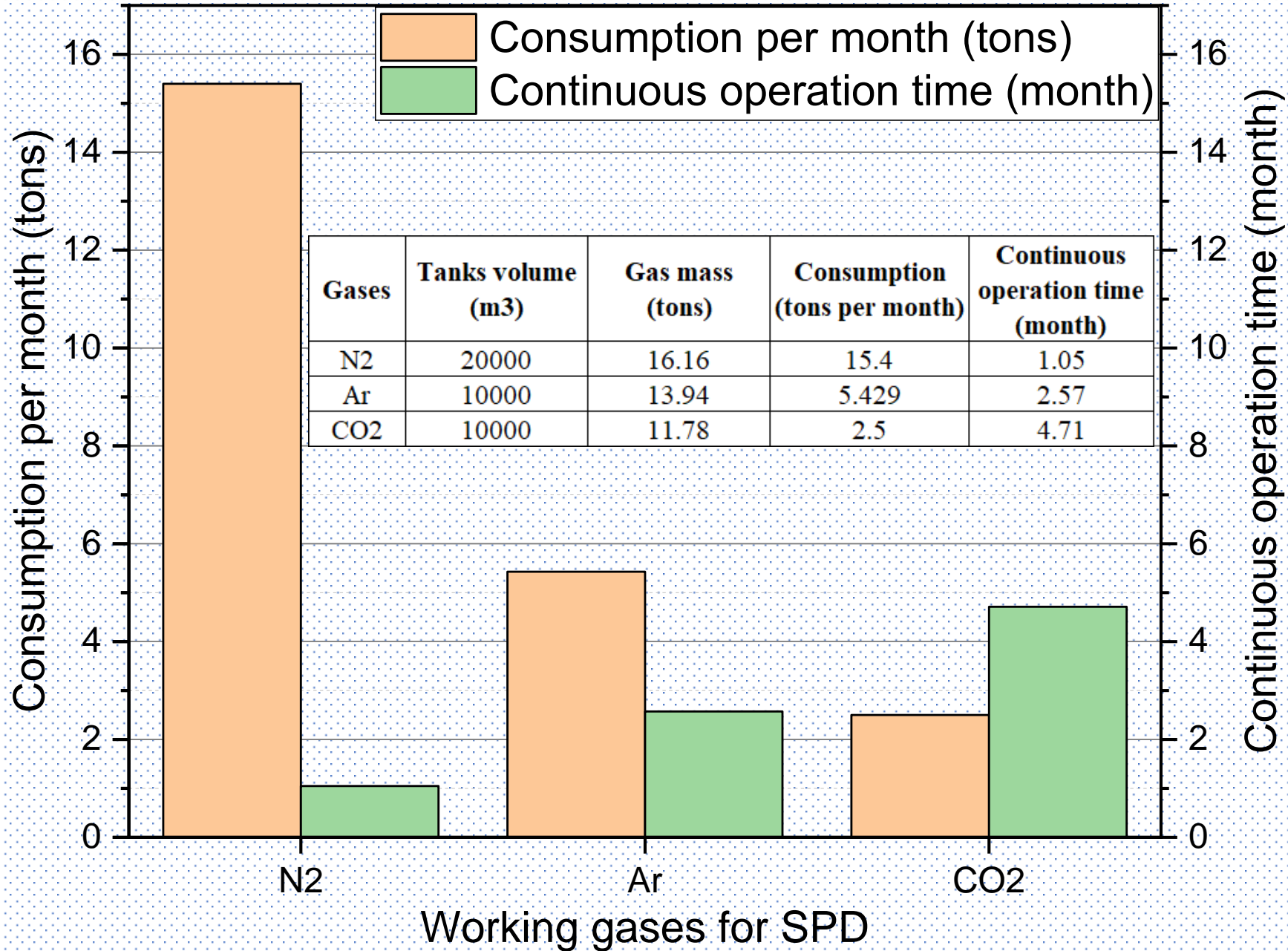
Pipelines

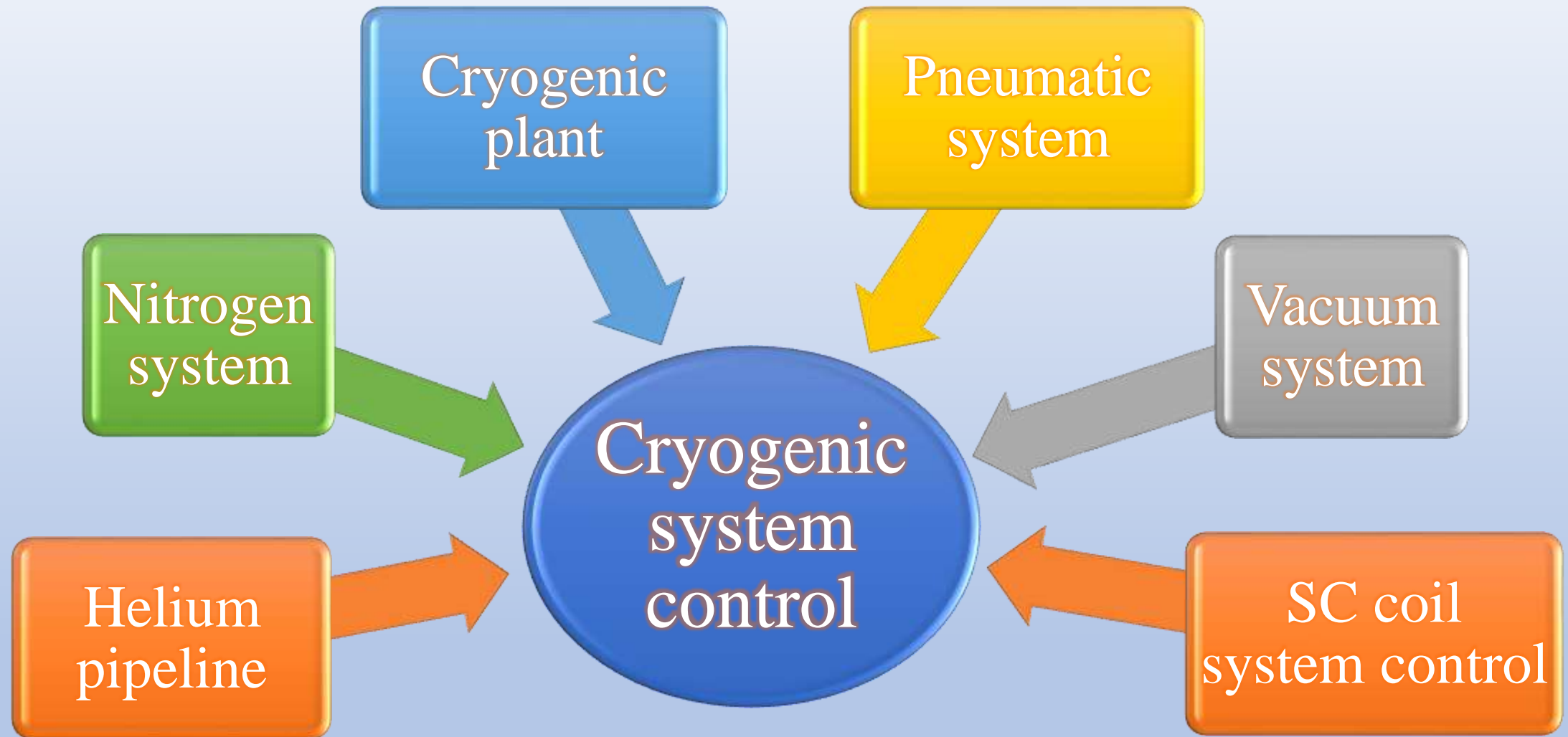
Cryogenic line:

LN₂ – 120 m
(rigid tube)
LN₂ – 40 m
(flexible tube)

Warm line:

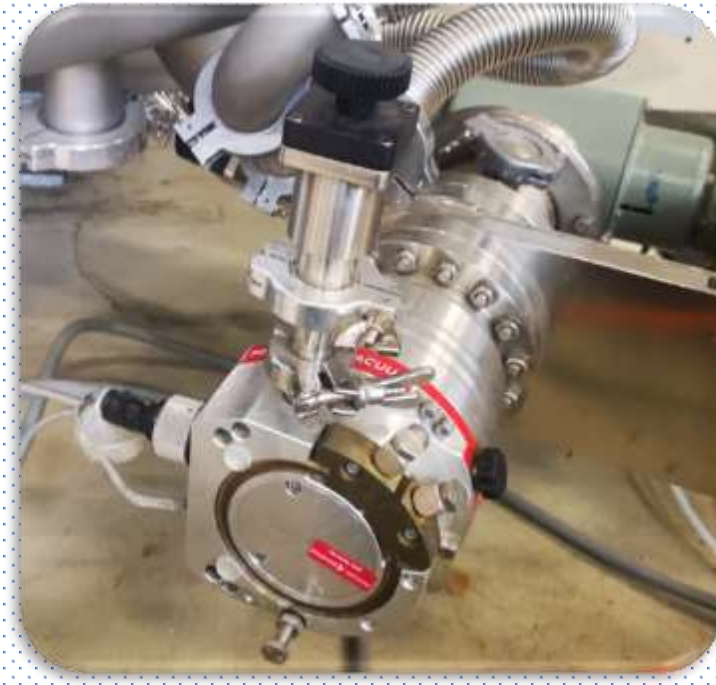
Ar – 120 m
(rigid tube)
N₂ – 120 m
(rigid tube)
CO₂ – 120 m
(rigid tube)





Other subsystems

Vacuum system



Pumping station with two foreline pumps and turbomolecular pump

Pneumatic system



Steps of creation																								
SPD	2022				2023				2024				2025				2026				2027			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Cryogenic plant	Red	Red	Red	Red	Red	Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Blue	Blue	Blue			
Helium pipeline					Red	Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Blue	Blue						
Nitrogen system					Red	Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Blue	Blue						
Vacuum system							Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Blue	Blue				
Pneumatic system							Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Blue	Blue				
Cryogenic system control								Red	Red	Red	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Blue	Blue	Blue	Blue



Conclusions:

- **The type of SPD magnet and the type of cryogenic plant was determined.**
- **The location of cryogenic tanks, their volumes and gas flow rates for SPD were determined.**
- **The cooling capacity, mass flow rate and working cycles of the cryogenic plant are calculated.**
- **The development of technical tasks for a cryogenic plant and a platform for cryogenic storage tanks is in the active phase.**
- **The work is carried out according to the plan.**



Thank you for
your attention!

