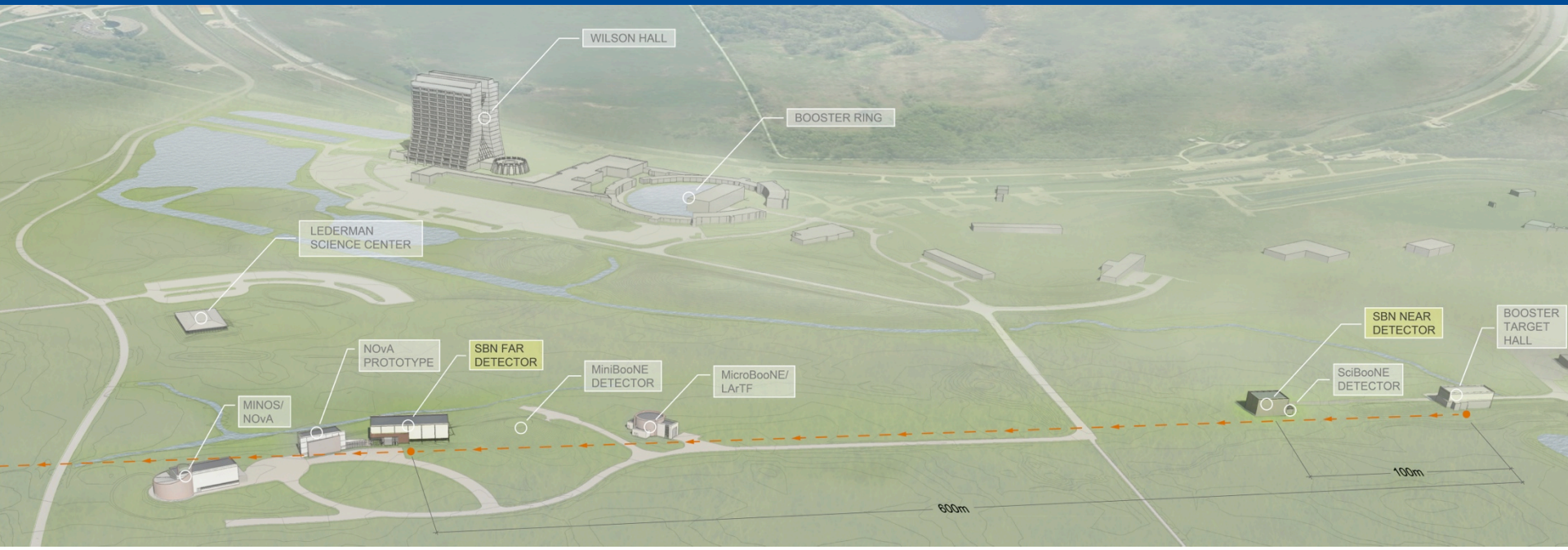


P&ID of SBN ND cryogenics

Michael Geynisman (for CERN-Fermilab Team)

Neutrino Platform General Meeting

March 3, 2016

The P&ID for the SBN ND cryogenics:

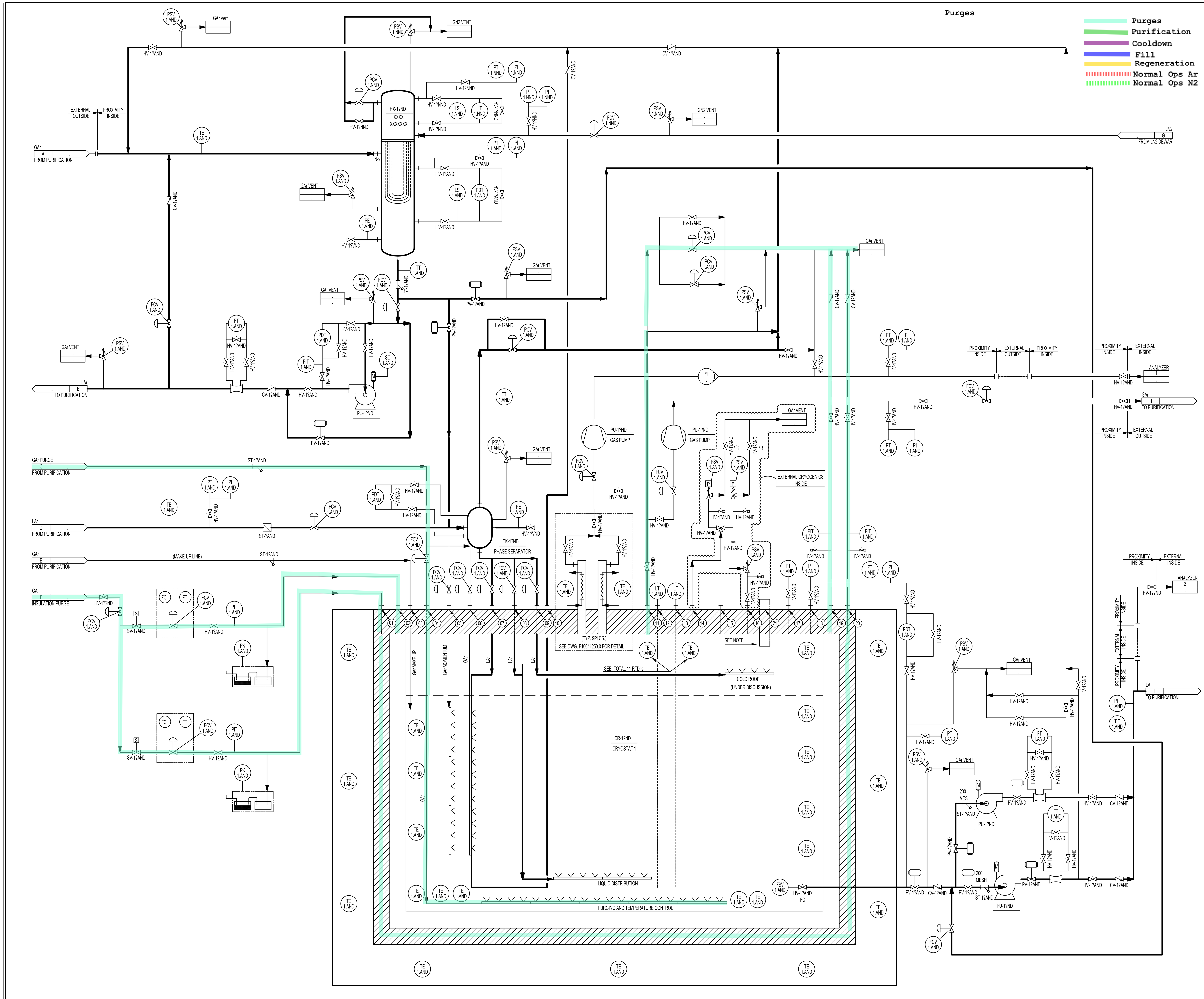
- Shares similarities with ProtoDUNE single phase and DUNE cryogenic system (for the benefit of prototyping), i.e. condenser pumps
- Has some unique features, i.e. LAr spray to control ullage temperature < 100K
- Shares similarities with SBN FD cryogenic system for the external cryogenics, i.e. identical LAr dewars supplied from CERN

This presentation shows:

- P&ID (4 sheets) and modes of operations
- Interfaces between internal-proximity-external
- Location of equipment inside and outside the SBN ND building
- Proposed schedule to finalize P&ID for equipment and piping tender

Requirements for **SBND** Cryogenics - Cryogenics

Required Parameter for Cryogenics	Value
LAr purity in cryostat	3 ms electron lifetime (100 ppt O2 equivalent)
Nitrogen contamination	Less than 2 ppm (to coincide with T600)
Design Pressure	345 mbarg (~5 psig)
Operating gas pressure	70 mbar (~1 psig) with +/- 5% (~0.05 psig)
GAr Piston purge rate of rise	1.2 m/hr
Membrane cool-down rate	From manufacturer (most likely < 10-15 K/hr)
TPCs cool-down rate	< 40 K/hr < 10 K/m (vertically)
Mechanical load on TPC	The LAr or the gas jet pressure shall not apply a mechanical load to the TPC greater than 200 Pascal
Nominal LAr purification flow rate (filling/ops)	1 volume change/day 7.9 m^3/hr = 35 gpm. Less circulation flow is allowed , e.g. 10 gpm, is rationale is verified. Similar to 1 change per 8 days for T600
All surfaces in the ullage during operations	< 100 K
Convective currents inside cryostat	< 10 cm/s
GAr purge within insulation (From LBNF)	1 volume change/day of the open space between insulation panels
Condenser cooling power	Based on fill with LAr (~25 kW)
Grounding and noise requirement	Electrical isolation from cryostat. Approval by SBND committee supervising detector and building grounding



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UNDER DEVELOPMENT

04/22/2015

LEGEND

→ DENOTES VACUUM JACKETED PIPE

→ DENOTES PROCESS PIPE

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DRAWN BY:	M. DELANEY										
CHECKED BY:	D. MONTANARI	B	F10041250.1	IFI	12/29/2015	MD	ISSUED FOR REVIEW INFORMATION	XX	FERMI	MA	MA
APPROVED BY:	D. MONTANARI	A	F10041250.1	IFR&C	04/22/2015	MD	ISSUED FOR REVIEW AND COMMENT	XX	FERMI	MA	MA
(CURRENT REVISION ONLY)											

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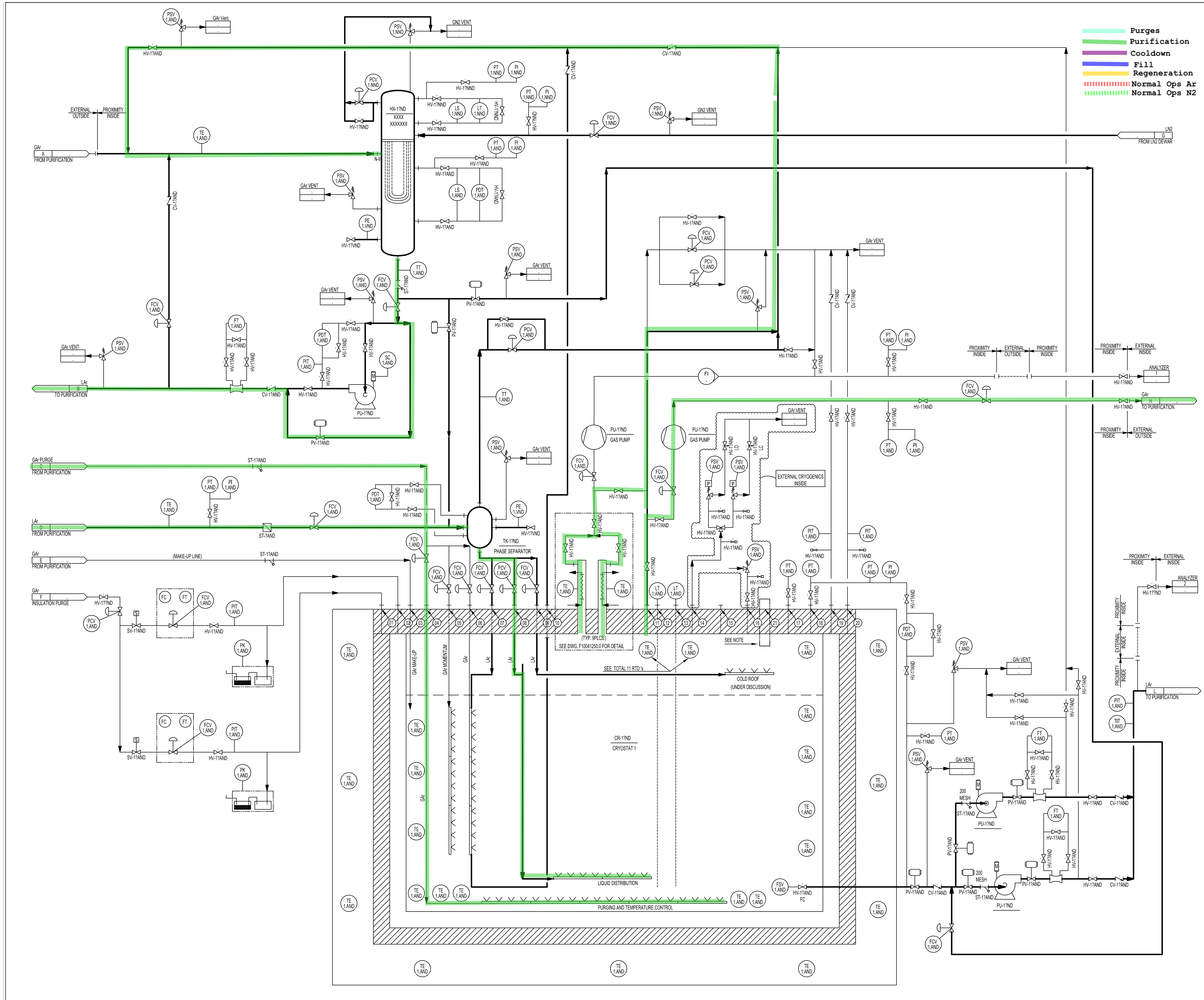

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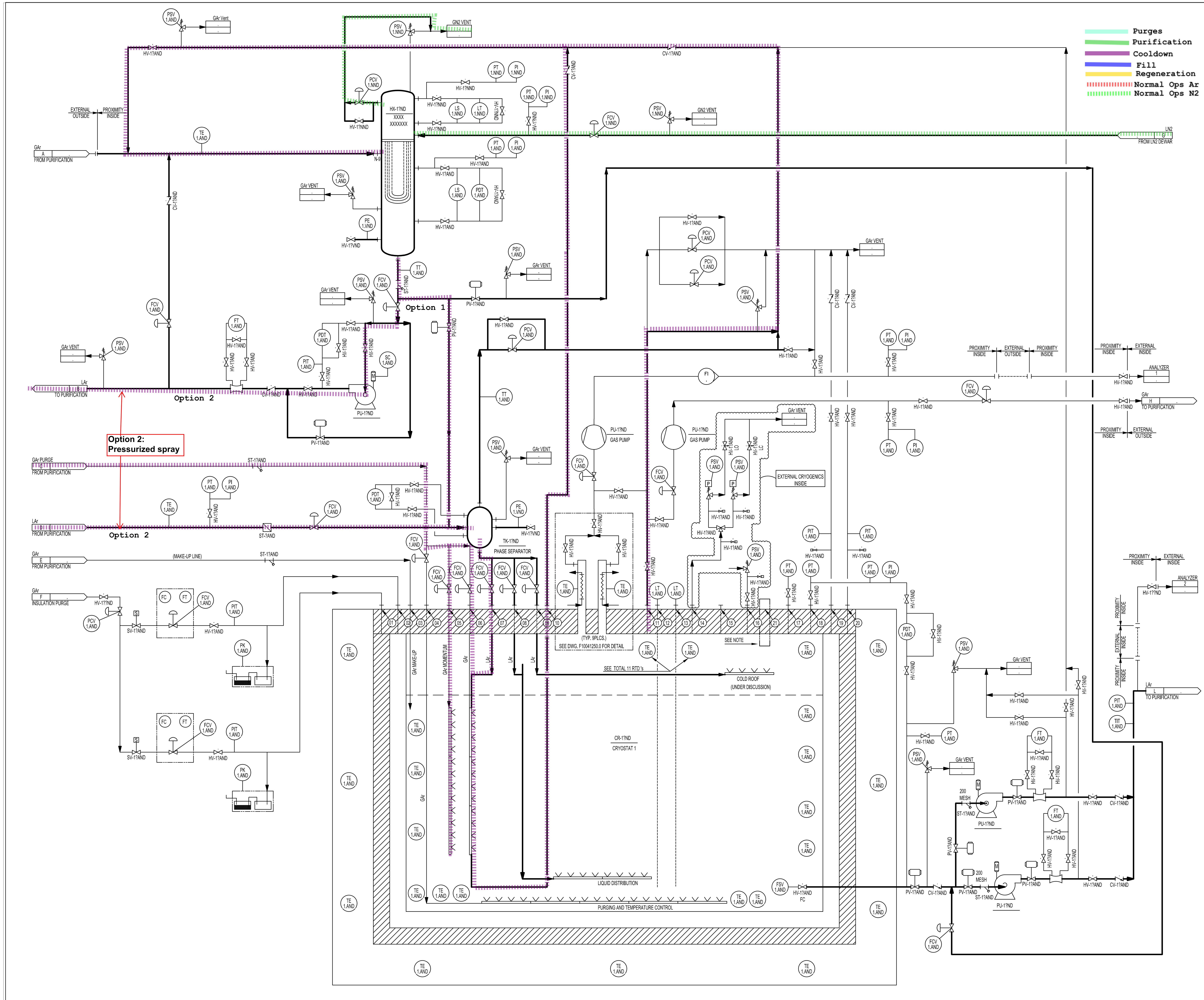

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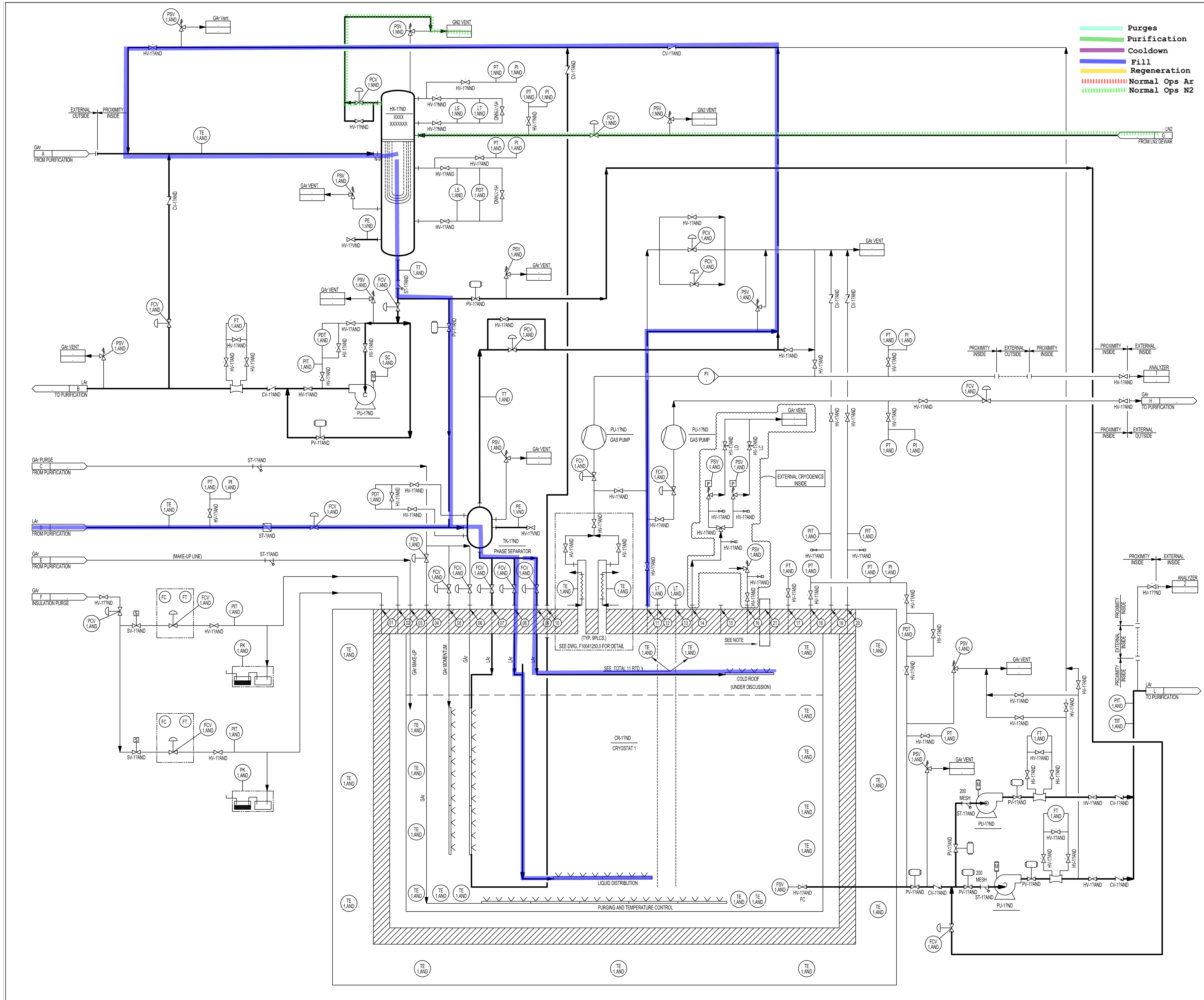

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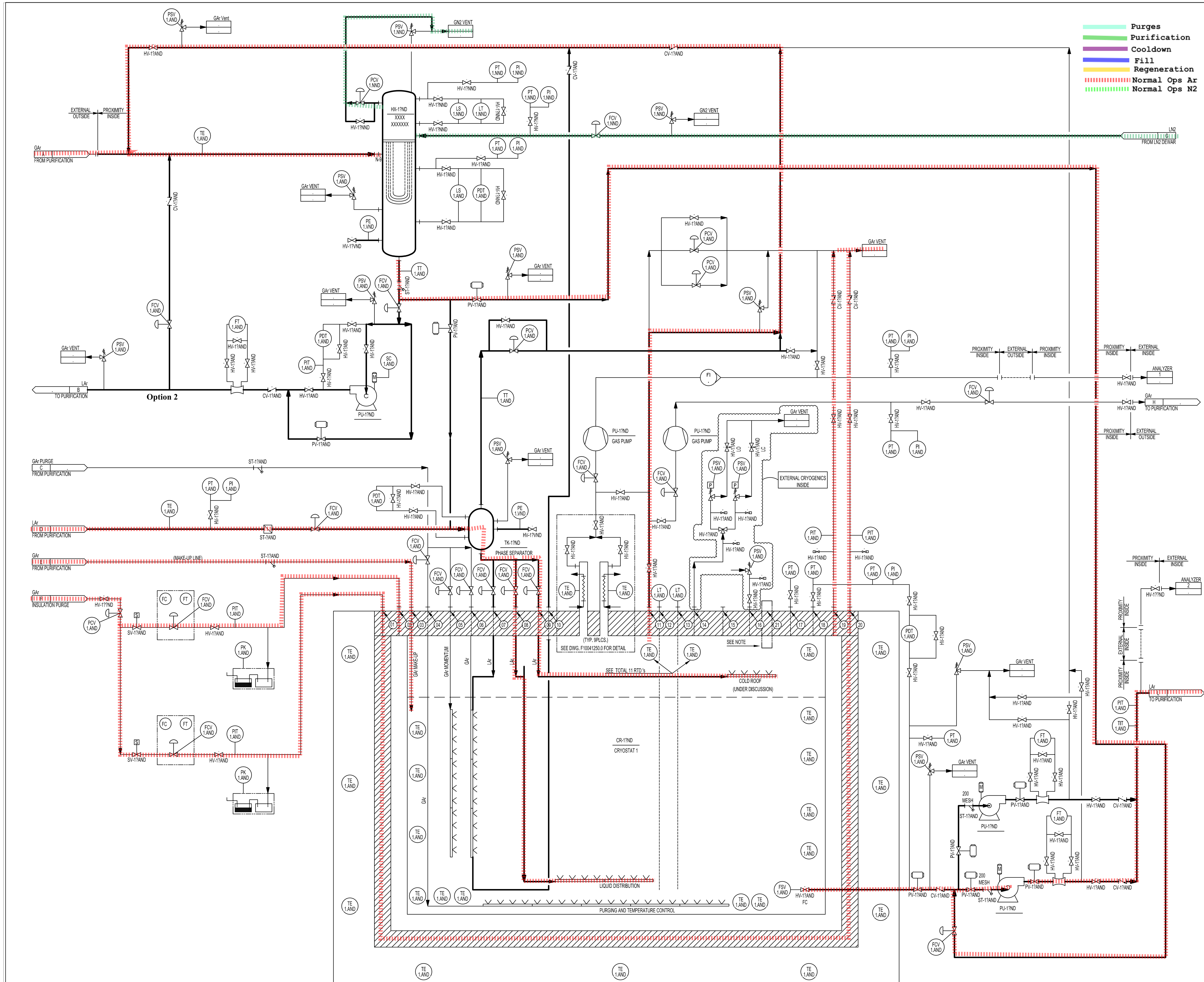

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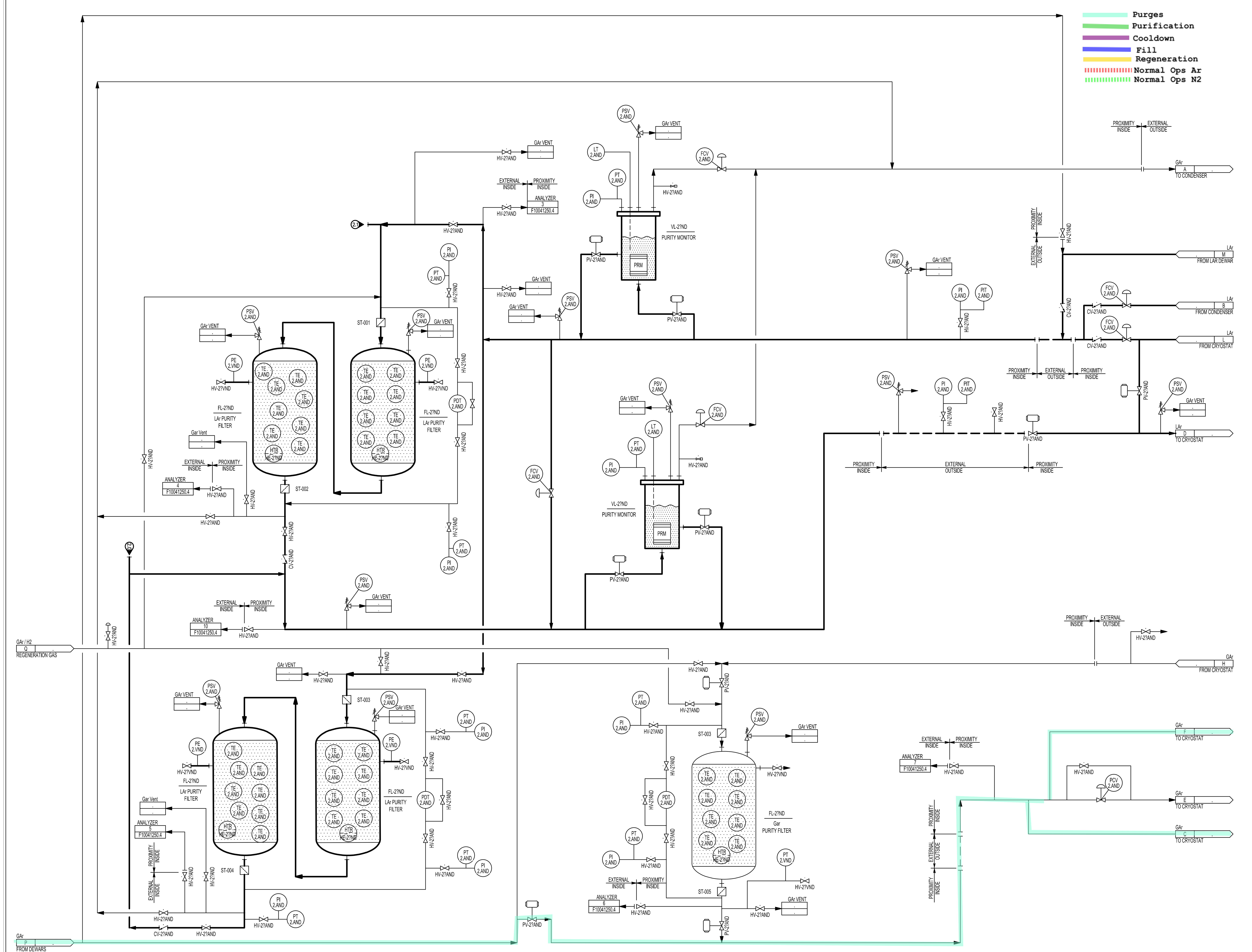

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1. CONNECTION POINTS FOR ALTERNATE OR BACKUP PURIFICATION FILTER (FUTURE). (1.X)
2. TO CONNECT ADDITIONAL FILTER IN PARALLEL (2.X)
3. THIS SHEET SHOWS PROXIMITY CRYOGENICS

CHECKED BY: ______ DATE: ______
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UNDER DEVELOPMENT
04/22/2015

LEGEND

- DENOTES VACUUM JACKETED PIPE
- DENOTES PROCESS PIPE

ORIGINATED BY:	D. MONTANARI										
DRAWN BY:	M. DELANEY										
CHECKED BY:	D. MONTANARI	B	F10041250.2	IFI	12/29/2015	MD	ISSUED FOR INFORMATION	XX	FERMI	RD	MZ
APPROVED BY:	D. MONTANARI	A	F10041250.2	IFR&C	04/22/2015	MD	ISSUED FOR REVIEW AND COMMENT	XX	FERMI	RD	MZ
(CURRENT REVISION ONLY)		REV NO.	DOCUMENT NO.	REVISION STATE	DATE	BY	REVISION DESCRIPTION	PROJECT ID	CONTRACTOR	ENGR BY	APPR BY

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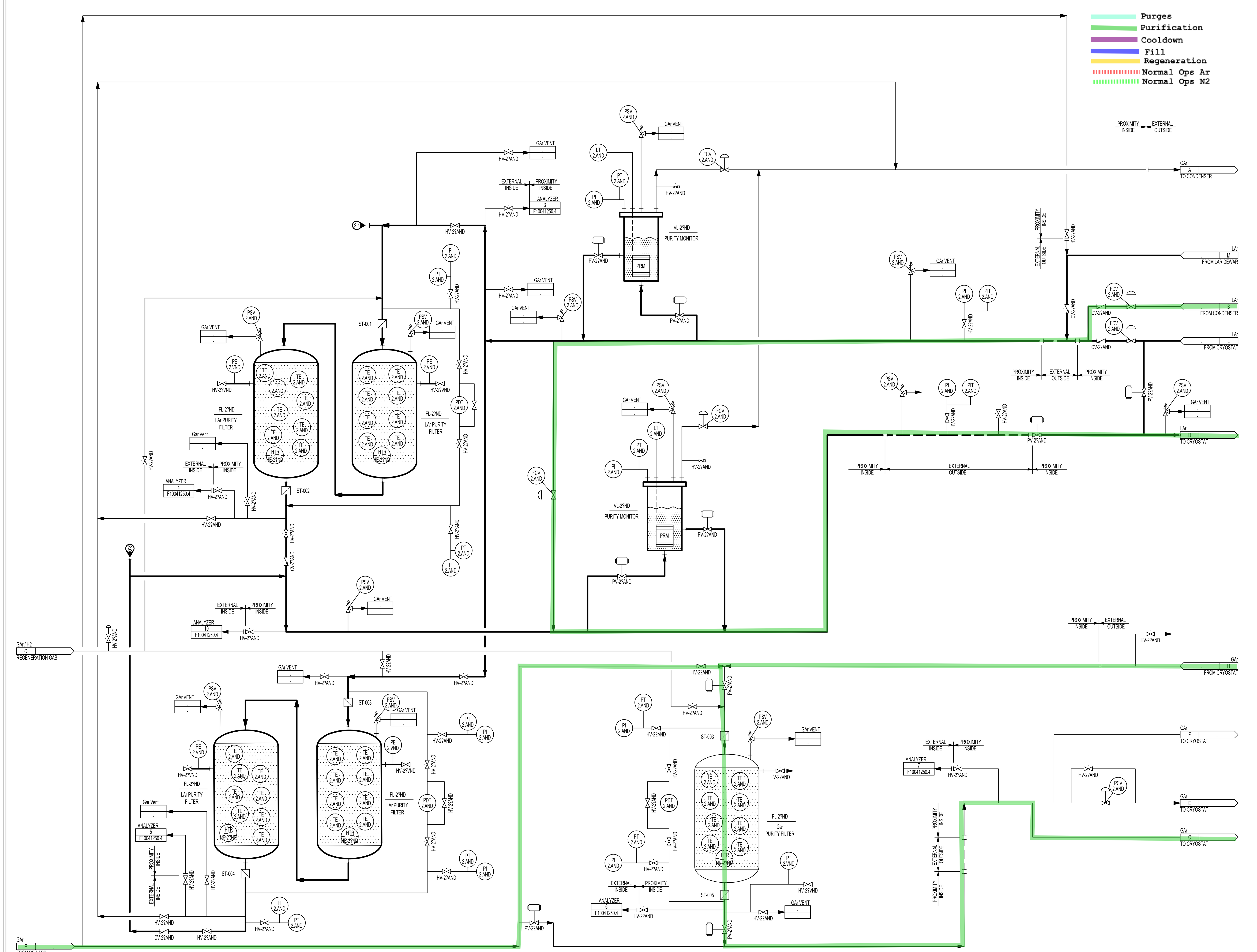
UNITED STATES DEPARTMENT OF ENERGY

MECHANICAL/ENG. DESIGN LAYOUTS
SBND
PIPING & INSTRUMENTATION DIAGRAM

UNIT: 01	SCALE: NONE	STATE: IFI	
DRAWN: MD	DATE: 08/29/2014	SHEET NO. 2 OF 4	
CHECKED: MZ	DRAWING NO. F10041250.2		REV. B
ENG'R: RD			



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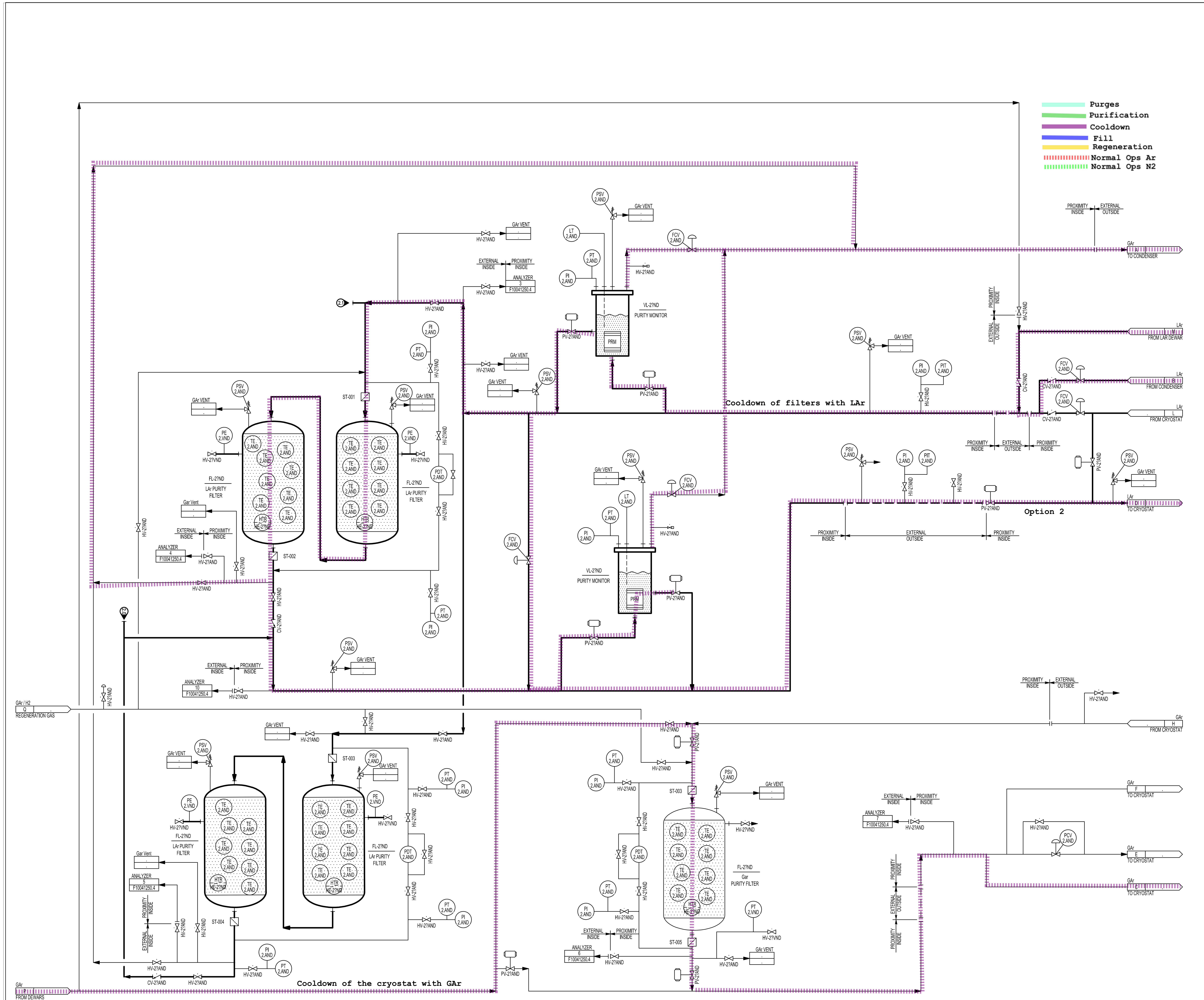

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ORIGINATED BY:	D. MONTANARI	REV NO.	DOCUMENT NO.	REVISION STATE	DATE	BY	REVISION DESCRIPTION	PROJECT ID	CONTRACTOR	ENGR BY	APPR BY
DRAWN BY:	M. DELANEY										
CHECKED BY:	D. MONTANARI	B	F10041250.2	IFI	12/29/2015	MD	ISSUED FOR INFORMATION	XX	FERMI	RD	MZ
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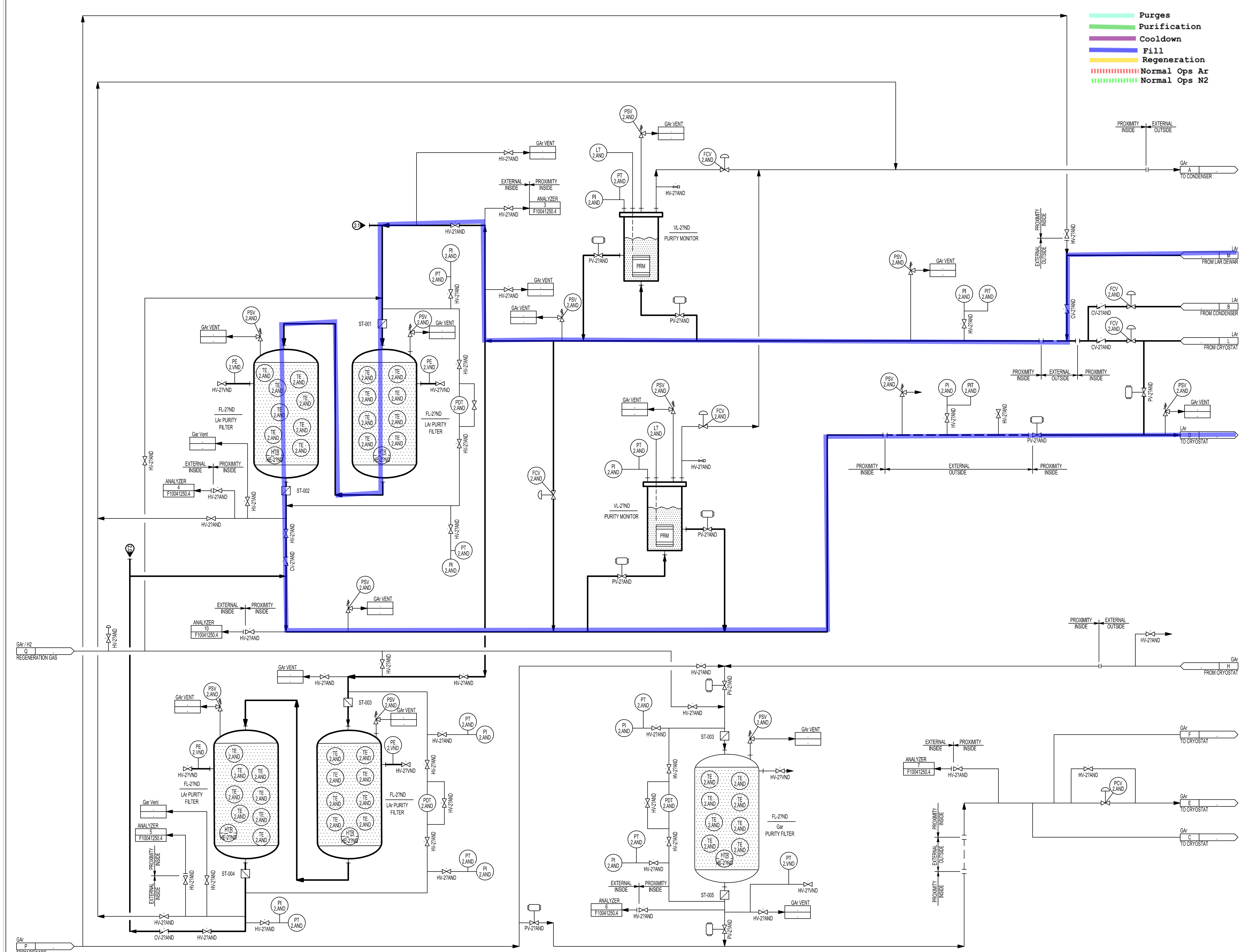

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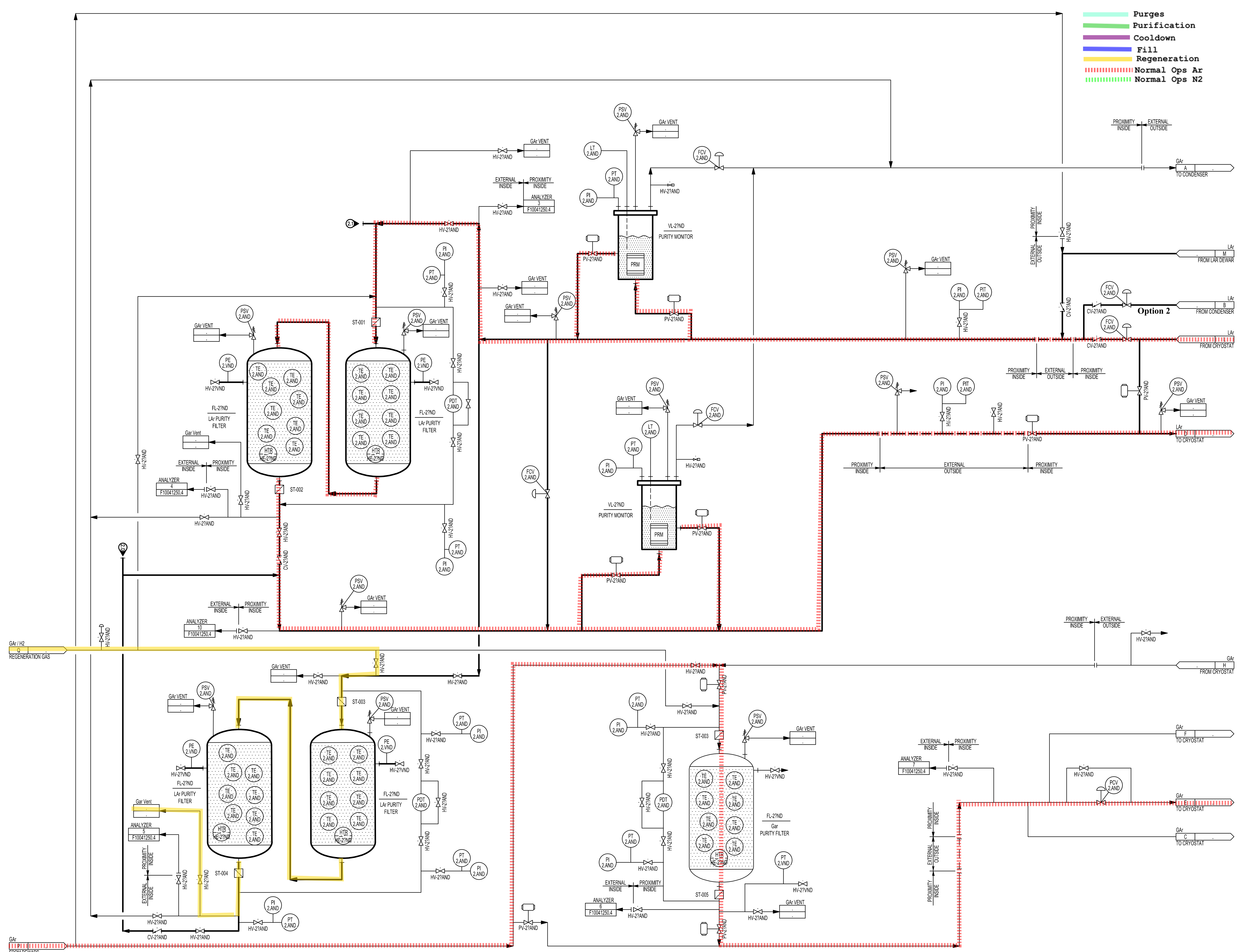

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04/22/2015

LEGEND

DENOTES VACUUM JACKETED PIPE

DENOTES PROCESS PIPE

ORIGINATED BY:	D. MONTANARI										
DRAWN BY:	M. DELANEY										
CHECKED BY:	D. MONTANARI	B	F10041250.2	IFI	12/29/2015	MD	ISSUED FOR INFORMATION	XX	FERMI	RD	MZ
APPROVED BY:	D. MONTANARI	A	F10041250.2	IFR&C	04/22/2015	MD	ISSUED FOR REVIEW AND COMMENT	XX	FERMI	RD	MZ
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DRAWN: MD	DATE: 08/29/2014	SHEET NO. 2 OF 4	
CHECKED: MZ	DRAWING NO. F10041250.2		REV. B
ENG'R: RD			

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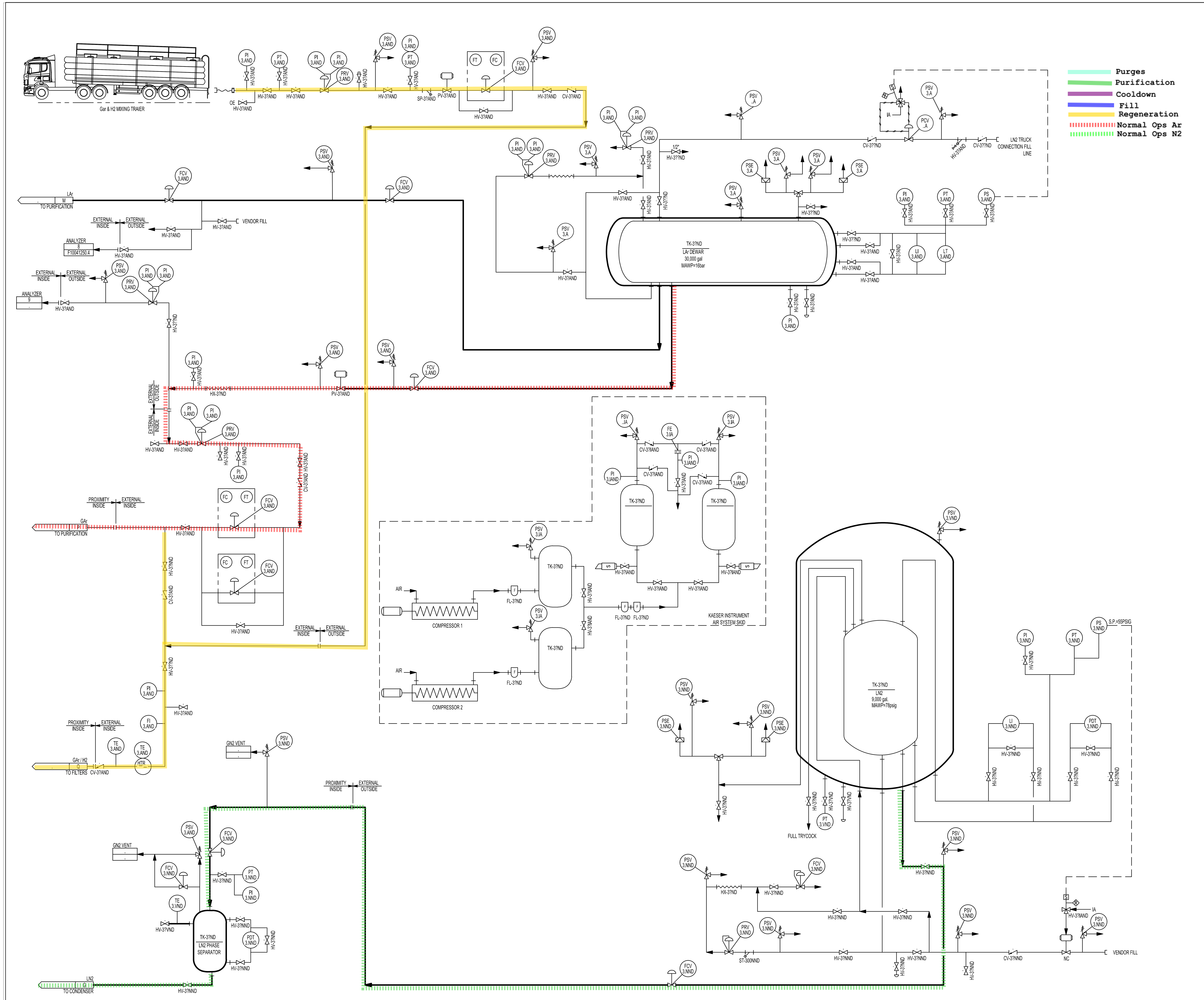

General Notes

1. THIS SHEET SHOWS EXTERNAL CRYOGENICS

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04/22/2015

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- DENOTES VACUUM JACKETED PIPE
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FERMI NATIONAL ACCELERATOR LABORTORY
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UNIT: 01	SCALE: NONE	STATE: IFR&C	
DRAWN: MD	DATE: 08/29/2014	SHEET NO. 3 OF 4	
CHECKED: MZ	DRAWING NO. F10041250.3		REV. B
ENG'R: RD			

		REV NO.	DOCUMENT NO.	REVISION STATE	DATE	BY	REVISION DESCRIPTION	PROJECT ID	CONTRACTOR	ENGR BY	APPR BY
ORIGINATED BY:	D. MONTANARI										
DRAWN BY:	M. DELANEY										
CHECKED BY:	D. MONTANARI	B	F10041250.3	IFI	12/29/2015	MD	ISSUED FOR INFORMATION	XX	FERMI	RD	MZ
APPROVED BY:	D. MONTANARI	A	F10041250.3	IFR&C	04/22/2015	MD	ISSUED FOR REVIEW AND COMMENT	XX	FERMI	RD	MZ
(CURRENT REVISION ONLY)											

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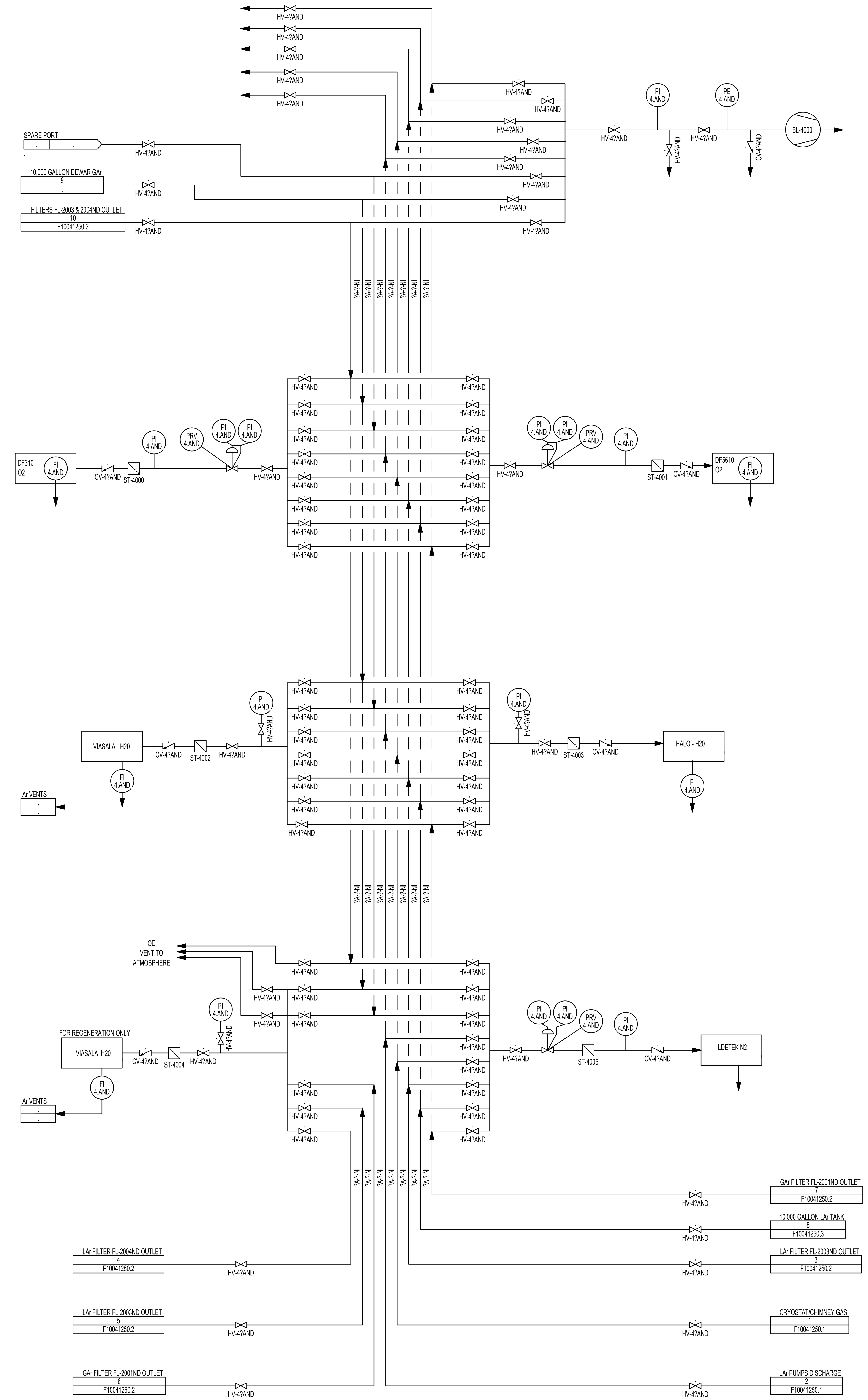

Purges
Purification
Cooldown
Fill
Regeneration
Normal Ops Ar
Normal Ops N2

General Notes

CHECKED BY: ________ DATE: ________

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04/22/2015

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PIPING & INSTRUMENTATION DIAGRAM

UNIT: 01	SCALE: NONE	STATE: IFI	
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		REV NO.	DOCUMENT NO.	REVISION STATE	DATE	BY	REVISION DESCRIPTION	PROJECT ID	CONTRACTOR	ENGR BY	APPR BY
ORIGINATED BY:	M. ADAMOWSKI										
DRAWN BY:	M. DELANEY										
CHECKED BY:	D. MONTANARI	B	F10041250.4	IFI	12/29/2015	MD	ISSUED FOR INFORMATION	XX	FERMI	RD	MZ
APPROVED BY:	D. MONTANARI	A	F10041250.4	IFR&C	04/22/2015	MD	ISSUED FOR REVIEW AND COMMENT	XX	FERMI	RD	MZ
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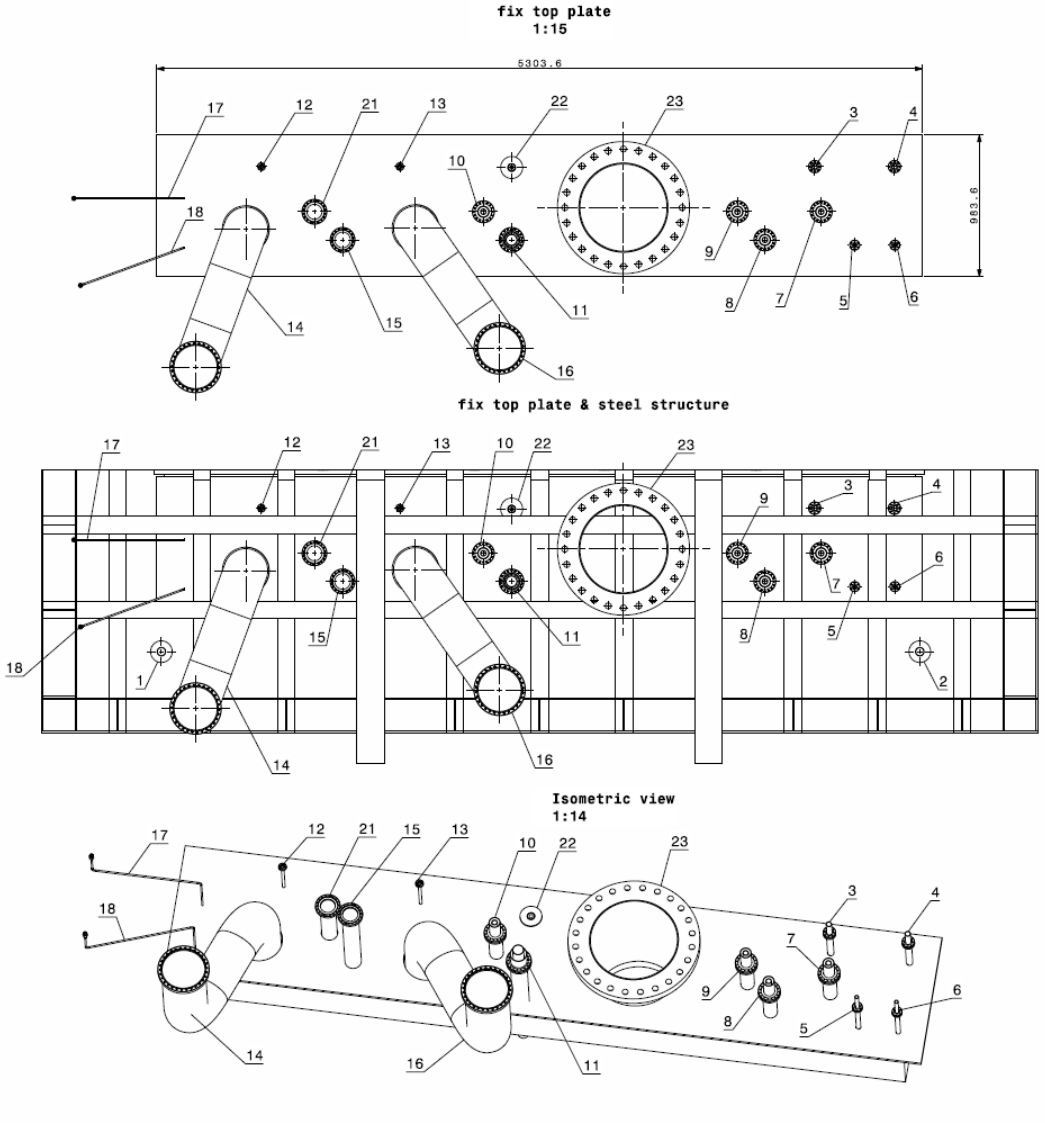
Interface internal - proximity via fixed top plate:



Cryogenic penetrations

Pos.	Description	Diam	Qty
1,2,19,20	Argon purge gas	2"	4
3	Argon make up gas	1.75"	1
4	Argon purge gas	1.75"	1
5	Argon gas momentum	1.25"	1
6	Argon gas cooldown	1.25"	1
7	Argon liquid cooldown	3.75"	1
8	Argon liquid distribution	3.75"	1
9	Argon liquid to cold roof	3.75"	1
10	Argon liquid cooldown path to condenser	3.75"	1
11	Argon gas boil-off	4.75"	1
12,13	Liquid level probes	0,75	2
14	Argon gas vent port	12"	1
15	Spare port	4.75"	1
16	Argon vacuum relief	12"	1
17,18	Instrumentation port	0.375"	2
21	Instrumentation port	4.25"	1

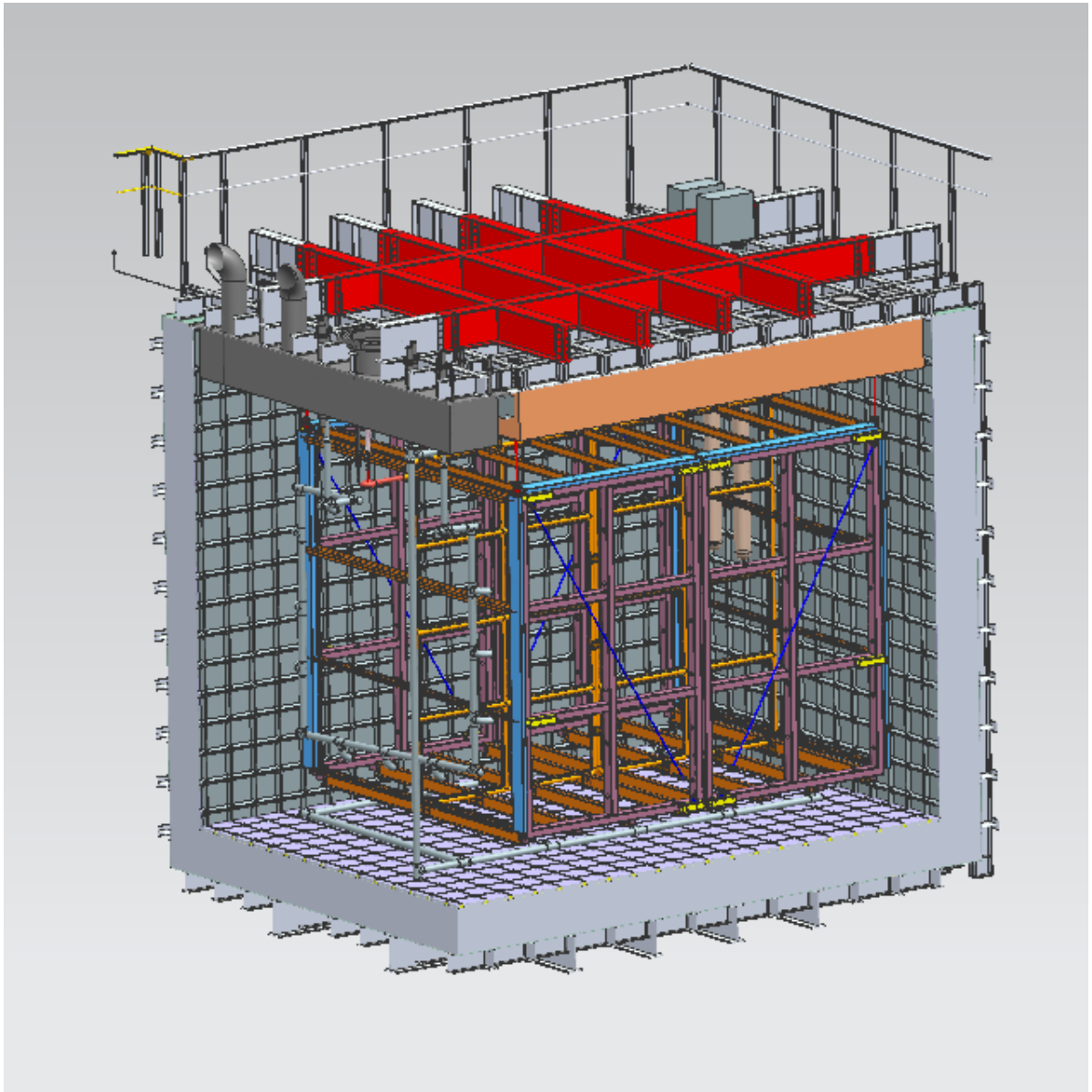
Detector penetrations

Pos.	Description	Diameter [mm]	Qty.
22	High Voltage Feedthrough		1
23	Manhole		1

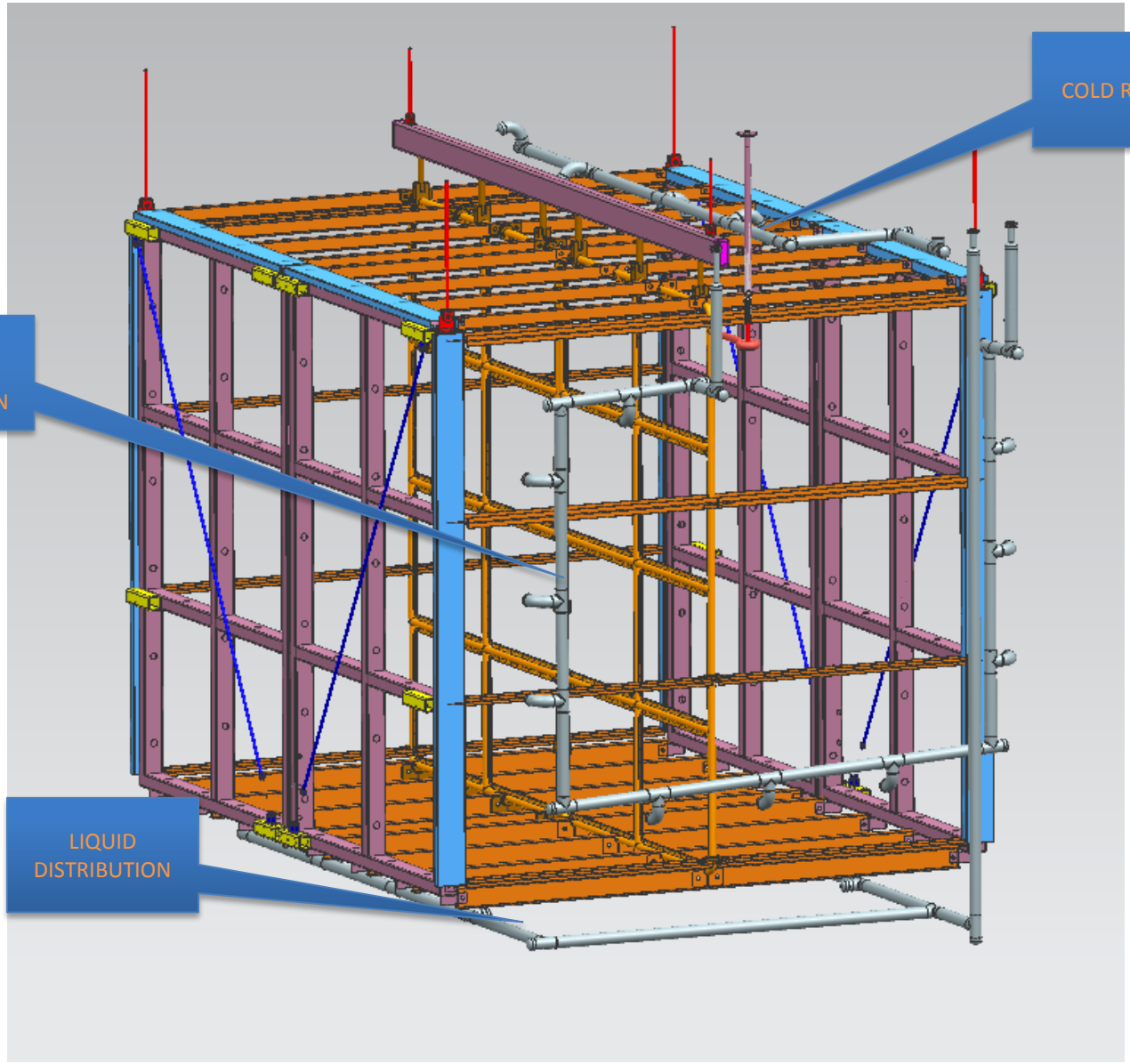
This component is described by 3 assosiated drawings:
-1/3: CENSNDCI0001 (main sheet)
-2/3: CENSNDCI0002
-3/3: CENSNDCI0003

SBND Cryostat Integration		DRAWN	E. Seletskaya 2015.12.01
INTEGRATION ASSEMBLY STEEL STRUCTURE & TOP CAP SBND	SCALE	CONTROLLED	
		RELEASED	
		APPROVED	
		LBD Document Number	ST0726654_03
		REPLACES	
NON VALABLE POUR EXECUTION NOT VALID FOR EXECUTION	DRG	- CENSNDCI0002	SHT 1 IND

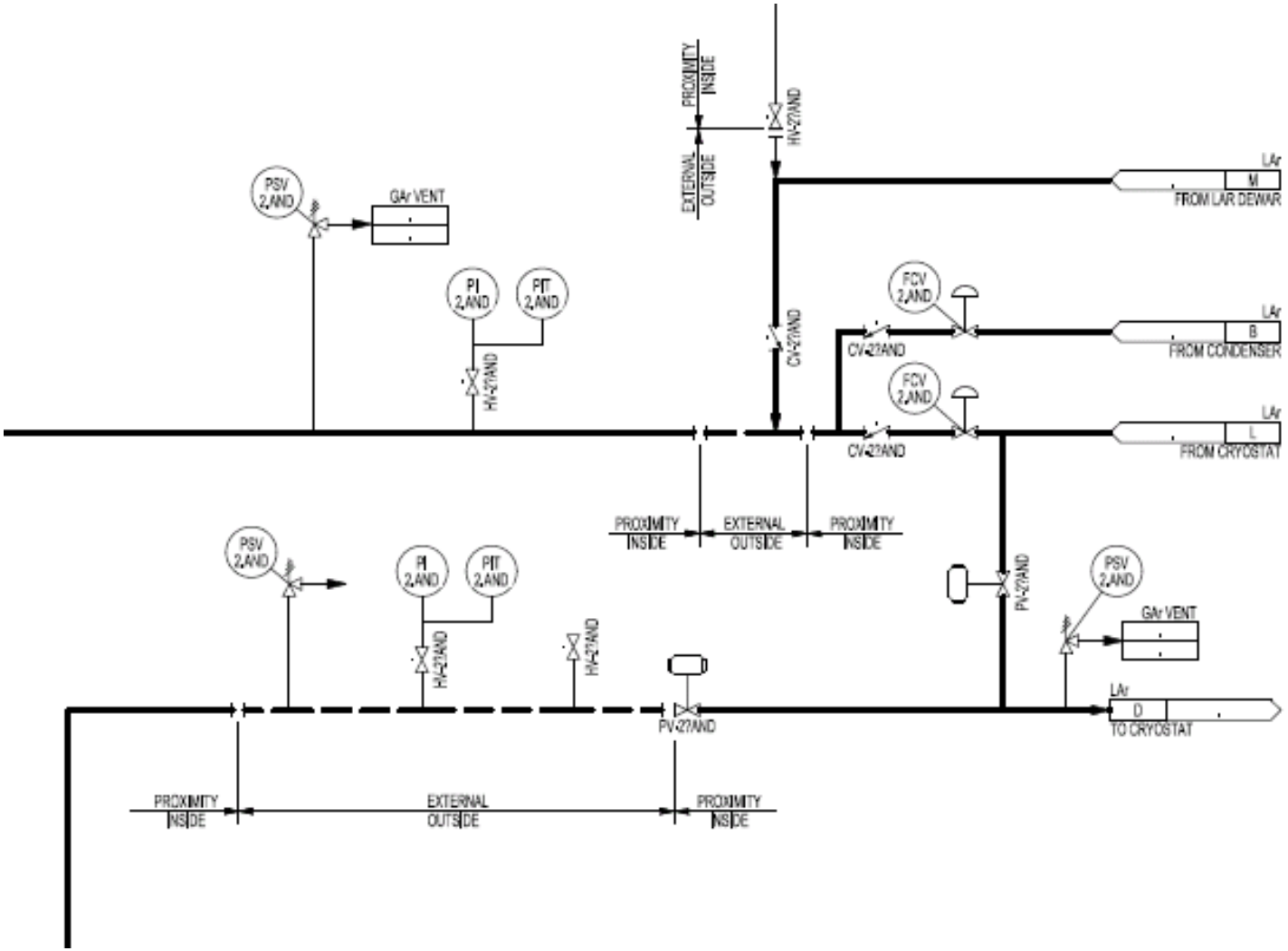
Interface internal - proximity via top plate and TPC:



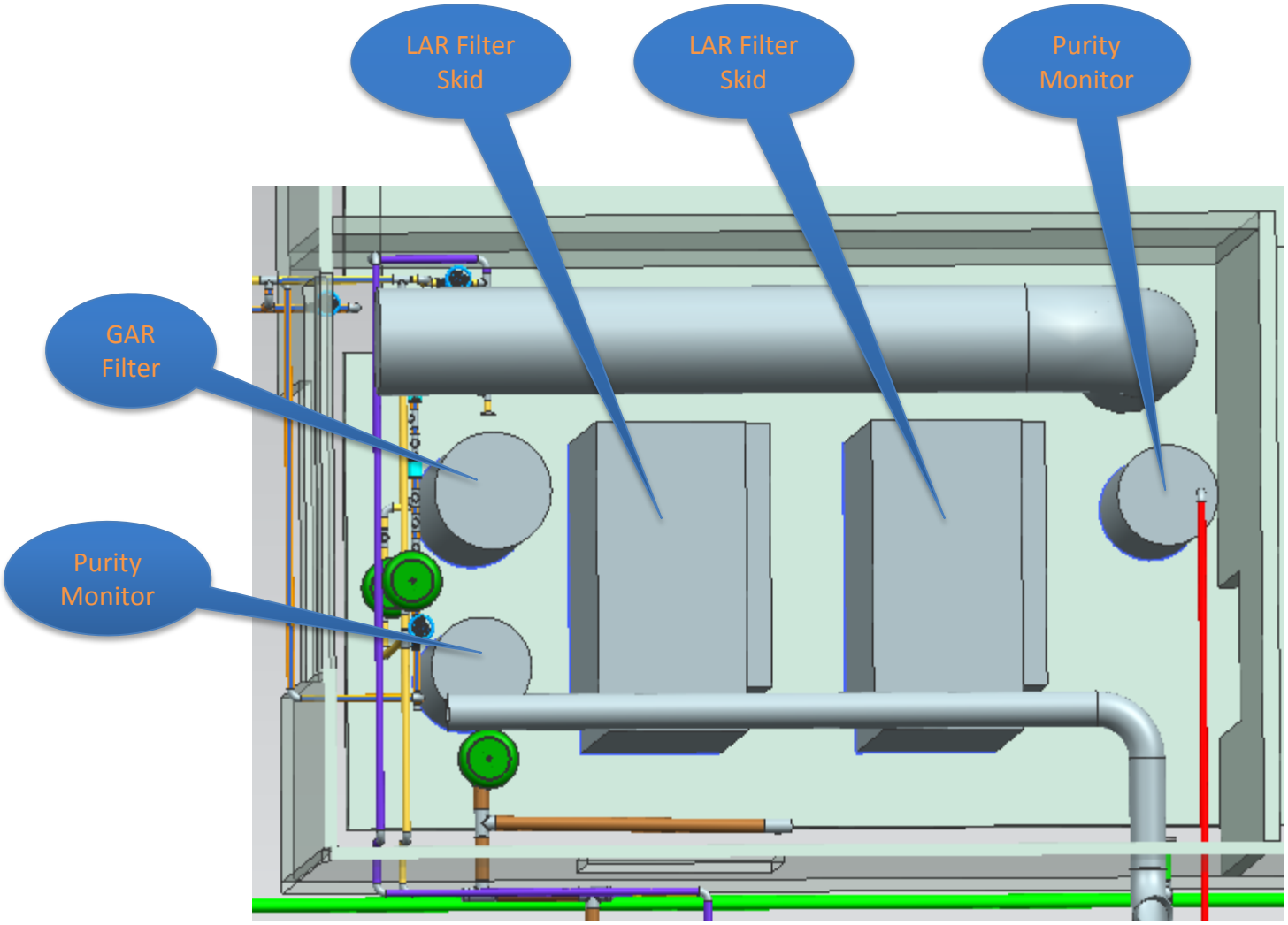
Interface internal - proximity via top plate and TPC:



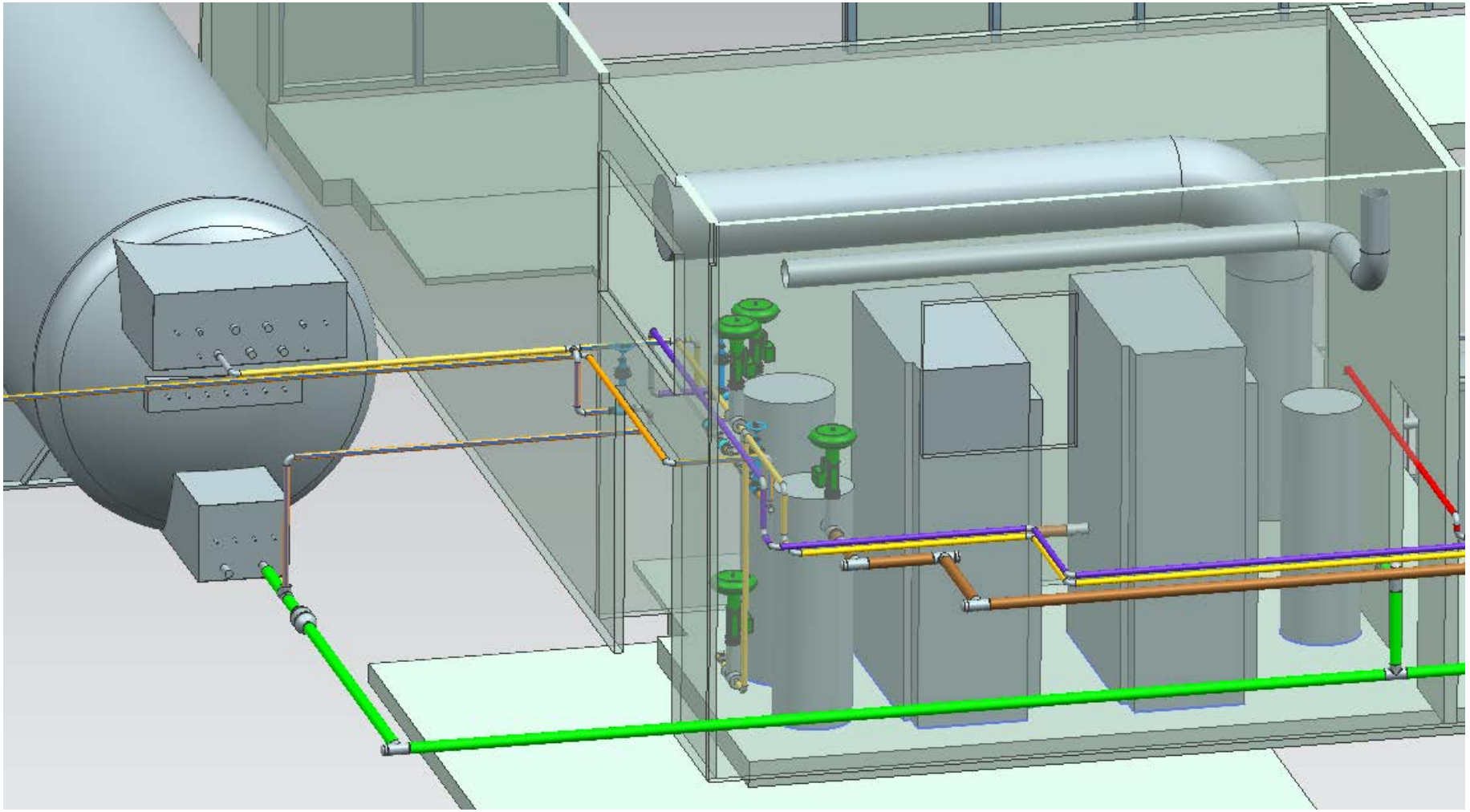
Interface proximity – external (typical example):



Interface cryo - building (typical examples):



Interface cryo - building (typical examples):



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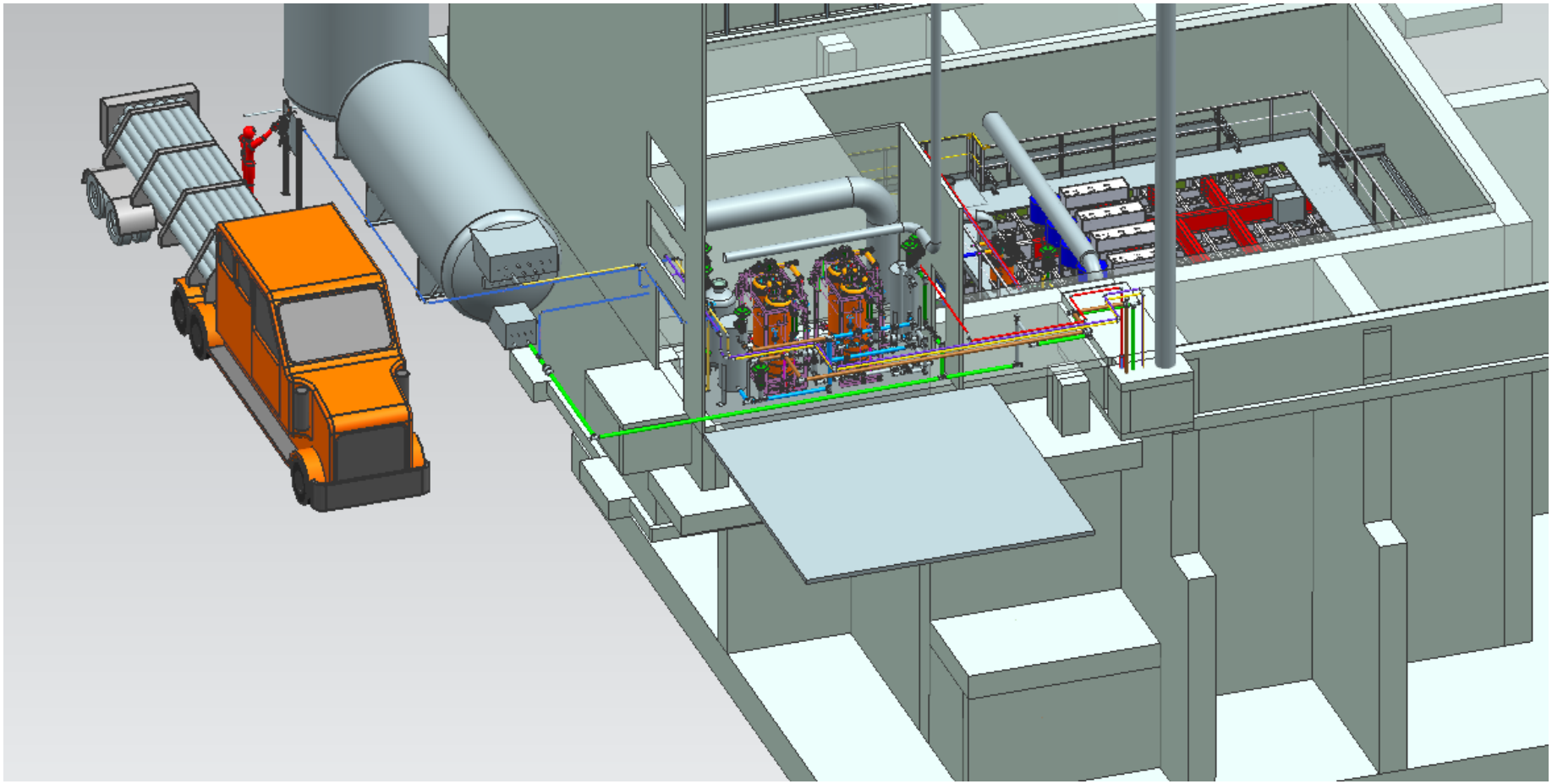
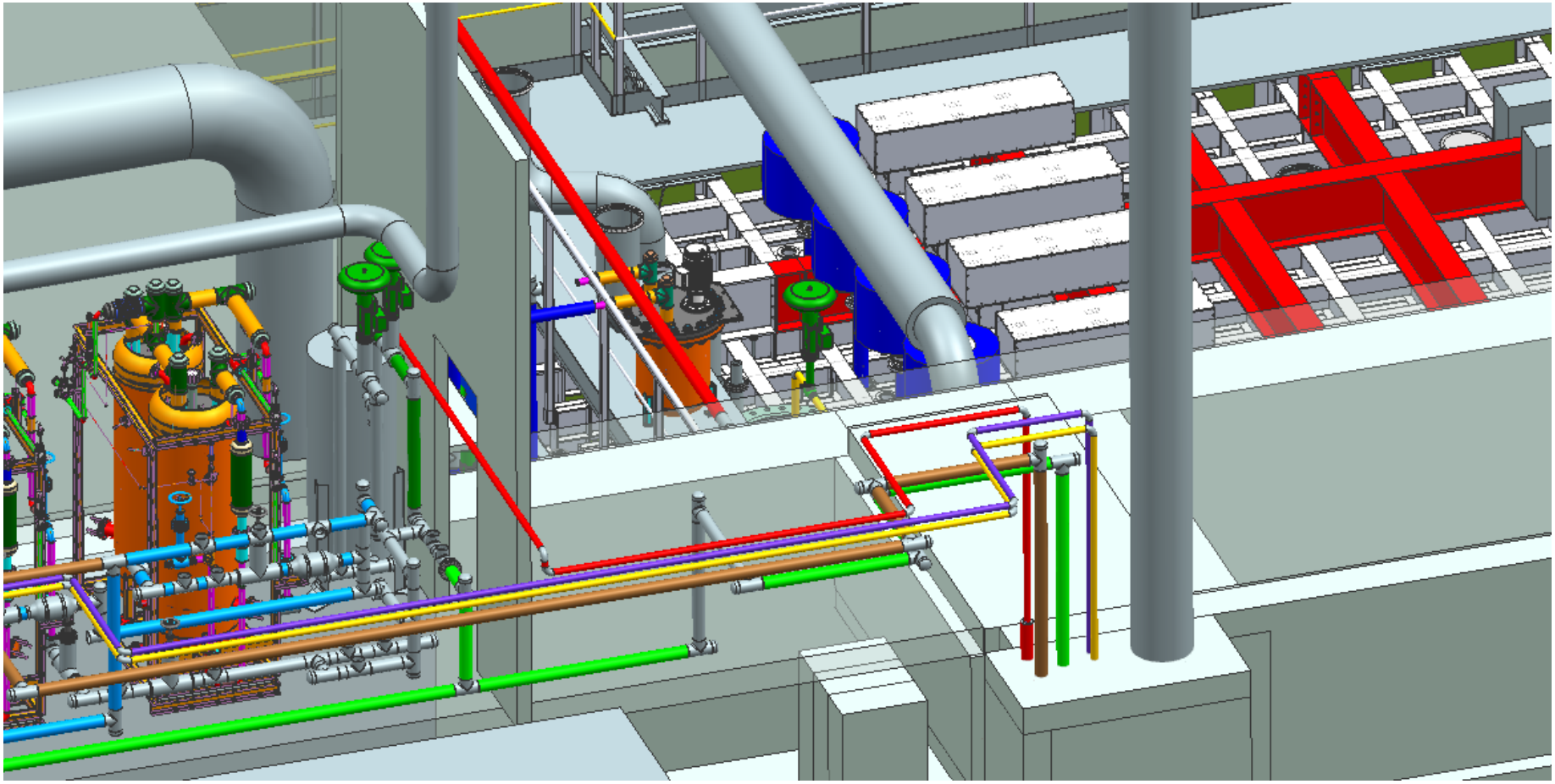
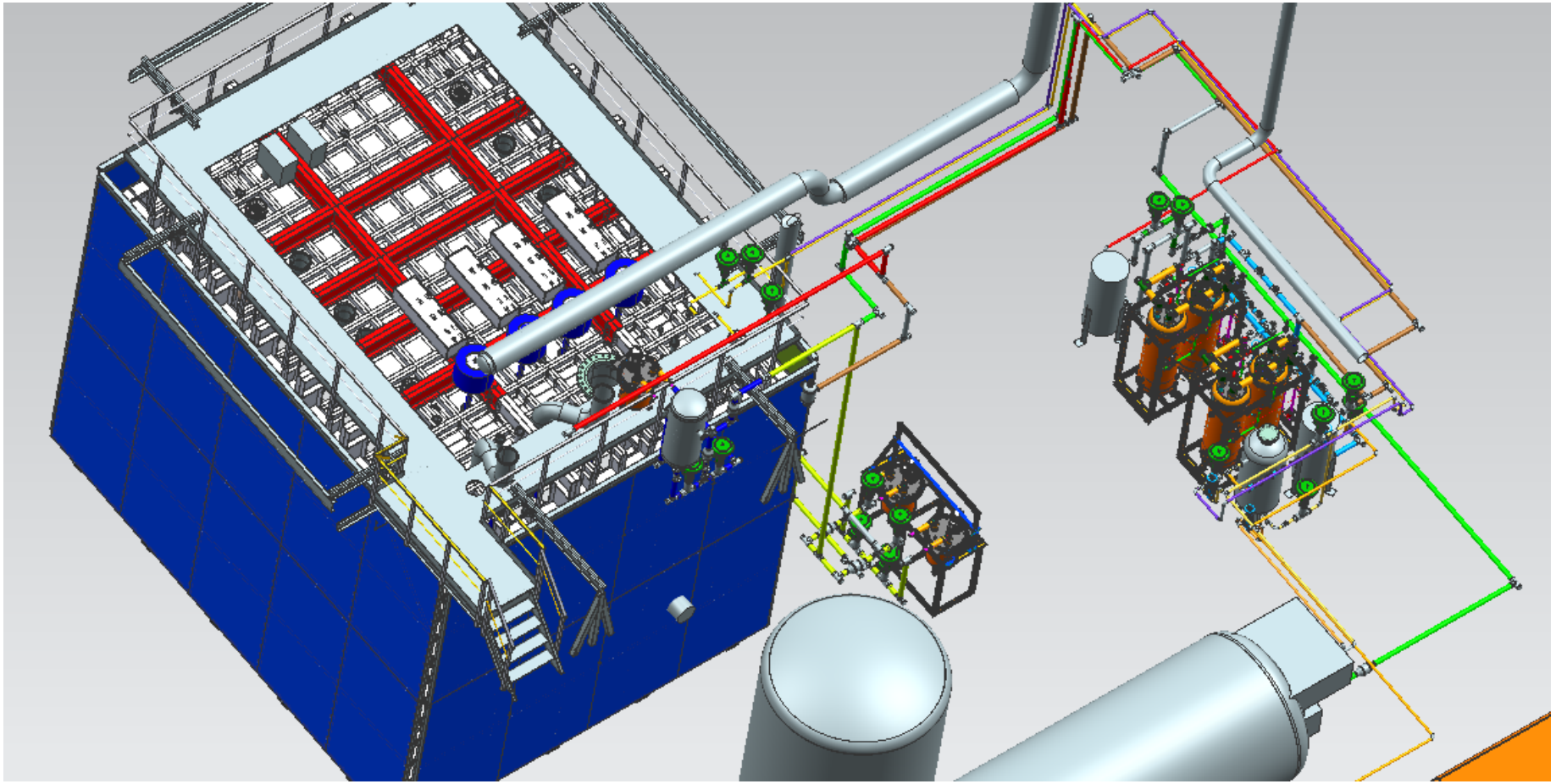


Interface to SBN ND building (typical examples):



Interface to cryo - building (typical examples):



Projected schedule to complete P&ID SBN ND cryogenics:

- Need to be complete at the same time as P&ID fro SBN FD, but haven't been discussed in detail for either proximity (CERN) or internal (Fermi) cryogenics

Stage of completion of PID (due by:)	SBN FD (leading)	SBN ND (follow)
Layout is complete at FNAL – transferred to CERN	March 3	March 3
Preliminary design of area of responsibility (layout, discussion of equipment, but no sizing or valve & instrumentation lists)	CERN is done FNAL is done	CERN has not started yet. Response is needed from CERN (proximity) by March 11 FNAL is done for external, need to complete internal.
Lines sizing and revision by CERN and FNAL	March 11	March 18 (?)
New numbering system implemented by FNAL	April 1	April 8 (?)
Ready for review (common, by CERN and FNAL)	April 15	April 15 (?)
Prepare equipment and piping specifications	May 13	May 13 (?)
Cross review and readiness for equipment and piping specifications. Specs are ready for CERN Specs committee review.	May 20	May 20 (?)