

DUNE-ND LAr cryogenics

Planning phase – Progress Report

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DUNE-ND LAr

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Outline

- Scope
- Product Breakdown Structure
- Layout
- P&ID
- Safety

Scope

WBS 131.01.03.04.03 LAr cryogenics

- **Proximity LAr cryogenics:**

Valve boxes and warm valve skids managing cryostat thermohydraulic conditions, vacuum jacketed transfer lines and warm pipes interconnecting all the functions.

- **Shaft LAr cryogenics:**

Lines connecting external cryogenics with cryogenic equipment in the shaft. Includes nitrogen phase separator valve box, vacuum jacketed piping and warm piping, including flexible piping sections to be installed in the energy chain by other WP.

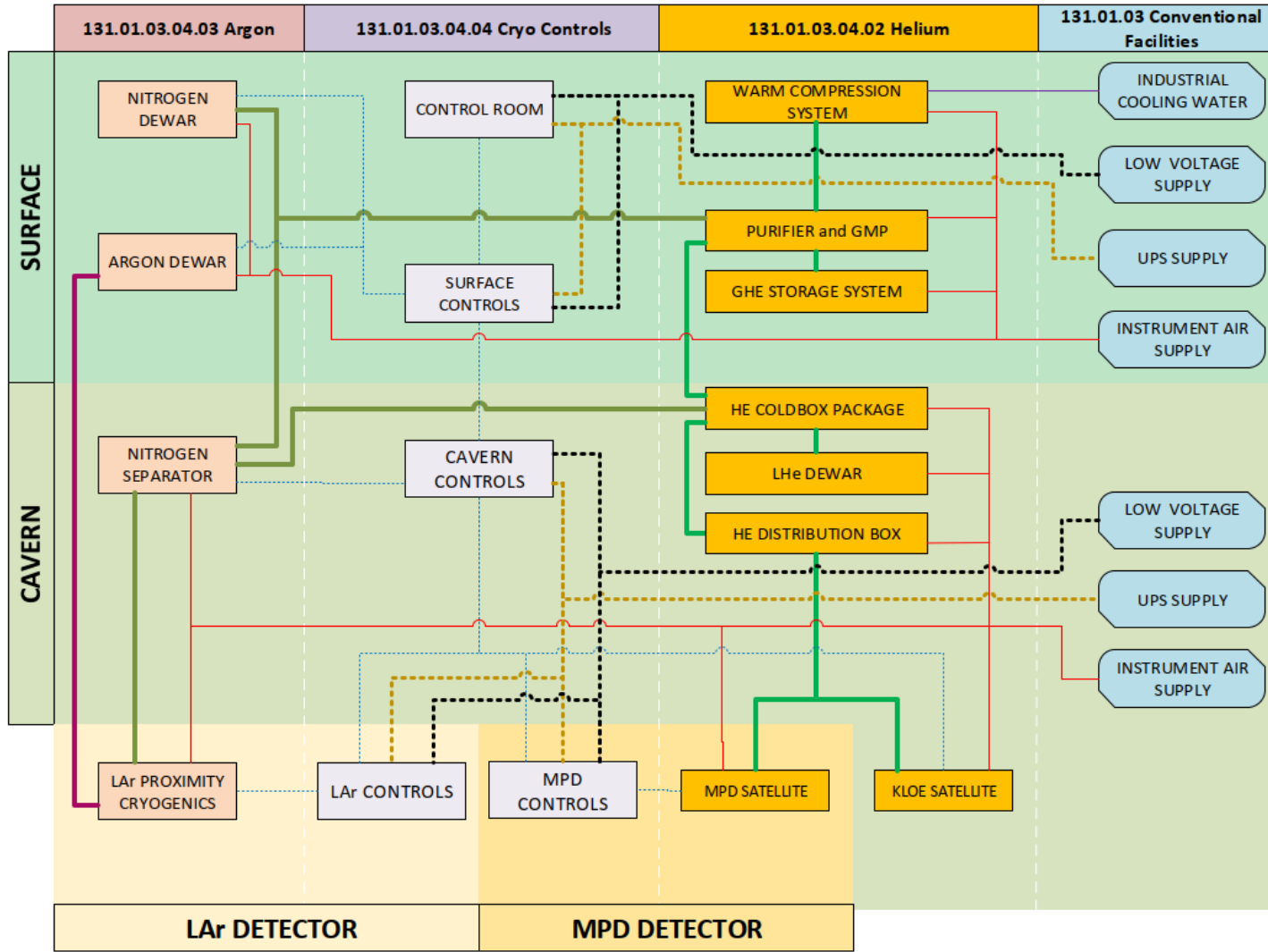
- **External LAr cryogenics:**

Liquid Nitrogen storage, Liquid Argon storage, reception and delivery infrastructure. Supply of gaseous argon, reception facility for argon/hydrogen gaseous mixture.



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Scope

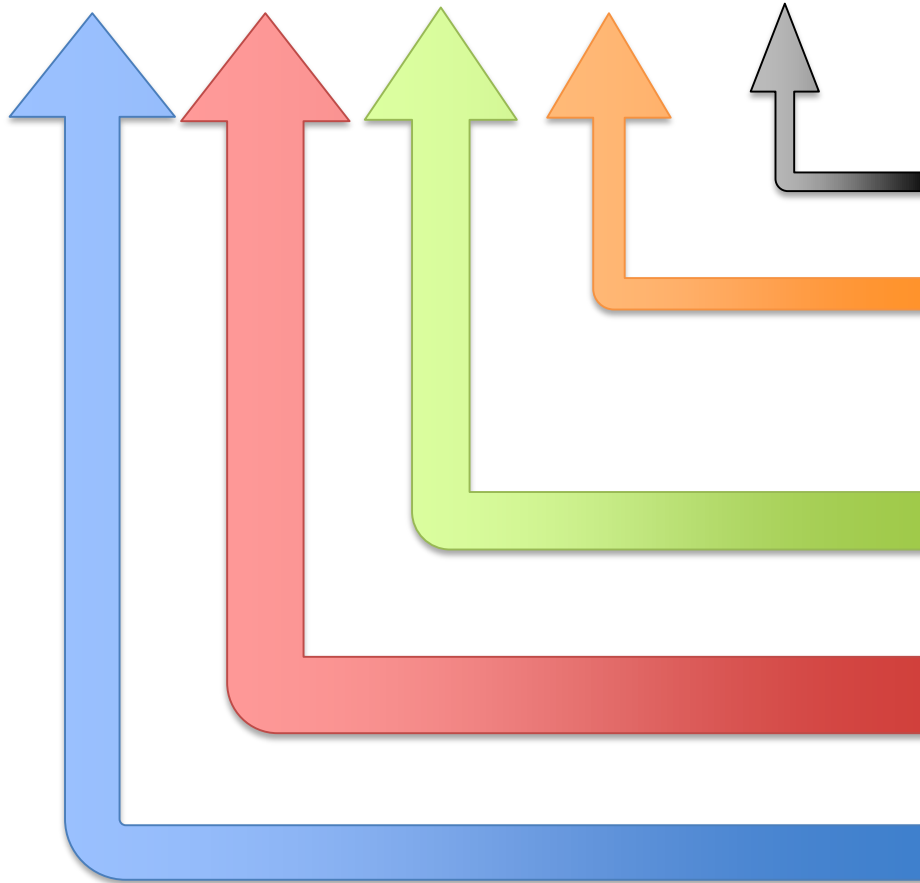


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PBS: Product Breakdown Structure

PBS Dictionary

WBS - SYSTEM - FAMILY - SERVICE - PART## - Part Name



Descriptive name for the part.

Consecutive unique number.

Groups parts in contact with the same fluid. Use: Milestone of pressure test only when all elements in that category are mechanically related together. **Argon, Instrument air.**

Defines the part family that is created under the same construction techniques. **Warm Pipes, Vacuum Jacketed Pipes, Structures.**

All the parts under this category form a functional equipment or skid, hashed box inside the P&ID. **Phase Separator, Storage Dewar, Warm Panel.**

Use for scope and interfaces, it defines in which WBS this element in scope. **LAr, He, CF, controls.**

PBS: Product Breakdown Structure

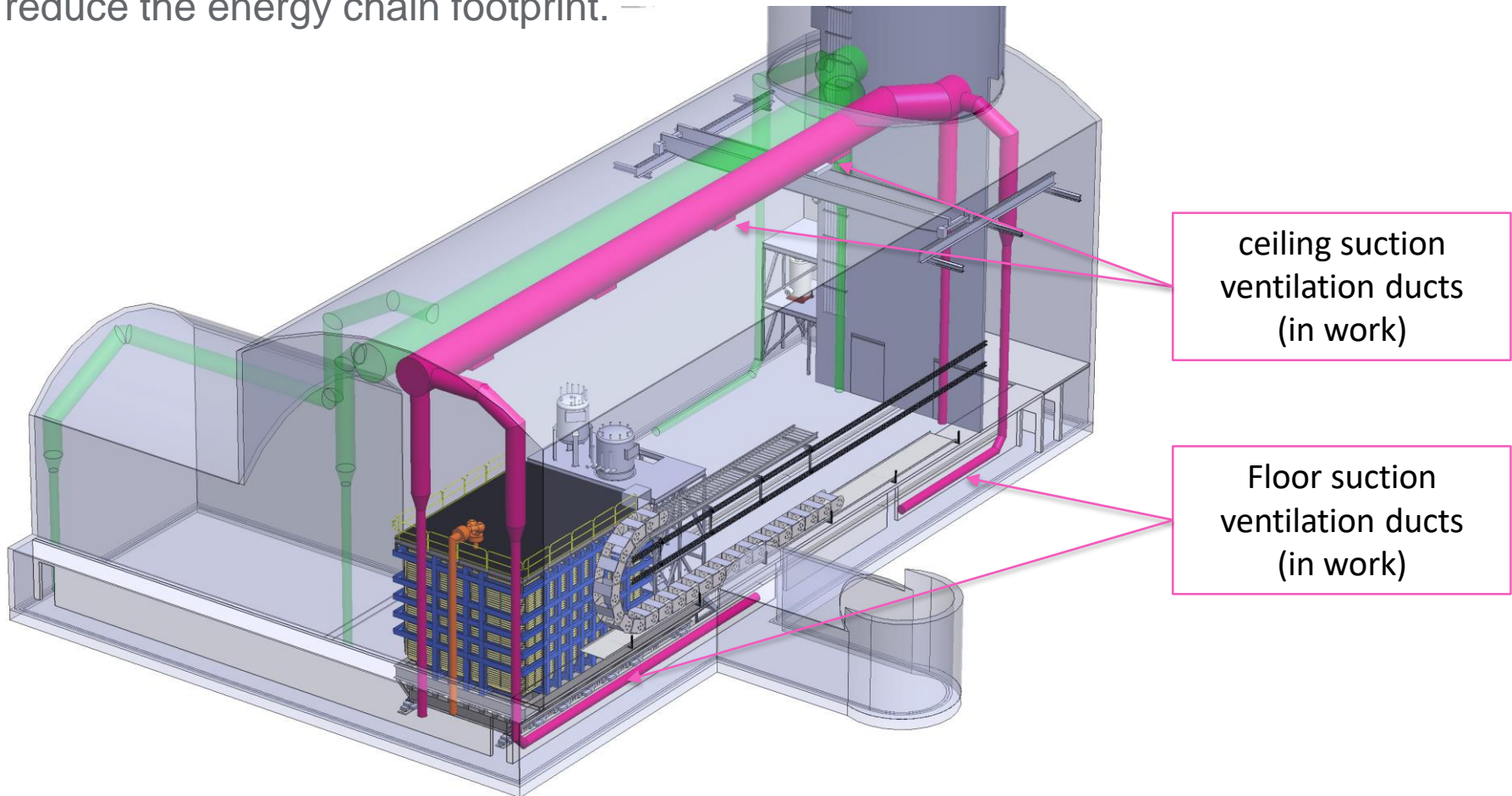
Product code	Product Name
131.01.03.CF.00-CINF-WP-IA-0001	Instrument Air Header
131.01.03.CF.00-CINF-WP-CHW-0002	Chilled Water Header - for vacuum pumps, turbines
131.01.03.CF.00-CINF-WP-ICW-0003	Industrial Cooling Water header - for compressors
131.01.03.04.03-ADEW-VES-AR-0004	Argon Storage Dewar System
131.01.03.04.03-NDEW-VES-N2-0005	Nitrogen Storage Dewar System
131.01.03.04.03-NSEP-VES-N2-0006	Nitrogen Phase Separator Valve Box
131.01.03.04.03-ASEP-VES-AR-0007	Argon Phase Separator Valve Box
131.01.03.04.03-ACP-VES-AR-0008	Argon Circulation Pump Valve Box
131.01.03.04.03-ACA-VES-AR-0009	Argon Condenser Valve Box
131.01.03.04.03-AF1-VES-AR-0010	Liquid Argon Purification Filter Valve Box
131.01.03.04.03-AF3-VES-AR-0011	Gaseous Argon Purification Vessel
131.01.03.04.03-ARP-EQP-AR-0012	Regeneration panel Skid
131.01.03.04.03-AWP-EQP-AR-0013	Warm Panel Skid
131.01.03.04.03-NSEP-VJP-N2-0014	Nitrogen Separator Supply line [Shaft section 1]
131.01.03.04.03-NSEP-VJP-N2-0015	Condenser Nitrogen Supply line [energy chain flexible section 2]
131.01.03.04.03-NSEP-VJP-N2-0016	Condenser Nitrogen Supply line [VB connection section 3]
131.01.03.04.03-ACA-VJP-N2-0017	Condenser Nitrogen Exhaust manifold [Shaft section 1]
131.01.03.04.03-ACA-VJP-N2-0018	Condenser Nitrogen Exhaust manifold [energy chain flexible section 2]
131.01.03.04.03-ACA-VJP-N2-0019	Condenser Nitrogen Exhaust manifold [VB connection section 3]
131.01.03.04.03-AF1-VJP-AR-0020	Liquid Argon Supply line [Shaft section 1]
131.01.03.04.03-AF1-VJP-AR-0021	Liquid Argon Supply line [energy chain flexible section 2]
131.01.03.04.03-AF1-VJP-AR-0022	Liquid Argon Supply line [VB connection section 3]
131.01.03.04.03-ACP-VJP-AR-0023	Pump discharge line
131.01.03.04.03-ACP-VJP-AR-0024	Pump suction line

energy chain lines
split in three sections

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Layout

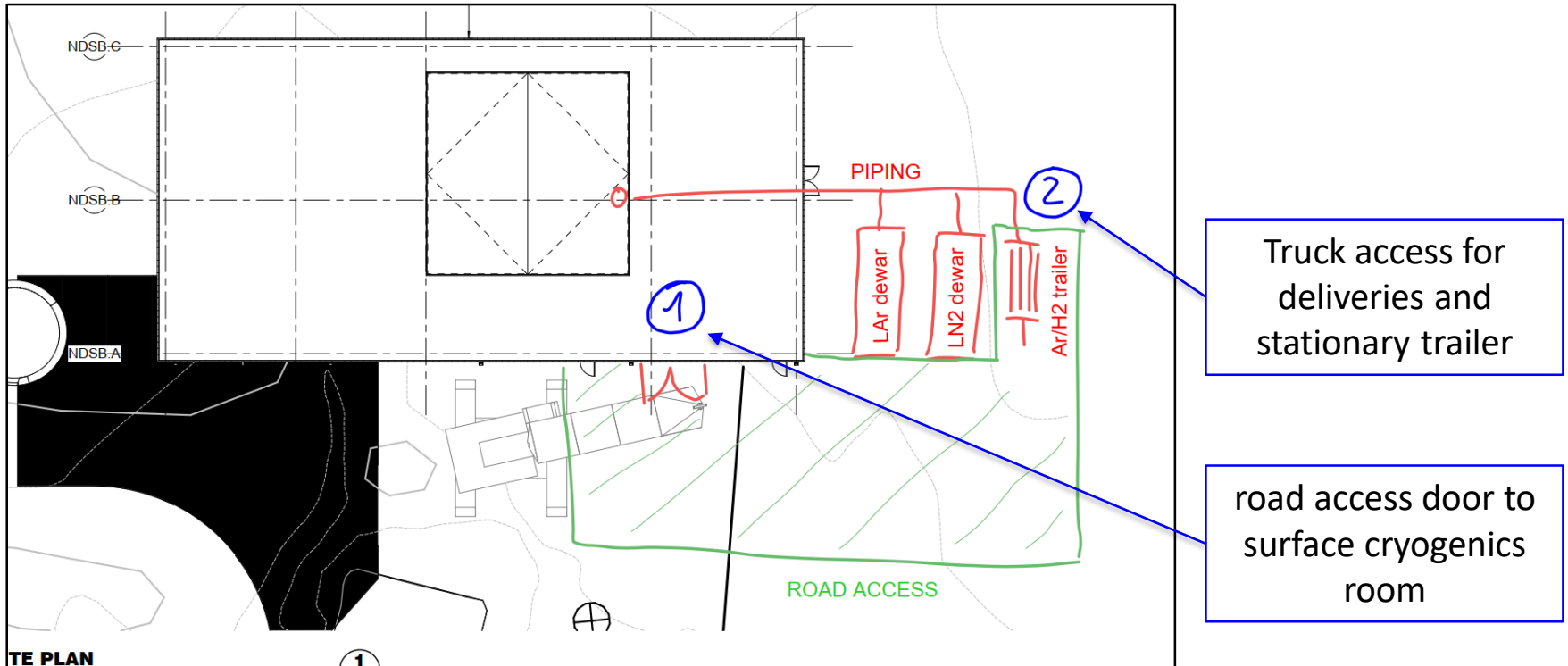
Strategy: Concentrate the liquid argon cryogenics in the moving platform to reduce the energy chain footprint.



Authors: Matthaeus Leitner et al.

Layout

External Layout

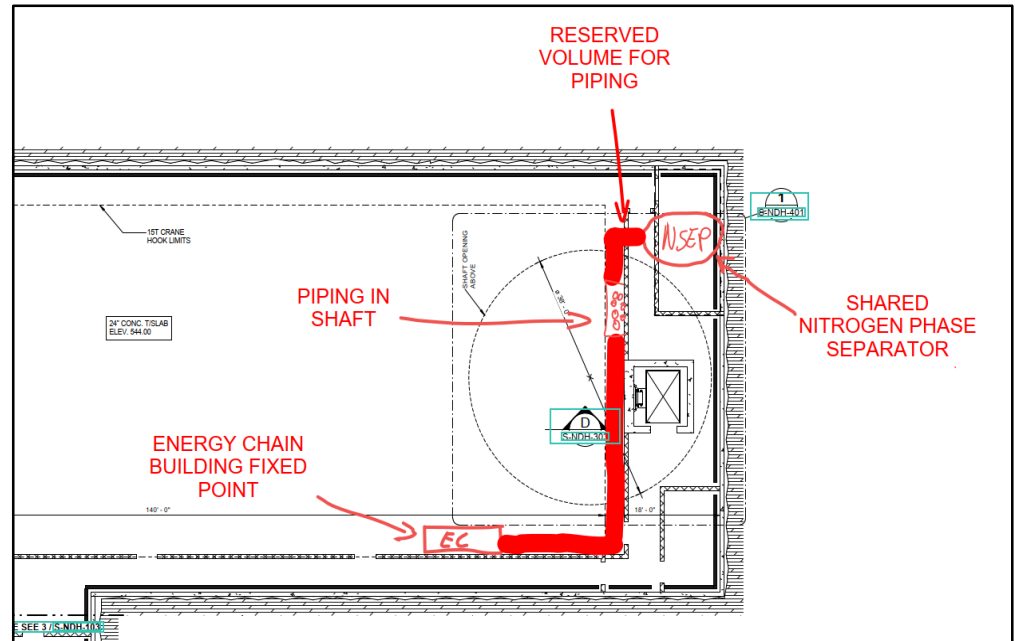


Layout

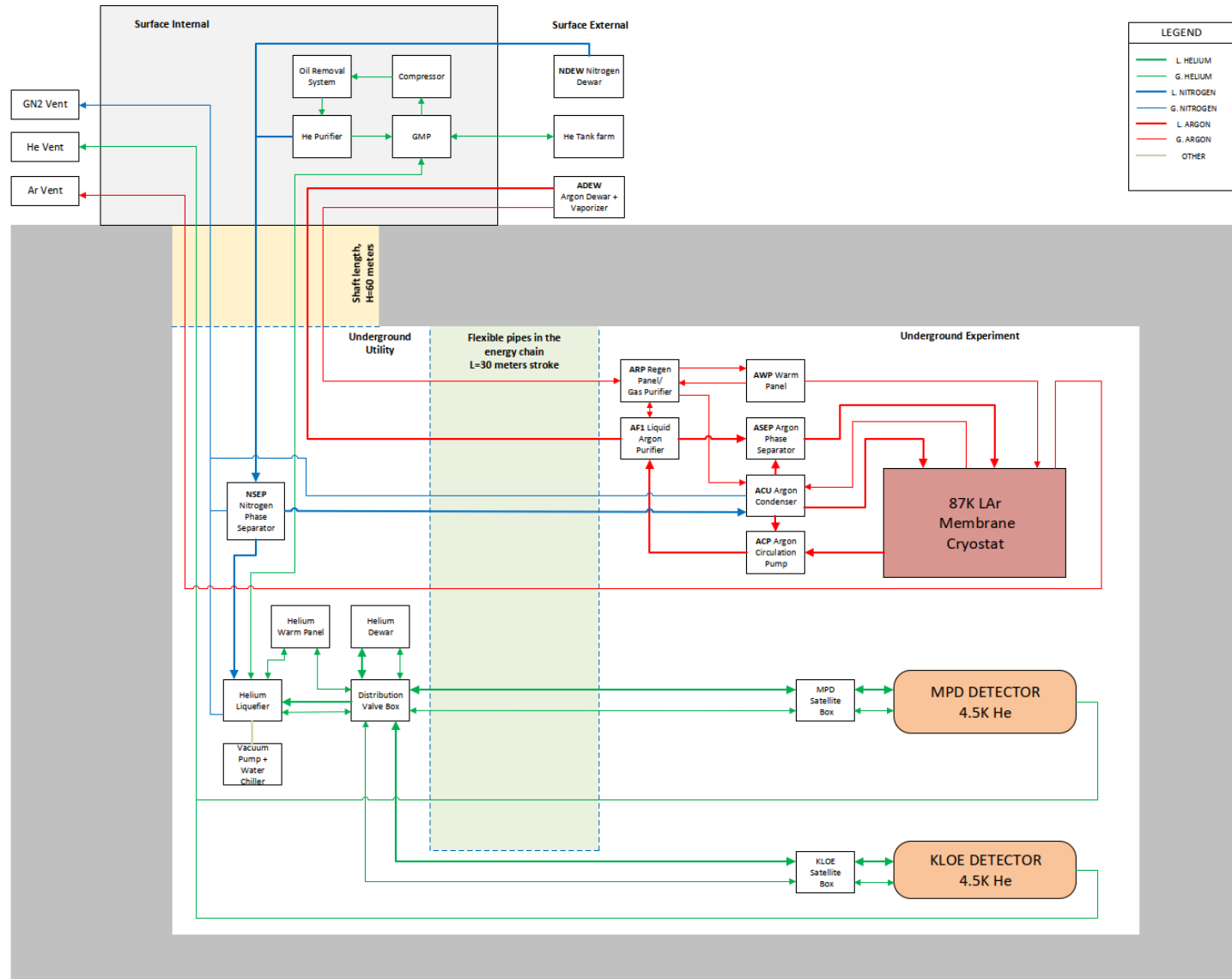
Shaft Layout

Preliminary Sizing: Piping in Shaft

Name	Function	External Diameter
1	LAr VJP (welded VJP)	Ø114mm
2	LN2 VJP (bayonet VJP)	Ø114mm
3	GAr supply	Ø63mm
4	GAr exhaust	Ø114mm
5	GN2 exhaust (bayonet VJP)	Ø139mm
6	GHe exhaust	Ø63mm
7	GHe Compressor Discharge	Ø63mm
8	GHe Compressor Suction	Ø88.9mm
9	Cryoplant Cooling water	Not required (chiller in the cavern)
10	Regeneration GAr/H2 mix supply	Ø63mm
11	Regeneration return	Ø88.9mm



Cavern Detail

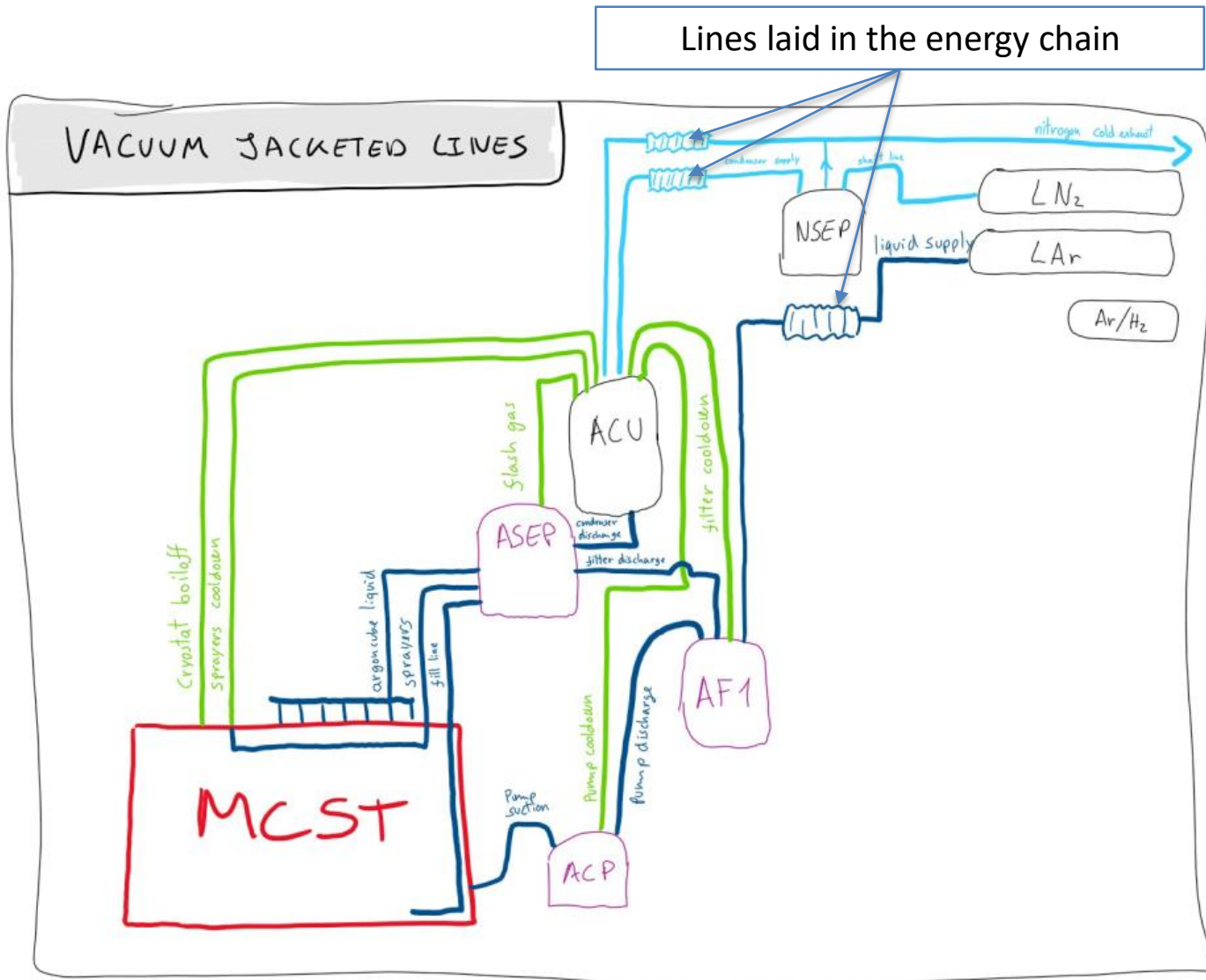


LEGEND	
—	L. HELIUM
—	G. HELIUM
—	L. NITROGEN
—	G. NITROGEN
—	L. ARGON
—	G. ARGON
—	OTHER

LEGEND disclaimer:
Lines represent functions. There might be multiple pipes for each function represented.

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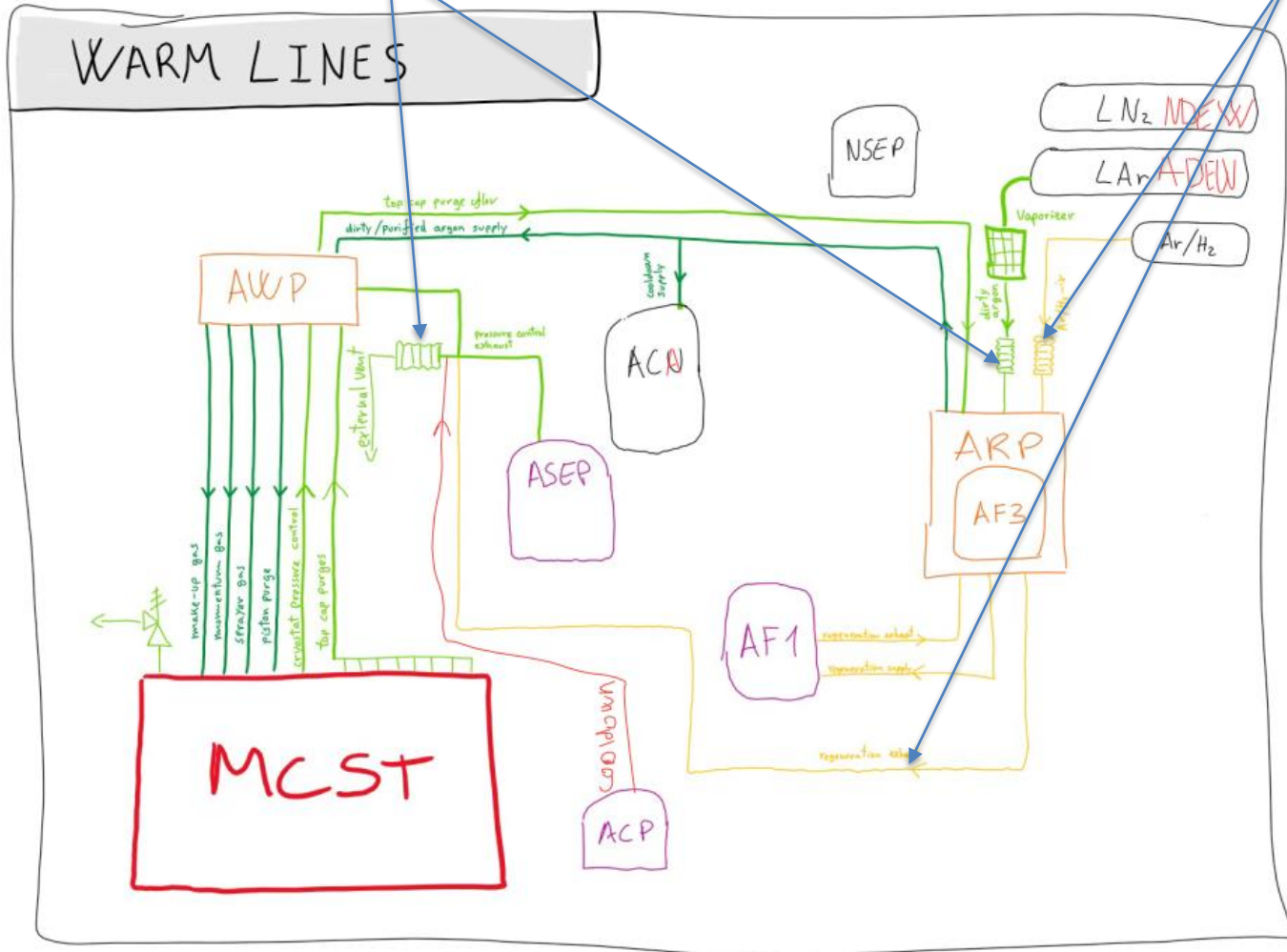


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Lines laid in the energy chain

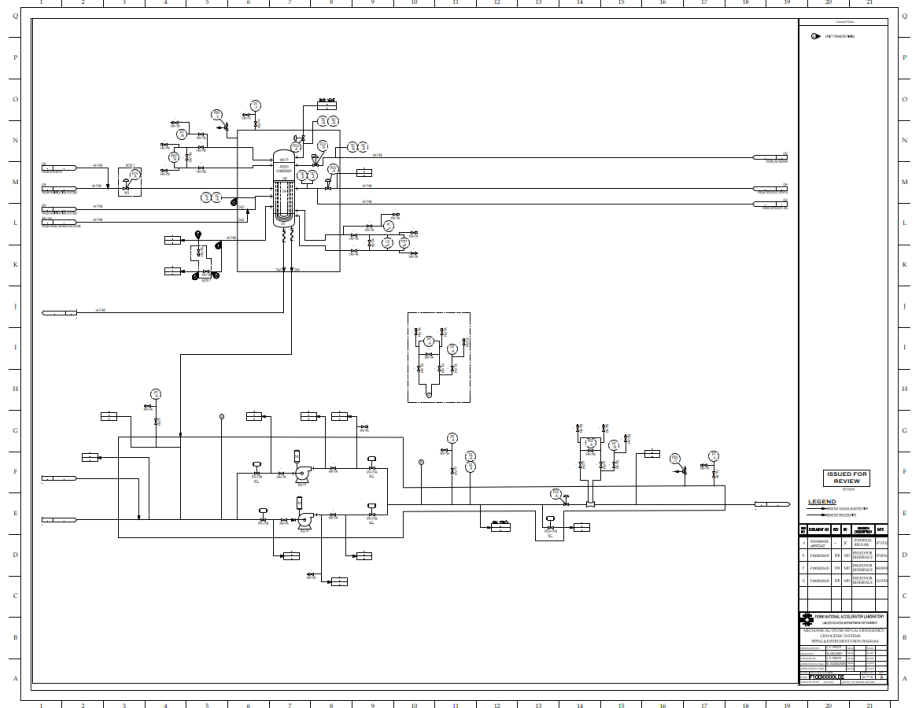
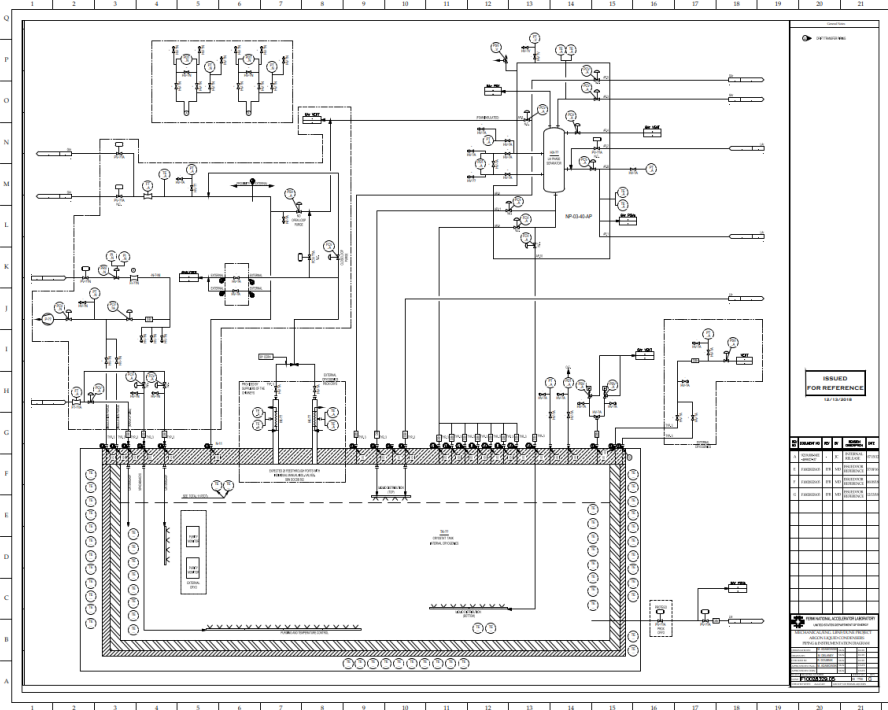
Lines on cryostat parking position



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P&ID

Strategy: Develop drawing from latest version of SBN-ND.



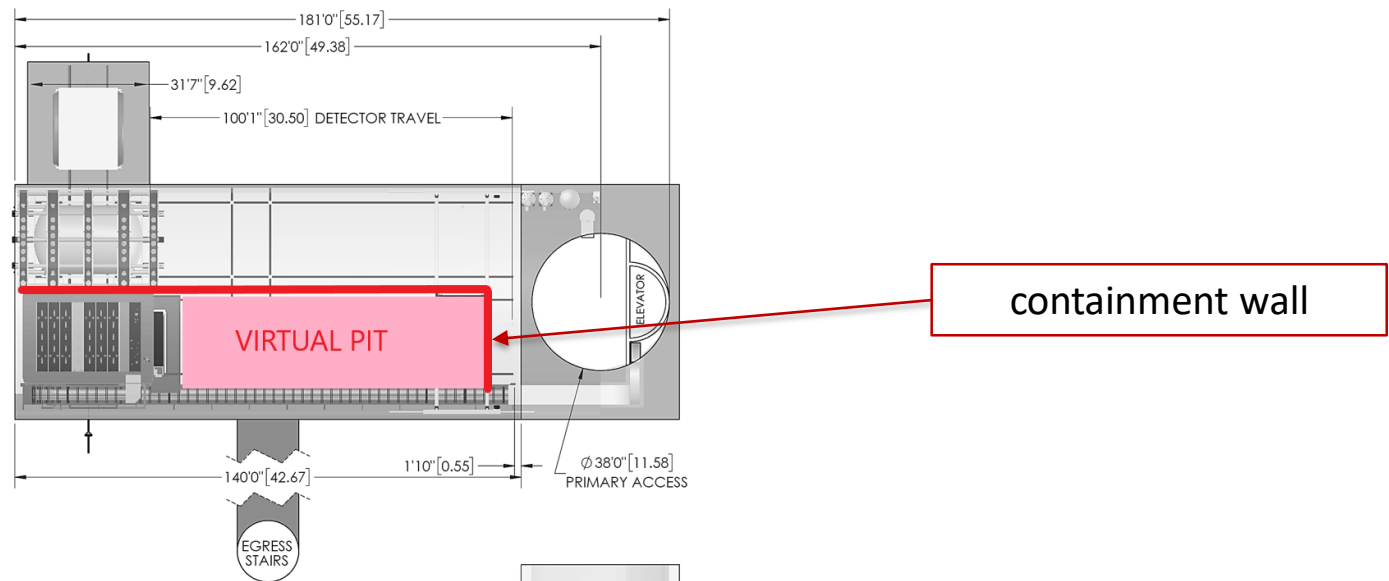
Author: Michael Delaney

Safety

Proposal to direct cryostat relief device discharge line directly into floor.

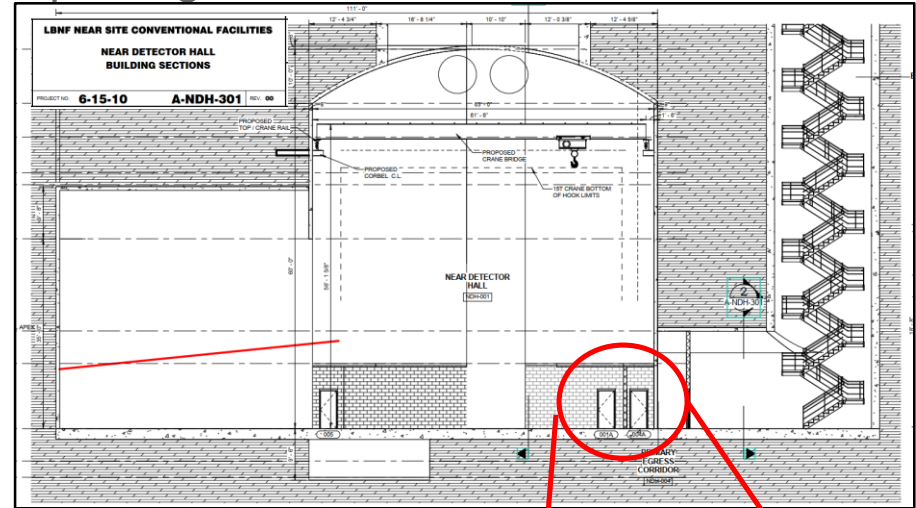
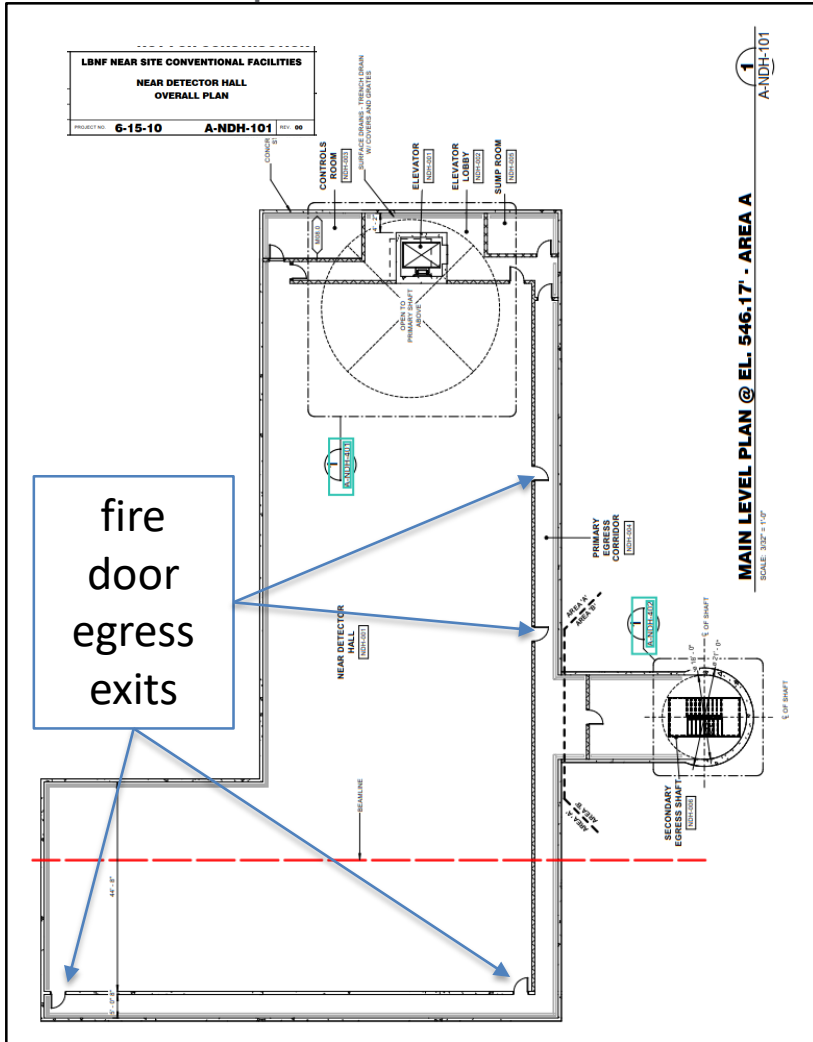
- **Motivation:** To avoid running a 12”+ diameter pipe to the surface and reduce energy chain footprint. To implement cost reduction and reduce system complexity.
- **Risk mitigation:** Ventilation measures already in place to evacuate GAR to mitigate ODH scenarios. Relief scenarios involve cold gas release, with largest flow rate due to a nitrogen to argon leak which has long duration hence a total low mass.

After commissioning of LAr ND, access to the cave cannot be restricted due to activity in KLOE and MPD. Proposal to install a sealed wall around the LAr cryostat movement footprint to contain eventual relief discharge.

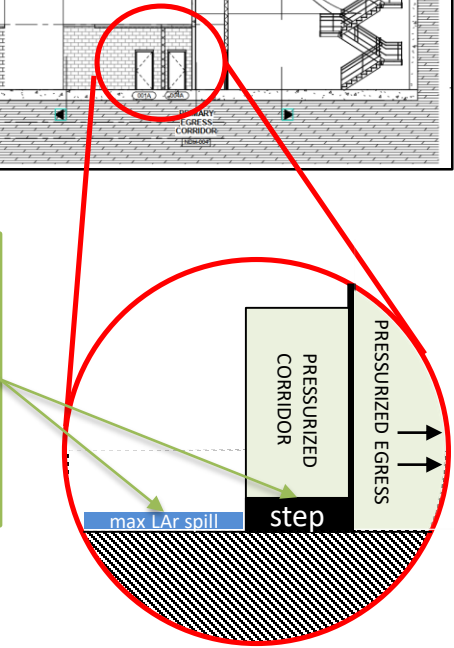


Safety

Raise escape corridor floor to avoid LAr spill to go inside.



The egress corridor floor will be one foot higher than the hall floor to mitigate liquid argon leaking into corridor through fire doors.



Thank you