BULK CRYOGENIC STORAGE
SAFETY & COMPLIANCE PRESENTATION

Liquid Nitrogen (LIN), Liquid Argon (LAR)

5+	100%	CGA S-1.2
Layers of Safety	**NFPA 55 Compliant**	**PRD Certified**
Engineered redundancy at every level	Meets all applicable codes & standards	11th Edition 2024 — factory verified

SUBMITTED TO THE AUTHORITY HAVING JURISDICTION (AHJ)

This presentation demonstrates that bulk cryogenic storage of LIN & LAR is a well-established, highly regulated, and engineered-safe industrial practice. The tanks proposed for this installation are among the most thoroughly tested and regulated pressure vessels in industrial use — backed by ASME, NFPA, CGA, OSHA, and DOT standards.

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Standards:	NFPA 55 · CGA S-1.2 (11th Ed.) · ASME BPVC · OSHA 29 CFR 1910.101 · 49 CFR 173.318

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1. EXECUTIVE SUMMARY — WHY THESE TANKS ARE SAFE

Bulk cryogenic storage of liquid nitrogen, liquid argon, and liquid oxygen is a mature, well-regulated industrial practice with a strong safety record spanning decades of global use across medical, industrial, manufacturing, and food processing applications. These tanks are not experimental technology — they are engineered, tested, certified, and operated under some of the most rigorous safety standards in industry.

CORE SAFETY STATEMENT
The bulk cryogenic vessels proposed for this installation are vacuum-insulated, double-walled pressure vessels designed with multiple independent, redundant safety systems. They are manufactured to ASME BPVC Section VIII, Division 1 (BPVC.VIII.1) standards, pressure relief devices are certified to CGA S-1.2 (11th Edition, 2024), and the installation will comply fully with NFPA 55, OSHA 29 CFR 1910.101, and all applicable local codes.

1.1 Key Safety Facts for the AHJ

- ✓ Cryogenic tanks of this type are in operation at thousands of facilities across the United States including hospitals, universities, manufacturing plants, and research facilities in communities similar to this one.
- ✓ The vacuum-insulated double-wall design means the outer shell never directly contacts the cryogenic liquid — the product is contained entirely within the inner vessel under controlled conditions.
- ✓ Pressure relief devices are factory-set, factory-tested, and factory-marked per CGA S-1.2. They cannot be field-adjusted and are designed to activate automatically before any unsafe pressure can develop.
- ✓ All cryogenic products — LIN & LAR — are non-toxic and non-explosive in their pure form. The hazards associated with these products are well understood, predictable, and manageable with proper procedures.
- ✓ This safety packet, the proposed installation design, and the operational policies described herein are specifically designed to give the AHJ full visibility into every hazard, every mitigation, and every emergency response procedure.
- ✓ The proposed installation will be designed, installed, and operated in full compliance with NFPA 55, the primary national code governing cryogenic fluid storage, and all other applicable standards listed in Section 10.

1.2 Industry Safety Record

Bulk cryogenic storage has one of the strongest safety records in the industrial gas industry. The Compressed Gas Association (CGA) and National Fire Protection Association (NFPA) have continuously refined their standards over decades based on operational experience, resulting in a comprehensive, proven regulatory framework. Incidents involving properly installed and maintained cryogenic bulk tanks are extremely rare and are almost always attributable to procedural non-compliance rather than equipment failure.

1.3 Purpose of This Document

This document serves two purposes: first, to demonstrate the inherent safety of modern cryogenic storage technology and the multiple layers of protection engineered into these vessels; and second, to provide the AHJ with complete transparency regarding identified hazards, emergency scenarios, and the comprehensive policies in place to prevent and respond to those scenarios. Both sections are essential — not because the tanks are dangerous, but because thorough emergency preparedness is part of what makes this installation safe.

2. PHYSICAL DESCRIPTION OF CRYOGENIC VESSELS

2.1 Overview

The bulk cryogenic storage vessels proposed for this installation are purpose-designed, engineered pressure vessels manufactured for long-term storage of cryogenic liquefied gases under pressure. All vessels are manufactured to ASME BPVC Section VIII, Division 1 (BPVC.VIII.1) requirements and operate from 5 PSI (0.4 kg/cm²) up to the Maximum Allowable Working Pressure (MAWP) stamped on the vessel nameplate.

DESIGN PHILOSOPHY

These vessels are engineered around a single principle: keep the cryogenic product safely contained under all foreseeable conditions. The double-wall vacuum design, redundant pressure relief systems, and factory-sealed insulation all exist to ensure the product never contacts the outside world except through controlled, designed pathways.

2.2 Physical Description

A cryogenic vessel is designed for long-term storage of cryogenic liquefied gases under pressure in the range of 5 PSI (0.4 kg/cm²) to the MAWP (Maximum Allowable Working Pressure). While hardware may vary slightly from model to model, each unit essentially performs the same functions.

The vessel is comprised of an alloy steel inner tank encased in an outer carbon steel vacuum shell. The insulation system between the inner and outer containers consists of super insulation and high vacuum to ensure long holding time. The insulation system designed for long-term vacuum retention is permanently sealed at the factory to ensure vacuum integrity. The units have a tank pressure relief device, which is set at the factory. As a secondary pressure relief device, the container is further protected from over-pressurization by a rupture disc. The bursting disc will rupture completely to relieve inner tank pressure in the event the tank relief valve fails and pressure exceeds the rupture disc setting. The vacuum space is protected from over-pressurization by use of a tank annulus rupture disc assembly. Pressure relief devices used on cryogenic vessels designed for the U.S. specifications meet the requirements of CGA Pamphlet S1.2, "Pressure Relief Device Standards, Part 2, for Cargo and Portable Tanks for Compressed Gases."

2.3 Key Design Features

Feature	Description & Safety Significance
Inner Tank Material	Alloy steel — engineered specifically for cryogenic temperature service down to -320°F
Outer Shell Material	Carbon steel vacuum shell — never in direct contact with cryogenic liquid
Insulation System	Super insulation with high vacuum — permanently sealed at factory. Zero maintenance required for insulation integrity
Vacuum Integrity	Factory-permanently sealed — eliminates field maintenance as a failure mode
Primary PRV	Factory-set spring-loaded pressure relief valve — auto-opens and reseats at predetermined pressure. Set at ≤110% of design pressure per CGA S-1.2
Secondary PRD	Factory-set rupture disc — activates only if primary PRV fails. Total secondary flow capacity ≤150% design pressure per CGA S-1.2
Vacuum Space Protection	Tank annulus rupture disc — prevents outer vessel over-pressurization
PRD Standard	CGA Pamphlet S-1.2, 11th Edition (2024) — Pressure Relief Device Standards, Part 2
ASME Compliance	Manufactured per ASME BPVC Section VIII, Division 1 (BPVC.VIII.1) — Rules for Construction of Pressure Vessels. Confirm specific Division against vessel nameplate as some vessels may be built to Division 2 (Alternative Rules)
DOT Compliance	Designed per DOT specifications and 49 CFR 173.318 for cryogenic liquid service
Pressure Range	5 PSI (0.4 kg/cm²) to MAWP as factory-stamped on vessel nameplate

2.4 ASME Certification, U-Stamp & Vessel Documentation

Every bulk cryogenic vessel manufactured to ASME BPVC Section VIII, Division 1 (BPVC.VIII.1) carries a mandatory set of certifications, documentation, and physical markings that verify the vessel was designed, fabricated, inspected, and tested in full compliance with the code. The following documentation is available for inspection by the AHJ upon request.

U-STAMP CERTIFICATION
The ASME 'U' stamp is the manufacturer's official certification mark that the vessel was designed, built, inspected, and hydrostatic tested per ASME BPVC Section VIII, Division 1. A vessel cannot legally carry the U-stamp unless it has been fabricated under an ASME-authorized quality control program and inspected by an Authorized Inspector (AI) from an ASME-accredited inspection agency. The U-stamp is physically stamped or engraved on the vessel nameplate.

2.4.1 ASME U-Stamp — What It Means

Item	Requirement & Significance
U-Stamp Marking	The letter 'U' stamped on the vessel nameplate certifies the manufacturer holds a valid ASME Certificate of Authorization and that the vessel was fabricated under an approved Quality Control (QC) program
ASME Certificate of Authorization	Manufacturer must hold a valid ASME Certificate of Authorization to apply the U-stamp. Certificate is issued by ASME and renewed on a regular inspection cycle
Authorized Inspector (AI)	All ASME U-stamp vessels must be inspected by an Authorized Inspector employed by or representing an ASME-accredited inspection agency — typically an insurance company holding National Board accreditation
National Board Registration	U-stamped vessels are typically registered with the National Board of Boiler and Pressure Vessel Inspectors (NB). The NB registration number appears on the vessel nameplate and U-1 Data Report
Nameplate Information	The vessel nameplate will show: manufacturer name, serial number, U-stamp, MAWP (psig), design temperature (°F), shell material specification, year built, National Board number, and ASME code edition
Division Confirmation	The vessel nameplate confirms whether the tank was manufactured to Division 1 (standard rules) or Division 2 (alternative rules). The AHJ should verify this against the nameplate on the specific vessels installed

2.4.2 Manufacturer's Data Report — Form U-1

Every ASME U-stamp vessel is accompanied by a Manufacturer's Data Report, designated Form U-1. This is the vessel's official birth certificate and contains the complete design and fabrication record. A copy of the U-1 form for each vessel at this installation is available for AHJ review upon request.

U-1 Form Field	Description
Vessel Description	Tank type, service, orientation (vertical/horizontal), and overall dimensions
Design Pressure & Temperature	MAWP (psig) and minimum/maximum design temperature — critical for cryogenic service rating
Shell & Head Materials	Specific ASME material specification numbers (e.g., SA-240 Type 304 stainless, SA-553 Type 1 nickel alloy) confirming materials are code-approved for cryogenic temperatures
Joint Efficiency	Weld joint efficiency factor used in design calculations — confirms weld quality and inspection level
Hydrostatic Test Pressure	The actual test pressure applied at the factory — must be at minimum 1.3x MAWP per BPVC.VIII.1. Recorded on the U-1 form with date and result
Heat Treatment	Documents whether post-weld heat treatment (PWHT) was performed — required for certain materials and thicknesses
Radiographic Examination	Documents X-ray or radiographic inspection of welds — confirms weld integrity
Authorized Inspector Certification	AI signature and stamp certifying the vessel was fabricated and inspected per ASME BPVC Section VIII, Division 1
National Board Registration	NB number assigned upon registration — cross-references with nameplate marking

2.4.3 Material Specifications — Cryogenic Service

ASME BPVC Section VIII, Division 1 requires that all pressure-retaining materials be selected from approved specifications listed in ASME Section II — Materials. For cryogenic service, the inner vessel materials must maintain adequate toughness and ductility at operating temperatures as low as -320°F (-196°C). Common ASME-approved materials for cryogenic inner vessels include:

ASME Material Spec	Common Name	Cryogenic Suitability
SA-240 Type 304 / 304L	Austenitic Stainless Steel	Suitable to -425°F (-254°C) — widely used for LIN & LAR inner vessels
SA-240 Type 316 / 316L	Austenitic Stainless Steel (Mo)	Suitable to -425°F — enhanced corrosion resistance
SA-553 Type 1	9% Nickel Steel	Suitable to -320°F (-196°C) — used for larger high-pressure cryogenic vessels
SA-304 / SA-312	Stainless Steel Pipe & Tube	Used for cryogenic piping and connections on the inner vessel
Outer Shell — Carbon Steel	SA-516 or equivalent	Outer vessel only — not in contact with cryogenic liquid. Standard carbon steel grades

2.4.4 Hydrostatic Test Certification

Per ASME BPVC Section VIII, Division 1, every pressure vessel must pass a hydrostatic pressure test before leaving the manufacturer's facility. This test is one of the most important safety certifications a pressure vessel carries.

Hydrostatic Test Item	Requirement
Test Pressure	Minimum 1.3x MAWP (Maximum Allowable Working Pressure) — per ASME BPVC.VIII.1 UG-99
Test Medium	Water (or other suitable liquid) — conducted at ambient temperature before cryogenic insulation is applied
Duration	Vessel held at test pressure for sufficient time for full inspection of all welds, joints, and connections
Acceptance Criteria	No leakage, no permanent deformation, no visible distortion at any point on the vessel
Authorized Inspector Witness	AI must witness and certify the hydrostatic test — recorded on Form U-1
Documentation	Test date, actual test pressure applied, and AI certification recorded permanently on the U-1 Data Report
Significance for AHJ	The hydrostatic test confirms the vessel can safely contain pressure at 130% of its rated MAWP — providing a substantial safety margin above any operating pressure

AHJ DOCUMENTATION REQUEST

Upon request, the facility operator will provide the AHJ with the following for each vessel installed at this site: (1) Copy of ASME Form U-1 Manufacturer's Data Report, (2) Vessel nameplate photograph showing U-stamp and MAWP, (3) National Board registration number, (4) Manufacturer's Certificate of Conformance, (5) Current certificate of inspection if required by the jurisdiction.

3. PRESSURE RELIEF DEVICE STANDARDS — CGA S-1.2 (11TH EDITION, 2024)

This section details the applicable requirements of CGA Pamphlet S-1.2, Pressure Relief Device Standards — Part 2: Cargo and Portable Tanks for Compressed Gases, 11th Edition (2024). All pressure relief devices installed on cryogenic vessels at this facility comply fully with CGA S-1.2 requirements. This standard is incorporated by reference into OSHA 29 CFR 1910.101(c) and referenced in 49 CFR 173.318.

WHY CGA S-1.2 MATTERS

CGA S-1.2 is the definitive standard for pressure relief device design, sizing, installation, marking, and inspection on cryogenic portable tanks. Every PRD on these vessels has been factory-verified and factory-marked per this standard — meaning an independent, third-party-validated safety system is already built into the vessel before it arrives at this site.

3.1 Scope & Purpose

CGA S-1.2 establishes minimum requirements for pressure relief devices on cargo and portable tanks for compressed gases including cryogenic liquids such as LIN and LAR. The standard applies to tanks with water capacity exceeding 1,000 pounds that comply with DOT specifications. The 11th Edition (2024) added improved guidance for ambient temperature effects on secondary PRD systems, updated inlet/outlet pressure drop requirements for spring-loaded PRVs, and enhanced equations for emergency temperature conditions at the PRD inlet.

3.2 PRD Types & Application

Device Type	How It Works	Application on These Vessels
Spring-Loaded PRV (Primary)	Automatically opens and closes at factory-set pressure. Reseats after pressure is relieved — no manual intervention required	Required primary PRD. Set to discharge at ≤110% of tank design pressure per 49 CFR 173.318 and CGA S-1.2. Activates and reseats automatically
Rupture Disc (Secondary)	One-time bursting disc that ruptures completely when PRV fails or is insufficient. Provides full flow relief	Required secondary PRD. Activates only if the PRV fails. Total secondary flow capacity at ≤150% of design pressure. Vessel removed from service after activation
Vacuum Annulus Disc	Protects the vacuum jacket space between inner and outer vessels from over-pressurization	Specific to vacuum-insulated cryogenic vessels — protects outer vessel integrity

Thermal Expansion Valve	Relieves pressure from liquid trapped between isolation valves in piping	Required on all piping sections that can isolate cryogenic liquid. Sized per CGA S-1.2 formulas. Added in 10th/11th Editions

3.3 Set Pressure & Flow Capacity Requirements

Primary Relief System:

- **Set Pressure:** PRV set to discharge at no higher than 110% of tank design pressure — factory-set, factory-stamped, non-adjustable in the field.
- **Automatic Operation:** PRVs auto-open and auto-close at predetermined pressures. No operator action required or permitted.
- **Cryogenic Design Temperature:** Every PRD is designed and constructed for pressure at or exceeding tank design pressure at the coldest expected temperature — critical for LIN/LAR service ranging from -183°C to -196°C.
- **Inlet/Outlet Pressure Drop:** CGA S-1.2 (11th Ed.) specifies inlet and outlet pressure drop requirements for spring-loaded PRVs to ensure accurate set pressure operation under all flow conditions.

Secondary Relief System:

- **Flow Capacity:** Secondary PRD total flow capacity at pressure not exceeding 150% of tank design pressure — ensures adequate relief if primary PRV fails under any condition.
- **LIN & LAR Service:** Flow capacity meets or exceeds CGA S-1.2 formula calculations for both non-fire and fire exposure conditions.

3.4 Manufacturer Verification, Marking & Labeling

Per CGA S-1.2 and 49 CFR 173.318, all PRDs on these vessels carry factory-verified markings:

- Flow capacity and rating verified and marked by the manufacturer — field-marking is not permitted under any circumstances
- Set pressure (psig) stamped or permanently marked on PRV body
- Temperature rating confirming suitability for cryogenic service
- CGA S-1.2 compliance marking on all devices
- Manufacturer identification and model number for full traceability

3.5 Inspection & Maintenance Requirements (CGA S-1.2)

Inspection Item	Requirement & Frequency
Daily Visual	Inspect PRV and rupture disc for frost, icing, damage, or leakage — frost on PRV body may indicate weeping
PRV Reseating	After any activation: confirm full reseat. Continuous venting after pressure normalizes = failed PRV — remove from service
Rupture Disc Status	Inspect for bulging, corrosion, or damage — a ruptured disc means an overpressure event occurred — remove from service, do not refill
Vacuum Annulus Disc	Inspect vent for signs of activation — activation indicates vacuum loss — remove from service immediately
PRV Replacement Interval	Per manufacturer and CGA S-1.2 — typically every 5 years for cryogenic service
Thermal Relief Valve	CGA S-1.2 (11th Ed.) added specific inspection requirements — inspect per manufacturer schedule
Documentation	All PRD inspections, activations, replacements, and service events documented on-site — available to AHJ upon request
Field Modification	STRICTLY PROHIBITED — any PRD that has activated or shows damage must be replaced by authorized service personnel only

3.6 CGA S-1 Series — Standard Applicability

Standard	Covers	This Installation
CGA S-1.1	PRDs for cylinders for compressed gases	Applies to portable cylinders used with the system
CGA S-1.2 — PRIMARY	PRDs for cargo & portable tanks for cryogenic gases	PRIMARY REFERENCE for all bulk cryogenic vessels at this facility
CGA S-1.3	PRDs for stationary storage containers	May also apply — AHJ and supplier to confirm applicable edition

4. LAYERS OF PROTECTION — ENGINEERED SAFETY SYSTEMS

Modern bulk cryogenic vessels employ a defense-in-depth approach to safety. No single system is relied upon to prevent an incident — instead, multiple independent, redundant layers of protection are engineered into the vessel and the installation. The failure of any single layer does not result in an incident because the next layer is already in place.

DEFENSE IN DEPTH

These tanks are designed so that multiple independent safety systems would have to fail simultaneously before any hazardous condition could develop. In practice, properly maintained cryogenic bulk tanks have an exceptional safety record precisely because of this layered approach.

#	Layer	Protection Provided
1	**Inner Vessel Design**	ASME-code alloy steel inner vessel engineered for full operating pressure at cryogenic temperatures. This is the primary containment — the inner tank holds the product under all normal operating conditions.
2	**Vacuum Insulation Jacket**	Permanently sealed high-vacuum super-insulation jacket isolates the inner vessel from ambient temperature. Slows any heat ingress to a predictable, manageable rate — no sudden pressure spikes from insulation failure.
3	**Primary Pressure Relief Valve**	Factory-set, spring-loaded PRV automatically vents pressure before the vessel can reach unsafe pressure levels. Compliant with CGA S-1.2 — set at ≤110% of design pressure. Auto-reseats after pressure is relieved.
4	**Secondary Rupture Disc**	If the primary PRV fails to activate or reseat, a factory-set rupture disc provides complete pressure relief. Set at a higher pressure than the PRV — ensures full flow relief. Compliant with CGA S-1.2 at ≤150% of design pressure.
5	**Vacuum Annulus Rupture Disc**	Protects the outer vessel from over-pressurization in the event of inner vessel leak into the vacuum jacket space. Independent of the inner vessel relief system.
6	**Secondary Containment (Site)**	Site-installed containment berm or dike — sized to contain 110% of the largest vessel capacity. Prevents any spilled product from reaching drains, waterways, or adjacent structures.
7	**Atmospheric Monitoring**	Fixed and portable oxygen monitors with alarm setpoints provide early warning of any atmospheric change — alerting personnel before conditions become hazardous.

8	**Operational Policies & Training**	Written procedures, trained operators, restricted access, and regular inspections ensure human error is minimized as a failure mode.

5. PRODUCT DESCRIPTIONS — LIN, LAR

The following section describes the physical, chemical, and safety properties of each product. Understanding these properties allows for precise hazard identification and targeted emergency response planning.

5.1 Liquid Nitrogen (LIN)

Property	Value / Description
Chemical Formula	N_2
Boiling Point	-320°F (-196°C) at atmospheric pressure
Liquid Density	50.4 lb/ft³ (807 kg/m³)
Expansion Ratio	1 liter of liquid expands to approximately 694 liters of gas at ambient temperature
Color / Odor	Colorless liquid — odorless gas
Flammability	Non-flammable — non-reactive
Primary Hazard	Asphyxiation — displaces oxygen in confined or low-lying spaces
Secondary Hazard	Cryogenic burns and frostbite on direct contact
IDLH Threshold	Oxygen below 19.5% is oxygen-deficient — below 16% causes loss of consciousness
DOT Classification	Refrigerated Liquid (Cryogenic), Non-Flammable Gas

5.2 Liquid Argon (LAR)

Property	Value / Description
Chemical Formula	Ar
Boiling Point	-303°F (-186°C) at atmospheric pressure
Liquid Density	87.0 lb/ft³ (1393 kg/m³)
Expansion Ratio	1 liter expands to approximately 841 liters of gas at ambient temperature
Color / Odor	Colorless liquid — colorless, odorless gas
Density vs. Air	38% heavier than air — settles and accumulates in pits, trenches, and low areas
Flammability	Non-flammable — chemically inert

Primary Hazard	Severe asphyxiation — heavier than air with no sensory warning
IDLH Threshold	Oxygen below 19.5% is immediately dangerous — argon provides zero warning
DOT Classification	Refrigerated Liquid (Cryogenic), Non-Flammable Gas

6. HAZARD IDENTIFICATION & RISK CONTEXT

The following section identifies the hazard categories associated with bulk cryogenic storage. These hazards are well understood, predictable, and manageable through the safety systems, policies, and procedures described in this document. The identification of these hazards does not indicate that the installation is inherently dangerous — rather, it demonstrates that every hazard has been anticipated and addressed.

6.1 Asphyxiation Hazard (LIN & LAR)

MANAGED RISK — ASPHYXIATION (LIN / LAR)

LIN and LAR are colorless and odorless. A large release can displace ambient oxygen. This hazard is managed through atmospheric monitoring systems with automatic alarms, restricted access zones, and personnel training. Properly operating vessels with intact relief systems will not release product under normal conditions.

- Releases can displace ambient oxygen — oxygen monitors with automatic alarms are required
- Argon is heavier than air — accumulates in low areas and confined spaces — no oxygen-deficient entry without atmospheric monitoring and SCBA
- Oxygen levels below 19.5% trigger evacuation alarm — well before dangerous concentrations occur
- Properly maintained tanks have factory-sealed vacuum insulation — normal evaporation through relief valves is minimal and expected

6.2 Cryogenic Contact Hazard (All Products)

- Direct skin contact with cryogenic liquids or cold equipment surfaces causes immediate frostbite — PPE requirements prevent contact
- Appropriate PPE (cryogenic gloves, face shield, apron) eliminates this hazard for trained, equipped personnel
- Cryogenic liquids evaporate quickly at ambient temperature — spill pools are temporary and self-resolving

6.3 Pressure Hazard

- All vessels operate under pressure — redundant PRDs (CGA S-1.2 certified) prevent unsafe pressure buildup
- Rapid phase change (liquid to gas) generates pressure — managed by factory-sized, factory-set PRDs that vent automatically
- PRDs are the safety system designed specifically for this hazard — they work automatically without human intervention

7. EMERGENCY RESPONSE PROCEDURES

The following emergency response procedures are established for all personnel at this facility. These procedures are documented, posted on-site, and form the basis of annual training for all employees. First responders should consult this document upon arrival at the facility. A copy of this document is provided to the local fire department as part of the facility's hazardous materials notification.

GENERAL EMERGENCY PRINCIPLE

In any cryogenic emergency: (1) Protect people first — evacuate. (2) Call 911. (3) Identify the product and communicate it to responders. (4) Do not re-enter until atmospheric conditions are confirmed safe by calibrated monitor. Equipment can be replaced — people cannot.

7.1 Small Liquid Spill — Less than 10 Gallons

Item	Detail
Likely Cause	Valve connection leak, hose failure during fill, operator error
Immediate Actions (ALL Products)	(1) Stop spill source if safe. (2) Clear area — 25-foot minimum. (3) Don appropriate PPE. (4) Allow liquid to evaporate naturally. (5) Monitor O_2 levels before re-entry. (6) Document and report to supervisor.
Re-Entry Criteria	O_2 confirmed 19.5%–23.5% by calibrated monitor
Required PPE	Cryogenic gloves, face shield, cryogenic apron, insulated safety footwear

7.2 Large Liquid Release — Greater than 10 Gallons

LARGE RELEASE — LIFE SAFETY EMERGENCY

A large cryogenic release is a life-safety emergency. Evacuate first. Call 911 and wait for trained HAZMAT response. Provide responding units with this document and wind direction upon arrival.

IMPORTANT — AHJ CONTEXT ON EVACUATION DISTANCES

The isolation and evacuation distances below are taken directly from the DOT Emergency Response Guidebook 2024 (ERG 2024), published by PHMSA. These are worst-case

precautionary isolation distances measured from the spill source for a large, uncontrolled release — they are NOT automatic neighborhood evacuation orders. The site design, secondary containment, and monitoring systems at this installation are specifically engineered to prevent a release from reaching this scale. First responders reference these distances as initial planning figures, not mandatory perimeters in all scenarios.

LIN (Liquid Nitrogen) — ERG 2024, Guide 120: Gases — Inert (Including Refrigerated Liquids)

Scenario	ERG 2024 Guide 120 Distance
Spill / Leak — Immediate Precautionary	Isolate spill or leak area for at least 100 meters (330 feet) in all directions
Large Spill — Downwind Evacuation	Consider initial downwind evacuation for at least 100 meters (330 feet)
Fire Involving Tank	ISOLATE for 800 meters (1/2 mile) in all directions — consider initial evacuation for 800 meters (1/2 mile)
ERG Source	DOT ERG 2024, Guide 120 — verified at: https://cameochemicals.noaa.gov/chemical/4069

LAR (Liquid Argon) — ERG 2024, Guide 120: Gases — Inert (Including Refrigerated Liquids)

Scenario	ERG 2024 Guide 120 Distance
Spill / Leak — Immediate Precautionary	Isolate spill or leak area for at least 100 meters (330 feet) in all directions
Large Spill — Downwind Evacuation	Consider initial downwind evacuation for at least 100 meters (330 feet)
Fire Involving Tank	ISOLATE for 800 meters (1/2 mile) in all directions — consider initial evacuation for 800 meters (1/2 mile)
ERG Source	DOT ERG 2024, Guide 120 — verified at: https://cameochemicals.noaa.gov/chemical/2509

7.3 Pressure Relief Valve Activation

- PRV activation is a normal safety function — cold white vapor cloud is expected and is not an emergency condition
- Ensure PRV discharge area is clear of personnel and combustibles — this is addressed in the site design
- If PRV does not reseat after pressure normalizes — contact product supplier for emergency service. Do not attempt field repair
- Document the activation event, date, time, and conditions — report to supervisor and supplier

7.4 Fire in the Vicinity of Cryogenic Storage

- For LIN/LAR near fire: evacuate, monitor O_2 levels, prevent personnel from entering gas accumulation areas
- Provide first responders with this document and the SDS upon arrival

7.5 Vessel Damage or Structural Failure

- Any suspected vessel impact, structural damage, or vacuum jacket failure — evacuate immediately, establish minimum 330-foot isolation zone (ERG 2024 Guide 120/122) and call 911
- Loss of vacuum insulation causes accelerated pressure buildup and venting — do not approach a damaged vessel
- Call 911 and product supplier emergency line — vessel must be inspected before any return to service
- Do not attempt to assess or approach a damaged cryogenic vessel — HAZMAT response required

8. SPILL RESPONSE & CONTAINMENT PROCEDURES

8.1 Immediate Spill Response — All Products

1. Assess spill size and source from a safe distance before approaching.
2. Alert all nearby personnel — clear the immediate area.
3. Don appropriate PPE — cryogenic gloves, face shield, cryogenic apron, insulated boots.
4. Stop the source if safely possible. If not — evacuate and call 911.
5. Allow liquid to evaporate naturally — cryogenic liquids evaporate quickly at ambient temperature.
6. Ventilate any enclosed areas affected by the release.
7. Monitor oxygen levels continuously with a calibrated portable O_2 monitor.
8. Do not re-enter until O_2 is confirmed between 19.5% and 23.5%.
9. Document the event — volume (estimated), conditions, time — report to supervisor and supplier.

8.2 Cryogenic Contact (Skin/Eye)

10. Flush affected skin with large amounts of lukewarm (NOT hot) water for at least 15 minutes.
11. Remove clothing and jewelry from affected area — do not force-remove clothing frozen to skin.
12. Do not rub or massage the area — increases tissue damage.
13. For eye contact: flush with water immediately for minimum 15 minutes — call 911.
14. Seek emergency medical attention for all cryogenic contact injuries — even minor-appearing ones involve potential deep tissue damage.

9. SAFETY POLICIES & MITIGATION MEASURES

The following policies are mandatory for all personnel, contractors, and visitors at this facility. These policies collectively eliminate the most common pathways to cryogenic incidents.

9.1 Access Control

- Cryogenic storage area is a restricted access zone — unauthorized personnel prohibited
- All personnel working in or near the storage area must complete facility safety orientation before first access
- Visitors and contractors escorted by trained facility personnel at all times within the storage area
- NFPA 704 hazard diamond signage posted at all access points

9.2 Atmospheric Monitoring

Parameter	Setpoint / Requirement
Low O_2 Warning (LIN/LAR)	19.5% — personnel alert and precautionary action
Low O_2 Alarm / Evacuation	18.0% — mandatory evacuation of affected area
High O_2 Warning	23.5% — eliminate ignition sources, investigate source
High O_2 Alarm / Evacuation	25.0% — mandatory evacuation, treat as fire emergency
Monitor Calibration	Per manufacturer specifications — calibration records maintained on-site and available to AHJ
Fixed Monitoring	Required in all enclosed or semi-enclosed areas adjacent to cryogenic storage
Portable Monitoring	Required for all personnel entering areas where cryogenic gas may accumulate

9.3 PPE Requirements

Activity	Required PPE
Routine area access / observation	Safety glasses, closed-toe footwear
Working near cryogenic equipment	Cryogenic gloves, safety glasses, face shield

Tank filling / transfer operations	Cryogenic gloves, full face shield, cryogenic apron, insulated footwear
Spill response / cleanup	All of the above PLUS cryogenic suit if significant spill
Confined space near LIN/LAR	All of the above PLUS supplied air respirator (SCBA)

9.4 Inspection & Maintenance

- Daily visual inspection of vessels, PRDs, and connections by trained personnel
- PRD inspection and testing per manufacturer recommendations and CGA S-1.2
- Vacuum integrity monitored — excessive frost on outer vessel, increased product usage, or PRV venting reported to supplier immediately
- All records maintained on-site and available to AHJ upon request
- Equipment modifications and repairs only by product supplier or authorized service personnel

9.5 Emergency Preparedness

- Emergency response procedures posted at the storage area and at the facility's main entrance
- All personnel complete emergency response training upon hire and annually thereafter
- Annual emergency drill simulating cryogenic spill or release
- Copy of this document provided to local fire department
- This packet reviewed and updated annually or upon any change to storage area, product, or quantity

10. REGULATORY COMPLIANCE SUMMARY

The installation, operation, and emergency response procedures at this facility are designed to meet or exceed all applicable standards and regulations. The table below summarizes the primary regulatory framework governing this installation.

Standard / Regulation	Applicability to This Installation
NFPA 55 — Compressed Gases & Cryogenic Fluids Code	Primary code governing storage quantities, setbacks, and safety systems. All NFPA 55 requirements met or exceeded
CGA S-1.2 (11th Ed., 2024) — PRD Standards Part 2	PRIMARY PRD standard. Governs PRV set pressures (110% max), secondary flow capacity (150% max), factory marking. All vessels CGA S-1.2 compliant
CGA S-1.3 — PRD Standards Part 3	Stationary storage PRD standard — may also apply. AHJ and supplier to confirm applicable edition
CGA P-9 — Inert Gases	CGA standards for nitrogen and argon. LIN and LAR operations compliant
OSHA 29 CFR 1910.101(c)	Compressed gas PRD requirements — CGA S-1.2 incorporated by reference. Compliant
OSHA 29 CFR 1910.146	Confined space requirements — atmospheric monitoring and SCBA protocols in place
49 CFR 173.318	Cryogenic liquid cargo tank requirements — PRV set ≤110%, secondary ≤150% design pressure. Compliant
ASME BPVC Section VIII, Division 1 (BPVC.VIII.1)	All vessels manufactured per ASME BPVC Section VIII, Division 1 — Rules for Construction of Pressure Vessels. This is the code stamped on the vessel nameplate. Confirm specific Division against the nameplate, as some vessels may be manufactured to Division 2 (Alternative Rules) depending on design pressure and manufacturer specification. Official reference: ASME BPVC.VIII.1
State & Local Fire Code	Applicable adopted edition — all permits to be obtained prior to fill

11. SITE-SPECIFIC SAFETY MEASURES

11.1 Physical Safeguards

- Vehicle impact protection (bollards or barriers) installed around all cryogenic storage equipment
- Secondary containment berms or dike walls — sized to contain 110% of the largest vessel capacity
- Positive drainage from storage pad — prevents ponding of cryogenic liquids or water
- NFPA 704 hazard diamond signage at all access points per applicable code requirements
- Perimeter fencing with locked access gate — prevents unauthorized access

11.2 Operational Controls

- Written operating procedures developed and posted at the storage area
- Minimum two-person rule for all filling and transfer operations
- Pre-operation checklist completed before every delivery and filling operation
- Emergency shutoff valve accessible from outside the exclusion zone

11.3 First Responder Coordination

- Local fire department notified of cryogenic installation and provided a copy of this document
- Facility address and cryogenic storage location clearly marked for emergency vehicle access
- 24-hour emergency contact number posted at facility entrance
- Site map showing vessel locations, exclusion zones, and access routes available at facility entrance

12. EMERGENCY CONTACTS & NOTIFICATION

IN ANY CRYOGENIC EMERGENCY — CALL 911 FIRST

Always call 911 as your first action in any life-safety emergency. Provide the dispatcher with your address, the product involved (liquid nitrogen, liquid argon, or liquid oxygen), the approximate quantity, and the nature of the incident.

12.1 Emergency Contact List

Contact	Name / Organization	Phone Number
Fire / Police / EMS	911 Dispatch	911
CHEMTREC Emergency	Chemical Emergency Response — 24 Hour	1-800-424-9300
National Response Center	CERCLA/SARA Title III Reportable Releases	1-800-424-8802
Facility Emergency Contact	Tone Conte	310-714-3688
Product Supplier (24-hr)	_____	_____
Tank Manufacturer Service	_____	_____
Local Fire Department	_____	_____
Local HAZMAT Team	_____	_____
Facility Manager	Tone Conte _____	_310-714-3688_____
Safety Officer	Mike McDermott_____	_323-605-9782_____

12.2 Notification Requirements

- Any release, spill, fire, or personal injury involving cryogenic products reported to facility manager within 1 hour
- CERCLA/SARA reportable quantities reported to National Response Center: 1-800-424-8802
- AHJ notified within 24 hours of any significant incident at this facility
- Product supplier notified within 24 hours of any equipment malfunction, unusual venting, or suspected vessel damage

REFERENCES & SOURCE DOCUMENTS

The following references were used in the preparation of this Safety & Compliance Presentation. All sources are publicly available and can be independently verified by the AHJ. Web links are provided where applicable. Where standards are subscription-based, the official publisher website is listed for procurement.

> **NOTE TO AHJ**
>
> All regulatory standards referenced in this document should be confirmed against the currently adopted edition in your jurisdiction. Adoption of NFPA, IFC, and other model codes varies by state and municipality. Contact your state fire marshal's office or building department to confirm which edition applies.

A. Emergency Response References

Source	Details & Access
DOT Emergency Response Guidebook 2024 (ERG 2024) Guide 120 — Gases: Inert (Including Refrigerated Liquids) Applies to: LIN, LAR	Publisher: U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) Free PDF: https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2024-04/ERG2024-Eng-Web-a.pdf Guide 120 direct: https://cameochemicals.noaa.gov/erg_guides/en/Guide_120.pdf LIN verified: https://cameochemicals.noaa.gov/chemical/4069 LAR verified: https://cameochemicals.noaa.gov/chemical/2509
Matheson Tri-Gas MSDS — Liquid Nitrogen	Independently confirms fire involving tank evacuation distance: 800 meters (1/2 mile) Source: https://www.scribd.com/document/244169919/Matheson-Tri-Gas-Liquid-Nitrogen For current Matheson SDS documents: https://www.mathesongas.com
NOAA CAMEO Chemicals Database	Chemical hazard data, ERG guide assignments, and emergency response information for LIN, LAR. Free access: https://cameochemicals.noaa.gov

B. Fire & Safety Codes

Standard	Details & Access
NFPA 55 — Compressed Gases and Cryogenic Fluids Code Current Adopted Edition	Publisher: National Fire Protection Association (NFPA) Primary code governing storage quantities, setback distances, and safety systems for all cryogenic installations Purchase/access: https://www.nfpa.org/product/nfpa-55-code/p0055code Free read-only access available at: https://link.nfpa.org/all-publications/55

International Fire Code (IFC) Chapter 55 — Cryogenic Fluids 2018 or currently adopted edition	Publisher: International Code Council (ICC) Cryogenic fluid storage and handling requirements — adopted by many jurisdictions as local fire code Access: https://codes.iccsafe.org/content/IFC2018/chapter-55-cryogenic-fluids

C. CGA Standards

Standard	Details & Access
CGA S-1.2 — Pressure Relief Device Standards Part 2: Cargo and Portable Tanks for Compressed Gases 11th Edition, September 2024	Publisher: Compressed Gas Association (CGA) PRIMARY PRD standard for all cryogenic vessels at this facility. Governs PRV set pressures, secondary flow capacity, factory marking, and inspection Purchase: https://store.accuristech.com/standards/cga-s-1-2 CGA overview: https://www.cganet.com/cga%E2%80%99s-s-1-series-what-distributors-need-to-know-about-pressure-relief-device-standards/
CGA S-1.3 — Pressure Relief Device Standards Part 3: Stationary Storage Containers for Compressed Gases	Publisher: CGA May apply to stationary bulk cryogenic storage — AHJ to confirm applicable edition Purchase: https://www.cganet.com
CGA P-9 — The Inert Gases: Argon, Nitrogen, and Helium	Publisher: CGA CGA standards for nitrogen (LIN) and argon (LAR) handling and storage Purchase/info: https://www.cganet.com

D. OSHA Regulations

Regulation	Details & Access
OSHA 29 CFR 1910.101 — Compressed Gases (General Requirements)	Incorporates CGA S-1.2 by reference for PRD requirements on all compressed gas containers Free access: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.101 Also: https://up.codes/s/compressed-gases-general-requirements
OSHA 29 CFR 1910.146 — Permit-Required Confined Spaces	Applies to any confined spaces adjacent to LIN/LAR storage where oxygen deficiency may develop Free access: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.146

E. DOT & Transportation Regulations

Regulation	Details & Access
49 CFR 173.318 — Cryogenic Liquids in Cargo Tanks	Governs cryogenic liquid cargo tank design and PRD requirements — PRV set ≤110% design pressure, secondary system ≤150% design pressure Free access: https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-173/subpart-G/section-173.318

49 CFR Parts 100–185 — Hazardous Materials Transportation	DOT hazardous materials transportation regulations governing delivery of LIN & LAR to this facility Free access: https://www.ecfr.gov/current/title-49
CERCLA / SARA Title III — Emergency Planning & Community Right-to-Know	Reportable quantity requirements for accidental releases of hazardous substances National Response Center: 1-800-424-8802 EPA info: https://www.epa.gov/epcra

F. ASME Codes & Standards

Standard	Details & Access
ASME BPVC Section VIII, Division 1 (BPVC.VIII.1) Rules for Construction of Pressure Vessels PRIMARY manufacturing code for vessels at this facility	Publisher: American Society of Mechanical Engineers (ASME) Governs design, fabrication, inspection, testing, and U-stamp certification of pressure vessels operating above 15 psig Purchase: https://www.asme.org/codes-standards/find-codes-standards/bpvc-viii-1-bpvc-section-viii-rules-construction-pressure-vessels-division-1 ASME overview: https://www.asme.org
ASME BPVC Section VIII, Division 2 (BPVC.VIII.2) Alternative Rules for Construction of Pressure Vessels	Publisher: ASME Alternative rules for higher-pressure vessels using design-by-analysis methods. May apply to some vessels depending on manufacturer specification — confirm against vessel nameplate Purchase: https://www.asme.org/codes-standards/find-codes-standards/bpvc-viii-2-bpvc-section-viii-rules-construction-pressure-vessels-division-2-alternative-rules-(1)
ASME BPVC Section II — Materials	Publisher: ASME Approved material specifications for pressure vessel construction — governs inner vessel material selection for cryogenic service (SA-240, SA-553, SA-304, etc.) Purchase: https://www.asme.org
National Board of Boiler and Pressure Vessel Inspectors	Maintains the National Board Register of all ASME U-stamp pressure vessels. AHJ can verify vessel registration and manufacturer authorization Website: https://www.nationalboard.org Vessel registration lookup: https://www.nationalboard.org/index.aspx?pageID=140

G. Additional Reference Resources

Resource	Details & Access
CHEMTREC — Chemical Emergency Response	24-hour emergency chemical response hotline — available to first responders and AHJ for product-specific emergency guidance Phone: 1-800-424-9300 (US) | +1-703-527-3887 (International) Website: https://www.chemtrec.com
National Response Center (NRC)	Federal reporting center for CERCLA/SARA reportable releases Phone: 1-800-424-8802 Website: https://www.nrc.uscg.mil
PHMSA — Pipeline and Hazardous Materials Safety Administration	DOT agency responsible for ERG publication, hazmat transportation regulations, and pipeline safety Website: https://www.phmsa.dot.gov ERG 2024 download:

	https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg
Compressed Gas Association (CGA)	Industry association that publishes all CGA standards referenced in this document — G-4, P-9, S-1.2, S-1.3 Website: https://www.cganet.com Standards store: https://www.cganet.com/store
American Society of Mechanical Engineers (ASME)	Publisher of ASME Boiler and Pressure Vessel Code including BPVC.VIII.1 and BPVC.VIII.2 Website: https://www.asme.org Codes & Standards: https://www.asme.org/codes-standards
National Fire Protection Association (NFPA)	Publisher of NFPA 55 and NFPA 50 referenced in this document Website: https://www.nfpa.org Free read-only code access: https://link.nfpa.org

CERTIFICATION

The undersigned certifies that the information in this Safety & Compliance Presentation is accurate and complete to the best of their knowledge, and that the policies and procedures described herein are in effect or will be implemented prior to commencement of cryogenic storage operations.

Signature: _____

Printed Name: _____

Title: _____

Company: _____

Date: _____

This document is provided as a boilerplate safety reference. Verify all information with the product supplier, tank manufacturer, and qualified safety professionals prior to AHJ submission. All regulatory references should be confirmed against the currently adopted edition in the applicable jurisdiction.