COPY NO. ____

LANSCE Division
HAZARD CONTROL PLAN Cover Sheet

Title: Liquid Nitrogen Filling System MPF-407, Rm. 110

HCP Number: LANSCE-3 HCP-11	**Date: 11/04/2003 (Renewal)**

Description of Activity:
Operation of an automated liquid nitrogen filling system located at TA-53, MPF-407, Room 110 for filling germanium detector dewars.

Principal Author of this Plan:
Name Ronald O Nelson Signature Ronald O. Nelson

Hazard Analysis Performed by:
Name Ronald O Nelson Signature Ronald O. Nelson

Initial Risk: ❒ Minimal ❒ Low ■ Medium ❒ High

Reviewed by (Subject Matter Experts and Independent Peers):

❒ Concurrence required; ES&H SME(s) and peer(s) *initial risk is high*
❒ Consultation required; ES&H SME(s) or peer(s) *initial risk is medium*

Name	Signature	Date

Additional controls are addressed by (BIO, SAD, RWP, AHAs, procedures, etc.):

Residual Risk: ❒ Minimal ■ Low ❒ Medium

Work Authorization:
(determined by residual risk: *minimal* requires TL/supervisor; *low* requires GL/DGL; medium requires DD)
Name Bruce Takala Title LANSCE-3 DGL Signature Bruce Takala Date 11-3-03

Next Review Date 11/03/2004

HAZARD CONTROL PLAN Renewal Cover Sheet

LANSCE Division

Title of Hazard Control Plan:
Liquid Nitrogen Filling System MPF-407, Rm. 110

Hazard Control Plan Identification Number: LANSCE-3 HCP-11

Brief Description of Work:
Operation of an automated liquid nitrogen filling system located at TA-53, MPF-407, Room 110 for filling germanium detector dewars.

Reviewer of the Plan (This HCP and the operating experience have been reviewed and no significant modifications are needed at this time)**:**

Ronald O. Nelson	Staff Member	Ronald O. Nelson	11/5/02
Name	Title	Signature	Date

Initial Risk Estimate: ❒ Minimal ❒ Low ■Moderate ❒ High

Applicable Safety Permits Required to Perform Work: None

Residual Risk Estimate: ❒ Minimal ■ Low ❒ Moderate

Work Authorization:

BRUCE TAKALA	LANSCE-3 DGL	Bruce Takala	11-5-02
Name	Title	Signature	Date

Next Authorization Review Date: 10/30/2003

LANSCE Division
Hazard Control Plan Cover Sheet

Liquid Nitrogen Filling System MPF-407, Rm. 110		
LANSCE-3 HCP-11	**Revision:** 1	**Date:** 5/2/2001
Location of Work: TA-53/ MPF-407		**Group:** LANSCE-3
Author:	**Signature**	**Date**
Ron O Nelson (LANSCE-3)	Ron O. Nelson	5/2/2001

Initial Risk Level: medium		
REVIEW/APPROVAL		
Reviewed by:		
Bruce Takala (LANSCE-3)	Bruce Takala	5-2-01
Dory Ryan ~~(ESH-5)~~ LANSCE-FM	Dory L. Ryan	5-3-01
John Graham (LANSCE-FM)	John Graham	5/3/01

Residual Risk Level: low		
Approved by:		
Steve Wender (LANSCE-3 GL)	Steve Wender	5/3/01
Next Authorization Review Date: 5/2/2002		

Work definition:

This Hazard Control Plan (HCP) outlines hazards and safe procedures for operation of the manual and automated liquid nitrogen (LN2) filling systems located at TA-53, MPF-407, Room 110. The purpose of these systems is to allow cooling of Ge detectors before and after annealing and during testing. The LN2 system is used on an "as needed" basis when working on detectors and is not continually operated. The nitrogen gas from the 240-liter LN2 dewar is also used as clean, dry gas when venting the vacuum systems of the Ge-detector annealing station.

Figure 1 shows the locations of the 240-liter LN2 dewar (outside of building MPF-407), the oxygen-level monitor, and the annelaing station in the building. Because lines from the gas and liquid outlet valves of the dewar enter the building, the potential for creating an oxygen-deficient atmosphere in the building exists when there is LN2 in the dewar.

The automated LN2 filling system consists of a manifold and cryogenic valves controlled by a set of time-delay relays and a feedback circuit. A master relay determines the time between fills – typically set at 8 to 12 hours. Other time-delay relays control the LN2 valves and are typically set for a maximum fill time of 10 minutes. A sense resistor in the exhaust line is connected to a feedback circuit that stops the fill if the detector dewar is full. These time-delay relays serve to limit the amount of LN2 that can be released by the system under normal operation. An optional autodialer can be used to notify personel if a dewar does not completely fill – as indicated by a "time-out" shutoff rather than a "dewar-full" shutoff. A release of more than the safe volume of cryogen in a short time requires both the open failure of the normally-closed solenoid operated supply valve on the 240 l dewar and the loss of connection of the supply hose inside the building. In the event of such a failure the low-oxygen alarm will serve to warn building occupants of the danger.

Ordinarily the LN2 filling system should require little attention other than periodic maintenance to check for leaks or other problems. The oxygen level monitor and alarms should alert users and building occupants of any low-oxygen levels. Because of the length of the building, a minimum of two loud alarms are installed, one near each end of the building. Tests will be conducted to ensure that the alarms can not easily be ignored in any part of the building.

LANSCE-3 is responsible for maintenance and records of the oxygen level monitor. The monitor and alarms should be tested every 8 weeks and repaired or replaced if not working properly.

Potential hazards: Cryogenic Liquids and Overpressures

Hazards exist with the use of cryogenic liquids. One of the main hazards arises from overpressures that may occur if the liquid evaporates to gas. The volume ratio between the gas at room temperature and the cryogenic liquid is about 1000. As a result, unless preventive measures are taken, substantial pressures will occur with cryogenic fluids

confined to small, fixed, unvented volumes. Overpressures are also possible if a blockage occurs in one of the tubes that exhausts the nitrogen. Blockages can occur in tubes at low temperature if condensables such as water vapor enter the system.

Nitrogen gas from LN2 contains no oxygen and can cause asphyxiation by diluting the air. If the oxygen concentration is below 8%, unconsciousness occurs in less than a minute. Depending on the room volume, modest quantities of cryogenic liquid can create an oxygen deficiency hazard if vaporized. Cold N2 is especially dangerous because it can settle near floor level.

Cryogenic liquids create hazards because of their low temperatures. Contact with the liquids, their vapors, and anything cooled to cryogenic temperatures can freeze living tissue; eyes are particularly vulnerable. Freezing can also cause breakage and loss of strength of materials which are not suited for cryogenic use such as most plastic or rubber.

If air condenses on a cold surface, the resulting liquid will contain 52% oxygen, since oxygen condenses at a slightly higher temperature than does nitrogen. Such liquid should be treated as liquid oxygen and not be allowed to contact combustible materials.

Cold surfaces will freeze water from the air, and over time build up ice. Ice can interfere with the operation of nearby mechanical devices (valves, relief devices, etc.) or cause shorting of electrical connections.

If other gases, particularly air, are allowed to leak into spaces containing LN2, they can condense and solidify, leading to plugged vent lines (possibly causing dangerously high pressure), plugs in other piping, interference with valve operation, erosion of valve seats and moving parts, and contamination of the LN2. Such contaminants will build up over time until they are removed by warming the system to temperatures above their boiling point.

Initial Risk Estimate:
The initial risk, based on the quantities of LN2 available, the hazards listed above, and the work to be performed, is estimated as "**medium**" per the LIR300-00-01 risk matrix.

Operational requirements:

LIR402-580-01.0 (*Cryogenic Fluids or Cryogens*), **LIR402-1200-01.0** (*Pressure, Vacuum, and Cryogenic Systems*), **TB 1402** (*Compressed Gases*), and **TB 1404** (*Inspection and Test of Pressure Systems*) describe requirements and procedures for designing, constructing, operating, and maintaining cryogenic and compressed gas systems, such as the one described here. These documents have been considered in writing this HCP.

Controls:

Personnel protective equipment (PPE):

Insulated gloves, and a face shield must be worn whenever work is being performed on components of the system that contain or might contain LN2.

Engineering controls:

Overpressure relief valves are installed at strategic locations in the system so there are no unvented volumes.

Ordinary boil-off gases are vented outside of the building. Low O_2 alarms are located in the building to warn occupants of oxygen deficient conditions. If an alarm is heard before or upon entering the building, personnel should leave the area immediately and call one of the contacts listed in the emergency procedures below

Pressure relief valves and vents are positioned and/or shielded to prevent exposure to personnel in the event of a release of LN2. Special plastic tubing (Tygothane) is used for all flexible tubing connections in the system to mitigate the potential for breakage and leaks. Only Tygothane tubing should be used when making repairs or modifications. Although handling of LN2 is not expected in routine operation, standard laboratory practice should be followed for handling cryogenic liquids when using hand dewars or conducting filling tests. Standard practice includes use of gloves and safety glasses when dealing with exposed LN2.

The majority of the time this system, except for the internal parts of the dewars, is at room temperature, so hazards from liquid oxygen are minimal. Because most of the system is at room temperature, large accumulations of ice should not occur. Permanent buildup of ice indicates a problem with a dewar or valve and should be investigated immediately.

Inspection Requirements:

All relief valves, vents, and connecting piping will be visually inspected annually for any defects or improper operation. The LN2 dewars will be visually inspected annually for loose fittings, signs of corrosion or damage. The oxygen level monitor in MPF-407 will be inspected every 8 weeks for proper operation.

Required Knowledge Skills & Abilities:

People who work on or operate the LN2 system must have cryogen training and compressed gas training. A list of authorized workers is attached. On the job training in the operation of the system is also required before a person may operate or work in the LN2 system.

Wastes:

No hazardous or radioactive waste is generated during the normal operation of this system.

Residual Risk:

The residual risk of operating or working on this system with implementation of the above PPE, engineering and administrative controls is estimated as "**low**".

Emergency Procedures:

A cryogenic emergency is the unexpected release of more than 30 l of LN2 in building MPF-407, or the activation of the oxygen monitor alarms by an oxygen deficient condition in the building.

In the event of a low oxygen alarm or catastrophic failure of any of the dewars:

(1) **Evacuate the entire building**. Personnel in MPF-407 room 110 should proceed outside and around the building to the pedestrian door in the west side of MPF-407, and call out for anyone inside to evacuate the building.

(2) **Proceed to the vehicle entrance gate (muster area) at the top of the WNR driveway**.

(3) **Call 911** (or pull a fire alarm box) **to summon help using a phone in buildings 406 or 882.** Request an ambulance. STAY ON THE LINE until the dispatcher has confirmed your location and the nature of the accident. If a person has collapsed within the building during a cryogenic emergency, **do not enter the building to attempt a rescue.** Call 911 and request assistance for a victim incapacitated in an oxygen depleted environment. Send someone to meet the emergency vehicle and direct to where it is needed.

Notify one of the contacts listed below:

Ron Nelson	667-7107, 984-8165, 104-2191
Steve Wender	667-1344, 983-3634, 104-2185
Bruce Takala	665-2029, 104-8827
LANSCE-3 Group Office	667-5377
CCR	667-5729

<u>Re-entering MPF-407 after Evacuation for a Cryogenic Emergency:</u>

If MPF-407 has been evacuated because of a large release of LN2, extra care must be taken before re-entry.

1. Call Industrial Hygiene (ESH-5, at 665-1869 or 665-4427) and request oxygen level monitoring.
2. Open doors to ventilate the building.
3. Have Industrial Hygiene monitor the room before personnel are allowed back in.

<u>Frostbite and Tissue Freezing:</u>

Remove any clothing that may restrict circulation in the frozen area.

DO NOT ATTEMPT TREATMENT. If part of the feet are frozen, DO NOT WALK. Wait for emergency personnel to arrive and administer aid.

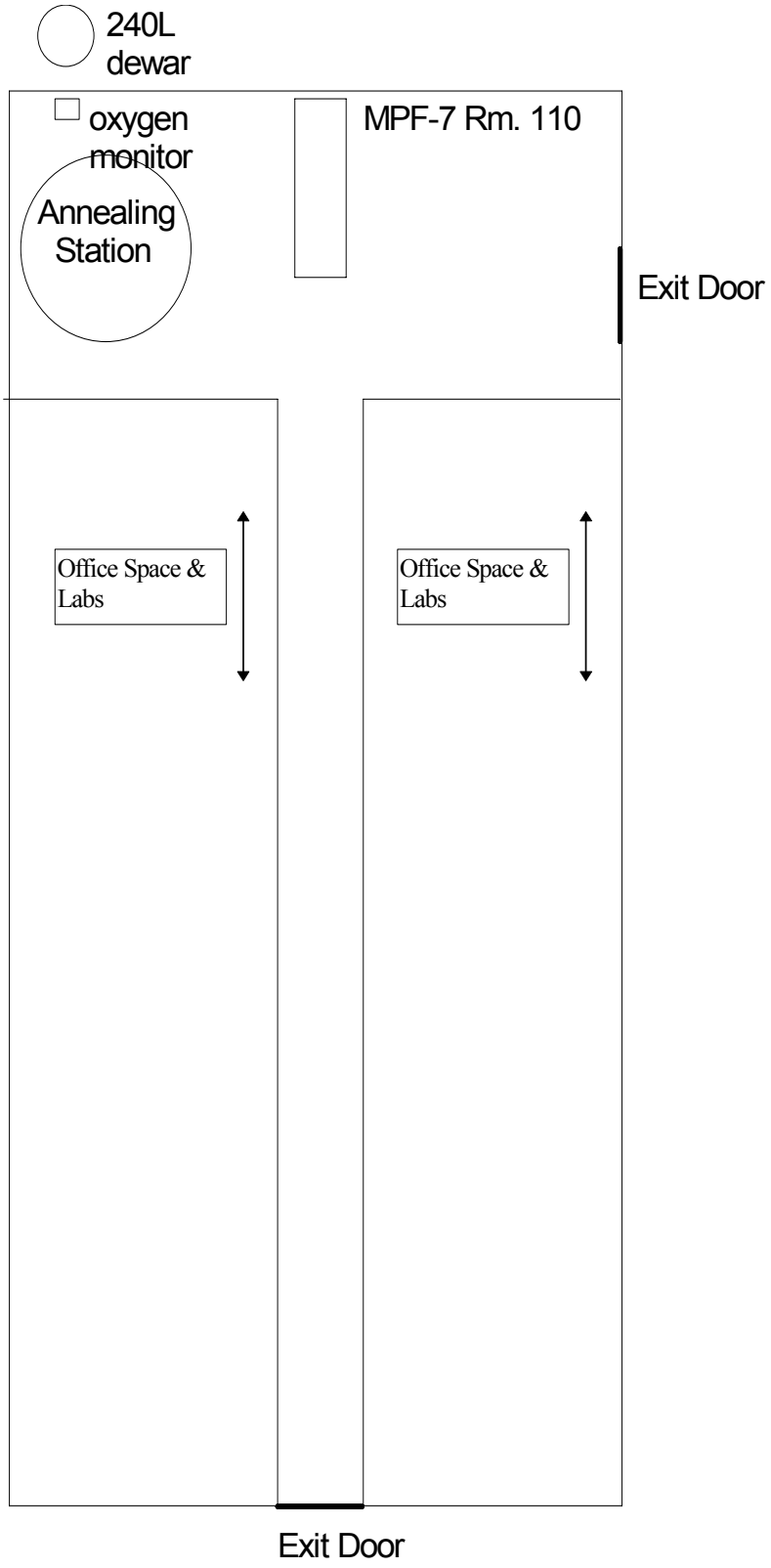
Calculation of "safe" volume of LN2 for Building MPF-407:

The volume of building MPF-407 room 110 is approximately $107m^3$ (8' high X 20' X 10' = 1600 ft^3 X $(0.027m/ft)^3$)= $43m^3$). According to LIR402-580-01.0 and the ES&H cryogen manual the safe working volume of LN2 is V_S (liters) = V_W (m^3)/13.3 = 43/13.3 = 3.2 liters. An accidental release of this volume of cryogen may activate the low O_2 level alarm, and is cause for evacuation.

Change Control Process:

This document must be reviewed at least annually. The latest version will be available on the LANSCE-3 web site, in the LANSCE-3 group office, and copies posted at the entrances to MPF-407.

Figure 1


240L
dewar
oxygen
monitor
MPF-7 Rm. 110
Annealing
Station
Exit Door
Office Space &
Labs
Office Space &
Labs
Exit Door

Attachment

The installation and operation of the automated liquid nitrogen filling system is the responsibility of personnel from LANSCE-3. The LANSCE-3 Group Office is located at TA-53, MPF-1, Room C138, telephone number (505) 667-5377.

The designated staff member is responsible for safe operation of the LN2 filling system and maintenance of this HCP. The staff member will be the primary contact for users of the LN2 system and safety personnel. Additional personnel from LANSCE-3, P-23 and external collaborators will also be responsible for maintenance and operation of the automated liquid nitrogen filling system. ALL users of the LN2 filling system, as well as visitors, are responsible for following the procedures outlined in this HCP.

A list of associated personnel is given below:

Staff members:

Ron Nelson	667-7107, 984-8165, pager 104-2191
Matt Devlin	665-0421, 663-1094, pager 104-5776

Technicians:

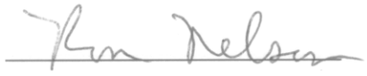
Gregg Chaparro	665-2861, pager 104-8734
Lloyd Hunt	665-6300, pager 104-8738
Art Bridge	665-4124, pager 104-2469

Attachment

Authorized LN2 System Workers

By signing the following people indicate that they have received the required training and are authorized to work on and operate the LN2 filling system described in this HCP.

Ron Nelson (LANSCE-3) 667-7107, 984-8165, 104-2191 (digital)



Gregg Chaparro (LANSCE-3) 665-2861, 104-8734/104-3023 (digital)

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Lloyd Hunt (LANSCE-3) 665-6300, 104-8738 (digital)

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Matt Devlin (LANSCE-3) 665-0421, 663-1094, 104-5776 (digital)

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Nikolaos Fotiades (LANSCE-3) 665-0589, 663-1070, 104-1934 (digital)

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