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Title: Safe Use of Cryogenic Liquids	
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LOCAL DETAILS			
Division	Nuffield Division of Clinical Laboratory Sciences	Department	Radcliffe Department of Medicine
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Date	Details of review	Version number	Name of reviewer

YOU ARE INSTRUCTED TO READ THE FOLLOWING THOROUGHLY BEFORE PROCEEDING TO UNDERTAKE THE METHODS DESCRIBED.

UNDER NO CIRCUMSTANCES ARE THESE INSTRUCTIONS TO BE AMENDED OR ALTERED IN ANY WAY OTHER THAN BY THE AUTHOR, APPROVER OR AN APPROPRIATE ALTERNATIVE.

1 References & Related Documents

This risk assessment is issued by the Nuffield Division of Clinical Laboratory Sciences, Radcliffe Department of Medicine. Health and safety inspectors seek to secure compliance with the law and may refer to this document as illustrating good practice. All staff undertaking work with cryogenic liquids should adopt the measures set out within this document to ensure that their health, safety and welfare are not knowingly compromised.

1.1 References for this risk assessment are as follows:

1.1.1 'CARE WITH CRYOGENICS' INFORMATION LEAFLET FROM BOC

1.2 Related documents for this risk assessment are as follows:

1.2.1 NDCLS-SOP-001 USE OF NDCLS CRYOSTORAGE FACILITY

1.2.2 UNIVERSITY POLICY STATEMENT S4/03 LIQUID NITROGEN

1.2.3 UNIVERSITY POLICY STATEMENT S7/99 MANUAL HANDLING OPERATIONS REGULATIONS 1992

1.2.4 UNIVERSITY SAFETY OFFICE MEMO M23/08 EXPLOSION RISK – SAMPLE RETRIEVAL FROM CRYOGENIC STORAGE

2 Risk Assessment

Liquid nitrogen (LN₂) is a colourless, odourless liquid that is extremely cold (boiling point is -196°C). As the liquid changes to gas at ambient temperature and pressure, the expansion ratio (the gas factor) is approximately 700 and, as such, the nitrogen gas will begin to displace the oxygen (O₂) in the air, leading to asphyxiation hazards. The resulting cold gas is heavier than air, so it accumulates in lower areas. NDCLS laboratories use LN₂ for long-term cell/tissue storage, and to snap freeze cells and tissues, primarily in the NDCLS Cryostorage Facility. There are three cell bank storage vessels that are filled manually, and one storage system, 'Frodo', that is automatically filled. Two 240l and one 100l pressurised cylinders are used as bulk stores. Engineering controls include the restriction of access to, and use of, LN₂ vessels to trained users, and an oxygen monitoring system that samples the O₂ content of the air and sounds an alarm and switches on a fan to extract the LN₂ vapour and vent it outside the building if the O₂ level drops below 20%. The low temperature of LN₂ also presents a significant hazard.

What is the hazard?	What are the likely accidents resulting from these hazards?	Who/what at risk Staff, Patients, Visitors, Contractors, Trust etc	What actions can be taken to prevent accidents?	Residual risk after preventive actions? low, medium, high
Reduced oxygen levels (due to nitrogen escape/spillage)	Fainting at slightly reduced oxygen levels; brain damage/immediate death at very reduced oxygen levels	Staff (at slightly reduced O ₂ levels; Staff, contractors and visitors at greatly reduced O ₂ levels	<ul style="list-style-type: none"> • O₂ levels in the Cryostorage facility must be checked on the monitor located next to the door of the facility prior to entry. • Staff must not enter the Cryostorage Facility if the alarm is sounding, or the blue light above the door is flashing, or the O₂ monitor reads below 20% (indicating that the O₂ concentration has been compromised). • If the alarm sounds while using the facility, leave the room and prevent entry of other people, allow the nitrogen gas to be extracted and only return when O₂ levels are above 19%. If there is any damage report to DSO or Cryostorage Facility Manager, who will take the appropriate course of action. • All staff must inform a colleague when working in an area with cryogenic liquids, including how long they are planning to go for, and ensure the colleague know what action to take if the staff member does not rerun within the allotted timeframe. • Only staff suitably trained in the safe decanting and use of LN₂ will be given an access fob. • Procedures involving the use of LN₂ e.g. manual filling of the dewars from the bulk storage cylinder tank, snap-freezing of tissues etc. must only be done by suitably trained staff. 	Medium

Low temperature	Cold burns, frostbite and hypothermia		<ul style="list-style-type: none"> All staff must wear adequate PPE (labcoat, face shield, cryo-gloves, closed shoes). All PPE located within the Cryostorage Facility is checked regularly to ensure that it is fit for purpose. Records are displayed within the facility. Any problems with PPE must be reported immediately to the DSO or Cryostorage Facility Manager. Adequate equipment (e.g. dewars with lids) must be used. 	Low-Medium
Moving LN ₂ tanks	Muscle strain and injury to feet	Staff	<ul style="list-style-type: none"> Push tanks rather than pull them, especially full tanks, to avoid muscle damage. Wear suitable footwear Avoid moving full tanks alone. 	Low-Medium
Changing hoses on filling tanks	Cold burns	Staff	<ul style="list-style-type: none"> Only suitably-trained staff may change hoses on bulk storage cylinder tanks. All connections to tanks must be secure. All staff must wear adequate PPE (labcoat, face shield, cryo-gloves, closed shoes). 	Low-Medium
Removing towers from storage	Cold burns (from LN ₂ splashes) Muscular strains from incorrect manual handling technique	Staff	<ul style="list-style-type: none"> Pull towers up slowly to allow gradual draining of LN₂ All staff must wear adequate PPE (labcoat, face shield, cryo-gloves, closed shoes). Do not over-stretch when reaching for/lifting towers, especially those in 'Frodo'. A kik-stool is available within the Cryostorage Facility for use as needed. Frodo has been sited to allow access from three sides, thus reducing the need to stretch. 	Low Low-Medium
Explosion of tubes caused by trapped expanding gas when taken out of storage tank	Physical injury Exposure to biological material	Staff	<ul style="list-style-type: none"> Upon removal from the storage bank, cryovials must be immediately placed in a larger sealable container or a box with a lid. Only approved cryovials with male connectors/outer seals 	Medium

			<p>should be used to prevent LN₂ entering the cryovial.</p> <ul style="list-style-type: none"> Adequate PPE (labcoat, face shield, cryo-gloves, closed shoes) must be worn, including a face shield/safety goggles for anyone in the vicinity) 	
Explosion of vacuum flasks	Physical injury Exposure to biological material	Staff	<ul style="list-style-type: none"> Visible checks should be carried out prior to use: the flask must be replaced if there is any damage to the seal. Any frosting occurring on the outside of the flask when there is LN₂ inside is an indication that the flask integrity has been compromised. If this is observed, the flask must be replaced. Adequate PPE (labcoat, face shield, cryo-gloves, closed shoes) must be worn, including a face shield/safety goggles for anyone in the vicinity) 	

3 Special Considerations

Is special monitoring required? (e.g. hearing test, eye test, health surveillance). If yes, specify details	No
What personal protective equipment is required? (e.g. labcoat, gloves, respiratory equipment, eye protection)	Labcoat and/or cryogenic apron, cryogenic gloves, face shield (labcoat and shield/safety goggles for anyone in the vicinity, not just the person handling the LN ₂)
Waste disposal information (if applicable)	N/A
Action to take in case of reasonably foreseeable emergencies (e.g. overheating, loss of electricity, flooding etc)	If the oxygen monitoring system has failed, inform the DSO and/or Cryostorage Facility Manager immediately. If possible, check integrity of tanks through the window before attempting to enter the room.
Special first aid measures	Cold burns: Loosen any clothing that may restrict blood circulation and seek hospital attention for all but the most superficial injuries. Do not try to remove clothing that is frozen to skin. Do not apply direct heat to the affected parts, but if possible place in lukewarm water. Clean plastic kitchen film or sterile dry dressings should be used to protect damaged tissues from infection or further injury, but they should not be allowed to restrict the blood circulation. Alcohol and cigarettes should not be given. Where exposed skin is stuck to cold surfaces such as uninsulated cryogenic pipework, isolate the source of the cold liquid and thaw with copious amounts of tepid water until the

	<p>skin is released. If burns are severe, seek medical advice and give a copy of the leaflet 'Treatment of Cryogenic Burns' to the medical staff (copies of the leaflet can be found in the document holder on the door of Room 4A10B).</p> <p>Hypothermia: People appearing to be suffering from hypothermia should be wrapped in blankets and moved to a warm place. Seek immediate medical attention. No direct form of heating should be applied except under medical supervision.</p> <p>Asphyxiation/loss of consciousness: Call 4444 for assistance. DO NOT ENTER THE ROOM.</p> <p>NB: All accidents/incidents must be reported in line with NDCLS procedures.</p>
Is lone working allowed?	Decanting from tanks is not allowed out of hours. If a small volume of LN ₂ is needed for out-of-hours work, this should be obtained earlier in the day when there are others around. If tanks need to be filled during periods of reduced staff numbers e.g. holiday periods, this must not be done alone.
Is additional training required? If yes, specify details	Yes. Training in all aspects of working in a room containing LN ₂ is required. All staff requiring access to the NDCLS Cryostorage Facility must receive the Induction Training Lecture. Competency sign-off will be required for procedures.
Is specific supervision required? If yes, specify details (e.g. competency record associated)	Yes. Supervisors should ensure that safe practice and/or competency has been established before allowing a new user to work with LN ₂ alone. A competency form may be required for specific procedures.
Do any special considerations need to be taken into account for expectant or nursing mothers?	Yes. Pregnant women should take extra care when removing towers/moving dewars as changing levels of the hormone relaxin may result in an increased propensity for muscle strain through lifting/stretching, and seek assistance of necessary.
Do any special considerations need to be taken into account for persons with limited mobility?	Yes. Extra care must be taken not to knock over dewars by ensuring a clear working area; moving of heavy items (filling tanks or access to towers in storage tanks) should be avoided.
Do any special considerations need to be taken into account for persons with pre-existing health conditions?	Yes. Transient exposure to very cold gas produces discomfort in breathing and can provoke an asthma attack in susceptible people.
Do any special considerations need to be taken into account for young persons with limited experience (e.g. work experience students)?	Yes. Young persons/students/short-term visitors should not be allowed to work with LN ₂ unsupervised.

4 Staff Record of Acknowledgement

By signing below, I agree that:

4.1 I have read and I understand the contents of this document and will work in accordance with this risk assessment

4.2 My supervisor/manager agrees that, subject to having received any further relevant training for procedures associated with this risk assessment, I am able to perform work covered by this risk assessment

4.3 I understand that further 'on the job' or other training supervision may be required before working independently

4.4 I understand that I may discuss my needs with my supervisor or line manager

Trainee				Supervisor/Manager	
Name	Position	Signature	Date	Signature	Date

Trainee				Supervisor/Manager	
Name	Position	Signature	Date	Signature	Date