**Manchester Institute of Biotechnology - Risk Assessment**

| **Date**: 31/08/2014 | **Assessed by:** Matthew J Cliff | **Validated by**:  | Location: MIB NMR facility LG029 | Review date: 31/08/2015 |
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| **Task / premises**: Use and maintenance of high field NMR spectrometers. Principal dangers arise from the superconducting magnets. These are very strong magnets, which have inherent dangers. In addition, the superconducting coils are cooled by liquid helium, which is in turn cooled by liquid nitrogen. Increase in the liquid helium temperature will result in sudden increase in resistance in the superconductor, which then produces heat, warming the helium further, and causing a positive feedback loop. The result is “quenching” of the magnet which involved the rapid boil-off of the helium and nitrogen. The volume of the room is large enough to ensure that all the oxygen would not be displaced, and the helium rapidly dissipates. There are low level and high level oxygen depletion monitors in the room.Quenching is principally avoided through regular refilling with liquid nitrogen (weekly) and helium (5-6 weeks). NB. Installation of nitrogen liquefaction on 500 MHz and 800 MHz spectrometers reduces nitrogen refill frequency to 6 months, unless this is switched off. Some risks may be associated with samples; the room containing the spectrometers is a “closed vessel” only environment, and no sample manipulation should take place in this room. There is a separate preparation laboratory for this purpose. Samples with significant associated risk should have an additional risk assessment completed, and use teflon tube liners where appropriate. |

| Activity  | Hazard  | Who might be harmed and how  | Existing measures to control risk  | Risk rating  | Result  |
| --- | --- | --- | --- | --- | --- |
| Use of NMR Magnets | Magnetic field | People in magnet room; particularly vulnerable are those with heart pacemakers and cochlear implants, as magnet will cause their failure. Injury from moving ferromagnetic objects attracted to magnets | * Safety training for all persons entering NMR facility addresses dangers of working with magnetic fields
* Swipe card access not authorised until safety training to the facility has been completed.
* People with pacemakers, metal implants, cochlear implants and neurostimulators are not permitted within magnet room.
* People are asked to remove all ferromagnetic items from clothing (pockets etc) and person (i.e. jewellery, bank cards, mobile phones) before approaching magnet.
* Warning signs on all entrances to magnet room. Barriers at the 5 Gauss limit of magnetic fields of magnets.
 | Low | A |
|  | Danger of asphyxiation | People in magnet room. Accidental release of large volume of oxygen-free gas (N2 + He), due to “quench” of magnet. | * Oxygen monitors (high-level and low-level alarm system installed and tested annually);
* Training of all NMR users to evacuate magnet room in the event of alarm.
* Strict procedures for regular refilling magnets with cryogens, maintaining integrity of all rubber seals, to prevent excessive boil-off.
* Minimal perturbation of magnet fields, to reduce possibility of quench.
* Weekly log of liquid helium and nitrogen levels taken by facility manager.
* Alarm system in place for 800 MHz spectrometer which should give 24 hours notice before any serious event involving helium system.
 | L | A |
|  | Broken NMR tubes | NMR users: cuts to fingers and contamination with sample. | * Handle carefully and wear gloves (to EN 374 standard)
* Avoid excessive force
* Do not use chipped NMR tubes – dispose of broken glass in glass waste bin.
 | L | T |
|  | Work at height |  | * Stepladders to BS EN 131 standard
* All users must receive stepladder/work at height training
 |  |  |
| Filling magnets with liquid nitrogen  | Magnetic field | People filling magnet. Same mechanisms of risk as above, but increased by close proximity to magnets, plus use of tools. | * Only those trained in magnet filling to be involved.
* 2 persons to perform filling, one to contact emergency services in case of serious injury.
 | L | A |
|  | Danger of asphyxiation | People filling magnet, and others in the magnet room during fill. Risk of quench slightly higher during filling. Transport dewar failure may also result in large release of gas | * Control measures as detailed above
* Liquid nitrogen filling/safety is included as part of the safety training for access/use of the NMR facility; all users will be trained in the safe filling of the machines with liquid nitrogen (according to the safe operating document – see NMR facility safety file); any personnel conducting a liquid nitrogen fill must have also attended stepladder training and gas safety training (which includes cryogen training).
* 2 persons to perform filling, one to contact emergency services in case of serious injury.
* Open door to magnet room during filling procedure, to increase ventilation.
* Carry personal O2 monitor during fill.
 | L | A |
|  | Extreme cold | People filling magnet. Cold burns to skin on contact with liquid cryogen or metal components in contact with liquid cryogens | * The following items of PPE must be worn: Howie-style laboratory coat, BS EN 511 compliant thermal gloves,BS EN166 compliant eye protection (chemical splash proof safety glasses), and sturdy footware (no steel toe caps). A selection of safety glasses and goggles are available from MIB Stores; users are advised to visit Stores and select eye protection which fits well and is comfortable to use. Regular lab inspections monitor the wearing of PPE; users found not to be wearing PPE when the risk assessment states that it must be worn will be subject to the MIB compliance policy.
* All users must have attended cryogenic safety training course.
 | L/M | A |
|  | Work at height |  | * Stepladders to BS EN 131 standard
* All users must receive stepladder/work at height training
 |  |  |
| Filling magnets with liquid helium  | Magnetic field | People filling magnet. Same mechanisms of risk as above, but increased by use of ferrous gas cylinders (He fill only). | * Select people identified by facility manager to perform helium filled, with appropriate training.
* He gas cylinder located in central region of room and remains there, long tubing used to connect to helium transport vessel.
 | L | A |
|  | Danger of asphyxiation | People filling magnet, and others in the magnet room during fill. Risk of quench slightly higher during filling. Transport dewar failure may also result in large release of gas | * Control measures as detailed above
* Fills will performed according to the safe operating document; any personnel conducting a liquid helium fill must have also attended stepladder training and gas safety training (which includes cryogen training).
* 2 persons to perform filling, one to contact emergency services in case of serious injury.
* Open door to magnet room during filling procedure, to increase ventilation.
* Carry personal O2 monitor during fill
 | L | A |
|  | Extreme cold | People filling magnet. Cold burns to skin on contact with liquid cryogen or metal components in contact with liquid cryogens. | * The following items of PPE must be worn: Howie-style laboratory coat, BS EN 511 compliant thermal gloves,BS EN166 compliant eye protection (chemical splash proof safety glasses), and sturdy footware (no steel toe caps). A selection of safety glasses and goggles are available from MIB Stores; users are advised to visit Stores and select eye protection which fits well and is comfortable to use. Regular lab inspections monitor the wearing of PPE; users found not to be wearing PPE when the risk assessment states that it must be worn will be subject to the MIB compliance policy.
* All users must have attended cryogen safety training course.
 | L/M | A |
|  | High pressure gas | People filling magnet, explosion caused by build up of gas in transport vessel or magnet. | * Normal air gases freeze at liquid helium temperatures and may block safety of fill/empty valves and transfer lines.
* All lines should be purged with gaseous He before connection to liquid helium containing vessels.
 | L/M | A |
|  | Work at height |  | * Stepladders to BS EN 131 standard
* All users must receive stepladder/work at height training
 | L | A |

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| **Authorisation by Facility Manager I confirm that I have considered and understand the experiment and the associated hazards. I am satisfied that all of the hazards have been identified and that the control measures to be followed will reduce the risks to acceptable levels.** **Print name: Signed:****Date:** |

**Declaration by researcher**

**I confirm that I have read this Risk Assessment and that I understand the hazards and risks involved and will follow all of the safety procedures stated. Where PPE has been identified as a control measure, I will ensure that it is worn.**

**Declaration by Facility ManagerI confirm that the researcher who has signed below is competent to undertake the work. My counter-signature indicates that I am happy for the work to proceed.**

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| **Name (please print)** | **signed** | **Facility Manager signature** | **date** |
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