SECTION 16: LABORATORY REFRIGERATORS AND FREEZERS

CONTENTS

16.1 INTRODUCTION

16.1.1 OVERVIEW

The University of Melbourne Parkville campus & other campuses contain many buildings that accommodate a variety of laboratories that have installations of laboratory fridges and freezers that store important and valuable substances at specific temperatures. These appliances are usually used to contain biological material of high research value and must be installed appropriately to ensure proper and sustainable operating conditions and, to provide an effective appliance to protect the valuable research material stored within them.

16.1.2 GENERAL SCOPE

This Design Standard provides University of Melbourne Staff, Project Managers, Architects. Electrical Engineers, Electricians, Builders, Security contractors, and others with guidance as to how to install laboratory fridges and freezers, and Ultracold freezer appliances in laboratory environments.

This Design Standard is designed to assist laboratory design practitioners to correctly accommodate moveable refrigeration appliances in laboratories. It also takes into consideration the high value of research materials stored in these appliances and aims to mitigate the risk of the appliance failure impacting on the contents.

The Design Standard document refers to four different types of laboratory Fridge / Freezer appliances – either installed individually in Laboratories or collectively in a dedicated Freezer room; referred to as a Freezer farm.

1 Laboratory Refrigerator (Fridge) – nominally operates at +5^{o}C
2 Combination Laboratory Fridge and Freezer - nominally operates at +5^{o}C and -20^{o}C
3 Laboratory Freezer - nominally operates at -20^{o}C
4 Ultracold Freezer - nominally operates at - 80^{o}C

16.1.2.1 Exclusions

- Cool rooms or Freezer rooms or Other Constant Temperature (CT) rooms
- Liquid nitrogen vessels – dewars

16.1.2.2 Cool Rooms or Freezer Rooms or Other Constant Temperature Rooms

This document does not cover the design or installation of cool rooms or freezer rooms which form part of the fabric of the building.

Advice for these specialist facilities are available in:-

- AS/NZS 2982:2010 - Laboratory Design and Construction
- AS/NZS 2243.1:2021 - Safety in Laboratories Planning and Operational Aspects;
- AS 2243 : Safety in Laboratories series

16.1.2.3 Liquid Nitrogen Storage Vessels - Dewars

This document does not cover the storage of research material in liquid nitrogen vessels - dewars, commonly referred to as cyrostorage.
Liquid nitrogen poses a high risk and special storage and handling facilities are required –

For advice on cryostorage refer to:-

- AS/NZS 2982-2010 Laboratory Design and Construction.
- AS 2243.3:2022 Safety in Laboratories – Part 3: Microbiological safety and containment
- AS 1894:1997 The storage and handling of non-flammable cryogenic & refrigerated liquids

16.1.3 STANDARDS AND REQUIREMENTS

16.1.3.1 Standards & Requirements

The following Australian Standards are particularly relevant to the design of laboratory refrigerators and freezers.

- AS/NZS 2982-2010 - Laboratory Design and Construction -
- AS/NZS 2243.1:2021 - Safety in Laboratories Planning and Operational Aspects;
- AS 2243 Safety in Laboratories series
- AS/NZS-60335.2.24 - Australian Electrical Standards - for refrigeration appliances
- AS/NZS -3000:2018- Electrical Installations

The design consultant is required to produce his own specification which incorporates this section and other sections of the Design Standards, as well the current version of all relevant Legislation, Regulations, Codes of Practice, and Australian Standards

16.1.3.2 Other Related Documents

- AS 1894 (1997): The storage and handling of non-flammable cryogenic & refrigerated liquids
- AS 2243 Safety in Laboratories series
- AS 2243.3:2022 Safety in Laboratories – Part 3: Microbiological safety and containment
- AS/NZS 3000.2018 -Australian/New Zealand Wiring Rules;
- AS / NZS 4474:2018 – Energy labelling and minimum energy performance Standards requirements
- AS / NZS IEC 62552:2018 Parts 1-3; Household refrigeration appliances – Characteristics and test methods
- Environment Protection Authority for relevant State
- The Gene Technology Act 2000;
- The Gene Technology Regulations 2001;
- AS 85000:2017 - QCPS - Quality Care Pharmacy Standard - quality management system for pharmacies in Australia;
- AS3864.1-2012 - Medical refrigeration equipment – For the storage of blood and blood products, Part-1: Manufacturing requirements;
- AS3864.2-2012 - Medical refrigeration equipment – For the storage of blood and blood products, Part-2: User-related requirement for care, maintenance, performance verification and calibration;
- Australian Government – National Health and Medical Research Council- Dept. of Industry, Innovation and Science - Australian Clinical Trials

16.1.4 DEFINITIONS

- Access Control – Challenger system – a form of alarm control system - used by Security to control access/egress with electronic door latches and for Security CCTV
- BAS -Building Automation System – used to monitor and send out alerts when there are issues with building operational systems such as HVAC.
- Captive mains power socket "Flip top" GPO – a GPO with a flip top cover to hold the mains plug and prevent the accidental removal of the mains plug
- Captive mains power PLUG industrial type with screw collar fitting – a plug to match captive socket, fitted to mains power flex cable which is attached to an electrical appliance typically an Ultracold freezer
- Captive mains power SOCKET industrial type with screw collar fitting – a mains power outlet with 3 flat pins, which maybe 10A or 15A, to be used with Ultracold Freezers at UoM. Usually fitted to the wall or a pendent style suspended from the ceiling
- Circuit Breaker – a device that is usually fitted to a circuit in a mains power distribution board. It isolates mains power when a high current, short circuit, is detected. It can also be manually activated/ reset to isolate/return mains power to a circuit.
- Commercial Freezer – similar to laboratory freezer
- Commercial Fridge – similar to laboratory fridge
- Converter - a Testo Saveris product - a type of Modem or network access point –that is part of the freezer temperature network. It is typically attached to a wall in the laboratory and establishes a WLAN through a CAT-6 cable attached to an IT network point in the vicinity, usually within 25m, of a Testo Saveris Wi-Fi Data logger.
- Cryogenic Liquids – liquids at very cold temperatures - typically liquid nitrogen (minus) -180^{o}C
- Cyclic defrost - an inbuilt heating cycle to reduce or prevent the build-up of ice in a freezer
- Data-Port – an IT network access point - RJ45 socket
- Dewar – a vessel that contains cryogenic liquids
- D.H.C.P. - Dynamic Host Configuration Protocol. is a network management protocol used to dynamically assign an IP address to any new node entering the network.
- Domestic Freezer – a refrigeration appliance mostly used in a domestic situation – generally has cyclic defrost refrigeration system which, in most cases, is not suitable for laboratory installations
- Dry Ice - a solid form of carbon dioxide, typically at -80 ^{o}C refer to solid carbon dioxide. Used for temporary refrigeration i.e. during transport.
- Earth Leakage Detector (ELD) - a type of RCD electrical safety switch
- FCU – Fan Coil Unit - a cooling condenser with an active fan connected to a buildings chilled water system
- Freezer Farm – a dedicated, and suitable fitted room, for a collection of laboratory fridges, laboratory freezers or ultracold freezers. Usually it is a collection of Ultracold Freezers.
- Freezer Temperature Monitoring system - a system that monitors and send out alerts when temperatures are outside a pre-determined high/low setpoint
- I.P. address – Internet Protocol address is a numeric address that identifies an individual item of computer equipment. This can be a static or dynamic number

- Laboratory Fridge - typically a refrigeration appliance, suitable for a laboratory application, that will maintain temperatures above zero (0.0) degrees, at +4 ^{o}C
- Laboratory Freezer - typically a refrigeration appliance, suitable for a laboratory application, that will maintain temperatures below zero (0.0) degrees, at around (minus) – 20 ^{o}C or – 30 ^{o}C
- Liquid Carbon Dioxide – R744 is a form of refrigerant. Usually in a G size cylinder attached to an Ultracold freezer as an optional temporary backup refrigeration system. – the use of liquid carbon dioxide is not recommended as a backup system.
- Liquid Nitrogen – liquid that is very cold and used for cold storage (minus) -180 ^{o}C
- Logger – a Testo Saveris product – a type of temperature data logger. Usually a T3D or T4D which is fitted to the front of a refrigerated appliance (fridge, freezer or ultracold freezer). The data logger periodically measures the temperature inside the appliance, and stores the data until it transmits the data, wirelessly to the local Converter, and then to the temperature monitoring computing database. The data logger has a temperature probe which is placed inside the appliance to measure the temperature.
- Medical Freezer – similar to laboratory freezer but with more accurate temperature control
- Medical Fridge – similar to laboratory fridge but with more accurate temperature control. Commonly used for Clinical trials or for Vaccine storage
- Network Node - is either a network redistribution point or a communication endpoint such as a data-port
- POE – Power Over Ethernet
- Refrigeration Condenser – a refrigeration heat exchanger usually located at the back, underneath or on top of a refrigeration appliance.
- RCD – Residual Current Device – an electrical safety device that is usually fitted to a mains circuit within a mains power distribution board. The RCD constantly measures the current between the active and earth lines and cuts mains power if it detects any residual current. Usually, an RCD responds very quickly and requires very low current levels to isolate mains power i.e. 10 milli Amp
- Safety Switch- refer to RCD
- Scientific Fridge - similar to laboratory fridge
- Scientific Freezer – similar to laboratory freezer
- Solid Carbon Dioxide – a very cold, solid pellet form of carbon dioxide, typically at (minus) – 80 ^{o}C
- Testo Australia Pty Ltd – local supplier of Saveris freezer monitoring equipment
- Testo Saveris – Manufacturer and brand of preferred freezer temperature monitoring equipment at UoM
- Ultracold Freezer – typically a refrigeration appliance that will maintain temperatures as low as (minus) - 80 ^{o}C. There are a number of refrigeration systems used for ultracold freezers - twin compressor cascade systems, single compressor system, dual single compressor system and Stirling engine system.
- Vaccine Fridge - a fridge with a defined operating rage typically; +1 to +8 ^{o}C
- WLAN –Wireless Local Area Network - a local form of wireless communication
- Wi-Fi – wireless communication system

16.1.5 BRIEF OVERVIEW SUMMARY

Laboratory fridge/freezer and ultracold freezer installations

Procurement:

- All new laboratory fridge, freezers and ultracold freezers must be purchased through a UoM preferred supplier as identified by UoM Procurement Services.
- Laboratory fridges and freezers must be “fit for purpose” and must not be of the domestic variety.
- Refrigeration appliances purchased for UoM from preferred suppliers will come supplied with the appropriate electrical plug and a temperature probe for connection to the UoM Freezer Monitoring system

Electrical:

- Each of the fridges / freezers will require appropriate power for each installation, i.e.; single circuit and flip up captive GPO preferable non-RCD and labelled accordingly
- Ultracold freezers will need a single circuit screw captive, 3pin 10A or 15A, GPO, no RCD on the circuit and labelled accordingly.

Carpentry:

- Appropriate space should be dedicated to fit the fridge or freezer, with a 10-cm space at either side, on top and behind the fridge or freezer – to allow for air circulation.
- Ultracold freezers may require additional space along the side for CO2 backup cylinders, if provided (rarely and not recommended), the space is needed for “G size” gas cylinders
- Laboratory entry doors must have a side leaf to allow for the relocation & passage of large ultracold freezers
- Floor coverings must be laboratory grade vinyl where fridges / freezer or ultracold freezers are located, and edges must be coved to contain liquid spills

Mechanical (HVAC)

- Ventilation and cooling is required to allow for the heat output of fridges and freezers and ultracold freezers. Heat extraction and makeup air supply must be considered.
- Air-conditioning is required to maintain an operating room temperature between 18 to 30^{o}C and must be operational 24/7

Monitoring

- The Freezer Management Unit must be consulted regarding the temperature monitoring of laboratory fridges, freezers and ultracold freezers.
- The construction project must provide one (1) UoM IT network data-port (type RJ45 single or double) in the laboratory containing research fridges or freezers. The data-port must be active, have POE and be patched to the freezer temperature monitoring network by UoM IT. Currently this is VLAN 1200
- The construction project may be required to purchase and supply / provide one (1) Testo Saveris T3D or T4D Wi-Fi temperature logger and mounting bracket per laboratory fridge, freezer appliance. This will be fitted by a specialist contractor.
- The University Preferred Freezer Temperature Monitoring System is the Testo Saveris Freezer Temperature Monitoring System – managed by the Freezer Management Unit within UoM Business Services
- The University Testo Saveris Freezer Temperature Monitoring System will automatically send notifications indicating “out of normal range” temperature alarms, to designated responsible research staff, by SMS and email.

- All new fridge / freezer and ultracold freezer purchases must be supplied with fitted temperature probes for the UoM monitoring system.
- Existing fridges and freezers will be retro-fitted with temperature probes by specialist contractors or the Freezer Management Unit.
- Each laboratory fridge or freezer will be given a UoM Freezer ID Tag placed on the front top of each appliance by the Freezer Management Unit.
- A Testo Saveris T3D or T4D Wi-Fi temperature logger and mounting bracket will be supplied and fixed to the front of laboratory fridges and freezers by the Freezer Management Unit
- The supplied data-port is used to connect the monitoring "Modem" and is used to setup a local freezer monitoring network Wi-Fi network (WLAN) and can accommodate up to 15 appliances wirelessly.
- The Freezer Management Unit will install the Wi-Fi modem (Converter or Gateway) for the monitoring service.
- The Freezer Temperature Monitoring Service, will also require the names of 3 research staff, from the Faculty, to receive alarms from the monitoring system. This will be programmed by the Freezer Management Unit.
- In-time, freezer monitoring software will be available to university managed PC computers, through UoM "Viewer Only" software, to enable research staff on the UoM network to view the operating temperatures for their laboratory fridges or freezers. In addition Cockpit software is also available and can be accessed via a web address, this software needs to be requested from the Freezer Management Unit.

16.2 GENERAL INFORMATION

16.2.1 GENERAL SAFETY CONSIDERATIONS

This Design Standard provides installation requirements of individual or multiple laboratory fridges or laboratory freezers or ultracold freezer appliances that must be considered for the safe and efficient installation of these appliances.

16.2.1.1 Electrical, Size, Weight, Heat Output and Ventilation

Safety aspects must be taken into consideration when planning for the installation of a new appliance or the relocation of existing laboratory fridges, freezers or ultracold freezer appliances.

These include infrastructure aspects of the laboratory fit-out such as:

- electrical mains power supply,
- the size and weight of the appliance
- the heat output of the appliance
- HVAC ventilation and cooling
- Lighting
- Floor covering
- Adequate floor space and passage around the appliance
- Freezer Temperature Monitoring

16.2.2 PROCUREMENT – NEW APPLIANCES

16.2.2.1 Considerations

The University has selected preferred major suppliers of laboratory grade appliances. These suppliers can assist and recommend appropriate laboratory fridges, laboratory freezers and Ultracold freezers.

A range of “fit for purpose” laboratory appliances are available at tendered prices, through the University IProct system, these appliances include laboratory fridges, freezers and Ultracold freezers in various sizes and configurations covering most laboratory and research applications.

The preferred suppliers cover the major range of brands and models of these appliances.

Laboratory fridges and freezers should be “fit for purpose” and must not of the domestic variety.

Refrigeration appliances purchased for the UoM from preferred suppliers will come supplied with the appropriate electrical plug and a temperature probe for connection to the UoM Freezer Monitoring System.

16.2.3 RELOCATION OF NEW APPLIANCES

16.2.3.1 Considerations.

Wherever possible, domestic fridges and domestic freezers should not be relocated into refurbished laboratory facilities. They should be replaced with ‘fit for purpose’ new laboratory grade appliances due to the risk to research materials from old and unreliable appliances.

Laboratory grade appliances, in good working condition and less than 10 years old, maybe relocated and used in refurbished laboratory facilities.

16.2.3.2 Safety & Loaded Weight Considerations

A safety risk assessment should be conducted, considering the size and weight of the appliance, prior to relocating any large laboratory refrigeration appliance.

When considering the relocation of large laboratory fridges, laboratory freezers and ultracold freezers, it should be noted that most appliances have castors that are designed to cope with the stationary total weight load. These castors can usually handle the load for small local movements of the appliance.
Laboratory appliances should not be moved over long distances when fully loaded with contents. Allowance should be made to relocate the contents separately, and then to relocate the empty appliance.

16.2.4 HVAC CONSIDERATIONS

16.2.4.1 Ventilation and Cooling Considerations

A laboratory facility must be designed to adequately reject heat by all fridges and freezers operating within the facility. Full redundancy shall be designed in cooling systems to allow for

HVAC equipment failure and maintenance issues. A mechanical engineer must make this assessment.

16.2.4.2 HVAC - Options

Preference is to use outside air ventilation where possible, especially where small numbers of fridges and freezers are contained within the room. However, if active cooling is required then specify in order of preference;

- Controlled chilled water system – dedicated fan coil connected to piped chilled water system within the building
- Self-Contained Cooling system – Split or packaged systems.

Fan coil units, (FCU's) shall be fitted with 3-way control valves and dedicated air filters.

16.2.4.3 Room Temperature Setpoints

Active cooling systems must be set to maintain room temperatures conditions 24 hours, 7 days a week to 22 ^{o}C with a dead band of 2 ^{o}C.

16.2.4.4 Room Temperature HVAC Monitoring

The Building Automation System (BAS) shall monitor room temperature and display ventilation and cooling system operational details on the head end of the graphic display.

A BAS alarm shall notify University maintenance staff of any abnormal room temperature conditions that occurs within the room ventilation or cooling system.

16.2.5 LIGHTING

Adequate laboratory lighting is essential to provide a safe working environment.

For lighting considerations refer to

- AS/NZS 2982-2010 - Laboratory Design and Construction -
- AS/NZS 2243.1:2005 - Safety in Laboratories Planning and Operational Aspects

16.2.6 FLOORS

16.2.6.1 Floor Coverings

Appropriate floor coverings must be used for laboratory or Freezer Farm facilities.

Typically, continuous vinyl floor coverings with coved edges shall be used.
For appropriate floor coverings consideration, refer to

- AS/NZS 2982-2010 - Laboratory Design and Construction
- AS/NZS 2243.1:2005 - Safety in Laboratories Planning and Operational Aspects

16.2.6.2 Room Flooding Considerations

The room shall be located to eliminate the risk of flooding or ingress of water due to burst pipework occurring nearby. The slope of the floor and adjoining corridors shall impede the natural flow of water, or in the case of a basement facility then an appropriate sump and sump pump shall be installed.

16.2.6.3 Floor Loadbearing Capacity - Weight Consideration

A consultant structural engineer shall confirm that the floor carrying capacity will cope with the anticipated total weight of all the refrigeration appliances within the laboratory facility.

Each laboratory fridge freezer appliance can weigh up to 300 kg (when empty) and an additional allowance should be made for the weight of the contents.

As a guide, allow 0.5 kg for each litre of appliance capacity, for example; for a 700L capacity appliance, 350 kg of contents should be added to the nett weight of the appliance.

16.2.7 ELECTRICAL

16.2.7.1 Considerations

The electrical power supply to the laboratory refrigerated appliances shall be arranged to minimise the likelihood of power failure as detailed by the following specific electrical components.

16.2.7.2 Laboratory Electrical Emergency Stop – Isolator buttons

In most cases, laboratory emergency electrical stop isolators are no longer required as these have been superseded by Safety Switches / RCD's for most electrical circuits supplying mains power to laboratories. - refer to figure 1

Laboratory fridges and freezers on dedicated electrical circuits should not be connected to electrical emergency stop buttons unless instructed otherwise and approved by the project manager. Refer to the University Design Standard on Electrical Services section 7

Figure 1 Example of electrical emergency stop red button.

16.2.7.3 Freezer Farm Facility

A new distribution switchboard shall be established within a Freezer Farm facility dedicated to powering all fridge and freezer appliances contained within the room. The switchboard must comply with Section 7, Electrical Services of the Design Standards.

Each refrigeration appliance shall be provided with a dedicated single circuit originating from the Freezer Farm switchboard.

Each refrigeration appliance dedicated single circuit shall be protected by a circuit breaker without an RCD device fitted.

16.2.7.4 Conditions for the exclusion of RCD protection

Extract from AS-3000 for exclusion of RCD protection

a) The connected equipment is required by the owner or operator to perform a function that is essential to the performance of the installation and that function would be adversely affected by a loss of supply caused by an RCD operation and,
b) The connected equipment is designed, constructed and used in such a manner that is not likely to present a significant risk of electric shock; and
c) The socket-outlet in a position that is not likely to be accessed for general purposes and
d) The socket-outlet is clearly marked to indicate the restricted purpose of the socket-outlet and that RCD protection is not provided. Refer to figure 6 for an example of required GPO signage

16.2.7.4.1 Conditions for Refrigeration Appliances to meet RCD removal requirements

To meet conditions, as described in AS-3000, the refrigeration appliance must be designed, constructed and used in such a manner that is not likely to present a significant risk of electric shock. This will require any new, used or current refrigeration equipment to be assessed to ensure it meets relevant electrical standards (for refrigeration appliances ASNZS-60335.2.24) prior to connecting it to a non- RCD protected circuit. It will also require the local department to use the appliance in a way that will not introduce risk of electric shock.

16.2.7.4.2 Refrigerated Appliances- operational requirements to meet non- RCD protected circuits

For this to be effective there needs to be a few actions:

1. Existing appliances need to be “tested and tagged” for electrical safety prior to installing on a non-RCD protected circuit.
2. Any refrigeration appliances (new and used) need to be assessed prior to installing on a non-RCD protected circuits. New freezers must meet Australian Electrical Standards (for refrigeration appliances ASNZS-60335.2.24). Used equipment must be “tested and tagged” for electrical safety prior to installing on a non-RCD protected circuit.
3. Operation of the equipment: must be in a manner that will not introduce significant risk of electric shock.

16.2.7.5 Essential Supply – Backup Power

Consideration shall be given to incorporating a standby backup diesel generator to provide an essential power supply to the Freezer Farm room switchboard. This shall be considered when stand-by power is not available.

16.2.7.6 Power Socket Outlets

To reduce the risk of a refrigerated appliance power plug being accidently disconnected, a captive-type secure mains socket system, as specified in this Design Standard shall be used.

16.2.7.6.1 For Laboratory Fridges & Laboratory Freezers

This is typically a “flip-top” captive GPO, eg.; Clipsal- type 10PL refer to figure 2

16.2.7.6.2 For Ultracold Freezers

This is typically a captive screw fitted industrial GPO, eg; Clipsal type 56 series refer to figures 3 & 4

16.2.7.7 Power Plugs

Normally, new refrigeration appliances purchased through the University's online purchasing system, iProct from preferred suppliers, will be delivered with the appropriate plug fitted. Refer to figures 2,3 & 4

16.2.7.7.1 Individual laboratory Fridges or Freezers - electrical plug requirements

Each laboratory fridge or freezer appliance will be fitted with a standard Australian electrical mains 3 pin plug.

16.2.7.7.2 Ultracold freezers -- electrical plug requirements

Each ultracold freezer appliance MUST be fitted with an industrial screw CAPTIVE mains 3 pin plug, Clipsal type 56 series - refer to figure 4

For existing electrical appliances an electrician will need to be contacted to remove and replace the 3 pin plug for ultracold freezers with the recommended industrial captive screw 3 pin plug & matching wall or pendant outlet.

16.2.7.8 Flexible Electrical Cables

The appliance flexible power cable shall be of sufficient length to allow for the appliance to be plugged directly into the captive supply socket without the need for an extension lead or power-board.

If this is not the case then, as required, an electrician will be engaged to replace the flexible electrical cable with one that is of suitable length.

VARIOUS CAPTIVE MAINS POWER OUTLETS, PLUGS and LABELLING

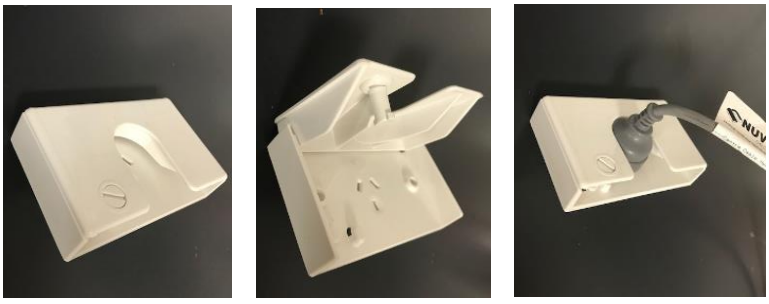

Figure 2 Standard GPO with the "FLIP TOP" cover for fridges and freezers-

Clipsal- type 10PL.

Figure 3 Industrial captive screw sockets – **wall mounted**-

Clipsal type 56 series.

Figure 4 Compatible Industrial **captive screw plugs** - Clipsal type 56 series.

Figure 5 Suspended **Pendent type** - Industrial captive screw sockets – Clipsal type 56 series.

Figure 6 Dedicated circuit - example of required signage for GPO with RCD removed.

16.2.8 NETWORK DATA POINT OUTLETS

16.2.8.1 Consideration

Several network data-points are required for communications such as telephone and Freezer Temperature Monitoring on the University IT network.

The Freezer Temperature Monitoring Program requires one or 2 network data-points near multiple refrigerated appliance installations.

16.2.8.2 Freezer Farm Facilities – network data-port requirements

Freezer Farm facilities require a minimum of two (2) network data-points provided for the Freezer Temperature Monitoring Program – refer to figure 7

16.2.8.3 Other Laboratory Facilities - network data-port requirements

In other laboratory areas, one network data-port shall be reserved for the Freezer Temperature Monitoring Program.

Figure 7 **(a)** Single RJ45 network socket. **(b)** Dual RJ45 network socket.

16.3 ROOM DESIGN STANDARDS

16.3.1 SPACE ALLOCATION REQUIREMENTS

Adequate space for individual laboratory fridges or freezers must be allowed for, as part of the laboratory design.

Consideration should be given to the maximum number of appliances in the facility / laboratory

Free Standing refrigeration appliances MUST not be bigger than 1500 L or wider than 1.5 m

16.3.1.1 Space requirements for air circulation around appliances

Appropriate space should be dedicated to fit the refrigerated appliance in the room, with a 10-cm space at either side, on top and behind the fridge or freezer – this is to allow for air circulation.

Refrigeration appliances typically have heat condensers either on the back or underneath the appliance, it is important to keep heat away from this condenser coil to allow for the proper operation of the appliance.

16.3.1.2 Locating refrigeration appliances in a laboratory

Space should be made available, preferably along an internal wall of a facility / laboratory, to adequately fit the appliances.

16.3.1.3 Laboratory Passage Clearance

Adequate space must be allowed for the movement of people along internal corridors, for when the appliance door is opened.

16.3.2 FLOOR CLEANING AND DUST FREE ENVIRONMENT

The facility design shall be such to provide easy access for floor cleaning and reduce the build-up of dust.

16.3.3 FREEZER FARM FACILITIES

Where a dedicated freezer facility is required, referred to as a “Freezer Farm”, then adequate space must be allowed for each fridge / freezer or ultracold freezer as well as future additions within the Freezer Farm.

The freezer farm shall be sized to adequately fit all current laboratory fridges and freezer, and ultracold freezers.

Some space allowance shall be provided for any future appliance acquisitions that maybe required.

Consideration must be given to the space needed to move appliances in and out for cleaning and maintenance. Sufficient space is required and must be allowed for personnel to access power outlets adjacent to freezers, without the need to move the appliance.

16.3.4 CONSTRUCTION CONSIDERATIONS

A Freezer Farm facility does not require external windows, as these will only introduce unnecessary heating loads. If a proposed Freezer Farm room has existing windows these should be covered with plasterboard and insulation to minimise external heat loads into the room.

The Freezer Farm facility shall be constructed with 2-hour fire rated construction for added protection of Ultracold Freezer appliances in the event of a fire that occurs elsewhere in the building.

When condenser decks are provided, the design consultant is to ensure that all requirements for safe access are incorporated into the project design.

16.3.5 LABORATORY ENTRY POINT – CONSIDERATIONS

The laboratory entrance shall take account the passage of large laboratory equipment like laboratory fridges and laboratory freezers.

As a guide, the laboratory entrance should have a minimum opening of a door and side-leaf, or double doors, with manual door closers fitted to both doors. This is to allow for the passage of larger laboratory appliances and equipment such as laboratory refrigeration appliances.

16.3.6 SUSTAINABILITY

16.3.6.1 General Considerations

Consideration of direct and indirect energy usage should be given to the design of the installation of refrigeration appliances in laboratories or dedicated freezer farm facilities.

16.3.6.2 Ultracold Freezers - Energy Consumption and Heat Output

Attention is drawn to Ultracold freezers as they use large amounts of electricity per day, a single Ultracold Freezer uses in the order of 14 kWh / day and produces a high heat output into the room, to maintain the relatively low temperatures inside the freezer cabinet. As a result, these appliances require a highly reliable power supply and HVAC 24/7 to maintain a cool operating environment.

16.3.6.3 Requirement for continuous Mains Power and HVAC

Multiple Ultracold Freezer units in a Freezer Farm Facility require special consideration. A dedicated switchboard capable of suppling sufficient power to all refrigerated appliances shall be provided. The switchboard shall be backed up with standby generator power where available. Isolation of the switchboard should not be impacted by the isolation of other switchboards on the floor ie by provision of a dedicated take-off switch on a riser or a separate supply to the upstream switchboard or main switchboard.

A 24/7 N+1 continuous cooling system shall be provided to the Freezer Farm facilities, this can be provided by a dedicated air conditioning unit with an alternative back-up unit such as a DX system or chilled water system. Power to the cooling systems should be provided with standby generator power where available.

16.4 REMOTE TEMPERATURE MONITORING AND ALARM

16.4.1 BACKGROUND

The University of Melbourne has established a Freezer Temperature Monitoring System independent from the Building Automation System (BAS), called the Testo Saveris Freezer Temperature Monitoring System. The Testo Saveris Monitoring System has a dedicated server that is solely responsible for the data logging and monitoring of temperatures originating from Faculty refrigeration equipment, such as Laboratory Fridges, Laboratory Freezers, Laboratory Ultracold Freezers, and other specialised Laboratory equipment such as Laboratory Incubators and storage Liquid Nitrogen tanks.

The objective of the Testo Saveris Monitoring System is to detect and remotely notify laboratory users, and maintenance personnel of the presence of problematic temperatures within important laboratory refrigeration appliances.

The University Freezer Monitoring system uses the Testo Saveris Temperature Monitoring system and is managed by the UoM– Freezer Management Unit, located within Infrastructure Service, together with contractors from Testo Australia.

16.4.2 SCOPE

16.4.2.1 Provision of Freezer Temperature Monitoring Equipment and Setup

The majority of laboratory fridges, freezers or ultracold freezers shall be connected to the University Temperature Monitoring System (Testo Saveris system).

The following system components will be installed by the Freezer Management Unit or a UoM approved contractor-

- For new appliances the Temperature probe with mini connector is supplied and should already have been fitted by the preferred suppliers.
-
- For existing appliances that require Freezer Temperature Monitoring, the Freezer Management Unit will provide the following: -
    - Temperature probe with mini connector; refer to figure 8
    - Freezer identification tag (UoM Freezer ID) – with Location details; refer to figure 9
    - Testo Saveris T3D or T4D Wi-Fi Logger & mounting bracket attached to appliance; refer to figure 10
    - Testo Saveris Wi-Ficonverter or gateway (WLAN-modem) attached to Laboratory fittings; refer to figure 11

TESTO SAVERIS 1 - FREEZER TEMPERATURE MONITORING COMPONENTS

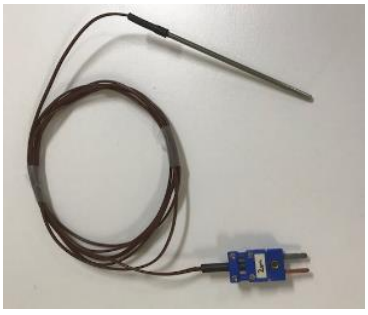

Figure 8 Temperature probe with mini connector.

Figure 9 Freezer ID label.

Figure 10 Testo Saveris 1 - T3D data logger.

Figure 11 Testo Saveris 1 - Converter connected to data port via cat 6 cable.

16.4.2.2. Testo Saveris Data Input

The data logger device will be programmed onto the Testo Saveris Monitoring System and, if the temperature profile is stable, then the Alarm feature will be available to the Faculty.

The Testo Saveris Monitoring System provides alarms, via SMS and email, where “abnormal temperatures” are observed.

16.4.2.3 Faculty Alarm Contacts.

The initial setup, additions and deletions of the Testo Saveris Monitoring Software System “alarm contacts”, will be managed by local laboratory officers in conjunction with the Freezer Management Unit – Business Services.

The Faculty must provide the names of (maximum) 3 x nominated responsible researchers contact details, to receive Freezer alarms; These details will be initially uploaded into the Testo Saveris software program by the Freezer Management Unit.

16.4.2.4 Testo Saveris Operating System maintained by the Freezer Management team

The University enterprise level - Freezer Management Operating System (the Saveris software) will reside on a secure University Virtual Machine, located in a secure University Computer Data Centre. The Saveris Enterprise software will be managed at the University by the Freezer Management Unit, with the support of the UoM IT Microsoft Platform team, and Testo Australia.

16.4.2.5 UoM Testo Saveris Freezer Temperature Monitoring System

The Testo Saveris Monitoring System consisting of; Testo Saveris Data Loggers, Converters or Gateways, Base-Stations and enterprise Saveris Software will be managed and maintained by the Freezer Management Unit and Testo Australia.

The Freezer Management Unit shall be the first point of contact if there is any maintenance issue with the Testo Saveris Monitoring System or components.

The contact address for the Freezer Management Unit is: -

- **email:**- **“** freezer-monitoring@unimelb.edu.au **”**

16.4.3 REMOTE TEMPERATURE MONITORING - SETUP

The majority of research laboratory fridges, freezers or ultracold freezer appliances require connection to the Freezer Temperature Monitoring System.

16.4.3.1 Freezer Monitoring setup

Each laboratory fridge or freezer or ultracold freezer appliance will be fitted with a temperature probe with a mini plug, suitable for connection to the Testo Saveris 1, TD3 or T4D logger. The Testo Saveris data logger is fitted with long life batteries.

16.4.4 TEMPERATURE MONITORING

Each laboratory fridge or freezer or ultracold freezer appliance that contains valuable research material must be connected to a “Temperature Monitoring System with Remote Alarm”. At the UoM most refrigerated appliances shall have its internal temperature monitored by the University enterprise Testo Saveris Freezer Temperature Monitoring system

A Testo Saveris system WLAN must first be established near the laboratory fridge or freezer or ultracold freezer installation. The WLAN shall comprise an RJ45 style outlet and associated Cat 6 cable for the connection of a Testo Saveris Converter. This is to establish the local Testo Saveris Wi-Fi network (WLAN).

The local Testo Saveris Wi-Fi network (WLAN) through the Converter or Gateway will accommodate up to 15 refrigerated appliance Monitored Data loggers, within a 25-m radius of the Converter.

The data-port outlet, RJ45 outlet must be suitably labelled, patched and activated to the Testo Saveris UoM IT Networks VLAN (currently 1200)

16.4.5 LOCAL TEMPERATURE ALERTS AND ALARMS

16.4.5.1 Ultracold Freezers - local alarm features

Most ultracold freezers are supplied with “local” temperature alarm devices**.**

The “local” alarm monitors the operational parameters of the Ultracold Freezer including- internal cabinet temperature, external room temperature, condenser temperature, mains power supply, compressor performance and door opening times.

When a “local temperature alarm” is activated it may be an “alert” or an “alarm” and is designed to attract the attention of the research staff that “own” the fridge / freezer.
It is the responsibility of the research staff to manage “local ultracold freezer alarms”.

16.4.5.2 Testo Saveris - only measures freezer temperature

The University Testo Saveris Freezer Temperature Monitoring System only measures the temperature inside the ultracold freezer unit. The Testo Saveris Freezer Monitoring System - alarm system is only triggered by fluctuations of temperature that are measured by the temperature probe inside the appliance.

When the Testo Saveris Monitoring System measures a temperature that is not in the normal temperature range, then an alarm is triggered. The Testo Saveris alarm system is independent of the internal Ultracold alarm system and it cannot control the local ultracold alarm system.

Often “local” alarms may be triggered by localised power outages but these do not necessarily trigger a “temperature alarm” on the Testo Saveris System unless the internal cabinet temperature rises significantly to trigger a “temperature alarm”.

16.5 OTHER ULTRACOLD FREEZER - BACKUP SYSTEMS

16.5.1 LIQUID CO2 BACKUP

Most Ultracold Freezers (minus 80 ^{o}C) can be purchased with the option to use a liquid CO2 backup system to maintain the very cold temperatures within the Freezer in the event of a power outage of other refrigeration problems.

CO2 backup systems are not recommended because they are not generally reliable. Freezer Temperature Monitoring with remote alarming provides sufficient early notification to prevent spoilage, should a refrigeration problem occur

16.6 ACCESS CONTROL – ROOM SECURITY

16.6.1 ACCESS CONTROL SYSTEM

- *Refer to Section 13 of the Design Standards – Security.*
  Requirements: -
  - Proximity card reader to the outside of the Laboratory / Freezer room.
  - Electric lock fitted to the door system.
  - Micro-switches to detect if the door has been left open.
  - Integration with the University Campus Access Control System.
  - Programmed to alert maintenance personnel if door has been left open too long.
  - Free handle exit egress through the door.
  - Automatic release of door lock during a building fire-alarm.

16.6.2 FREEZER MONITORING VIA ACCESS CONTROL

At all UoM locations Access Control is no longer required for monitoring of laboratory fridges or freezers, or ultracold freezers.

If laboratory fridges or freezers are found to be connected to the Access Control System this must be advised to the Freezer Management Unit in Business Services for corrective action.

16.7 BAS MONITORING

16.7.1 GENERALLY

BAS monitoring is almost exclusively used to monitor and manage the building infrastructure systems such as HVAC, room temperatures, make up air flow rates, water temperature, water flow rates, pump operational status i.e. “on/off”, mains power supply, diesel generator operational status i.e. on/off, etc

16.7.2 BAS FOR FREEZER ALARM MONITORING

In some areas of the University the BAS system is still used to monitor the alarm status of Ultracold freezers that are located within the building.

The sites include:

- Doherty Institute (Building 248) – also known as the “PDI”
- Kenneth Myer building- (Building 144) - also known as “Neurosciences building”, or the “Melbourne Brain Centre” (MBC)

16.8 DESIGN CHANGE AUTHORISATION

All requests for changes to the requirements of the Design Standards must be made on the Modification Request Form. No design work is to proceed on the basis of a proposed modification, until the modification request has been approved in writing.
A schedule of requested design changes and a signed copy of all approved requests is to be provided to the University as part of the project handover requirements.

16.9 OPERATIONAL MAINTENANCE, AS-BUILTS, WARRANTIES & MANUALS

The Design consultant must ensure that the project documentation includes a requirement for all refrigeration and monitoring items to be provided with a full routine and regulatory maintenance period of at least 12 months from the date of practical completion / commissioning. Any registrations of equipment are to be placed in the University’s name prior to practical completion / commissioning.

The University of Melbourne CAD Standards detail the formatting and submission requirements for as-built drawings, manuals, and warranties. The CAD Standards can be found in the Associated Documents section of the Design Standards web page