



Cold Storage Management Standard Operation Procedure

1.0 Purpose

The purpose of this SOP is to describe how research grade cold storage facilities should be managed to ensure safe and efficient storage of samples.

2.0 Scope

The scope of this SOP includes freezers operating at -150C, -80C, -70C, and -20C. It targets all such freezers storing materials designated for research purposes, particularly medical and life sciences research.

3.0 Introduction

Cold storage is a constantly growing need in research, particularly in life sciences and medicine. Materials crucial for drug testing, clinical trials and various studies are stored with the expectation of their security. The value of the materials contained in one ultra-low temperature (ULT) freezer can easily exceed £100,000. Most research intensive institutions will possess hundreds of such freezers, yet few such institutions will enforce an accompanying management policy to ensure samples are stored in a standardised fashion. This SOP aims to ensure that all samples will have adequate and efficient facilities for their secure storage.

4.0 Sample Management

4.1 Samples should be stored in a racked system or as organised as possible to aid in event of defrost or emergency removal.

4.2 All samples should be labelled in a manner that reflects estimated storage period (freeze resistant labels, freezer suitable storage containers).

4.3 All samples should possess labelling that permits any user to identify the owner(s), associated laboratory, contents, date of storage, expiry date or when the sample should be disposed of, and quantity where applicable in case of defrosting or emergency removal.

5.0 Risk Assessment

5.1 All freezers operating in central stores will have at minimum a secondary temperature probe with temperatures externally visible. Temperature should be centrally monitored.

5.2 All freezers running at -40C or colder should be assessed for alarm necessity. Should an alarm system be decided against, an explanation must be recorded and logged. Alarms should be centrally monitored with clear protocols for call-out in case of emergency.

5.3 All freezers operating in central stores have temperatures checked and logged once per day.

5.4 All concerns surrounding freezer running temperatures should be directed to a designated member of the laboratory or facilities staff who has access to logged freezer temperatures.

5.5 In case of emergency, do not open freezer door unless absolutely necessary.

5.6 Each freezer should have the following easily viewable: appliance number (barcode), alarm/external temperature monitor, a current list of owners of both the freezer contents, any special instructions for handling of contents in the absence of the owners, current first, second, and third points of contact in case

of emergency. A process map for freezer failure has been amended to this SOP, and should be applied to all freezers where necessary (unless an alternative is utilised).

5.7 Emergency protocols are determined for not only single freezers, but building, campus, or institutional emergencies.

5.8 All cold storage units in research spaces should be considered for secondary temperature monitors or alarms, though this is to the decision of the owner. Out-of-hours responses, centralisation of data, and response hierarchy should all be considered.

6.0 Freezer Procurement, Maintenance, and Disposal

6.1 Whole-life costing has been incorporated into the purchase of each ULT freezer, as well as racking requirements.

6.2 There are no domestic units in research spaces.

6.3 Mixed fridge-freezers units are not purchased unless necessary, as they reduce running efficiency by 25%. Instead separate units should be purchased, and fridges should never be stacked on top of freezers.

6.4 Purchasers should consider long-term storage requirements and purchase larger ULT freezer and -20C freezer models, unless absolutely certain their requirements will not increase.

6.5 All ULT freezers will have their filters cleaned no less than every 3-6 months by a designated member of staff.

6.6 Staff should ensure running temperatures of all fridges and freezers are standardised: ULT freezers should run between -60C and -80C (depending on requirements, normal freezers should run at -20C (not -25C or colder), and fridges should be set for 4C. Some freezers are designed to run at -40C in which case staff should consider switching to -20C when possible.

6.7 All freezers are on an 18-month tracked defrost cycle encouraged and supported by alternative storage space being available for short periods. Should an alternative storage space be unavailable, freezers should be defrosted manually by scraping of the interior (particularly in areas which can compromise seals).

There should be no boxes or materials blocking airflow at the back of the fridges/freezers.

6.8 All ULT and -150C freezers are serviced yearly as organised by a designated member of laboratory staff. Maintenance contracts should be paid via inclusion in grant applications for research concerning stored materials. Research staff have clear lines of contact for KCL facilities in case of emergencies. For relevant contacts in your area, contact facilities or the sustainability department.

7.0 Freezer Facilities

7.1 ULT freezers are not maintained in the laboratory where possible.

7.2 Freezers filters, fans, vents, or heat exchange coils are kept clear to maintain ventilation.

7.3 All facilities containing more than 5 ULT freezers of any sort should have backup power available in case of an emergency. ULT/-150C freezers containing critical samples should consider use of liquid nitrogen or carbon dioxide gas to maintain temperature within these units.

7.4 Freezer rooms storing materials at -60C or colder should maintain an ambient temperature of 15C to 22C, with an optimal temperature being 15C.

7.5 Mechanical cooling and air conditioning should only be provided where a clear business case exists.

7.6 Heat load is directly considered when moving or introducing a new freezer. ULT freezers produce significant amounts of heat which can have negative effects on the efficiency of other equipment, including freezers.

7.7 Working units which are designated for replacement should be offered for sharing internally prior to sending for disposal, unless there are mechanic issues which have rendered the unit a risk to maintain.

Record of Amendments

| Version | Section | Amendment | Current Version |
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Appendix 1 – Freezer Failure Process Map Exemplar (Bernard Freeman, SGDP)

Emergency Action Protocol in the advent of a freezer malfunction

Freezer Store

FIRST CONTACT

There are two means by which you will hear about a freezer emergency – either from the IOP security staff or from the SGDP remote alarm system. If you hear from the security staff, this will always be direct to your mobile phone, whereas the alarm system will simultaneously phone, email and text you. If you get a call from security (telephone number 0207 848 0003), first ask for the following information:

- 1) The location of the freezer and name of the freezer. If the freezer is not in your area, advise the security staff to contact somebody designated for that area.
- 2) Current temperature of freezer. If necessary ask them to go and check the temperature and call you back.

If the call you receive is from the alarm system, the current temperature and freezer ID will be given to you in the message. The email and text message you receive will also contain the freezer name.

Please note: if you speak to security personnel, please make sure they know NOT to open a freezer. This is the easiest way for a freezer to lose temperature and will cut down immensely on the time you have available for you to rescue the contents

ASSESSING THE URGENCY OF A BREAKDOWN

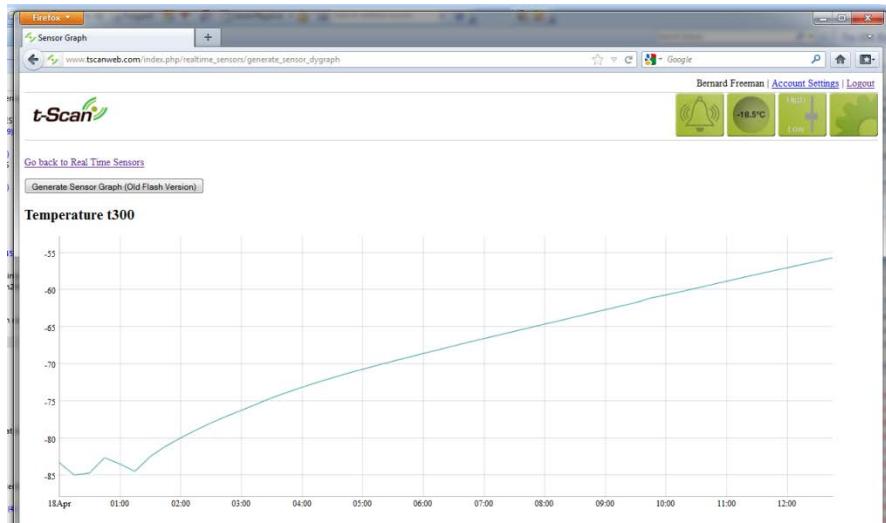
False alarms are quite common, so be aware of this when deciding on your next actions. The time of day can often help in deciding whether the alarm is a false one – freezer doors are usual

left open for example during the day, and not at 3am in the morning, so this later time is more likely to be a real emergency. If you get a call from security, they might be able to tell you if the temperature is rising or falling, but if you can log onto the T-Scan system (www.tscanweb.com) the information you get from this will be far more useful – the system can give you a graph of the exact temperature records, up-to-date to within 20 minutes, so you might be able to see whether the freezer is recovering from a prolonged opening of the door or is actually malfunctioning.

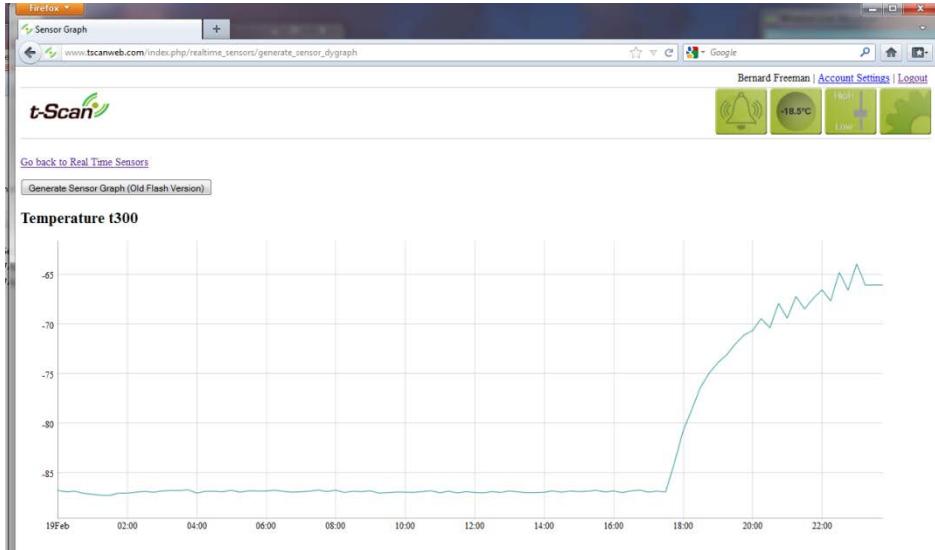
The alarm temperature is currently set to -55°C which a freezer can easily fall to if a door is left open for too long while samples are being organised within. There are many signs that can suggest whether a freezer is actually malfunctioning or not, but the new alarm system gives us some data not available to us previously which can help us decide exactly what is going on. Accessing the temperature profile for the previous few hours can show clearly whether the temperature has risen sharply, which would happen if the door has been left open, or is more gently, which would occur in the event of a freezer malfunction. Large freezers hold their temperatures very well when turned off, so a malfunctioning freezer should have a very shallow temperature profile.

Other helpful hints as to whether a malfunction has occurred are knowing the history of the freezer use, the people using it and the comings and goings of samples on a daily basis.

The picture below shows the temperature profile for a freezer that has malfunctioned. The temperature started to rise just after 1am in the morning - note the gradual rise over 12 hours to -55 °C – this is the set point at which the remote alarm system will start calling users.



Compare this graph to the one below, in which the door was accidentally left open (it was not wide open, but just a crack). You will notice that the freezer has lost 20 °C within less than four hours. If the freezer had been left wide open, the rise in temperature would have been extremely steep.



In the event of an emergency call (whether from security or the automated alarm system) always consider phoning other members of staff on the same emergency lists as yourself. They should also have got the same emergency calls that you have received and will also probably be wondering what to do about it and whether to phone you. If in any doubt, phone other people and come into work to assess the situation. These situations are always much easier to deal with when there is more than one person involved.

ATTENDING AN EMERGENCY

Once you have made the decision that something needs to be done to save the contents of the freezer, first consider the time the malfunction has taken place and the current temperature of the freezer. If you receive the call at for example 4am on a Tuesday morning and the temperature is around -50, it's probably not worth coming in before your normal time at work. If however, the call is at 3pm on a Saturday or midnight during the week, you should definitely think about coming in as soon as possible. Also, if the temperature appears to be rising extremely fast (such as would happen if a door is left open), this should warrant a trip to work to sort out the problem. Remember, a freezer will keep its temperature for several hours, but the exact time it takes to warm up depends on many factors including the age of the freezer and how full it is.

Once you are at work, the first thing you should do is inform the security staff at the main reception. They are extremely helpful and will be very useful if you need advice, moral support, another pair of hands and depending on the circumstance they might also have to call emergency callout electricians etc. This might happen if for example a series of power sockets along one wall have tripped out.

Once you are at the freezer, please consider the situation carefully before opening it. Once the freezer has been opened there is no going back as you will flood the internal chamber with warm air which it won't be able to recover from if it is truly malfunctioning. Again, look at the T-Scan logs (all computers in the IOP and freezer store can access this website, as well as most mobile phones, iPADS etc) to see if this gives any indications as to what exactly is happening to the freezer. You might find for example that by the time you've got to work, that the temperature has started to correct itself and no action needs to be taken. If the door is tightly shut and the temperature shows no sign of correction, you will have to make the decision to relocate the contents to another freezer. If this happens it is much easier to carry out an operation such as this with at least one other person available, so try and get someone else in your emergency group list to join you.

Get everything you need for the transfer available before you open the freezer door (trolley, cryoprotective gloves etc). Make sure the empty back up freezer is on, at temperature and not full of samples that shouldn't be there. Samples that shouldn't be in the emergency backup freezer can be taken out if necessary. If for some reason there is not enough space in the empty freezer (for example if two freezers go down), you will have to try to squeeze samples into any space in any of the other freezers in the freezer store. There are also other empty backup freezers dotted around the IOP – in the SGDP, brain bank, and Neuroscience. With help from the security team, you might be able to use these in an emergency. Once everything is in place, open the malfunctioning freezer and move everything as quickly as you can into the backup freezer. Once you have finished, please close the malfunctioning freezer and leave it turned on, so we can assess it fully in the morning.

If you have used anything other than the empty backup freezer to transfer samples into, please make a note of which freezers you have used and the positioning of the samples so that these can be found easily and put back into their original position once the freezer has been fixed.

SUMMARY FLOWCHART OF PROCEDURES TO CONSIDER IN CASE OF A FREEZER EMERGENCY.

