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Decommissioning Safety Assessment of the ANSTO Camperdown Facility

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0	6 July 2010	-
1	24 August 2010	Report revised to reflect SAC Assessors' comments.

Authorship

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EXECUTIVE SUMMARY

A hazard identification and risk assessment study was conducted for the first stage of the ANSTO Camperdown facility decommissioning operations which involves the dismantling of the 30 MeV cyclotron, PET beam room, control room and the GMP area hot cells. Following this study, recommendations were made for improvement of safety. The hazard identification was performed by a multidisciplinary team using guidewords based on IAEA guidance. The risk assessment of the hazards was made using the ANSTO risk assessment processes.

Most activities were assessed as having a low risk although there were some classes of tasks which gave a risk rating of medium. The radiological risk associated with the decommissioning tasks is assessed as low. A number of activities involved lifts with the potential for dropped loads and serious injuries. The large lifts external to the building will be planned and executed by a specialist contractor and this is appropriate because they have the necessary detailed knowledge and experience. For all lifts managed by ANSTO there is a recommendation that they are examined in SWMS to ensure this good practice is followed. There are also medium level risks from working at heights. These also require SWMS and there is a recommendation to ensure proper working platforms are used. The electrical activities also present as a medium risk. In addition to the usual controls, all existing power to the decommissioning areas will be isolated and safe temporary power supplies will be used. This is good construction site practice which minimises electrical risk.

A final recommendation is made to ensure that the emergency response is planned to the extent possible.

The risk assessment undertaken was semi-quantitative methods using engineering judgement. There were no high risk scenarios or scenarios with potential consequences at or above 1 mSv to a member of the public to warrant this.

The risks considered in this report were assessed taking into account satisfactory implementation of the recommendations. Therefore, since this report is intended to support ANSTO internal safety approval for the work and the application to ARPANSA for a Decommissioning licence for the facility it is expected that the client will prepare a document outlining the disposition of the recommendations in consultation with the author of this report.

The team concluded that the risks associated with the proposed Camperdown Decommissioning as assessed within the scope of this report are tolerable, providing the recommendations are adequately addressed.

CONTENTS

1. INTRODUCTION

This report documents the safety assessment of the ANSTO Camperdown facility decommissioning operations which involves dismantling of the 30 MeV cyclotron and the GMP area hot cells. The safety assessment was performed in compliance with ANSTO OHSE Standards and Guides using a generic hazard identification process followed by risk assessment. The assessment includes radiological and industrial hazard assessment of various hazardous scenarios.

The report forms a part of the Licence Application to be submitted to ARPANSA for the decommissioning of the ANSTO Camperdown facility.

2. BACKGROUND

The ANSTO Camperdown Facility, formerly called the National Medical Cyclotron (NMC) is located within the boundaries of the Royal Prince Alfred Hospital precinct. Construction of the facility started in 1990 and was completed in 1992. The facility has a 30 MeV cyclotron (IBA30) and process related GMP and SPECT hot cells. The first proton beam was produced in mid-1991 and limited radionuclide production began some months later. In 1996 an addition of the south beam rooms was made and commissioned in 1997.

The 30 MeV Cyclotron and some of the hot cells will be decommissioned to facilitate the installation of a new 18 MeV cyclotron and associated hot cells suitable for research. The new facility will be the subject of separate licence applications.

The existing 30 MeV Cyclotron is licensed as a Prescribed Radiation Facility (PRF) and the Radiopharmaceuticals processing area is licensed as a Nuclear Installation under the ARPANS Act (1998) and Regulations (1999). Prior to decommissioning the facility, a new licence needs to be obtained from the Regulator ARPANSA in compliance with the Act and Regulation.

3. SCOPE

The safety assessment includes the following decommissioning activities:

- Cyclotron dismantling
- Cyclotron beam-line dismantling
- Control room equipment and Ion Source Power Supply equipment
- GMP area hot cells dismantling
- Target transfer system dismantling
- Lifting and transport of the cyclotron to LHSTC and the movement of other items.

The study does not include safety assessment of any dismantling tasks in the north SPECT Beam Room, south SPECT Beam Room and the radiochemical production cells including the Iodine Plant since there will be no dismantling tasks involved in these areas at this stage. A risk assessment of these dismantling tasks will be performed when the detailed information of these tasks become available and will be the subject of additional documentation.

Details for the storage of the dismantled items and waste including the safety controls and final disposition are discussed in the Waste Management Plan AC-D-LA-E6d [2] A separate document will assess the risks of the transport and disposition of those items from Camperdown to Waste Operations facilities at Lucas Heights.

4. FACILITY DESCRIPTION – CYCLOTRON AND HOT CELLS

The NMC is near to the Royal Prince Alfred Hospital (RPAH). The facility is a stand-alone building, bounded on the north side by Lucas Street Car-park, extending on its southern side to Grose St. Its eastern boundary is 75m west of Missenden Rd, in line with the pedestrian crossing in front of the hospital security gates on Missenden Rd. The total site occupies an area of less than 2000 m^2. The facility houses a 30 MeV cyclotron, three beam rooms, hot cells for SPECT product processing and hot cells in a GMP Area clean room. In

addition there are laboratories for product testing and workshops for maintenance of the cyclotron. Further details of the facility are provided in the Decommissioning Plan AC-D-LA-E7a [5]

5. RADIOACTIVE ITEMS AND WASTE

The types and level of radioactive items for possible reuse and wastes generated from the decommissioning operations are given in the Waste Management Plan. All of these materials will be managed under the same arrangements.

The estimated volumes of these materials are as follows:

- Cyclotron and beam component volume totals 35.6 cubic metres. Assuming a 2m stack height, 17.8 square metres of storage space is required for these components.
- The hot cells from the GMP area and the control cabinets volume totals 52.8 cubic metres and will occupy a 26.4 square metre floor space.

The majority of the disassembled components from the cyclotron vault, such as beam lines, vacuum valves, stripper rods, switching magnets, RF Amp assemblies, ion sources assembly, pneumatic transfer ducts, waster manifolds, vacuum pumps and cryo pumps, etc will be stored in the basement of the Camperdown facility as low level solid waste. Additional radioactive items will be stored in the shielded SPECT Beam Rooms. This is described in the Waste Management Plan.

A separate document will assess the risks of the transport and disposition of those items from Camperdown to Lucas Heights Waste Operations Facilities.

The cyclotron yoke will be placed in a lifting frame and lifted through the roof opening of the vault and transported to LHSTC for storage. The lifting and transportation job will be carried out by a specialist contractor.

Further details including the active and non-active waste quantities and its storage plans are provided in the Waste Management Plan AC-D-LA-E6d [2].

6. DISMANTLING TASKS

6.1 Cyclotron Vault Area (Room 0053)

In the cyclotron vault area, the following dismantling tasks will be carried out:

Tasks
Remove vacuum valves
Remove stripper rod sleeves
Remove switching magnet assembly
Remove RF Amp assembly
Disconnect all services to cyclotron and beam lines
Remove beam lines
Disconnect and remove stripper rod assemblies
Disconnect and remove ion source assembly.
Remove pneumatic transfer ducts
Remove manifolds for cooling water, deionised water, vacuum
Remove cryo pumps and helium pumps from under cyclotron
Remove ladders and railings.
Remove quadruple magnets
Remove roof plug
Lift the cyclotron magnetic structure through roof

All of the listed components in the table above except the cyclotron magnetic structure will be unbolted, removed and lowered using the vault crane or by hand onto a trolley and then taken from the vault. Following this the cyclotron magnetic structure will be removed from the vault through the roof opening using a crane placed outside the building.

6.2 Control Room (Room 0043)

The following dismantling tasks will be carried out in the control room

Tasks
Disconnect electrical cables, remove cables from the trench
Remove cabinets (about 15) and furniture.

6.3 Hot Cells in GMP Area (Room 0037 and 0038)

Removal of GMP Area hot cells includes the following items:

Items
A bank of 4 Von Gahlen cells (2 of these to be delivered to an external Australian organisation);
2 FDG shielded enclosures
A single large Von Gahlen cell

The hot cells will be disassembled (by unbolting individual components) and removed from the building on a movable trolley. A preliminary Safe Work Method Statement (SWMS) has been prepared and the final SWMS will be prepared with the involvement of the work team just before the job. The tasks to dismantle the hot cells are summarised below:

Tasks
Isolate hot cells electrically, disconnect services, remove Gyprock
Remove hot cells extract ductwork shielding
Remove hot cells top lead shielding plate, remove side lead panels
Remove hot cells liners
Remove all items from the GMP Area

6.4 Ion Source Power Supply Room (Room 0040)

The dismantling activities in this room include the following tasks:

Tasks
Isolate Ion Source Power Supply (ISPS) electrically
Remove ISPS rack components
Dismantle and remove cabinets
Remove cables from trenches

6.5 Beam Rooms

PET Beam Room (Room 0059)

The dismantling tasks in the PET Beam Room include the following:

Tasks
Remove PET target station, shielding and beam line
Remove water lines, remove water manifold
Remove existing water pumping system/station
Remove pneumatic lines

North SPECT Beam Room (Room 0051) and South SPECT Beam Room (Room 0061)

The equipment in these beam rooms will not be dismantled at this stage but will be removed at a later stage. Access to these rooms will be restricted.

6.6 Basement (Rooms L1001 & L1002)

After dismantling, the radioactive items and waste from the cyclotron vault and the PET Beam room will be placed on a moveable trolley and will be taken via the corridor to the goods lift near the basement. The trolley will be unloaded from the lift at the Basement. All items will be removed from the trolley and stored in the rack provided in the Basement

Some items that are more highly active will be stored temporarily in a shielded area in the basement as described in the Waste Management Plan.

6.7 Radiochemical Production Area (Room 0048 & 0049)

The radiochemical production cells, including the Iodine Plant will not be dismantled at this stage but will be removed at a later stage. The cells will be kept in safe and secure condition with proper care and maintenance activities done on it at regular intervals.

7. RISK ASSESSMENT METHODOLOGY

7.1 Hazard Identification

The method adopted in this study has been to conduct a hazard identification workshop using a set of guidewords suitable for the dismantling tasks (see Appendix A). The guidewords were selected by the hazard identification team from a set which was given in the IAEA Safety Guide WS-G-5.2 [1]. The guidewords were used to prompt the discussion and to identify the potential hazardous scenarios, which were then considered for the risk assessment. Not all disciplines were required for all sessions. The hazard identification workshop sessions took place on 2, 9, 16 and 30 June and 6 July 2010 with the participants as shown in the following table. The findings of the hazard identification are shown in the Hazard Identification & Risk Assessment table in Appendix C.

Table 1: Hazard ID workshop participants

Team Member	Role/Expertise	2 June 2010	9 June 2010	16 June 2010	30 June 2010	6 July 2010
Basil Ellis	Senior Safety & Reliability Adviser	✓	✓	✓	✓	✓
Alamgir Kabir	Safety & Reliability Adviser	✓	✓	✓		✓
Alison Parkes	Senior Radiation Protection Adviser	✓	✓			
Prashant Maharaj	Radiation Protection Adviser				✓	✓
Alec Kimber	ANSTO Camperdown Project Manager				✓	
Algis Lencus	Decommissioning Manager	✓	✓	✓	✓	✓

Team Member	Role/Expertise	2 June 2010	9 June 2010	16 June 2010	30 June 2010	6 July 2010
Gary Simms	Decommissioning Works Coordinator	✓		✓		
Rod Manning	Senior Cyclotron Engineer	✓		✓		
John McLeod	OH&S Adviser	✓		✓		
Luke McNamara	OH&S Adviser		✓			

7.2 Risk Assessment Method

After the hazard identification workshops, a risk assessment was carried out to assess the risk of various hazardous scenarios identified during the workshop. It also considered other scenarios that were identified as having potential safety implications from discussion with the facility officer and other project personnel. The risk assessment was performed according to ANSTO OHSE Guide AG 2400 – *Guidance on the Conduct of Risk Study*. The risk assessment, including the recommendations, was reviewed by the team after completion of the workshops.

Six categories of likelihood and five categories of consequence are used to enable the hazardous scenarios to be located on the risk evaluation tables. The likelihood and consequence of the hazardous scenarios were also assessed as per the Frequency Evaluation Table and the Risk Matrix given in Appendices G and H of ANSTO OHSE Guide AG 2400. These are reproduced in Appendix B of this report. Details of the criteria and risk treatment are given in section 9.2 of ANSTO OHSE Guide AG 2400. The process for assessing the risk is given in the guidance document and is summarised below.

- Risk is determined by the combination of likelihood and severity of consequence.
- Risks assessed as Very High are not acceptable.
- Risks assessed as High are generally not acceptable unless there is an overwhelming societal benefit and the risks are low as reasonably practicable (ALARP).
- Risks assessed as Medium level are not normally acceptable but may be argued as tolerable if significant national or societal benefit accrues and risk are ALARP and good safety practice is followed. Further control measures should be considered.
- Risks assessed as Low level are generally tolerable if it can be shown that radiation exposure is ALARA and the risks are ALARP.
- Risks assessed as very low are tolerable generally without any further control measures.

The above criteria have been applied to the risks identified and discussed in section below.

8. RESULTS OF THE RISK ASSESSMENT

The risk assessment of different hazardous scenarios is tabulated in the 'Hazard Identification & Risk Assessment' table in Appendix C. The more significant scenarios are discussed in the subsections below. To simplify the discussion, the full list of controls, the consequences and the likelihood for each scenario are not given here but can be found in the Appendix C.

The risk rating of most tasks is low, although there are some classes of tasks that have a medium risk rating. Following the ANSTO risk assessment process, the tasks showing a

medium risk will be examined to ensure that the appropriate controls are in place and where necessary to make recommendations for further controls.

Several lifting tasks in both the cyclotron vault and in the GMP hot cells dismantling (see section 8.2) have a medium risk rating. These lifting activities also involve the potential for falling heavy objects. Although the events are unlikely, there is the potential for a serious injury or even fatality which gives a high consequence score. The other main group of lifting tasks involve the use of the external cranes to remove the vault plugs and cyclotron and to load / unload the transporter.

A second class of tasks that show a medium risk arise from the need to work at heights to dismantle the cyclotron and components (see section 8.3). These have the potential to cause serious injury which gives a high consequence score.

The third class of tasks that show a medium risk involves electrical work because there is there is the risk of electrocution (see section 8.4)

8.1 Radiation risks

There are no tasks that have been assessed to present a risk rating higher than **low**. This reflects that there is no remaining active product material and the only activity is from activation of some of the cyclotron components. The worker dose from the tasks has been closely considered in the Radiation Protection Plan AC-D-LA-E6c [3] which gives the collective dose for all of these dismantling tasks and this includes the movement and storage of the radioactive items/waste in the basement. The risk of radiological exposure to the workers involved with the decommissioning job is assessed as low.

8.2 Lift accidents / dropped loads

8.2.1 Vault tasks

The dismantling tasks in the vault involve the unbolting / removal of heavy items and lowering the items to floor level. These have the potential for a serious injury which is a moderate consequence score and although the risk is unlikely, the risk rating is medium. For many of these tasks it will be possible to use the existing vault crane. In general all of these tasks will require careful planning to make best use of lifting equipment and to minimise risk. It is usual practice in ANSTO to plan these activities carefully using Safe Work Method Statements (SWMS) with the involvement of riggers and OHS specialists. The recommendation below is made to ensure this happens for this case.

Recommendation R1*:* Prepare SWMS with input from riggers covering all tasks where there is a medium risk including those from a lifting accident, dropped load or working at heights.

With this careful planning, the risks from these tasks are tolerable.

8.2.2 Hot cells dismantling

Many activities in dismantling the GMP Area hot cells involve the removal of heavy items from 1 – 2 metres to floor level. These have the potential for a serious crush injury which has a moderate consequence score and although the risk is unlikely, the risk rating is medium. As for the vault lifting tasks, these require careful planning and Recommendation 1 addresses this.

With this careful planning, the risks from these tasks are tolerable.

8.2.3 Large external crane lifts and tasks at Camperdown

Removing the cyclotron magnetic structure through the vault roof opening and securing it on the large transporter is a significant activity and there are several large lifts involved. The lift of the cyclotron itself requires a 400 tonne crane. This will be brought to the site in parts and assembled using a 90 tonne crane. The main 400 tonne crane lifts will be to remove the vault plugs and the cyclotron magnetic structure after which it will be dismantled. When the transporter delivers the cyclotron magnetic structure to Lucas Heights, it will be unloaded from the tray height using a crane and hydraulic jacks.

Because very heavy items are being lifted, a load fall or crane accident could result in a fatality which has a severe consequence score and although such a fatality is extremely unlikely, the risk rating is medium.

A specialist lifting contractor is being used to plan and execute these large lifts. There will be detailed planning which will be the equivalent of the ANSTO SWMS process. This detailed planning will include a Safety Management Plan, a computer lift simulation and the traffic management plan. With these measures in place, the risks are tolerable.

8.2.4 Risk to the public from external tasks at Camperdown

The large lifts and associated tasks outside the Camperdown have the potential to cause injury to members of the public. The tasks will be well-planned and controlled. There will be barriers set up to keep the public out of the dangerous areas and the main large lifts will be closely managed. With the specialist planning and these controls, the likelihood of a fatality to a member of the public is incredible and the risk rating is low.

A separate HAZOP and risk study [6] have been carried out for the lifting and movement of the heavy loads (i.e., cyclotron yoke, roof plugs and the crane used in the lifting process) at the ANSTO Camperdown site.

8.3 Working at heights

8.3.1 Cyclotron vault

There are some dismantling activities that require a worker to unbolt / remove items while at heights over 1 – 2 metres. If the worker falls there is the potential for a serious injury which has a consequence score of major and although it is unlikely, the risk rating is medium. Generally given the locations and low falls, the use of safety harnesses will not be feasible. The advice from OHS specialists is that the best preventative measure is to use sound work platforms and the use of ladders should be avoided wherever possible. The recommendation below addresses this.

Recommendation R2*:* Disallow working from ladders for the project except for cases approved by the OHS Adviser.

Because these tasks have a medium risk, *Recommendation R1* requires that they are covered by a SWMS. With these measures in place, the risks of working at heights are tolerable.

8.3.2 Other tasks

When the vault roof plug is removed, there is potentially the risk of falling through the hole into the vault and this also presents a medium risk rating because of the severe consequences. This area will be well controlled as part of the measures for the large lifts. Also the lift specialist plans the use of an elevated work platform for controlling the large lifts. With these measures, the risk is tolerable.

8.4 Electrical risks

Any work involving electrical equipment and wiring has the potential for shock and even electrocution. Because these tasks have the potential for a fatality which has a severe consequence score, the risk rating is medium even though the likelihood of a fatality is extremely unlikely. This outcome reflects the hazardous nature of electricity and the conservative risk assessment process used in ANSTO.

The power to the equipment such as the cyclotron will be isolated early in the dismantling tasks. There will be no very high voltages associated with the operation of the cyclotron.

There are a suite of industry practices which make electrical work safe. The hazardous work is done by qualified electricians following the Australian Standards for Wiring Rules (AS 3000). The ANSTO tagging and isolation procedures will be followed. To make the work areas (such as the vault) safer, the construction area practice of isolating all power and lighting to the area and then installing temporary lighting / power will be followed.

With these measures in place, the electrical risks are tolerable.

8.5 Transport risks

A specialist contractor has been engaged to plan and execute the large external crane lifts and the transport of the cyclotron magnetic structure to ANSTO Lucas Heights. There will be some fixed activity in some items in the structure and this will result in low dose rates estimated to be less than 20 micro-Sv/h. While it is expected to be free of loose contamination, the transport requirements prescribe that it will be packaged in sheeting which will prevent possible loss if there is any.

The movement of large loads through the city areas is common and there are standard measures in place to minimise the risks. There will be a single trip from the Camperdown site to Lucas Heights and this distance is approximately 30 km. The route is planned and the journey will be made in the middle of the night. The Lift and Transport Plan prepared by Toll Project Services gives a recommended route subject to approval by the RTA. There will be an escort. There are standard emergency procedures.

The driver(s) will be DG qualified. The prime mover of the vehicle will be less than five years old and therefore the likelihood of engine breakdown is low. ANSTO Health Physics Surveyor (HPS) will survey the load before departure and will travel with the escort crew. The driver(s) will have dosimeters. Given the low hazard and the control measures, the radiation risk to the contractors is rated as low.

The risk of a traffic accident causing injury to the driver or escort crew is assessed as low given the planning and measures as noted above. With the planning and control measures in place, the transport risks to the contractors and ANSTO staff are tolerable.

8.5.1 Risk to the public during transport to LHSTC

There are two scenarios whereby the transport of the cyclotron magnetic structure could potentially present a risk to a member of the public. If there was an accident or breakdown of the transporter which was not well managed, a member of the public might approach an area of the load where there was a dose rate above background. Given all the measures to reduce the likelihood of an incident, this event is very unlikely. If it were to occur, the Health Physics Surveyor (who would be travelling with the convoy but not in the same vehicle as the low loader) would promptly work with the driver to set up barriers and this should prevent approach by the public. The dose received would be minimal with an insignificant consequence and the risk rating for dose to a member of the public is very low.

The risk to other drivers or pedestrians from a vehicle accident involving the transporter or escort vehicles is also assessed as low for the same reasons. With the measures described, the risk to a member of the public is tolerable.

8.6 Other risks

The other risks are covered in the appended hazard identification / risk assessment table. As noted earlier, these have risk ratings of low and these are tolerable given the listed measures are in place.

The dismantling activities do not include any industrial tasks such as hot work (grinding, welding), jack picking etc.

8.6.1 Accidents

The hazard identification / risk assessment process has identified a number of scenarios where there is the potential for an accident or incident. The measures used to reduce the likelihood or mitigate the risk are listed. The particular emergency response measures which will operate, should the specific risk be realised, are not listed for each case. The measures are discussed in a general way in the Decommissioning Emergency Plan AC-D-LA-E6f [4] with the application.

The site specific emergency procedures which operated during the radiopharmaceuticals production period will only apply in a general way during the main decommissioning work.

A new procedure specific for the decommissioning and considering the known possible accident scenarios should be prepared in conjunction with the other detailed work planning with input from both project and safety staff. The following recommendation addresses this.

Recommendation R3*:* Develop an emergency procedure to operate during the main decommissioning which covers the known possible accident scenarios and carry out exercise drills before the main work.

8.6.2 Risk of movement of items and waste to the basement

Moveable trolleys will be used to transfer the activated items and waste to the basement. The trolleys have a raised railing/lip along the perimeter which will prevent any items being dropped off the trolley accidentally. The items are not excessively heavy and the operators are experienced and trained in this kind of tasks. They will wear safety boots which will mitigate any consequence of any accidental impact to their foot during the transfer. Therefore the risk of any injury to workers is considered low.

9. CONCLUSIONS

A hazard identification and risk assessment study was conducted and recommendations made for improvement of safety. The hazard identification was performed by a multidisciplinary team using guidewords based on IAEA guidance. The risk assessment of the hazards was made using the ANSTO risk assessment processes.

Most tasks were assessed as having a low risk although there were some classes of tasks which gave a risk rating of medium. The radiological risk associated with the decommissioning tasks is assessed as low. A number of activities involved lifts with the potential for dropped loads and serious injuries. The large lifts external to the building will be planned and executed by a specialist contractor and this is appropriate. For all lifts managed by ANSTO there is a recommendation that they are examined in SWMS. There are also medium level risks from working at heights. These also require SWMS and there is a further recommendation to ensure proper working platforms are used. The electrical activities also present as a medium risk. The usual controls are satisfactory.

A final recommendation is made to ensure that the emergency response is planned to the extent possible.

The risk assessment undertaken was semi-quantitative methods using engineering judgement. There were no high risk scenarios or scenarios with potential consequences at or above 1 mSv to a member of the public to warrant this.

The risks considered in this report were assessed taking into account satisfactory implementation of the recommendations. Therefore, since this report is intended to support ANSTO internal safety approval and the ARPANSA regulatory approval of the proposed ANSTO Camperdown Decommissioning it is expected that the client will prepare a document outlining the disposition of the recommendations in consultation with the author of this report.

The team concluded that the risks associated with the proposed Camperdown Decommissioning as assessed within the scope of this report are tolerable, providing the recommendations are adequately addressed.

10. RECOMMENDATIONS

The following recommendations result from the risk assessment and are explained in the previous section.

1. Prepare SWMS with input from riggers covering all tasks where there is a medium risk including those from a lifting accident, dropped load or working at heights.
2. Disallow working from ladders for the project except for cases approved by the OHS Adviser.

3. Develop an emergency procedure to operate during the main decommissioning which covers the known possible accident scenarios and carry out exercise drills before the main work.

11. REFERENCES

1. International Atomic Energy Agency (IAEA), Safety Assessment for the Decommissioning of Facilities Using Radioactive Material, Safety Guide No. WS-G-5.2, Vienna 2008.
2. Radioactive Waste Management Plan for Decommissioning the ANSTO Camperdown Facility, AC-D-LA-E6d
3. Radiation Protection Plan Decommissioning of the ANSTO Camperdown Facility, AC-D-LA-E6c
4. Emergency Plan for Decommissioning the ANSTO Camperdown Facility, AC-D-LA-E6f.
5. ANSTO Camperdown Facility Decommissioning Plan, AC-D-LA-E7a.
6. ANSTO Memorandum on “Risk Assessment for Lifting of Cyclotron from Vault at ANSTO Camperdown”, Dated 12 August 2010, General Records File 10/431.

APPENDIX A - GUIDEWORDS

The following guideword were selected by the hazard identification team and used for the hazard identification process of the ANSTO Camperdown decommissioning project.

Guideword	*Usage*
Radiation (activated materials)	Considered for each activity
Contamination	"
Beryllium-7 contamination	"
Chemicals	"
Electrical	"
Fire	"
Dust	"
Pressure	
Lifts / dropped load	"
Flooding	"
Risk to public	"
Manual handling	"
Working at heights	"
Confined spaces	"
Slips / trips / falls	General hazards applicable to most activities. Controls listed in one place in the hazard table.
Cuts / abrasions	"
Noise	"
Fatigue	"

APPENDIX B - RISK ASSESSMENT EVALUATION TABLES

B.1 Frequency Evaluation Table

Description	How likely is the Potential Outcome?
Very likely	Happens quite frequently. Historical records of greater than one occurrence per year at ANSTO in a similar situation Well publicised occurrences in other similar facilities Mathematically, the expected (or mean) frequency f is such that $f \geq 1\ y^{-1}$; (ie. happens more often than once each two years)
Likely	Will probably occur. Central estimate is once every 3 years. Has occurred a couple of times at ANSTO Known hazard $1 > f \geq 0.1\ y^{-1}$ (ie. happens less often than once each year but more than once each ten years)
Unlikely	Might occur. Central estimate is once every 30 years. Has occurred at ANSTO Known hazard in similar facilities and industrial situations $0.1 > f \geq 10^{-2}\ y^{-1}$ ie. happens less often than once each ten years but more than once each hundred years)
Very unlikely	Occurrence is conceivable. Central estimate is once every thousand years. Hasn't happened at ANSTO Known to have happened in the industry $0.01 > f \geq 10^{-4}\ y^{-1}$ (ie. happens less often than once each hundred years but more than once each ten thousand years)
Extremely unlikely	Could occur at some time. Central estimate is once every 100 000 years. Known to have happened but has not happened in similar industries $10^{-4} > f \geq 10^{-6}\ y^{-1}$ (ie. happens less often than once each ten thousand years but more than once each million years)
Incredible	Not expected to occur May occur only in exceptional circumstances Unreported $f < 10^{-6}\ y^{-1}$ (ie. happens less often than once each million years)

B.2 RISK MATRIX (Risk Evaluation Table)

What is the most serious potential Outcome?							How Likely is the potential outcome to be that serious?					
Description	**Injury or Disease**	**Radiation Dose** rad worker & public per event or pa	**Environment Damage**	**Plant Damage**	**ANSTO's Reputation**		**Incredible**	**Extremely unlikely**	**Very unlikely**	**Unlikely**	**Likely**	**Very likely**
							< 10^{-6} pa	10^{-6} pa to 10^{-4} pa	10^{-4} pa to 0.01 pa	0.01 pa to 0.1 pa	0.1 pa to 1 pa	> 1 pa
							F	E	D	C	B	A
Severe	Death, permanent disability or permanent ill health	more than 100 mSv	Long term damage (>10y) with effects beyond the Buffer Zone	Severe plant damage	Government or public pressure to curtail operations	5	Low	Medium	High	High	Very High	Very High
Major	Long term illness or serious injury but recovery probable	20 – 100 mSv	Medium term damage (>1y) but confined to the buffer zone	Major plant damage	Regulator or court fine; Major media concern; Parliamentary inquiry	4	Low	Low	Medium	Medium	High	Very High
Moderate	Medical attention. Several lost time days	1 – 20 mSv	Short to medium term (<1y) effects confined to site but breaching statutory requirements	Moderate plant damage	Media & regulator attention; Lowered public image	3	Very Low	Low	Low	Low	Medium	High
Minor	First aid	0.1 – 1 mSv	Effects confined to work area but is anomalous and/or exceeds guidelines	Minor plant damage	Report to regulator required; Minor public concern	2	Very Low	Very Low	Very Low	Low	Low	Medium
Insign-ificant	Minimal effects No injuries	less than 0.1 mSv	Within routine operational conditions but may be an aspect with potential for improvement	No plant damage	Unlikely to enter public arena	1	Very Low	Very Low	Very Low	Very Low	Low	Low

APPENDIX C - HAZARD IDENTIFICATION & RISK ASSESSMENT

Date: 2, 9, 16, 30 June and 6 July 2010

Present: See report section 7.1.

Note: Several of the hazards e.g. slips / trips / falls were general to most activities. These are recorded at the end of this table.

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
	Room 0053 Cyclotron Vault	Remove vacuum valves	Radiation	Dose rate of 100 µSv/hr.	Could receive excessive dose (extremity)	EPD and Health Physics coverage.	Minor	Likely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Remove stripper rod sleeves	Radiation	3 mSv/h on contact	Excessive dose (extremity)	Shielding (lead waste bin) at laydown point.	Minor	Likely	Low	Risk tolerable
			Manual handling	Ergonomically difficult removal	Injury	Will use two for removal lift if needed Lead waste bin is purpose designed with wheels	Moderate	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Remove switching magnet assembly	Lift accident	1 m drop	Injury Damage to equipment	Lifting & crane controls Load cell on crane	Moderate	Unlikely	Low	Risk tolerable
			Manual handling	Ergonomically difficult	Injury	Use crane or hydraulic lifter to platform	Moderate	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Remove RF Amp Assembly	Radiation	About 200 µSv/h contact dose rate.	Minor dose to the workers	EPD and health physics coverage.	Minor	Likely	Low	Risk tolerable
			Electrical	Electrocution	Death or permanent disability or permanent ill health.	Qualified and experienced Electricians. Isolation prior to the work and use of isolation tags.	Severe	Extremely unlikely	Medium	Risk tolerable - see section 8.4
			Lift/drop accident	50 kg	Injury	Lifting & crane controls Load cell on crane	Moderate	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Disconnection of all services to cyclotron and beam lines	Radiation	Dose rate in area.	Could receive dose (extremity)	EPD and Health Physics coverage.	Minor	Likely	Low	Risk tolerable
			Electrical	Electrocution	Death or permanent disability	Qualified and experienced Electricians. Complete isolation prior to the work and use of isolation tags. Use temporary lighting. Discharge capacitors.	Severe	Extremely unlikely	Medium	Risk tolerable - see section 8.4
			Pressure	Possible residual pressure in air or oil line	Injury	Prepare isolations list / depressuring requirements.	Moderate	Unlikely	Low	Risk tolerable
			Working at heights	Fall from top of cyclotron	Serious injury	Prepare SWMS. Use work platform or similar.	Major	Unlikely	Medium	Risk tolerable - see section 8.3 and recommendations 1 & 2
			Confined Space	Difficulty recovering collapsed worker	Injury	Prepare Confined Space Risk Assessment	Moderate	Unlikely	Low	Risk tolerable

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
	Room 0053 Cyclotron Vault	Remove beam lines	Radiation	< 40 microSv/h on contact	Negligible hazard	EPD and Health Physics coverage.	Minor	Likely	Low	Risk tolerable
			Lift accident	250 kg load 1 m drop	Long term Injury to hand/leg, but recovery probable. Damage to equipment	Lifting & crane controls Load cell on crane	Major	Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
	Room 0053 Cyclotron Vault	Disconnect stripper rod assemblies	Lift accident	200 kg load 1 metre drop	Long term injury	Lifting & crane controls Load cell on crane	Major	Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
	Room 0053 Cyclotron Vault	Remove ion source assembly	Lift accident	2.7 m drop	Serious Injury Damage to equipment	Lifting & crane controls Load cell on crane	Major	Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
			Working at heights	2.7 m fall	Serious Injury	Guard rail at height	Major	Unlikely	Medium	Risk tolerable - see section 8.3 and recommendations 1 & 2
	Room 0053 Cyclotron Vault	Remove Pneumatic Transfer ducts	Radiation	Negligible	Very minor exposure (if any)	Not expecting any activation product inside the duct.	Minor	Likely	Low	Risk tolerable
			Contamination	possible contamination from duct internals	Negligible	Use of PPE and health physics coverage.	Insignificants	Likely	Low	Risk tolerable
			Working at heights	2.5 m fall	Serious Injury	Use of work platform or similar Training and experience.	Major	Unlikely	Medium	Risk tolerable - see section 8.3 and recommendations 1 & 2
	Room 0053 Cyclotron Vault	Remove manifolds for cooling water, deionised water, vacuum	Pressure	Pressure release causes impact or missile	Injury	All manifolds drained before removal	Minor	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Remove cryopumps & helium pumps from under cyclotron	Contamination	Possible contamination	Minimal dose to the workers	EPD and health physics coverage.	Insignificant	Likely	Low	Risk tolerable
			Dust	Possible dust inhalation	Injury	P2 dust masks or as advised by HPS and OHS Adviser	Minor	Unlikely	Low	Risk tolerable
			Confined Space	Difficulty recovering collapsed worker	Injury	Prepare Confined Space Risk Assessment - noted above	Moderate	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Remove ladders and railings. Lower and remove items.	Radiation	5 – 10 µSv/h background	Minimal dose to the workers	EPD and health physics coverage.	Insignificant	Likely	Low	Risk tolerable
			Working at heights	2 m fall	Serious Injury	Fall arrester anchored to the I-beam while standing on the cyclotron tank and working to unbolt items?	Major	Unlikely	Medium	Risk tolerable - see section 8.3 and recommendations 1 & 2
	Room 0053 Cyclotron Vault	Remove vacuum pump under cyclotron	Chemicals	Oil only Increased risk of slips	Injury	See slips / trips / falls				
			Slips / trips / falls	Slip or fall into trench	Injury	Good housekeeping Guard rail around trench	Moderate	Unlikely	Low	Risk tolerable

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
			Confined space	Trench has confined space issues e.g. difficult egress	Injury	Do Confined Space Risk Assessment and implement controls	Moderate	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Remove Quadruple Magnets from north wall	Radiation	Dose rate of 8 mSv/hr at contact	Could receive excessive dose (extremity)	EPD and Health Physics coverage. Extremity dosimeters.	Minor	Likely	Low	Risk tolerable
			Lift accident	200 kg item.	Injury Damage to equipment	A standard procedure Use existing beam line platform with purpose designed trolley to remove	Moderate	Unlikely	Low	Risk tolerable
	Room 0053 Cyclotron Vault	Jack up cyclotron & assemble lifting frame	Lift accident	Heavy items.	Serious injury Damage to equipment	Standard procedure Pre-planned with equipment Using specialist lifting contractor	Major	Very unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
			Manual handling	Strain or injury assembling frame	Injury	Use lifting equipment where possible	Moderate	Unlikely	Low	Risk tolerable
	Building outside west	400 T crane parts & counterweights arrival & setup	Lift accident	Heavy item falls	Death or permanent disability	Setup by specialist contractor Barriers	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Risk to public	Heavy item falls	Death or permanent disability to member of public	Neighbours warned beforehand Setup by specialist contractor Barriers	Severe	Incredible	Low	Risk tolerable
			Risk to public property	Damage to public building	Major property damage	Neighbours warned beforehand Setup by specialist contractor with Traffic Management Plan Barriers	Major	Very unlikely	Medium	Risk tolerable - see section 8.2
	Building outside west - Vault	Remove roof plugs	Lift accident	Plug lifting point failure Plug falls or hits structure	Death or permanent disability	Lift planned & executed by specialist lifting contractor Lift slow / controlled	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Lift accident	Crane topples	Death or permanent disability	Lift planned & executed by specialist lifting contractor	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Risk to public	Plug falls / hits member of public	Death or permanent disability to member of public	Setup by specialist contractor Barriers	Severe	Incredible	Low	Risk tolerable
			Risk to public property	Damage to public building	Major property damage	Neighbours warned beforehand Setup by specialist contractor with Traffic Management Plan Barriers	Major	Very unlikely	Medium	Risk tolerable - see section 8.2
			Working at heights	Fall into plug hole.	Death or permanent disability	Use of elevated working platform to control lifts	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.3 and

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
						Specialist riggers controlling lift.				recommendations 1 & 2
			Flooding	Rain ingress into vault	Spread of contamination into trench	Planning will be for dry day. Tarps over plug hole. Vault decontaminated beforehand.	Minor	Unlikely	Low	Risk tolerable
	Building outside west - Vault	Remove crane I-beam to free up the lifting path.	Lift accident	I-beam falls or hits structure	Serious injury	Lift planned & executed by specialist contractor Lift slow / controlled	Major	Very Unlikely	Medium	Risk tolerable - see section 8.2
			Working at heights	Fall while unbolting beam from vault ceiling	Serious Injury	Use of work platform or similar Training and experience.	Major	Unlikely	Medium	Risk tolerable - see section 8.3 and recommendations 1 & 2
	Building outside west - Vault	Remove cyclotron through roof	Lift accident	Cyclotron falls or hits structure	Death or permanent disability	Lift planned & executed by specialist contractor Lift slow / controlled	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Lift accident	Crane topples	Death or permanent disability	Lift planned & executed by specialist contractor	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Risk to public	Cyclotron falls / hits member of public	Death or permanent disability to member of public	Setup by specialist contractor Barriers	Severe	Incredible	Low	Risk tolerable
			Risk to public property	Damage to public building	Major property damage	Neighbours warned beforehand Setup by specialist contractor with Traffic Management Plan Barriers	Major	Very unlikely	Medium	Risk tolerable - see section 8.2
	Building outside west	Load chained down on transporter - ready for trip	Radiation	Dose to riggers	Dose	ANSTO HPS control Driver dosimetry	Insignificant	Likely	Low	Risk tolerable
			Manual handling	Strain	Injury	Lift planned & executed by specialist contractor	Moderate	Unlikely	Low	Risk tolerable
	Building outside west	400 T crane parts & counterweights disassembly & removal	Lift accident	Heavy item falls	Death or permanent disability	Managed by specialist lifting contractor	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Risk to public	Heavy item falls	Death or permanent disability to member of public	Neighbours warned beforehand Setup by specialist contractor Barriers	Severe	Incredible	Low	Risk tolerable
	Transport route Camperdown to LHSTC	Drive to LHSTC	Radiation	Dose to drivers	Dose	ANSTO HPS survey before departure ANSTO control Driver dosimetry	Insignificant	Likely	Low	Risk tolerable
			Vehicle accident	Drivers / crew injured	Injury	Planned route Night - low traffic	Moderate	Unlikely	Low	Risk tolerable

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
						Escort vehicles DG drivers Transporter < 5 years old				
			Risk to public	Vehicle breakdown followed by member of public approach	Dose to member of public	Controls above which minimise likelihood, plus Accident procedure including setup of barriers HPS in escort crew	Insignificant	Very Unlikely	very low	Risk tolerable
			Risk to public	Vehicle accident	Serious injury	Loading by specialist contractor, chained down. Reduces likelihood Planned route with large turning circles, night - low traffic, escort vehicles, DG drivers. All reduce likelihood	Major	Extremely unlikely	Low	Risk tolerable
	LHSTC Hut 36	Cyclotron unloaded	Radiation	Dose to crew	Dose	ANSTO HPS survey before departure ANSTO HPS control Dosimetry	Insignificant	Likely	Low	Risk tolerable
			Lift accident	Heavy item falls 1 m	Death or permanent disability	Managed by specialist lifting contractor Low - from transporter tray	Severe	Extremely Unlikely	Medium	Risk tolerable - see section 8.2
			Manual handling	Strain	Injury	Lift planned & executed by specialist contractor	Moderate	Unlikely	Low	Risk tolerable
	Room 0043 Control Room	Disconnect electrical cables, remove cables from trench	Electrical	Electrocution	Serious Injury	Qualified and experienced Electricians. Isolation prior to the work. Use of temporary lighting.	Severe	Extremely unlikely	Medium	Risk tolerable - see section 8.4
			Radiation	Exposure to radiation while pulling cables from the North Beam room	Estimated 60 microSv/hr	Use of EPD and HPS. Time/distance/shielding	Insignificant	Very Likely	Low	Risk tolerable
			Confined space	Risk considered earlier	Difficulty recovering collapsed worker	Confined space risk assessment.	Moderate	Unlikely	Low	Risk tolerable
	Room 0043 Control Room	Remove cabinets (about 15) and furniture.	Manual handling	Back strain, muscle strain	Injury	Experienced workers. Lifting aids where needed.	Moderate	Unlikely	Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Isolate hot cells electrically, disconnect services, remove Gyprock	Electrical	Worker could be electrocuted if there is any live cables	Serious Injury	Qualified and experienced Electricians. Follow As 3000. Isolation prior to the work.	Severe	Extremely unlikely	Medium	Risk tolerable - see section 8.4

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
			Dust	Gyprock and other dust inhalation	Injury (eye injury, respiratory problem)	Use of PPE, i.e., mask, gloves etc. Experienced workers.	Minor	Unlikely	Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Remove hot cells extract ductwork shielding & ductwork	Dropped load	Crush injury	Serious injury	Use lifting device, rigger	Major	Very Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
			Manual handling	Strain	Injury	Use lifting device, rigger	Moderate	Unlikely	Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Re move door assemblies	Dropped load	Crush injury	Serious injury	Use lifting device, rigger	Major	Very Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
			Manual handling	Strain	Injury	Use lifting device, rigger	Moderate	Unlikely	Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Remove roof assembly, side panels	Dropped load	Crush injury	Serious injury	Use lifting device, rigger	Major	Very Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
			Manual handling	Strain	Injury	Use lifting device, rigger	Moderate	Unlikely	Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Remove lead shielding	Dropped load	Crush injury	Serious injury	Use lifting device, rigger	Major	Very Unlikely	Medium	Risk tolerable - see section 8.2 and recommendation 1
			Manual handling	Strain	Injury	Use lifting device, rigger	Moderate	Unlikely	Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Remove hot cells liners	Contamination		Minor	Decontaminated and cleaned prior to removal. EPD and HPS coverage.	Insignificant	Very unlikely	Very Low	Risk tolerable
			Chemicals	Any residual chemicals inside the cells		All chemicals will be removed and disposed prior to removal. Active Trade waste lines will be blanked off.	Insignificant	Very unlikely	Very Low	Risk tolerable
	Room 0037 & 0038 Old GMP Area	Remove all items from GMP room	Dropped Load	Fall of heavy loads causes injury	Injury	Electric forklift	Moderate	Unlikely	Low	Risk tolerable
			Trip, slip	Slip, trip while moving load	Injury to leg/arm.	Flat surface from GMP room to the outside of building,	Moderate	Unlikely	Low	Risk tolerable
	Room 0040 OLD ISPS Room	Isolate Ion Source Power Supply (ISPS) electrically	Electrical	As considered for Room 0043 (Control Room) above.						Risk tolerable - see section 8.4
	Room 0040 OLD ISPS Room	Remove ISPS rack components	Drop load	Crush injury	Minor injury to finger/hand/feet	Experienced workers	Minor	Unlikely	Low	Risk tolerable
	Room 0040OLD ISPS Room	Dismantle/remove cabinets	Drop load	Heavy item (100 – 200 kg)	Minor injury to finger/hand/feet	Removed using trolleys Experienced workers	Minor	Unlikely	Low	Risk tolerable

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
	Room 0059 & 0058 Old PET Beam Room	Remove pneumatic lines	Radiation	Maximum 30 µSv/h	Minimal dose to the workers	EPD and health physics coverage.	Minor	Likely	Low	Risk tolerable
			Chemical	Residual liquid (if any) in the tubes could spill	Minor injury	Gloves	Insignificant	Unlikely	Very Low	Risk tolerable
	Room 0059 & 0058 Old PET Beam Room	Remove PET target station, shielding and beam line	Radiation	Maximum 30 µSv/h	Minimal dose to the workers	EPD and health physics coverage.	Minor	Likely	Low	Risk tolerable
			Drop Load	Heavy items (shielding plate and target racks) could drop	Injury to workers	Unbolt steel frames into small items. 2 or more workers	Moderate	Unlikely	Low	Risk tolerable
	Room 0059 & 0058 Old PET Beam Room	Remove existing water pumping system/station		Small items - no significant issues.						
	Room 0059 & 0058 Old PET Beam Room	Remove water lines, remove water manifold	Cuts / abrasions / crushes	Considered below						
	Basement (Rooms L1001 & L1002)	Transfer radioactive items and waste to the Basement using movable trolley.	Radiation	Contact dose rate varies of 100 µSv/h to 3mSv/h	Dose to operators (extremity dose)	Hot items are in shielded trolley and stored in a shielded area in the basement. Short time exposure and operators maintains distance from the items while the trolley is pushed. EPD and Health Physics coverage.	Minor	Likely	Low	Risk tolerable.
			Manual handling	Small items loaded/unloaded from the trolley and placed onto the rack at the Basement	Back injury. Injury to hand and/or feet.	Work planned with the consultation of OHS adviser. Training and experience. PPE	Moderate	Unlikely	Low	Risk tolerable
			Drop load	Items could drop from the trolley onto operators foot.	Injury to foot/leg	Railing along the trolley perimeter. Safety boot Training and experience	Moderate	Unlikely	Low	Risk tolerable
	All rooms	All activities	Fire	Combustibles or oil fire	Injury (smoke inhalation, burns) Damage to equipment	Housekeeping inspections to minimise combustibles Emergency evacuation procedures	Moderate	Very unlikely	Low	Risk tolerable
			Dust	Unforseen scenario	Injury (eye injury, respiratory problem)	Glasses Dust masks if needed	Minor	Very unlikely	Low	Risk tolerable

ID	Room / Area	Task	Hazard Guideword	Scenario(s)	Consequence	Controls	Consequence score	Likelihood score	Risk Rating	Acceptability
			Slips / trips / falls	OHS accident	Injury	Good housekeeping Barriers, guards where needed	Moderate	Unlikely	Low	Risk tolerable
			Cuts / abrasions / crushes	OHS accident	Injury	Good work planning Use of crane where possible Gloves	Moderate	Unlikely	Low	Risk tolerable
			Noise	Hearing damage	Injury	Ear plugs, ear muffs where appropriate	Minor	Unlikely	Low	Risk tolerable
			Heat	Collapse	Injury	Controlled work periods Rest breaks Water	Moderate	Very unlikely	Low	Risk tolerable
			Fatigue	Unsafe workmanship	Injury	Controlled work periods Rest breaks	Minor	Unlikely	Low	Risk tolerable

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