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SEPP33 REPORT

ON PROPOSED
BULK OXYGEN TANKS

MATER HOSPITAL

Prepared by Bill Callan
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Member of the Australasian Institute of Dangerous Goods Consultants
Premier Engineering Services Pty Ltd

June 2013

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Circulation:

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Disclaimer:

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Executive Summary

The proposed development is subject to SEPP33 (State Environmental Planning Policy No.33, “Hazardous and Offensive Development Application Guidelines”) and exceeds the screening threshold quantity set out in that Policy. Liquid oxygen is classified as a dangerous good with a sub-risk of Class 5.1 (Oxidizing substance), for which the threshold quantity is 5 tonnes. The proposed inventory (maximum) is approximately 14.4 tonnes. This indicates that a Preliminary Hazard Analysis (this document) is required to demonstrate that the proposal meets the acceptable risk criteria, which are set out in HIPAP No.4, “Risk Criteria for Land Use Safety Planning”.

The format required of a Hazardous Analysis such as this is set out In HIPAP No.6 “Hazardous Analysis”, and this format is generally followed in this report. There is, however, one difficulty brought about by the particular hazards associated with liquid oxygen. HIPAP6 advises an examination of elements such as dispersion models, fire, explosion, toxic release, projectiles etc., which are commonly the result of hazardous instances involving flammable or toxic materials. Oxygen is neither flammable nor toxic. The main hazard associated with liquid oxygen is its ability to vigorously accelerate combustion. Therefore, the main risk control measure is to isolate the oxygen from accumulations of materials of a combustible nature. In the absence of such materials, the risk (at least the risk envisaged in SEPP33 being the risk of off-site harm) is very low.

This being the case, the best way to demonstrate the safety of the proposed installation is to demonstrate compliance with the relevant Australian Standard, AS1894, “The storage and handling of non-flammable cryogenic and refrigerated liquids”. This compliance has been documented separately and is attached to this report as Attachment 1.

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In addition, a qualitative risk assessment has been prepared – refer Attachment 2. The ratings and definitions used in this assessment are shown in Attachment 3. This document summarizes the risks associated with dangerous goods storages in general and with bulk oxygen facilities in particular. The risk elements are taken from the NSW Occupational Health and Safety Regulation, Clause 174Rff, being the “particular risks” which are required to be assessed and mitigated under that Regulation.

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The following headings are suggested by HIPAP6. Comments are mostly very brief because the main issues are covered in the attached Compliance Report.

Findings and Recommendations

The proposed location of the oxygen tanks is designed with two purposes in mind. Firstly, it maximises the separation of the tanks from structures, activities and circumstances which might impact on the inherent hazardous nature of the materials. Secondly, it provides maximum distance between the tanks and potential effects of an incident involving them, should such an event occur.

Therefore the recommendation is that the proposed development should be approved subject to compliance with AS1894, as set out in the attached compliance report.

Site Description and Surrounding Areas

The attached Compliance Report deals with the separations between the facility and a range of infrastructure, ranging from adjacent property land use to streets, buildings, drains and other items. The following description attempts to put the surroundings into context.

The proposed location of the tanks is at the north-west corner of the site. The tanks are located on the northern boundary (but separated from it by firewalls) so that the nearest hospital buildings will be the new construction to the south but separated by the entrance roadway.

To the north of the site is an access-way identified as Sinclair Street (a continuation of Sinclair St which extends from the west to the site corner in question), but which is in fact a pedestrian walkway. To the north of the walkway are residential apartments.

To the south and east of the tanks is the hospital building itself.

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To the west is Rockland Road (north-south). On the western side of Rocklands Road, there are residential apartments to the north of Sinclair St and the Melanoma Institute to the south.

Process

The process is very simple. Liquid oxygen evaporates into the ullage space of the tank, and is drawn off from the ullage space as gaseous oxygen by pipeline to the various points of oxygen consumption in the Hospital. Evaporators are installed to aid the vaporisation of oxygen if demand requires. There are no process conditions which impact on this assessment.

Hazard Identification

The attached Risk Assessment gives a quantitative analysis of the hazards associated with an oxygen storage. Some quantitative component is introduced by a simple assessment of both likelihood and consequence, but the main purpose of this assessment is to act as a “word diagram” of hazard assessment, as envisaged in HIPAP6.

It is recognised that this assessment does not deal adequately with low likelihood/high consequence incidents. Therefore it is appropriate to deal briefly with such an occurrence. The characteristics of liquid oxygen are such that several conditions need to be satisfied in order to produce such an incident. An example might be an aircraft crash, which would produce a significant loss of containment of the oxygen, introduce a significant fuel load, and undoubtedly include an ignition source. The point is that the likelihood of each of these conditions is very small and the conflation of all becomes almost inconceivably remote.

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Consequence analysis

Two points require comment. The first is that consequence is determined by the availability of a fuel source, so absence of this element is the major risk control measure. The second point is that, in contrast to most scenarios involving flammable liquids or gases, even a catastrophic event may have low consequence.

Estimation of Likelihood

Various scenarios may be invoked, but it is unlikely that any mathematical expression of likelihood will be helpful. The importance of separation of the oxygen from fuel sources is emphasised.

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Attachment 1 – Compliance Report

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DANGEROUS GOODS COMPLIANCE REPORT

ON PROPOSED
BULK OXYGEN TANKS
(Proposed Location at north-west corner of site)

MATER HOSPITAL

Prepared by Bill Callan
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March 2013

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Mr Maurie Pearl – Facilities Manager – Mater
Mr Glenn Pearson – Zone Architects Pty Ltd

Document Control:

DOCUMENT NUMBER: MH-O2-0313

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Draft	March 25, 2013	Draft for comment
Issue 1	March 27, 2013	Issued for use

Disclaimer:

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Background

Mater Hospital plans to extend the hospital facilities at its Crows Nest site. As part of this redevelopment, there will be a need to increase the supply of medical oxygen (in the form of liquefied oxygen in tanks). Both the site and its surroundings are high density, and this has given rise to difficulties in finding a safe and effective location for the tanks. The original development proposal required modification due to a Council requirement that the Plant Room be relocated from the roof to a lower level.

Many options have been considered, including a proposal for a location at the front of the site, immediately adjacent to the extended building, and below ward areas. After extensive consultation with the architect, the gas supplier, Premier Engineering (as Dangerous Goods Consultant), and specialist risk engineers, it has been determined that this location is not appropriate, on the grounds of lack of inherent safety. Therefore, possible alterative sites were again assessed.

This report covers the option of locating the tanks in a currently landscaped area at the north-west corner of the site, adjacent to the site vehicle entrance. The purpose of this report is to assess this location for compliance with the relevant legislation,

The site layout is shown in Appendix 1, and the proposed oxygen tank layout is shown in Appendix 2.

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Executive Summary

The proposed location for the oxygen tanks satisfies the important criteria for location of dangerous goods bulk installations, namely

- Inherent safety – the location is away from vulnerable installations such as wards, and away from places where people congregate.

- Safe product transfer – the supply tanker and filling arrangements will comply with the relevant legislation (the “ADG Code”).

- The proposal complies with the relevant Australian Standard (AS1894 – The storage and handling of non-flammable cryogenic and refrigerated liquids).

- The facility will, in contrast to previous options considered, not place operational personnel (including both Hospital Facilities, and the supplier) at increased risk, as the area is open, with clear access and good ventilation.

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Legislation

The legislation covering the storage and handling of dangerous goods is contained in the

- Work Health and Safety Regulation 2012.

This Regulation calls up a number of Australian Standards of which the following may be relevant to the proposed facility:

- AS1894-1997 Storage and handling of non-flammable cryogenic and refrigerated liquids
- AS2896 –1998 Medical gas systems – installation and testing of non-flammable medical gas pipeline systems

This report deals only with AS1894-1997 compliance.

Further guidance is provided by WorkCover's "Storage and Handling of Dangerous Goods – Code of Practice 2005". (Note that this document relates to the old OHS legislation – the revised Code of Practice is not yet published).

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Classes of dangerous goods which will be stored at this site:

1. Class 2.2/5.1 - Cryogenic gases – liquid oxygen in tanks
2. Class 2.2 – Inert compressed gases in cylinders
3. Class 2.2 sub 5.1 – Oxidising compressed gases in cylinders
4. Class 2.1 - Flammable gases in cylinders
5. Class 8 – Corrosives (cleaning agents and reagents) in packages.
6. Class 3 – Flammable liquids in packages

The cryogenic gases are covered by AS1894. Gases in cylinders are covered in AS4332. Corrosives are covered by AS3780. Flammable liquids are covered by AS1940.

This report deals with only the bulk oxygen tanks. Other dangerous good will be sufficiently separated from the tanks so that there is no impact.

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Cryogenic Gas Tanks

Oxygen will be supplied to the Hospital by pipeline from two bulk tanks of 7000 litres capacity each, with evaporators. The tanks will be contained within an enclosure separating the facility from the public footpath (right of way) to the north.

AS1894 Requirements for Bulk Oxygen

The following clauses of the Standard (AS1894, The Storage and Handling of Non-Flammable Cryogenic and Refrigerated Liquids) are applicable to the bulk tanks. Many other clauses, such as Emergency Management, are also relevant but do not impinge on the underlying compliance of the proposed design. Clauses not mentioned below are considered to be not relevant to the proposal, or alternatively have no impact on the consideration of the design.

Clause 1.6 - This clause requires that all storage areas are appropriately secured against access by unauthorised persons. The proposed compound meets this requirement, by means of a locked compound.

Clause 3.3 – This clause covers design requirements and requires consultation with the gas supplier if there is to be a change of service. Such a change of service is unlikely.

Clause 3.4 - This covers foundations and supports. It is usual for the gas supplier to deal with these details.

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Clause 3.5 - This clause covers the location of storage vessels.

Clause 3.5.1 - requires the installation to be located to minimise risk to personnel, local population and property. It can be argued with considerable force that this location achieves this objective in comparison to other potential sites previously considered.

The clause also requires consideration to other potentially hazardous processes in the vicinity. The proposed location is well away from any such activities.

The location must be acceptable to both the gas supplier and the user – a process of consultation with the supplier (BOC Gases) is in place, and the tank layout appended is supplied by BOC.

Clause 3.5.2 - requires protection against vehicular damage. The tanks and fill point are protected by the tank enclosure, which is proposed to be of block wall construction or similar (see comments below re FRL requirements), plus kerbing. Further details on impact protection are included in Appendix D of the Standard.

Clause 3.5.3 – requires that any spill of liquid oxygen flows away from locations where people are at risk. The point of potential release is located 10 metres from the street to the west so that there is ample separation to allow dissipation. The right of way behind the tanks is elevated above the enclosure ground level and separated by a wall.

Clause 3.9.1 – This covers the location of the transfer area. The main requirements are that the delivery tanker has a level, accessible filling position,

with quick, direct and unobstructed exit. On sites where it is not possible to turn a delivery tanker on the site's internal roads, it is usual to reverse the tanker into position to achieve these objectives. The location is almost level and acceptable to the gas supplier.

Clause 3.9.3 - requires that controls and instrumentation be visible from the fill point. No problems are envisaged with this requirement, as the fill point is located immediately adjacent to the tank enclosure..

Clause 3.13 - requires in-service inspection and maintenance. While this is normally carried out by the gas supplier, it is prudent for the occupier to ensure that the work is carried out.

Section 4 of the Standard relates to separation of the facility from protected areas, other dangerous good storages etc.:

Section 4.3 – the new proposed location needs to be separated from the

- Property boundary
- Street, road boundary
- Areas where smoking etc is permitted
- Adjoining publically accessible areas
- Drains and pits
- Areas where patients are confined to bed
- Dangerous goods including pipelines.

Separations are measured from the tank shell and/or the associated valves and manifolds and can be measured around a screen wall. In this facility, the tank enclosure is surrounded on the north, east and west sides by a wall of FRL

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240/240/240. The wall is required to be at least 1 metre above the highest “leak point” on the tank, such as a relief valve. In this proposal, the wall will be as high as the tanks. In all instances, separations from items mentioned above exceed requirements.

Clause 4.4 – the transfer area should consist of a concrete hard-stand of at least 2.5 m X 2.5 m, on which the tankers couplings can stand. The design of this area should avoid joints within 1 metre of the position of the hose couplings. Asphalt or bitumen are not suitable for this area. The proposed area will be concrete.

Clause 4.10 – Electrical Equipment – the gas tank supplier usually ensures that all such equipment is suitable for this service. Equipment should have a rating of not less than IP54 in accordance with AS1939. Flameproof equipment is not required.

Section 6 Operational and Personnel Safety

Clause 6.3.5 - Control of Entry: This requires that unauthorised persons are not permitted in the storage areas and that persons other than employees are accompanied at all times and also be made aware of the hazards associated with the store.

Clause 6.3.6 - Clear access must be available for emergency equipment, personal protective equipment, cleanup equipment, as well as entry, exit and emergency escape. This is provided by the opening at the southern side of the tank compound, adjacent to the transfer area.

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Clause 6.3.7 - Lighting at the bulk tank is required to allow easy reading of all markings and signs.

Clause 6.11 - First Aid: The standard requires provision of a suitable First Aid kit and instructions including the MSDS.

Clause 8 - Fire Protection: No specific requirements are given in the Standard and it should be borne in mind that the fire protection requirements are basically those to prevent a fire adjacent to the storage impinging on the storage itself. Given that no combustible materials are stored in the vicinity, but there is vegetation around the storage, it is recommended that a water hose or hose reel be installed, to deal with any impinging fire, and, if necessary, provide cooling to the tanks.

Work Health and Safety Regulation Requirements

As well as the risk management requirements discussed above, there are a number of other legislative requirements to be met. These include:

- Risk management needs to be formally addressed, communicated and monitored, including induction, training, contractor management etc.

- Notification of Dangerous Goods on Premises and Dangerous Goods, Register and Manifest.

- Review of Emergency Plan - the revised Site Emergency Plan should be resubmitted to Fire and Rescue NSW, in the format required on their

website. (Further information on Emergency Plan requirements are contained in Appendix L of AS1894).

- The oxygen tanks will be supplied with placarding suitable for a bulk facility.

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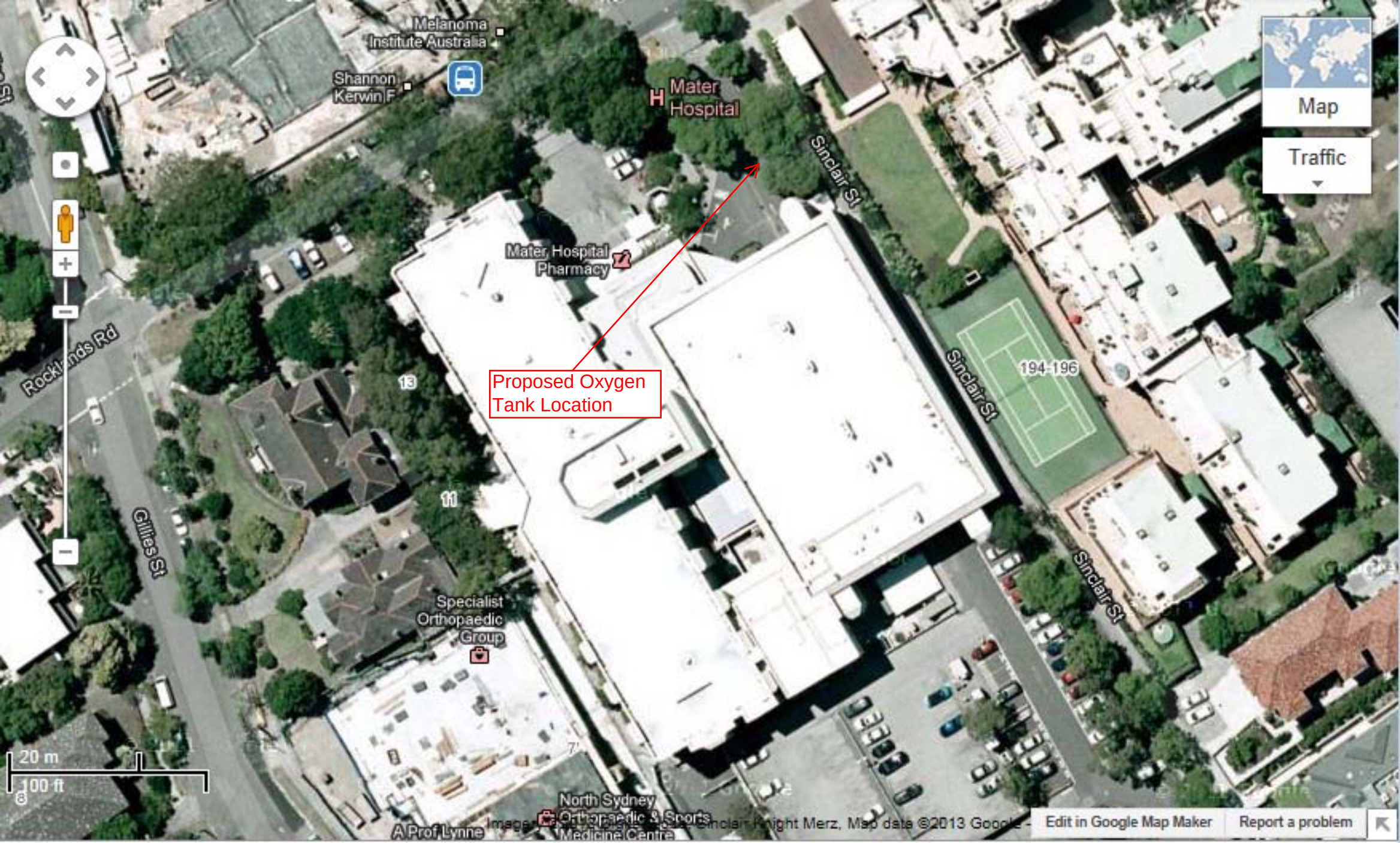
Appendix 1 – Proposed Oxygen Tank Location


Melanoma Institute Australia
Shannon Kerwin F
Mater Hospital
Sinclair St
Mater Hospital Pharmacy
Proposed Oxygen Tank Location
Rocklands Rd
13
11
Gillies St
194-196
Sinclair St
Sinclair St
Specialist Orthopaedic Group
North Sydney Orthopaedic & Sports Medicine Centre
A Prof Lynne
20 m
100 ft
Map
Traffic
Edit in Google Map Maker
Report a problem

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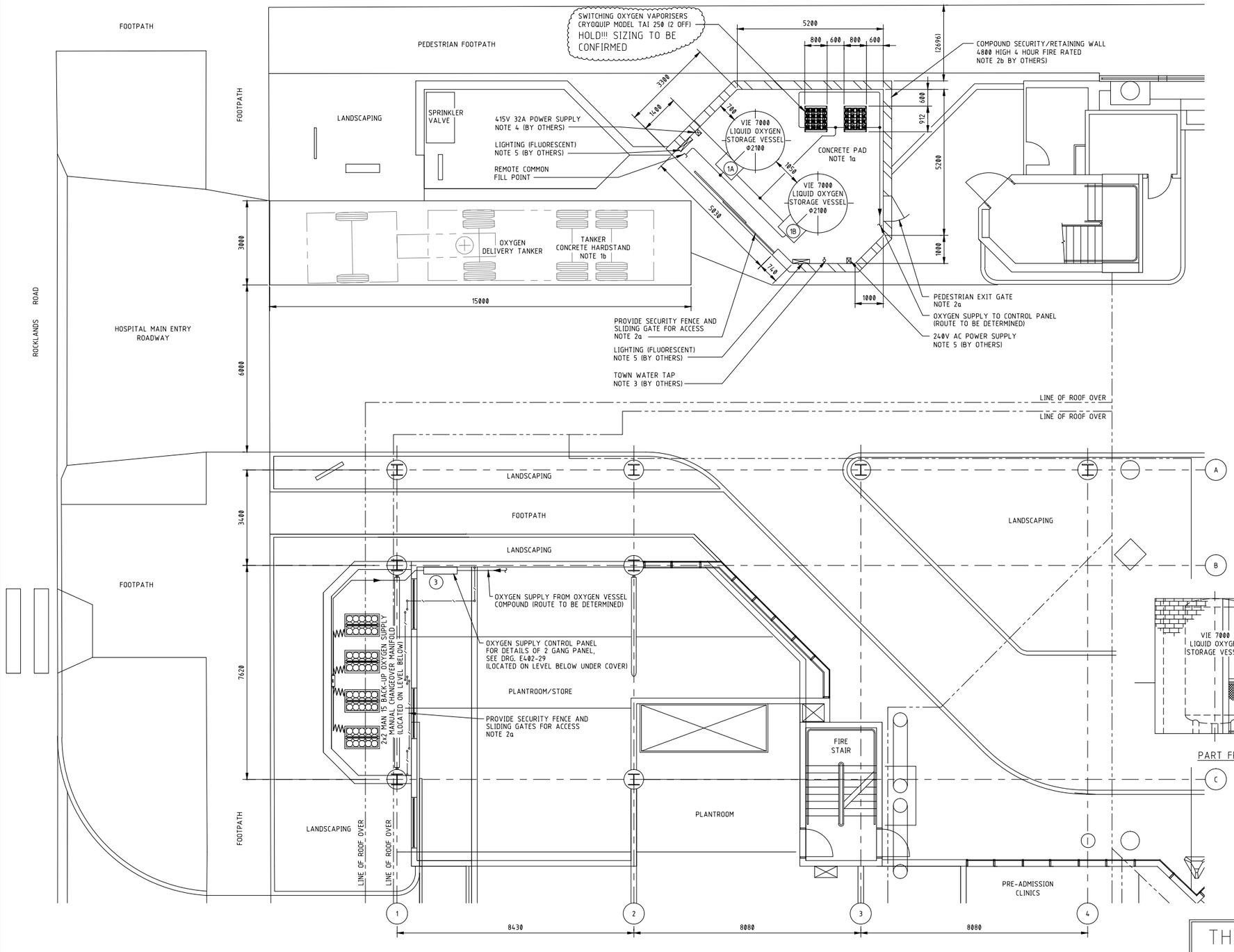
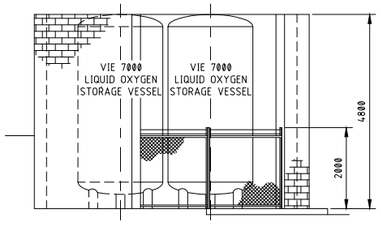
Appendix 2 – Oxygen Enclosure Layout

THIRD ANGLE PROJECTION
ALL DIMENSIONS IN MILLIMETRES



PLAN VIEW



PART FRONT ELEVATION

NOTES:

1a. CONCRETE PAD: (BY OTHERS)
F'c 32 MPa (GRADE N32R, 80 SLUMP)
REINFORCING: F81 TOP, F81 BOTTOM, 40 COVER ON TOP, 65 COVER BOTTOM AND SIDES
EMPTY VESSEL MAY BE INSTALLED AFTER 7 DAYS AND VESSEL FILLED AFTER 14 DAYS.
CONCRETE WORKMANSHIP TO BE IN ACCORDANCE WITH AS3600.
FOR MORE DETAILS, SEE ANZIGA DRG. 142-002 REV.A6.
VESSEL CONCRETE PAD SIZE: AS SHOWN x 250 THICK

1b. TANKER CONCRETE HARDSTAND: (BY OTHERS)
TANKER CONCRETE HARDSTAND SIZE: 15000x3000x225 THICK
FOR MORE DETAILS, SEE ANZIGA DRG. 142-002 REV.A6.

2a. SECURITY FENCING: (BY OTHERS)
TO BE SUPPLIED AND INSTALLED IN ACCORDANCE WITH AS1725 AND AS2423.
END AND CORNER POSTS: 50 DN. GALV. PIPE
TOP AND BOTTOM RAILS: 32 DN. GALV. PIPE
EXTENSION POSTS: 2 STRANDS OF BARBED WIRE
CHAIN MESH: 50x3.15x1800 HEAVY GAUGE
FIXINGS: FLANGE BOLTED TO CONCRETE SLAB
SLIDING ACCESS GATE: 2500 WIDE (3 OFF)
SINGLE PEDESTRIAN SWING GATE: 900 WIDE (1 OFF)
OVERALL HEIGHT: 2000 MIN.

2b. SECURITY/RETAINING WALL: (BY BUILDER)
WALL TO BE 4800 HIGH AND 4 HOUR FIRE RATED CONCRETE BLOCK OR BRICK WALL TO ALL SIDES AS SHOWN.

3. WATER SUPPLY: (BY OTHERS)
3/4" STOP SCREWED TAP, 600mm ABOVE GROUND LEVEL, COMPLETE WITH HOSE TO BE PROVIDED IN ENCLOSURE OR WITHIN CLOSE PROXIMITY.

4. TANKER POWER OUTLET: (BY OTHERS)
OUTLET - CLIPSAL 4 MODULE BASE CAT. No. 56E4VHGY
SWITCH - 32A CAT. No. 56SW332LEGY
SOCKET - 4 PIN 32A CAT. No. 56SO432LEGY
RCD - CAT. No. 4RC463/30 (30mA)
RCD COVER - CAT. No. 56RC4NGY WITH NEON ACROSS 2 PHASES
SUPPLY CIRCUIT BREAKER - MCB 32A D CURVE, WIRING AND INSTALLATION IN ACCORDANCE WITH AS3000-2000.
RCD MUST BE MOUNTED AT THE OUTLET TO LET THE DRIVER TEST BEFORE USE. DO NOT MOUNT RCD AT SUPPLY DISTRIBUTION BOARD.

5. LIGHTING AND 240V AC POWER POINT SUPPLIED BY ELECTRICAL.

6. LOW VOLTAGE WIRING: (BY OTHERS)
CONSISTS OF INDEPENDENT TELEPHONE LINE FOR TELEMETRY AND FOUR (4) TWISTED PAIR CABLES FOR OXYGEN ALARMS WHICH WILL TERMINATE AT THE MAIN MEDICAL GAS ALARM PANEL LOCATED IN A 24 HOUR MONITORED LOCATION.

7. THE ALARM CABLE IS TO BE INSTALLED WITHIN STEEL CONDUIT AT FRONT OF VESSEL OR WHERE A POSSIBLE O2 SPILL CAN OCCUR. (BY ELECTRICAL)

8. IMPACT PROTECTION: (BY OTHERS)
TO BE PROVIDED IN HIGH TRAFFIC AREAS AS PER AS1894-1997 APPENDIX D.

9. FIRE PROTECTION: (BY OTHERS)
MINIMUM REQUIREMENT IS A GARDEN HOSE OF SUFFICIENT LENGTH TO REACH ALL PARTS OF THE DEPOT, PERMANENTLY ATTACHED TO A WATER SUPPLY AT A DISTANCE OF 8 METRES FROM THE DEPOT.

10. REFERENCES:
TO BE ADDED WHEN INSTALLATION IS CONFIRMED THAT IT COMPLIES WITH ALL RELEVANT STANDARDS.

HOLDS!!!
1. VAPORISER LOCATION FOR GOOD AMBIENT AIRFLOW?
2. SEPARATION DISTANCE IN THE VERTICAL TO THE HOSPITAL FLOORS ABOVE?
3. PIPELINE ROUTE FROM COMPOUND TO CONTROL PANEL?
4. IMPACT PROTECTION BOTH IN FRONT AND ALONGSIDE THE SPRINKLER VALVE ROOM (NOT MUCH ROOM)?

MANDATORY ALARMS:

1A	RE-ORDER OXYGEN	PRIMARY VESSEL 1 CONTENTS GAUGE
1B	RE-ORDER OXYGEN	PRIMARY VESSEL 2 CONTENTS GAUGE
2	EMERGENCY OXYGEN SUPPLY OPERATING	OXYGEN SUPPLY CONTROL PANEL
3	BACK-UP OXYGEN SUPPLY LOW PRESSURE	BACK-UP VESSEL
4	OXYGEN SUPPLY FAILURE	EMERGENCY FILL FACILITY

THIS DRAWING HAS NOT YET BEEN REVIEWED FOR COMPLIANCE WITH RELEVANT STANDARDS

UNDER REVISION

REV.	DATE	DRAWN	REVISIONS	PASSED	APPROVED
1E	11-3-13	DJP	COMPLIANCE STAMP ADDED. NOTE 10 REMOVED.		
1D	8-3-13	DJP	ISSUED FOR REVIEW		
1C	1-3-13	DJP	GENERAL UPDATE		
1B	27-2-13	DJP	GENERAL UPDATE TO COMPOUND		
1A	22-2-13	DJP	GENERAL UPDATE TO COMPOUND		
1.0	21-2-13	DJP	UNDER REVISION		

REV.	DATE	DRAWN	REVISIONS	PASSED	APPROVED
1G	25-3-13	DJP	VESSEL COMPOUND RELOCATED		
1F	13-3-13	DJP	UPDATE AFTER SITE RISK ASSESSMENT		

REFERENCE DRAWINGS

PROJECT 4958 | SCALE 1:75

BOC

10 JULIUS AVENUE, NORTH RYDE, NSW 2113

LAYOUT - VESSEL INSTALLATION
TWIN VIE7000 LIQUID OXYGEN
MATER PRIVATE HOSPITAL - CROWS NEST
CUSTOMER ENGINEERING DEPT NSW

A1 | FORM Nº DEP-002-F02/5 | DRAWING Nº C208-1095 | SHEET 1 | VERSION 1

570 806

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Attachment 2 – Risk Assessment

Hazard Identification, Risk Assessment & Control Record

Location	**Mater Hospital**	Plant Item / Operational Area:	**Liquid Oxygen Tanks - Class 2.2/5.1**	No:	**BOC1&2**
Area	Liquid Oxygen Tanks - 2 X 7000VIE	Task Details:	**Dangerous Goods Storage - Particular risk control measures (OHS Reg 174R-174AA) Note: Even though these control measures are based on the headings contained in the OHS Regulation (since superceded by the WHS Regulation), they are still relevant and useful.**		
Prepared By:	BC - Draft			Date	2013-05-16
Review Date:		Reviewed By:		Due:	

NO.	PROCEDURE IN STEPS	POTENTIAL SAFETY HAZARD OR ENVIRONMENTAL ASPECT	INHERENT RISK			CONTROL MEASURE	RESIDUAL RISK		
			L	C	R		L	C	R
1	Inventory reduction or substitution?					Medical requirement. No practical way to reduce inventory.			
2	Stability	No issues found	1	1	1	Product is stable - refer MSDS.	1	1	1
3	Separation from other DG storages	Dangerous reaction, heating, toxic fumes - possibility of increase in flammability of combustibles or spontaneous combustion	2	4	8	Tank separate from buildings containing DG's. Nearest DG depots are gas cylinders in loading dock more than 20m away.	1	1	1
4	Separation from water	Heating, spitting	1	1	1	Not relevant.	1	1	1

5	Separation from boundaries	Spill off site, potential for vandalism	2	2	4	Tank is in a locked compound. Risk of leak is greatest when tanker is delivering - supplier has procedures in place. Separated from northern boundary by firewall.	1	2	2
6	Interaction with other dangerous goods	Violent reaction with heat and toxic reaction products - increase in flammability of combustibles	2	4	8	Incompatible DG stored away from tank - refer Site Plan.	1	2	2
7	Ignition sources	Fire/explosion	1	4	4	Ignition only relevant when flammables or combustibles present. Compound should be kept clear of accumulations of leaves and rubbish.	1	2	2
8	Ventilation and atmospheric emissions	Off site odours	1	1	1	Not applicable.	1	1	1
9	Contamination of food and personal products	Toxic effects to personnel	1	1	1	Not toxic. Appropriate PPE mandatory for tank filling operations. No eating or drinking in operational area. (Note that an oxygen enriched atmosphere can render clothing extremely flammable - refer Emergency Response Summary).	1	1	1
10	Construction of bulk containers	Tank leak or catastrophic failure	2	3	6	Tanks supplied and maintained by BOC. Tanks to AS1210.	1	2	2

11	Impact damage	Catastrophic loss of containment	1	4	8	Tank located in a compound with no vehicle access, protected by walls and kerbing.	1	2	2
12	Containment of spills	Potential environmental damage and personnel exposure. Oxidising effect.	1	4	4	Dissipation is correct method of spill management.	1	2	2
13	Transfer - overfill due to lack of ullage	Personnel exposure and / or loss of containment.	2	4	8	Fill limit is indicated by tri-cock situated at the fill point.	1	2	2
14	Transfer - leak	Personnel exposure and / or loss of containment.	2	4	8	Pump and pipework monitored during transfer. Dedicated fittings. Hardstand area provided.	1	2	2
15	Introduction of incompatible material	Violent reaction, loss of containment, personnel exposure to fumes, splashing if wrong gas delivered	2	3	6	Correct placarding, one supplier only, dedicated fittings.	1	2	2
16	Fire protection	Toxic decomposition and/or loss of containment, or overpressure due to impinging adjacent fire.	1	2	2	Refer Emergency Plan. Hydrant and hose reel available adjacent to the tank enclosure.	1	1	1

17	Emergency planning	Spill, chemical burn to personnel. Intensification of fire.	2	2	4	Refer Hospital Emergency Plan and specific Emergency Response Summary for this storage.	1	2	2
18	Confined space	Asphyxiation	1	4	4	Confined Space Entry Procedure would apply, but not likely as supplier would probably replace tank rather than attempt on site entry and repair.	1	2	2

Code of Practice: AS1894 Storage and handling of non-flammable cryogenic and refrigerated gases

Note: These tanks are filled and maintained by the gas supplier, so this assessment does not address such issues as valve identification, maintenance and inspections issues etc which are handled bythe supplier. Hospital staff are not involved in handling liquid oxygen at this location, so personal safety issues are also not covered, as these will be covered by the supplier's procedures for their delivery staff.

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Attachment 3 – Risk Ratings and Definitions

RISK ASSESSMENT
RATINGS AND DEFINITIONS

Likelihood		
How Likely?		**Description**
4	Almost Certain	**The event is very likely to occur at any time** or the event has happened more than once in the past
3	Likely	**The event will probably occur at some time** or the event has happened in the past ("I've heard of it happening")
2	Unlikely	**There is some chance that the event could occur but it is not expected to happen**
1	Rare	**Practically impossible for the event to occur** or may only occur in exceptional circumstances

Consequences		
• **Health and Safety** • **Environmental** • **Property Damage / Financial Costs / Disruption to Activities/**		
Level		**If the event occurred, expected consequences could be:**
4	Severe / Catastrophic	• Death and/or permanent disability to one or more persons; and/or • Major off-site and/or on-site release and serious detrimental effects to environment; and/or • Major property damage and/or major disruption to activities and/or major financial costs expected.
3	Major	• Serious injury(s) to one or more persons – leading to time off work and/or work restrictions; and/or • Serious on-site or off-site release requiring outside assistance for recovery, possible detrimental effects to environment; and/or • Property Damage and/or disruption to activities and/or substantial financial costs expected.
2	Moderate	• Minor injury(s) to one or more persons which may result in outside medical treatment but does not lead to time away from work or any work restrictions; and/or • On-site release - contained or recovered with outside assistance • Minor property damage and/or some disruption to activities and/or some financial costs expected.
1	Minor / Insignificant	• No injury or First Aid treatment only – does not require any outside medical treatment and does not lead to time away from work or any work restrictions; and/or • No on-site release **or** minor on-site release contained immediately; and/or • Minor or no property damage and/or no disruption to activities and/or minimal financial costs expected. Nuisance and/or annoyance.

RISK ASSESSMENT MATRIX

Likelihood / Consequences		Almost Certain	Likely	Unlikely	Rare
		4	3	2	1
Catastrophic	4	16	12	8	4
Major	3	12	9	6	3
Moderate	2	8	6	4	2
Minor	1	4	3	2	1

RED 16 to 8	**High Risk**	**Unacceptable - Urgent action required**. Report to Senior Management and implement corrective action plan immediately.
BLUE 6 to 4	**Medium Risk**	**Determine relevant corrective actions and put in place as soon as possible.**
GREEN 3 to 1	**Low Risk**	**Do something where / when possible or manage by routine procedures.**

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