AECOM

The University of Sydney

6 June 2013

Document No. 60300419_FinalRpt(Rev0)_6June2013.docx

Commercial-in-Confidence

Australian Institute of Nanoscience

SEPP33 Screening

Australian Institute of Nanoscience

SEPP33 Screening

Prepared for

The University of Sydney

Prepared by

AECOM Australia Pty Ltd
Unit 8, 2 Eden Park Drive, Macquarie Park NSW 2113, PO Box Q410, Sydney NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

6 June 2013

60300419

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document Australian Institute of Nanoscience

Ref 60300419

Date 6 June 2013

Prepared by Renton Parker

Reviewed by Steve Sylvester

Revision History

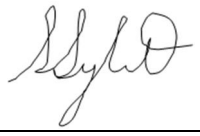
Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	14-May-2013	Draft	Steve Sylvester Associate Director	
0	06-Jun-2013	Final	Steve Sylvester Associate Director	

Table of Contents

List of Tables

List of Figures

Abbreviations

Description	Abbreviation
Australian Institute of Nanoscience	AIN
As Low As Reasonably Practicable	ALARP
Education Investment Fund	EIF
Preliminary Hazard Analysis	PHA
State Environmental Planning Policy 33	SEPP33
Transmission Electron Microscope	TEM

Executive Summary

The Australian Institute of Nanoscience Building to be constructed at the University of Sydney will contained several Dangerous Goods required in the experiments that will be carried out in the building in the future. To assess the potentially hazardous nature of the development a SEPP33 Screening has been completed following the methodology outlined the Department of Planning document "*Applying SEPP33*". The results of the screening for each of the classes stored in the facility are detailed below.

SEPP33 Screening

Class 2.1 – Flammable Gases

95.5kg of Class 2.1 Dangerous Goods is to be stored which is less than the 100kg threshold limit and so the development is not considered to be potentially hazardous and no further assessment is required.

Class 2.2 – Non Toxic, Non Flammable Gases

353.5kg of Class 2.2 Dangerous Goods is to be stored, however, SEPP33 does not apply to Class 2.2 Dangerous goods and so no further assessment is required.

Class 2.3 – Toxic Gases

326kg of Class 2.3 Dangerous Goods is to be stored which is greater than the 100kg threshold limit and so the development is considered to be potentially hazardous and so further assessment in the form of a Preliminary Hazard Analysis (PHA) will be required for the development to proceed.

Class 3 – Flammable Liquids

406 kg of Class 3 Dangerous Goods is to be stored which is less than the 1 tonne threshold limit and so the development is not considered to be potentially hazardous and no further assessment is required.

Class 5.1 – Oxidising Agent

296kg of Class 5.1 Dangerous Goods is to be stored which is less than the 5 tonne threshold limit and so the development is not considered to be potentially hazardous and no further assessment is required.

Class 6.1 – Toxic Substances

296kg of Class 6.1 Dangerous Goods is to be stored which is less than the 0.5 tonne threshold limit and so the development is not considered to be potentially hazardous and no further assessment is required.

Class 8 – Corrosive Substances

400kg of Class 8 Dangerous Goods is to be stored which is less than the 5 tonne threshold limit and so the development is not considered to be potentially hazardous and no further assessment is required.

Conclusions

The amount of toxic gases stored triggers SEPP33 and so the development is considered potentially hazardous and a PHA would be required to be completed to proceed with the development.

Recommendations

It is recommended that a review of the toxic gases to be used is completed to ensure that no unnecessary amounts of toxic gases are to be used within the facility. If the amount can be brought below 100kg then the development would not be considered potentially hazardous and a PHA would not be required to be completed.

1.0 Introduction

1.1 Background

In 2010, the University of Sydney (the University) was awarded funding from the Federal government's Education Investment Fund to assist in the construction of a building to facilitate research into the physical sciences, focussing on nanoscience. With co-investment form the University, the Australian Institute of Nanoscience (AIN) will be a world leading research and teaching facility designed to meet the future requirements of nanoscience research. In addition to the research capabilities of the building, comprehensive facilities for student-focussed undergraduate and graduate teaching will be integrated into the building.

A Part 4A application has been submitted by the University to the NSW Department of Planning and Infrastructure (the Department) that included Dangerous goods Storage designs prepared by AECOM for the AIN. In response to the Part 4A application the Department provided the following comment/ requirement to the University:

"… *If there is doubt that the proposal would exceed substance storage thresholds, as stipulated within 'Applying SEPP 33, Hazardous and Offensive Development Application Guideline', then this is something that should be thoroughly investigated to determine if a PHA is required*"

The University has contracted AECOM's to assess the potentially hazardous nature of the AIN development by completing a SEPP33 screening assessment as required by the Department.

1.2 Objectives

The objective of the work is to assess the nature and quantity of Dangerous Good that will be stored or used at the AIN building in accordance with the requirements of SEPP33.

1.3 Scope of Work

The scope of work comprises the following activities:

- SEPP33 screening of the AIN building at the University of Sydney including a visit/meeting to determine locations and quantities of dangerous goods; and
- Report on the findings of the assessment.

2.0 Methodology

2.1 Applying SEPP33

The methodology used to assess the AIN facility will be that supplied in the document “Applying SEPP33” distributed by the NSW Department of Planning (Ref 1.). The methodology includes;

- Review the products to be stored at the University and categorise them by class;
- Review the quantity of each class of Dangerous Goods;
- Compare the quantity of each class of Dangerous Goods to the acceptable limits of SEPP33;
- Determine whether the quantity is acceptable under the terms of SEPP33; and
- Report findings of the SEPP33 screening.

3.0 Project Description

The main campus of the University of Sydney is located in the inner-west of Sydney bordered by the suburbs; Darlington, Glebe, Camperdown, Newtown and Chippendale as shown in **Figure 1**. Shown in **Figure 2** is the location of the AIN building on Physics Road within the University of Sydney.

Figure 1 Location of University of Sydney, NSW (Source Google Maps)

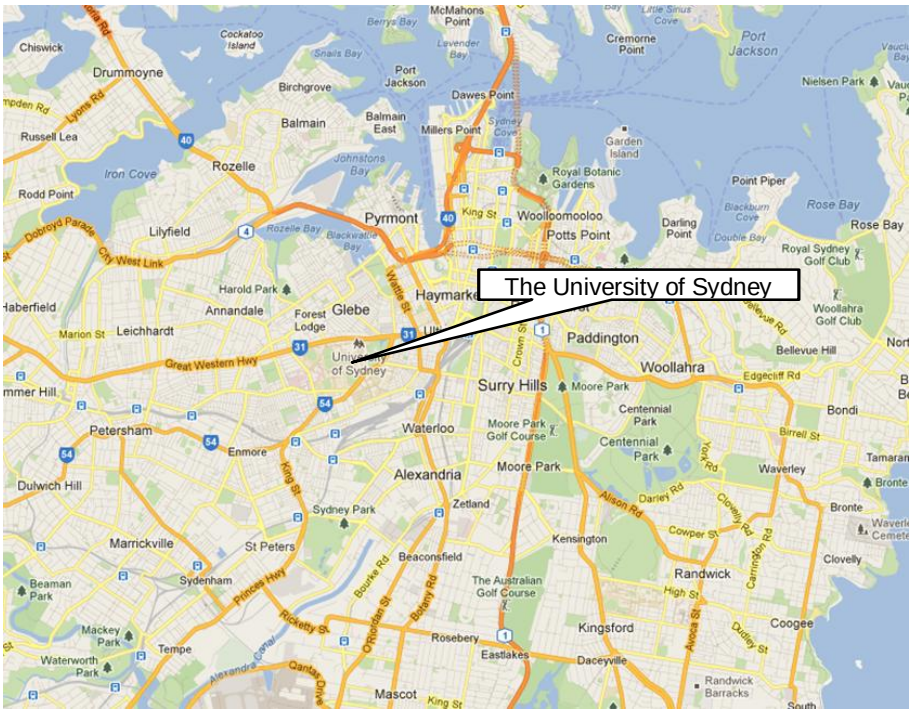
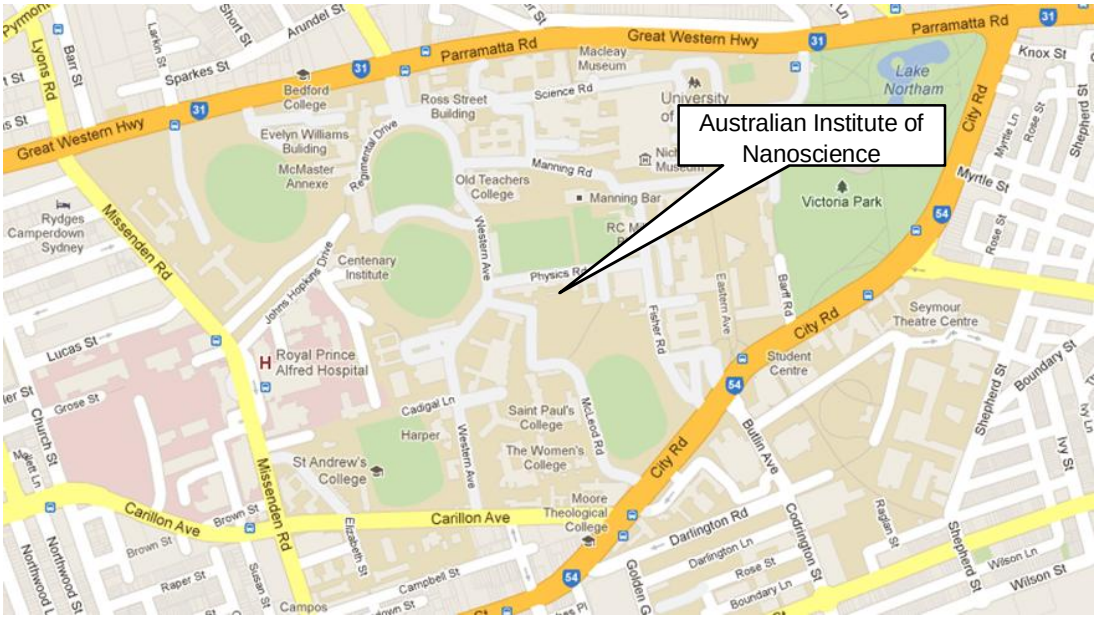


Figure 2 Location of the AIN Building on Physics Road (Sourced from Google Maps)



3.1 Project Overview

In 2010, the University of Sydney was awarded $40 million in funding from the Federal government's Education Investment Fund (EIF) to assist in the construction of a $110 million building to facilitate research into the physical sciences, focussing on nanoscience With co-investment form the University, the Australian Institute of Nanoscience (AIN) will be a world leading research and teaching facility designed to meet the future requirements of nanoscience research. In addition to the research capabilities of the building, comprehensive facilities for student-focussed undergraduate and graduate teaching will be integrated into the building which includes retaining the heritage-listed façade of the School of Physics.

During 2011 a team of consults (Architectus, Jestico + Whiles and CH2M Hill) was engaged to work with the University of Sydney on the AIN project. These consultants are the joint Principal Design Consultants for the AIN Project.

3.2 Building Overview

The building is designed to accommodate research and teaching of undergraduate and postgraduate students. The facilities to be built within the facility are:

- Research laboratories;
- Teaching Spaces;
- Office Spaces;
- Café, and
- Internal courtyard.

Each of these facilities will be discussed in detail in the following sub-sections.

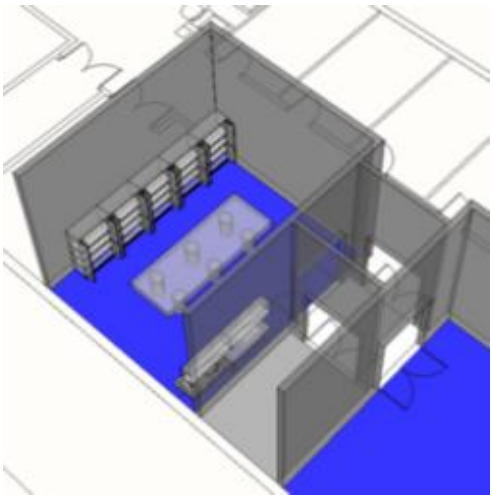
3.2.1 Laboratories

A total of 2500m^2 of research space will be constructed including 30 individual laboratories for general research and a clean room for environment sensitive experiments. Experiments that will be conducted in the clean room include experiments that must have interference from the following sources removed/accurately controlled; temperature, humidity, dust, mechanical vibration and electromagnetic interference. These lab areas are discussed in further detail below.

3.2.1.1 Research Laboratories

The general research laboratories consist of 30 individual laboratories covering a total floor area of 2,1000m^2. The laboratories to be constructed within the AIN will house a range of different environments based on the experiments to be conducted which include; transmission electron microscopes (TEM), precision metrology, quantum science, photonics, materials science and astronomical instrumentation. The average floor space for each laboratory will be 40m^2 although there are provisions for some to be designed to double the height to accommodate the full range of experimental possibilities. Each laboratory will be able to control temperature within the experiment space to +/- 0.1°C and will be equipped with ample 'grey' space for pumps, chillers, experiment gases and other service equipment. Provided in **Figure 3** is a general laboratory space showing the connecting pathway between works paces and the grey space between laboratories.

Figure 3 Laboratory Space in the Australian Institute of Nanoscience (Source from the University of Sydney Website)



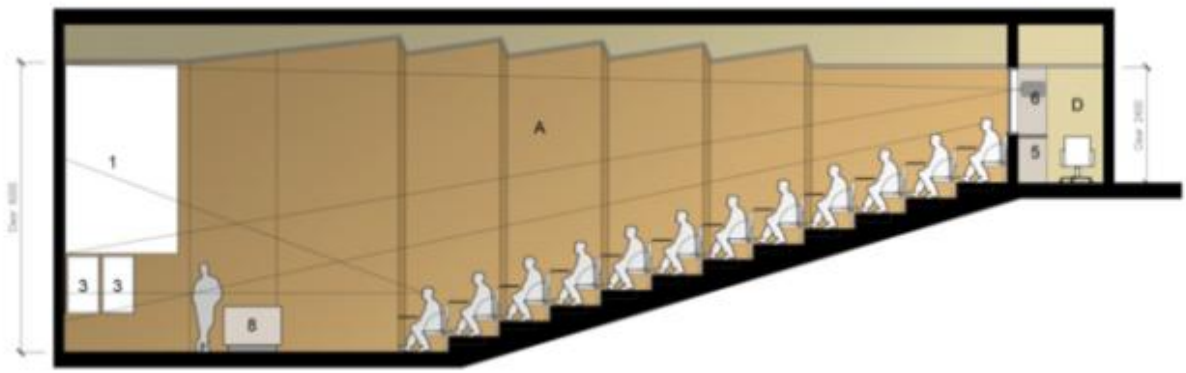
3.2.1.2 Clean Room

The AIN clean room contain ISO Class 5 and Class 7 work spaces and will be feature space that can be upgraded to ISO Class 4. Within the clean room 'tools' for advance lithography will be stored such as; an i-liner stepper, electron beam tools, thin film deposition tools and other tools for etching patterns. These tools enable researches to build sophisticated photonics, advanced electronics, devices for applications in quantum science, communications technologies, medical imaging and astronomy.

3.2.2 Teaching Spaces

Incorporated into the AIN building will be a traditional 320 seat lecture theatre, a 90 person learning studio, one large and two medium sized seminar rooms (one of which is video-conference enabled), and a 40 person teaching laboratory. In addition to the formal teaching spaces there is 200 offices to accommodate staff and postgraduate research students, a range of meeting rooms and break out spaces, a café linking the heritage listed School of Physics and AIN building and an internal courtyard. Provided in **Figure 4** is an image of the lecture theatre to be built in the AIN building.

Figure 4 Lecture Theatre in the Australia Institute of Nanoscience (Sourced from the University of Sydney Website)



4.0 Dangerous Goods Classes and Quantities

4.1 Gases

Provided in **Table 1** is a summary of all the gases stored within the AIN facility at the University of Sydney

Table 1 Gases Stored within the Australian Institute of Nanoscience Building

Gas	UN No.	Class	Sub Risk	Quantity (L)
Argon	1006	2.2	-	188
Boron Trichloride	1741	2.3	-	88
Carbon Tetrafluoride	1982	2.2	-	88
Fluoroform	1984	2.2	2.3	88
Dichlorosilane	2189	2.3		88
Germane	2192	2.1	2.3	88
Hydrogen Chloride	1050	2.1	2.3	88
Helium	1046	2.2	-	288
Nitrogen	1066	2.2	-	88
Nitrous Oxide	1070	2.3	5.1	88
Ammonia	1005	2.2	2.3	188
Nitric Oxide	1660	2.3	5.1	88
Nitrogen Dioxide	1067	2.3	5.1	88
Oxygen	1072	2.2	5.1	176
Sulphur Hexafluoride	1080	2.2	-	88
Silane	2203	2.1	-	88
Acetylene	1001	2.1	-	100
Methane	1971	2.1	-	100
Hydrogen	1049	2.1	-	100

4.1.1 Total Gases Stored

Shown in **Appendix A** is the process by which the weight of gases stored was calculated. Provided in **Table 2** is a summary of the quantities for each class of gas held within the facility.

Table 2 Quantities of Classes Stored within the Australian Institute of Nanoscience Building

Class	Quantity (kg)
2.1	95.5
2.2	353.5
2.3	326
5.1	96

4.2 Chemicals

Chemicals will be used within the AIN Facility at the University of Sydney. Provided in **Table 3** is a list and quantities of the Dangerous Goods stored.

Table 3 Chemicals Stored in the Cleanroom within the Australian Institute of Nanoscience Building

Chemical	UN No.	Class	Sub Risk	PG	Quantity (L)
Dichloroethane	1184	3	6.1	II	88
Tetraethyl orthosilcate	1292	3	-	III	88
Acetone	1184	3	-	II	10
Ethanol	1170	3	-	II	10
Toluene	1294	3	-	II	10

In addition the quantities listed above, provisions are made the classes shown in **Table 4**.

Table 4 Additional Chemicals within Laboratories within Australian Institute of Nanoscience Building

Class	Quantity (L)
3	200
5.1	200
8	400

4.2.1 Total Chemicals Stored

Provided in **Table 2** is a summary of the quantities for each class of gas held within the facility.

Table 5 Quantities of Classes Stored within the Australian Institute of Nanoscience Building

Class	Quantity (kg[1])
3	406
5.1	200
6.1	88
8	400

[1] It has been assumed that 1L is approximately the same as 1kg for all intents and purposes of this assessment for liquids, gas weights have been assessed in **Appendix A**

5.0 SEPP33 Screening

Shown in **Appendix A** is the process used to calculate the weight of gas in each of the cylinders required for the SEPP33 Screening.

5.1 Class 2.1 – Flammable Gases

A review of the quantity of flammable gases stored on site revealed that there is approximately 95.5kg of flammable gases stored within the AIN facility. Above 100kg of pressurised flammable gas the amount of gas allowed to be stored is determined by separation distances to sensitive and non-sensitive land uses. As the quantity of gas stored is <100kg SEPP33 is not triggered and so no further assessment is required.

5.2 Class 2.2 – Non Toxic, Non Flammable Gases

A review of the quantity of Class 2.2 Dangerous Goods stored revealed that 353.5kg will be stored within the AIN facility. It is noted that SEPP33 does not apply to Class 2.2 Dangerous and so it is not triggered and no further assessment is required.

5.3 Class 2.3 – Toxic Gases

A review of the quantity of Class 2.3 Dangerous Goods stored revealed that 326kg will be stored within the AIN facility. Under SEPP33 only 100kg of toxic gases can be stored. As the amount stored is greater than the threshold, the development is considered potentially hazardous under SEPP33 and further assessment in the form of a Preliminary Hazard Analysis (PHA) would need to be completed to proceed with the development.

5.4 Class 3 – Flammable Liquids

A review of the quantity of Class 3 Dangerous Goods stored revealed that 406kg will be stored within the AIN facility. Above 1 tonne of flammable liquids the amount of liquid allowed to be stored is determined by separation distances to sensitive and non-sensitive land uses. As the quantity of flammable liquids being stored is less than 1 tonne SEPP33 is not triggered and so no further assessment is required.

5.5 Class 5.1 – Oxidising Agent

A review of the quantity of Class 5.1 Dangerous Goods stored revealed that 296kg will be stored within the AIN facility. Under SEPP33 5 tonnes of Class 5.1 Dangerous Goods can be stored. As the quantity of oxidising agents being stored is less than 5 tonne SEPP33 is not triggered and so no further assessment is required.

5.6 Class 6.1 – Toxic Substances

A review of the quantity of Class 6.1 Dangerous goods store revealed that 88 kg will be stored within the AIN facility. The packaging group has not been specified for these Dangerous Goods and so the worst case scenario has been adopted and they are assumed to be PG I. Under SEPP33 0.5 tonnes of Class 6.1, PG I can be stored before SEPP33 is triggered. As the quantity is less than 0.5 tonnes SEPP33 is not triggered and so no further assessment is required.

5.7 Class 8 – Corrosive Substances

A review of the quantity of Class 8 Dangerous goods store revealed that 400 kg will be stored within the AIN facility. The packaging group has not been specified for these Dangerous Goods and so the worst case scenario has been adopted and they are assumed to be PG I. Under SEPP33 5 tonnes of Class 8, PG I can be stored before SEPP33 is triggered. As the quantity is less than 5 tonnes SEPP33 is not triggered and so no further assessment is required.

6.0 Conclusions and Recommendations

6.1 Conclusions

A SEPP33 Screening has been completed for the Australian Institute of Nanoscience building located at the University of Sydney in accordance with the methodology provided in Department of Planning document "*Applying SEPP33*". The screening showed that the majority of Dangerous Goods stored were below thresholds and so no further action is required in reference to these Dangerous Goods. However, the quantity of Class 2.3, toxic gases exceeded the threshold outlined in Applying SEPP33 and so the developmental would be considered potentially hazardous. For the development to proceed a PHA would need to be completed to assess the potentially hazardous nature of the development to ensure that the risks are As Low As Reasonably Practicable (ALARP).

6.2 Recommendations

It is recommended that a review of the potential uses of the toxic gases be completed to determine whether unnecessary amounts are being stored. If the total amount of toxic gases being stored can be brought below 100kg then this will be below the threshold and the development will not be considered potentially hazardous and so no further assessment would be required.

7.0 References

1) “Applying SEPP33” Department of Planning, State of New South Wales, 2008

Appendix A

Weight Calculation of Compressed Gases

Appendix A Weight Calculation of Compressed Gases

The weight of a compressed gas within a cylinder can be calculated using the ideal gas law shown below.

$$PV = nRT$$ **Equation 1**

Where

P = Pressure (atm)

V = Volume (L)

n = moles (mol)

R = 0.08206 ($L.atm.K^{-1}.mol^{-1}$)

T = Temperature (K)

Figure 5 was provided by the University of Sydney to highlight the cylinders being used within the AIN Facility.

Figure 5 Gas Cylinder Information

Compressed Gas Cylinders

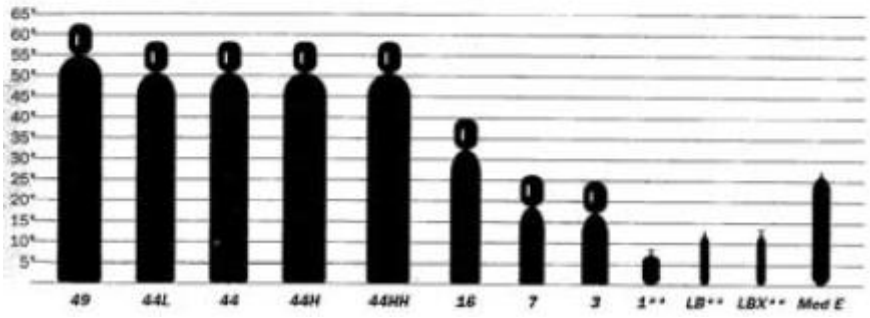
HIGH PRESSURE MILD STEEL

CYLINDER SIZE		49	44L	44	44H	44HH	16	7	3	1"	LB"	LBX"	Med E
Service Pressure	psig	2400	2015	2265	3500	6000	2015	2015	2015	2200	1800	1800	2015
Approximate Capacity*	liters	8071	5976	6740	9487	13990	2181	934.6	396.5	147	53.8	53.8	566
	cu. ft.	285	211	238	335	494	77	33	14	5.2	1.9	1.9	20
Outside Diameter	inches	9.25	9	9	10	10	7	6.25	4.25	4.2	2	2	4
Height w/o Valve	inches	55	51	51	51	51	32.5	18.5	16.75	7.25	12	12	26
Tare Weight w Valve	lbs.	143	112	133	189	303	63	28	11	6	3.5	4.5	14
Internal Water Volume	liters	49	44	44	44	42.9	16	7	3	0.98	0.44	0.44	4.5
	cu. in.	2990	2685	2685	2607	2383	976	427	183	60	27	27	275

* Ideal Gas at STP

** Non-returnable cylinder. Price of cylinder included in the price of the gas.

Note: LBX is an LB cylinder with a CGA valve other than 170 or 180



The pressure is assumed to be the service pressure which for a 44L cylinder (used in the AIN facility) is 2015 psig. Converted to atm, pressure is taken to be 141.7atms. The volume of the cylinder is 44L and the temperature is assumed to be 298K (25℃).

It is assumed that all cylinders are compressed to the service pressure and so the number of moles of any gas present in the cylinder can be calculated as follows.

$$n = \frac{PV}{RT}$$ **Equation 2**

$$n = \frac{141.7 \times 44}{0.08206 \times 298} = 255\ moles$$

Table 6 Weights of Compressed Gases Stored in the Australian Institute of Nanoscience Building

Gas	UN No.	Class	Sub Risk	Quantity (kg)
Argon	1006	2.2	-	43.5
Boron Trichloride	1741	2.3	-	95
Carbon Tetrafluoride	1982	2.2	-	49
Fluoroform	1984	2.2	2.3	36
Dichlorosilane	2189	2.3		52
Germane	2192	2.1	2.3	39
Hydrogen Chloride	1050	2.1	2.3	18.5
Helium	1046	2.2	-	4
Nitrogen	1066	2.2	-	14
Nitrous Oxide	1070	2.3	5.1	22.5
Ammonia	1005	2.2	2.3	18.5
Nitric Oxide	1660	2.3	5.1	15
Nitrogen Dioxide	1067	2.3	5.1	23.5
Oxygen	1072	2.2	5.1	35
Sulphur Hexafluoride	1080	2.2	-	74.5
Silane	2203	2.1	-	16
Acetylene	1001	2.1	-	13
Methane	1971	2.1	-	8
Hydrogen	1049	2.1	-	1
Helium	1046	2.2	-	7

Provided in **Table 7** is a summary of the quantities of the individual classes of Dangerous Goods.

Table 7 Quantities of Classes Stored within the Australian Institute of Nanoscience Building

Class	Quantity (kg)
2.1	95.5
2.2	353.5
2.3	326
5.1	96