CURTIN UNIVERSITY

PROJECT DELIVERY GUIDELINES

HAZARDOUS MATERIALS STORAGE GUIDELINES

000329

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide an overview of planning and design principles when consulting for Curtin University projects involving facilities and spaces where hazardous substances are or will be stored.

This guideline helps in the planning and designing of areas at Curtin University in which the storage of chemicals, gases and/or nanomaterials is conducted and where there is a potential risk or hazard to users and other people.

It also outlines Curtin's requirements and expectations for these areas complying with regulatory requirements and good practice to achieve consistency in the quality of the design and construction.

Curtin promotes a safe design approach and the adoption of a consultative risk management approach. The intent of this approach is to identify hazards and risks that can be eliminated or controlled as part of the design process.

1.2 EXCLUSIONS

The following areas are not included as part of this guidance document:

- chemical management
- Class 1 dangerous goods
- underground bulk storage tanks
- LPG and LNG
- bulk storage tanks
- liquefied chlorine
- cryogenic liquids
- waste management
- Class 7 dangerous goods – radioactive materials
- biologicals
- the built environment – asbestos, natural mineral fibres (NMF), chlorofluorocarbons (CFCs)
- concessional spirits
- emergency management.

For each of these areas, as with those addressed in this document, risk mitigation methods shall be integrated within design from the early stages of the project in order to minimise operational health, safety and environmental risk, and the need to address such issues after project completion. This shall be achieved by maintaining a safety-in-design risk register over the life of the project. Specialist input may be required.

1.3 LEGISLATIVE REQUIREMENTS AND STANDARDS

Design requirements must comply with relevant legislation and standards and referenced and related documents, which include, as a minimum, the following:

ACTS AND REGULATIONS

- National Standard for the Storage and Handling of Workplace Dangerous Goods
- WA Occupational Safety and Health Act 1984
- WA Occupational Safety and Health Regulation Regulations (1996)
- Work Health and Safety Act 2011 (Harmonised)
- Work Health and Safety Regulations 2011 (Chapter 7) (Harmonised)
- WA Industrial Chemical (Notification and Assessment) Act 1989
- WA Industrial Chemical (Notification and Assessment) Regulations 1990
- Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)
- Australian Dangerous Goods Code
- WA Dangerous Goods Safety Act (2004)
- WA Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007
- WA Dangerous Goods Safety (Security Risk Substances) Regulations 2007
- WA Medicines and Poisons Act (2014)
- WA Medicines and Poisons Regulations (2016).

RELEVANT STANDARDS

The applicable standards that may apply to the storage of chemicals, gas and nanoparticles at Curtin University are listed below:

- ADG Code 7.4 Australian Code for the Transport of Dangerous Goods by Road or Rail
- AS1940 The storage and handling of flammable and combustible liquids
- AS/NZS2243.1 Safety in laboratories – Part 1: Planning and Operational Aspects
- AS/NZS2243.2 Safety in laboratories – Part 2: Chemical Aspects
- AS/NZS2243.10 Safety in laboratories – Part 10: Storage of Chemicals
- AS/NZS3833 The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
- AS1894 The storage and handling of non-flammable cryogenic and refrigerated liquids
- AS4326 The storage and handling of oxidizing agents
- AS2714 The storage and handling of organic peroxides

- AS/NZS4452 The storage and handling of toxic substances
- AS3780 The storage and handling of corrosive substances
- AS/NZS4681 The storage and handling of Class 9 (miscellaneous) dangerous goods and articles
- AS1216 Class labels for dangerous goods
- AS4332 The storage and handling of gases in cylinders
- AS4289 Oxygen and acetylene reticulation systems
- AS1894 The storage and handling of non-flammable cryogenic and refrigerated liquids
- AS3961 The storage and handling of liquefied natural gas
- AS/NZS1596 The storage and handling of LP Gas
- AS/NZS2022Anhydrous ammonia – Storage and handling
- AS/NZS2982 laboratory design and construction
- AS/NZS60079 – Part 10.1: Explosive atmospheres Classification of areas
- ISO/TS 12901-1 (2012-11-15); Nanotechnologies – Occupational Risk management applied to engineered nanomaterials – Part 1 Principles and approaches
- ISO/TS 12901-2 (2014-01-15); Nanotechnologies – Occupational Risk management applied to engineered nanomaterials – Part 2 Use of the control banding approach.

REFERENCE DOCUMENTS

Reference to the following listed documents is required to complete the information provided by this guideline:

- *Guidance for the Storage of Chemicals*
- *Guidance for Gas Management and Gas Store Design*
- *Guidance for the Management and Assessment of Nanomaterials in Research*.

These documents are available as part of the Project Delivery Guidelines suite at https://properties.curtin.edu.au/workingwithus/guidelines.cfm.

1.4 RISK MANAGEMENT APPROACH

INTRODUCTION

Risk management is considered an acceptable way of organising efforts to determine safe systems for using, handling, generating and storing hazardous substances.

Laboratories, stores, workshops, pilot plant areas or any space where hazardous substances are used, handled, generated or stored are designed to address the many and varied requirements for safe operation and usage. The design process should include hazard identification, risk assessment and risk management to achieve safe and functional design.

Documentation of risk control measures and determination of residual risk, and the storage of this information in a manner that is useful and easily extracted is integral to understanding the University's overall hazardous substances risk profile. This shall be achieved by maintaining a safety-in-design risk register over the life of the project.

Project design teams must engage and collaborate with space users throughout the project process; the provision of appropriate, fit-for-purpose facilities that can be safely operated is considered the primary project outcome.

Examples of considerations that should be examined during the design process include:

- the type of activity for the area/room
- potential hazards (e.g. chemical, flammable, toxic, odour) related to the activity
- the impact of activities on surrounding spaces both internally and externally
- quantities and classifications of chemicals, substances and gas to be used and stored in the facility
- storage and delivery requirements
- special structural, anti-vibration, insulation or shielding requirements
- code requirements for provisions such as safety shower and eyewash locations, electrical exclusion zones, services isolation provision and bench clearances
- security requirements, systems and access control
- specialised containment or fume exhaust requirements
- after-hours emergency alert systems for occupant safety and for maintenance of preservation of important research material, samples and processes
- equipment requiring essential power and monitoring systems and a functional description of what the protocols are to alert security and laboratory staff should equipment or laboratory processes become faulty.

The risk management procedure that is based on *Storage and handling of dangerous goods – Code of practice* is outlined in Section 11 of *Guidance for the Storage of Chemicals*.

SECURE ACCESS ARRANGEMENTS

Imposing access restrictions to laboratory and hazardous substances storage spaces is the primary method of mitigating risk for University students, staff and contractors whose qualifications, induction level and/or operational requirements preclude them from unrestricted access to the space(s).

Access restriction shall be determined through risk assessment and must consider the range of personnel who may require access (e.g. Operations and Maintenance contractors such as cleaners who work outside business hours).

Special risk areas such as some scheduled poisons storage areas and radiation source storage areas may require a Security Management Plan to document the security measures in place and response measures agreed with Curtin Safer Communities for the purpose of assisting permit/licence holders in their communication with regulators.

Security control measures (detailed in *000327 PDG Security Infrastructure DesignGuidelines*) apply to the specific area types:

- Chemical, Gas Biological Labs and Research Areas (Restricted Space) – Area 17
- Hazardous Materials Storage – Area 18.

2 STORAGE OF CHEMICALS

2.1 BASIC PRINCIPLES FOR THE STORAGE OF CHEMICALS

Any storage of chemicals shall:

a) comply with the requirements of AS2243.10

b) comply with the requirements of the standards applicable to the storage of each class or mixed classes of dangerous goods stored

c) be subject to a documented and approved risk assessment and have documented control measures applied that provide a level of safety equal to or higher than that achieved by items (a) or (b).

The storage of chemicals, including wastes, shall be based on the properties and mutual reactivities of the chemicals. Incompatible chemicals shall be kept segregated from one another, e.g. by fire isolation in a chemical storage cabinet or by segregation in space. A separate spill catchment shall be provided for each incompatible liquid.

Chemical storage capacity shall be determined on the needs of the user group(s) and shall aim to eliminate the risks resulting from inappropriate chemical storage resulting from inadequate facilities.

The segregation for chemicals is based on their compatibility with other dangerous goods and should be identified within safety data sheets. Further guidance on compatibilities is given in Section 4 of *Guidance for the Storage of Chemicals*, as per the *Storage and handling of dangerous goods – Code of practice*.

2.2 STORAGE OPTIONS

2.2.1 STORAGE OPTIONS OVERVIEW

Curtin's policy is to maintain chemical quantities in 'exempt' or small quantities. Where there is a requirement to store chemicals above placard quantities, specific risk assessments and design considerations must be undertaken. Storage above placard quantities will necessitate a dangerous goods licence.

Chemical quantities and their storage arrangements are determined by AS/NZS2243.10: 2004.

Note: AS/NZS2243.10 allows a high level of flexibility in the range of hazardous chemicals that may be stored but it severely limits the total storage quantity. This standard is most appropriate for stores containing a large and possibly unpredictable range of hazardous chemicals, usually in relatively small quantities. Alternative standards may prove to be more suitable or practical and may be an option. However, different standards cannot be selectively applied to parts of the store.

For particular groups of chemicals or items, due to their hazardous nature or regulatory requirements, additional storage requirements may be necessary and will be informed by a risk assessment.

Further design considerations, including ventilation and location for each of these storage options are detailed in *Guidance for the Storage of Chemicals*.

Laboratory storage (exempt)

The quantities of hazardous chemicals stored in laboratories should not exceed those permitted to be stored in a laboratory other than in a chemicals storage cabinet, as per the maximum quantities stated in AS/NZS2243.

Shelving intended for storage of chemicals shall be appropriately bunded and constructed of chemically resistant materials. The location, number and size of shelving shall be determined based on volume requirements, segregation requirements and in consideration of proximity to egress pathways and safety equipment.

Chemicals amounts above these stated quantities must be stored within a compliant chemical storage cabinet; with their design and management taken into account.

Chemical storage cabinets

Chemical storage cabinets are used within a store or laboratory to prevent contact between incompatible substances, to provide appropriate bunding and to reduce the rate of a fire spreading. Cabinets may be used for the storage of packaged dangerous goods of classes and divisions 3, 4.1, 4.3, 5, 6.1 and 8. Incompatible chemicals shall not be stored together. Separate chemical storage cabinets shall be used to maintain appropriate segregation.

The capacity of any chemical storage cabinet used in a laboratory to store chemicals of classes 4.1, 4.2, 4.3, 5.1 or 5.2 shall not exceed 50 L. For other chemicals, the capacity shall not exceed 250 L.

The aggregate cabinet storage capacity, in a radius of 10 m measured from any one cabinet shall not exceed 250 L or 250 kg.

Other design considerations are detailed in Section 9 of *Guidance for the Storage of Chemicals*, including:

- preferred colours for cabinets
- maximum quantities of chemicals
- location of cabinets
- construction
- ventilation
- cabinet marking
- exclusion of ignition sources.

Laboratory and Workshop chemical stores (small quantities)

The maximum storage quantities of various types of chemicals shall not exceed the quantities specified in AS2243.10 and the aggregate maxima.

The maximum quantity of all substances in the store must not exceed 4,500 L or 4,500 kg.

Safety equipment, such as an eye-wash facility, emergency shower and the provision of a first aid station must be included in the planning and design of laboratory chemical stores.

2.2.2 LABORATORY STORE CONSTRUCTION

For external and internal stores, the store construction shall comply with the requirements for flammable liquid stores in AS1940. Such design features as:

- floor construction and treatment
- spillage containment
- temperature
- fire-resistance levels
- ventilation
- access
- fire protection

are detailed further in Section 7 of *Guidance for the Storage of Chemicals*.

2.2.3 DISPLAY OF HAZARD IDENTIFICATION INFORMATION

Signage at the entrance to a laboratory chemical store shall be displayed, including:

- restricted access - "Authorised access only" (or equivalent) (refer to AS1319)
- dangerous goods (DG) diamonds.

Placarding is required when volumes of gases exceed those identified in *The Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007, Schedule 1 — Quantities of Dangerous Goods*.

Placard specifications and signage information are detailed in Section 8 of *Guidance for the Storage of Chemicals*.

2.2.4 SCHEDULED POISONS

The storage and use of restricted poisons, medicines and drugs for the purpose of teaching, analysis and research is governed by strict regulatory requirements. The relevant schedules of poisons under the Poisons Act (schedules 4,7,8) require differing storage and handling that will determine specific design requirements, e.g. mandatory use of a safe for the storage of schedule 8 medicines. Details for each of these scheduled poisons requirements are further explained in Section 12 of *Guidance for the Storage of Chemicals*.

The Office of Research and Development (ORD) Poisons Safety Officer shall be identified as a stakeholder for any project involving the storage, use or handling of scheduled poisons.

3 STORAGE OF GAS

3.1 CLASSIFICATION

Gases that are compressed, liquefied or dissolved under pressure are classified in the Australian Dangerous Goods (ADG) Code as dangerous goods of Class 2. The classes of gas and the association with the Globally Harmonized System of classification and labelling of chemicals (GHS) are further explained in Section 4 of *Guidance for Gas Management and Gas Store Design*.

For further information on gas classification, cylinder sizes and gas capacities refer to Section 4 of *Guidance for Gas Management and Gas Store Design*.

3.2 HAZARDS

All compressed and liquefied gases should be regarded as hazardous, with some of the hazardous properties being:

- asphyxiant – asphyxiate gas will displace air when released in an enclosed space decreasing oxygen concentrations.
- flammable – flammable gases can burn or explode under certain conditions
- oxidising – oxidising gases can react rapidly and violently when in presence of an ignition source
- corrosive – some gases can burn and destroy living tissue or corrode metals
- toxic – toxic gases cause adverse health effects with exposure through inhalation, eye or skin contact.
- highly reactive – some pure compressed gases are chemically unstable.

3.3 STORAGE QUANTITIES

Where feasible, the quantities of gas should be restricted to the minimum levels consistent with the operations of the laboratory, workshop, pilot plant area or any space where gas is used, handled, generated or stored. The maximum quantities of gases permissible for 'minor quantities' storage and dangerous goods storage are shown in Section 5 of *Guidance for Gas Management and Gas Store Design*.

Where gas storage capacity is being increased for a space, building or site, the impact of increased storage capacity on the space, building and site shall be considered and appropriate controls implemented.

3.4 GAS STORE DESIGN

The design, installation and commissioning for gas storage shall be carried out by competent personnel with experience in the required field(s).

Equipment and systems provided shall be new, free from defects and meet with the relevant technical specifications.

Gas storage areas shall be designed to accommodate shorter and smaller sized gas cylinders (C, D and E), and not singularly F and G sized bottles.

3.4.1 GENERAL STORE REQUIREMENTS

Gas stores should be located outdoors, preferably in a secure cage protected from sunlight. Storage indoors is not recommended; unless the building has been designed for that purpose with appropriate fire-rated walls and ventilation. Where gases are stored indoors, additional safety considerations and control measures need to be given.

Relevant design requirements as per AS4332 are detailed in *Guidance for Gas Management and Gas Store Design* and include:

- location of gas store
- floor construction
- construction materials and the minimum fire resistance level
- access security
- electrical equipment and fittings
- possible ignition sources
- segregation and separation of incompatible gases (as per AS4332 and AS4289).

OUTDOOR MINOR STORAGE

In addition to the general store requirements, outdoor minor stores for gases in cylinders should be separated from other dangerous goods stores by a minimum distance of three metres, in accordance with AS4332.

Outdoor stores should not be located within one metre from any door, window, air vent or duct.

INDOOR MINOR STORAGE

In addition to relevant general store requirements, the keeping of cylinders indoors shall be in accordance with AS4332 and its restrictions. (Refer to Section 5 of *Guidance for Gas Management and Gas Store Design*.)

STORES ABOVE MINOR QUANTITIES

Where the gas storage requirements exceed minor quantities and the store location is adjacent to a building or located within a building, design and construction should be in accordance with AS4332.

3.4.2 STORAGE LOCATION IN LABORATORIES

GENERAL

The storage of size F, G and K gas cylinders inside a building should be avoided wherever possible. Gas storage should be located outside the building and reticulated into the areas where gas is required.

Where storage outside the building is not possible, provisions can be made for the storage of gas cylinders in the laboratory; however, additional safety considerations and control measures need to be given.

For the storage of gases in a laboratory, consideration is to be given to the type of gas being stored and the additional safety design elements that include:

- gas/air quality monitoring sensors
- ventilation
- fire-rated walls
- securing of cylinders
  - using a purpose-built, non-abrasive coated chain, strap or cable, or
  - using a secure racking system
- appropriate signage
- optimal temperature – the integrity of gas cylinders can be compromised if stored at high temperatures.

The laboratory storage should be as close as possible to the usage point. The cylinders are to be stored in an upright position in a dry, well-ventilated area that is away from pedestrian traffic, and does not impede access to stairs and walkways. This area should not be subject to mechanical or physical damage, heat or electrical circuits, to prevent possible explosion or fire.

Further storage requirements and the requirements for high-risk gases and LP gas are given in *Guidance for Gas Management and Gas Store Design.*

3.5 GAS RETICULATION

Specific details are given in Section 7 of *Guidance for Gas Management and Gas Store Design*.

General design considerations include:

The storage of size F, G and K gas cylinders inside a building will be avoided wherever possible. It is preferred to locate cylinders outside the building and reticulate into the areas where gas is required.

The suitability for the type of gas and purity required should be considered when designing gas reticulation systems. It is integral that laboratory users are engaged in the design process to ensure the reticulation system will meet their required gas and purity needs.

Required controls shall be determined using risk assessment and include assessment of ventilation and air exchange, reticulated pressure and other safety devices fitted, such as regulators, flashback arrestors and excess flow valves.

Relevant information on valves and regulators and special provisions for oxygen and acetylene are provided in Section 7 of *Guidance for Gas Management and Gas Store Design*.

Where flammable gases are reticulated into laboratories, a hazardous area assessment should be prepared by a suitably qualified hazardous substances consultant, mechanical engineering consultant or gas specialist.

Emergency gas shut-off must be installed in any laboratory where there is reticulated gas. This shut-off may interface with other services, such as electrical services or other piped services shut-off, or with the operation of mechanical extraction. The requirement to interface with other services shall be determined using risk assessment.

The need for ongoing maintenance and servicing checks of gas reticulation and alarm systems is an important consideration.

3.6 OTHER SAFETY REQUIREMENTS

3.6.1 VENTILATION

It is a requirement of AS4332 that stores must be provided with an appropriate ventilation system, such as:

- natural ventilation
- mechanical ventilation.

3.6.2 HAZARD IDENTIFICATION

Appropriate signage is to be displayed at the entrance to the gas store:

- restricted access with a sign "Authorised access only"
- dangerous goods (DG) diamonds.

Refer to AS1216 for details of specific class labels for dangerous goods.

Refer to AS1319 for requirements of safety signs for the occupational environment.

Placarding is required when volumes of gases exceed those identified in *The Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007*, *Schedule 1 — Quantities of Dangerous Goods.*

Examples and specifications for signage and placarding are detailed in Section 6 of *Guidance for Gas Management and Gas Store Design*.

3.6.3 FIRE PROTECTION

The store should be equipped with an alarm that will sound at an attended place when there is smoke, or when heat is generated.

The selected method of fire protection shall be compatible with all hazardous chemicals stored. As a minimum, there shall be one portable fire extinguisher immediately outside the door to the store.

Additions or changes to fire protection for the space may trigger the need to update evacuation diagrams.

Additional requirements are needed for acetylene as per AS4289.

3.6.4 GAS DETECTION

A comprehensive laboratory gas monitoring system may detect gas leaks, gas releases, ventilation failures, and power failures.

A risk assessment should be carried out to determine the requirement for gas detection wherever gas is used.

A gas detection system may interface with emergency shut-offs such as gas supply or electrical services, or with operation of mechanical services. The need for the gas detection system to interface with other systems shall be determine using risk assessment.

When gas detection is installed, a Gas Alarm Response Plan shall be prepared in collaboration with end users and external emergency response personnel.

3.6.5 SAFETY EQUIPMENT

The requirement for access to an eye wash and a shower shall be determine through risk assessment. Additional safety showers and/or changes to safety shower locations shall trigger the need to update evacuation diagrams, and must be communicated to Operations and Maintenance.

A first-aid station shall be provided in a clean area. It shall comprise, as a minimum, an appropriate first-aid kit and first aid instructions, e.g. SDS, for all substances being kept or handled.

4 STORAGE OF NANOMATERIALS

4.1 GENERAL

Nanoparticles are ultra-fine particles having a diameter between 1 and 100 nanometres (nm) and may be suspended in a gas or liquid, or embedded in a matrix in the case of composites. Nanoparticles (NPs) can occur naturally or be engineered using nanotechnology.

Engineered nanomaterials are designed with specific properties in mind and encompass nano-objects and nanostructured materials. The former are defined as materials with one (nanoplate), two (nanorod) or three (nanoparticle) external dimensions in the nanoscale (i.e. between approximately 1 and 100 nm).

Nano-objects, and their agglomerates and aggregates greater than 100 nm (NOAA) are applicable to engineered materials that consist of nano-objects such as nanoparticles, nanofibres, nanotubes and nanowires, as well as aggregates and agglomerates of these materials.

NANOMATERIALS AS HAZARDOUS MATERIAL

Hazard levels for nanomaterials are currently unestablished or incomplete. With the limited knowledge about the toxicity of some nano-objects, agglomerates and aggregates (NOAAs) and the concern that current safety data sheets do not adequately reflect the hazardous nature of such NOAAs, it is recommended that all nanomaterials in a particulate form or in a form where particles potentially could be released are considered potentially hazardous unless sufficient information to the contrary is obtained.

The current advice is to approach the risk management of these materials conservatively. If there is no exposure, no dose will accumulate and, despite the potential toxicity of the particles, there will be no risk to health.

HEALTH EFFECTS

The potential health risk of a substance is generally associated with the magnitude and duration of the exposure, the persistence of the material in the body, the inherent toxicity of the material, and the susceptibility or health status of the person. Since nanotechnology is an emerging field, there are uncertainties as to whether the unique properties of engineered nanomaterials also pose unique occupational health risks.

EXPOSURE ROUTES

Primarily, the inhalation of nanoparticles is the main potential risk to health, with dermal exposure and ingestion being other routes. The amounts of nanomaterial processed or manufactured in the workplace is one of the most important determinants of exposure. The presence of large amounts of NOAA in the workplace increases the potential for the generation of a higher concentration in the air and, therefore, can lead to higher exposures.

As a consequence, there is a need to assess activities and gather information to estimate potency of the process to release NOAA into the workplace air. For further information, refer to Section 7 of *Guidance for the Management and Assessment of Nanomaterials in Research.*

4.2 RISK MANAGEMENT

GENERAL MANAGEMENT APPROACH

The health risk potential of engineered nanomaterials will depend on the nature of the nanomaterials, magnitude and period of exposures to airborne nanomaterials, and also on the transformation, release and dispersion. The implementation of exposure controls of nanomaterials in the workplace can be utilised to reduce the risk potential.

One of the difficulties in applying this approach to nanomaterials is that the information available might be incomplete or, worse, incorrect. It is inappropriate in the absence of knowledge to assume that a nanoparticle form of a material has the same hazard potential as it has in a larger particulate form.

Where exposure cannot be prevented, the methodology involves assessing the risks and applying controls. This is further detailed in Section 7 of *Guidance for the Management and Assessment of Nanomaterials in Research*.

SELECTION OF CONTROLS

In general, the purpose of applying controls is to ensure that exposure of the workforce is as low as reasonably practicable. In general, it is advisable to adopt a control as high in the control hierarchy as is technically and economically feasible.

It is difficult to make specific recommendations concerning the control approaches to be used in specific exposure situations. However, several generic approaches can be applied that might be helpful.

Control banding (CB) is an approach by which control methods are selected based on knowledge or assumptions about the hazardous nature of the materials being used and the exposure potential of the situation. CB has frequently been used in risk management guidance for other particles and chemicals and is usually based on a matrix having the axes of exposure and hazard, into which various control approaches are placed.

The control banding process, the five control approaches and additional control measures are detailed in Section 10 of *Guidance for the Management and Assessment of Nanomaterials in Research.*

Measurement methodology and health surveillance are the basis for monitoring and evaluating controls.

CONTROL OF EXPOSURE TO NOAA

Design considerations include:

- use of contained installations – to isolate personnel from the process of deliberate release of NOAAs into the air

- use of extraction ventilation e.g. fume cabinets, fume hoods and dust extractors with the selection dependent on the level of risk
- limiting access to areas that contain nanoparticles.

In addition, there should be easy access to equipment for maintenance and performance testing.

PREVENTION OF FIRE AND EXPLOSION

The same principles applying to the management of fine powders, dusts or dusty materials should be considered for nanoparticles, as some types of nanoparticle products can be raised from a layer and become airborne more easily than coarser products, and remain in suspension for a long time.

Additional design considerations include:

- using explosion protection measures
- preventing reactive or catalytically active nanoparticles from contacting incompatible substances
- implementing fire prevention measures (complying with existing regulations), especially with regard to electrical equipment protection
- taking precautions to avoid the risk of auto-ignition of NOAAs
- selecting an appropriate extinguishing agent taking into account the compatibility or incompatibility of the nanomaterial with water.

ABBREVIATIONS

Abbreviation	Term
CB	Control banding
CFCs	chlorofluorocarbons
DG	Dangerous goods
GHS	Globally Harmonized System (of classification and labelling of chemicals)
NCC	National Construction Code
NMF	natural mineral fibres
NOAAs	Nano-objects, agglomerates and aggregates
SDS	Safety Data Sheet

REFERENCE DOCUMENTS

Title
Guidance for the Storage of Chemicals
Guidance for Gas Management and Gas Store Design
Guidance for the Management and Assessment of Nanomaterials in Research
Storage and handling of dangerous goods – Code of practice