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A REVIEW OF CHANGES TO DSEAR FOR THE INCORPORATED NATIONAL ASSOCIATION OF BRITISH AND IRISH MILLERS LTD

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1. Background

The Dangerous Substances and Explosive Atmosphere Regulations (2002) (DSEAR) has been amended with effect from December 2016. The changes should not place additional burdens on business, as the hazards should already be controlled.

In summary all gases held or used at pressures greater than 2 Barg are now, additionally regulated by DSEAR. The change aligns DSEAR hazardous materials with CLP[1]. Broadly, this brings into DSEAR many compounds which have no reactivity or hazard other than retained energy by virtue of pressure. Materials commonly found on sites have also been brought under DSEAR by a change in the definition of flammability; the temperature range of 'flammable' has a revised upper limit of 60°C compared to the previous 55°C. Materials such as diesel, gas oil and light heating oils are now explicitly classified as flammable.

The Health and Safety Executive has not updated the DSEAR ACOP (L138 2nd edition) in response to the changes and indicates that hazards, controls and consequences should already be managed.

The impact to nabim members should be minimal. In addition to diesel and fuel oils the most common area where nabim members are likely to be affected are gases at pressures over 2 Barg are:

- Natural gas.
- Compressed air systems
- LPG fuel tanks and cylinders
- Compressed gas cylinders

The number and scope of regulations pertaining to materials, handling, equipment and management is extensive in the UK and Ireland. This document is limited in scope to DSEAR though the principles will have applicability across nabim.

2. Diesel, gas oil and light fuel oils.

Although these materials are now classified as flammable and require Hazardous Area Classification [HAC] and suitable risk assessments the physical chemical properties of the materials remains the same. The dominant physical property is the Flash Point which is frequently greater than 50°C. This document cannot provide examples of every context for the storage and use of these materials.

[1] Classification, Labelling and Packaging of Chemicals Regulations.

Storage in plastic Intermediate Bulk Containers [IBCs] should be avoided as plastic provides no effective containment in the event of a small nearby fire [https://www.youtube.com/watch?v=_pfbHGxyHNc]. Attention needs to be paid to secondary containment and the potential for escalation. Many fuel tanks are designed with integral bunds which has advantages. Tanks with integral bunds can reduce the effects of solar heating of the headspace; in addition designs with top-filling and top-discharge are preferable, as there is no simple method of draining such tanks. Protection against vehicle impact and possibly tertiary [environmental] containment can respectively reduce the likelihood and consequences of accidental releases.

The elevated flash point of these fuels implies that flammable vapour clouds are not expected even in exceptionally warm weather conditions experienced at nabim members' sites.

In use, for example as fuel for boilers, the supply pressure is most likely to be low (less than 3Barg) and the potential for a failure of pipe work to from a mist or fine spray is very low. Higher pressures can cause sprays to be formed when small leaks occur; such mists can be ignited at temperatures significantly lower than the nominal Flash Point. HSD has been involved in remedial work following an incident[2] where an oil spray from a high pressure system was drawn through a burner combustion-air fan into the combustion chamber that resulted in an explosion.

HAC and explosion risk assessments for such fuels in normal and foreseeable abnormal circumstances are necessary but unlikely to be onerous.

3. Natural Gas

It is unlikely that natural gas is at a pressure greater than 2 barg after it has been received on site and pressure regulated for distribution across site. For larger sites the inlet and pressure reduction facility will commonly be the property of, and managed by the gas supply company. There is a duty of co-ordination in DSEAR which should manage the DSEAR hazards, controls including Hazardous Area Classification (HAC) and equipment maintenance and selection. Irrespective of inlet pressure, inlet stations and metering stations require DSEAR risk assessments and HAC. There should be no changes as a result of this legislative change.

4. Compressed Air Systems

Compressed air systems are commonplace for instrument air and pneumatic conveying. Compressors and receivers, although operating at pressures in excess of 2 Barg, very rarely present hazards beyond those of stored energy.

[2] A UK food site but not nabim.

The design, installation, use and maintenance of compressors and compressed air systems should already be adequately controlled by the provisions of e.g. Pressure Systems Safety Regulations [PSSR], Provision and Use of Work Equipment Regulations [PUWER] and the Management of Health and Safety at Work Regulations. HSD proposes that businesses (a) record they have compressed air systems in their DSEAR assessments and (b) reference the PSSR/PUWER assessment controls. It is not recommended that PSSR/PUWER assessments are duplicated in the DSEAR assessments.

5. LPG Fuel Tanks and Compressed Gas Cylinders

It has long been HSD's practice to assess the storage and use of liquefied and compressed flammable gases within DSEAR assessments. Much of the requirements are subject to industry codes. Consideration of hazards includes the Control of Substances Hazardous to Health [CoSHH] though this is outside the scope of this briefing document. The contents of liquefied and compressed gas cylinders can be divided into a number of hazardous properties; pure compounds or mixtures may possess one or more hazards:

- Oxidising
- Inert
- Toxic / Very Toxic
- Flammable
- Pyrophoric or
- Corrosive.

All gases with the exception of oxygen and air are asphyxiant; though oxygen is not without safety concerns.

Oxygen is a particularly powerful **oxidising agent** and will greatly assist in combustion. The presence of oxygen will make ignition of substances easier which, for example, includes oils / greases and clothing. The former can auto-ignite with explosive consequences. The latter can result in oxygen being trapped in layers of clothing and carried about with the person. Oxygen is most likely to be uses as in oxy-fuel cutting / welding equipment.

Examples of **inert** gases are nitrogen and carbon dioxide; both are asphyxiant and the latter is toxic. The majority of nabim member's sites are unlikely to have pure nitrogen. A common gas mixture used by nabim members is the 'Argoshield' range [an Argon, Carbon Dioxide, Oxygen blend] used for MIG welding. Inert gases are not combustible; therefore it is the pressure hazard which is dominant within DSEAR.

Toxic compounds that might be found at a limited number of nabim sites include Carbon dioxide [CO_2] or refrigerants; CO_2 may be found as fire suppression in computer rooms or ovens. Ammonia may be found as a refrigerant and its use appears

to be making a resurgence; ammonia is particularly toxic and also combustible. Ammonia has always required DSEAR risk assessment and HAC in addition to CoSHH. Other refrigerants are likely to be fluoro/chlorocarbon based and non-combustible.

Many **flammable** gases can be found at nabim members' sites including LPG, Propane / Butane and acetylene. Acetylene is a very dangerous gas, not only is it flammable it is potentially unstable and violent decomposition can occur if acetylene cylinders are overheated or exposed to fire. Sudden impact can also initiate decomposition; handling with due care is also required. Acetylene cylinders are typically used for oxyacetylene cutting, welding etc. Alternative fuels and equipment are available e.g. oxy-propane, but these fuels do not burn as hot as oxy-acetylene. Nabim members are advised to review the necessity of acetylene, that flashback arrestors are fitted, and regulators hoses and lances are well maintained.

It is exceedingly unlikely that nabim members will have **pyrophoric** materials and the matter is not considered further.

No matter which liquefied or compressed gas a cylinder contains, a nearby fire can emit infra-red radiation with such intensity as to cause over pressurisation and rupture. Nabim members should give due consideration to the design and location of gas cylinder storage.

Some cylinders are fitted with over pressure safety devices such as:

- propane, butane and other LPG cylinders;
- some older acetylene cylinders;
- carbon dioxide cylinders and
- transportable vacuum-insulated cryogenic gas containers.

Although such cylinders may be protected by integral pressure relief devices this should prevent rupture when the cylinder is exposed to excessive heat. If a cylinder releases its contents through an integral protective device, then a hazardous situation is very likely to arise in the vicinity of the release.

Cylinders should be stored in an upright position with the valve closed and the plug in place; this requirement is an absolute for the storage of liquefied gases. Leakage of a small quantity of liquid LPG from a cylinder will create a large volume flammable atmosphere of the order of 17,000 times the liquid volume [based on liquid propane].

A common misconception is that nominally empty gas cylinders are 'empty'; they continue to contain the original material albeit at a reduced pressure. It is recommended that such 'empty' gas cylinders are viewed as equally hazardous as 'full' cylinders, though they will be managed slightly differently.

5.1 Management of cylinder stores

It is a common need for sites to manage a number of different gases in cylinders. It is unsafe simply to put all cylinders irrespective of 'full' or 'empty' into one or two cages. The following advice is provided.

1. Stores should be marked with the appropriate safety hazard signage.
2. Cylinders should be stored upright with suitable measures to prevent them toppling over. This can include secure chains or lashings or the use of specially designed pallets. Round-bottomed cylinders and small cylinders may require additional arrangements.
3. Cylinders should be kept out of puddles or pools so as to prevent corrosion.
4. Full (including part used) cylinders should be stored separately and the areas properly identified with signs such as "Gas cylinders FULL" and "Gas cylinders EMPTY".
5. Generally, gases with the hazard category should be grouped together and the areas properly identified according to the gases stored.
6. Toxic gases (e.g. ammonia). By storing toxic gases separately from other gases there will less activity in the area, reducing risk of an accident and exposure of personnel should an incident occur. It is important to have good access to toxic gas cylinders for routine checking and control.
7. Unserviceable cylinders, or those under quarantine, should be stored separately from serviceable cylinders. Such cylinders should be returned to the gas supplier as soon as practicable.
8. Gas cylinders are legally required to be inspected every 5 or 10 years therefore greatly aged stock should be returned to the gas supplier as soon as possible.
9. Excessive stock levels should be avoided. Stock rotation on a first in first out principle should be employed.
10. Stores are to be kept clean and subject to regular housekeeping. Contamination of cylinders is to be prevented. All excess packaging and other combustible material should be removed. Contact with grease, oils, hydrocarbons or tarry substances may give rise to spontaneous ignition particularly with high pressure or oxidising gases.
11. Foreseeable emergency situations should be planned for and rehearsed.

The design of the store should follow general principles.

5.2 General principles of cylinder storage

The following should not be used to design gas cylinder stores; nabim members are directed to suitable guidance such as BCGA Guidance note GN2 and UKLPG Code of Practice No 7. The following distances between gas types

should be provided; greater separation is required from bulk gas storage if it is present. The use of suitable firewalls may eliminate the need for separation distances. Physical partitions or barriers may be used to reduce the separation distances. Where the site boundary adjoins a vulnerable population (e.g. school) then the store should be at least 8m from the boundary.

Feature	**Inert gas including CO_2**	**Oxidants**	**Flammables** Compressed or dissolved gases only e.g. H2 and Acetylene	**LPG and other liquefied flammables**	**Toxics**
Site boundaries	1m	1m	3m	1m < 400kg 3m >400kg	3m
Building openings (doors, windows etc.)	1m	1m	1m	3m	3m
Smoking, naked flames, sources of ignition and heat sources (including vehicles)	1m	1m	3m	1m<400kg 3m >400kg	3m
Unprotected electrical equipment	0m	0m	3m	1m <400kg 3m >400kg	0m
Air compressors and ventilation intakes (including boiler houses)	3m	3m	3m	3m	3m
Combustible material (e.g. paper, pallets etc.)	0m	3m	3m	3m	3m

In relation to the general siting of the stores the stores should:

- be located in the open air where there is good natural ventilation; storage within a building is not recommended;
- be sited away from designated emergency exits and escape routes;
- be at ground level for vessels containing cryogenic material, liquefied or heavier than air gases.
- Have no immediate pathways to underground facilities, basements, drains and cable ducts etc.;
- Not be located adjacent to other stores containing combustible material or products.
- Secure to prevent theft of cylinders.
- Where LPG is stored, then 1 off 9kg powder firefighting cylinder should be provided for up to 400kg LPG.

LPG and other liquefied flammable gases should be stored separately to other cylinders.

5.3 Ventilation

Ideally, the store would be well ventilated with no roof and up to two solid walls. High walls (>2m height) or thin corridor style storage is not conducive to good ventilation. Generally, no more that 50% of the perimeter should be obstructed. However, a typical storage facility for non-flammable cylinders or for small quantities of flammable cylinders can comprise three adjacent walls provided that at least 25% of the perimeter is constructed to ensure that ventilation is not impaired e.g. mesh fencing.

If overhead weather protection is required, then it should be constructed so as to prevent pockets of (lighter than air) gases forming. Gaps between end walls and sloping roofs can provide this.

5.4 Access

Access to the cylinder store requires careful consideration. Given that most cylinders will require specialist trolleys for moving them then sufficient room is needed to allow free access for the trolley and operator to safely stow or remove a cylinder. The ground should be suitable level or sloped to enable full control of a trolley to be maintained throughout the journey. Concrete laid with a slight fall, to prevent puddling, is ideal.

Where installed emergency exits should open outwards from the store and not require a key, card or another device to operate. The escape route should be unobstructed and clearly signed.

5.5 Lighting and electrical equipment

The area should have adequate lighting to enable reliable identification of cylinders and contents, retaining chains or sashes, clear sight for the movement of cylinders. Where flammable materials are stored consideration might be required as to whether suitably rated lighting/electrical equipment is necessary.

The non-flammable gases likely to be found on nabim member sites are Argoshield, Carbon Dioxide (fire suppression) and possibly reduced oxygen blends for packaging any added value products. The comments relating to the storage and use (above 2 barg) made in 3 Compressed Air Systems would apply equally here.

6. Conclusions

The changes to DSEAR by the inclusion of gases at greater than 2 Barg should have little additional burden to nabim members. If materials are non-combustible then nabim members should consider referencing risk assessments from within their DSEAR Risk Assessment; additionally, no HAC is necessary for non-combustible materials.

Nabim members are encouraged to review the suitability of compressed gas cylinder and LPG storage arrangements by comparison to existing codes.