Issues in DSEAR Implementation 2015

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The DSEAR legislation has been implemented in the UK since 2003. The regulations implemented sections of a number of EU directives, principally Directive 99/92/EC (also known as 'ATEX 137' or the 'Workplace Directive') which is entitled: 'On minimum requirements for improving the health and safety protection of workers potentially at risk from explosive atmospheres'. These regulations have become familiar in many sectors of industry handling flammable materials.

As a result of the increasing EU pressure for global harmonisation and the implementation of the Classification, Labelling and Packaging Regulations, the definition of "Dangerous Substances" has been extended to include compressed gases where there is explosion potential and corrosive to metals. These changes came in during June 2015 but have not been widely publicised and are poorly understood. In practice, this may have a significant effect on some businesses which are not currently covered by DSEAR.

In practice, many people focus on the Hazardous Area Classification aspect of DSEAR and forget that the main purpose of the legislation is the prevention of injury to personnel from fire and explosion hazards. Thus, the important part of the legislation i.e. the Risk Assessment is often neglected.

There are many areas where conventional hazardous area classification is not applicable and yet "dangerous substances" are present. There is also a degree of confusion within many industries over what constitutes a dangerous substance and therefore confusion over where hazardous area classification is an applicable Basis of Safety. The use and limitations of hazardous area classification are discussed, in particular where high flashpoint materials are present and where it is impossible to eliminate ignition sources.

The concept of a DSEAR Basis of Safety is explored in this paper and the times when Hazardous Area Classification is and is not applicable are outlined. Several examples are presented including: Workshops e.g. vehicle maintenance and repair facilities Laboratories handling multiple materials and having multiple hazards Fuel dispensing installations

The topic of mists relating to pressurised release of high flashpoint fuels is considered and the potential effect on hazardous area classification. A rational approach to area classification is proposed using a Basis of Safety type argument.

The impact of the 2015 changes to DSEAR are discussed. Areas where further research and guidance are required are indicated.

Note: Tony Ennis is a member of the committee that writes the Energy Institute Area Classification guidance EI15. He also has extensive experience of DSEAR implementation and gas dispersion modelling.

Introduction

DSEAR (Ref.1) is the UK implementation of two EU ATEX directives with parts of the Chemical Agents Directive. The DSEAR legislation principally implemented two directives, these being:

- Directive 99/92/EC (also known as 'ATEX 137' or the 'Workplace Directive') which is entitled: 'On minimum requirements for improving the health and safety protection of workers potentially at risk from explosive atmospheres'
- Directive 94/9/EC (also known as ATEX 100a or the Equipment Directive') entitled 'Directive on Equipment and Protective systems intended for use in potentially explosive atmosphere'

When DSEAR was implemented in 2003, it was essentially a formalisation of what had been custom and best practice in the oil and chemical industries for many years. Whilst companies handling large quantities of solvents and other flammable materials had usually taken suitable precautions, many of the smaller companies, often only handling relatively small amounts of flammable materials were not as rigorous in taking suitable precautions for the protection of personnel from fire and explosion hazards in the workplace. DSEAR also tidies up parts of certain older legislation such as the Petroleum (Consolidation) Act 1928 which was partly repealed.

In particular, there was often little understanding of the requirement for hazardous area classification and a suitable risk assessment. There has long been the requirement for risk assessment under the Management of Health & Safety at Work Regulations (1992, updated in 1999, Ref.7). The requirement for the use of ignition protected equipment was also often neglected and equipment was often poorly installed or maintained.

One positive point from DSEAR was the harmonisation of hazardous area equipment standards across the EU and including all equipment being sold into the EU. Previously it was necessary to cross reference between various countries' standards when selecting hazardous area equipment and harmonisation of the standards saves much time and confusion during equipment selection and specification.

There are three key regulations in DSEAR, these being 5, 6 and 7.

Regulation 5	DSEAR Risk Risk Assessment. Specifically for the protection of people from fire & explosion hazards
Regulation 6	Risk Reduction. Implement a hierarchy of risk reduction and mitigation measures
Regulation 7	Hazardous Area Classification. Defines the areas where a flammable gas, vapour or dust cloud may occur

Dangerous Substances

Dangerous substances are defined within DSEAR as:

- Flammable materials (liquids, gases, vapours and dusts)
- Compressed gases where an explosion hazard exists
- Acids where contact with metal may liberate hydrogen

In 2015 this was extended to include the following categories as a result of the global harmonization of the legislation and change from the use of CHIP to CLP. It should be noted that this has not been widely publicised and the majority of companies are completely unaware of the requirement to take into consideration compressed inert gases e.g. gas cylinders and gas tanks. Further information on this change is provided below.

With regards to flammable materials, there is also a large degree of misunderstanding relating to whether certain materials should be subject to hazardous area classification or not. In particular, materials with flashpoints high than normal UK ambient temperatures. In several cases, companies have used the petroleum fuel classes in EI15 (Ref.5) to determine the requirement for hazardous area classification.

Class	**Flashpoint range**	**Requirement for area classification**
IA	Flammable liquids have a flash point below 73°F (22.8 °C) and a boiling point below 100 °F (37.8°C)	Area classification always required
IB	Flammable liquids having a flash point below 73°F (22.8 °C) and a boiling point greater than or equal to 100 °F (37.8 °C)	Area classification always required
IC	Flammable liquids having a flash point greater than or equal to 73 °F (22.8 °C) and below 100°F (37.8 °C)	Area classification always required (flashpoint close to UK ambient maxima)
II	Combustible liquids having a flash point greater than or equal to 100 °F (37.8 °C) and below 140 °F (60 °C)	Area classification always required if flashpoint <40°C or if operating within approximately 10-15°C of flashpoint
IIIA	Combustible liquids having a flash point greater than or equal to 140 °F (60 °C) and below 200 °F (93.3°C)	Area classification required only if operating within approximately 10-15°C of flashpoint
IIIB	Combustible liquids having a flash point greater than or equal to 200 °F (93.3 °C)	Area classification required only if operating within approximately 10-15°C of flashpoint

Thus it can be seen that the fuel class is not always a good indicator as to whether a material requires hazardous area classification. Hazardous area classification is only necessary when:

A material has a flashpoint which is lower than or close to the maximum ambient temperature

In practice, within the UK, this means materials with flashpoint <40°C since UK ambient temperatures may potentially reach 30°C. In order to provide a safety margin a difference of 10°C between ambient temperature and flashpoint is considered reasonable.

The material may be heated to above or close to the flashpoint in process or storage

This may seem fairly obvious, but consideration also needs to be given to ambient heating of tanks through solar radiation when surface temperatures of steel tanks may exceed 40°C in the UK.

There is a risk of formation of a flammable mist

This may typically occur during the splash filling of tanks, or in rare cases, when there is a pressurised release of liquid which is atomised. Mists are dealt with further below.

It should be noted that DSEAR is strictly only applicable to temperate climates i.e. those having a maximum ambient temperature in the order of 30°C. Where ambient temperatures may be higher, then the approach of ambient conditions to the flashpoint of the material must be taken into account when assessing the hazard and potential for flammable vapour generation. For example, in countries where ambient temperature may exceed 50°C e.g. Middle East and tropical zones, special consideration needs to be given for the potential generation of flammable vapour even for materials with flashpoint >60°C, especially where solar radiation may cause surface heating of tanks and equipment.

2015 Changes to DSEAR

Having become used to the legislation, in 2015, DSEAR changed as a result of the implementation of the globally harmonised Classification, Labelling and Packaging Regulations (CLP) to include:

- Compressed gases
- Substances corrosive to metals

At the time of writing, this has not been widely publicised and many companies are still unaware of the changes. The HSE website contains the following guidance (Jan 2016):

> *From June 2015 DSEAR also covers substances that are corrosive to metals and gases under pressure. It places a formal requirement on employers to assess the risks for substances if classified for these properties and put in place suitable control and mitigation measures.*
>
> *It is anticipated that the impact of these changes will be minimal because the intrinsic hazards of the substances being used or present in workplaces is unchanged. The need to carry out a risk assessment, and have in place procedures for the safe use of chemicals not currently covered by DSEAR, is already necessary to meet the general requirements of the HSW Act 1974, and the Management of Health and Safety at Work Regulations 1999. Businesses already complying with these duties are therefore unlikely to need to take any additional action.*
>
> *Since April 2015 mines are no longer exempt from DSEAR regulations 5(4)(c), 7 and 11.*

Whilst the changes are understandable, the assertion that "*Businesses already complying with these duties are therefore unlikely to need to take any additional action*" seems somewhat wide of the mark. In theory this one change means that anyone storing inert gas cylinders e.g. companies using MIG / TIG welding gases such as CO2 and Argon will now need to complete a DSEAR assessment for their cylinder use and storage, similarly any company with a bulk nitrogen tank. Additionally, it could be implied that DSEAR would now apply to any installation with a compressed air tank, any business refilling scuba diving tanks and all fire brigades refilling and storing air cylinders.

The scope and application of this particular part of the legislation would appear to need further clarification in order to prevent much unnecessary paperwork.

Hazardous Area Classification

Hazardous Area Classification is, in the author's experience, often poorly understood and badly implemented. It is probably one of the least well understood parts of the DSEAR legislation and the part that can be the most troublesome to implement.

There are four principal guidance documents:

BS EN 60079-10-1 (Ref.2) BS EN 60079-10-2 (Ref.3)	British Standards with IEC equivalents which give basic guidance for hazardous area classification and introduce some of the basic concepts around ventilation. Part 10-1 is for vapours and gases and part 10-2 is for dusts. This standard contain the basics of area classification and a limited number of examples.
IGEM/SR/25 (Ref.4)	This covers hazardous area classification specifically for natural gas installations. It contains a number of examples and tables of hazard ranges for various situations and gas pressures.
EI15 (Ref.5)	This guidance is produced by the Energy Institute and covers situations mainly relating to the oil and petrochemical industries. This guidance contains numerous examples covering a wide range of situations and materials. There are also various tables for hazard range estimation from leaks.

Despite the above documents, there is little applicable direct guidance for the fine chemical and pharmaceutical industries among others. Typical problems encountered are:

- Over-zoning of areas
- Inappropriate zoning
- Failure to understand the Basis of Safety for zoned areas
- Zoning of areas where ignition sources cannot be eliminated
- Inadequate or non-existent area classification drawings
- No written area classification i.e. drawings only provided
- Failure to specify Gas Group and Temperature Class for zoned areas

Over zoning is an issue where non-hazardous areas are zoned as a result of the misunderstanding or misinterpretation of the extent of flammable zones. This is an issue for two reasons, firstly it causes sections of plant to be effectively treated as high risk and secondly there is an increased cost of equipment since ATEX equipment is considerably more expensive than non-ATEX.

There are several methods by which hazardous area classification can be carried out. These can be summarised as:

Direct example	Use of a directly applicable example from one of the guidance documents	This is the preferred methodology, but the list of examples in the literature is not exhaustive
Modified direct example	Direct example modified for specific situation which may differ slightly from the direct example	If the situation is not too different to a direct example then it may be possible to estimate the zones by reference to the example
Risk Based	This is discussed in EI15 and the associated document "A risk-based approach to hazardous area classification"	This methodology is a risk based approach utilising the acceptability of risk and the frequency of releases and ignition. This method can be very time consuming to implement.
Gas dispersion	Model the release using an applicable gas dispersion model	Gas dispersion modelling can be useful but is generally limited to outdoor situations due to limitations on the lower wind speed in most dispersion models.
CFD	It is possible to use CFD modelling of dispersion to estimate zoning,	CFD modelling is time consuming and expensive and should only be considered for special situations.

From experience, over 10 years after DSEAR was implemented, it appears that many smaller companies do not fully understand where hazardous area classification is a requirement. This has led to several Improvement Notices being issued by the HSE.

The requirement for information on hazardous area classification can be summarised as follows:

- Written description of the size and shape of the zone
- Zone rating (0, 1, 2 or 20, 21, 22 as applicable)
- Drawing of the hazardous area
- A note of the Temperature Class and Gas Group of the hazardous materials in the area

The intent of the legislation is that the extent of the zone may be identified on the installation by reference to the area classification report and drawings. The drawings should, where necessary, indicate both an elevation and plan view unless the extent of the zone can be clearly assessed otherwise. The drawing does not have to be a fully dimensioned CAD drawing but must show the key features of the installation and the dimensioned extent of the zones such that the intent of the legislation is met.

Experience has shown that area classification drawings vary in standard between expensive to produce full CAD drawings and poorly hand drawn efforts. Several improvement notices have been issued by HSE due to unsuitable area classification drawings. Ideally the notation used in BS EN 60079-10 should be used for the drawings, but any other pattern may be used as long as there is a suitable drawing key.

It is essential that the Temperature Class and Gas Group be included in the area classification in order that hazardous area equipment can be correctly specified for the area. Where possible, blanket area classification should be avoided as this can result in significant additional equipment expense as well as restriction on operation of the area.

Limitations of Hazardous Area Classification

Hazardous area classification is, at best, an inexact science, especially when applied in the real world. Area classification is typically accurate to the nearest 1m for large zones and to the nearest 0.1m for very small zones. Examples of larger zones would include the hazard radii associated with larger pumps and examples of smaller ones would be the 100mm zone around petrol dispensers.

It is necessary to realise when zoning that the shape and extent of the zone is dependent on several factors, in particular:

- Release rate
- Release direction
- Release velocity

- Release density relative to air
- Release phase (gas, vapour, liquid, two-phase)
- Ventilation factors

To give an example, the author came across one case where gas dispersion had been used to model a zone surrounding a small hydrogen release where the area classification report stated a zone of 294mm. From this it was clear that the person preparing the report had a poor understanding of hazardous area classification.

Area classification is usually done is a conservative manner and therefore tends to over-estimate the size of zones for safety. This is reflected in the all of the guidance. Whilst gas dispersion can be used to estimate flammable zones, the limitations of the technique and the accuracy of gas dispersion models should be clearly understood and taken into account if reliance is placed on this methodology. Gas dispersion should be carried out to half LEL under a range of wind / weather conditions including low wind speed and stable atmospheric conditions and the worst case considered. Any potential deviations of release rate etc should also be taken into account during the modelling.

In practice, many people become obsessed by area classification and neglect the other aspects of DSEAR, in particular, the requirement to implement the hierarchy of risk reduction measures in Regulation 6.

It should also be clearly be understood that hazardous area classification is simply a basis of safety for areas where a flammable vapour may be foreseeable under normal operation. The basis of safety for zoned areas being the elimination (as far as is practically possible) of all ignition sources. Since it has been determined that a flammable gas, vapour or dust mixture may be present, the only means by which a fire or explosion can be prevented is the elimination of ignition sources within that flammable zone.

Temporary Zones

Some DSEAR zones may only be in place for a short period i.e. during certain operations or circumstances. Typical of these are:

- Zones in place during vehicle refuelling at petrol stations
- Road tanker discharging
- Drum or container filling

In addition, temporary zones may exist in the event of, for example, a spillage of flammable solvent into a bunded area. In this case, a temporary zone may extend beyond the bund wall whilst the spillage exists. The temporary zones is put in place for the period when the activity causing the zone is carried out, and then is removed when the activity is complete.

A simple example of this is the discharge of fuel from road tanker when a temporary zone is in place around the tanker discharge valves, which a 4m radius Zone 2 in place during the discharge process. Once the discharge is complete and the hose disconnected and stowed, the zone is removed, which then allows the road tanker to move off.

Experience has shown that temporary zones are often poorly understood and not properly indicated on area classification drawings.

Managed Zones

Whilst hazardous area classification is very important, it is equally important that zoning is applied intelligently. Under zoning can result in the potential for ignition of a flammable atmosphere but over-zoning can make it virtually impossible to operate a given process safely and in accordance with DSEAR.

It is, however, possible to manage a non-zoned area as if it were zoned for the purpose of providing additional safety in a given area, taking into account that this may have cost and operational implications. It is also possible to manage, for example, a Zone 2 area as a Zone 1. This can be in order to simplify the selection of equipment for a mixed zone installation and thus ensure that Zone 2 electrical equipment is not installed in a Zone 1 area in error. Where a zone is a “managed” zone, this should be clearly indicated on the area classification drawing and in the risk assessment.

Hierarchy of Risk Reduction & Mitigation Measures

Regulation 6 lists a hierarchy of risk reduction and mitigation measures. These can be summarized as follows in the order given in the regulation:

Risk Reduction Measures

1. Reducing the quantities of dangerous materials to a minimum
2. Avoiding the release of the dangerous substance
3. Control of any releases at source
4. Prevent of the formation of explosive atmospheres
5. Collection and removal to a safe place of materials which are released

6. Avoidance of ignition sources

7. Segregation of incompatible dangerous substances

Risk Mitigation Measures

a) Minimisation of the Number of Employees Exposed

b) Avoidance of Propagation of Fires or Explosions

c) Provision of Explosion Pressure Relief Arrangements

d) Provision of Explosion Suppression Equipment

e) Plant Constructed to Withstand Explosion Pressure (Containment Integrity)

f) Provision of Personal Protective Equipment

It can be seen that the measures are generally common sense in reducing the risk, however, it is possible to dispute the order in which they are implemented. For example, the second to last measure is *"(e) Plant Constructed to Withstand Explosion Pressure (Containment Integrity)",* and it could be argued that this is more inherently safe than (c) or (d) which are both listed above it since if an explosion is contained then there is no risk of the failure of a protective system to operate.

It is the author's personal view that the hierarchy listed in the regulations and followed in the HSE DSEAR Regulations and HSE ACOP (Ref.6) requires review. The ACOP gives extensive guidance on what is required for DSEAR compliance as well as useful interpretation of the DSEAR regulations. As such it is recommended reading for anyone involved in DSEAR compliance. In the event of an installation being found deficient by the HSE, an improvement notice is often issued under Regulation 6 of DSEAR with the statement of "*failure to implement the hierarchy of risk reduction measures"* being included. This is because the implementation of regulation 6 implicitly requires the consideration of regulations 5 and 7.

It should be remembered that the key to DSEAR compliance is to ensure that risks to personnel are controlled to an appropriate level for the activities being carried out and that the Basis of Safety for hazardous (zoned) areas is clearly understood.

DSEAR Risk Assessment

A DSEAR risk assessment is broadly similar in principle to any other risk assessment in that it considers:

- The possible hazardous events
- The causes
- Consequences
- Prevention, protection & mitigation measures in place
- Some assessment of the level of residual risk

The HSE guidance on risk assessment (Ref.9) gives basic risk assessment advice. The risk assessment should be tabulated, and should consider the hierarchy of risk reduction and mitigation measures listed in regulation 6 as above. Note that it may be useful to consider the measures in the hierarchy in which they are listed in the legislation.

Mists

Flammable mists can be formed as a result of the release of a pressurised liquid, usually one below its' normal flashpoint. Mists have unusual properties in terms of flammability, often being flammable well below the nominal flashpoint of the bulk liquid and also being flammable at a range of concentrations which would not be so under bulk vapour conditions of the same material. Mist may not disperse evenly due to gravitational effects and can also be affected by ventilation.

Many people are not aware of the difference between a mist and a spray and hence it is necessary to clarify the definitions in order that the potential for formation of a mist is put into context into context. Mists and sprays can be defined as follows:

- **Spray:** Large droplets, typically of mm size falling to ground under the effect of gravity within a very short space of time
- **Mist:** Small droplets, typically micron sizes forming a stable cloud which may take several minutes to fall to ground. May be seen as a white fog like cloud.

The two types of release should not be confused and experience has shown that sprays are often erroneously called "mists". HSE have carried out a literature survey (Ref.12) and a second report (Ref.13) on estimating the potential hazard from flammable mists. Neither of these reports has offered anything directly applicable to DSEAR other than to note the potential for mist formation in certain circumstances.

The current version of EI15 offers advice on mists, and states the following:

"Continuous and primary grade mist releases should normally only be associated with processes where a liquid is being deliberately sprayed e.g. spray painting."

This statement appears to be reasonable based on the author's experience or working in the fuel and chemical industries and is considered a good basis for estimating the potential for mist formation when carrying out area classification.

In addition, a presentation at a UK Explosion Liaison Group meeting in 2010 by HSL (Ref.14) indicated that there was an extremely small number of incidents directly attributable to mists, other than those where a mist had been generated deliberately e.g. during fumigation of buildings. The majority of the other mist explosion incidents were attributable to well known issues during loading of ships with bulk fuel or large diesel engine crankcase explosions. Only 33 relevant incidents were found over a 50+ year period worldwide using a variety of databases.

Thus, it can be concluded that mist explosion incidents in the process industries are extremely uncommon although it is entirely possible that there is some under-reporting of mist explosions world-wide. The risk of accidentally formed mists cannot be completely discounted from area classification and is dealt with in more detail in Annex 1 to EI15. It is recommended that the potential for formation of mists be considered during the DSEAR assessment where there is a significant risk of release of a high flashpoint material under high pressure.

Basis of Safety for Non-Zoned Areas

There are several types of area where flammable materials may be used and yet where hazardous area classification is not a valid basis of safety but DSEAR is still applicable. A brief list of these areas is:

- Workshops e.g. motor vehicle repair shops
- Laboratories

Workshops

Flammable materials are present in many workshops and may include such materials as the fuel in vehicle fuel tanks, oxy-acetylene or oxy-propane welding equipment plus flammable propane propellant found in aerosols and the inevitable oils and lubricants. The flashpoint of most lubricants (engine oil, greases) is well above the point at which area classification would be required, e.g. typical lubricating oil flashpoints are >80°C. There may, however, be smaller quantities of materials with low flashpoints in the area including concentrated screen wash containing a flammable concentration of isopropanol.

Since standard road vehicle electrical systems are not ATEX approved, and nor are most common power tools, it is effectively impossible to eliminate ignition sources from the area and therefore hazardous area classification is not a valid basis of safety. Thus, a risk assessment is required which implements the hierarchy of risk reduction measures to provide a tolerable level of risk and ensures the protection of personnel from fires and explosions.

In practice, much of the safety of a workshop comes down to safe operating practices in the storage and handling of flammable materials, principally when working on vehicle fuel systems.

Note that the exception to area classification in workshops is vehicle inspection pits where heavier than air flammable vapour may collect, but this is generally the only zoned area within a workshop. Many older workshops have pits which do not meet modern standards of safety as they do not have ATEX lighting or any LEV extraction to minimise the risk of build-up of a flammable atmosphere.

Laboratories

Laboratories commonly handle quantities of flammable materials and yet also have numerous potential ignition sources. Experience has also shown that laboratory knowledge of DSEAR and compliance with DSEAR is often poor and fire and explosion risks poorly controlled. The detailed reasons for this are outside the scope of this paper, but it can be surmised that laboratories are seen as “safe” places to work, especially by those working in them. There have, however, been several large laboratory fires both in industry and academia.

- In 2015 a post-doctoral researcher died in a lab explosion and fire at Tsinghua University in China.
- Also in 2015, Liverpool University suffered an explosion in a chemistry lab where one person was injured; and;
- In 2014, the University of East Anglia had a fire in a chemistry lab, fortunately with no-one hurt.

Experience has also shown that laboratories often contain more than 200 litres of highly flammable materials, i.e. materials with flashpoints less than 21°C, and many materials with flashpoints <10°C, the most common ones probably being acetone, diethyl ether and methanol. In one particular case, 50 litres of highly flammable material with a flashpoint of 11°C was found stored in two 25 litre plastic drums in front of the emergency exit.

In practice, the amount of storage in laboratories is often well in excess of the recommended or indeed immediately required amounts for the work in hand. In one of the worst cases, over 40 litres of highly flammable mixed solvent waste containing a variety of reactive materials was found stored in a laboratory and which had been there for over a week. Housekeeping of hazardous raw materials is also often found to be an issue with laboratories as is the use of compressed gas cylinders.

The safe storage of flammable liquids within laboratories requires continuous attention to housekeeping and the prompt removal of flammable waste materials. Since many common laboratory solvents are delivered in glass “Winchester” bottles, it is also necessary to ensure that these are stored in a safe location such as a fire resistant cabinet.

Many laboratories still use Bunsen burners to provide heating for experiments which are an obvious source of ignition but there are numerous other items of electrical equipment which also constitute potential ignition sources.

As for workshops, it is not generally possible to area classify laboratories. One reason for this is that ATEX laboratory equipment is not generally available and the second is that reactive materials may be in use which have inherent risk of fire. Thus, laboratories need to make appropriate arrangements for the storage and handling of flammable materials and carry out experiments using dangerous materials in fume cupboards.

Whilst hazardous area classification is generally not appropriate for laboratories, it can clearly be seen that an appropriate risk assessment is an absolute necessity for laboratory operations. The reduction of risk in laboratory areas should include:

- Minimisation of inventory of flammable raw materials
- Minimisation of waste materials in the area and appropriate storage
- Use of fire resistant storage cabinets for all flammable materials not in use
- Conduct hazardous experiments in fume cupboard containment
- Control of use of Bunsen burners and gas systems and installation of "Gas guard" emergency shut down system

For non-zoned areas, there is additional guidance on handling flammable materials safely in HSG 51 (Ref.10) and HSG 140 (Ref.11) which is particularly applicable to many laboratory situations. Although OSHA (Ref.15) produce a laboratory safety guide, this is very general and there is, overall, a distinct lack of specific guidance for DSEAR safety in laboratory areas. There is also a web page on the HSE website but this is limited in information and also very generic.

DSEAR "Basis of Safety"

The key to DSEAR compliance is to be able to clearly state the Basis of Safety for any given area. This is not explicitly stated in any of the guidance or legislation, but if is considered an essential part of understanding how an area is safe for personnel to work in by reference to a "basis of safety".

For zoned areas, the basis of safety is the prevention of ignition sources within the zoned area. This is achieved by the use of various measures including:

- ATEX (ignition protected) electrical & mechanical equipment
- Anti-static precautions including work wear
- Precautions to minimise the risk of occurrence of a flammable atmosphere
- Explosion protection systems

Whilst this is relatively clear from the legislation, the basis of safety in other areas where flammable materials are present but area classification is not an option are less clear. The basis of safety for areas such as workshops can be defined by reference to the implementation of the hierarchy of risk reduction and mitigation measures in Regulation 6 as described above.

In practice, much of the means by which a non-zoned area is safe usually comes down to the operational practices of the personnel working in the area. Prevention of the release of hazardous materials is probably the key risk reduction measure in these areas.

For any given area where flammable materials are handled it should be possible to explicitly state the basis of safety for operation in the area and the means by which personnel are protected from fire and explosion hazards in the workplace.

Conclusions

Over ten years after its' introduction, the DSEAR legislation is still poorly understood and poorly implemented by many companies. Experience has shown that many companies also focus on hazardous area classification and neglect the more important Risk Assessment part of the regulations. This can leave an unacceptable level risk in some areas which are not subject to hazardous area classification.

There is a patent lack of understanding generally of the factors affecting area clarification and how to apply area classification correctly. This leads to numerous errors in the extent and frequency of occurrence of flammable zones. Although there is extensive guidance for the gas and fuels industries, the limited number of examples in BS EN 60079-10 does not adequately cover area classification for many process industries e.g. the pharmaceutical and fine chemical sectors. Additionally, the limitations of hazardous area classification are poorly understood and the zone extents are often treated as being fixed boundaries for safety. Temporary zones, their use and applicability are not properly explained.

The application of DSEAR to non-zoned areas is poorly understood and poorly covered within the available guidance. In particular, there is little guidance for small scale and laboratory type operations and also areas where area classification is not practicable due to the presence of ignition sources in normal operation.

The hierarchy of risk reduction measures in HSE ACOP L138 requires further consideration, in particular with reference to the use of explosion containment as a basis of safety.

Whilst the potential for flammable mist formation should not be overlooked, there is the potential that we assign to high a level of risk to what is, in practice, a very infrequent event. Whilst further research may be needed in this area, it is considered to be a low priority compared to improving the understanding of current area classification guidance. Car should also e taken not to overcomplicate area classification in particular as this will inevitably result in more errors.

Additional guidance is required for laboratory and workshop environments and other areas such as boiler houses where hazardous area classification is not a tenable basis of safety.

In conclusion, although we have come a long way since DSEAR was enacted in 2003, there is still much work to do in order to manage compliance with the legislation. In particular, specialist area classification guidance is required for the non-fuel process industries and better guidance on DSEAR risk assessment would also be welcome. In addition, better specific guidance for DSEAR compliance in laboratory and small pilot plant environments would be useful.

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