EI15 4th Edition, Improvements and Application

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The Energy Institute code of practice (Part 15) for area classification is a key piece of process safety guidance, used across all industry sectors handling flammable fluids. The 3rd edition has been in print for almost 10 years and is referenced in the UK DSEAR approved code of practice, L138, as a key guidance document for the effective management of the risks associated with the potential ignition of flammable fluids.

The Energy Institute guidance has been substantially revised to incorporate feedback from the industry sectors and engineers who practice hazardous area classification, as well as the UK Regulators (HSE and HSL). The 4th Edition is to be published in July 2015.

The changes will keep the guidance at the forefront of pragmatic methods for hazardous area classification. This paper will highlight the significant changes in the guidance, especially those concerned with the ventilation of enclosed spaces, the selection of hole sizes for use in determining a zone extent, and the new references to liquefied natural gas.

Keywords: DSEAR, ATEX, Hazardous Area Classification, EI15

Introduction

A large number of organisations in a variety of industry sectors store and process flammable fluids. In the UK, these companies must comply with the requirements of the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002. Regulation 7.1 [HSE, 2002] states that areas where flammable materials are handled must be classified into zones. The zone then dictates the ignition controls that must be adopted to limit the probability of a flammable atmosphere being ignited and creating a fire or explosion hazard, to an acceptable level. The technique for classifying the zone is known as Hazardous Area Classification (HAC).

The international standard for HAC is IEC 60079-10-1:2010, '*Classification of Areas- Explosive Gas Atmospheres*'. It lays out the fundamentals of HAC, defining the zones and providing a methodology for determining the adequacy of ventilation in dispersing a flammable atmosphere inside an enclosure.

The standard has a number of limitations. Firstly it does not provide detailed guidance on the size of zones that a given release scenario could generate. Secondly the ventilation calculations are overly conservative, over estimating the size of the hypothetical volume of a release of natural gas by three orders of magnitude [HSL, 2008].

Users can overcome these issues by using an Industry Code that is relevant to their process technology, hazardous substances and industry sector, indeed the standard recommends the use of such a code.

The 'Model Code of Safe Practice Part 15, Area Classification for Installations Handling Flammable Fluids' commonly known as EI15 (formerly IP15) is such an Industry Code. It is used widely in the UK and abroad, both for onshore and offshore facilities. It was originally written by and for the oil and gas industry, but has since become a key document used in many industry sectors since being referenced within DSEAR guidance.

The third edition has been in print since 2005. This version was a significant change from edition 2, introducing the concept of the Risk Based Approach to determine an equivalent hole size, the mass flow rate through which is used to establish the hazardous zone [EI, 2005].

The fourth edition is due for publication in July 2015. This version revises edition 3, taking into accounts input from users of the guidance as well as feedback from the HSE. There are a number of significant changes in the guidance, particularly associated with ventilation, which will have a significant effect on the way that processing areas are classified into zones.

Acknowledgements

The author would like thank the Energy Institute (EI) for authorising this paper. Thanks must also be given to my colleagues in the Working Group who over several years have re-written the sections of the document as well as considering the need to incorporate hundreds of suggestions from users to improve the code.

The EI wishes to thank the member organisations who either provided funding directly for the update to the guidance or indirectly by allowing their staff the time to participate in the Working Group.

Thanks must also go to the HSE for funding the work carried out by the HSL for studies that led to improved guidance on ventilation. Indeed, special thanks go to Dr. Matt Ivings and his team from the HSL for their work in this area.

Finally, special thanks goes to Howard Crowther who was responsible for chairing the Working Group and to Toni Needham who both recorded the minutes of the meetings and drafted the document. The work could not have progressed as well as it did without the commitment and professionalism of both Howard and Toni.

Note of Caution

The statements and data in this paper are for information only. Until edition 4 is formally issued by the EI, this information is subject to change and so should not be used to justify any technical decisions.

Significant Changes to EI15

There are a number of changes to the fourth edition of EI15. The following sections detail those that are most significant and that users of the guidance need to be aware of.

Document Structure and Layout

It is the opinion of the Working Group that the Point Source Approach, coupled with Risk Based HAC is preferable to the Direct Example Approach. To emphasise this point, these aspects are kept in the main body of the document with the Direct Examples moved to Annex D. The Direct Examples have not been changed significantly, with only minor edits based on comments from users of the 3rd edition.

A number of sections have been removed completely from the document, mainly those related to certified equipment and other ignition sources. These subjects are covered in more detail in the document, 'Model Safe Code Of Practice 1, The selection, Installation, Inspection, and Maintenance of Electrical and Non-electrical Equipment in Hazardous Areas', published by the Energy Institute [EI, 2010].

Ventilation

Ventilation Within Enclosures

The ability of ventilation to dilute a release of flammable material to a level below it's Lower Explosive Limit (LEL) is a key aspect in determining the type of zone in an enclosure. Previous versions of the guidance have used a benchmark of 12 air changes per hour to define when the ventilation is determined to be 'adequate'. There were a number of caveats to this approach but this criteria was often used to determine if a secondary release would give rise to a zone 2 or a zone 1. Adequate ventilation allowed a secondary release to be classified as zone 2 whereas inadequate would be classified as a zone 1.

The fourth edition uses work carried out by the HSL to provide more accurate determination of the amount of ventilation required to dilute a release to a safe level. This new criteria is detailed in HSL MSU/2012/10 'Technical Input on Ventilation Effectiveness for Area Classification Guidance EI15', and is summarised in section 4 and Annex F of the new guidance.

The new approach uses the principal that an adequate level of ventilation will limit the bulk concentration of the flammable concentration in the enclosure to a level below 25% of the LEL. This level of ventilation is proportional to the properties of the fluid being released and the release rate of the material. The ventilation rates required to justify an adequate level of ventilation into an enclosure are summarised in the Table 4.1, reproduced here:-

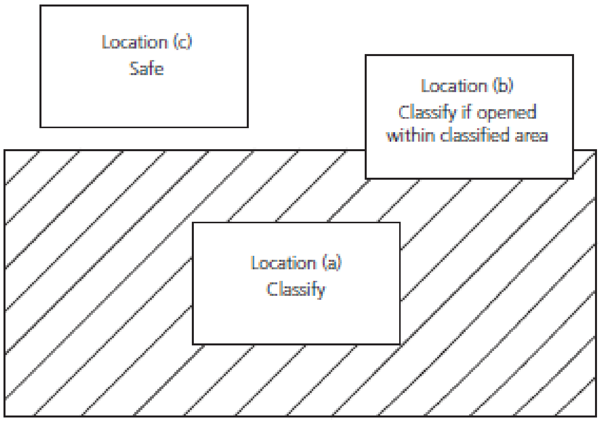
Fluid category	Release pressure (bar(a))	Ventilation flow rate to dilute to 25% LFL (m3/s)			
		Release hole diameter			
		1 mm	2 mm	5 mm	10 mm
A	6.81	1.14	4.56	28.5	(114.)
	10	1.46	5.84	36.5	(146.)
	50	3.40	13.6	85.1	(340.)
	100	4.83	19.3	121.	(483.)
B	5	0.99	3.94	24.6	(98.4)
	10	1.47	5.86	36.6	(147.)
	50	3.41	13.6	85.3	(341.)
	100	4.84	19.4	121.	(484.)
C	5	0.94	3.74	23.4	(93.6)
	10	1.40	5.62	35.1	(140.)
	50	3.27	13.1	81.8	(327.)
	100	4.65	18.6	116.	(465.)

G(i)	5	0.07	0.27	1.70	6.79
	10	0.14	0.56	3.48	13.9
	50	0.75	2.99	18.7	74.7
	100	1.63	6.51	40.7	163.
G(ii)	5	0.13	0.52	3.23	12.9
	10	0.26	1.05	6.57	26.3
	50	1.33	5.31	33.2	133.
	100	2.64	10.6	66.1	264.

Table 1 – Reproduction of Table 4.1 from EI15 Edition 4

This relationship brings EI15 in line with other industry guidance including IGEM SR25 'Hazardous Area Classification of Natural Gas Installations' Edition 2 and the HSL QUADVENT software package.

The concept of an enclosure sited inside a zone 2 that does not have any internal releases of flammable fluid, automatically being a zone 1 is removed. Work by the HSL determined that if there was sufficient air movement to allow vapour into the enclosure, then there is sufficient ventilation such that an accumulation is not possible and the zone inside the enclosure can be as per the externals. This will affect areas such as analyser houses or hydraulic cabinets which are frequently located in zone 2 areas. A diagram has been included to demonstrate when classification of enclosures is required, reproduced below:-



Notes

1. Location (a) – building within existing classified areas use Table 4.2 to determine zone classification of buidling depending on ventilation.
2. Location (b) building encroaching on existing classified area
   I) Openings into existing zone 2 area, use Table 4.2 to determine zone classification of building depending on ventilation.
   II) Gas tight building with no openings within zone 2 area-building safe.
3. Location (c) building outside existing classified area-building safe but should be located as far as possible away from classified area.

Figure 4.3: Buildings without an internal source of release located within or adjacent to classified areas

Figure 1 – Reproduction of Figure 4.3 from EI15 Edition 4

Outdoor Areas

Edition 3 discusses sheltered and obstructed outdoor areas but many users felt that the guidance lacked clarity. The working group have re-written this section and introduced a concept of congested and stagnant areas.

A congested area is one where obstacles reduce the air movement to less than would be experienced in the open air but not so much that the area is stagnant. This description will fit many industrial areas such as pipe racks, offshore modules open on two or more sides and lightly sheeted in areas such as compressor houses. Secondary releases will give rise to a zone 2.

When an area is considered as congested, point zoning is not appropriate and the area will be blanket zoned. This zone will extend for the radius established using the Risk Based Approach, taken from table C4, around the periphery of the space. Small non-hazardous zones must not be classified inside the area.

A stagnant area is one that is outdoors but where air movement is limited to such an extent that releases are insufficiently diluted and so secondary releases give rise to a zone 1, as per inadequately ventilated enclosures.

Point Sources

Sample Points

Edition 4 recognises that there are a number of sampling systems that can be used, some of which will give rise to primary releases and that all sample points will have a secondary grade release which may occur as the result of abnormal occurrences during sampling. This is a significant change from edition 3 which could give large zone 1 areas from a sample point, regardless of the methods used.

Edition 4 describes a number of sampling methods, allowing the user to choose the scenario that suits their system the best and then to classify a small primary (zone 1) with a larger secondary release (zone 2).

Pumps

The advice on pumps has been altered to differentiate between rotary pumps (centrifugal, lobe, gear pumps) and reciprocating pumps. All packed gland seals should have a zone 1 around the seal as they have appreciable fugitive emissions as a result of their requirement for the process fluid to lubricate the packings.

The hole sizes from all pump types have been altered to reflect real world experiences. This is described fully in the Hole Sizes section.

Relief Valves and Atmospheric Vents

The classification of relief valve discharges and process vents in edition 3 was often miss-interpreted so the guidance in the fourth edition has been made more explicit.

It is now clear that the release from a relief valve lifting at it's set point is to be considered as a release under area classification. If the resulting zone is larger than 30m in radius, additional safeguards may be required such as relocating the discharge point or diverting the release to a flare system.

Relief valves will have a 1m zone 1 around the vent tip to account for fugitive emissions and the relief valve lifting will give rise to a zone 2, the extent of which should be determined through modelling.

Edition 3 had tables for determining the zone around a vent or drain. These tables have been retained but the advice makes it more explicit that these tables are for low pressure vents rather than relief valve or high pressure discharges. There have been occasions where a jet release from a high pressure source has been incorrectly represented by a slumping plume release.

Piping Systems

Edition 3 advised that if the piping system had less than 10 flanges (known as significant flanges) and was designed to ASME B31.3 a zone around each flange was not required. This advice has been removed so that every flange will require a zone around it.

The advice in edition 3 stating that where there are a large number of leak points in close proximity, that area should be a zone 1, has been removed as it was not felt by the Working Group to be technically correct.

Hole Sizes

The EI commissioned a report by Quantra to interrogate the HSE HydroCarbon Release Data Base. This was to establish real world release rates from secondary releases and the hole sizes which gave rise to the leak. This data replaced the hole sizes in edition 3 which originated from the Cox Lees and Ang guide to HAC.

This work looked at losses of containment in the offshore industry and back calculated an estimated hole size. The working group reviewed this data and determined a new table of hole sizes, including some new equipment types. The table is included here:-

	Hole size (mm)		
Equipment Type	LEVEL I Greater than 1,0E-2 /release source-yr	LEVEL II 1,0E-2 - 1,0E-3 /release source-yr	LEVEL III 1,0E-3 - 1,0E-4 /release source-yr
Single seal TB	2	5	10
Double seal	1	2	10
Centrifugal compressor	1	5	30

Reciprocating compressor	2	10	30
Reciprocating Pump	2	10	30
Flanges	1	1	5
Valves	1	2	10

Table 2 – Reproduction of Table C15 from EI15 Edition 4

Compared to Edition 3, the hole sizes for Level I installations are smaller and reciprocating pumps and compressor categories have been added.

LNG Data

An additional fluid category for LNG has been added to the hazard radii tables. Previously, use was made of the data for LPG, category A but his gives incorrect distances. So, the HSL have modelled both pressurised releases and pool spills that LNG users can use with increased confidence.

Fluid category	Release pressure see note 4 (bar(a))	Hazard radius R_1 (m)				Hazard radius R_2 (m)			
		Release hole diameter				Release hole diameter			
		1 mm	2 mm	5 mm	10 mm	1 mm	2 mm	5 mm	10 mm
A	5[1]	2	4	8	14	2	4	16	40
	10	2,5	4	9	16	2,5	4,5	20	50
	50	2,5	5	11	20	3	5,5	20	50
	100	2,5	5	11	22	3	6	20	50
B	5	2	4	8	14	2	4	14	40
	10	2	4	9	16	2,5	4	16	40
	50	2	4	10	19	2,5	5	17	40
	100	2	4	10	20	3	5	17	40
C	5	2	4	8	14	2,5	4	20	50
	10	2,5	4,5	9	17	2,5	4,5	21	50
	50	2,5	5	11	21	3	5,5	21	50
	100	2,5	5	12	22	3	6	21	50
G(i)	5	< 1	< 1	<1	1,5	< 1	< 1	1	2
	10	< 1	< 1	1	2	< 1	< 1	1,5	3
	50	< 1	1	2,5	5	< 1	1,5	3,5	7
	100	< 1	1,5	4	7	1	2	5	11
G(ii)	5	< 1	<1	1,5	3	< 1	< 1	2	4
	10	< 1	1	2	4	< 1	1	2,5	5
	50	< 1	2	4	8	1	2	6	11
	100	1	2	6	11	2	3	8	14
LNG	1.5	2.2	3.4	6.2	9.8	1.8	2.8	6.6	30.2
	5	2.6	5.0	10.3	16.6	2.2	3.9	11.3	40.1
	10	2.9	5.5	10.3	20.4	2.5	4.5	12.6	37.5

Notes
1. At the fluid storage temperature of 20ºC the nominal discharge pressure of 5 bar(a) is below the saturated vapour pressure of Fluid category A. The saturated vapour pressure (6,8 bar(a)) was used to calculate the discharge rate and dispersion.
2. Data for LNG is given in C1.4.
3. No data is available for gasoline blends with ethanol, however for blends with small quantities of ethanol, these could be treated as category C. It is recommended that modelling is carried out.
4. Release pressure should be taken as the maximum allowable operating pressure.

Table 3 – Reproduction of Table C4 from EI15 Edition 4

Summary

EI15 Edition 4 provides a comprehensive review of edition 3. It rectifies a number of the main shortcomings of edition 3 and provides practical guidance that effectively supports the international standard.

These revisions allow the guide to be used more effectively by the Chemical, Energy and Pharmaceutical industry sectors for more realistic determination of hazardous areas.

Further work that could be carried out in advance of edition 5 would be to revise the sections on drilling which were not significantly altered due to there being no relevant experience on the Working Group.

References

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5. IGE/SR/25 Edition 2 – Hazardous area classification of natural gas installations. Institute of Gas Engineers and Managers 2010
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7. RR630 Area classification for secondary releases from low pressure natural gas systems, HSL 2008