HSD Safety Ltd
Loss Prevention Consultants

# MANAGEMENT OF ELECTRICAL EQUIPMENT IN HAZARDOUS (Ex ZONED) AREAS

## Prepared for nabim

## BY

## HSD SAFETY LTD

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# MANAGEMENT OF ELECTRICAL EQUIPMENT IN HAZARDOUS (Ex ZONED) AREAS

## EXECUTIVE SUMMARY.

HSD Safety Ltd. (HSD) has prepared guidance relating to the management of electrical equipment in hazardous (Ex zoned) areas to assist nabim members in development of appropriate management strategies to suit their individual business organisational structures.

The structure and layout of this report is explained below;

- Section 1 outlines the concepts used by relevant European or International standards for the inspection and maintenance of electrical equipment in hazardous areas. The purpose of this section is to enable “non-specialists” involved in management of flour mills to understand the overall requirements.
- Section 2 summarises the key roles, responsibilities and competencies required for effective management of explosion hazards. The purpose of this section is to put the requirements of relevant European or International standards for inspection and maintenance of electrical equipment into context as part of overall explosion safety.
- Section 3 explains how the roles and responsibilities above can be assigned on a typical flour mill, focussing on management, maintenance and inspection of electrical equipment in hazardous areas.
- Section 4 summarises documentation requirements

Further guidance is provided in the following Appendices

- Appendix A; References
- Appendix B: Example inspection scheme

Guidance on the following topics is provided separately in HSD Safety Report Ref. 181157-C

- Selection and installation of electrical equipment in hazardous (zoned) areas
- Management of change (plant / equipment, processes and organisational)

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### APPENDICES

## 1.0 BACKGROUND

Electrical equipment installed in hazardous areas, where explosive atmospheres may be present, requires features specially designed to make it suitable for use, e.g. special ignition protection measures specified in relevant parts of the BS EN 60079 series, which implements the international IEC 60079 series of standards

For safety, it is essential that the integrity of those special features is preserved throughout the lifetime of the equipment and installations. The appropriate standard to follow is BS EN 60079-17 [Ref. 1], which also defines several key roles for “responsible persons” and “operatives” along with their responsibilities, knowledge, skills and competencies.

BS EN 60079-17 [Ref. 1] requires an initial inspection before electrical equipment installed in hazardous areas is first used and following any adjustment, maintenance, repair, reclamation, modification or replacement. There are then two approaches that are specified to ensure ignition protection integrity is preserved, both require maintenance necessary to rectify faults.

- regular periodic inspections, or
- continuous supervision by skilled personnel

The requirements of BS EN 60079-17 [Ref 1] vary depending on the approach used and the roles, responsibilities, knowledge, skills and competencies required by people at a site will depend on the approach taken as well as the size and complexity of the site and the numbers of each equipment / installation type in hazardous areas.

**Regular periodic inspection**; this is a relatively straightforward approach which requires time-based inspection by suitably competent persons who are sufficiently independent of the demands of maintenance activities. For fixed electrical equipment, the interval between periodic inspections should not exceed three years without seeking expert advice. Expert advice is also required to determine the grade(s) of inspection (visual, close or detailed). Movable electrical equipment requires a close inspection at least every 12 months. Equipment with enclosures which are frequently opened (such as battery housings) requires detailed inspection at least every 6 months, plus a pre-use inspection by the user to ensure that the equipment is not obviously damaged.

**Continuous supervision by skilled personnel**; this is a more complex approach and requires equipment / installations to be visited on a regular basis, in the normal course of work, by skilled personnel. There is no set frequency for attendance and inspection however for areas of the site with a significant inventory of explosion protected systems, BS EN 60079-17 states that it would be inappropriate to include

it as part of the continuous supervision concept if the visit frequency is less frequent than once per week. This concept also requires a “technical person with executive function” to be identified for each installation. Note; installation in this context means each individual installation of electrical equipment in a hazardous area.

For the electrical equipment types and installations in hazardous areas on a typical flour mill, the approach to ongoing integrity management will normally be “regular periodic inspections” rather than “continuous supervision by skilled personnel”.

HSD Safety Ltd. (HSD) has prepared guidance, based on appropriate European or International standards, relating to the management of electrical equipment in hazardous (Ex zoned) areas.

The aim is to allow nabim members to review their own management systems and develop appropriate management strategies to suit their individual business organisational structures.

### 1.1 Assumptions

The following assumptions have been made in this report;

| | Assumption | Justification for assumption |
|---|---|---|
| 1.1.1 | The roles and responsibilities defined in Section 2 are generic roles and responsibilities rather than actual job titles or job descriptions | Job titles and job descriptions vary between organisations and sites and it would be impracticable for HSD to consider all the variants that exist between nabim members and sites |
| 1.1.2 | It is assumed that hazardous area zones have been classified according to BS EN 60079-10-2 Ref. 2 and housekeeping standards control dust layers in the workplace | This is based on typical hazardous area zones observed by HSD in well-managed flour milling facilities. |
| 1.1.3 | It is assumed that systems and arrangements are in place for the safe management of electrical systems and equipment according to HSR25 Ref. 3 | This is based on the assumption that arrangements are in place for electrical safety in accordance with the Electricity at Work Regulations |
| 1.1.4 | It is assumed that engineers maintain and promote high ethical standards and challenge unethical behaviour and work to appropriate codes of conduct | This is based on the Statement of Ethical Principles for engineering professionals Ref. 4 |

### 1.2 Limitations

The report and assessments have limitations as follows

**Limitation**

1.2.1 The guidance in this document excludes the process of hazardous area classification and the selection or specification of electrical equipment for use in hazardous areas. For further details on this topic see HSD Safety Report Ref. 181157-C which covers management of change and project management.

1.2.2 The standard of planned inspection / maintenance regimes and associated maintenance and commissioning (re-commissioning) procedures and checklists can vary significantly between organisations and sites. These can have a major influence on the management of electrical equipment in hazardous areas. Assumptions have been made as described above or in individual sections.

1.2.3 The standard of documentation of maintenance and inspection records and breakdown history can vary significantly between organisations and sites. A significant history of failures and / or signs of obsolescence are warnings that ignition protection may not be effectively maintained. Assumptions have been made as described above or in the individual sections.

## 1.3 Glossary of Terms

For the purpose of management of electrical equipment in hazardous (Ex zoned) areas, the following terms and definitions apply;

| Term | Definition / Meaning |
|---|---|
| Close inspection | An inspection which encompasses those aspects covered by a visual inspection and, in addition, identifies those defects, such as loose bolts, which will be apparent only by the use of access equipment, for example steps, (where necessary), and tools |
| Detailed inspection | An inspection which encompasses those aspects covered by a close inspection and, in addition, identifies those defects, such as loose terminations, which will only be apparent by opening the enclosure, and/or using, where necessary, tools and test equipment |
| Equipment Protection Level (EPL) | A measure of the integrity of ignition protection applied to the equipment. This term has recently replaced Equipment Categories, which were the original method of measuring the integrity of ignition protection |
| Hazardous area | An area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment |
| Initial inspection | Inspection of all electrical equipment, systems and installations before they are brought into service |
| Periodic inspection | Inspection of all electrical equipment, systems and installations carried out on a routine basis |
| Sample inspection | Inspection of a proportion of the electrical equipment, systems and installations |
| Verification dossier | A set of documents showing the compliance of electrical equipment and installations |
| Visual inspection | Inspection which identifies, without the use of access equipment or tools, those defects, such as missing bolts, which will be apparent to the eye |
| Zones | Hazardous areas classified into zones based upon the frequency of the occurrence and duration of an explosive atmosphere |

### 1.4 Workflow; Management of electrical equipment – hazardous areas

The process for management of electrical equipment – hazardous areas in an existing facility is complex. The typical workflow required for assessments on a typical flour mill is illustrated below for new plant / equipment and for existing plant / equipment.

**Figure 1.1 — Workflow; new plant / equipment**

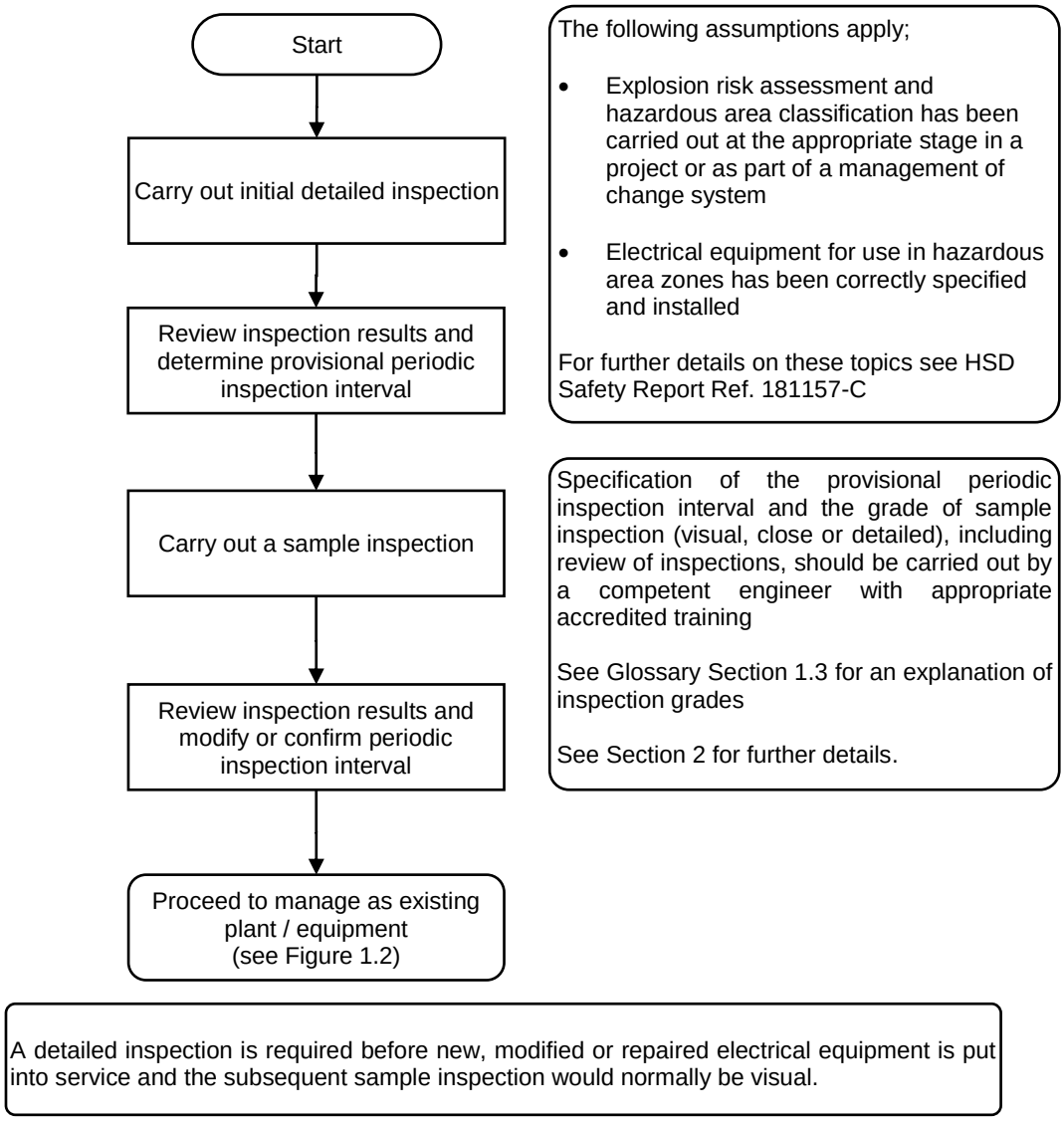
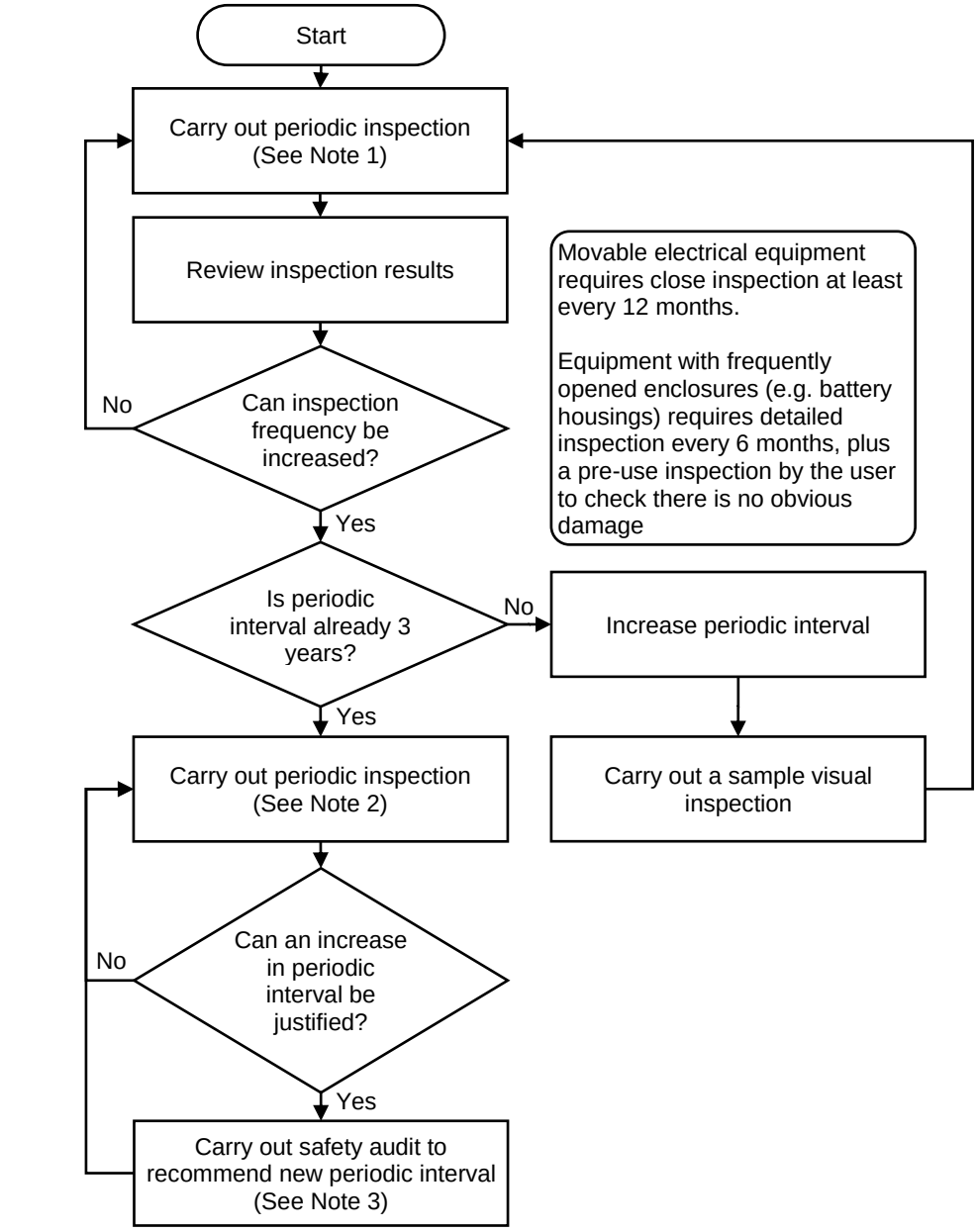


**Figure 1.2 — Workflow; new plant / equipment**




Specification of grades / intervals of periodic inspection and grades of sample inspection, including review of inspections, should be carried out by a competent engineer with appropriate accredited training (see Section 2 for further details).

Note 1; at this stage a combination of periodic close inspection and / or sample visual inspection is typical.

Note 2; at this stage a combination of periodic close inspection and / or sample detailed inspection is typical.

Note 3; the periodic inspection interval should not be increased above 3 years without seeking authoritative expert advice

## 2.0 ROLES, RESPONSIBILITIES AND COMPETENCIES

This section has been divided into the following topics;

- Key roles, responsibilities for effective management of explosion hazards
- Technical competence requirements
- Behavioural competence requirements
- Underpinning knowledge and understanding requirements

### 2.1 Explosion Hazard Management

In order to put the requirements of relevant European or International standards for inspection and maintenance of electrical equipment into context as part of overall explosion safety it is necessary to define the key roles, responsibilities and competencies required for effective management of explosion hazards.

| Responsibility / Role | Competence Requirement |
|---|---|
| Explosion Risk Assessment and Hazardous Area Classification | Typically, an experienced chemical / process engineer who has a good overall understanding of the processes and equipment on site with additional training & experience in explosion hazards, risk controls and area classification. |
| Management of Electrical Equipment in Zoned Areas | Typically, an experienced electrical, control / instrumentation engineer who has additional training & experience in explosion protection e.g. BE EN 60079-10, BE EN 60079-14 & BS EN 60079-17 (see separate table below) |
| Inspection & Maintenance of Electrical Equipment in zoned areas | Typically, an experienced electrical, control / instrumentation technician with specific accredited training and experience (see separate table below) |
| Management of Non-Electrical Equipment in Zoned Areas | Typically, an experienced mechanical or process engineer who has additional training & experience in explosion protection / ignition risk assessment |
| Inspection & Maintenance of Non-Electrical Equipment in zoned areas | Typically, an experienced mechanical maintenance technician with specific accredited training and experience (see separate table below) |
| Permit to work issuers,<br>Hot work permit issuers,<br>Risk Assessment / Method Statement Approvers. | Can demonstrate a good understanding of fire and explosion hazards and their control measures and the safeguards required for “non-routine” work. Demonstrated by training and experience. |
| Operations people working in Ex zoned areas e.g. Plant Managers, Plant Supervisors & Technicians / Operators | General awareness of fire and explosion hazards plus area or process specific explosion awareness. Demonstrated by training and experience |

*Continued on following page*

| Responsibility / Role | Competence Requirement |
|---|---|
| People carrying out general engineering / maintenance work in Ex zoned areas e.g. Engineering Managers, Supervisors, Maintenance Technicians | General awareness of fire and explosion hazards plus area or process specific explosion awareness. This could be covered as part of permit to work training / competence. Demonstrated by training and experience. |
| 3rd parties carrying out general engineering / maintenance work in Ex zoned areas e.g. maintenance contractors, pest control, cleaners | General awareness of fire and explosion hazards plus area or process specific explosion awareness. This could be covered as part of contractor induction / competence. Demonstrated by training and experience. |
| Visitors e.g. occasional visitors to site who are accompanied by an employee at all time. | General awareness of fire and explosion hazards. This could be covered as part of visitor induction / competence. Demonstrated by training and experience |

BS EN 60079-17 Ref 1 requires that inspection and maintenance of electrical equipment installations in hazardous areas should be carried out only by experienced personnel, whose training has included;

- Instruction on the various types of protection and installation practices
- The requirements of the standard
- The relevant national regulations/company rules applicable to the installation
- The general principles of area classification

Continuing education or training should also be undertaken by personnel on a regular basis and evidence of the relevant experience and training should be available e.g. evidence of current qualifications / competency should be readily available to auditors, regulatory inspectors or other interested parties.

### 2.2 Technical Competence

Assessed / certified training is available from accredited 3rd parties for competencies relating to the installation, inspection and maintenance of equipment in hazardous areas. These modules match the competency requirements detailed in BS EN 60079-17 Ref 1 for certain key roles and responsibilities. As you are probably aware, these modules are typically referred to as CompEx Modules, they are summarised below;

| Module | Description |
|---|---|
| Ex F | Foundation Course; Provides an understanding of the requirements of safe working practices within potentially explosive atmospheres<br>Aimed at maintenance personnel working in hazardous area zones |
| Ex 01-04 | Gas Vapour; Installation, Maintenance & Inspection of electrical equipment in explosive atmospheres<br>Aimed at electrical, control and instrumentation personnel responsible for electrical equipment in hazardous areas (Zone 0, 1 & 2) |

*Continued on following page*

| Module | Description |
|---|---|
| Ex 05-06 | Dust; Installation, Maintenance & Inspection of electrical equipment in explosive atmospheres<br>Aimed at electrical, control and instrumentation personnel responsible for electrical equipment in hazardous areas (Zone 20, 21 & 22) |
| Ex 11 | Competency requirements for operatives working with mechanical equipment in explosive atmospheres<br>Aimed at mechanical technicians and engineers who install, inspect or maintain mechanical equipment in potentially explosive atmospheres |
| Ex 14 | Core Competence for Site Responsible Personnel – electrical equipment in explosive atmospheres<br>Aimed at engineers responsible for implementing inspection and maintenance of electrical equipment in potentially explosive atmospheres |
| *Note* | *There is currently no accredited training for Site Responsible Personnel for mechanical equipment in explosive atmospheres.* |

Further guidance on maintenance and inspection of electrical equipment in hazardous areas and the CompEx scheme is given in EEMUA 186 [Ref. 5]

### 2.3 Behavioural Competence

Behavioural (e.g. managerial) skills for the management of electrical equipment in hazardous areas are not covered by the technical training discussed in Section 2.3. For an individual with managerial responsibilities, e.g. line management or systems management, these can generally only be assessed by their employer.

The Engineering Council publish a competence standards document [Ref 6], which can be useful for training needs / competence assessment for three different levels of engineers;

- Engineering Technicians
- Incorporated Engineers
- Chartered Engineers

Generic areas of competence are covered, including;

- Responsibility, management and leadership;
- Communication and interpersonal skills,
- Professional commitment;

It is also worth noting that most professional engineering institutions have Codes of Conduct which require professional engineers to follow ethical principles. For example; the Engineering Council publish guidance for codes of conduct for professional engineering institutions [Ref. 7], which requires members accept appropriate responsibility for work carried out under their supervision and to observe a set of published ethical principles [Ref. 4] which state for example;

- Engineering professionals have a duty to uphold the highest standards of professional conduct

- Engineering professionals have a duty to obey all applicable laws and regulations and give due weight to facts, published standards and guidance
- Engineering professionals have a duty to acquire and use wisely the understanding, knowledge and skills needed to perform their role, including'
    - Perform services only in areas in which they are currently competent or under competent supervision
    - Keep their knowledge and skills up to date

**2.4 Underpinning Knowledge and Understanding**

Underpinning knowledge and understanding of explosion hazards and risk controls and how they apply in flour milling should be carefully considered when assigning responsibilities.

CompEx Ex04-04 and Ex14 modules (see Technical Competence in Section 2.2) have defined requirements for "prior knowledge" relating to electrical equipment and installations, which should be assessed and considered by each organisation or site.

However, the CompEx Scheme is the recognised Global Competency Scheme of choice for the major oil, gas and chemical users who want to protect both their workers and capital assets. The 'size' of business structures to implement and manage such competence is 'major' and not suited to nabim members. The guidance document EEMUA 186 [Ref. 5] which supports the CompEx scheme is heavily focussed on gases and vapours but does have a short section on combustible dusts. In addition, it contains industry specific sections, which are limited to;

- Fuel filling stations
- Water and wastewater industries

For example, a CompEx accredited electrical, control, instrumentation engineer with experience in other industries such as oil, gas or chemicals, may not have sufficient knowledge and understanding of hazards in flour milling and the practicability of risk controls relating to electrical equipment in hazardous areas on a typical flour mill.

## 3.0 APPLICATION ON A TYPICAL FLOUR MILL

It is acknowledged that most flour mills operate on lean principles and it would be impracticable for an individual site to carry the cost of managerial roles at the top of the table in Section 2.1 e.g.

- Explosion Risk Assessment and Hazardous Area Classification
- Management of Electrical Equipment in Zoned Areas

The concept of "Team Competence" is often applied to the management of technical aspects of process safety such as the management of electrical equipment in hazardous areas. A simple example of team competence is where the Engineering Management Competence lies with one person and the Technical Engineering Competence lies with an electrical, control, instrumentation engineer e.g. between the two people they have overall competence.

For a typical flour mill several of the roles towards the top of the following table may not be based at the site. Depending on the size and structure of an organisation these roles may be part a corporate function or support may be provided to the site by people based at larger mills. Support may also be provided by 3rd party specialists.

No matter how the roles are assembled it is important that the individuals and the business (e.g. top management and human resources) can clearly identify the structure and people carrying out these key roles.

| **Responsibility / Role** | **Application at a typical flour mill** |
|---|---|
| Explosion Risk Assessment and Hazardous Area Classification | A site-based person should have a good understanding and awareness of explosion hazards, risk controls and hazardous area classification to enable them to follow appropriate standards and guidance produced relating to flour milling. This person would require support from a "technical authority", corporate function or from a 3rd party specialist |
| Management of Electrical Equipment in Zoned Areas | Two options are available depending on the size of the site and the organisational structure;<br>• An experienced engineering / maintenance manager with current appropriate accredited training e.g. CompEx Module Ex14 or;<br>• An experienced engineering / maintenance manager supported by an experienced electrical, control, instrumentation engineer with current appropriate accredited training e.g. CompEx Module Ex14.<br>See discussion following this table. |

| Responsibility / Role | Application at a typical flour mill |
|---|---|
| Inspection & Maintenance of Electrical Equipment in zoned areas | Typically, an experienced electrical, control, instrumentation technician with current appropriate accredited training e.g. relevant CompEx Modules.<br>For flour mills where hazardous areas relate to dusts the following modules would typically be required;<br>• ExF; Foundation<br>• Ex04–Ex05; Dust<br>See discussion following this table. |

As outlined in Section 1, the "continuous supervision by skilled personnel" approach is unlikely to be applicable to a typical small-medium sized flour mill and therefore the roles of "technical person with executive function" and "skilled personnel" defined in BS EN 60079-17 [Ref. 1] are not applicable on site. However, the general qualification and competence requirements of BS EN 60079-17 [Ref. 1] are applicable. It is worth noting that there is no definition in the standard for "responsible person" – this term is a generic term used for anyone who has a defined responsibility or role.

Ideally all electrical, control / instrumentation technicians who work in hazardous areas should have the relevant accredited training (e.g. relevant CompEx modules), however it is recognised that this may not be practicable for a typical small – medium sized flour mill and in many cases the regular periodic inspection of electrical equipment in hazardous areas will be outsourced to 3rd party providers.

When deciding on the provision of training for site personnel, it is important to note that following any adjustment, maintenance, repair, reclamation, modification or replacement of electrical equipment in a hazardous area; the installation must be inspected by a competent person, who has the relevant accredited training (e.g. relevant CompEx modules), before it is put into use.

The practicality of reliance on 3rd party providers to inspect electrical equipment following reactive maintenance or repair should be considered carefully. Such an approach can have hidden cost elements such as call-out costs for 3rd party technicians or downtime waiting for them to arrive on-site.

It should be noted that the number of items of electrical equipment, and the types of equipment, installed in hazardous areas will play a major part in deciding on the correct approach to take for inspection of electrical equipment in hazardous areas by CompEx accredited technicians. As illustrated below, the number of items of electrical equipment in hazardous area zones is likely to be significantly less than that which was historically present and the historical approach e.g. utilised when ATEX / DSEAR first came into force may no longer be practicable.

Older versions of standards and guidance relating to hazardous area classification for combustible dusts, such the ones outlined below, applied a much more conservative

"blanket zoning" approach to hazardous area classification. This meant that depending on the age of a flour mill, the extent of hazardous (zoned) areas was much larger than those currently defined and there was a significantly larger number of items of electrical equipment installed in hazardous areas that required "ignition protection"

- BS 6467-2 [Ref. 8], which pre-dates ATEX / DSEAR by many years, utilised a Zone Z / Zone Y, which approximate to Zone 21 and Zone 22 used in standards developed for ATEX / DSEAR.
- European standards relating to ATEX, such as BS EN 50281-3 [Ref. 9], published shortly before ATEX / DSEAR came into force, introduced the Zone 20, Zone 21 and Zone 22 approach but also employed "blanket zoning"
- Both these standards provided guidance on the extent of zones as summarised below, but gave limited guidance relating to dust layers and how they impact on zone classifications and extents. It should be noted that the zone extents are significantly greater than in current standards and guidance;
    - Zone 20; within process equipment enclosures.
    - Zone Z or Zone 21; normally only small extent, typically up to 1 metre from nearest point of the source of release extending vertically downwards to the ground or level of a solid floor.
    - Zone Y; in most circumstances extending up to 15 metres horizontally from sources of release and vertically upwards to 3 metres above the source of release
    - Zone 22; in most circumstances extending up to 1 metre around the sources of release and vertically downwards to the ground or to the level of a solid floor

Since the early 2000's, guidance in standards has changed significantly, particularly relating to combustible dust layers. BS EN 60079-10-2 [Ref 2], first published in 2009, provided detailed definitions of housekeeping levels relating to dust layer accumulation which has allowed many workplace areas to be re-classified as "not classified".

This means that hazardous areas extents have generally been reduced further, to a point where there is no requirement to define Zone 22 areas in much of the workplace of a well-managed flour mill. In this case hazardous areas will generally be confined to the internals of processing equipment and a limited number of localised hazardous area zones in the workplace. Electrical equipment installed in these hazardous are zones is likely to be limited to instrumentations installed within silos, bins and other process equipment and a limited number of items of electrical equipment in the workplace located close to a specific release sources. The number of items of equipment may be several orders of magnitude less than that which were historically located in "blanket zones".

The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) employs the principles of inherent safety and defines a priority order for control measures. It should be noted that the following control measures are above the avoidance (or control) of ignition sources;

1. Reduce the quantity of dangerous substances to a minimum
2. Avoid or minimise the release of dangerous substances
3. Control the release of dangerous substances at source
4. Prevention of the formation of an explosive atmosphere, including application of appropriate ventilation
5. Ensure that any release of a dangerous substance is suitably collected, safely contained, removed to a safe place, or otherwise rendered safe

The Approved Code of Practice L138 [Ref.10] clearly states "combustible dusts should be prevented from accumulating to such an extent that, if dispersed and they became airborne, an explosive atmosphere would result".

For a flour mill with extensive blanket zoned areas in the workplace, it is worth reviewing the current sources of dust releases, the effectiveness of housekeeping and hazardous area classification to determine if zone extents can be reduced.

## 4.0 DOCUMENTATION

Each organisation, or site, should develop a simple management standard or procedure for the management of for electrical equipment in hazardous (zoned) areas. This standard / procedure should;

- Outline the overall inspection process
- Ensure appropriate checklists and records are used for inspection
- Explain what to do with the inspection records
- Explain how to deal with inspection failures
- Refer to an "arrangements" document which defines who currently takes on the responsibilities / roles listed in Section 3.0 for each site e.g. "who does what..."

Each organisation, or site, should also develop simple management standards or procedures for the following;

- Selection and installation of electrical equipment in hazardous (zoned) areas
- Management of change (plant / equipment, processes and organisational)

For further details on these additional topics see HSD Safety Report Ref. 181157-C.

Each site should have a verification dossier, as defined in BS EN 60079-14 [Ref. 10], which should contain sufficient documentation to demonstrate the compliance of all electrical equipment and installations in hazardous areas.

For effective inspection and maintenance, up to date documentation should be available on each site, including;

- A copy of the hazardous area classification report and drawings
- Specified requirements for each location including
    - Equipment Protection Level (EPL) or ATEX category
    - Equipment group
    - Temperature class / maximum surface temperature
- Equipment characteristics e.g.
    - Preferred types of protection
    - Temperature ratings
    - Ingress protection (IP) rating
    - Corrosion resistance
- Inspection / maintenance records and requirements
    - Inspection regime for each type of equipment e.g. specifying the frequency of inspection and grade of inspection
    - Lists and locations of
        - Electrical equipment in hazardous areas
        - Spares
        - Certificates of conformity
        - Technical information
    - Previous inspection records
    - Maintenance records

Inspection and maintenance records for electrical equipment in hazardous areas should be kept for the lifetime of the equipment. Checklists should be used to carry out visual, close and detailed inspections of electrical equipment and to record the findings of the inspections. These checklists should be based on the appropriate schedules detailed in Tables 1, 2 & 3 of BS EN 60079-17 [Ref. 1]

- Table 1; for equipment with the following types of protection
    - Ex “d” – protection by flameproof enclosure
    - Ex “e” – protection by increased safety
    - Ex “n” – non-sparking electrical equipment
    - Ex “t / Td” – protection by enclosure
- Table 2; for equipment protected by Ex “i” – intrinsic safety
- Table 3; for equipment protected by Ex “p” and Ex “Pd” – pressurised enclosure

See Appendix B for an example inspection schedule.

In addition to the documentation above, records are also needed for training, competency of staff and the selection process for use of 3rd party contractors / specialists.

## APPENDIX A – REFERENCES

The following published standards and guidance have been used as part of this assessment;


1. BS EN 60079-17:2014; Explosive atmospheres. Part 17: Electrical installations inspection and maintenance (978 0 580 80125 9).

2. BS EN 60079-10-2: 2015; Explosive atmospheres – Part 10-2: Classification of areas – Explosive dust atmospheres (ISBN 978 0 580 80696 4)

3. HSR25, The Electricity at Work Regulations 1989 – Guidance on Regulations, 3rd Edition (ISBN 978 0 7176 6636 2), published by HSE.

4. Statement of Ethical Principles for engineering professionals, 2017, published by the Royal Academy of Engineering and the Engineering Council.

5. Publication 186; A Practitioner's Handbook for potentially explosive atmospheres, Edition 7 (ISBN 978 0 85931 212 7), published by the Engineering Equipment and Material User Association.

6. UK Standard for Professional Engineering Competence, 3rd Edition, published January 2014 by the Engineering Council

7. Guidelines for Institutions Codes of Conduct, Revision 2017/1, published by the Engineering Council.

8. BS 6467-2:1988, Electrical apparatus with protection by enclosure for use in the presence of combustible dusts. Guide to selection, installation and maintenance (ISBN 0 580 16259 1).

9. BS EN 50281-3:2002; Electrical apparatus for use in the presence of combustible dust. Classification of areas where combustible dusts are or may be present (ISBN 0 580 40602 4)

10. L138, Dangerous Substances and Explosive Atmospheres Regulations 2002, Approved Code of Practice and guidance, 2nd Edition (ISBN 9780717666164), published by HSE.

11. BS EN 60079-14:2014; Explosive atmospheres. Part 14: Electrical installations design, selection and erection (978 0 580 93501 5).

## APPENDIX B; EXAMPLE INSPECTION SCHEDULE

From Table 1 of BS EN 60079-17:2014

| | Check that:<br>X = required for all types, n = type "n" only, t = type "t" and "tD" only | Ex "d" | | | Ex "e" | | | Ex "n" Ex"t/tD" | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade of inspection | | | | | | | | |
| | | D | C | V | D | C | V | D | C | V |
| A | **GENERAL (ALL EQUIPMENT)** | | | | | | | | | |
| 1 | Equipment is appropriate to the EPL/Zone requirements of the location | X | X | X | X | X | X | X | X | X |
| 2 | Equipment group is correct | X | X | | X | X | | X | X | |
| 3 | Equipment temperature class is correct (only for gas) | X | X | | X | X | | n | n | |
| 4 | Equipment maximum surface temperature is correct | | | | | | | t | t | |
| 5 | Degree of protection (IP grade) of equipment is appropriate for the level of protection/group/conductivity | X | X | X | X | X | X | X | X | X |
| 6 | Equipment circuit identification is correct | X | | | X | | | X | | |
| 7 | Equipment circuit identification is available | X | X | X | X | X | X | X | X | X |
| 8 | Enclosure, glass parts and glass-to-metal sealing gaskets and/or compounds are satisfactory | X | X | X | X | X | X | X | X | X |
| 9 | There is no damage or unauthorized modifications | X | | | X | | | X | | |
| 10 | There is no evidence of unauthorized modifications | | X | X | | X | X | | X | X |
| 11 | Bolts, cable entry devices (direct and indirect) and blanking elements are of the correct type and are complete and tight | | | | | | | | | |
| | – physical check | X | X | | X | X | | X | X | |
| | – visual check | | | X | | | X | | | X |
| 12 | Threaded covers on enclosures are of the correct type, are tight and secured | | | | | | | | | |
| | – physical check | X | X | | | | | | | |
| | – visual check | | | X | | | | | | |
| 13 | Joint surfaces are clean and undamaged and gaskets, if any, are satisfactory and positioned correctly | X | | | | | | | | |
| 14 | Condition of enclosure gaskets is satisfactory | X | | | X | | | X | | |
| 15 | There is no evidence of ingress of water or dust in the enclosure in accordance with the IP rating | X | | | X | | | X | | |
| 16 | Dimensions of flanged joint gaps are:<br>– within the limits in accordance with manufacturer's documentation or<br>– within maximum values permitted by relevant construction standard at time of installation or<br>– within maximum values permitted by site documentation | X | | | | | | | | |
| 17 | Electrical connections are tight | | | | X | | | X | | |
| 18 | Unused terminals are tightened | | | | X | | | n | | |
| 19 | Enclosed-break and hermetically sealed devices are undamaged | | | | | | | n | | |
| 20 | Encapsulated components are undamaged | | | | X | | | n | | |
| 21 | Flameproof components are undamaged | | | | X | | | n | | |
| 22 | Restricted breathing enclosure is satisfactory – ( type "nR" only) | | | | | | | n | | |
| 23 | Test port, if fitted, is functional– ( type "nR" only) | | | | | | | n | | |
| 24 | Breathing operation is satisfactory– ( type "nR" only) | X | | | X | | | n | | |
| 25 | Breathing and draining devices are satisfactory | X | X | | X | X | | n | n | |
| | **EQUIPMENT SPECIFIC (LIGHTING)** | | | | | | | | | |
| 26 | Fluorescent lamps are not indicating EOL effects | | | | X | X | X | X | X | X |
| 27 | HID lamps are not indicating EOL effects | X | X | X | X | X | X | X | X | X |
| 28 | Lamp type, rating, pin configuration and position are correct | X | | | X | | | X | | |
| | **EQUIPMENT SPECIFIC (MOTORS)** | | | | | | | | | |
| 29 | Motor fans have sufficient clearance to the enclosure and/or covers, cooling systems are undamaged, motor foundations have no indentations or cracks. | X | X | X | X | X | X | X | X | X |
| 30 | The ventilation airflow is not impeded | X | X | X | X | X | X | X | X | X |
| 31 | Insulation resistance (IR) of the motor windings is satisfactory | X | | | X | | | X | | |

*Continued on following page.*

| Check that:<br>X = required for all types, n = type "n" only, t = type "t" and "tD" only | | Ex "d" | | | Ex "e" | | | Ex "n" Ex"t/tD" | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Grade of inspection | | | | | | | | |
| | | D | C | V | D | C | V | D | C | V |
| B | **INSTALLATION – GENERAL** | | | | | | | | | |
| 1 | Type of cable is appropriate | X | | | X | | | X | | |
| 2 | There is no obvious damage to cables | X | X | X | X | X | X | X | X | X |
| 3 | Sealing of trunking, ducts, pipes and/or conduits is satisfactory | X | X | X | X | X | X | X | X | X |
| 4 | Stopping boxes and cable boxes are correctly filled | X | | | | | | | | |
| 5 | Integrity of conduit system and interface with mixed system maintained | X | | | X | | | X | | |
| 6 | Earthing connections, including any supplementary earthing bonding connections are satisfactory (for example connections are tight and conductors are of sufficient cross-section) | | | | | | | | | |
| | – physical check | X | | | X | | | X | | |
| | – visual check | | X | X | | X | X | | X | X |
| 7 | Fault loop impedance (TN systems) or earthing resistance (IT systems) is satisfactory | X | | | X | | | X | | |
| 8 | Automatic electrical protective devices are set correctly (auto-reset not possible) | X | | | X | | | X | | |
| 9 | Automatic electrical protective devices operate within permitted limits | X | | | X | | | X | | |
| 10 | Specific conditions of use (if applicable) are complied with | X | | | X | | | X | | |
| 11 | Cables not in use are correctly terminated | X | | | X | | | X | | |
| 12 | Obstructions adjacent to flameproof flanged joints are in accordance with IEC 60079-14 | X | X | X | | | | | | |
| 13 | Variable voltage/frequency installation complies with documentation | X | X | | X | X | | X | X | |
| | **INSTALLATION – HEATING SYSTEMS** | | | | | | | | | |
| 14 | Temperature sensors function according to manufacturer's documents | X | | | X | | | t | | |
| 15 | Safety cut off devices function according to manufacturer's documents | X | | | X | | | t | | |
| 16 | The setting of the safety cut off is sealed | X | X | | X | X | | | | |
| 17 | Reset of a heating system safety cut off possible with tool only | X | X | | X | X | | | | |
| 18 | Auto-reset is not possible | X | X | | X | X | | | | |
| 19 | Reset of a safety cut off under fault conditions is prevented | X | | | X | | | | | |
| 20 | Safety cut off independent from control system | X | | | X | | | | | |
| 21 | Level switch is installed and correctly set, if required | X | | | X | | | | | |
| 22 | Flow switch is installed and correctly set, if required | X | | | X | | | | | |
| | **INSTALLATION – MOTORS** | | | | | | | | | |
| 23 | Motor protection devices operate within the permitted $t_E$ or $t_A$ time limits. | | | | X | | | | | |
| C | **ENVIRONMENT** | | | | | | | | | |
| 1 | Equipment is adequately protected against corrosion, weather, vibration and other adverse factors | X | X | X | X | X | X | X | X | X |
| 2 | No undue accumulation of dust and dirt | X | X | X | X | X | X | X | X | X |
| 3 | Electrical insulation is clean and dry | | | | X | | | X | | |
| (D = detailed, C = close, V = visual) | | | | | | | | | | |