INSTALLATION & MAINTENANCE OF ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS

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FLUOR®
STEP # 1
STEP # 3
INTRODUCTION

◆ 2 most important standards will be discussed as they encompass not only design, erection and installation but also maintenance and inspect of electrical equipment in hazardous areas.

◆ Extensive reference has been made to the SANS Standards as they are to a great extent self-explanatory and need to be studied in depth and then applied as necessary.
EXPLOSIVE ATMOSPHERES –

Part 14: Electrical installations design, selection and erection

“Knowledge, skills and competencies of responsible persons, operatives and designers”
F.2 KNOWLEDGE AND SKILLS

◆ F.2.1 Responsible persons

Regarding Responsible persons it is important to note is that there must be an understanding of electrical engineering, be able to read and assess engineering drawings, understand relevant standards in Ex protection and have a knowledge of QA and auditing.

◆ The responsible person is not to do the work but rather to manage Competent Operatives

◆ F.2.2 Operatives (selection and erection)

Here it must be noted that Operatives are not exempt from selection and erection principles in that they require an understanding of general principals of Ex protection, of inspection and maintenance and here we observe reference to SANS 60079-17, techniques in selection and erection and importance of permit to work systems and safe isolation.
F.2 KNOWLEDGE AND SKILLS

F.2.3 Designers (design and selection)

The criteria for design and selection are the most rigid for the very reason that an error here could have serious and disastrous consequences.

For the most part the knowledge must be detailed regarding general principles of Ex protection, types of protection and marking, Permit to Work system, techniques in selection and erection of equipment and a general understanding of Inspection and Maintenance as per SANS 60079-17.
F.3 COMPETENCIES

F.3.1 General

Competencies shall apply to each of the explosion protection techniques for which the person is involved.

F.3.2 Responsible persons

Responsible Persons shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements.
F.3 COMPETENCIES

- **F.3.3 Operatives**
  Operatives also have to demonstrate competency and provide evidence thereof regarding documentation use and availability, job reports, preparation and installation of concepts of protection and use and production of installation records

- **F.3.4 Designers**
F.4 Assessment

Competency of Responsible Persons, Operatives and Designers shall be **verified** and **attributed at intervals** determined by regulations and standards with evidence that necessary skills are acquired, act competently across the range of activities and relevant knowledge and understanding underpinning competency.
Adequate precautions to avoid ESD & Lightning to be implemented

Use of light alloy (Mg, Al, Ti, ) material to be assessed critically in HAZ AREAS due to its incendive properties

Where reasonably practical, electrical apparatus generally and switch & control apparatus should be installed outside the Hazardous Areas

Electrical apparatus may be installed in open air in a non-hazardous area
Installation Guidelines of Electrical Equipment in Hazardous Areas

- Equipment designed for higher gas groups can be used for less hazardous gas groups (for e.g., Equipment certified for II C can be used for II A, B or I)

- Portable hand-lamps, communication equipment and other test equipment shall be Ex i type

- All equipment shall be installed so as to avoid mechanical damage

- Earthing shall be carried out as per SANS CODES

- Bonding of all pipeline flanges should be carried out so as to avoid Electro-static discharges

- Internal earthing to be provided for all FLP equipment in addition to external earthing
All circuits and apparatus in Hazardous Areas should be provided with means to ensure quick disconnection in the event of any fault (O/C, S/C or E/F)

Protection & Control apparatus shall be normally located in non-HAs but if unavoidable, they may be of the right protection type

All electrical apparatus (for every apparatus or sub-groups) should be provided with an effective means of isolation, including neutral

Metal conduits, armored cables

Correct terminations using proper sized cable glands (double-compression, FLP type)

Unused cable openings of all electrical apparatus shall be closed with plugs suitable for the type of protection
INSTALLATION GUIDELINES OF ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS

- Copper or Aluminium (above 16 sq. mm only) conductors can be used

- FLP plugs & sockets should have preferably PUSH-IN, TWIST-ON type to avoid ignition while insertion or removal

- Adequacy of IP equipment

- Test equipment
  - Insulation Resistance megger shall be Ex i type
  - Earth Megger shall be Ex i type
  - Hotspot Detection equipment
INSPECTIONS
Knowledge, skills and competencies of “responsible persons”, “technical persons with executive function” and “operatives”
B.2 Knowledge and skills

Regarding Responsible persons and technical persons with executive function it is important to note is that there must be an understanding of electrical engineering, be able to read and assess engineering drawings, understand relevant standards in Ex protection, have a working knowledge of relevant standards and have a knowledge of QA and auditing.
B.2.1 Responsible persons and technical persons with executive function

Regarding Responsible persons and technical persons with executive function it is important to note is that there must be an understanding of electrical engineering, be able to read and assess engineering drawings, understand relevant standards in Ex protection, have a working knowledge of relevant standards and have a knowledge of QA and auditing.
“B.2.2 Operatives (inspection and maintenance)

Here it must be noted that Operatives are not exempt from inspection and maintenance principles in that they require an understanding of general principals of Ex protection, of inspection and maintenance, comprehensive understanding of the selection and erection requirements of IEC60079-14 and here we observe reference to SANS 60079-19, techniques and repair and reclamation requirements.
B.3 Competencies

B.3.1 General

Persons shall be competent for each of the explosion protection techniques in which they are involved e.g. Exd.

B.3.2 Responsible persons and technical persons with executive function

Responsible Persons and technical persons with executive function shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements.
B.3.3 Operatives

Operatives also have to demonstrate competency and provide evidence thereof regarding documentation use and availability, practical skills necessary for the inspection and maintenance of relevant concepts of protection.
B.4 Assessment

Competency of Responsible Persons, technical persons with executive function shall be verified and attributed at intervals not exceeding 5 years on the basis of sufficient evidence that the person has the necessary skills for the scope of work, can act competently across the range of activities and relevant knowledge and understanding underpinning competency.
Typical inspection procedure for periodic inspections

(See 4.3)

NEW PLANT

Type initial
Grade: detailed

DETERMINATION
Determine provisional periodic interval

EXISTING PLANT

Type sample
Grade: visual

Can an increase in the periodic inspection interval be justified?

Yes

Type periodic
Grade: visual

No

Type periodic
Grade: visual

Increase periodic interval

Type sample
Grade: visual

Is the periodic interval already three years?

Yes

Type periodic
Grade: visual (C)

Type sample
Grade: detailed

Can an increase in the periodic inspection interval be justified?

Yes

Carry out safety audit to recommend new periodic interval

* IC ignition capable in normal operation, i.e., where the internal components of the apparatus produce in normal operation, arcs, sparks or surface temperature capable of causing ignition.
MAINTENANCE RECOMMENDATIONS IN HAZARDOUS AREAS

◆ FLP Equipment
  – All bolts in place
  – All openings closed
  – No site modification / alteration
  – Internal & external earthing
  – Double-Compression, FLP cable glands
  – No physical damage
  – No damage to Flame path
  – All threaded connections-minimum 5/6 threads engagement
  – Flange faces to be smooth & original (to be careful while opening stuck covers)
MAINTENANCE RECOMMENDATIONS IN HAZARDOUS AREAS

- Light alloy paint even for the purpose of maintenance must not be applied on any external surface of the equipment to prevent incendive frictional sparking.
- Equipment shall not be tampered to open covers, etc.
- No components shall be added or removed or even replaced. This has to be done after getting re-certified by the OEM.
- A scheme of regular inspection & maintenance of the items should be made on the basis of guidelines / standards. Any equipment which is originally flameproof may loose its integrity if not maintained properly.
- The equipment should be de-energized before attempting any repair.
Drawings /Records
- Updated SLD
- Updated HAC drawing
- Drawing with various equipment installed in various identified zones
- Certification / re-certification records
- IR / ER records

Sufficient Spare stock of critical equipment (various Ex types)

Solid obstruction (steel structures, walls, other electrical equipment) effects (close to equipment flanges)
- IIC - 40 mm clearance
- IIB - 30 mm
- II A - 10 mm
- I - no clearance envisaged
MAINTENANCE RECOMMENDATIONS IN HAZARDOUS AREAS

- Integrity of IP equipment
  - Use of gasket is permitted if certified as part of the equipment
  - No sealing of flange faces (this could affect the ability of the enclosure to withstand the maximum explosion pressure)
  - Application of non-setting grease or anti-corrosive agent is permissible
  - Non-hardening tape can be used in II A gas groups, II B tape is to be avoided and no use of tape in II C gas groups
- Insulation integrity to be periodically tested and maintained
- Maintenance personnel
  - Inspection, Maintenance, testing, replacement and repair in HAs shall be carried out by trained personnel only
  - Refresher training for them is essential
Periodic examination of flange gaps and flange faces for any effects of corrosion / damage, etc.

Maintenance Tests (at an interval not exceeding 3 years)
- IR measurements
- Earth electrode resistance measurements
- Earth loop resistance measurements
- Operation & Setting of Protection devices
MAINTENANCE RECOMMENDATIONS IN HAZARDOUS AREAS

- Ex i - No addition / alteration of circuit components / power limitation barriers, etc.
- Check Ex p equipment / panels / rooms for low pressure interlock operations, periodic review of air in take stack location
- Terminations in Ex e, n types equipment
- Use of non-sparking tools
SANS 10142 -1:2012 - The wiring of premises Part 1: Low-voltage installations

SANS 60079-10 - Classification of areas - Explosive Gas Atmospheres, part 10-1:2010

SANS 60079-14 - Explosive Atmospheres Part 10-1:2009 Electrical Installations and Design, Selection and Erection

SANS 60079-17 - Explosive Atmospheres Part 17:2009 Electrical Installations and Inspection and Maintenance


IP Part 15 - Area Classification Code for Petroleum Installations

API RP 505 : Recommended practice for Classification of locations for Electrical installations at Petroleum Facilities classified as Class 1, Zone 0, Zone 1 and Zone 2
I hereby wish to express my thanks to Fluor and SAFA for allowing me the opportunity to publish and present this paper and extend my appreciation to the delegates who sat so patiently and listened. I wish to thank the Bureau for the rights to refer to the relevant SANS Standards.

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The information contained in this paper is based on many years experience and exposure of the author, in the field of hazardous area classification and selection of equipment for safe use therein, as well as the review and study of technical publications and other writers. While the statements purpose to be accurate, each reader is responsible for their own interpretation.