INSPECTION, MAINTENANCE AND REPAIR OF ATEX EQUIPMENT

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Abstract - To apply the directive 1999/92/EC, the employer shall ensure that the work equipment, used in place where explosive atmosphere may occur, are maintained so as to reduce at most explosion risks.

The maintenance shall be realized in a permanent concern for keeping the protection level of work equipment in ATEX. This level shall never be either modified or deteriorated.

That's why this activity shall be carried out only by workers who have been trained to the specificity of the protection types and shall be the matter of specific follow-up and management.

The safety shall also be guaranteed if the maintenance and overhaul of equipment are sub-contracted.

We will establish technical and organizational recommendations to ensure a safe maintenance of ATEX equipment. On a technical point of view, the international standards IEC 60079-17 et IEC 60079-19 deal with inspection, maintenance, repair and overhaul of electrical apparatus for explosive gas atmospheres. With regard to the mechanical equipment, we will produce some elements of our referential ISMATEX and SAQRATEX.

To deal with the management of maintenance, we shall particularly watch over the identification of the ATEX equipment, the archiving of technical documentation, the establishment of maintenance planning, and to the traceability of the interventions.

We shall also be sure that the maintenance workers are correctly trained and experimented, either they are internal workers or sub-contractors.

Index Terms — Repair, Workshop, Spare parts, Maintenance, Inspection, Overhaul, Reclamation, Traceability, Training, Quality management system, Assessment, Competency,

I. INTRODUCTION

According to directive 1999/92/EC, all necessary measures must be taken to ensure that the workplace, work equipment and any associated connecting device made available to workers are maintained in such a way as to minimize the risks of an explosion. The methods and the rules to achieve this goal must be defined in the explosion protection document drawn up by the employer responsible for the workplace.

First, we will carry out a short inventory of the regulation requirements and applicable standards for maintenance and repair of equipment used in explosive atmospheres.

In a second time we will establish organizational and technical recommendations so as to maintain the level of protection of equipment and to fulfill the requirements of the directive 1999/92/EC.

It's important to note that this article does not relate to technical measurements and/or of organization which must be applied in order to ensure the protection of workers during the actions of maintenance carried out in explosive atmospheres.

The following definitions will be used:

- Repair : Action to restore a faulty apparatus to its fully serviceable condition and in compliance with the relevant standard.
- Overhaul : Action to restore to a fully serviceable condition an apparatus which has been in use or in storage for a period of time but which is not faulty.
- Maintenance : Routine actions taken to preserve the fully serviceable condition of the installed apparatus.
- Reclamation : Means of repair involving, for example, the removal or addition of material to reclaim component parts which have sustained damage, in order to restore such parts to a serviceable condition in accordance with the relevant standard.
- Inspection : action comprising careful scrutiny of an item carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item.

II. INVENTORY OF REGULATION REQUIREMENTS AND APPLICABLE STANDARDS

A. European regulation

Although the user remains responsible for the maintenance and the repair of its equipment according to the directive 1999/92/EC, it is necessary to pay the attention to the requirements of directive 94/9/EC that could be connected to these activities.

1) Repaired equipment and modifications

Repaired equipment is product whose functionality has been restored following a defect without adding new features or any other modification. As this occurs after the product has been placed on the market and the product is not to be sold as a new product, the ATEX Directive 94/9/EC does not apply.

It is however important to note that directive 94/9/EC re-applies to a modified product where the modification is

considered to be substantial and if it is intended to be placed again on the EU market for distribution and/or use.

In the sense of directive 94/9/EC a substantial modification is any modification affecting one or more of the health and safety requirements (e.g. temperature) or the integrity of a type protection. In the case of the electrical equipment protected by a recognized protection type, the following modifications may be regarded as substantial:

- Modification of the temperature class or temperature of surface of equipment following variation of dissipated power,
- Motors supplied at varying frequency and voltage by a converter if this type of application is not specified by the instruction manual,
- Luminaries: modification of power and type of lamp,
- Electrical box: modification of the dissipated powers or the internal temperatures,
- Intrinsically safe equipment: modification of the associated accumulators,
- The drilling of holes in an explosion-proof enclosure,
- Etc.

When modifications are realized, it's necessary to ask to the manufacturers and/or to the authority in charge of certification, if the equipment can continue to be used in potentially explosive atmosphere.

2) Spare parts

A typical repair operation would be the replacement by a spare part. The spare part is normally not required to comply with directive 94/9/EC unless the spare part represents equipment or component as defined by the directive and it is placed for the first time on the EU market for distribution and/or use. In the case of the electrical equipment protected by a protection type recognized, the following spare parts can be regarded as equipment or component :

- Separate cable glands (equipment or component), [1]
- Terminals,
- Push button assemblies,
- Relays,
- Ballast for fluorescent lamps « EEx e »,
- Etc.

[1] In some cases, cable glands are fully with the enclosure or specific to the enclosure. They have been tested as part of the enclosure concerned and are not regarded as equipment or component.

Bearings, mechanical seals, screws, etc. are not usually placed on the market with the explicit intention to be incorporated into ATEX equipment but for general engineering purposes. In such case, their conformity has to be assessed in the course of the conformity assessment of the integral product and they don't represent equipment or components as defined by the directive.

It is preferable to obtain new parts from the manufacturer, and the repairer shall ensure that only appropriate spare parts are used in the repair or overhaul of certified apparatus. Depending on the nature of the apparatus, these spare parts may be identified by the manufacturer, the apparatus standard or the relevant certification documentation. If the manufacturer of the original spare part offers a new different one in its place (due to technical progress, discontinued production of the old part, etc.), and it is used for the repair, the repaired product (as long as no substantial modification of the repaired product takes place) does not need to be brought into conformity at this time with directive 94/9/EC as the repaired product is not then placed on the market and put into service.

When it is impossible to obtain spare parts coming from the manufacturer and if a new part, different from that which is in place must be used, this modification (as long as this modification cannot be regarded as substantial) must be realized under the responsibility of the user, within the framework of the 1999/92/EC directive. In this case, it seems necessary to formalize an assessment, showing that the modification doesn't affect one or more of the health and safety requirements or the integrity of a type protection. This analysis should be attached to the explosion protection document drawn up by the employer responsible for the workplace.

3) Instructions for maintenance

In addition, it is important to recall that all equipment must be accompanied by instructions for safe use (installation, operation and maintenance)

According to directive 94/9/EC, the instructions must contain the drawings and diagrams necessary for the putting into service, maintenance, inspection, checking of correct operation and, where appropriate, repair of the equipment or protective system, together with all useful instructions, in particular with regard to safety.

B. Standards

Although they are not imposed by the directives, standards may nevertheless be used like technical references for the activities of inspection, maintenance, repair and overhaul of electrical equipment used in explosive atmospheres. However, there is no equivalent for non-electrical equipment.

4) Repair and overhaul for electrical apparatus used in explosive atmospheres

The standard IEC 60079-19 gives instructions, principally of a technical nature, on the repair, overhaul and reclamation of a certified electrical apparatus designed for use in explosive atmospheres. It gives guidance on the practical means of maintaining the electrical safety and performance requirements of repaired apparatus, but also defines procedures for maintaining, after repair, compliance of the apparatus with the provisions of the certificate of conformity or with the provisions of the appropriate explosion protection standard where a certificate is not available.

Concerning electrical apparatus for explosive gas atmospheres, the standard provides instructions for the following types of protection:

- Flameproof enclosures « d »,
- Increased safety « e »,
- Pressurized enclosure « p »,
- Intrinsic safety « i »,
- Types of protection « n »,

- Group II Zone 0 electrical apparatus.

Concerning electrical apparatus for use in the presence of combustible dust, the standard covers the following types of protection:

- Protection by enclosures « tD »,
- Pressurized enclosure « pD ».

5) Inspection and maintenance of electrical installations in explosive atmospheres

The standards IEC 60079-17 and IEC 61241-17 are intended to be applied by users and maintenance companies. They cover factors directly related to the inspection and maintenance of electrical installations within hazardous areas (respectively gas and combustible dusts). They give general requirements (documentation, qualifications of personnel, maintenance requirements, earthing and equipotential bonding, etc.) and additional inspection schedule requirements for electrical apparatus protected by:

- Flameproof enclosures « d »,
- Increased safety « e »,
- Pressurized enclosures « p » and « pD »,
- Intrinsic safety « i » and « iD »,
- Types of protection « n »,
- Protection by enclosures « tD ».

6) Specific standards

In addition, other standards give indications for maintenance of particular applications, such as:

- IEC 62086-2 : Electrical apparatus for explosive gas atmospheres - Electrical resistance trace heating - Part 2 : Application guide for design, installation and maintenance
- IEC 61779-6 : Electrical apparatus for the detection and measurement of flammable gases - Part 6 : Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases

III. ORGANISATIONAL AND TECHNICAL RECOMMENDATIONS

7) Subcontractors selection

While the international standards and rules related to the electrical equipment for explosive atmospheres are very strong and binding for the construction and the installation of these appliances, there are few rules and international standards for the repair and maintenance. There are international standards relative to the repair, inspection and maintenance of the electrical apparatus for explosive atmospheres but they do not apply to the non-electrical equipment. Moreover, the use of a standard is not always sufficient to establish a reliable climate among the repairer and his customer and it is necessary to set up strict working procedures to establish this confidence. It can be one of the objectives of repair workshops (and/or maintenance companies) certification.

Regulation and standards recognize the necessity of a required level of competence for the repair and maintenance of an ATEX apparatus. Some manufacturers may recommend that the apparatus shall be repaired only by people whose competencies are established. Nevertheless, in some cases the manufacturer has either disappeared, or abandoned the manufacturing of this equipment, or stopped supplying spare parts.

There are also cases where the repair services of the manufacturers are completely separate and independent of the design and production units. In such cases, to utilize the manufacturer facilities does not completely exempt to check repairer competence.

Except specific local regulation, the certification of the companies of repair and maintenance is not obligatory but it remains a solution to guarantee a safe maintenance of ATEX products.

Users will utilize the most appropriate repair facilities for any particular item of equipment, whether they are the facilities of the manufacturer or a suitably competent and equipped repairer. Anyway, the user remains responsible for the maintenance and the repair of its work equipment.

8) Subcontractors certification

The purpose of such certification must be to guarantee that the operations are made according to the state of the art and that the level of safety of the repaired equipment stays the same that the one of the original equipment.

a) Quality management system:

It can be based on the quality management system of the repairer and/or maintenance company. An organization as a quality management system leads to a specific plan of organization to ensure the traceability and the quality of the works. This plan can be inspired by the arrangements taken within the framework of the European directive 94/9/EC relative to equipment for potentially explosive atmospheres as regards to product quality assurance and the survey of the manufacturer.

Therefore, such a company must:

- have the means and the professional skill necessary for the interventions to be realized (inspection, maintenance, repair, overhaul and/or reclamation),
- have the means required to realize the necessary tests and measurements,
- demonstrate the traceability of the interventions,
- put a marking plate on the equipment in case of repair, overhaul and/or reclamation.
- ensure the reporting to the user of interventions made on the equipment

The quality management system must show that these requirements are fulfilled. The organization scheme of the company can be based on the following actors:

- "The authorized person " who is the final responsible for the operations. He is in charge of the quality assurance system, defines and organizes responsibilities in the field of ATEX equipment
- "The person responsible for final verification". He has the responsibility of final checking and marking in case of repair, overhaul and/or reclamation,
- "Operative persons" who are involved in the interventions on ATEX products.

b) Technical guidance documents:

As previously described, IEC standards can be used like technical references for the activities of inspection, maintenance, repair and overhaul of electrical equipement used in explosive atmospheres.

In our referential for repair workshops certification, we have adapted the IEC standard 60079-19 to take into account and to add the requirements relative to the group I as well as the requirements relative to the French mine regulations and the former French technical specifications for flameproof enclosures used in potentially explosive atmospheres (well known as “ADF” products). However we have excluded the modification of equipment and strengthened the procedures when a repair is made without the documentation of the manufacturer. We have also adopted a single repair marking instead of two defined in IEC 60079-19.

This technical guidance document is supplemented by specific procedures for various apparatus and various types of protection. These procedures, more detailed than the technical guidance document, resume the working procedures of the various repairers:

- Repair procedure for electrical rotating machines,
- Reclamation procedure for flameproof joints.

To fulfil a request from users and repairers we also have introduced the requirements for:

- repair of non-electrical equipment complying with the CEN standard series EN 13463-1,
- the repair of industrial trucks complying with the CEN standard EN 1755,
- interventions on usual mechanical components (bearings, seals, mechanical seals, etc.)

9) Training and competency assessments

The operatives directly concerned with the maintenance, the repair and/or overhaul of the certified apparatus must be trained, experienced, skilled and knowledgeable and/or supervised on this type of work.

The responsible persons (“authorized person” and “responsible person for final verification and operative persons” as defined in chapter a) *Quality management system*) have to, besides the knowledge in their repairing scope, know the regulations, the standardization and the concepts of certification for the apparatus for explosive atmospheres. So we advise a training program which comprises:

- awareness on the risks due to the explosive atmosphere, general points on the explosions, regulations in force, the standards guidance documents considered,
- understanding of documents issued by certifying authorities and the manufacturers,
- information about the protection by enclosure ("d", "e", "p" "m", tD, pD, diesel engines),
- and/or information about the protection of the electronic equipment ("i", SYST, etc.),
- and/or information on the standards of the EN 13463-1 series,
- information on technical procedures.

Following such as training, the competency assessments can proceed in the following way:

- individual answers to questionnaires (types of protection, technical procedures, etc.). The documents delivered during the training could be used,
- checking of a repaired equipment,
- At the conclusion of the evaluation, every person having acquired the level defined receives an individual agreement renewed every 3 years.

In the event of intervention in hazardous area, these persons and the operatives concerned must also know the specific rules of interventions in explosive atmospheres (instructions, procedures, permits to work, working clothes and tools, etc.) That would thus be regarded as a sufficient and appropriate training with regard to explosion protection according to directive 1999/92/EC.

10) Documentation

All relevant documentation that is available shall be obtained (standards, certification documents, manufacturer documentation). Records of any previous repairs, overhauls or modifications shall be kept by the user and made available to the repairer.

This is one of the principal difficulties for the old equipment where the traceability of the previous interventions as well as manufacturer documentation are no more available. If the manufacturer does not exist any more, the documents of certification pass in the public domain and can be requested from the authority in charge of certification. If documentation remains unavailable, the repair or reclamation must be realized in accordance with the relevant explosion-protected standards (it means the standards to which the apparatus was originally designed) This rule will apply in particular to the reclamation of flameproof joints.

At the completion of the work, job reports shall be submitted to the user containing, at least, the following:

- Details of fault detected
- Full details of maintenance, repair or overhaul
- List of replaced or reclaimed parts
- Results of all checks and tests (in sufficient detail to be useful if required by the next repairer)
- Summary of previous history of the product including information as gathered

A filing of this documentation is necessary in order to guarantee the correct and regular maintenance of equipment.

IV. CONCLUSION

In France, the need of a certification for the safety equipment against firedamp was expressed in 1999 by the Lorraine coal mines. This need was motivated by the preservation of the safety of the underground mine exploitations even in conditions of recession of the coal mines and mining industry in France. Indeed, this recession leads to a decreasing of the investments and reduces the interest of the manufacturers of equipment. In the same way, the working units of French coal mines have no more the need to buy new equipment and are obliged to

maintain existing equipment. Furthermore, because of the decrease of their manpower, the technical services or the maintenance units of coal mines can not ensure any more all the repairs.

In a lot of cases the manufacturers of mining equipment have either disappeared, or abandoned the manufacturing of these equipment, or stopped supplying spare parts. So it makes difficult the repair of the apparatus by the manufacturer or by his subcontractor.

The repairs should be made more and more by outside workshops not always informed about the requirements and the compulsory constraints for the electric equipment intended for mines susceptible to firedamp or for explosive atmospheres.

On another hand, more and more chemical and petrochemical companies outsource some facilities and services to external companies and they ask for a minimum quality of these services. This concern is reinforced by a requirement of the ATEX 1999/92/EC, which required that work equipment and work places are maintained in a such way to minimise the risk of explosion.

The aim of INERIS certifications for repair and maintenance companies is to become official national certifications. It ensures to users, the competency and the commitment of specialised subcontractors and a guaranty of safety, quality and traceability. It was designed by INERIS in order to cover:

- all type of equipment, electrical and non-electrical,
- all explosive atmospheres comprising flammable dust atmospheres,
- the need of all the users of equipment for explosive atmospheres (oil, chemical, food industries…)

It is hoped, to improve the safety, that such an approach should be used wherever there is a risk of an explosive atmosphere.

The number of certified companies and the interest of users companies show the usefulness of such a certifications.

V. REFERENCES

[1] Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, *Official Journal no. L100,* 1994-04-19, 1-29.

[2] Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres, *Official Journal no L23/57, 2000-01-28*

[3] IEC 60079-19, Ed. 2.0 : *Electrical apparatus for explosive gas atmospheres - Part 19: Repair and overhaul for apparatus used in explosive atmospheres (other than explosives)*

[4] IEC 60079-17 : *Electrical apparatus for explosive gas atmospheres - Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)*

[5] IEC 61241-17 : *Electrical apparatus for use in the presence of combustible dust . Part 17 : Inspection and maintenance of electrical installations in hazardous areas (other than mines).*

[6] EN 13463-1 : *Non-electrical equipment for potentially explosive atmospheres – Part 1 : Basic method and requirements.*

[7] EN 1755 : *Safety of Industrial trucks – Operation in potentially explosive atmospheres – Use in flammable gas, vapour, mist and dust*

[8] IEC 62086-2 : *Electrical apparatus for explosive gas atmospheres - Electrical resistance trace heating - Part 2 : Application guide for design, installation and maintenance*

[9] IEC 61779-6 : *Electrical apparatus for the detection and measurement of flammable gases - Part 6 : Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases*

[10] Referential ISMATEX : 2006, *Installation, Maintenance and Service in explosive atmospheres* - INERIS

[11] Referential SAQRATEX : 2006, *Système d'Assurance Qualité des Réparateurs de matériels destinés à être utilisés en ATEX (Quality Assurance System for Repair Workshops)* - INERIS

VI. VITA

Olivier COTTIN is member of INERIS, person in charge for certifications of the companies of repair and maintenance in ATEX field (SAQRATEX and ISMATEX certifications)

He has developed the referential ISMATEX for the certification of companies involved in conception, realization and maintenance of electrical and non-electrical installations in hazardous areas.

He's also in charge, within the framework of the European directive 94/9/EC, of Quality Assurance Notifications of manufacturers.

He graduated in 1999 from ENSAM, a national college of engineering.

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INERIS is notified for ATEX 94/9/CE European Directive.

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