# THE IMPLEMENTATION OF BEST PRACTICES IN SONATRACH WITH REGARD TO EXPLOSIVE ATMOSPHERES BASED ON ATEX DIRECTIVES

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**Abstract-** There have been so many spectacular examples of accidents when working in hazardous areas which have resulted in explosions and fires causing the loss of lives, destruction of properties and public image of companies suffers a lot.

In order to enhance health and safety standards in the European industry, the EU issued two directives called Directive 94/9/EC (ATEX 95) and Directive 99/92/EC (ATEX 137). The first one places duties on manufacturers, suppliers...with regard to the design, construction and manufacturing processes of equipment and protective systems whereas the latter places duties on employers to protect workers from explosive atmospheres by risk assessing areas where these atmospheres may arise, preventing their formation, avoiding ignition sources and mitigating the detrimental effects of possible explosions.

SONATRACH as a group does not have its own directive to address such issues. SONATRACH is attempting to implement a health and safety management system.

The present study introduces the best practices with regard to explosive atmospheres. A review of practices worldwide showed that ATEX directive constitute a major improvement.

The ATEX directive requirements were then applied to sub-unit in an LNG plant.. A further risk assessment for unwanted catastrophic accident and societal risk was also carried out.

**Keywords:** ATEX-Risk Assessment-Best Practices

## 1. INTRODUCTION

There have been so many spectacular examples of accidents when working in hazardous areas which have resulted in explosions and fires causing the loss of life and destruction of installations and public image of companies suffers a lot.

From the Vapour Cloud Explosion (VCE) of Cyclohexane in Flixborough to the one in isomerisation unit in the biggest US refinery in Texas City through Liquefied Petroleum Gas (LPG) Boiling Liquid Expansion Vapour Explosion (BLEVE) in Mexico City and VCE initiated in a boiler in Skikda Liquefied Natural Gas (LNG) trains which caused 27 people killed and more 80 others injured are some of these catastrophic examples

But this negative situation led to major changes in laws and huge efforts were devoted to risk reduction.

The EU issued two directives: ATEX 95 and ATEX 137 (ATEX comes from French language: the two first syllables of ATMOSPHERES EXPLOSIBLES constitute the word ATEX) which came in force in July 2003 for new equipment/ installations and will be so in July 2006 for existing ones.

The former places duties on manufacturers, suppliers...with regard to the design, construction and manufacturing processes of equipment and protective systems whereas the latter places duties on employers to protect workers from explosive atmospheres by risk assessing areas where these atmospheres may arise, preventing their formation, avoiding ignition sources and mitigating the detrimental effects of possible explosions. [1]

Our country is not bound to these directives but no law which deals with explosive atmospheres-as stated in these directives- exists in the Algerian regulations so far. As a user of equipment, spare parts… we have to prepare ourselves to such a situation, this on the one hand.

SONATRACH as a Group does not have its own directive to address such issues on the other hand.

But an HSE Management System (HSE MS) is being implemented as well as a directive from SONATRACH CEO which defines the actions and measures to be taken in terms of safety namely improvement and reinforcement of prevention and risk management and particularly expresses the obligations of compliance inside the company was recently released.

This in turn, is an excellent opportunity to analyse actual situation, compare it to best practices and propose an implementation scheme.

What are SH expectations ? In fact SH is interested to know how to implement its HSE MS. Therefore one of the important objectives is to link the findings to this Management System (MS) and seek how to include proposals with regard to explosive atmospheres. This can be done by analysing actual situation, determining best practices, linking the findings to the HSE MS and giving recommendations.

What is the approach now to address such issues?

It is based on performing a gap analysis and applying the findings to a particular area. This will result in recommendations and an implementation scheme.

## 2. THE STUDY RESULTS

What is the Algerian situation?

A review of Algerian regulations showed that Algeria has not yet tackled such issue as it is dealt worldwide. In other words, no risk assessment is mandatory or an area classification. There have been risk assessment and area classification depending on the constructor at design stage and no update was carried out or made mandatory.

Now, What about SONATRACH?

As sated earlier, there is a very good opportunity to address such issues. SONATRACH has recently documented an HSE MS and CEO issued in January a directive which shows top management commitment, reinforces the MS and defines policy, actions and measures to be taken. This is very interesting in fact, because these elements can simply allow implementing best practices.

Two plants were visited in order to collect data concerning the actual situation: an LNG plant (GL4Z) and LPG one (GP2Z) both located in ARZEW industrial area.

Many positive aspects were noticed during site visits such as:

- Experienced personnel and very keen to learn
- A Permit To Work system being updated
- Good house-keeping and maintenance of equipment even though installations are very old
- A Distributed Control System being implemented…

Whereas in the same time, other aspects need to be looked at:

- No risk assessment is done systematically even though it is a new installation such as the new ethylene sphere storage because simply there is no mandatory regulation and none is performed for existing non electrical equipment
- No procedures or work instructions for catastrophic scenarios exist
- No detailed information on lessons learnt from SKIKDA accident
- No area classification exists in LNG plant except for noise and a classification was carried out recently in LPG plant using American classification without any details
- Some working equipment and Personal Protective Equipment are not compliant. We noticed workers using pneumatic drill just near LNG train
- Contractors and facility siting need to be addressed very deeply

Let us define explosive atmospheres first. According to ATEX directive an explosive atmosphere means *a 'mixture with air, under atmospheric conditions of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture'*[1]

Therefore, what are the best practices with regard to explosive atmospheres?

Four basic principles of explosion protection are applied.

- Area classification
- Types of protection
- Temperature classification

Degree of protection

Two views were studied: the North American and the European one.

Despite the similarities namely the temperature classification and the degree of protection for instance, there are some differences which allow make the choice between the two views.

### *2.1. North American Case*

Relying on engineering good practices, North American deal only with electrical equipment; non electrical equipment is therefore not considered. According to National Electrical Code 500 and 505 and section 18 (Canadian Electrical Code) these areas are classified as follows [2]:

- Class I, fire or explosion hazards may exist due to flammable gases, vapours or liquids,
- Class II, for combustible dusts, and
- Class III, for ignitable fibres or flyings

And subdivided into:

- Division 1, explosive atmospheres may exist all or some of the time during normal operating conditions and
- Division 2, explosive atmospheres may not exist under normal operating conditions.

### *2.2. The European Case*

Table 1 below summarizes the European classification.

Table 1 ZONE CLASSIFICATION

| Zone | Occurrence of explosive atmosphere | Duration of explosive atmosphere |
|---|---|---|
| Zone 0 | Continuously | Long periods |
| Zone 1 | Likely | In normal operation occasionally |
| Zone 2 | Not likely | Short period only |

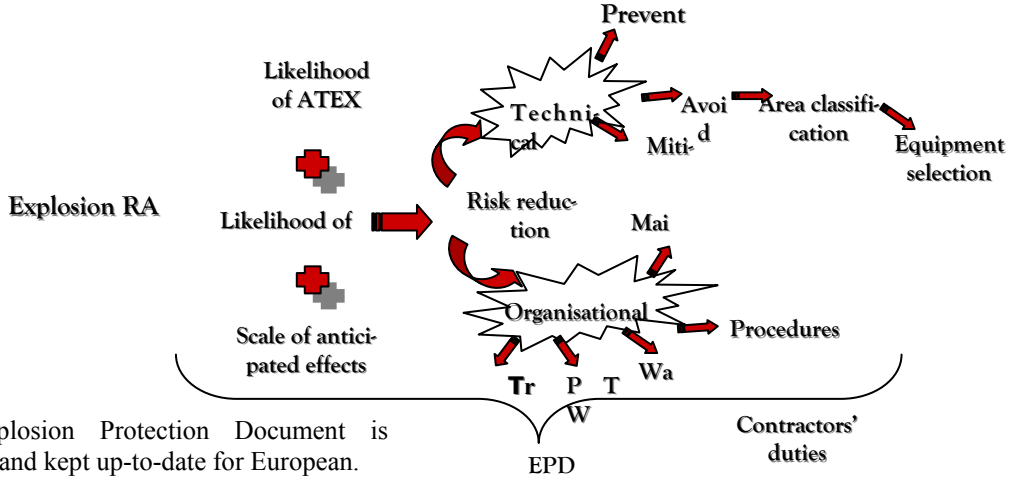
In fact the big novelty lays in the introduction of non electrical equipment.

In support to ATEX directives European Union issued standards for non electrical equipment intended for use in potentially explosive atmospheres known as prEN 13463. [3] The basic method and requirements are provided in part 1 of these standards and the other parts give the requirements for the specific types of ignition protection which may be used.

When comparing the two views, the main differences can be summed up as follows:

- Hazardous Area Classification: no difference between continuous and primary grade of release for American view
- Equipment: introduction of non electrical equipment for European
- Technical and organisational measures: Risk assessment is made mandatory for European and

Figure 1 ATEX the essentials




an Explosion Protection Document is drafted and kept up-to-date for European.

As a result ATEX directives constitute a major improvement indeed.

ATEX best tackles these issues.

What are ATEX requirements?

In a nutshell, as it is shown in figure 1 above:

The employer must perform an explosion Risk Assessment taking into account:

- The likelihood of explosive atmospheres occurrence and persistence
- The likelihood that ignition sources are present, become active and effective and

The scale of anticipated effects

If there is an explosive atmosphere, then explosion protection measures are necessary. These measures are technical and organisational. The technical measures should be applied in priority order so that to:

- Prevent the formation of hazardous explosive atmospheres,
- Avoid their ignition or

At least mitigate their effects so as to protect the health and safety of personnel and public.

The organisational measures deal with:

- Procedures & working instructions
- Training of staff
- Maintenance and inspection
- PTW

Warning signs…

Where workers from several companies are present in the same workplace each employer is responsible for all matters coming under his control but the task of coordination falls to the employer responsible for the workplace. [1]

Eventually, the employer must draft an Explosion Protection Document. This document shall demonstrate in particular that:

- The explosion risks have been determined and assessed
- Adequate measures will be taken to achieve the objectives of the directive
- Those hazardous places have been classified in zones
- For these places minimum requirements will apply
- The workplace and working equipment are designed, operated and maintained with due regard for safety

## 3. APPLYING THE FINDINGS

As sated before the findings will be applied to a particular area. The area in question is a new ethylene sphere storage not yet commissioned in the LNG plant.

A risk assessment was performed based on ATEX requirements (article 4).

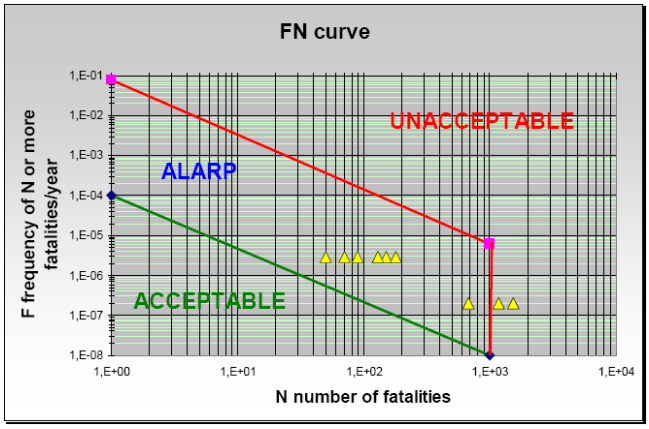
Sources and grades of release in places where explosive atmospheres may arise were identified as well as potentially sources of ignition.

Risk reduction measures were deemed necessary thus, technical and organisational explosion protection measures were proposed.

According to the risk evaluation and calculations a hazardous area classification was carried out. The grades of release were mainly secondary and the area was mostly classified zone 2. As a result, equipment selection and categorisation was proposed.

A risk assessment of catastrophic accidents was also performed. Fault Tree Analysis (FTA) and Event Tree Analysis (ETA) were used to determine causes and consequences of a catastrophic incident; an explosion due to a major release of ethylene, as well as an FN curve [5]

Figure 2: FN curve




was drafted to determine societal risk as a result of a simulation of risk evaluation of uncontrolled incidents using ALOHA software (see figure 2) [6].Risk Assessment results for catastrophic accident:

***Cause analyses (FTA):***

- Explosion occurrence: **1.86 x $10^{-6}$/year**
- Ethylene release: **6.2 x $10^{-6}$/year**
- Effective ignition source: **3 x $10^{-1}$/year**

***Consequence analyses (ETA):***

- Controlled incident: **4.2 x $10^{-7}$/year**
- Uncontrolled incident with 0.5 probability that a transition to a BLEVE is possible given flame impingement: **2.04 x $10^{-7}$/year**
- Vapour Cloud Explosion: **1.08 x $10^{-6}$/year**
- No loss ignited: **5.58 x $10^{-7}$/year**

The FN curve gives two unacceptable cases which necessitate further measures.

## 4. THE LINK TO THE HSE MS [4]

All given recommendations fall in the scope of SONATRACH HSE Management System being implemented in the company. In addition to point 1 which relates to leadership, commitment and responsibility, they can be summed up as follows:

- All areas where explosive atmospheres may occur are identified, risk assessed and classified and all ignition sources avoided (Element 2 of HSE MS)
- All equipment must be appropriately selected (Element 2 of HSE MS)
- All work in such places must be carried out with clear and understandable written instructions and procedures (Element 2 of HSE MS).
- All maintenance activities must be performed with a permit to work system (Element 2 of HSE MS).
- Staff must be provided with appropriate working equipment and PPE (Element 3 of HSE MS).
- Contractors' duties and procurement policy (Element 5 of HSE MS).
- Drafting and updating the EPD (Element 6 of HSE MS).
- Where explosive atmospheres may arise appropriate training must be provided to all personnel working in such places (Element 7 of HSE MS)

- The overall explosion safety must be verified by competent persons in all places where explosive atmospheres may occur before the first use (Element 7 of HSE MS)
- All escape facilities must be provided and maintained as well as emergency instructions are issued and implemented (Element 9 of HSE MS).

And eventually review and audit (Element 10 of HSE MS).

## 5. IMPLEMENTATION SCHEME

At SH Group level as a general implementation scheme,

- Set a work team in order to determine an action plan for SONATRACH Group.
- Set multi-disciplinary teams at all levels (maintenance, process, HSE, human resources…) to accomplish these tasks
- Evaluate actual situation with regard to explosive atmospheres
- Perform a gap analysis
- Evaluate level of efforts required to upgrade installations
- Implement recommendations
- Schedule a training program in order to achieve the objectives and issue necessary guidelines and provide explanation about ATEX meanings and goals
- Audit and review

At operational levels, the local implementation scheme should be as follows:

Places where explosive atmospheres may occur must first:

- Be identified and
- Classified consequently according to the likelihood and frequency of occurrence of these atmospheres

Afterward

- Decide whether existing equipment are well selected and appropriately categorised according to risk assessment findings and area classification
- Take technical and organisational measures
- Draft an EPD and keep it up to date
- Draft checklists for coordination measures, tasks and EPD completion

## 6. CONCLUSIONS & RECOMMENDATIONS

For SONATRACH, as it was stated before, ATEX directives constitute a major improvement therefore we recommend implementing ATEX requirements as best practices and following the implementation scheme proposed in the study.

Concerning national regulations, we recommend closing the loop by updating and adapting existing regulations

In particular, this could be done by:

- The drafting of new regulations with regard to the protection of workers susceptible to be exposed to hazardous explosive atmospheres by the definition of the minimum requirements and adequate measures aiming to improve their safety and health protection.
- Updating the labour law (code) by adding regulations concerning arrangements of working areas notably the definitions of zones where explosive atmospheres may arise.
- Updating the coordination duties where several companies are working in the same area.

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