Hazardous Area Installations--- How to make 92 % of sites safer without increasing the costs of compliance

Executive Summary

Hazardous Areas are typically found in large facilities like chemical processing plants, oil production platforms, tank farms, refineries, storage tanks, ships, grain silos, warehouses and other similar areas, which have the risk of explosion or fire due to explosive mixtures of vapors or dusts. While most technical personnel, who work in such facilities or help in designing these installations, are fairly aware of hazardous areas and the risks involved, the report of a recent study carried out by the **Health and Safety Executive**, UK, is surprising, as well as shocking. It points to the fact, that many so called hazardous area installations, were not up to the standard and some were downright unsafe. It states that, out of the **TWELVE** major sites surveyed, only **ONE** site passed the inspection. This means **eleven** of the **twelve** sites (a whopping **92 %**) had potentially dangerous hazardous area electrical & instrument installations. Out of these sites surveyed, on 50 % of the sites, the situation was so bad that formal enforcement action had to be taken by the authorities. The high incidence of poor hazardous area installations was also thought to be behind many of the actual dangerous occurrences reported.
This White Paper is an attempt to help engineers and managers, not only in the UK, but also elsewhere, to have a clear understanding of this subject and address the key issues involved.
The aim should be to make 100 % of installations safer, all over the world.

Introduction

Hazardous Areas in a typical facility are classified on two aspects. One is the probability of a flammable, or explosive mixture being present in that area and secondly, the type of the material being present. Hence classification entails specifying the area (known as Area Classification) as well as the material (Material Classification). A third parameter, temperature is also important and Temperature classification is also carried out. An equipment then, carries a marking which shows the Area, Material and Temperature classification for which it can be installed safely, i.e. without the risk of explosion hazard.
So far so good, so where are the problems?
Read on to get an insight.

Area Classification---What is the present state in hazardous area chemical plants?

Of the twelve sites mentioned above, many could not produce any supporting documentation to show that they had classified (or zoned) the hazardous areas. They could not even mention the standard to which the zoning was carried out, which is shocking, to say the least and could have potentially dangerous consequences. This points to a large scale lack of awareness of the basic concepts of hazardous areas and can only be corrected by proper training of the personnel involved.

Why poor area classification increases costs and decreases safety and how it affects you.

How you classify the hazardous area in your facility is one of the most important but least understood and neglected issues today. Why? Because the way in which you classify a hazardous area can significantly affect the operating costs of your facility in the long run.
Globally, in area classification, there are two major standards. One is the IEC (International Electrotechnical Commission) system, which is mainly followed in Europe, Asia, Australia and many other regions. The second system is the NEC (National Electrical Code) which is popular in North America and parts of the middle east. The IEC system has three zones (Zones 0, 1 and 2) based on decreasing probability of explosive vapor or gas mixtures being present and the NEC system has two (Division 1 and Division 2), again based on decreasing probability of hazardous mixtures of gas or vapor being present.
If your facility has been designed by an engineer who has wrongly "overclassified" the hazardous areas, then you are unnecessarily incurring additional costs without any benefits. What is overclassification? Simply, it is declaring an area as hazardous when it is really not. How does this increase costs? By forcing you to buy and maintain expensive explosion protected equipment when an ordinary weatherproof one would have been just as good. Secondly, since the area is anyway not hazardous, you are paying more for safety that you do not need. It is the equivalent of wearing a safety helmet while having lunch in your home.
Declaring an area as Zone 1, when instead it should really be Zone 2 is also a case of overclassification. This then restricts your ability to use some of the cost effective techniques like "Non incendive" which are available for use in Zone 2 only (but not allowed in Zone 1).
What is worse is that if your plant has large swathes of areas marked as "hazardous" then you may have a very difficult time with your local authorities, if you approach them for permissions for expansions, etc. These days they will always have the NIMBY syndrome (Not in my backyard). This would be really tragic if the area does not deserve to be marked as hazardous, but it has been done by some overzealous engineer many years back.
What about underclassification? Underclassification is declaring an area as non-hazardous, which should in fact be marked as hazardous. This is possible due to ignorance or incompetence of the design engineer or perhaps the original design was modified by the owner/operators without considering reclassification. This is downright dangerous and is much more serious. You should immediately properly classify any area that deserves to be marked as hazardous and follow the safety standards for these areas. Install explosion protected equipment which is suitable for these areas and here too, you will save costs (both human and monetary) by giving hazardous areas the respect that they deserve.
In a recent tragic case in the US, a large dust explosion took place. Faulty area classification and usage of non-hazardous area electrical equipment in hazardous areas is thought to have been the cause of the disaster. Unfortunately, six lives were lost in the incident.

Area Classification issues----Mitigation of root causes

How can this problem be resolved? By conducting an audit of your present facility, marking hazardous areas with reference to the current standards available, as well as training the personnel in the basics of area classification. Logically, everyone who works in hazardous areas should know what is a "hazardous area" and this knowledge can be imparted only through regular training. But a regular classroom style training is impractical, as well as very costly, in today's business environment where there are no "spare employees" who can cover the ones who have to be sent outside for training.
Hence, an e-learning program, remains as the only cost effective way to train large numbers of operations and maintenance personnel continuously and effectively.

Proper Electrical Explosion Protection methods increase safety, reduce dangerous occurrences and reduce costs.

If one follows the IEC standards, there are many different ways of explosion protection for electrical equipment, which are recognized. The most used ones are Explosionproof /flameproof, Intrinsic Safety, Increased Safety, Non-incendive, Pressurization/Purging, Encapsulation, Powder filling. Not all of them can be applied in all situations, nor do all have the same capability. However, choosing one over the other types, in case multiple ways of explosion protection are allowed, can lead to big cost implications. For example in a facility if one has Zone 0, 1 and 2 in various parts, then obviously in Zone 0, one can only use Intrinsic safety, but in Zones 1 and 2 one can use both Intrinsic Safety, as well as explosionproof methods and in Zone 2, one can use these two methods as well as Increased safety and Non incendive as well.
In this example, if one uses only Intrinsic Safety everywhere, the design and maintenance become simplified, technicians need to be trained in only one type of installation and number of parts that have to be stored in inventory for maintenance are few. This immediately means that though the initial project costs may be higher, the total cost of ownership is significantly lower. This one design basis can affect the entire lifecycle costs in a significant way. However, in this example if the design engineer decides to use different methods of protection for the different areas, then one has a problem of having multiple instructions for the different zones, (thereby confusing the maintenance technicians, who then may make some hazardous errors). Having to maintain multiple parts in stores is another disadvantage in this case.
Another example is where a facility, which was designed many years ago, used only purging everywhere. This was not a problem in the earlier years, but now with rising costs of compressed air, the cost of explosion protection also goes up with every passing year! This would not have happened had they used something like Increased Safety, for example.
Yet another example would be where there are no electrical installations in Zone 0 and Zone 1 but only in Zone 2. One can then easily use Increased Safety or Non-incendive methods of protection which would be much cheaper than going in for either explosionproof or Intrinsically safe.

The type of electrical explosion protection method which is to be used therefore is a significant factor which can affect the lifecycle costs of a facility. Proper choices result in better safety at lower costs.
Worse than this is however, the usage of non suitable hazardous area electrical equipment in hazardous areas. This means even though it may be suitable for use in some hazardous areas but not all. For example, something that is suitable for use in Division 1, Groups C and D cannot be used in a Division 1, Group B area.
However this kind of underdesign, does happen many times and results in accidents. In a case in the US involving an explosion in a facility handling Ethylene Oxide (a group B gas under the NEC), the electrical equipment installed in the area was found to be not suitable for Group B (though it was explosionproof).This lack of awareness is thought to be a cause of the unfortunate event.
This points to the urgent need of training of the engineering personnel in Protection techniques. Training of these technical personnel can thus save your company in thousands of dollars worth of capital as well as lifecycle (maintenance) costs. Again an e-learning program is a quick, reliable and cost effective way to impart this knowledge to the engineering staff.

The state of Maintenance in Hazardrous area installations

As per the British study referred to above, many of the hazardous area installations were maintained by contract labor with doubtful training and competence in doing this kind of work. Competencies were weak in most cases with only one site having some kind of refresher training for its employees.
This may be because of many reasons, including cost pressures of reducing manpower, wholesale outsourcing of maintenance functions to “lowest cost” contractors who may not have adequately trained manpower, or simply because of downsizing of engineering departments in process industries (the original engineers who had an idea of the design no longer remain and are replaced by newcomers who have little idea about the installation).
However, if one does a well scheduled maintenance and inspections with trained manpower, many problems can be detected which can be nipped in the bud. These may be many things like bolts missing on explosionproof boxes or improper grounding of barriers. Or it may be that an instrument which is certified for use only in Zone 2 was installed in Zone 1 (because the technician who replaced it could not understand what those funny symbols and labels mean!)
If these kind of operations are tolerated, it can result in explosions and undesirable events. The cost of such an event is much more than the cost of preventive measures.
The cost of training employees should no longer be a constraint as an effective e-learning program can be very cost effective either as a basic training or as a refresher course. In fact the cost of training in this way will be miniscule, compared to the cost of ignorance, which could result in a major disaster.

Root causes of poor area classification, improper selection of protection methods and poor maintenance & what we can do to mitigate it

How do these problems of overclassification or underclassification occur anyway? Why does it happen that a selection of a particular protection technique over another is not done correctly, or done with inadequate thought of the life cycle costs? Why do maintenance issues crop up and sites that were designed and installed with proper equipment to begin with, turn into potentially unsafe installation?
This is because there seems to be a general lack of awareness, amongst many people in design , engineering and in industry today, regarding explosion protection methods and standards.
This was not seen earlier, when industries had a large pool of in house trained engineers and technicians, who were experienced and they in turn had seniors and mentors (with lots of time) who trained and maintained the "knowledge base" of the organization. This knowledge base has largely shrunk today, thanks to cost cutting, downsizing and restructuring of most in house engineering departments.
Thus a lot of companies are left with a less than adequate engineering resources. So how does one address the problem?
The quick and cost effective solution is a fast track training and skill development program for hazardous area installations. This is also brought out by the recommendation of the British study mentioned above. Young engineers and technicians often lack the mentoring that their predecessors had and this is risky for you, not only in terms of expense but in terms of safety too.
The other way is to hire outside consultants to do this for you. This will however be not only costly but more important is the fact that it is not going to add to the knowledge base of the organization in any way, whereas training the employees would surely do this. For effective training however, the e-learning course that you select, should be comprehensive (cover all aspects of hazardous areas), be easy to learn with animations and simulations, as well as test the learner with assessments to judge how much material has been absorbed.

Note:
If you have any comments or any questions regarding this White paper (bouquets or brickbats!) please feel free to write to us at mail@abhisam.com or call us on **001-407-965-1387**
We would love to hear from you!

About Abhisam

Abhisam Software is a young, knowledge based startup dedicated to providing e-learning solutions to personnel working in a range of industries in areas of safety, automation and control systems domains. **Abhisam** is the only company to come out with an **e-learning** course on **"Hazardous Area Instrumentation",** which has been highly acclaimed by experts in the field.