Explosion protection of electrical installations in the Peoples´ Republic of China

Adapting the national regulations to IEC-practice

by B. Liang

Figure 1: BASF chemical plant in China

China assumes a special position in the very rapidly growing economic region of Asia Pacific. Currently, the economy in the Peoples' Republic is growing faster than in all other countries of the world.

Attracted by the breathtaking changes and the enormous growth rates in comparison with Europe, foreign investors are making major investments in sectors such as production and processing of crude oil and natural gas as well as the chemical and pharmaceutical industries. For instance, the Bayer Group is to invest 1.8 billion US $ in China in the years to come, at the Caojing production site near Shanghai alone.

Owing to the imminent risk of explosion of many main and auxiliary processes in this industry, there is a major demand for explosion protected apparatus. Foreign investors are, of course, particularly interested in being able to use the technical and organisational solutions, which have long proven their worth at their parent plants – for example within the EC – in their new installations in China as well without extensive modifications, in respect of explosion protection.

The article below is intended to present certain interesting and current aspects of explosion protection of electrical apparatus in the Peoples' Republic of China.

Harmonisation with international standards underway

The law in the Peoples' Republic of China stipulates that all apparatus for use in hazardous areas must be tested and approved by a National Testing and Certification Agency (e.g. NEPSI). The corresponding national (GB) standards form the basis for this approval procedure.

Since China is a member of the International Electrotechnical Commission (IEC), the responsible persons in the Peoples' Republic of China are currently harmonising national standards with the corresponding standards of the IEC or the US NEC. However, it must be stated that this process is, at present, by no means complete. Coordination and harmonisation of the various levels of knowledge and experience of international or local end users, engineering companies and local public authorities still costs the companies participating in the relevant investment projects a great deal of time and money.

Table 1 lists the national Chinese Standards, which have already been more or less adapted to the corresponding IEC Standards

Some of the old Chinese Standards for explosion protection issued by the previous China State Bureau of Technical Supervision (CSBTS) have been in force for over 17 years and are still valid today.

Much of the explosion protected apparatus

Table 1: Explosion Protection Standards in the Peoples´ Republic of China

Chinese Standard	Title	Corresponds to
GB 3836.1-2000	Electrical apparatus for explosive gas atmospheres Part 1: General requirements	IEC 60079-0:1998
GB 3836.2-2000	Electrical apparatus for explosive gas atmospheres Part 2: Flameproof enclosure "d"	IEC 60079-1:1990
GB 3836.3-2000	Electrical apparatus for explosive gas atmospheres Part 3: Increased safety "e"	IEC 60079-7:1990
GB 3836.4-2000	Electrical apparatus for explosive gas atmospheres Part 4: Intrinsic safety "i"	IEC 60079-11:1990
GB 3836.5-1987	Electrical apparatus for explosive gas atmospheres Part 5: Pressurized enclosure "p"	
GB 3836.6-1987	Electrical apparatus for explosive gas atmospheres Part 6: Oil Immersion "o"	
GB 3836.7-1987	Electrical apparatus for explosive gas atmospheres Part 7: Powder filling "q"	
GB 3836.8-1990	Electrical apparatus for explosive gas atmospheres Part 8: Type of protection "n"	
GB 3836.9-1990	Electrical apparatus for explosive gas atmospheres Part 9: Encapsulation "m"	
GB 3836.10-1990	Electrical apparatus for explosive gas atmospheres Part 10: Hermetically sealed "h"	
GB 3836.11-1990	Electrical apparatus for explosive gas atmospheres Part 11: Method of test for ascertainment of maximum experimental safe gap (MESG)	
GB 3836.12-1990	Electrical apparatus for explosive gas atmospheres Part 12: Classification of gases and vapours in accordance with their maximum experimental safe gap (MESG) and their minimum ignition current (MIC)	
GB 3836.13-1997	Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul of electrical apparatus used in explosive gas atmospheres	
GB 3836.14-2000	Electrical apparatus for explosive gas atmospheres Part 14: Classification of hazardous areas	IEC 60079-10:1995
GB 3836.15-2000	Electrical apparatus for explosive gas atmospheres Part 15: Electrical installation in hazardous areas (other than mines)	IEC 60079-14:1996
GB 12476.1-2000	Electrical apparatus for use in the presence of combustible dusts Part 1-1: Electrical apparatus protected by enclosure and limitation of the surface temperature. Specification for apparatus	IEC 61241-1-1:1990

produced is based on these old Standards and this apparatus is still sold on the market.

Many planning engineers, users and even many of the around 700 Chinese manufacturers use these old Standards both for selection and operation as well as for manufacture and testing. Consequently, a situation may occur in which design engineers, end users and public authorities are working with different versions of one Standard within one project team which, of course, may lead to misunderstandings and difficulties.

Differences between the old and new Standards

We shall briefly discuss some of the essential differences between the old and new Standards for the most important types of protection below.

GB 3836-2-2000:
Flameproof enclosure "d":

a. For Group I apparatus (mining Annex C): Contains additional requirements for Group I apparatus (mining), which have been adopted from the old Standard GB 3836-2: 1983 and which do not comply with IEC 60079-1.

b. material of enclosure:
Old Standard: plastic enclosures are permitted only for a free internal volume < 2 l. Threaded openings for attachment are not permitted. Only metal is permitted as the material for larger volumes.
New Standard: the enclosure may consist of any material,if it passes the tests required in this standard.

c. Special requirements applicable to motors, plugs and sockets and lighting fittings:
Old Standard: special requirements applicable to motors, plugs and sockets and lighting fittings are listed in this Standard.
New Standard: no special requirements applicable to specific apparatus. These →

➔ have been transferred to GB 3836.1 General requirements.

d. Spigot joints:
Old Standard: no special requirements; the dimension of joint must correspond to the conventional requirements for flameproof joints
New Standard: for cylindrical joints made of metal (e.g. on cylindrical bushings for flameproof enclosures) which meet the following requirements, the joint width can be reduced to 5 mm:
- The joint area perpendicular to the cylinder shall not move during the test.
- The requirements of the mechanical impact test with high impact energy must be complied with.
- The diameter of the cylinder must be <=60 mm.

e. Flameproof joint for apparatus of Group IIC:
Old Standard: no specification for joints of IIC apparatus (including acetylene).
The precise dimensions (width and gap) must be measured and tested after manufacture. Due to the lack of specifications, apparatus of Group II C cannot be designed safely and reliably.
New Standard: detailed joint dimensions have been defined. This greatly simplifies the designer's work.

f. Threaded joint:
Old Standard: at least 6 thread turns engaged. The thread pitch may not be less than 0.7 mm.
New Standard: at least 5 thread turns and no stipulation of the thread pitch.

g. Seal and O-ring:
Old Standard: a seal is permitted on the enclosures which must be opened during maintenance and servicing. This, in turn, shall not influence the pressure resistance which means that the enclosure must pass the pressure and flame transmission test without seal.
New Standard: the seal may be a part of the flameproof joint.

h. Cable entries:
Old Standard: the following requirements should be met for "direct cable entry":
- No sparks, arcs or ignitable temperatures arising in any other way shall occur during normal operation.
- The rated power of apparatus of Group II shall not exceed 1 kW.

New Standard: no specific requirements for "direct cable entry"

GB 3836.3-2000 Increased safety "e"

a. Creepage distances and clearances:
Old Standard: the creepage distances and clearances are designed for the rated voltage. The voltage is rated in accordance with the old Chinese Electrical Code.
New Standard: the creepage distances and clearances are rated in accordance with the working voltage in accordance with IEC 60664-1 Insulation co-ordination within low-voltage systems, Part 1: Principles, requirements and tests.

b. Additional requirements applicable to specific apparatus and type testing of this apparatus have been added to the new Standard in accordance with IEC 60079-7.
Old Standard: only the mechanical strength and the degree of protection (IP protection) must be tested for the junction boxes and terminal boxes.
New Standard: the power loss of the conductors inside of the junction or terminal box must be measured. Consequently, a temperature-rise test must be conducted as type test.

GB 3836.15-2000:
Electrical installations in hazardous areas

Even though the new Standard very largely corresponds to IEC 60079-14:1996, certain deviations have been adopted. These deviations with respect to IEC practice are the cause of a great deal of confusion in practical work in the installations.

a. Only the following apparatus with type of protection Increased safety "e" may be used in Zone 1:
- Junction boxes and terminal boxes, which do not cause arcs, sparks or excessive temperatures in normal service.
- Low-voltage asynchronous motors with integrated thermal protection
- Single-pin fluorescent lamps

b. Apparatus installed in Zone 2 should be approved by a certification authority. This means that the European practice of manufacturer's responsibility (Manufacturer's Declaration) for apparatus for use in Zone 2 is not permitted.

These deviations constitute the main difference between this section of this Chinese Standard and the IEC Standard and thus have some consequences in practice:

The end user or the engineering company rarely specify apparatus with type of protection "n" for Zone 2.

Chinese manufacturers have Ex d or Ex de apparatus for Zone 1 and for Zone 2 in their range. However, this apparatus is frequently too expensive, i.e. uneconomical, for use in Zone 2.

GB 3836-8-1987:
Apparatus type of protection "n"

This old Standard was used only to specify motors and was not applicable to most other apparatus, such as switchgear and lighting fittings.

The new edition has been adapted to IEC 60079-15:1996 and has been in force since January 2004. Application of type of protection "n" is thus entirely new for control equipment and lighting fittings for most local end users, design engineers and public authorities and it will certainly take some time until the required degree of acceptance has been achieved.

Installation practice

The installation method used chiefly in China to date was conduit installation with BSPP thread. Thanks to the American influence, NPT was also accepted sometimes.

However, in previous years, direct or indirect cable entry has become more and more popular: the metric ISO thread is also widespread.

However, situations even occur in which entirely different installation methods are selected within one project or installation. Coordinating these different methods with different thread types costs all those involved: designers, manufacturers, users and suppliers included a great deal of unnecessary time and money.

Besides the end user, the manufacturers and the certification authority, there are also two other institutions, which play a very important role in China.

Firstly, there are socalled "design institutes", whose consent must be procured for all planning activities for new installations. Thus, the entire planning documentation must be approved prior to start of construction by one of these institutes.

Secondly, there are governmental authorities, such as the local labour offices as well as health and safety offices or the fire brigade authority, who are responsible for final inspection of the wiring in the installations. The installations may not be put into service until after passing an acceptance test.

China is an active member of the IEC and IECEx Scheme. Development of explosion protection, targeted at the IEC practices, is fully underway worldwide and it is a constant and irreversible process.

This development appears to be too slow for many participants with respect to China,but one must take into consideration the size of the country and the diversity of the tasks in hand.

Opening up the Peoples' Republic of China for the IEC Explosion Protection Standards very greatly assists further industrial development in this big, aspiring country. The apparatus manufactured and installed in accordance with these Standards not only makes a contribution towards safe operation of the installations equipped with the apparatus, but also constitutes an essential element of the protection concept for production facilities and operating staff.