BRAZIL MOVES FROM DIVISIONS TO ZONES

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Abstract – After decades of using the *National Electrical Code®* (NEC) and North American standards to classify hazardous locations according to the *National Electrical Code®* (NEC), Brazil is now starting to use the *International Electrotechnical Comission* (IEC) standards. Because of these revised directives, the electrical installations and designers of Oil and Gas Industry plants have faced the challenge to harmonize the electrical installations between the NEC and IEC requirements. Considering that the Brazilian Oil and Gas Sector is expected to invest approximately US$ 100 billion in the next ten years [1], this change will cause a huge impact. Although this paper is mainly focused on the Brazilian market, it will discuss very similar difficulties found by other countries in the same process of changing to IEC [2]. As Brazilian regulations also require compulsory National conformity certification for electrical and electronic equipment used in hazardous locations, these aspects and installation details will be also discussed.

Index Terms — Area classification, hazardous locations, Zone, conformity certificate, Brazilian standards, IEC.

I. INTRODUCTION

The first contact of Brazilian designers with IEC installation techniques was during the late 1970's, when the Brazil´s state Oil Company contracted its first seven large production, offshore jacketed platforms, with constructional characteristics similar to those operating in North Sea. Those projects used European electrical distribution system, with armored cables, cable trays and cable glands for ordinary as well as hazardous locations.

In 1980, the *Brazilian Technical Standards Association* (ABNT), adopted IEC basis and changed the orientation of the Brazilian electrical installations low voltage standard, issuing a totally new standard "*NBR 5410 – Electrical installations of buildings - Low voltage"*. Some changes greatly impacted the electrical installations market, as for example, cable sections were described as square millimeters instead of AWG.

For hazardous area installations, ABNT translated IEC standards into Portuguese and adopted them (with minor or no deviations) as National standards. The work began with the issuing of the explosion-proof constructional requirements standard *"NBR 5363 – Electrical apparatus for explosive atmospheres: Flameproof enclosures d – Specification"*, (based on IEC 60079-1 [3]). The Brazilian area classification standard (based on IEC 60079-10 [4]) is expected to be issued in 2002.

II. PRESENTING THE IEC 60079-10

The API RP-500 [5] has been used by Brazilian electrical designers to define hazardous areas into Divisions 1 and 2, and more recently the API RP-505 [6] made the first approach to Zones concept. However, taking into account the coming Brazilian hazardous location classification standard, new references will be required.

The objective of the area classification study is not only to identify the possibility of an explosive atmosphere existing in a given location, but more importantly, to influence the design of any plant or facility to minimize such risks.

The IEC 60079-10 is concerned with the classification of hazardous areas, but it does not apply to:

a) mines susceptible to firedamp;
b) the processing and manufacture of explosives;
c) areas where a risk may arise due to the presence of ignitable dusts or fibers;
d) catastrophic failures as for example, the rupture of a vessel or pipelines;
e) rooms used for medical purposes;
f) areas where the presence of flammable mist may give rise to an unpredictable risk.

Brazil uses three Zones definition (Zones 0, 1 and 2), instead of the two Divisions as stated in the NEC. The basic elements for establishing which Zone to apply, includes the knowledge of the sources of release and the degree of ventilation (available or provided). See Appendix A for more details.

III. EXTENT OF ZONES

The boundary of a particular zone is mainly determined by both chemical and physical parameters, as: the release rate of gas or vapor; volatility of the flammable liquid; ventilation; relative density of the gas or vapor when it is released, and the region topography [7].

It is important to say that IEC 60079-10 doesn´t define the extent of zones. The given formulas are used only to perform the ventilation study of the location. It is suggested that each situation will achieve specific results. In its Annex C, figure C1, there is a flowchart approach to be used as a guide for the area classification study. The last block of the flowchart indicates that is necessary to use an appropriate code or calculations to determine the extent of zones. Soon it will be possible to use special software to define the extent.

Nowadays there are some working groups elaborating statistical data about release rates to be used in area classification studies. One of them is the U.K. based *Inter-Institutional Group on the Classification of Hazardous Locations* (IIGCHL), that joined oil companies engineers and university researchers aiming to make a more quantitative approach of hazardous area classification [8].

The area classification drawings for Brazilian oil and gas units were used to adopt API RP-500 terminology. However, due to the *Labor and Employment Ministry´s Regulatory Rule for Electrical Installations and Services* (NR-10), which made the use of IEC standards mandatory in the absence of corresponding Brazilian standards, the American standards are no longer applicable. There are some differences between IEC and NEC classification methods, (e.g.: IEC 60079-10 doesn´t mention the use of gas detectors to reduce the area classification or its extent, as API RP-505 does on its item 6.8). In Appendix A, other characteristics (and difficulties) are shown.

IV. INSTALLATION DIFFERENCES

There is a great effort from the Study Comissions of the *Brazilian Electricity Committee* (COBEI) to harmonize all Brazilian electrical standards with IEC ones and it has published the hazardous location standards based on the IEC 60079 series. Another factor pushing Brazil this way is the government directive to develop technical unified standards for the *South Cone Common Market* (MERCOSUL) - which commercially unites Brazil, Argentina, Uruguay and Paraguay - using IEC standards as its basis.

Regarding the installations possibilities given in the *"NBR 5418 – Electrical installations in explosive gas atmospheres – Procedure"* – a Brazilian IEC 60079-14 [9] based standard - some characteristics are described:

A. Wiring Methods

Some characteristics of IEC methods used in Brazilian installations are:

1) *Power Cables:* Types similar to THHN [10] can be actually used (since the jacket material is suitable to resist the environment conditions and mechanical damage risks), while those types similar to XHHW [10] can only be used inside electric panels. As dimensional requirement, the minimum gage for solid or concentric stranded conductors is 1,5 mm^2 . It is necessary to carefully select the cable type, to avoid gas flow through the space between internal conductors.

2) *Enclosures Entries:* Direct entry of cables into flameproof chambers is allowed. To keep the integrity of Ex enclosures, it is necessary to specify for each cable that enters an enclosure, the adequate cable gland. For Ex-d enclosures, metallic certified Ex-d cable glands have to be selected, according to the cable type (if armored or not) and its internal and external diameter. For Ex-e (metallic or plastic) enclosures, plastic Ex-e cable glands can be used for non-armored cables; for armored ones, Ex-d cable glands can be used. Currently it is not required that cable gland with sealing compound chamber is used for direct entry into flameproof equipment.

3) *Intrinsic Safety Circuits:* Similar directions to those given by ISA RP-12.6 [11] standard are applied. The cables for intrinsic safety system, are identified by blue color sheath.

B. Potential Equalization

It is always necessary, to avoid dangerous sparks between metallic structures. Connecting the neutral conductor to the equalization system conductors is prohibited. Notified occurences in older plants during electrical power system faults, that resulted in sparks (due to potential differences generated between the power distribution grounding system, and the "dedicated grounding" for intrinsically safe systems), recommended that all grounding systems must be interconnected, allowing hazardous and non-hazardous areas to be at the same electrical potential, especially in the event of faults occurring.

C. Conduit System

Metallic conduits can be used, threaded, complying with the constructional requirements given by *"NBR 5597 – Carbon steel rigid conduit and with fitting protective coating with ANSI B.1.20.1 specification"*. They have to be sealed using the same directives given by NEC. Mixed systems (i.e. electrical equipment originally designed to be used with conduits but receiving cable glands instead, or the opposite) are allowed. The Brazilian standards allow to use direct and indirect entries (which terminal chambers Ex-e type are used to wiring connections, before the main Ex-d enclosure) methods. Indirect method referred to as factory sealed in North America, has the advantage to allow connections without opening of the flameproof equipment enclosure, but is still little used in our plants.

Considering that metal may become corroded, especially on offshore or shoreline locations (which if unchecked, can affect explosion protection integrity), cable trays of non-metallic materials (e.g.:glass fiber polyester reinforced) are receiving an increased preference among users.

These possibilities provide easier ways to build up processing units in the oil and gas industry, because cable trays and cable glands are less labor intensive during the initial installation and in follow-up maintenance, than the threaded conduit system.

D. Site Modifications

Field drilling of Ex-d boxes is not allowed. As the Brazilian compulsory conformity certification is required for all electric and electronic equipment to be installed in classified areas [12], any changes to approved equipment would nullify its certificate. To keep the construction flexibility and to avoid any potential safety problems, it is strongly recommended to specify Ex-d enclosures with spare holes, facilitating future site modifications. For Ex-d enclosures, these spare holes must be kept closed with approved metallic plugs.

It is worth to say that the existence of spare holes on Ex-d boxes does not imply that end users´ modifications are allowed. Ex-d enclosures only carry certification for a given internal tested configuration. When new components are added into Ex-d enclosures, they must be retested by the OEM or end-user for a temperature classification and a precompression of flamepaths. (It has to be guaranteed that no precompression paths will arise due to the new added components). After this evaluation, a new conformity certificate will be issued by the certification body, and a new label must be put on the enclosure.

E. Types of Protection

Although some terminology from IEC Ex type names is similar to that in the NEC ones (e.g. explosionproof x flameproof, and pressurized), the test requirements in each case are different, so the terminologies cannot be considered as "synonymous". Under IEC conditions it is possible to design apparatus with mixed types of protection. One of these interesting possibilities is Ex-ed, allowing e.g., Ex-d circuit breakers inside light weight Ex-e non-metallic boxes. With this configuration, there is no danger of maintenance non-conformities (e.g. missing bolts on Ex-d enclosures), providing safer installation. The IEC types are shown in Table I:

TABLE I
IEC TYPES OF PROTECTION

Symbol	Main characteristics		
	Description	IEC Standard	Application
Ex-d	Flameproof	60079-1	Zones 1, 2
Ex-p	Pressurized	60079-2	Zones 1, 2
Ex-q	Sand filled apparatus	60079-5	Zones 1, 2
Ex-o	Oil immersed apparatus	60079-6	Zones 1, 2
Ex-e	Increased safety	60079-7	Zones 1, 2
Ex-i	Intrinsic safety	60079-11	Zones 1, 2 (i_b) All Zones (i_a)
Ex-nA	Non-sparking	60079-15	Zone 2
Ex-m	Encapsulated	60079-18	Zones 1, 2
Ex-nC	Hermetically sealed	60079-15	Zone 2
Ex-s	Special	n/available	As defined on certificate

For Zone 0, only intrinsically safe equipment type Ex-i_a can be used. Ex-i_a keeps the circuit energy below the ignition level even with two simultaneous failures, while Ex-i_b keeps the energy limitation only for a single failure. The characteristics of Ex-i_a apparatus are similar of those required by ISA-RP12.6.

F. Zone 2 Equipment

For Zone 2 applications, there is the Ex-nA type, which is similar to NEC Non-incendive (which has been used in US for many years). Only in the last year IEC issued the international standard *"IEC 60079-15 – Electrical apparatus for explosive gas atmospheres – type of protection n",* about this technique. (It was first issued before as a report). As an option, the use of non-sparking equipment (e.g.: induction motors), constructed in compliance with any Brazilian industrial standard, with its temperature class compatible with the gas or vapor ignition temperature, is allowed (as NEC does).

G. Area Reclassification

If an existing location is classified according to the Division system, the Brazilian standards do not require that it has to be reclassified as a Zone. However, to buy new Ex equipment, the Brazilian Ex Conformity Assessment System requirements must be followed.

V. THE BRAZILIAN Ex CONFORMITY ASSESSMENT SYSTEM

When the matter refers to safety or health, the Brazilian government can dictate that compulsory conformity certification is required. As many examples of bad quality Ex equipment were found, putting installations and people under high risk, the *National Institute of Metrology, Industrial Quality and Normalization* (INMETRO) issued in 1991, the Edict 164/91 stipulating that all electrical and electronic equipment (Brazilian and imported ones), for use in potentially explosive atmospheres, must obtain a compulsory certification to be put on the market. The conformity certificates must be issued by an *INMETRO Accredited Certification Body for Products* (OCP), according to IEC requirements, and they have an expiration date on them, that one should pay attention to when buying Ex equipment. There are three OCP: UC (São Paulo), CERTUSP (São Paulo) and CEPEL (Rio de Janeiro), and they must follow the rule of procedure for Ex certification.

A. The Rule of Procedure for Brazilian Equipment

According to the in force INMETRO Edict 176/00 [12], there are two conformity certification models that can be applied to Brazilian Ex equipment.

1) *Brazilian Conformity Mark:* This model consists of type tests of prototypes, based on corresponding type of protection to IEC standards, plus the evaluation of the manufacturer´s Quality Management System, made by audits based on ISO 9002 [13] standard (at least one per year). These audits are taken into consideration when defining the expiration date of the certificate. It is not mandatory for the OCP to hold the Register of the manufacturer´s Quality Management System. This model also expects tests on samples collected in the manufacturer and in resellers, and it is mainly applied to equipment in line production.

2) *Batch Certification:* This second model has no evaluation of the manufacturer´s Quality Management System based on ISO standards. Beyond the approval of shop tests for all lot units, 6% of the produced units (at minimum one piece) must be approved in type tests. The certification is valid to all lot units, and each one shall be individually identified. This model is actually applied to big motors produced for special applications or special requests from users.

Under the first model, which is the most common, the OCP can be responsible for the manufacturer´s Quality Management System evaluation too. The constructional evaluation can be performed by the experts from the OCP or by the experts from the laboratory station contracted to perform the tests.

The results of the tests and constructional evaluation are formatted in an Evaluation and Test Report. This report and the audit report are submitted to the OCP´s Certification Commission; after approval by this comission, the Conformity Certificate can be issued and the manufacturer facility receives annually at least one audit on its Quality Management System. Samples can be collected from the production line or in the market, and then submitted to an accredited testing lab, according to the program contracted between the OCP and the applicant.

B. The Procedure for Imported Equipment

There are some special situations that the compulsory Brazilian certification doesn't apply:

1) *Imported Offshore Platforms:* When the electrical equipment are to be used on imported offshore platforms, they are dispensed with Brazilian conformity certification, since the supplier presents an approval of the maritime classification society responsible for that platform.

2) *Importing Identical Items not Exceeding 25 Units:* When importing quantities below 25 units of the same Ex item, it will be necessary for the supplier to present to an OCP the following documentation:
   - Ex type conformity certificate,
   - ISO 9002 Manufacturer´s Facility Quality Management System Certificate,
   - Proforma invoice.

   This will allow the OCP to issue (within thirty days), a *Declaration of Documentation Analisys* (DAD), saying that the imported Ex equipment (those identified on proforma invoice) have safety characteristics similar to those required by Brazilian standards.

3) *Skid Mounted Equipment:* To "skid-mounted devices" (e.g.: gas compressors, oil pumps, etc.), the documentation described in the previous item, regarding all electrical and electronic Ex equipment installed on each skid (e.g: electric motors, pressure transmitters, luminaires, cable glands, etc.), has to be presented to an OCP by the supplier. This will allow the OCP to issue a DAD, but usually takes more than thirty days, due to higher quantity of documents.

VI. THE PROCUREMENT POLICY

The major procurement policy is to contract under *turn-key* basis, so it is common to receive at a given site, Ex equipment from different countries.

Although the turn-key policy aims to get the most profitable costs x benefits ratio, this does not mean that the cheapest products will be automatically accepted. There are technical specifications describing the desired performance level, and the Oil companies express their preferences for suppliers, on their "Vendors lists".

These Vendors lists show for each equipment category, (e.g.: motors, cables, switchgears, etc.) the manufacturers that achieved good performance level based on evaluations that include: after-sales technical support policies, spare-parts availability, performance and energy efficiency levels of products. Furthermore there are Brazilian legal requirements for imported Ex equipment, described on V.

VII. ECONOMICAL COMPARISONS

Cost is a key area of interest these days. When planning an installation, the designer must take into consideration reliability, safety, components delivery time and construction time among others factors. On the other side, clients want functional plants with lower maintenance costs, but without compromising safety.

To illustrate the cost differences between two hazloc electrical installation methods in the Brazilian market, an estimate is presented for the following conceived plant: four 20 hp, 460 V, 3 ph induction motor driven oil pumps in a Zone 1 area; one master command panel with the motor starters; four push-button control stations and two 2 x 36 W fluorescent luminaires.

The design conditions were: for cable system, Ex-e and/or Ex-ed plastic equipment would be used, with cables routing on cable trays at 18' height; for conduit system, Ex-d cast aluminium copper-free equipment only would be used with cables routing in metallic conduits within underground concrete encasement. To simplify, cables and motor costs were not considered, and minor accessories were included in civil construction costs. This estimate was based on an average of three companies budgets, using Brazilian currency (Real), and it is expressed on Table II:

TABLE II
COMPARATIVE COSTS

Item	Prices converted to US$		
	Qty. & description	Cable system+Ex-e	Conduit system+Ex-d
01	01 Main distribution panel	15,065.50	8,576.10
02	04 Push button stations	682.96	286.32
03	10 Sealing units ∅ 0.5"		52.83
04	08 Sealing units ∅ 1.5"		60.71
05	02 Sealing units ∅ 2.5"		44.48
06	98 m Met. conduit ∅ 0.5"		513.53
07	98 m Met. conduit ∅ 1.5"		667.61
08	14 m Met. conduit ∅ 2.5"		110.04
09	01 Pull-point box		230.66
10	69 m Cable tray	783.40	
11	10 Cable glands ∅ 0.5"	72.56	
12	08 Cable glands ∅ 1.5"	496.15	
13	02 Cable glands ∅ 2.5"	300.60	
14	02 Luminaires	1,004.36	803.49
15	Civil construction works	5,580.78	8,451.96
Total		23,986.31	19,797.73

According to these data, the total material cost for conduit system installation is lower than cable installation. It is necessary to consider that maintenance costs for metallic Ex conduit system, especially in corrosive ambient, are bigger than for cable system. Another factor of interest is that the time spent (35 days) and the overall cost for construction works of conduit system were bigger than that for cable system (20 days). It is worth to say that all Ex-e and Ex-ed equipment are not manufactured in Brazil yet, and that all Ex-d components have local manufacturers.

VIII. TRAINING

The wider the range of Ex types, the more knowledge regarding installation techniques has to be acquired to perform safe installations.

The turn-key procurement policy demands more training to cover special requirements for imported items.

To face subcontractors´ turn-over index, which frequently leads to construction non-conformities and consequently much time spent to correct them, there is a tendency to create a professional certification program, specifically designed for hazardous areas equipment installers for the Oil and Gas sector. Brazilian professionals associations are making contacts with Oil and Gas companies to discuss the syllabus of the certification exams, and the infrastructure for certification centers.

IX. CONCLUSIONS

Changing to Zone area classification system is not an easy task. IEC system can bring economical advantages due to wider choice of electrical equipment types and broader selection of materials in highly corrosive areas, but does not necessarily give the cheapest construction cost, because import duties are usually involved.

In respect of area classification study, one key point is to recognize that the method of determining the extent is partly by the use of mathematical approaches, and partly by experimental evidence. So, the area classification procedure needs to be carried out by a group formally constituted from experienced professionals, including the Process engineer, the Mechanical engineer, the Safety Officer and the Electrical engineer, with the necessary seniority to ensure the credibility of the study. It will involve sound research and coordinated efforts from maintenance, design, process and safety representatives to acquire sources of release data.

This method seems to be more difficult to users, but does not intend to overclassify areas. It is a broader, more expensive analysis method, but has the objective to give shorter extent and consequently, reducing the quantity of Ex equipment. As a transition step, the use of API-RP-505 figures seems to be the quickest way to define the area classification extent [14], until more detailed data is available.

The turn-key procurement basis increases the presence of imported items in the Brazilian market and as consequence, more training about installations and maintenance techniques is needed.

Installation cost is not a motivator for using IEC techniques, because it can be higher than conduit system cost, but long term costs including flexibility, less weight and easier maintenance have to be carefully considered.

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XI. VITA

Estellito Rangel Jr. graduated from the Veiga de Almeida University, Rio de Janeiro, Brazil, in 1978 with a B.S. degree in Electrical Engineering. In 1983 he joined Petrobras where he has been working in the Engineering Department, participating in internal electrical standards development and auditing installations. Member of COBEI, Hazardous Locations Subcommittee, he has authored other papers on area classification and oil industry electrical installations.

APPENDIX A

Area classification using the IEC 60079-10

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I. INTRODUCTION

The classic area classification method requires the knowledge of the performance of a given plant. However, IEC 60079-10 introduces a new approach, known as "source of hazard method". This does not mean that the historical method may not be used, but it is expected that knowing each source of release and the characteristics of release at that point, it would be possible to customize the evaluation for the plant being analised, allowing to restrict the size of its hazardous areas.

While this method objective is to identify each source of release and the hazardous area created by it, there is still the problem of multiple sources in the same or close locations. It is clearly not likely that all of the sources of release will release at the same time but in multiple cases some may, and the extent of any hazardous area so produced requires to be identified.

Examples of classic area classification are given below:

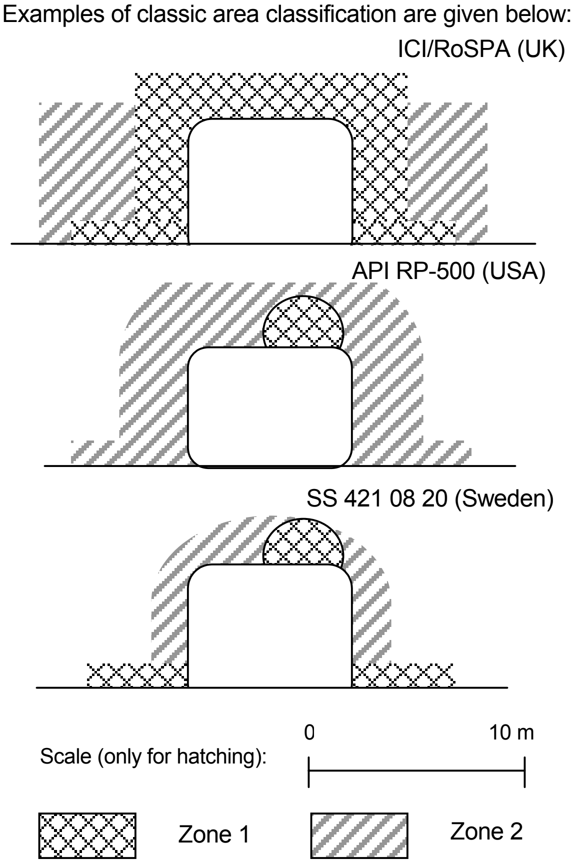

Fig. A-1. Zone extent for fixed roof tanks given by different standards [8].

II. CONCEPTS

The basic elements for establishing which Zone to apply, includes the knowledge of the sources of release and the degree of ventilation (available or provided).

A. *Sources of Release*

Each item of process equipment should be considered as a potential source of release of flammable material. If it is established that the item may release flammable material into the atmosphere, it will be necessary to determine the grade of release, by establishing the probable frequency and duration of release. The sources of release are classified using the following basis:

1) *Continuous Grade of Release*: This is a point from which a flammable gas or vapor may be released continuously or for long periods into atmosphere.

2) *Primary Grade of Release:* This is a point from which a flammable gas or vapor may be released periodically or occasionally in normal operation into the atmosphere.

3) *Secondary Grade of Release:* This is a point from which a flammable gas or vapor is not expected to be released in normal operation, but at which release may be expected infrequently and for short periods of time.

B. Relationship between Sources of Release and Zones

In the case of gases and vapors atmospheres where ventilation is good, (for example: outdoors), there is a clear relationship between the grade of release and the zonal classification which is as follows: continuous grade of release leads to a Zone 0; primary grade of release leads to a Zone 1 and secondary grade of release leads to a Zone 2. As a practical statement, Zone 0 will be only present inside vessels and pipelines.

C. Degree of Ventilation

The effectiveness of the ventilation in controlling dispersion and persistence of the explosive atmosphere will depend upon the degree and availability of ventilation. The following three degrees of ventilation are recognized:

1) *High Ventilation:* Can reduce the concentration at the source of release virtually instantaneously, resulting in a concentration below the lower explosive limit (LEL).

2) *Medium Ventilation:* Can control the concentration, resulting in a stable situation in which the concentration beyond the zone boundary is below the LEL while release is in progress.

3) *Low Ventilation:* Cannot control the concentration while

release is in progress and cannot prevent undue persistence of a flammable atmosphere after release has stopped.

D. Assessment of Degree of Ventilation

The assessment of the degree of ventilation first requires the knowledge of the maximum release rate of gas or vapor at the source of release, either by verified experience, reasonable calculation or sound assumptions. The theoretical minimum ventilation flow rate to dilute a given release of flammable material to the required concentration below the lower explosive limit can be calculated by means of the formula:

$$\left(\frac{dV}{dt}\right)_{\min} = \frac{\left(\frac{dG}{dt}\right)_{\max}}{k \times LEL}\frac{T}{293} \quad (1)$$

where:

$\left(\frac{dV}{dT}\right)_{\min}$	minimum flowrate of fresh air [m^3/s]
$\left(\frac{dG}{dt}\right)_{\max}$	maximum rate of release [kg/s]
LEL	lower explosive limit [kg/m^3]
k	safety factor: 0,25 for continuous and primary grades of release; 0,5 for secondary grade of release
T	ambient temperature [K]

One key point is to adequately estimate the maximum release rates in order to use the IEC 60079-10 formulas.

Then, the hypothetical volume V_z [m^3] of potentially explosive atmosphere around the source of release can be estimated using the following formula:

$$Vz = \frac{f \times \left(\frac{dV}{dt}\right)_{\min}}{C} \quad (2)$$

where:

f	efficiency of ventilation, ranging from 1 (ideal situation) to 5 (impeded air flow)
C	number of air changes [s^{-1}]

The time required for the average concentration to fall from an initial value X_0 to the LEL times k after the release has stopped (persistence time) can be estimated from:

$$t = \frac{-f}{C}\ln\frac{LEL \times k}{X_o} \quad (3)$$

where:

X_0	initial concentration of flammable substance [kg/m^3]
$\ln$	natural logarithm: 2.303 $\log_{10}$

The volume V_z can be used to provide a means of rating the ventilation as high, medium or low. The persistence time can be used to decide what degree of ventilation is required for one area to comply with the definitions of Zones 0, 1 or 2.

It is important to note that the higher the amount of ventilation in respect of the possible release rates, the smaller will be the extent of the zones, in some cases reducing them to a negligible extent.

III. SUMMARY AND CONCLUSIONS

There are some differences in hazardous areas extent recommended in the various codes of current performance in control of ignition sources. There are two factors which suggest that the effect of these differences may be less than first appears. One is that for a large section of plant what matters is the envelope around a particular leak source. The other is that, for large leaks particularly, the overall density of ignition sources may be as important as the distances from particular leak sources to particular ignition sources. These remarks have less bearing, of course, on isolated leak sources.

One remarkable difference brought by the source of release method is that Zone 1 is not automatically surrounded by Zone 2.

This method will require research to adopt for a given facility, consolidated rates of release, because IEC 60079-10 does not show typical figures for oil and gas industrial installations, as API RP-505 does.

The complete sources of release data must be recorded and kept at site, available to plant operators. Any procedures or process modifications must be recorded on the hazardous area documentation.

Zone classified facilities are expected to be similar to the Division ones, with relatively small Zone 1 areas surrounded by much larger Zone 2 areas. Taking into consideration that each plant has its own sources of release characteristics, it will be possible to optimize the hazardous locations extent, letting the traditional figures to be used on special cases, e.g.: congested internal locations.