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Comparison of the techniques of intrinsic safety 'ic' and energy limitation 'nL'

Background

Some years ago [2002?] a decision in principle was made by the IEC committee TC31 to discontinue the energy limited technique from the Type'n' standard IEC 60079-15 and transfer the responsibility for this safety technique to the intrinsic safety [IS] sub-committee. This was largely because the relevant expertise was available within the IS committee and the change coincided with some thinking on the application of categories of safety to hazardous area equipment. This decision is now feeding through the system as the 'ic' technique. It is embodied in the current issue of the apparatus standard [IEC 60079-11] the CDV of the system standard [IEC 60079-25] and the FISCO standard [IEC 60079-27]. The next edition of the IEC code of practice [IEC 60079-14] contains a useful guide to the corellation between the three levels of protection and the recently introduced concept of 'Equipment Protection Levels' [EPLs]. The 'nL' concept is dealt with in one sentence "Energy-limited circuits 'nL' shall comply with all the requirements for intrinsically safe circuits 'ic'"

The basic principle remains unchanged, that is to create a system which is intrinsically safe in 'normal operation'. Normal operation includes open circuiting and short-circuiting of field wiring so as to permit 'live working'. In addition there are some construction requirements so as to ensure a reasonable level of integrity.

The situation is slightly confused because the North American practice is to use 'non-incendive' apparatus in Division 2, which is almost the same as 'nL' apparatus but not quite. The major difference is that 'non-incendive' apparatus uses a factor of safety of 1,1 on the usual IEC ignition curves whereas the 'nL' standard and the 'ic' requirement is a unity factor of safety. This means that 'ic' and 'nL' apparatus may not meet the requirements of 'non-incendive' apparatus although in the majority of cases it does. The use of cadmium discs and the most easily ignited mixture of gases within the test apparatus are considered to ensure an adequate factor of safety for Zone 2 purposes. This change in safety factor means that the available power in 'ic' circuits is greater than that in other IS circuits.

It is important to recognise that the significant effect of the change to 'ic' is that the application of this equipment is clarified but there is no intention to modify the fundamental principle. The remainder of this note highlights the areas where this clarification is effective. In the past the absence of positive guidance enabled individuals to make decisions, which they considered adequately safe.Some more expert practitioners will regret the loss of this flexibility. Possibly the 'non-incendive ' technique will live on for some time because of this factor.

Major effects of the change to 'ic'

A significant advantage of the change to 'ic' is that it clarifies the use of 'ia' and 'ib' apparatus in Zone 2 systems. For example, it is already common practice to use 'ia' isolating switch interface in Zone 1 systems and these can also be used in Zone 2 systems as they are an economic solution to this particular problem. The use of a single type of interface for all switch applications is cost effective and reduces spares inventory. A similar situation arises in some other frequently used instrument loops.

The change in safety factor from 1,5 to 1,0 allows a significant change in output parameters when 'ia' and 'ib' apparatus is used in an 'ic' system. For example the permitted capacitance for a 28V source changes from 83 nF to 272 nF and this change can be established by reference to the IS standard [IEC 60079-11]. A more convenient technique is to multiply the permitted output inductance, L/R ratio and capacitance by 2,25, which gives an adequately safe conservative answer. A significant advantage of using 'ia' or 'ib' sources of power in 'ic' systems is that cable parameters are no longer a problem. In almost all circumstances the practical acceptably safe limits of 200 nF and 30μH/Ω are exceeded and any conventional cable is acceptable regardless of its length.

The majority of 'ia' and 'ib' apparatus, which may be exposed to the hazardous atmosphere, is certified T4 and consequently there is no point in re-classifying it for Zone 2 applications. [unless you are

unfortunate enough to have carbon disulfide as the hazardous gas]. However temperature classification of 'ic' apparatus is done in 'normal operation' and this relaxation may be useful on the odd occasion.

The draft system standard and the FISCO standard both permit 'nL' apparatus to be used in 'ic' systems provided that the apparatus documentation contains all the information necessary to design an adequately safe system

The cable and earthing requirements for IS circuits are equally applicable to 'ic' circuits. This means that all three types of circuit are permitted in multicores and in the same cable trays. This is a change in practice since 'nL' circuits were not accepted in IS multicores. If the rash decision is made to use a multicore subject to fault [Type C or D in IEC 60079-14] then all the circuits become 'ic'. This situation is best avoided because among other things the required calculations are tedious and sometimes difficult. The permitted mixing of the three types of IS circuits also applies to such equipment as junction boxes and plugs and sockets provided that the constraints on creepage and clearance are met.

The change to 'ic' also permits the use of 'simple apparatus' in Zone 2 circuits, thus removing concern about switches, thermocouples, RTDs and similar apparatus. This is a significant clarification particularly because the temperature classification of 'ic' apparatus is done in normal operation

The application of the limited degree of 'live maintenance' permitted on IS circuits to 'ic' circuits is a further useful clarification. Previously the interpretation as to what was permitted in 'nL' and non- – incendive circuits varied considerably.

The less obvious advantage of 'ic' is that a single technique is now applicable to all hazardous Zones. This means that the training of instrument technicians can be concentrated on the one technique and they do not have to consider the need for isolation or other changes in practice when working on equipment. This must decrease the possibility of making mistakes, which creates a safer working environment.

The principal disadvantage of the 'ic' concept is that the creation of system documentation becomes inevitable. This requirement was also implied for 'nL' and non-incendive systems but was not a specific requirement and consequently could be fudged. This opportunity is not possible if IS techniques are used.

Certification requirements

The certification requirements for equipment for use in Zone 2/ Division 2 locations vary in different parts of the world. An over simplified summary is that certification by at least one approved body [FM. UL. & CSA] is necessary for equipment used in North America and self-certification is permitted under the ATEX directive for use in Europe. The rest of the world has different practices depending on the prevailing major influence. There is increasing acceptance the IEC Ex scheme. Certification within this scheme can only be done by approved notified bodies and consequently it would seem probable that 'ic' apparatus will usually be third party certified in the foreseeable future. When this becomes the norm then the probability is that manufacturers will only produce 'ia' or 'ib' apparatus because the reduction in costs will not justify the production of a different product specifically for Zone 2.

Conclusion

The substitution of 'ic' for 'nL' does not change the basic principle of 'intrinsic safety in normal operation' which was the basic principle of 'nL'. The unification of the three levels of protection within the one method of protection means that a common code of practice can be applied to all three. This useful simplification clarifies a number of previously unspecified aspects of Zone 2 instrumentation, which were the subject of divergent interpretations. The direction in which the 'ic' technique evolves is difficult to predict, except that it will be some years before a full range of equipment is available.

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