B.6.4. Une analyse critique de la publication CEI 332-3 (1992) et de la norme italienne CEI 20-22 (1987) par rapport aux exigences de la directive européenne sur les produits de construction en ce qui concerne la propagation du feu

FARNETI F., ENEL, Milan, Italie
VERCELLOTTI U., CESI, Milan, Italie

Cet article commence par faire la présentation des differences entre la situation normative Internationale et Italienne sur les techniques d'essai du comportement au feu. On decrit une étude effectueé sur câbles sans halogènes et câbles PVC en particulier pour application dans les centrales de production italiennes.
Les essais de propagation de l'incendie sur câbles en nappes dans les configurations Internationale et Italienne sont examinés en detail dans les aspects liés à l'auto-extinction du câble.
Après une comparaison de la sévérité, sélectivité et limites de l'approche actuelle, les auteurs décrivent la position des Normes examinées en parallèle avec les niveaux d'exposition fixés par la Directive de l'Union Européenne concernant les produits de construction.

B.6.4. A critical assessment of IEC 332-3 (1992), the Italian standard CEI 20-22 (1987) and the requirements of EEC construction products directive from the fire propagation point of view

FARNETI F., ENEL, Milan, Italy
VERCELLOTTI U., CESI, Milan, Italy

After a brief recall of the situation relative to European and International standardization, the paper presents an evaluation on the fire propagation testing techniques.
Experimental analysis on Zero Halogen and PVC cables is described with special reference to cables used in Italian power plants.
Fire propagation on cable bunches in the Italian and International configuration is discussed, focusing on self-extinction of the cables tested.
After having evidenced the severity, the selectivity and the limits of the actual experimental approach, the paper describes the position of these two standards compared with the exposure levels prescribed by E.E.C. Construction Products Directive.

Introduction

At the present time, fire propagation of electric cables is verified through conventional tests that simulate the real operating conditions, such as the volume of combustible material exposed to fire, arrangement of cables in the environment, temperature at which it is possible to ignite pyrolysis gases that are generated from cables and ventilation conditions.
These Standards indicate that tests must be performed on bundles of cables with different categories or classes according to the type of installation to be simulated.
The article makes a critical comparison between the current international standards, the document IEC 332-3 (1992) [1], which involves the use of a gas burner as a heat source, and the relative Italian standard, CEI 20-22 (1987) [2], for that part that includes the use of an electric oven as the ignition source.
Based on what was previously described, there are great differences between the two testing methods [3], [4], [5], for this reason, ENEL, together with CESI, has begun a research to verify the repeatability of the results obtained with the two aforementioned standards, while also analysing which methodological or plant modifications can make the results similar that are obtained from the fire non-propagation tests performed on the same cable but with different testing methods.
The tests were performed on different types of cables, including the zero halogens version, used for example in ENEL power plants, and the type with PVC components. In addition, the article also focuses on a comparison of the severity of the two aforementioned methods with respect to the requirements of the fire reaction classes set forth by the E.E.C. Construction Products Directive.

Testing conditions

As known, the international document [1], which was recently reviewed (1992), identifies the ignition source as one or two gas burners fed with air and propane in quantities that generate about 70000 BTU/h which corresponds to about 20.5 kW for each burner.
The amount of combustible material used for the test varies, according to the categories (A, B, C), from 1.5 to 7.0 l/m, to take into account the different plant situations.
The Italian standard [2] uses as ignition source an electric oven with a power equal to about 30 kW and the amount of combustible material used for the test is 5 or 10 kg/m, depending on the cable being tested and thus also considers the different plant situations.
The flow rate of the combustion air for [2] is greater than in [1] and the testing specification in the Italian case leads to a chimney effect between the cable bundles which is not present in the IEC test. In fact, as reported in Tables I ÷ IV, in case [2] the cables are placed between the two faces of the electric oven and then are irradiated in the front and in the back, while in case [1], the heat source only strikes the front side of the cables being tested. However, for cables with cross-sections > 35 mm², procedure [1] includes spacing between the cable pieces being tested, and this spacing creates a chimney effect between contiguous pieces.

Type of cables used for the test

Cable pieces, taken from samples of various national manufacturers, were used for the comparison tests.
Zero halogens cables used were the same already tested during qualification for ENEL power plants, while for what concerns cables from the general market, samples were taken from the manufacturers.
In particular, for the case involving power plant cables, low-voltage cable pieces were used 7x1.5, 1x50, 3x95, 1x2.5, 1x3x1 and 27x2x0.5 mm² and one M.V. cable 3x70 mm² consisting of different materials (with and without shielding).
These cables were chosen since they were found to be more critical, within the families of qualified cables, with regard to fire propagation because they involve, for example, a greater percentage of combustible materials compared to the metal material.

Tests performed and discussion of results

About 50 tests were performed during the research. The tests carried out according to [1] were performed both under standard and non standard conditions, i.e. increasing the number of layers, using different quantities of combustible material or using a heat source with a double power rating (two burners).
Tests carried out according to [2] were performed using as ignition source an electric oven supplied so as to provide an average temperature from 410 to 440 °C without cables being tested. These test conditions are indicated, together with the results obtained, in Tables I - IV.
In particular, by analysing the results, it was found that:

- for the M.V. cable, 3x70 mm², the test according to [1] tended to be more severe than [2]. The use of the double burner however does not modify the final result of the test with respect to what is obtained with the standard conditions;
- for the l.v. power cables, 3x95 mm², with test [1] there is a considerable increase in fire propagation with respect to what is obtained with [2], for both "standard" testing procedures and by doubling the power of the heat source. The latter seems not to be more discriminating than the standard one;
- for l.v. cables, 1x50 mm², which with [1] are spaced, the presence of the microchimneys between the pieces leads to negative results (for shielded and non-shielded cables) under standard conditions and by varying the number of ignition sources. These results conflict with what is obtained with [2] where contiguous cable pieces are used without obtaining negative results. The decreasing of the volume of combustible materials tested with [1] did not give rise to essential alteration of behaviour;
- for l.v. control cables, 7x1.5 mm², the test [1] under standard conditions is, on the average, less severe than [2], while by using two burners the fire propagation is more severe in [1] than what is obtained in [2];
- for the "building wires" tested under standard conditions negative results were obtained contrarily to [2]. Furthermore the decreasing of the volume of combustible materials tested with [1] did not give rise to essential alteration of behaviour;