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INTERNATIONAL ELECTROTECHNICAL COMMISSION

TECHNICAL COMMITTEE No. 17: SWITCHGEAR AND CONTROLGEAR

SUBCOMMITTEE 17A: HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR

Confirmed minutes of the IEC-IEEE Meeting on Impulse Test Procedures

Following the decisions taken during the SC 17A meeting and the joint SC 17A/SC 17C meetings in Seoul, October 2004, an ad-hoc IEC-IEEE Task Force on Test procedure for Impulse tests has met in Paris on November 29th, 2004.

This document contains the minutes of the meeting. The recommendations from this Task Force will be implemented in the 3rd committee draft on amendment 3 to IEC 62271-100 (High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers) and the 2nd committee draft for the revision of IEC 60694 (Common specifications for high-voltage switchgear and controlgear standards), the future IEC 62271-1.

1 Participants

IEC SC17A-17C	**D. Dufournet (Chair SC17A)**
IEC MT36	**N. Trapp (DE-Convenor MT36)**
	P. Riffon (CA)
	M. Waldron (GB)
IEC MT34	**W. Degen (DE-Convenor MT34)**
	R. Jeanjean (FR)
	L. Falkingham (GB)
IEEE	**W. Long (US)**
CIGRE A3-11	**D. Peelo (CA)**
IEC TC28	**A. Sabot (FR-Sec. TC28)**
	E. Kynast (DE)
Observer: H.Heiermeier (CH-MT36)	
Excused : A. Bosma (SE-Sec. SC17A), L.Farr (US-IEEE)	

2 Objectives of the meeting

In accordance with the decisions taken during the meeting of IEC SC17A (see item 9.3 in the minutes of meeting) and the common meeting of IEC SC17A-17C (see item 4.1 of the minutes of meeting) in Seoul, October 2004, an IEC-IEEE Task Force has been set up to make recommendations for the revision of sub-clause 6.2.4 in the draft Amendment 2 f2 to 62271-100 and in the draft 62271-1. Recommendations are required on two items:

- verification tests for Procedure B
- keeping or removing Procedure C

3 Verification tests for Procedure B

The following possibilities have been considered by the Task Force:

- Test plan 15/2MF (5 final withstands required during verification tests, max.2 disruptive discharges during complete series, as in 62271-200)
- Test plan 15/2M Plus (5 final withstands required during verification tests, 1 disruptive discharge is allowed during verification tests, according to doc 17A/704/CD)
- Test plans 15/2M & 15/2Ma (no disruptive discharge during verification tests),
- 15/2M: 5 final withstands required during verification tests
- 15/2Ma: 3 final withstands required during verification tests
- Test plan 15/2Ma2 (3 final withstands required during verification tests, max.2 disruptive discharges during complete series)

For clarification, D.Dufournet (Chair SC17A) presented the wording corresponding to each test procedure (see appendix 1).

E. Kynast (DE) presented a new approach were 3 impulse tests only would be required to verify the non-self restoring insulation is not damaged, no disruptive discharge been allowed during verification tests (see appendix 2). The aim is to keep the number of disruptive discharges and the total number of tests as low as possible.

D. Peelo (CA- CIGRE WG A3-11) presented his calculations on operating characteristics of the different 15/2 tests procedures (see appendix 3).

It is concluded that all tests plans considered are very close in terms of risk for the user and risk for the manufacturer and in addition result in virtually equal average outgoing product quality.

After a long discussion during which the advantages and disadvantages of all test plans were considered, the Task Force concluded that the requirements must be as follows:

- one series has at least 15 tests,
- 5 withstands after the last disruptive discharge,
- maximum 2 disruptive discharges during the complete series,
- maximum number of impulses is 15 + 2 x 5 = 25

The technical content is that of test plan 15/2MF, as in present IEC 62271-200, but the wording of the subclause in -200 cannot be taken as such and has to be improved.

This presentation of requirements will avoid to have “unfair” situations possible in the past with two devices having a series of impulses with two disruptive discharges, one with a higher number of tests been rejected and the other one accepted with a lower number of tests.

The number of withstands required after the last disruptive discharge is kept at 5 as this number is also required in 6.2.11 of IEC 62271-100 “Voltage test as condition check” and as it has also been introduced or will be introduced, by other TCs (TC28, TC36 ..).

R.Jeanjean reminded that the 3 impulses were introduced in standards for transformers in order to avoid damage to oil impregnated papers.

MT36 of SC17A will write a first draft of subclause 6.2.4 during its meeting on Nov 30th-Dec.1st, 2004.

When finalized the wording it will be also introduced by TC28 in its draft revision of 60071-2. and will be given to TC 42 for information.

4 Single test procedure or with alternative ?

P.Riffon (CA) presented a table summarizing the different impulse test procedures used in various IEC Standards for high voltage equipment (see appendix 4). All standards mentioned have an unique impulse test procedure.

D.Dufournet (Chair) indicated that it is not only a technical issue and that the introduction of dual logo IEC-IEEE standards requires having impulse test procedures that are acceptable to both organizations (see appendix 5).

The Task Force agreed that a single test procedure, common with IEEE, should be the objective, but as it is not possible in the short-term a pragmatic recommendation is agreed:

- Procedure B is the preferred method
- Procedure C could be acceptable in some countries for some cases of switching devices, and introduced in a note, provided that explanations are given to explain the differences

The preference given to Procedure B is justified in item 5.

5 Procedure B versus Procedure C

D.Peelo (CA) presented the comparison of operating characteristics of the procedure B and procedure C (see appendix 6).

It is noted that the risk to the user (to accept a bad equipment) is higher with procedure C. Procedure C does not discriminate well between “good” and “bad” products as compared to Procedure B (test plan 15/2MF). Additionally, Procedure C will result in a lower average outgoing product quality. Slide 2 will be modified to include the test plan adopted in item 3 (action Dave Peelo).

W.Long (US) presented the comparison of procedure B and procedure C (see appendix 7). When the probability of disruptive discharge is low (less than 10%), procedures B and C give the same probability of passing a test series. In his view, cases with a probability of disruptive discharge higher than 10% are not of concern in practice. He showed the calculations of cumulative probabilities that an equipment will pass the complete series of tests, with the assumptions that all tests have the same probability of passing (independently from the polarity, point of application of the impulse..) which seems only to be possible for totally symmetrical arrangements like vacuum circuit-breakers.

When all tests configurations are considered there is less difference between procedure B and C, but this is limited to cases where the previous assumptions can be made, and limited to cases where three-pole configurations are tested.

If one pole of a high voltage circuit-breaker 145 kV and above is tested, the number of test series is reduced and the calculation does not apply. It is also indicated that it is allowed in IEC to reduce the number of configurations tested when arrangements are symmetrical (see Table 11 in 17A/688/CD, draft revision of 60694).

D. Peelo will check the calculations with combined tests series as it was not possible to do that before the meeting.

The majority of participants concluded that Procedure C is valid in some cases of switching devices with all three poles tested.

Explanations on the applicability of Procedure C will be provided in the application guide.

A presentation was made on behalf of L.Farr (US) who could not attend the meeting (see appendix 8).

In a case considered, a 2% change in the mean discharge voltage applied lead to a 40% change in failure probability. There is a difference in IEC and ANSI/IEEE in the tolerance for the impulse peak voltage during testing. In ANSI the required value must be attained or exceeded.

NOTE: L.Farr suggested to add that the average of the peak impulse voltages applied must be determined and be at or above the required BIL level. This proposal was not discussed during the meeting.

L.Farr indicated that future work is necessary on this issue and that a seminar will be organized in conjunction with the next IEEE Switchgear committee meeting.

It is proposed to have a presentation of the IEC SC17A-17C test procedure, and that L. Falkingham, D.Stone, W.Degen could prepare this presentation.

6 Summary of recommendations to SC17A and SC17C

The Task Force recommends that:

- Procedure B is the preferred test procedure in documents of IEC SC17A & 17C. It is adapted, based on the following, to include the check that the non-self restoring insulation is not damaged:

- ♦ one series has at least 15 tests,
- ♦ 5 withstands after the last disruptive discharge,
- ♦ maximum 2 disruptive discharges during the complete series,
- ♦ maximum number of impulses is 15 + 2 x 5 = 25

- Procedure C could be considered acceptable in some countries for some cases of switching devices. It will be introduced in a note and explanations will be provided in IEC 62271-1 to explain the differences with procedure B.

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