WG C37.012a Burlington, VT 2019 29 04

Minutes of Meeting

WG: C37.012a Guide for the Application of Capacitance Current Switching for AC High-Voltage Circuit Breakers Above 1000 V Amendment Changing the Capacitive Inrush/Outrush Limitations of Switchgear

Chair: Roy Alexander
Vice-Chair: Brian Roberts
Acting Secretary: Luke Colletti

Monday April 29th, 2019 (8:00-9:45 AM)
Location: Burlington, VT
Participants: 16 Members
34 Guests

Introductions of members and guests

Verbal call for patent identification
No essential patents identified

Introduction by the Chair
Meeting was kicked off with the chair describing the purpose of the amendment.
The draft of C37.012a sent out in March 2018 may have gone too far in totally eliminating inrush current frequency as a concern.

A presentation was given by the chair describing the results of the capacitive discharge tests performed on SF6 Circuit Breakers, 3 - 72.5kV, and the latest, 245kV. Results of the 72.5kV breaker test indicated no shock wave damage even with very high I x f. (> 25 x the tested values generally used. The 245kV tests resulted in a broken auxiliary nozzle that might be attributed to shock wave type phenomena. It seems reasonable that shock wave strength would be proportional to arc length (and this gap voltage) This could be a reason that shock wave damage may have occurred in the 245kV tests that was not seen at 72.5kV. Not all experts are convinced that shock waves were the cause of the auxiliary nozzle separation seen in the 245kV tests.

Discussion of the Presentation
Could the current and frequency be a concern for the system?

The system can be exposed to more severe current and frequency for other events such as lightning. Control circuitry can be a concern, but there are other ways to mitigate those concerns such as secondary MOVs.

Were the cold dielectric tests performed during the capacitive discharge testing performed with a standard lightning impulse?

Confirmed the test were performed with a lightning impulse with no gas flow in the breaker (stationary contacts). Acknowledged this was a crude approximation of the TRV capability that was done primarily for comparison purposes.

Explain the shockwave phenomena?

The current though the arc creates a shockwave as the arc grows from a thin filament to a stable size. The mechanical shock wave is transferred through the medium (e.g., oil, gas, etc.).

The tracking of solid insulation observed in the 245 kV breaker capacitive discharge tests is concerning.

Was the tracking to ground observed on both sides of the breaker, and for how long was DC voltage applied?

The tracking was observed on the grounded side of the breaker and across the contacts (interrupter support tube) The DC voltage was applied usually for over a minute, but the Grounded side only saw voltage during the discharge, which was estimated to be about 40% of the test voltage at a ringing frequency of 27kHz. The insulator to ground saw no dc voltage. DC voltage was impressed on the insulator support tube.

It was suggested the exposure to DC for long durations could have been a contributing factor to some of the failure modes during the capacitive discharge testing.

If we suggest using higher I x f limits we should warn users about other concerns that may occur from allowing a higher Ixf (e.g., ground potential rise, control circuit issues, etc.) (the existing C37.012 does this.)

It was stated C37.012 is a guide and should not give specific ratings to be used for kAkHz. It is ok to recommend the application of higher values based on the outcome of the groups findings, however it is not appropriate to put ratings in the document that are different than those in C37.04. Suggested language that says something like we feel the old values are not appropriate so you can do this…

Tests have shown you can greatly exceed the currently used Ixf in the standards without causing the breaker to fail, however, how many times can this be done before problems arise?

A user stated they use current-limiting reactors to fix the outrush current and that usually takes care of the inrush current.

Some engineering firms use the IEEE standards as the primary basis for design. Therefore, if we have examples in C37.012 that illustrate inrush current frequency is a concern they will use that in their design. (This is the reason for eliminating the specific example that does that)

It was asked when a paper will be published on the capacitive discharge testing?

There is no definite timeline for the publication, but it will likely not be soon.

Outcome

The sense of the group is that frequency alone is not a reason to limit capacitive inrush, but rather the I x f , and of course the rated peak inrush current magnitude. It is understood, the peak inrush current rating should not be exceeded even for low inrush frequencies.

It can be mentioned that some testing has shown significantly higher I x f values (3x – 25x) the type test values, are not damaging to an SF6 breaker and likely not to vacuum breakers either. However, no specific increased I x f guidance can be given . Not enough testing has been done to make generic recommendations. Generally, The peak inrush current rating should not be exceeded. The frequency of the inrush is of much less importance. For non oil circuit breakers, if the inrush current magnitude is an order of magnitude or more less than the rated value, the frequency does not seem to be a concern.

A revised draft of C37.012a will be circulated in July for discussion at the next meeting.

Roy Alexander
Chair C37.012a

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Roy Alexander	RWA Engineering	Chair
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Steve May	Southern Company	G
Tony Mannarino	PSE&G	
Michael Boulus	PSE&G	G
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Kirk Smith	retired	G
Eddie Hester	Entergy	NB
Jennifer Hunter	Meppi	G
Bob Sicker	First Energy	G
Dan Steigerwalt	Duke Energy	G
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Dave Mitchell	Dominion	G
Bobby Rich	Dominion	G
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Neil Hutchins	Southern Company Services	Member
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Michael Christian	ABB	member
Karthik Verma	Siemens	Guest
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John Webb	ABB	member
Jeremy Heusberger	Mitsubishi Electric Power Products Inc.	Guest

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