

IEEE/PES SWITCHGEAR COMMITTEE
C37.100.2 Common Clause for Capacitive Current Switching Testing
MEETING MINUTES
Online Meeting
Tuesday, April 20, 2021
1:30 AM – 3:15 AM (CDT – UTC-5)

S21

First official WG meeting with 22 attendees.

Reviewed Patent and copyright slides

Chair explained that PAR is for an amendment 1 with a limited scope to change the list of usual single phase test factors k_c to include factors for devices with “large pole disparity (i.e. non simultaneous >90 electrical degrees).

Possible proposed new k_c list :

- There are seven commonly used values for k_c as follows:
- a) **1.0**—Breaking in grounded source and grounded neutral systems without significant mutual influence of adjacent phases of the capacitive circuit. For example, grounded capacitor banks with grounded neutral and shielded cables.
- b) **1.2**—Breaking in effectively grounded neutral systems with rated voltages 72 kV and above (for example line charging) or in systems with belted cables. When pole disparity is <90 electrical degrees.
- c) **1.3** *Line charging breaking in effectively grounded systems 72.5 kV and above when pole span is non simultaneous.*
- d) **1.4**—This value is used for the following:
 - 1) Breaking in non-effectively grounded neutral systems. For example, breaking of capacitor banks with ungrounded neutral and belted cables, **and overhead lines in effectively grounded neutral systems and pole disparity > 90 electrical degrees for voltages <52kV where no shield wires or neutrals are present.**
 - 2) Breaking in the presence of single- or two-phase ground faults in systems having an effectively grounded neutral. For example, line-charging breaking tests.
- e) **1.5** *breaking of overhead lines <52kV with effectively grounded neutral systems and conductors <50mm²*
- f) **1.7**—Breaking in the presence of single- or two-phase ground faults in non-effectively grounded neutral systems.
- NOTE—Class C1 performance is sufficient when k_c is equal to 1.7 or greater.)
- **2.1**—Capacitive current switching devices with non-simultaneous operation on ungrounded systems For example, single-phase capacitive current switching devices, or air switch attachments.

K_c is $\frac{1}{2}$ the recovery voltage

Recovery voltage for an ungrounded capacitor bank

- Ungrounded capacitor the extreme case
- For close pole disparity <90 degrees
- Recovery voltage = 2.5 if pole 2 is delayed a little $RV = 3.0$

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- Max RV is 4.1 if pole disparity is worst case
- Grounded cap bank RV= 2.0

For an overhead line:

- There is Capacitance between Phases and Capacitance phase to ground in parallel.
 $2.0 < RV < 4.1$

Higher ground capacitance moves RV towards 2.0, and lower ground capacitance RV moves towards 4.1

For an overhead line with large pole disparity:

- IF $2.6 < RV < 4.1$ why has using 2.4 i.e. $k_c = 1.2$ been successful all these years?
- Margin on the 2.4
 - Dielectric strength higher than design
 - Operating voltage when switching is less
 - Current chopping makes trapped voltage and thus RV less
 - High arc voltage
 - Polarity sequence on interruption is important not just the time between poles.
 - Favorable sequences repeat every cycle.
 - Most unfavorable pole sequence a somewhat rare occurrence. (<1/4 of operations)
 - Even if a restrike happens it will clear later no harm no foul

Perhaps the biggest reason is the case of a truly unloaded line being switched by an air switch with attachments or other large pole disparity device is rarely if ever done:

On distribution lines they are almost never switched unloaded.

Transmission lines may be rarely switched unloaded with a large pole disparity switching device (eg. air switches)

Switching a transmission line with only unloaded Delta wye transformers connected to it presents a ferroresonant topology, that may cause trouble if conditions are adverse and ferroresonance occurs. Such a ferroresonance has been reported in a few cases.

- Neil McCord, RWA, and Luke Collette working on a transactions paper covering this change in k_c values for non simultaneous pole switching devices.
- [Validity of a unloaded line switching case by non simultaneous pole switching devices to be covered in the paper.](#)
- Once Paper is peer reviewed and accepted, we will move forward with this amendment.

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- Expect to submit paper early August 2021.
- Plan to have a Ballotable draft to be approved by WG October 2021

Discussion opened for other issues with C37.100.2 and none were mentioned.

Submitted by Roy Alexander
Chair C37.100.2a

Items in blue discussed after the C37.100.2 meeting at the HVS meeting.

Attendance TBA