Chair: Ian Rokser
Secretary: Federico Di Michele

Meeting Agenda

1. Call to Order

The meeting will be called to order.

Meeting started at 10:15 time. Three sessions were held.

2. Call for Patents/Copyrights

IEEE Patent and Copyright slides will be shown.

Chair presented the IEEE slides about IEEE patents and copyrights.

3. Introduction of Members/Guests

Self introductions of members/guests as follow:

- Members and guests from the IEEE shall announce name, affiliation and location.
- Experts from the IEC shall announce name, country, and the standards body being represented.
- Those who are both IEEE members and IEC experts should announce themselves as IEC experts.

Members and guests presented their selves according to rules above.

4. Current status & project plan

Updating regarding activities status and future steps.

Link to timeline: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE2NzU0NTc0XQ/WzIsODUxMDIxNzNd/

Chair presented the current status and future steps in the next months and years. In particular chair focused on different ballots and timelines requested by IEC and IEEE. An expert asked if next virtual meeting will continue to have two sessions in different times, to allow people from different countries to participate. This because he seems to have lost something missing one of the two appointments. Another expert proposed to rotate the meeting let suffering one part of the world per time. The chair will attempt to rotate the meeting times rather than having two meetings with a duplicate agenda.

5. New DLMT Operating Procedures document

The chair will give an overview of the document and allow discussion.

Chair presented the document “how we operate”, showing which will be the choices in case of conflict between IEC and IEEE. To join imeet Central you don’t need to be IEEE SA or IEEE members, but just a WG member. Chair confirmed that no quorum is required. Chair

explained motion and voting process during the meeting (typical for IEEE but not required for IEC).

6. Old business: Report of assignments from Virtual Meeting (July 10th)

Updating about pending assignments: "Changes considered" Status = "Review proposal at F23"

- Individual assignments
  - ❖ BIL 25-shot limit (Stefan Micic / Kennedy Darko)

    Kennedy Darko shared a slide presentation with the DLMT in Stefan Micic's absence. Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3MzMyNTU0XQ

    Number of preliminary shots before the official tests. Why 25? It is arbitrary. It is demonstrated that some VI needs more shots or shots with higher lightning impulse voltage for a better preconditioning. Then the proposal is to leave to the manufacturer to define in advance the number of shots to be performed and the values of the voltages at which perform the shots.

    An expert pointed out that 25 is not arbitrary. It comes from a technical discussion that STLNA addressed to STL, deciding 25 was the maximum limit of preconditioning shots.

    Chair proposed to have a dedicated ad hoc coming out with a final decision.

    ➔ Ad hoc composed by: Stefan Micic, Frank DeCesaro, Marcos Botelho, Mohit Chhabra, Ganesh Balasubramanian and Kirk Smith. The goal of the ad hoc is to find and review relevant literature and propose new draft language for preliminary shots. The preference is to increase flexibility but maintain a fixed limit. Plan to report out at January 2024. Leader: TBD
  - ❖ Fig. 3 – Depiction of Source (Harm Bannink)

    New figure including the source has been prepared and presented. Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3Mzc3ODQ5XQ

    An expert pointed out that a reference was wrong.

    ➔ Harm will revise the drawing accordingly. Following the update, the new figure will be inserted into the draft document.
  - ❖ Simplification of kpp = 1.3 tests (Harm Bannink)

    Topic will be discussed later because more time is required to find an alternative procedure.
  - ❖ Modification of Low Current tests (Harm Bannink)

    Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3Mzc3ODQ4XQ

    In the past it was asked to perform the mainly active load current switching. TRV for load switching is totally negligible compared to that requested for T5 and T10 duties (clearly more severe). They are full inductive tests and not realistic. Harm Bannink proposed to come back to critical current test, where if arcing time is no longer at lower duties (T20, T50) than at T100, then no tests are required. An expert found a comment of 2011 from IEEE,

saying that new technologies must be proved about load switching and low currents.

➔ Chair will discuss the topic with the commenter and evaluate how to proceed.

- ❖ Partial discharge timing (Blair Kerr)

  Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3Mzc3ODI3XQ

  A document listing the deviations currently present in different standards has been shown to the experts, but no proposal has been made. Nenad Uzelac volunteered to address the topic to IEEE C37.301 and take care to make a proposal. However, it seems that IEEE C37.301 WG has been stopped.

  ➔ Chair will ask the commenter to make a proposal.

- ❖ Handling of control vs. C37.68 (Ian Rokser)

  Link to spreadsheet: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3NDc4ODM5XQ

  Karla Trost made a review clause by clause between C37.60 and C37.68: 35 differences were found, but just 3 have been addressed to WG.

  Topic 1: add the duration of the submersion time (10 days). An expert commented to refer to another IEEE standard (unfortunately we lost the reference), but Karla said that utilities declared that they are not pumping the water after 24 hours. DLMT agrees by consensus to add the duration and submersion time for submersible equipment to the draft document.

  Topic 2: include in the nameplate an updated list of information. DLMT agrees by consensus to add the information for the control nameplate to the draft document. Topic 3: add mandatory requirement for IP code depending on the application. DLMT agrees by consensus to add the IP requirements for various applications to the draft document.

- Ad hoc groups
  - ❖ Products without a ground connection (Leslie Falkingham, Chris Ekpoudom, David Dart, Marcos Botelho)

    Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3MzM0NTY1XQ

    David Dart made the proposal to include devices without a ground connection within the standard and consider requirements for these devices within the body of standard. In particular following subclause must be revised: Table 1, 6.3, 7.1.2, 7.1.3, 7.1.101.2, 7.1.101.3, 7.2.1, 7.2.6.2, 7.4.3, 7.101.8, 7.103.2, 7.111.2 and Annex B2.

    An expert pointed that changing the title of table 1 needs also the change of the column about automatic reclosers grounded and ungrounded. Comment accepted.

    Subclause 7.1.2 – replace “spacing” with “distance”.

    Due to time constraints, only a portion of the slides was presented. Experts are requested to review the slides linked herein and to be prepared to give approval or comments at the January 2024 meeting. This ad hoc remains open until January to address any feedback received from the DLMT.

- Products rated >38kV (Blair Kerr, Leslie Falkingham, Paul Found, Riley Caryn, Christopher Slattery)
  Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3Mzc3ODI1XQ
  Paul made the proposal to keep the new scope as decided during the last PAR WG, so without upper voltage limit. He also focused the attention of the WG about the two possibilities to face this change: 1. Keep the standard as it is and add new subclauses valid over 38 kV. 2. Rewrite the actual subclauses defining a new procedure managing all voltage values. The DLMT agreed in principle to option 1 – maintaining existing sections up to 38kV, and adding new subclauses valid over 38kV.
  The proposal is to specify ratings and requirements greater than 38kV and up to 72kV, which is the highest known rating for reclosers available in the market. If higher rated reclosers are developed in the future, the DLMT can consider at that time to add additional ratings to the standard.
  This ad hoc is completed. The chair thanks the experts for their contributions.
  - ➔ Mohit Chhabra and Harm Bannink volunteered to be part of a new ad hoc preparing a proposal how to revise the standard with no voltage limits. The goal is to identify subclauses to change or add and draft language for these subclauses - to cover reclosers rated up to 72kV. Ad hoc to report out at January 2024 meeting. Leader: TBD
- Products with dependent manual operation (Leslie Falkingham, David Beseda, Jonathan Neujahr, David Dart, Marcos Botelho)
  Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3Mjc5MDQ4XQ
  David Beseda presented the change in the scope including now reclosers which have dependent manual close operation. IEC world is pushing back this decision. The ad hoc proposed to restore the old sentence in the scope, and amend the normal and special service conditions suggesting to clearly indicate that closing operation with dependent manual operations should be avoided. Some experts pointed out that this is a typical issue of cutout mounted reclosers. Other experts explained that in last edition the request of the market was to include the cutout mounted but adding the note in the scope about dependent manual operation. An expert suggested to include the use of bypass switch to avoid dependent manual close operation but this is not possible because it is a recommendation for practice operations.
  An expert was asking if cutout should go out from the standard falling in the IEEE C37.62. This is not possible, because they still have a reclosing functionality.
  An expert pointed out that “should” can be replaced with “shall”. However, we have to proceed with “should” because these application are out of the scope, so we can just do recommendations.
  Some US utilities which basically use this kind of application, consider useless the sentence to be added in the normal and service condition.
  Chair divided the topic into two subtopics: 1. Restore the sentence in the scope, to avoid conflicts with IEC. No objections, DLMT agrees by consensus.

2. Add the suggested wording or create a new ad hoc finding the right words to be used. WG Preferred to add the language to Clause 4, amended as follows:

> Cutout mountings do not have a fault closing rating. As such, devices that install into the cutout mounting with interrupting contacts in the closed position should not be closed into the cutout mounting while energized.

The proposals of the ad hoc are accepted, including the amended wording above for subtopic 2. A PAR revision will be submitted, and the draft will be updated.
This ad hoc is completed. The chair thanks the experts for their contributions and cohesive proposal.

- Extension of type test results (Sergey Rogozhkin, Paul Found, Harm Bannink, Christopher Slattery, Marcos Botelho, Mark Feltis, Blair Kerr, Chris Hastreiter)
  Link to slides: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE3Mzc3ODI0XQ
  Secretary presented slides showing what was discussed till now in the ad hoc. However work is not completed and volunteers are required. An expert asked if the recommendations will be generic or specific. Secretary replied that more specific they are, better it is. An expert also pointed out that manufacturer could need to sell just switching equipment without control unit (bought by end users separately).
  This ad hoc is completed. The chair thanks the experts for their contributions.
  Two new ad hoc groups have been composed to propose a possible procedure.
  - ➔ For control unit: Mark Feltis, Marcos Botelho, Karla Trost, Cody Marshall; Chris Ekpoudom, Christopher Hastreiter and Paul Found. The goal is to propose how to modify the standard (location, requirements, verbiage) for extension of type test results to additional or modified control units. Ad hoc to report out at January 2024 meetings. Leader: TBD
  - ➔ For switching part: Mohit Chhabra, Pedro Castillo, Darko Kennedy, Blair Kerr, Chris Ekpoudom. The goal is to propose how to modify the standard (location, requirements, verbiage) for extension of type test results to modified switch units. Ad hoc to report out at January 2024 meetings. Leader: TBD
- Conformance to Guide 107 EMI/EMC (Aleksander Sergeyenko, Mark Feltis)
  Mark Feltis shared some information about guide 107 EMI/EMC. Chair explained that IEC is mandatorily asking to have the standard complying with the guide. We have submitted subclause 7.111.1 to the IEC group monitoring conformance to IEC Guide 107 to ask for approval of the existing language in D1.11.
- STL guide review (Sergey Rogozhkin, Harm Bannink)
  Presentation has been skipped. We will seek to cover this topic in an online meeting prior to the January meetings.

7. New business

Discussion about "Changes considered" list.

Link to spreadsheet: https://ieee-sa.imeetcentral.com/c37-60/folder/WzIwLDE2NzU0NTY5XQ

- "Changes considered" Status = "Complete"

  Comments already approved and changed in the draft standard. No objections were raised to these changes.

- "Changes considered" Status = "Discuss with WG"

  Chair presented following topics which could be interesting to modify in the new edition of the standard:

  - Cable and Line charging testing procedure (alignment with IEEE C37.74). Topic not of interest, and no deficiencies have been raised so far in this subclause. DLMT rejects this proposal.
  - Introduction of capacitive classes C1/C2. Topic not of interest, and no deficiencies have been raised regarding cable charging & line charging tests as being suitable for recloser applications. It was also mentioned that 20 + 20 operations is not statistically sufficient to determine different probabilities of restrikes. DLMT rejects this proposal.
  - Updating of X/R values on Table 11: An expert explained that when testing a recloser with high ratings (e.g., 25kA interrupting current), achieving a low X/R ratio (e.g., X/R = 8 for T20 = 5kA) is very difficult, requiring a lot of added resistance with high heat generation. Does this X/R ratio make sense for a unit of this rating?

    ➔ Chair will find experienced users to support.
  - Testing guide to cover 50/60 Hz. Topic to be discussed in the ad hoc related to IECvsSTL.
  - Combination of test duties of circuit-breaker/reclosers. DLMT rejects this proposal due to significant differences in operating sequences, number of tests, and other parameters. DLMT perceives that there is not much overlap between the duties of 62271-100 and 62271-111 today so combining them would not be of much benefit. Additionally, the DLMT prefers to maintain clear distinctions between reclosers (defined as a switchgear-control system with short operating sequence) and circuit-breakers (defined as the breaker in isolation).
  - Replacing cable/line connected definition with S1/S2 classes as currently used by IEC for circuit-breakers. DLMT rejects this proposal. The DLMT prefers to maintain clear distinctions between reclosers and circuit breakers.
  - Updating of Rated voltage supply, subclause 5.9:

    ➔ Karla Trost volunteered to prepare a proposal.
  - Simultaneity of poles.

    ➔ David Dart volunteered to prepare a proposal.
  - Introduction of mechanical tests classes. DLMT rejects this proposal. The DLMT prefers to maintain clear distinctions between reclosers and circuit breakers..
  - Subclause 7.103.1.2 Application of single phase tests and three phase tests for triple-single reclosers. Discussed but not resolved.

- Subclause 6.3 Earthing. Discussed but not resolved.

- "Changes considered" Status = "Assign at F23"
- Additional activities to be done (definition of new individual assignments and ad hoc groups)
  Topics not discussed due to limited time.

8. Next steps/ meeting(s):

Face-to-face meeting in Europe (January 2024 – still to be confirmed)
Chair asked to experts their intention to participate to a face-to-face meeting in Europe in January 2024. About 10 people gave their consensus. The meeting will be hosted by CESI laboratories in Milan, Italy. A Microsoft Forms has been sent out to check the most suitable schedule. Results will be communicated next week.
Face-to-face meeting – IEEE PES Spring in Fort Lauderdale (April 2024)
Possible plenary or dedicated virtual meeting between face-to-face events.

9. Adjournment

Meeting closed at 17:40 time.

LIST OF ATTENDEES

Status	Last name	First name	Affiliation
Convenor	Rokser	Ian	Eaton - IEC USA
Secretary	Di Michele	Federico	CESI - IEC Italy
IEC Member	Bannink	Harm	G&W - IEC Netherlands
IEC Member	Botelho	Marcos	IEC Germany
IEC Member	Dart	David	NOJA Power - IEC Australia
Member	Bush	Kelsey	ABB
Member	Hirz	Harry	VESCO
Member	Darko	Kennedy	G&W
Member	Feltis	Mark	Schweitzer Eng
Member	Kapitula	John	ABB
Member	Li	Eric (Qian)	Powertech Labs
Member	Neujahr	Jonathan	Eaton
Member	Olivares	Roberto	Siemens
Member	Riley	Caryn	NEETRAC
Member	Slattery	Christopher	First Energy
Member	Trost	Karla	G&W
Member	Balasubramanian	Ganesh K	Eaton
Member	Beseda	David	S&C
Member	Ekpoudom	Chris	Southern States
Member	Stemmerich	Joe	Trayer Engineering Corporation
Member	Herring	Ricky	Siemens
Member	Castillo	Pedro	ABB

Status	Last name	First name	Affiliation
Member	Marshall	Cody	Schweitzer Engineering Laboratories
Member	Sigmon	Hall	Siemens
Member	Hastreiter	Chris	Eaton
Member	Pell	Stephen	Siemens
Member	Chhabra	Mohit	S&C Electric
Member	Kirkpatrick	Brendan	SCE
Member	Dhawan	Anil	Allegis Groups
Member	McKenny	Ken	UL solutions
Member	Busilan	Dan	Dominion Energy
Member	Found	Paul	BC Hydro
Guest	Davies	Stacey	Siemens
Guest	Coldsnow	Kent	Fort Collins Utilities
Guest	Hatfield	Ben	Trayer Engineering Corporation
Guest	Agliata	Peter	S&C Electric
Guest	Gieger	Jeff	ABB
Guest	Shocket	Abe	ABB
Guest	Uzelac	Nenad	G&W
Guest	Yin	Connie	G&W Canada
Guest	Mihretu	Feven	PG&E
Guest	Panos	Elias	PG&E
Guest	Andris	Samuel	KEMA Labs
Guest	Cummings	Kate	G&W Electric
Guest	DeCesaro	Frank	DeCesaro Consulting Solutions
Guest	Vazquez	Eric	PG&E
Guest	Smith	Kirk	Retired
Guest	Lovins	Colby	Federal Pacific
Guest	Benge	Jonathan	OG-E
Guest	Garcia	Kaylor	Utility Solutions Inc
Guest	Hanna	Robert	JST Power
Guest	Koustubh	Ashtekar	JST Power
Guest	Lee	Yong Woo	KERI
Guest	Contreras	Ivan	ABB
Guest	Montoya	Stephanie	MKI
Guest	Almeida	Edwin	Southern California Edison
Guest	Glaesman	Peter	Pcore Electric
Guest	Fernandes	Andrew	Trayer Engineering Corporation
Guest	McGlown	Kevin	JST Power
Guest	Santulli	Jennifer	IEEE SA

C37.60

Technical Proposals Reviews
Lightning impulse withstand voltage – conditioning procedure

Lightning impulse voltage test

What should the conditioning method be?

Existing:

7.2.5 Criteria to pass the test

Subclause 7.2.5 of IEC 62271-1:2017 is applicable with the following modification:

When testing switchgear incorporating an open vacuum interrupter, for each polarity, a maximum of 25 preliminary impulse tests may be performed at up to and including the rated withstand voltage. The number and level of preliminary impulses is to be stated by the manufacturer. Breakdowns that are observed during these preliminary tests shall be disregarded for the purposes of the withstand statistics used to determine pass or fail performance of the equipment.

NOTE For more information about the application of preliminary impulses to an open vacuum interrupter, see reference [14].

Lightning impulse voltage test

What should the conditioning method be?

Comments and analysis:

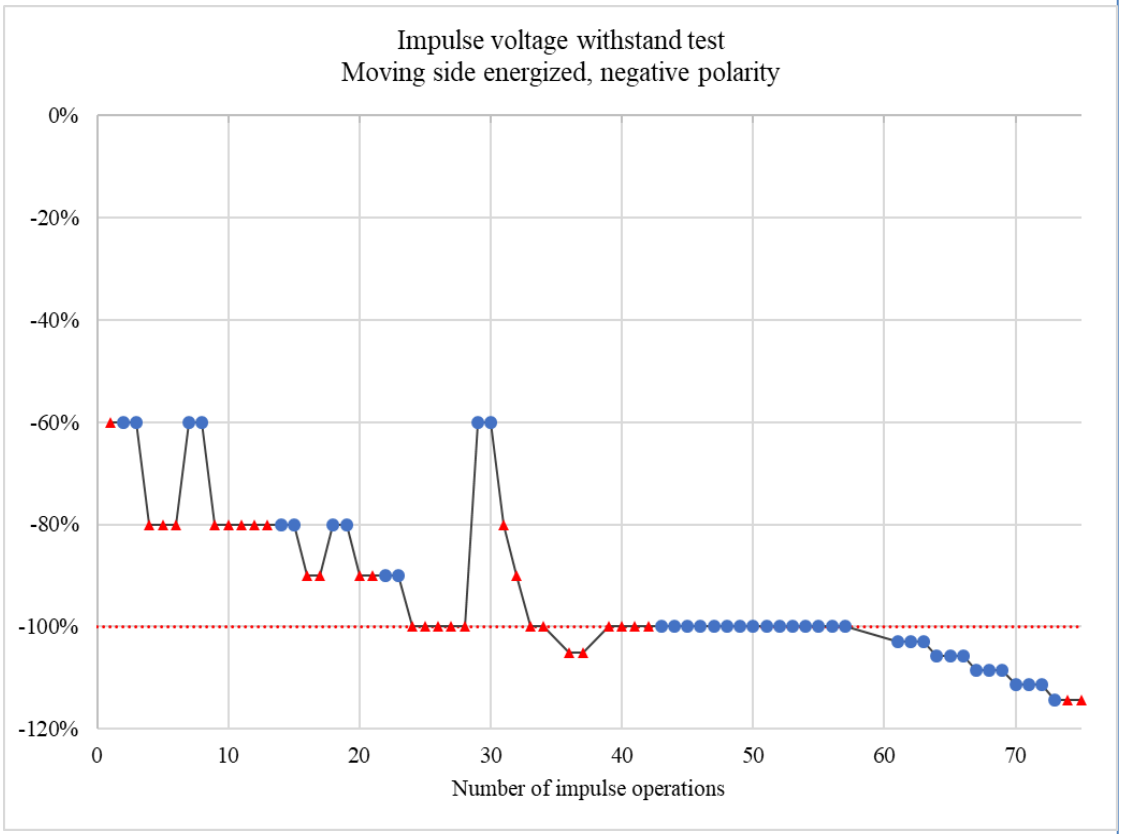
- The number of preliminary impulse tests (25) seems arbitrarily chosen.
- It has been demonstrated that certain vacuum interrupter units require more than 25 conditioning impulses to perform at their rated impulse level.
- Additionally, conditioning at higher-than-rated impulse levels (105% for example) has been shown to be beneficial in certain cases.

Lightning impulse voltage test

What should the conditioning method be?

Test data:

- This example displays a test performed on a vacuum interrupter, negative polarity, with the moving side energized.
- This unit required >30 conditioning impulses after which it passed at >115% rated withstand voltage.
- The unit would have failed the test using today's conditioning criteria.



Lightning impulse voltage test
What should the conditioning method be?

Proposal:

Reword the highlighted sentence in Subclause 7.2.5 to:

When testing switchgear incorporating a vacuum interrupter, for each polarity and configuration (moving side energized / stationary side energized), the manufacturer / equipment integrator should specify the conditioning procedure. This should include:

1. The maximum number of preliminary impulse tests that may be performed.
2. The applied voltage and number of impulse tests performed at each voltage level.

Vacuum interrupter and switchgear datasheets shall specify the lighting impulse conditioning method.

Lightning impulse voltage test

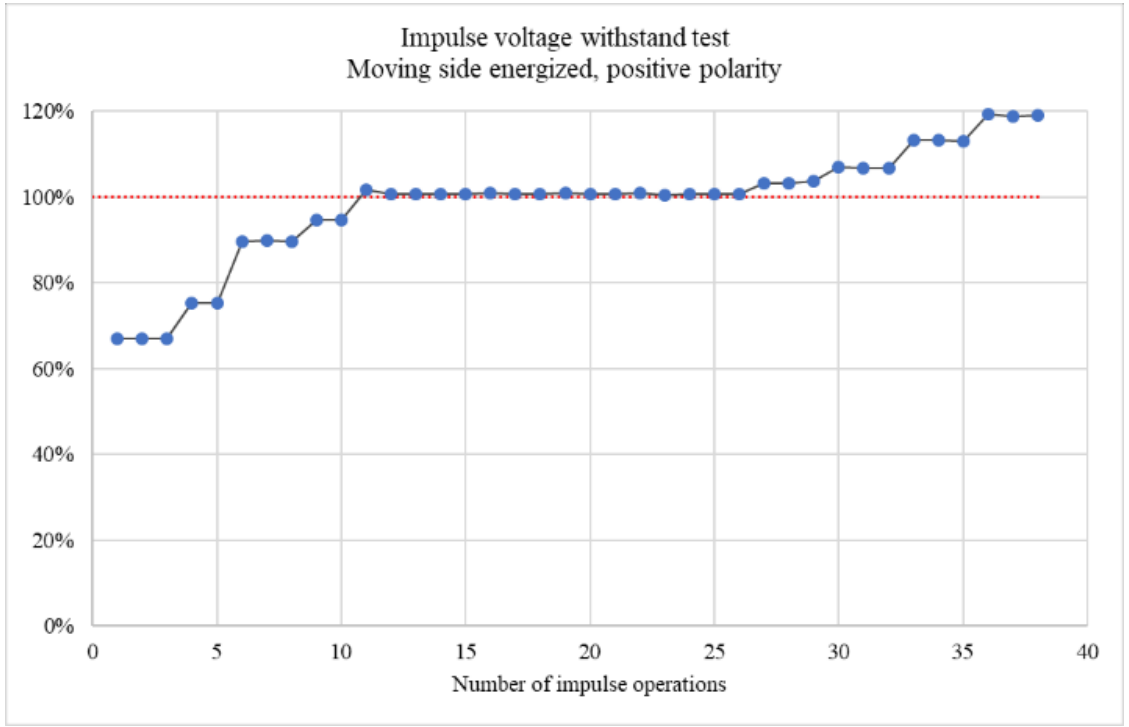
What should the conditioning method be?

Example:

Specification for vacuum interrupter impulse withstand preconditioning could be as follows:

Lightning impulse withstand conditioning procedure:

- 3 conditioning impulses at 55-65% rated withstand voltage
- 3 conditioning impulses at 70-80% rated withstand voltage
- 3 conditioning impulses at 90-95% rated withstand voltage
- 3 conditioning impulses at 100% rated withstand voltage
- 3 conditioning impulses at 105% rated withstand voltage



	C37.60-2018/IEC62271-111-2019	PC37.68 Draft 3.5 (7/31/2023) **Items in Red are differences. Items in *Blue Italics are notes.***
Definition:	publicly accessible situated in an area where no means are implemented to expressly prevent access and where any person can access without authorization	publicly accessible (per C37.100.5-2018): Unsecured locations (typically areas not within a gated and locked fenced area or otherwise guarded by locked doors) located less than 3 meters above the ground (or an equivalent surrounding surface area).
Normal Service Conditions:	For submersible units, the water head does not exceed 3 m above the base of the enclosure during occasional submersion. Exposure to chemical or electrochemical reactions may be encountered in a sub-grade environment. The sub-grade environment may contain chemicals that contribute to mild corrosive reactions.	Normal (usual) conditions for submersible equipment include the following: Head of water does not exceed 3 m above the top surface of the MBC enclosure for a duration not to exceed 10 days.
Application requirements:		Distinguishes between controls mounted to the switchgear, controls mounted on the outside for the pad-mount enclosure, and/or remote from the switchgear.
Power/ Control Circuits (DESIGN)	Switchgear, including all auxiliary circuits (electronic controls, supervision, monitoring and communication), that relies solely on an auxiliary power supply shall be able to operate normally when the auxiliary power supply measured at the supply terminals of the auxiliary equipment is such that: • the voltage variation is within the limits of the supply voltages shown in **Tables 4 and 5**; • **in the case of a DC auxiliary supply voltage, the ripple voltage is limited to a value not greater than 5 % of the DC component.** The requirements for voltage variation do not apply to self-powered control equipment, e.g. powered by integrally mounted current transformers or battery powered controls. 5.10 Rated supply frequency of auxiliary and control circuits Subclause 5.10 of IEC 62271-1:2017 is applicable. *(50hz and 60hz)* The requirements for voltage variation do not apply to self-powered control equipment, e.g. powered by integrally mounted current transformers or battery powered controls.	*Voltage powered:* 6.5.1 Power supply input voltages *AC Only, No DC ranges.* Subclause 5.9.1, Table 5 of IEEE Std C37.100.1-2018 applies *(Similar but not the same nominal voltages. Includes ranges for closing/tripping/auxiliary functions)* for products covered by this standard. The manufacturer is responsible for documenting and publishing the designed AC input voltage range in the equipment manual. 6.5.2 Power supply input frequency Subclause 5.10 of IEEE Std C37.100.1-2018 applies.*(50hz and 60hz)* *Current powered:* The manufacturer shall specify the minimum value of line current for operation of the MBC and any associated operational restrictions or limitations. The MBC shall be capable of performing specified operation(s) at the minimum value of line current without the aid of a secondary or alternative power source. The minimum operating conditions for the device to have a normal 345 (unrestricted) performance shall be specified by the manufacturer. For example- current level, current duration, temperature and humidity etc. The manufacturer shall specify any dependency of using an alternative power source during the absence of line current to perform secondary functions such as close operation after lockout, status indication and remote communications.
Batteries (DESIGN)	No specific requirements	Subclause including requirements for connector; manufacturer instrurctions. Subclause on design of the battery charger Subclause on documentation of battery performance expectations.
Overcurrent Protection (for control circuits): (DESIGN)	No specific requirements	The MBC shall include a fuse or other protection method for each power supply input, suitable to carry nominal load and peak currents, unless mutually agreed to by the user and manufacturer. The MBC should include fuses or other protection methods for protection of internal components and user accessories as agreed upon between the user and manufacturer.
Power supply and battery test: (Type Test)		Voltage powered devices - power input IEC 60255-26:2023 Clause 7.3.10 applies and shall be used in conjunction with IEC 61000-4-11:2020 (Table 1 – Class 2, Table 2- Class 2). Current powered devices - power input If not required by the applicable equipment standard, the following apply: - Short-Time Withstand and Peak Withstand Current Test per IEC 62271-1:2017 Clause 7.6. - Dielectric Impulse Tests per IEC 62271-1:2017 Clause 7.2.5. The MBC is required to operate per the requirements of applicable standards following the completion of the tests.

ıing of switchgear and controlgear: (DESIGN)	All conductive components and enclosures that may be touched during normal operating conditions and are intended to be grounded shall be designed to carry 30 A (DC) with a voltage drop of maximum 3 V to the grounding point provided at the recloser. For purposes of this subsclause, the term “conductive” does not include semi-conductive surfaces. A recloser control housing that may be mounted separately from the recloser or that contains control elements that rely on solid earthing (grounding) for surge immunity shall also have provisions for the connection of an earth (ground) lead.	The enclosure shall have provisions for the connection of a groundconductor. All conductive components that may be touched during normal operating conditions shall be grounded or bonded to the ground connection point. The manufacturer shall document the allowable range of ground conductor sizes in the instruction manual.
Grounding (TYPE TEST)		The grounding design of the MBC enclosure shall be tested to demonstrate the ability of the enclosure to carry the rated MBC power current in the case of an internal fault within the MBC. One of the following grounding design test options shall be used. Option 1: Apply rated ground fault current to conductive components of the enclosure that may be touched during normal operating conditions. The MBC enclosure shall maintain step, touch, and transferred potentials per IEC 61936-1:2010 Clause 10.2.2. Option 2: Clause 6.3 of IEEE Std C37.60-2018 / IEC 62271-111:2019 applies. Following the test, the MBC shall pass all Production Tests as defined in Clause 8.
Electrical Shock/ Hazardous Parts:	6.4.2 Protection against electric shock Subclause 6.4.2 of IEC 62271-1:2017 is applicable with the following modification. Special access restrictions may be required for overhead/pole mounted reclosers. See 6.4.3. From 62271-1: Installed on the frame - shall be suitably protected against disruptive discharge. Circuits which require access shall be accessible without the need to compromise clearances to hazardous parts.	The equipment shall be designed so that during normal operating conditions no hazardous voltages greater or equal to 50V ac or dc are exposed to the user when the MBC door is opened without performing a second conscious act (such as accessing behind a latched or otherwise secured swing-out panel). The control enclosure shall be labelled to warn of hazards, including but not limited to hazardous voltage, in order to reduce the likelihood of injury. Protections, such as physical barriers or interlocks, and safety labels shall be provided inside the control enclosure. The MBC shall be designed so that, during the unusual operating condition of mating connectors being disconnected, no hazardous voltages greater or equal to 50V ac or dc are exposed to the user. Some design methods include female connectors, connectors with protective covers, or other physical or electrical interlocks. All exposed hazardous energized parts greater or equal to 50V ac or dc shall be indicated with a safety label. A means of isolation or discharge shall be provided for the source of energy. If more than one source of voltage is present in the MBC enclosure, a warning label shall be affixed to the interior of the MBC enclosure clearly identifying them. All safety labels, their color, wording, and placement, shall be in accordance with ANSI Z535.4.
Energy Storage:	When the energy storage is a charged capacitor, the requirements of 6.6.1 apply when the capacitor is charged except that indication of the charged state may be placed on the energy storage device rather than the switching device. In the case of an energy storage device embedded within electronic controls of the recloser, a ‘readiness to operate’ indicator satisfies this requirement.	If the MBC design includes a stored/trapped source of energy, such as batteries or high energy capacitors, it shall be indicated with safety labels. Instructions to maintain, replace, troubleshoot, and de-energize these components shall be provided in the instruction manual for maintenance.

Nameplate:	If the recloser is operated or controlled by a detachable control enclosure, this enclosure shall also have an appropriate nameplate.	MBCs shall be provided with nameplates that contain the necessary information to uniquely identify them. Table 4 provides the minimum required information. (Manufacturer's Name or Trademark; Manufacturer's Type Designation / Model Number; Serial Number; Date of Manufacture) Table 5 provides optional information subject to agreement between manufacturer and user. (Voltage Ratio Settings; Current Ratio Settings; Input Power Range; Battery Voltage & A/hr Rating; IP Rating) For MBCs with externally mounted nameplates, the nameplates and their methods of attachment shall be weatherproof and corrosion resistant. If the MBC consists of separate component enclosures connected with cables and/or conduit, each enclosure shall be provided with a nameplate.
Degrees of protection provided by enclosures:	General: IP1XB (IEC60529) Publicly Accessible: IP4X (or higher; IEC60529) Against Water: IPX3 (or higher; IEC60529) Against Impact: None	No General Ratings Publicly Accessible: IP43 (or higher, IEC60529) Non-publicly Accessible: NPA Polemount: IP33 (or higher, IEC60529) NPA: Dry Vault: IP33 (or higher, IEC 60529) NPA: Wet Vault/ Temporary Submersion: IP67 (or higher, IEC60529) NPA: Wet Vault/ >30Min Submersion or >1m depth: IP68 (IEC60529) with depth and duration specified and agreed by manufacturer and purchaser. NPA: Padmount (within enclosure): IP32 (or higher, IEC60529)
Other Requirements for equipment in publicly accessible areas	Such enclosures shall be designed to mitigate the potential hazards of the equipment to unauthorized persons. Consideration for securing associated external cable and cable connections and the prevention of internal access other than by authorized personnel shall be agreed upon between the user and the manufacturer. In order to secure the control enclosure, the following measures are typically used to address the hazards presented by publicly accessible equipment. a) Three-point door latching mechanisms, or equivalent, are used to secure a door of entry. NOTE 1 A three-point latching mechanism allows for all un-hinged sides of a door to be latched, thereby securing all sides of a door. Such mechanism greatly increases the security of the door compared to a singlepoint latching mechanism. b) Enclosure panels are fastened or hinged to resist disassembly, breaking, or prying open from the outside with the doors in the closed and locked position. No externally removable screws, bolts, or other fastening devices exist by which access to energized parts in the enclosure might be obtained without the use of special tools. c) Locking bolts and associated threaded receptacles, hinges, and hinge pins are AISI6 type 304 stainless steel or material of equivalent corrosion resistance. d) Enclosures have padlock provisions, utilizing a minimum of one padlocking means provided per entry door. NOTE 2 In some jurisdictions and when specified by the user, conformance to IEEE Std C57.12.28.xx may be required.	Requirements for the prevention of internal access other than by qualified personnel shall be agreed upon 213 between the user and the manufacturer. 214 MBCs intended for installation in publicly accessible locations shall provide an orderable option for 215 mechanical protection of external cables. This option shall include hardware fastened such that it can only 216 be removed with access to the inside of the enclosure. 217 Enclosures shall be designed to mitigate the potential hazards presented to unqualified persons by the MBC. 218 The MBC enclosure shall be lockable, unless located where access is limited to qualified personnel only. 219 NOTE 1— To help secure the MBC enclosure against unqualified access, the following measures may be 220 used: 221 a) Three-point door latching mechanisms, or equivalent, are used to secure a door of entry. 222 A three-point latching mechanism allows for all un-hinged sides of a door to be latched, thereby 223 securing all sides of a door. Such mechanism increases the security of the door compared to a single224 point latching mechanism. 225 b) Enclosure panels are fastened or hinged to resist disassembly, breaking, or prying open from the 226 outside when the doors in the closed and locked position. No externally removable screws, bolts, or 227 other fastening devices exist by which access to energized parts in the enclosure might be obtained 228 without the use of special tools.

Accumulation of water:		The MBC enclosure shall be designed to prevent accumulation of water internally and externally. When the 237 door is opened, water shall not drip inside of the MBC from the external surface of the MBC. The materials 238 used for sealing doors and connectors shall be impervious to liquid water.
Connections to/through Control Enclosure:		6.2.1 Connections Connections to the MBC enclosure may include external connectors and/or hardwired interfaces using hubs and fittings. The connections shall be selected to meet the design requirements of the MBC's for it's environmental application. All external connectors shall have keying to assist with proper alignment of the cable to the receptacle and to reduce the chance of connecting the improper cable. All connectors of the same type shall be uniquely and permanently identified when the application requires the use of more than one of a specific connector. NOTE—Identification of connectors can be accomplished with labels affixed to the enclosure, connector, or cable. The number of connections to the MBC should be limited to the minimum number required for proper operation and to avoid electrical interference. Some types of connections are shown below: Power supply connection Command, sensing and measurements Telecommunication 6.2.2 Hubs and fittings When hubs and fittings are required to meet environmental requirements and local regulations, they may be shipped separately from the MBC, if the application does not support them installed by the manufacturer. The MBC manufacturer shall provide all necessary hardware, gaskets, and installation instructions. 6.2.3 Unused openings Unused openings in the enclosure (e.g. knockouts), if supplied, shall not compromise the ability of the enclosure to withstand required tests.
Operational Requirements:	None other than as relates to recloser operation sequence.	Subclause on Local commends; Subclause on opration logic for local operations, order of operations, and contradictory commands. Subclause on control operation counters; Subclause on indication shown on control Subclause on Automatic and Remote Operation. Subclause on Display and access to the display.
Vibration and shock test		Vibration: IEC 60255-21-1: 1988, Vibration, Shock, Bump, and Seismic Tests in Measuring Relays and Protective Equipment; Vibration tests (sinusoidal) Class 1 (endurance); Class 0 (response) for pad-mount and vault mount; MBCs Class 1 (response) for pole mount MBCs Shock IEC 60255-21-2: 1988, Vibration, Shock, Bump, and Seismic Tests in Measuring Relays and Protective Equipment; Shock and bump tests Class 1 (shock withstand, bump); Class 0 (shock response) for padmount and vault mount MBCs; Class 1 (shock response) for pole mount MBCs
Seismic test		Requirements for seismic testing should be agreed to by the manufacturer and user.
Surge withstand capability test	Testing shall be in accordance with IEEE Std C37.90.1-2012. Alternatively, testing may be in accordance with IEC 60255-26:2013 for both the slow damped oscillatory wave test and the fast transient test with the modifications given in Table 21. The test report shall state which procedure (IEEE or IEC) is used for these tests.	IEEE Std C37.90.1 applies. Alternatively, both the following IEC tests, with the modifications given in Table 7 may be performed. The test report shall state which procedure (IEEE or IEC) is used for surge withstand capability testing. *Language updated to newest versions of the standards.* IEC 60255-26:2023 Clause 7.2.67.3.5 (Test case 1; Slow damped oscillatory wave test) applies and shall be used in conjunction with IEC 61000-4-18:2019. IEC 60255-26:2023 Clause 7.3.4 (Test case 1) 7.2.5 Electrical fast transient/burst applies and should be used in conjunction with IEC 61000-4-4:2012. Table 7 — Characteristic modifications for surge withstand capability testing in accordance with IEC 60255-26:2023

Surge immunity test		IEC 60255-26:2013 Clause 7.3.6 (Test case 1) applies and shall be used in conjunction with IEC 61000-4-5:2014 (Table 1 - Test level: 4).
Conducted RF immunity test		IEC 60255-26:2023 Clause 7.3.7 applies and shall be used in conjunction with IEC 61000-4-6:2013 (Table 1 - Test level: 3).
Radiated RF immunity test		IEEE Std C37.90.2 applies
Electrostatic discharge immunity test		IEEE Std C37.90.3 applies. Alternatively, IEC 60255-26:2023 Clause 7.3.2 applies and shall be used in conjunction with IEC 61000-4-2:2008 with the following modifications to Table 5, item 5.2 in IEC 60255-26:2023: - change Electrostatic discharge (Contact) range to 2, 4, and 8 kV (test voltage) - change Electrostatic discharge (Air) range to 4, 8, and 15 kV (test voltage) The test report shall state which procedure (IEEE or IEC) is used for Electrostatic Discharge Immunity testing.
Dielectric and impulse test	*7.2 Performed on the complete unit and may/may not test all circuits/ports inside of the control.*	Clause 8 of IEEE Std C37.90-2005 applies. The manufacturer shall list the various circuits (ports) tested and the test voltages applied.
Radiated and conducted emissions test		IEC 60255-26:2023 Clause 7.2, and CISPR 11:2015 (Group 1, Class A) apply.
SSAO test:	7.111.2	*Modifications currently proposed in C37.68D3.5 which have not been approved.*
Heat, cold and humidity tests	Mechanical tests at low and high temperature (7.109.4)	The MBC shall pass any temperature type testing requirements of the relevant switchgear standard for the equipment with which it is designed to operate. Additionally: IEC60068-2-1 (cold) and IEC 60068-2-2 (dry heat) with detailed parameters and monitoring. And: IEC 60068-2-30:2005 (cyclic humidity) with specific test parameters. Alternate procedure of IEC 60068-2-38. OR IEC 60068-2-38 when applicable.
Analog Input tests		The manufacturer is responsible for demonstrating and documenting the accuracy rating of each analog input across the rated temperature range of the MBC.
Time Current Tests	Clause 7.108	Not specifically called out. But would be required as part of C37.60/IEC62271-111
Routine Test / General:	b) control, secondary wiring and accessory devices check tests; e) reclosing and overcurrent calibration; Test reports of the routine tests are not required unless otherwise agreed upon between the manufacturer and the user.	Basic functionality tests (detailed in the subclauses) shall include the following: - verify operation of analog and digital inputs and outputs. (eg. sensor inputs). - verify operation of control logic. - verify operation of communication capabilities. Test reports shall be prepared that contain documented evidence of the inspected attribute, and the measured outcome. The final test report will be retained for at least the warranty period of the MBC, available for customer review, and acceptance. When a MBC system includes components supplied by other facilities or vendors, such components shall also be tested, and documented, for their intended functionality by the MBC manufacturer. The manufacturer of the final assembly shall verify that all relays, circuit boards, and/or any other subassembly has been inspected for compliance with the intended function.

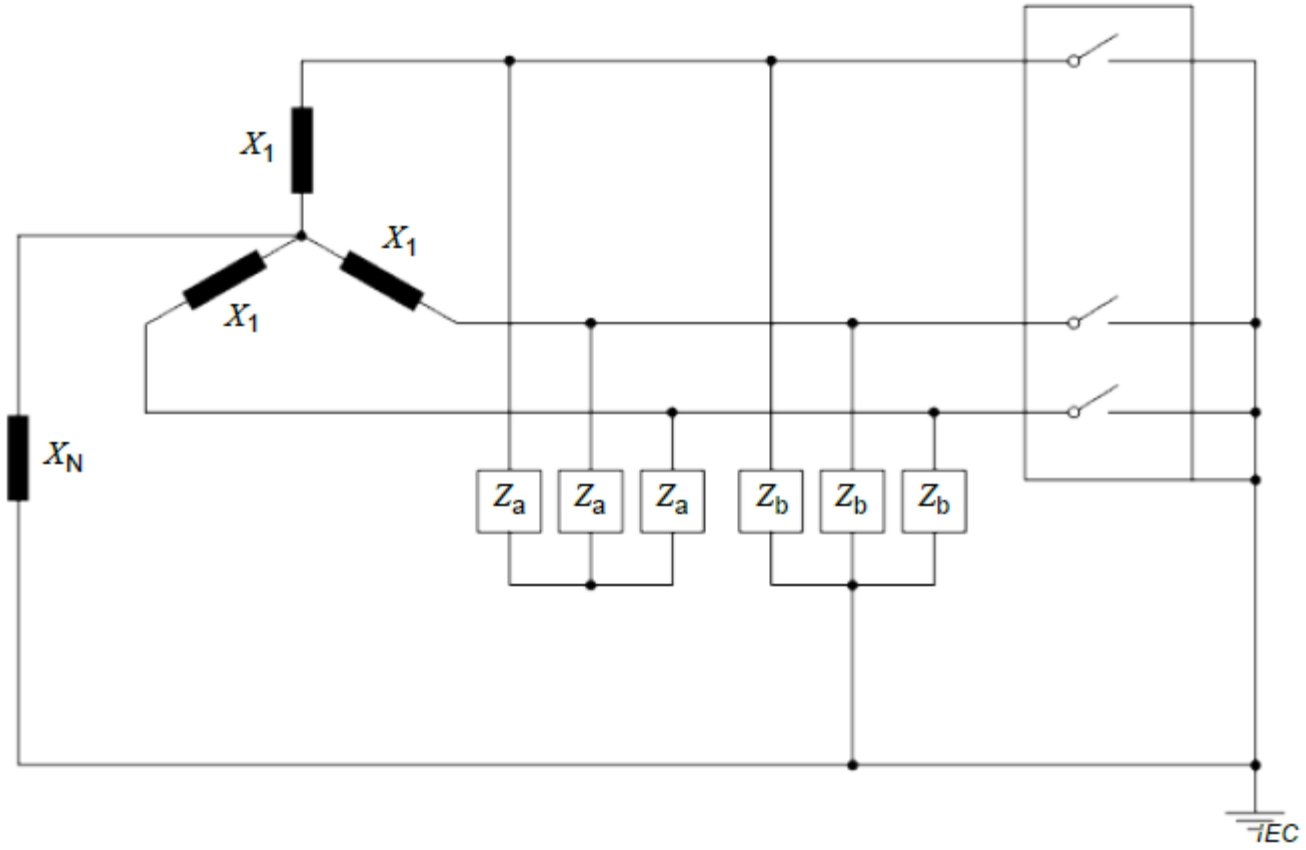
Routine Test/ Aux and control circuits	Control, secondary wiring and accessory devices shall be checked to verify that all connections have been made correctly. Devices and relays, if needed, shall be checked by actual operation where feasible. Those circuits for which operation is not feasible shall be checked for continuity.	The intention of this test is to verify that the MBC has been assembled and wired correctly. As such, testing shall be performed by interfacing with the product in the manner it will be used in the end application. If it is necessary for a production test system to bypass a portion of the product's wiring to perform a test, a secondary test shall be performed to verify the wiring that was bypassed (by checking the continuity of each wire). Each input and output of the MBC, defined as a connection point where the customer would interface with the product such as switchgear interface, digital I/O, or battery connector, shall be tested to verify operation using a load representative of the intended application. All analog inputs shall be tested according to the manufacturer's production practice and shall be tested to be within published accuracy ranges. Where applicable, motor drive elements shall be tested for proper operation using a representative device or load simulating the motor. Motor drive element functional testing shall include confirmation of operation during normal ac power input conditions, as well as auxiliary battery backup power supply. Operations shall complete within the time specified by the manufacturer and the MBC shall provide correct position indication.
Routine Tests/ Dielectric tests		Clause 8.2 of IEEE Std C37.90-2005 applies. MBC's shall be tested with a minimum of the Series B test voltages, applied on contacts, inputs, outputs, and any communication interfaces on the MBC.
Routine Tests/ Communication capabilities		The manufacturer shall test communication ports with the appropriate performance test(s) to demonstrate the intended functionality.
Routine Tests/ Dielectric medium monitoring		Dielectric medium monitoring inputs which utilize an analog signal shall be tested using an appropriate simulated input (voltage, current, etc.), covering the measurement range of the MBC. Monitoring inputs that utilize a digital input shall be tested using the appropriate input condition corresponding to the pass/fail condition.
Routine Test/ Reclosing and overcurrent trip calibration	Reclosers shall be subjected to the following calibration, where applicable, for conformance to published time-current characteristic curves. Calibration may be performed on the individual control elements sub-assembly prior to final assembly on the recloser. When the latter is done, the effect of the operating time on the recloser shall be recognized, and the complete assembly shall be tested to ensure that the device will trip the recloser. A sinusoidal wave shape current at a convenient voltage shall be used. The calibration may be performed in any order deemed appropriate by the manufacturer	
Routine Test/ Mechanical operations tests:	25 consecutive close-open operations to check performance of mechanism, sequencing, and time devices. Shunt-trip reclosers shall have five operations performed at minimum control voltage.	
Routine Test/ Site ready testing		Site ready devices are combinations of switchgear and MBCs that are preassembled by the manufacturer to simplify installation in the field. Site ready units can include potential transformers supplying input voltage to the MBC, voltage and current sensors, lightning arrestors, etc. While standard switchgear and MBC routine tests verify the functionality of each component and are normally adequate for use in site ready units, users may wish to specify site ready tests in addition to normal routine tests for added confirmation of the site ready assembly. The user may specify testing from the following list: a) perform 10 consecutive operational tests without trouble or malfunction to check the performance of the switchgear and position indication of the MBC, at least 5 tests shall be performed at minimum MBC input voltage. b) energize potential transformers at nominal input voltage. At least 5 consecutive operational tests shall be performed without trouble or malfunction. c) operate voltage and current sensors at nominal input levels and the MBC shall indicate the correct level within the specified tolerance.

Routine Test/ Grounding			The manufacturer shall torque all grounding hardware to acceptable values and the manufacturer shall establish and document their own consistent readings to show consistent & acceptable torquing has been achieved. MIL-HDBK-419[B6][B6][B7] Book 2 Table 1-23 may be referenced for torque value selection. In addition, the manufacturer shall demonstrate continuity of the grounding.

C37.60 - Reclosers DLMT Ad hoc: updating fig. 3 with the missing source

Report out at IEEE Switchgear Committee fall 2023 meetings
October 10, 2023

Current drawing:



Key

X_N is the source neutral impedance

X_1 is the positive sequence short-circuit reactance

Z_a is the phase-to-phase impedance of TRV circuit

Z_b is the phase-to-ground impedance of TRV circuit

X_N much larger than X_1 for first-pole-to-clear factor of 1,5

$X_N = 0{,}75\ X_1$ for first-pole-to-clear factor of 1,3

For $Z_0/Z_1 = 2$, $Z_a = Z_b = 2Z_1$

where Z_0 zero sequence component of short-circuit impedance on supply side.

Figure 3 – Three-phase short-circuit representation

Revised drawing:

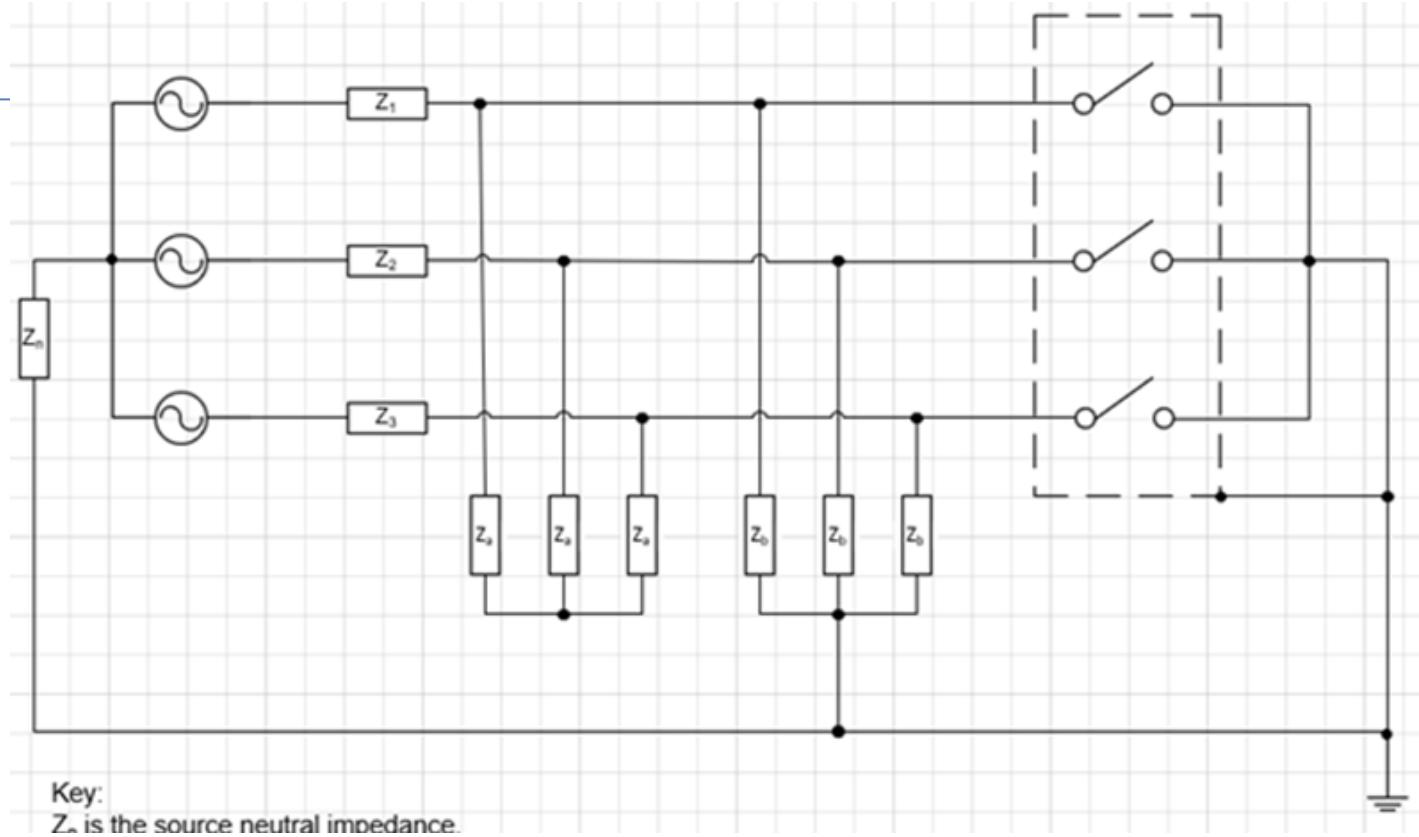


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Figure 3 – Three-phase short-circuit representation

Based on:

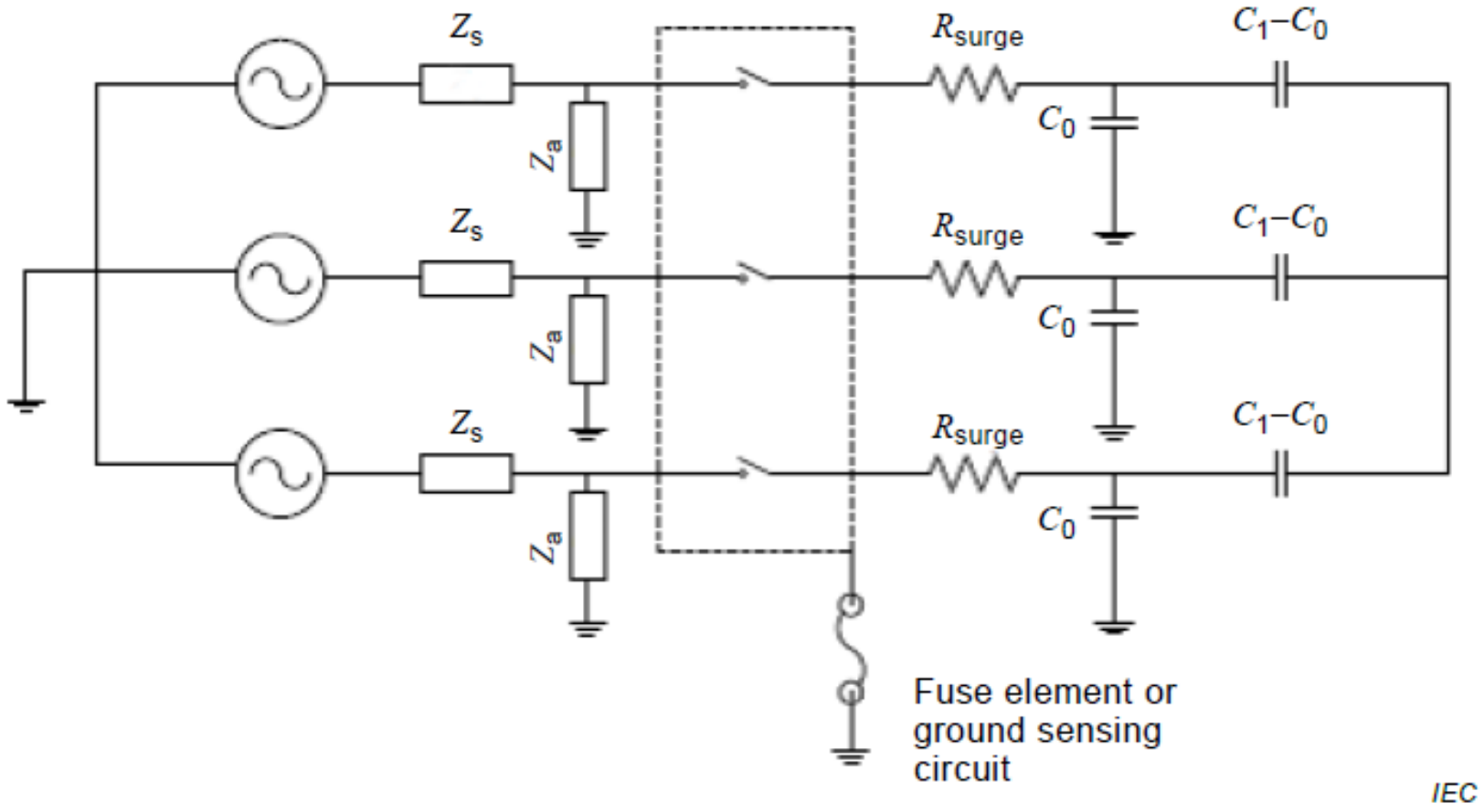


Figure 2a – Three-phase circuit

C37.60 - Reclosers DLMT: Introduce a new testing condition which allow to omit T5 and T10 low current duties

Report out at IEEE Switchgear Committee fall 2023 meetings
October 10, 2023

Background

7.104 Low current tests

- Required for all reclosers to demonstrate the switching capability at low currents.
- T10 10% rated short-circuit current
- T5 5% rated short-circuit current

Low current test-duty

7.104.4 Low current test-duty

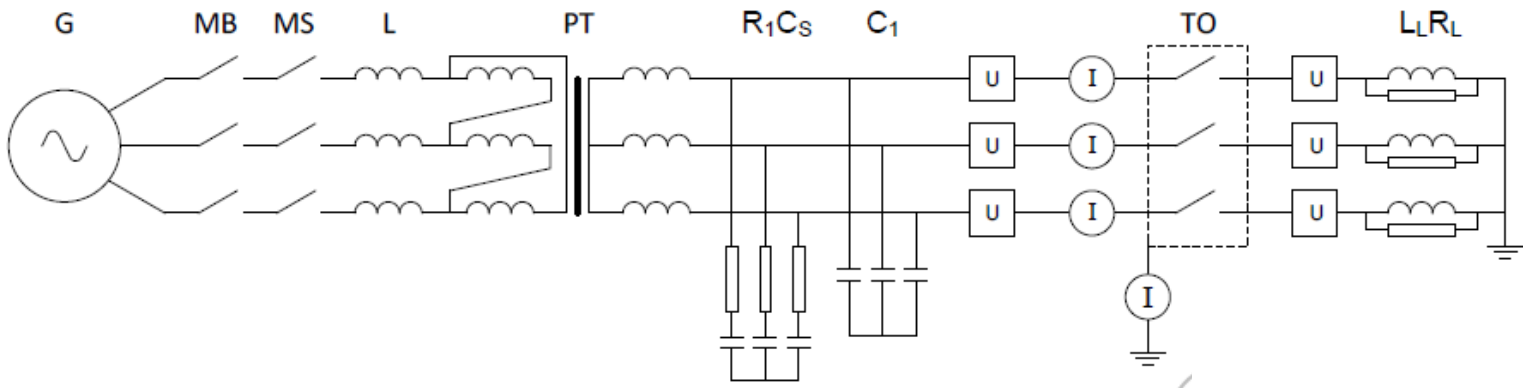
The low current test-duty shall consist of four open operations at each current level. The tests may be performed in any combination of O (open) and C (close) operations

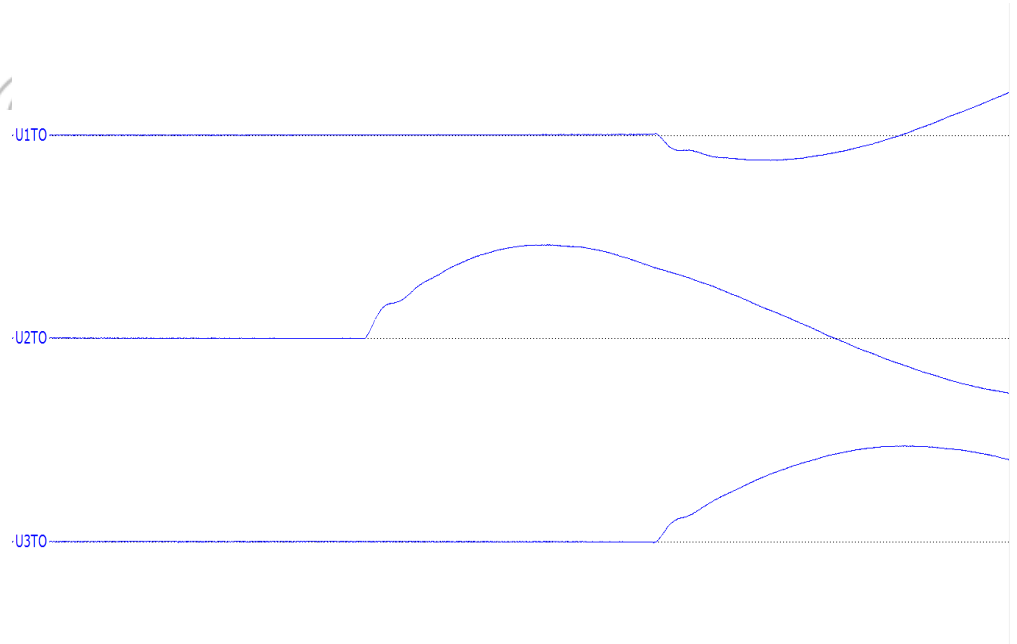
as is convenient for the laboratory, e.g. O, CO, O – t – CO recloser

History

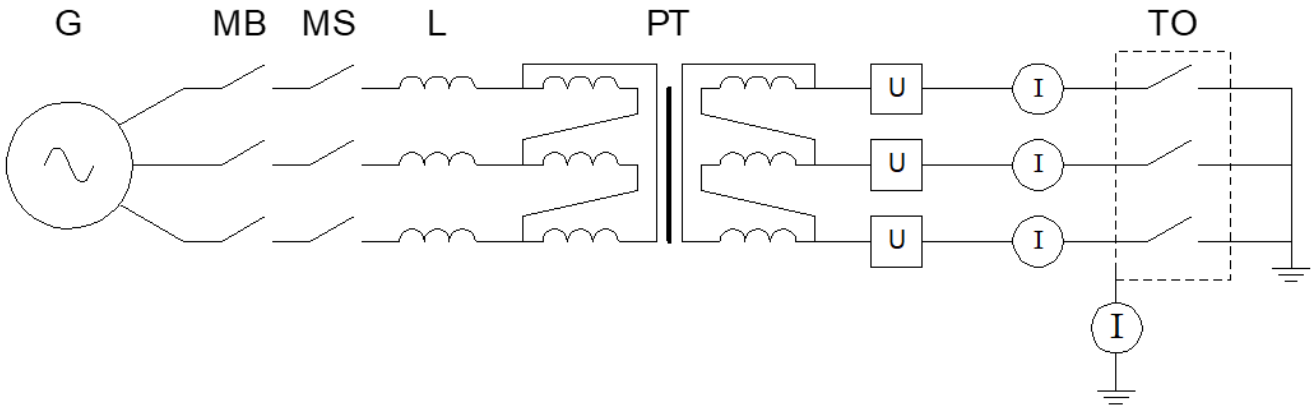
- The low current tests replace the mainly active load switching test duty that was required under the 2003
- critical current tests specified in the 2007 edition
- The low current tests are intended to serve as evidence that the recloser is capable of interrupting current levels throughout its operating current rating which was formerly evidenced by load current tests

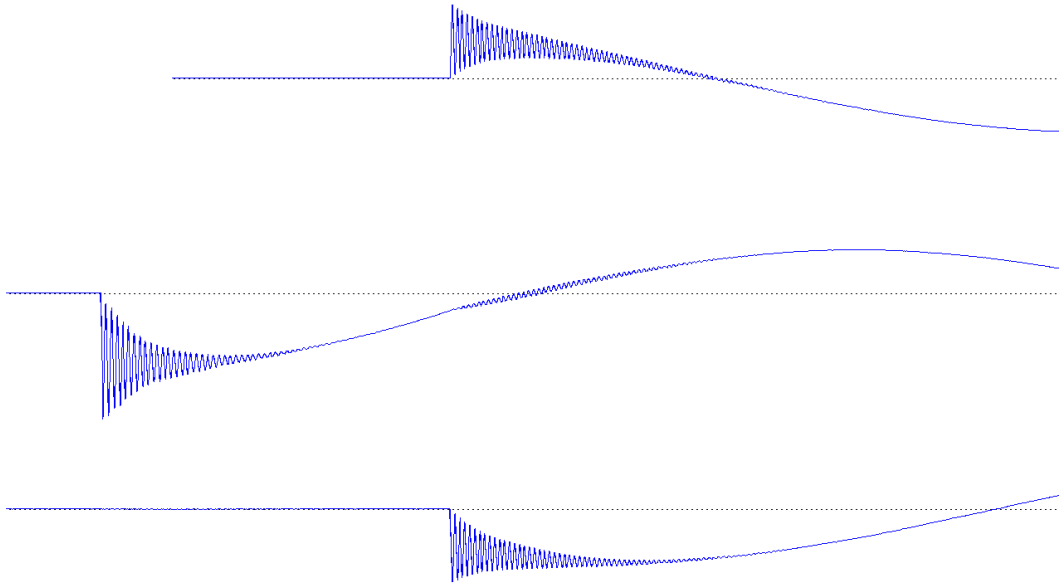
Load switching TRV





T5 – T10 TRV





Discussion

- T5 and T10 circuits
  - These circuits are entirely inductive and not representing load switching.
- Critical current tests are known and used in circuit breaker standards
  - It shall be assumed that there is a critical current if the minimum arcing times in the test-duties of either T20 or T50 is one halfcycle or longer than the minimum arcing times in the adjacent test duties. For three-phase tests the arcing times of all three phases shall be taken into account.
- No need for additional prove for load switching, this is covered by the basic short-circuit test duties(T100, T50 and T20).
  - As handled by circuit breakers standards.
- Go back to the previous standard (critical current) as specified 2007 edition.

Proposal

- Go back to the previous standard (critical current) as specified 2007 edition.
  - T5 and T10 only applicable if there is critical current.

Reclosers DLMT Ad hoc: Dependent manual operation

Report out at IEEE Switchgear Committee fall 2023 meetings

October 10, 2023

Background – Existing PAR Scope

- Scope of 2018 edition includes the phrase:

  “Devices that require a dependent manual operation are not covered by this document.”

- Many of the cutout-mounted reclosers deployed around the world can be closed into the cutout mounting with a dependent manual close operation to put the recloser into service.
  - For reclosers that have contacts in closed position when installed into the cutout mounting.
- The PAR Study Group met on April 19, 2023 and chose to remove this exclusion from the scope to better cover such reclosers and the associated operations to close the device into the cutout

IEV ref	441-16-13
en	**dependent manual operation** (of a mechanical switching device) an operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator

Background – IEC Concerns

- After the April 19 meeting, the chair received feedback from multiple members of IEC TC17 indicating strong resistance to this change.
- The IEC requires that any device capable of fault interruption must have defined parameters for closing and opening under all conditions
  - All such IEC TC17 standards exclude devices requiring dependent manual operation from scope
  - Thus several experts from the IEC expect this statement to be restored to scope
- The ad hoc met with this resistance in mind – and with a goal to propose a path forward:
  - David Beseda
  - Marcos Botelho
  - David Dart
  - Federico Di Michele
  - Leslie Falkingham
  - Jonathan Neujahr
  - Ian Rokser

The Problem

- The desire within the PAR study group is to define and/or disposition a dependent manual close operation that is common with cutout mounted reclosers
- The IEC does not want to include any sort of dependent manual close operation in the scope or requirements of the recloser standard.

IEC and IEEE Fuse Standards

- This operation is common for cutout fuses
- How the IEC and IEEE fuse standards address the topic of closing a cutout fuse into a cutout mounting.
  - The IEC standard for high voltage expulsion fuses (IEC 60282-2) includes the following note in the scope: "NOTE 3 This standard does not cover load-switching nor fault-making capabilities."
  - The IEEE fuse standard (IEEE C37.41) includes the following note in "4.1 Normal and Special service conditions - General": "Devices covered by this standard should not be closed into an energized circuit since they do not have making-current ability…“

Ad hoc proposal

- Cutout mounted reclosers that close into the cutout with contacts in the closed position can comply with the scope/requirements of the standard if closed into the cutout mounting with the circuit de-energized.
- Restore exclusion from -2018 edition into our scope
  - Requires a PAR revision
  - Append C37.60 “4.1 Normal and Special Conditions,” subclause “4.1.1 General” to read as follows (italicized text is new).

    “Subclause 4.1.1 of IEC 62271-1:2017 is applicable.

    Cutout mountings do not have a fault closing rating. As such, devices that install into the cutout mounting with interrupting contacts in the closed position should not be installed into the cutout mounting while energized.”

Background – Why the IEC opposes covering such devices in scope

- How IEC standards handle dependent manual operation
  - Every TC17 standard dealing with fault interrupting switching devices includes the same verbiage:
    - *Devices that require a dependent manual operation are not covered by this document.*
  - 62271-100:2021 for circuit breakers specifies *closing* operations:

> This part of IEC 62271 is not applicable to:
>
> – circuit-breakers with a closing mechanism for dependent manual operation;

- Why?
  - Because of the possibility of closing into a fault.
  - If a fault is present:
    - Must withstand peak current at the instant of close
    - Must prevent opening again
  - Reclosers are considered to be related to circuit breakers and so must have the same behavior
- This is a very firm principle in IEC, especially in Europe
  - This same discussion was had in the previous revision of C37.60 / 62271-111 and some experts expressed they could not continue with the project if such devices were covered in scope

Reasons to return the scope to the present standard which restores the exclusion of devices requiring dependent manual operation

- Changing the scope to include devices which use manual dependant operation is a significant change to the standard which goes against IEC practice. This why the present standard includes this prohibition
- Although manual dependant operation is acceptable within ANSI/IEEE as a dual logo standard we must take into account the views of both organisations to make a significant change
- The vast majority of Reclosers do not have manual dependant operation and are covered by the existing standard

Reclosers DLMT Ad hoc: Extension of test results

Report out at IEEE Switchgear Committee fall 2023 meetings

October 10, 2023

Background

- Current edition of dual logo standard does not include any reference to extension of tests results.
  - Standard says: “The definition of an automatic circuit recloser includes its automatic control. Manufacturer shall include in the information provided to the testing laboratory sufficient information to identify the control used in the type tests. Where appropriate, this information shall include model number, serial number, firmware revision, software revision and other appropriate control software information.
  - Manufacturers could need to sell the same switching equipment of the recloser with a different automatic control or to modify slightly the switching equipment keeping the same automatic control.
  - It is not present any guide instructing how to proceed in case of any change in the automatic circuit recloser (nor for the switching part nor for the control unit).
- Here the need to evaluate the possibility to add a new chapter in the new edition of the standard, giving basic rules how to manage extension of test results.

Possible scenarios and discussions

- Extensions of test results in case of different control unit
  - This seems to be the most urgent request, being a common practice to change the control unit (or just update it) for market and application purposes
  - To be checked if any existing IEC or IEEE standard, which defines the requirements for a control unit, can be used as reference to guide the extension of test results.
    - How to move if different IEC and IEEE standard exists?
    - How to move if no standard exists at all?
- Extension of test results in case of different switching equipment
  - This seems to be less urgent and more critical
  - IEC 62271-100 for circuit-breakers defines a specific procedure to be followed in case of “different operating mechanism”. Any extension is limited to this scenario.
    - Which are the changes which can be allowed with few additional tests (and not a complete repetition of the test object homologation)?
    - It is difficult to find any IEC or IEEE standard to be used as reference to guide extension of test results.

Next steps

- Maintain the ad hoc group to move on with the activities (Ad hoc met before San Diego meeting, however activities have been delayed due to other important topics affecting the standard scope and to be solved within this meeting)
- Create separate task forces within ad hoc, proposing a solution for the change of the control unit and the change of the switching part
  - For control unit: find a reference standard to be used as general reference and adapt it to reclosers, if needed
  - For switching part: propose the changes allowed for extension of test results and propose a limited number of tests valid to cover this extension.

C37.60 - Reclosers DLMT Ad hoc: Products without a ground connection

Report out at IEEE Switchgear Committee fall 2023 meetings
October 10, 2023

Products without a ground connection Background

Scope of 2018 edition does not mention explicitly “devices without a ground connection”:

Several requirements are impossible to fulfill without a ground connection, e.g.:

- 6.3 Earthing of switchgear and controlgear
- 7 Applicability of various dielectric and surge test requiring an equipment ground connection

Products without a ground connection Background

This topic does not technically impact the scope, but impact sections of the document, therefore include devices without a ground connection within the standard and consider requirements for these devices within the body of standard.

Ad hoc team recognizes that even ungrounded devices have some ground or other potentials near them which affect the dielectrics of the device. The relationship of the device to ground or to another phase could be significant.

Products without a ground connection

Ad hoc proposal

Ad hoc team proposes to include a definition in Clause 3 and rework requirements in the impacted sections within the document.

Definition:

Ungrounded (not earthed) recloser

an automatic circuit recloser other than a cutout-mounted recloser which does not have a connection to earth

– Usage within the standard the wording “ungrounded recloser”

Products without a ground connection
Ad hoc proposal

Ad hoc team proposes to rework requirements following sections within the document:

- Table 1 - Ratings for automatic circuit reclosers, cutout mounted reclosers and **ungrounded reclosers**
- Sections:
  - 6.3 - Earthing of switchgear and controlgear
  - 7.1.2 - Information for identification of test objects
  - 7.1.3 - Information to be included in type-test reports
  - 7.1.101.2 – Mounting of device
  - 7.1.101.3 – Earthing (grounding) of device

Products without a ground connection
Ad hoc proposal

Ad hoc team proposes to rework requirements following sections within the document:

- Sections:
  - 7.2.1 - General
  - 7.2.6.2 – General case
  - 7.4.3 – Electrical continuity of earthed metallic parts test
  - 7.101.8 – Test duties
  - 7.103.2 – Interrupting performance
  - 7.111.2 – Simulated Surge Arrester Operation Test
  - Annex B2 – Simulated Surge Arrester Operation Test

Products without a ground connection

Back-up

Products without a ground connection

Sections impacted and proposed wording

Table 1 – Ratings for automatic circuit reclosers, cutout mounted reclosers and ungrounded reclosers

Item	Rating description	Reference subclause	Automatic circuit recloser	Cutout mounted recloser
1	Rated maximum voltage (V) or (U_r)	5.2	X	X
2	Rated insulation level (U_d), ($\underline{U_p}$)	5.3	X	X[b,c]
3	Rated frequency (f_r)	5.4	X	X
4	Rated continuous (normal) current (I_r)	5.5	X	X
5	Rated short-time withstand current (I_k)	5.6	X	X
6	Rated peak withstand current (I_p)	5.7	X	X
7	Rated duration of short circuit (t_k)	5.8	X	X
8	Rated supply voltage of closing and opening devices and of auxiliary circuits (U_a)	5.9	X	--
9	Rated minimum tripping current (series-trip reclosers only)	5.101	X	X
10	Rated short-circuit breaking current (I_{sc})	5.102	X	X
11	Rated symmetrical (fault) making current	5.103	X	X
12	Rated operating sequence	5.104	X	X
13	Rated line-charging (I_l) and cable-charging (I_C)current switching	5.106[a]	X	X[d]
14	First-pole-to-clear factor, k_{pp}	5.105		

[a] Line-charging, cable charging and load current switching are related required capabilities.

[b] Rated insulation levels for a cutout mounted recloser are derived in part from the fuse support or base in which it is installed. The fuse support or base shall be considered a part of the cutout mounted recloser for the purpose of type testing.

Add: Rated insulation levels for an ungrounded recloser are dependent on the mounting arrangement and its potential proximity to any localised grounding system and with reference to alternate phases when in a three-phase system for the purpose of type testing.

[c] Open position tests for cutout mounted reclosers are given for the device in the "dropped-out" position unless an operating sequence allows the device to rest with an open interrupter gap and a closed isolation gap in which case, both the isolation gap alone and the interrupter gap alone shall be tested for the open position test cases.

[d] Switching capability for a cutout mounted recloser may require the use of an auxiliary open and closing device. The auxiliary open and closing device shall be considered a part of the cutout mounted recloser for the purpose of type testing. Consult manufacturer for operating details.

Products without a ground connection

Sections impacted and proposed wording

6.3 Earthing of switchgear and controlgear

Modify the first paragraph as follows:

Reclosers intended to be earthed shall be provided with a reliable earthing point for connection of an equipment earth conductor (EEC) suitable for the specified fault conditions. Parts of metallic enclosures connected to the earthing system may be designed to be part of the earth circuit.

Add to the end of subclause 6.3:

Cutout mounted reclosers shall have the fuse cutout base earthed.

Ungrounded reclosers are not required to be earthed.

Products without a ground connection
Sections impacted and proposed wording

7.1.2 Information for identification of test objects

Subclause 7.1.2 of IEC 62271-1:2017 is applicable with the following addition:

The definition of an automatic circuit recloser includes its automatic control. Manufacturer shall include in the information provided to the testing laboratory sufficient information to identify the control used in the type tests. Where appropriate, this information shall include model number, serial number, firmware revision, software revision and other appropriate control software information.

Add

For ungrounded reclosers, details shall be provided regarding the positioning and minimum spacing to a ground plane and minimum spacing to alternate phases when in a three-phase system.

Products without a ground connection
Sections impacted and proposed wording

7.1.3 Information to be included in type-test reports

Add

For ungrounded reclosers, details shall be provided regarding the positioning and spacing to a ground plane and spacing to any alternate phases for the test.

Products without a ground connection
Sections impacted and proposed wording

7.1.101.2 Mounting of device

Add

For ungrounded reclosers, the mounting arrangement shall be based on the manufacturer's recommendations regarding the positioning and minimum spacing to a ground plane and minimum spacing to alternate phases when in a three-phase system.

7.1.101.3 Earthing (grounding) of device

Add

For ungrounded reclosers, the ground plane shall not be placed closer to the device than the minimum distance recommended by the manufacturer so as not to decrease the withstand voltage.

Products without a ground connection
Sections impacted and proposed wording

7.2.1 General

Subclause 7.1.2 of IEC 62271-1:2017 is applicable with the following additions and modifications:

Rated insulation levels for cutout mounted reclosers are based in part on the rating of the fuse support or base identified by the manufacturer in 7.1.2 and 7.1.3. See 7.2.6.3 for special test conditions for the cutout mounted recloser.

Add

Rated insulation levels for ungrounded reclosers will be impacted by their proximity to any ground plane and spacing to alternate phases when in a three-phase system as identified by the manufacturer in 7.1.2 and 7.1.3.

Products without a ground connection
Sections impacted and proposed wording

7.2.4 Arrangement of the equipment

Add

c) For ungrounded reclosers, due consideration should be taken into account in relation to the supporting structure of the recloser and its proximity to any localised grounding system and its proximity to alternate phases when in a three phase system.

Products without a ground connection
Sections impacted and proposed wording

7.2.6.2 General case

Subclause 7.2.6.2 of IEC 62271-1:2017 is applicable with the following addition:

Single phase reclosers shall be tested for conditions 1, 4 and 7 of Table 10 of IEC 62271-1:2017. The connections of the terminals for phases B and C are not applicable.

Add

For cutout mounted reclosers, the Frame ground shall be connected to the pole mounting point of the cutout base.

For ungrounded reclosers a reference frame ground shall be provided based on its minimum clearances identified by the manufacturer in 7.1.2 and 7.1.3.

Products without a ground connection
Sections impacted and proposed wording

7.4.3 Electrical continuity of earthed metallic parts test

Subclause 7.4.3 of IEC 62271 1:2017 is applicable.

Change to

Subclause 7.4.3 of IEC 62271 1:2017 is applicable to earthed reclosers and to the cutout mounted recloser base.

Subclause 7.4.3 of IEC 62271 1:2017 is not applicable to ungrounded reclosers.

Products without a ground connection
Sections impacted and proposed wording

7.101.8 Test duties

Add following notes to figures 2a and 2b:

For cutout mounted reclosers, the fuse element or ground sensing circuit ground shall be connected to the pole mounting point of the cutout base.

For ungrounded reclosers, the fuse element or ground sensing circuit are not required.

Products without a ground connection
Sections impacted and proposed wording

7.103.2 Interrupting performance

Add one more condition:

f) For cutout mounted reclosers, the pole mounting point of the cutout base shall be connected to earth.

Products without a ground connection

Sections impacted and proposed wording

7.111.2 and Annex B2 – Simulated Surge Arrester Operation Test

There is value in doing the test as some conditions stress the insulation of the recloser, the current sensing circuit, and the sensitivity of the electronics as a whole. The SSAO test will need to be adapted to ungrounded reclosers. A new circuit diagram will be required.