MATERIAIS PARA REDES – APARELHAGEM AT E MT

Órgão de Corte de Rede Tipo 3 (OCR3)

Características e ensaios

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DIT – Direção Inovação e Desenvolvimento Tecnológico
R. Camilo Castelo Branco, 43 • 1050-044 Lisboa • Tel.: 218100100
E-mail: tec@e-redes.pt

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1 INTRODUCTION

This document specifies a recloser according to the IEC 62271-111 standard and a control cabinet to be used in overhead Medium Voltage (MV) networks of the Portuguese DSO: E-REDES. The device shall be remotely controlled via the GSM network, using IEC 60870-5-104 as communication protocol, applying in particular the Light protocol implementation document (IEC 60870-5-104) identified as DEF-C98-422.

The recloser will also operate as a sectionalizer, with an automation function, as described later in this document.

In this document, the recloser device is named as OCR3.

1.1 Relevant changes in the present edition 2 of the technical specification.

The most relevant changes are the following:

- CIM module will be a Router supplied by E-REDES;
- Recloser power line terminals must be now part of the OCR3 supply;
- Sectionalizer functionality was updated and is now mandatory;
- Fault location functionality is now mandatory;
- Ethernet connection between the RTU and the CIM is now mandatory;
- Synchrocheck functionality and Oscillography is now mandatory and were clarified;
- Cable protection against vandalism was increased;
- Battery requirements were updated;
- Cabinet door lock was updated;
- SF6 is now forbidden;
- Additional safety and environmental legislation included.

2 STANDARDS, MODULARITY, QUALITY AND TESTING

2.1 General

Requirement	Description
R001	**Standards complied** All reclosers covered by this specification shall be manufactured and tested in accordance with IEC 62271-111 or IEEE C37.60.

The recloser and controls shall be designed according to internationally recognized engineering practices, providing safety and reliability for operators and maintenance staff.

2.2 Modularity

Requirement	Description
R002	**Modularity** The design of the recloser and control cabinet shall consist of modular construction to provide maximum flexibility.

A standard package configuration shall include the recloser, a Recloser Interface Module (RIM), a Control Cabinet (CC), a Remote Terminal Unit (RTU), a Power Supply Module (PSM), a Communication Interface Module (CIM) a Protection Module (PM) as well as a Front Operating Module (FOM) shall be provided. The overall package is referred to as “OCR3”.

The various mounting provisions for the recloser and control cabinet shall be included in the supply, taking in account the pole characteristics in the E-REDES network.

The hardware inside the control cabinet can be either individual modules or a combination of multifunctional modules, which combines the functionality of more than one module.

If modules are combined, it means that the requirements of the individual portion will apply to the combined module as well.

2.3 Quality

Requirement	Description
R003	**Quality** The manufacturer shall be independently certified to meet ISO 9001 Standards.

2.4 Environmental conditions

The operating temperature range for the OCR 3 shall be -20 °C to +40 °C with a relative humidity of 5 % to 95 % (non-condensing).

The OCR 3 shall work as per specification for an altitude up to 1000 m above sea level.

Precipitation and condensation must be considered and a level of solar radiation not below the 1000 W/m^2.

2.5 Service conditions

The medium voltage supply used are 10kV, 15kV and 30kV and the accepted variations are in accordance with the standard EN 50160.

2.6 Testing

Each module shall be tested according to the requirements shown in the relevant chapter of this specification. The manufacturer shall demonstrate compliance with the specification requirements by presenting test reports elaborated by accredited laboratories, or others accepted by E-REDES.

Nevertheless, there are a number of type tests related to environmental performance that **must be carried out on the complete OCR3**, i.e. with all modules assembled together. These will be carried out according to the standards given in Table 1:

Table 1

International standards

Reference	Edition	Title
IEC 60068-2-1	2007	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2	2007	Environmental testing - Part 2: Tests. Tests B: Dry heat
IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12h + 12h cycle)"

3 MODULE SPECIFICATION

3.1 Recloser

3.1.1 Type

This section describes the requirements for a three-phase automatic circuit recloser, which is to be used in the overhead medium voltage network of E-REDES.

Requirement	Description
R004	**Recloser – Maintenance** The recloser shall be maintenance free.

3.1.2 International Standards

The recloser covered by this specification shall be manufactured and tested in accordance with all relevant IEC 62271-111, IEEE and IEC and EN Standards as shown in Table 2.

Table 2

International standards

Reference	Edition	Title
IEC 62271-111 IEEE C37.60	2019 2012	High voltage switchgear and control gear - Part 111: Overhead, pad-mounted, dry vault, and submersible automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV
IEC 61000-4	-	Electromagnetic Compatibility - Testing and Measurement Techniques
IEC 60529	2013	Degrees of protection provided by enclosures (IP Code)
EN 50102	1996	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK Code)
IEC 62262	2002	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC 60815-1	2008	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 1: Definitions, information and general principles
IEC 60068-2-5	2018	Environmental testing - Part 2-5: Tests - Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering
IEC 61869-1	2007	Instrument transformers - Part 1: General requirements

3.1.3 Electrical Ratings

The recloser specified in this document shall – with reference to the intended voltage level - comply with the electrical ratings shown in Table 3.

Table 3
Electrical ratings

	Type	OCR3		
	Category	"Recloser" according to IEC 62271-111		
R005	Number of Phases	3		
R006	Rated frequency, Hz	50	50	50
R007	Maximum Design Voltage, kV	12	17.5	36
R008	Nominal Operating Voltage, kV	10	15	30
R009	Basic Insulation Level (BIL), kV	75	95	150
-	50 Hz Withstand Voltage, kV			
R010	Dry, One Minute	28	38	70
R011	Wet, Ten Seconds	23	32	60
R012	Continuous Current Rating, A RMS	630	630	630
R013	Interrupting Rating, Symmetric, A	12.500	12.500	12.500
R014	Maximum short circuit duration, s	3	3	3

3.1.4 Current Sensing

Requirement	Description
R015	**Recloser – Current sensing** The recloser shall be equipped with 3 current sensors, suitable for operation in a medium voltage distribution network and considering the ratings show in Table 3

The current sensor shall be housed within the encapsulation of the recloser. The current sensors shall be according to IEC 61869-1 and other applicable relevant standards.

The manufacturer shall clearly indicate the measurement range of its current sensors and demonstrate their precision according to the relevant IEC standards.

The accuracy of the current measurements shall be high enough to respect the complete measurement chain accuracy indicated in 3.5.3 .

In case CTs are used, the system must be designed in a way that disconnecting the cable in any end, shall automatically lead to the short circuit of CT's secondary side.

3.1.5 Voltage Sensing

Requirement	Description
R016	**Recloser – Voltage Sensing** The recloser shall be equipped with 6 sensors, 3 on each side of the equipment. The voltage sensor shall be housed within the encapsulation of the recloser. The voltage sensors shall be according to IEC 61869-1 and other applicable relevant standards.

The sensors voltage detection functionalities for the 3 phases on both sides, must have a user programmable threshold. This threshold shall vary, at least, between 95 % and 20 % of the nominal line voltage. The maximum step for user configuration of the voltage detection threshold shall be 5 %.

The manufacturer shall clearly indicate the measurement range of its voltage sensors and demonstrate they are according to the relevant IEC standards, namely during the FAT (Factory Acceptance Tests).

The accuracy of the voltage measurements shall be high enough to respect the complete measurement chain accuracy indicated in 3.5.3 .

3.1.6 Mechanical Requirements

Requirement	Description
R017	**Recloser – Operations** The recloser shall be designed for 10.000 complete open/close operations.
R018	**Recloser – Poles** All three poles of the recloser will be operated simultaneously.
R019	**Recloser – Polymer insulation** The recloser shall use solid polymer insulation and provide complete encapsulation of the internal vacuum interrupters. The insulation shall be highly resistant to ozone, oxygen, moisture, contamination, ultraviolet light and voltage tracking. No coatings are acceptable. SF6 are forbidden.
R020	**Recloser – Current interruption** Current interruption shall occur in vacuum interrupters.
R021	**Recloser – Break** A single break on each phase is accomplished by separating contacts inside the vacuum interrupter.
R022	**Recloser – Interruption mechanism** The interruption mechanism shall be operated by a magnetic actuator, providing linear trip-and-close motion to three encapsulated vacuum interrupter modules.
R023	**Recloser – Mounting support** Mounting support brackets shall be provided for pole mounting.

	The mounting provisions for all mounting types and all available pole types including the support for the six surge arresters (3 on each side) and Supply VT shall be part of the delivery.
R024	**Recloser – Power line** The recloser power line terminals should be supplied and suitable for directly connection of aluminum or cooper cables leads without any other fitting and without need of any maintenance during the recloser lifetime. The cable leads are not part of the supply.

3.1.7 Functional requirements

Requirement	Description
R025	**Recloser – Trip free** The recloser shall be mechanically and electrically trip free.
R026	**Recloser – Close Signal** Any applied close signal, shall not inhibit the recloser from tripping on the programmed time-current curve.
R027	**Recloser – Operating times** The mechanism shall perform consistently, regarding opening and closing times, for 20 m control cables. Nevertheless, when specifically requested, it may be longer and the mechanism shall perform similarly.
R028	**Recloser – Operating handle** The mechanism shall include an operating handle to manually trip by means of a hot stick. Lockout is ensured either mechanically or electrically via operation on the FOM.
R029	**Recloser – Lockout** Lockout means that no closing will be possible, either locally or remotely.
R030	**Recloser – Indicator Position** A contact position indicator shall be mounted on the bottom of the recloser for access viewing from the ground.
R031	**Recloser – Ground** The recloser shall have a ground connector mounted to the recloser housing.
R032	**Recloser – Clearing time** The recloser clearing time, as defined per IEC 62271-111, shall be less than 100 ms (with relay “protection operating time” set to 0 ms/instantaneous) in any operational situation (under load or short-circuits), under all specified environmental conditions. The closing time shall be less than 100 ms, as defined per IEC 62271-111 in any operational situation and under all environmental conditions. The supplier shall demonstrate the required performance via test reports.

R033	**Recloser – Magnetic Actuator** The magnetic actuator shall be powered by either batteries or capacitors.

3.1.8 Nameplate

Requirement	Description
R034	**Recloser – Nameplate** Each recloser shall possess a metal name/type label placed in a visible position. The nameplate must be suitable for outdoor application. It should contain the information according to IEC 62271-111. The nameplate should be written in Portuguese.

3.1.9 Environmental Requirements

The requirements described in section 2.4 apply.

Requirement	Description
R035	**Recloser – Temperature Conditions** The operating temperature range for the OCR 3 shall be -20 °C to +40 °C with a relative humidity of 5 % to 95 % (non-condensing).
R036	**Recloser – Altitude** The OCR 3 shall work as per specification for an altitude up to 1000 m above sea level.
R037	**Recloser – Pollution** The recloser must be able to be installed in air atmospheres considered polluted with a degree of pollution of level Heavy, in accordance with IEC 60815-1 Standard.
R038	**Recloser – Weather conditions** Precipitation and condensation must be considered and a level of solar radiation not below the 1000 W/m2.

3.1.10 Tests

3.1.10.1 Generalities

Requirement	Description
R039	**Recloser – Tests General** The conformity of the characteristics of the recloser with the present specification must be confirmed through the execution of tests, performed in accredited laboratories or others with the previous agreement of E-REDES.

3.1.10.2 Type tests

Requirement	Description
R040	**Recloser – Type tests** The type tests must be executed on a representative recloser prior to delivery, with the aim to show that all reclosers will comply with the specified requirements. A recloser is considered as representative when it will have the same nominal voltage, the same nominal current, the same type, the same dielectric and the same production system. The type tests must be executed according to IEC 62271-111 Chapter 6. Moreover, the radiation performance of the recloser module shall be verified according to IEC 60068-2-5.

3.1.10.3 Routine tests

Requirement	Description
R041	**Recloser – Routine tests** The manufacturer has to make sure that all reclosers delivered are tested and inspected before being shipped. The tests have to be conducted and documented on each individual recloser. The factory tests on the recloser must at least include all tests as per IEC 62271-111, Chapter 7. In case there are any controls in the recloser, the respective standard tests from the RTU section have to be applied as well.

3.2 Recloser Interface Module (RIM)

3.2.1 Functional Requirements

Requirement	Description
R042	**Recloser – Connectors** The recloser shall be connected to the control cabinet using separable weatherproof connectors at the recloser and at the control cabinet.
R043	**Recloser – Control Cables** The RIM control cable's standard length shall be 20 m. Nevertheless, when specifically requested, it may be longer. The RIM shall have a suitable size and number of cores for the connection of the Control Cabinet.
R044	**Recloser – Wires** The wires transmitting the currents and voltages from current and voltage sensors, shall be suitably protected against external electric and magnetic fields. The wires are either embedded in the RIM or connected to the CC as a separate cable.
R045	**Recloser – Disconnecting** Disconnecting the RIM shall not lead to tripping of the recloser.

3.2.2 Construction

Requirement	Description
R046	**Recloser – Construction** The RIM shall have adequate mechanical and UV protection. The Antenna and VT cables shall have adequate mechanical and UV protection.

3.2.3 Technical requirements

Requirement	Description
R047	**Recloser – Voltage Rating** The voltage rating shall be 0.6/1 kV.
R048	**Recloser – Conductor type** The conductors shall be circular, shaped or compacted.
R049	**Recloser – Conductor temperature** The maximum continuous conductor temperature shall be 90 °C.

3.3 Control Cabinet (CC)

3.3.1 International Standards

The CC covered by this specification shall be manufactured and tested in accordance with all relevant Standards as shown in Table 4. Additionally, it shall be designed to internationally recognized engineering practices, providing safety and reliability for operators and maintenance staff. A special consideration must be given to batteries and capacitors to ensure safe operation and maintenance under all circumstances including failures and malfunctions.

Table 4

International standards

Reference	Edition	Title
IEC 60529	2013	Degrees of protection provided by enclosures (IP Code)
EN 1303	2015	Building hardware - Cylinders for locks - Requirements and test methods
IEC 61000-6-2	2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
IEC 61000-6-4	2018	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

3.3.2 General

Requirement	Description
R050	**Control Cabinet – Installation** The controls for the recloser shall be contained in a weatherproof control cabinet (CC). The cabinet shall be suitable for outdoor installation on the pole, at approximately 1,5 m above ground level, easy to reach for an operator.
R051	**Control Cabinet – Components** The CC will house the PSM, RTU, FOM, CIM and the PM.
R052	**Control Cabinet – Protection** It shall be designed to protect unqualified person from opening the CC or operating the recloser.
R053	**Control Cabinet – RIM protection** The CC shall have a weatherproof connector for the RIM and for eventual external power sources on the bottom of the CC to prevent water and dust to enter.
R054	**Control Cabinet – Material** The CC shall be made of stainless steel or aluminum.
R055	**Control Cabinet – Lock** The CC shall have a lock for the cabinet door. The lock must close in two points (minimum) and must allow a key European type of half cylinder with a total length of 40,5 mm, according to EN 1303, which will be supplied by E-REDES. The cam shall be positioned at 3 o'clock. An alternative lock for the use of 5mm arc padlocks (supplied by E-REDES) could be proposed for approval by E-REDES, in order to evaluate the robustness of the solution and E-REDES pad-lock compatibility.
R056	**Control Cabinet – Counter** The CC shall have a 4-digit operating counter for the connected recloser.
R057	**Control Cabinet – AC socket** The CC shall provide an AC socket with suitable voltage and power to feed a standard laptop PC and a field test device. The maximum output power should be at least 200 W. The output shall be overload protected in order to protect the voltage supply transformer from the overload.
R058	**Control Cabinet – Light** The CC shall have internal light.
R059	**Control Cabinet – Circuit Diagram** The CC shall have the circuit diagram attached inside the cabinet.
R060	**Control Cabinet – Lifting** The CC shall provide lifting facilities.

R061	**Control Cabinet – Water Protection** All control, VT and antenna cables shall be connected with weatherproof fittings to prevent water from entering.
R062	**Control Cabinet – Terminal Blocks** The CC shall contain all Input/Output terminal blocks for interfacing the various modules inside the CC.
R063	**Control Cabinet – Condensation** The CC shall have means to prevent condensation, considering the specified environmental conditions.
R064	**Control Cabinet – Moving parts** No moving parts (e.g. fans, hard discs, etc.) are accepted in the CC and in all its components.
R065	**Control Cabinet – Vandalism Protection** The CC and all control, VT and antenna cables and fittings shall be sufficiently protected against vandalism. **Note**: If we can open or remove the vandalism protection from outside of the CC we shall use a special tool, this tool should be approved by E-REDES.
R066	**Control Cabinet – Design security** The CC shall be designed in a modular way, with no cables spreaded and no exposed dangerous components like capacitors, always giving a high level of safety to the maintenance and commission operators.

3.3.3 Environmental Requirements

The requirements described in section 2.4 apply.

Requirement	Description
R067	**Control Cabinet – IP** The CC shall have a protection level at least equivalent IP 54.
R068	**Control Cabinet – Temperature Conditions** The operating temperature range for the OCR 3 shall be -20 °C to +40 °C with a relative humidity of 5 % to 95 % (non-condensing).

3.3.4 Other technical requirements

3.3.4.1 Transport, storage, installation, operation and maintenance

Requirement	Description
R069	**Control Cabinet – Manual** The manufacturer shall supply the necessary instructions for the transport, storage, installation, operation and maintenance.

3.3.4.2 Nameplate

Requirement	Description
R070	**Control Cabinet – Nameplate** Each CC shall possess a name/type label of waterproof material, placed in a visible position. The nameplate must contain at least the following items: **Items in the nameplate** / **Portuguese items** Type of the CC / Tipo de CC Manufacturer's name / Fabricante Manufacturer's serial number / Número de Série Year of production / Ano de Fabrico Total mass (with all components included) / Peso total (todos os componentes incluídos) The nameplate shall be written in Portuguese.

3.3.5 Type tests

Requirement	Description
R071	**Control Cabinet – Type Tests** The CC shall be type tested and certified according to the emission and immunity levels described in IEC 61000-6-2 and IEC 61000-6-4, including all the equipment installed. The Ingress protection (IP) rating of the CC shall be tested and certified, according to IEC 60529 standard.

3.3.6 Routine tests

Requirement	Description
R072	**Control Cabinet – Routine Tests** The manufacturer of the CC has to make sure that all CC delivered are tested and inspected before being shipped. The tests have to conducted and documented on each individual CC. The factory test shall at least include these functions: — CC inspected for damage; — CC inspected for proper assembly; — work light checked for proper function; — cables and conduit are routed properly; — control cabinet door functions properly; — warning labels are present, current and readable; — data sheet is attached to the inside of the control cabinet door; — operator's manual and documentation is present; — control cabinet keys are present and functioning properly; — power off/on test is acceptable. All modules inside the CC have to be tested for functionality and interoperability. A full test plan has to be provided with the submission of the tender.

3.4 Power Supply Module (PSM)

3.4.1 General Requirements

The Power Supply Module (PSM) is supplying the devices in the control cabinet (CC) and the recloser with electrical energy.

3.4.2 Functional Requirements

Requirement	Description
R073	**Power Supply Module – Input Voltage** The nominal input voltage range shall be between 100 and 240 VAC at 50 Hz and a tolerance of ±10%.
R074	**Power Supply Module – Circuit Protection** The incoming power shall be protected and isolated by a circuit breaker.
R075	**Power Supply Module – Battery Protection** The supply from the battery shall be protected and isolated by a circuit breaker or a fuse.
R076	**Power Supply Module - Signalization** The state of all circuit breakers shall be individually indicated as a signal to the RTU. It shall be possible to transmit this information to the control center. Alternatively, it is acceptable to transmit to the control center the loss of AC supply and loss of battery.

R077	**Power Supply Module – Voltage Transformer** A single phase voltage transformer for the power supply from the overhead line shall be included. The supplier must declare the characteristics of the VT and must test it according to the relevant IEC standards.
R078	**Power Supply Module – Battery Supply** A battery shall be provided for backup control operation in the event of loss of primary supply.
R079	**Power Supply Module – Battery Type** Manufacture shall supply the backup battery specification, catalogs and tests. The battery technology solution to be proposed shall be according to E-REDES specification DFT-C98-411. Note: Other solutions could be proposed for E-REDES evaluation and approval.
R080	**Power Supply Module – Battery Test** The PSM shall provide the functionality of automatic and periodic battery testing with a state signalization to the RTU.
R081	**Power Supply Module – Battery lifespan** The PSM shall be able to detect a deteriorating state of a battery close to the end of its lifespan and shall signal it to the RTU.
R082	**Power Supply Module – Battery operation** The battery shall be capable of operating the recloser, the control, protection and communication for a minimum of 24 hours with no external supply connected and the cabinet door closed. During the 24 hours it shall be possible to have 6 open and closing actions (see section 3.4.4).
R083	**Power Supply Module – Discharged** If the primary supply has not been restored within the allowable discharge time of the battery, based not only on the 24 hours but also on the battery capacity detection, the control shall automatically shut down.
R084	**Power Supply Module – Auxiliary power supply** The supplier shall indicate where to connect an auxiliary power supply in the case of a complete loss of energy.

3.4.2.1 Nameplate

<table>
<tr><th>Requirement</th><th>Description</th></tr>
<tr><td>R085</td><td>
Power Supply Module – Nameplate

Each PSM shall possess a name/type label of waterproof material, placed in a visible position. The nameplate must contain at least the following items:
<table>
<tr><th>Items in the nameplate</th><th>Portuguese items</th></tr>
<tr><td>Input Voltage and Frequency</td><td>Tensão e Frequência de entrada</td></tr>
<tr><td>Output Voltage and Frequency</td><td>Tensão e Frequência de saída</td></tr>
<tr><td>Input power</td><td>Potência de Entrada</td></tr>
<tr><td>Output power</td><td>Potência de Saída</td></tr>
</table>
The nameplate shall be written in Portuguese.
</td></tr>
</table>

3.4.3 Environmental Requirements

The requirements described in section 2.4 apply.

Requirement	Description
R086	**Power Supply Module – Environmental Requirements** The operating temperature range for the OCR 3 shall be -20 °C to +40 °C with a relative humidity of 5 % to 95 % (non-condensing).

3.4.4 Type tests

Requirement	Description
R087	**Power Supply Module – Type Tests** The manufacturer shall present a certificate of a type test made according to an international standard to guarantee the 4-year lifetime of its batteries. A special test for the battery concerning the ability to perform 6 open and closing actions during 24 hours shall be carried out in the following manner: — 4 opening and closing actions to be made at any time during the 24 hours according to manufacturer's proposal; — 2 opening and closing action to be made in the last 15 minutes before the end of the end of the 24 hours period.

3.5 Remote Terminal Unit (RTU)

3.5.1 International Standards

The RTU covered by this specification shall be manufactured and tested in accordance with all relevant IEC and E-REDES Standards as shown in Table 5.

Table 5

International and E-REDES standards

Reference	Edition	Title
IEC 62271-111	2019	Overhead, Pad-Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems Up to 38 kV
IEC 60870-2-1	1995	Telecontrol equipment and systems - Part 2: Operating conditions - Section 1: Power supply and electromagnetic compatibility
IEC 60870-2-2	1996	Telecontrol equipment and systems - Part 2: Operating conditions - Section 2: Environmental conditions (climatic, mechanical and other non-electrical influences)
IEC 60870-5-104	2006	Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles
DEF-C98-422	–	Instalações de Telecomunicações – Light Protocol Implementation Document (IEC60870-5-104)
DMA-C98-104	–	AUTOMAÇÃO, PROTEÇÃO, COMANDO, CONTROLO E COMUNICAÇÕES - Router para implementação de Arquitetura Integrada de Comunicações ao nível do Posto de Transformação MT/BT”
DFT-C98-411	–	Baterias para Equipamento de Automação e Telecomando de Rede MT

3.5.2 General

Requirement	Description
R088	**Remote Terminal Unit - Features** The Remote Terminal Unit (RTU) shall be encased in control cabinet. The RTU shall be designed to protect unqualified person from operating. The RTU shall allow remote access. The RTU shall provide a self-test and diagnosis function. The RTU shall provide a watchdog function. In case of failure of any OCR 3 module, this should be signaled to the control center.

3.5.3 Inputs and outputs

Requirement	Description
R089	**Remote Terminal Unit – Number of measurements** The RTU shall have enough inputs to allow the following measurements:

	— 6 voltage measurements (one per each phase on each side of the device); — 3 current measurements (one per each phase); — Battery capacity measurement. The complete measurement chain (analogue measurement plus analogue-digital conversion) shall have accuracy not worse than ±5 %.
R090	**Remote Terminal Unit – Measurements** Additionally, to voltage magnitude in each phase and currents in each phase, it shall be able to measure kW, kvar, kWh and kvarh. Alternatively, it is accepted to be able to measure kW, kWh and PF. The digital status inputs shall be provided with optical insulation. The digital inputs and outputs shall be enough to control and monitor the following functionalities: — Control (open/close) and monitor the status of the switch; — Control (activate/deactivate) protection functions and monitor the tripping of phase and ground over-current functions; — Control and monitor the operation mode of the OCR3 (recloser/sectionalizer); — Control (activate/deactivate) auto reclosing and monitor the initiation of reclosing cycles; — Control (activate/deactivate) ABR (Automatic Backfeed Restoration) mode.

3.5.4 Communication

Requirement	Description
R091	**Remote Terminal Unit – Communication protocol** It shall support a communication protocol according to IEC 60870-5-104 in accordance with the PID called “Protocol Implementation Document (Light Version)” (E-REDES specification DEF-C98-422). The certificate will be valid for a specific model of RTU and firmware version. Changes in the RTU model or firmware version will require a new certificate to be obtained.
R092	**Remote Terminal Unit – Communication type** A communication to the engineering PC shall be possible by means of an electric, optic or wireless interface.
R093	**Remote Terminal Unit - Communication** The communication between the RTU and the network control center (NCC) is done through a Communication Interface Module (CIM) described in DMA-C98-104. **Note**: The consumption of the CIM will have a value of 8 W. The Communication Interface Module would be supplied by E-REDES. The connection between RTU and the CIM must be ethernet RJ45 10/100BASE-T. To feed the CIM, the RTU must have 48 V (or a future defined range) power supply and space enough to install a router with 230x160x100mm maximum dimensions, to be attached with DIN rail.

3.5.5 Events and Time Tagging

Requirement	Description
R094	**Remote Terminal Unit – Event Detection** The RTU shall have event detection with a time resolution of 10 ms.
R095	**Remote Terminal Unit – Clock** The RTU shall have an internal clock for time stamping in case there is no external timing, for example from the network control center (NCC). The internal clock shall have a maximum deviation of 200 ms/h when not synchronized.
R096	**Remote Terminal Unit – Event Buffer** The RTU shall have an event buffer to store events. The event buffer shall have a capacity of at least 100 events. An event can consist of: — Protection functions pickup and trip; — Alarms associated to malfunctions in the CC (fuses or circuit breaker tripping, malfunctions in the modules); — Other alarms (open door, user configurable alarms). The buffer shall keep the most recent events and delete the oldest ones, in a “first in – first out” manner.

3.5.6 Engineering

Requirement	Description
R097	**Remote Terminal Unit – Data files** The configuration of the RTU shall also be carried out from a remote PC via Internet links or the customer's Intranet or by a download via the NCC by IEC 60870-5-104 file transfer protocol. Upload of the data files shall be possible for reverse data engineering.

3.5.7 Power Supply

Requirement	Description
R098	**Remote Terminal Unit – Power Supply** The RTU shall be fed by the battery backed PSM in the CC.

3.5.8 Front Operating Module (FOM)

Requirement	Description
R099	**Remote Terminal Unit – Front Operating Module** The RTU shall be equipped with a FOM to allow operators to locally control the switch.

	It shall be protected from any unauthorized operation. Additionally, it shall provide the operator with at least the following information: — selector switch for LOCAL / REMOTE; — indicator for LOCAL / REMOTE; — push buttons for OPEN and CLOSE; — switch position indication; — selector switch for protection profile; — indicator for protection pickup and trip; — nameplate.

3.5.9 Environmental Requirements

The requirements described in section 2.4 apply.

Requirement	Description
R100	**Remote Terminal Unit – Environmental Requirements** The operating temperature range for the OCR 3 shall be -20 °C to +40 °C with a relative humidity of 5 % to 95 % (non-condensing).

3.5.10 Type Tests

Requirement	Description
R101	**Remote Terminal Unit – Type Tests** The type test must be executed on a representative RTU prior to delivery, with the aim to show that all RTU's comply with the specified requirements. The RTU shall be type tested and certified according to IEC 62271-111 regarding surge withstand and dielectric testing. It shall also by type tested and certified according with IEC 60870-2-1 (or the relevant series of IEC 61000) regarding EMC performance.

3.6 Protection Module (PM)

3.6.1 International Standards

The PM covered by this specification shall be manufactured and tested in accordance with all relevant Standards as shown in Table 7.

Table 6

International standards

Reference	Edition	Title
IEC 62271-111	2019	High voltage switchgear and control gear - Part 111: Overhead, pad-mounted, dry vault, and submersible automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV
IEEE C37.90	2005	Standard for Relays and Relay Systems Associated with Electric Power Apparatus

IEC 60255 series	-	Electrical Relays
IEC 61000-6-2	2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
IEC 61000-6-4	2018	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

3.6.2 General Requirements

Requirement	Description
R102	**Protection Module – Assembly** The protection module (PM) shall be mounted in the CC for continuously supervising voltages and currents of the line. It is preferable that the protection analogue inputs of the protection device are connected to the sensors of the recloser.
R103	**Protection Module – Self Test** The PM shall provide a self-test and diagnosis function. **Note**: Applicable when PM is independent of the RTU.
R104	**Protection Module – Watchdog** The PM shall provide a watchdog function. **Note**: Applicable when PM is independent of the RTU.
R105	**Protection Module – Signalization** In case of a PM failure this shall be signaled to the control center. **Note**: Applicable when PM is independent of the RTU.
R106	**Protection Module – Protection parameters** It shall be possible to set, change and update the protection parameters (time and current thresholds and curves) locally via a laptop or remotely from the control center.

3.6.3 Functional Requirements

Requirement	Description
R107	**Protection Module – Selectivity** The protection device shall have a Time-Overcurrent and an inverse time characteristic both for phase and ground faults. Four protection profiles shall be provided, each capable of fully specifying the operation of the control in overcurrent protection. Within each protection profile there shall be two configurations for positive and negative power flows.
R108	**Protection Module – Configuration access** The profiles shall be selectable both locally and remotely.
R109	**Protection Module – Profiles** The profiles shall be selectable both locally and remotely. It should also be possible to shift between two power flow configurations automatically if predetermined conditions are sensed (e. g. inversion in power flow).
R110	**Protection Module – TCC Overcurrents** Each profile shall allow 8 independent Time-Current Curve (TCC) specifications: — Four Phase Overcurrents; — Four Ground Overcurrents.
R111	**Protection Module – TCC Data bases** The selected TCC shall be chosen from a library and shall be user selectable from a database of time-current curves to permit implementation of any standard or modified curve.
R112	**Protection Module – TCC Relays** At least the following time-current curves (conforming to the IEC 60255) can be selected: — definite time; — Standard Inverse (SI); — Very Inverse (VI); — Extremely Inverse (EI).
R113	**Protection Module – TCC Editor** Time-current curves shall also be available through a TCC editor to allow users to design their own curves.
R114	**Protection Module – Directionality** It shall be possible to have directionality added to the overcurrent protection functions both for phase-phase and phase-ground faults, in order to detect power flow inversion and shift between power flow configurations automatically.

Requirement	Description
R115	**Protection Module – Inrush restraint** The control shall include an Inrush Restraint feature designed to prevent inadvertent actions of protection functions related to peak currents after charging the feeder (preferably this functionality should take in account harmonic content of the line current, in particular 2nd harmonic, whose presence will block protection functions).
R116	**Protection Module – Fault Location** In order to allow the location of a fault on the feeder, the information on fault's resistance and reactance shall be available locally and remotely to the control center, both for phase-phase and phase-ground faults. The geographical location of the fault will be performed by the SCADA, based in these measurements. The fault resistance and reactance shall be sent to SCADA immediately after the trip of the protection function. The information to be sent to SCADA is the following: Phase-phase faults — Ra-b + Xa-b — Ra-c + Xa-c — Rb-c + Xb-c Phase-ground faults — Ra-g + Xa-g — Rb-g + Xb-g — Rc-g + Xc-g Where a, b and c represent each of the three phases and g represents ground. The SCADA system is prepared to receive two measurements, R and X. For instance, if we have a phase-ground fault with phase a, the protection will send R and X relatively to this fault. If we have a phase-phase fault with phase a and phase b, the protection will send R and X relatively to this fault.
R117	**Protection Module – Reclose retry** A Reclose Retry feature shall be included. This feature issues multiple reclose attempts in the event closing power is lost. A reclose signal shall be issued at programmable intervals for a programmable number of attempts. This feature shall be independently activated for each protection profile.
R118	**Protection Module – Harmonic** It is preferable to have comprehensive harmonic information for three-phase voltages and currents plus neutral current. The analysis shall include total harmonic distortion in percent of the fundamental frequency plus the percent contribution for each of the second through fifteenth harmonics. Graphing capabilities shall also be included.
R119	**Protection Module – Histogram** It is preferable to have the data provided in a histogram format, which displays statistical information including time tagged Min/Max values. Each record shall have programmable limits and the ability to clear records to start gathering new information. The histogram data shall display the number of occurrences of a metered variable versus the value of the variable.
R120	**Protection Module - Alarm** It is preferable that the PM includes a fully configurable alarm system with the ability to select any possible data and status alarm. Data alarms shall be included to compare metered values and preset limits for a selectable time delay. Status alarms shall operate when user-selected functions change state.

Requirement	Description
	Both alarm types shall also have the ability to initiate an event recorder incident and also initiate a data profile sample. The control shall include a programmable data-profiler feature which enables data collection at user-selectable intervals. The profiler shall have the ability to graph the collected data to display a trend and a cyclic representation of the profile.
R121	**Protection Module – Event Recorder** An Event Recorder shall be provided to record and store events in non-volatile memory. The recorder shall include information on the time and date of the event, event type and data pertinent to the occurrence. The events recorded include the following: — Overcurrent Phase Trip; — Overcurrent Ground Trip; — Successful Reclose; — Overcurrent Lockout; — Non-Reclose Lockout; — High Current Lockout; — Close Retry Lockout; — Local Close (Front Op. Panel); — Local Open and Lockout (Front Op. Panel); — Remote Lockout from Discrete I/O; — Loss of ac Power; — Restoration of ac Power; — EPROM Failure; — Check Battery; — Failed to Close from Close Signal.

3.6.4 Oscillography

Requirement	Description
R122	**Protection Module – Channels** The protection module must have oscillography for all phase currents and voltages with enough memory to allow analysis of overcurrent events. 9 channels - currents and voltages on both sides of the equipment. (3 currents, 3 single voltages on the ABC side and 3 single voltages on the RST side)
R123	**Protection Module – Scope of Oscillography** Oscillography should allow for continuous analysis of the data recorded before, during, and after the occurrence of a given event.
R124	**Protection Module – Number of digital inputs** A minimum number of 40 digital inputs must be guaranteed. **Note**: Other number could be proposed for E-REDES evaluation and approval.
R125	**Protection Module – Number of analog inputs**

	A minimum number of 10 analog inputs must be guaranteed. **Note**: Other number could be proposed for E-REDES evaluation and approval.
R126	**Protection Module – Data Availability** The stored data must be available for local or remote consultation. It must be possible to download remotely the oscillography files.
R127	**Protection Module – Minimum Frequencies** The system must have a minimum frequency response: - 1kHz for analog inputs; - 1kHz for digital inputs. **Note**: the function should preferably allow you to adjust its frequency response, setting frequencies above 1kHz for analog inputs.
R128	**Protection Module – Recording Time** The oscillography recording should be limited by the following recording time intervals: - time period before the fault (between 0.01s and 0.5s, 10ms step); - time period of the fault duration; - time period after the fault (between 0.1s and 2s, 100ms step). - Timeout (up to 2.5s): it will be the time used to limit the total recording time, when we are facing a situation where the trigger reset will not happen. **Note:** The definitions of the oscillography register timings are defined in the General Guide for Protection and Automation of the National Distribution Grid. **Note**: Other times could be proposed for E-REDES evaluation and approval.
R129	**Protection Module – Changing recording times** In IEDs it should be possible, via the IHM or remotely, to change the desired pre-fault and post-fault time periods for oscillography records.
R130	**Protection Module – Recording capacity** The IED must have sufficient storage capacity to hold a minimum of 25 oscillograph records in memory. **Note**: Other number could be proposed for E-REDES evaluation and approval.
R131	**Protection Module – Structure** The oscillograph record must follow the FIFO (Fisrt In, First Out) data structure

3.6.5 Environmental Requirements

The requirements described in section 2.4 apply.

Requirement	Description
R132	**Protection Module – Environmental Requirements** The operating temperature range for the OCR 3 shall be -20 °C to +40 °C with a relative humidity of 5 % to 95 % (non-condensing).

3.6.6 Power Supply

Requirement	Description
R133	**Protection Module – Power Supply** The PM shall be fed by the battery backed PSM in the CC.

3.6.7 Type Tests

Requirement	Description
R134	**Protection Module – Type tests** The type tests must be executed on a representative PM prior to delivery, with the aim to show that all PM will comply with the specified requirements. The PM shall be type tested and certified according to IEC 62271-111, IEEE C37.90, IEC 60255 series and IEC 61000 series.

4 SOFTWARE FUNCTIONAL REQUIREMENTS

4.1 General

The purpose of the equipment specified in this document is the reduction of customer outages by automatically sectionalizing and reclosing of overhead lines. Below is an overview of intended functionality, which has to be implemented in the software of the RTU and the PM.

4.2 Functionality

The OCR3 is intended to be used, either as a recloser or a sectionalizer in the network.

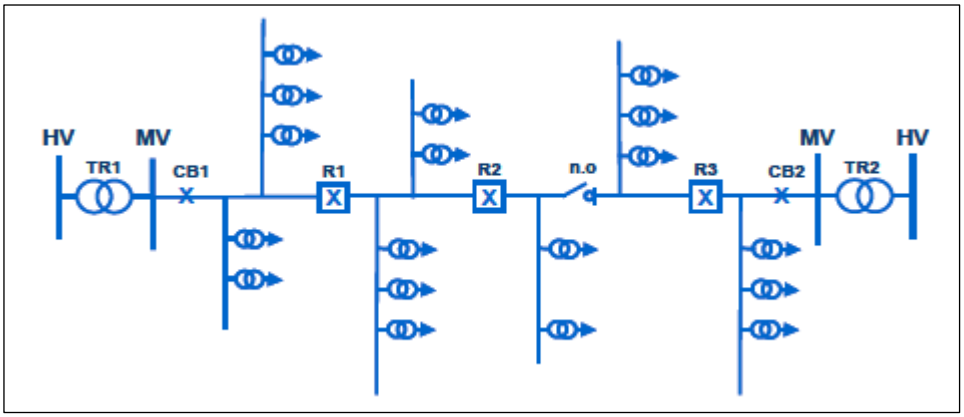

Figure 1 – Application of reclosers in the network

The intended use of the OCR3 shall be configured with a software switch. The position of the software switch can be controlled local or remotely. The operation mode of the OCR3, sectionalizer or recloser shall be indicated in control cabinet and remotely. Figure 1 shows the application of the reclosers (Marked as Rx) in the network.

4.2.1 Recloser mode

Requirement	Description
R135	**Software Functional Requirements** In the recloser mode the OCR3 shall work as a circuit breaker with full protection and reclosing functionality. The recloser will only perform closing operations if the voltage sensed in upstream side is above a threshold between 60 and 95 %Un and the voltage sensed in the downstream side is below a threshold between 0 and 20 %Un. If both sets of voltage sensors measure a non-zero voltage, then the recloser will not perform the closing operation regardless of if the order is automatic (reclosing cycle). The recloser will also not perform automatic closing operations if zero voltage is felt on both sides. Figure 2 shows the flowchart of the intended functionality. (Note: the lack of voltage threshold should be configurable and must allow a minimum setting value of 20 %Un). Recloser shall provide Switch On To Fault (SOTF) functionality, i.e. when an operator switches a recloser on to a fault, the recloser shall be tripped to lockout without performing auto reclosing cycle.

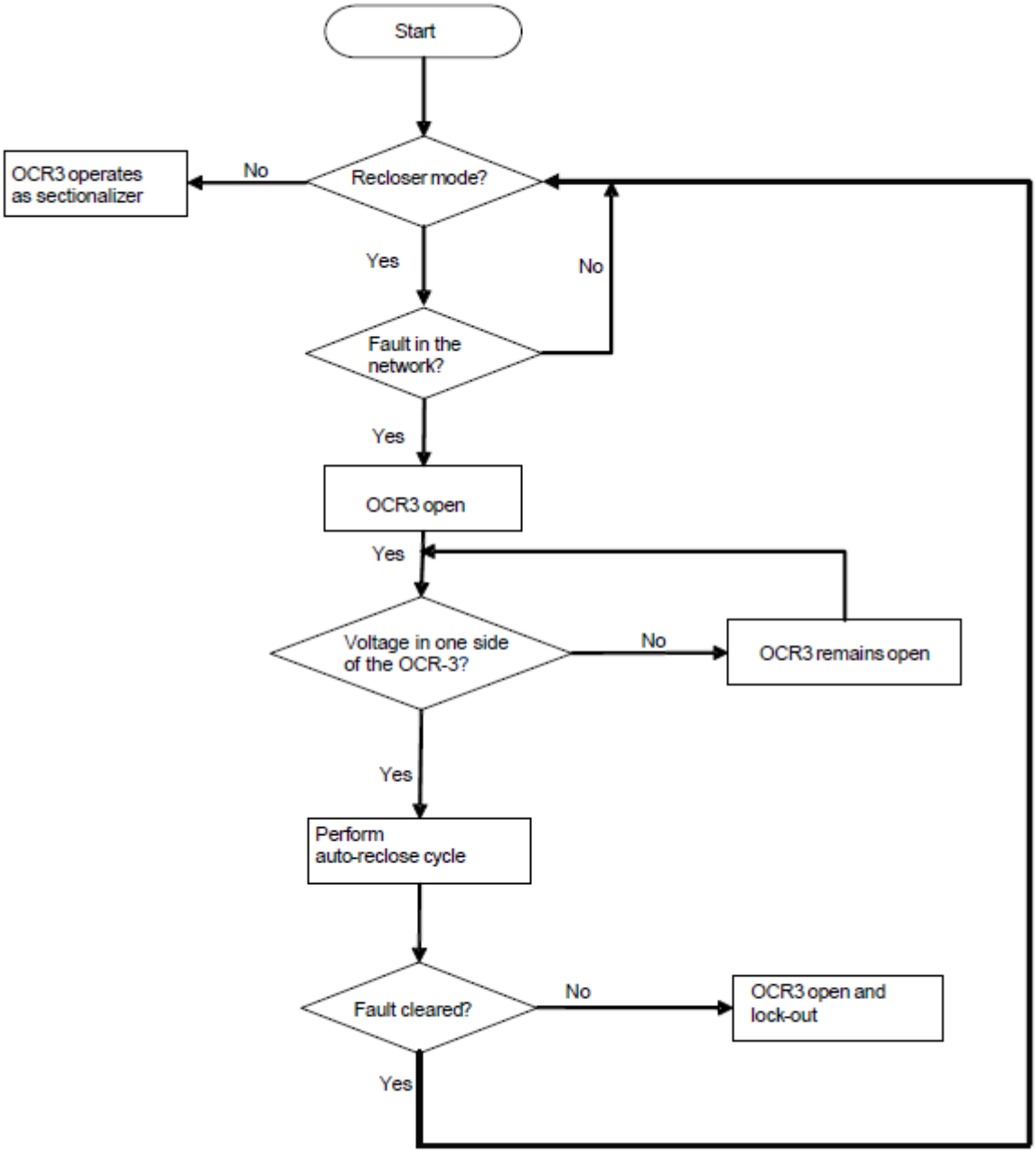

Figure 2 – Flowchart functionality OCR3: Recloser

4.2.2 Sectionalizer mode

Requirement	Description
R136	**Software Functional Requirements** In the sectionalizing mode the OCR3 shall work as a sectionalizer, which means that it has to monitor the line voltage and currents. This mode of operation does not assume there is a substation circuit breaker or recloser upstream configured with one first auto-reclose cycle. During the operation of the automation, the operating conditions referred to in the flowchart as CFE and CAB must be checked with the logic equations (Boolean algebra) defined below: $$CFE = DISJFE.\overline{DISJAB}.\overline{LOC}.SECCON$$ $$CAB = DISJAB.\overline{DISJFE}.\overline{LOC}.SECCON$$ Where: • $DISJFE$ - Circuit breaker indication (OCR3) closed; • $\overline{DISJFE}$ - Circuit breaker indication (OCR3) not closed; • $DISJAB$ - Circuit breaker indication (OCR3) opened; • $\overline{DISJAB}$ - Circuit breaker indication (OCR3) not opened; • $\overline{LOC}$ - OCR3 signaling not in local (Remote); • $SECCON$ - Sectionalizer mode on. The purpose of checking these conditions is to ensure that the automation is restored to its initial state, regardless of where it was operating, when the following situations occur: • The unit by some fault be in an undetermined state, neither open or closed; • The OCR3 is placed on local; • The OCR3 that should be in a certain position (Open or Closed) in some phase of the automation, is no longer. For example, when a manual command is given to the unit, remote or local; • When someone during the sectionalizer automation switches OCR3 to recloser mode. By placing the CFE check at the beginning of the automation (see flowchart) we also ensure that besides the reset to the initial state. The sectionalizer automatism will never work again if: • The unit is not closed (Open or in an undetermined position); • The OCR3 remains in local. After the OCR is opened by the sectionalizer (after the opening time) it is continuously and indefinitely waiting to see voltage again on one side of OCR3, unless the CAB conditions are no longer checked. If after voltage return from one side of OCR3 the voltage drops again during the TFe Count, the count should be restarted and OCR3 should return to the waiting state for voltage return. If the voltage returns on both sides of OCR3 during the Closing Time count, the unit should remain open and interlocked, returning the automation to its initial state. Objective: avoid having an automation that can parallel two substations. Voltage OK (UOK in the flowchart) refers to the presence of a compound voltage value greater than a configurable threshold between 60% and 95% Un (as per DMA OCR3). Voltage not OK (U NOK in the flowchart) refers to a composite voltage value lower than the threshold. These voltage measurements should be made using the 3 single voltage measurements. If after OCR3 Closing in the course of TEnc a F-F or F-T defect is detected the unit should open immediately without waiting for the Opening time. Glossary: • CFE – OCR3 closed conditions • CAB – OCR3 opened conditions • U – Tension in OCR3 • F-F – Phase Phase fault detected • F-T – Phase to ground fault detected • Tab – Opening Time

	• TFe – Closing Time • TEnc – Interlocked time • TBloq – Locking Time

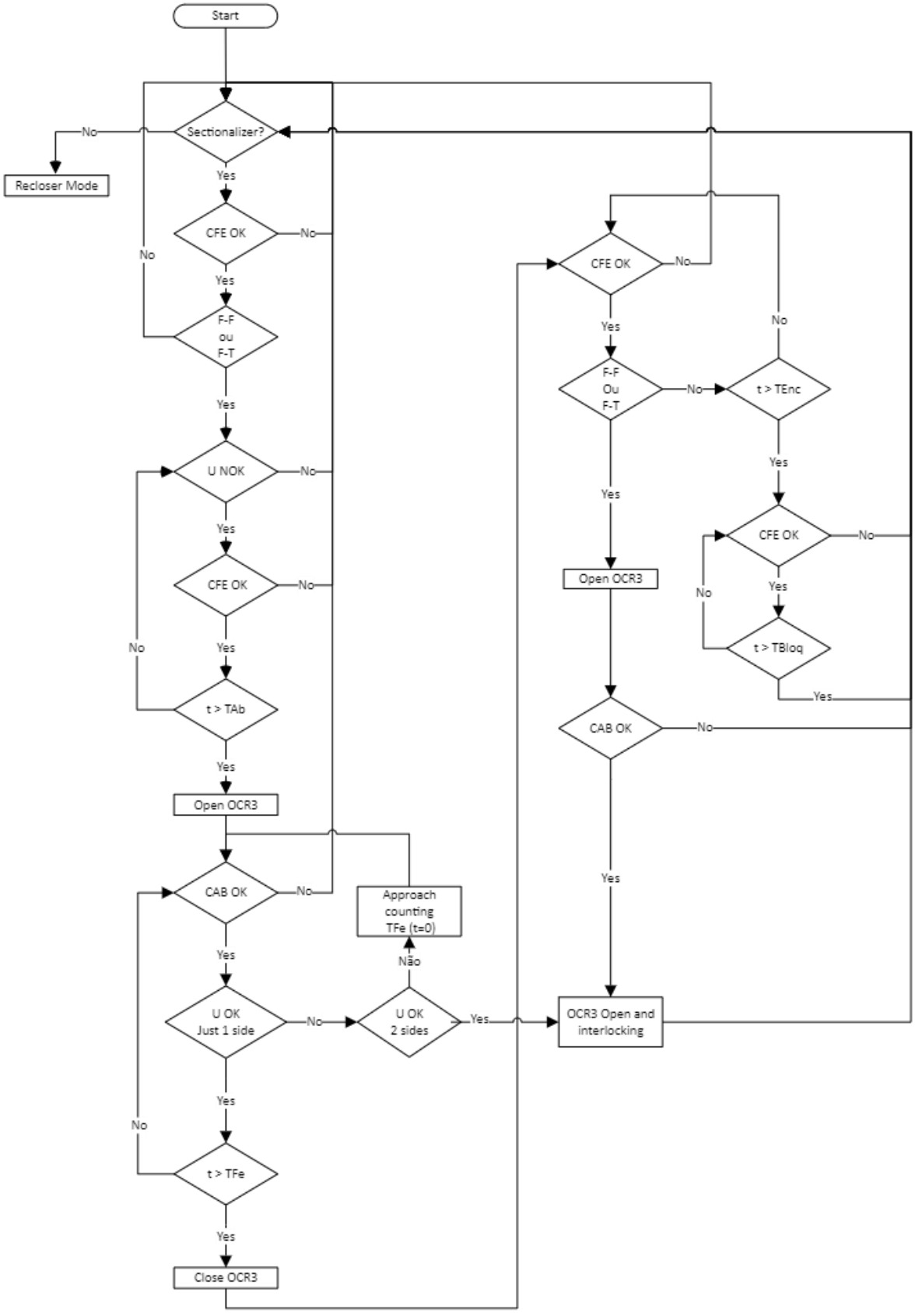

Figure 3 – Flowchart functionality OCR3: Sectionalizer

4.2.3 ABR - Automatic Backfeed Restoration

Requirement	Description
R137	**Software Functional Requirements** The reclosers on normally opened (N.O) points can work in two operating modes: Automatic or Manual. In automatic mode, the reclosers on N.O points will close automatically after detecting loss of voltage from the normal power flow side. In manual mode, the reclosers on N.O points will close after an order is issued from the control center. In either operating modes, the recloser shall provide Switch On To Fault (SOTF) functionality, i.e. when the recloser switches on to a fault, it shall be tripped to lockout without performing auto reclosing cycle.

4.2.4 Power flow direction feature

Requirement	Description
R138	**Software Functional Requirements** The OCR3 devices (regardless of working as reclosers or sectionalizers) on the grid must automatically adapt to the new power flow direction thus adjusting their settings. So, for each device there will be 2 groups of settings: — normal power flow setting group; — reverse power flow setting group. Figure 4 illustrates this notion for the case of time coordinated relays.

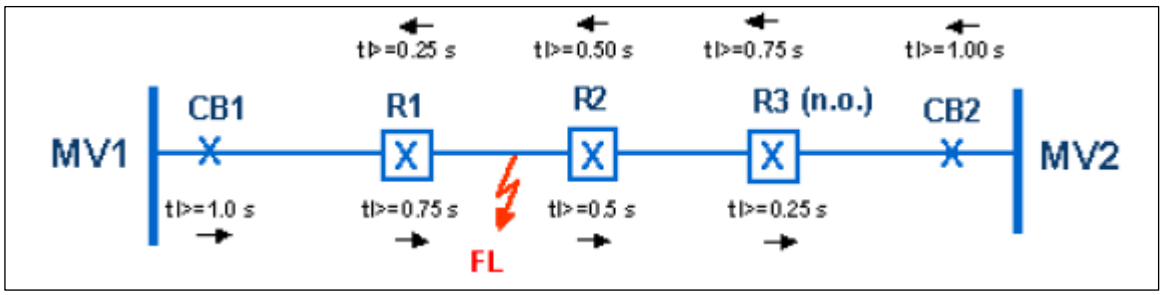

Figure 4 – Time settings of reclosers, for normal and reverse power flow directions

This feature is essential because during the time to repair the faulty element, there may be other faults that will be fed from the alternative location which makes relevant to ensure coordination between the reclosers and the protection at the alternative feeding point.

4.2.5 Synchrocheck

The synchrocheck function is used when two power systems will be connected. This function checks upstream and downstream power line voltage conditions before closing OCR3. It must fulfill the following requirements:

Requirements	Description
R139	**Synchrocheck – Modes** "Manual" mode: The synchrocheck function shall be off service. The operator is responsible to ensure the safety close conditions. "Automatic" mode: The synchrocheck function shall be on service. This function must work accordingly the functional requirements.
R140	**Synchrocheck – Use Cases** Use cases allowed: – "Live - Live" – "Live - Dead" – "Dead - Live" – "Dead - Dead"
R141	**Synchrocheck – Voltage thresholds** – Dead: < 0.2 PU – Live: > 0.8 PU
R142	**Synchrocheck – Range settings** – Amplitude: ± 3 kV – Frequency: ± 0.2 Hz – Phase: ± 10 º
R143	**Synchrocheck – Time settings** – Synchronism time: 50 ms – Maximum close time: 10 s

5 SAFETY AND ENVIRONMENT LEGISLATION

Requirements	Description
R144	**Composition and end-of-life treatment** Sufficient information about the composition of the equipment, including the incorporation of recycled and recyclable materials. Sufficient information that all components of the equipment can be disassembled or recycled in accordance with current international and national legislation. The equipment and/or materials to be supplied must minimize the use of non-recyclable materials in order to reduce waste during the transportation and installation phases.
R145	**Circularity and Carbon Footprint** The supplier shall provide a statement with the characterization of circularity criteria incorporated during the extraction and/or manufacturing and/or transportation of the product that increase the potential for the use of their materials, such as: - recovery potential of the product/materials, - origin of the materials: percentage of incorporation of recycled or reused materials/components and virgin materials - percentage of incorporation of critical materials that appear on the list of essential raw materials for the EU, published in 2020, - elemental composition of the product (bill of material), - amount of carbon emitted. The supplier should refer to the availability of reverse logistics services applied to the product and/or packaging. The declaration to be submitted should refer to any verification requirements defined in standards or certifications under ISO/TC 207/SC5 - Life Cycle Assessment, ISO/TC 323 - Circular Economy, ISO 8887-1:2017 - Technical Product Documentation, Environmental Product Declaration, Cradle to Cradle Certification or others.
R146	**Safety and environmental legislation** The equipment/products and their constituents must comply with the applicable European technical standards and comply with all applicable legislation in force, namely the Reach, RoHs, WEE and Ecodesign Directives.
R147	**Safety and Environmental Legislation - Ecodesign** The manufacturer/supplier shall ensure that all equipment/products supplied and used in his or his subcontractors' tasks conform to the applicable European technical standards, constitute the best available technologies, comply with all ecodesign norms and standards, and comply with all applicable legislation in force.
R148	**Safety and environmental legislation - Batteries and accumulators** The manufacturer/supplier shall ensure compliance with all requirements set forth in Decree-Law No. 152-D/2017, of December 11, and complementary legislation.
R149	**Safety and Environment Legislation - Noise** The manufacturer/supplier shall comply with all the requirements in the standards, regulations and legislation in force, namely those defined in the Decree-Law no. 9/2007/ European Directive 2002/49/CE and respective amendments.

Requirements	Description
R150	**Safety and Environment Legislation - REACH** The manufacturer/supplier shall comply with all the requirements established in Regulation EC 1907/2006, of December 18, 2006 (REACH), regarding the supply and use of dangerous substances, and shall make available the Safety Data Sheets/Safety Data Sheets (SDS/SDS).
R151	**Safety and environmental regulations - Electrical and electronic equipment** The manufacturer/supplier shall ensure compliance of: Legal provisions relating to electrical and electronic equipment in accordance with the provisions of Directive 2012/19/EU, of the European Parliament and of the Council, of 4 July 2012, as well as other applicable legislation. (Decree Law No. 67/2014, of May 7)
R152	**CE Marking** The contractor must submit a CE Declaration of conformity.

6 MARKINGS

Requirements	Description
R153	**JUMP Program** The OCR3 must follow the instructions defined in the document "Programa JUMP – Etiquetagem de materiais e equipamentos", regarding the form and method of labeling and label design (QR code and barcode label). For materials managed by serial number, the barcode must be printed on the equipment and the durability of the equipment must be guaranteed for its entire service life. Note: The field "Installation Type" must be filled in with "XXXXXXXXXXXXXX".
R154	**CE Marking** The enclosure must comply with all applicable CE marking requirements and be visibly, legibly and indelibly marked with the respective symbol.

7 MISCELLANEOUS REQUIREMENTS

7.1 Languages

Nameplate: Portuguese.

FOM messages: Portuguese.

Manuals: English and Portuguese.

8 TABLE OF COMPLIANCE

The successful bidder is required to submit a table of compliance as stated below. In this table the bidder has to confirm compliance to each of the items of this specification. In case the equipment offered does not fully comply with the specification the bidder has to mark it as not compliant.

An alternative configuration can be offered by marking it alternative and describing the alternative solution in the remarks.

TABLE OF COMPLIANCE
Pole Mounted Recloser and Controls - OCR3

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
1	Standards complied	as 2.1 and 3.1.2				
2	Modularity	as 2.2				
3	Quality	as 2.3				
4	Recloser – Maintenance	as 3.1.1				
5	Number of phases	as 3.1.3				
6	Rated frequency (Hz)	as 3.1.3				
7	Maximum design voltage (kV)	as 3.1.3				
8	Nominal operating voltage (kV)	as 3.1.3				

[1] - Manufacture value or ✔, as the case.
[2] - Sign with a “x” if conform (C).
[3] - Sign with a “x” if not conform (NC).
[4] - Write here drawing references, test reports references and other relevant documents. Refer also the necessary to clarify all indications. If not enough space, attach a new sheet and refer it in this column. The manufacturer may also provide other valuable remarks such as alternative solutions.

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
9	Basic insulation level (BIL) (kV)	as 3.1.3				
10	50 Hz Withstand Voltage – Dry 1 minute (kV)	as 3.1.3				
11	50 Hz Withstand Voltage – Wet 10 seconds (kV)	as 3.1.3				
12	Continuous Current Rating (A) RMS	as 3.1.3				
13	Interrupting Rating, Symmetric (A)	as 3.1.3				
14	Maximum Short Circuit duration (s)	as 3.1.3				
15	Recloser – Current sensing	as 3.1.4				
16	Recloser – Voltage Sensing	as 3.1.5				
17	Recloser – Operations – 10.000 open/close operations;	as 3.1.6				
18	Recloser – Poles: – Three poles operated simultaneously;	as 3.1.6				
19	Recloser – Polymer insulation: – Type of insulation;	as 3.1.6				
20	Recloser – Current interruption: – Current interruption occur in vacuum interrupters;	as 3.1.6				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
21	Recloser – Break: – Single break on each phase in vacuum interrupter;	as 3.1.6				
22	Recloser – Interruption mechanism: – Mechanism housing with magnetic actuator with linear trip-and-close motion;	as 3.1.6				
23	Recloser – Mounting support: – Describe mounting provisions, surge arresters and supply VT;	as 3.1.6				
24	Recloser – Power line: – Recloser power line terminals should be supplied and suitable for directly connection of aluminum or cooper cables;	as 3.1.6				
25	Recloser – Trip free: – The recloser mechanically and electrically trip free;	as 3.1.7				
26	Recloser – Close Signal: – Tripping signal (mechanically or electrically) must be priority and with time-current curve;	as 3.1.7				
27	Recloser – Operating times: – Opening and closing operation times consistent for 20 m control cables; – Declare the maximum possible length of the cable, further to the specified 20 m;	as 3.1.7				
28	Recloser – Operating handle: – Manual opening and closing by means of hot stick; – Lockout is ensured either mechanically or electrically;	as 3.1.7				
29	Recloser – Lockout: – Full switching capability when operated by handle;	as 3.1.7				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
30	Recloser – Indicator Position: – Contact position indicator for access viewing from the ground;	as 3.1.7				
31	Recloser – Ground: – Ground connector on recloser housing;	as 3.1.7				
32	Recloser – Clearing time: – Recloser clearing time < 100 ms for all conditions; – Recloser closing time < 100 ms for all conditions.	as 3.1.7				
33	Recloser – Magnetic Actuator: – Magnetic actuator powered by batteries or capacitors;	as 3.1.7				
34	Recloser – Nameplate: – Metal-type and visible position, with IEC 62271-111 recloser information.	as 3.1.8				
35	Recloser – Temperature Conditions: – Operating ambient temperature range from -20 to +40°C;	as 2.4 and 3.1.9				
36	Recloser – Altitude: – Work as specification for an altitude up to 1000 m;	as 2.4 and 3.1.9				
37	Recloser – Pollution: – Pollution degree level Heavy (IEC 60815-1);	as 3.1.9				
38	Recloser – Weather conditions: – Precipitation and condensation and level solar radiation > 1000 W/m^2.	as 2.4 and 3.1.9				
39	Recloser – Tests General: – Tests shall be executed in accredited laboratories or others with the previous agreement of E-REDES	as 3.1.10.1				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
40	Recloser – Type tests: – Executed according to IEC 62271-111 – Chapter 6 – Additional type tests according to IEC 60068-2-5. – Type tests for the controls in the recloser (if is the case).	as 3.1.10.2				
41	Recloser – Routine tests: – Each recloser must be factory tested at least as per IEC 62271-111 chapter 7. – The controls in the recloser must be factory tested (if is the case).	as 3.1.10.3				
42	Recloser – Connectors: – Separable waterproof connectors between recloser and control cabinet;	as 3.2.1				
43	Recloser – Control Cables: – RIM length: 20 m;	as 3.2.1				
44	Recloser – Wires: – Disconnecting the RIM shall not lead to the trip of the recloser;	as 3.2.1				
45	Recloser – Disconnecting: – Wires from current and voltage sensors must be protected against external electric and magnetic fields;	as 3.2.1				
46	Recloser – Construction: – RIM shall have adequate mechanical and UV protection; – Any pipes to protect me mechanically all above cables, if necessary:	as 3.2.2				
47	Recloser – Voltage Rating: – Voltage 0.6/1 kV;	as 3.2.3				
48	Recloser – Conductor type: – The conductors shall be circular, shaped or compacted;	as 3.2.3				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
49	Recloser – Conductor temperature: – Maximum conductor temperature – 90 °C;	as 3.2.3				
50	Control Cabinet – Installation: – The controls for the recloser shall be contained in a weatherproof; – The CC shall be suitable for outdoor installation at 1,5m from ground);	as 3.3.2				
51	Control Cabinet – Components: – The CC shall house the PSM, RTU, FOM, CIM and the PM modules;	as 3.3.2				
52	Control Cabinet – Protection: – It shall be designed to protect unqualified person from opening the CC or operating the recloser;	as 3.3.2				
53	Control Cabinet – RIM protection – The CC shall have a weatherproof connector	as 3.3.2				
54	Control Cabinet – Material: – The CC shall be made of stainless steel or aluminum;	as 3.3.2				
55	Control Cabinet – Lock: – The CC shall have a lock for the cabinet door; – The lock must allow a key European type half cylinder with a total length of 40,5 mm, according to EN 1303; – Acceptable to have a lock prepared for the use of pad-locks 5 mm arc, supplied by E-REDES;	as 3.3.2				
56	Control Cabinet – Counter: – 4 digit operating counter in CC	as 3.3.2				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
57	Control Cabinet – AC socket: – AC socket with suitable voltage and power to feed a standard Laptop PC and a testing device (at least 200W)	as 3.3.2				
58	Control Cabinet – Light: – Internal light	as 3.3.2				
59	Control Cabinet – Circuit Diagram: – Circuit diagram must be attached inside the CC	as 3.3.2				
60	Control Cabinet – Lifting – The CC shall provide lifting facilities	as 3.3.2				
61	Control Cabinet – Water Protection – All control shall be connecter with weatherproof fittings	as 3.3.2				
62	Control Cabinet – Terminal Blocks – The CC shall contain all Input/Output terminal blocks for interfacing the various modules inside the CC	as 3.3.2				
63	Control Cabinet – Condensation: – The CC shall have means to prevent condensation	as 3.3.2				
64	Control Cabinet – Moving parts: – No moving parts inside CC	as 3.3.2				
65	Control Cabinet – Vandalism Protection: – Protected against vandalism	as 3.3.2				
66	Control Cabinet – Design security: – CC shall be designed in a modular way, with no cables spreaded and no exposed dangerous components	as 3.3.2				
67	Control Cabinet – IP: – The CC shall have a protection level at least equivalent IP54.	as 3.3.3				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
68	Control Cabinet – Temperature Conditions: – Temperature range shall be -20°C to +40°C with relative humidity of 5% to 95% (non-condensing)	as 2.4 and 3.3.3				
69	Control Cabinet – Manual: – Instruction for transport, storage, installation, operation, and maintenance	as 3.3.4.1				
70	Control Cabinet – Nameplate: – Nameplate	as 3.3.4.2				
71	Control Cabinet – Type Tests: – The CC shall be tested and certified according to IEC 61000-6-2 and IEC 61000-6-4 – The IP rating of the CC shall be tested and certified according to IEC 60529	as 3.3.5				
72	Control Cabinet – Routine Tests: – Routine tests	as 0				
73	Power Supply Module – Input Voltage: – Nominal input range 100 VAC to 240 VAC at 50 Hz and a tolerance of +/- 10%	as 3.4.2				
74	Power Supply Module – Circuit Protection: – Incoming power protected and isolated by circuit breaker	as 3.4.2				
75	Power Supply Module – Battery Protection: – Supply from the battery protected and isolated by circuit breaker	as 3.4.2				
76	Power Supply Module – Signalization: – Signalization of all individual circuit breakers to the RTU and to be transmitted to control center	as 3.4.2				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
77	Power Supply Module – Voltage Transformer: – Single phase voltage transformer for power supply from the overhead line	as 3.4.2				
78	Power Supply Module – Battery Supply: – Automatic and periodic test of battery and signalization. – Detect and signal to the RTU when the battery is close to the end of its life span.	as 3.4.2				
79	Power Supply Module – Battery Type: – Backup battery specification, catalogs, and tests	as 3.4.2				
80	Power Supply Module – Battery Test – Automatic and periodic battery testing	as 3.4.2				
81	Power Supply Module – Battery lifespan – Detect a deteriorating state of a battery and signal it to the RTU	as 3.4.2				
82	Power Supply Module – Battery operation: – Battery capacity designed for operating the recloser for a minimum of 24 hours	as 3.4.2				
83	Power Supply Module – Discharged: – Mechanism for automatic shutdown in case of loss of power and before battery completely discharges	as 3.4.2				
84	Power Supply Module – Auxiliary power supply: – Auxiliary power supply connection in the case of a complete loss of energy.	as 3.4.2				
85	Power Supply Module – Nameplate: – Nameplate	as 0				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
86	Power Supply Module – Environmental Requirements: – Temperature range shall be -20°C to +°40°C with relative humidity of 5% to 95% (non-condensing)	as 2.4				
87	Power Supply Module – Type Tests: – Type tests	as 3.4.4				
88	Remote Terminal Unit - Features The RTU shall be provided with: – Remote communication – Self-test and diagnosis function – Watchdog function – Failure signalization to control center	as 3.5.2				
89	Remote Terminal Unit – Number of measurements: – Inputs/Outputs complete measurement chain shall have an accuracy of at least 5 %	as 3.5.3				
90	Remote Terminal Unit – Measurements: – Be able to measure RMS, Phase Angle, PF, kW, kvar, kWh and kvarh	as 3.5.3				
91	Remote Terminal Unit – Communication protocol: – It shall support a communication protocol according to IEC 60870-5-104 (PID) and DEF-C98-422	as 3.5.4				
92	Remote Terminal Unit – Communication type: – Communication interface for engineering PC	as 3.5.4				
93	Remote Terminal Unit – Communication: – RTU must have 48 V power supply and space enough to install a router with 230x160x100mm – RTU/CIM must be ethernet RJ45 10/100BASE-T	as 3.5.4				
94	Remote Terminal Unit – Event Detection: – Have an event detection with a time resolution of 10 ms	as 0				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
95	Remote Terminal Unit – Clock: – Have a internal clock for time stamping with maximum deviation 200 ms/h when not synchronized with NCC	as 0				
96	Remote Terminal Unit – Event Buffer: – Have an event buffer to store events (at least 100 events)	as 0				
97	Remote Terminal Unit – Data files: – The configuration and the upload of files of the RTU shall be carried out from a remote PC via internet, intranet or IEC 60870-5-104	as 3.5.6				
98	Remote Terminal Unit – Power Supply: – The RTU shall be fed by the battery backed PSM in the CC	as 3.5.7				
99	Remote Terminal Unit – Front Operating Module Shall provide to local operator: – selector switch for LOCAL/REMOTE – indicator for LOCAL/REMOTE – push buttons for OPEN/CLOSE – switch position indication – selector switch for protection profile – indicator for protection pickup and trip – nameplate	as 3.5.8				
100	Remote Terminal Unit – Environmental Requirements: – Temperature range shall be -20°C to +°40°C with relative humidity of 5% to 95% (non-condensing)	as 2.4 and 3.5.9				
101	Remote Terminal Unit – Type Tests: – The RTU shall be type tested and certified according to IEC 62271-111. – Type test shall be conducted according to IEC 60870-2-1;	as 3.5.10				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
102	Protection Module – Assembly: – Protection analogue inputs of the protection device connected to the sensors of the recloser	as 3.6.2				
103	Protection Module – Self Test: – The PM shall provide a self-test and diagnosis function.	as 3.6.2				
104	Protection Module – Watchdog: – The PM shall provide a watchdog function.	as 3.6.2				
105	Protection Module – Signalization: – In case of failure the PM shall signaled to the control center	as 3.6.2				
106	Protection Module – Protection parameters: – It shall be possible to set, change and update the protection parameters (time and current thresholds and curves) locally via a laptop or remotely from the control center.	as 3.6.2				
107	Protection Module – Selectivity: – Four protection profiles	as 3.6.3				
108	Protection Module – Configuration access: – The profiles shall be selectable both locally and remotely.	as 3.6.3				
109	Protection Module – Profiles: – It shall be possible to shift between profiles automatically if pre-determined conditions are sensed (e.g. inversion in power flow)	as 3.6.3				
110	Protection Module – TCC Overcurrents: Each profile shall allow 8 independent Time-Current Curve specifications: – Four Phase Overcurrents – Four Ground Overcurrents	as 3.6.3				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
111	Protection Module – TCC Data bases: – The Time-Current shall be selected from a library from database curves to permit implementation of any standard or modified curve	as 3.6.3				
112	Protection Module – TCC Relays At least the following Time-Current curves (conform IEC 60255) can be selected: – Definite time – Standard time (SI) – Very inverse (VI) – Extremely inverse (EI)	as 3.6.3				
113	Protection Module – TCC Editor: – Time-Curve Editor shall be available	as 3.6.3				
114	Protection Module – Directionality: – It shall be possible to have directionality added to the overcurrent protection functions both for phase-phase and phase-ground faults	as 3.6.3				
115	Protection Module – Inrush restraint: – Inrush Restraint features	as 3.6.3				
116	Protection Module – Fault Location – Fault Location features	as 3.6.3				
117	Protection Module – Reclose retry – Reclose retry feature (independent for each protection profile)	as 3.6.3				
118	Protection Module – Harmonic – Comprehensive harmonic information for three-phase voltages and currents plus neutral current	as 3.6.3				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
119	Protection Module – Histogram – Histogram data	as 3.6.3				
120	Protection Module - Alarm Fully configurable alarm system: – Compare metered values to preset limits for a selectable time delay – Initiate an event recorder incident and also initiate a data profile sample	as 3.6.3				
121	Protection Module – Event Recorder – Event recorder	as 3.6.3				
122	Protection Module - Oscillography – Have oscillography for all phase currents and voltages	as 3.6.3				
123	Protection Module – Scope of Oscillography – Oscillography should allow for continuous analysis of the data recorded before, during, and after the occurrence	As 3.6.4				
124	Protection Module – Number of digital inputs – A minimum number of 40 digital inputs must be guaranteed	As 3.6.4				
125	Protection Module – Number of analog inputs – A minimum number of 10 analog inputs must be guaranteed	As 3.6.4				
126	Protection Module – Data Availability – Stored data must be available for local or remote – It must be possible to download remotely	As 3.6.4				
127	Protection Module – Minimum Frequencies – 1kHz for analog inputs; – 1kHz for digital inputs.	As 3.6.4				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
128	Protection Module – Recording Time – Time period before the fault (between 0.01s and 0.5s, 10ms step) – Time period of the fault duration – Time period after the fault (between 0.1s and 2s, 100ms step)	As 3.6.4				
129	Protection Module – Changing recording times – change the desired pre-fault and post-fault time periods for oscillographic records	As 3.6.4				
130	Protection Module – Recording capacity – Minimum of 25 oscillograph records in memory	As 3.6.4				
131	Protection Module – Structure – Record must follow the FIFO	As 3.6.4				
132	Protection Module – Environmental Requirements – Temperature range shall be -20°C to +40°C with relative humidity of 5% to 95% (non-condensing)	as 2.4 and 3.6.5				
133	Protection Module – Power Supply – The PM shall be fed by the battery backed PSM in the CC	as 0				
134	Protection Module – Type tests: – The type test must be executed on a representative PM prior to delivery, with the aim to show that all PM will comply with the specified requirements – The PM shall be tested and certified according IEE C37.90, IEC 62271-111, IEC 60255 series and IEC 61000 series.	as 0				
135	Software Functional Requirements – Recloser mode	as 4.2.1				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
136	Software Functional Requirements – Sectionalizer mode	as 4.2.2				
137	Software Functional Requirements – ABR feature	as 4.2.3				
138	Software Functional Requirements – Power flow direction feature	as 4.2.4				
139	Synchrocheck - Modes – Manual and Automatic mode	as 4.2.5				
140	Synchrocheck – Use Cases – “Live - Live” – “Live - Dead” – “Dead - Live” – “Dead - Dead”	as 4.2.5				
141	Synchrocheck – Voltage thresholds – Voltage thresholds Dead: < 0.2 PU – Live: > 0.8 PU	as 4.2.5				
142	Synchrocheck – Range settings – Amplitude: ± 3 kV – Frequency: ± 0.2 Hz – Phase: ± 10º	as 4.2.5				
143	Synchrocheck – Time settings – Synchronism time: 50 ms – Maximum close time: 10 s	as 4.2.5				
144	Composition and end-of-life treatment	as 5				

Recloser Module _____ kV/_____ A – Product Reference: _____				**Manufacturer:** _____		
CHARACTERISTICS		Section	Manufacture[1]	C[2]	NC[3]	References/Remarks [4]
145	Circularity and Carbon Footprint	as 5				
146	Safety and environmental legislation	as 5				
147	Safety and Environmental Legislation - Ecodesign	as 5				
148	Safety and environmental legislation - Batteries and accumulators	as 5				
149	Safety and Environment Legislation - Noise	as 5				
150	Safety and Environment Legislation - REACH	as 5				
151	Safety and environmental regulations - Electrical and electronic equipment	as 5				
152	CE Marking	as 5				
153	JUMP Program	as 6				
154	CE Marking	as 6				

Manufacturer (signature) **Date: _____ / __ / __**

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