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Manual Methods

CHAPTER:

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REVISION CONTROL

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1. SCOPE OF DOCUMENT

This specification defines the standards and requirements for the design, manufacture, inspection, packing and delivery of the Protection, Control and Measurement cabinets for the Transformer Substations.

2. DEFINITIONS

- Owner: Purchaser of the cabinets detailed in this specification.
- Contractor: Supplier who is responsible for the manufacturing, testing, and delivery of the cabinets detailed in this specification.
- NI: Iberdrola Standard.
- MO: Iberdrola Manual.
- IEC: International Electrotechnical Commission.
- CPC: Contract Particular Conditions.

3. FIELD OF APPLICATION

The Protection, Control and Metering cabinets will be installed in the Transformer Substations of the Owner.

However, this specification may also be applicable to external customers that do not provide a technical specification for the design and manufacture of these cabinets.

4. SCOPE OF SUPPLY

The Contractor shall provide, according to the requirements of this technical specification:

- Metal enclosures: Each control cabinet shall be completely assembled, wired, and tested at the factory. The Contractor is responsible for providing all materials listed in the materials list of the project, with the exception of the equipment marked as provided by the Owner.
- Installation and wiring of all elements mentioned in the previous clause, including those provided by Owner.
- Layout drawings, list of materials and internal wiring of the cabinets.
- Functional tests (as annex 1).
- Receipt of the cabinets (as Annex 2).
- Packing, storage and on-site transportation.

5. STANDARDS

The cabinets shall be designed, manufactured and tested according to the standards listed below. These standards will be considered in its latest edition at the time of the bid submission.

In the event of a contradiction or inconsistency between this specification and the following standards referred to herein, then this specification shall take precedence.

For all those aspects that are not defined in these standards or in this technical specification, the Contractor shall propose an applicable standard for approval by Owner.

5.1 European standards

- IEC 61439-1: "Low-voltage switchgear and controlgear assemblies. Part 1: General rules".
- IEC 61000-6-2 "Electromagnetic compatibility (EMC). Part 6-2: Generic standards. Immunity for industrial environments."
- IEC 61000-6-4 "Electromagnetic compatibility (EMC). Part 6-4: Generic standards. Emission standard for industrial environments".
- IEC 60529: "Degrees of protection provided by enclosures (IP Code)."
- IEC 60947-1: "Low-voltage switchgear and controlgear. Part 1: General rules."
- IEC 60947-2: "Low-voltage switchgear and controlgear. Part 2: Circuit-breakers."
- IEC 60947-3: "Low-voltage switchgear and controlgear. Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units."
- IEC 60947-5-1: "Low-voltage switchgear and controlgear. Part 5-1: Control circuit devices and switching elements. Electromechanical control circuit devices."
- IEC 60255-5: "Electrical relays. Part 5: Insulation coordination for measuring relays and protection equipment. Requirements and tests."
- IEC 60228: "Conductors of insulated cables."
- EN 10130: "Cold rolled low carbon steel flat products for cold forming. Technical delivery conditions."
- EN 12476: "Phosphate conversion coating of metals. Method of specifying requirements."
- ISO 2409: "Paints and varnishes - Cross-cut test."

5.2 Owner standards

- MO 07.P2.26: "Signalling for ST-STR substations."
- NI 56.10.00: "Unsheathed insulated unipolar cables for panels and metering."
- NI 76.83.01: "Conduits for insulated cables panels and cabinets."
- NI 00.02.50: "Drawing formats."
- NI 00.02.52: "Drawings folding."
- NI 00.02.53: "Scales for drawings."
- NI 00.02.55: "Drawing and labeling of plans."
- NI 00.02.60: "Drawings identification codes."
- NI 00.02.61: "Drawing files identification codes."
- NI 00.13.01: "General conditions of the Iberdrola Group for contracting equipment and materials."

6. SERVICE CONDITIONS

The Protection, Control and Metering cabinets will be installed in the substation control house.

6.1 Atmospheric conditions

The cabinets will be designed and manufactured to withstand environmental conditions for indoor installations, according to IEC 61439-1:

- Ambient air temperature: - 5 °C a + 40 °C.
- Maximum ambient air average temperature over a period of 24 h: + 35 °C.
- Relative humidity: 90 % at a maximum temperature of + 20 °C.
- Altitude of the site of installation: does not exceed 2.000 m.

6.2 Operating conditions

All equipment, devices and auxiliary elements mounted in the cabinets must work properly for the following values:

- DC auxiliary control supply: 125, 48 y 24 Vcc + 10 % - 20 %, 5 % ripple.
- Thermal short circuit current for DC circuits: 6 kA.
- AC auxiliary supply: 400 - 230 Vca + 10 % - 10 %, 50 Hz.
- Thermal short circuit current for AC circuits: 10 kA.

6.3 Electromagnetic compatibility

The operating environment of the cabinets shall be as specified in IEC 61439-1 as industrial installations (environment A), as shown in the electromagnetic compatibility standards IEC 61000-6-2 and IEC 61000-6-4.

The internal installation and wiring must be carried out in accordance with the devices and components manufacturer's instructions (arrangement with regard to mutual influences, cable, screening, grounding, etc).

7. MATERIALS

The materials installed in the cabinets will be defined for each particular case, in the CPC document and additional technical documentation provided by Owner for manufacturing.

7.1 Materials provided by Owner

All the equipment and auxiliary elements supplied by Owner will be provided with the appropriate mounting information. The Contractor will be responsible for reception and proper storage of these elements, according to the manufacturer's instructions.

In case any equipment or item provided by Owner is received damaged or incorrect, the Contractor will notify the Owner as soon as possible, providing damaged equipment identification and description of the damage or fault detected, so the Owner may initiate corrective actions.

It is also the responsibility of the Contractor to notify the Owner if any equipment of the Owner's supply, is not received in time for installation, or cannot be properly installed. Owner will decide the solution to take once notified.

7.2 Materials provided by Contractor

Equipment and auxiliary elements provided by the Contractor shall comply with the brand, type and characteristics indicated in the CPC document and additional technical documentation provided by Owner during the bidding process. In the event that are not defined, the Contractor shall submit a proposal for Owner's approval.

The Contractor shall include in the bid all materials (DIN rails, wireways, wiring, etc) not specified in the technical documentation, but needed for the correct assembly and operation of the cabinets.

The Contractor shall include unitary prices of the installed materials and its installation, as necessary condition to consider the bid.

8. DESIGN AND CONSTRUCTION REQUIREMENTS

8.1 Enclosure

The enclosure will be a complete free standing cabinet, completely assembled, with the following characteristics:

- *External dimensions:*
 - Width: 800 mm.
 - Depth: 800 mm.
 - Height: 2200 mm (plus a 100 mm height plinth).
- *Protection degree:* IP 54.
- *Enclosure frame:* folded and welded steel sheets to get a minimum total thickness of 2.5 mm.
- *Rear, roof and side plates:* 1.5 mm thick steel plate.
- *Mounting plate and swing rack:* 2 mm thick steel plate.
- *Nuts and bolts:* stainless or anti-corrosion treated steel.

The rear of the cabinet will be fully closed, allowing only access to the interior from the front of the cabinet.

A heavy duty swing rack frame shall be provided on all cabinets, with 45 units of usable height for 19 inch racks and shall have hinges and swing out guides. All blank swing rack frame spaces shall be fitted with filler panels of indicated number of rack units. The swing rack will pivot on the left side (facing the front of the cabinet), and shall be able to open 170 degrees.

The swing rack will be equipped at its top with an adjustable locking mechanism to prevent collision with the adjacent cabinet or any accidental closing. The frame of the swing rack must withstand a load of 170 kg when opened 90 degrees, without suffering an elastic deformation that interferes with its normal closing, without the use of any auxiliary elements for closing such as sheaves or rollers.

The cabinets will be provided at the bottom with removable gland plates, able to withstand a weight of 140 kg.

A front door with tempered glass or polycarbonate cutout shall be provided on all cabinets. The front door shall be hinged on the right side (facing the front of the cabinet), and shall be able to open 180 degrees.

A vinyl sticker of 154 x 85 mm (see figure 1) with the Owner's logo shall be placed at the top right of the front door, attached in a way that the equipment in the swing rack is properly displayed.



Figure 1. Owner's logo

The Contractor will be responsible for fabricating the necessary mounting brackets to properly accommodate non-flush mounted equipment.

Cabinet door handles shall be equipped with push button type for opening, without any key locking system.

The cabinets will properly withstand the stresses that occur during transport, and be provided with removable eyebolts with the corresponding plugs.

The construction of the cabinets shall allow mounting them side by side and it must be possible to replace any of them if necessary.

The cabinets will be mounted on a metal base and fixed with anchor bolts. These items will not be supplied by the Contractor, but the Contractor will provide the necessary information for the design of them.

8.2 Swing rack

The equipment distribution on the front and inside the cabinet will be made as indicated in the corresponding CPC document and technical documentation during the bidding process.

The protective relays, miniature circuit breakers, metering instrumentation and panel-mounted energy meters shall be placed on the front of the swing rack.

The control and protection units used for local operation shall be placed at eye level and centered in the swing rack.

The blank plates for miniature circuit breakers will allow the placement of a maximum of nine (9) breakers with the corresponding auxiliary contacts for signaling, with a cover for the breakers that are not required. All blank or drilled plates for recessed mounting of circuit breakers or other equipment shall be of steel sheet.

To facilitate wiring and its subsequent maintenance, the rear of the swing rack will be equipped with a set of plastic wireways, secured by the appropriate hardware to be kept separate from the equipment conveniently.

All work shall be done and completed in a thorough and workmanlike manner, in accordance with modern practices in electrical cabinet fabrication.

8.3 Grounding

At the front bottom and left side of the cabinet, a 30 x 5 mm thick copper ground bar shall be installed. This ground bar will be installed at a distance of 300 mm above the floor level.

The joints between sections of the ground bar shall be made with a minimum of two screws.

The ground bar shall be identified painted on a side with yellow-green colour, or an insulated and self-extinguishing adhesive.

The ground bar shall be drilled and tapped on its axis and along its length, for M6 type screws every 4 cm with the corresponding screws, nuts and lockwashers to accommodate ground connections. All ground connections shall use stainless steel or silicon bronze screws, bolts, nuts, and lockwashers.

The ground bus shall not block access to any equipment or terminals.

All protection relay housings and equipment shall be connected to ground, including doors and cabinet steel plates.

A ground terminal suitable for anchoring a 95 mm² cable should be placed at one end of the ground bar. The other end of the ground bar shall be prepared in the event that it is necessary to relocate this terminal.

Grounding of the equipment housings installed in the swing rack will be located at the top of the swing rack (see figure 2). It will consist of a copper plate, connected to the grounding bar in the bottom of the cabinet with a 6 mm² cross-section cable.



Figure 2. Swing rack equipment grounding

8.4 Wireways

Wiring between devices, terminal blocks and other equipment shall be facilitated through the use of plastic wireways with covers.

The wireways shall comply with NI 76.83.01 standard, will be halogen-free and of grey colour. The wireways shall not be loaded over 75 % of its capacity.

The dimensions of the wireways will comply with NI 76.83.01 standard and distance between them and the terminal blocks shall not be less than 50 mm.

The wire tie wraps shall be of insulated and self-extinguishing material and will be easy to remove if necessary. Spiral wraps will not be permitted.

8.5 Terminal blocks

Terminal blocks shall be provided in complete assemblies, which include mounting strips, silver plated DIN rails, end anchors, barriers, and standoff brackets if necessary.

DIN rails shall have the maximum length to allow future expansion in the total number of terminals or devices.

Mounting rail shall be approved for use by terminal block manufacturer. End barriers shall be provided at one end of each terminal strip. Heavy-duty anchors shall be provided by same terminal block manufacturer.

All terminal blocks shall be numbered consecutively from bottom to top with appropriate markers fixed on the terminals.

Markers shall be insulated, halogen-free and flame retardant. Each terminal must be marked using a clear and permanent marking system.

In case of border points between companies or other applications where billing of energy consumption is needed, voltage and current terminal blocks shall be protected with sealable and transparent covers.

In table 1 the names of each terminal block are shown, according to each application and related to terminal block width.

APPLICATION	DESCRIPTION	WIDTH (mm)
Circuit breakers	A	8
Interlocking and tripping	B	8
Signals between companies	BF	8
Disconnectors	D	6
Control system signals	E	6
Current metering	I	11 or 13
Gas pressure gauges or transducers	L	6
Swing rack terminal blocks	R	8
Tap changers	S	6
Transformers and grounding reactances	T	8
Rings	U	8
Voltage metering	V	11 or 13
Busbar protection signals	W	8
AC incoming supplies	X	11 or 13
DC incoming supplies	Y	11 or 13

Table 1. Terminal block names and width definition

In cases where the cross-section of external wiring requires a larger terminal block width, the Contractor shall notify the Owner for an appropriate solution.

Accepted terminal block manufacturers and models are shown in table 2.

ABB E2x6/13.EES1T.V0 type terminals must be mounted on DIN asymmetric rails and protected by a removable and transparent polycarbonate cover. The screw connections on such terminals will be done between the conductive plate and the first nut, in both cases of one or two conductor connections, with the aim of:

- Ensure the electrical connection (nut and locknut tightening torque).
- Guarantee another connection between nut and washer in operating service works.

WIDTH (mm)	MANUFACTURER	CHARACTERISTICS
13	ABB E2x6/13.EES1T.V0	Disconnect slide
11	Phoenix Contact OTTA6-T-P/P	Shorting links
11	Weidmüller WTL6/4FF M3x8 DIN screw	Test socket screws
11	Wieland WRT 6 TK	
8	ABB M6/8.ST1.V0	Disconnect slide
	Phoenix Contact URTK-S	Shorting links
	Weidmüller WTL6/1 EN STB	Test socket screws
	Wieland WKN 6 TK	
6	ABB M4/6.SNBT1.V0	Disconnect blade
	Phoenix Contact UT4-MT-P/P	
	Weidmüller WTR2,5 STB 2,3	
	Wieland WK4 TKM/U/V0	

Table 2. Terminal block manufacturers

8.6 Internal wiring

8.6.1 Characteristics

Internal wiring cables shall be unipolar, flexible class 5, complying with IEC 60228 and NI 56.10.00. The wire shall be manufactured with tinned, stranded copper conductors and insulated with cross-linked polyethylene compound or equivalent synthetic, heat resistant.

Internal wiring must be halogen free, fire and flame retardant, with reduced smoke and opacity emissions.

Insulation colour must be grey, excluding grounding circuits that will be yellow-green.

8.6.2 Routing

Wiring between terminals of different elements of the cabinet shall be continuous between terminations. There shall be no splices or intermediate derivations in wires.

Electrical devices including miniature circuit breakers, auxiliary relays, resistors, terminal blocks etc. shall be mounted in an appropriate location. Internal wiring cables will be arranged in specific areas allowing reasonable access to the devices.

The wires will be arranged in a way they are not too tight, permitting a recovery of at least 10 cm, and not too long to avoid cable clutter.

Connections will be arranged ensuring that cable runs are as short as possible, avoiding back and forth between the cabinet and the swing rack.

Whenever possible, cable runs will be designed to avoid overlapping of AC and DC signals in the same wireway, or different polarities of the substation battery system.

Wires between the cabinet and swing rack shall be protected by appropriate length flexible tubes, allowing opening the doors effortlessly. Tubes will be fixed to the cabinet by clamps of a suitable diameter.

Tubes will not be loaded above 75 % of their capacity and a guide wire will be installed inside each of them, properly identified.

8.6.3 Optical fiber

An optical fiber patch panel will be installed at the bottom left side of the cabinet. This patch panel will facilitate on-site interconnection of optical fibers, without accessing the equipment mounted in the cabinet.



Figure 3. Fiber optic patch panel

This patch panel shall allow twenty (20) fiber optic connections and will be equipped with a transparent and removable cover, offering protection for the fiber links (see figure 3).

Fiber optic bend radius shall be considered. The path of the optical fiber will be independent, arranged in wireways in the swing rack and flexible tube to the cabinet. Fixing system will be similar as the exposed in section 8.6.2.

8.6.4 Internal equipment layout

The auxiliary relays and devices installed inside the cabinet will be located at the top of the mounting plate. These will be mounted on galvanized DIN rails, placed horizontally and attached to the mounting plate.

Horizontal and vertical wireways will interconnect the cables to the auxiliary relays. The separation between horizontal wireways will be at least 180 mm, so connections can be easily arranged and the wire marking system is visible (see figure 4).

If possible, auxiliary relays will be placed at an approximate distance of 15 mm between them, allowing the installation of the relay labels in the upper right corner. This facilitates the wire terminations do not hide the labels (see figure 4).

Labels will never be installed on equipment or removable items such as auxiliary relays or DIN rails, these will always be installed on the mounting plate.

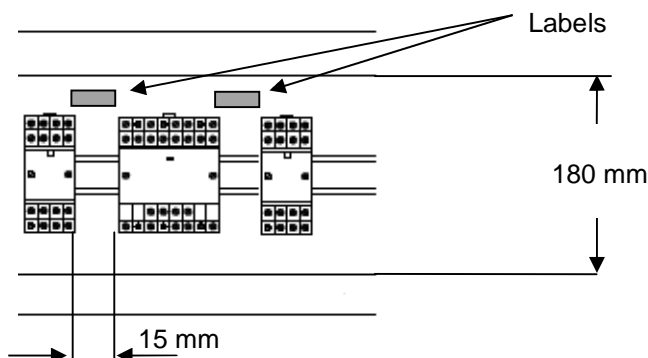


Figure 4. Labels and relay layout on the mounting plate

8.6.5 Wire marking

Each conductor shall be marked with a permanent wire marking system identifying the “from-to” wire designation at each end of the wire. All markers shall be halogen-free and printed, not handwritten.

Wire markers must be readable and each wire may be easily disconnected, without having to manipulate any other element than the wire. A small loop shall be provided to allow this operation.

The markers will always be read from left to right and shall be printed in one or two rows (see figure 5).

- Marking in one row: left side of the marker will identify origin and right side will identify cable destination.
- Marking in two rows: top will identify origin and bottom will identify cable destination.

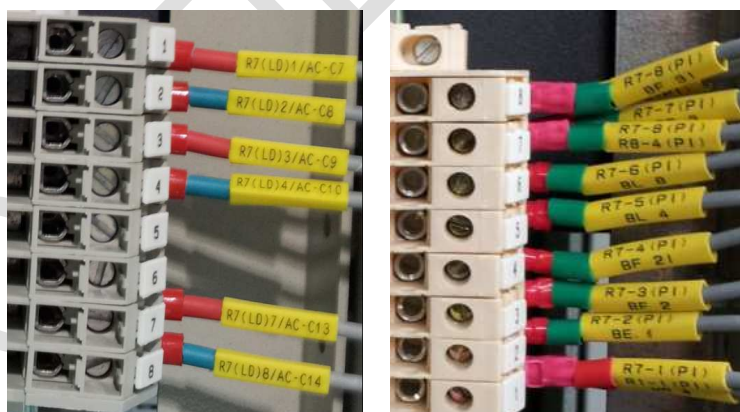


Figure 5. Wire marking systems (one or two rows)

Cable terminations will have halogen-free sleeves, coloured according to tables 3 and 4 (see MO 07.P2.26). This colour identification will be shown in the internal wiring drawings.

AC CIRCUITS	COLOUR
Voltage	Black
Current	White

Table 3. Colour identifications for AC circuits

DC CIRCUITS	COLOUR
Direct positive	Red
Direct negative	Blue
Not direct positive or negative	Green
Transducer outputs	Yellow

Table 4. Colour identifications for DC circuits

All markers and sleeves must be visible and shall not be placed inside any cable duct.

Terminal blocks located on the swing rack (R), shall be a sliding link terminal blocks with a test jack that allows a banana plug type connector, unless otherwise approved by Owner (see table 2). These terminal blocks shall be mounted and centered on the non-hinged end of the swing rack (see figure 6).

The connection side to the protection relay will be identified as (PI) and the connection side to the cabinet as (PE).

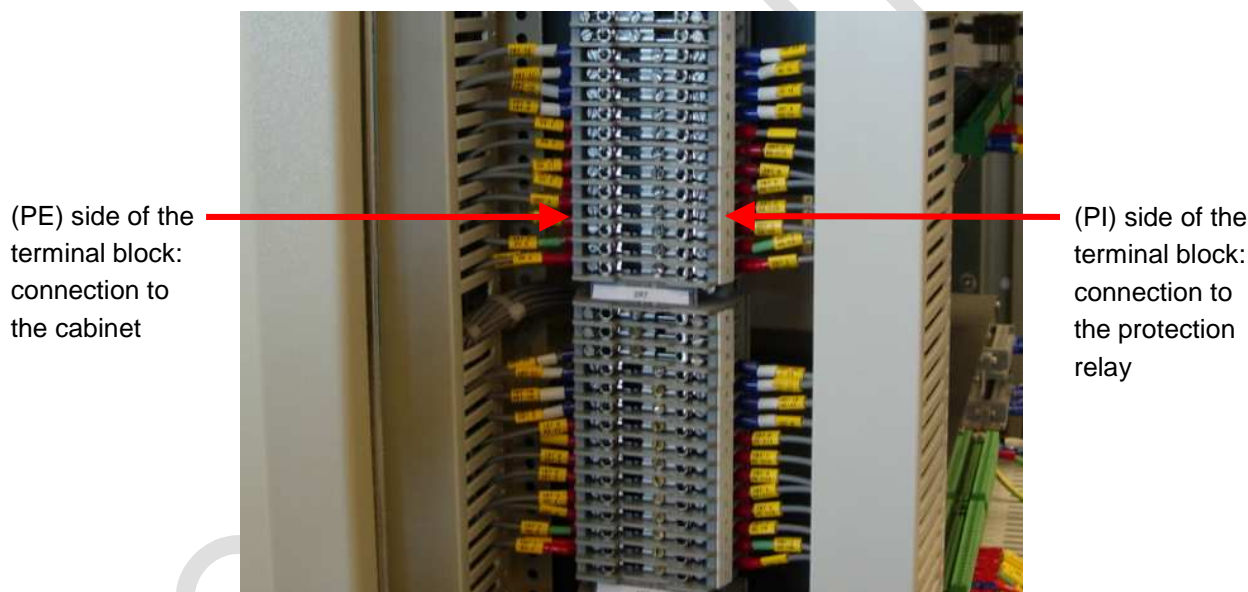


Figure 6. Swing rack terminal blocks

8.6.6 Wire terminations

Wire terminations shall be insulated and made with appropriate ratchet type crimping tools. To ensure a proper connection and to avoid damage to the terminal lug, it is mandatory that the crimping tool be used in accordance with instruction for its use, and that the proper crimping tool is used for each terminal lug and wire size.

The cable lugs will consist of high-quality copper with electrolytic tin plating, with a hard-soldered crimping zone for maximum conductor pull-out forces and halogen-free.

The number of wire terminations per termination point shall not exceed two. Crimping two wires in the same cable lug is not permitted.

The cable lug characteristics will be the following:

- *Insulated ring cable lugs*: shall be used for voltage, current and power supply connections (V, I, X and Y terminal blocks and protection relays with bolt connections admitting this type of lug).
- *Insulated fork cable lugs*: used for auxiliary relay sockets and digital input and output protection signals with bolt connections.
- *Insulated flat pin cable lugs*: shall be used for screw connections in protection relays or 6 and 8 mm wide terminal blocks.
- *Insulated pin cable lugs*: shall be used for miniature circuit breaker connections or terminals without a plain clamping surface.

When two flat pin cable lugs must be connected in the same terminal, both will be conveniently mounted back to back to ensure contact and electrical continuity. The connection of flat pin lugs shall be parallel and not oblique to the clamping surface (see figure 7).

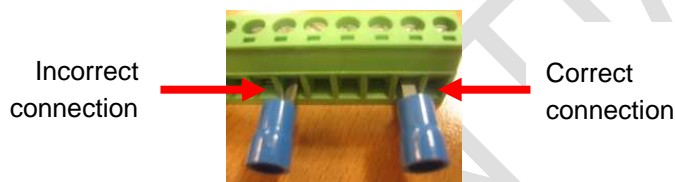


Figure 7. Flat pin cable lug connections

8.6.7 Wire cross-section

The wire cross-section shall be adequate to withstand rated current of the circuits. The cross-section of each wire will be represented in the internal drawings.

The minimum cross-sections of the internal wiring will be:

- Cables of 2.5 mm² section:
 - Incoming circuits to the miniature circuit breakers (230 V AC and 125 V DC).
 - Protection and metering circuits connected to secondary windings of current transformers (5 A) and voltage transformers (110 V AC).
- Cables of 1.5 mm² section:
 - Control and command circuits.
 - Other circuits.

In energy metering point cabinets, internal wiring for voltage and current measuring will be arranged with a minimum cross-section of 4 mm².

8.7 External wiring

8.7.1 Terminal blocks

In the protection and control cabinets, the terminals blocks corresponding to incoming supply circuits, current and voltage metering, will be mounted vertically on the bottom left side of the cabinet. These will be installed just above the optical fiber patch panel, starting at approximately 800 mm above the floor, so that they are more accessible for cabling and testing. The order of these terminals will be, from bottom to top: incoming supplies (X and Y), current (I) and voltage (V).

The rest of the external wiring terminal blocks shall be placed vertically starting at the bottom of the mounting plate.

Figures 8 and 9 show the arrangement of terminal blocks on the left side and mounting plate.



Figures 8 and 9. Terminal blocks arrangement on left side and mounting plate

In energy metering point cabinets, all the terminal blocks shall be installed vertically, starting at the bottom of the mounting plate.

Partition plates will be installed to allow visual and electrical separation of the different terminal groups. Terminal blocks shall be grouped by name and functionality.

8.7.2 Wireways

In the protection and control cabinets, a vertical 80 x 120 mm wireway shall be installed on the mounting plate and left side of the cabinet for external wiring (see figures 8 and 9).

At the bottom of the mounting plate and left side of the cabinet, a horizontal 80 x 120 mm wireway will be installed to facilitate distribution and arrangement of the external wiring (see figures 8 and 9). This wireway will be located just below the terminal blocks on the mounting plate and below the fiber optic patch panel on the left side of the cabinet.

With the same purpose, in the energy metering point cabinets, a vertical and horizontal 80 x 120 mm wireway will be mounted on the mounting plate.

Wireways mounted for external cabling will be reserved for this purpose, so it is not admitted to include internal wiring or any equipment in them.

8.7.3 Anchoring profiles

At the bottom of the front and left side of the cabinet, a galvanized steel profile will be installed at a distance of 250 mm above the floor, which allows the installation of clamps for the external wiring cables anchoring.

8.8 Nameplates and labels

Adhesive backed laminated PVC type nameplates shall be provided on the front of the cabinets, to identify each cabinet according to the drawings. This identification will consist of a black 250 x 50 mm wide nameplate, with white letters of 13 mm height.

The Contractor shall provide each cabinet with one label marked in a durable manner and located at the bottom right side of the glass door, legible when the cabinet is installed and in operation. This label must include Contractor's name or trade mark and date of manufacture according to IEC 61439-1.

Nameplates and labels shall also be placed on the front and inside the cabinet to identify all visible equipment.

The nameplates and labels will be installed on the mounting plate or another element of the enclosure or cabinet, never on the equipment.

- *Nameplates installed in the front:* these will be installed just below the equipment, according to the functional identification in the wiring diagrams (see example in figure 10).

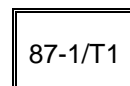


Figure 10. Nameplates on the front of the cabinet

- *Nameplates and labels installed in the back of the swing rack or inside the cabinet:* these will be installed on the upper right side of the equipment. The label will consist of the two letter identifier wiring scheme shown in the wiring diagrams and the functional identifier of the drawings (see example in figure 11).

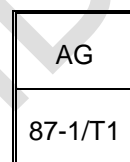


Figure 11. Labels internal to the cabinets

Labels will consist of adhesive black PVC plates of 1.5 mm thick, of 40 x 15 mm for nameplates in the front of the cabinet and 25 x 15 mm for internal labels. Letters will be white and with a minimum height of 3 mm.

All nameplates and labels will be placed with a suitable adhesive, so they can be easily removed without damaging the finish of the cabinet.

The letter font type and numbers will be previously approved by Owner.

8.9 Lighting and heating

The cabinet lighting will consist of a low consumption lamp activated by a door actuated switch. Its location and power will be suitable for maintenance works inside the cabinet.

The power supply for maintenance will consist of a Schuko socket (16 A, 230 V AC) properly grounded to power work tools and equipment.

A 230 V AC thermostat and heating resistance will be installed, in order to avoid condensation inside the cabinet.

The cabinets shall be provided with natural ventilation, through slotted plinth on bottom and ventilation hood with dust filter on top.

8.10 Painting and finish

The colour of the cabinets will be RAL-7032 textured semi gloss for all surfaces, including drilled plates for anchored equipment. RAL-7035 colour will only be accepted for interior surfaces of the cabinets.

Plinth colour shall be RAL-7022.

All cut or sheared metal edges shall be ground smooth prior to painting and priming. Steel plates will be dipcoat primed and then powder-coated.

At least, the following requirements will be required, in case there is not a standard procedure approved by Owner:

- All Contractor fabricated metal surfaces will be cleaned free of grease, rust and foreign matter.
- Phosphating process according to ISO 12476, then painted with several layers to reach a minimum total thickness of 60 microns.
- Phosphate layer will be according this standard as ferrous metals (coating mass per area unit of 0.1 to 1.5 g/m²).

The Contractor shall provide the painting certificates, carrying out a random verification of adherence and thickness values required.

9. DOCUMENTATION

9.1 Documentation provided by Owner

For the bidding process, Owner will send the Contractor the following documentation:

- Contract conditions.
- Technical specifications applicable.
- Cabinet front layout and material list.

Once the order is received, Owner will send the Contractor the detailed drawings for cabinet design and construction.

The Contractor shall facilitate the final documentation detailed in the next section.

9.2 Documentation provided by Contractor

The drawings to be delivered by Contractor as part of the supply will be developed with a CAD program, Intergraph Microstation or AutoCAD. In general, the drawings shall be designed with the latest versions of the software, compatible with the Owner's.

Drawings will be developed according to the Document Management System of the Owner, and it is the responsibility of the Contractor to register them into the system, reporting these activities to the technical manager of the project.

For this purpose, the Owner will provide the necessary information to fulfill the identification forms of the drawings and the identification system of the computer files.

All drawings shall be submitted for approval to Owner, without exempting the Contractor's responsibilities with respect to the proper functionality of the cabinets and consistency of the drawings.

The Contractor shall complete the functional test protocol described in Annex 1, delivering this protocol to Owner before the final inspection of the supply.

Upon completion of the construction and after successful inspection according to Annex 2, the Contractor will deliver to Owner the following technical documentation:

- *Functional test protocol*: annex 1 document filled in and signed.
- *Modifications in working drawings*: these modifications will be delivered in red (additions) and yellow (deletions) format.
- *Constructional drawings*:
 - Index sheet with list of revisions.
 - Front and internal layout of the cabinets, including equipment name tags.
 - Enclosure dimensions, element, accesories and floor anchoring details.
 - Material list, including brand, model and wiring identifiers.
 - Internal wiring with “from-to” wire identification, cross-section and wire colours.
- *Equipment manuals*: for the equipment supplied by Contractor.

DOCUMENTS	TO ENGINEERING DEPARTMENT	TO CONSTRUCTION DEPARTMENT
Functional tests	Computer file (pdf)	One (1) copy, A4 size paper
Working drawings (red and yellow)	Computer file, colour scanned (pdf)	One (1) copy, A3 size paper
Constructional drawings	Computer file with digital signature (dgn, dwg)	Two (2) copies, A3 size paper

Table 5. Documentation delivery

Table 5 shows the format and number of copies to deliver of the technical documentation.

The paper copies for the Construction department will be delivered on-site with the cabinets.

10. QUALITY CONTROL

The Contractor shall have a quality system implemented that meets the requirements of EN ISO 9001, controlling manufacturing processes through testing (mechanical, electrical and chemical) and non-destructive testing.

The Owner or its representative reserves the right to inspect the equipment during manufacture and prior to shipment, and reserves the right to witness production tests. The Owner shall have right of access to the Contractor's manufacturing facilities during Contractor's normal business hours.

10.1 Testing and warranty

The Contractor will guarantee all the supplied equipment and materials according to NI 00.13.01 “General Conditions of the Iberdrola Group for contracting equipment and materials”.

The Contractor shall perform factory tests to insure that the cabinets will maintain its high quality standard of materials and reliability in operation. Tests on each cabinet shall be per IEC 61439-1 Section 11. Annex 1 “Functional tests” must be completed by the Contractor and provided prior to final inspection.

The Contractor shall furnish all labor, materials, power and instrumentation required to conduct all inspections and testing. The Owner or its representative may inspect each cabinet upon completion, and after factory tests have been performed. Whether or not an inspection is made does not relieve the Contractor of any responsibility for manufacturing the cabinets in accordance with this specification.

The Contractor must notify the Owner two weeks prior to shipment and before the cabinets are prepared, to allow for final inspection per Annex 2 "Final inspection". The cabinets cannot be shipped prior to final inspection and acceptance by Owner.

The Owner or its representative reserves the right to reject that which they identify as defective or unsuitable for use, or which is not in accordance with the approved drawings and this specification. The Contractor, at their expense, shall correct that which has been identified as defective or unsuitable.

If a cabinet fails inspection, the Contractor, at their expense, shall ensure corrections are performed which will satisfy all requirements of this specification. The Contractor shall supply a qualified service technician for the length of time required to perform these inspections.

10.2 Packing, storage and transport

All equipment shall be delivered per project schedule. On delivery, the Contractor will be required to provide a truck with a lift gate for unloading. Any equipment needed (including dolly, etc.) to get the control cabinets into the control house will be provided by the Contractor.

The cabinets will be supplied fully equipped with all equipment mounted and wired within the factory. However, fragile equipment that could be damaged during shipping will be packed in their original boxes for transportation.

The cabinets will be wrapped in bubble wrap. In case of special shipments (by sea or air), additionally a wooden crate package will be considered and silica gel bags to avoid condensation of humidity.

The Contractor will be responsible for any damage to the cabinets or equipment during transport and unloading. The damage will be repaired by the Contractor free of charge for Owner.

If for any reason after finish and final inspection, the cabinets cannot be shipped, the Contractor will be responsible for storage until cabinets can be shipped. If necessary, the Contractor may negotiate an alternative storage with Owner.

The Contractor may not proceed to ship the cabinets to site or warehouse without previous authorization of Owner.

10.3 Marking and delivery

Each package shall be marked with the following information:

- Owner / Order number or contract.
- Destination.
- Package number.
- Contractor.
- Indication of the suspension points, fragility, etc.

The data shall be marked clearly and indelibly, or adequately protected to prevent deterioration.

The packing list accompanying the packages will contain the following information:

- Owner / Order number or contract.
- Destination.
- Identification of package weight and dimensions.
- Indication of full or partial shipment.

11. ANNEXES

- Annex 1: "Functional tests".
- Annex 2: "Final inspection".

CONFIDENTIAL

DOCUMENT IDENTIFICATION:		REV.:
PROJECT:		
PREPARED BY CONTRACTOR (if applicable)	PREPARED BY OWNER (if applicable)	
DATE: NAME: SIGNATURE:	DATE: NAME: SIGNATURE:	
<p>This protocol describes the functional tests intended to detect faults in materials and workmanship and to ascertain proper functioning of the manufactured cabinets according to the technical specification MEH-15430 “Protection, Control and Metering Technical Specification”.</p> <p>These verifications shall be carried out by Contractor’s qualified personnel after cabinet assembly.</p> <p>The protocol will be completed and signed by the Contractor and delivered to Owner before final inspection. It will be part of the quality plan between Owner and Contractor.</p> <p>The protocol presents several checkboxes to fill in:</p> <p><i>CORRECT (YES) INCORRECT (NO) NOT APPLY (N/A) OBSERVATIONS (OBS.)</i></p> <p>If the verification point shows a remarkable observation, malfunction or incorrect assembly, the “OBS.” checkbox will be checked and remarks written in the table at the end of each section.</p> <p>Once the incorrect assembly or fault is solved, the CORRECT “YES” checkbox will be marked.</p> <p>The Contractor will fill out only one protocol per order of Control, Protection and Metering cabinets.</p>		
1. CABINET VERIFICATION		
Substation:	<div style="border: 1px solid black; height: 25px;"></div>	
Order number:	<div style="border: 1px solid black; height: 25px;"></div>	
Number of cabinets supplied:	<div style="border: 1px solid black; height: 25px;"></div>	
Type: Transformer control and protection cabinet:	<div style="border: 1px solid black; height: 25px;"></div>	
Feeder control and protection cabinet:	<div style="border: 1px solid black; height: 25px;"></div>	
Bus coupler control and protection cabinet:	<div style="border: 1px solid black; height: 25px;"></div>	
Energy metering points cabinet:	<div style="border: 1px solid black; height: 25px;"></div>	

2. CONSTRUCTIONAL VERIFICATIONS

The following categories will be verified, according to IEC 61439-1 standard:

2.1 Degree of protection of enclosures	CORRECT	N/A	OBS.
---	----------------	------------	-------------

Visual inspection to confirm the degree of protection..... YES ☐ NO ☐ ☐ ☐

2.2 Clearances and creepage distances	CORRECT	N/A	OBS.
--	----------------	------------	-------------

Visual inspection to confirm clearances and creepage distances

in air are 4.5 mm or higher (see note 1)..... YES ☐ NO ☐ ☐ ☐

2.3 Integrity of the protective circuits	CORRECT	N/A	OBS.
---	----------------	------------	-------------

Protection against unintentional direct contact with hazardous live parts... YES ☐ NO ☐ ☐ ☐

Grounding circuit continuity checked in all accessible conductive parts.... YES ☐ NO ☐ ☐ ☐

Screwed and bolted connections checked for the correct tightness..... YES ☐ NO ☐ ☐ ☐

2.4 Incorporation of built-in components	CORRECT	N/A	OBS.
---	----------------	------------	-------------

Installation of built-in components is in accordance with assembly

manufacturing instructions and drawings..... YES ☐ NO ☐ ☐ ☐

2.5 Internal electrical circuits and connections	CORRECT	N/A	OBS.
---	----------------	------------	-------------

Check of the correct wire cross-section of the circuits..... YES ☐ NO ☐ ☐ ☐

Terminal blocks are checked for correct tightness on a random basis..... YES ☐ NO ☐ ☐ ☐

2.6 Terminals for external conductors	CORRECT	N/A	OBS.
--	----------------	------------	-------------

The number, type and identification of terminals is checked..... YES ☐ NO ☐ ☐ ☐

2.7 Mechanical operation	CORRECT	N/A	OBS.
---------------------------------	----------------	------------	-------------

Effectiveness of mechanical actuating elements, interlocks and locks

including those associated with removable parts..... YES ☐ NO ☐ ☐ ☐

Stop arm kit included and checked..... YES ☐ NO ☐ ☐ ☐

(1): According to Annex G of IEC 61439-1: overvoltage category III, equipment rated impulse withstand voltage 4 kV.

However, a minimum distance of 3 mm should be guaranteed by physical measurement.

[illegible]

Insulation resistance devices used for the test:

Equipment		
Vendor		
Serial number		
Date of calibration		

(2): The test is satisfactory if the insulation resistance between circuits and exposed conductive parts is at least 1000 Ω/V per circuit referred to the supply voltage to earth of these circuits.

3.2 Power frequency voltage test

According to IEC 61439-1 standard, the verification of insulation resistance in previous section may be by measurement an alternative to for cabinets with incoming protection rated up to 250 A.

3.3 Wiring and operational performance

All the circuits shall be inspected and an electrical function test will be carried out.

3.3.1 Current metering circuits

All the current metering circuits will be identified. A current of 1 A will be injected to check every single phase of these circuits.

Using a current clamp, the circuits will be tested and checked there is no current circulation in other phases of each circuit.

As an alternative method for the test, a continuity tester may be used.

All the circuits identified in the drawings will be tested.

Current circuits		CORRECT		N/A	OBS.
Winding 1 ($\phi 1$, $\phi 2$, $\phi 3$)		YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Winding 2 ($\phi 1$, $\phi 2$, $\phi 3$)		YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Winding 3 ($\phi 1$, $\phi 2$, $\phi 3$)		YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Winding 4 ($\phi 1$, $\phi 2$, $\phi 3$)		YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Winding 5 ($\phi 1$, $\phi 2$, $\phi 3$)		YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.3.2 Voltage circuits

All the voltage metering circuits will be set to a voltage of 110 V AC between phases or $110 / \sqrt{3}$ V phase to earth.

Each circuit will be tested individually and checked that there is no voltage in the other circuits.

As an alternative method for the test, a continuity tester may be used.

All the circuits identified in the drawings will be tested.

Voltage circuits		CORRECT		N/A	OBS.
Winding 1 ($\phi 1, \phi 2, \phi 3$)	<input type="text"/>	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>
Winding 2 ($\phi 1, \phi 2, \phi 3$)	<input type="text"/>	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>
Winding 3 ($\phi 1, \phi 2, \phi 3$)	<input type="text"/>	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>
Winding 4 ($\phi 1, \phi 2, \phi 3$)	<input type="text"/>	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>
Winding 5 ($\phi 1, \phi 2, \phi 3$)	<input type="text"/>	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>

3.3.3 Polarities

To check the polarities and supplying DC current, a rectifier shall be used with:

- Output voltage: 125 V DC +10 - 20%
- Voltage ripple < 3 %

The terminal blocks for DC power supply will be identified, and the positives and negatives will be wired according the drawings. With all the miniature circuit breakers opened, the following verifications will be carried out:

1. Correct polarity of all circuit breakers.
2. One breaker will be closed with the others opened. The corresponding circuit will be checked for proper polarities. In the other circuits, there must be zero voltage.
3. This verification will be carried out with the rest of miniature circuit breakers.

Polarities		CORRECT		N/A	OBS.
Test of the miniature circuit breakers polarities.....	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Verify that all circuits are correctly polarized.....	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.3.4 Close and tripping circuits

To simulate the high voltage breaker, a latching relay will be wired to the circuit simulating the breaker's closing and tripping coils. The auxiliary contacts of this relay shall simulate the contacts of the high voltage breaker, according to the drawings.

The auxiliary contacts of the latching relays must operate when the auxiliary relay coils are activated or deactivated. To do so, bridges between terminal blocks or protection relay outputs may be done.

As an alternative method for the test, a continuity tester may be used.

3.3.4.1 Breaker closing circuits

All the wired contacts in the circuits will be verified:

- Interlocking.
- Closing command and reclose.
- Coil supervision circuit will be verified using a continuity tester.

Breaker closing circuit		CORRECT	N/A	OBS.
Closing circuit verification.....	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>
Continuity test of the coil supervision circuit.....	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>

3.3.4.2 Breaker tripping circuits

All the wired contacts in the circuits will be verified:

- Tripping commands
- Tripping operation successful.

Breaker tripping circuit		CORRECT	N/A	OBS.
Tripping circuit verification.....	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>
Continuity test of the coil supervision circuit.....	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>

3.3.5 Disconnecter circuits

To simulate the high voltage disconnectors, a latching relay will be wired to the circuit. The auxiliary contacts of this relay shall simulate the contacts of the disconnector, according to the drawings.

As an alternative method for the test, a continuity tester may be used.

All the wired contacts in the circuit will be verified:

- Interlocking.
- Open and close commands.

Disconnector circuits		CORRECT	N/A	OBS.
Disconnectors circuit verification	YES	<input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>

3.3.6 Inputs and outputs of the protection and control relays

The input circuits of the protection and control relays shall be checked measuring a correct positive on the terminals of the unit:

- Actuating the corresponding auxiliary relays.
- Wire bridges may be used in terminal blocks.
- Cabinet push buttons may be used.

Outputs will be forced making a positive in the terminals of the protection and control units, so the complete circuit is verified.

Input and output signals of the control and protection relays		CORRECT	N/A	OBS.
Protection and control relays activate properly.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Check input and output circuits of the protection and control relays.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.3.7 Other circuits

3.3.7.1 Transformer circuits (interlocking relays and tap changer)

A functional verification of the mechanical relays that protect the transformers will be carried out (relays 86, 63B, 63J and 87), checking their activation and reset commands.

Transformer circuits (86 relay and tap changer)		CORRECT	N/A	OBS.
Transformer circuits (86 relay and tap changer) verification.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.3.7.2 Signaling and alarm circuits

The continuity of these circuits will be checked closing the alarm and signaling contacts, actuating the main relay or breaker that changes the state of the contact.

Signaling and alarm circuits		CORRECT	N/A	OBS.
Signaling and alarm circuits verification.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OBSERVATIONS

DOCUMENT IDENTIFICATION :		REV.:
PROJECT :		
PREPARED BY CONTRACTOR (if applicable)	PREPARED BY OWNER (if applicable)	
DATE: NAME:	DATE: NAME:	
SIGNATURE:	SIGNATURE:	
<p>This document describes the final inspection to be carried out in the manufactured cabinets according to the technical specification MEH-15430 “Protection, Control and metering Technical Specification”.</p> <p>The protocol will be filled out by Purchaser’s personnel during the final inspection at the Contractor’s factory.</p> <p>This protocol shall register the verifications and possible deficiencies detected by the Purchaser in the supplied cabinets. The Contractor shall bear all costs and expenses, including applicable overheads, for corrective work needed.</p> <p>The protocol presents several checkboxes to fill in:</p> <p><i>CORRECT (YES) INCORRECT (NO) NOT APPLY (N/A) OBSERVATIONS (OBS.)</i></p> <p>If the verification point shows a remarkable observation, malfunction or incorrect assembly, the “OBS.” checkbox will be checked and remarks written in the table at the end of each section.</p> <p>Once the incorrect assembly or fault is solved, the CORRECT “YES” checkbox will be marked.</p> <p>It is only necessary to fill out one protocol per order of Control, Protection and Metering cabinets.</p>		

1. CABINET VERIFICATION

Substation:

Order number:

Number of cabinets inspected:

Type: Transformer control and protection cabinet:

Feeder control and protection cabinet:

Bus coupler control and protection cabinet:

Energy metering points cabinet:

OBSERVATIONS

2. VISUAL INSPECTION

2.1 Enclosures		CORRECT	N/A	OBS.
Frame design of folded and welded steel sheets, total thickness of 2.5 mm	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rear, roof and side plates of steel sheet minimum 1.5 mm thick.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mounting plate of steel sheet minimum 2 mm thick	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protection degree IP-54.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enclosure painting RAL-7032 (1).....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dimensions (height / width / depth): 2200 mm / 800 mm / 800 mm.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plinth dimensions (height): 100 mm.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slotted plinth painting RAL-7022.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Swing rack pivots on the left side and opens 170 °.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Front door with tempered glass or polycarbonate cutout provided.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cabinet door handles are push button type (2).....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Paint is proper type without scratches or runs.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Paint is without cracks.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The doors open and close properly.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Non insulated elements are protected against indirect contacts, for example				
ABB E2x6/13.EES1T.V0 terminal blocks of 13 mm width.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cautions or warning of hazards provided on non insulated elements.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cabinets are equipped with removable eyebolts.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The cabinet is cleaned of oil and film, with uncluttered look.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A vinyl sticker with the Owner's logo is placed at the top right of the front door.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OBSERVATIONS

2.2 Design

CORRECT

N/A

OBS.

Front layout and material list according to drawings:

- ☐ Yes
☐ No. Reasons →

Equipment layout is arranged according to the drawings.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Terminal blocks vertically installed on mounting plate and cabinet left side.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Current (I), voltage (V) and incoming supply (X, Y) terminal blocks are properly mounted (3).....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Distance between wireways and terminal blocks not less than 50 mm	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A vertical 80 x 120 mm wireway is installed for the external wiring.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A horizontal 8 x 120 mm wireway is installed below the external wiring terminal blocks to facilitate distribution and arrangement of wires.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A galvanized steel profile is installed to allow installation of clamps for the external wiring cables anchoring	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Galvanized anchoring profiles mounted at 250 mm above the floor	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Minimum distance of 180 mm between horizontal wireways on the mounting plate, so connections to auxiliary relays and equipment are easily arranged.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Auxiliary relays are placed at an approx. distance of 15 mm between them.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To facilitate wiring to protection relays and its subsequent maintenance, the rear of the swing rack will be equipped with a set of plastic wireways.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bottom with removable gland plates able to withstand a weight of a person.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fiber optic patch panel at bottom left side of the cabinet, allowing twenty (20) fiber connections and equipped with a transparent and removable cover.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protection relay terminal blocks are mounted and centered on the non-hinged end of the swing rack.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Screw connections on ABB E2x6/13.EES1T.V0 terminal type are done between the conductive plate and the first nut.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nameplates and labels of equipment and terminal blocks are correctly placed.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mounting plate labels consist of the two letter identifier wiring scheme and are installed on the upper right side of the equipment, being visible.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
All the control terminal blocks are equipped with disconnect slide or blade.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Terminal blocks are numbered consecutively from bottom to top.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Each terminal is marked using a clear and permanent marking system.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Terminal blocks shall be grouped by name and functionality	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Partition plates are installed to allow visual and electrical separation of the different terminal block groups.....	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In energy metering point cabinets, voltage and current terminal blocks are protected with sealable and transparent covers.....

YES ☐ NO ☐ ☐ ☐

2.3 Grounding	CORRECT	N/A	OBS.
---------------	---------	-----	------

At the front bottom and left side of the cabinet, a 30 x 5 mm thick copper ground bar shall be installed, at a distance of 300 mm above the floor level.....

YES ☐ NO ☐ ☐ ☐

Joints between sections of the ground bar made with minimum of two screws

YES ☐ NO ☐ ☐ ☐

A ground terminal suitable for anchoring a 95 mm² cable, is placed in one end of the ground bar.....

YES ☐ NO ☐ ☐ ☐

All protection relay housings and equipment are connected to ground, including cabinet steel plates.....

YES ☐ NO ☐ ☐ ☐

Glass door and swing rack are connected to cabinet's grounding.....

YES ☐ NO ☐ ☐ ☐

The ground bar is drilled and tapped on its axis and along its length with M6 screws every 4 cm with the corresponding nuts and lockwashers

YES ☐ NO ☐ ☐ ☐

Grounding of equipment housings in the swing rack is located at the top of the swing rack, consisting of a copper plate connected to the cabinet's ground with a 6 mm² cross-section cable.....

YES ☐ NO ☐ ☐ ☐

2.4 Equipment identification	CORRECT	N/A	OBS.
------------------------------	---------	-----	------

Adhesive backed laminated PVC nameplate is provided on the front of the cabinet with identification of 250 x 50 mm and 13 mm height white letters.....

YES ☐ NO ☐ ☐ ☐

Contractor's label is marked in a durable manner and located at the bottom right side of the glass door

YES ☐ NO ☐ ☐ ☐

Nameplates installed in the front of the swing rack are installed just below the equipment

YES ☐ NO ☐ ☐ ☐

The labels of equipment consist of the two letter identifier wiring scheme shown in the wiring diagrams and the functional identifier of the drawings.....

YES ☐ NO ☐ ☐ ☐

Labels consist of adhesive black PVC plates of 1.5 mm thick, 40 x 15 mm for nameplates in the front of the cabinet and 25 x 15 mm for internal labels.....

YES ☐ NO ☐ ☐ ☐

Nameplates and labels are adhesive, not screwed to the steel plate.....

YES ☐ NO ☐ ☐ ☐

Nameplates and labels are mounted below, not on the equipment.....

YES ☐ NO ☐ ☐ ☐

2.5 Internal wiring	CORRECT	N/A	OBS.
Insulation colour: grey (5).....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grounding circuits colour: yellow-green (5).....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There shall be no splices or intermediate derivations in wires.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tubes and wireways shall not be loaded above 75 % of their capacity.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wires are arranged in a way they are not too tight and not too long, to avoid cable clutter.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ducts for the optical fiber cables are be independent of control wiring ducts.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fiber optic is arranged in wireways in swing rack and flexible tube to cabinet.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tubes are be fixed to the cabinet by clamps of a suitable diameter	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Each conductor shall be marked with a permanent wire marking system identifying the "from-to" wire designation	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wire markers are read from left to right and printed in one or two rows.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cable terminations have coloured and halogen-free sleeves (6).....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wire terminations are insulated and made with ratchet type crimping tools.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The number of wire terminations per termination point shall not exceed two (4)..	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voltage, current, power supply signals in bolt connection type terminal blocks and protection relays are made with insulated ring type cable lugs.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Auxiliary relay sockets and digital input and output protection signals with bolt connections are made with insulated fork cable lugs.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Terminal blocks with screw connection are wired using pin or flat pin cable lugs according to requirements.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When two flat pin cable lugs must be connected in the same terminal block both will be conveniently mounted back to back	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
All the wire markers and colour sleeves are visible, shall not be placed inside any cable duct or wireway.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protection relay terminal blocks shall be mounted and centered on the non-hinged end of the swing rack, connection side to the protection relay will be identified as (PI) and the connection side to the cabinet as (PE).....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voltage, current metering circuits and supply circuits of the miniature circuit breakers are wired with 2.5 mm ² cross-section.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Control, command and other circuits are wired with a 1.5 mm ² cross-section.....	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In energy metering point cabinets, voltage and current measuring wired with a minimum cross-section of 4 mm ²	YES <input type="checkbox"/> NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.6 Lighting, power socket and heating	CORRECT	N/A	OBS.
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Thermostat and heating resistance installed.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Schuko socket with grounding terminal mounted.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Low consumption lamp activated by a door actuated switch.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.7 Documentation	CORRECT	N/A	OBS.
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The cabinets are provided with the constructional drawings (front layout, material list and internal wiring) signed by the technical manager of the project.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Red and yellow modifications are delivered to technical manager of the project.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The number of paper copies is correct according to MEH-15430.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Annex 1 protocol has been completed with succesful results and signed by the Contractor.....	YES <input type="checkbox"/>	NO <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OBSERVATIONS

3. NOTES

- (1) RAL-7035 colour will only be accepted for interior surfaces of the cabinets.
- (2) Cabinet door handles shall be equipped with push button type for opening, without any key locking system.
- (3) In the protection and control cabinets, the terminals blocks corresponding to incoming supply circuits, current and voltage metering, will be mounted vertically on the bottom left side of the cabinet.
In energy metering point cabinets, all the terminal blocks shall be installed vertically, starting at the bottom of the mounting plate.
- (4) The number of wire terminations per termination point shall not exceed two, in terminal blocks with screw connection types, flexible push-in bridging system shall be used to avoid wiring two cables in the same clamp.
- (5) Internal wiring cables shall be unipolar, flexible class 5, complying with IEC 60228 and NI 56.10.00. The wire shall be manufactured with tinned, stranded copper conductors and insulated with cross-linked polyethylene compound or equivalent synthetic, heat resistant. Internal wiring must be halogen free, fire and flame retardant, with reduced smoke and opacity emissions.

(6)

AC CIRCUITS	COLOUR
Voltage	Black
Current	White

Colour identifications for AC circuits

DC CIRCUITS	COLOUR
Direct positive	Red
Direct negative	Blue
Not direct positive or negative	Green
Transducer outputs	Yellow

Colour identifications for DC circuits