

Customer					
Project					
<p>220/30 kV end-user substation</p> <p>Technical Offer</p>					
00					
Rev.	Description	Date	Prepared	Controlled	Approved

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- Annex 1: HV SS Equipment
- Annex 2: MV SS Equipment
- Annex 3: Protection and Control System for SS
- Annex 4: Layout and Sections for SS
- Annex 5: Single Line diagram for SS

1 INTRODUCTION

The present Technical Specification refers to the following scope of work:

- Design, supply, erection, test and commissioning of a 220/30kV Substation side end user

1.1 Documentation and information of reference

The definition of the characteristics and the amounts of equipment and materials described in the present technical specification is based on the following documentation:

- **220/30kV SS single line diagram n° 01.02.00**
- **220/30kV SS layout n° 01.02.01**
- **Project technical specification:**
 - **“Relazione tecnica stazione “Su Scioffu”” – n° 03.01.06**
 - **“Relazione tecnica progetto preliminare “Su Scioffu”” – n° 03.01.03**

Therefore the characteristics and the amounts of the present technical specification will be verified and, where necessary, modified in order to adapt them to requirement of the final design.

1.2 Reference documents and standards

The substations and its equipment shall be designed, manufactured, erected and tested according to the following main standards and laws:

- IEC standards
- ISO standards
- DPR 547 dated 27 April 1955
- Laws 46/90, 626/94
- ISPESL regulations

In particular:

IEC-60056	HV Alternating currents Circuit Breakers
IEC-60439	LV Switchgear and control gear assemblies
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV
IEC-60947	LV switchgear and control gear
IEC-60227	Electrical equipment within LV systems
EN-50164, 61663	Lightning protection system
IEC-60076	Transformers and reactors
IEC-60831	Specifications for capacitors
IEC-60354	Loading guide for oil-immersed power transformers

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IEC-60296 On-Load tap-changers

1.3 Site and environmental conditions

- Height above sea level <1000 m
- Climate moderate
- Environment temperature -5÷+40 °C
- Relative humidity 90 %
- Wind velocity 30 m/s
- Seismic 0.2 g
- Soil carrying capacity >= 3kg/cmq

1.4 Electrical technical characteristics

- Nominal voltage 220 kV
- Maximum system voltage 245 kV
- Rated Frequency 50 Hz
- Power frequency withstand voltage 460 kV
- Impulse withstand voltage 1050 kV
- Nominal current: 2000 A
- Rated short duration current 40 kA x 1 s
- Specific creepage distance 25 mm/kV

HV equipment is positioned according to CEI 11-1 considering the clearance distances foreseen for the system and impulse voltage values of 245 kV and 1050 kV.

In particular:

- Minimum height from ground of live parts: 4500 mm
- Distance between phases axis of equipment: 2200 mm

It is hereby guaranteed that all supplied equipment shall be adequate to the state of the art and of the best quality, and suitable for a long-term safe operation in the locations foreseen.

2 220/30kV end-user Substation

2.1 Technical description of SS layout

SS is equipped with:

- One (1) bay for incoming line composed of:
 - One (1) three-phase disconnecting switch with grounding blades
 - Three (3) capacitive voltage transformers
 - One (1) circuit breaker, three-pole operation
 - Three (3) current transformers
 - Three (3) inductive voltage transformers for fiscal measures

- Two (2) bays for power transformers each composed of:
 - One (1) three-phase disconnecting switch without grounding blades
 - One (1) circuit breaker, three-pole operation
 - Three (3) current transformers
 - Three (3) surge arresters
 - One (1) 50/63MVA power transformer
 - One (1) marshalling kiosk

- One (1) busbars system composed of:
 - Six (6) post-insulators
 - One (1) three-phase grounding blades
 - Three (3) capacitive voltage transformers

- Metallic structures and HV terminals and connections
- One (1) MV switchgear
- Two (2) MV/LV auxiliary transformers
- Panels board for Protection and Control system
- Panels board for RTU for Local control and telecontrol
- One (1) work station for local control
- One (1) disturbance recorder
- Two (2) AC/CC distribution panels and auxiliary systems (rectifiers and battery)
- One (1) energy measure panels for HV side
- Nine (9) metering panels for outgoing MV lines
- LV-MV Cables
- One (1) generator set
- Internal lighting system and electrical sockets for SS building
- External lighting system
- Fire detection system
- Intrusion detection system
- Control access system

- HVAC system
- Secondary earthing system
- Only design for primary earthing system

2.2 Battery limit of supply

The battery limit of supply is the following:

- 220kV Terna SS side:
 - Metallic structures for cable terminals – included
 - Cable terminals – not included
 - Connection of the fibre optic to the equipment of SS – not included
- MV side:
 - MV switchgear - included
 - MV outgoing lines with terminals for solar plant - not included
- LV side:
 - Distribution panel and LV cables between equipment in the scope of supply – included
 - Connection of the fibre optic to the equipment of solar plant - not included
- Control, protection and communication system:
 - Terminal blocks inside the Protection and Control panels - included
 - Control cables between equipments and devices included in the scope of supply – included
 - Control cables between equipments and devices not included in the scope of supply – not included

2.3 Exclusions from scope of supply

- Supply and installation of primary earthing system
- Design and execution of civil works
- Other HV equipment requested by Enel/Terna at energy delivery point (i.e. surge arrester, current transformers, disconnecting switch, etc)
- Civil works (i.e. building, foundations, etc) for equipment requested by Enel/Terna at energy delivery point
- Topographical and height survey for the ground
- Costs for the works for the presence of other services (cable or overhead power line, water pipeline, etc) in the ground where SS will be built
- Design, supply, installation and commissioning of optic fibres or other cables for connecting other telecommunication system not included in ABB offer
- Cost of Client's inspector to factory tests
- Training

- Electrical Energy and water for construction site
- Cost for Permissions, authorizations and expropriations.
- Ministerial, Regional and Municipal Permits in order to get license to perform the works
- Property inquiry license in order to get approval from the owner of the site to perform the works
- Any other costs linked to archeological and property goods safeguard
- Transportation and neutralization of all polluted materials coming out from excavation and/or other working activities
- Any other compensation (if any) for Terna/Enel for the use of “Progetto Unificato Enel Direzione Costruzioni”.
- Spare parts and any other materials or service not mentioned and not included in our offer.

2.4 Technical characteristics of equipment

2.4.1 HV SS equipment

2.4.1.1 *DISCONNECTOR with grounding blades*

- Manufacturer: Coelme or equivalent
- Type TCB-E 245-2000
- Standard: IEC 62271-102
- Maximum system voltage: 245 KV
- Rated current: 2000 A
- BIL: 1050 kV
- Power frequency withstand voltage (1 min.): 460 kV
- Rated short time withstand (1s):
 - RMS 40 kA
 - Peak value 100 kA
- Line blades operating mechanism: with motor
- Grounding blades operating mechanism: with motor
- AUXILIARIES
 - Rated voltage 110Vcc
 - Line auxiliary contacts: 6NO+6NC
 - Grounding auxiliary contacts: 4NO+4NC

2.4.1.2 *DISCONNECTOR without grounding blades*

- Manufacturer: Coelme or equivalent
- Type TCB 245-2000
- Standard: IEC 62271-102
- Maximum system voltage: 245 KV
- Rated current: 2000 A
- BIL: 1050 kV
- Power frequency withstand voltage (1 min.): 460 kV
- Rated short time withstand (1s):
 - RMS 40 kA
 - Peak value 100 kA
- Grounding blades operating mechanism: with motor
- AUXILIARIES
 - Rated voltage 110Vcc
 - Line auxiliary contacts: 6NO+6NC

2.4.1.3 *GROUNDING BLADES for busbar*

- Manufacturer: Coelme or equivalent

- Type ES 245-40
- Standard: IEC 62271-102
- Maximum system voltage: 245 KV
- BIL: 1050 kV
- Power frequency withstand voltage (1 min.): 460 kV
- Rated short time withstand (1s):
 - RMS 40 kA
 - Peak value 100 kA
- Grounding blades operating mechanism: with motor
- AUXILIARIES
 - Rated voltage 110Vcc
 - Grounding auxiliary contacts: 4NO+4NC

2.4.1.4 *CIRCUIT BREAKER*

- Manufacturer: ABB
- Type: LTB 245E1 – BLG 1002A
- Standard: IEC 62271-100
- Frequency 50 Hz
- N° poles: 3
- Insulation: SF6
- Maximum system voltage: 245 kV
- Rated Voltage: 220 kV
- Rated current: 2000 or 1000 A
- Rated short-time withstand current 50 kA
- Rated making current 125 kA
- Rated short circuit duration 1 s
- Short duration power frequency withstand voltage 1 min: 460 kV
- Lightning Impulse withstand voltage 1/50 micros: 1050 kV
- Operating mechanism (spring type) BLG1002A-three pole operated
- Rated operating sequence acc. to IEC O - 0.3 s - CO -1 min – CO
- AUXILIARIES
 - Motor 110 Vcc
 - Operating coils 110 Vcc
 - Auxiliary relay 110 Vcc
 - Heater 230 Vca
- Auxiliary contacts: 9NO+9NC

2.4.1.5 *INDUCTIVE VOLTAGE TRANSFORMER*

- Manufacturer: Arteche or equivalent
- Type UTF 245

- Standard: IEC 60044-2
- Maximum system voltage: 245 kV
- Transformer ratio: 220000: $\sqrt{3}/100:\sqrt{3}$ V
- Performance: 30 VA Cl. 0.2 UTF
- Rated voltage factor: 1,5
- Short duration power frequency withstand voltage 1 min: 460 kV
- Lightning Impulse withstand voltage 1/50 micros: 1050 Kv

2.4.1.6 CAPACITIVE VOLTAGE TRANSFORMER

- Manufacturer: ABB
- Type: CPB 245
- Standard: IEC 60044-2
- Maximum system voltage: 245 kV
- Transformer ratio: 220000: $\sqrt{3}/100:\sqrt{3}$ V/100:3 V
- Performance:
 - protection core 1: 30 VA 3P
 - protection core 2: 30 VA 3P
- Rated voltage factor: 1,9
- Short duration power frequency withstand voltage 1 min: 460 kV
- Lightning Impulse withstand voltage 1/50 micros: 1050 kV

2.4.1.7 CURRENT TRANSFORMER

- Manufacturer: ABB
- Type: TG 245
- Standard: IEC 185
- Insulation: SF6
- Maximum system voltage: 245 kV
- Rated Voltage: 220 Kv
- Short duration power frequency withstand voltage 1 min: 460 kV
- Lightning Impulse withstand voltage 1/50 micros: 1050 kV
- Rated short-time withstand current: 50 kA
- Rated primary transformer ratio: 200-400 A
- Rated secondary transformer ratio: 5-5-5 A
- Core number: 1 / 3
- Burdens:
 - Metering core 1: 20 VA Cl 0.2
 - Metering core 2: 20VA-5P10
 - Protection core 1: 20VA-5P10

2.4.1.8 SURGE ARRESTER

- Manufacturer: ABB
- Type: EXLIM Q 192 EH 245
- Reference Standards: IEC 99-4
- Insulation: normal
- Rated Voltage: 192 kV
- Max. Residual Voltage with current wave 8/20 μ s:
 - 5 kA 429 kV
 - 10 kA 452 kV
 - 20 kA 497 kV
- Max. Residual Voltage with current wave 30/60 μ s:
 - 0,5 kA 369 kV
 - 1 kA 381 kV
 - 2 kA 396 kV
- Discharge class according to IEC standards: 3
- Surge counter included type EXCOUNT-A

2.4.2 Power Transformer (Preliminary design)

- Type Outdoor
- Rated Power [MVA] 50/63
- Cooling ONAN/ONAF
- Primary Voltage [V] 220.000
- Primary Tapings +-10x1 % on load
- Secondary Voltage [V] 30.000
- Impedance: 15 %
- Load losses at 75°C: 295kW
- No Load losses: 42kW

For details see Annex I.

2.4.3 Metallic structures, HV terminals and connections

It will be foreseen the following materials:

- All HV connection materials i.e. terminal connectors, aluminum tube, clamps. All connection materials foreseen are permanent corona-free connections with sufficient thermal/mechanical strength for continuous and short circuit condition.
- All metallic tubular structures for HV equipment (calculation according to D.P.R. 1062 dated 21 June 1968; hot deep galvanization shall be carried out according to CEI 7-6 fasc. 239 standard)

2.4.4 MV switchgear

It will be foreseen a 30 kV GIS insulated switchgear type ZX1.2.

The switchgear composition is:

Typical unit	N°
Incoming line units	2
Junction unit	1
Outgoing line units	6
Measurement unit	2
Auxiliary Transformer unit	2

For details see Annex II.

2.4.5 MV/LV auxiliary transformer

It will be foreseen N°2 auxiliary transformers 30/0,4 kV 100 kVA

General Characteristics

- Manufacturer: ABB or equivalent
- Type: 3Ph
- Rated Frequency: 50 Hz
- Insulation: resin
- Rated Power: 100 kVA
- Rated voltage (no load):
 - MV 30 kV
 - LV 0.40 kV
- Tap changer no load: +/- 2 x 2.5 %
- Winding:
 - MV Winding: Delta
 - LV Winding: Star
- Vector group: Dyn11
- Vsc% 4%

2.4.6 Protection and Control system


It will be supplied an electrical control and monitoring system with the following characteristics:

ELECTRICAL CONTROL AND MONITORING SYSTEM

	<i>Q.ty</i>
Y Protection and Control Panel	1
In One Panel 800x800x2200 IP41:	
Incoming Feeder	
- REC650 Control and Monitoring relay (27/59-59N-21)	1
- RXMVB 4 – Lockout Relay (86)	1
- RXMS 1- Tripping or trip-free Relay (94)	1
Transformer 1	
- REC650 Control and Monitoring relay (27/59-59N-50/51-50N/51N-81><)	1
- RET650 Monitoring relay (87T-90-50BF)	1
- RXMVB 4 – Lockout Relay (86)	1
- RXMS 1- Tripping or trip-free Relay (94)	1
Transformer 2	
- REC650 Control and Monitoring relay (27/59-59N-50/51-50N/51N-81><)	1
- RET650 Monitoring relay (87T-90-50BF)	1
- RXMVB 4 – Lockout Relay (86)	1
- RXMS 1- Tripping or trip-free Relay (94)	1
n.°1 RXSF1 – (80)	1

CONTROL SYSTEM

Y RTU560 for telecontrol with ENEL	1
In One Panel 800x800x2200 IP41	
RTU560	
- CSR 01 Basic Rack	1
- Ext. Sub-Rack 19 slots	1
- Supply Unit x RTU560 (560PSU01)	1
- Supply Unit x RTU560 (560PSU02)	2
- CPU CMU05, 4 ser 2 Ethernet	3
- Basic Licence	2
- HMI Licence (Incl. PLC/Archives Licence)	1
- Analog Input (23AE23)	2
- Binary Input (23BE23)	6
- Binary Output (23BA20)	1
- Power supply unit per 23BA20	1
- Meinber M300 GPS	1

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- Router 2811	2
- Switch HP 2524	2
- Module 560 CVT 02 R0001 (CT/VT Interface 110 Vac, 1A)	3
- Switch Ruggedcom	1
- REC670 – Disturbance Recorder	1
Y SCADA INTEGRATE HMI System (supplied loose)	1
- Industrial PC	1
- Monitor	1
- Mouse + Keyboard	1
- Deskjet Printer	1
- RCE Printer	1
Y Disturbance recorder	
- PC Desktop + Monitor LCD	1
- Mouse + Keyboard	1
- Modem ISDN	1
- PCM600 basic software for disturbance recorder	1
Y Switch interface with MV	
- Switch Ruggedcom	1

PROJECT ACTIVITY

Y Commissioning

- Commissioning (20days)
- Spare Parts for Commissioning (One relè for type)


It shall be supplied also the Electrical protection coordination and selectivity study.

For details see Annex III.

2.4.7 AC/CC distribution panel and auxiliary systems

It will be supplied:

- N°1 AC/DC distribution panel with the following characteristics:
 - AC Distribution: three-poles miniature circuit breakers (MCB) from 10 to 25 A
 - DC Distribution: two-poles miniature circuit breakers (MCB) from 10 to 25 A
- N°1 rectifier/battery charger 60A – 400Vac/110Vcc, suitable for automatic recharging of the battery and, at the same time, for feeding the 110 V d.c. users, directly connected in parallel to the battery.

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- N°1 sealed lead battery; the battery shall be mounted in a panel.

2.4.8 Energy Measurement panel

It shall be supplied:

- N°1 Energy Meter (class 0,2) for HV metering
- N°6 Energy Meters for MV metering
- Cables and accessories

2.4.9 LV-MV Cables

The following MV cables will be supplied and installed:

- 1x400mm² type RG7H1R 18-30kV to connect the two power transformers to MV main distribution board.
- 1x70mm² type RG7H1R 18-30kV to connect the MV main distribution board to two Auxiliary MV/LV transformers.

All LV cables, that connect the equipment of the scope of supply, are included in our offer.

2.4.10 Generator set

It shall be supplied an emergency generator set with the following characteristics:

- Rated voltage: 400 V
- Rated Power 20 kVA
- Type low noise
- Tank 46 l
- Autonomy 10 h

2.4.11 Internal lighting system and electrical sockets for SS building


For the SS building they shall be supplied lighting and electrical sockets systems with the following materials:

- Fluorescent lamps type 1x36W for ordinary lighting
- Fluorescent lamps type 1x11W with micro-inverter for emergency lighting (1h autonomy)
- Standard sockets type 2P+T 230V 10-16A
- Switches
- Cables, conduits and accessories

2.4.12 External lighting system

It shall be supplied an external lighting system with the following equipment:

- fibreglass poles with aluminum lamps with power 150W and/or 400W

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- Cables and accessories

2.4.13 Fire detection system - Intrusion detection system - HVAC system

It shall be supplied a fire detection system with the following equipment:

- control unit with battery
- smoke detectors
- Cables and accessories

It shall be supplied an intrusion detection system with the following equipment:

- control unit with battery
- badge connecting device
- detectors with magnetic contacts
- external siren
- Cables and accessories

It shall be supplied n°1 HVAC systems for LV and telecommunication panels room with the following characteristics:

- Cooler power: 8150 BTU/h
- Electrical Power 850 W
- Noise level 37DBA
- Cooler R22

2.4.14 Secondary and primary earthing system

It will be foreseen the secondary earthing system.

For the underground earthing system (primary earthing system) ABB will provide only the design. The execution and the supply of primary earthing system will be included in the scope of supply of the company who will realize the civil works.

At the end of erection of all substation, measuring of step and touch voltages will be done to verify they are not exceeding the limit values given in the standards.

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2.5 Erection, Commissioning and technical documentations

2.5.1 Erection

All the activities required to bring the substations completely working shall be provided. The erection & mounting activity shall be carried out in according to the CEI & IEC standards.

2.5.2 Commissioning & testing

The commissioning and testing of the HV equipment shall be carried out in accordance with the following standards:

- CEI 42-4
- CEI 42-5
- fasc. 405: ac circuit breaker with rated voltage > 1000 V
- fasc. 469: ac disconnecting and earthing switches with rated voltage > 1000 V
- fasc. 236: current transformers

Type test are not included, reports on similar tests and test certificates will be delivered. Routine tests will be performed according to IEC standard.

The site commissioning shall be carried out the completion of the erection activity of the single functional unit. Therefore, all the equipment, wiring and HV&MV elements of each functional unit shall be tested & checked at the same time.

All on site verification needed to prove the complete functionality of the system will be performed, namely:

- dimensional checks (check of insulation and clearance distances, levelling, etc....)
- operating checks for controls, indications, alarms, interlocks, etc....
- measuring of insulation resistance for LV panels and circuits
- check of continuity of protection conductor circuits

2.5.3 Engineering documentation

The following documentation shall be provided:

- General S/S technical table
- S/S Single line diagram
- Main Equipment list
- S/S Layout with section and plan views
- Logic block diagram

- Overall dimensional drawings of metallic structures
- Static and dynamic table on foundations
- Earthing system calculation
- Equipment overall dimensional drawings
- Earthing system layout
- Lighting system layout
- Functional wiring diagrams
- Shipping documents
- Routine test reports
- Installation and maintenance manual for equipment
- Protection Setting table
- Start up & Commissioning report