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Title: Hornsea Offshore Wind Farm Technical Specification for Procurement - 400VAC UPS =BRU	DCC:				
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Client document no:
HOW01=V01BRU&EEC001

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1 General information

Please notice that this specification is valid for 3 substations:

=HOW01Z11

=HOW01Z12

=HOW01Z13

This means that each system must be built in a total of 3 times.

The offshore wind farm is located in United Kingdom, approximately 120 km east of Grimsby.

The purpose of this document is to define the specification for: 400 VAC UPS 1 & 2 And Battery Bank for UPS 1 & 2.

Reference designation (tag):

Tag:	Description
=BRU11UC001-UC001	400VAC UPS 1
=BRU11CC001-CC001	Battery Bank for UPS 1
=BRU21UC001-UC001	400VAC UPS 2
=BRU21CC001-CC001	Battery Bank for UPS 2

Location:

UPS - LV, Utility and UPS Room 1 & 2.

Batteries – Battery Room 1 & 2

1.1 Design Lifetime

Inverter/UPS System: 26 years

Battery System: 13 years

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1.2 Standards

Standards:
EMC Directive 2014/30/EU
RoHS Directive 2011/65/EU
LVD Directive 2006/95/EC
EN 50272 Safety requirements for secondary batteries and battery installations
EN 60038 IEC standard voltages
EN 60044 Instrument transformers
EN 60068 Environmental testing
EN 60092 Electrical installations in ships
EN 60255 Measuring relays and protection equipment
EN 60332 Test on electric cables and optical fibre cables under fire conditions
EN 60364 Low voltage electrical installations - Protection for safety and protection against electric shock
EN 60529 Degrees of protection provided by enclosures (IP code)
EN 60896 Stationary lead-acid batteries
EN 60947 Low-voltage switchgear and control gear
EN 61000 (EMC) Electromagnetic compatibility (EMC)
EN 61439 Low-voltage switchgear and control gear assemblies
EN 61892 Mobile and fixed offshore units - Electrical installations
EN 62040 Uninterruptible power systems
EN 62305 Lightning Protection systems
EN/ISO 13849 Safety of machinery – safety related parts of control systems
IEC 60331 Fire-Resisting Characteristics of Electric Cables
IEC 60617 Graphical symbols for diagrams
IEC 61641 Low-voltage switchgear and control gear assemblies – guide for testing under conditions of arcing due to internal fault
IEC 81346 Structuring principles and reference designations
DNV GL OS-J201 Offshore Substations for wind farms
DNV-OS-D201 Electrical Installations

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1.3 Supporting documents

List of documents supplied by Semco Maritime:

Document number:	Document title:	Revision:
1030469-SEMCO-E-LA-0019 (HOW01=Z12B&EED001)	Load List - LV System	0
1030469-SEMCO-E-FD-0001 (HOW01=V01BR&EDB001)	Design Brief - UPS System	0
1030469-SEMCO-E-XJ-0001 (HOW01=Z12B&EFA001)	Single Line - LV System	A
1030469-SEMCO-E-SA-0002 (HOW01=V01BRU&EEC001)	Technical Specification for Procurement - 110VDC Rectifier =BUU	A
	Layout Drawing – Utility Deck	A
	Layout Drawing – Mezzanine Deck	A

List of documents supplied by Dong Energy:

Document number:	Document title:	Revision:
2427059	HOW01 - Employer's Requirements 7.6.11 UPS and DC Systems	2228140D
2229666	SUBTS-010 Guideline for use of technical standards	2212300C
2381118	SUBTS-150 Material selection	2212412E
2290839	SUBTS-200 General requirements LV & Utility systems	2213183D
2364050	SUBTS-201 Electrical Cable and wiring	2213186E
2364052	SUBTS-203 Earth, bonding and lightning protection	2213189E
2364058	SUBTS-207 Switchboards and Cabinets	2213661E
2393400	SUBTS-209 UPS and DC systems	2213629F
2393424	SUBTS-220 FAT, SAT and SIT Testing	2247164D
2364067	SUBTS-221 LV Signal List	2276374C
2364068	SUBTS-222 Room Matrix	2251291C
2290963	SUBTS-223 Workmanship for Electrical Installations	2264951B
2232446	N1 - HOW01 - CAD Manual	2232446A
	Z1xUAB01&CTB241 - ELECTRICAL EQUIPMENT EARTHING AND BONDING PRINCIPLES	B – Issued for AFC.

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1.4 Document Hierarchy

1. Technical queries, Communication notes and Rolling minutes of meeting.
2. Employer's requirements, DEWP SUBTS.
3. Semco Maritime Technical Specification for Procurement and Design Brief.

Where 1 is the most important.

Technical queries are embedded in the Design Brief.

2 System type

☐ Inverter ☒ UPS

2.1.1 Inverter / UPS Type

☐ Offline/standby ☐ Line-interactive ☒ Online/double-conversion

2.1.2 System Architecture

☒ Modular design ☐ One unit design

2.1.3 Bypass Circuits

☒ Maintenance Bypass ☒ Static bypass switch ☐ Bypass Transformer

☐ Automatic Transfer switch

2.1.4 Parallel Operation

☐ Yes ☒ No

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3 Electrical system

3.1 Distribution load

	Load	Unit
P	15,15	kW
Q	6,25	kVAr
S	16,39	kVA
Cosφ	0,9	-

Date: 2016-07-28

Load details are specified in document: 1030469-SEMCO-E-LA-0019
(HOW01=Z12B&EED001) - Load List - LV System.

3.2 Design factors – Inverter / UPS system

Design factor: 0%

3.2.1 Future expansion possibilities

Cabinet: No.

If modular architecture is chosen - Number of future expansion slots: 1

Circuit breakers and other equipment facilitating future expansion has to be pre-installed.

3.3 Earthing system

☒ TN-S ☐ IT

Control and signal circuits:

☒ TN-S ☐ IT

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3.4 Nominal voltage (V)**3.4.1 Input voltage**Number of live wires ☐ 1 ☐ 2 ☒ 3

Voltage:

☐ 24 ☐ 48 ☐ 110 ☐ 220 ☐ 230☐ 240 ☐ 400 ☒ 230/400 ☐ 254/440 ☐ Other:**3.4.2 Output voltage**Number of live wires ☐ 1 ☐ 2 ☒ 3

Voltage:

☐ 24 ☐ 48 ☐ 230 ☐ 240 ☐ 400☒ 230/400 ☐ 254/440 ☐ 400/690 ☐ Other:**3.5 Frequency f_f Hz****3.5.1 Input**☐ DC ☒ 50 ☐ 60 ☐ Other:

Frequency variations: +5-6%

3.5.2 Output☒ 50 ☐ 60 ☐ Other:Frequency variations: ± 0.5 Hz**3.6 Power Factor****3.6.1 Power Factor Correcting rectifier**☐ No ☒ Yes**3.6.2 Input**

Power factor > 0,95

3.6.3 Output

Power factor > 0,90

3.7 Crest Factor

3:1

3.8 Charge Requirements**3.8.1 Charging methods**

- ☒ Temperature compensated charging voltage
- ☐ Boost charging
- ☐ Equalization charge

3.8.2 Charging time

- ☐ DNVGL-OS-D201 Chapter 2 Section 2 4.1.2 d) 80% capacity within 10hours.
- ☒ Other: 90% not exceeding 8 hours. Full capacity not exceeding 10 hours.

3.9 Harmonic Distortion**3.9.1 Input - Voltage**

Harmonic Voltage distortion (THDU):

- ☒ EN62040-3 5.2.1 f) $\leq 8\%$

Other:

3.9.2 Input – Current

Harmonic Current distortion (THDi):

- ☐ EN 62040-3

- ☒ Other:

THDI upstream $\leq 3\%$ at full rated loadTHDI upstream $\leq 5\%$ at 25% to 75% of full rated load**CONFIRMED BY MAK PP SYSTEMS**

3.9.3 Output

3.9.4 Output - Voltage

Harmonic Voltage distortion (THDU):

☐ EN 62040-3

☒ Other:

THDU downstream ph/ph and ph/N $\leq 2\%$ for linear loads

THDU downstream ph/ph and ph/N $\leq 3\%$ for non-linear loads

3.9.5 Output – Current

Harmonic Current distortion (THDi):

☒ EN 62040-3

☐ Other:

3.10 Efficiency

☐ IEC / EN 62040-3 Annex I.

☒ Other: Minimum 90 %.

3.11 Control and signal circuits

Supply ☒ Internal ☒ Redundant

Circuit type ☐ SELV ☐ PELV ☐ FELV

Voltage ☐ 24 ☐ 230 ☐ Other:

Other auxiliary voltages ☐ No ☒ Yes: 110VDC from SCADA

3.11.1 Rated frequency f_f (Hz)

Control and signal circuits:

☐ DC ☐ 50 ☐ 60 ☐ Other:

3.11.2 Transient overvoltages

☐ Category I ☐ Category II ☒ Category III

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☐ Category IV

Surge protection ☐ No ☒ Yes, for: =BRU11/21 Class II.

3.12 Short-circuit withstand capability

3.12.1 Prospective short-circuit current at supply terminals I_H (kA)

I_{cc} : 19,3 kA

Minimum short-circuit current: TBA kA

3.12.2 Prospective short-circuit current in the neutral

TBA

3.12.3 Prospective short-circuit current in the protective circuit

TBA

3.12.4 Co-ordination & Selectivity

Co-ordination **upstream** circuit

☒ No ☐ Yes

Circuit Breaker:

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Selectivity:

☐ No ☒ Yes

Circuit Breaker: Schneider Compact NSX100B

Co-ordination **downstream** circuit☐ No ☒ Yes

Circuit Breaker: (Chosen by supplier)

Selectivity:

☐ No ☒ Yes

Circuit Breaker: Schneider Acti 9 IC60N 16A C-curve

3.13 Protection of persons against electric shock in accordance with IEC 60364-4-41**3.13.1 Protection against direct contact**

IEC 61439-1 clause 8.4.2

☒ Basic protection ☐ Other:**3.13.2 Protection against indirect contact**

IEC 61439-1 clause 8.4.3

Upstream:☐ Automatic disconnection of supply, placed in this assembly.☒ Automatic disconnection of supply, placed in upstream assembly.Residual current device selectivity ☒ No ☐ Yes☒ Electrical separation☐ Total insulation**CONFIRMED BY MAK PP SYSTEMS**

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Downstream:

☒ Automatic disconnection of supply, placed in this assembly.

☐ Automatic disconnection of supply, placed in upstream assembly.

Residual current device selectivity ☒ No ☐ Yes

☒ Electrical separation

☐ Total insulation

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3.14 Installation environment**3.14.1 Location type**

IEC 61439-1 clause 3.5, 8.1.4, 8.2

☒ Indoor ☐ Outdoor**3.14.2 Protection against ingress of solid foreign bodies and water (IP)**

IEC 61439-1 clause 8.2.2, 8.2.3, IEC 60529

☐ IP20C ☒ IP22 ☐ IP23 ☐ IP41 ☐ IP43 ☐ IP44
☐ IP54 ☐ IP65 ☒ Other: IP2X when the panel doors are open.

After removal of removable/withdrawable parts:

☐ As for connected position ☐ Reduced protection to:**3.14.3 External mechanical impact (IK)**

IEC 61439-1 clause 8.2.1, 10.2.6, IEC 62262

☐ Not required ☒ IK05 ☐ IK07 ☐ Other:**CONFIRMED BY MAK PP SYSTEMS**

3.14.4 Ambient air temperature – Lower limit

- ☐ IEC / EN 62040-3 4.2.1.1: Indoor: 0 °C
- ☒ DNVGL-OS-D201 Section 3 Table 1: Indoor: 0 °C

3.14.5 Ambient air temperature – Upper limit

- ☐ IEC / EN 62040-3 4.2.1.1: Indoor: 40 °C
- ☒ DNVGL-OS-D201 1.1.3 Environmental conditions
- UPS is used for emergency services: ☐ No ☒ Yes
- ☐ 35 °C ☒ 45 °C ☐ Other:

3.14.6 Ventilation

- ☒ Ventilation, fan, filter and thermostat. Fan in top, blowing out, filter in bottom.
- ☐ Ventilation, fan, filter and thermostat. Fan in bottom, blowing in, filter in top.
- ☐ Ventilation, raised top plate(s)
- ☐ Ventilation, louver plates in top and bottom
- ☒ Ventilation, only if needed
- ☐ No ventilation
- ☐ Other:

3.14.7 Maximum relative humidity

- ☒ IEC / EN 62040-3 4.2.1.1: 20% to 80%
- ☐ DNVGL-OS-D201 Section 3 2.3.3
- ☐ Indoor: 95 % ☐ Other:
- (Non-condensing)

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3.14.8 EMC environment

IEC 61439-1 clause 9.4, 10.12, Annex J

☒ A ☐ B

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3.15 Installation method**3.15.1 Type and properties**

- ☒ Floor standing ☐ Wall mounted ☐ Transportable
☐ Mobile ☐ Corner ☐ Other:

Make:

- ☒ Cubic ☐ Eaton ☒ Rittal
☐ Logstrup ☒ Schneider Electric ☐ ABB
☐ Eldon ☐ Other:

Colour or surface treatment:

- ☒ RAL 7035 (light grey) ☐ RAL 7015 (slate grey) ☐ RAL 7013 (brown grey)
☐ Brushed steel ☐ Other painting requirement:

Miscellaneous requirements:

Cable section ☒ No ☐ Yes ☐ Not relevant

Other: Minimum installation space from top MCT to equipment – 60 cm.

Hinged ☒ Left ☒ Right ☐ No hinge

Hinging must be inter-changeable.

=BRU11 – Left

=BRU21 – Right

Lock ☒ No ☐ YesDoor stop / lid strap ☐ No ☒ YesLighting ☒ No ☐ Yes, type, power:Service socket ☒ No ☐ CEE 7/4 (schuko) ☐ Other:Eye bolts for lifting ☐ No ☒ Yes**CONFIRMED BY MAK PP SYSTEMS**

Window or door with glass for special components ☐ No ☒ Yes: For controllers.

Transparent lids for DIN-rail sections ☒ No ☐ Yes

Swing frame ☒ No ☐ Yes

Control circuit terminals:

☐ Not relevant ☐ Minimum 4 mm² ☒ Disconnect type

☒ Other: All Semco Maritime interfaces must be wired to terminals. Terminating control circuits directly on components is not allowed.

Spare terminals ☐ No ☒ Yes, for: Remaining wires in cables.

Separate earthing bar for cable shield ☐ No ☒ Yes, for: Only applicable for analogue signal cables. Terminals for shielding must be earthed at one point.

3.16 Internal wiring

IEC 61439-1 clause 8.6, 8.6.5, 8.6.6
Identification of conductors by colour:

Main circuits:

☐ IEC 60445 ☒ Other: IEC 60204-1

Control circuits:

☐ IEC 60445 ☒ IEC 60204-1 ☐ Other:

Miscellaneous requirements:

Ferrules with sleeve ☐ No ☒ Yes

Halogen free, including cable ducts ☐ No ☒ Yes

Fire resistant wires (IEC 60331) ☐ No ☒ Yes

Flame retardant wires (IEC 60332) ☒ No ☐ Yes

Control circuit wiring: minimum 0,75 mm²

Internal wiring material: ☐ Copper ☒ Tinned copper

3.16.1 Available space

- ☐ % Evenly distributed
- ☐ % In separate section with busbars and DIN-rails
- ☐ % In separate sub-section with DIN-rails

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Space for special components:

Possibility of extension ☐ Left ☐ Right ☒ No

3.16.2 Maximum overall dimensions and weight

☐ No requirements

☒ Maximum dimensions (mm): Refer to the Design brief. Dimensions will agreed to in clarification meetings.

Height: 2000 Width: 1200 Depth: 1000

Plinth/base height: 100mm

☐ Maximum weight (kg): 450kg ☐ Other requirements:

3.16.3 Documentation holder

☒ Yes ☐ No

Must contain applicable as-built wiring diagrams and general layout drawing. Startup / shutdown / maintenance-bypass procedure must also be foreseen.

3.16.4 Direction(s) of external conductors

Incoming cables:

☒ Top ☐ Bottom ☐ Left ☐ Right ☐ Middle ☐ Back

Outgoing cables:

☒ Top ☐ Bottom ☐ Left ☐ Right ☐ Middle ☐ Back

Entry:

☐ Flange, membrane ☐ Gland ☐ Gland plate and glands

☒ Cable entry system

Delivered by assembly manufacturer ☒ No ☐ Yes

Mounted by assembly manufacturer ☐ No ☒ Yes

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Make ☒ Roxtec ☐ Other:**3.16.5 External conductor, cross sections and terminations**

Incoming cross sections:

☐ No requirements ☐ Minimum 4 mm² ☒ Other: **TBA**

Incoming terminations:

Main supply: **TBA** mm²Maintenance bypass supply: **TBA** mm²☐ No requirements ☐ Screw terminals ☒ Clamp terminals☐ Cable lugs ☐ Other:

Outgoing cross sections:

☐ No requirements ☐ Minimum 4 mm² ☒ Other: **TBA**

Outgoing terminations:

Consumer: **TBA** mm²Battery Circuit: **TBA** mm²☐ No requirements ☐ Screw terminals ☒ Clamp terminals☐ Cable lugs ☐ Other:**3.16.6 Special identification requirements**☐ No ☒ Other: RDS-PP

All components must be tagged according to RDS-PP. Semco will tag components during review.

3.17 Interface, Control and Measurements – UPS/Inverter**3.17.1 Communication**☒ Hardwired ☒ Web interface ☐ Modbus ☐ SNMP ☐ IEC 61850☐ RS485**CONFIRMED BY MAK PP SYSTEMS**

All Semco maritime interfaces must be wired to DIN rail mounted terminals\connectors.

3.17.2 Signal requirements

Notice: All hardwired signals must be failsafe. Meaning fault/alarm = 0.

☐ Semco Maritime standard signals:

Inveter/UPS healthy
Inveter/UPS major failure
Inveter/UPS minor failure
Mains failure – Battery operation
Fuse/MCB/SPD failure
Command - Stop Chargeing

☒ Other: Please refer to DEWP SUBTS-221 LV Signal List.

Besides the signals listed in DEWP each systems must be prepared to receive a command to stop charging.

4 Battery system

4.1 Installation Environment

Room temperature: 17 – 23 °C

4.2 Backup Time

3 Hours

☒ Total

☐ Each battery bank

4.3 Design factors - Batteries

Design margin: 0

Aging Factor: 1,25

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Temperature Correction: 0

4.4 Type**4.4.1 Venting**☐ Open Vented ☒ Valve regulated (closed)**4.4.2 Plate and medium type**☐ Liquid electrolyte ☒ Gel ☐ AGM ☐ Lithium ☐ NiCd☐ OCSM ☐ OPzV ☐ OPzS ☐ GRoE☐ Other:**4.5 Control and Measurements - Batteries**☒ Midpoint measurement☒ Temperature sensor☐ Individual cell monitoring☐ With web interface☐ Other:**4.6 Cell or Block Battery**☐ Single cell battery☐ Multicellular Block battery☒ No requirements**4.7 Battery Bank Voltage**☐ 24 VDC ☐ 48 VDC ☐ 110 VDC ☐ 220 VDC ☐ 408 VDC**CONFIRMED BY MAK PP SYSTEMS**

☒ Other: No requirements.

4.7.1 Battery cut-off voltage / end voltage

The system must have facilities to cut off discharge when cell voltage reaches below specified cell voltage. The system must be able to return to normal operation without manual intervention.

1,73 V/pr. Cell.

4.8 Maximum Ripple Current / Voltage

4.8.1 Ripple current

☒ EN 62040-3 5.4.2.2 Max 5 % of C10 Ah.

☐ Other:

4.8.2 Ripple voltage

Maximum 5 %

5 Battery Installation Method

5.1 Rack / Cabinet

☐ Cabinet ☐ Rack ☒ Seismic Rack, acceleration: 0,1 G

5.2 Maximum Battery Weight

___ kg

5.3 Drip tray

A drip tray must be provided if open vented batteries with liquid electrolyte is specified.

Drip tray: ☐ Yes ☒ No

5.4 Cooling plates

Cooling plates between the batteries must be considered regardless of battery type.

5.5 Coating requirements – Battery Racks / Cabinet

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Coating must conform with EN 50272-2 (Safety requirements for secondary batteries and battery installations Part 2: Stationary batteries) 5.2 Protection against indirect contact. The coating must provide insulation from the batteries and place of installation. If the coating is incapable of conforming to this requirement, the rack / cabinet must be prepared for installation of 2 bonding points.

6 FAT – Factory Acceptance Test

Performed in accordance with IEC/EN 62040-3.

7 SAT – Site Acceptance Test (Commissioning)

The supplier is required to participate in the site acceptance test and perform the first start-up of the system.

Quote from DEWP SUBTS-220 FAT and SAT:

SAT for batteries shall follow IEEE 1188 standard and as a minimum is to include:
Before test the following values is to be read and recorded for later references.

- Voltage of each cell/unit
- Temperature of 10% of cell/unit
- Overall battery terminal float voltage
- Individual cell/unit internal ohmic values

And following procedures during the test:

- Load bank setup based on actual load on the project to secure requested autonomy time and also that the voltage of the string has not exceeded 85% of the nominal terminal voltage at the time as per IEC62271-200 for MV and IEC62271-203 for HV.
- During the discharge, overall voltage, current and cell/unit voltages shall be logged.
- Batteries shall be observed for any intercell/unit connector and terminal heating.

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8 Supplier Document Requirement List (SDRL)

Legend:

WAO = Weeks After Order
WBT = Weeks Before Test
WPTD = Weeks Prior To Deliver

Document SDRL code	Document	Included in bid	Delivery time
LB	Supplier Master Document Register, with Issue dates	Yes	2 WAO
KB	Quality Plan/including Inspection, and Test Plan	No	2 WAO
CA	Heat Loss calculation	Yes	5 WAO
CA	Battery bank sizing calculation	Yes	5 WAO
XD	Layout Drawing	Yes	3 WAO
XT	Wiring Diagrams	No	3 WAO
XJ	Single line	Yes	2 WAO
LB	Instrument Panel Component List	Yes	5 WAO
CA	Factory Acceptance Test Procedure FAT	No	5 WBT
DS	Equipment Datasheets including Weight Datasheets and various Certificates	Yes	3 WPTD
MD	Instruction for Receipt, Lifting and Installation	No	3 WPTD
KE	Packing List	No	3 WPTD
LG	Special Tool List	No	3 WPTD
MA	Operation and Maintenance Manual	No	3 WPTD
KA	Commissioning and Start-Up / shutdown Procedures	No	3 WPTD

Wiring diagrams and layout drawing must be issued to Semco Maritime for review in due time before construction is started. Semco Maritime must conduct the review within 14 days.

Three (3) revisions of each document are to be expected:

- Issued for comments
- Accepted for construction
- As-Built

The Operation and Maintenance Manual must include a method statement on installation and exchange of the batteries. I shall also include a suggestion for mechanical aids for manual handling.

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8.1 Documentation media☐ PC|Schematic Automation☐ CADdy++☒ Paper and pdf-file☒ AutoCad .dwg file.☒ Other requirements: All graphical submitted documents must follow the requirements in DEWP CAD manual.**CONFIRMED BY MAK PP SYSTEMS**

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9 Abbreviations

The following abbreviations are used in this document:

a.c.	Alternating Current
CB	Circuit Breaker
CE	Communauté Européenne
d.c.	Direct Current
DNV/GL	Det Norske veritas / Germanischer Lloyd
EN	European standard
ESD	Emergency Shut Down
FAT	Factory Acceptance Test
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Standards Organization
kA	Kilo Ampere
kV	Kilo Voltage
Roxtec/MCT	Multi cable Transit
PLC	Programmable Logic Computer
RDS-PP	Reference Designation System for Power Plants
FAT	Factory Acceptance Test
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
TN-S	Terra neutral separate
UPS	Uninterrupted Power supply
TBA	To be announced

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