Norfolk Vanguard West

VATTENFALL

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General Data for Main Equipment

Vanguard West Onshore & Offshore Converter Stations

System Design (OTC=30031)

Equipment Specification (DCC=EEC010)

Employer Doc. No.:
VGWT-SEN-E-SP-0001

Siemens Energy Doc. No.:
N-000621_EC_30031#VGWT&EEC010/001

Norfolk Vanguard West

Employer: Norfolk Vanguard West Ltd.

1320MW
± 320 kV DC / 400 kV AC
SE Contract No.N-000621

Doc. ID: E4A000001487938

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This document is a Contractor's Specification provided in accordance with the Norfolk Vanguard West Contract between Vattenfall Wind Power Ltd, Siemens Energy Global GmbH & Co. KG, Siemens Energy Ltd and Aker Solutions AS

Revision History

Client Rev.	Contractor Rev.	Description
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1 Introduction

1.1 Scope

This specification contains the general information for the equipment and systems to be supplied for Norfolk Vanguard West HVDC project. The HVDC shall connect the Norfolk Vanguard West Offshore Wind Farm to the Necton substation of National Grid Transmission System in UK.
Further specific equipment and system requirements are defined in the dedicated individual equipment specifications. In case of contradictions, the content of these specific equipment specifications takes precedence over the general information provided in this document.

1.2 Locations

The HVDC shall link the Norfolk Vanguard West Offshore Wind Farm to the Necton substation of National Grid Transmission System. Norfolk Vanguard West Offshore Wind Farm Project connects 1320MW of wind power installed at 66kV voltage level at the Norfolk Vanguard West Offshore Wind Farm to the 400kV system at the substation Necton in UK. The energy from the WTG's (Wind Turbine Generators) will be collected via 66kV Array Cable strings and transmitted to the Offshore platform (OSS). On the Offshore platform (OSS) the 3-phase high voltage alternating current (HVAC) power will be transformed to 320kV and converted to high-voltage direct current (HVDC). DC Export Cables will transmit the power from the Offshore platform (OSS) to the Onshore Substation (ONS). The ONS will convert the HVDC power to 400kV and deliver via HVAC 3-phase, via dual circuit cables to the existing TSO substation at Necton, UK. From there it will be connected to long overhead AC transmission.

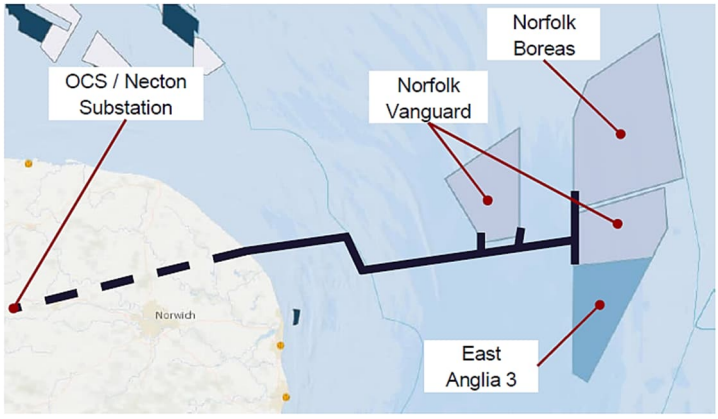

Figure 1-1: Project Locations

- Offshore converter station (OSS) is Norfolk Vanguard West in Southern North Sea (approximately 80-120 km off the UK east coast).
- Onshore converter station (ONS) is further connected to Necton substation, UK.

1.3 Expressions and Definitions

The following words and expressions shall have the meanings assigned hereby to them.

- "**VGWW**" means Offshore converter station (OSS)
- "**VGWO**" means Onshore converter station (ONS)
- "**VGWT**" means both Offshore & Onshore converter stations
- "**Owner**" means Employer (Vattenfall Europe Windkraft GmbH) i.e., Norfolk Vanguard West Ltd.
- "**Contractor**" means Siemens Energy
- "**Manufacturer**" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described hereunder
- "**Equipment Specification**" refers to an additional specification written for each component
- "**Standards**" means international, regional, and national standards as well as guidelines of Owner or the Contractor. Further details are supplied in chapter 3

1.4 Abbreviations

C&P	Control & Protection
CWC	Converter Water Cooling
EHS	Environment, Health, and Safety
HPE	Bundesverband Holzpackmittel, Paletten, Exportverpackung e.V.
HV	High Voltage
ISPM	Internationaler Standard für Pflanzenschutzmaßnahmen
ITP	Inspection and Test Plan
RIV	Radio Interference Voltage
QA	Quality Assurance
QM	Quality Management

FC	Frequency Converter
EC Motor	Electronically Commutated Motor

2 Quality Management, Lifetime, EHS

2.1 General

The Manufacturer shall design, engineer, and fabricate using a QM system in accordance with ISO 9001 and ISO 10005.
As a result, the Manufacturer shall submit the valid QM certificate for the manufacturing facility according to ISO 9001 and the QA plan / ITP. The conformity declaration according to ISO/IEC 17050-1 as part of the product documentation must be submitted prior to delivery.

2.2 Lifetime and Durability

All supplied equipment shall be designed and manufactured for safe operation and maintenance for a minimum expected **lifetime of 30 years** *(30 years from the date of handover)* in the prevailing ambient and electrical environment. Where individual components have an expected life of less than 30 years, their replacement strategy and design life must be declared by the Manufacturer in the Manufacturer's proposal. Arrangements shall be in place to ensure the availability of replacement parts as satisfactory to the Contractor and the Employer. **An initial supply of spares to cover the first 5 years of operation will be supplied.** The Manufacturer delivers a spare part list for the maintenance of the respective equipment. For further details on spares strategy, please refer to the Contractor's document "P-019827_BP_11311_#NF01&ADB070_001 **Spare Part Strategy**". The equipment for outdoor application shall be capable of withstanding the effects of weather according to clause 4. The equipment for indoor application shall be capable of withstanding indoor environmental conditions according to clause 4. A maintenance interval of **three (3) years** is required for the project as Employer requirement.

2.3 Environmental, Health & Safety

The guidance provided in ISO 14001 model or equivalent (e.g., EMAS) will be used as basis for conformity in the integration of the overall project environmental management system.

In addition, the Manufacturer must comply with all applicable environmental, health and safety standards, codes and regulations that have been enacted or apply to the region or country in which the works are to be undertaken. Health & Safety Standards must be in accordance with ISO 45001 or equivalent (e.g., OHRIS).

2.4 Auditing

At any point in between the award of contract and the finalization of the project the Contractor, Owner and/or third-party consultants/certifier shall have access to audit the QM system and the EHS management system and/or to make inspection at the workshop of the Manufacturer by himself or his authorized representative. The Contractor is authorized to check (or having examined) the compliance with the product properties and quality parameter any time.

3 Standards and Precedence of Standards

Equipment and services offered are to fully comply with employer specifications and be in accordance with the relevant international standards and referenced national standards.
Where deviations are unavoidable, the deviations are to be fully detailed for employer approval.

Where a standard is quoted in the text of the equipment specification, the Manufacturer shall make use of the version of the quoted standard current at the time of offer and shall not substitute another standard unless approval to substitute the other standard is obtained from the Contractor.

If an inappropriate standard has been referenced, or a suitable standard has not been referenced, the Manufacturer shall inform the Contractor in writing and written agreement shall be sought from Owner.
Where no applicable standard is published the Manufacturer shall propose a code of practice or regulation and seek the Contractor approval prior design, manufacture, testing, erection, and commissioning of this item and written agreement shall be sought from Owner.
The equipment shall be designed, manufactured, tested, supplied, installed, and commissioned considering to the following standards in the precedence as listed below (*including but not limited to*):

- Employer Requirements (ER's)
- Standards as specifically noted in the text of the respective equipment specification

- IEC standards
- EN ISO standards

The use of units and symbols shall be based upon the International System of Units (SI) in all documents, correspondence, technical schedules, and drawings. On drawings where other units have been used, the metric equivalent shall be marked in addition.

4 Environmental Conditions

4.1 General Outdoor Conditions

Description	Unit	VGWW Offshore Platform (OSS)	VGWO Onshore Substation (ONS)
Altitude			
Mean height above sea level	[m]	<100	<100
Ambient temperatures			
Minimum *at any time*	°C	N/A	-10
Maximum *at any time*	°C	N/A	+35
Wind speed			
Reference wind speed $V_{b,0}$ *10 min. average, EN 1991-1-4 [8.2]*	m/s	N/A	24,2
Max. wind speed	m/s	N/A	34
Ice data			
Radial ice thickness	mm	N/A	10
Site pollution severity *as per IEC 60815-1*	a to e	N/A	e (very heavy)
Corrosion category *as per ISO 12944*	C1 to CX	N/A	C4
Solar Radiation	W/m²	N/A	1000
Lightning flash density	km²/year	N/A	1

Table 4-1: Environmental outdoor conditions

Note-1: N/A is shown for OSS conditions (since main equipment is in HVA/C controlled environment).

Note-2: All HV equipment shall be tested and certified with -10℃ minimum ambient temperature. But no HV equipment will have any performance impact exposed to -15℃ minimum ambient temperature.

4.2 Indoor conditions Converter Hall (including OSS Converter Reactors)

		VGWW	VGWO
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
Ambient temperatures to be considered for component		All values are for pre-energization and operational conditions	
Minimum *at any time*	°C	+5	+5
Maximum *at any time*	°C	+50	+50
Max. air humidity	%	60	60
Min. air humidity	%	according to HVAC requirements	according to HVAC requirements

Table 4-2: Environmental indoor conditions Converter Hall (including OSS Converter Reactors)

4.3 Indoor conditions GIS / Transformer room / DC Cable Sealing End

		VGWW	VGWO
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
Ambient temperatures to be considered for component		All values are for pre-energization and operational conditions	
Minimum *at any time*	°C	+5	N/A
Maximum *at any time*	°C	+40	N/A
Max. air humidity	%	90	N/A
Min. air humidity	%	according to HVAC requirements	N/A

Table 4-3: Environmental indoor conditions GIS / Transformer room / DC Cable Sealing End

4.4 Air Quality

Air temperature will be controlled in such a way so that no moisture condensation at the equipment

surface will occur. Air will be filtered; the rooms in the platform will be kept under slight overpressure.

5 AC System Data

5.1 AC System Voltages

		VGWW	VGWO
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
Nominal	kV_{RMS}	66	400
Minimum continuous	kV_{RMS}	62.7 (0.95 p.u.)	360 (0.9 p.u.)
Maximum continuous	kV_{RMS}	69.3 (1.05 p.u.)	420 (1.05 p.u.)
Maximum (during LOM)	kV_{RMS}	72.5 (1.098 p.u.)	N/A
Maximum, Temporary (15 min)	kV_{RMS}	N/A	440 (1.1 p.u.)
Temporary Undervoltage	kV_{RMS}	below 0.9 p.u. acc. to ECC.6.3.15	below 0.9 p.u. acc. to ECC.6.3.15
Temporary Overvoltage	kV_{RMS}	1,3 p.u.	acc. to TGN (E) 288

Table 5-1: AC System Voltages

5.2 AC System Frequency

		VGWW	VGWO
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
Nominal	Hz	50	50
Stationary Frequency range (performance)	Hz	49 -51	49 -51
Temporary frequency range (rating)	Hz		
20 min		51.5 – 52	51.5 – 52
90 min and 30 s		51 – 51.5	51 – 51.5
90 min and 30 s		47.5 – 49	47.5 – 49
60 s		47 – 47.5	47 – 47.5

Table 5-2: AC System Frequency

5.3 Short Circuit Levels

		VGWW	VGWO
		Offshore Platform (OSS)	Onshore Substation (ONS)
Description	**Unit**		
Maximum short circuit current for hv ac switchgear	kA	25	63
Duration of short circuit	s	1	1

Table 5-3: AC System Short Circuit Levels

6 Specific Creepage Distances, Shed Profiles and Clearances

6.1 Material

The insulators shall be **composite type** and comply with the applicable standards (special requirements can be listed in the equipment specification of individual component for employer approval).

6.2 Specific Creepage Distances

Specific indoor and outdoor creepage distances for all components are specified according to the site pollution severity.

The AC Unified Specific Creepage Distances are determined in accordance with IEC 60071-2, IEC TS 60815-2, and IEC TS 60815-3.

The DC Specific Creepage Distances are defined according to extensive experience with DC insulators since 1980, IEC TS 60815-4 and IEC 60071-5.

Generally, the minimum creepage distance of equipment is based on the “Base Voltage for Creepage Calculation” and depends on the average diameter D_a. D_a is defined according to IEC 60815-2 to -4.

Specific creepage distances given as phase-to-phase value or as phase to ground value are to be considered only for single phase equipment insulated to earth. Special attention must be paid whenever equipment is connected from phase to phase.

6.3 Specific Indoor Creepages for AC and DC Equipment

		VGWW	VGWO
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
Subject to AC			
phase to ground	mm/kV	22	22
Subject to mixed voltage consisting of AC and DC			
within converter tower	mm/kV	14	14
Converter Hall	mm/kV	20	20
DC Cable Sealing End Hall	mm/kV	30	N/A

Table 6-1: Specific Indoor Creepages for AC and DC Equipment – Porcelain and Composite

No diameter correction is required for indoor installation in clean and dry environment.

6.4 Specific Outdoor Creepages for AC Equipment

			VGWO
			Onshore Substation (ONS)
Description	**D_a** (Diameter)	**Unit**	
Subject to AC			
phase to phase	$D_a \leq 300$ mm	mm/kV	31
phase to ground	$D_a \leq 300$ mm	mm/kV	$31 * \sqrt{3} = 53.7$

Table 6-2: Specific Outdoor Creepages for AC Equipment – Porcelain and Composite

For larger diameters, the actual creepage distance shall be correlated to the diameter of insulators and bushings as follows:

D_a > 300 mm:

Porcelain, glass, and composite insulators $K_{ad} = 0{,}0005 * (D_a / mm) + 0{,}85$

6.5 Specific Outdoor Creepages for DC Equipment

			VGWO Onshore Substation (ONS)
Description	**D_a** (Diameter)	**Unit**	
Subject to DC			
Porcelain	D_a≤250 mm	mm/kV	60
Composite	D_a≤250 mm	mm/kV	50

Table 6-3: Specific Outdoor Creepages for DC Equipment – Porcelain and Composite

For larger diameters, the actual creepage distance shall be correlated to the diameter of insulators and bushings as follows:

Da > 250 mm:

Porcelain and glass insulators $K_{ad} = \left(\frac{D_a}{250\ mm}\right)^{0,3}$

Composite insulators $K_{ad} = \left(\frac{D_a}{250\ mm}\right)^{0,17}$

6.6 Shed profile

The shed profile shall follow the design rules of IEC/TS 60815.

	Indoor		Outdoor	
	Porcelain and Glass (non-HTM)	**Composite / Hybrid (HTM)**	**Porcelain and Glass (non-HTM)**	**Composite / Hybrid (HTM)**
Subject to AC	IEC/TS 60815-2	IEC/TS 60815-3	IEC/TS 60815-2	IEC/TS 60815-3
Subject to DC			IEC/TS 60815-4	IEC/TS 60815-4

Table 6-4: Applicable standards for shed profile determination

In addition, the Creepage Factor (CF) for all DC insulators and bushings must be CF ≤ 4,2 for composite

material and CF ≤ 3,5 for porcelain.

6.7 Clearances

Generally, the minimum AC clearance shall be determined according to IEC 60071-1.
If evidence can be provided that smaller clearances fulfill the withstand requirements, this may be acceptable. Air pressure altitude correction is already considered for installations < 1000 m above sea level. No further altitude correction factors are needed.

7 Acceleration Design Requirements

Converter station equipment shall be designed and qualified in accordance with the values below.
It must be made sure that the acceleration requirements are fulfilled at the installation place over the complete lifetime. The equipment shall be suitable to withstand all acceleration stresses without any degradation of the equipment itself or its proper functioning.
The acceleration stresses are characterized as follows:

		VGWW	
		Offshore Platform (OSS)	
Description	**Unit**		
In-place Condition		Wave, current, wind loading (Continuous events)	Accidental ship collision loading, big waves (Temporary events)
Acceleration (horizontal and vertical)	[g]	0,05 (~1,355 x 108 load cycles)	0,3

Table 7-1: Acceleration Design Requirements for temporary events

8 Primary Flat and Cylindrical Terminals

8.1 Type of Terminal

8.1.1 Flat HV Terminals

The primary terminals for all HV equipment shall comply with those of IEC/TR 62271-301. This is applicable not only for switchgear and controlgear but also for other HV equipment. Threaded terminal holes are not permitted. HV terminals are to be designed to safely carry the short-circuit current.

8.1.2 Cylindrical HV Terminals

Primary cylindrical terminals are authorized for equipment like bushings and dc current measuring devices.

8.1.3 Earthing Terminals

Earthing terminals are to be designed to safely carry the short circuit current in accordance with DIN 46011. Threaded terminal holes are not permitted.

Separate earthing connections for single parts of assembled equipment are not permitted, only one grounding point is allowed. The connection area must be marked with the earthing sign according to IEC 60417.

8.1.4 Other HV Terminals

Cylindrical HV terminals or HV terminals with thread are allowed, but not preferred.

The use of cylindrical HV terminals or HV terminals with thread shall be agreed between Contractor and the Manufacturer in advance in the project.

8.2 Material of Terminal

8.2.1 Flat Terminals – HV and Earthing

In general, flat terminals shall be made of aluminum or aluminum alloy. Terminals of aluminum or an aluminum alloy shall not be treated.

Terminals which are not carrying continuous current can also be made of other materials, e. g. galvanized steel. For example, the terminals of surge arresters are manufactured of galvanized steel.
Earthing terminals made of galvanized steel shall be galvanized after holes and screw threads are drilled.

8.2.2 Other Terminals

Cylindrical terminals, if required, shall be made of electrolytic copper, and silver-plated to a minimum thickness of 12 µm.
A copper alloy sensitive to seasonal cracking, layer corrosion, or crystalline corrosions shall not be used. The alloy shall have the same cracking frequency as pure aluminum.

9 Material and Workmanship

9.1 General

The material and workmanship throughout shall be in accordance with the purpose for which they are intended. Each component shall be designed to be consistent with its duty.

All supports, bolts, nuts, washers, lock-nuts and mounting hardware fabricated of ferrous metals shall be hot-dip galvanized or made from stainless steel in accordance with the applicable standards.
The Manufacturer shall furnish locking devices for threaded fasteners which will lock them in such a manner as to prevent them from coming loose in transit and in service.

All joints and fastenings shall be designed, constructed, and registered in such a way that the component parts may be accurately positioned and constrained to fulfil their required function. The heads of all bolts shall be adjusted flush with the surfaces which they fasten (where applicable).

All spare parts shall be interchangeable with and shall be made of the same materials and workmanship as the corresponding parts of the work supplied under these specifications.

9.2 Color Scheme

Description	Indoor	Outdoor
Composite Insulators	Grey	Grey
Porcelain Insulators	Brown / Grey	Brown / Grey
Outside surfaces of panels, cabinets, and junction boxes	RAL 7035	RAL 7035

Table 9-1: Color scheme for the system

9.3 Cementing of porcelain insulators

Cementing of porcelain insulators must be carried out in a way to ensure durable connection between the cast iron fitting and the porcelain body and must be done in one casting step.
Portland cement is to be used to ensure a strong connection even after excessive heating of the cement during a short circuit over the insulator.
Special attention must be paid to the sealing. The seals must be filled completely with cement. Silicone seams must not be used.

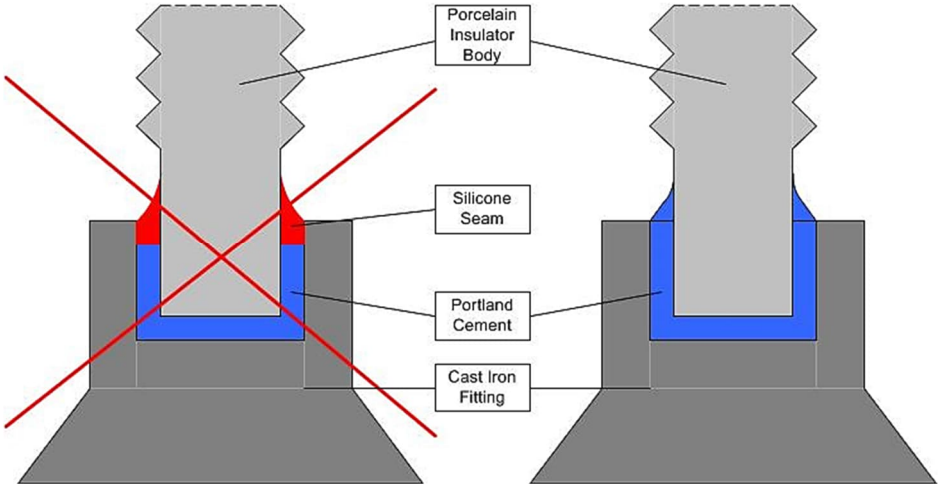

Figure 9-1: Cementing of porcelain insulators

10 Transport, Packing, Storage, Marking

Details of requirements on Transport, Packing, Storage and Marking will be defined in a separate specification.

Goods must be packed according to the HPE packing guidelines and the guidelines for regulation wood packing material in international trade, ISPM No. 15. The packing must be suitable for a storage period of 12 months.
Containers used for the sea transport are solely accepted as a means of transport. They shall not be accepted as a means of package.
Furthermore, main equipment, spare parts, tools, dangerous goods and temporarily imported material must be packed and marked separately.
For all deliveries, the Manufacturer must comply with all applicable national and international export-, customs- and foreign trade regulations.
For the marking special templates (markings, packing list) will be provided by the Contractor. Filling and returning these forms are duty of the Manufacturer.
If possible, the maximum dimension of packing of (LxWxH) 11,5 m x 2,3 m x 2,2 m and a maximum weight of 20 t shall be respected. If this is not possible the Manufacturer shall notify the Contractor in writing.
For the packing one-way execution must be used. Specialized transport racks, -flanges, -cover plates etc. shall be avoided largely.

Converter station equipment shall be designed and qualified in accordance with the values below. The equipment shall be suitable to withstand all transport and installation (T&I) stresses without any degradation of the equipment itself or its proper functioning.

Shipping condition (sea voyage of substation with equipment installed and where necessary seafastened) from dockyard to offshore location (relating to foundation footprint) and Offshore Installation (lifting, float-over) are characterized as follows:

- **Acceleration (horizontal and vertical) for all scenarios: 0,6 g**
- **Roll/Pitch angle for scenarios transport and installation: +/-10°**
- **Range of excitation frequencies for all scenarios: 0.31 - 0.63 rad/s (0.05 - 0.1Hz)**

The need of transportation supports or special transportation measures (“sea fastening”) to protect installed goods or systems and to keep the above-mentioned conditions have to be indicated by the Manufacturer in the offer documents. Necessary transportation supports and locking have to be included in the scope of supply.

11 Electromagnetic Compatibility

All equipment shall operate in its electromagnetic environment as specified, without any adverse impact on other equipment or itself. Emission and immunity characteristics shall be realized according to the specific, applicable equipment- standards.

No audible or visible corona shall be detectable at maximum operating voltage of the equipment during normal operation.

Radio Interference Voltage (RIV) shall not exceed 2500 µV.

12 Auxiliary Power Supply

All voltages are defined as supply voltages according to IEC 60038.

12.1 AC Power Supply

The tolerances for the frequency given in chapter 5 must be considered.
A redundant AC power supply system is provided for each converter station. All equipment must be suited for operation in the specified range without failure and influence on lifetime.

		VGWW	**VGWO**
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
Voltage			
rated value	V	400	400
tolerance	%	-15 / +10	-15 / +10
Type of system earthing		TN-S except for the AC UPS which is IT	TN-C-S except for the AC UPS which is IT
Phases		3	3
nomenclature		L1/L2/L3/N/PE	L1/L2/L3/N/PE
colour scheme of utility		Brown / black / grey / blue / green / yellow	Brown / black / grey / blue / green / yellow

Table 12-1: AC auxiliary power supply

In addition, the following requirements regarding harmonics have to be considered:

Auxiliary Power Supply System

If not otherwise stated above the power quality requirements, specified **in IEC 61000-2-4** “Electro-magnetic compatibility (EMC) – Part 2-4: Environment – Compability levels in industrial plants for low-frequency conducted disturbances”, edition 06/2002, **class 3** shall be applicable to all loads, frequency converters and other devices connected to the power supply system. The measuring location shall be the 400 V AC distribution boards of the auxiliary power supply system.

Requirements to be fulfilled by the devices connected to the Power Supply System:

All loads, frequency converters and other devices connected to the power supply system shall fulfill the following requirements

Input current ≤ 16 A:

- IEC 61000-3-2 (e.g., single EC motors, resp. single application full load current < 16 A)
- Single loads, operated in groups (full load current > 16 A) shall be equipped with power factor correction to reduce the THDi ≤ 50% (e.g., EC motors which are part of a large system like EC cooler bank)

Input current 16 A < … ≤ 75 A:

- IEC 61000-3-12 (e.g., FC with 4% AC-choke or equivalent DC choke)

Input current > 75 A:

- The Manufacturer must inform Siemens about currents higher than 75A.
- FCs shall be equipped with 4% AC choke or equivalent DC-choke (THDi limitation to ≤ 50%)

12.2 DC Power Supply

A redundant DC power supply system is provided for each converter station. All equipment must be suited for operation in the specified range without failure and influence on lifetime.

		VGWW	**VGWO**
		Offshore Platform (OSS)	**Onshore Substation (ONS)**
Description	**Unit**		
DC Voltage Level			
rated value	V	220	220
tolerance	%	-15 / +10	-15 / +10
Type of system earthing		IT	IT
DC-DC Converter for the Employer's IT equipment	V	110 and 24	110 and 24

Table 12-2: DC auxiliary power supply

13 Secondary Terminals and Cabinets

If installed indoors, enclosures shall have a degree of protection of not less than **IP41** according to IEC 60529.
If installed outdoors, enclosures shall have a degree of protection of not less than **IP56** according to IEC 60529.
Provision for an appropriate locking shall be made.
The enclosure shall be kept dry inside by suitable means of ventilation and drainage.
The Manufacturer shall employ suitable anti-condensation heaters in enclosures. A suitable cover shall prevent accidental contact of hot surfaces.
The cubicles must be furnished with an illumination lamp that is controlled by a door contact switch and a domestic general-purpose outlet, where practical, and protected by an MCB (Miniature Circuit Breaker) according to local standard.
All enclosures shall be readily accessible from ground level.
All external connections should enter the enclosure from below, unless explicitly agreed to by the Contractor. They shall not influence the degree of protection. Cubicles located outdoor shall have cable glands. Gland plates shall be detachable and delivered suitable for drilling on site. The cable entry of the indoor cubicles will be provided from below, realized with split slidable bottom plate and rubber sealing. Cable glands must be according to IEC 62444.
Equipment must not be mounted on doors of cubicles.

Please also refer to the employer requirements according to Ref03 (clause 14 to 16).

The distance between the bottom row of terminal blocks to the bottom flange or between two rows of terminal blocks shall be at least 150 mm.

Terminals shall be fit for purpose and provided with appropriate labelling. If AC and DC terminals installed in one enclosure, they must be grouped separately.

14 Motors and Operating Mechanisms

All mechanisms shall be readily accessible from ground level and comply with the clause above.
The use of suitable lubricants shall ensure proper operation not influenced by time.
A position indicating device shall be mounted at a prominent place.
Protection relay settings must regard voltage and frequency fluctuations, ensuring full operation for the entire range. Thus, for drives delivered with their protection relays, the Manufacturer shall preset all relays to parameters which allow full operation at the rated supply voltage in the complete tolerance band.
Outside of buildings the mechanisms should be executed inside locked control cabinets.
All motors and operating mechanisms must be protected against unauthorized use with dismantling or cover.

15 Nameplates

All nameplates or means of identification shall be clean and free of any dirt or paint.
Their content shall comply with the employer requirements Ref03 (clause 17), with applicable standards and the individual equipment specification.

All nameplates shall be written in the **English** language (UK spelling).

The nameplates shall be permanently attached in a conspicuous position and clearly visible. They shall be made of non-corrosive material, attached with corrosion resistant material. The legibility of the nameplates shall not be influenced by time and shall be suitable for complete specified lifetime of the equipment in the intended environment.

Prior to manufacturing / design freeze, all nameplates are to be approved by the Contractor.

16 Documentation

16.1 General

Detailed requirements on Documentation will be defined in a separate specification and in the employer requirements Ref03 (clause 20). Manufacturer's drawings and documents will be submitted to the Contractor for approval after the relevant design step is finished. Within 16 calendar days the Contractor shall notify the approval or the disapproval with the relevant detailed comments. The Manufacturer shall inform the Contractor immediately about any mistake, omission, or contradiction in any piece of document or correspondence.
Approved drawing headers are available and will be forwarded after placing the order.
The Contractor will inform the Manufacturer about the designation of the documents requested for this project. This filing system applies to all documents.

The specifications for the final marking of cable ends are defined form the Contractor in the case of an order and shall be adhered to.

All documents need to be provided in **English** language. Spelling shall be in **UK English**.

16.2 Size of Documentation

Drawings	A0/A1/A2/A3/A4
Layout and assembly	A0/A1/A2/A3
General manuals and documentation	A3/A4

16.3 Electronic Documents

Standard documentation will be supplied in original electronic files.
All documents shall be PDF searchable.

16.4 Data Format

The outline drawings and manuals shall be allocated in unprotected PDF format.
Furthermore, circuit diagrams must be made in Engineering Base, not protected PDF format. Outline drawings shall be supplied in unprotected PDF format, AutoCAD and .stp as 3D files.

17 References

No	Document number	Title
[R01]	**HVDC-VAT-A-FD-0002** Rev. P05	**Project Description and Scope of Work** *(Employer Requirements)*
[R02]	**HVDC-VAT-E-FD-8901** Rev. P04	**Electrical Basis Of Design** *(Employer Requirements)*
[R03]	**HVDC-VAT-E-FD-8903** Rev. P05	**High Voltage Equipment** *(Employer Requirements)*