


Norfolk Vanguard East



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Equipment Specification- AC Volatge Transformer

Onshore Site: Vanguard Onshore Converter Station

AC Voltage Transformer (OTC=BA111)

Equipment Specification (DCC=EEC010)

Employer Doc. No.:
VGEO-SEN-E-SP-0051

Siemens Energy Doc. No.:
N-000261_EC_BA111#VGEO&EEC010/001

Norfolk Vanguard East
Employer: Norfolk Vanguard East Ltd

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

Doc. ID: E4A000001675916

Technical Classification:


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Revision History

Client Rev.	Contractor Rev.	Description
A01	A01	First Issue


Mandatory Contractor Notice under 5.2.3

This is the Contractor Notice under 5.2.3 stating:

that the Contractor's Document is considered ready for review in accordance with Sub-Clause 5.2;
and


that the Contractor's Document complies with the Contract, or extent to which it does not comply
(as described in the table below).

Contract/ER Reference	Section Ref.	Short Description	Deviation Reference

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1 Introduction

For general introduction of the project please refer to reference [R01], General Data for Main Equipment.

2 Scope of Supply

The scope of supply includes design, manufacture, test, and documentation as specified herein and in compliance with the applicable Standards (given in clause 6) and reference [R02]. Any deviation to the standards or to this equipment specification needs the written consent of the Contractor.

The scope of supply comprises of:


- the units mentioned under clause 7,
- all spare parts in accordance with clause 2.1, given in total in clause 7,
- all special tools, if applicable according to clause 2.2 as an option.

The AC Voltage Transformer units shall be delivered with support insulators, brackets, dampers and mounting supports for installation on the foundations. All supplementary material necessary for erection, i.e., nuts, bolts, washers, etc. shall be also included.

Nuts and bolts for fixing the equipment on the foundation are not included in Manufacturer's scope of supply. However, the Manufacturer shall state their minimum requirements on these nuts and bolts (e.g., strength, quality, etc.) in their outline drawings.

2.1 Spare Parts

It is the intention to use components with an identical design in order to minimize the number of necessary spare parts. The minimum quantities of spare parts are given in clause 7.

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2.2 Special Tools and Maintenance Equipment

Equipment for which no special tools are needed during erection, maintenance, repair or replacement is preferred. However, if special tools are needed, they shall be clearly identified and included in the scope of supply as an option.

The AC Voltage Transformers have to be provided with means for lifting to facilitate safe and rapid motion, installation and replacement. All movable parts shall be properly fixed during transport in order to avoid damages.

2.3 Interfaces

Interfaces are:

Primary terminals: see reference [R01].

Earthing terminals: see reference [R01].

Foundation Plates: The holes of foundation plates shall be of sufficient distance for the use of anchor bolts.


Insulator mounting base: Necessary fixing details to be given in outline drawings.

Mounting pedestals: Base fixing details to be given in outline drawings.

Foundation plates: The foundation plates shall be designed for the use of anchor bolts.

The use of welding as fixing method is not accepted.

Dimensional drawings submitted by the Manufacturer shall include details of these interfaces, as well as footprints (including fixing details), pedestals, structure. Please refer also to Reference [R01].

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3 Design Requirements

3.1 General

All equipment and material provided by the Manufacturer shall be new, free from defects and of the same type, standard and quality as mentioned in this Equipment Specification. All workmanship shall be of the highest industrial standard, of accepted engineering practice, in accordance with the relevant standards and to the entire satisfaction of the Contractor. Any deviation to these standards or to this Equipment Specification shall be stated and requires the written consent of the Contractor.

3.2 Electrical Requirements

For detailed technical information please refer to clause 8 and reference [R01] & [R02].

3.2.1 Transient Stresses

In addition to the steady state conditions, the equipment will be stressed with transient currents and voltages as given in clause **Error! Reference source not found..** Combinations as well as repetitions of the transient stress cases can follow in a very short time frame. The equipment has to be designed to be capable of withstanding the stresses (including combinations and repetitions) without any adverse influence on its life time.


3.3 Design and Construction Requirements

3.3.1 Component design

It has to be guaranteed, that the nesting of birds or other small animals in the device's corners and cavities is prevented by suitable constructive measures (e.g. cover sheets, sieves).

All voltage transformers shall have a capacitive tap for $\tan\delta$ testing, measurement of capacitance and partial discharges.

The AC Voltage Transformers shall be designed such that they do not saturate while operating during transients. The coils shall be securely fixed to the core, and the core and the coils shall be rigidly fixed to prevent movement under short circuit stresses as well as during handling and shipment.

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All cables shall be fixed with metric cable glands mounted on a removable horizontally bottom plate. The cable glands shall consist of metal (brass nickel plated). The Manufacturer has to supply all necessary cable glands for all incoming cables. Additionally the terminal box shall be provided with a facility (e.g. grounding terminals, screen bus) near the cable glands (max. 100 mm) to connect the cable screen to ground.

The AC Voltage Transformers are to be provided with secondary terminal boxes which houses the terminal clamps and earthing clamps for the secondary winding.

Further requirements of the terminal boxes, terminal blocks and wiring are defined in reference [R01].

3.3.2 Corrosion protection

All details, contact parts and even screws exposed to corrosion shall be hot-dip galvanized (in the case of ferrous materials) or they shall be made of non-corrosive material. Further requirements are defined in reference [R01].

3.3.3 Nameplates / rating plates


For further requirements / details see Reference [R01].

In addition, the amount of SF₆, GWP and CO₂ equivalent of SF₆ according to EU regulation 517/2014 on fluorinated greenhouse gases shall be stated on the Nameplates / Rating Plates (if applicable).

The Nameplates / rating plate will be permanently attached in a conspicuous position. It will be made of non-corrosive material. The legibility of rating plate will not be influenced by time. Further requirements are defined in Reference [R01].

3.3.4 Insulation

The AC Voltage Transformers shall be of oil-immersed or SF₆-insulated type hermetically sealed in both cases and applicable for outdoor use. The internal insulation shall be permanently protected

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against moisture. All oil filled transformers shall be provided with an oil sampling point (valves where the oil is extracted using a hypodermic needle are not applicable).

3.3.4.1 Gas insulation

AC Voltage Transformers with gas insulation shall be equipped with a temperature compensated gas pressure monitoring device (densimeter), which can easily be read from ground level during operation without any danger to personnel.

The densimeter is equipped with switches for warning and alarm.

In general, 4 independent switches shall be provided:


- 1 switch for warning of gas leakage for notification to Human Machine Interface (HMI)
- 3 switches for alarm of further gas leakage: 2 redundant switches for the C&P system and 1 switch for notification to HMI

Contacts and terminal blocks for gas monitoring shall be included in one common secondary terminal box. For gas monitoring, the secondary terminal box shall provide provision for 8 terminal blocks (2 contacts per switch) designed to handle 2,5 mm² cables.

Additionally, the manufacturer shall provide provision for 3 threaded holes for cable glands with a size of M25 for cables of gas monitoring system. The threaded holes should be sealed (against dust and moisture) by matching dummy plugs.

The switches shall be in open position during normal operation of the AC Voltage Transformers. The pressure / density limits for warning and alarm signals shall be specified by the manufacturer. In case of gas leakages / density of gas below the specified limits the switches shall close.

Further details are provided in Figure 3.3-1

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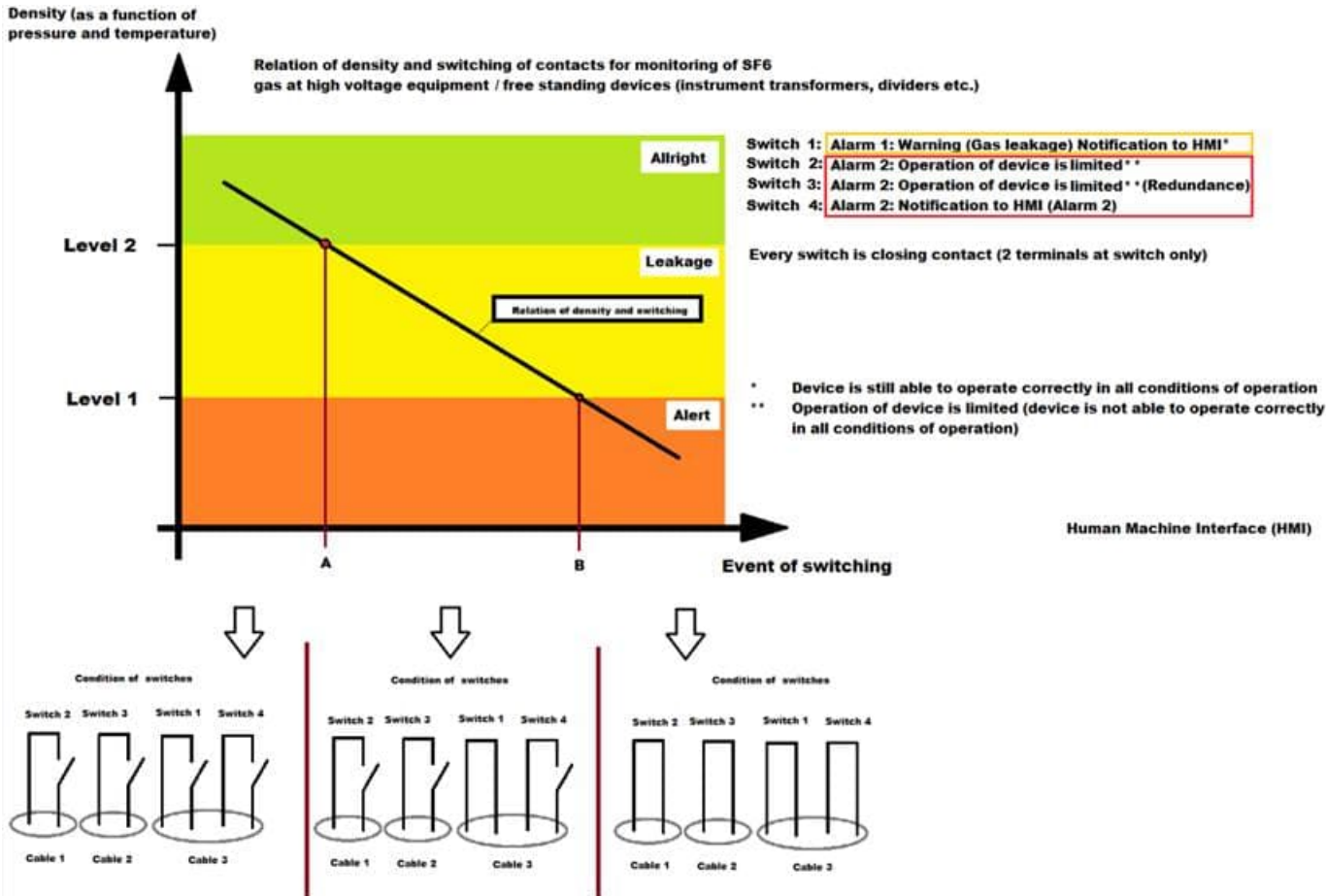



Figure 3.3-1: Relation of density and switching of contacts for monitoring of SF6

3.3.4.2 Oil insulation

AC Voltage Transformers shall be equipped with oil level indicators which shall be easily read from ground level during operation without any danger for personal.

3.3.5 Electrical shielding

The AC Voltage Transformers shall be equipped with corona rings and / or shielding electrodes if technically required.

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3.3.6 Insulators

The insulators shall be of porcelain or composite type and comply with the applicable standards.

For detailed information on electrical requirements please refer to clause 8.

The Manufacturer shall use a suitable shed profile for the insulators which has been demonstrated to be effective for the environmental conditions as specified in reference [R01].

The insulators' design shall be such that in case of any AC Voltage Transformers fault occurring internally proves a safe and controlled pressure release via the integrated protection device without violent shattering or destructive rupture of the insulators.

4 Test

All tests on the equipment must be carried out in accordance with common industrial practice and the standards (given in clause 6) in order to demonstrate compliance with the specification. The conducted tests might be witnessed by the Owner, the Contractor or an authorized inspecting engineer. All test documentation, including test plans and test reports, are to be approved by the Contractor.


Factory test reports of sub-suppliers shall be carefully checked and submitted together with the manufacturer's test certificates.

4.1 Factory Tests

The Manufacturer must provide all instruments, equipment and facilities required to conduct the factory tests. All test documentation, including test specification and any existing test reports shall be submitted together with an Inspection and Test Plan.

This test documentation shall be basis for the performance of the tests and shall include all test levels, acceptance criteria and test descriptions.

Factory tests have to be performed only on fully assembled equipment as per outline drawings. This requirement shall be assured and a confirmation document shall be sent to the Contractor by the Manufacturer as part of the visual inspection before the tests.

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The repetition of type tests may not be needed, if evidence can be provided, that relevant test requirements are covered by previous tests (not older than 10 years) on equipment with comparable design and similar rating. In this case the Manufacturer shall submit the relevant test reports with all the necessary information including an appropriate comparison of test values and methods. Such tests can be waived entirely, based on the documents provided by the Manufacturer.


After the test performance the manufacturer must submit the complete test documents with reports, required descriptions, sketches, diagrams, and pictures.

4.1.1 Type Tests

Type tests reports shall be submitted to ascertain that design and materials, the equipment, complies with the specified characteristics and operational requirements. The Manufacturer shall present valid test reports and similarity reports, which shall at least include the following tests:

Pos.	Type Test	Standard
A	Temperature rise test	IEC 61869-5 cl. 7.2.2
B	Impulse voltage tests on primary terminals (Contains LIWL and SIWL test)	IEC 61869-5 cl. 7.2.3
C	Wet test for outdoor type transformers	IEC 61869-5 cl. 7.2.4
D	Electromagnetic Compatibility tests (contains RIV test)	IEC 61869-5 cl. 7.2.5 IEC 61869-1 cl. 7.2.5
E	Capacitance and tan δ measurement at power frequency	IEC 61869-5 cl.7.2.501
F	Short circuit withstand capability test	IEC 61869-5 cl. 7.2.502
G	Ferro-resonance test	IEC 61869-5 cl. 7.2.503
H	Transient response test (for protective capacitive transformers)	IEC 61869-5 cl. 7.2.504
I	Type test for carrier frequency accessories	IEC 61869-5 cl. 7.2.505

Table 4-1: List of Type Tests for AC Voltage Transformers

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4.1.2 Routine Tests

The routine tests must be conducted on each unit to prove the quality of the equipment. The routine test shall be carried out in accordance with the applicable standards. The Manufacturer shall propose a test program, which shall at least include the following tests:

Pos.	Routine Test	Standard
A	Power-frequency withstand tests on primary terminals	IEC 61869-5 cl. 7.3.1
B	Partial discharge measurement	IEC 61869-5 cl. 7.3.2
C	Power-frequency withstand tests between sections	IEC 61869-5 cl. 7.3.3 IEC 61869-1 cl. 7.3.3
D	Power-frequency withstand tests on secondary terminals	IEC 61869-5 cl. 7.3.4 IEC 61869-1 cl. 7.3.4
E	Test for accuracy	IEC 61869-5 cl. 7.3.5
F	Verification of terminal markings	IEC 61869-5 cl. 7.3.6 IEC 61869-1 cl. 7.3.6
G	Enclosure tightness test at ambient temperature	IEC 61869-5 cl. 7.3.7
H	Ferro-resonance check	IEC 61869-5 cl. 7.3.501
I	Routine test for carrier frequency accessories	IEC 61869-5 cl. 7.3.502


Table 4-2: List of Routine Tests for AC Voltage Transformers

The order of the tests is not standardized, but determination of errors shall be performed after the other tests.

Repeated power-frequency tests on primary windings should be performed at 80% of the specified test voltage.

4.2 Site Tests

The Manufacturer must propose a program for pre-commissioning checks. Pre-commissioning checks shall ensure that the equipment has suffered no damage in transit, has been properly installed in the field, is safe to energize, load or start-up and will perform and operate as specified and designed.

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Objectives, procedures, and methodologies as well as pass-criteria shall be detailed in the program.

5 Quality Assurance (QA)

For the Quality Assurance requirements please refer to reference [R01].

6 Standards

At least the following standards are applicable and mentioned here for guidance.

Standard	Title	Issued
IEC 61869-1	Instrument transformers – Part 1 General requirements	10/2007
IEC 61869-5	Instrument transformers – Part 5 Additional requirements for capacitor voltage transformers	07/2011


Table 6-1: List of applicable standards mentioned for guidance

For additional information and order of precedence with respect to the standards please refer to Reference 01.

7 Bill of Quantities

Item	Designation	Description	Quantity in total
VGEO_M_01	#VGEO-CA10-Q01-BA01	AC Voltage Transformer (1-ph units)	3
VGEO_S_01	=Spare Unit	AC Voltage Transformer (1-ph units)	1

Table 7-1: Bill of quantities for Onshore Converter Station


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8 Technical Data

All current and voltage figures in the following tables are r.m.s values unless otherwise specified.

Converter Stations		Norfolk Onshore Station	
Main Data			
Type of device	(Capacitive / inductive)	inductive	
Insulation Location according to Insulation Coordination		L	
Installation location	(indoor / outdoor)	outdoor	
Type of insulation	(oil / SF6 / epoxy resin / clean air)	SF6	
Type of insulator	(composite / porcelain / epoxy resin)	Composite	
Electrical data			
Rated primary voltage	(ph - ph)	kV	400
MCOV (Maximum Continuous Operating Voltage) (ph - ph)		kV	420
Rated frequency f_r		Hz	50
LIWV (Lightning impulse withstand voltage)		kV _{peak}	1425
SIWV (Switching impulse withstand voltage)		kV _{peak}	1050
Base voltage for creepage calculation	(ph - gnd)	kV	242.5*
Minimum creepage distance ($D_a < 300\text{mm}$)			
Note: Diameter correction acc. to General Data	specific (ph - gnd)	mm/kV	53.7
	total (ph - gnd)	mm	13022
Max. RIV level at $1.1 \cdot U_m / \sqrt{3}$	(line to ground)	μV	2500
Rated voltage factor	(continuous)	%	1.2
	(for 30 seconds)	%	1.4
Core (Winding) data			
Winding no.			
Accuracy class		0.5/3P	
Rated transformation ratio k_r (line to ground)		kV // V	$396/\sqrt{3} : 110/\sqrt{3}$
Rated burden		VA	50
Winding no. 2			
Accuracy class		0.5/3P	
Rated transformation ratio k_r (line to ground)		kV // V	$396/\sqrt{3} : 110/\sqrt{3}$
Rated burden		VA	50
Winding no. 3			
Accuracy class		0.2	
Rated transformation ratio k_r (line to ground)		kV // V	$396/\sqrt{3} : 110/\sqrt{3}$
Rated burden		VA	15
Mechanical data			
Terminal forces, static		kN	2
Terminal forces, dynamic		kN	5
On-site testing of the gas-density meter without deinstallation (e.g. WIKA Valve Testing Device)		Yes	

Table 8-1: Technical Data of AC Voltage Transformer.

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9 List of References

Ref. No.	Document No.	Title
[R01]	VGWT-SEN-E-SP-0001	General Data for Main Equipment
[R02]	HVDC-VAT-E-FD-8903_P05	High Voltage Equipment

Table 9-1: List of References