



# Norfolk Vanguard East

# RWE

A01	A01	09	09	24	Issued for review	C. Gupta	Kavi. M	M. Krohn
VAT	SEN/ AKS/ SAC					Name	Name	Name
Revision		DD	MM	YYYY	Issue Purpose	Prepared	Checked	Checked/ Approved

Contractor LOGO/ information		Contract Number	
 		<b>C508119</b>	
		Subcontractor/ Supplier	
		<b>N/A</b>	
(Sub)-Contractor Document Number			
<b>N-000261_EC_BC111#VGEO&amp;EEC010/001</b>			
Package Description (if applicable)			
<b>N/A</b>			
Tagging Information			
RDS-PP Coding		Norsok Coding	
<b>N/A</b>		<b>N/A</b>	
AC Current Transformers - Equipment Specification			
Employer Document Number			Employer Revision
<b>VGEO-SEN-E-SP-0006</b>			<b>A01</b>
Superseded   Equivalent			Contractor Revision
<b>N/A</b>			<b>A01</b>
Language	System	Scale	Size/Format
<b>EN</b>	<b>89</b>	<b>1/1</b>	<b>A4</b>
			Pages
			<b>18</b>
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# AC Current Transformers - Equipment Specification

**Onshore site: Vanguard East onshore converter station**

AC Current Transformer (OTC=BC111)

Equipment Specification (DCC=EEC010)

**Employer Doc. No.:**

VGEO-SEN-E-SP-0006

**Siemens Energy Doc. No.:**

N-000261\_EC\_BC111#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: E4A000001675906

Export Control Classification:

ECCN: N	AL: N
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 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System 89
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01 Sheet 3 of 18

## 1 Revision History



Client Rev.	Contractor Rev.	Description* SPECIFY THE CHANGES MADE PER REVISION + incl. page number
A01	A01	First issue

## 2 Mandatory Contractor Notice under 5.2.3

This is the Contractor Notice under 5.2.3 stating:

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

 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Employer Document Number VGEO-SEN-E-SP-0006	Revision		System 89
Package Description (If Applicable) N/A	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
AC Current Transformers - Equipment Specification			Sheet 4 of 18	



## Index:

<b>1 Revision History</b>	<b>3</b>
<b>2 Mandatory Contractor Notice under 5.2.3</b>	<b>3</b>
<b>3 Introduction</b>	<b>6</b>
<b>4 Scope of Supply</b>	<b>6</b>
4.1 Spare Parts	6
4.2 Special Tools and Maintenance Equipment	6
4.3 Interfaces	7
Interfaces are:	7
<b>5 Design Requirements</b>	<b>7</b>
5.1 General	7
5.2 Electrical Requirements	8
5.2.1 Transient Stresses	8
5.3.2 Corrosion protection	9
5.3.3 Nameplates / rating plates	9
5.3.4 Insulation	9
5.3.4.1 Gas Insulation	9
5.3.4.2 Oil Insulation	10
5.3.5 Electrical shielding	11
5.3.6 Insulators	11
<b>6 Tests</b>	<b>11</b>
6.1 Factory Tests	11
6.2 Type Tests	12
6.3 Routine Tests	13
6.4 Site Tests	13
<b>7 Quality Assurance (QA)</b>	<b>14</b>
<b>8 Standards</b>	<b>14</b>
<b>9 Bill of Quantities</b>	<b>15</b>
<b>10 Technical Data</b>	<b>16</b>
<b>11 List of References</b>	<b>18</b>

## List of Tables:

 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Package Description (If Applicable) N/A	Employer Document Number VGEO-SEN-E-SP-0006	Revision	System <b>89</b>
AC Current Transformers - Equipment Specification	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001	Empl. A01	Contr. A01	Sheet 5 of 18

<b>Table 6.1: List of Type Tests.....</b>	<b>12</b>
<b>Table 6.2: List of Routine Tests.....</b>	<b>13</b>
<b>Table 8.1: List of applicable standards mentioned for guidance .....</b>	<b>14</b>
<b>Table 9.1: Bill of quantities for Onshore Converter Station.....</b>	<b>15</b>
<b>Table 10-1:Technical Data for AC Current Transformer at converter station Onshore.</b>	<b>17</b>
<b>Table 11.1:List of References.....</b>	<b>18</b>

 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System <b>89</b>
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01 Sheet 6 of 18

### 3 Introduction

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

### 4 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,
- optionally the special tools in accordance with clause 2.2.

The AC Current Transformer shall be delivered with corona rings, if necessary, secondary terminal box, internal wiring, and terminals. 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 his minimum requirements on these nuts and bolts (e.g., strength, quality, etc.) in his outline drawings.

#### 4.1 Spare Parts

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

#### 4.2 Special Tools and Maintenance Equipment

Equipment for which no special tools are needed during installation, 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.

 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System <b>89</b>
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
					Sheet 7 of 18

The AC Current Transformer must 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.

## 4.3 Interfaces

### Interfaces are:

Primary terminals: see reference [R01].

Earthing terminals: see reference [R01].

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.

## 5 Design Requirements

### 5.1 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.

 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Employer Document Number VGEO-SEN-E-SP-0006	Revision		System <b>89</b>
Package Description (If Applicable) N/A	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
AC Current Transformers - Equipment Specification			Sheet 8 of 18	

## 5.2 Electrical Requirements

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

### 5.2.1 Transient Stresses

In addition to the steady state conditions, the equipment will be stressed with transient currents and voltages as given in clause 8. Combinations as well as repetitions of the transient stress cases can follow in a very short time frame. The equipment must be designed to be capable of withstanding the stresses (including combinations and repetitions) without any adverse influence on its lifetime.

## 5.3 Design and Construction Requirements

### 5.3.1 Component design

It must 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 AC Current Transformers, except dry type instrument transformers, shall have provision for  $\tan\delta$  testing, measurement of capacitance and partial discharges.



The AC Current Transformers shall be designed such that they do not saturate during transients. Each secondary winding shall have an individual core. 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.

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 must 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 Current 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].



 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Employer Document Number VGEO-SEN-E-SP-0006	Revision		System 89
Package Description (If Applicable) N/A	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
AC Current Transformers - Equipment Specification			Sheet 9 of 18	

### 5.3.2 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].

### 5.3.3 Nameplates / rating plates

For further requirements / details see Reference [R01].

In addition, the amount of SF6 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].

### 5.3.4 Insulation

The AC Current Transformer 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 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).

#### 5.3.4.1 Gas Insulation



AC Current 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 mm<sup>2</sup> cables.

		Contract Number C508119	Tagging Information N/A	Lang. EN
Package Description (If Applicable) N/A	Employer Document Number VGEO-SEN-E-SP-0006	Revision	System <b>89</b>	
AC Current Transformers - Equipment Specification	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001	Empl. A01	Contr. A01	Sheet 10 of 18

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 Current 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 5.2-1

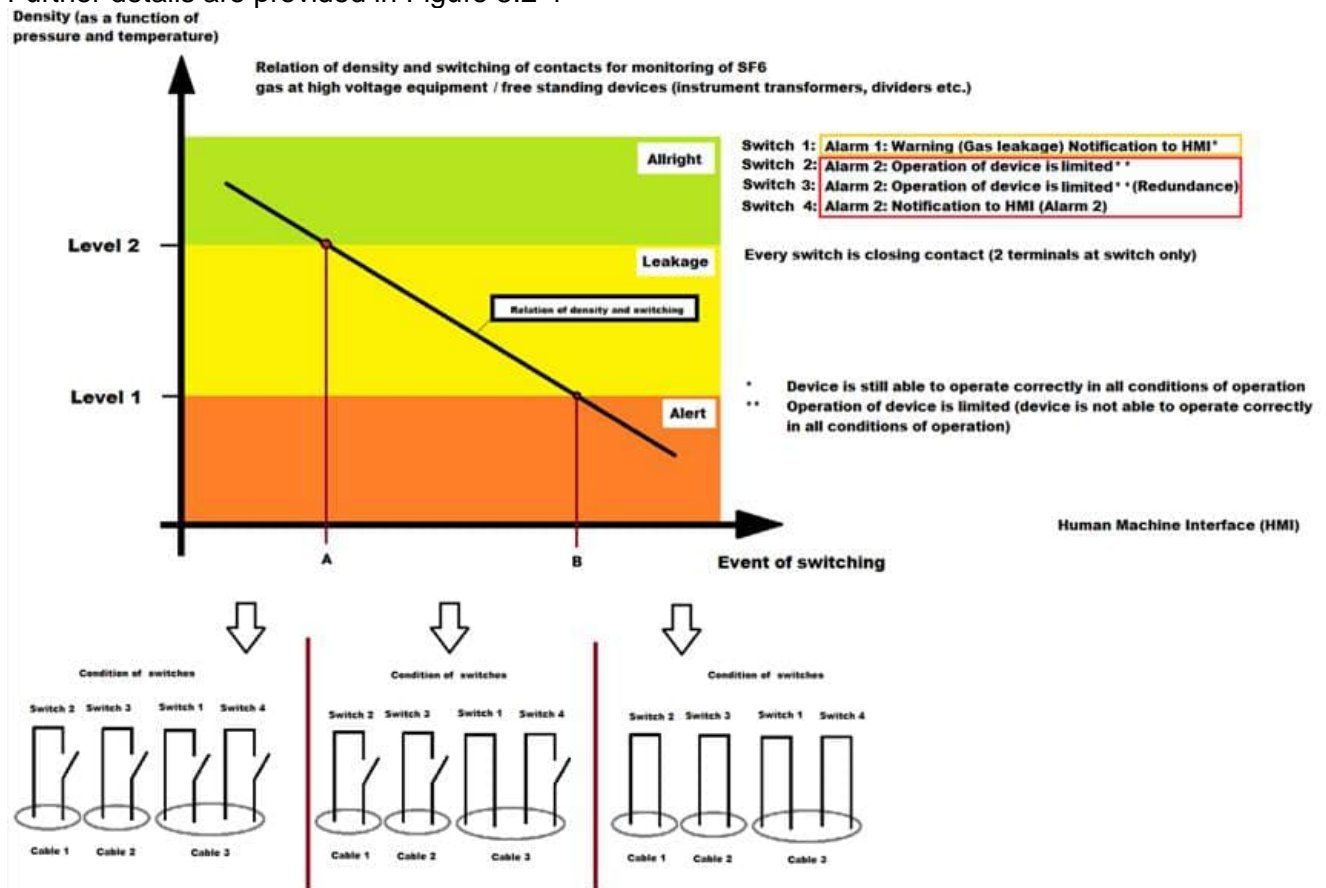




Figure 5.2-1: Relation of density and switching of contacts for monitoring of SF6

### 5.3.4.2 Oil Insulation

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

 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Employer Document Number VGEO-SEN-E-SP-0006	Revision		System <b>89</b>
Package Description (If Applicable) N/A	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
AC Current Transformers - Equipment Specification			Sheet 11 of 18	

### 5.3.5 Electrical shielding

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

### 5.3.6 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 current 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.

## 6 Tests

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.

### 6.1 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 must 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

 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Employer Document Number VGEO-SEN-E-SP-0006	Revision		System 89
Package Description (If Applicable) N/A	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
AC Current Transformers - Equipment Specification			Sheet 12 of 18	

Manufacturer as part of the visual inspection before the tests.

The repetition of type tests may not be needed, if evidence can be provided, that relevant test requirements are covered by previous tests 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 partially or 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.

## 6.2 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 61869-2 cl. 7.2.2
B	Impulse voltage tests on primary terminals (Contains LIWL and SIWL test)	IEC 61869-2 cl. 7.2.3
C	Wet test for outdoor type transformers	IEC 61869-1 cl. 7.2.4
D	Electromagnetic Compatibility tests (Contains RIV test)	IEC 61869-1 cl. 7.2.5
E	Test for accuracy	IEC 61869-1 cl. 7.2.6 IEC 61869-2 cl. 7.2.6
F	Verification of the degree of protection by enclosures	IEC 61869-1 cl. 7.2.7
G	Enclosure tightness test at ambient temperature	IEC 61869-1 cl. 7.2.8
H	Pressure test for the enclosure	IEC 61869-1 cl. 7.2.9
I	Short-time current test	IEC 61869-2 cl. 7.2.201

Table 6.1: List of Type Tests

 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Package Description (If Applicable) N/A	Employer Document Number VGEO-SEN-E-SP-0006	Revision	System 89
	AC Current Transformers - Equipment Specification	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001	Empl. A01	Contr. A01
				Sheet 13 of 18

### 6.3 Routine Tests

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

Pos.	Routine Test	Standard
A	Power-frequency withstand test on primary terminals	IEC 61869-2, cl. 7.3.1
B	Partial discharge measurement	IEC 61869-1, cl. 7.3.2
C	Power-frequency withstand tests between sections	IEC 61869-1 cl. 7.3.3
D	Power-frequency withstand tests on secondary terminals	IEC 61869-1, cl. 7.3.4
E	Test for accuracy	IEC 61869-2, cl. 7.3.5
F	Verification of terminal markings	IEC 61869-1, cl. 7.3.6
G	Enclosure tightness test at ambient temperature	IEC 61869-1, cl. 7.3.7
H	Pressure test for the enclosure	IEC 61869-1, cl. 7.3.8
I	Determination of the secondary winding resistance (if applicable)	IEC 61869-2 cl. 7.3.201
J	Determination of the secondary loop time constant (if applicable)	IEC 61869-2 cl. 7.3.202
K	Test for rated knee point E.M.F. and exciting current at rated knee point E.M.F. (if applicable)	IEC 61869-2 cl. 7.3.203
L	Inter-turn overvoltage test	IEC 61869-2 cl. 7.3.204



Table 6.2: List of Routine Tests

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.

### 6.4 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

 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System <b>89</b>
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
					Sheet 14 of 18

field, is safe to energize, load or start-up and will perform and operate as specified and designed. Objectives, procedures, and methodologies as well as pass-criteria shall be detailed in the program.

## 7 Quality Assurance (QA)

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



## 8 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 61869-2	Instrument transformers – Part 2: Additional requirements for current transformers	09/2012

Table 8.1: List of applicable standards mentioned for guidance



For additional information and order of precedence with respect to the standards please refer to Reference [R01] & [R02].

 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System <b>89</b>
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
					Sheet 15 of 18

## 9 Bill of Quantities

Item	Designation	Description	Quantity in total
VGEO_M_01	#VGEO-CA10-Q01-BC01	AC Current Transformer on Line side	3
VGEO_M_02	#VGEO-TD10-TA01-BC61	AC Current Transformer on Transformer neutral or Starpoint CT	1
VGEO_S_01	=Spare Unit	AC Current Transformer located on Line side	1
VGEO_S_02	=Spare Unit	AC Current Transformer located on Transformer neutral or Starpoint CT	1

Table 9.1: Bill of quantities for Onshore Converter Station



 	Contract Number C508119	Tagging Information N/A		Lang. EN
	Package Description (If Applicable) N/A	Employer Document Number VGEO-SEN-E-SP-0006	Revision	System 89
	AC Current Transformers - Equipment Specification	Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001	Empl. A01	Contr. A01
				Sheet 16 of 18

## 10 Technical Data

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



N_000261_TC_BC111_VGEO_EEC010			Project name:Norfolk Vanguard East	
Equipment Specification, AC Current Transformers				
Converter Stations			Station B	Station B
Location designation			#VGEO-CA10-Q01-BC01	#VGEO-TD10-TA01-BC61
Items		Units	VGEO_M_01	VGEO_M_02
Main Data				
Type name			Type A	Type B
Type of device			Inductive CT	inductive CT
Installation location	(indoor / outdoor)		Outdoor	Outdoor
Type of insulation	(oil / SF6 / epoxy resin, clean air)		SF6	SF6/Clean air
Type of insulator	(composite/porcelain/epoxy resin)		composite	composite
Electrical data				
Rated primary voltage	(ph - ph)	kV	420	T.B.D.*
MCOV (Maximum Continuous Operating Voltage)	(ph - ph)	kV	420 440 for 15 min	17.5kV(ph-gd)
Rated frequency $f_r$		Hz	50	50
Frequency Range		Hz	49 to 51	49 to 51
LIWV (Lightning impulse withstand voltage)		kV <sub>peak</sub>	1425	95
SWV (Switching impulse withstand voltage)		kV <sub>peak</sub>	1050	
Base voltage for creepage calculation Note: USCD (Unified Specific Creepage Distance)	(ph - gnd)	kV	242.49	10.10
Minimum creepage distance ( $D_a < 300\text{mm}$ )				
Note: Diameter correction acc. to General Data	specific (ph - gnd) US	mm/kV	53.7	53.7
	total (ph - gnd)	mm	13022	543
Rated primary current $I_N$		A	2500	-
Rated cont. thermal current factor		%	1.5 x $I_N$	
Core data				
Core no.1:			Protection	
Transformation ratio $k_r$		A	3000-1	3000/1
Accuracy class			TPY	5PR15
$K_{td}$			$K_{td}>5$	5
$R_b$ (Rated resistive burden)		$\Omega$	2	-
$T_s$ (Rated value of secondary loop time constant)		ms	400	
$K_{ssc}$			$K_{ssc}=15$	-



 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System 89
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
					Sheet 17 of 18

<b>Core no.2:</b>			Protection	-
Transformation ratio $k_r$		A	3000-1	3000/1
Accuracy class			TPY	5PR15
Ktd			Ktd>5	5
Rb (Rated resistive burden)		$\Omega$	2	-
Ts (Rated value of secondary loop time constant)		ms	400	
Kssc			Kssc=15	-
<b>Core no.3:</b>			metering	
Transformation ratio $k_r$		A	2400-1 ext 120%	-
Accuracy class			0.2S	-
Instrument Security factor			FS5	-
Burden		VA	10	-
<b>Core no.4:</b>			protection	
Transformation ratio $k_r$		VA	2000/1000-1A	-
Accuracy class			BS-EN NGTS PX-A	-
Minimum knee point voltage $V_k$		V	$V_k > 300(R_{ct} + 7.5)$	-
<b>Core no.5:</b>			Protection	
Transformation ratio $k_r$		VA	2000/1000-1A	-
Accuracy class			BS-EN NGTS PX-A	-
Minimum knee point voltage $V_k$		V	$V_k > 300(R_{ct} + 7.5)$	-
<b>Mechanical data</b>				
Terminal forces, static		kN	2	2
Terminal forces, dynamic		kN	5	5
<b>Project related data</b>				
Minimum ambient temperature		°C	-10	-10
Maximum ambient temperature		°C	35	35

Table 10-1: Technical Data for AC Current Transformer at converter station Onshore

 		Contract Number C508119	Tagging Information N/A		Lang. EN
Package Description (If Applicable) N/A		Employer Document Number VGEO-SEN-E-SP-0006		Revision	System <b>89</b>
AC Current Transformers - Equipment Specification		Subcontractor Document Number N-000261_EC_BC111#VGEO&EEC010/001		Empl. A01	Contr. A01
					Sheet 18 of 18

## 11 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 11.1: List of References