Base Load Power Hub (BLPH)

SITE ACCEPTANCE TEST PROCEDURE
HV Switchgear
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STANDARDIZED H.V. MINIVER/C SWITCHBOARDS

Site Acceptance Test Procedure



IMESA® ELECTRICAL ENGINEERING

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Summary

1. INTRODUCTION 4
1.1. PROJECT OVERVIEW 4
1.1.1. Project Location 4
1.1.2. Project Concept 5
2. SCOPE AND APPLICABILITY 7
3. APPLICABLE STANDARDS AND DOCUMENTS 7
4. SAFETY RECOMMENDATIONS 8
5. GENERAL DESCRIPTION 9
5.1. PURPOSE OF SAT 9
5.2. TESTING TASKS 9
5.3. TEST EQUIPMENT 11
5.4. TEST PHASE AND PASS/FAIL CRITERIA 12
6. PRE-COMMISSIONING PROCEDURE 12
6.1. GENERAL INFORMATION 12
6.2. PRE-COMMISIONING ACTIVITIES 13
7. COMMISIONING ACTIVITIES 14
8. SAT TESTING PROCEDURE 15
8.1. MECHANICAL TESTS 15
8.2. MEASUREMENT OF THE RESISTANCE OF THE MAIN CIRCUITS 16
8.3. TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS 16
8.4. PRIMARY INJECTION ON CURRENT AND VOLTAGE TRANSFORMERS 17
8.5. SECONDARY INJECTION TESTS ON PROTECTION RELAYS 18
8.6. HI-POT TEST 19
8.6.1. POWER-FREQUENCY WITHSTAND VOLTAGE TEST AND INSULATION RESISTANCE MEASUREMENT 19
8.6.2. DIELECTRIC TEST ON AUXILIARY CIRCUIT AND INSULATION RESISTANCE MEASUREMENT 21
8.7. INFRARED SENSORS TESTS 22
8.7.1. TEST PROCEDURE – TEST WITH CIRCUITS NOT ENERGISED 23
8.7.2. TEST PROCEDURE – TEST WITH CIRCUITS ENERGISED 23
8.8. NETWORK and GOOSE TESTING 24
8.8.1. INTERNAL GOOSE MESSAGING TEST 24
8.8.2. EXTERNAL GOOSE MESSAGING TEST 25
8.8.3. INFRARED SENSORS MODBUS NETWORK 25
9. PRE-ENERGIZATION REQUIREMENTS 26
10. PRE-COMMISSIONING, COMMISSIONING AND SAT REPORT TEMPLATES 27

1. INTRODUCTION

1.1. PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.
Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1. Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

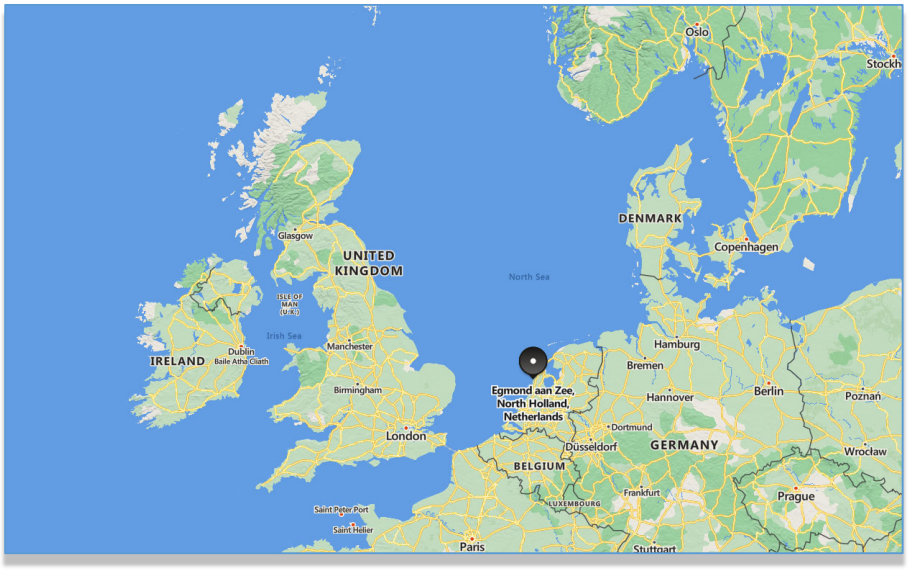


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

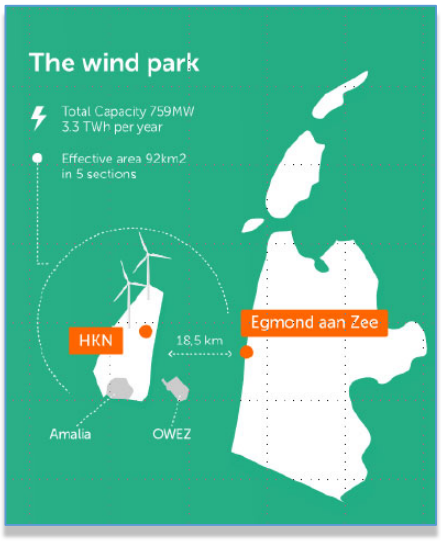


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2. Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

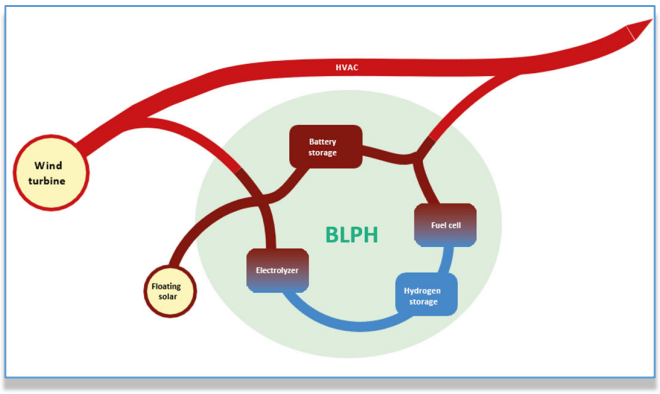


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.
The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2. SCOPE AND APPLICABILITY

This document provides the commissioning and start-up methods, as well as the testing procedures at site, applicable to H.V. Electrical Switchboards, manufactured by IMESA in compliance to Standard IEC 62271-200 and designated as Miniver-C type.

The procedure is applicable to the following switchgear tag: SG-100D1

3. APPLICABLE STANDARDS AND DOCUMENTS

The tester will make reference to Standards IEC 62271-200 and IEC 62271-1 and to the engineering documents listed here below.

Ref.	Imesa Doc No.	Description
A1	**1723002197-EL-DA-00006**	**SG-100D1 General Arrangement DWG and foundation load calculation including COG**
A2	**1723002197-EL-DG-00010**	**SG-100D1 Electrical Single Line Diagram**
A3	**1723002197-EL-DG-00015**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - INCOMING FEEDER (including Terminals and BOM)**
A4	**1723002197-EL-DG-00016**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - BUS BAR METERING (including Terminals and BOM)**
A5	**1723002197-EL-DG-00017**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - BESS FEEDER (including Terminals and BOM)**
A6	**1723002197-EL-DG-00018**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - ELECTROLYSER FEEDER (including Terminals and BOM)**
A7	**1723002197-EL-DG-00019**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - FUEL CELL FEEDER (including Terminals and BOM)**
A8	**1723002197-EL-DG-00020**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - TRANSFORMER FEEDER TR200ED1 (including Terminals and BOM)**
A9	**1723002197-EL-DG-00021**	**SG-100D1 MV SWG FUNCTIONAL DIAGRAM - TRANSFORMER FEEDER TR200DE1 (including Terminals and BOM)**
A10	**1723002197-EL-DG-00022**	**SG-100D1 MV SWG INTERCONNECTING AND AUX DISTRIBUTION DIAGRAM (including BOM)**
A11	**1723002197-EL-DG-00023**	**SG-100D1 MV SWG LOGIC DIAGRAM - INCOMING FEEDER**
A12	**1723002197-EL-DG-00024**	**SG-100D1 MV SWG LOGIC DIAGRAM - BUS BAR METERING**
A13	**1723002197-EL-DG-00025**	**SG-100D1 MV SWG LOGIC DIAGRAM - BESS FEEDER**
A14	**1723002197-EL-DG-00026**	**SG-100D1 MV SWG LOGIC DIAGRAM - ELECTROLYSER FEEDER**
A15	**1723002197-EL-DG-00027**	**SG-100D1 MV SWG LOGIC DIAGRAM - FUEL CELL FEEDER**
A16	**1723002197-EL-DG-00028**	**SG-100D1 MV SWG LOGIC DIAGRAM - TRANSFORMER FEEDER TR200ED1**
A17	**1723002197-EL-DG-00029**	**SG-100D1 MV SWG LOGIC DIAGRAM - TRANSFORMER FEEDER TR200DE1**
A18	**1723002197-EL-DS-00034**	**SG-100D1 EQUIPMENT DATA SHEETS INCLUDING MSDS and WEIGHT DATA SHEET**
A19	**1723002197-EL-CAL-00014**	**SG-100D1 CURRENT and VOLTAGE TRANSFORMER SIZING CALCULATION and CHARACTERISTIC**
A20		**MV Switchgear - F.A.T. Report**
A21	**1723002197-EL-CAL-00056**	**OPERATION SEQUENCES AND KEY INTERLOCK**
A22	**1723002197-EL-CAL 00054**	**INSTALLATION OPERATING AND MAINTENACE MANUAL**

Hard copy of the a.m. IMESA documents, properly stamped and signed as "AS BUILT", will be available for the needed testing activities and verifications.

4. SAFETY RECOMMENDATIONS

WARNING



- **All the operations of electric maintenance and installation must be performed by qualified technicians**
- **All the standard electric safety procedures must be respected**
- **Never touch inside the switchboard; only after making sure it is out of voltage and grounded**
- **Always wear personal protective equipments (insulating shoes in rubber, protective glasses, safety helmet, etc…)**
- **Never work alone**
- **Never remove safety screens**
- **Always pay maximum attention when handling components or performing measurements inside the panel**
- **It shall be taken in mind that this test procedure is only for the equipment and is to be used together (not instead of) all safety procedures specified by local Laws, rules, regulations and Standards**

People attending the commissioning and testing activities must wear:

SHOES: Workers, staff of the Customer, the End User or its representatives (inspectors) present during the tests shall wear safety shoes, ever. The staff of the Customer, the End User or its representatives (inspectors) present during the tests must arrive already equipped with their own shoes. The staff of the Customer, the End User or its representatives (inspectors), present during the tests and not wearing safety shoes, may still access the Safe Area, but not the test area. They will therefore only observe the test from Safe Area and conducting the review of the results in test reports.

GLASSES: Workers must wear safety glasses when performing risky for their eyes.

HELMET: Workers must wear protective helmets when performing lifting and handling, or when there is a suspended load. When there are suspended loads or handling and lifting the staff of the Customer, the End User or its representatives (inspectors) present during the tests must remain in the Safe Area.

GLOVES: Workers must wear gloves when performing risky for the hands or vibrations.

DRESS: All workers must wear appropriate safety clothing, forever. Helmet, gloves, glasses, safety clothing are not required to staff of the Customer, the end Customer or his representatives (inspectors) present during the tests.

When testing the dielectric properties (applied voltage test), **insulated gloves** and **shoes with retractable toe caps**, as well as suitable **protection clothing covering body and arms**, to be worn.
If the test is suspended even temporarily, the test instrument must be disconnected from the mains.

Before to start any activity, to thoroughly check that the following points are confirmed:

- the lighting system in the area is suitable and in operation
- phone or radio communication system is available, even temporarily for the present activities
- the fire-fighting system is in operation and provided with valid certification (portable fire extinguishers may be also suitable for purpose)
- earthing plant in the area and earthing connections of the subsystems to be energized have been completed and tested

5. GENERAL DESCRIPTION

5.1. PURPOSE OF SAT

The purpose of the SAT (Site Acceptance Test) is to inspect the switchboard, after installation at site, to ensure that it is ready for energization and start-up and also that its performance requirements will be met.
Prior to performing any Site Acceptance Testing, all Punch list items have to be rectified and closed.

5.2. TESTING TASKS

After completion of the installation phase of the switchboard and in order to prepare it for SAT, pre-commissioning and commissioning are to be first carried out, as further detailed in the next paragraphs.

The overall test activities will be performed by means of the specific test equipment, under the control and responsibility of the test executor, along with some assistants.

The main steps that will be performed are the following:

- Verification of the test procedures and of the related documentation availability.
- Preparation of the test setup
- Execution of the tests according to the Test Procedure and release of the SAT Test Report
- Signing of the SAT Test Report by the test executor and the attending people.

Estimated lead time to carry out all these tests is 3/4 weeks (it depends on site activities conditions, actually).

For additional tests not included in its own scope of work, IMESA will provide technical support, as agreed in advance.

List of the tests

Item	Activity	Tool	Support Requested	Type of Test
a.	Mechanical check	Torque Wrench	Mech. Engineer Inspection/Quality Officer	Mandatory
b.	Testing contact resistance at busbars, CBs & Fused Contactors	Current generator and digital multimeter	Electrical Engineer Inspection/Quality Officer	Mandatory
c.	Primary Injection on current transformers	Injection current bench	Electrical Engineer Inspection/Quality Officer	Suggested (to verify that CT is not damaged)
d.	Primary Injection on voltage transformers	Apply low voltage to check the functionality of VT (400V)	Electrical Engineer Inspection/Quality Officer	Suggested (to verify that VT is not damaged)
e.	Testing of protection relays by secondary injection	Secondary injection bench (Omicron)	Electrical Engineer (Relay specialist) Inspection/Quality Officer	Mandatory

Item	Activity	Tool	Support Requested	Type of Test
f.	Functional test of IEDs, and interlocks.	Secondary injection bench (Omicron)	Electrical Engineer (Relay specialist) Inspection/Quality Officer	Mandatory
g.	High voltage test	Hi pot equipment	Electrical Engineer Inspection/Quality Officer	Mandatory
h.	Infrared sensors tests	Non-contact temperature measuring tool	Electrical Engineer (Temperature sensors specialist) Inspection/Quality Officer	Suggested (to verify correct settings)
i.	Arc flash detecting system test	Camera Flash Secondary injection bench (Omicron)	Electrical Engineer (Relay specialist) Inspection/Quality Officer	Mandatory
j.	Network Goose Messaging system test	Secondary injection bench (Omicron)	Electrical Engineer (Relay specialist) Inspection/Quality Officer	Mandatory
k.	ENMC system communication test	Secondary injection bench (Omicron)	Electrical Engineer (Relay specialist) Inspection/Quality Officer ENMC test is intended in charge to PMS vendor (IMESA to only provide assistance, where requested and agreed)	Mandatory
l.	Partial discharge detecting system test	Calibration tools	Electrical Engineer (Relay specialist) Inspection/Quality Officer	Suggested (to verify correct settings)

5.3. TEST EQUIPMENT

- Megger (e.g. : Chauvin Arnoux ca 6547)
- Tester / Multimeter
- Testing bench for primary injection (e.g. : Omicron CPC 100)
- Relay Testing System (through current / voltage secondary injection - (e.g. : Omicron CMC 353)
- Torque Wrench (e.g. Dina Beta NM 20÷100)
- Voltage drop test equipment (e.g. : Multimeter + TEIB PP77 100A DC)
- Hi-pot test bench (e.g. : Phenix 650-2P)

NOTES:

- it shall be advised in advance availability of the testing equipment at site or whether those are to be provided by the commissioning engineer himself;
- availability of calibration certificates of the above testing equipment, having valid date, must be ensured.

5.4. TEST PHASE AND PASS/FAIL CRITERIA

For each test a set of pass/fail criteria will be defined (it is also possible that each test has a different criteria) in order to establish an acceptance procedure.
Where acceptance and rejection criteria are not established, they shall be defined according to the best practice, making reference to standards or samples.

The main possibilities are the following:

- All the steps are successfully performed (the test passes)
- Some steps fail but the function under test is verified (the test passes after client approval)
- Some steps fail and the function under test is not verified (the test fails)
- Some steps fail but with a specific corrective action the proper function is recovered (the test must be repeated);

If the test fails, a related NCR will be released.

6. PRE-COMMISSIONING PROCEDURE

6.1. GENERAL INFORMATION

Locking magnets are installed on the HV circuit breaker / HV Fused contactor compartments, to increase general safety of the H.V. Switchboard.

RLE1
Locking magnet on the operating mechanism.
If de-energized, it mechanically prevents circuit breaker / contactor closure.

RLE2
Locking magnet on the truck.
If de-energized, it mechanically prevents circuit breaker / contactor racking-in and racking-out operations.

RLE3 (provided on request)
Locking magnet on the earthing switch.
If de-energized, it mechanically prevents any earthing switch operation (closing and opening, as well).

RLE4
Locking magnet on the circuit breaker compartment door.
If de-energized, it prevents opening and closing of the circuit breaker compartment door.

Circuit Breaker and contactor status (Open / Close / Tripped) is showed on the HMI panel of the protection relays.

For the programmable indication, assigned to the single LED indicator available on the protection relay's HMI panel, please, refer to the relevant table in the schematic diagrams.

IT IS RECOMMENDED TO FORESEE THE ATTENDANCE OF AN IMESA TECHNICIAN DURING THE ABOVE MENTIONED ACTIVITIES

6.2. PRE-COMMISIONING ACTIVITIES

Before to start Pre-Commissioning, please, read carefully the I.O.M. document (Installation, Operation and Maintenance manual).
Then proceed with the following checks and actions.

1. Switchboard's cubicles shall be in good and clean status. Make sure that switchboard is clean, free from dust, traces of humidity, installation material debris, cables pieces, tools, provisional connections, etc. , as well as any foreign object.
2. Visually check the interior and exterior of the switchboard for signs of evident damage
3. Make sure that the switchboard is correctly installed according to the General Arrangement Drawings
4. Maintenance clearances shall be according to the General Arrangement Drawings
5. Make sure that any support or protection used to handle the equipment has been removed
6. Make sure that, after completion of the installation, the switchboard overall protection degree is as per General Arrangement Drawings
7. Visual inspection to check that bolted connections of the HV and earthing circuits (at busbars, CBs poles, CTs, VTs, etc.) are suitably tighten. No disalignment is expected at the marks provided over the bolt, during torque wrench tightening at the factory. In case found, to torque wrench again the connection (see par. 7.1).
8. Cable passages shall be free and unobstructed
9. Couple the auxiliary interpanel connections by the relevant plugs and socket (see schematic diagrams with control voltage distribution loop, panels interconn. wiring and communication network loop)
10. Cabling of control cables from the field in accordance with I/O list / schematics shall be completed
11. Check the incoming / outgoing power cables proper support and earthing screens connections.
12. Make sure that terminals and all the connections have been properly tightened
13. Make sure that all the safety interlock keys (master and copies) have been provided and installed. There are manoeuvres not allowed (forced operations shall be avoided).
14. Remove each H.V. circuit breaker and contactor from its cubicle, by means of the provided lifting / transport trolley, for a visual check of the breaker status and cleaning; including fixed poles of the enclosure and tulip contacts on the removable part.
    Make sure that the breaker is free from dust and traces of humidity and that there are no signs of evident damage.
15. Make sure that all H.V. fuses are correctly installed and that rating is in conformity to the schematic diagrams and parts lists.
16. All necessary warning and caution signs (voltage level indication, warning for live parts, etc.) shall be installed according to the safety standards and procedures.

The results of the a.m. activities shall be recorded on PRE-COMMISSIONING ACTIVITIES REPORT form (see par. 9)

7. COMMISIONING ACTIVITIES

Carry out the following checks and actions.

1. To be verified that all HV circuit breakers and HV fused contactors are in open and racked-out position; with charged closing springs.

   N.B. : it is recommended to manually rewind all the circuit breakers closing springs, before to supply the relevant spring motor chargers, with aux. supply voltage 110 V d.c. , in order to prevent concurrent start-up of many motor gears, which may result in excessive load for the supplying circuit.

   As an alternative, it can be taken care that supply to those motors is provided one by one; by separately closing the relevant MCB, provided within the LV compartment of each feeder unit.
2. Check that all the earthing switches are in closed position.
3. Connect all external aux. supplies and check that are at correct voltage value and phase sequence.
4. Check thoroughly the Operating Sequences and the relevant mechanical safety interlocks, by putting in service and then again out of service all the H.V. units.
5. With CBs / Contactors in test position, close and open the same by local command.
6. Make sure that the phase sequence, at the H.V. circuits, is in accordance to the electrical diagrams and that all incoming breakers are connected with the same phase sequence.
7. Check monitoring loops (hardwired status / alarm signals / visual status indications).
8. Check protection relays loops, concerning IEDs' integrated logic functions.
9. Put the HV CBs / HV Contactors in service (racked-in) position and repeat the test for opening / closing the same from local and remote commands, including control loops from / to the field (commands, status, alarm, etc.)

   N.B. : It is necessary to simulate voltage presence at the bus-bars and at the incomers, to enable CBs closing commands. Voltage presence shall be simulated, at voltage and frequency protection relays, to avoid trip commands for "dead bus-bars" function (see relevant schematic diagrams and protective relays selectivity study).
10. Check HV CBs / HV Contactors tripping, locking-out and alarming functions.

The results of the a.m. activities shall be recorded on the COMMISSIONING ACTIVITIES REPORT form (see par. 9)

8. SAT TESTING PROCEDURE

8.1. MECHANICAL TESTS

1. Bus-bars tightening check

Torque wrench all the bolted joints of the shipping sections, which have been coupled at site, according to the values indicated here below.
After tightening, each bolt is to be marked by red paint to indicated its relative position against the fixed part (as done for the torque wrench tightening provided at the factory).

The table below shows the torque wrench settings to be used for bolted connections fixing the panels and the bus-bars, too.

Screws	M6	M8	MI0	M12	M14	M16
Wrench setting (Nm) -Min	8	19	40	68	100	160
Wrench setting (Nm) - Nominal	9	22	45	75	115	185
Wrench setting (Nm) - Max	10	25	50	83	130	200

2. Tightening at CTs and VTs primary terminals

Primary terminals of the current transformer are made of copper, with threaded screws inserts provided to be used for fastening the primary conductor.

Torque wrench values are to be applied in accordance to the data sheets / to the installation manuals of the Current & Voltage Transformers' manufacturer.

The results of the a.m. activities shall be recorded on SAT REPORT FOR MECHANICAL TEST form (see par. 9)

8.2. MEASUREMENT OF THE RESISTANCE OF THE MAIN CIRCUITS

Measurement of the resistance of the main circuit shall be carried out where joints between shipping sections have been coupled at site. The test is to carried out in accordance to subclause 6.4.1 of Std. IEC 62271-1.
For the routine test, the d.c. voltage drop or resistance of each pole of the main circuit shall be measured under conditions as much as possible similar, with regard to ambient air temperature and point of measurement, to those of the corresponding type test.
The measurement is to be made by volt-ammetrical method with a d.c. current equal to 100 A, across the main circuit of each panel unit phase.

Acceptance criteria:
The measured resistance shall not exceed 1,2 Ru where Ru is equal to the resistance measured before the temperature rise type test.

The results of the a.m. activities shall be recorded on SAT REPORT FOR MEASUREMENT OF THE RESISTANCE OF THE MAIN CIRCUITS form (see par. 9)

8.3. TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS

Insulation resistance measurement
When the breaker is closed, measure the insulation resistance, phase to ground, with 5 kV d.c. Megger. The test is to be carried out with the other two phases short-circuited and connected to ground.
Then open the breaker and measure the insulation resistance pole to pole.
The above to be carried out for all the phases.

Minimum value of insulation resistance is to be 50 MΩ.

Contact resistance test
The breaker will be in close position before starting the test.
Then inject d.c. current of 100 A on each pole (from in to out of each phase) and measure the voltage drop across it. The measurement is to be done by multimeter
By applying Ohm's law, the resistance value is then calculated. The obtained value needs to be compared with the value given by the manufacturer. Reference is to be made to the voltage drop value of VD4 Circuit Breakers/VSC Contactors, detailed in the relevant Test Reports.

As an alternative, an apparatus with direct reading (Omicron) can be used.

The results of the a.m. activities shall be recorded on SAT REPORT FOR TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS form (see par. 9)

8.4. PRIMARY INJECTION ON CURRENT AND VOLTAGE TRANSFORMERS

1. Testing CTs ratio

   Test the CT for correct ratio with direct current injection to CT primary circuit and reading the measured value from the instruments or protection relays LCD display, provided at the LV compartment front door.

2. Testing VTs ratio

   Test the VT for correct ratio with direct voltage injection to VT primary circuit (low voltage 400 V, for testing purpose) and reading the measured value from the instruments or protection relays LCD display, provided at the LV compartment front door.

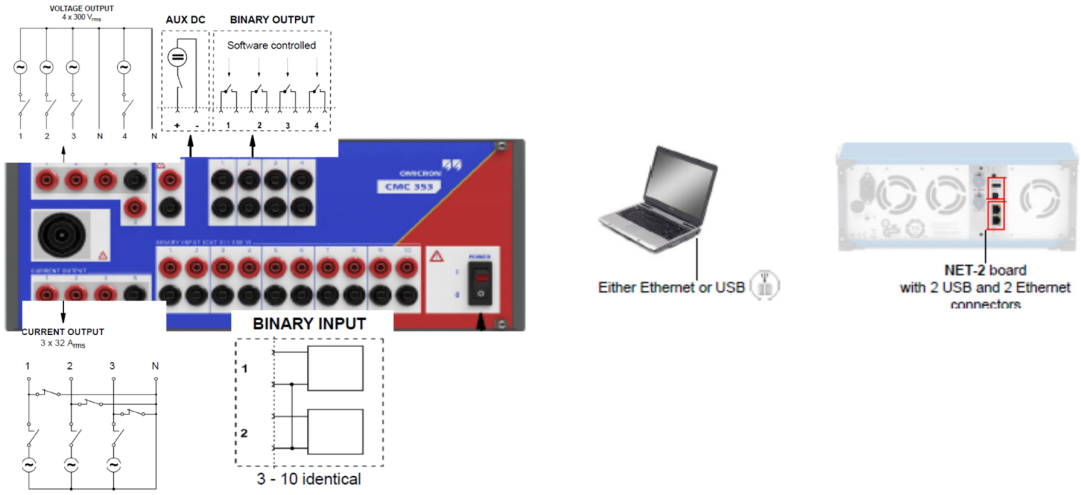
   The results of the a.m. activities shall be recorded on SAT REPORT FOR PRIMARY INJECTION TESTING ON CTs AND VTs form (see par. 9)

8.5. SECONDARY INJECTION TESTS ON PROTECTION RELAYS

Refer to the schematic diagrams, for connections and for checking logic functions.
Refer to the selectivity study for the protection relays' setting parameters.
Softwares to be employed for uploading, setting and testing the H.V. Switchgear's protection relays are:

- Interface Software to be used – ABB PCM600 2.9 32 bit / ABB PCM600 2.10 32 bit
- ITT600 Integrated Testing Tool or equivalent

Omicron secondary injection test kit – connection and interface



Example of testing instruments connection

1 – Connection of the test set to the PC (USB Port) for data exchange: output of the data simulation, loading of the binary signal
2 – Connection of the analogue outputs of the test set to the transformer inputs of the test object, to inject the simulated currents and voltages.
3 – Connection of the binary outputs of the test set to the binary inputs of the test object, to send binary input signals to the test object.
4 – Connection of the binary inputs of the test set to the binary outputs of the test object, to receive the binary output signals from the test object.

The recorded tripping values shall be in conformity with the Selectivity study

N.B. : Checks on the Partial Discharge detecting systems calibration are also intended within this testing phase.

The results of the a.m. activities shall be recorded on SAT REPORT FOR PROTECTION FUNCTIONS CHECK form (see par. 9)

8.6. HI-POT TEST

The dielectric tests are carried out to check that the installation and re-connection activities at site have been made correctly and that no damage occurred to the equipment, during shipment and installation.

These tests shall be performed before to install the power and cables.

8.6.1. POWER-FREQUENCY WITHSTAND VOLTAGE TEST AND INSULATION RESISTANCE MEASUREMENT

All the VT's, surge arresters, insulation monitoring devices, etc. must be disconnected before the test. A voltage generator, at industrial power frequency voltage, is to be used to carry out the test.

1. Insulation resistance measurement

Before and after the Hi-pot test, insulation resistance measurement is to be carried out, applying 5 kV d.c. by means of Megger device. The measurement is to be carried out at each phase, while the other two are short-circuited and connected to ground.
The values detected before and after the Hi-pot test will be recorded in the SAT Report.

2. Carrying out the test on the power circuits

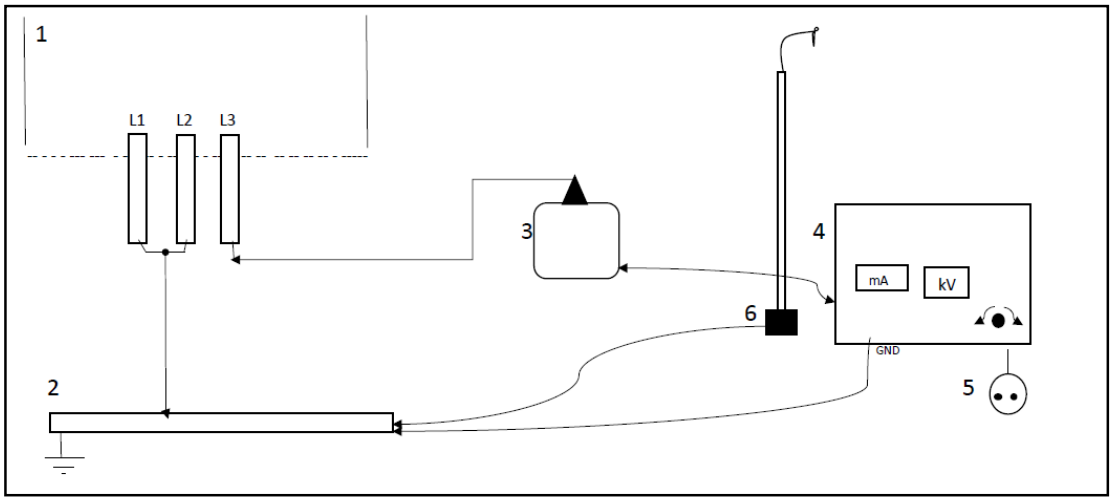
The test voltage to be applied, referring to the rated voltage of the switchboard is as follows (ref. IEC 62271-1, Table 1):

Rated Voltage kV r.m.s. value)	Test Voltage (kV r.m.s. value) AC (100% during F.A.T.)	Test Voltage (kV r.m.s. value) AC (80% during S.A.T.)	Applicability
7.2	20	16	

N.B. : the above test voltage value is 80% of the rated power-frequency withstand voltage at FAT, as specified in clause 7.105 of Std. IEC 62271-200.

HI-Pot Test Lay-Out

1) HV Switchboard Busbar
2) Ground Reference
3) Step-up Transformer
4) Hi-Pot Tester
5) Power supply
6) Ground stick



Example: test layout for testing at phase L3

- Connect to ground the control desk, the VT truck, the foil, the equipment under test
- Limit the test area by means of appropriate barriers
- Connect the MV pole of the VT to the phase under test of the panel, while the other two phases are connected together and to ground
- Connect the flashing lights barriers, the VT truck and its power plug
- The operator, before starting the test, must ensure that nobody is within the hurdles
- Close the main switch of the testing bench and rotate slowly the rheostat knob, until reached the test voltage value, read on the voltmeter (**N.B.** if the rheostat knob is in zero position, the circuit is not closed)

All the above indication may be slightly different, depending on the VT truck type, available at site.

Check the dielectric strength of the main circuits by applying the test voltage for 1 minute on the following points:

- between phase L1 and the phases L2 and L3 connected to ground
- between phase L2 and the phases L1 and L3 connected to ground
- between phase L3 and the phases L1 and L2 connected to ground

The test is considered successful when no discharge or perforation occur within 1 minute.
If discharge phenomena are perceived, the test is considered anyway valid if the test bench does not detect this phenomenology.

After the test or if there has been a discharge, return to zero the rheostat and discharge any possible capacitive voltage remained on the VT pole, by means of the foil. After that, it will be allowed to access to the test object.

Apply the same test to the other two phases, in turn, by repeating the steps described here above.

The results of the a.m. dielectric tests shall be recorded on SAT REPORT FOR HI-POT TEST form (see par. 9)

8.6.2. DIELECTRIC TEST ON AUXILIARY CIRCUIT AND INSULATION RESISTANCE MEASUREMENT

1. Insulation resistance measurement

Before and after the dielectric test on auxiliary circuits, insulation resistance measurement is to be carried out, applying 500 V d.c. by means of Megger device. The measurement is to be carried out at each pole, while the other one is connected to ground.

The values detected before and after the below test will be recorded in the SAT Report.

2. Carrying out the dielectric test on the auxiliary circuits

The test is to be carried out by applying the voltage test between the single pole of the auxiliary and control circuits and ground (between each conductor and the other conductors connected to ground, in turns).

All current absorbing equipment, which would be damaged by the application of the testing voltage (coils, metering instruments, differential circuit breakers, etc.) must be disconnected before the test.

The voltage value to be applied is 2000 V, with duration of 1 min. (CEI EN 62271-1, pos. 6.2.10 applies).

The test is considered successful, if no discharge or perforation occur during the test (1 minute).

The results of the a.m. dielectric tests shall be recorded on SAT REPORT FOR DIELECTRIC TEST ON AUX. CIRCUITS form (see par. 9)

8.7. INFRARED SENSORS TESTS

It is here detailed the test method to carry out testing on Exertherm devices, based on infrared thermal sensing.

1. All sensor distance from busbar locations must adhere to standards for clearance from bus bars and cables, depending on circuits rated voltage.

2. Testing must be carried out in a location which provides reasonably stable ambient conditions; i.e. avoid rooms where direct sunlight cannot be prevented, or which are subject to frequent ambient variances.

3. Ambient temperature will be measured on the Exertherm Sensors i.e. at the lens end of the IRT/c using any suitably calibrated non-contact temperature measuring instrument, with certified accuracy. Calibration certificate must be available for scrutiny and up to date.

4. The following method of ambient measurement will be adopted.

   Ambient air temperature is to be between 10°C and 40°C

   - Measurement of ambient air temperature: indoor ambient air temperatures shall be determined by taking the average of the readings of three temperature-measuring devices, such as thermometers or thermocouples, placed as follows:

   a) One level with the top of the structure
   b) One 30 cm above the bottom of the structure
   c) One midway between the two positions a) and b).

   - All temperature-measuring devices shall be placed 30 cm from the structure, not in front of ventilators, and in locations unaffected by drafts caused by the structure or appreciable radiation from the equipment. When the ambient air temperature is subject to variations that might result in errors in measuring the temperature rise, the temperature-measuring devices should be immersed in a suitable liquid, such as oil, in a suitable container, or reliably attached to a suitable mass of metal.

NOTE - A convenient form for such a container consists of a metal cylinder with a hole drilled partly through it. This is filled with liquid and the temperature-measuring device is placed therein. The size of the container should be at least 2.5 cm in diameter and 5.0 cm high.

The ambient temperature used when calculating the connection delta temperature will be the local ambient recorded at the Exertherm Sensor location.

5. All Datacard power supplies will be maintained at 24V d.c. ±10%.

6. All equipment test apparatus and Sensors to be used during these tests will be left to acclimatise in the switchgear for a period of a minimum of 1 hour prior to any tests taking place.

7. It is assumed that all Datacards are programmed and commissioned according to the relevant product instructions.

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8.7.1. TEST PROCEDURE – TEST WITH CIRCUITS NOT ENERGISED

1. Ensure all power supplies are set at the correct voltage and within specification i.e. at 110 V d.c. and 24 V d.c. ±10%.

2. Take a reading of room ambient as described in the previous section and note this value on the test check sheet (section Room Ambient)

3. Take a reading of the ambient temperature at the Sensor under test and note this value on the test check sheet (section Ambient Test Reading)

4. Take a reading from the Datacard software on the Sensor under test and note the value on the test check sheet (section Sensor Reading Under Test)

5. Take a reading of absolute temperature from the busbar with a suitably calibrated and certified temperature measurement device and note this reading. This should be an average reading across the connection point and not just one 'spot' temperature and note the value on the test check sheet (section Absolute Reading At Sensor)

6. Subtraction of the ambient temperature (at the sensor) from the connection temperature will result in the Delta T value and note the value on the test check sheet (section Calculated Delta T Reading). This should comply with the IR Sensor reading ±3°C (5.4°F)

7. Note down all these readings for future reference.

Repeat the steps 3 to 7 for all Sensors in the panel.

All these readings should produce a Delta T value of between -3°C (-5.4°F) to +3°C (+5.4°F)

It should be noted that this is not process control and therefore readings will not be exact to the degree. The Exertherm Sensor is 100% repeatable in identical conditions.

8.7.2. TEST PROCEDURE – TEST WITH CIRCUITS ENERGISED

1. With the switchgear energised and set in test conditions, with test currents and loading, allow all temperature, including ambient temperature to become stable.
   Leave all equipment to again acclimatise to local conditions for a minimum of 30 minutes.

2. Ensure all power supplies are set at the correct voltage and within specification i.e. at 110 V d.c. and 24 V d.c. ±10%.

3. Take a reading of room ambient temperature as described in the previous section and note this value on the test check sheet (section Room Ambient)

4. Take a reading of the ambient temperature at the Sensor under test and note this value on the test check sheet (section Ambient Test Reading)

5. Take a reading from the Datacard software on the Sensor under test and note the value on the test check sheet (section Sensor Reading Under Test)

6. Take a reading of absolute temperature from the busbar with a suitably calibrated and certified temperature measurement device and note this reading. This should be an average reading across the connection point and not just one 'spot' temperature and note the value on the test check sheet (section Absolute Reading At Sensor)

7. Subtraction of the ambient (at the sensor) from the connection temperature will result in the Delta T value and note the value on the test check sheet OEM Design Validation Test Record (section Calculated Delta T Reading). This should comply with the Exertherm IRT/c sensor reading ±3°C (5.4°F)

8. Note all these readings for future reference.

Repeat these steps 4 to 7 for all Sensors in the panel.

All these readings should produce a Delta T value of between -3°C (-5.4°F) to +3°C (+5.4°F).

The results shall be compared to the relevant data sheet for the Sensor's tolerances in terms of accuracy and repeatability.

The results of the a.m. tests shall be recorded on SAT REPORT FOR INFRARED SENSORS TESTS form (see par. 9)

8.8. NETWORK and GOOSE TESTING

Preliminary checks

1) Ensure that each IED is set with the right parameter of the network below cited
   - Technical key
   - IP address
   - Subnet Mask (in charge to Network vendor engineer)
   - Main NTP address (in charge to Network vendor engineer)
   - Backup NTP address (in charge to Network vendor engineer)
   - Time clock (in charge to Network vendor engineer)
2) Ensure that Ethernet switch is duly set (in charge to Network vendor engineer)
3) Ensure that the IED is switched ON

8.8.1. INTERNAL GOOSE MESSAGING TEST

- Function ANSI 27 block for feeders

Simulate voltage loss from VTs on Busbars metering unit, by opening the distribution MCB, at the secondary circuits of the VTs, or rack-out the VTs trolley, or simulate fuses blown on the VTs' primary circuits.
On different feeder, simulate undervoltage condition with racked-in & closed position of the HV breaker. The HV Circuit Breaker or HV Vacuum Contactor shall remain closed.

- Arc Flash Trip

CABLE COMPARTMENT

Arc Flash detected on power cables compartment shall only open the breaker of its own feeder unit, in case of contemporary detection of arc flash light and current flow reading, through the CTs and protection relay.
At the Incoming units, breaker opening is activated by only detecting arc flash light.

Test execution:
Connect the test bench in order to inject a secondary current, according the setting tables, to the unit's protection relay.
Inject the current and simulate a flash light in the cables compartment, from the rear of the Swbd.
The test can be consider passed if the breaker will be opened.

BUSBARS OR CB COMPARTMENT:

Arc Flash detected on Busbars chamber or on CB compartment shall result in a complete shutdown of the Switchboard, in case of contemporary detection of arc flash light and current flow reading, through the CTs and protection relay.

Test execution:
Connect the test bench in order to inject a secondary current, according the setting tables, to the protection relay of the Incoming unit.
Choose a CB compartment or Busbar section where to simulate the flash light, inject the current and simulate the flash light in the compartment.
The test can be consider passed if the complete shutdown of the busbars section will be verified.

8.8.2. EXTERNAL GOOSE MESSAGING TEST

Scope of these tests is in cooperation with the Network vendor engineer.
The tests can start only if all Ethernet switches have been set from the Network vendor engineer.

- PMS Goose test:

The HVSB receives and transmit goose messages from/to PMS.
For testing purpose of proper communication with PMS, the HVSB vendor can support the PMS vendor or the Network vendor engineer for execution of the following activities:

- opening closing the HV circuit breaker / HV Contactors
- racking-in / racking-out HV circuit breaker / HV Contactors
- opening / closing the earthing switches
- secondary injection tests on the protection relays

This part of the SAT is in charge to the Network Vendor.

8.8.3. INFRARED SENSORS MODBUS NETWORK

Scope of these tests is in cooperation with the Network vendor engineer.
The tests can start only if all Ethernet switches have been set from the Network vendor engineer.

These activities can be performed in parallel to IR sensors tests (see paragraph 7.7). This is possible also if the Network is not connected with the PMS, by connecting directly to the switch installed in the HVSB.

This part of the SAT is in charge to the Network Vendor.

The results of the a.m. Goose messaging tests shall be recorded on SAT REPORT FOR GOOSE MESSAGING TESTS form (see par. 9)

9. PRE-ENERGIZATION REQUIREMENTS

Before to proceed with energization of the HVSB, the following is to be verified.

- Make sure to pull off the short-circuit jumpers fitted on amperometric terminal boards, to avoid running the units with current transformer (-TI..-L..) short-circuited at secondary windings.
- Make sure to have re-closed the disconnecting terminals fitted on voltmetric terminal boards, to avoid running the units with voltage transformer (-TU-L..) not connected at secondary windings.
- Make sure that all the miniature CBs for aux. and measuring circuits are closed
- All system protections, controls, detectors and monitoring devices shall be reset and ready for operation
- All protections and control logics shall be reset and ready for operation
- All recording equipment, where provided, shall be in operation
- No alarm and/or trip signal shall be active
- Earthing switches shall be locked in open position
- Voltage transformers shall be in service position (racked-in), with primary fuses suitably placed
- H.V. circuit breakers and vacuum contactors shall be in service position (racked-in), open and available
- Fuses at the HV vacuum contactors shall be suitably placed
- Mechanical and electrical interlocks are to be suitably in operation
- All removable protections against direct contacts with accessible parts (panels, grids, plates, doors, etc.), shall be correctly placed and fixed
- All the doors shall be closed and fixed panels are to be correctly positioned and bolted

10. PRE-COMMISSIONING, COMMISSIONING AND SAT REPORT TEMPLATES

The following forms are intended for recording the results of Pre-Commissioning, Commissioning and SAT activities.

Forms provided by the customer may also be employed, on request.

PRE-COMMISSIONING ACTIVITIES REPORT

COMMISSIONING ACTIVITIES REPORT

SAT REPORT FOR MECHANICAL TESTS

SAT REPORT FOR MEASUREMENT OF THE RESISTANCE OF THE MAIN CIRCUIT

SAT REPORT FOR TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS

- INSULATION RES. MEASUREMENT -

SAT REPORT FOR TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS

- INSULATION RES. MEASUREMENT –

SAT REPORT FOR PRIMARY INJECTION TESTING ON CTs AND VTs

SAT REPORT FOR PROTECTION FUNCTIONS CHECK

SAT REPORT FOR HI-POT TEST

SAT REPORT FOR DIELECTRIC TEST ON AUX. CIRCUITS

SAT REPORT FOR INFRARED SENSORS TESTS

SAT REPORT FOR GOOSE MESSAGING TESTS

IMESA ELECTRICAL ENGINEERING

PRE-COMMISSIONING ACTIVITIES REPORT

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Legend **OK** - **N/A** – not applicable **×** SEE NOTE

DESCRIPTION	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	
COLUMN: 1																	
COLUMN: 2																	
COLUMN: 3																	
COLUMN: 4																	
COLUMN: 5																	
COLUMN: 6																	
COLUMN: 7																	

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

IMESA ELECTRICAL ENGINEERING

COMMISSIONING ACTIVITIES REPORT

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Legend **OK** - **N/A** – not applicable **×** SEE NOTE

DESCRIPTION	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**							
COLUMN: 1																	
COLUMN: 2																	
COLUMN: 3																	
COLUMN: 4																	
COLUMN: 5																	
COLUMN: 6																	
COLUMN: 7																	

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

IMESA ELECTRICAL ENGINEERING

SAT REPORT FOR MECHANICAL TESTS

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Legend **OK** - **N/A** – not applicable × SEE NOTE

DESCRIPTION	**1**	**2**															
COLUMN: 1																	
COLUMN: 2																	
COLUMN: 3																	
COLUMN: 4																	
COLUMN: 5																	
COLUMN: 6																	
COLUMN: 7																	

NOTES:

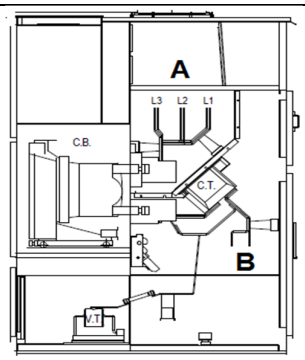
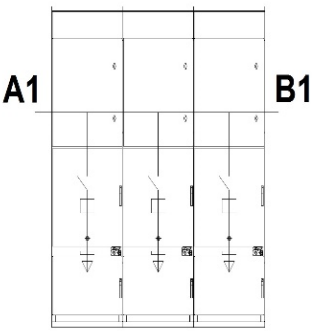
TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR MEASUREMENT OF THE RESISTANCE OF THE MAIN CIRCUIT

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Value of injected current: 100 A

TYPICAL PANEL ARRANGEMENT DRAWING	**Measure =ment between AB or A1/B1**	Phase **L1** *Measured resistance* **(μΩ)***	Phase **L2** *Measured resistance* **(μΩ)***	Phase **L3** *Measured resistance* **(μΩ)***
 Panel unit circuit  Switchboard's bus-bars				

* *To obtain the measured resistance value, in μΩ, is sufficient to multiply by 10 the measured v.d. in mV (e.g. : voltage drop of 1.4 mV = 14 μΩ)*

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS - INSULATION RES. MEASUREMENT -

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Megger test with 5 kV d.c.

DESCRIPTION	Phase **L1** *Measured insulation resistance* **(MΩ)***	Phase **L2** *Measured insulation resistance* **(MΩ)***	Phase **L3** *Measured insulation resistance* **(MΩ)***
COLUMN: 1			
COLUMN: 2			
COLUMN: 3			
COLUMN: 4			
COLUMN: 5			
COLUMN: 6			
COLUMN: 7			

* *Minimum value of insulation resistance is to be 50 MΩ*

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR TESTING H.V. CIRCUIT BREAKERS AND H.V. FUSED CONTACTORS - RESISTANCE OF THE MAIN CIRCUIT -

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Value of injected current: 100 A

DESCRIPTION	Phase **L1** *Measured resistance* **(μΩ)***	Phase **L2** *Measured resistance* **(μΩ)***	Phase **L3** *Measured resistance* **(μΩ)***
COLUMN: 1			
COLUMN: 2			
COLUMN: 3			
COLUMN: 4			
COLUMN: 5			
COLUMN: 6			
COLUMN: 7			

* *To obtain the measured resistance value, in μΩ, is sufficient to multiply by 10 the measured v.d. in mV (e.g. : voltage drop of 1.4 mV = 14 μΩ)*

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

IMESA ELECTRICAL ENGINEERING

SAT REPORT FOR PRIMARY INJECTION TESTING ON CTs AND VTs

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Legend **OK** - **N/A** – not applicable × SEE NOTE

DESCRIPTION	**1**	**2**															
COLUMN: 1																	
COLUMN: 2																	
COLUMN: 3																	
COLUMN: 4																	
COLUMN: 5																	
COLUMN: 6																	
COLUMN: 7																	

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

IMESA ELECTRICAL ENGINEERING

SAT REPORT FOR PROTECTION FUNCTIONS CHECK

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**
PROT. RELAYS' COORD. STUDY DOC. :	**PANEL UNIT:**	**RELAY SERIAL NO. :**

protection unit setting test values					***protection unit operation check values***			
Protection Function	*ANSI Code*	*Setting*		*CT/VT Ratio*	*Phase*	*Test Value*	*Operating Time*	*Result*
		Value	Time [s] or K					
				CT/VT Ratio				

Notes:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR HI-POT TEST

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Legend **OK -** **N/A** – not applicable **×** SEE NOTE

DESCRIPTION	**1**	**2**											
HI-POT TEST ON POWER CIRCUITS													

Applied Voltage on the power circuits: 16 kV (80% of the FAT rated value)
Duration Time: 60 s

Measured Insulation Resistance

BEFORE TEST	AFTER TEST
L1=	L1=
L2=	L2=
L3=	L3=

NOTES:
Equipment disconnected during Hi-Pot test:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR DIELECTRIC TEST ON AUX. CIRCUITS

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Legend **OK -** **N/A** – not applicable **×** SEE NOTE

DESCRIPTION	**1**	**2**											
DIELECTRIC TEST ON AUX. CIRCUITS													

Applied Voltage on the power circuits: 2000 V a.c.
Duration Time: 60 s

Measured Insulation Resistance

BEFORE TEST	**AFTER TEST**
110 V d.c. =	**110 V d.c. =**
230 V a.c. =	**230 V a.c. =**
24 V d.c. =	**24 V d.c. =**

NOTES:
Equipment disconnected during dielectric test:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR INFRARED SENSORS TESTS

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

Modbus Address		Serial N.	

Data Card Channels (2)								
	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8
Section Reference (1)								
Phase Reference								
Sensor Type								
IR.EM-06.SC – Delta T								
No Sensor								
IR.EM-06.SC ONLY								
Busbar Size								
Mounting Distance								
Gain Factor Used								
Site Acceptance Test								
Initial Value								
Heat Tested Reading								

(1) Note CB = Cable Compartment BB = Busbar Compartment

(2) See ref. Documents 1723002197-EL-LIS-00041 and 1723002197-EL-DG-00022

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**

SAT REPORT FOR GOOSE MESSAGING TESTS

SWBD: **SD-100G1**

CUSTOMER:	**PROJECT DESCRIPTION:**	
SITE:	**AREA:**	
SWITCHBOARD:		
DATE:	**DOC. N**	**REV:**

					From					
					SIGNAL Description	BB VT OPEN	ES BB OPEN	CLOSING COMMAND	OPENING COMMAND	
	CUBICLE	DEVICE	SIGNAL	GOOSERX N		0	1	2	3	
Destination Unit			TRIP							
			ARC FAULT							

NOTES:

TEST PERFORMER	**WITNESS**	**QUALITY OFFICER**	
EXECUTED	**ACCEPTED / VERIFIED**	**ACCEPTED / VERIFIED**	
Sign:	**Sign:**	**Sign:**	**Sign:**
Company: **Name:**	**Company:** **Name:**	**Company:** **Name:**	**Company:** **Name:**
Date:	**Date:**	**Date:**	**Date:**