



February 2016

**TECHNICAL DESCRIPTION TD-77A/4**  
**170 KV COMPACT GAS INSULATED INTEGRATED SUBSTATION MODULES**

**I. SCOPE**

This technical description covers IPTO's requirements with regard the design features, rated characteristics and testing of 170kV compact gas insulated integrated substation modules (GIS), suitable for outdoor installation.

**II. REQUIRED TYPE OF THE 170kV COMPACT INTEGRATED SUBSTATION MODULES**

The compact integrated substation modules consists of gas insulated switchgear (GIS), possibly with some air insulated parts (e.g. CTs). In the latter case they are called mixed technology switchgear (MTS) or hybrid insulated switchgear.

The module consists of at least one switching device directly connected to, or sharing components with, one or more other devices, such that there is an interaction between the functions of the devices.

**III. KEYWORDS**

Gas insulated compact integrated modules, hybrid insulated compact integrated module, pre-fabricated modules.

**IV. STANDARDS**

For the compact gas (SF<sub>6</sub> in accordance with IEC 60376 standard) insulated modules, the applicable standards shall be:

- IEC 62271-1
- IEC 62271-203
- IEC 62271-205
- IEC 62271-102
- IEC 62271-100
- IEC 62271-300
- IEC 60137
- IEC 62271-209
- IEC 60840

- IEC 61869-1
- IEC 61869-2
- IEC 61869-3
- IEC 61869-4

## **V. USE**

The 170kV compact GIS integrated substation modules are to be used mainly in 150kV transmission line incoming bays of air insulated 150/20kV substations, where there is not sufficient space for the deployment of conventional air insulated equipment. Also, they can be used in cases where erection time is limited and of major concern.

## **VI. SERVICE CONDITIONS**

- |                              |   |
|------------------------------|---|
| 1. Installation              | : Outdoors                                |
| 2. Ambient temperature range | : Maximum +45°C                           |
|                              | : Minimum -25°C                           |
| 3. Altitude                  | : Up to 1000m above sea level             |
| 4. Relative humidity         | : ≤ 95%                                   |
| 5. Ice coating               | : 10mm                                    |
| 6. Pollution level           | : moderate to heavy depending on location |
| 7. Wind speed                | : 150Km/h                                 |
| 8. Other conditions          | : Snow and fog                            |

## **VII. 150kV ELECTRICAL SYSTEM CHARACTERISTICS**

- |  |  |
|--|--|
| 1. Nominal Voltage                     | : 150KV  |
| 2. Maximum Operating Voltage           | : 170KV  |
| 3. Lightning impulse withstand voltage | : 750KV peak                                     |
| 4. Short circuit level                 | : 31KA   |
| 5. Number of phases                    | : 3  |
| 6. Nominal Frequency                   | : 50 Hz  |
| 7. Earthing (grounding) method         | : The 150KV system is solidly earthed (grounded) |
| 8. Auxiliary voltages                  | : 110V DC, 3Φ 400V AC or 1 Φ 230VAC              |

## **VIII. COMPACT GIS INTEGRATED SUBSTATION MODULE REQUIRED BASIC DESIGN FEATURES**

### **1. Components of the module**

The compact integrated GIS substation module shall consist of the following electrical power system equipment.

- a. One (1) 3-pole circuit breaker or three (3) single pole SF<sub>6</sub> circuit breakers suitable however for 3-pole operation.

- b. Two (2) 3-pole or two (2) sets of three (3) single-pole SF<sub>6</sub> insulated disconnectors for isolating completely the circuit breaker at both sides (up-stream and down-stream). In case that the module is to be connected to the air insulated double bus bars of a S/S then three (3) 3-pole or three (3) sets of three single-pole SF<sub>6</sub> disconnectors will be provided. In the latter case, the busbar disconnectors shall provide bus-transfer current switching capability. The disconnectors shall be suitable for 3 pole operation.
- c. One (1) three-pole or three (3) single-pole SF<sub>6</sub> insulated earthing switches suitable however for 3 pole operation.
- d. Three (3) current transformers.
- e. Three (3) SF<sub>6</sub> insulated voltage transformers.
- f. Connections to the air insulated substation busbars or overhead lines shall be via SF<sub>6</sub> to air bushings with silicone rubber insulation.

All bushings shall be in accordance with IEC 60137. They shall have LI withstand voltage of 750kV peak and AC withstand voltage of 325kV rms, 1 min.

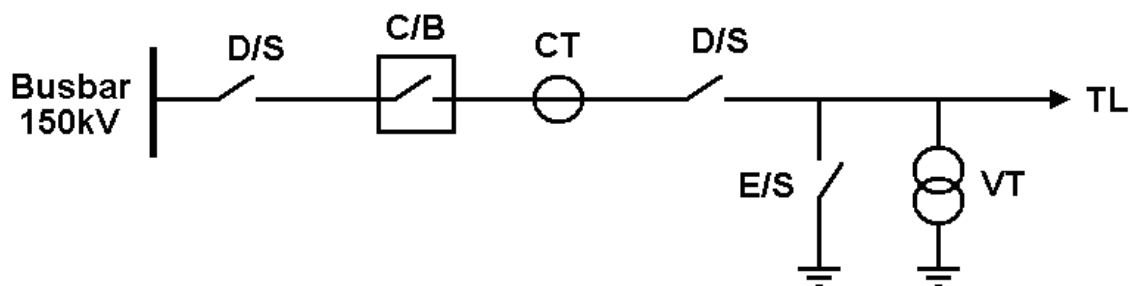
If it is requested, connections to incoming cables shall be via XLPE cables to SF<sub>6</sub> terminations of plug-in type, which will be split into two (2) connectors (plug and socket). The cables will always come in from the bottom of the switchgear. The terminations shall be in accordance with IEC 60840 and IEC 62271-209. The socket connector will be premanufactured inside the GIS module. The plug connector on the cable end will be supplied as loose equipment by the manufacturer of the GIS module, as well.

#### Note

- A compact integrated module can on request be consisted only of items a and b, as indicated above. If this is the case, it will be indicated in the inquiry.
- The earthing switch and disconnectors may be of SF<sub>6</sub> combined disconnector and earthing switch type, electrically operated. Manual operation shall be always possible in case of failure of the auxiliary feeding supply.

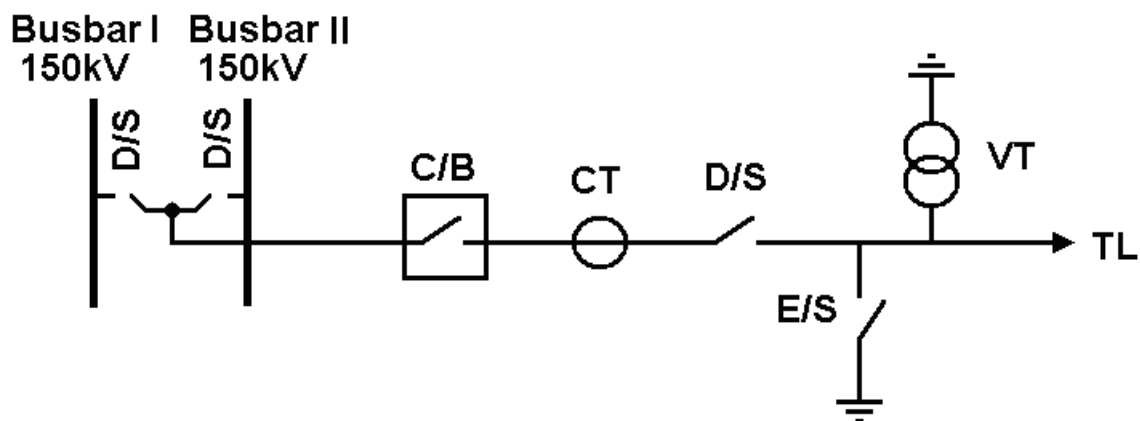
## 2. Configuration of the modules components

The configuration of the module's components shall be that the single busbar as indicated in Fig. No.1 below



**Fig No.1** Configuration of the module (single-line diagram)

or double busbar as indicated in Fig. No.2:



**Fig No.2** Configuration of the module (single-line diagram)

If the compact integrated module consists only of circuit breaker and disconnectors, the above schemes shall be modified accordingly.

3. Visual confirmation of the disconnector's position

The disconnectors' position (open or closed) must be easily and clearly distinguishable from ground level. Modules which are not equipped with this particular feature shall be rejected.

4. Method of achieving the disconnection function

The disconnector – circuit breaker assembly shall be of GIS type. The disconnectors can be independent of the circuit breaker or be integrated with it. In any case, independent isolating gaps will be provided. No disconnecting circuit breaker is allowed.

5. Required type of mode of operation for achieving the disconnection function

The disconnector operation shall be obtained by an electric motor driven mechanism and in case of emergency manually, by a hand-crank.

6. Support structure or structures of the module

The support structure or structures shall be part of the supply and shall consist of hot-dip galvanized steel. The anchoring bolts, nut, washers and grover shall be from hot dip galvanized steel and shall also be part of the supply.

7. Earthing of the structure or structures of the module

The structure or structures shall be equipped with screws or a copper strip of current capability of 31.5 KA ending in a rectangular in shape terminal which shall be used for connection to the earthing (grounding) mat of the substation.

8. Required dimensions of the module

1. The maximum acceptable dimensions of the module consisting of disconnectors, earthing switch, circuit breaker, CTs and VTs shall be as follows:
  - a. Length (L): 5.0m
  - b. Width (W): 4.8m

- c. Height (H): 6.0m (terminals)
2. The maximum acceptable dimensions of the module consisting of disconnectors and circuit breaker shall be as follows:
  - a. Length (L): 4.5m
  - b. Width (W): 4.8m
  - c. Height (H): 5.5m (terminals)
9. Required interlockings for the module
  - a. An interlocking shall exist which shall prevent the operation of the disconnectors (opening or closing) when the circuit breaker is in the closed position.
  - b. An interlocking shall exist which shall prevent operation of the earthing switch when the disconnectors are not in the off position.
  - c. The switching operations are possible only if the gas pressure is higher than a threshold level.
10. Seismic Requirements  
 The module shall be capable for AF5 seismic level as per IEC 62271-300 (severity levels: horizontal 0.5g and vertical 0.25g). To prove the AF5 seismic level capability, either test certificates must be submitted in the technical offer or a mathematical model analysis.
11. Terminals  
 The terminals of the module which shall be used to connect the module with the rest of the equipment of the substation shall suitable for connection via bronze connectors (supply of IPTO) with copper tubes of 30mm in diameter.
12. Auxiliary Contacts  
 At each terminal strip for connection to other equipment, out of the compact substation module, 10% free terminals shall be provided.

## **IX. REQUIRED RATINGS AND FEATURES OF THE CIRCUIT BREAKER OF THE MODULE**

- |  |                                  |
|--|----------------------------------|
| 1. Type  | : SF6 puffer or auto-puffer type |
| 2. Rated Voltage   | : 170KV                          |
| 3. Rated frequency                                       | : 50Hz                           |
| 4. Rated normal current                                  | : 1250A                          |
| 5. Rated short circuit breaking current – a.c. component | : 31.5 KA rms                    |
| 6. Rated short circuit making current                    | : 79 KA peak                     |
| 7. Rated short-time withstand current                    | : 31.5 KA rms                    |
| 8. Rated peak withstand current                          | : 79 KA peak                     |
| 9. Rated duration of short circuit                       | : 3 sec                          |
| 10. Rated power frequency withstand voltage              | : 325KV rms                      |
| 11. Rated lightning impulse withstand voltage            | : 750KV peak                     |
| 12. First pole-to clear factor                           | : 1.5                            |
| 13. Rated transient recovery voltage for terminal faults |                                  |

a. Rated transient recovery voltage	: 291KV peak
b. First pole-to-clear factor	: 1.5
c. RRRV	: 2KV/ $\mu$ s
14. Rated transient recovery voltage for short-line faults	
a. Rated transient recovery voltage	: 194KV peak
b. First pole-to-clear factor	: 1
c. RRRV	: 2KV/ $\mu$ s
15. Rated line-charging breaking current	: 63A
16. Rated cable-charging breaking current	: 160A
17. Rated break time	: $\leq$ 60ms
18. Rated opening time	: $\leq$ 40ms
19. Rated closing time	: $\leq$ 70ms
20. Type of material of the SF <sub>6</sub> to air bushings	: Silicon rubber
21. Creepage distance of bushings (applies to the complete module)	: 4250mm
22. Rated operating sequence	: O-0.3sec-CO-3min-CO
23. Type of operating mechanism	: Spring type
24. Rated supply voltage of the motor for spring charging	: 110V DC
25. Rated supply voltage for the auxiliary circuits of the operating mechanism	: 110V DC
26. Number of operating mechanism	: one or three (one per pole) (no single-pole operation capability required)
27. Number of auxiliary contacts free of voltage	: Seven (7) make and seven (7) break
28. Class protection of the operating mechanisms housing	: IP44 as per IEC 60529
29. Anti condensation heaters for the housing of the control panel	: Anti condensation heaters are required and shall be controlled electrically
30. SF <sub>6</sub> loss per year	: $\leq$ 1%
31. Static horizontal terminal load	: 1000N
32. Size of the terminal blocks used for the operating mechanism	: 4mm <sup>2</sup> for control and 10mm <sup>2</sup> for supply conductors
33. Rated supply voltage for the anti-condensation heaters	: 1 $\Phi$ , 230V AC
34. Number of tripping coils	: 2
35. Local/Remote control switch for the local control panel	: A selector control switch with three (3) positions 'manual-Local-Remote' must be provided and with as many stages as needed for the control circuits of the breaker. In the 'manual' position the circuit breaker shall be operated by the hand crank.

The ‘‘Local’’ position and in conjunction with two (2) push-buttons or a control switch, will be used to control the CB from the operating mechanism cabinet for maintenance purposes only. When the CB is under local control, the CB bay will be out of service. The ‘‘Remote’’ position will be used to control the CB from a remote place and for tripping purposes. The Local/Remote switch shall be equipped with an additional number of stages beyond those needed for the control circuits which shall be used to be inserted to both positive (+) and negative (-) 110 V DC buses of the control circuits.

- |  |   |
|--|---|
| 36. Open/close push-buttons or a two (2) position control switch (local control) | :The panel of the operating mechanism shall be equipped with one (1) push button for opening and one (1) for closing or instead with a control switch of two (2) positions (open-close) |
| 37. Mechanical endurance class   | : M2  |
| 38. Restrike class during capacitive current breaking (line and cable charging)  | : C1  |
| 39. Emergency manual operation   | : The circuit breaker must be equipped with capability for manually opening without the use of DC auxiliary supply voltage (with hand crank)  |
| 40. Color of the tank for the gas insulated module                               | : grey color type   |

## **X. REQUIRED RATINGS AND FEATURES OF THE DISCONNECTORS**

- |                    |   |
|--------------------|---|
| 1. Type            | : Three pole or 3 single pole SF <sub>6</sub> insulated |
| 2. Rated voltage   | : 170KV   |
| 3. Number of poles | : Three (3)   |
| 4. Rated frequency | : 50Hz  |
| 5. Rated current   | : 1250A   |

6. Rated insulation levels	
a. Power frequency withstand voltage	
- Phase to earth and between phases	: 325 KV rms
- Across the isolating distance	: 375 KV rms
b. Lightning impulse withstand voltage	
- Phase to earth and between phases	: 750 KV peak
- Across the isolating distance	: 860 KV peak
7. Rated short-time withstand current	: 31.5 KA rms
8. Rated peak withstand current	: 79KA peak
9. Rated duration of short circuit	: 3sec
10. Mechanical endurance class	: M1
11. Type of the driving (operating) mechanism	: Three-pole or one per pole to rotate the disconnecter and earthing contacts
12. Number of auxiliary contacts free of voltage	: 5 make, 5 break and 2 make – early closing, 2 break – late opening
13. Class protection of the housing (cabinet) of the driving mechanism	: IP44 as per IEC 60529
14. Anticondensation heaters (inside the control panel):	Anticondensation heaters are required and controlled electrically (1Φ, 230VAC)
15. Supply voltage of the auxiliary circuits of the driving mechanism	: 110V DC
16. Selector switch for the driving mechanism	: The driving mechanism must be controlled by a selector switch of four (4) positions (MANUAL-LOCAL-REMOTE-OFF). In position No.1 only manual operation shall be allowed via the hand crank. In position No.2 only electrical local operation shall be allowed. The local electrical operation shall be achieved via local push-buttons or control switch for starting and stopping. In position No.3 only electrical remote operation shall be allowed.
17. Size of the terminal blocks for the driving mechanism	: The size of the terminal blocks shall be such as to allow the use of 4mm <sup>2</sup> control and 10mm <sup>2</sup> supply conductors.
18. Emergency operation	: The emergency operation



shall be achieved via a hand-crank manually. This operation is already being described above.

## **XI. REQUIRED RATINGS AND FEATURES OF THE EARTHING SWITCH**

- |  |   |
|--|---|
| 1. Type                                | : Three pole or 3 single pole SF <sub>6</sub> insulated.  |
| 2. Type of operation                   | : Either by electric motor or manually by hand-crank, provided that safety interlockings are satisfied. |
| 3. Rated voltage                       | : 170kV   |
| 4. Rated frequency                     | : 50Hz  |
| 5. Rated insulation levels             |   |
| a. Power frequency withstand voltage   | : 325kV rms   |
| b. Lighting impulse withstand voltage  | : 750kV peak  |
| 6. Rated short-time withstand current  | : 31.5KA rms  |
| 7. Rated peak withstand current        | : 79KA peak   |
| 8. Rated duration of short circuit     | : 3sec  |
| 9. Mechanical endurance class          | : M0  |
| 10. Electrical endurance class         | : E0  |
| 11. Auxiliary circuits supply voltage  | : 110V DC   |
| 12. Size of terminal blocks            | : terminal blocks shall be suitable for 4mm <sup>2</sup> size control conductors                        |
| 13. Auxiliary contacts free of voltage | : 2 make and 2 break  |
| 14. Control of the driving mechanism   | : By selector and control switches as already described above.  |

### Note:

The GIS integrated module may have a unique local control panel (IP44), fully prefabricated, pre-wired and tested as unique interface panel between the GIS integrated module and the control and protection system of the whole substation. From this panel all the local control functions described above for the switching equipment shall be performed by the use of control switches with as many stages as needed for the control circuits of the circuit breaker, disconnectors and earthing switch.

All the wiring from the local control panel to individual equipment of the GIS integrated module shall be supplied by the manufacturer of the module.

## **XII. REQUIRED RATINGS AND FEATURES OF THE CURRENT TRANSFORMERS**

- |         |   |
|---------|---|
| 1. Type | : SF <sub>6</sub> insulated ring type or bushing (ring) type, single- |
|---------|---|

	phase with one (1) primary winding with two (2) sections and three (3) secondary windings each with its own magnetic core.
2. Ratio	: 1000-500/1-1-1A
3. Primary current	: 1000-500A
4. Secondary current	: 1A
5. Insulating medium	: SF <sub>6</sub> or epoxy resin insulated
6. Secondary terminals	: The secondary terminals shall be suitable for 4mm <sup>2</sup> size conductors
7. Highest voltage	: 170kV
8. Rated frequency	: 50Hz
9. Temperature category	: -25° C/+45° C
10. Rated continuous thermal current	: 1,2 x I <sub>N</sub>
11. Secondary windings use and required characteristics	
a. Winding for metering purposes	
- Number of windings	: 1
- Rated power output	: 30VA
- Accuracy class	: 0.5
- Instrument security factor	: F <sub>s</sub> ≤ 5
b. Winding for protection purposes	
- Number of windings	: 1
- Rated power output	: 30VA
- Accuracy class	: 5P
- Accuracy limit factor	: 20
c. Winding for protection purposes	
- Number of windings	: 1
- Rated output	: 30VA
- Accuracy class	: 5P
- Accuracy limit factor	: 20
12. Rated short-time thermal current	: 40KA for one (1) second
13. Rated dynamic current	: 100KA peak
14. Power frequency withstand voltage for the secondary terminals	: 3kV
15. Transmitted overvoltage peak limit	: ≤ 1,6kV at pulse of 222kV

### **XIII. REQUIRED RATINGS AND FEATURES OF THE VOLTAGE TRANSFORMERS**

1. Type	: SF <sub>6</sub> , single-phase, inductive type with one (1) primary winding and three (3) separate secondary windings.
2. Insulating medium	: VTs insulated in SF <sub>6</sub> are acceptable.

3. Ratio	: $160000/\sqrt{3} \text{ } / \text{ } 120/\sqrt{3} - 120/\sqrt{3} - 120/\sqrt{3} \text{ V}$
4. Primary voltage	: $160000/\sqrt{3} \text{ V}$
5. Secondary voltage	: $120/\sqrt{3} \text{ V}$
6. Secondary terminals	: The secondary terminals must be suitable to be wired with 4mm <sup>2</sup> size conductor Furthermore, all secondary phase leads shall be protected by 2A explosion type fuses and the neutral leads by links. All these fuses and links shall be installed inside the secondary terminal box.
7. Secondary windings use and required characteristics	
a. Windings for metering purposes	
- Number of windings	: 2
- Rated power output	: 25VA
- Accuracy class	: 0.5
- Percentage voltage error	: $\pm 0.5$
- Phase displacement	: $\pm 20$ minutes
b. Windings for protection purposes	
- Number of windings	: 1
- Rated power output	: 10VA
- Accuracy class	: 3P
- Percentage voltage error	: $\pm 3.0$
- Phase displacement	: $\pm 120$ minutes
8. Rated frequency	: 50Hz
9. Number of secondary windings	: 3
10. Partial discharge level	: $\leq 5$ pC at 118kV
11. Power frequency withstand voltage of the primary	: 325kV rms
12. Lighting impulse withstand voltage of primary	: 750kV peak
13. Power frequency withstand voltage of the neutral primary terminal	: 3kV
14. Power frequency withstand voltage of secondary windings	: 3kV rms
15. Temperature category	: -25°C / +45 °C
16. Rated voltage factors	: 1.2 continuous 1.5 for 30sec
17. Transmitted overvoltage peak limit	: $\leq 1.6$ kV at pulse of 222kV

#### Note

If a combined instrument transformer consisting of a VT and a CT shall be offered, it must have the characteristics and features described in the above paragraphs of XII and XIII of this hereby technical description

## **XIV. TESTS**

All testing shall be in accordance with the applicable IEC standards relevant to the equipment involved unless it is indicated otherwise.

### **A. Routine tests**

The 170kV compact integrated substation module shall be subjected to the following routine tests.

1. Functional tests on auxiliary and control circuits of the module
2. Mechanical function tests on all moving parts of the module, including any mechanical interlocks. Verification of proper functioning of the disconnectors' and earthing switches' mechanical position indication devices.
3. Visual checks of the entire module consisting of the following.
  - a. Language on the name plates.(which must be English)
  - b. The color and quality of paint and corrosion protection of the metallic surfaces Furthermore, the checking of the galvanization shall be carried out with the magnetic method in accordance with ISO-2178 standard.
4. Power frequency voltage test for all primary equipment of the module.
  - a. Phase-to - earth : 325kV rms
  - b. Phase-to - phase : 325kV rms
  - c. Across the isolating distance  
for the disconnectors : 375kV rms
  - d. Phase-to-earth for the neutral  
primary terminal of the VT : 3kV rms(Not applicable for the bushing type CTs)
5. Partial discharge measurements for all primary equipment of the module  
(Not applicable for the bushing type CTs)
6. Power frequency voltage test on all control  
auxiliary circuits for the circuit breakers,  
disconnector and earthing switch  
(IEC 62271-1, IEC 62271-100, 62271-102) : 1kV for 1 s
7. Measurement of the resistance of the main circuit
8. Power frequency voltage test for the CTs, VTs
  - on secondary windings : 3kV rms
  - between sections of primary winding : 3kV rms
9. Inter-turn overvoltage test for the CTs
10. Verification of terminal markings for the CTs, VTs
11. Accuracy tests for the CTs, VTs

12. Gas tightness test for all gas insulated devices or compartments.
13. Pressure test for the vessel and for the partitions of the module in accordance with IEC 62271-203.

## **B. Type Tests**

Since the compact integrated substation modules are based on well established and tested components, bidders are required to submit with the technical offer all type test certificates that they have at their disposal. These type test certificates must cover the following type tests per module component. All the tests indicated in paragraphs XIV-B-1 to XIV-B-5 are applicable, as modified in IEC 62271-203.

1. For the circuit breaker (as per IEC 62271-100, IEC 62271-203 and IEC 62271-1)
  - a. Power frequency voltage test
  - b. Lightning impulse voltage test
  - c. Dielectric test on auxiliary and control circuits (AC=2kV)
  - d. Tightness test
  - e. Verification of IP degree of protection for the control enclosures
  - f. Environmental temperature tests (max-min temperature)
  - g. Measurement of the resistance of the main circuit
  - h. Temperature-rise test
  - i. Short-time and peak current withstand tests
  - j. Mechanical operation tests
  - k. Short-circuit current making and breaking tests
  - l. Short-line fault test
  - m. Single-phase fault test
  - n. Line-charging current switching test
  - o. Cable-charging current switching test
2. For the disconnectors and earthing switches  
(as per IEC 62271-102, IEC 62271-203 and IEC 62271-1)
  - a. Power frequency voltage test
  - b. Lightning impulse voltage test
  - c. Dielectric test on auxiliary and control circuits (AC=2kV)
  - d. Tightness test
  - e. Verification of IP degree of protection for the control enclosures
  - f. Measurement of the resistance of the main circuit
  - g. Temperature-rise test
  - h. Short-time and peak current withstand tests
  - i. Mechanical operation tests, including mechanical interlocks
  - j. Environmental temperature tests (max-min temperature)
  - k. Bus-transfer current switching tests  
(applicable only for busbar disconnectors in double busbar configuration)
  - l. Functional test of mechanical position indicating device

3. For the CTs (as per IEC 61869-2 and IEC 61869-1)
  - a. Short-time current test
  - b. Temperature rise test
  - c. Accuracy tests
  - d. Verification of IP degree of protection for the terminal box
4. For the VTs (as per IEC 61869-3 and 61869-1)
  - a. Temperature rise test
  - b. Short-circuit withstand capability test
  - c. Lightning impulse test
  - d. Accuracy tests
  - e. Verification of IP degree of protection for the terminal box
  - f. Gas tightness test

5. Tests on complete module assembly

As mentioned in par. II, there are interactions between the devices comprising the substation module, meaning the transfer of electrical, mechanical and thermal stresses between them during normal operation or during faults. According IEC 62271-205, at least the following type tests shall be performed at the complete, assembled module:

- a. Dielectric tests
- b. Radio interference voltage test
- c. Measurement of the resistance of the main circuits
- d. Temperature-rise test
- e. Short-time and peak current withstand tests
- f. Mechanical operation tests, including mechanical interlocks

Furthermore, any other type tests of the individual devices are possible to be performed at the assembled module, taking care to avoid any undue stresses on other devices of the module.

Additionally the following type tests for the GIS part of the module are required:

- a. Pressure tests for the vessel and for the internal partitions (proof tests)
- b. Tightness tests for the internal partitions
- c. Thermal cycle test for the internal partitions and insulators

If any of the above type test certificates mentioned in par. XIV-B is not submitted with the technical offer, IPTO maintains the right to ask for the execution of the test or tests for which no test certificate or certificates has or have been submitted. Furthermore, the economic offer shall be charged with the test or tests which have not been submitted. Therefore, for this reason in the economic offer, prices for all the above indicated type tests must be submitted.

## **XV. NAMEPLATES**

The module shall be equipped with a name plate or plates of anti-corrosion material on which the following information shall be marked.

1. Name of manufacturers
2. Type

3. A list with all of its components
4. Rated power frequency withstand voltage
5. Rated lightning impulse withstand voltage
6. Rated frequency
7. Rated normal current
8. Rated short circuit breaking current
9. Rated duration of short-circuit
10. Rated supply voltage of control and auxiliary circuits
11. Rated supply voltage for all operating and driving mechanisms
12. Mechanical endurance class of the CB and disconnectors
13. Electrical endurance class for the earthing switch
14. Ratio of the CT
15. Rated output and corresponding accuracy class of the secondary windings of the CT
16. Rated short-time thermal current of the CT
17. Rated dynamic current of the CT
18. Ratio of the VT
19. Rated output and accuracy class of the secondary windings of the VT
20. Rated voltage factor and corresponding rated times for the VT

#### **XVI. DATA TO BE SUBMITTED BY ALL BIDDERS**

1. Outline physical drawings of the module
2. Technical brochures of the offered module and of its components
3. Any seismic test certificates for AF5 seismic level or a mathematical model analysis
4. All type test certificates listed in paragraph XIV-B of this hereby technical description. In any case, for the technical evaluation purposes, IPTO reserves the right to demand from the Bidders to confirm any stated values of specific technical features by the submission of related test certificates. Congruency failure between values will be reason for the offer's rejection.
5. A preliminary drawing of the steel support structure or structures of the module
6. Attachment "A" of this hereby technical description completely filled. Failure to comply or partial filling will constitute sufficient reason for rejection of the offer.

#### **XVII. DATA WHICH MUST BE SUBMITTED BY THE SUCCESSFUL BIDDER**

1. Complete physical drawings of the module for approval before the construction of the module (3sets)

2. Complete schematic and wiring drawings of the module for approval before the construction of the module (3sets)
3. A detailed drawing of the modules support structure or structures which will enable IPTO to construct its or their steel reinforced concrete base or bases
4. Maintenance and assembly instructions in detail
5. "As built" drawings in a electronic accessible form

#### **XVIII. WARRANTY**

A warranty of three (3) years must be provided beginning from the date of delivery of the module for damages caused either by faulty design or by unreliable components or by combination of both.

#### **XIX. PACKING**

Every transport unit of the module shall be packaged inside robust wooden boxes of at least 20mm thickness. The boxes will be of "pallet type", with strengthened base. Every module shall be contained in a separate set of boxes. All boxes shall be properly labeled and the label shall contain explicit information as to what each box contains.

The equipment must be delivered with the appropriate for operation quantity of SF6 gas.



**ATTACHMENT “A”**  
**170 KV COMPACT GAS INSULATED INTEGRATED SUBSTATION MODULES**

*This attachment shall be completely filled. Failure to comply will constitute sufficient reason for rejection of the offer.*

1. Type :.....  
.....
2. Manufacturer :.....  
.....
3. List all the components of the module  
and indicate total number of each  
component. :.....  
.....  
.....  
.....  
.....
4. Show the configuration of the module :.....
5. Can the position of the disconnectors be  
visually confirmed from ground level? :.....
6. Described how the disconnection function  
is achieved :.....  
.....
7. Is the disconnection function achieved  
by an electric motor driven mechanism  
and also by hand-crank? :.....
8. Indicate type of steel used for the support  
structure or structures of the module :.....
9. Is the steel support structure or structures  
hot-dip galvanized :.....

10. Describe the earthing of the support structure or structures of the module : .....  
.....  
.....
11. Indicate the dimensions of the offered module (LXWXH) :.....
12. List all required interlocking of the offered module :.....  
.....  
.....  
.....  
.....  
.....
13. Is the module as it is mounted on its support structure capable of AF5 seismic level :.....
14. Describe the type of material and shape of terminals employed at the entrance and exit of the module :.....  
.....
15. Type and material of bushings  
- Creepage distance : .....  
- Insulation levels : .....
16. Ratings and features of the circuit breaker
  - a. Type : .....
  - b. Rated voltage :.....
  - c. Rated normal current :.....
  - d. Rated short circuit breaking current - A.C. component :.....
  - e. Rated short circuit making current :.....

- f. Rated short-time withstand current :.....
- g. Rated peak withstand current :.....
- h. Power frequency withstand voltage :.....
- i. Lightning impulse withstand voltage:.....
- j. First pole-to-clear factor :.....
- k. Transient recovery voltage of terminal faults
  - Transient recovery voltage :.....
  - First pole-to-clear factor :.....
  - RRRV for terminal faults :.....
- l. Rated transient recovery voltage for short-line faults :.....
  - Rated transient recovery voltage:.....
  - RRRV :.....
  - First pole-to-clear factor :.....
- m. Rated line-charging breaking current :.....
- n. Rated cable-charging breaking current :.....
- o. Rated break time :.....
- p. Rated opening time :.....
- q. Rated closing time :.....
- r. Type of material of bushings :.....
- s. Creepage distance of bushings :.....
- t. Rated operating sequence :.....
- u. Type of the operating mechanism :.....
- v. Supply voltage for the motor of the spring charging :.....

- w. Supply voltage for the auxiliary and control circuits of the operating mechanism :.....
- x. Number of the operating mechanisms :.....
- y. Number of auxiliary contacts free of voltage :.....
- z. Class protection of the operating mechanism's panel as per IEC 60529 :.....
- a.1 Are the anti-condensation heaters provided controlled electrically? : .....
- b.1 SF<sub>6</sub> loss per year :.....
- c.1 Static horizontal terminal load : .....
- d.1 Are the terminal blocks suitable for 4mm<sup>2</sup> size control and 10mm<sup>2</sup> supply conductors? : .....
- e.1 Supply voltage of the anti-condensation heaters :.....
- f.1 Number of tripping coils :.....
- g.1 Is the operating mechanism controlled by an manual/local/ remote selector switch? :.....
- h.1 Is the operating mechanism controlled by two (2) push-buttons or by a switch for local opening and closing? :.....
- i.1 Is the manual/local/remote switch equipped with enough stages even and for the insertion to both positive (+) and negative (-)110V DC buses of the control circuits? :.....
- j.1 Mechanical endurance class :.....
- k.1 Restrike class during capacitive current breaking (line and cable charging) :.....

- l.1 Is the breaker equipped with emergency manual operation? :.....
- m.1 Color of the tank of the module :.....

#### 17. Ratings and features of the disconnectors

- a. Rated voltage :.....
- b. Number of poles :.....
- c. Rated frequency :.....
- d. Rated current :.....
- e. Power frequency withstand voltage
- Phase to earth and between phases :.....
  - Across the isolating distance :.....
- f. Lightning impulse withstand voltage
- Phase to earth and between phases :.....
  - Across the isolating distance :.....
- g. Rated short-time current :.....
- h. Rated peak withstand current :.....
- i. Rated duration of short circuit :.....
- j. Mechanical endurance class :.....
- k. Type of driving mechanism :.....
- .....
- .....
- .....
- l. Number of auxiliary contacts free of voltage :.....
- m. Class protection of the housing of the driving mechanism :.....
- n. Are anti-condensation heaters inside the control panel provided,

- controlled through thermostat? :.....
- o. Supply voltage of the  
auxiliary circuits :.....
- p. Is a selector switch of four (4)  
Positions off/local/  
remote/manual provided? :.....
- q. Are two (2) bush-buttons for  
local opening and closing provide? :.....
- r. Are the terminal blocks suitable  
for 4mm<sup>2</sup> size control and 10mm<sup>2</sup>  
supply conductors? :.....
- s. Is the emergency operation  
achieved by a hand-crank? :.....

#### 18. Ratings and features of the earthing switch

- a. Type :.....
- b. b. Type of operation :.....
- c. Rated voltage :.....
- d. Rated frequency :.....
- e. Power frequency withstand voltage :.....
- f. Lightning impulse withstand voltage:.....
- g. Rated short-time withstand current :.....
- h. Rated peak withstand current :.....
- i. Rated duration of short circuit :.....
- j. Electrical endurance class :.....
- k. Auxiliary supply voltage :.....
- l. Are the terminal blocks suitable  
for 4mm<sup>2</sup> size control conductors :.....
- m. Auxiliary free of voltage contacts :.....

#### 19. Ratings and features of the current transformers

- a. Type :.....  
:.....
- b. Ratio :.....
- c. Primary current :.....
- d. Secondary current :.....
- e. Insulating medium :.....
- f. Are the secondary terminals  
suitable for 4mm<sup>2</sup> size conductors? :.....
- g. Highest voltage :.....
- h. Rated frequency :.....
- i. Temperature category :.....
- j. Rated continuous thermal current :.....
- k. Number of secondary windings  
and use :.....
- l. Winding for metering purposes
  - Number of windings :.....
  - Rated power output :.....
  - Accuracy class :.....
  - Instrument security factor :.....
- m. Winding for protection purposes
  - Number of windings :.....
  - Rated power output :.....
  - Accuracy class :.....
  - Accuracy limit factor :.....
- n. Winding for protection purposes
  - Number of windings :.....

- Rated power output :.....
- Accuracy class :.....
- Accuracy limit factor :.....
- o. Rated short-time thermal current :.....
- p. Rated dynamic current : .....
- q. Power frequency withstand voltage : .....
- r. Lighting impulse withstand voltage : .....
- s. Power frequency withstand voltage for the secondary windings :.....
- t. Transmitted over voltage peak limit: .....

## 20. Ratings and features of the voltage transformers

- a. Type :.....  
.....  
.....  
.....
- b. Insulating medium :.....
- c. Ratio :.....
- d. Primary voltage :.....
- e. Secondary voltage :.....
- f. Are the secondary terminals suitable for connection to 4mm<sup>2</sup> size conductors? :.....
- g. Are the secondary phase leads protected by 2A explosion type fuses? :.....
- h. Are the secondary neutral leads



- protected by links? :.....
- i. Number of secondary windings :.....  
:.....
- j. Windings for metering purposes
- Number of windings :.....
  - Rated power output :.....
  - Accuracy class :.....
  - Percentage voltage error :.....
  - Phase displacement :.....
- k. Winding for protection purposes
- Number of windings :.....
  - Rated power output :.....
  - Accuracy class :.....
  - Percentage voltage error :.....
  - Phase displacement :.....
- l. Rated frequency :.....
- m. Partial discharge level :.....
- n. Power frequency withstand voltage :.....
- o. Lightning impulse withstand voltage :.....
- p. Power frequency withstand voltage  
for the secondary windings :.....
- q. Temperature category :.....
- r. Rated voltage factors
- continuous :.....
  - 1.5 for 30 seconds :.....
- s. Transmitted over voltage peak limit :.....

- t. Power frequency voltage withstand  
of the neutral (earthed) primary terminal:.....
- 21. Total weight of the module :.....
- 22. Are the anchoring bolts nuts and  
washers for the steel support structure  
or structures part of the supply? :.....
- 23. Is the steel support structure or structures  
part of the supply? :.....
- 24. Are the anchoring bolts, nuts and  
washers of the steel structure or  
structures of hot dip galvanized steel :.....
- 25. In case of cable line connections, are the  
plug-in cable terminations part of  
the supply? :.....
- 27. Is the equipment delivered  
with the appropriate for  
operation quantity of SF<sub>6</sub> gas? :.....