

9.1 ERECTION

The Contractor shall unpack, place accurately in position and make ready for service all the equipment required by the Specification. All installations, assembly operations and adjustments shall be done in a neat and professional manner and in accordance with the seismic withstand requirements specified in the Specification, in accordance with the manufacturer's instructions.

All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits.

The Contractor shall supply and use all lubricants and other consumables as required. Lubricants used for installation purposes shall be drained out, flushed where necessary, and replaced with the lubricant required for operation. All these consumables shall be supplied by the Contractor till completion of successful trial operation. All support insulators, bushings, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable beams and handling capacity. The slings shall be of sufficient length to avoid any damage to the equipment due to excessive swing, scratching by sling ropes etc. All handling equipment, sling ropes etc. shall be tested before erection and periodically for strength.

Bending of the pipes shall be done with suitable bending machine through cold bending only & in such a manner that inner diameter of pipe is not reduced. Cutting of the pipes shall be done with proper cutting tool.

The Contractor shall arrange all the equipment, instruments, accessories, tools & tackles, auxiliaries, cranes etc. required for the successful erection of Works.

All cabling interconnections between the HVDC station and the other equipment of the Employer, not falling under the scope of supply of this Contract which are required for purpose of interlocking, alarm, annunciation, control, protection, monitoring or for other purposes shall be in the scope of the Contractor. Cabling between equipment under present scope such as DCCT, DCVD, AC VD/CVT, Arrestor and the Control room is part of present scope. Also cabling from Battery room to control room including DCDB cables and from Valve cooling MCC to Valve cooling equipment.

9.2 Factory Tests

The Contractor shall test in the factory the individual items of equipment in his scope of supply. The routine tests and type tests as specified in the Specifications shall be as per applicable standards and as further specified herein.

All type tests and acceptance tests performed subsequent to the date of award and all routine and other tests, shall be witnessed by the

Employer or his Representative(s)/consultants, unless authority to

proceed with the tests in his absence is received from the Employer in writing, and all the test reports shall be submitted to the Employer, as specified in Section 10, for approval.

If any equipment fails to pass any test, it may be repaired and the defective parts replaced or redesigned. Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure.

Contractor shall submit Joint Inspection Report of equipments under Re- Work/Re- Engineering along with procedure for the same to POWERGRID for review. The Re-Work/Re-Engineering can be started in parallel. If the whole equipment replaced or supplier may be changed, as necessary, the equipment retested without additional cost to the Employer and extension of the delivery time. If the equipment fails to pass the so agreed repeat test(s), the Employer reserves the right to reject the equipment or part thereof in which case the complete equipment shall be replaced and supplied without any additional cost to the Employer and without any time extension.

Further, in case type/ routine tests are required to be repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses for re-testing and Employer's inspector shall be borne by the contractor.

The charges shall be recovered from contractor as below:

- (i) For inspection/visits outside India
 - a. Man day rate @ USD 500 per day for all expenses other than air tickets
 - b. Air ticket to and fro (economy) at actuals
- (ii) For inspection/visits inside India
 - a. Man day rate @ INR 28900 per day for all expenses other than air tickets
 - Air ticket to and fro (economy) at actuals

None of the equipment to be furnished or used in connection with this Contract shall be dispatched until factory tests are satisfactory. Such factory tests on the equipment shall not however relieve the Contractor from full responsibility for furnishing equipment conforming to the requirements of this Contract, nor prejudice any claim, right or privilege which the Employer may have because of the use of defective or unsatisfactory equipment. Should the Employer waive the rights to inspect and test any equipment such a waiver shall not relieve the Contractor, in any way, of his obligations under this Contract.

The Contractor shall provide all instruments and facilities required to perform all the type tests and other factory tests.

The Contractor shall perform comprehensive Factory system tests for Equipment/Systems having complex interfaces within them or with other equipment/systems such as the dc controls & protection, Station monitoring and recording systems, transient fault recorders etc. Control and protection systems shall be set as far as practical in the factory during the testing so that only minor adjustments shall be required at the Site.

9.2.1 Factory Routine Tests

All equipment to be supplied under the Contract shall be subject to acceptance/routine tests as specified in this Specification and/or as required by the relevant Standards, at the factory.

9.2.2 Factory Type Tests

9.2.2.1 General

All equipment being furnished shall meet the type test requirements specified herein and/or those required by the relevant Standards. The certified type test reports shall be submitted for the Employer's approval. The tests shall be conducted in the Contractor's or his Sub-Contractor's works/laboratory or in independent laboratory after due approval of test procedures, parameters, acceptance criteria and test program by the Employer.

Test data for equipment of different but comparable rating to that proposed to be supplied, may be accepted, if the Contractor can prove to the satisfaction of the Employer's that the equipment proposed shall meet the specified requirements.

9.3 Site Testing

9.3.1 General

After the installation and preliminary adjustments of equipment, the Site tests, shall be performed in the following stages:

- Erection checks
- Commissioning tests
- Subsystem tests
- Subsystem energization tests
- System tests

The site testing has been categorized in above stages for the sake of convenience only. There may be overlapping of two or more stages for particular tests. The Contractor shall perform the site testing with complete responsibility.

The Contractor shall provide all instruments, equipment and facilities required to perform these site tests. Calibration certificates for the test equipment shall be available at site for review by the Employer prior to the start of the testing

All special & test equipment necessary to simulate devices or switching sequences and required for commissioning shall be provided by the Contractor. Results of the site tests shall be well documented and shall form a part of plant documentation.

9.3.2 ERECTION CHECKS

The checks shall be carried out on all equipment after completion of erection/installation, in accordance with the relevant approved commissioning procedures to be submitted by the Contractor . These checks shall ensure that the equipment has sustained no damage in transit, has been properly erected/installed, is correctly set, and is ready for energization or start-up. These checks shall be carried on all equipment after completion of erection according to the approved field quality plan/installation manual of individual equipment. Scope of erection checks will include the new equipment installed and interfacing in bidders scope

The checks shall include, but not be limited to, the following:

- a) Visual examination of
 - Physical damage
 - Paint/zinc coating
 - Corona ring surface
 - Ground connection
 - Electrical connections
 - Cleanliness, specially for insulators & bushings
 - Oil leakage
 - Welded joints/application of Zinc rich paint over them
 - Moving parts for proper lubrication
 - Visit to switch yard area for general observation of any discrepancy
- b) Checking of nameplates
- c) Torque check of electrical connections and mechanical joints
- d) Check of tightness of cable terminations, cable tags and cable glands
- e) Check of cabling i.e. cable trenches ladders and cable dressing
- f) Electrical clearance measurement.

9.3.3 Commissioning Tests

After completion of erection finalization checks, equipment tests shall be conducted. These tests shall verify the proper function and healthiness of individual equipment. The tests shall conform to the approved field quality plan/procedures. The Contractor shall, in the quality plans, specify the tests required for each equipment in the station.

The equipment (pre-commissioning) tests shall be in accordance with the standards, practices, codes & Specifications, as applicable, as well as specified below.

9.3.3.1 General Checks

The following general checks/tests shall be carried out on all equipment, wherever applicable:

- a) All checks and tests specified by the manufacturers in their drawings and manuals as well as all tests specified in the relevant field quality plan (FQP).
- b) Pressure test on all pneumatic lines at (minimum) 1.5 times the rated pressure and leakage test as per relevant standards.
- c) Insulation resistance checks on primary equipment consisting of power factor tests and hi-pot tests (as Applicable).
- d) Insulation resistance check of control cables, motor etc.
- e) Resistance measurements of transformers, reactors, filter resistors etc.
- f) Loop resistance measurement of all protection circuits and metering circuits including interface circuits emanating from the Employer's ac yard/control room. Check to confirm short circuiting of unused CT windings.
- g) Wiring continuity and insulation resistance tests, including checks for cables emanating from the Employer's facilities.
- h) Functional tests on control, protection and alarm circuits including relay and control settings, checks on software based equipment and all man - machine interfaces for equipment which have not undergone Factory System Test (FST) and for equipment/systems where modifications have been taken place.
- i) Checks of all interlocks including interlocks to interfacing equipment located in the Employer's switchyard.
- j) Checks of all alarms & annunciations.
- k) Single point earthing checks for all equipment including CT secondary circuits. (Including CT secondary in the Employer's ac yard connected to HVDC side protections).
- l) Power abnormality tests for electronic equipment, if not already carried out during FST.
- m) Power supply parameters for electronic equipment, if not already carried out during FST.

- n) Diagnostic demonstration of software functions for control, protection, measuring and applicable telecommunication equipment.
- a) System and redundant equipment switchover function including switchover for transformer cooling bank.
- b) Functional tests on auxiliaries & all auxiliary systems.
- c) Check for air distribution, humidity and temperature on air conditioning system.
- d) Mechanical balancing, alignment, capacity and vibration checks.
- e) Surface treatment, galvanising or painting checks.

Following additional checks & tests for all INSULATING OIL FILLED EQUIPMENT shall be conducted:

- a) Check for oil leakage.
- b) Check for oil level and top up wherever necessary.
- c) Insulating oil tests.
- d) Dissolved gas analysis.
- e) Checks of all protective, alarm and metering functions.

9.3.3.2 Not used

9.3.3.3 Not used

9.3.3.4 Measuring Devices

- a) Insulation resistance test.
- b) Polarity test.
- c) Ratio identification test - checking of all ratios on all cores by primary injection of current.
- d) Dielectric test of oil (wherever applicable).
- e) Magnetizing characteristics test.
- f) Continuity checks on capacitor units of equipment like CVT, CVD etc. including line connection as per connection diagram.
- g) Spare CT cores, if any, to be shorted and grounded.

9.3.3.5 Lightning Arrester

- a) Resistance of ground connection.
- b) Reading of surge counters before and immediately after installation.

9.3.3.6 Motors

- a) Insulation resistance
- b) Phase sequence and proper direction of rotation.

c) trial operation

9.3.3.7 ELECTRICAL AUXILIARY SYSTEM (as per scope)

The phase sequence and auto changeover of all supplies in the station system shall be carried out.

9.3.3.8 Station Earthing

- a) Check continuity of earthing grid interconnections.
- b) Check for weld joint and application of zinc rich paint on galvanized surfaces.

Equipment earthing of present scope items are under present scope. Station earthing is not under present scope. Only continuity to be verified during commissioning.

9.3.3.9 Conductor Stringing Work, Tubular Bus Work and Power Connectors.

- a) Visual check for finish & welding.
- b) Electrical clearance check; specially at opened disconnector positions.
- c) Torque check on all bus bar power connectors and other accessories.
- d) Sag and tension check on conductors.
- e) Contact resistance check or Milli volt drop test on all joints.
- f) Dye penetration test/radiography test on 10% sample basis on weld joints.
- g) Test check on 5% sample (weld) joints after cutting the weld piece to observe any voids, etc.
- h) milli volt drop test

9.3.3.10 Cubicle Wiring (if not already done in Factory System Test)

- a) Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.
- b) Functional checking of all control circuits e.g. closing, tripping control, interlock, supervision and alarm circuit.

9.3.3.11 Relays

- a) Check all terminals to body.
- b) Megger all terminals to body and AC to DC terminals.
- c) Check operating characteristics by secondary injection.
- d) Check minimum pick up voltage of DC coils.
- e) Check operation of electrical/mechanical parts.
- f) Relay settings.

- g) Check CT and VT connections with particular reference to their polarities for directional relays, wherever required.

9.3.3.12 Meters

- a) Check calibration.
- b) Megger all insulated portions.
- c) Check CT and VT connections with particular reference to their polarities for power type meters.

9.3.3.13 Communication

- a) Carrier frequency generation.
- b) Common channel signalling unit test tone and other FSK tones.
- c) System signal frequencies and levels.
- d) Channel frequency response, group delay distortion, signal-to-noise ratio and crosstalk.
- e) Tele control signal functions, response time and bit error rate.
- f) Power supply and alarm checks.
- g) Coupling loss and noise measurements at PLC frequencies at back to back converter station.
- h) Telephone and automatic exchange system functions and performance.
- i) Return loss measurements at carrier terminals/coupling devices.
- j) k) Proper interfacing with optical fibre based telecommunication system.
- k) Matching of coupling device and carrier terminal hybrid transformers.
- l) Optical fibre terminal equipment tests to establish proper functioning and signal levels.
- m) Change over from main communication channel to back-up channel and vice versa

9.3.3.14 Valve Cooling System

- a) Tests of all alarm and trip functions
- b) Tests of changeover to backup pumps/coolers
- c) Tests of temperature controls.
- d) Test of level/leakage functions.
- e) Raw water/fine water monitoring functions.
- f) Failure of auxiliary power supplies.

9.3.4 SUB-SYSTEM TESTS

After successful completion of equipment tests on relevant equipment, sub-system tests shall be conducted. In the sub-system tests the joint function of the equipment shall be verified. The test shall be made in accordance with the approved commissioning instructions. The major sub-systems for the station shall be defined as follows:

- HVDC converter (thyristor valves, smoothing reactors etc.)
- HVDC converter Valve cooling systems
- Control, protection, alarm, monitoring, & reporting system
- Communication systems (communication with NLDC, RLDC and NTAMC)
- Electrical auxiliary Power system (as applicable per scope)
- Fire detection and protection systems (as applicable per scope)

9.3.5 Subsystem Energization Tests

After successful completion of the relevant sub-system tests, sub-system energization tests shall be performed. All independent sub-systems shall be energized or started up in accordance with the relevant approved commissioning procedures to be submitted by the Contractor. These tests shall demonstrate the electrical and mechanical integrity of these sub-systems. During these tests the Contractor shall make the initial adjustment to the equipment for satisfactory operation.

Prior to commencement of each of the sub-system energization tests, the Contractor, in consultation with the Employer, shall make the following, to ensure the safety of personnel and equipment.

- Review of completeness of tests documentation.
- Review of safety instructions, work permit procedures and tagging procedures
- Review of the operation instructions
- Final inspection of equipment.

9.3.6 System Tests

After the successful completion of the sub-system energization tests, system tests shall be performed in accordance with the relevant approved commissioning procedures.

The program of tests proposed by the Contractor shall include:

- a) Tests within back to back station including any tests necessary to confirm insulation, voltage and current capability of high voltage equipment and proper functioning with associated controls and protection including switching sequences, protection sequences, and transfer of control modes & effect of commutation failure.

- b) Forward and reverse power transmission
- c) Transient and dynamic control tests

The tests to be carried out shall comprise at least, but not be limited to, the tests listed below. It is recognized that some of these tests shall have been carried out as part of the Factory system tests. Repetition of these (successful) tests shall not necessarily be required if there have not been any subsequent modifications and properly documented tests results are available. In case it is not possible to carry out some of the tests at site, proper functioning of protection equipment shall be demonstrated in Factory system tests.

9.3.6.1 Tests at and up to Nominal Continuous Rating

- a) Rated voltage
- b) Rated current
- c) Voltage regulation
- d) Current ripple
- e) Power factor
- f) Radio interference level
- g) DC current/voltage control:
 - Maximum
 - minimum
 - current margin
 - high reactive power absorption mode
 - inverter current control mode with tap changers in manual mode and current margin compensation.
- h) power control

9.3.6.2 Tests at Other Loads

- a) emergency ratings
- b) minimum current
- c) short time overloads power rating

9.3.6.3 Tests of Control Functioning

- a) **Switching sequences:**
 - start/deblock
 - stop/block
- b) **Converter control performance:**
 - Steady state operation in all possible operating and control modes during operation, low ambient conditions, etc. The various automatic current limits shall be checked.

- operating mode transfers
 - current order step setting, step changes
 - valve group margin angle setting step changes
 - commutation failure recovery
 - power order changes
 - ac system stabilizing control, transient signal changes
 - power limit changes
 - coordination of all control system limits
 - deblock/block
 - current margin compensation on power step increase
 - power compensation during inverter current control
 - converter control switchover
 - ac system disturbances and faults
 - dc system disturbances and faults
 - converter faults
 - converter transformer and/or filter switching
 - ac/dc auxiliary supply changeovers and/or failures
harmonic measurements (ac and dc)- as per cl
4.10
 - SSO performance if required by studies
 - frequency control
 - runback and other special controls
- c) **Stepping sequences:**
- change in power flow
 - tap changer control (auto & manual modes)
 - ac filter
- d) **other sequences**
- e) **reactive power control performance**
- dynamic over voltage limiter
 - steady state over voltage limiter
 - voltage control mode
 - reactive power exchange mode
 - filter switching mode changes
 - manual filter switching mode operations
- f) **interaction related control performances**
- g) **any other control verification**

9.3.6.4 Tests of Protection Equipment

a) **response of disturbances:**

- ac/dc auxiliary supply changeover and/or failures
- start/stop or deblock/block
- converter transformer switching
- filter switching

b) **fault protection proven by simulation (e.g. by initiation of protection equipment)**

Converter valve faults (including valve short circuits)

- valve group faults including short circuit across dc side, and fault to ground on secondary of converter transformer feeding highest voltage section of the 12 pulse valve group
- ac system faults
- dc switchyard faults
- converter transformer faults
- ac filter faults
- over current protection
- over voltage/under voltage protection
- over frequency / under frequency protection
- capacitor bank protection
- protection for high firing angles/high harmonics
- Sudden changes in sending or receiving end ac system voltage.

c) **fault protection proven by staged tests:**

d) **overall coordination of protection**

e) **SSO damping controller testing if provided.**

All the tests with the exception of 9.3.6.4 b) shall be conducted with the HVDC system operating in the normal mode, .In addition to the above, the Contractor shall also carryout the site tests to establish that the performance/guarantees provided, like audible noise etc. are met.

If any (item of) equipment furnished by the Contractor fails to pass any of the above tests or shows any signs of failure, it shall be rectified and defective parts replaced or redesigned. The Equipment/Works shall then be retested without additional cost to the Employer.

The retesting shall include the test under which the failure occurred, as well as all of the tests already completed, which might be affected by the repair. All additional items of equipment of the same type and rating furnished shall conform in all respects with the item of equipment which passed the above tests.

During the tests the Contractor shall make final adjustments to the equipment/works for satisfactory operation.

The Contractor in consultation with the Employer shall arrange tests such that the frequency and duration of interruptions to power transmission during tests are minimized.

It is recognized that some of the acceptance tests shall have been carried out as part of the Factory system tests and system tests. Repetition of these (successful) tests shall not necessarily be required if there have not been any subsequent modifications and properly documented tests results are available.

9.3.7 TRIAL OPERATION

Trial Operation shall be as per 1.11

9.3.8 TESTING OF REPAIRED EQUIPMENT

If any equipment is damaged after factory testing, during transit, commissioning or otherwise, the Contractor shall estimate the extent of damage and shall propose, for consideration of the Employer, whether he wants to repair the same equipment or shall replace the same with new one. In case he proposes to repair, a repair procedure, for approval of the Employer shall be submitted along with the proposal. The Employer's decision for repair or replacement shall be final and binding.

The testing requirement shall be discussed and agreed for each such individual equipment. The Employer may decide to carryout all applicable specified tests on the repaired equipment. All costs for such activities shall be borne by the Contractor.

If the damage is of such nature that it is apprehended that it may adversely affect the performance & life of equipment/plant but cannot be quantified by means of testing, then the Contractor shall replace such equipment/plant or alternatively offer an extended guarantee for a period of at least 5 years from the date of completion of warranty period.

9.4 Commissioning Responsibilities

The test equipment supplied for this contract shall be commissioned at the site and brought into operation by the Contractor.

The Contractor shall provide a commissioning supervisor and other staff as approved by the Employer. The Contractor shall provide commissioning procedures and details of test equipment required and these procedures shall include, but not be limited to, the tests specified above in this section. These procedures shall be submitted at least six weeks prior to the starting of the tests at site.

The Employer reserves the right, without additional cost to the Employer, to add to the commissioning procedures any tests he may find necessary to prove correct performance of the Equipment/Plant.

During the commissioning the Contractor's commissioning Supervisor shall assume charge and be responsible for the equipment(s) being commissioned. The Employer's clearance and safety procedures shall apply during the commissioning work, with the start of "sub-system Energization Tests" and the Employer shall nominate a representative to coordinate with the Contractor's commissioning Supervisors on matters relating to system operation and control.

The Contractor shall supply the ac and dc testing equipment for the dielectric tests and all measuring devices, including instrument transformers, oscillograph etc., for tests to be performed at the Site.

These instruments and instrument transformers shall be previously calibrated as per accepted standards.

The Contractor shall bring each stage of Works into operation according to the contract.

No inspection, test or operation which is required to take place or be done in, upon, or about the works which have been energized or existing equipment or facilities of the Employer which are or may be electrically charged or energized from any source, shall be permitted unless and until a written 'Permit to Work' has been issued for this purpose by the Employer. When the inspection, test or operation is sanctioned by the 'Permit to Work' and such inspection, test or operation has been completed, the Contractor shall give written clearance to the Employer of said completion and return the 'Permit to Work' to the issuing authority. The 'Permit to Work' shall specify the date and for what period the said permit shall apply and the permit shall only be valid for such date and such period of time.

The system tests shall be performed after obtaining the permission from the concerned load despatch centres (LDC's). The Employer cannot guarantee that neither the tests shall be performed without interruption nor the tests shall be performed at any particular time period during a particular day. The Contractor shall request the Employer in writing seven days in advance to arrange permission from LDC's, thereafter the Employer shall obtain the permission from the LDCs. The Contractor may be required to perform tests during odd hours.

9.5 Test Equipment On Site

The test equipment shall be supplied to site and shall be properly adjusted & calibrated.

9.5.1 Station Operation And Maintenance Test Equipment

The Contractor shall supply the test equipment which shall be required by the Employer for the operation & maintenance of the station. The Bidder/Contractor shall include in the Bid an itemized list of such test equipment. The Contractor shall provide a description of the intended use

of each item of test equipment, reasons for the quantity recommended for each unit, major parameters of each unit, and brochures describing each unit together with available features and/or accessories. The Contractor shall supply at least the following test equipments alongwith any additional equipment which may be required for the operation and maintenance of the station.

All testing and maintenance equipment shall be used at the time of commissioning and same shall be handed over to site after successful commissioning. The condition of equipments shall be good at time of handing over of equipments and the damaged equipments shall be rectified/ repaired to the satisfaction of site engineer or else shall be replaced by the contractor/ bidder.

Following test equipments/tools are to be supplied.

Sl.	Description	Qty	Remarks
1.	<p style="text-align: center;">Battery Operated 10 KV</p> <p>Insulation Tester: Output V: 0-10 kV in steps (Digital), short Circuit Current min. 5mA at 10KV</p> <p>Accuracy 1. IR : ± 05 % of reading 2. Voltage: ± 05 % of reading</p> <p>Measurement Range: Insulation Resistance : 0- 1T Ω (Auto Ranging & Digital) Test Modules : Auto IR,PI,DAR</p> <p>Test Leads and accessories Two complete set of screened cables, each of 3m and 15m with suitable clamps & connectors, compatible with the instruments should be provided for successfully carrying out the test in POWERGRID S/S. Additionally all the required accessories should be provided for the smooth functioning of kit. Further hard carrying case (which should be robust/ rugged enough) for ensuring proper safety of the kit during transportation shall have to be provided</p> <p>Design/Engg. The complete equipment along with complete</p>	1 no	<p>1. The instrument should be suitable for measuring insulation resistance and PI, in live switchyard upto 765 kV level, as per applicable standard testing procedure of Powergrid. 2. The test results should have repeatability, consistency & immunity to electromagnetic interference in live switchyard upto 765 kV levels. 3. The instrument should automatically discharge the energy transferred to test specimen at the end of test. 4. The instrument should have Guard Terminal to eliminate the effect of surface leakages etc.</p> <p>Guarantee Warranty/Guarantee Period: Min 01 year from the date of successful & complete commissioning at Powergrid sub-station. All the materials, including accessories, cables etc. are to be covered under warranty/guaranty period. If the kit needs to be shifted to supplier's works for repairs</p>

डेटा वर्गीकरण : प्रतिबंधित/RESTRICTED

<p>accessories must be designed / engineered by Original Equipment Manufacturer</p> <p>Power Supply It shall work on single phase 230 Volts $\pm 10\%$, 50 Hz $\pm 5\%$ supply with standard socket/ Internal rechargeable Battery.</p> <p>Operating Temperature 0 to +50 deg C</p> <p>Relative humidity Max. 90% non-condensing</p> <p>Protection/ Control Against short circuit, over voltage, improper ground connection over load & transient surges, the kit should have alarm/cut-off features to protect the instrument</p> <p>Weight It should be easily portable</p> <p>Display/Control Digital LCD/Keypad</p>	<p>within warranty/guaranty period, suppliers will have to bear the cost of spares, software, transportation of kit for repair at test lab/ works. Calibration Certificate Unit shall be duly calibrated before supply and the date of calibration shall not be older than two month from the date of supply of Kit</p> <p>After sales service will have to submit the documentary evidence of having established mechanism in India for prompt after sale services. Environment The test kit shall be compatible for EMI/EMC/Safety environment requirement as per IEC.</p>
---	--

<p>2.</p>	<p>Digital Oscilloscope</p> <p>Optional features</p> <ol style="list-style-type: none"> 1) Play pause feature of stored waveform 2) Math functions like differential , integral and sine, cosine 	<p>1 nos</p>	<p>General Requirements :</p> <ol style="list-style-type: none"> 1) Minimum 4 channel 2) Must be able to measure a 50 hz sine wave of 1400 volts peak-peak or 700 volts peak. 3) Bandwidth 100MHz or better. The bandwidth shall be a minimum of 100MHz for all channels and for all voltage ranges 4) Scope shall have XY and YT mode. 5) Sample rate shall be at least 1GHz for single channel and 2GHz in dual channel if the difference exists 6) Recording or memory shall be at least 500K points 7) Vertical resolution should be at least 12 bit 8) Trigger modes shall at least have the following : source, level, slope, Pulse, edge(rising and falling), 9) Cursor mode shall be for both amplitude and time 10) Auto measure shall be at least: Period, frequency, pulse width (both +ve and -ve), rise time, fall time, max and min, pk-pk, mean, rms, duty cycle, Phase delay
-----------	---	--------------	---

			<p>11) Math functions shall at least include addition, subtraction, Multiply, Divide, FFT (the window must at least be hamming and rectangular) .</p> <p>12) There should be a run/stop button so that the waveform can be held on the screen and one can zoom and pan the waveform</p> <p>13) Probes : The probes supplied (including those supplied by the manufacturer) must atleast have 1 current probe to measure upto 10 Amps continuous, 1 differentially isolated probe (10:1), 2 nos of probes of 1:1 attenuation. Note all probes must be of at least 100MHz bandwidth and have a resistor of 10 Mega ohm or larger and capacitance of less than 13 pico Farad.</p>
--	--	--	--

डेटा वर्गीकरण : प्रतिबंधित/RESTRICTED

3.	DC current source	1 no	General Requirements : 600 A for 1 minute continuous & 200 A continuously.
4.	Capacitance Inductance and meter resistance	1 no	General Requirements : Basic accuracy : ± 0.1 % Frequency : 100Hz to 100kHz 10 The equipment should be Table top and should be able to carry out measurement of R,L & C of valve components.

5.	<p>Automatic Relay testing unit</p> <p>Output 1. All outputs shall have over voltage and short circuit protection. Specifically, all the voltage and current generators shall have over-voltage/short-circuit protection. The instruments should not get over heated, while supplying the rated output continuously. Further, the kit should be stable even during extensive continuous usage and should not get hanged or restarted. 2. V/I Generators: a) Current Outputs: Software controlled/configurable six phase. Current outputs: 0 – 15A (r.m.s) minimum between 10 Hz to 300 Hz sine wave, Resolution: 1mA or less. Output Burden: 150 VA minimum per phase. b) Voltage Outputs: Software controlled/configurable four-phase voltage. Voltage output:0-300 Volts AC/DC (Ph-N) between 10 Hz to 300 Hz sine wave, Resolution: 10mV or less. Output Burden: 50VA minimum per phase. c) The total current/voltage output channels should be at least 08 nos. 3. Aux. DC Output: Software controlled, 0-250 V and 50W min. (continuous rating), with continuous / step-less control. The DC supply should have short circuit protection, galvanically isolated and over load indication</p> <p>Measuring Input 1. Voltage range -10V to +10 V DC 2. Current range -20mA to +20 mA DC 3. Accuracy - 0.02% or better</p>	1 no	<p>General Requirements :</p> <p>Functional Requirement 1. The instrument should be suitable for testing all types & models of relays (used in protection schemes of transmission lines, transformer, reactor and bus bar etc.) of all the major manufacturers in fully automatic mode (including high-burden electromechanical relays) as well as transducers having accuracy class of 0.25 or better. The test kit should be suitable for dynamic and transient testing, with facility of transient (COMTRADE format) record playback for both analog and digital channels. 2. The kit shall be suitable for testing of the relays in the substations having conventional protection as well as protection based on IEC 61850 protocol using GOOSE/GSSE. The test results should have repeatability, consistency in results. ∴ They may be supplied with GPS receiver accessories. (for syn end to end testing Test Leads and accessories Complete set of test leads, PC cables, drawing, manuals,tools, Licensed OS software & antivirus for PC, Licensed software of the testing kit, combination plugs, power supply cables, original carrying case (which should be robust/ rugged enough for proper safety of the kit during transportation), manual (both in soft copy & hard copies) etc. required for carrying out all types of testing Design/Engg. The complete equipment along with complete accessories must be designed/engineered by Original Equipment Manufacturer</p>
----	---	------	--

<p>Test Frequency V/I Generator/Amplifier shall have controlled frequency range from 10Hz to 1 kHz for sine and DC to 3 kHz (minimum) for transients with resolution of 1 mHz or better and accuracy 0.01 % or better</p> <p>Phase Angles 0 to 359.90 lag/lead with resolution of 0.1 degree or better, with accuracy of 0.5 deg. (min.).</p> <p>Accuracy Accuracy shall be $\leq \pm 0.2\%$ for voltage and current sources throughout the range. The total distortion shall also be less than 0.2%.</p> <p>Binary I/O Configuration Minimum four binary outputs and eight inputs with galvanic isolation. Software controlled input should be capable of sensing potential free relay contacts (NO/NC) as well as potential of 0 to 250V AC/DC. Associated timers should have time resolution of 100μS or better. The software controlled outputs should have potential free contacts (NO/NC) with breaking capacity of 8 Amp 250V AC/DC.</p> <p>Fault Replay It should also have the facility of Transient data playback, by accepting transient fault data in COMTRADE format along with the facility to extend pre-fault/post-fault durations. It should accurately simulate disturbance signal along with DC and high frequency components (with sampling rate of 3kHz or better) as well as Binary signals.</p>	<p>Power Supply It shall work on single phase 230 Volts $\pm 10\%$, 50 Hz $\pm 5\%$ supply and standard AC socket.</p> <p>Operating Temperature 0 to +50 deg C Relative humidity Max. 90 % non-condensing Protection/ Control Against short circuit, over voltage, improper ground connection over load & transient surges, the kit should have alarm/cut-off features settings to protect the instrument.</p> <p>Cooling Arrangement Necessary in built cooling arrangement should be provided to dissipate the heat generated during testing. No external coolant/accessory shall have to be required.</p> <p>Software The software should be suitable for automatic testing & report generation and analysis. The software of the kit should be windows based and should be operated through suitable Laptop PC. All control tasks and data acquisition, processing and recording of test results shall be performed by the operating software on laptop PC or controller. The software should be capable of creating customized relay characteristics as well as of importing relay characteristics from IED/Relay. The kit should support GPS receiver with suitable port which shall enable carrying out end to end testing using GPS receivers available at both ends of the local and remote substations. Software should have facility to simulate line fault for end to end testing. The software shall be able to get updated with respect to new relays and new operating</p>
--	---

<p>Further, it should offer repeatability of results, e.g same fault location for a particular fault etc</p> <p>Communication ports / IEC 61850 compatibility Shall have the ETHERNET connectivity as a standard feature. The ETHERNET port shall be suitable for control through external PC as well as for IEC 61850 protocols. GOOSE/ GSSE configuration software module should be provided with the kit for effective checking of protection relays/ IEDs based on IEC 61850 protocol. It shall read, write, poll and check data models/ values in detail. It shall have the facility to transfer GOOSE information to suitable modules during testing of IEDs. Specifically, it will be the responsibility of the supplier to demonstrate the working of IEC 61850 module for input / output GOOSE messaging and capturing of live data</p>	<p>techniques whenever they are introduced. The updating shall be intimated and done by supplier during the period of guarantee and AMC.</p> <p>PC Interface It shall include supply of one laptop PC of Dell/Lenovo/HP make with latest specifications such as Core i5 Intel Processor, 4GB RAM, 320GB or better HDD, 15" TFT screen, Combo DVD Drive ie having CD read / write facility complete with required cables and connectors with preloaded operating MS Window 7 professional or better with latest version of application software required for storage, analysis and record management</p> <p>Environment The test kit shall be compatible for EMI/EMC/safety environment requirement as per IEC .</p> <p>Guarantee Warranty/Guarantee Period: Min 01 year from the date of successful & complete commissioning at Powergrid sub-station. All the materials, including accessories, cables, laptops etc. are to be covered under warranty/guaranty period. If the kit needs to be shifted to supplier's works for repairs within warranty/guaranty period, suppliers will have to bear the cost of spares, software and transportation of kit for repair at test lab / works</p> <p>Calibration Certificate Unit shall be duly calibrated before supply and the date of calibration shall not be older than two month from the date of supply of Kit</p> <p>After sales service: Vendor will have to submit the documentary evidence of having established mechanism</p>
--	---

डेटा वर्गीकरण : प्रतिबंधित/RESTRICTED

			in India for prompt "after sale services".
--	--	--	--

6.	<p>Frequency Counter</p>	1 no	<p>General Requirements : Range 5Hz to 100 MHz with 8 digits It Shall have high sensitivity. high resolution with 8 digits or better</p>
7.	<p>HARMONIC ANALYSER</p> <ul style="list-style-type: none"> ▪ Self powers from unregulated A-phase voltage input 90-600VAC/110-600VDC or auxiliary IEC input (90-250VAC) ▪ Internal, rechargeable backup battery with automatic, built-in charger <ul style="list-style-type: none"> ▪ Unlimited from VA or auxiliary input, 15 minutes recording from backup battery before autostop ▪ Measure up to 600V RMS with applicable voltage, input cables to category 3 certification, 0-600V AC/DC ▪ Accuracy depending upon input voltage range (Vendor to provide data sheet) ▪ Input Impedance 1 MOhm ▪ All trending taken are true RMS. Stores maximum, minimum, and average per each user-selected storage interval 	1 no	<p>General Requirements : Capable of measuring the harmonics upto 60th order. The unit should be also capable to measure flickers and be used as a power analyser with high accuracy and being a single channel unit. The equipment should be capable of directly displaying individual and total harmonic distortions. Unit should be a strong and precision power meter with harmonics and flicker measurement.</p>
8.	<p>Variable stabilized power supply</p>	1 no	<p>General Requirements : 0 to +/- 50 Volt adjustable stabilized 200 Watt output power supply.</p>
9.	<p>Variac (single phase & three phase) power supply</p>	1 no	<p>General Requirements : 250 volt single phase, 415 volt three phase four wire variable supply. Max output current at three phase version is 25 Amps per phase. There should be a suitable out put over load prevention.</p>

10	Digital multimeter	2no.	<p>General Requirements : Capable of measuring Dc and AC voltages (range 200mV to 600 V) and currents (range 2 mA to 10 A), frequency, resistance. It shall also have provision of measuring Current range in mA and voltage range in mV shall be available. Shall have accuracy + 0.2 % for DC Voltage and current measurement.</p>
11	Function generator	1 no.	<p>General Requirements : Capable of generating sine, square, triangular waves, arbitrary for varying magnitude (0 to 20 volt) and varying frequency 0 to 100KHz shall have high power output and suitable protection. It shall be capable of generating sine, triangle, square, positive and negative pulses, broadband amplifier ,DC Input supply 230 V AC.</p>

<p>12</p>	<p>Impedence Analyser The unit should feature :-</p> <ul style="list-style-type: none"> ● Precise high frequency impedance measurements from 100 Hz to 10KHz ● Resistance measurement from 0.1 m Ohm to 990 M Ohms ● Very fast measurement speed ● 0.1% to 2% + 1 Dgt basic measurement accuracy ● Clear displays <p>Test conditions Frequency range : 100Hz to 10 KHz</p>	<p>1 no</p>	<p>Measurement parameters :-</p> <ul style="list-style-type: none"> ● Capacitance (C) ● Inductance (L) ● Resistance (R) ● Dissipation Factor (D) ● Quality Factor (Q) <p>Power Supply Input voltage 230 V AC Mains frequency 50 Hz</p>
<p>13</p>	<p>PPhase angle meter</p>	<p>1 no</p>	<p>It should be able to measure the phase difference between all possible combinations of input voltages and currents. It shall have measurement range of 0-359.9deg, input current range 0-10A and can be increased by means of a clamp on meter CT, Input voltage 0-500 V, shall be able to measure phase angle between current-current, voltage –voltage and current –voltage of Sine wave with resolution 0.1 degree.</p>

14	PCB repairing work station	1 set	<p>The equipment should have soldering, de-soldering tools.</p> <p>The soldering machine should have variable temperature settings and controlled through microprocessor based system</p>
15	Portable Earthing kit	1 no.	<p>The kit shall have insulated glass fiber telescopic stick suitable for working in 400KV AC/Valve Hall. Self bonding spring loaded jaw type clamps of anticorrosive material suitable for various bus bar conductors/ tubes and earthing cables are to be specially designed to combine low electrical resistance with high mechanical strength suitable for system earth fault current so as to enable the user to achieve an effective connection in order to safely dissipate static electricity (including filter capacitor banks).</p> <p>.</p>

<p>16</p>	<p>Precision Multi-meter</p> <p>7½digit precision multi-meter, having a large 24-digit vacuum fluorescent display, a bar graph function allowing user programming of high and low pass/fail limits, audible & visual indication of component specification and Auto Dynamic Filter (ADF) to enable automatic selection of suitable filter.</p> <p>7½ Digit DMM suitable for calibration of voltage source, current source, Decade boxes and frequency sources & also should have the option of facility for low thermal 10 channel scanner for multiple inputs to be displayed or compared.</p> <p>Basic Accuracy : 18PPM/Year</p> <p>D.C. VOLTS</p> <p>14 Ranges: 3mV to 10kV</p> <p>min Resolution: 10nV</p> <p>D.C. CURRENT</p> <p>15 Ranges: 3uA to 30A</p> <p>Maximum Resolution: 100pA</p> <p>RESISTANCE</p> <p>22 Ranges: 30mohm to 1Gohm</p> <p>Min Resolution: 10nOhm</p> <p>FREQUENCY</p> <p>Range: 0 to 100kHz</p> <p>Resolution: 1Hz</p> <p>A.C. VOLTAGE</p>	<p>1nos.</p>	<p>General Requirements :</p> <p>Capable of measuring Dc and AC voltages and currents, frequency, resistance. It shall also have provision of measuring Current range in mA and voltage range in mV shall be available. Shall have accuracy + 0.2 %.</p> <p>IEEE INTERFACE Should be fitted as standard & confirming to IEEE-488</p> <p>OPERATING TEMPERATURE:</p> <p>0 to 50 degree C</p> <p>CALIBRATION CERTIFICATE</p> <p>To be supplied with calibration certificate having national/international traceability</p>
-----------	---	--------------	--

<p>6 Ranges: 3mV to 3kV min Resolution: 1 micro V A.C. CURRENT 8 Ranges: 0 to 30 Amps min Resolution: 1 nA CAPACITANCE 5 Ranges: 0- 300uF min Resolution: 1pF Accuracy: $\pm 0.2\% + 20 / \pm 0.25\% + 20$ digits PT 100 Range: -200°C to +600°C Resolution: 0.001°C Accuracy: $\pm 0.05^\circ\text{C} / \pm 0.06^\circ\text{C}$ SPECIAL FEATURES Self test Mode, Diode/Zener Test, Max/Min functions , Continuity Testing ,A.C./D.C. Coupled facility, Countdown and sample beep on long filter periods Oxygen free copper input terminals.</p>		
---	--	--

17	A)Clamp on meter	1 nos.	General Requirements : 2000A AC, 1000 A DC with a feature of measuring different order harmonics; Accuracy of the instrument shall be 1% of the range. Resolution 100 mA upto 200 A and 1A for higher.
	B) Leakage AC Current (0 – 5 A) with resolution of at least 01 mA	1 nos	For very small AC current measuring
	C) Very low current 0-30 mA	1 nos	
	D) AC and DC current 0-400 Amp	1 nos	
	E)Low DC current (0 - 2/20A D.C)	1 nos	For DC leakage current measurement

18. Fiber signal transmitter & receiver (OTDR) to test the healthiness of FO cables-1no.

19. Tool Kit consisting spanner set, set of screw drivers, Heavy drill machine along with different type & size drill bits etc.1nset

20. Splicing & termination kit.1no

21. Thyristor Test Equipment (as per Cl. 6.1.2.9) 2set

22. Special tools for valve cooling system-1 set

23. Special tools required for thyristor maintenance and replacement – 2 sets.

24. Scissor Lift of suitable size & height capable of handling maintenance and replacement works in valve hall – 01 Number.

The Test Kits shall be successfully demonstrated at site for acceptance. Test kit supplied shall be having experience matching with POWERGRID usage profile.

9.5.2 USE OF TEST EQUIPMENT BY THE CONTRACTOR

The Test and maintenance equipment shall be delivered to the Employer in as new condition and shall be used thereafter for maintenance on equipment in operation. Any test and maintenance equipment which was previously utilized by the Contractor for commissioning shall be refurbished and restored to as new condition or alternately he shall replace it by new equipment at no additional cost to the Employer. This condition also applies to all maintenance equipments mentioned in

chapter-7 of this specification.

9.6 Quality Assurance Requirements

9.6.1 Quality Assurance Programme

To ensure that the equipment and services under the Scope of Contract whether manufactured or performed at the Contractor's works or at his sub- Contractor's premises or at the Employer's site or at any other place of work are in accordance with the Specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions prior to commencement of manufacturing. A quality assurance programme of the Contractor shall generally cover the following:

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Design and Documentation control system.
- c) Qualification data for Contractor's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and field activities.
- h) Control of calibration and testing of measuring and testing equipment.
- i) System for quality audits.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Employer.
- l) System for maintenance of records and
- m) Furnishing of quality plans (QP)/inspection and test plan (ITP) for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

9.6.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

All services, materials, components and equipment covered under this specification shall be engineered, designed, procured, manufactured, erected, commissioned and tested at all the stages, as per a

comprehensive Quality Assurance Programme. An indicative programme of quality assurance to be carried out by the Contractor for various items shall be given in the Bid.

It is the Contractor's responsibility to draw up and implement such agreed programme for system as a whole as well as for individual equipment. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Contractor and shall be submitted to the Employer for approval.

The Contractor shall furnish with his bid a list of approved suppliers for the information of the Employer.

- 9.6.2.1** Engineering and design quality Plan shall detail out the studies, overall detail design documentation and communicating, defining interfaces and controlling changes. To achieve quality, reliability and schedule objectives that project shall be designed so that it meets performance requirements.

Manufacturing Quality Plan shall detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this Specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents etc., during all stages of materials procurement, manufacture, assembly, and final testing/performance testing.

- 9.6.2.2** Field Quality Plan shall detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities from receipt of materials/equipment at site onwards.

- 9.6.2.3** The Bidder/Contractor shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with respective Quality Plan. These Quality Plans and reference documents/standards etc. shall be subject to Employer's approval without which manufacture shall not proceed.

In these approved QPs, the Employer shall identify customer inspection points (CIP), test/checks which shall be carried out in presence of the Employer's Engineer or his authorised representative and beyond which the work shall not proceed without consent of Employer or his authorised representative in writing. All deviations to specification, approved quality plans and applicable standards must be documented and referred to the Employer for approval and disposition.

- 9.6.2.4** No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Employer's Engineer and / or his authorised representative, and duly authorised for dispatch issuance of Material Inspection Clearance Certificate (MICC).

Before making request for issuance of MICC, the Contractor shall ensure that approval of type tests, data sheets, drawing etc. had already been obtained from Employer.

All materials used or supplied shall be accompanied by valid materials certificates and tests and inspection reports. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

- 9.6.2.5** All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME section - IX/BS- 4870/Equivalent IEC or other International equivalent standard acceptable to the Employer.
- 9.6.2.6** All the (sub)-Vendors proposed by the Contractor for procurement of bought out item list of which shall be drawn up by the Contractor and finalised with the Employer shall be subject to the Employer's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Employer and shall form part of the purchase order between the Contractor and the Vendor.
- 9.6.2.7** The Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's of their sub-Contractor's (sub-vendor's) quality management and control activities. The Contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 9.6.2.8** As a part of quality assurance of engineering and design, the technical review meetings (TRMs) shall be conducted between the Employer and/or his consultants/representative and the Contractor and/or his subContractor(s). The duration and cycle of such TRMs shall be as frequent and regular as required to meet the time schedules. The meetings shall be held at either at the Employer's office and/or at the office/manufacturing place of the Contractor/sub-Contractor or at any other place as agreed mutually.
- 9.6.2.9** The Contractor shall agree upon a schedule of submissions of documents concerning the Quality Assurance Program within two months of the effective date of the Contract. This schedule shall indicate the list of mutually agreed items/equipment for which quality Plans shall be submitted by the Contractor and the last dates for the submissions. It shall be ensured by the Contractor that the submissions are so programmed that all relevant approvals are obtained from the Employer for these documents in a timely manner before the material induction and commencement of the manufacture for any equipment.
- 9.6.2.10** The documents that shall be submitted by the Contractor to the Employer for review and approval as per the agreed schedule include:
- a) QA Manuals

- b) Quality Plans (Inspection & Test Plans) for all equipment/materials manufactured in the Contractor's works and/or in the sub-Contractor's works
- c) Purchase Specifications for equipment procured from sub-Contractors.
- d) Contractor's assessment reports of his sub-Contractors
- e) Field Quality Plans for all activities at site
- f) Reference documents referred to in Quality Plan.
- g) Erection, commissioning, operation and maintenance manuals

9.6.2.11 QA Document Package

The Contractor shall submit the following Quality Assurance Documents to the Employer. These documents shall be as per the approved Quality Plans for the concerned equipment. The documents shall include, but not limited to, the following:

- a) Routine test reports & Acceptance test reports
- b) Type test reports
- c) Quality records etc. corresponding to items identified Quality Plan
- d) Inspection reports for Customer inspection points
- e) Reports on repair/modification carried out to make the item/equipment acceptable.
- f) Non-destructive examination result reports including radiography interpretation reports, wherever applicable.

The above documents are required to be submitted in required number of copies within three weeks after dispatch of equipment.

9.7 Inspection and Testing

9.7.1 In order to verify that all the manufacturing of equipment by the Contractor as well as materials & equipment being procured and provided by the Contractor are in complete conformance with the requirement of the Contract, the Employer and/or his duly authorized representative shall have access to the Contractor's premises or works at all reasonable times to inspect and examine the material, equipment and workman ship during its manufacture or installation.

In addition to carrying out inspection the Employer and/or his authorized representative/Consultant all carry out quality audit on the Contractor's Quality Assurance System and conduct quality surveillance to check conformance to quality procedure/practice in general. The Contractor shall provide necessary facilities to carry out all the above activities at their works and the works of the sub-Contractors.

9.7.2 The Contractor shall provide a detailed inspection schedule for those inspection stages identified as CIP and shall furnish updated schedules once every two months.

- 9.7.3** The Contractor shall give the Employer/Inspector six(6) weeks written notice, by telex or by letter, of the tentative date any material/equipment shall be ready for witness points, corresponding to Customer inspection points (CIP), when the Employer/Inspector is based in India. Final confirmation shall be given at least 15 days in advance.

The Employer/Inspector, unless witnessing of the tests is waived, shall attend such tests, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence. The Contractor shall forthwith forward to the Employer copies of duly certified test reports. Test reports of all tests corresponding to CIP performed in the supply shall be reviewed and approved, subject to satisfactory conduction and successful passing of the test, by the Employer or his authorised representative (even if the witnessing of the test was waived).

- 9.7.4 The Employer or his authorized representative shall, within fifteen (15) days from receipt of such reports, give notice in writing to the Contractor of any objection to any aspect of the test reports or any or all equipment and workmanship which in his opinion is not in conformance with the Contract. The Employer or his authorized representative shall advise his reasons for objections on completion and review of the activity. The Contractor shall give due consideration to such objection(s) and shall either make the modifications that may be necessary to overcome the said objection(s) or shall confirm in writing giving reasons therein that no modifications are necessary to comply with the Contract. However, the Contractor may proceed with the works/dispatch even before the receipt of written objection(s), if any, at his own cost & risk.

- 9.7.5** Whenever the Employer's inspection engineer undertakes the inspection, at a particular stage identified as Customer inspection point (CIP) in the Quality Plan, the acceptance of test reports/test results and the MICC where applicable shall be given immediately after the test if the results, including those for previous points identified as per clause 9.6 are found to be in conformity with the Contract. In case of any deviations, the Employer/Inspector at his discretion may refer the matter to the Employer's main office, together with the manufacturer's comments, who in turn shall communicate his final decision regarding the acceptance or otherwise to the Contractor within fifteen (15) days of the receipt of such test reports/results.

In case the presence of the Employer/Inspector is waived, the acceptance of test results and issuance by the Employer of Material Inspection Clearance certificate wherever applicable, shall be given within fifteen (15) days after receipt of test reports/results for the CIP as well as for previous CIP's identified in the approved Quality Plan, provided such test reports/test results are found to be in order.

The Employer/Inspector shall at his discretion and based on the outcome of any inspection and the requirements of the contract, have the right to 'accept', 'accept as noted' or 'reject' any equipment/material. The

reasons/comments in case of each ruling shall be communicated to the Contractor in writing.

9.7.6 In all cases where the contract provides for tests, whether at the premises of works of the Contractor or of any sub-Contractor, the Contractor, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, apparatus and instruments as required to fulfil the requirements of the approved Quality Plan.

9.7.7 The inspection by Employer/Inspector or waiver of the presence of the Employer/Inspector, issue of CIP clearance certificate and issue of Material Inspection clearance certificate (MICC) thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality plans forming part of the contract.

The Employer shall not be found to accept the material/equipment if on further testing it is found to be not in compliance with the requirements of the contract.

The Contractor shall include in all orders to his sub-Contractors, the requirements for any equipment, being supplied by the sub-Contractor for incorporation in his equipment to be subjected to inspection and testing by the Employer or his authorised representative. Copies of such orders or purchase specifications, blanked for prices, shall be forwarded to the Employer.

9.7.8 The costs of all tests specified in the Contract together with the same for all tests facilities, test samples and such like shall be to the Contractor's account.

9.7.9 The Employer/Inspector shall have complete authority to reject, on behalf of the Employer, any material, equipment or parts thereof considered unsatisfactory and not in accordance with the Contract. Accept, accept as noted or reject materials, equipment or any components thereof shall not relieve the Contractor of any of his obligations under the Contract, nor impose any liability whatsoever on the Employer.

9.7.10 The Employer shall have the right to have Inspectors on the Site, on a regular basis or from time to time as required at his sole discretion to monitor the quality and the progress of the work.

Generally, the site inspection shall be as per the approved Field Quality Plans (FQPs) and the Installation & Operation Manual(s). All quality related documents and test results shall be a part of plant documentation