सत्यमेव जयते

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
वितरण आयोजन एवं प्रौद्योगिकी प्रभाग
Distribution Planning & Technology Division

No. CEA/DP&T/QAP/2022 Dated 04-01-2022

विषय: विद्युत वितरण क्षेत्र में प्रमुख उपकरणों के लिए टाइप टेस्ट वैधता अवधि और मॉडल गुणवत्ता आश्वासन योजना के लिए सामान्य/सामान्य दिशानिर्देश प्रस्तुत करने के संबंध में ।

Subject: Submission of common/general Guidelines for Type Test Validity period and Model Quality Assurance Plan for major equipments in Power distribution sector -reg.

Madam/Sir,

Ministry of Power (MoP) had desired the Standardization of Type Test Validity period and Model Quality Assurance Plan for major equipments used in Power Sector. Accordingly, Central Electricity Authority (CEA) constituted a Committee under Member(GO&D/Hydro) with members from CEA, Power Sector Utilities, Manufacturers, etc. The Committee further constituted five sub-groups with regard to Hydro Generation, Thermal Generation, Renewable Energy, Transmission and Distribution comprising representatives of Central Power PSUs, State Power PSUs and Private Power utilities.

The Sub-Group for distribution sector was constituted under Chief Engineer (DP&T), CEA. After detailed deliberations and discussions amongst the Committee and sub-group members and inputs provided by the manufacturers/ vendors/ utilities, etc. the document has been prepared containing draft guidelines for Type Test validity period and Model Quality Assurance Plan of major equipments in power distribution sector.

The draft guidelines for Type Test validity period and Model Quality Assurance Plan of major equipments in power distribution sector is attached herewith for wider circulation and general comments from different stakeholders. It is requested that the comments on the same may please be sent to this office upto 03-02-2022 through email on cedpt-cea@gov.in.

Encl: As above

भवदीय

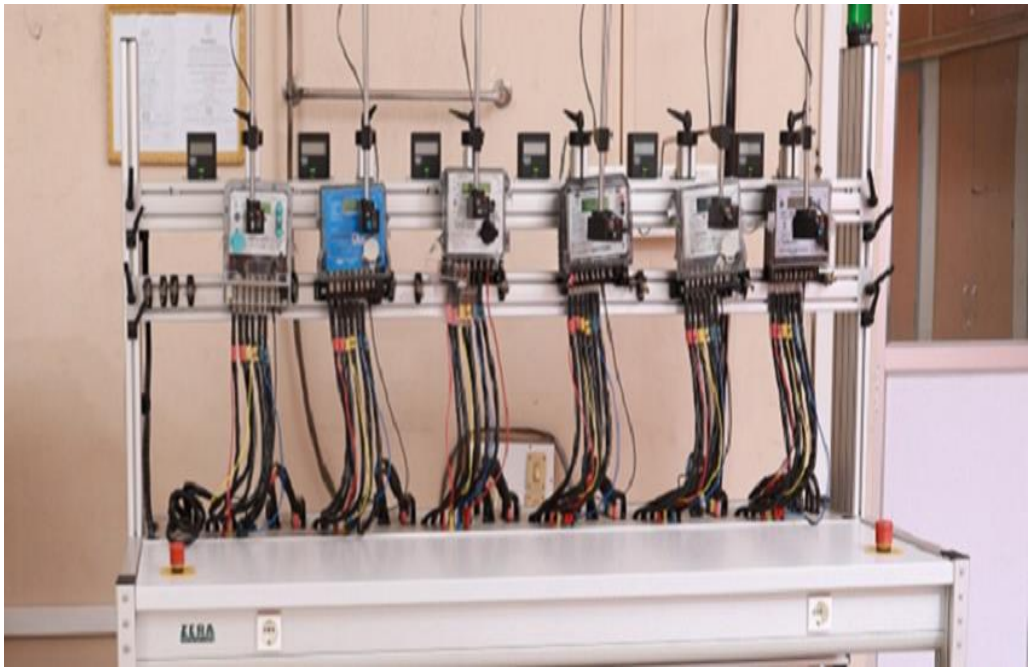
प्रवीण कमल
04/01/2022

(प्रवीण कमल)

निदेशक

Draft

Guidelines
for
Validity Period of Type Test (s)
and
Quality Assurance Plan of
Major Equipments
Used in
Power Distribution System



Central Electricity Authority 2022

GUIDELINES
FOR
VALIDITY PERIOD OF
TYPE TEST (S) OF
MAJOR EQUIPMENTS
USED IN
POWER DISTRIBUTION SYSTEM

Guidelines for validity period of Type Test(s) and Quality Assurance Plan of Major equipments used in distribution sector

1. Background

Several manufacturers and utilities had emphasized the need of uniform guidelines pertaining to testing procedures in the country as this is unnecessarily leading to wastage of national resources, time & money and increasing burden on manufacturer & testing facilities and cost to the end consumers. Therefore, there is a need to address such issues and develop uniform practice/ guidelines relating to the period of validity of Type Test reports of major Electro-Mechanical (E&M) Equipment in Power Sector for the benefit of end users, utilities and manufacturers in the country considering the end objective of Type Testing of the Equipment.

In view of above, Ministry of Power (MoP) had desired the Standardization of Test Protocols for E&M Equipment used in Power Sector. Accordingly, Central Electricity Authority (CEA) had constituted a Committee with members from CEA, Power Sector Utilities, Manufacturers, etc. vide CEA OM dated 01.11.2021 (enclosed as **Exhibit-I**) to deliberate on the subject matter. The major decisions taken during the series of meetings (02.11.2021, 05.11.2021 and 30.11.2021) held by the Committee were to standardize the duration of validity of Type Tests conducted on various E&M equipment and preparation of Model Quality Assurance Plan (MQAP) of major E&M equipment in the entire power sector.

Further five Sub-Groups were constituted for framing the guidelines for validity of Type Test(s) and preparation of MQAP of major E&M Equipment pertaining to different sub-sectors of Power Sector, viz. Hydro Generation, Thermal Generation, Renewable Energy, Transmission and Distribution comprising representatives of Central Power PSUs, State Power PSUs and Private Power utilities.

After detailed discussions amongst the Committee and sub-group members and inputs provided by the manufacturers/ vendors/ utilities, etc. this document has been prepared containing draft guidelines for Type Test validity period of major Electro-Mechanical Equipment in power sector.

2. Purpose of uniform Guidelines for Validity Period of Type Test(s)

This document details the guidelines for validity period of Type Tests in respect of Power Distribution Sector including general requirements to be met by all other sub-sectors of Power sector viz. Hydro, Thermal, Renewable (Solar/ Wind, etc.), and Transmission. The purpose of publication of these guidelines is enlisted below:

i. **To reduce the repeatability of tests, wherever possible**. Specifying validity period of Type Test would ensure that the equipment need not be tested again and again unnecessarily if no major change has been introduced in the basic design/ technology/ material/ mechanical construction/ functionalities of the equipment/ performance characteristic/ manufacturing process of the equipment. This would help in saving cost as well as time of all the stakeholders involved (i.e. manufacturers/ vendors/ utilities, etc. and in turn the end consumer as well).

ii. **To avoid overloading of testing facilities**. It is often observed that certain testing facilities are overburdened due to non-optimal utilization of testing facilities spread across the country. Specifying the validity of Type Test(s) would reduce frequency of tests on similar equipment and hence reduce burden on the existing laboratories.

iii. To avoid discrepancy in validity period of Type Test(s) being accepted or followed by various manufacturers or utilities and **set uniform guidelines for all equipment manufacturers and procurers across the country**.

3. General Guidelines applicable for all Sub-Sectors

a) Type Tests on indigenous equipment, for which testing facility is available in India, should be conducted in any of the independent laboratories approved by Government or accredited by National Accreditation Body of the Country, like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA) etc.

b) The Type Test(s) conducted in-house by manufacturers shall also be acceptable provided the lab is accredited by National Accreditation Body of the Country and the tests have been witnessed by a representative of an authorized third party/ Power Utility.

c) Type Tests on imported equipment should be conducted in an Indian laboratory or foreign laboratory accredited by National Accreditation Body of respective Country.

d) Type Tests on indigenous equipment, for which testing facility is not available in India, should be conducted in a laboratory of foreign Country accredited by National Accreditation Body of that Country.

e) The result of all Type Test(s) shall be recorded properly in Type Test Reports (TTRs) containing sufficient information like the ratings, the relevant design criteria/ parameters and drawings, model number, test circuit, calculations (if any), photos and compliance to the relevant standards (IS/ IEC/ equivalent & above). The relevant clauses of the standards (IS/ IEC/ equivalent & above) according to which Type Test(s) have been conducted and acceptance criteria/ values need to be brought out clearly in the report.

f) All the testing equipment used for Type Testing should have been duly calibrated and the valid calibration reports should form part of the Type Test reports.

g) The equipment shall be supplied from the same manufacturing works, from where the sample unit was manufactured and successfully Type

Tested as per relevant standards (IS/ IEC/ equivalent & above) or at the works of Parent organization in case of technology transfer/ Joint Venture (JV)/ own manufacturing plant etc. for the initial period of 03 years from the date of establishment of manufacturing plant.

h) Validity period of Type Test(s) conducted on the equipment i.e. the period for which Type Test Reports (TTRs) shall remain valid and acceptable to user/ utility provided no major change has been introduced in the basic design/ technology/ material/ mechanical construction/ functionalities of the equipment/ performance characteristic/ manufacturing process of the equipment, shall be as given in Table in this document.

i) The Type Test(s) of the equipment shall be revalidated during its validity period, if there is change in technology or basic design or generic materials employed or manufacturing process or combination of any of the above. However, minor changes, which have no effect on functionality & reliability of the equipment, may not require repetition of Type Tests. Minor changes do not include change in electrical stress, thermal stress, mechanical stress, change in construction, change in dielectric material, impregnating oil, thickness of electrode & internal fuse design in a capacitor, enclosure materials (magnetic, non-magnetic like stainless steel, Aluminium) etc.

j) If relevant standard (IS/ IEC/ equivalent & above) of the equipment is revised or amended, fresh Type Test is warranted even if equipment has not changed in design/ material etc. However, fresh Type Testing will be limited to only those tests for which test procedure/ method, any technical requirement or test levels have been changed in the revised standards. In such cases, enough time should be given to manufacturer to comply with revised provision in standards.

k) The change in the make of component(s) of the equipment shall not be the criteria for repetition of Type Test(s) provided that the component of new make has been successfully Type Tested and its use shall not

affect the functionality, performance & reliability of the equipment. The Type Test reports of the component of new make shall be submitted.

l) Utilities, if so desire, may repeat the Type Test(s), at their own cost even if valid TTRs have already been provided by the bidder/manufacturer. However, the utilities should refrain from making it a regular practice. The utility must clearly specify which Type Test(s) would be repeated in the event of award of the contract and quotation for such tests should be invited separately in the price bid. In such case, utility shall provide extra time for repetition of such Type Test(s).

m) The philosophy of extending Type Test(s) results of the equipment is based on two primary factors: similar design and design with higher stresses (electrical, mechanical, thermal, and environmental). Validity of Type Test report of an equipment can be extended to the same equipment of similar design and/or lower design stress provided relevant standard (IS/ IEC/ equivalent & above) permits.

n) It is practically impossible to subject all possible arrangements of the GIS (for a particular switching scheme corresponding to a specified voltage level) to Type Test(s) as various arrangements are possible using same combination of equipment depending on layout arrangement and space availability. The performance of any particular arrangement shall be substantiated from Type Test results obtained on representative assemblies or sub-assemblies. The user shall check to ensure that tested sub-assemblies can be a representative form of the user's arrangement and meet his desired requirement/ objective.

o) For capacitors, the successful completion of each Type Test is also valid for units having the same rated voltage and lower output (KVAR), provided that they do not differ in any way (i.e. design, construction, material, and production process etc.) that may influence the properties to be checked by the test.

p) Repetition of short circuit test on transformer is not required due to change in make and type of bushings and/or make of OLTC provided bushings and OLTC of supplied make have same or better rating and have been successfully type tested as per relevant IS/ IEC/ equivalent & above.

q) The utility shall not reject the transformer for supply against the contract, if the Short Circuit (SC) tests was conducted on the subject transformer as per relevant standard (IS/ IEC/ equivalent & above) and it has successfully passed the SC tests and other Type Test(s) as per relevant standards.

Proposed Validity of Type Test Certificate – Distribution

Sl. No.	Name of Equipment	Validity Period (in years)
i.	Power Transformer (66, 33 KV, 22 KV)	5
ii.	Distribution Transformers (as per IS 1180)	5
iii.	Circuit Breaker	5
iv.	Isolator	5
v.	Lightening Arrester	5
vi.	Instrument Transformers (CT/PT)	5
vii.	LV and MV Switchgear	5
viii.	GIS & Hybrid Switchgear	5
ix.	Cables and associated joints	5
x.	Capacitor/ Capacitor Bank	5
xi.	Relays	5
xii.	Energy Meters • Electronic Meter • Smart Meter	 5 3
xiii.	Battery and Battery Charger	5
xiv.	Conductors and earth wire	5
xv.	Insulators (Porcelain/ Glass)	5
xvi.	Composite Insulator	5
xvii.	PLCC/ FO cable / OPGW	5
xviii.	Distribution Line insulator hardware fittings, and accessories for conductor & ground wire	5

Guidelines for validity period of Type Test(s) and Quality Assurance Plan of Major equipments used in distribution sector

GUIDELINES
FOR
QUALITY ASSURANCE PLAN OF
MAJOR EQUIPMENTS
USED IN
POWER DISTRIBUTION SYSTEM

Guidelines for validity period of Type Test(s) and Quality Assurance Plan of Major equipments used in distribution sector

1. Background

Quality Assurance aims to keep the quality of a product/ equipment above a specified level and ensures that the product not only meets all customer requirements but also meets the suppliers' objectives and targets. Further, following a good Quality Assurance Plan (QAP) reduces the chance of costly mistakes and mitigates risk. This is specially required for Power Sector for ensuring quality, reliable and economic power supply as it serves billions of people on a daily basis besides serving commercial and industrial sectors in their contribution to economic growth of country. To achieve this, manufacturers and utilities rely on QAP. However, it has often been observed that there is variance in QAPs being followed by different manufacturers, utilities, etc. suiting their requirements. It appears that there is a need for uniform guidelines for QAPs which shall be followed by all stakeholders throughout the country. Further, these Model QAPs (MQAPs) shall be efficient in terms of number and type of tests being performed during the entire cycle from raw material/ sub-component sourcing to production to their commissioning so as to reduce unnecessary testing, avoid redundancy at various stages and consequently save time and cost of the project.

2. Quality Assurance Plan (QAP): Introduction

Quality of an equipment can be improved by taking effective steps at the initial stage itself, which include 'use of high quality raw materials' and 'improved manufacturing processes'. The performance of an equipment largely depends on the excellence of design. However, all good designs may not yield good end product unless they are well supported by good materials, good and healthy machines and skilled workmen (operators)/ workmanship. The formulation and implementation of an efficient QAP comprises of a properly designed quality assurance program along with proper documentation at every stage, an efficient quality assurance test and finally implementation of quality assurance plans.

3. Broad Categories of Tests conducted on E&M Equipment in Power Sector

3.1 Type Tests:

- These tests are conducted for validation of design i.e. for confirming the main and basic design expectation of the equipment. These tests are done mainly on a prototype unit and not on all manufactured units in a lot.
- This is a test conducted on an equipment, which is representative of other equipment, to demonstrate that these comply with specified requirements not covered by routine tests. It needs to be noted here that an equipment is considered to be representative of others, if it is fully identical in rating and construction, but the Type Test may also be considered valid, if it is made on an equipment which has minor deviations of rating or other characteristics. These deviations should be subject to agreement between the manufacturer and the purchaser.
- In case Type Test Certificate is available for the specified validity period for the same design, the repeat test is not required.
- The Type Tests are conducted as per relevant applicable Standard.

3.2 Routine Tests:

- These tests are conducted mainly for confirming the operational performance of the individual unit in a production lot.
- These are at present conducted as per relevant applicable Standard.

3.3 Special Tests:

- These are the tests other than a Type Test and/ or Routine Test as agreed by the manufacturer and the purchaser in the contract.
- These tests are done as per customer requirement to obtain information useful to the user during operation or maintenance of the equipment.
- These are conducted as per relevant applicable Standard (as specified under Contract or to meet certain requirement of Contract).

3.4 These above mentioned tests are further classified on the basis of the stage at which they are conducted, either at the works of the contractor or at site as given

below:

1. The Type Tests/ Routine Tests/ Special Tests as the case may be, if conducted at the works of the manufacturer before Manufacture Dispatch Clearance Certificate (MDCC) of the equipment from the works to the site are called as Factory Acceptance Tests (FAT). The objectives of FAT are generally as follows:

a) Factory Acceptance Test (FAT) -

- A FAT helps to verify that newly manufactured and packaged equipment meets its intended purpose. The FAT validates the operation of the equipment and makes sure the customers' purchase order specifications and all other requirements have been met.
- This is a test that runs on the equipment or components before it is delivered to its intended destination.
- FATs are usually done at the factory works to make sure that certain requirements are met. Further, these tests are normally done with the customer, and also, in certain more demanding cases, with a third party inspection agency.
- These are conducted as per relevant applicable Standard.

2. The Routine tests/ Special tests as the case may be, if conducted at the site during erection and commissioning are called as Site Acceptance Tests (SAT). The objectives of SAT are generally as follows:

b) Site Acceptance Test (SAT)

- These tests are done to make certain that specified quality is met by the equipment at site and to offer customers quality testing and documents, and also further ensuring that nothing has changed or was damaged during shipment from supplier premises, storage and its installation.

- SATs are done at the specific places where usually commissioning is done.
- While FATs can use simulations to demonstrate as to how the equipment will function in its future operating environment, it may be difficult to mimic the actual operating conditions.
- SATs are only conducted after the FAT has taken place and the item/ equipment has been delivered. This is the only way to truly determine whether a piece of new equipment will function as required.
- These are conducted as per relevant applicable Standard.

4. Purpose of Uniform Guidelines for Model Quality Assurance Plan (MQAP):

There is an imperative need to have convergence in the preparation of Model Quality Assurance Plan (MQAP) as this will avoid variance among different stakeholders (manufacturers/ purchaser/ utilities, etc.), significantly save time & money and reduce burden on suppliers & testing facilities and cost to the end consumers by removing redundancies in testing procedures. Therefore, there is an urgent requirement to frame guidelines to make a uniform MQAP.

The major objective behind publication of these guidelines for MQAP of major E&M equipment of Power Sector are broadly as given below:

(i) To prepare Model QAPs, which are efficient and simultaneously have overall coverage of tests. Unnecessary and repetitive tests at different stages would be optimized and the tests for only important/ major equipment would be included in these MQAPs. The sample size for testing shall also be standardized in the MQAPs. This would help in saving cost, time and conflicts for not only the vendors/ manufacturers but also the purchaser/ consumer.

(ii) To moderate/ optimize Customer Hold Points (CHPs) for non-critical tests. For

this purpose, model QAPs are being framed and accordingly those tests are identified for which only the Test Certificates (TCs) shall be sufficient and acceptable upon its review, thereby reducing the overall number of CHPs in inspections.

(iii) To bring the convergence in QAPs being prepared by various manufacturers or approved by utilities and **set uniform guidelines of MQAP for all major Electro-Mechanical equipment manufacturers/ suppliers and purchasers in the country**.

(iv) To avoid overloading of testing facilities. This shall be achieved in conjunction with the guidelines for the validity period of Type Test(s) for major E&M equipment of Power Sector. Specifying the validity of Type Test(s) and removal of repetition of non-critical tests as per applicable Standards and optimizing CHPs in MQAPs would reduce the burden on the existing testing facilities leading to reduction in waiting time and henceforth optimal utilization of testing facilities which are available with limited number of laboratories.

5. Broad Guidelines for Model QAP of Power Sector

a) All the utilities/ purchaser/ developers/ suppliers in Power sector shall prepare and follow the Model QAPs (enclosed as **Annexures**).

b) MQAPs of those E&M equipment which have not been covered in the **Annexures** shall be subject to the terms of mutual agreement between manufacturer and purchaser.

c) Test Certificates (TCs) of Bought-out items establishing the purchaser's requirement upon review shall be acceptable to the purchaser.

d) Any change in practice or acceptance norms (with reference to various tests / parameters in respective National / International standard) would be suitably incorporated by manufacturer from time to time and submit the same for

approval of purchaser / utility.

e) These guidelines of MQAPs specify the maximum numbers of CHPs and highest limit of sampling size that could be included in the specification by the developer/ purchaser while conforming to the applicable Standard.

f) In order to save time, both the supplier and the purchaser shall be free to identify lesser number of tests as CHPs as per specific needs of purchaser subject to the agreement between them.

g) The utilities/ purchaser may request for additional tests which have not been covered in MQAPs of listed E&M equipment, at their own cost. However, the utilities should refrain from making it a regular practice.The utility must clearly specify as to which additional test(s) would be required during the awarding of the contract and quotation for such tests should be invited separately in the price bid. In such case, the utility shall provide extra time for repetition of such test(s). In case there is change in the governing regulations/ applicable standards, the supplier would conduct the required test at his own cost.

h) The purchaser reserves the right to get the test conducted again at the supplier's works/ accredited laboratory at supplier's cost in case the Test Certificates are not establishing/ meeting the purchaser's requirement.

i) The TCs at initial/ raw material/ in-process stage by customer shall be prepared and maintained by the supplier. Further, the same shall be considered as accepted only after its acceptance by the purchaser upon review at appropriate stage of CHP.

j) The quantum of checks shall be strictly kept as specifically quantified in the column of 'Quantum of Check'and shall be governed by the document referred under column of 'Acceptance Norms' in QAP. However, wherever the quantum of check has been mentioned as 'sample per lot', the same shall be minimum 2 numbers or 5% of the lot whichever is higher except in the case of Type Tests.

k) No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to pre-despatch final inspection including verification of records of all previous tests/ inspections by Purchaser's authorised representative and duly authorised for despatch.

l) Manufacturer shall carry out all tests/ inspection required to establish that the items/ equipment conform to requirements of the specification and the relevant codes/ Standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

m) Quality approval of the results of the tests and inspection will not, however, prejudice the right of the Purchaser to reject the equipment if it does not comply with the specification, when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the manufacturer in ensuring complete conformance of the materials/ equipment supplied to relevant specification, standard, data sheets, drawings (approved by the Purchaser), and minutes of various meetings with customer / Purchaser etc.

n) Any repair/ rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Purchaser/ authorised representative.

o) All inspection, measuring and test equipment used by manufacturer shall be calibrated periodically depending on its use and criticality of the test/ measurement to be done. The manufacturer shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by purchaser. In case repair is carried out in the measuring and test equipment it should be compulsorily recalibrated. All calibrated measuring and test equipment must be properly sealed after calibration to stop any kind of manipulation with the equipment. Wherever mutually agreed between manufacturer & purchaser, the manufacturer shall re-calibrate the measuring and test equipment in the presence of the Inspector.

p) The latest CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations shall also be complied with for ensuring the minimum technical requirements for construction of Generating Stations, Transmission & Distribution Lines and Substations.

ANNEXURE

MODEL QUALITY ASSURANCE PLAN OF MAJOR EQUIPMENTS IN POWER DISTRIBUTION SECTOR

Quality Assurance Plan

The Utility shall be solely responsible & accountable for assuring quality in the project works. Utility shall formulate a detailed comprehensive Quality Assurance (QA) plan for the works to be carried out under the project with an objective to create quality infrastructure works. The QA and Inspection Plan shall be integral part of the contract agreement with the contractor or equipment supplier and erection agency as the case may be in case of turnkey/partial turnkey/ or departmental execution of works. Utility has to ensure that the quality of materials/equipment supplied at site and execution of works carried out at field is in accordance to Quality Assurance Plan /Guaranteed Technical Particulars (GTP) and Technical specifications /Approved Drawings/Data Sheets etc.

The utility & Contractor shall strictly ensure Quality Assurance checks during the day to day course of project execution, including 100% pre-dispatch inspections of all materials as per Manufacturing Quality Plan/ Approved Drawings / Technical Specifications/ Datasheet/ GTP/applicable national & international standards etc.

The Utility should prepare a separate Field Quality Plan (FQP) for civil, electrical, mechanical, etc. works supported with drawings which shall be approved by their competent authority and may be uploaded at web portal. The contractor should adhere to this FQP while carrying out physical works. The Utility should also prepare a comprehensive FQP for testing & commissioning of Grid Substations, Distribution transformer Substation, 33 KV, 11 KV line, LT line etc. The system should be energized only after performing all tests as described in the FQP and after clearance from Electrical Inspector. Proper records in this regard, including tests on earth resistance, insulation resistance of 11 kV line & Distribution Transformer etc. shall be maintained, jointly signed by Utility and contractor.

All the quality assurance checks conducted in the field should be documented properly and signed by the quality engineer of the contractor & utility and shall be kept for future reference. These documents shall be maintained by the Utility in proper order and shall be made available at site for verification during inspection.

Vendor approval: It is a Good Practice that all the materials to be procured for project works shall be purchased from the authorized vendors approved by the Quality Assurance Department of Utility. Approved vendors list should be uploaded periodically on the utility web portal. New vendors/suppliers may be approved by the utility, provided capability of manufacturer's is assessed suitably by visiting the factory premises and checking the testing facility available before accepting it as approved vendor.

Material Inspection: The important materials should be inspected at manufacturer premises before dispatch. The Following materials may be inspected for pre-dispatch inspection at manufacture premises

1. Power Transformer,
2. Distribution Transformer
3. Ring Main Unit
4. CT/PT Unit (Outdoor) & Metering Cubicle (Indoor)
5. Circuit Breaker,
6. Insulators,
7. Cables
8. Conductor
9. Control & Relay Panel,
10. Overhead Conductor/ ABC
11. Energy Meter
12. Poles
13. Insulators

The utility may add the important material in the above list. At least one sample from each type of the above materials/ equipment should be inspected by the Utility representative. The inspection/testing/witnessing of acceptance tests shall be as per approved Drawings/Technical Specifications/Datasheet/GTP/QA Plan and applicable national & international standard.

Sampling from field: Any material, as deemed fit/as per utility practice may be picked from site/store for testing at test laboratory chosen by inspecting official.

Quality Assurance Programme ofthe Bidder/Contractor :

To ensure that the equipment and services under the scope of the tender whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Utility site or at any other place of work, are in accordance with the specifications / tender conditions, the Contractor shall adopt a suitable Quality Assurance Programme . Such programme shall be broadly outlined by the contractor and finalized after discussions with the utility before the award of the contract. The detailed programme shall be submitted by the contractor after the award of contract and acceptance by the Utility.

A Quality Assurance Programme ofthe contractor shall generally cover the following:

- Organization structure of the Contractor for management and implementation of the proposed quality assuranceprogram
- Documentation control system
- Qualification data for bidder's key personnel
- The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- System for shop manufacturing and site erection controls including process controls and fabrication andassembly control
- Control of non-conforming items and system for corrective actions
- Inspection and test procedure both for manufacture and field activities
- Control of calibration and testing of measuring instruments and field activities

- System for indication and appraisal of inspection status
- System for quality audits
- System for authorizing release of manufactured product
- System for maintenance of records
- System for handling storage and delivery
- A manufacturing quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.
- A Field quality Plan covering field activities

The manufacturing & Field quality Plans shall be mutually discussed and approved by the Utility after incorporating necessary corrections by the Contractor as may be required. The Utility or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

The Contractor would be required to submit all the Quality Assurance documents as stipulated in the Quality Plan at the time of Utility Inspection of equipment/material. The contractor shall supply the materials of type & design which has already been Type Tested. Contractor shall provide copy of such tests at the time of bidding and also at site in support of type-tested materials supplied under the contract.

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation describing the systems to the Utility for review and approval. The contractor shall obtain approval of Utility for the relevant document at each stage before proceeding for manufacturing, system development, factory testing, site testing, training etc. The schedule for submission/approval of each document shall be finalised during the discussions before placement of the contract, this schedule shall be in line to overall project schedule. The Contractor shall be responsible for any time delay, misinterpretation, error and

conflict during design, manufacturing, testing and erection of the Works resulting from non-compliance with the requirements of the approved Specification.

The Contractor shall submit to the Utility all documents in accordance with an approved schedule of submissions and shall submit any further information (in the form of drawings, documents, manuals, literature, reports etc.) when asked by the Utility while commenting /approving any drawings/documents etc.

PRE- DISPATH INSPECTION

Pre-dispatch inspection shall be performed on various materials at manufacturer's work place for which contractor shall be required to raise requisition giving at least sufficient time (say 10 days). Depending on requirement, inspection shall be witnessed by representatives of Utility . The contractor shall ensure that pre-dispatch inspection for materials are intimated only when the material is completely ready for inspection. On due date of inspection, if it is found that materials are not ready in required quantities or the inspection could not be carried out due to non-availability of requisite calibrated certificate of instruments with manufacturer, closing of works on scheduled date of inspection, non-availability of sufficient testing/material handling staff at manufacturer works etc, all expenditures incurred on deployment of various inspecting officials along with some specified fine may be imposed on the agency and re-inspection may be carried out on expense of contractor. 2nd such situation at same manufacturer/supplier may result in rejection of name of manufacturer from list of approved vendors/sub-vendors. In case sub-standard materials (old component, re-cycled materials, re-used core material, re-used transformer coil material etc) offered for inspection and are noticed during the inspection, materials shall be rejected and approval of sub-vendor may also be cancelled for all future projects.

PRE-COMMISSIONING TESTS

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Utility and the contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-

commissioning tests at Site. The list of pre-commissioning tests to be performed should be included in the Contractor's quality assurance programme.

COMMISSIONING TESTS

The contractor will use all required instrumentation and control equipment during commissioning tests and such measuring equipment and devices should be duly calibrated as far as practicable. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions. Any special equipment, tools and tackles required for the successful completion of the Commissioning tests shall be provided by the contractor, free of cost.

The specific tests to be conducted on equipment should be included in the technical specifications. However where the pre-commissioning tests have not been specified specifically they shall be as per relevant IS code of practice or as mutually agreed. The Contractor shall also be responsible for obtaining statutory clearances from the concerned authorities for commissioning and operation of the equipment including the Electrical Inspector. Necessary fee to perform these works may be paid by Utility or as mutually agreed.

QUALITY ASSURANCE PLAN FOR STAGE INSPECTION-I OF POWER TRANSFORMER (66 kV, 33 kV, 22kV)

S No.	Particulars	As offered	As observed	Deviation and Remarks
(A)	Inspection of Core : (I) Core Material 1) Manufacturer's characteristic certificate in respect of grade of lamination used. (Please furnish test certificate)			
	2) Thickness of core lamination			
	3) Remarks regarding Rusting and smoothness of core.			
	(II) Core Construction :			
	(1) Core Diameter (mm)			
	(2) Total cross sectional area of core			
	(3) Effective cross sectional area of core			
	(4) Whether top yoke is cut for LV connection.			
	(5) If yes, at 4 above, whether Reinforcement is done.			
	(6) Core length (leg center to leg center)			
	(7) Window height.			
	(8) Core height			
	(9) Core weight only			
(B)	INSPECTION OF WINDING			
	(I) Winding material			
	(1) Material used for			
	a) HV winding			
	b) LV winding			
	(2) Grade of material for			
	a) HV winding			
	b) LV winding			

	(3) Test certificate of manufacturer (enclosed copy) for winding material of:			
	a) HV			
	b) LV			
	(II) Construction Details 1) Size of Cross sectional area of conductor for :			
	a) HV winding			
	a) LV winding			
	2) Type of insulation for conductor of :			
	a) HV winding			
	b) LV winding			
	3) Diameter of coils in:			
	a) LV winding			
	a) Internal Diameter (mm)			
	ii) Outer diameter (mm)			
	b) HV winding			
	a) Internal diameter (mm)			
	ii) Outer diameter (mm)			
	4) Current density of winding material used for:			
	a) HV			
	b) LV			
	5) Total No. of turns			
	a) HV coils			
	b) LV coils			
	6) Total weight of coils of			
	a) LV winding (Kg)			
	b) HV winding (Kg)			
(C)	INSULATION MATERIALS			
	(I) DPC Paper Insulation			
	a) Type of Paper (Dotted Kraft or Diamond Dotted Kraft)			

	b) Make			
	c) Thickness (mm)			
	d) DPC laying direction			
	e) Percentage Overlapping			
	II) Interlayer Insulation			
	a) Type of Paper			
	b) Make			
	c) Thickness (mm)			
	III) Between HV and LV winding			
	a) Type of Paper			
	i. Make			
	ii. Thickness (mm) (all size)			
	b) Type of Pressboards			
	i. Make			
	ii. Thickness (mm) (all size)			
	IV) Between core and LV			
	Type of Paper			
	i. Make			
	ii. Thickness (mm) (all size)			
	Type of Pressboards			
	i. Make			
	ii. Thickness (mm) (all size)			
	V) Material used for top and bottom yoke and insulation			
	a) Type of Material			
	i. Make			
	ii.Thickness (mm) (all size)			
	VI) Material used for Spanner, wedge and Axial for insulation			
	a) Type of Material			

	i. Make			
	ii. Thickness (mm) (all size)			
	iii. Visual condition(i.e free from dust, burr, damage and sharp edges)			
	VII) Test certificate of manufacturer (enclose copy for all type of papers and pressboard used)			
(D)	TANK :			
	(I) Construction Details:			
	1) Shape			
	2) Thickness of side wall (mm)			
	3) Thickness of top and bottom plate (mm)			
	4) Provision of sloping top cover			
	5) Tank internal dimensions (mm)			
	a) Length X Width			
	b) Height			
	(II) General Details :			
	1) Inside painted by oil corrosion resistant paint (please specify which type of coating done)			
	2) Provision of lifting lugs.			
	a) Numbers			
	b) Reinforcement done by welding all side of Lug			
	3) Provision of air release plug			
	4) Provision of hot dip galvanized GI Nuts Bolts with 1no. plain and 1no. spring washer.			
	5) Deformation of side wall of tank when subject to:			
	a) Vacuum of (-) 0.7 Kg/sq.cm for 30 minutes.			
	b) Pressure of 0.8 Kg/sq.cm. for 30 minutes.			
(E)	TERMINALS:			
	1) Material whether of Brass Rods			
	a) HV			
	b) LV			
	2) Size (dia. In mm)			

	a) HV			
	b) LV			
(F)	BUSHINGS – Two part			
	1) Whether HV & LV bushings mounted as per drawing.			
	a) HV- Top Inclined			
	b) LV – Side			
	2) Bushing Clearance: (mm)			
	a) LV to Earth			
	b) HV to Earth			
	3) Bushing are two part and inner part shall be sealed and external part is replaceable without affecting sealing and need of opening of top cover.			
(G)	TANK BASE:			
	1) Whether tank base is welded folded upwards, as Specified in specification.			
(H)	OIL:			
	1) Name of supplier			
	2) Breakdown voltage of oil: (kV)			
	a) Filled in tanked transformer			
	b) In storage tank (to be tested by Inspecting officer).			
	3) Supplier's test certificate (enclose copy)			
(I)	ENGRAVING:			
	1) Engraving of Sl. No. and name of firm and YoM.			
	a) On bottom of clamping channel of core-coil assembly.			
	b) On Body of tank (on Yellow base with Black)			
(J)	NAME PLATE DETAILS:			
	Whether Name Plate is as per approved drawing			
(K)	COLOUR OF TRANSFORMER			
	1) Tank body (Inner side)			
	2) Tank body (Outer side)			

QUALITY ASSURANCE PLAN FOR STAGE INSPECTION- II OF POWER TRANSFORMER (66 kV, 33 kV, 22kV)

S. No.	Name of test	Specified value(Range)	Test Result	Pass/Fail
1	Visual inspection for material used, it's finish and workmanship	Free from cracks, nicks, protrusion and other visible defects.		
2	Physical Verification of complete CCA with all fittings including insulation used, packing used, Bus bars, Flats, Channels etc.	GTP Values		
3	Clearances and Dimension measurements.	GTP Values		
4	Physical Verification Leads positions	GTP Values		
5	Ratio Measurement at all Taps	GTP Values		
6	Magnetic Balance Test	GTP Values		
7	2KV/Isolation Test for one minute	Should Withstand		

QUALITY ASSURANCE PLAN FOR FINAL INSPECTION OF POWER TRANSFORMERS (66 kV, 33 kV, 22kV)

S. No.	Name of test	Specified value(Range)	Test Result	Pass/Fail
1	Visual inspection for material, finish and workmanship	Free from cracks, nicks, protrusion and other visible defects.		
2	Physical Verification of complete Transformer with all assembly including test rollers, radiators, cable boxes etc. and Checking of weights, Dimensions.	Approved GTP Values		
3	Measurement of Winding Resistance	Approved GTP Values		
4	Measurement of voltage ratio and phase displacement	Approved GTP Values		
5	Verification of vector group relationship	DYn11		
6	Measurement of short-circuit impedance and Load Loss.	Approved GTP Values		
7	Measurement of No-Load Loss and Current (Losses at 90, 100 and 110% of rated voltage).	Approved GTP Values		
8	Measurement of insulation resistance.	Approved GTP Values		
9	Dielectric Test	GTP Values		
10	Test on ON-Load Tap Changer	GTP Values		
11	Zero-Phase sequence Measurement	Approved GTP Values		
12	Oil Pressure/leakage test on completely assembled transformer at 0.35kg/sq.cm for 8 hrs.	Should withstand		
13	Bushing shall be tested for Capacitance and Power factor and shall meet the manufacture's requirement.	GTP		
14	All CTs and resistance of image coil for winding temperature indicator shall be	GTP		

	checked for ratio test, polarity and knee point voltage test			
15	Determination of Capacitances and dissipation factor winding-to-earth and between windings.	GTP		
16	Magnetic balance test	GTP		
17	Measurement of Magnetizing current at low voltage			
18	Voltage Regulation at rated load and at unit, 0.9, 0.8 lagging power factor	GTP		
19	Measurement of Acoustic Noise Level	GTP		
20	Measurement of the power taken by the fans	GTP		
21	Functional tests on auxiliary equipment: i. Test on OTI and WTI ii. High Voltage test on insulation test for Auxiliary Wiring.	GTP		
22	Test on Oil filled in Transformer i. Dielectric Strength of Oil ii. Water Content. iii. Dielectric Dissipation factor (tan delta at 90° C. iv. Resistivity	GTP		
23	Temperature rise test	GTP		
24	Short Circuit withstand test	Should withstand		
25	Lightning Impulse voltage test with chopped wave.	GTP		

QUALITY ASSURANCE PLAN FOR STAGE INSPECTION OF DISTRIBUTION TRANSFORMER

S No.	Particulars	As offered	As observed	Deviation and Remarks
(A)	**Inspection of Core :**			
	(I) Core Material			
	4) Manufacturer's characteristic certificate in respect of grade of lamination used. (Please furnish test certificate			
	5) Thickness of core lamination			
	6) Remarks regarding Rusting and smoothness of core.			
	7) Whether laminations used for top and bottom yoke are in one piece.			
	8) Core Losses			
	(II) Core Construction :			
	(1) No. of steps			
	(2) Dimension of steps			

As offered :

Step No.	1	2	3	4	5	6	7	8	9	10	11	12
W mm												
T mm												

As found :

Step No.	1	2	3	4	5	6	7	8	9	10	11	12
W mm												
T mm												

	(3) Core Diameter (mm)			
	(4) Total cross sectional area of core			
	(5) Effective cross sectional area of core			
	(6) Whether top yoke is cut for LV connection.			
	(7) If yes, at 6 above, whether Reinforcement is done.			
	(8) Core length (leg center to leg center)			
	(9) Window height.			
	(10) Core height			
	(11) Core weight only			
(B)	**INSPECTION OF WINDING**			
	(I) Winding material			
	(4) Material used for			
	c) HV winding			
	d) LV winding			
	(5) Grade of material for			
	c) HV winding			
	d) LV winding			
	(6) Test certificate of manufacturer (enclosed copy) for winding material of:			
	c) HV			
	d) LV			
	(II) Construction Details 7) Size of Cross sectional area of conductor for :			
	b) HV winding			
	c) LV winding			
	8) Type of insulation for conductor of :			
	c) HV winding			
	d) LV winding			
	9) Diameter of wire used for delta formation (mm)			
	10) Diameter of coils in:			

	c) LV winding			
	i) Internal Diameter (mm)			
	ii) Outer diameter (mm)			
	d) HV winding			
	j) Internal Diameter (mm)			
	ii) Outer diameter (mm)			
	11) Current density of winding material used for:			
	c) HV			
	d) LV			
	12) Whether neutral formation on top.			
	13) HV coils / Phase			
	c) Number			
	d) Turns/coil			
	e) Total turns			
	14) LV coils /Phase			
	a) Number			
	b) Turns / coil			
	c) Total turns			
	15) Total weight of coils of			
	c) LV winding (Kg)			
	d) HV winding (Kg)			
	10) Winding is free from metallic/non-metallic dust, burr and deformations under DPC paper.			
	d) HV Winding			
	e) LV Winding			
(C)	**INSULATION MATERIALS**			
	(II) DPC Paper Insulation			
	f) Type of Paper (Dotted Kraft or Diamond Dotted Kraft)			
	g) Make			

	h) Thickness (mm)			
	i) DPC laying direction			
	j) Percentage Overlapping			
	VIII) Interlayer Insulation			
	f) Type of Paper			
	g) Make			
	h) Thickness (mm)			
	IX) Between HV and LV winding			
	a) Type of Paper			
	iii. Make			
	iv. Thickness (mm) (all size)			
	b) Type of Pressboards			
	i. Make			
	ii. Thickness (mm) (all size)			
	X) Between core and LV			
	Type of Paper			
	iii. Make			
	iv. Thickness (mm) (all size)			
	Type of Pressboards			
	i. Make			
	ii. Thickness (mm) (all size)			
	XI) Material used for top and bottom yoke and insulation			
	a) Type of Material			
	i. Make			
	ii.Thickness (mm) (all size)			
	XII) Material used for Spanner, wedge and Axial for insulation			
	a) Type of Material			
	i. Make			

	ii. Thickness (mm) (all size)			
	iii. Visual condition(i.e free from dust, burr, damage and sharp edges)			
	XIII) Test certificate of manufacturer (enclose copy for all type of papers and pressboard used)			
(D)	**CLEARANCES: (mm)**			
	(I) Related to core and winding			
	1) LV to core (radial)			
	2) Between HV and LV (Radial)			
	3) (i) Phase to phase between HV conductor			
	(ii) Whether two nos. press board each of minimum 1mm thick provided to cover the tie rods.			
	4) Thickness of duct between HV and LV coil mm			
	(II) Between core – coil assembly and tank:			
	1) Between winding and body			
	a) Tank length wise			
	b) Tank breadth wise			
(E)	**TANK :**			
	(III) Construction Details:			
	6) Rectangular shape			
	7) Thickness of side wall (mm)			
	8) Thickness of top and bottom plate (mm)			
	9) Provision of sloping top cover towards HV bushing.			
	10) Tank internal dimensions (mm)			
	c) Length			
	d) Breadth			
	e) Height			
	f) On HV side			
	g) On LV side			
	(IV) General Details :			

	6) Inside painted by oil corrosion resistant paint (please specify which type of coating done)			
	7) Gasket between top cover and tank			
	a) Material			
	i) Thickness (mm)			
	ii) Jointing over laps (mm)			
	8) Provision of lifting lugs:			
	c) Numbers			
	d) Either reinforced by welded plates edge wise below the lug up to re-enforcing angle of the tank done.			
	9) Pulling lug of MS plate			
	a) Nos.			
	b) Thickness (mm)			
	c) Whether provided on breadth side or length side			
	10) Provision of air release plug			
	11) Provision of hot dip galvanized GI Nuts Bolts with 1no. plain and 1no. spring washer.			
	12) Deformation length wise side wall of tank when subject to			
	c) Vacuum test as per the relevant IS/ GTP.			
	d) Pressure test as per relevant IS/GTP.			
(F)	**RADIATORS:**			
	1) Fin radiators as per GTP/ relevant standard.			
	a) Dimension of each fin (L × B × T)			
	b) Fins per radiator			
	c) Total No. of radiators bank			
	2) Verification of manufacturer's test certificate regarding Heat dissipation (excluding Top and Bottom) in w/sq.m			
	3) Verification of position of radiator with respect to bushing.			
(G)	**CONSERVATOR**			
	1) Dimensions (L ×D) (in mm.)			
	2) Volume (m3)			
	3) Inside dia. of conservator tank pipe (mm)			

	4) Whether conservator outlet pipe is projected approx. 20 mm inside the conservator tank.			
	5) Whether arrangement made so that oil does not fall on active parts.			
	6) Whether die cast metal oil level gauge indicator having three positions at (-5^{0}C , 30^{0}C and 98^{0}C)			
	7) Whether drain plug & filling hole with cover provided			
	8) Inner side of the conservator Tank painted with -			
(H)	**BREATHER:**			
	1) Whether UV protected seamless acrylic body breather for silica gel provided.			
	2) Make			
	3) Capacity			
(I)	**TERMINALS:**			
	3) Material whether of Brass Rods/Tinned Copper.			
	c) HV			
	d) LV			
	4) Size (dia. In mm)			
	c) HV			
	d) LV			
	5) Whether SRBP tube / insulated paper used for formation of Delta on HV.			
(J)	**BUSHINGS**			
	4) Whether HV bushings mounted on top cover/ side walls.			
	c) HV			
	d) LV			
	5) Whether arrangement for studs for fitting of HV Bushing are in diamond shape (so that arcing horns are placed vertically).)			
	6) Position of mounting of LV bushings			
	7) Bushing Clearance: (mm)			
	c) LV to Earth			
	d) HV to Earth			
	e) Between LV bushings			

	f) Between HV bushings			
(K)	**TANK BASE CHANNEL/ ROLLERS:**			
	2) Size of channel (mm)			
	3) Whether channels welded across the length of the tank			
(L)	**OIL:**			
	4) Type of oil and Name of supplier			
	5) Breakdown voltage of oil: (kV)			
	b) Filled in tanked transformer			
	b) In storage tank (to be tested by Inspecting officer).			
	6) Supplier's test certificate (enclose copy)			
(M)	**ENGRAVING:**			
	2) Engraving of Sl. No. and name of firm.			
	a) On bottom of clamping channel of core-coil assembly.			
	b) On Top cover of tank			
(N)	**NAME PLATE DETAILS:** Whether Name Plate is as per approved drawing			
(O)	**COLOUR OF TRANSFORMER**			
	3) Tank body with			
	4) Conservator with			

Note: Type Test, Routine Test, Any special test shall be conducted as per the relevant IS i.e. IS 1180

ACCEPTANCE TESTS TO BE CARRIED OUT

S No.	PARTICULARS	Specified Value	Reference documents	Test Results	Pass/Fail
1.	Visual and Physical verification	GTP/Drawing	GTP/Drawing		
2.	Ratio Test		IS 2026 (Part 1) cl. 16.3		
3	Vector Group & Polarity check		IS 2026 (Part 1) cl.16.3		
4.	No load loss measurement	GTP value	IS 2026 (Part 1) cl.16.5		
5.	Max. Load loss measurement (watt) at 50% loading at 75°C	GTP value	IS 2026 (Part 1) cl.16.4		
	Max. Load loss measurement (watt) at 100% loading at 75°C Note – Calculation sheet to be attached along with	GTP value			
6.	Winding Resistance :	GTP Value	IS 2026 (Part 1) 16.2.1 & 16.2.3		
	H.V. (in Ohms) Resistance at 75 deg.C (Calculated)				
	L.V. (in Ohms) Resistance at 75 deg.C (Calculated)				
7.	Insulation resistance (M ohm) HV-LV HV-E LV-E		IS 2026 (Part 1) cl.16.6		
8.	a) Separate source Voltage withstand test voltage:		IS 2026 (Part 3) cl.10		
	HV	28 kV for 60 secs.			
	LV	3 kV for 60 secs.			

9.	Induced over-voltage withstand test at double voltage and double frequency	100 Hz, 866 volts for 60 seconds.	IS 2026 (Part 3) cl.11		
10.	No load current at	GTP values	IS 2026 (Part 1) cl.16.5		
	90% volts				
	100% volts				
	112.5% volts				
11.	Neutral current measurement (A)	within 2% of the Full load current			
12.	Percentage Impedance at 75 deg.C (Please furnish calculation sheet)	GTP/TPDDL Specification	IS 2026 (Part 1) cl.16.4		
13.	Transformer oil test (Break down voltage)	>60KV per 2.5mm for one minute			
14.	Oil leakage test (0.35Kg/sq.cm)	Should Withstand for one hour	IS 1180 (Part 1) clause 21.5.1.3		
15.	Pressure test		IS 1180 (Part 1) cl. 21.5.1.2		
16.	Temperature Rise test (Over ambient temperature)	top oil – 35^0 top oil – 40^0	IS 2026 (Part 2) Clause no.4		
17.	Verification of Bushing clearance HV/LV (mm) a) Phase to Phase b) Phase to Earth	GTP			
18.	Paint Thickness test /Cross Adhesion Test	GTP/Utility Specification	IS1180 part 1 clause no. 21.4.d		
19.	Engraving on Name plate, Guarantee plate and Tank body	GTP	GTP		
20.	Copy of calibration certificates of testing equipment be enclosed.	100% testing equipment			
21.	Verification of tightening torque w.r.t torque chart.	GTP	Approved torque chart		
22.	Raw Material sourcing and consumption documents verification in		As per acceptance		

	offered lot		clause in the specification		
23	CT- OEM Test reports if applicable	RTC			
24	Breather test reports for air pressure (Type test of OEM from NABL lab)				
25	Breather mounting fixing on conservator with Teflon tape				
26	CT mounting without touching bus bar				
27	Operation of Auxiliary contacts NONC operation test of various accessories like PRV, OTI, float switch etc. as applicable.				
28	Checking of CT terminal Ferruling S1 & S2 for all phases, in Auxiliary box.	As per Approved Drawing	As per Approved Drawing		

QUALITY ASSURANCE PLAN FOR 11 kV ABC CABLE

A	**Material/Part**	**Name of test**	**Acceptance Criteria**
1	Conductor	Material-Raw Material Certificates to be checked by Inspecting Officer	Plain Aluminium, grade H2/H4, Stranded Compacted Circular, Conductor raw material shall be procured from reputed suppliers.
2	Conductor Screen		1st layer: Semi-conducting tape 2nd layer: Semi-conducting compound Semiconducting compound shall be procured from reputed raw material suppliers.
3	Insulation		XLPE insulation shall be applied through CCV/VCV line by triple extrusion process with 'Dry Curing' and 'Water Cooling'. a) XLPE compound shall be super cleaned and procured from reputed raw material suppliers. b) Both XLPE and semi conductive compounds shall be used from same raw material supplier.
4	Insulation Screen		a) 1st layer : Semi-conducting compound b) 2nd layer: Semi-conducting water swellable tape Semiconducting compound shall be procured from reputed raw material suppliers. c) 3rd layer: Annealed copper tape
5	Armour- (a) Three Core Cable		Low carbon annealed hot dipped galvanized round steel wires. Armour shall be procured from reputed raw material suppliers.
6	Armour- (b) Single Core Cable		1 CORE CABLE-H4 Grade Aluminium wires. Armour shall be procured from reputed raw material suppliers.
7	Outer Sheath-(a) PVC Outer Sheath for normal cable		Polyvinyl chloride (PVC) ST-2 FRLSH type compound with 'lead napthenate' additive as 'termite & rodent repellent' applied by extrusion process. PVC compound shall be procured from reputed raw material suppliers.

8	Outer Sheath-(b) HDPE Outer Sheath for 3 core co-extruded cable (Inner layer)		HDPE ST-7 shall be procured from reputed raw material suppliers.
9	Outer Sheath-(b)HDPE Outer Sheath for 3 core co-extruded cable (Outer layer)		HDPE ST-7 shall be procured from reputed raw material suppliers.
10	Sealing end cap		Adhesive coated polyolefin heat shrinkable end cap shall be provided at both ends of the cable.
11	Cable Drum		Steel drums shall be provided. Drum shall be free from sharp edges and visual defect. Stencil plate on one flange side of the drum and laminated paper sheet on other side flange of drum.
Acceptance Tests			
1	**Conductor**	Conductor resistance test	Max. DC resistance @ 20 deg C (Ohm/km) for 150 sq mm-0.206 Ω/km 300 sq mm-0.10 Ω/km 400 sq kn-0.0778 Ω/km 630 sq mm-0.0469 Ω/km 1000 sq mm-0.0291 Ω/km
		Test for non-conductivity of water swellable tape/yarn of conductor	a) Non-conductive water swellable yarn/tape/ combination of both shall be provided in between interstices of the conductor. b) Also, this water swellable tape and yarn shall be compatible to withstand conductor continuous temperature of 90 deg C and short circuit temperature of 250 deg C without any decay. c) It shall not affect the electrical conductivity of the conductor.
		Visual inspection for	a) Before stranding, the cross-section of the Aluminium conductor shall be circular, and shall have uniform smooth

		conductor cleanliness	surface, free from sharp edges and free from any defects. b) Stranded Conductor shall be free from oil traces & aluminum dust. Conductor (after stranding) shall be super cleaned. c) Traces of aluminum dust on conductor or conductor screen shall not be acceptable.
		Conductor water penetration test	Using test equipment
2	Conductor Screen	Thickness of semi-conducting tape over conductor	1st layer: Semi-conducting tape shall be applied over conductor with nominal thickness of 0.2 mm. 2nd layer: Semi-conducting conductor screen shall be applied through triple extrusion process
		Test for conductivity of semi-conducting tape over conductor	Continuity check using Multimeter
		Resistivity of extruded semi-conducting conductor screen	Resistivity of semiconducting conductor screen shall not exceed 1000 Ω-m
		Thickness of extruded semi-conducting conductor screen	Minimum thickness of conductor screen shall be 0.5 mm at any point of measurement
3	Insulation	Tensile strength & Elongation at break (before ageing)	As per IS 7098 (Part2)-Table1 (12.5 N/mm², Min.)
		Insulation thickness	a) Minimum thickness of insulation shall be 3.14 mm at any point of measurement.

			b) Nominal thickness shall be 3.6 mm.
		Eccentricity and Ovality of insulation	Eccentricity of insulation shall not exceed 10%.
		Hot set test	The insulation properties shall be stable under thermal conditions arising out of continuous operation at conductor temperature of 90 deg. C rising momentarily to 250 deg. C under short circuit conditions.
		Volume resistivity	IS 7098 Part 2 (Annexure E)
		Void & contamination test on core (by silicon dip method)	Interfacial region between insulation and insulation screen shall be uniform. Protrusion/convolution/ other defects are not acceptable. Core shall be free from void and contamination.
		Surface smoothness of insulation	
4	Insulation Screen	Resistivity of insulation screen	Resistivity shall not exceed 500 Ω-meter.
		Thickness of insulation screen	0.3 mm (min.)
		Visual inspection for any convolution/ protrusion between conductor screen and XLPE insulation, XLPE insulation and insulation	Surface of insulation screen shall be smooth, free from cavity/ nicks/scratches/ other visible defects

		screen	
		Thickness & % Overlapping of semi-conducting water swellable tape	Min. thickness shall be 0.3 mm at any point of measurement. overlapping: 15% (min.)
		Thickness & % Overlapping of copper tape	Annealed copper tape, helically wound over the water swellable tape with minimum 15% overlap. Minimum thickness shall be 0.045 mm at any point of measurement.
5	Inner sheath	PVC thickness	3CX150 sq.mm. 0.6 mm 3CX300 sq.mm. 0.7 mm 3CX400 sq.mm. 0.7 mm 1CX630 sq.mm. 0.5 mm 1CX1000 sq.mm. 0.6 mm
		Colour of inner sheath	Black
6	Fillers	For 3 Core Cable	Virgin Polypropylene fibers of natural colour, shall be tightly filled in empty space as fillers.
7	Armour- (a) Three Core Cable	Tensile test	As per Clause 8 of IS 3975-Table5 (300-500 Mpa)
		Mass of zinc coating	Zinc coating shall be 290 g/m2 as per IS 4826:1979
		Uniformity of zinc coating	Hot dipped galvanizing layer shall be uniform on low carbon annealed steel wires.
		Adhesion test	As per Clause 9 of IS 3975 (The zonc coating shall not crack or flake off to such an extent that the same may be removed by rubbing with bare fingers)
		Diameter and no. of wires	3CX150 sq.mm. 2.5 mm (GI wire) 3CX300 sq.mm. 3.15 mm (GI Wire) 3CX400 sq.mm. 4.00 mm (GI wire)

		Coverage %	The armor wires shall be applied as closely as practicable. Shall not be less than 90% of total circumference.
8	Armour- (b) Single Core Cable	Tensile test	As per Clause 3.1 of IS 8130 (Above 150 N/mm^2
		Wrapping test	As per Clause 6.2.2 of IS 8130 (Wire should not break)
		Resistance test	The DC resistance shall be measured at room temperature and corrected at 20°C by means of appropriate factors given in Table 6 of IS 8130 (1984). The corrected DC shall not exceed the values given in the appropriate tables.
		Diameter and no. of wires	As per the utility specifications /GTP
		Coverage %	The armor wires shall be applied as closely as practicable. Shall not be less than 90% of total circumference.
9	Outer Sheath-(a) PVC Outer Sheath for normal cable	Thickness	As per the utility specifications /GTP
		Tensile strength and Elongation at break (before ageing)	Table 2 of IS 5831 [Tensile Strengh (min.)-125 $N/mm^{2,}$ Elongation at Break (min.)-150%]
		Colour of outer sheath	Crimson Red, colour code: 540 as per IS 5:2007.
		Surface uniformity of outer sheath (on full drum)/ shall be free from any damage- void, nick, cavity.	Surface of outer sheath shall be free from cavity/ nicks/ other visible defects.
		Presence of lead napthenate in PVC outer sheath (on full drum)/ shall be	Polyvinyl chloride (PVC) ST-2 FRLSH type compound with 'lead napthenate' additive

		free from any damage- void, nick, cavity.	
		Flammability test	IS 7098 Part 1-Period of burning after removal of the flame shall not exceed 60 seconds and the unaffected (uncharred) portion from th elower edge of the top clampshall be at least 50 mm)
		Oxygen index	IS 7098 Part 2 Clause 20.10 (The test on samples of outer sheath shall be done at 27 ± 2°C or ambient. The oxygen index shall not be less than 29)
		Temperature index	IS 7098 Part 2, Clause 20.15 (The extrapolated values of temperature at which oxygen index is 21 shall be minimum 250°C.)
		Acid gas generation	IS 7098 Part 2. Clause 20.13 (The level of HCl evolved shall not exceed 20 percent by weight)
		Smoke density	IS 7098 Part 2, Clause 20.14 (Smoke density rating shall be 60 maximum.)
10	Outer Sheath-(b) HDPE Outer Sheath for 3 core co-extruded cable (Inner layer)	Thickness	HDPE ST-7, Minimum thickness at any point of measurement – 3 mm
		Tensile strength and Elongation at break (before ageing)	Table 3 of IS 7098 part 2 (Tensile Strength-12.5 N/mm^2 min.; Elongation at Break-300% min.)
		Colour	Crimson red of colour code 540
11	Outer Sheath-(b)HDPE Outer Sheath for 3 core co-extruded cable (Outer layer)	Thickness	Nominal Thickness at any point of measurement – 2 mm.
		Tensile strength and Elongation at break (before ageing	Table 2 of IS 7098 part 2 (a) Tensile strength (N/mm^2) b) Elongation at break 12.5 N/mm^2, Min 300 percent, Min)
		Carbon content	Carbon content shall be as per IS 7098

		Colour	Black
		Surface uniformity of outer sheath (on full drum)/ shall be free from any damage- void, nick, cavity	Surface of outer sheath shall be free from cavity/ nicks/ other visible defects-Through rewinding of drum (As per TATA POWER-DDL specification)
12	Complete Cable	Partial Discharge test	5pC min.
		High voltage test	21 kV for 5 minutes.
13	Additional Tests	Raw material consumption	Document verification as proof to be submitted, Invoice to be shown from procurement to consumption
		Colour coding identification over copper screen (for 3C cable)	Each of the three core identification strips shall be applied longitudinally beneath copper screen. Width of the coloured strip shall be 7-10 mm.
		Sequential marking check	At interval of every 1 meter, following details to be embossed: a) Sequential meter marking (shall be marked through printing) b) Property of Utility c) Manufacturer name d) Month & Year of Manufacture e) Voltage grade f) Size of the cable g) Purchase Order no. h) Cable code
		Cable drum length verification	Cable length on one drum shall be 250 meters max. +/- 5%.
		Packaging of cable on cable drum	By recyclable PVC sheet

		Diameter over outermost sheath of co-extruded cable	As per approved GTP
		Weight of outer sheath of co-extruded cable/ km	As per approved GTP
		Weight of total HDPE of co-extruded cable/ km	As per approved GTP
14		Marking (Drum)	i. Following details shall be provided on flanges of drum: a) Manufacturer's name b) Type of Cable c) Size of Cable d) Voltage Grade e) Length of the cable on the drum f) Direction of the rotation of the drum g) Gross mass h) Country of manufacture i) Year and month of manufacture j) Purchase Order no. k) Drum No.

QUALITY ASSURANCE PLAN FOR LT ABC CABLE

Name of test	Referred documents	Test (Pass or Fail)
Tensile test (for phase/street light conductor)	As per IS10810.	
Wrapping test (for phase/street light conductor)	As per IS10810	
Breaking load test for messenger conductor	As per IS10810	
Elongation test for messenger conductor	As per IS10810	
Conductor resistance test	As per IS10810	
Test for thickness of insulation	As per IS10810	
Tensile strength and elongation at break test	As per IS10810	
Hot set test for XLPE insulation	As per IS10810	
Insulation resistance test	As per IS10810	
High voltage test	As per IS10810	
Carbon black content	As per IS10810	
Any other	As per the utility	

QUALITY ASSURANCE PLAN FOR 11kV XLPE CABLE

A RAW MATERIAL		CHARACTERISTICS	REFERENCE
1	Aluminium/Copper Rod	a) Tensile strength	As per the utility specifications / GTP
		b) Resistivity	As per the utility specifications / GTP
		c) Diameter	As per the utility specifications / GTP
		d) Chemical composition	As per the utility specifications / GTP
		e) Surface finish	As per the utility specifications / GTP
2	PVC Compound	a) Tensile Strength	As per the utility specifications / GTP
		b) Elongation at break	As per the utility specifications / GTP
		c) Thermal stability	As per the utility specifications / GTP
3	**TR-XLPE** Compound (Borealis/Dow chemical/ Hanwa)	a) Packing	As per the utility specifications / GTP
		b) Tensile Strength	As per the utility specifications / GTP
		c) Elongation at break	As per the utility specifications / GTP
		d) Hot set test	As per the utility specifications / GTP
		e) Volume Resistivity	As per the utility specifications / GTP
		f) Cure Curve (Max. Torque)	As per the utility specifications / GTP
		g) Density	As per the utility specifications / GTP
4	Semi-conducting Compound (Borealis/Dow chemical/ Hanwa)	a) Packing	As per the utility specifications / GTP
		b) Volume Resistivity	As per the utility specifications / GTP
		c) Tensile Strength	As per the utility specifications / GTP
		d) Elongation at break	As per the utility specifications / GTP
		e) Cure Curve (Max. Torque)	As per the utility specifications / GTP
		f) Density	As per the utility specifications / GTP
5	Copper tape	a) Thickness & width	As per the utility specifications / GTP
		b) Tensile Strength	As per the utility specifications / GTP
		c) Elongation at break	As per the utility specifications / GTP
		d) Resistivity	As per the utility specifications / GTP
6.	Armour wires/strips (Galvanised steel)	a) Dimensions	As per the utility specifications / GTP
		b) Surface condition/finish	As per the utility specifications / GTP

		c) Tensile Strength	As per the utility specifications / GTP
		d) Elongation at break	As per the utility specifications / GTP
		e) Torsion test for round wire	As per the utility specifications / GTP
		f) Wrapping test	As per the utility specifications / GTP
		g) Mass of zinc coating	As per the utility specifications / GTP
		h) Uniformity of zinc coating	As per the utility specifications / GTP
		i) Adhesion test	As per the utility specifications / GTP
		j) Resistivity test	As per the utility specifications / GTP
7	Water Swellable tape	a) Dimensions	As per the utility specifications / GTP
		b) Swelling height	As per the utility specifications / GTP
		c) Resistivity	As per the utility specifications / GTP
		d) Weight	As per the utility specifications / GTP
8	Steel Drum	a) Dimension	As per the utility specifications / GTP
		b) Finish & workman ship	As per the utility specifications / GTP
9	Cable Pulling eye	a) Dimensions & Material	As per the utility specifications / GTP
		b) Finish & workman ship	As per the utility specifications / GTP
		c) Tension test on pulling eye	As per the utility specifications / GTP
10	Binder tape	a) Dimensions & material	As per the utility specifications / GTP
11	Polypropylene filler	a) Size	As per the utility specifications / GTP
12	Heat shrinkable end cap	a) Bore diameter	As per the utility specifications / GTP
		b) Length of end cap	As per the utility specifications / GTP
B. PROCESS INSPECTION			
1	Wire Drawing	a) Diameter	As designed
		b) Surface finish	Smooth and Free from defects
		c) Tensile test (for Al)	IS: 8130/84
		d) Elongation test (for Cu)	IS: 8130/84
		e) Wrapping test (for Al)	IS: 8130/84

2	Stranding	a) No. of wires/strands	As designed
		b) Lay length & Lay direction	As designed
		c) Dia of conductor	As designed
		d) Surface finish	Smooth and Free from defects
3	Core extrusion (Conductor screen, Insulation & insulation screen)	a) Compound Make/Grade	
		b) Thickness of insulation & extruded S.C. layers	As per design
		c) Surface finish	Smooth and Free from defects
		d) Printing on outer semi- conducting layer	Do not heat, freely strippable
		e) Tensile Strength	IS 7098/II/2011
		f) Elongation at break	IS 7098/II/2011
		g) Hot set test	IS 7098/II/2011
		g1) Ovality of core	Tech. Data Sheet
		h) Eccentricity of insulation	Tech. Data Sheet
		i) Core diameter	Tech. Data Sheet
		j) Void & contamination test for insulation (Silicon Oil test)	Tech. Data Sheet
		k) Wafer boil test for extruded semi-conducting layers	As per BIS
4	Taping - water Swellable semi-conducting	a) Dimensions	Tech. Data Sheet
		b) Tape Application (Overlap)	Tech. Data Sheet
5	Taping - Copper tape	a) Width & Thickness of tape	Tech. Data Sheet
		b) Number of tapes	Tech. Data Sheet
		c) Tape application (Overlap)	Tech. Data Sheet
6	Laying up	a) Identification of cores	Tech. Data Sheet
		b) Direction of lay, core Sequence & Lay length	IS 7098/II/2011
		c) Application of binder tape	Tech. Data Sheet
		d) Shape of laid up assembly	Reasonably Circular
7	Inner sheath	a) Material & type	Tech. Data Sheet

		b) Thickness	Tech. Data Sheet
		c) Surface finish	Smooth and free from defects
		d) Colour of inner sheath	Tech. Data Sheet
8	Armouring	a) Dimension of armour wires/strips	Tech. Data Sheet
		b) No. of armour strip/wire	Tech. Data Sheet
		c) Armour coverage	IS 7098/II/2011
		d) Direction of lay	IS 7098/II/2011
		e) Lay length/Gear setting	
		f) Surface finish	Smooth and free from defects
9	Outer sheath/Rewinding	a) Material & type	Tech. Data Sheet
		b) Anti rodent & termite additives	Tech. Data Sheet
		b) Thickness	As per the utility specifications / GTP
		c) Overall diameter	As per the utility specifications / GTP
		d) Surface finish & colour of sheath	Smooth and free from defects
		e) Cable length verification	Tech. Data Sheet
		f) Marking	Tech. Data Sheet
C FINAL INSPECTION			
1	Routine tests	a) High Voltage	IS 7098/II/2011
		b) Conductor Resistance	IS 8130/84
		c) Partial Discharge	IS 7098/II/2011
		d) Impulse	
		e) Armour Coverage	
		f) Physical Dimensions	
		g) Freely Strippable insulation screen (Strippability Test)	Factory Standard
2	Stage Inspection	Wire Drawing	Tech. Data Sheet
		Extrusion process	Tech. Data Sheet
		Raw maerial inspection at factory	Tech. Data Sheet
		Wrapping of Aluminium	Tech. Data Sheet
		Tensile test for Aluminium	Tech. Data Sheet

3	Acceptance tests	a) Annealing test for copper	IS 8130/84
		b) Tensile test for aluminium	IS 8130/84
		c) Wrapping test for aluminium	IS 8130/84
		d) Conductor resistance test	IS 8130/84
		e) Test for thickness of insulation & sheath	IS 7098/II/2011 & Tech. Data sheet
		f) Hot set test for insulation	IS 7098/II/2011
		g) Tensile strength & Elongation at break of insulation & outer sheath	IS 7098/II/2011 & IS 5831/84
		h) Partial discharge test	IS 7098/II/2011
		i) High voltage test	IS 7098/II/2011
		j) Insulation resistance (Volume resistivity) test	IS 7098/II/2011
		k) Tests for dimension of armour wires/strips	IS 3975, IS 10810 Pt. 36 & Tech. Data sheet
		l) Test for anti termite & anti rodent property of outer sheath	Tech. Data Sheet
		m) Rewinding of cable on drum	To check cable appearance, drum appearance, cable winding, packing, embossing/printing/sequential marking
		n) Void & contamination test for insulation (Silicon Oil test)	Tech. Data Sheet
		o) Wafer boil test for extruded semi-conducting layers	Tech. Data Sheet
		p) Freely Strippable insulation screen	Factory Standard
		q) Water Penetration test (WPT) on core (i.e.Logitudinal Water Blocking Test)	Tech. Data Sheet
		r) Armour coverage	Tech. Data Sheet
		s) Ovality	Tech. Data Sheet
		t) Eccentricity	Tech. Data Sheet

		u) Mass & uniformity & zinc coating on armour	Tech. Data Sheet
		v) Resistivity of Strip armour	Tech. Data Sheet
		w) Swelling height of water swellable tape	Tech. Data Sheet
		x) Cable pulling eye strength test on one sample	Tech. Data Sheet
		y) Flammability test	As per IS- 78098/II/2011
		z)Impulse withstand test	IS 7098/II/2011
		z1) Ageing & Water absorption test(Gravimetric) on Insulation & Outer sheath	IS 5831/84
		z2) Heating Cycle with Potential	Tech. Data Sheet
		z3) Raw Material Verification in all aspects	Tech. Data Sheet
4	Type tests at vendor's works	a) Tests on conductor	Tech. Data Sheet
		i) Annealing test for copper	IS 8130/84
		ii) Tensile test for aluminium	IS 8130/84
		iii) Wrapping test for aluminium	IS 8130/84
		iv) Conductor resistance test	IS 8130/84
		b) Tests for armouring wires/strips	Tech. Data Sheet
		i) Dimensions of wire/strip	IS 3975, IS 10810 Pt. 36 and Tech. Data Sheet
		ii) Tensile strength & Elongation at break	IS 3975
		iii) Torsion test for wire	IS 3975
		iv) Winding test for strip	IS 3975
		v) Uniformity of zinc coating	IS 3975
		vi) Mass of zinc coating	IS 3975
		vii) Resistivity of wire/strip	IS 3975
		c) Test for thickness of insulation & sheath	IS 7098/II/2011 & Tech. Data sheet
		d) Physical tests for insulation	
		i) Tensile strength & Elongation test	IS 7098/II/2011

		ii) Ageing in air oven	IS 7098/II/2011
		iii) Hot set test	IS 7098/II/2011
		iv) Shrinkage test	IS 7098/II/2011
		v) Water absorption (gravimetric)	IS 7098/II/2011
		e) Physical tests for outer sheath	
		i) Tensile strength & Elongation test at break	IS 5831/84
		ii) Ageing in air oven	IS 5831/84
		iii) Shrinkage test	IS 5831/84
		iv) Hot deformation test	IS 5831/84
		v) Loss of mass in air oven	IS 5831/84
		v) Heat shock test	IS 5831/84
		vi) Thermal stability test	IS 5831/84
		f) Electrical tests in sequence	
		i) Partial discharge test	IS 7098/II/2011
		ii) Bending test	IS 7098/II/2011
		iii) Partial discharge test	IS 7098/II/2011
		iv) Dielectric power factor as a function of voltage	IS 7098/II/2011
		v) Dielectric power factor as a function of temperature	IS 7098/II/2011
		vi) Heating cycle test	IS 7098/II/2011
		vii) Dielectric power factor as a function of voltage	IS 7098/II/2011
		viii) Partial discharge test	IS 7098/II/2011
		ix) Impulse withstand test	IS 7098/II/2011
		x) High voltage test	IS 7098/II/2011
		g) Insulation resistance (Volume resistivity test)	IS 7098/II/2011
		h) Flammability test	IS 7098/II/2011
D PACKING & MARKING			
1	Packing & Marking	a) Cable end sealing	IS 7098/II/2011/ and as per agreement
		b) Pulling eye at leading end	As per agreement
		b) Stencilling/Marking on drum	IS 7098(Part 2):2011/ and as per agreement

QUALITY ASSURANCE PLAN FOR 11 KV RING MAIN UNITS (3WAY, 4WAY & 5WAY) WITH ALL ACCESSORIES (BREAKER, CONTROL CUBICLE, WIRING, MOTOR, SPRING, INSULATORS, EARTHING PROVISION ETC.)

ROUTINE TEST /ACCEPTANCE TEST

Sl. No.	Test	Reference
1	Dimensional & Visual Checks	GTP/ Utility Specifications
2	PF withstand voltage test on LBS and CB combined with switches closed position	GTP/ Utility Specifications
3	HV withstand test across isolator distance with opened contact of VCB	GTP/ Utility Specifications
4	Voltage Indication Tests	GTP/ Utility Specifications
5	Measurement of contact resistance on LBS & CB combined with closed switch condition	GTP/ Utility Specifications
6	Operational & Interlock Tests	GTP/ Utility Specifications
7	Leak Detection Test at bushing terminals after RMU assembly	GTP/ Utility Specifications
8	HV withstand test	GTP/ Utility Specifications
9	Insulation resistance test	GTP/ Utility Specifications
10	Routine Tests as per IS / IEC	GTP/ Utility Specifications
11	Compatibility & data integration check after operations, alarms and reset check	GTP/ Utility Specifications
12	Relay testing should be done with primary injection kit on installed relay	GTP/ Utility Specifications

RAW MATERIAL SCRUTINY BASED ON TEST CERTIFICATES /VISUAL INSPECTION

Sl. No.	Component	Attribute	Applicable Procedure
1	Main Tank	Visual & dimensional /Material Grade/Surface cleaning & galvanization/welding	As per Utility specifications
2	SF6 Tank	Visual & dimensional /Material Grade/Surface cleaning & galvanization/welding	As per Utility specifications
3	Support Structure & Front Cover	Visual & dimensional /Material Grade/Surface cleaning & galvanization/mimic diagram	As per Utility specifications
4	Load Break Switch	Rating/type/appearance/finish/Routine Test Confirmation/Functional check/compatibility for Remote or SCADA operation	As per Utility specifications
5	Circuit Breaker Assembly	Material grade/Physical check/functionality of coils, motor, auxiliary switch, wiring, gear box, spring charging	As per Utility specifications
6	Vacuum Interrupter	Visual & Dimensional check/Material grade/Silver Plating thickness	As per Utility specifications
7	Current Transformers for CB Compartment	Material grade/Physical check/Routine Test Confirmation	As per Utility specifications
8	Relay	Material grade/Functional check/Routine Test Confirmation	As per Utility specifications
9	Bushings & Cable Termination	Visual & Dimensional check/Material grade/locking provision in cable compartment	As per Utility specifications
10	Earthing	Visual Inspection/Earth busbar material grade/dimension/connection	As per Utility specifications
11	Fault Passage Indicator	Visual,Dimensional & Functional check/provision of SCADA output contact	As per Utility specifications
12	Voltage indicator lamps and Phase Comparators	Visual,Dimensional & Functional check/Material Grade	As per Utility specifications
13	Remote Control of the RMU & other requirements	Visual,Dimensional & Functional check/Material Grade (for Motorized, Non-motorized & Smart RMU	As per Utility specifications

14	Cable Boot for Cable Termination	Visual inspection	As per Utility specifications
15	Paint	Visual Inspection/Paint shade	As per Utility specifications
16	Control wiring	Material grade/functionality check	As per Utility specifications
17	Complete switchgear	Material grade/Physical check	As per Utility specifications

QUALITY ASSURANCE PLAN FOR SMART METERS

Item Requirement	Characteristics	Acceptance Criteria
Meter Body	Physical Appearance	Smooth, Clean , free from Grease
	Grade of Material	Fire retardant, Self Extinguishing, UV stabilized , recyclable and anti oxidation properties
	Flammability requirement	As per utility
	Materials	
	a) Base:	As per the utility.
	b) Cover:	As per the utility.
	Thickness, Min.	As per the utility.
Terminals and Terminal Block	Physical Appearance	Smooth, Clean , free from Grease
	Grade of Material	Fire retardant, Self Extinguishing, UV stabilized , recyclable and anti oxidation properties
	a) Terminal Block material	As per the utility.
	Depth of Terminal Hole	As per the utility.
	Internal Diameter of Terminal Hole	As per the utility.
	Clearance between adjacent terminals	As per IS 16444
	Arrangement	Single row with 11 pin configuration
	a) Terminal Cover:	As per GTP
	Material withstand temperature for terminal block	As per the utility / GTP.
	Material pressure withstand for terminal block	As per the utility / GTP.
PCB	Glass epoxy, fire resistance grade.	As per relevant standards/ Technical specification
Battery		As per relevant standards/ Technical specification

Temperature Sensor	Temperature Sensor shall be internal to the meter and its accuracy shall be as per relevant IEC/IS standards. The OEM Test Report to be furnished.	As per relevent standards/ Technical specification
Microcontroller and RTC having separate battery	Accuracy shall be as per relevant IEC/IS standards, RTC shall be provided with separate battery in its ckt. The microcontroller should be of superior quality from reputed make with long life.	As per relevant standards/ Technical specification
Optical port	Optical port should be used to transfer the meter data to meter reading instrument. The mechanical construction of the port should be such to facilitate the data transfer easily. It should be magnetic locking type.	As per relevant standards/ Technical specification
Memory chip	Chip should not be affected by the external parameters like sparking, high voltage spikes or electrostatic discharges.	As per relevant standards/ Technical specification
Display modules	The display modules should be well protected from the external UV radiations. The display visibility should be sufficient to read the meter. The construction of module should be such that the displayed quality should not be disturbed with the life of display. It should be Trans-reflective with wide viewing angle, industrial grade with extended temperature range.	As per relevant standards/ Technical specification

Electronic components	The active and passive components should be of the surface mount type and are to handled and soldered by the state of art assembly processes.	As per relevant standards/ Technical specification
Measurement/ computing chips	The measurement/ computing chips used in the meter should be with the surface mount type.	As per relevant standards/ Technical specification
Communication Module		As per relevant standards/ Technical specification

Note: Type Test, Routine Test, & Acceptance Test shall be conducted as per the relevant IS

EXHIBIT I

CEA OM DATED 01/11/2021 REGARDING CONSTITUTION OF COMMITTEE FOR STANDARDIZATION OF TEST PROTOCOLS FOR ELECTRO-MECHANICAL EQUIPMENT IN POWER SECTOR

File No.CEA-HY-17-145/1/2018-HETD Division

भारत सरकार/Government of India
विद्युत मंत्रालय/Ministry of Power
केंद्रीय विद्युत प्राधिकरण/Central Electricity Authority
जल विद्युत अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Hydro Engg. & Technology Dev. Division
सेवा भवन, आर. के. पुरम-1, नई दिल्ली-110066
Sewa Bhawan, R. K. Puram-1, New Delhi-110066

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No. 10/3/HE&TD/2021/ **Date:**01.10.2021

OFFICIAL MEMORANDUM

Subject: Constitution of Committee for Standardization of Test Protocols for Electro-Mechanical equipment in Power Sector-reg.

As Hon'ble Union Minister of Power has desired to standardize Test Protocols for Electro-Mechanical equipment in Power Sector, a Committee is hereby constituted consisting of the following members:

1.	Member (GO&D & Hydro),CEA	Chairman
2.	Chief Engineer (TE&TD), CEA	Member
3.	Chief Engineer (PSE&TD), CEA	Member
4.	Chief Engineer (DPT), CEA	Member
5.	Chief Engineer (RTD), CEA	Member
6.	Representative of CPRI	Member
7.	Representative of NTPC	Member
8.	Representative of PGCIL	Member
9.	Representative of NHPC	Member
10.	Representative of BHEL	Member
11.	Representative of SECI	Member
12.	Representative of DISCOM	Member
13.	Chief Engineer (HE&TD), CEA	Member & Convener

Further, the Committee may co-opt any other member, if required.

The **Terms of Reference (ToR)** of the Committee shall be as given below:

1) Standardization of Type Tests, Routine Tests, Field Acceptance Tests, etc.
2) The possibility of using CEA Regulations as part of Test Protocols.
3) Incorporation of outcome at Sl. No. 1 in CEA Regulations for making it enforceable.
4) Any other issue/ agenda with the consensus of the Committee.

The Committee shall submit a Report within 01 week from the date of receipt of this order.

This issues with the approval of the Competent Authority.

01/10/21

(Sonam Srivastava)
Asstt. Director

File No.CEA-HY-17-145/1/2018-HETD Division

To :

1. Chairman, CEA
2. Member (GO&D and Hydro), CEA
3. Chairman & Managing Director, NTPC Limited, NTPC Bhawan, SCOPE Complex, Institutional Area, Lodhi Road, New Delhi – 110003 – with a request to nominate a representative of NTPC (not below the rank of ED/GM)
4. Chairman & Managing Director, PGCIL, Power Grid Corporate Office, Saudamini, Plot No.2, Sector 29, Near IFFCO Chowk, Gurgaon (Haryana) – 122001 – with a request to nominate a representative of PGCIL (not below the rank of ED/GM)
5. Chairman & Managing Director, NHPC Ltd., NHPC Office Complex, Sector-33, Faridabad – 121003 (Haryana) – with a request to nominate a representative of NHPC (not below the rank of ED/GM)
6. Managing Director, SECI, 6th Floor, Plate-B, NBCC Office Block Tower-2, East Kidwai Nagar, Kidwai Nagar, New Delhi, Delhi 110023– with a request to nominate a representative of SECI (not below the rank of ED/GM)
7. Chairman & Managing Director, Bharat Heavy Electricals Limited, BHEL HOUSE, Siri Fort, New Delhi-110049 – with a request to nominate a representative of BHEL (not below the rank of ED/GM)
8. Chief Engineer (TE&TD), CEA
9. Chief Engineer (DPT), CEA - with a request to co-opt a representative from any DISCOM
10. Chief Engineer (PSE&TD), CEA
11. Chief Engineer (RTD), CEA - with a request to co-opt members from RE Sector (not below the rank of ED/GM)
12. Chief Engineer (HE&TD), CEA
13. DG, CPRI, Central Power Research Institute, Prof.Sir C.V.Raman Road,Post Box No: 8066, SadaShiva Nagar (p.o), Bengaluru, 560080