

# **TRANSMISSION CORPORATION OF TELANGANA LIMITED**

([www.transco.telangana.gov.in](http://www.transco.telangana.gov.in))



**MAJOR GUIDELINES FOR EXECUTING INTERCONNECTION FACILITIES BY  
SOLAR ENERGY DEVELOPERS IN TELANGANA STATE**

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**1. PROCEDURE FOR CONNECTIVITY, SELECTION OF SITE AND ROUTE FOR CONSTRUCTION OF INTERCONNECTION FACILITIES WITH STATE GRID AND APPROVAL OF LINE PROFILES:**

**FOR DEVELOPERS COMING THROUGH BIDDING ROUTE:**

- i. In case of Developers who bid against the already notified Substations, upon completion of the bidding process, CGM (Commercial & RAC) / TSSPDCL shall issue LoI to the successful Developers for entering into PPA with DISCOMs.
- ii. After the developers have entered into PPA, CGM(Commercial & RAC) / TSSPDCL shall communicate the list of Developers who have entered into PPA, to Chief Engineer(Commercial) / TSTRANSCO or Chief General Manager (O&M)/TSDISCOM depending on the Voltage Level at which the Developer is getting connected, for preparation of estimates.
- iii. Chief Engineer (Commercial)/ Chief General Manager (O&M)/TSDISCOM shall communicate the above developers list to the concerned Chief Engineer (Zone)/ TSTRANSCO or CGM (Operation) / TSDISCOM respectively within 3 days of receipt of such information.
- iv. The developer shall approach the Chief Engineer (Operation)/TSDISCOM or Chief Engineer (Zone) / TSTRANSCO as the case may be for furnishing their plant details, proposed line lengths and coordinate for giving required details for initial cost estimation.
- v. If the proposed solar power injection is at 33kv or 11kv voltage level at Discom 33/11kv substation, the Chief General Manager (Operation)/ TSDISCOMs shall prepare the initial cost estimates for line and bay and shall communicate the payment to be made by the developer initially within 10 days of the developer's request letter.
- vi. If the developers proposed solar power injection is at 33kv voltage level and Point of interconnection is at 132/33kv substation of TSTransco, the respective Zonal Chief Engineer/ TSTRANSCO shall prepare the cost estimate for the 33kv bay and communicate the payments to be made by the developer within 10 days from the developer's request letter.  
However the developer shall approach the concerned Chief General Manager (Operation)/TSDISCOM for 33kv sub transmission line and plant end 33kv bay estimate and CGM/Operation shall communicate the payments to be made by the developer within 10 days from the date of the developer's request letter.

- vii. If the developer's proposed solar power injection is at 132kv voltage class and above, the respective Chief Engineer (Zone) / TSTRANSCO shall communicate within 15days from the date of developer's letter to Chief Engineer (Transmission), the details like the line length based on the preliminary survey, cost of the land for bay, any modifications to be made in the Switchyard or control room to facilitate the developer's power injection for preparation of the initial cost estimates for construction of interconnection facilities.
- viii. However the developer shall extend all his cooperation and make his representative available to the concerned officials till all the inputs are made available for preparation of the initial cost estimates.
- ix Chief Engineer (Transmission)/TSTRANSCO shall communicate the developer within 10 days from the date receipt of field information in respect of following cases.

**I.If the interconnection facility to be executed by TSTRANSCO/TSDISCOMS**

- a. Tentative cost of the Scheme to be paid by the developer, if he wants TSTRANSCO / TSDISCOMS to build the interconnection facilities for him.
- b. The developer shall be informed to pay the balance payment after the approval of the line profile and substation SLD & layout drawings duly revising the above initial cost estimate. The developer shall pay the balance payment as communicated by TSTRANSCO/TSDISCOMS.

**II. If the interconnection facilities to be executed by the Developer himself**

- a. The tentative supervision & engineering charges and other applicable charges along with applicable taxes as per the policies and rules in vogue based on the tentative cost arrived as above.
- b. The balance supervision & engineering charges and other applicable charges along with applicable taxes shall be paid by the developer as communicated by TSTRANSCO/TSDISCOMS after the line profile and substation SLD & layout drawings approvals based on the revised cost estimates.
- c. However the above charges shall be collected as per the state government policy for renewable energy in vogue.

- x) After payment of the necessary charges, the developer shall arrange for an approved surveyor of TSTransco for exploring the possible routes from their pooling station to the interconnecting substation in coordination with the field construction wing of TRANSCO/ DISCOM. The approved surveyors list is available with Chief Engineer (Transmission) and is put on the website of TSTRANSCO.
- xi In order to save project time, the developer may request simultaneously for approval of work agency for substation and line works from the eligible contractors. The approvals for the same shall be accorded by Chief Engineer (Transmission)/TSTRANSCO or Chief General Manager (O&M) based on the agency eligibility for the proposed work within 7 days.
- xii The EE (Construction) shall scrutinize the line route proposals and submit the same to the respective Chief Engineer (Zone) of TS TRANSCO for approval.
- xiii If the proposal is not in order, the EE (Construction) shall inform the same to the developer for resubmission of data.
- xiv After finalizing the site and route, the Chief Engineer (Zone) of TS TRANSCO shall communicate the route approval of the line to the developer.
- xv. The line route approval shall be accorded within 10days from the submission of line survey report.

## **2. PROTECTION AND SYSTEM RELATED INFORMATION**

### **I. PROTECTION PHILOSOPHY**

- 1) For 220kV and 400kV feeders with line length > 10Kms:
  - a) Main-1 : Numerical line distance relay
  - b) Main-2 : Numerical line distance relay
- 2) For 220kV and 400kV feeders with line length < 10Kms
  - a) Main-1 : Numerical line differential relay with inbuilt distance Protection features with Fiber optic communication.
  - b) Main-2 : Numerical line distance relay
- 3) For 132kV feeders with line length > 10Kms
  - a) Main : Numerical line distance relay
  - b) Backup : Numerical directional IDMT O/C & E/F relay
- 4) For 132kV feeders with line length < 10Kms
  - a) Main : Numerical line differential relay with inbuilt distance Protection features with Fiber optic communication.
  - b) Backup : Numerical directional IDMT O/C & E/F relay

Both main-1 and main-2 should be of different make & type with 4 forward and one reverse zone feature with Disturbance recorder (DR)& Event logger (EL) features and communication capabilities in compliance to IEC61850 protocol and suitable for substation automation.

- 5) For 33kV feeders  
Shall be provided with Numerical 3 (THREE) directional IDMT over current & 1(ONE) directional IDMT E/L relays at both ends.
- 6) 220kV and 400kV feeders shall be provided with carrier inter trip scheme at both ends.
- 7) 400kV feeders shall have single Phase auto reclose facility at both ends.
- 8) Bus bar and LBB protection shall be provided in 220kV and higher voltage switchyards. The bus bar protection scheme shall have provision for future expansion also.

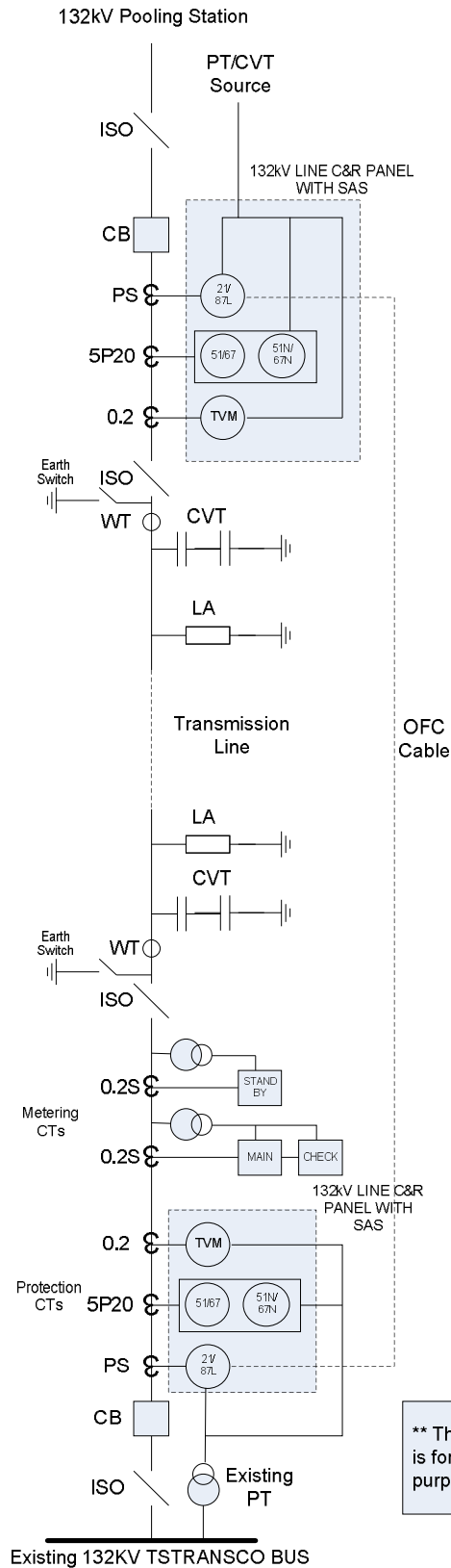
- 9) As per SRPC recommendations, two separate DC supply sources shall be provided along with complete trip circuit i.e, trip coils, and master trip relays etc in 220KV and higher voltages switchyards.
- 10)The control voltage shall be 220Volts DC.
- 11)If single metering bay is provided for multiple feeders, then the metering bay including bus shall be provided with bus-bar protection relay.
- 12)In case the developer proposes a radial transmission line, then there shall be a separate switchyard equipment, control & relay panels for both transmission line and power transformer respectively at developer's end.
- 13)LVRT/HVRT protection features should be provided as per the CEA regulations & CERE order Dt:05.01.2016.
- 14)The requirement with respect to harmonics, DC Current injection and flicker shall comply with clause **B** of the CEA grid connectivity regulations 2013 applicable to wind generating stations and generating stations using invertors.
- 15)Dedicated transmission line from the power developer pooling station to Point of connection (POC) at DISCOM/ TSTRANSCO substation are to be provided by the developer.
- 16)The field officials shall send the request letter for computing the relay settings at least 2 weeks in advance duly furnishing approved SLD, CT details, line particulars (Line length, conductor type & others), power transformers (rating, % impedance & others) and relay particulars (Make & type).
- 17)In case of introduction of new relays, the developer shall ensure technical presentation of the product by company engineer prior to request for the relay settings.
- 18)The typical Single Line Drawings for 132KV&220KV evacuation scheme are appended.
- 19)For obtaining charging permission from SLDC for radial lines, the concerned field officials shall furnish the statutory compliance report atleast two days in advance with a copy to SE/power system wing in advance.

- 20) For obtaining the charging instructions for parallel feeders, field officials shall furnish the statutory compliance report along with their request letter at least one week in advance for formulation of charging instructions and circulating the same through the CE/SLDC & Telecom.
- 21) The developer shall provide the required reactive power compensation as per CEA regulations in vogue / or as per instructions of TS power utilities. The developer shall conduct study in this regard for a day cycle for one week and furnish in this regard for a day cycle for one week and furnish the report to the concerned officers.

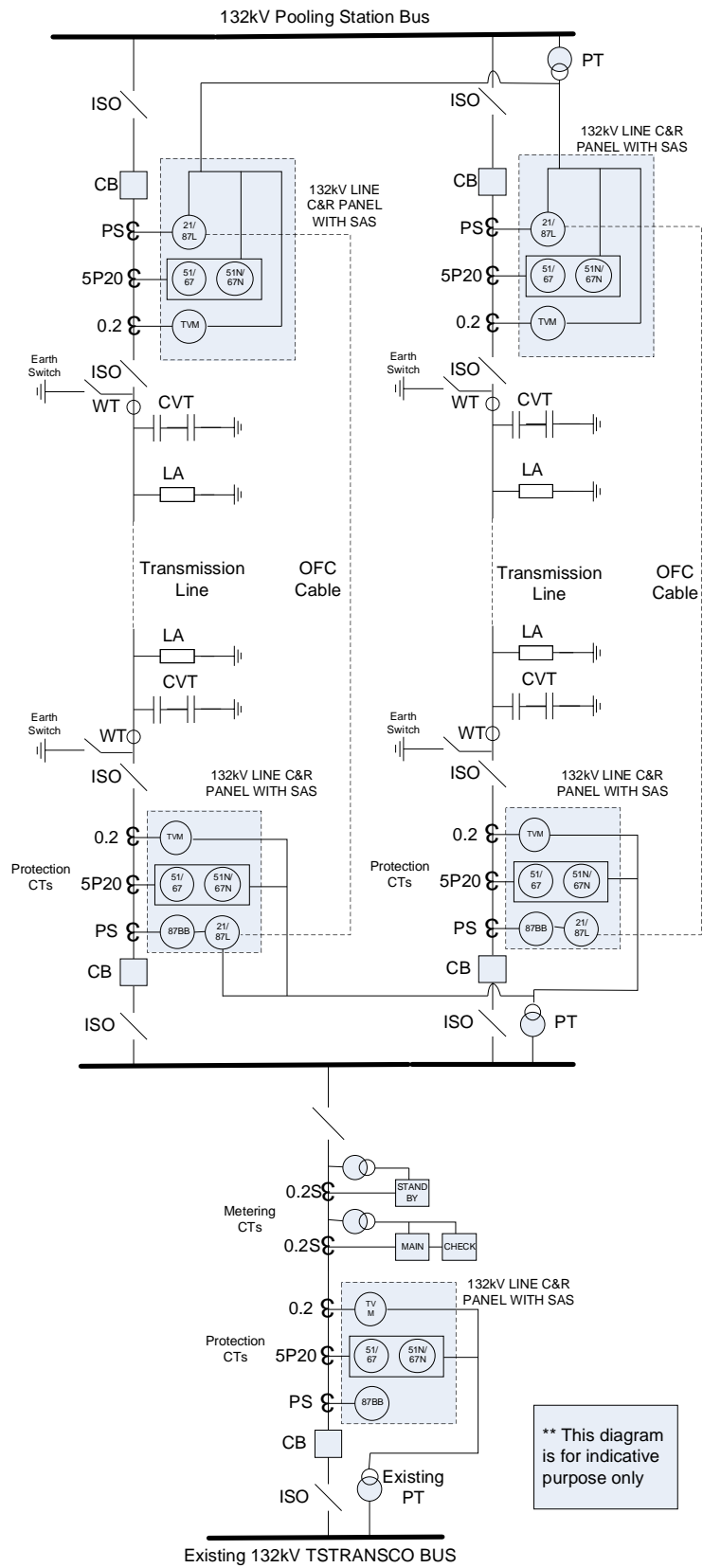


# TYPICAL SLD FROM POOLING SS TO TS TRANSCO SUBSTATION

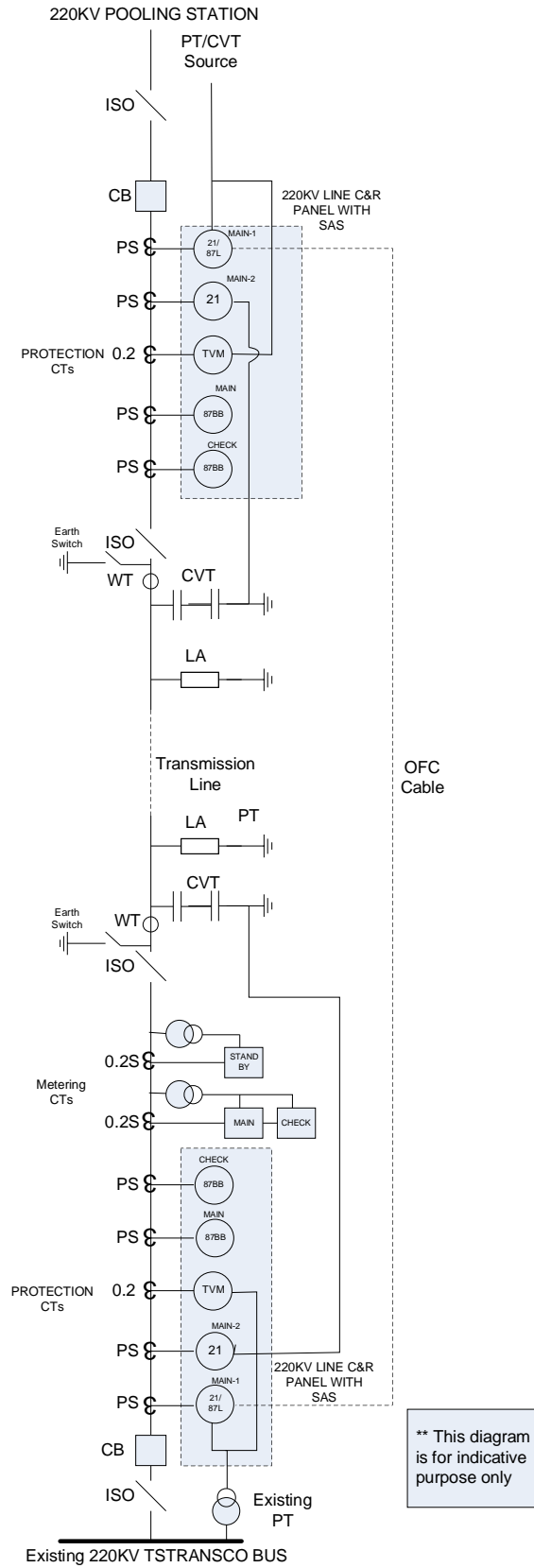
Typical SLD for 132kV Radial feeder from Pooling Station to TSTRANSCO SS



Typical SLD for 132kV double circuit from Pooling Station to TSTRANSCO SS



Typical SLD for 220kV Radial feeder from Pooling Station to  
TSTRANSCO SS





## **II. POWER SYSTEM RELATED INFORMATION.**

### **UHT/EHT TRANSMISSION LINE LOADINGS AS FOLLOWED BY TSTRANSCO (At 45 degree Ambient & 75 Degree max. Conductor temperature)**

<b>Sl. No</b>	<b>Voltage</b>	<b>Type of Conductor</b>	<b>Current carrying capacity in Amps</b>	<b>Max.Loading <math>P=\sqrt{3} VI \cos\Phi</math> (MW)</b>	<b>SIL (MW)</b>	<b>Normal Loading Limit (MVA)</b>	<b>Emergency Loading Limit (MVA)</b>
1	132kV	ACSR PANTHER	366	75.31	50 (66.39%)	67 (80.07 %)	90 (121.5%)
2	220kV	ACSR ZEEBRA	560	192.04	132 (68.73%)	178 (83.42%)	305 (159%)
		ACSR SINGLE MOOSE	630	216.39	132 (61%)	190 (79.02%)	305 (141%)
3	400kV	ACSR TWIN MOOSE	1262	786.88	515 (65.45%)	555 (63.48%)	1247 (158.5%)
		ACSR QUAD MOOSE	2524	1573.76	614 (39.01%)	800 (45.75%)	1500 (95.33%)
4	765kV	ACSR QUAD BERSIMIS	2928	3491.58	2250 (64.44%)		4050 (104.39%)

**\*  $\cos \Phi = 0.9$**

The injection capacity at each substation KV level was arrived as shown below:

<b>Sl. No.</b>	<b>Interfacing/Grid substation (Inter-Connection Plant)</b>	<b>Injection Voltage level (AC)</b>	<b>Injection capacity at Substation (MW)</b>
1	33/11 KV	33 KV	2 to 8
2	132/33KV	33 KV	9 to 15
3	132/33KV	132 KV	16 to 50
4	220/132 KV	132 KV	16 to 50
5	220/132 KV	220 KV	51 to 100
6	400/220 KV	220 KV	51 to 150

### **3. DATA MAPPING AND SAS SYSTEM**

1. The OPGW and Optical terminal Equipment to be provided up to the interconnecting Substation for all plants connecting at 132kV voltage level and above.
2. For all plants connecting at 132kV voltage level and above, the plant data in 101/104 protocol is to be transmitted to the nearest data collection point ie DCPC / RTU by providing PLCC channels in transit stations as per IEGC code clause no. 4.6.2 and clause no. 5.2(u). In case the plant data is integrated to the nearest RTU then necessary hardware and software to be upgraded accordingly by the developer.
3. For all plants connecting at 33kV Voltage level and below, the plant data is to be transmitted to SLDC through leased line over MPLS on IEC 60870-5-101/104 protocol in secured VPN tunnel. This data shall be integrated to the existing SCADA system at SLDC temporarily till REMC (Renewable Energy Management Centre) is established. Once REMC is established, all solar/wind generators are required to pay one time charges to link to REMC towards meeting the capital cost and maintenance cost.
4. The data acquisition system (DAS) equipment installed at the plant end shall be KEMA certified for IEC60870-5-101/104 protocol.
5. All solar power plants shall provide weather related parameters like temperature, solar irradiation, wind velocity etc., as per grid code clause No.6.5(23). The solar generating stations shall forecast/schedule their power as per CERC/SERC regulations.
6. (a) Solar generating stations shall be capable of supplying dynamically varying reactive power support so as to maintain power factor within the limits of 0.95 lagging to 0.95 leading as per sub clause 1 of B2 of CEA (Technical standards for connectivity to Grid) Amendment Regulations, 2013 dated:15.10.2013.  
(b) Solar generating units, shall be capable of operating in the frequency range of 47.5 Hz to 52 Hz and shall be able to deliver rated output in the frequency range of 49.5 Hz to 50.5 Hz

## **4.METERING**

### **1) Location of energy meters:**

- i) The Main, Check and standby meters shall be provided as per the respective clauses of PPA.
- ii) If the project is connected to grid through single circuit, the metering shall be in the feeder bay at interconnecting point.
- iii) If the project is connected to grid through more than one circuit, there shall be a metering bay in the interconnecting point with suitable protection as specified by the system protection wing of Transco.

### **2) Class of accuracy:**

- a) All interface meters (i.e. main, check and standby meters) and net generation meters at generating plant end shall be of 0.2S accuracy class.
- b) In generating stations, the accuracy class of meters for gross generation shall not be inferior to that of 0.2S accuracy class. Class of accuracy of all other meters not specified above shall be of 1.0 class or better, if connected at 650 volts or below, of 0.5S class or better if connected at above 650 volts and up to 33KV and of 0.2S class or better if connected at above 33KV.
- c) The energy accounting and audit meters (e.g., gross generation, auxiliary consumption, captive consumption etc) need not be having ABT features. Non ABT meters having 15 minutes integration period and storage capacity for 45 days load survey data are sufficient for the purpose.
- d) The ABT meters at interconnection point should be compatible with EBC database.

### **3) Metering equipment i.e., CTs and PTs:**

- a) The main and check meters shall be connected to the same set of CTs and PTs and the standby meter to a separate set of CTs and PTs.
- b) Each energy meter (Main and Check form single unit) shall be provided with dedicated CTs and PTs and other instruments like indicating meters, recording meters, protective relays, SAS etc shall not be connected to these CTs and PTs.
- c) The ratio of CTs shall be the nearest available standard ratio to the current corresponding to the maximum generation capacity minus auxiliary consumption.

- d) If the evacuation is on double circuit line the CT ratio for each feeder shall suit as above.
- e) The CTs and PTs used for metering shall be of single core and single ratio of suitable capacity as mentioned above.
- f) Metering CTs shall be of 0.2S class of accuracy and metering PTs shall be of 0.2 class of accuracy.
- g) The secondary burden of CTs shall be 5VA and of PTs shall be 10VA.
- h) The instrument security factor (ISF) of CTs shall be  $\leq 5$ .

**4) Wiring of energy meters:**

- a) In general, the wiring shall be as per Annexure-I, II & III to T.O.O. (JMD/V&S), Ms. No. 394 Dated 19.01.2012 whose essence is reproduced below.
- b) All the cables shall be drawn through C clause heavy duty G.I. conduits up to the metering box.
- c) It is to be ensured that the meters record energy in EXPORT mode when the power flow is away from the BUS and in IMPORT mode when the power flow is into the BUS. If the metering location is at the Power Plant/Consumer Switchyard, then the above points should be ensured considering the reference BUS at the power plant/consumer switchyard only.
- d) Secondary star points of CTs & PTs shall be earthed individually inside the metering panel to the earthing terminal provided for the purpose and the earthing terminal shall be connected directly to the earth flat.
- e) Earthing of metering CTs & PTs, metering cubicle, secondary star points of CTs & PTs shall be through GI earth flat of size not less than 50x8mm. Double earthing shall be done for all the equipment including metering CTs & PTs.



## **5.PROCEDURE FOR APPROVAL OF LAYOUTS AND DRAWINGS**

### **I. SUBSTATION SLD AND LAYOUT DRAWINGS APPROVALS**

For voltage class 33kv and below, Superintending Engineer/OMC/TSTransco or Superintending Engineer/ Operation/ TSDISCOM shall accord the approval for 33kv bay drawings in TSTRANSCO/TSDISCOMS as the case may be. However the pole scheduling and route approval of the line shall be accorded by Superintending Engineer/Operation /TSDISCOMS.

With respect to voltage class 132kv and above, respective Superintending Engineer (OMC)/TSTransco shall approve the line profiles with information to Chief Engineer (Transmission)/TSTRANSCO within 10days. CE (Zone) shall forward Single line drawings and layout drawings after proper scrutiny to Chief Engineer (Transmission)/TSTRANSCO. Chief Engineer (Transmission)/TSTRANSCO shall approve the SLD and layout drawings, within 15days from the date of submission to respective Executive Engineer(construction).

The Executive Engineer(Construction) shall prepare and submit the BOQ required for the project to Chief Engineer(Zone) through Superintending Engineer(OMC). The Chief Engineer(Zone) shall accord approval for BOQ which will form the basis for execution of the project and shall send a copy of the same to Chief Engineer(Transmission)

In this regard the developer shall submit the following drawings.

- 1) The Single line drawings and switchyard layout drawings to EE (Construction) with proposed bay(s) for terminating his interconnecting line(s) to the proposed switching station (if any) and the Pooling Substation as the case may be.
- 2) The single line diagram (SLD) shall contain and clearly show the following details.
  - a) Placing of various equipment in the switchyard clearly mentioning the existing and the proposed at both ends of the line i.e. at pooling station and also the point of connection at TSTRANSCO/Discom substation

- b) The ratings of the equipments proposed like
  - i) ratios, burdens, classes of accuracy, ISF of CTs & PTs for each core
  - ii) Connections of each core to the relays/meters that are connected to CTs and PTs
  - iii) Rating of circuit breakers, isolators etc
  - iv) Ratings of PTRs i.e., transformation ratio, rated HV & LV currents, voltages, percentage Impedances etc.
- c) The SLD shall also contain details of the solar plant i.e. number of PV cells, rating of each PV cell, grouping combination of PV cells, Inverter ratings, short circuit withstandability, provision of LVRT/HVRT and line lengths upto the pooling station etc.
- 3) Layout drawing shall contain the details like type of station towers, booms and equipment layout with clear dimensions, fencing and earthing details.
- 4) System earthing shall be carried out as per TS TRANSCO practices in vogue time to time to maintain the earth resistance, step and touch potentials in the switchyard area. The developer shall measure the overall earth resistance as a part of pre commissioning tests.
- 5) Where it necessitates extending the existing control room by the developer, it shall be extended for a minimum of one column span of existing control room or space sufficient to accommodate the developer panels including operating space whichever is higher. The developer shall furnish the civil drawings for the control room extension duly indicating the present control room dimensions. The drawing for the control room extension shall be approved by the Superintending Engineer/Civil/Zone.
- 6) The EE (Construction) shall scrutinize the proposals based on the field conditions and submit the same to CGM (O&M) of Discom or the Chief Engineer (Transmission)/ TS TRANSCO through their respective CGM (Operation) and Zonal Chief Engineers respectively for according the final approvals.
- 7) The CGM/O&M/Discom, Chief Engineer (Transmission) / TSTRANSCO shall ensure the SLD, Layouts, location of ABT meters and system protection compliance in coordination with concerned wings prior to giving the final approvals to avoid major changes at later stage of the project.

- 8) For facilitating proper scrutiny, the developer shall arrange for field inspection if required by EE (Construction).
- 9) If the proposal is not as in order the EE (Construction) shall inform the same immediately to the developer for resubmission of layouts.

**10) The drawings for C&R panels shall be as follows.**

- a) The drawing should clearly indicate the protection and metering philosophy adopted.
- b) Schematic C&R panel Drawings with SAS shall be submitted along with approved SLD and Layout of the yard (both at Pooling station end and TS TRANSCO substation end).
- c) Drawings shall be submitted in A3 size only and they shall be legible. Architecture drawing for SAS, GTP and BOM (for Relays/SAS system) shall be submitted along with the drawings.
- d) Type of protection scheme adopted, signals considered, trip relays & tripping circuit, voltage selection scheme, ferrule Nos., T.B. arrangement, interposing relays, BOM & GTP for the relays/ SAS system, Architecture formation for SAS etc. shall be clearly indicated.
- e) Remote Gateway shall be provided along with SAS system (like Main & Redundant HMIs, EWS, GPS, printers, FO cable, Inverters etc.) to send the station data to the SLDC.
- f) Invariably at TS TRANSCO substation end also, C&R panel with SAS, Breakers, CTs, PTs and associated equipment shall be provided. Integrating of the new C&R panels with the existing SAS shall be in the scope of developer.
- g) Aux. Supply for the C&R panels and other equipments shall be of 220 V DC.
- h) C&R panels manufactured by relay manufacturers only are accepted by TS TRANSCO as a practice. In case of new companies, the practice adopted in TS TRANSCO is to accept only those manufacturers who meet the qualification requirements of the approved specification for C&R panels (conventional/SAS) and have given demonstration on their Numerical protection relays to Transmission wing, field MRT Engineers and system protection wing to understand and check the suitability of these Relays in TS transmission network.

The possibility of using new relays to certain specific quantity on trial basis, with the concurrence of management, so that the new relays performance may be evaluated in the field, though they meet our eligibility criteria.

- i) The following are the regular C&R panel suppliers in TSTRANSCO.
  - 1) M/s Alstom T&D India.
  - 2) M/s ABB India.
  - 3) M/s GE India.
  - 4) M/s Schneider Electric and
  - 5) M/s Siemens India.
- j) The standard SAS specification of TSTRANSCO is appended in the soft form.

## **6. APPROVAL OF CONTRACTING AGENCY**

- 1) The developer shall apply to CGM (O&M) of Discom or the Chief Engineer (Transmission) of TS TRANSCO for approval of the contracting agency through which they want to execute their interconnection facilities constructed under the supervision of Discom/TS TRANSCO with following details.
  - a) Name and address of the contracting agency and its registration, if any, with Discom/TS TRANSCO as the case may be.
  - b) Experience/Performance certificates issued by an officer not below the rank of Executive Engineer or equivalent cadre of State power utility / Government organizations/ PSU for the works done along with contact numbers and email address to avoid delay in verification.
- 2) Evaluation criteria for approval of contracting agency:
  - a) The contractor shall have corresponding experience in erection of bay extensions, substations, transmission lines etc., of 110KV or higher voltages against each of the works of the proposed scheme.
  - b) The contractor shall possess a valid electrical A-Grade license issued by GOTS.
  - c) The contractor should not be a blacklisted contractor of TSTRANSCO/TSDICSOM.
- 3) After evaluation as above, CGM (O&M) of Discom or the Chief Engineer (Transmission)/TS TRANSCO shall inform the approval/rejection of proposed contracting agency to developer.
- 4) If rejected the developer shall propose another agency with all the above details.
- 5) Maximum two contracting agencies shall be permitted for construction of interconnection facility by the developer.

## **7.PROCEDURE FOR PROCUREMENT OF MATERIAL/EQUIPMENT**

1. The list of approved vendors of TSTRANSCO/TS Discom for various materials/equipments that are to be procured by the developer is available at respective company websites. The Transmission/P&MM wings of TSTRANSCO and Discoms shall update the above vendor list once in a month.
2. All the standard specification for the major materials along with the approved drawings is available in TSTRANSCO/Discom websites. All the equipment approved drawings and GTPs of various vendors shall be uploaded and updated by Transmission/P&MM wings of TSTRANSCO and respective wings of Discoms.  
The developer shall procure required materials/equipments from the respective approved vendors of Discom/TS TRANSCO.
3. If the materials/equipments that are proposed for procurement are manufactured by following the design/drawing/GTP already approved by Discom/TS TRANSCO, developer need not apply for approval of drawings/GTPs of that particular material/equipment.
4. If the materials/equipments that are proposed for procurement are manufactured by not adopting design/drawing/GTP approved by Discom/TS TRANSCO (though from an approved vendor) or from a new vendor not approved by Discom/TS TRANSCO, the developer shall apply to CGM (O&M) of Discom or the Chief Engineer (Transmission) of TS TRANSCO for approval of vendor as well as the design/drawing/GTP of the materials/equipments duly furnishing the all relevant documents and type test certificates.
5. After receiving request for approval of vendor or design/drawing/GTP of a particular material/equipment, the CGM (O&M) of Discom or the Chief Engineer (Transmission) of TS TRANSCO shall communicate the approval of the vendor. If rejected, the reasons shall be informed to the developer.
6. If rejected, the developer shall make fresh request for approval material/equipment.
7. The developer shall offer for witnessing the factory acceptance tests on materials/equipments at manufacturer's facilities and the request for the same shall be place with CGM (O&M) of Discom or Chief Engineer (Transmission). Before offering the date of inspection, the developer shall ensure that the

materials/equipments would be ready on the proposed date of inspection. The request shall be at least 15 days prior to the scheduled date of inspection.

8. While submitting the inspection call for material inspection, the developer/contractor shall enclose the manufacturer's intimation letter addressed to the developer/contractor regarding readiness of material and scheduled date of inspection.
9. After receiving the call for inspection of materials/equipments, the CGM (O&M) of Discom or the Chief Engineer (Transmission) shall send the same, duly verifying the credentials, to the Quality Control Wing for arranging inspection.
10. Inspection call shall reach to the Quality Control Wing at least ten days before the scheduled date of inspection.
11. The developer shall note that some of the manufacturers would communicate about readiness of the material as well as the scheduled date of inspection in advance, but would fail to offer the material for inspection on scheduled date of inspection due to delays in manufacturing process. In such case the QC wing shall return the call to the CE(Transmission) duly mentioning the reasons. The CE(Transmission) shall intimate the same to the developer asking him to resubmit the inspection call duly ensuring the readiness of materials/equipments.
12. The QC Wing shall arrange the inspection of materials/equipments at manufacturers' facilities for witnessing factory acceptance tests on the scheduled date. At the most they can delay the inspection by three (3) days from the scheduled date.
13. The material will be accepted, if the acceptance tests are passed as per relevant standards, the inspection authority shall communicate the dispatch clearance (DI) to the Developer after completion of the inspection.
14. The CGM/CE (Transmission) shall intimate the developer about the rejection of materials/equipments duly mentioning the reasons and asking him to resubmit the inspection call after ensuring that all the remarks are attended to. The developer shall resubmit the inspection call accordingly and all the procedure will apply in toto for the second call also.
15. Material inspection will be undertaken by the Quality Control Wing at free of cost.

16. After receiving the DI, the developer shall arrange for the dispatch of materials/equipments to the site with standard wooden and polythene cover packing for transit and on site storage to avoid ingress of moisture and other foreign material.
17. After receipt at site the developer shall arrange inspection of materials/equipments by the EE (Construction) for ensuring their healthiness and orderliness.
18. If the materials/equipments are found to be healthy and in order, the EE (Construction) shall issue clearance for erection.



## **8.PROCEDURE FOR CONSTRUCTION OF INTERCONNECTION FACILITIES**

- i) The construction activity involves,
  - a. Check survey and marking of towers in transmission line
  - b. Leveling of site in substation
  - c. laying of foundations for substation structures, transmission line towers
  - d. erection of substation structures and transmission line towers
  - e. erection of equipment in substation
  - f. stringing of line and connecting jumpers in transmission line
  - g. stringing of bus and connecting jumpers in substation
  - h. Measurement of earth pit resistances of all earth pits, both combined and individual, in substation.
  - i. statutory inspection by O&M wing
  - j. Attending to the remarks communicated by O&M wing after statutory inspection.
  - k. pre-commissioning tests on equipment in substation
  - l. measurement of line signature of transmission line
  - m.measurement of tower foot resistance at each tower
- ii) The developer shall intimate the scheduled construction activity 15 days in advance to the EE (Construction)
- iii) The EE (Construction) shall arrange the supervision of the activity and/or inspection by quality control officer on the scheduled day.
- iv) After completion of construction, the developer shall request the EE (Construction) for arranging the statutory inspection by O&M wing.
- v) The EE (Construction) shall arrange statutory inspection by O&M wing within 10 days.
- vi) The O&M wing shall intimate the remarks within 3 days to EE (Construction) from the date of inspection.

- vii) EE (Construction) shall intimate the remarks of statutory inspection within 3 days to the developer for compliance.
- viii) The developer shall arrange the compliance for the remarks of statutory inspection under the supervision of construction wing.
- ix) After the construction is satisfactorily completed, the developer shall intimate 15 days in advance the scheduled dates of pre-commissioning tests on substation equipment, measurement of tower foot resistances in line, measurement of line signature of transmission line etc.
- x) The EE (Construction) shall arrange for supervision of pre-commissioning tests on substation equipment by MRT wing, measurement of tower foot resistances in line, measurement of line signature of transmission line by construction wing on the scheduled days.
- xi) After review of pre-commissioning tests on substation equipment, measurement of tower foot resistances in line, measurement of line signature of transmission line, if any defects are identified that are to be attended to before charging the line and equipment, the EE (Construction) shall intimate the same to developer for compliance within 3 days.
- xii) The developer shall obtain necessary charging permission from PTCC & CEIG in the meantime and furnish the same to EE (Construction).
- xiii) The developer shall also ensure the compliance of LVRT/HVRT requirements as per the CEA Technical standards for grid connectivity and shall submit all the relevant documentation for compliance of the same before requesting the line charging.
- xiv) The developer shall arrange the calibration of ABT meters (Main check and standby meters) in the presence of concerned MRT officials Discom/TSTRANSCO. The developer shall also arrange a copy of NABL accredited lab certificates for the instrument transformers and meters at the time of field calibration.
- xv) After ensuring that the interconnection facilities, i.e., line, pooling substation & bays in interconnecting substation etc., are constructed as per standards and can be charged, the EE (Construction) shall issue work completion certificate to the developer with copies up to CE (Zone) or CGM(op) as the case may be.
- xvi) Measurement of actual works executed shall be recorded in MBooks duly following the procedures.

## **9.PROCEDURE FOR SYNCHRONIZATION**

- 1) The developer may undertake the commissioning of the Project in phases. In such case, the minimum capacity to be commissioned in each phase shall be 5MW. During synchronization of each phase, the prescribed procedure shall be followed.
- 2) Grid supply may be required for commissioning the equipment of developers, particularly the solar and wind. In such case supply may be extended duly taking necessary approvals like PTCC approvals, charging permission/ instructions from SLDC, work completion certificate from EE (Construction), charging permission from CEIG etc.
- 3) Synchronization shall be done only after ensuring the readiness of generator in all aspects. Synchronization of first phase shall be done within one week of the extension of supply.
- 4) The developer shall furnish to CGM (Comml & RAC)/TSSPDCL or CGM (IPC&RAC)/TSNPDCL the certificates/approvals for layout, equipment, components etc. of the project by statutory authorities like TNREDCL (Telangana New & Renewable Energy Development Corporation Limited), CEIG (Chief Electrical Inspector to Government) to the Competent Authority well in advance so that the approval is given in time.
- 5) The Developer shall also furnish the details along with manufacturer test certificates of project facilities i.e., all the equipments/components installed in his project.
- 6) The equipments/components shall conform to the relevant minimal technical requirements/standards and guidelines published by the Ministry of New and Renewable Energy (MNRE), Bureau of Indian Standards (IS) or International Electro technical Commission (IEC), the Indian Electricity Grid Code/State Electricity Grid Code whichever is in force and the specifications/ requirements of TSTRANSCO/TSDISCOM, if any (as per solar RfS document).
- 7) The developer shall get the power quality assessed as per the guidelines in the presence of Discom/Transco MRT wing and submit the report to CGM (Comml & RAC)/TSSPDCL or CGM (IPC&RAC)/TSNPDCL.
- 8) After verification, the CGM (Comml & RAC)/TSSPDCL or CGM (IPC&RAC)/TSNPDCL shall issue consent for the project facilities.

- 9) The developer shall furnish the construction completion certificate issued by the EE (Construction) to CGM (Op) of Discom or CE (Zone) of TSTRANSCO duly enclosing the certificates/approvals to the effect that the construction of interconnecting facilities has been done as per the guidelines.
- 10) CGM (Op) of Discom or CE (Zone) of TSTRANSCO, after ensuring that the interconnecting facilities are constructed as per the guidelines, shall issue consent for interconnecting facilities and inform the same to CGM (Comml & RAC)/TSSPDCL or CGM (IPC&RAC)/TSNPDCL.
- 11) The developer shall furnish the information (including static data for REMC) in the prescribed formats to Chief Engineer/TSLDC by enclosing necessary documents.
- 12) The developer shall also submit the required undertakings for compliance with relevant regulations & guidelines e.g., with respect to forecasting and scheduling.
- 13) After verification of the received information regarding REMC forecasting and scheduling to be in order, Chief Engineer/TSLDC shall accord permission for synchronization and inform the same CGM (Comml & RAC)/TSSPDCL or CGM (IPC&RAC)/TSNPDCL.
- 14) After obtaining consent for the project & interconnecting facilities and permission for synchronization from respective Competent Authorities and ensuring fulfillment of terms and conditions of agreements (PPA, OA etc.) entered into with TSTRANSCO/TS Discom including amendments, if any, the CGM (Comml & RAC)/TSSPDCL or CGM (IPC&RAC)/TSNPDCL shall issue approval for synchronization and appoint a Committee to supervise the physical synchronization of the project.
- 15) The committee composition shall be as follows.

**a) Where power injection is at 33kv level in TSTransco Substation**

Superintending Engineer/OMC/TSTransco as Coordinator

Divisional Engineer/MRT/TSTransco

Divisional Engineer/Operation/TSDISCOM

Divisional Engineer/M&P/TSDISCOM

**b) Where power injection is at 33kv or below level in TSDISCOM's Substation**

Superintending Engineer/Operation//TSDISCOM as Coordinator

Divisional Engineer/Operation/TSDISCOM

Divisional Engineer/M&P/TSDISCOM

**c) Where power injection is at 132kv or above level in TSTransco Substation**

Superintending Engineer/OMC/TSTransco as Coordinator

Divisional Engineer/Operation/TSDISCOM

Divisional Engineer/MRT/TSTransco

Divisional Engineer/M&P/TSDISCOM

**16) Responsibilities of Synchronization Committee**

- i. The Committee shall plan meticulously so that all the members are mandatorily present at the field on the proposed day of synchronization.
- ii. The committee shall verify before certifying the synchronization that,
  - a) All the equipments/components of the project corresponding to the capacity proposed for synchronization are physically available and comply with the standards.
  - b) All the equipments/components of the project and interconnecting facilities are commissioned as per the guidelines.
  - c) The committee shall take an undertaking from the developer that they shall conduct all the requisite power quality tests such as individual and total harmonic distortion of voltage and current in all the three phases, DC current injection, flicker, power factor and frequency as per the standards in vogue within 2 months from the date of synchronization. The first payment for the energy charges shall be released only after satisfactory compliance of the same and reports are to be certified by CGM/IPC of Discom or CE/Zone of Transco to whose network the project is connected. The certified copy of the test reports shall be sent to Chief Engineer/SLDC for consent.

17) If all requirements as per standards and regulations are satisfactorily met, the developer shall be issued synchronization certificate.

18) If any deviation from the requirements is found, the developer shall be asked to propose another date and be ready duly correcting/rectifying the findings.

19) Similar procedure shall be followed during next time also.

## **10.ASSESSMENT OF POWER QUALITY**

- 1) The assessment of power quality shall be done at interconnection point (Point of Common Coupling - PCC) as follows.
- 2) For voltage, Total Harmonic Distortion (THD = harmonics as a percentage of fundamental) and for current Total Demand Distortion (TDD = harmonics as a percentage of maximum demand current) shall be assessed.
- 3) The probes/clamp on meters used for measurement of current shall be designed for measuring in the range 0-1Amp, to have full scale measurement, as the measurement of harmonics shall be done at substation end where the currents are available at secondary of the metering CTs.
- 4) The measurement shall be done for a continuous period of 7 days (168 Hrs) as per the IEEE519.
- 5) The measurement window width for harmonics and DC component shall be 200 milliseconds.
- 6) The very short time harmonic values of voltages and currents shall be assessed over 3-second intervals.
- 7) Short time harmonic values of voltages and currents are assessed over 10-minute intervals based on aggregation of 200 consecutive very short time values for a specific frequency component.
- 8) 10 minute interval based short term flicker (Pst) and the 2-hour interval based long term flicker (Plt) shall be measured.
- 9) DC current injection into grid shall be averaged over 5 minute intervals.

### **10)Evaluation of power quality:**

#### **i) Recommended harmonic voltage limits:**

99th percentile very short time (3 second) values should be less than 1.5 times the values given in Table below.

95th percentile short time (10 minute) values should be less than the values given in Table below.

Bus Voltage at PCC	Individual Voltage Distortion (%)	Total Voltage Distortion THD (%)
$1 \text{ kV} < V \leq 69 \text{ kV}$	3.0	5.0
$69 \text{ kV} < V \leq 161 \text{ kV}$	1.5	2.5
$161 \text{ kV} < V$	1.0	1.5

ii) **Recommended harmonic current limits:**

99th percentile very short time (3 second) harmonic currents should be less than 2.0 times the values given in Table below.

99th percentile short time (10 minute) harmonic currents should be less than 1.5 times the values given in Table below.

95th percentile short time (10 minute) harmonic currents should be less than the values given in Table below.

Maximum Harmonic Current Distortion in Percent of $I_L$						
Individual Harmonic Order (Odd Harmonics)						
Voltage at PCC	$<11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	TDD
$120 < V \leq 69 \text{ KV}$	4.0	2.0	1.5	0.6	0.3	5.0
$69 \text{ kV} < V \leq 161 \text{ kV}$	2.0	1.0	0.75	0.3	0.15	2.5
$V > 161 \text{ kV}$	2.0	1.0	0.75	0.3	0.15	2.5

iii) **Levels for  $P_{st}$  and  $P_{lt}$ :**

95th percentile  $P_{st}$  values and all  $P_{lt}$  values should be less than the values given in Table below.

	MV ( $1 \text{ kV} < MV < 35 \text{ kV}$ )	HV ( $35 \text{ kV} < HV < 230 \text{ kV}$ ) & EHV ( $> 230 \text{ kV}$ )
$P_{st}$	0.9	0.8
$P_{lt}$	0.7	0.6

iv) **Level of DC current injection:**

Values of DC current injection at 33%, 66% and the maximum possible generation shall be less than 0.5% of rated output current.

-Sd/-  
**Chief Engineer/Transmission**