

# ANDHRA PRADESH ELECTRICITY REGULATORY COMMISSION

## Regulation No. 1 of 2007

### TRANSMISSION LICENSEE STANDARDS OF PERFORMANCE

(Published in A.P. Gazette Part II Extraordinary, dated 31.1.2007)

In exercise of the powers conferred by sections 181 read with section 57 (1), 57 (2) and 86 (1) (i) of the Electricity Act, 2003 (36 of 2003), the Andhra Pradesh Electricity Regulatory Commission makes the following Regulation, namely:

#### 1. SHORT TITLE AND COMMENCEMENT

- 1.1 This Regulation may be called the “Andhra Pradesh Electricity Regulatory Commission (Transmission Standards of Performance) Regulation, 2007”.
- 1.2 This Regulation shall be applicable to the State Transmission Utility/ Transmission Licensee in the State of Andhra Pradesh.
- 1.3 This Regulation extends to the whole of the State of Andhra Pradesh.
- 1.4 This Regulation shall come into force on the date of its publication in the official Gazette of Andhra Pradesh.

#### 2. DEFINITIONS

- 2.1 In this Regulation, unless the context otherwise requires:
  - (a) “Act” means the Electricity Act, 2003 (Central Act No. 36 of 2003);
  - (b) “APTRANSCO” means Transmission Corporation of Andhra Pradesh Limited registered under the Companies Act, 1956;
  - (c) “CEA” means the Central Electricity Authority;
  - (d) “Commission” means Andhra Pradesh Electricity Regulatory Commission;
  - (e) “Consumer” in the context of this Regulation means any person who is provided with the transmission services by the transmission licensee and includes any person whose premises are for the time being connected for the purpose of providing transmission services from the licensee, and persons who have applied for availing transmission services from a transmission licensee.
  - (f) “EHV/EHT” means Extra High Voltage/Extra High Tension (voltage level above 33,000 volts);
  - (g) “Grid Code” means the set of principles and guidelines

prepared in accordance with the terms of Section 86 (1)(h) of the Electricity Act 2003;

- (h) "IEGC" means the Indian Electricity Grid Code approved by Central Electricity Regulatory Commission (CERC) and shall include any Grid Code specified by Central Commission under clause (h) of sub-section (1) of section 79 of the Act;
- (i) "PGCIL" means Power Grid Corporation of India Limited, a Central Transmission Utility notified under sub-section (1) of section 38 of the Act;
- (j) "Rules" means the Indian Electricity Rules, 1956 and/or any other rules made under Act;
- (k) "State" means the State of Andhra Pradesh
- (l) "State Transmission System" means the system of EHV electric lines and electrical equipment operated and/or maintained by State Transmission Utility and/or any Transmission Licensee for the purpose of the transmission of electricity among generating stations, external interconnections, distribution systems and any other user connected to it with in the state of Andhra Pradesh;
- (m) "User" means a person, including Generating Stations within the State, Transmission Licensees or Distribution Licensees within the State and open access customer who use the State Transmission System and who must comply with the provisions of the Grid Code;

2.2 Words and expressions used but not defined herein shall have the meaning assigned to them in Electricity Act 2003, Indian Electricity Grid Code, Andhra Pradesh Electricity Grid Code and Indian Electricity Rules, 1956.

### 3. OBJECTIVE

This Regulation lays down the performance standards to maintain certain critical grid parameters within the permissible limits. These standards shall serve as guidelines for State Transmission Utility (STU)/Transmission Licensee to operate the Intra-State Transmission System for providing an efficient, reliable, coordinated and economical system of electricity supply and transmission. The main objectives of these performance standards are:

- (a) To ensure that the grid performance meets minimum standards essential for the Users' system demand and proper functioning of equipment;
- (b) To enable the Users to design their systems and equipment to suit the electrical environment that they operate in; and

- (c) To enhance the quality standards of the State Transmission System in order to move towards standards stipulated in or established under the authority of National and State Acts and Rules in the short term and gradually towards the international standards in the long term.

#### **4. STANDARDS OF PERFORMANCE**

4.1 The Transmission performance standards are classified under the following two categories:

- (a) **Mandatory Standards** - Those performance standards, the failure to maintain which attracts the provisions of sub-section (2) of the section 57.
- (b) **Desirable Standards** - Those performance standards, which are desirable for providing quality, continuity and reliability of services by the Licensees, and though also specified by the Commission do not, unless provided otherwise by the Commission from time to time, attract the provisions of sub-section (2) of the section 57.

4.2 The following standards are the mandatory standards:

- (a) **Voltage Variation**
- (b) **Safety Standards**

These are statutory standards to be complied with by the Licensee as per Electricity Rules 1956 wherever not inconsistent with the Act. The new Rules under section 53 of Act are yet to be issued by the CEA in consultation with the State Government. The standards specified in this Regulation shall therefore be revised after new Rules under the Act come into effect.

4.3 Desirable standards too have been specified herein under section 86 (1) (i) of the Act, with the main objective of providing quality, continuity and reliability of services to the consumers. The Commission shall fix the time-bound schedule for implementation/compliance of/with each parameter of these standards. The following standards are specified herein as desirable of achievement:

- (a) **Feeder Availability**
- (b) **Sub-station Availability**
- (c) **Voltage Unbalance**
- (d) **Neutral Voltage Displacement (NVD)**
- (e) **Voltage Variation Index (VI)**
- (f) **System Adequacy**
- (g) **System Security**

## 5. PHASING OF IMPLEMENTATION

5.1 The performance standards excepting the Mandatory Standards, specified herein shall be implemented in a phased manner in three stages as follows:

- (a) Preliminary Stage (Level-1): The time period of two (2) years immediately after these standards come into force shall be considered as Preliminary Stage. During this preliminary stage, Standards marked as Level 1 shall be achieved, unless specified otherwise.
- (b) Transition Stage (Level-2): Time period spreading up to three (3) years after the Preliminary Stage shall be considered as Transition Stage. During this period, the licensee is expected to upgrade its systems. Standards marked as Level 2 shall be achieved during Transition Stage, unless specified otherwise.
- (c) Final Stage (Level-3): Two years after expiry of the Transition Stage when substantial improvements should have been carried out and the system considered to be in satisfactory condition with necessary capability improvement. Standards marked as Level 3 shall be achieved during this Final Stage.

5.2 In all cases, where standards are specified by appropriate authorities, for example Electricity Rules 1956, such standards shall be required to be complied with as specified by that authority, may be from the preliminary stage itself.

### **Standards to be complied with:**

5.3 The Commission specifies the following standards for STU / Transmission Licensees:

- (a) Voltage Variation:
  - (i) Voltage Variation is defined as the deviation of the root-mean-square (RMS) value of the voltage from its nominal RMS value, expressed in terms of percentage. Voltage Variation may be either of short duration not exceeding one minute or of long duration for a time greater than one minute.
  - (ii) For the purpose of these standards, the sustained variation in steady state voltage exceeding one minute duration shall be considered. The specified permissible limits of sustained voltage variation shall not apply in the cases where the circumstances are reasonably beyond the control of State Transmission Utility/Transmission Licensee e.g. major break-downs, grid failures, accidents, system distress conditions, etc.

- (iii) State Transmission Utility /Transmission Licensee shall make all possible efforts to ensure that the grid voltages remain within the following voltage levels at all points of its Transmission System:

Nominal Voltage (kV)	Maximum Value (kV)	Minimum Value (kV)
400	420	360
220	245	200
132	145	120
33	35	30
11*	11.67	10

\*11kV voltages to be maintained by the transmission licensee only in those cases where 11kV supply is extended from the EHT substation.

(b) Safety Standards:

- (i) State Transmission Utility /Transmission Licensee shall observe the general safety requirements as laid down in IE Rules, 1956, for construction, installation, protection, operation and maintenance of electric supply lines and apparatus.
- (ii) Relevant rules under IE Rules, 1956 pertaining to safety standards and practices shall be followed.
- (iii) State Transmission Utility / Transmission Licensee shall develop its own Operation and Maintenance Manual (including Safety Regulations) taking into consideration the safety requirements for the construction, operation and maintenance of electrical plants and electric lines as may be specified by the Central Electricity Authority under Clause (c) of section 73 read with Section 53 of the Act.

(c) Feeder Availability:

- (i) The feeder availability gives the percentage of time during which the feeder remained available for transmission. Feeder Availability shall be calculated based on following formula:

$$\% \text{ Availability of} = \frac{(\text{No of feeders} \times 8760 - \text{Annual outages in feeder-hours}) \times 100}{\text{Feeder Total availability in feeder-hours}}$$

Here, total availability in hours is equal to the number. of hours in a year i.e. 8760 (non-leap year)

(ii) The Transmission Licensee shall achieve 99% feeder availability from the preliminary stage itself.

**(d) Sub-station Availability:**

(i) The sub-station availability expressed in percentage is the measure of the extent the power transmission capacity remained available from a sub-station. Sub-station availability shall be calculated based on following formula:

$$\% \text{ Availability of SS} = \frac{(\text{Installed capacity in MVA} \times 8760 - \text{Outage in MVA} \times \text{Hours}) \times 100}{\text{Installed capacity in MVA} \times 8760}$$

(ii) The Transmission Licensee shall achieve 97% Substation availability from the preliminary stage itself.

**(e) Voltage Unbalance:**

(i) The phase voltages of a 3-phase supply should be equal in magnitude and phase angle. The loads on each phase should be balanced. Deviations will result in decreased efficiency, negative torque, vibrations and overheating. Severe unbalance could lead to malfunctioning of some equipment. The unbalance is computed as follows:

$$\% \text{ Voltage Unbalance} = \frac{\text{Max Deviation from Mean of } \{V_{RY}, V_{YB}, V_{BR}\} \times 100}{\text{Mean of } \{V_{RY}, V_{YB}, V_{BR}\}}$$

Where,  $V_{RY}$  is Voltage between R & Y phases,  $V_{YB}$  is Voltage between Y & B phases and  $V_{BR}$  is voltage between B & R phases.

(ii) Subject to Distribution Licensee(s) observing the Grid Code Connection Conditions in this regard, the voltage unbalance shall not exceed the values given below:

Implementation Stage	Voltage Level	Limit of voltage unbalance
Preliminary Stage - Level 1	220kV and Above	2%
Transition Stage - Level 2	132kV	3%
Transition Stage - Level 2	33kV and 11kV buses in EHV Substation	3%

Provided that the above limit for Voltage unbalance at the interconnection point with Distribution System are subject to

Distribution Licensee maintaining current unbalance between phases within limit of 3% applied for all feeders of one voltage class emanating from a sub-station including railway traction etc. measured at 3 sub-stations in a row. The Voltage unbalance shall be measured at sub-stations provided with measuring instruments having accuracy class within 1% limit.

**(f) Neutral Voltage Displacement (NVD):**

- (i) Unbalance in loads on three phases cause shifting of neutral from earth potential. Neutral displacement is applicable for transformers with 'Star Point' solidly grounded. Under "solidly" grounded conditions, the potential of neutral should be equal to earth i.e. zero. But in actual conditions, the earthing of the star point is imperfect and so the star to ground offers small resistance. This results in flow of negative sequence currents (because  $I_R + I_Y + I_B$  is not equal to zero, where,  $I_R$  is the current in the R-Phase,  $I_Y$  is the current in the Y-Phase and  $I_B$  is the current in the B-Phase) through neutral to ground. The neutral therefore shifts from earth potential. This performance standard shall be achieved for star point of all EHT transformers having 33kV or 11kV on the low voltage side.
- (ii) Unbalance voltages and displacement of neutral result in decreased efficiency, negative torque, leakage currents, vibrations and overheating. Severe unbalance and neutral displacement could lead to malfunctioning of some equipment.
- (iii) The State Transmission Utility /Transmission Licensee shall ensure that the neutral point voltage of the transformers with respect to earth will not have potential greater than 2% of the no load phase to phase voltage of the transformer.
- (iv) This standard shall be implemented in the Preliminary Stage (Level1) itself.

**(g) Voltage Variation Index (VVI):**

Voltage Variation Index representing the degree of voltage variation from nominal value (in %) over a specified period of time shall be computed separately by the State Transmission Utility /Transmission Licensee for higher than nominal system voltage and lower than nominal system voltage as per the following formula:

$$VVI = \text{Square Root of } \left\{ \sum_{i=1}^N (V - V_i)^2 / N \right\} \times (100 / V_s) \%$$

Where,

$V_i$  = RMS value of measured voltage (in kV) at  $i^{\text{th}}$  hour in the period for which VVI is computed

$V_s$  = RMS value of the nominal system voltage i.e. 400kV, 220kV and 132kV etc. as may be applicable at the interconnection point

$N$  = Number of hourly measurements over the specified period of time

The data from defective metering or any abnormal data shall be discarded from calculations. The VVI shall be computed on monthly basis:

Preliminary Stage - Level 1  $\leq 10$  To be achieved for more than 90% of buses

Transition Stage - Level 2  $\leq 6$  To be achieved for more than 90% of buses

Final Stage - Level 3  $\leq 4$  To be achieved for more than 90% of buses

**(h) System Adequacy:**

System adequacy is the ability of the electric system to receive the generated power or supply the aggregate electrical demand and energy requirements of its consumers at all times, taking into account scheduled and reasonably expected unscheduled outage of system elements. Adequacy of the power system is usually measured in terms of Loss Of Load Probability (LOLP). LOLP is the probability of transmission system capacity not being able to meet system load. LOLP can also be expressed as Loss Of Load Expectation (LOLE) in hours per year. This measure does not consider the amount or duration of the generation capacity shortfall. State Transmission Utility / Transmission Licensee is expected to achieve LOLE hours in percentage as under:

Implementation Stage	Nos. of hours in year when system demand		Loss Of Load Expectation (LOLE) in % of hours ( $C=B \times 100/8760$ )
	can be fully met subject to generation availability (A)	can not fully met even with generation availability (B = 8760 - A)	
Preliminary Stage - Level 1	7446	1314	15%
Transition Stage - Level 2	7884	876	10%
Final Stage - Level 3	8672.4	87.60	1%

(i) **System Security:**

Security is the ability of the electric system to withstand sudden disturbance such as electric short circuit or unanticipated loss of system element, detailed in Clause 6 of “Manual on Transmission Planning Criteria” issued by CEA. The State Transmission System shall be designed for a security level of “n-1” i.e. to withstand a single contingency with little negative effect. This means the most severe fault or tripping of a critical generator, transformer or line should not result in instability of the system, overloading lines and/or transformers for more than 15 minutes, voltage drop of more than 10% when the system import is increased by 20%. State Transmission Utility /Transmission Licensee shall maintain the system security level of "n-1" (single contingency) plus spinning reserve margin for Steady State Operation.

Implementation Stage	System Security Level of “n-1” (Single Contingency) plus spinning reserve margin of:
Preliminary Stage - Level 1	No mandatory requirement
Transition Stage - Level 2	0.5% of system peak load
Final Stage - Level 3	1% of system peak load

**6. REPORTING REQUIREMENT AND COMPLIANCE**

6.1 State Transmission Utility /Transmission Licensee shall furnish to the Commission an half yearly report in the format prescribed at ANNEXURE-A, by October 31st and April 30th of each year on actual performance vis-a-vis the performance standards laid down in these standards as modified from time to time. The report shall contain all parameters irrespective of whether such parameters are applicable during the current reporting period. The State Transmission Utility /Transmission Licensee shall maintain the base data like Log Sheet, Complaint Registers and Interruption Register and relevant load flow studies in respect of system security etc. at sub-station level for compilation of monthly report at circle level. The consolidated report shall be based on circle-wise compilation for whole State Transmission Utility /Transmission Licensee. The circle-wise compilation and base data at sub-station level shall be subject to its scrutiny as considered necessary by the Commission.

- 6.2 The State Transmission Utility /Transmission Licensee shall display on their website the actual performance against the required standards on a monthly basis.
- 6.3 For the purpose of this Regulation, the half-year periods would be as follows:
- (a) 1st Half year: 1st April to 30th September
  - (b) 2nd Half year: 1st October to March 31st.
- 6.4 The Commission may, from time to time, modify the contents of the regulation/formats or add new regulation/formats for additional information.
- 6.5 In addition to the hard copies, the information shall necessarily be submitted in such electronic form or through compact disks or e-mail as the Commission may direct.
- 6.6 Effect of default in compliance with the Standards
- (a) Consequent to failure of State Transmission Utility /Transmission Licensee to meet performance standards specified herein, the affected Utility/Consumers shall be entitled to seek relief/compensation from State Transmission Utility /Transmission Licensee, as may be determined by the Commission:  
  
Provided that the STU/Transmission Licensee shall be given an opportunity of being heard before such compensation is determined by the Commission:  
  
Provided further that the compensation so determined shall be payable within 90 days of its determination by the Commission:  
  
Provided also that the payment of compensation by the State Transmission Utility /Transmission Licensee shall be without prejudice to any penalty , which may be imposed or prosecution initiated by the Commission as provided in the Act.
  - (b) The Commission at its own discretion may require the State Transmission Utility /Transmission Licensee to furnish a report on actual performance levels maintained against the standards specified by the Commission with its Petitions for Annual Revenue Requirement (ARR) and Tariff Determination, which shall be subject to public hearing for tariff setting by the Commission.

## **7. MISCELLANEOUS**

### **Annual Review of Performance Standards**

7.1 The Commission in consultation with State Transmission Utility /Transmission Licensee shall review the performance standards for Transmission System as specified above once in every 5 years or more frequently as may be required.

### **Use of the Information**

7.2 The Commission shall have the right to use the information submitted by State Transmission Utility /Transmission Licensee as it deems fit including publishing it or placing it on the Commission's website and/ or directing the State Transmission Utility /Transmission Licensee to display the information in the licensee's website.

### **Power to Amend**

7.3 The Commission may, at any time add, vary, alter, modify or amend any provisions of this Regulations.

### **Savings**

7.4 Nothing in this Regulation shall be deemed to limit or otherwise affect the inherent power of the Commission to make such orders as may be necessary to meet the ends of justice or to prevent abuses of the process of the Commission.

7.5 Nothing in this Regulation shall bar the Commission from adopting in conformity with the provisions of the Act, a procedure, which is at variance with any of the provisions of this Regulation, if the Commission, in view of the special circumstances of a matter or class of matters and for reasons to be recorded in writing, deems it necessary or expedient for dealing with such a matter or class of matters.

7.6 Nothing stated in this Regulation shall, expressly or implicitly, bar the Commission from dealing with any matter or exercising any power under the Act for which no Regulation has been framed, and the Commission may deal with such matters, powers and functions in a manner it thinks fit.

### **Exemption**

7.7 The Commission may relax adherence to specific performance standard during Force Majeure conditions such as war, mutiny, civil commotion, riot, flood, cyclone, storm, lightening, earthquake, grid failure, and strike/curfew, lockout, fire

affecting the State Transmission Utility's/Transmission Licensee's installations and operation activities.

- 7.8 The Commission under specific circumstances may also relax any provisions of Regulation in general or in specific cases for the period(s) specified in its order(s).

(BY ORDER OF THE COMMISSION)

**S. SURYAPRAKASA RAO**  
Secretary