

Rajasthan Electricity Regulatory Commission (Transmission Licensee's Standards of Performance) Regulations, 2004

RAJASTHAN

India

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Rule

RAJASTHAN-ELECTRICITY-REGULATORY-COMMISSION-TRANSMISSION of 2004

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Rajasthan Electricity Regulatory Commission (Transmission Licensee's Standards of Performance) Regulations, 2004Published vide Notification No. Secy/RERC/REG/No. 24, dated 20.4.2004Last Updated 29th May, 2019No. Secy/RERC/REG/No. 24. - In exercise of powers conferred on it by Section 57 read with Sections 9, 33 & 34 of the Rajasthan Power Sector Reforms Act, 1999 and all powers enabling it in that behalf, the Rajasthan Electricity Regulatory Commission (RERC) after consulting the Commission Advisory Committee & Other stakeholders makes the following regulations, namely:-

1. Short title, commencement and extent.

(1)These Regulations may be called the Rajasthan Electricity Regulatory Commission (Transmission Licensee's Standards of Performance) Regulations, 2004.(2)These Regulations shall be applicable to all Transmission Licensees.(3)They shall come into force on the date of their publication in the Rajasthan Gazette.

2. Definitions.

- In these regulations, unless the context otherwise requires;(1)"Entities" means RVPN and/or any User of State Transmission System as defined in Grid Code and includes Distribution Licensee and RVUN.(2)"Grid Code" means the code prepared by the Licensee in accordance with the terms of

clause 12 of the Transmission and Bulk Supply Licensee, 2001.(3)"Licensee" means the holder of the Transmission Licence.(4)"RVUN" Rajasthan Rajya Vidyut Utpadan Nigam Limited registered under the Companies Act, 1956.(5)The Words and expressions used in these regulations and not defined herein, shall bear same meaning as in the Act or rules & regulations framed thereunder or in absence thereof, the meaning as commonly understood in electricity transmission industry.

3. Objective.

- This standard shall serve as guidelines for transmission licensee to operate its' State Transmission System for providing an efficient, reliable, coordinated and economical system of electricity supply and transmission. These standards set the levels of operational security and quality of supply, which licensee shall be obliged to maintain in making power available for the purposes of supply to licensees and supply to/receipt from various generating stations, as laid down in the Transmission Licence. The objectives of the performance standards are:(1)To ensure that the Grid Performance meets a minimum standard which is essential for the Users system demand and the equipment function properly.(2)To enable the Users to design their systems and equipment to suit the electrical environment that they operate in.(3)To enhance the quality standards of the State Transmission System in order to move towards standard stipulated in or established under the authority of National and State Acts and Rules in the short term and gradually moving towards international standards in the long term.(4)To provide quality of power at the interface point of 33 KV and 11 KV lines emanating from wind farm of other generating stations and terminating at RVPN EHV GSS.

4. Implementation.

- The performance standards established herein shall be implemented in three stages:-(1)Preliminary Stage. - The time period of one year immediately following approval of these standards shall be considered as Preliminary Stage. During preliminary stage Standards marked at level I shall be achieved. Existing conditions shall prevail in the preliminary stage with all efforts for moving forward to next stage. However all Entities shall endeavor to minimise the duration of the Preliminary Stage.(2)Transition Stage. - Time period spreading upto 2 years after preliminary stage during which improvements are expected to be made to the system with injection of investment capital. Standards marked at level 2 shall be achieved during Transition Stage.(3)Final Stage. - Period after expiry of Transition Stage when substantial improvements, have been carried out and the system is considered to be in a satisfactory condition with necessary capital improvement. Standards marked at level 3 shall be achieved during Final Stage.

5. System Availability.

- Licencee shall ensure weighted annual average system availability not less than the percentage given below:

Preliminary Stage-Level 1 95%

Transition Stage-Level 2 97%

Final Stage-Level 3 98%

During level 1 and level 2 stage, the licensee shall maintain annual availability level of 98% of their transmission system including sub-station bay at interconnection points with EHV, 33 KV & 11 KV transmission system from generating station during peak generation period not exceeding 4 months in a year and shall ensure quicker restoration of such transmission system during that period. (1) System availability of a sub-station feeding power to a Distribution Licensee is to be determined according to the following formula: % System Availability of nth sub-station = $(a_1 + a_2 + a_3 + \dots + a_n) / N$ where $a_1, a_2, a_3, \dots, a_n$ is the % availability in 1, 2, 3, ... n th hour. N is the number of hours in the period, which for one year shall be equal to 8760. If a sub-station is Off due to State Load Despatch Centre (SLDC) emergency instructions or the supply to Distribution Licensee is kept Off for not adhering to the Connection Condition or Distribution Licensee System is faulty then such period shall not be considered as non-available for system availability computations. If licensee on account of any transmission system constraint unable to meet, the demand and kW or energy drawal is restricted then the sub-station availability for that hour shall be equal to 100-percentage specified restriction. It is clarified that the constraint of transformer capacity limitation of CT ratio or bus bar or other bay constraints shall be applicable for HV lines at the point of interconnection with RVPN's system. (2) System availability to Distribution Licensee as a whole shall be weighted average of system availability of any sub-stations supplying power to that Distribution Licensee. The weightage of a sub-station being the sum of the capacity in MVA of EHV Transformers installed at that sub-station during that period. (3) Weighted Average Availability of Distribution Licensee = $(SAS_1 \times C_1 + SAS_2 \times C_2 + \dots + SAS_n \times C_n) / (C_1 + C_2 + \dots + C_n)$. Where SAS_n is the system availability of nth sub-station and C_n is the sum of the capacity of EHV transformers of nth sub-station.

6. Voltage Management.

- (1) Voltage Profile. - Licensee shall make all possible efforts to ensure that the grid voltage remain within the following voltage levels at all EHV sub-stations of its Transmission System on real time basis at SLDC. Voltage profile at each interconnection point shall be maintained as under:-

Voltage (kV rms)

Nominal	Maximum	Minimum
400	420	360
220	245	200
132	145	120
66	72.6	59.4
33	34.98	30.03
11	11.66	10.01

(2) Voltage Unbalance. - This performance standard shall be achieved during Final Stage (Level-3). The phase voltages of a 3-phase supply should be of equal magnitude. Deviations will result in decreased efficiency, negative torque, vibrations and overheating. Severe unbalance could lead to malfunctioning of some equipment. Some types of load like electric traction, Induction & Arc. Furnace may induce un-balance in the supply voltages. Distribution Licensee shall ensure that the

loads connected at the inter-connection points are perfectly balanced. Subject to Distribution Licencee observing the Grid Code Connection Conditions in this regard the voltage unbalance expressed as the following ratio shall not exceed the values given below:-

(i) Voltage Unbalance = $\frac{\text{Deviation between highest and lowest phase voltage}}{\text{Average voltage of three phases.}}$

Voltage Level	Limit of voltage unbalance
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220 Kv and above	2%
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Below 220 Kv	3%
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(3) Voltage Variation Index. - This performance standard shall be achieved during Final Stage (Level-3). Voltage variation Index representing the degree of voltage variation from nominal value of over a specified period of time shall be computed by the RVPN. $N \sum (V_i - V_s)^2$

$VVI = \frac{1}{100} \sqrt{\frac{1}{N} \sum (V_i - V_s)^2}$

Where V_i = RMS value of voltage in KV at i th hour in the period for which VV I is computed V_s = the nominal voltage in RMS value of the system i.e. 400 KV, 220, KV and 132KV etc. as may be applicable at the inter-connection point. N = number of hourly measurements over the specified period of time. The Voltage Variatic Index (VVI) on annual basis shall not exceed the limit of 1% for voltage levels of 220 kV, 132 kV and 66 kV and in respect of 400 kV nominal voltage the WI shall not exceed the 1.125%. RVPN shall determine is index separately for higher and lower than normal system voltages. Defective metering/abnormal data will be discarded while computing the index. (4) Current unbalance. - Current unbalance shall not be more than 3%. Current unbalance shall apply on all the feeders of a voltage class emanating from a sub-station taken as a group. In case of railway traction it shall apply on 3 sub-stations in a row taken as a group. Distribution Licencee shall be given at least 12 hours to remedy current unbalance. Failure to meet this criterion shall be discussed in committee proposed under grid code and remedial measures agreed there on.

7. Frequency Management.

(1) State Transmission System shall always operate as an integral part of the Northern Grid. However, frequency management is the joint responsibility of all constituents of the Northern Grid. Licencee shall be responsible for complying with the provisions of IEGC. Licencee shall fulfill its responsibility to enable the Northern Regional Load Despatch Centre to keep the frequency within specified ranges: This shall be monitored and achieved during the Preliminary Stage (Level-1)

Target range

Upper Limit	50.5Hz
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Lower Limit	49.0Hz
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Statutory acceptable limit

Upper Limit	51.5Hz
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Lower Limit	48.5 Hz
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(2) Frequency Variation Index (FVI). - A performance index representing the degree of frequency variation from nominal value of 50.00 Hz over a specified period of time. $N \sum (F_i - 50.0)^2$

$FVI = \frac{1}{100} \sqrt{\frac{1}{N} \sum (F_i - 50.0)^2}$

Where F_i = actual frequency in Hz at i th time period. N = number of measurements over the specified period of time. Licencee shall observe the Indian Electricity Grid Code (IEGC) stipulations for frequency Variation Index as and when implemented in the Northern Region.

8. Reliability.

- System reliability includes three aspects:-(1)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 their 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 system capacity not being able to meet system load. LOLP can also be expressed as loss of load expectation (LOLE) in days per year. This measure does not consider the amount or duration of the capacity shortfall. Licencee to consider LOLE days in percentage as under:-

Implementation Stage	Nos. of days in year when system demand can be fully met subject to generation availability	Nos. of days in year when system demand cannot be fully met even with generation availability	Loss of load expectation (LOLE) in % of days
Preliminary Stage-Level-1	325	40	11%
Transition Stage-Level-2	345	20	6%
Final Stage-Level-3	358	7	2%

LOLE for different voltage level shall be reviewed after first annual review.(2)System Security. - Security is the ability of the electric system to withstand sudden disturbance such as electric short circuits or unanticipated loss of system element. 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 of lines and/or transformers for more than 15 minutes, voltage drop of more than 10% when the system import is increased by 20%. Licencee shall maintain the system security level of " $n-1$ " (single contingency) plus spinning reserve margin for Steady State Operation.(3)Service Reliability. - The points where electric power is supplied from transmission system to the Users (Distribution Licensees, another transmission system, EHV consumers) are called delivery point or grid supply points. Outage at these points, directly affects the Users of the Grid. The reliability level at the delivery points is therefore an indication of quality of service provided by Licencee to its Users. System reliability of the Grid is expressed in terms of • (System Average Interruption Frequency Index (SAIFI)) • (System Average Interruption Duration Index (SAIDI))(4)System Average Interruption Frequency Index (SAIFI). - This index gives number of interruptions in power supply to loads expressed as per year per EHV GSS for a voltage class. All interruptions of duration exceeding 5 (five) minute at a time shall be counted in computing this index. Interruptions due to acts of nature, orders of civil/military authorities, scheduled, outage

(including three shift operation of agriculture pump sets), load shedding to meet capacity shortage, failure of PGCIL and BBMB's transmission system or failure of generating units (leading to grid failure or system islanding) are to be excluded. $SAIFI = \frac{\sum}{N}$: Where \sum = Sum number of interruptions exceeding 5 minutes at a time duration in the year for the voltage class. N = Number of EHV sub-stations in service at the beginning of year having that class of voltage supply. (5) System Average Interruption Duration Index (SAIDI). - This index gives weighted average interruptions in a year with reference to the total connected load on the system. All interrupted loads for duration exceeding 5 (five) minutes at a time in the year are to be counted in computing the index. Interruptions due to acts of nature, orders of civil/military authorities, scheduled outage (including three shift operation of agriculture pump sets), load shedding to meet capacity shortage, failure of PGCIL and EEMB's transmission system or failure of generating units (leading to grid failure or system islanding) are to be excluded in the computation of this index. SAIDI gives the measure of average interruption time per EHV/GSS on annual basis for voltage class. $SAIDI = \frac{\sum D}{N}$: Where $\sum D$ = Sum of duration all interruptions of exceeding 5 minutes at a time in the year for the voltage class. N = Number of EHV sub-stations in service at the beginning of year having that class of voltage supply.

Implementation Stage	SAIFI	SAIDI
Preliminary Stage-Level-1	No limit	No limit
Transition Stage-Level-2	24 per year	10 hrs/year
Final Stage-Level-3	18 per year	8 hrs/year

9. Harmonic Distortion.

- This standard shall be achieved during Final Stage (Level-3). (1) General. - Many loads in power system produce current and voltages at frequencies in multiple of the fundamental frequency. These multiple frequency voltage and currents are called harmonics and their ratio to the fundamental frequency is called harmonic order. Harmonics effect system operation and life of the equipments. Harmonics of add orders are more undesirable. Especially Industrial sub-stations the effect of harmonics are more severe. Some types of loads like Induction and Arc Furnace, electromagnetic equipment such as X-ray machines etc. may produce harmonics in supply voltages. Distribution Licencee shall ensure that the loads connected at the inter-connection points with Licencee not induce any harmonic voltage and distort the supply waveform. Subject to Distribution Licencee observing the Grid Code Connection Conditions in this regard, Licencee shall monitor the voltage harmonic levels at the supply points to the Users (Distribution Licencee, RVUN and major EHV consumer) and other strategic locations on the transmission system. (2) Indicator of Quality for System Harmonics. - Harmonic contents of the supply voltage is indicated by the following indices:-

$$V_{THD} = \frac{\sqrt{\sum_{i=2}^{\infty} V_i^2}}{V_{12}} \times 100\%$$

$$V_{THD} = \frac{V_i}{V_1} \times 100\%$$

V₁

Where V₁ : ith harmonic of voltage V₁ : Fundamental frequency (50 Hz) voltage V_{thd} : Voltage total harmonic distortion V_ihd : Voltage distortion of ith harmonic (3) Control and Measurement. - Harmonic measurement shall conform to IEC Std. 1000-4-7 or IEEE Std. 519. The Total Harmonic Distortion (THD) determined in accordance with IEC Std. 1000-4-7 shall not exceed 1% at the inter-connection point of EHV system in the Final Phase. The measurement should be taken at 10 minutes interval and shall last for 1 week per site. Licencee shall measure the THD at strategic such inter-connection points which it consider prone to harmonic voltage generation at regular interval of 6 months. RVPN shall intimate the programme to RVUN or Distribution Licensee as the case may be at least 7 days in advance and their representative may be present during such measurements. Wherever THD exceeds the limit or individual harmonics exceed 0.5%, RVPN shall measure harmonics with and without load/generating station to ascertain the origin. Licencee will compile a list of all metering points, which are prone to harmonic generation for taking remedial measures.

10. Safety.

- The implementation shall start from the Preliminary Stage (Level-1). Licencee shall observe the General Safety Requirements as laid down in I.E. Rules for construction, installation, protection, operation and maintenance of electric supply lines and apparatus. Licencee shall designate suitable control persons as specified in Grid Code for coordination of safety procedures before work is taken up, during work, and after work is completed till the concerned system component is energized, both inside its own Transmission System and across a control boundary between Licencee's Transmission System and that of any User. Licencee shall develop its own Safety Manual for the purpose of Safety Coordination and the safety manual shall be effective in preliminary stage itself.

11. Annual Review of Performance Standards.

- Annual Review Committee shall be formed by the licensee and its recommendation shall be submitted to the Commission for approval.