

GUJARAT ELECTRICITY REGULATORY COMMISSION (GERC)

Power System Management Standards

Notification No. 7 of 2005

In exercise of the powers conferred under Section 42 (b) of the Gujarat Electricity Industry (Reorganisation and Regulation) Act, 2003 (Gujarat Act 24 of 2003), and all powers enabling it in that behalf, the Gujarat Electricity Regulatory Commission hereby makes following standards, namely:-

Short Title, Extent and Commencement

- a. These Standards may be called the Gujarat Electricity regulatory Commission (Gujarat Power System Management Standards) 2005.
- b. These Regulations extend to the whole of the State of Gujarat.
- c. These Regulations shall come into force on the date of their publication in the Gazette.

SECTION-1

INTRODUCTION

1.1 OVERVIEW:

1.1.1 Scope of Gujarat Power System Management Standards:

The Gujarat Power System Management Standards, herein after called Power System Management Standards, provide guidelines for the operation and management of power system including power generation, power transmission and power distribution and will be supplemental to Grid Code.

1.2 STRUCTURE OF THE POWER SYSTEM MANAGEMENT STANDARDS:

Power System Management Standards consist of 4 Sections as follows:

1.2.1 **Section-1: Introduction** This section outlines the broad features of the Power System Management Standards.

1.2.2 **Section-2: Power Generation Management Standards**

This section provides guidelines for operation of Generating Stations.

1.2.3 **Section-3: Transmission System Management Standards** This section provides guidelines for operation of Transmission System.

1.2.4 **Section-4: Distribution System Management Standards** This section outlines the guidelines for operation of Distribution System.

1.3 DEFINITIONS

1.3.1 The definitions of terms used in these Standards shall be construed in accordance with those given for the like terms in the Grid Code.

1.4 RESPONSIBILITY

1.4.1 In the interest of system security, SLDC shall have full control for real time operations of power system. SLDC shall issue suitable instructions to any Generating Company/ Station or Licensee or User for safe grid operation, according to the provisions in Grid Code.

1.4.2 The Load Despatch Centre as may be notified by the Government of Gujarat under section 31 of the Electricity Act, 2003 (36 of 2003), shall be the State Load Despatch Centre (SLDC) for the purpose of Grid code.

1.5 NON COMPLIANCE

1.5.1 Any User experiencing difficulty in complying with the instructions issued by SLDC, shall promptly report such difficulty to SLDC and take remedial action as directed by SLDC.

1.5.2 In case of, repeated non compliance with the instructions of SLDC, SLDC will take appropriate action according to Grid Code for ensuring the security of the system.

1.6 STANDARDS AND REQUIREMENTS SPECIFIED BY CENTRAL ELECTRICITY AUTHORITY

1.6.1 For effective power system management and operation, the licensees shall follow the Standards and requirements as specified by the Authority according to Section 73 of Electricity Act, 2003 covering matters such as:

- (a) the technical standards for construction of electrical plants, electric lines and connectivity to the grid;
- (b) the safety requirements for construction, operation and maintenance of electrical plants and electric lines;
- (c) the Grid Standards for operation and maintenance of transmission lines;
- (d) the conditions for installation of meters for transmission and supply of electricity.

SECTION-2

POWER GENERATION MANAGEMENT STANDARDS

2.1 INTRODUCTION:

- 2.1.1 These Standards provide guidelines for operation of power stations covering aspects of:
- (a) Outage planning of generating stations,
 - (b) Generation scheduling and despatch,
 - (c) Frequency / Voltage / Reactive power management,
 - (d) Black Start operations etc.

2.2 OUTAGE PLANNING

- 2.2.1 The Generating Companies/Captive Power Plants (CPP) shall co-ordinate with SLDC for their outage plans to ensure adequate availability of power to the Grid System.
- 2.2.2 Notwithstanding provision in any approved outage plan, no generating unit of a Generating Company or Captive Power Plant feeding the grid in excess of 5 MW shall be removed from service without specific release by the State Load Despatch Centre (SLDC)
- 2.2.3 Whenever an outage occurs, the user shall inform SLDC about the expected restoration time. Any change in expected restoration time shall be communicated to SLDC.

2.3 GENERATION SCHEDULING AND DESPATCH

- 2.3.1 All Generating Companies as well as Generating Stations owned by Licensee shall provide $\frac{1}{4}$ hourly MW / MVAR / maximum MWh availability (00.00 – 24.00 hours) of all Generating Units, to SLDC daily on day ahead basis by 09.00 hours.
- 2.3.2 CPPs (5MW and above capacity) feeding in to the grid shall provide the $\frac{1}{4}$ hourly import / export figures to SLDC daily on day ahead basis by 09.00 hours.
- 2.3.3 In working out the MW / MVAR / maximum ex-bus MWh, hydro power stations shall take into account their respective prevailing reservoir levels and any other restrictions on water usage and shall report the same to SLDC.

- 2.3.4 The total ex-bus MWh, which can be actually delivered by Generating Companies during the day, shall also be declared. The maximum capacity for each time block ($\frac{1}{4}$ hour) and the total declared available capacity (MW) for the day, including limitation on generation during any specific period of the day as declared by the Generating Companies along with inputs from CPPs as well as Generating Stations owned by Licensee, shall form the basis of generation scheduling.
- 2.3.5 In case of thermal stations, the declaration shall be for the capacity of the Generating Station (excluding units closed due to orders from SLDC) to deliver ex-bus MWh for each time block of the day ($\frac{1}{4}$ hour). The capacity of the Generating Plant hereinafter referred to as declared capacity shall form the basis of generation scheduling.
- 2.3.6 SLDC shall obtain from Western Region Load Despatch Centre (WRLDC) the $\frac{1}{4}$ hourly MW entitlements from Inter State Generating Stations by 11.00 hours on a day ahead basis.
- 2.3.7 SLDC shall produce a day ahead $\frac{1}{4}$ hourly generation schedule after consolidation of the data provided by the Generating Companies/inputs from CPP and Generating Stations owned by Licensee and WRLDC. It will take into account the $\frac{1}{4}$ hourly demand estimates and latest planned drawal schedule agreed with WRLDC.
- 2.3.8 In preparation of the despatch schedule, SLDC shall take into account, the priority of the Generation Stations provided by the Distribution Licensees keeping in mind the technical constraints. In case it is not available, the relative commercial costs to the Licensees for the operation of the Generating Units based on latest updated cost structure furnished by Generating Companies/ CPPs shall be used.
- 2.3.9 SLDC shall prepare the day ahead generation schedule keeping in view the following:
- (a) Transmission system constraints from time to time.
 - (b) $\frac{1}{4}$ hourly load requirements as estimated by SLDC based on the inputs provided by all Distribution Licensees and CPPs.
 - (c) The availability of generation from Generating Companies, Inter State Generating Companies and CPPs as well as Generating Stations owned by Distribution Licensee together with any constraints in each case.
 - (d) Optimisation of both MW/MVAR outputs from Generating Stations.

- 2.3.10 SLDC may also require Generating Companies / CPPs as well as Generating Units owned by Distribution Licensee to generate MVAR within their respective capability limit to maintain station bus voltages within the specified band of maximum and minimum.
- 2.3.11 SLDC shall intimate tentative generation schedule / import / export schedule for the following day to all Generating Companies / CPPs (including any generating unit not required to be run) by 18.00 hours.
- 2.3.12 Generating Companies shall promptly report to SLDC regarding changes of Generating Unit availability or capability, or any unexpected situation, which would affect its operation.
- 2.3.13 All CPPs and Generating Stations owned by Licensee shall similarly report regarding their export to SLDC. SLDC shall advise users as soon as possible of any necessary rescheduling.

2.4 FREQUENCY MANAGEMENT

- 2.4.1 The SLDC shall endeavour to run the system within the frequency band of 49.0 Hz to 50.5 Hz.
- 2.4.2 The SLDC shall be vigilant when the frequency begins to rise above 50 Hz and initiate the following measures to bring down the frequency to around 50 Hz.
- (a) Advise hydro stations to reduce generation without water spillage and give appropriate instructions to other Generating Stations.
 - (b) Check generation scheduling Vs generation and request concerned Generating Company as well as the CPPs and Generating Stations owned by the Distribution Licensee with excess generation to conform to generation schedule.
 - (c) Advise thermal stations to reduce the generation to the required extent but not to the extent requiring oil support.
- 2.4.3 In case frequency rises to 50.5 Hz in spite of above measures, the SLDC shall:
- (a) Advise all the Generating Units as well as CPPs and Generating Units owned by Licensee to implement backing down schedule which shall always be updated in the merit order, to reduce the generation considering variable cost in reducing order (i.e. Units with the highest variable will back down first); or in logical manner with due consideration to day ahead generation schedule.

- 2.4.4 In case the frequency still has a rising trend even beyond 50.5 Hz, and if there is import at Connection Points/ Interface Point with Western Grid, SLDC in consultation with WRLDC may island the Gujarat State system from the rest of the Western Grid as may be feasible for system security.
- 2.4.5 SLDC shall be vigilant when frequency begins to fall below 49.5 Hz and initiate the following measures to raise the frequency to approach 50 Hz:
- (a) Check generation Vs generation schedule and request concerned Generating Companies as well as CPPs and Generating Stations owned by the Licensee with less generation to conform to generation schedule.
 - (b) Check whether there is any excess drawl at any Connection Point/ Interface Point by any Distribution Licensee and advise such Licensee/ Company to restrict its drawl within schedule.
 - (c) Advise generating stations to synchronise standby machines if available.
- 2.4.6 In case the frequency still falls and reaches 49.0 Hz the SLDC shall advise the Distribution Licensees to shed load manually. The Distribution Licensees shall not restore normal load shedding unless and until permitted by SLDC.
- 2.4.7 In case the frequency still continues to fall and reaches 48.5 Hz, SLDC shall in consultation with WRLDC examine the possibility to island the Gujarat State system from rest of Western Grid if there is export at Connection Point / Interface Point with other states in the region.
- 2.4.8 Automatic load frequency relays would be one of the devices to assist to maintain frequency at 50 Hz.

2.5 VOLTAGE AND REACTIVE POWER MANAGEMENT

- 2.5.1 Generating companies shall make available to SLDC, STU and Transmission Licensee the up-to-date capability curves for all Generating Units indicating restrictions if any, to allow accurate system studies and effective operation of the Transmission System. CPPs shall similarly furnish the net reactive capability that will be available for export / import from the Transmission System.
- 2.5.2 Load flow studies shall be conducted for different conditions of operation commonly encountered. The voltages of all the node points shall have to be maintained within the specified limits. On the basis of these studies

SLDC shall instruct Generating Companies and CPPs to maintain specified voltage levels at connecting Points / Interface Points by transformer tap changing to the extent possible and use MVAR reserves in accordance with technical limits of Generating Units as per capability curves. High transient voltages, which may generally occur during load throw off and switching operations, should be controlled to within specifications.

2.6 BLACK START OPERATIONS

- 2.6.1 The SLDC shall maintain and keep updated a record of Generating Station Black Start capabilities and associated Generating Station Black Start operation plans. The Generating Companies shall be responsible for commencing their planned Black Start procedure on the instruction of the SLDC and steadily increasing their generation according to the demand intimated by the SLDC.
- 2.6.2 The SLDC may arrange for mock orientation of Black Start preparedness in the system at least once in a year on a prearranged programme to provide for corrections.

2.7 SCHEDULE OF DESPATCH

- 2.7.1 Generation Despach
 - 2.7.1.1 All Generating Companies shall regulate generation and CPPs shall regulate their export according to the daily generation schedule. All Generating Units, above 5 MW including CPPs as well as Generating Stations owned by Licensee, will be subject to despatch instructions of SLDC. CPPs as well as Generating Stations owned by Licensee will be subject to these instructions to the extent of their respective exports to the STU/ Transmission Licensee. SLDC shall issue similar despatch instructions to all Generating Companies / CPPs on same level as previously available for day ahead schedule unless rescheduling is requested by Generating Companies/ CPPs. In the absence of any revised despatch instructions by SLDC, Generating Companies and CPPs shall generate / export according to the available ¼ hourly day ahead generation schedule. Despach instruction shall be in the standard format. These instructions will recognise declared availability and other parameters, which have been made available by the Generating Company to SLDC. These instructions shall include date,

time, name of the Generating Station, Generating Units (total export in case of CPP), name of operators sending and receiving the same.

2.7.1.2 Despatch instructions may include:

- (a) Switching a generator in or out of service.
- (b) Details of reserve to be carried on a unit.
- (c) Increasing or decreasing MVAR generation/absorption to maintain voltage profile based on margin level.
- (d) Beginning pre-planned black start procedures.
- (e) Holding generating units on standby if available.

2.7.2 Communication with Generating Companies: - Despatch instructions shall be issued by e-mail/Fax/Tele-printer/Telephone/PLCC/VSAT or any other convenient mode of communication and confirmed by concerned officers with name and designation at sending and receiving end and logging the same at each end. All such oral instructions shall be complied with immediately, and written confirmation shall be issued by Fax, Tele-printer or otherwise.

2.7.3 Action required by Generating Companies

2.7.3.1 All Generating Companies and CPPs as well as Generating Stations owned by Licensee shall comply promptly with despatch instructions issued by SLDC unless such instruction affect the safety of plant or personnel. They shall promptly inform SLDC in the event of any unforeseen difficulties in complying with an instruction. All Generating Units shall have Automatic Voltage Regulators (AVR) in service. All Generating Units shall have the governors available and in service and must be capable of automatic increase or decrease in output within the normal declared frequency range and within their respective capability limits. Generating Companies shall immediately inform SLDC by telephone of any loss or change (temporary or otherwise) of / in the operational capability of any generating unit which is synchronised to the system or which is being used to maintain system reserve. Generating Companies shall inform SLDC of any removal of AVR and / or governor from service along with reasons thereof. CPPs shall similarly inform any change in status affecting their ability in complying with despatch instructions. Generating Companies including CPPs shall not de-synchronise Generating Units without instruction from SLDC except on the grounds of safety to the plant and personnel, which shall be promptly reported to SLDC.

- 2.7.3.2 Generating Companies and CPPs shall report any abnormal voltage and frequency related operation of generating units / feeders promptly to SLDC. Generating companies including CPPs shall not synchronise Generating Units without instruction from SLDC.
- 2.7.3.3 In the event of any emergency in the Generating Station, the Generating Company may synchronise units with the grid with prior intimation in the interest of safe operation of the grid following standing instructions developed for such purpose under “contingency planning” of the Grid Code.
- 2.7.3.4 Should a Generating Company fail to comply with any of the above provisions, it shall inform SLDC promptly of this failure with reasons.

2.8 STANDARDS TO BE MET BY THE GENERATING COMPANIES: -

- 2.8.1 The IEGC/Grid Code specifies voltage and frequency standards with limits of variation for transmitting the power, which the Generating Company including CPPs as well as Generating Stations owned by Licensee have to comply with.
- 2.8.2 Thermal/nuclear Generating Units shall not run at leading power factor. However, for the purpose of charging, Generating Unit may be allowed to operate at leading power factor as per the respective capability curves.
- 2.8.3 The Transmission Licensee shall incorporate conditions in wheeling agreement requiring the generating companies and CPPs as well as Generating Stations owned by Licensee, to commit:
- (a) Reactive power capability (MVAR)
 - (b) Economic back down level.
 - (c) Loading increment rate from back down level to maximum continuous rating (MW/Min).
 - (d) Loading decrement rate from maximum continuous rating to back down level (MW/Min).
 - (e) Pickup rates on synchronising in MW to the extent that it does not jeopardise safety of its plant and personnel under the following conditions:
 - Cold Start.
 - Warm Start.
 - Hot Start.

2.9 MONITORING OF GENERATION

- 2.9.1 The Transmission Licensee shall provide facilities such as SCADA system and point-to-point voice and data communication links to SLDC for receiving the following real time data from generating companies:
- (a) Frequency.
 - (b) MW output.
 - (c) MVAR output.
 - (d) MW and MVAR flow in outgoing lines.
 - (e) Voltage at interconnection bus.
- 2.9.2 The SLDC shall establish suitable procedure for monitoring the following parameters of a generating plant:
- (a) Declared gross generation capacity.
 - (b) Loading rate of a unit.
 - (c) Un-loading rate of a unit.
 - (d) Active and Reactive power delivery following despatch instructions.

SECTION- 3

TRANSMISSION SYSTEM MANAGEMENT STANDARDS

3.1 INTRODUCTION:

- 3.1.1 This section formulates guidelines for grid operation covering following aspects:
- (a) Data management and system studies.
 - (b) Load despatch and communication
 - (c) Voltage and reactive power management.
 - (d) Demand management.
 - (e) System operation.
- 3.1.2 These Standards shall serve as guidelines for the STU to operate the transmission system for providing an efficient, coordinated and economical system of electricity transmission.

3.2 DATA MANAGEMENT AND SYSTEM STUDIES

- 3.2.1 For planning the Transmission System for efficient operation the STU should collect, store & manage detailed up to date data of the complete system. This will enable in carrying out system studies whenever required. The details of system data to be collected and stored shall generally be as indicated in Annexure- 1.
- 3.2.2 SCADA system at SLDC shall be equipped with appropriate real time data stamping facility at preferably 5 to 10 seconds interval for facilitating event analysis and data verification.
- 3.2.3 The STU shall periodically carryout the following system studies.
- (a) Load flows under different conditions of operation.
 - (b) Steady state and transient stability limits of the system.
 - (c) Location and extent of reactive power compensation required in the system for maintaining satisfactory voltage profile in the system.
 - (d) Fault levels at different points in the system.
 - (e) Transient & dynamic studies.
 - (f) Any other studies as may be required.

3.3 LOAD DESPATCH

3.3.1 According to the Section 32 (2) of Electricity Act, 2003, the following are the functions of State Load Despatch Centre, which shall :

- (a) be responsible for optimum scheduling and despatch of electricity within a State, in accordance with the contracts entered into with the Licensees or the Generating Companies operating in that State;
- (b) monitor the grid operations;
- (c) keep accounts of the quantity of electricity transmitted through the State grid;
- (d) exercise supervision and control over the intra-state transmission system;
- (e) be responsible for carrying out real time operations for grid control and despatch of electricity within the State through secure and economic operation of the State grid in accordance with the Grid Standards and the state Grid Code.

3.3.2 The SLDC shall also perform the following functions.

- (a) Daily generation, load scheduling and issuing despatch instructions.
- (b) Monitoring line MW and MVAR draws, EHT bus Voltages and Frequency.
- (c) Monitoring generation output, export/import at various Connection Points / Interface Points.
- (d) Co-ordinating restoration process after partial or total blackouts in the Transmission System.
- (e) Finalisation of outage plan for Transmission System for carrying out maintenance, construction, modification, diversion etc., in co-ordination with the Generating Stations and Distribution System so that the security standards of the Transmission System are not affected.
- (f) Co-ordination with Transmission Licensee for installation of automatic under frequency load shedding (AUFLS) for automatic tripping of non-critical Loads as identified by the Distribution Licensee and informed to SLDC,

- (g) Co-ordinated operation of major Transmission Lines and generation to maintain frequency and voltage profile within set limits.
- (h) Co-ordination of the studies to review adequacy of the system and inter system operating practices under unusually severe system disturbances in association with STU / the Transmission Licensee.
- (i) Issue of standing instructions to operating staff of each system to deal with separation of the system from inter-connected network.
- (j) Co-ordinate with Regional Power Committee and WRLDC for Inter State Grid Management and event analysis as well as for implementation of corrective measures.

3.4 COMMUNICATION

- 3.4.1 The STU / Transmission Licensee shall establish and maintain a reliable and efficient point-to-point voice and data communication links between State Load Despatch Centre (SLDC), Western Regional Load Despatch Centre (WRLDC), Generating Stations and EHT substations.
- 3.4.2 All operational communications/instructions transmitted by/to SLDC shall be recorded and preserved by all concerned for such period as may be necessary.

3.5 REACTIVE POWER MANAGEMENT

- 3.5.1 The STU / Transmission Licensee shall endeavour for optimum use of the existing reactive resources and the reactive reserves in the system to meet the steady state voltage limits at all buses in the Transmission System as set out in "Transmission System Planning and Security Standard" of Grid Code.

3.6 VOLTAGE MANAGEMENT

- 3.6.1 The STU / Transmission Licensee shall monitor voltage levels at all EHT substations of its transmission system on real time by installing data acquisition system.
- 3.6.2 System voltage shall be regulated by taking all feasible measures to regulate system reactive power flows and frequency.
- 3.6.3 All local voltage problems shall be remedied to the extent possible by operating local transformer taps by Transmission and Distribution Licensees in accordance with the provisions of the Grid code or in consultation with the SLDC.

3.6.4 In case of system high voltage, the SLDC shall take the following measures:

- (a) Request Generating Stations to decrease MVAR generation in accordance with machine capability curves.
- (b) Switch in bus reactors where provided in consultation with WRLDC.
- (c) Switch out capacitors where provided (if they are switched in).
- (d) Arrange to reduce taps of 400/220 kV and 220/132 kV Interconnecting Transformers.
- (e) Switch out one circuit of double circuit transmission line (if lightly loaded).
- (f) Any other measures considered necessary.

3.6.5 In case of system low voltage, the SLDC shall take the following measures:

- (a) Request Generating Stations to increase MVAR generation in accordance with machine capability curves.
- (b) Switch out bus reactors (if they are switched in).
- (c) Switch in capacitors.
- (d) Arrange to increase system Voltage by changing the taps of 400/220 kV and 220/132 kV Interconnecting Transformers.
- (e) Restoration of circuits under outage.
- (f) Instruct manual load shedding

3.7 DEMAND MANAGEMENT

3.7.1 The STU/ Transmission Licensee shall monitor MW/MVAR loading of each EHT line and each Interconnecting Transformer on real time basis by installing data acquisition system.

3.7.2 If any system component is being overloaded/overheated, the load on the same shall be reduced following suitable procedure.

3.8 LOAD SHEDDING

3.8.1 SLDC shall check whether there is any excess drawl at any Connection Points/ Interface Points by any Distribution Licensee and advise him to restrict his Drawl within schedule. If there is no such excess Drawl, and there is also no possibility of increasing the generation by the Generating Companies, load shedding should be ordered by SLDC by tripping such of the lines as found necessary and appropriate at that time. Under

frequency relays appropriately set shall be provided for the purpose by the Transmission Licensee wherever possible and once installed, shall not be bypassed under any circumstances unless specifically permitted by SLDC.

3.9 ISLANDING SCHEME

- 3.9.1 To avoid total blacking out of the grid during system disturbances and for early normalisation, islanding schemes for major Generating Stations and part/parts of the Transmission System shall be developed by SLDC in consultation with WRLDC, STU, Generating Stations and Distribution Licensees.

3.10 POST DISTURBANCE ANALYSIS

- 3.10.1 All major grid disturbances causing tripping of generating units (110 MW and above), tripping of Transmission lines (220KV and above) causing full/partial system blackout, breakdown of Transmission lines causing prolonged interruption and load restrictions may be promptly discussed in the Grid Code Review Panel. Additionally a sub-committee that may be formed if required by the Panel for further investigation , immediately after the occurrence. Disturbance reports and recommendations made in such meetings shall be compiled and circulated to all members of the Grid Code review Panel for implementation.

3.11 EVENT REPORTING

- 3.11.1 The STU/Transmission Licensee/SLDC shall monitor all abnormal occurrences or events affecting the operation of the system as outlined in the Grid Code in section “Operational event and Incident/Accident reporting”.
- 3.11.2 The Transmission Licensee shall ensure that within 10 minutes of an occurrence, verbal/telephonic communication shall be made by its to a designated officer to the officer in charge of the shift of SLDC who shall have authority to ask for follow up action as deemed fit. The shift officer at SLDC must, however, give utmost priority in safeguarding the system before initiating the reporting procedure.
- 3.11.3 Within one hour of restoration of normalcy, a preliminary report shall be prepared in a form (to be standardised by the STU) by the designated officer of the Transmission Licensee in consultation with various agencies and communicated to the designated officers of the concerned agencies. (as may be decided by the SLDC)

3.11.4 Within 48 hours, a detailed report shall be prepared in a form (to be standardised by the STU) and communicated to the designated officer/officers of concerned agencies. (as may be decided by the SLDC)

3.12 OUTAGE PLANNING

3.12.1 The STU/ Transmission Licensee shall ensure that its plan for outage of circuits / transformers required for maintenance, construction, modification, diversion, etc. does not violate the security standards of Transmission system.

3.13 PROTECTION COORDINATION

3.13.1 The STU/ Transmission Licensee shall co-ordinate the settings of relays in the protection schemes of the Transmission System with those of the Generating Companies, CTU and grid system of neighbouring states at respective Connection Points / Interface Points.

3.14 SHORT CIRCUIT LEVELS

3.14.1 As a routine measure the STU/ Transmission Licensee shall intimate all Users of the Transmission System, the approximate short circuit level (fault level) of the Transmission System at each Connection Points/ Interface Points both at EHT bus and at HT bus.

3.15 ON LOAD TAP CHANGING

3.15.1 The STU/ Transmission Licensee shall prepare a schedule as approved by SLDC for operation of on-load taps of power transformers and Interconnecting Transformers at each EHT substation in the Transmission System under abnormal voltage profile.

3.16 SAFETY CO-ORDINATION

3.16.1 The STU/ Transmission Licensee shall observe the general safety requirements for construction; installation, protection, operation and maintenance of electricity supply lines and apparatus as laid down in IE Rules 1956, which are in force for time being and as may be subsequently replaced by technical standards for construction of electrical plants, electrical lines and connectivity to the grid formulated by CEA as specified under Section 73(b) of Electricity Act, 2003.

3.16.2 The STU/ Transmission Licensee shall designate suitable Control Persons as specified in Grid Code for co-ordination of safety procedures before

work is taken up, during work and after work is completed till the concerned system component is energised, both inside its own Transmission System and across working area between its Transmission System and that of any User.

- 3.16.3 The STU/ Transmission Licensee shall develop its own safety manual for the purpose of safety co-ordination.

3.17 MAINTENANCE SCHEDULES

- 3.17.1 The STU/ Transmission Licensee shall develop maintenance schedules of lines and substation equipment in conformity with applicable provisions of I. E. Rules 1956, which are in force for time being and as may be subsequently replaced by technical standards for construction of electrical plants, electrical lines and connectivity to the grid formulated by CEA as specified under Section 73(b) of Electricity Act, 2003 and relevant CBI&P manuals/manufacturers' maintenance manuals.

3.18 MAINTENANCE STANDARDS

- 3.18.1 The STU/ Transmission Licensee shall establish a hierarchy for implementation of the maintenance standards and its monitoring to comply with the stipulations mentioned in "Standard of Performance of Licensee" issued separately by GERC.

3.19 SPARES

- 3.19.1 For convenience of maintenance, repairs and replacement of line equipment and substation equipment, the STU/ Transmission Licensee shall develop a suitable policy on spare parts so as to ensure system reliability.

3.20 TESTING LABORATORIES

- 3.20.1 The STU/ Transmission Licensee shall establish testing laboratories of its own fully equipped for routine testing of relays, meters, current transformers, potential transformers, condenser bushings and other electrical accessories used in Substations in accordance with relevant Indian standards and manufacturer's instructions. Alternatively, the STU/ Transmission Licensee shall have easy access to any accredited testing facilities.

3.21 TESTING ORGANIZATION

3.21.1 The STU/ Transmission Licensee may establish testing organisations under its control, staffed with qualified, trained and skilled persons and equipped with all necessary testing equipment, power supply etc., for conducting periodical field tests of substation equipment such as transformer, circuit breaker, current transformer, potential transformer, station battery, relays and meters, control wiring, cables, lightning arresters, substation earthing, etc. Alternatively, the STU/ Transmission Licensee shall have easy access to any accredited testing facilities.

3.22 TOOLS, TACKLES AND SKILLED MANPOWER

3.22.1 The STU/ Transmission Licensee shall maintain in good condition all necessary equipment, tools, tackles etc. alongwith required strength of skilled manpower, for carrying out maintenance of lines, substation equipment and ensure their availability at all substations.

3.23 INSPECTION OF LINES AND SUBSTATIONS

3.23.1 The STU/ Transmission Licensee shall carry out periodical inspection of all lines and sub-stations of its transmission system, to ensure that preventive maintenance of lines and substations is carried out according to preventive maintenance schedules and maintain appropriate records.

3.24.2 ANNEXURE – 1

DATA FOR OPERATION AND STUDIES WITH REFERENCE TO CLAUSE 3.2

All data should be on 100 MVA base.

1. Line data for lines of 132 kV level and above.

- (a) From Bus Number:
- (b) From Bus name:
- (c) To Bus Number:
- (d) To Bus Name:
- (e) Voltage Level (kV):
- (f) Ckts Number:
- (g) Line length (KM):
- (h) Conductor Size and Number of conductors per phase:
- (i) Pos. Sequence Resistance /Km (in p.u.):
- (j) Pos. Sequence Reactance /Km (in p.u.):
- (k) Pos. Sequence Half-line susceptance/Km (in p.u.):
- (l) Zero Sequence Resistance /Km (in p.u.):
- (m) Zero Sequence Reactance /Km (in p.u.):
- (n) Zero Sequence Half line susceptance/Km (in p.u.):
- (o) Line capacity (amps) (specify ambient temperature °C and temperature rise over ambient in °C):
- (p) Line reactors (if any) (at both ends) MVAR:
- (q) Year of commissioning:
- (r) No. of locations:
- (s) Suspension/Tension:
- (t) No. of joints with location nos.:
- (u) No. of Railway crossing:
- (v) Road crossing:
- (w) Express / Highway crossing:
- (x) Canal crossing:
- (y) River crossing:
- (z) EHT line crossing with location:

2. Transformer Data for all 400/220 kV and 220/ 132kV Auto Transformers and Generator Transformers.

- a) From Bus Number:
- b) From Bus name:
- c) To Bus Number:
- d) To Bus Name:
- e) Voltage on HV Side (kV):
- f) Voltage on LV Side (kV):
- g) Number of Transformers:
- h) Resistance (in p.u.):
- i) Reactance (in p.u.):
- j) Tap setting:
- k) Nominal Tap:
- l) Tap Step:
- m) Tap Range:
- n) Transformer Type (2 or 3 winding. Vector Group):
- o) Rating of Transformer (MVA):
- p) Year of Commissioning:

2.1 Special data for 3 winding Transformer

- a) Impedance between (p.u.)
 - HV-MV:
 - MV-LV:
 - HV-LV:
- b) Voltage on HV side:
- c) Voltage on MV side:
- d) Voltage on LV side:
- e) Loading capacity of Tertiary (if any):
- f) Grounding impedance in p.u. :
(if the neutral of the star is grounded)
- g) Tan Delta
- h) DGA
- i) FRA

3. Bus Data:

- a) Bus Number:
- b) Name of Bus:
- c) Bus Voltage (kV):
- d) Gen. Bus/Load Bus:
- e) P gen. (MW):
- f) Q gen. (MVAR):
- g) P Load (MW):
- h) Q Load (MVAR):
- i) V obtained from Gen. Bus:
- j) MVAR Capability curve for generators:
- k) Shunt reactor, if any:
- l) Shunt capacitor if any:

4. MACHINE DATA

A) Generator Data

- a) Capacity MVA (maximum continuous rating), MW, MVAR, (minimum) & MVAR (Maximum):
- b) Generator voltage in kV nominal, minimum, maximum:
- c) Sequence impedance of winding on its 'own' base/Grounding impedance.
- d) Direct Axis:
 - Synchronous Reactance:
 - Transient Reactance:
 - Sub-transient reactance:
- e) Quadrature Axis
 - Synchronous Reactance:
 - Transient Reactance:
 - Sub-transient reactance:
- f) Inertia constant in MW-Sec/MVA
- g) Damping constant:
- h) Armature Resistance:
- i) Armature Leakage Reactance:

- j) Direct Axis
Transient time constant:
Sub- transient time constant:
- k) Quadrature Axis
Transient time constant:
Sub- transient time constant:

B) Turbine Data

- (a) Type of Turbine i.e. Hydro/Steam, Francis, Kaplan etc.
- (b) Block diagram of turbine model along with the values of gain constants and time constant.
- (c) Turbine damping constant
- (d) Speed of machine, nominal speed
- (e) Any other constant/ Specification as described in the block diagram of Turbine model.

C) Exciter Data

- (a) Block diagram of exciter model along with the values of gain and time constant like:
Voltage Regulator gain and time constant
Main exciter gain and time constant
Stabilising loop/closed loop gain and time constant
- (b) Power system stabiliser data.

D) Speed Governor Data.

- (a) Block diagram of governor model along with the values of gain and time constant.
- (b) Max. & Min. valve position limits.
- (c) Effective speed governor system gain
- (d) Valve servo time constant.

5. DEMAND DATA FOR ALL 220 kV AND 110 kV SUBSTATIONS

- (a) Weekly MW/MVAR load details.
MW/MVAR loading should indicate the percentage of agricultural load, industrial load, domestic load & commercial load separately.

Restrictions imposed

Assessed reduction in Demand due to restrictions

Unrestricted demand

: MW

: MVAR

(b) Name of Substation:

Typical daily load curve (for week day)

6. REAL TIME DATA

- (a) Each Generating Units - Generation MW
- (b) All 400/220 kV Line flow - MW and MVAR
- (c) All 400/220 kV Transformer flow - MW and MVAR
- (d) All 220/132 kV Transformer flow - MW and MVAR
- (e) Bus Voltages at 400 kV, 220 kV buses
- (f) Tap positions - 400/220 kV & 220/132 kV Transformers.
- (g) Status of Circuit Breaker positions of all 400 kV, 220 kV and 132 kV lines, transformers, generators.

SECTION- 4

DISTRIBUTION SYSTEM MANAGEMENT STANDARDS

4.1 INTRODUCTION:

- 4.1.1 This section formulates guidelines for operational criteria covering following aspects:
- (a) Demand and Supply Scheduling
 - (b) Load Monitoring.
 - (c) Load Balancing.
 - (d) Voltage Monitoring and Control.
 - (e) Data Logging.
 - (f) Load Management.
 - (g) Communication.
 - (h) Safety Co-ordination
 - (i) Maintenance

4.2 DEMAND AND SUPPLY SCHEDULING

- 4.2.1 All Distribution Licensees (including Licensees having own Generating Units viz AECO) shall provide $\frac{1}{4}$ hourly MW / MVAR / maximum MWH requirement (00.00 – 24.00 hours) of their respective area of supply, to SLDC daily on day ahead basis by 09.00 hours.
- 4.2.2 SLDC shall produce a day ahead $\frac{1}{4}$ hourly demand schedule after consolidation of the data provided by the Distribution Licensee. It will take into account the $\frac{1}{4}$ hourly generation availability including latest planned drawal schedule agreed with WRLDC.
- 4.2.3 SLDC shall prepare the day ahead Demand schedule keeping in view the following:
- (a) Transmission System constraints from time to time.
 - (b) $\frac{1}{4}$ hourly Demand requirements as estimated by SLDC.
- 4.2.4 SLDC may also require the Distribution Licensee to maintain the power factor at 0.9 and above.
- 4.2.5 SLDC shall intimate the supply schedule for the following day to all Distribution Licensees by 18.00 hours.

4.3 LOAD MONITORING

- 4.3.1 Station Log Sheets for 66kV Substations and substations at higher than 66kV voltage and Registers for station operations duly recording the hourly readings of the meters such as current, load, voltage etc., and the station operations shall be maintained at each station. A separate register for the daily energy meter readings for both the energy received and energy sent out shall be maintained along with the above.

4.4 LOAD BALANCING

- 4.4.1 As far as possible the Distribution Licensee shall limit the unbalanced load on the LT side of the distribution transformers within 10% of the peak load.
- 4.4.2 The secondary currents and voltages of the distribution transformers shall be recorded at least once a month during expected peak load hours on all the phases.

4.5 VOLTAGE MONITORING AND CONTROL

- 4.5.1 The Voltage monitoring at each Substation feeding 11 kV Distribution System shall be carried out by data logging.
- 4.5.2 The Voltage monitoring on the LT side of the distribution transformers shall be carried out by the Distribution Licensee as deemed necessary to monitor the voltage levels for at least two numbers of transformers in each 11 kV feeder as follows:
- (a) One Transformer at the beginning of the feeder.
 - (b) One Transformer at the tail end of the feeder.
- 4.5.3 Improvement to voltage conditions shall be achieved by operating tap changer wherever available in 22 / 11 kV substations and by contacting over telephone the operators of Transmission Licensee at the Connection Point / Interface Point, to correct Voltage at the sending end whenever required.

4.6 DATA LOGGING

- 4.6.1 All-important data such as Voltage, Current, Power factor, MW, Transformer data such as tap position, oil/winding temperature, etc shall be logged on hourly basis in all Substations 66kV and above feeding distribution lines.
- 4.6.2 The following records among others shall be maintained for each Substation either at centralised location or at each Substation as per the

practices of Distribution Licensee. However, the list is suggestive but not exhaustive:

- (a) Operation and maintenance manuals for the equipment and the entire station consisting of the details of operation of the station and maintenance of equipment,
- (b) Maintenance registers for the equipment and station batteries,
- (c) Interruption Registers,
- (d) Line Clearance Register,
- (e) Equipment registers.

4.6.3 A detailed analysis of the above data shall be made to assess the performance of the equipment, overloading conditions and the necessity for major maintenance.

4.7 LOAD MANAGEMENT

4.7.1 In the event of total or partial black outs of Transmission System or regional system, the Distribution Licensee shall follow procedures as laid down in the Grid Code for restoring normalcy.

4.7.2 In the event of break down within its own system, the Distribution Licensee shall restore/ maintain supply within the limits specified in the performance standards by taking appropriate measures.

4.8 COMMUNICATION

4.8.1 The Distribution Licensee shall establish reliable communication facilities such as Fax, E-mail, etc., with major substations. All operating instructions, messages and data received from or sent to the concerned grid substations and Load Dispatch Centres shall be duly recorded at the Substations.

4.9 SAFETY COORDINATION

The Distribution Licensee and Consumers shall strictly follow the provisions of I E Rules 1956, which are in force for time being and subsequently the safety requirements for construction, operation and maintenance of electrical plants and electrical lines as specified by CEA inline with the provisions given in section-73(c) of Electricity Act, 2003.

4.10 MAINTENANCE

- 4.10.1 The Distribution Licensee, for the guidance of the operation and maintenance staff shall prepare suitable maintenance manuals and programs for the various components of the Distribution System. Proper records shall be kept duly updating the maintenance work done as per schedule, the details of faults, malfunctions etc., encountered in the lines and equipment during the period, the remedial action taken, etc., for each component of the distribution system.
- 4.10.2 The following pre-requisites shall be first ensured for the satisfactory maintenance:
- (a) The ability of the system to meet the probable over-loading due to transfer of loads from the adjacent systems during emergencies.
 - (b) The quality of the materials used.
 - (c) Trained and adequately equipped maintenance staff.
 - (d) Schedule of maintenance for each component of the system.
- 4.10.3 The maintenance work shall consist of routine inspection, cleaning, testing and adjustments, if any required and is different from the work carried out after a break down of any equipment in service, for restoring the same to the working condition, which cannot be planned in advance.
- 4.10.4 The maintenance schedules drawn shall cover the following:
- (a) Inspection
 - (b) Preventive maintenance
 - (c) Overhauls
- 4.10.5 Inspection
- (a) This shall include the periodical inspection in service for a check on the condition of the equipments/lines in service to verify the faults and defects that may develop during its operation so that advance action can be taken to rectify the defects in a planned manner and prevent breakdowns.
- 4.10.6 Preventive maintenance
- (a) This shall cover the periodical work including tests required to determine the electrical and mechanical strengths to ascertain the suitability in service and ensure proper working condition. The schedule drawn shall be on the basis of data obtained from inspection and maintenance checks, giving priority to the defects encountered during operation of the line or equipment.

4.10.7 Overhauls

- (a) This shall cover the preventive maintenance work to be done on the equipment based on the past experience and manufacturers' recommendations and involves major disassembly of the equipments. The schedule drawn shall be based on the normal life expectancy of the equipment or data obtained from inspection and maintenance checks.
- (b) The maintenance schedules shall be drawn for all the following components of the Distribution System separately:
 - (i) Power transformers and distribution transformers of 500 KVA and above.
 - (ii) Pole mounted distribution transformers and capacitors.
 - (iii) 22 and 11 kV circuit breakers along with all the associated switchgear.
 - (iv) LT circuit breakers.
 - (v) Pole mounted auto-reclosers.
 - (vi) 22 and 11 kV distribution lines including G.O.S.
 - (vii) LT lines including switches and fuses.
 - (viii) The Licensee's authorised representative including meter reader should report the visible abnormalities of service connection to the appropriate authority for taking corrective action.

4.10.8 Effective maintenance work shall be ensured keeping the following guidelines for the efficient working of the distribution system and for preventing accidents that may arise due to failure of any of the components. However, the following guidelines are suggestive but not exhaustive.

- (a) The distribution lines shall be inspected thoroughly before and after the rainy season.
- (b) The defects noticed during inspection should be rectified at the time of inspection itself if they are of minor nature, whenever and wherever possible. In case of such of the defects, which cannot be rectified easily, the same have to be attended to at the earliest possible occasion duly chalking out a program in advance.
- (c) If abnormal conditions such as excessive heating or arcing or prohibitively low clearances etc., are observed, the equipment or the

line shall be immediately disconnected and rectification of defects carried out.

- (d) Manufacturers' instructions shall always be given due consideration and implemented.
- (e) A continuous record of all the test results shall be maintained.
- (f) Appropriate inspection/maintenance checks/history sheets shall be maintained containing details of all inspection and maintenance work done.
- (g) All the required safety precautions/safety devices shall be used while carrying out the maintenance works.
- (h) The maintenance schedule shall be periodically reviewed by the Distribution Licensee in the light of previous experience and updated to include all possible improvements required for ensuring adequate maintenance, prevention of accidents and reduction in interruptions.

4.10.9 Off-schedule inspections

Inspections of the following nature shall be carried out to maintain the system at the required level of reliability in operation.

- (a) Special inspections: These shall be made immediately after severe weather conditions, such as heavy windstorms, thunderstorms and rains to detect any damage or breakage of poles, insulators, conductors and/or equipment, and necessary action taken.
- (b) Emergency inspections: These shall be carried out on a line during its breakdown, to locate and identify the cause of trouble as early as possible in order to restore the power supply.
- (c) Follow up inspections: Whenever one or more short time interruptions are noticed which may have taken place due to temporary faults, the inspection shall be carried out to locate and identify the cause of interruptions and suitable maintenance action shall be taken whenever and wherever necessary.
- (d) Check inspections: The designated engineer in charge of the distribution system shall make these inspections periodically as a check on the conditions of the line and equipment and the efficacy of maintenance. He shall point out such defects, which might not have been noticed by the maintenance staff in the first instance.

AHMEDABAD
30th March, 2005

P. S. SHAH
SECRETARY