འབྲུག་གློག་ཤུགས་དབང་འཛིན།

Bhutan Electricity Authority

གློག་མེ་རྒྱུད་ལམ་སྒྲིག་བྱེམས།

Grid Code Regulation, 2008

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1 Purpose, Scope and Commencement

1.1 Introduction

1.1.1 This Regulation shall be cited as the Bhutan Electricity Authority Grid Code Regulation 2008.

1.1.2 The purpose of this regulation is to establish the basic rules, procedures, guidelines and standards to befollowed by the various Licensees and all power utilities connected to the Transmission System so as to plan, develop, maintain and ensure secure, reliable and efficient operation of the Transmission System in economic manner. It aims to create a level playing field for all Users, without any discrimination.

1.2 Commencement

This regulation shall come into force from 1st July 2008.

1.3 Objective

1.3.1 The objective of the Grid Code Regulation is to establish a single set of technical rules, applicable to all the entities connected to, or using, the Transmission System. The Grid Code Regulation provides the following:

(i) Documentation of the principles and procedures which define the relationship between the Licensees using the Transmission System, as well as the System Operator and the Ministry;

(ii) Facilitation of the planning, development, operation & maintenance of an economic and reliable Transmission System; and

(iii) Facilitation for beneficial trading of electricityby defining a common basis of operation of the Transmission System, applicable to all the Users of the Transmission System.

1.4 Scope

1.4.1 All parties that connect with and/or utilize the Transmission System shall abide by the principles and procedures defined in the Grid Code Regulation in so far as they apply to that party.

1.4.2 Exemptions from provisions of the Grid Code Regulation may be granted by the Authority, for which the interested User shall approach the Authority in accordance with the defined process and guidelines.

1.4.3 Prior to the implementation of this Grid Code Regulation, Generation Licensees may have concluded Power Purchase Agreements which may be at variance to the provisions of this Grid Code Regulation. Nothing contained in this Grid Code Regulation is intended to modify the parties' rights and obligations under the Power Purchase Agreements. In the event of any conflict, the Power Purchase Agreements takes precedence only to the extent that it does not affect the safety and security of the Transmission System.

1.4.4 This regulation shall extend to the whole of the Kingdom of Bhutan.

1.5 Dispensation.

Nothing contained in this Grid Code Regulation shall have effect, in so far as it is inconsistent with the provisions of the Act and Regulations framed under the law.

1.6 Non-Compliance

1.6.1 Section 11.1 of the Act provides the functions of the Authority. Under Sub-section (vii) of Section 11.1 of the Act, it has been provided that the Authority,

establish a dispute resolution process and settle disputes between Licensees and between Customers and Licensees relating to the enforcement of the Act, Regulations, Codes, Standards and Licence issued under the Act.

1.6.2 In case of a persistent non-compliance of any of the stipulations of this Grid Code Regulation by any Licensee, the matter shall be reported by the System Operator to the Authority as per the dispute resolution mechanism under section 11.1 (vii) of the Act. In case of non-compliance by the System Operator the matter shall be reported by the concerned Licensee to the Authority. The Authority, in turn after due process, may order the defaulting Licensee/System Operator for compliance, failing which, the Authority may take appropriate actions.

1.7 Confidentiality

Under the terms of the Grid Code Regulation, the System Operator and Transmission Licensee shall receive information from Users relating to their systems in respect of their generation or supply business. The System Operator and Transmission Licensee shall not, other than required by the Grid Code Regulation, disclose such information to any other person without the prior written consent of the User concerned, unless required by the Ministry or the Authority.

2 Interpretation and definitions

2.1 Definitions

For the purpose of this regulation, any word or expression used to which a meaning has been assigned in the Electricity Act of Bhutan, 2001, shall have that meaning, unless explicitly indicated in this regulation. The following words and expressions shall have the meaning ascribed to them:

"Act" means the Electricity Act of Bhutan, 2001;

"Alert State" means the condition of the Transmission

System as defined in Section 6.4.1.2;

"Authority" means the Bhutan Electricity Authority;

"Automatic Voltage Regulator" means a continuously acting automatic excitation control system to control the voltage of a Generating Unit measured at the generator terminals;

"Bhutan Electricity Authority" means the authority of that name established pursuant to Part 2 of the Act;

"Black Start" means the procedure necessary to recover from a partial or a total blackout;

"Connection Agreement" means an agreement between the User and the Transmission Licensee setting out the terms relating to a connection to and/or use of the Transmission System;

"Connection Point" means a point at which a User's plant and/or apparatus connects to the Transmission System;

"Contingency Reserve" means generating capacity that is intended to take care of the loss of the largest synchronized generating unit;

"Demand" means the demand of Active Power and Reactive Power of electricity unless otherwise stated;

"Dispatch Schedule" means the electrical power and energy output of a generating station, Ex-Power Plant, that is scheduled to be supplied to the Transmission System;

"Distribution Licensee" means a person who has obtained a Licence to distribute electricity in pursuant toSection 22 of the Act;

"Distribution" means the conveyance of electricity through a distribution system, which distributes electricity at voltage below 66kV or as deemed by the Authority to be a part of the distribution network;

"Disturbance Recorder" means a device provided to record

the behaviour of the pre-selected digital and analogue values of the system parameters during an Event;

"Drawal Schedule" means the electrical power that a distribution Licensee is scheduled to receive from the generating stations, Ex-Power Plant;

"Eastern Grid" means the part of the Transmission System that is located in the East of the country;

"Emergency State" means the condition of the Transmission System as defined in Section 6.4.1.3

"Event Recorder" means a device provided to record the sequence of operation in time, of the relays/ equipments at a location during an Event;

"Event" means an unscheduled or unplanned occurrence on the Transmission System including disturbances, faults, incidents and breakdowns;

"Ex-Power Plant" means the net electrical power and energy output of a generating station, after deducting auxiliary consumption and transformation losses;

"Extreme State" means the condition of the Transmission System as defined in Section 6.4.1.4;

"Flexible Alternating Current Transmission System" means facilities that enable power flows on AC lines to be regulated, to control loop flows, line loadings etc;

"Forced Outage" means an outage of a Generating Unit or a transmission facility due to a fault or other reasons which has not been planned;

"Frequency Regulating Reserve" means a generating unit's capability of assisting in frequency control through governor action;

"Generating Unit" means an electrical generating unit coupled to a turbine within a power station together with all

plant and apparatus at that power station which relates exclusively to the operation of that unit;

"Generation Licensee" means a person who has obtained a Licence for generation of electricity pursuant to Section 22 of the Act;

"Good Utility Practices" means any of the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry during the relevant time period which could have been expected to accomplish the desired results at a reasonable cost consistent with good business practices, reliably, safely and with expedition;

"Governor Droop" means, in relation to the operation of the governor of a Generating Unit, the percentage drop in system frequency which would cause the Generating Unit under free governor action to change its output from zero to full load;

"Grid Planning Studies" means studies on the performance of a Transmission system, including but not limited to load flow studies, short circuit studies, steady state stability analysis studies, voltage stability analysis studies and reactive power compensation studies;

"High Voltage" means voltage of 66 kV and above;

"Island Grid" means a portion of the Transmission System that is electrically isolated from the rest of the Transmission System;

"Large Consumer" means any Consumer who is directly connected to the Transmission System or whose notified maximum demand exceeds a level of five (5) MW, or such level as the Authority may determine from time to time;

"Licensee" means any person issued with a Licence pursuant to Section 22 of the Act;

"Load" means the electrical power and energy taken by a utility/ installation;

"Low Voltage" means voltage not exceeding 400 volts between phase to phase for three phase supply or 230 volts between phase to neutral in case of single phase supply;

"Maximum Continuous Rating" means the normal rated full load power output capacity of a Generating Unit which can be sustained on a continuous basis at specified conditions;

"Medium Voltage" means voltages of 6.6kV or 11kV or 33kV;

"Ministry"means the ministry which is assigned responsibility for the electricity sector;

"Net Drawal Schedule" means the Drawal Schedule of a beneficiary after deducting the apportioned transmission losses (estimated);

"Normal State" means the condition of the Transmission System as defined in Section 6.4.1.1;

"Person" means any individual, firm, company, association, partnership or body of persons, whether incorporated or not;

"Power System Master Plan" means a long-term plan prepared for the development of the Power System;

"Power System" means the total system relating to power supply including associated generation,transmission and distribution networks;

"Reactive Power" means the square root of the difference between the square of the kilovolt-amperes and the square of the kilowatts and is expressed as VAR;

"Restorative State" means the condition of the Transmission System as defined in Section 6.4.1.5;

"Single Line Diagram"means diagrams which are aschematic representation of the HV apparatus and the connections to all external circuits at a Connection Point incorporating its numbering nomenclature and labelling;

"Site Common Drawings" means drawings prepared for each Connection Point, which incorporates layout drawings, electrical layout drawings, common protection/control drawings and common service drawings;

"Site Responsibility Schedule" means a schedule specifying the ownership and responsibility for all the equipment at a site where a connection is made;

"Spinning Reserve" means part loaded generating capacity with some reserve margin that is synchronized to the system and is ready to provide increased generation at short notice pursuant to dispatch instruction or instantaneously in response to a frequency drop;

"Static VAR Compensator" means an electrical facility designed for the purpose of generating or absorbing Reactive Power;

"System Co-ordination Committee" means a committee having representation of all the stakeholders to plan, review and co-ordinate power system operation;

"System Operator" means the person/s designated by the Authority in this role, whose function is defined under Section 39 of the Act;

"Tight Power Pool" means the situation in a power system where the centralized scheduling and dispatch of generation is done by the System Operator.

"Transmission Licensee" means a person who has obtained a Licence for transmission of electricity in pursuant to Section 22 of the Act;

"Transmission System" means a network operating at a nominal voltage of 66 kV and above or as deemed by the Authority to be a part of the transmission network.

"Transmission" means activities pertaining to a Tansmission System including conveyance of electricity at voltages above 66kV or as deemed by the Authority to be a part of the transmission network;

"User" means any Person using the Transmission System;

"Western Grid" means the part of the Transmission System that is located in the West of the country.

2.2 Abbreviations

The following abbreviations shall have the meaning ascribed to them:

"AC" means Alternating Current;

"AVR" means Automatic Voltage Regulator;

"BST" means Bhutan Standard Time;

"D/C" means Double Circuit;

"ERLDC" means the Eastern Regional Load Despatch Centre, Kolkata, India;

"FACTS" means Flexible Alternating Current Transmission System;

"HV" means High Voltage;

"ICT" means Inter-Connecting Transformer;

"IST" means Indian Standard Time;

"kV" means kilovolt;

"LV" means Low Voltage;

"MCR" means Maximum Continuous Rating;

"MV" means Medium Voltage;

"NLDC" means national Load Dispatch Centre;

"S/C" means Single Circuit;

"SRS" means Site Responsibility Schedule;

"SVC" means Static VAR Compensator;

"TOO" Time of Origin;

"MW" means megawatt;

"MWh" means megawatt-hour;

"MVAR" means megavolt-ampere reactive; and

"VAR" means volt-ampere reactive.

3 Role & Responsibilities

3.1 Introduction

This chapter defines the functions of the Licensees and the roles of the Authority and the Ministry so far as they relate to the Grid Code Regulation.

3.2 Role of the Ministry

3.2.1 In accordance to Section 17.1 of the Act, the role of the Ministry, relevant to this Grid Code Regulation, shall be:

(i) To determine general policies, targets, strategies of the electricity industry operation;

(ii) To approve power system expansion plans;

(iii) To provide policy on customer service standards and Licensee standards;

(iv) To set policy encouraging energy service extensions and providing electricity services for the under privileged;

(v) To provide policy on protection against and solutions to energy shortage;

(vi) To provide policy in respect of privateparticipation; and

(vii) To perform other duties as stipulated under the Act.

3.2.2 Ministry shall also formulate the Power System Master Plan for development of the electricity system and co-ordinate for the optimum utilization of resources.

3.3 Role of Bhutan Electricity Authority

3.3.1 As per the provisions of the Act, the functions assigned to the Authority relevant to the Grid Code Regulation, shall be:

(i) To develop regulations, standards, codes, principles andprocedures, which include, but not limited to the following:

(a) Performance standards, including minimum technical and safety requirements for construction operation and maintenance of generation, transmission and distribution facilities;

(b) Terms and conditions for provision of access to the Transmission System and distribution networks; and

(c) System operation including dispatch of generation;

(ii) To process application and issue, modify and revoke licences for generation, transmission, system operation, export, import, distribution and sale of electricity;

(iii) To monitor the performance of Licensees and their compliance with provisions of the Act, regulations, standards, codes, licenses and contracts approved by the Authority;

(iv) To impose any fines, sanctions or penalties for any breach of provisions of this Act, regulations,standards, codes licences or contract to be approved by the Authority; and

(v) To perform other duties as stipulated under the Act.

3.3.2 The Authority shall, in the performance of its functions:

(i) ensure the reliability, quality, security and efficiency of electricity supply;

(ii) encourage competition in electricity generation, transmission and supply;

(iii) ensure non-discriminatory access to the transmission and distribution;

(iv) ensure a fair balance of the interest of the public, customers and participants in the electricity sector;

(v) facilitate the developmentof the generation, transmission and distribution of electricity throughout the country; and

(vi) ensure the protection of the natural resources, the environment and other public interests affected by the development of electricity supply.

3.4 Role of System Operator

3.4.1 As per Section 39 of the Act, the Authority may designate a person to be a "System Operator", who shall:

(i) co-ordinate the power supply system to obtain instantaneous balance between generation and consumption of electricity;

(ii) be responsible for dispatching generation installations;

(iii) co-ordinate the transmission outages;

(iv) monitor the import and export of electricity;

(v) prepare forecasts of generation requirements;
(vi) prepare regulations, with approval of the Authority, for the dispatch of generation installations; and
(vii) perform such other functions as may be prescribed by the Authority in the Licence or by regulations.

3.4.2 The System Operator shall not, in the performance of its functions, show undue preferences or discrimination against any person.

3.5 Role of Transmission Licensee

3.5.1 The Transmission Licensee shall undertake transmission of electricity through its Transmission System.

3.5.2 The Transmission Licensee shall discharge all function of short-term planning and co-ordination relating to Transmission System with the following:

(i) The Ministry;
(ii) The System Operator;
(iii) Generation Licensees;
(iv) Distribution Licensees,
(v) Other Licensees;
(vi) The Authority; and
(vii) Any other person or designated by the Ministry.

3.5.3 The Transmission Licensee shall provide access to all existing and potential Users of the Transmission System on the payment of fees and other charges for the Transmission System services as may be approved by the Authority.

3.6 Role of Distribution Licensees

3.6.1 The area of the Licensee's distribution of electricity shall be defined in the Licence.

3.6.2 A Distribution Licensee shall provide access to all existing and potential Users of the distribution network on payment of charges, and on the terms and conditions for network services as may be approved by the Authority.

3.6.3 The quality of distribution service shall be in accordance with standards prescribed by the Authority.

3.7 Responsibilities of Transmission System Users

3.7.1 All Users connected to the Transmission System are responsible for:

(i) Planning, constructing and maintaining all necessary equipment for the connection to the Transmission Grid according to standards approved by the System Operator. This includes upgrading of the installations and the necessary protective devices to enable a safe and reliable connection to the Grid;

(ii) Providing the System Operator with all requested data and technical and economical characteristics on design, construction and operation of facilities to be connected to the Transmission Grid;

(iii) Providing adequate key personnel satisfying appropriate qualification standards to be approved by the System Operator; and

(iv) Complying with the necessary operating liaison procedures and installation of communication equipment according to specifications made by the System Operator.

3.8 Communication

3.8.1 Licensees and Users shall appoint a representative to be responsible for all communications between the System Operator and the respective User.

3.8.2 The System Operator may use any communication media for issuing instructions to Users. Any such instructions

shall be confirmed within 24 hours by electronic message or in writing.

3.8.3 For communication between the System Operator and Licencees/Users, any communication media may be used. Communication considered to be of importance by one of the parties shall subsequently be confirmed in writing.

3.8.4 Instructions given by the System Operator that shall have commercial implications for Licensees and Users shall always be given in writing unless the instructions have an emergency character.

3.8.5 The System Operator, Licensees and Users shall accept the recording, by whatever means, of instructions of communications as evidence of those instructions or communications unless otherwise specified in this Grid Code Regulation.

3.8.6 Data and notices to be submitted to the System Operator under this Grid Code Regulation shall be delivered in writing either by hand or sent by registered post unless otherwise specified in the Regulations. Any such notices shall be confirmed within 24 hours by electronic message or in writing. In case of insufficient time, the delivery by facsimile transfer is acceptable, which shall be followed by the original, through registered post or by hand.

4 Planning Code

4.1 Introduction

4.1.1 The Transmission Licensee shall discharge all functions of short-term planning and co-ordination related to the Transmission System in association with the Ministry, Generation Licensees, System Operator, Distribution Licensees and any other person notified by the Authority in this behalf.

4.1.2 This section specifies the policy and procedures which shall be applied in planning of the Transmission System.

4.2 Objective

The objectives of the planning code are to:

(i) Specify the principles, procedures and criteria which shall be used in the planning and development of the Transmission System;

(ii) Promote co-ordination amongst all the Licensees in any proposed development of the Transmission System;

(iii) Identify the planning studies to be performed; and

(iv) Provide methodology and information exchange amongst the Licensees in the planning and development of the Transmission System.

4.3 Scope

This section applies to the Transmission Licensee, Generation Licensees and the Distribution Licensees connected to and/or using and involved in developing the Transmission System.

4.4 Planning Policy

4.4.1 The Ministry shall develop the overall Power System Master Plan, which includes developments for the Transmission System including export transmission facilities. The Power System Master Plan may be periodically updated to reflect revisions in load

projections and generation scenarios.

4.4.2 The Transmission Licensee shall carry out the planning process from time to time as per the requirement for identification of Transmission System which shall fit in with the Power System Master Plan or to meet the transmission needs of the Transmission License.

4.4.3 The Transmission Licensee shall consider the data of authenticated nature collected from and in consultation with all the utilities of the Power System. The following shall also be referred:

(i) The Power System Master Plan developed by the Ministry;

(ii) Any transmission planning criteria and guidelines of the Ministry; and

(iii) Power data, hydrological statistics and other reports issued by the Ministry, which are relevant to the development of the Transmission System.

4.4.4 In addition to new facilities to evacuate power from a new generating station, the Transmission Licensee shall plan the system strengthening schemes to overcome and prevent constraints in power transfer and to improve the overall performance of the Transmission System. Such schemes shall be discussed with the System Operator and other Users/Licensees and submitted to the Authority for approval.

4.4.5 All Generation Licensees and Distribution Licensees shall provide the desired planning data to the Ministry and to the Transmission Licensee every year to enable them to formulate and finalise their plans.

4.4.6 The investment plans of the Transmission Licensee shall include the additional transmission requirement which may cover not only transmission lines but also additional equipment such as transformer, capacitors, reactors,

amongst other transmission equipment. Special attention shall be accorded to capacitors, reactors, SVC and FACTS.

4.4.7 The investment plans of the Transmission Licensee shall also indicate the action taken to fulfill the plans and actual progress made on new schemes.

4.4.8 The planning of the Transmission System for export of power from the generating stations to neighbouring countries shall be discussed and reviewed with the concerned agencies of the neighbouring countries.

4.5 Grid Planning Studies

4.5.1 The System Operator shall prepare aggregated medium-term (5 years) and long-term (10 years) load forecasts for the overall system. These plans shall include the identification of likely power and energy balances and the possibilities of export as well as capacity and/or energy deficits during the planning period.

4.5.2 The System Operator shall review and revise all plans for the expansion of the generation capacity. Based on these plans, the System Operator shall prepare a medium-term expansion plan for the generation capacity comparing the different alternatives and identifying an estimated least cost expansion plan.

4.5.3 The Transmission Licensee shall conduct Grid Planning Studies to ensure the safety, reliability, security, sufficiency and stability of the Transmission System. Grid Planning Studies shall:

(i) Assess the impact on the Transmission System or to any User system of any demand forecast or any proposed addition or change of equipment facilities in the Transmission System and to identify the corrective measures to eliminate the deficiency

in the Transmission System. All transmission connections with the Transmission System shall be taken into consideration while performing the Planning studies;

(ii) Assess the behaviour of the Transmission System during normal and outage-contingency conditions and the behaviour of the Transmission System during the transient condition due to any disturbance or switching operation;

(iii) Include load flow studies to evaluate the behaviour of the Transmission System for the existing and planned transmission facilities under forecasted maximum and minimum load condition and to study the impact on the Transmission System of the connection of new generating plants, loads and transmission lines;

(iv) Include short circuit studies to evaluate the effect on the Transmission System of the connection of new generating plants, transmission lines and other facilities that shall result in increased fault duties for the Transmission System;

(v) Include steady state stability analysis studies to determine whether the Transmission System is vulnerable to steady-state stability problems. The studies shall identify appropriate solutions, such as proper tuning of power system stabilizers or the identification of safe operating conditions;

(vi) Include voltage stability analysis studies to determine if the Transmission System is vulnerable to voltage collapse under heavily loaded conditions. The studies shall identify the requirement for installation of dynamic and static reactive power compensation; and

(vii) Include Reactive Power compensation studies of the Transmission System including reactive power requirement at the generating station switchyards.

4.6 Planning Criteria

4.6.1 The transmission planning criteria shall be based on the security philosophy envisaged in the planning of the Transmission System, as per the guidelines of the System Operator and Ministry.

4.6.2 As a general policy, the Transmission System shall be capable of withstanding and be secured against the following outages without necessitating load shedding or rescheduling of generation during steady state operation:

(i) Outage of a 66 kV D/C line; or

(ii) Outage of a 132 kV S/C line; or

(iii) Outage of a 220 kV S/C line; or

(iv) Outage of a 400 kV S/C line; or

(v) Outage of single Interconnecting Transformer.

The above contingencies shall be considered assuming a pre-contingency system depletion (planned outage) of another 66 kV D/C line or 132 kV S/C or 220 kV S/C line in another corridor and not emanating from the same substation. All the Generating Units may operate within their capability curves and the network voltage profile shall also be maintained within voltage limits specified.

4.6.3 The Transmission System shall be capable of withstanding the loss of most severe single system infeed without loss of stability.

4.6.4 Any one of the events defined above shall not cause:

(i) Loss of supply;

(ii) Prolonged operation of the system frequency below and above specified limits;
(iii) Unacceptably high or low voltage;
(iv) System instability; and
(v) Unacceptable overloading of Transmission System elements.

4.6.5 In all substations (66 kV and above) at least two transformers shall be provided.

4.7 Planning Data

4.7.1 All Licensees and Users shall provide all data as required by the System Operator to execute the co-ordinated planning of the operation and expansion of the system. Such data should include, but not necessary be limited to:
(i) Load forecasts;
(ii) Technical and economical characteristics of generation units, including capital and operational costs of the units; and
(iii) Technical and economical characteristics of the relevant transmission and distribution systems.

4.7.2 The System Operator may establish further specifications as to the data requirements.

4.7.3 The Licensees and Users shall identify all such data that may be required to be kept confidential.

4.8 Implementation of Transmission Plan

The investment programme to install new transmission lines, reactors and capacitors shallbe prepared by the Transmission Licensee in consultation with the concerned agencies and submit the same to the Authority for approval. The completion of these works, in the required time frame, shall be ensured by the Transmission Licensee.

5 Connection Conditions

5.1 Introduction

This section specifies the minimum technical and design criteria which shall be complied with by the Transmission Licensees and any User connected to, or seeking connection to, the Transmission System. This Section also sets out the procedures by which the Transmission Licensee shall ensure compliance by any User with the above criteria as pre-requisite for the establishment of an agreed connection.

5.2 Objective

5.2.1 The power system shall expand with the addition of new transmission lines and Users and it shall continue to perform with reliability, security and quality standards at any point of time. A new connection to the Transmission System shall not adversely affect the Transmission System nor shall the Transmission System adversely affect the new connection.

5.2.2 Procedures are required to be laid down in order to ensure that:

(i) a prospective User is well informed, in advance, of the Standards and Conditions he has to meet for being integrated into the existing power system, the Standards and Parameters of the existing system with which its system has to be interfaced and the electrical environment in which his system has to operate; and

(ii) there is no discrimination to any player in regard to connectivity.

5.2.3 The ownership and responsibility for all the equipment shall be clearly specified in a Site Responsibility Schedule for every site, where a connection is made.

5.3 Scope

5.3.1 These connection conditions shall be applicable to the Transmission Licensee and all the Users seeking new connection with the Transmission System as well as to the existing Users who may modify/upgrade their system.

5.4 Procedure for connection

5.4.1 Prior to a potential User being connected to the Transmission System, all necessary conditions outlined in the Grid Code Regulation in addition to other mutually agreed requirements to be complied with, shall be fulfilled by the potential User. Any potential user seeking to establish new or modified arrangement of connection to or for use of the Transmission System, shall submit an application in standard format to the Transmission Licensee along with the following details:

(i) Report stating the purpose of the proposed connection and/or modification including capacity, connection point, description of apparatus to be connected or modification of the apparatus already connected and beneficiaries of the proposed connection;

(ii) Construction schedule and target completion date; and

(iii) Confirmation that the applicant shall abide by Grid Code Regulation and provisions of the Regulations/Standards issued by the Authority.

5.4.2 The Transmission Licensee shall normally make a formal offer to the applicant within a period of three months after the date of receipt of all details. Details of the requirements and procedures will be set out in the offer of a connection to the Transmission System and the resulting Connection Agreement with the applicant. Upon compliance, the Transmission Licensee shall notify the

applicant that it can be connected to the Transmission System.

5.4.3 However, in case of the existing connections between Transmission network and other Licensees including Distribution Licensees, Generation Licensees, a relaxation of two years in respect of the connection conditions is allowed so that the present arrangements may continue. The process of re-negotiation of the connection conditions with Licensees shall be completed within a period of one year. In case it is determined that the compliance of connection conditions would be delayed further, the Authority may consider further relaxation depending upon the application submitted by the concerned Licensee along with the Transmission Licensee's recommendation/comments. The cost of modification, if any, shall be borne by the concerned Licensee.

5.5 Connection Agreement

Every connection of a User's system to the Transmission System shall be covered by a Connection Agreement between the User and the Transmission Licensee. The Connection Agreement shall contain general and specific, technical and financial conditions, applicable to that connection. A connection agreement shall include (but not limited to), as appropriate, within its terms and conditions, the following:

(i) A condition requiring both parties to comply with the Grid Code Regulation;

(ii) Description of the point of connection including the technical and economical characteristics of the connected installations;

(iii) Specification of the transmission capacity, both in technical and geographical terms, made available;

(iv) Details of any capital expenditure arising from

necessary reinforcement or extension of the system and demarcation of the same between the concerned parties, and connection fees if applicable;

(v) Site Responsibility Schedule;

(vi) General philosophy and guidelines on protection; and

(vii) Meter, metering, testing and communication requirements.

5.6 Standards

All installations, equipment or apparatus to be included in the Transmission System or to be connected to the Transmission System shall comply with the relevant standards of Bhutan. In the absence of such standards, the responsible standardisation entity shall be consulted, along with the Authority, to obtain permission to adapt to good utility practice.

5.7 Site Responsibility Schedule

5.7.1 A Site Responsibility Schedule (SRS) shall be prepared for every connection. At the connection site where equipment of both entities, i.e., the Transmission Licensee and the Distribution Licensee are installed, the Distribution Licensee shall furnish required data to the Transmission Licensee which shall prepare SRS. At a generating station, the Transmission Licensee shall furnish the necessary data to the Generation Licensee who shall prepare SRS.

5.7.2 The following information shall be included in the SRS:

(i) Schedule of HV apparatus;

(ii) Schedule of plant, LV / MV apparatus, services and supplies;

(iii) Schedule of telecommunications and

measurement apparatus; and

(iv) Safety rules applicable to each plant/apparatus.

5.7.3 Following information shall also be furnished in the SRS for each item of equipment installed at the connection site:

(i) The ownership of equipment;

(ii) The responsibility for control of equipment;

(iii) The responsibility for maintenance of equipment;

(iv) The responsibility for operation of equipment;

(v) The manager of the site;

(vi) The responsibility for all matters relating to safety of persons at site; and

(vii) The responsibility for all matters relating to safety of equipment at site.

5.6.4 All HV apparatus on any connection site shall be shown on a diagram in detail.

5.8 Site Common Drawings

5.8.1 Site Common Drawings shall be prepared by the owner company (Transmission Licensee or User) using the information furnished by the other company (User or Transmission Licensee) containing the following information:

(i) Connection site equipment layout;

(ii) Electrical layout;

(iii) Common protection and controls; and

(iv) Common services (water, compressed air, telephone, electricity supply for lighting and other appliance, etc.)

5.8.2 Each item of equipment at the connection site shall be assigned with one unique number to facilitate identification.

5.9 Single Line Diagrams

5.9.1 Single Line Diagram shall be furnished for each Connection Point by the connected Users to the System Operator. These diagrams shall include all HV connected equipment and the connections to all external circuits and incorporate numbering, nomenclature and labelling etc. The diagram is intended to provide an accurate record of the layout and circuit connections, rating, numbering and nomenclature of HV apparatus and related plant.

5.9.2 Whenever any equipment has been proposed to be changed, then the concerned User shall communicate the necessary changes to Transmission Licensee and to all concerned. When the changes are implemented, changed Single Line Diagram shall be circulated by the User to the System Operator and to the Transmission Licensee.

5.10 Access and maintenance at connection site

5.10.1 The Connection Agreement shall indicate any procedure necessary for site access and other required facilities for installation, operation, maintenance, etc.

5.10.2 The User's equipment at the site owned by the Transmission Licensee shall be maintained promptly and properly by the User and vice versa so that the equipment and personnel of the site owner are not jeopardized by the neglect of the other entity.

5.11 Site Operational and Safety Procedures

5.11.1 The Transmission Licensee and the User shall ensure that staff is available to take necessary safety precautions and carry out operational duties at the site. Written operating and safety procedures shall be made available at the each site.

5.11.2 The telephone numbers and addresses of the officers of each entity responsible for operation at the connection site shall be furnished to the other entity.

5.12 Boundaries between Systems of Entities

5.12.1 Boundary between a Generating station and the Transmission System: The boundary shall be the gantry of the Substation/Switchyard/Pothead-yard or the other terminal equipment as may be decided by and between the two parties.

5.12.2 Boundary between the Transmission System and the Distribution System: The boundary shall be the outgoing terminal structure or pole as the case may be decided by and between the parties.

5.12.3 In respect of 5.12.1 and 5.12.2 above, at particular inter-connections for both the parties may jointly agree on a different boundary.

5.12.4 The boundary between the Transmission Licensee and a User directly connected to the Transmission System is the isolator in the Transmission System, which is also the point of commencement of supply.

5.13 General Conditions for Connection to the Transmission System

5.13.1 The System Operator shall determine the availability of transmission capacity for Users to connect to the Transmission System. The System Operator shall further approve any equipment required for connecting the particular installations and time schedules for the implementation of the requested connections.

5.13.2 Within the power system, instantaneous values of system frequency and voltage are subject to variation from their nominal value. All agencies shall ensure that Plant and Apparatus requiring service from/to the Transmission System is of such design and construction that

satisfactory operation shall not be prevented by such variation.

5.13.3 Rated frequency of the system shall be 50.0 Hz and shall normally be controlled within the limits as specified in Section 6.4.1.

5.13.4 The variation of voltage may not be more than the voltage range specified in the Section 6.4.1.

5.13.5 The Distribution Licensee shall not depend upon the Transmission System for reactive compensation support when connected.The Distribution Licensee shall estimate and provide the required reactive compensation in its distribution network to meet its full Reactive Power requirement, unless specifically agreed with the Transmission Licensee.

5.13.6 All sub-station equipment shall comply with the codes and standards approved by the Authority.

5.13.7 All equipment shall be designed, manufactured, tested and certified in accordance with the quality assurance requirements as per Codes and Standards approved by the Authority.

5.13.8 The User shall cooperate with the Transmission Licensee and the System Operator in respect of the operational matters listed below, but not limited to:

(i) Carryout the modifications in his equipment considered necessary, whenever the power system is upgraded or modified;

(ii) Protection coordination (relay settings);

(iii) Provide on line data to the appropriate load dispatch centre;

(iv) Participate in contingency operations such as load shedding, islanding, black start, providing

start-up power and restoration;

(v) Furnish data to the Transmission Licensee, System Operator and any committee constituted by the Ministry or by the Authority for disturbance analysis and other studies;

(vi) Maintain meters and communication system in its jurisdiction in good condition;

(vii) Coordinated outage plan ; and

(viii) Prompt implementation of instructions of the System Operator.

5.13.9 Each connection between a User and the Transmission System shall be controlled by a circuit breaker capable of interrupting at the connection point, the short circuit current shall be in the range as advised by the Transmission Licensee in the specific Connection Agreement.

5.13.10 All hydropower generation units having Francis Turbines shall be capable of continuous stable operation at any load between 50% and 100% MCR, Pelton turbine between 30% and 100% MCR and those having Kaplan Turbine between 70% and 100% MCR at normal operating head.

5.13.11 The generating units shall be capable to generate/absorb reactive power within their respective capability limit without sacrificing on the active generation.

5.13.12 The System Operator may introduce further specifications on connection requirements if and when found necessary.

5.13.13 To enable the execution of its obligation, the System Operator shall, after giving prior notice and reason, have access to the Licensees' and Customers' facilities and metering equipment.

5.14 International Connections to the Transmission System

The procedure for international connection to the Transmission System and the execution of agreement for the same shall be done by the agency who has been assigned this responsibility by the Ministry.

5.15 Schedule of assets of the Transmission System

5.15.1 All Transmission Licensee shall submit annually to the Authority by 31st March each year a schedule of transmission assets which constitute the Transmission System as on 31st December of the previous year.

5.15.2 The System Operator may, after approval of the Authority, disconnect installations from the Transmission System if the connected User has failed to meet with the substantial requirements as set forth in this Grid Code Regulation.

6 Operations and Operational Planning

6.1 Introduction

This section covers all important aspects of Transmission System operation, including operation planning.

6.2 Objective

The objective of this section is:

(i) To specify the operating states, operating criteria, operating policies and system security aspects that shall ensure the safety, reliability, security and efficiency of the Transmission System;

(ii) To define the operational responsibility of the System Operator, Generators, Distribution Licensees etc;

(iii) To specify the procedure for demand estimation for operational purpose;

(iv) To describe the operating reserves and demand control strategies use for the control of system frequency and the methods used for voltage control.

(v) To specify the procedure for coordinated generation and transmission outage planning;

(vi) To specify the role/responsibility for Black Start procedure;

(vii) To establish a procedure for operational liaison;and

(viii) To identify the periodic reports to be issued and event information to be reported.

6.3 Scope

This section applies to all Users of the Power System connected with the Transmission System including Generation, Transmission and Distribution Licensees.

6.4 Transmission System Operating States and Operating Criteria

6.4.1 Transmission System Operating States

6.4.1.1 The Transmission System shall be considered to be in the Normal State When:

(i) The Transmission System frequency is within the limit of 49.5 Hz. to 50.5 Hz;

(ii) The voltage at all connection points are within the limits of 0.95 times and 1.05 times of the nominal values;

(iii) The transmission line loadings and sub-station equipment are below 90% of their continuous ratings; and

(iv) Sufficient operating margin is available.

6.4.1.2 The Transmission System shall be considered to be in the Alert State when any one of the following conditions exists:

(i) The Transmission System frequency is beyond the normal operating limit but within 49 to 51Hz;or

(ii) The voltage at connection points are outside the normal limit but within the limits of 0.9 times and 1.1 times of the nominal values; or

(iii) There is a critical loading or imminent overloading of transmission line or substation equipment; or

(iv) Adverse weather condition.

6.4.1.3 The Transmission System shall be considered to be in the Emergency State when multiple outage contingency has occurred without resulting in total system blackout and any one of the following condition exists:

(i) There is a generation deficiency and frequency is below 49 Hz;

(ii) Transmission System voltage are outside the limit of 0.9 times and 1.1 times of nominal values; and

(iii) The loading level of any transmission line or sub-station equipment is above 110% of its continuous rating.

6.4.1.4 The Transmission System shall be considered to be in the Extreme State when the corrective measures undertaken by the System Operator during an emergency state failed to maintain system security and resulted in cascading outages, islanding, and/or system voltage collapse.

6.4.1.5 The Transmission System shall be considered to be in the Restorative State when generating units, transmission lines, sub-station equipment and loads are being energized and synchronized to restore the Transmission System to its normal state.

6.4.2 Transmission System Operating Criteria

6.4.2.1 The Transmission System shall be operated so that it remains in the Normal State.

6.4.2.2 The Transmission System shall be operated and maintained to meet the power quality standards as specified by the System Operator.

6.4.2.3 The security and reliability of the Transmission System shall be based on the single outage contingency criterion.

This criterion specifies that the Transmission System shall continue to operate in the Normal State following the loss of a single generating unit, transmission line, or transformer.

6.4.2.4 The Transmission System frequency shall be controlled by the Frequency Regulating Reserve during the Normal State, and by the timely use of Contingency Reserve and demand control during other conditions.

6.4.2.5 Adequate Frequency Regulating Reserve and Contingency Reserve shall be available to stabilize the Transmission System and facilitate the restoration to the Normal State following a multiple outage contingency.

6.4.2.6 Following an incident that makes it impossible to avoid Island Grid operation, the Transmission System shall separate into several self-sufficient Island Grids, which shall be resynchronized to restore the Transmission System to a Normal State.

6.5 Operating Policy

6.5.1 The primary objective of integrated operation of the Transmission System is to enhance the overall operational economy and reliability of the entire electric power network throughout Bhutan. Participant utilities shall cooperate with each other and adopt Good Utility Practice at all times for satisfactory and beneficial operation of the Transmission System.

6.5.2 Overall real time operation of the Transmission System shall be supervised by the System Operator from the National Load Despatch Centre (NLDC) located at Thimphu. The roles of the System Operator shall be in accordance with the provisions of Section 3 of this Grid Code Regulation.

6.5.3 The control rooms of the NLDC, Eastern Grid Data

Centre, and Western Grid Data Centre, all Generating Power Plants, HV (66 kV and above) sub-stations and any other control centres of the constituents shall be manned round the clock by qualified and adequately trained personnel or otherwise they are controlled remotely but the remote control centre must be manned.

6.6 System Security Aspects

6.6.1 All Licensees shall endeavour to operate their respective power systems and generation stations in synchronism with each other at all times, such that the entire Transmission System operates as one synchronised system.

6.6.2 No part of the Transmission System shall be deliberately isolated from the rest of the Transmission System, except:

(i) under an emergency, and conditions in which such isolation would prevent a total Transmission System collapse and/or enable early restoration of power supply;

(ii) when serious damage to a costly equipment is imminent and such isolation would prevent it; and

(iii) when such isolation is specifically instructed by the System Operator.

Complete synchronisation of the Transmission System shall be restored as soon as the conditions again permit it. The restoration process shall be supervised by theSystem Operator, as per operating procedures separately formulated.

6.6.3 No important element of the Transmission System shall be deliberately opened or removed from service at any time, except when specifically instructed by the System Operator or with specific and prior clearance of the System Operator. The list of such important elements on which the above stipulations apply shall be prepared by

the System Operator in consultation with the Transmission Licensees, and be available with the System Operator. In case of opening/ removal of any important element of the Transmission System under an emergency situation, the same shall be communicated to the System Operator atthe earliest possible time after the event.

6.6.4 Any tripping, whether manual or automatic, of any of the above elements of the Transmission System shall be precisely communicated by the concerned Licensee to the System Operator as soon as possible, and within ten minutes of the event. The reason (to the extent determined) and the likely time of restoration shall also be given. All reasonable attempts shall be made for the elements' restoration as soon as possible.

6.6.5 Except under an emergency, or to prevent damage to the equipment, no generator shall suddenly reduce his generation output by more than 5 (five) MW without prior communication to, and consent of, the System Operator. Similarly, no Large Consumer shall cause a sudden increase in his load by more than 5 (five) MW without prior communication to, and consent of, the System Operator.

6.6.6 Provision of protections and relay settings shall be coordinated periodically throughout the Transmission System, as per a plan to be separately finalised by the System Co-ordination Committee (SCC).

6.6.7 All Users shall make all possible efforts to ensure that the Transmission System frequency always remains within the 49.5 to 50.5 Hz band, the normal frequency range.

6.6.8 Procedures shall be developed to recover from partial/

total collapse of the Transmission System and periodically updated in accordance with the requirements given under Section 6.12. These procedures shall be followed by all the Users to ensure consistent, reliable and quick restoration.

6.6.9 Each Licensee shall provide an adequate and reliable communication facility internally and with the System Operator to ensure exchange of data information. Wherever possible, redundancy and alternate path shall be maintained for communication along important routes.

6.6.10 Each Licensee shall send data including Disturbance Recorder and sequential Event Recorder output to the System Operator for purpose of analysis of any Transmission System Event; No Licensee shall refuse provision of any data or information required by the System Operator for maintaining reliability and security of the Transmission System and for analysis of an Event.

6.7 Operational Responsibilities

6.7.1 Operational responsibilities of the System Operator

6.7.1.1 The System Operator shall coordinate and maintain the power quality in the Transmission System during normal conditions.

6.7.1.2 The System Operator shall ensure that the load-generation balance is maintained during emergency conditions and take prompt corrective actions following these emergency conditions, to restore the system to normal conditions.

6.7.1.3 The System Operator shall control Transmission System voltage variations during emergency conditions through a combination of direct control and timely instructions to Generators and other Licensees.

6.7.1.4 The System Operator in consultation with all Users shall develop a detailed operating procedure. This procedure shall in conformity with this Grid Code Regulation.

6.7.1.5 The System Operator shall perform all necessarysystem studies to determine the safe operating limits that shall protect the Transmission System against any instability problem, including those due to multiple outage contingencies.

6.7.2 Operational Responsibilities of Generation Licensees

6.7.2.1 The Generation Licensee shall be responsible for maintaining its generating units to fully deliver the capabilities declared and ensure the maximum possible availability of the unitsby proper & timely maintenance.

6.7.2.2 The Generation Licensee shall provide accurate and timely planning and operational data to the Transmission Licensee and System Operator.

6.7.2.3 All generating units, which are synchronised with the Transmission System, irrespective of their ownership, type and size, shall have their governors in normal operation at all times. If any generating unit of over ten (10) MW is required to be operated without its governor in normal operation, the System Operator shall be immediately advised about the reason and duration of such operation and action shall be taken to restore it back as soon as possible. All governors shall have a Governor Droop of between 3 to 10 percent. No dead bands and/or time delays shall be deliberately introduced.

6.7.2.4 All Generating Units, operating at/up to 100% of their Maximum Continuous Rating (MCR) shall normally be capable of (and shall not in any way be

prevented from) instantaneously picking up five percent (5%) extra load or within technical limits prescribed by the manufacturer when frequency falls due to a system contingency. The generating units operating at above 100% of their MCR shall be capable of (and shall not be prevented from) going at least up to 105% of their MCR when frequency falls suddenly. Any generating unit of over ten (10) MW not complying with the above requirement shall be kept in operation (synchronised with the Transmission System) only after obtaining the permission of the System Operator. However, the Licensee can make up the corresponding short fall in Spinning Reserve by maintaining extra Spinning Reserve on the other generating units of the Licensee.

6.7.2.5 The recommended rate for changing the governorsetting, i.e. supplementary control for increasing or decreasing the output (generation level) for all generating units, irrespective of their type and size, would be one (1) percent per minute or as per manufacturer's limits. However, if frequency falls below 49.5 Hz, all partly loaded generating units shall pick up additional load at a faster rate, according to their capability.

6.7.2.6 All generating units shall normally have their AVRs in operation, with appropriate settings. In particular, if a generating unit of over ten (10) MW size is required to be operated without its AVR in service, the System Operator shall be immediately informed about the reason and duration, and its permission obtained.

6.7.2.7 All generating units shall generate/absorb VAR within their capability curve as per system condition/instruction from the System Operator.

6.7.2.8 Black Start facility available with the generators, if any shall be ensured to always remain in the operating condition.

6.7.3 Operational Responsibility of Transmission Licensee

6.7.3.1 The Transmission Licensee shall provide and maintain all Transmission System equipment and facilities including those required for maintaining power quality.

6.7.3.2 The Transmission Licensee shall design, install, commission and maintain the Transmission System's protection system as finalized in the System Co-ordination Committee.

6.7.3.3 The Transmission Licensee shall also facilitate identification, installations and commissioning of system protection schemes (including inter-tripping and runback) in the power system to protect against situations such as voltage collapse and cascading.

6.7.3.4 The Transmission Licensee shall ensure that safe and economic Transmission System operating procedures are always followed.

6.7.4 Operational Responsibilities of Distribution Licensees/Other Users

6.7.4.1 Distribution Licensees/Users shall provide and maintain voltage control equipment on its system to support the voltage at the connection points. Distribution Licensees/ Users shall also provide and maintain reactive power supply facilities on its system to meet its reactive power demand.

6.7.4.2 If required by the System Operator, Distribution Licensees shall provide automatic under-frequency load shedding facilities in their respective systems, t o arrest frequency decline that may result in a

collapse/disintegration of the Transmission System and shall ensure its effective application to prevent cascade tripping of generating units in case of any contingency.

6.7.4.3 Distribution Licensees shall ensure that the under frequency load shedding/islanding schemes are functional. However, in case of extreme exigencies, under-frequency relays and/or islanding schemes may be temporarily kept out of service with prior consent of the System Operator or as directed by the System Operator.

6.8 Demand Estimation for Operational Purposes

6.8.1 The Distribution Licensee shall formulate a short term demand forecast (MW, MVAR and MWh) from the historical data and demand estimation submitted by Large Consumers.

6.8.2 The Distribution Licensee shall review the status of load materializing as per the previous load forecast. Energy sales in each tariff class shall be projected in the forecasted period over the corresponding figures relating to the base year by adopting an appropriate statistical method. The projection shall take into account the assumed normal growth for non-specific loads, specific and identified loads of 1MW and above.

6.8.3 The peak load requirement at each connection point/ interface point shall be estimated taking into account distribution losses. If the Distribution Licensee received power at a number of connection points in a compact area which are inter-connected in a ring then such Distribution Licensee shall forward the overall short term forecast as well as at each connection points with the variation or tolerance as mutually discussed and agreed upon.

6.8.4 The Distribution Licensee and Large Consumers shall provide their above mentioned demand estimates for the period from 1st Jan to 31st Dec by 15 January of the subsequent year on a financial year ahead basis. This shall be updated for every month subsequently in the previous month on month ahead basis, and in the previous day on day ahead basis as required by the System Operator.

6.8.5 Based on the data furnished by the Distribution Licensees and Large Consumers the System Operator shall make monthly peak and off peak period demand estimate for the year ahead and daily peak and off peak demand estimates for the month ahead.

6.8.6 The System Operator shall make demand estimation on hourly basis for day ahead scheduling and dispatch purpose.

6.8.7 Distribution Licensees shall also provide the System Operator, estimates of loads that may be shed, when required, in discrete blocks with details of arrangements of such load shedding.

6.8.8 The System Operator shall maintain a data base of total demand of the country on an hourly basis.

6.9 Operating Margins and Demand Control

6.9.1 Operating Margin

6.9.1.1 Operating Margin comprises of Contingency Reserve and Operating Reserves required for satisfactory operation of the power system to cover uncertainties in variation in demand forecasts, loss of external connections, loss of generation, constraint in the transmission system and/ or any other factor.

6.9.1.2 The System Operator shall decide the required Contingency Reserves on the basis of historical trends in reduction in availability of generation and increase in demand then demand forecast during real time operation.

6.9.2 Demand Control

6.9.2.1 Distribution Licensees should reduce their demand in the event of insufficient generating capacity, and transfers from external interconnections being not available to meet demand, or in the event of breakdown or operating problems (such as frequency, voltage levels or thermal overloads) on any part of the Transmission System.

6.9.2.2 In case of certain contingencies and/or threat to system security, the System Operator may direct the Distribution Licensees to decrease their drawal by a certain quantum. Such directions shall immediately be acted upon.

6.9.2.3 Each Licensee shall make arrangements that shall enable manual demand disconnection to take place, as instructed by the System Operator, under normal and/or contingent conditions.

6.9.2.4 The measures taken to reduce the Licensee's drawal in its area of supply from the Transmission System shall not be withdrawn as long as the frequency/voltage remains at a low level, unless specifically permitted by the System Operator.

6.10 System Voltage and Reactive Power Requirements

6.10.1 The System Operator, Licensees and Users shall co-ordinate the use of voltage control equipment to maintain the system voltage within the system criteria.

6.10.2 To the extent possible, each Distribution and

Transmission Licensee and User connected to the Grid System shall meet its own local requirements for reactive power.

6.10.3 The Generation Licensees shall on an aggregated level have sufficient reactive reserve capacity to maintain the system voltage during emergency conditions.

6.10.4 The System Operator shall define the required load profile and allocate within the technical capability of the generation units, the generation and reserve reactive capacity throughout the system to ensure that the voltage is kept within acceptable levels in the event of the loss of a component decisive to the system voltage.

6.10.5 Each Generation Licensee shall, subject to the technical capability of the generation units, operate its plants to provide the required reactive generation and reserve capacity as instructed by the System Operator.

6.11 Outage Planning

6.11.1 The System Operator shall be responsible for analysing the outage plans given by all Licensees, and finalisation of the outage plan for the following calendar year.

6.11.2 All Licensees shall provide the System Operator their proposed outage plans for the next financial year by 1st December of each year. These shall contain identification of each generating unit/line/inter-connecting transformers (ICTs), the preferred date for each outage and its duration and where there is flexibility, the earliest start date and latest finishing date.

6.11.3 The System Operator shall thereafter prepare an outage plan for the next calendar year by 15 December of each year taking into account the available resources in an optimal manner and to maintain security standards. The same shall be done after carrying out necessary system studies and, if necessary, the outage plans of Users shall be rescheduled. An adequate balance between generation and load requirements shall be ensured while finalising the outage plan.

6.11.4 The final outage plan shall be communicated to all Licensees by the System Operator by 31 December of each year.

6.11.5 The above outage plan shall be reviewed by the System Operator on a quarterly and monthly basis in coordination with all concerned Licensees, and adjustments made wherever found to be necessary.

6.11.6 In case of emergency in the system viz., loss of generation, break down of transmission line affecting the system, Transmission System disturbance, system isolation, the System Operator may conduct studies again before clearance of the planned outage.

6.11.7 The System Operator is authorised to defer the planned outage in case of any of the following:

(i) Major Transmission System disturbance (total black out in country);

(ii) System isolation;

(iii) Black out in a Distribution Licensee / Supply Licensee system; and

(iv) Any other event in the system that may have an adverse impact on the system security by the proposed outage.

6.11.8 Each Licensee shall obtain the final approval from the System Operator prior to availing an outage.

6.11.9 The outage plan of Generators and Transmission System associated with export of power to neighbouring countries shall be finalized in consultation with the concerned System Operator of the neighbouring country.

6.12 Recovery Procedures

6.12.1 Detailed plans and procedures for restoration of the Transmission System under partial or total blackout shall be developed by the System Operator in consultation with all Licensees and shall be reviewed and updated annually.

6.12.2 Detailed plans and procedures for restoration after partial or total blackout of each Distribution System connected to the Transmission System shall be finalised by the concerned Licensee, in coordination with the System Operator. The procedure shall be reviewed, confirmed and/or revised once every subsequent year.

6.12.3 A list of generating stations with Black Start facility, Transmission System elements associated with export of power to neighbouring countries, synchronising points and essential loads to be restored on priority, shall be prepared and be available with the System Operator.

6.12.4 The System Operator is authorised during the restoration process following a black out, to operate with reduced security standards for voltage and frequency as necessary in order to achieve the fastest possible recovery of the Transmission System.

6.12.5 All communication channels required for

restoration process shall be used for operational communication only, until Transmission System Normal State is restored.

6.13 Operational Liaison

6.13.1 The operational liaison function is a mandatory built-in hierarchical function of the System Operator and Licensees, to facilitate quick transfer of information to operational staff. It shall correlate the required inputs for optimisation of decision making and actions.

6.13.2 Operations and events on the Transmission System

6.13.2.1 Before any operation is carried out on Transmission System, the System Operator shall inform each Licensee, whose system may, or shall, experience an operational effect, and give details of the operation to be carried out.

6.13.2.2 Immediately following an Event on Transmission System, the System Operator shall inform each Licensee, whose system may, or shall, experience an operational effect following the Event, and give details of what has happened in the Event.

6.13.3 Operations and events on a Licensee System

6.13.3.1 Before any operation is carried out on a Licensee's system the Licensee shall inform the System Operator, in case the Transmission System may, or shall, experience an operational effect, and give details of the operation to be carried out.

6.13.3.2 Immediately following an Event on a Licensee's system, the Licensee shall inform the System Operator, in case the Transmission System may, or shall, experience an operational effect following the Event, and give details of what has happened in the Event.

6.13.4 Safety co-ordination

6.13.4.1 The System Operator shall establish procedures for establishing and maintaining the necessary isolation and earthing when work and/or testare carried out.

6.13.4.2 Such procedures shall cover:

(i) The nomination and qualifications of a safety co-ordinator for the installations of the affected Licensee (-s);
(ii) Notification and communication procedures for work on apparatuses;
(iii) The implementation of the isolation and earthing;
(iv) Tests of whether the system is isolated or earthed; and
(v) Cancellation of isolation and earthing.

6.14 Periodic Reports

6.14.1 A quarterly report shall be issued by the System Operator to all Licensees, Authority and the Ministry, and shall cover the performance of the Transmission System for the previous quarter. The

report shall contain the following but not limited to:

(i) Performance of Generating Stations;
(ii) Peak demand,energy availability and requirement for the country;
(iii) Export and import of electricity to/ from neighbouring countries;
(iv) Frequency profile: Maximum and minimum frequency recorded and the frequency duration in different frequency bands;
(v) Voltage profile of selected substations;
(vi) Major generation and transmission outages;
(vii) Transmission constraints; and
(viii) Instances of persistent or significant non-compliance with the Grid Code Regulation.

6.14.2 Other Reports

6.14.2.1 The System Operator shall also prepare an annual report covering the performance of the Transmission System and details as required by the Ministry and the Authority annually for development of Power System Master Plan and formulation of other policy decisions.

6.14.2.2 The System Operator shall also provide information and reports which may be called upon by the Authority or by the Ministry in the interest of smooth operation of the Transmission System.

6.15 Event Information

6.15.1 Any Event on the other User's system having anoperational effect on Transmission System shall be reported by the concerned User to the System Operator.

6.15.2 The reportable incidents that require reporting are as follows:

(i) Tripping of any inter-connecting transformer (ICT), transmission line or capacitor bank;
(ii) Tripping of any generating units;
(iii) Major protection failure;
(iv) Exceptionally high/low voltage frequency;
(v) Serious equipment problem i.e. major circuit breaker, transformers, bus-bar fault etc.;
(vi) Overloading of equipment or transmission lines;
(vii) Activation of any alarm or indication of abnormal operating condition;
(viii) Breakdown or faults or temporary changes in the capabilities of the plant and/or apparatus; and
(ix) Loss of load.

6.15.3 Reporting Procedure

6.15.3.1 All reportable incidents shall be reported orally by the User whose equipment has experienced the incident to all other significantly affected Users and the System Operator.

6.15.3.2 The reporting User shall submit a written confirmation to the System Operator in the specified format.

6.15.3.3 Form of Written Reports: A written report shall be sent to the System Operator or a Licensee, as the case may be, and shall

confirm the oral notification together with the following details of the Event:

(i) Time and date of Event;
(ii) Location;
(iii) Plant and/or equipment directly involved;
(iv) Description and cause of Event;
(v) Antecedent conditions;
(vi) Demand and/or generation (in MW) interrupted and duration of interruption;
(vii) All relevant system data including copies of records of all recording instruments including data from Disturbance Recorders and Event Recorders;
(viii) Sequence of trippings with time;
(ix) Details of relay flags;
(x) Remedial measures and recommendation for future improvement; and
(xi) Any other relevant information.

7 Scheduling and Dispatch Code

7.1 Introduction

7.1.1 The entire Bhutan Grid operates in synchronism with the Indian Grid and the major generation in Bhutan is envisaged to be exported to the Indian Grid as per Memorandum of Understanding between the Royal Government of Bhutan and Government of India. The Scheduling and Dispatch Code for Bhutan has to be technically compatible with the Scheduling and Despatch Code of the Indian Electricity Grid Code Regulation.

7.1.2 This section sets out the:

(i) Demarcation of responsibilities between System Operator, Generation Licensees and Distribution Licensees;

(ii) Demarcation of interface responsibilities with the Eastern Regional Load Despatch Centre(ERLDC), Kolkata (West Bengal), for export/import schedule at the India-Bhutan border;

(iii) The procedure for scheduling and dispatch; and

(iv) The reactive power and voltage control mechanism.

7.2 Objective

7.2.1 This section deals with the procedures to be adopted for scheduling of the various generating stations in Bhutan, export to India and drawal by various Distribution Licensees within the country on a daily basis with the modality of flow of information between the agencies involved in the process.

7.2.2 It also provides the method for issuing real time dispatch/ drawal instructions and rescheduling, if required, to Generating Stations, Distribution Licensees and Large Consumers in order to maintain minimum deviation from schedule so as to facilitate maintaining the

Transmission System frequency within the stipulated band of 49.5 to 50.5 Hz.; in addition to coordination amongst the Generation Licensees, Distribution Licensees and Transmission Licensee for congestion management and voltage control.

7.3 Scope

7.3.1 This Section shall apply to the System Operator, Generation Licensees, Distribution Licensees and Large Consumers.

7.3.2 The scheduling and dispatch procedure for scheduling of drawal by the Indian purchasers from Bhutan shall be as per the bilateral agreements between the contracting parties.

7.4 Demarcation of responsibilities

7.4.1 The Power System shall be operated as a Tight Pool in which the System Operator shall have complete responsibility for:

(i) centralized scheduling and centralized dispatch of generation;
(ii) scheduling the drawals of the Distribution Licensees and export to India;
(iii) regulating the demand of the Distribution Licensees; and
(iv) arranging any bilateral interchanges.

7.4.2 The entire Power System shall be treated and operated as a single national system. However, until integration is achieved between the Eastern and Western Grids, the System Operator shall prepare schedules for the Eastern and Western Grids separately.

7.4.3 The generating stations shall be responsible for power generation in accordance with the daily schedules advised to them by the System Operator. The

generating stations shall also be responsible for the operation and maintenance of their generating stations, such that these stations achieve the best possible long-term availability and economy.

7.4.4 Generating stations are normally be expected to generate power according to the daily schedules advised to them. In the event of any unforeseen situation at the generation stations necessitating deviation from the schedules, the same shall be informed to the System Operator. The System Operator after examining the Transmission System conditions shall interact with the other generating stations, Distribution Licensees, importing agencies and reschedule the dispatch which shall be complied with by the concerned agencies.

7.4.5 Provided that when the frequency is higher than 50.5 Hz, and spilling of water is not envisaged, the System Operator shall reschedule the dispatch schedule of generating stations. Similarly, in the event of frequency falling below 49.5Hz the System Operator may consider revision in dispatch schedule after examining the overall inflow position and scheduled dispatch of other generating stations.

7.4.6 Notwithstanding the above, the System Operator may direct the Distribution Licensees for demand management wherever possible and generating stations to increase/decrease their generation in case of contingencies e.g. overloading of lines/transformers, abnormal voltages, threat to system security etc. Such directions shall immediately be acted upon.

7.4.7 The Generation Licensees while entering in to an agreement for sale of power shall discuss the metering and supply arrangements with the System Operator. All such agreements and subsequent modifications shall

be filed with the System Operator in advance.

7.4.8 It shall be incumbent upon the generating stations to declare the plant capabilities faithfully, i.e., according to their best assessment. The generating stations based on the past historical data/records as well as with the data gauge available for inflows shall estimate the hourly inflow pattern for declaration of the day-ahead plant capability in terms of energy and power.

7.4.9 The energy meters on all interconnections with the Distribution Licensees and with generators and other identified points for recording of actual bilateral energy exchange and reactive energy drawals shall be installed. The type of meters to be installed, metering scheme, metering capability, testing and calibration requirements and the scheme for collection and dissemination of metered data shall be in accordance with Annexure 3.

7.4.10 The System Operator shall be responsible for computation of actual energy export/import of each generating stations and at each distribution point. All computations carried out by the System Operator shall be open to all the utilities for checking and verification for a period of fifteen (15) days. In case any mistake/ omission is detected, the System Operator shall forthwith make a complete check and rectify the same.

7.4.11 The System Operator, in order for periodic review from the actual deviation from the dispatch and net schedules being issued shall check the hourly logbooks maintained by the aforesaid agencies and prepare a report of deviations from schedules. This may enable the System Operator to refine the future demand estimation and issue correct schedules. All the agencies shall furnish such details to the System

Operator whenever the same is sought for such information.

7.5 Scheduling and dispatch procedure

7.5.1 All the generating stations synchronized with the Transmission System and whose scheduling shall be done by the System Operator shall be duly listed. The station capacities and any contracted shares by thegenerating stations shall also be listed.

7.5.2 By 0900 hours on each day all the hydroelectric stations shall estimate their respective inflows and assess their respective energy capability as well as the maximum ex-bus power deliverable based on the number of machines available. Generating stations with their own system demands such as auxiliary and colony loads shall also estimate the hourly demand pattern for such load and any other constraints including maintenance that might cause a restriction in generation in any period during the next day. The total energy capability and anticipated hourly power capability that can be delivered to the Transmission System, on an Ex-Power Plant basis, shall be calculated after deducting the above local demands. A sample format for presenting the availability is shown at Annexure 1.

7.5.3 By 0930 hours every day, all generating stations directly connected to the Transmission System shall advise the System Operator of the station-wise Ex-Power Plant demand and energy capabilities (in the sample format of Form 1) foreseen for the period from 0000 hours to 2400 hours of the following day.

7.5.4 The Distribution Licensees and Large Customers who do not purchase from Distribution Licensees shall communicate their forecasted demand on the Transmission System for the next day, net of supply

from embedded generators, on an hourly basis to the System Operator by 0930 hours each day.

7.5.5 Embedded generators shall communicate their expected energy and power capability to the System Operator by 0930 hours for record purposes.

7.5.6 The capabilities of each of the generating stations and the corresponding hourly estimated demand of the entire Power System shall be compiled by the System Operator every day for the following day. A format for compilation for such information by the System Operator is enclosed at Annexure 2. A copy of Annexure 2 shall be forwarded by the System Operator to ERLDC.

7.5.7 Until the East and West Grids are interconnected inside Bhutan, the day-ahead demand on the Eastern Grid and that of Western Grid shall be estimated by the System Operator separately on an hourly basis.

7.5.8 By 1130 hours, the System Operator shall advise the ERLDC of the expected cross-border transfer at Salakati in India. The cross-border transfer at Salakati shall be arrived at subtracting the demand on the Eastern Grid and notional transmission loss from the ex-power plant energy available to the Eastern Grid.

7.5.9 Similarly by 1130 hours, the System Operator shall advise ERLDC of the expected cross-border transfer at Birpara and Binaguri in India. The cross-border transfer at Birpara and Binaguri shall be arrived at subtracting the demand on the Western Grid and notional transmission loss from the ex-power plant energy available to the Western Grid

7.5.10 By 1330 hours, the ERLDC shall inform the System Operator of any modifications required in the cross-

border transfers arising from any anticipated transmission constraints. ERLDC, in finalizing the dispatch schedule for its own system, shall reconfirm the same to the System Operator by 1730 hours (i.e.1700 hours IST).

7.5.11 The System Operator by 1800 hours shall issue the hourly schedule of generation to each of the generators, excluding embedded and off-grid generators.

7.5.12 The System Operator by 1800 hours shall also issue a Net Drawal Schedule for Distribution Licensees. Until the Eastern and Western Grids are connected inside Bhutan, the System Operator shall however, prepare the Net Drawal Schedule for Eastern and Western Grids separately.

7.5.13 While finalizing the above daily dispatch schedules for the generating stations the System Operator shall ensure that the same are operationally reasonable, particularly in terms of maintaining optimum efficiency, avoiding problems due to cavitations etc. The generators are required to furnish the System Operator the typical ramping up/down rate capabilities of their machines.

7.5.14 In case of Forced Outage of a unit, the System Operator shall revise the schedules on the basis of revised declared capability by the concerned generator. Where such revision affects the cross-border transfers, the generator shall communicate the revision to the System Operator in Bhutan who shall then forward the information to ERLDC.

7.5.15 In the event of bottleneck in evacuation of power due to any constraint, outage, failure or limitation in the

Transmission System, associated switchyard and sub-stations owned by the Transmission Licensee, sudden demand change by the Distribution Licensees or Large Consumers, the System Operator shall revise the schedules and advise the ERLDC.

7.5.16 In case of any Transmission System disturbance within Bhutan, the scheduled generation of all Generators and scheduled drawal by the Distribution Licensees and Large Consumers shall be deemed to have been revised to be equal to their actual generation/drawal for the period affected. Certification of Transmission System disturbance and its duration shall be done by the System Operator.

7.5.17 Revision of declared capability by the Generating stations (exporting power to Indian Transmission System) for sudden increase or decrease in inflows for the remaining period of the day shall also be allowed with advance notice. The concerned generator may advise the System Operator in Bhutan of such revision who shall then forward the information to ERLDC.

7.5.18 If, at any point of time, the System Operator observes that there is need for revision of the schedules in the interest of better system operation, it may do so on its own initiative.

7.5.19 After 2400 hours, the schedule finally implemented during the day (taking into account all ex-ante changes in dispatch schedule of generating stations and Drawal Schedule of the Distribution Licensees and Large Customers) shall be issued by the System Operator. These schedules shall be compared to the actual generation /drawal for the purpose of refinement of demand estimation.

7.5.20 The System operator shall properly document all the above information i.e. station-wise foreseen ex-power plant capabilities advised by the generating stations, the Drawal Schedules for all Distribution Licensees as issued and all revisions with reasons thereof.

7.5.21 The procedure for scheduling and the final schedules issued by the System Operator shall be open to all concerned for any checking and verification, for a period of five (5) days. In case any mistake or omission is detected, the System Operator shall forthwith make a complete check and rectify if necessary.

7.6 Reactive Power and Voltage Control

7.6.1 Reactive power compensation should ideally be provided locally, by generating reactive power as close to the reactive power consumption as possible. The utilities are therefore expected to provide local reactive power compensation/generation such that they do not draw reactive power from the Transmission System, particularly under low-voltage conditions.

7.6.2 Notwithstanding the above, the System Operator may issue instructions to the generators to generate or absorb reactive power as per their capability curves in order to control the voltage level. The System Operator may also instruct switching in/out of lines/ transformers in order to control the voltage level.The security and reliability criteria need be critically examined while issuing such switching instructions.

7.6.3 In general, the Distribution Licensees shall endeavour to minimize the reactive power drawal at an interchange point when the voltage at that point is

below 95% of rated, and shall not return reactive power when the voltage is above 105%. ICT taps at the respective drawal points may be changed to control the reactive power interchange as per a Distribution Licensee's request but only at reasonable intervals. The System Operator shall periodically review the reactive power drawal/injection at the distribution points and may suggest programmes for installation of Reactors/Capacitors.

7.6.4 Switching in/out of all bus and line reactors, and shunt capacitors throughout the Transmission System shall be carried out as per instructions of the System Operator. Tap changing on all ICTs up to 66/33 kV shall also be done as per the System Operator's instructions only.

8 Management of Grid Code Regulation

8.1 Introduction

8.1.1 The Grid Code Regulation is a regulation issued by the Authority under Section 89 of the Act.

8.1.2 Any amendments to the Grid Code Regulation shall also be specified by the Authority only.

8.2 Objective

This Section defines the method for managing the Grid Code Regulation, pursuing of any change/modifications and the responsibilities of the concerned to effect that change.

8.3 Scope

The Authority shall be responsible for managing the Grid Code Regulation.

8.4 Management of Grid Code Regulation

8.4.1 The Grid Code Regulation and any amendments shall be finalised and notified according to the prescribed

procedure issued by the Authority.

8.4.2 The request for amendments or modifications to the Grid Code Regulation and for removal of difficulties shall be addressed to the Authority for periodic consideration, consultation and disposal.

8.4.3 Any dispute or query regarding interpretation of Grid Code Regulation may be addressed to the Authority and clarifications issued by the Authority shall be taken as final and binding on all concerned.

Annexure I: Availability Declaration

(To be sent to the System Operator by the Generators in accordance with Section 7.5.3)

MSG NO_____ DATE_____

TOO:_____(BST)

EXPECTED EX-POWER PLANT AVAILABILITY DECLARATION FOR HYDRO STATIONS FOR DATE_____

Anticipated Ex-Power Plant power and energy availability for the day				
Power Station:	Tala	Chukha	Basochu	Kurichu
Expected Maximum Ex-Power Plant Power (MW)				
Expected Ex-Power Plant Energy (MWh)				
Anticipated in-flow (m^3/s)				

Anticipated line constraints/ outages / other constraint, if any			
Tala	Chukha	Basochu	Kurichu

Anticipated hourly Ex-Power Plant availability for the day (MW)

Hour	Tala	Chukha	Basochu	Kurichu
0000				
0100				
0200				
0300				
0400				
0500				
0600				
0700				
0800				
0900				
1000				
1100				
1200				
1300				
1400				
1500				
1600				
1700				
1800				
1900				
2000				
2100				
2200				
2300				

(SIGNATURE)

(OFFICER IN CHARGE)

Annexure 2: Consolidated Availability

MSG NO_____ DATE_____

TOO:_____(BST)

EXPECTED TRANSMISSION SYSTEM AVAILABILITY FOR DATE_____

Transmission System (East/West/Total)				All figures in MW		
Hour	**Total Ex-Power Plant Availability**	**Total Ex-Transsmission System**	**Domestic Transsmission System Losses**	**Total available for Export Ex-Power Plant**	**Export Transimission System Losses**	**Total available for export at border**
	A	B	C	D=A-B-C	E	D-E
0000**						
0100						
0200						
0300						
0400						
0500						
0600						
0700						
0800						
0900						
1000						
1100						
1200						
1300						
1400						
1500						
1600						
1700						
1800						
1900						
2000						
2100						
2200						
2300						

* Negative figure indicates an import requirement

** 0000 hrs means midnight

Annexure 3: Metering Philosophy

1. The energy meters of uniform technical specification shall be provided so as to permit accounting of the energy transactions at actual drawal /injection from one Licensee to other Licensee system.

2. The main meter and check meter shall be provided on all the outgoing feeders from the bus-bars of the generating switchyard to measure and record the energy delivered to the Grid. The main & check meter shall be connected to same core of CTs & VTs.

3. The Main Energy Meter shall be owned by the Licensee in whose premises the meter is located and the check meters shall be owned by the other Licensee. For the Energy meters already installed at various metering points the present system of ownership of meters may be continued. For any future addition/replacement of the meters, the concerned Agencies shall provide and install the same.

4. The main energy meters shall be used for billing provided the main meters have been in continuous service throughout the month. If any one or more main meters have been removed from service for repairs or have not registered energy supply for any duration of time, the reading of the corresponding check meter or meters shall be taken as basis for billing. The owners of the meters shall be responsible for maintenance of the meters.

5. If the reading of the main meter(s) installed differ from the corresponding check meter(s) by more than $\pm$ 0.6 %, for class of 0.2 accuracy meter then the main and check meters shall be taken up for joint calibration. Energy figures recorded by the main meter for the month concerned shall be revised accordingly if the overall error on the main meter exceeds the above said percentage on actual testing. In the event any meter is removed from calibration/testing, the relevant Agency shall substitute the meters and to be jointly witnessed.

6. Pending results of such testing being available, the billing shall continue to be based on the energy recorded by the main meter(s).

7. All the energy meters installed on feeders of 66kV and above shall be of a minimum accuracy class of 0.2 and accuracy class 0.5 for 33kV and below. In future, as and when the meters are replaced, efforts shall be made to install higher accuracy class energy meters.

8. All the main and check meters shall be tested and calibrated annually as per prevailing standards in the country, jointly by the concerned Agencies. The cost of testing /calibration of the energy meters shall be borne by the respective owner of the energy meters.

9. The concerned representatives shall record the energy meter reading(s) at 1230 hours (BST) on the 1st of every calendar month. Recording of energy meter readings shall be done jointly by the authorized representatives of the concerned Agencies. Any error beyond permissible value observed in the meters shall be set right by joint calibration of the meters.

10. The current and voltage transformers to which the above meters are connected shall have a measurement accuracy class of 0.5 or better.

11. The meter shall be totally sealed and tamper proof, with no possibility of any adjustments at site, except for a restricted clock operation. The harmonic shall preferably be filtered out while measuring and only fundamental frequency quantities shall be measured/computed.

Approved in the Ninth Commission Meeting held on the 21st day of the 2nd Month of the Male Earth Rat Year corresponding to 28th March 2008.