
## Bangladesh Energy Regulatory Commission

# ELECTRICITY GRID CODE
# 2018

Effective Date: December, 2018

# Bangladesh Energy Regulatory Commission

**NOTIFICATION**
**Dated: xx December 2018**

In exercise of the powers conferred by section 59 of the Bangladesh Energy Regulatory Commission Act 2003 (Act 13 of 2003), read with sub-sections 2(e) and 2(f) thereof and for the fulfillent of the objectives of the Act, the Bangladesh Energy Regulatory Commission is pleased to make the following regulations:

**Short Title and Commencement**

(i) These regulations may be called Bangladesh Energy Regulatory Commission (Electricity Grid Code) Regulations, 2018 or in short **Grid Code**.

(ii) These regulations shall come into force from the date of publication in the official gazette.

# GRID CODE CONTENTS

# GRID CODE REVISIONS

| REVISION NUMBER | DATE ISSUED | SECTION(S) REVISED |
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# 1. INTRODUCTION

## 1.1 GENERAL:

In exercise of the powers conferred by section 59 of the Bangladesh Energy Regulatory Commission Act 2003 (Act 13 of 2003), for the fulfillent of the objectives of the Act, the Bangladesh Energy Regulatory Commission has formulated the Electricity Grid Code; hereafter called the **Grid Code**.

The **Grid Code** is a document that governs the boundary between the **Licensee** and **Users** and establishes procedures for operations of facilities that will use the **Transmission System**. The **Grid Code** specifies criteria, guidelines, basic rules, procedures, responsibilities, standards and obligations for the operation, maintenance and development of the Electricity **Transmission System** of Bangladesh to ensure a transparent, non-discriminatory and economic access and use of the **Grid**, whilst maintaining a safe, reliable and efficient operation of the same to provide a quality and secure electricity supply as reasonably as practicable.

It should be noted that the **Grid Code** is not concerned with the detailed design and operation of **Power Stations** and **Distribution Systems**, provided that their overall compatibility with the **Transmission System** needs is assured.

## 1.2 STRUCTURE OF THE GRID CODE

The **Grid Code** contains criteria and provisions on the following areas:

i. **Management of the Code:** specifying the responsibilities of the **Transmission Licensee (Licensee)**, formation and functioning of **Code Review Panel**, and **Grid Code** review and revision;

ii. **Planning:** specifying the technical and design criteria and procedures to be applied by the **Transmission Licensee (Licensee)** in the planning and development of the **Transmission System** and by other **Users** connected or seeking **Connection** to the **Transmission System**;

iii. **Connection:** specifying the technical design criteria and standards to be complied with by the **Licensee** and other **Users** connected or seeking **Connection** to the **Transmission System**;

iv. **Outage**: specifying the procedures relating to coordination of the **Outages** for scheduled maintenance of the **Transmission System**, **Generating unit** and **Distribution System** that will use the **Transmission System**;

v. **Schedule and Dispatch:** specifying the procedures to be followed by the **System Operator,** the **Licensee** and **Users** relating to the scheduling and dispatch of **Generating Units** to meet the electrical demand;

vi. **Operations:** specifying the conditions under which the **Licensee, System Operator** shall operate the **Transmission System** and other **Users** of the **Transmission System** shall operate their plant and/ or systems for the generation and distribution of electricity in so far as necessary to protect the security and quality of supply and safe operation of the **Licensee's Transmission System** under both normal and abnormal operating conditions. Operation of the **Grid** generally covers:

Frequency and Voltage Management
Contingency Planning
Cross Boundary Safety
Operational Event and Accident Reporting
Tests
Numbering and Nomenclature
Data Registration;

vii. **Protection:** specifying the coordination responsibility and minimum standards of protection that are required to be installed by **Users** of the **Transmission System**;

viii. **Metering:** specifying the minimum operational and commercial metering to be provided by the **Licensee** and **Users**, Communication requirements, Data acquisition;

ix. **Performance Standard:** specifying the technical standards, uniform accounting system and financial standards and reporting indices in these respects to be implemented by the **Licensee.**

## 1.3 THE PURPOSE OF THIS CODE

(a) The operating procedures and principles governing **Licensee's** relationship with all **Users** are set out in the **Grid Code**.

(b) The **Grid Code** specifies day-to-day procedures for both planning and operational purposes and covers both normal and exceptional circumstances.

(c) This **Code** also sets out the technical requirements to be met by those who are connected to the **Transmission System.**

(d) It is conceived as a statement of what is optimal (particularly from a technical point of view) for all **Users** as well as the **Single Buyer** in relation to the planning, operation and use of the **Transmission System**.

(e) It seeks to avoid any undue discrimination between **Users** and categories of **Users**. It

should be noted that the holder of the **Transmission License** is also defined as a **User**.

## 1.4 SCOPE

The **Licensee** shall comply with the **Grid Code** in its capacity as holder of the **Transmission License** and **Generators**, **Distribution Utilities**, and **Bulk Power Consumers** shall also comply with it as **User's** of the **Transmission System** in the course of their generation, distribution and utilization of electricity.

## 1.5 INTERPRETATION

**1.5.1** The meaning of certain terms (which are printed in bold letters) used in the **Grid Code** shall be in accordance with the definitions listed in **Section** 2, **"Definitions"**, of the **Grid Code**.

**1.5.2** **Section** 2 of this code has been developed on the premise that accepted engineering terms do not require additional definitions.

**1.5.3** The term "**Grid Code**" means any or all parts of this document.

## 1.6 IMPLEMENTATION AND OPERATION OF THE GRID CODE

**1.6.1** The **Licensee** has the duty to implement the **Grid Code**. All **Users** are required to comply with the **Grid Code** that will be enforced by the **Licensee**. **Users** must provide the **Licensee** reasonable rights of access, service and facilities necessary to discharge its responsibilities in the **Users'** premises and to comply with instructions issued by the **Licensee**, reasonably required to implement and enforce the **Grid Code**.

**1.6.2** If any **User** fails to comply with any provision of the **Grid Code**, it shall inform the **Licensee** without delay of the reason for its non-compliance and shall remedy its non-compliance promptly. Consistent failure to comply with the **Grid Code** may lead to **Disconnection** of the **User's** plant and/ or facilities.

**1.6.3** The operation of the **Grid Code** will be reviewed regularly by the **Grid Code Review Panel** in accordance with the provisions of the relevant **Section** of the **Grid Code**.

## 1.7 GENERAL REQUIREMENTS

**1.7.1** The **Grid Code** contains procedures to permit equitable management of day to day technical situations in the **Power System**, taking into account a wide range of operational

conditions likely to be encountered under both normal and abnormal circumstances. It is nevertheless necessary to recognize that the **Grid Code** cannot predict and address all possible operational conditions.

**1.7.2** **Users** must therefore understand and accept that the **Licensee** and the **System Operator** in such unforeseen circumstances may be required to act decisively to discharge its obligations under its **License**. **Users** shall provide such reasonable co-operation and assistance as the **Licensee** and the **System Operator** may request in such circumstances.

## 1.8 CODE RESPONSIBILITIES

In discharging its duties under the **Grid Code**, the **Licensee** has to rely on information that other **Users** supply regarding their requirements and intentions. The **Licensee** shall not be held responsible for any consequences that arise from its reasonable and prudent actions on the basis of such information.

## 1.9 CONFIDENTIALITY

Under the terms of the **Grid Code**, the **Licensee** and the **System Operator** will receive information from **Users** relating to their intentions in respect of their Generation or Distribution/ Supply businesses. The **Licensee** shall not, other than as required by the **Grid Code**, disclose such information to any other person without the prior written consent of the provider of the information.

## 1.10 PROCEDURES TO SETTLE DISPUTE

**1.10.1** In the event of any conflict between any provision of the **Grid Code** and any contract or agreement between the **Licensee** and a **User**, the provision of the **Grid Code** will prevail.

**1.10.2** In the event of any dispute regarding interpretation of any part of the **Grid Code** provision between any **User** and the **Licensee**, the matter may be referred to the **Commission** for its decision. The **Commission's** decision shall be final and binding.

## 1.11 COMMUNICATION BETWEEN THE LICENSEE AND USERS

**1.11.1** All communications between the **Licensee** and **Users** shall be in accordance with the provisions of the relevant **Section** of the **Grid Code**.

**1.11.2** Unless otherwise specifically required by the **Grid Code,** all communications shall be in writing, save that where operation time scales require oral communication, these communications shall be confirmed in writing as soon as practicable.

## 1.12 PARTIAL INVALIDITY

If any provision or part of a provision of the **Grid Code** should become or be declared unlawful for any reason, the validity of all remaining provisions, or parts of provisions, of the **Grid Code** shall not be affected.

## 1.13 DIRECTIVE

Under the provisions of section 24 of the **Act**, the Government may issue policy **Directives** on matters concerning electricity including on measures that are considered necessary for the overall planning and coordination for the development of the electricity sector. The **Licensee** shall promptly inform the **Commission** and all **Users** of the requirement of such direction that affects the **Grid Code**. The **Users** shall comply with the directions.

## 1.14 MAINTENANCE

**1.14.1** It is a requirement that all **User**'s Plant and **Apparatus** on the **Licensee's** sites are maintained properly to ensure that they do not pose a threat to safety of any of the **Licensee's** Plant, **Apparatus** or Personnel on the **Licensee**'s site. The **Licensee** shall have the right to inspect test results and maintenance records relating to such Plant and **Apparatus** at anytime.

**1.14.2** It is also a requirement that all the **Licensee**'s Plant and **Apparatus** on **User**'s sites are maintained properly to ensure that they do not pose a threat to the safety of any **User**'s Plant, **Apparatus** or Personnel on the **User** site. **User**s shall have the right to inspect test results and maintenance records relating to such Plant and **Apparatus** at anytime.

## 1.15 CITIZEN CHARTER

The **Licensee** shall publish Citizen Charter incorporating also its obligation under the License issued by the **Commission** and the **Grid Code**.

# 2. DEFINITIONS AND ABBREVIATIONS

## 2.1 DEFINITIONS

| Defined Term | Definition |
|---|---|
| **Act** | The Bangladesh Energy Regulatory Commission Act, 2003, (Act 13 of 2003). |
| **Apparatus** | Electrical **Apparatus** and includes all machines, fittings, accessories and appliances in which conductors are used. |
| **Appendix** | An **Appendix** to a **Section** of the **Grid Code**. |
| **Area of Supply** | The area within which alone a **Distribution Utility** is for the time being authorized by his License to supply electricity. |
| **Back to Back** | Back to Back is an interface substation where both Rectifier and Inverter are present for conversion and reconversion of AC and DC transmission. |
| **BERC** | Bangladesh Energy Regulatory Commission. Also known as the **Commission.** Established by Bangladesh Energy Regulatory Commission Act 2003. |
| **Black Start** | The process of recovery from a total or partial blackout of the **Transmission System**. |
| **Bulk Power Consumer** | A person or establishment to whom electricity is provided and who has a dedicated supply from the **Grid** at 132kV or 230kV. |
| **Capability Curve** | Boundaries of the area within which a **Generating Unit** can operate safely. |
| **Check Metering System** | The tariff **Metering System** installed as Back-Up or Check Meter**.** |

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| **Connection** | The electric lines and electrical equipment used to effect a **Connection** of a **User's** system to the **Transmission System**. |
| **Connection Agreement** | An agreement between the **Licensee** and a **User** setting out the terms relating to the **Connection** to and/ or use of the **Transmission System.** |
| **Connection Conditions** | The technical conditions to be complied with by any **User** having a **Connection** to the **Transmission System** as laid down in **Section** 5: "**Connection Conditions**" of the **Grid Code**. |
| **Connection Point** | The point of **Connection** of the **User** system or equipment to the **Grid**. |
| **Control Person** | A person identified as having responsibility for cross-boundary safety under **Section** 10: "**Cross Boundary Safety**" of the **Grid Code**. |
| **Conventional Generating Unit/ Plant** | A **Generating Unit**/ Plant which is not a Variable Renewable Energy **Generating Unit/** Plant. |
| **Declared Available Capacity** | The estimated net capacity of the **Generating Units** announced by the **Generator** that equals the Dependable Capacity less any reductions due to scheduled outage, forced outage or maintenance outage. |
| **Detailed Planning Data** | As referred to Data Registration **Section**. |
| **Directive** | A policy **Directive** issued by the Government of Bangladesh or the **Commission** under the provision of the **Act**. |
| **Disconnect** | The act of physically separating a **User's** electrical equipment from the **Transmission System**. |
| **Distribution Utility/ Distributor** | An organization which is licensed to own and/ or operate all or part of the **Distribution System** and responsible for supply of electricity. |
| **Distribution System** | The system of electric lines and electrical equipment owned and operated by a **Distribution Utility**. |

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| **Electricity Act, 2018** | The Electricity Act adoptted in 2018 (Act 7 of 2018). |
| **Electricity Rules, 1937** | The Electricity Rules formulated in1937. |
| **Entity** | Any Establishment, including the **Single Buyer, Generator,** the **Licensee, Distributor,** the **System Operator, System Planner** and **User,** who uses the **Transmission System** and who must comply with the provisions of the **Grid Code**. |
| **External Interconnection** | Electric lines and electrical equipment used for the transmission of electricity between the **Transmission System** and any other **Transmission System** other than the **Power System** of Bangladesh. |
| **Extra High Voltage or EHV** | Nominal voltage levels of 132 kV and above. |
| **Generating Unit** | The combination of an alternator and a turbine set (whether steam, gas, water or wind driven) or a reciprocating engine and all of its associated equipment, which together represents a single electricity generating machine. |
| **Generating Plant** | A facility consisting of one or more **Generating Unit**s, where electrical energy is produced from some other form of energy by means of suitable **Apparatus**. |
| **Generator** | An organization that has a License to generate electricity and who is subject to the **Grid Code**. |
| **Grid Code/ Code** | The set of principles and guidelines managed and serviced by the **Licensee** in accordance with the terms and conditions of the **Transmission License** and approved by the **Commission**. |
| **Grid Code Review Panel/ Panel** | The **Panel** set up under **Section** 3: "Management of the **Grid Code**". |
| **IPP** | Independent Power Producer being a **Power Station** owned by a **Generator** who sells power to the **Single Buyer** under **PPA** signed according to the Private Sector Power Generation Policy of Bangladesh. |

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| **Licensee** | The holder of the **Transmission License** for the bulk transmission of electricity between **Generators** and **Distributors/ Bulk Power Consumers**. |
| **Load Dispatch Centre (LDC)** | The control room operating round the clock for the purpose of managing the operation of the **Transmission System** and coordination of generation and distribution on a real time basis. |
| **Merit Order** | A way of ranking **Generating Units** based on ascending order of variable cost (fuel and variable O&M) to meet demand at the least cost. |
| **Metering System** | The tariff metering system installed at the **Connection Points** in the **Transmission System** and owned by the **Single Buyer**. |
| **National Load Dispatch Centre (NLDC)** | Same as definition of **LDC.** |
| **National Plan** | National Development Plan prepared and produced by the Planning Commission. |
| **Net Electrical Output** | The net electrical energy expressed in kW or kWh delivered to the **Connection Point** by the **Generator**. |
| **Operating Committee** | The committee with members representing the **Generator,** the **Single Buyer,** the **System Operator** and the **Licensee** dealing with all operational matters affecting the **Transmission System** and meeting regularly. |
| **Off Peak Period** | That period in a day when electrical demand is the lowest. |
| **Outage** | The reduction of capacity or taking out of service of a **Generating Unit**, **Power Station** or part of the **Transmission System** or **Distribution System.** |
| **Peak Period** | That period in a day when electrical demand is at its highest level. |

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| **Photovoltaic (PV)** | A method of generating electrical energy by converting solar radiation into direct current electricity using semiconductors that directly produce electricity when exposed to light. |
| **Photovoltaic Generating Plant** | A **Generating Plant** which is made up of one or more solar panels, a controller or inverter, and the interconnections and mounting for the other componenets, which is connected to the system at a single **Connection Point.** |
| **Power Purchase Agreement** or **PPA** | The agreement between a **Generator** and the **Single Buyer** in which, subject to certain conditions, the **Single Buyer** agrees to purchase the electrical output of the **Generator's Generating Unit** and the **Generator** agrees to provide services from this Unit. |
| **Power Station** | An installation of one or more **Generating Units** (even when sited separately) owned and/ or operated by the same **Generator** and which may reasonably be considered as being managed as a single integrated generating complex. |
| **Power System** | The combination of the Generation System, **Transmission System** and **Distribution System**. |
| **Power System Master Plan (PSMP)** | Master plan for the **Power System** reviewed and updated periodically, preferably every 5 years, covering all issues relating to the **Power System.** |
| **Power System Stabilizer** | A supplementary excitation controller used to damp **Generator** electro-mechanical oscillations in order to stabilize the **Grid**. |
| **Private Generator** | A **Generator** which is not classified as a **Public Sector Entity** and operates as IPP/ Rental or any other basis under a **PPA** with the **Single Buyer**. |
| **Public Sector Entities** | The Bangladesh Power Development Board, the Bangladesh Rural Electrification Board constituted under the relevant Order, Ordinance and Act or any other power sector entity owned by the Government. |

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| **Section** | A **Section** or part of this **Grid Code** that is identified as covering a specific topic. |
| **Single Buyer** | An **Entity** in the public sector purchasing electricity from both public and **Private Generator**s and selling them to **Distributors**/ **Bulk Power Consumers** under Power Purchase and Power Sales Agreements respectively. It may ultimately be responsible for planning of least cost generation expansion; arranging establishment of private power generating stations as per generation expansion plan and for **Power System** operation including economic dispatch of generation. |
| **Standard Planning Data** | As referred to in Data Registration **Section**. |
| **Supervisory Control and Data Acquisition / SCADA** | **SCADA** refers to centralized real time control and monitoring system architecture that uses software and hardware elements where data collection functions are carried out from field through a communications system and system data is monitored centrally and control instructions are issued from master station to all parts the system. In Power System it is the combination of transducer/ IED, RTU, communication links and data processing systems which provides information to the **NLDC** and issues commands to field on the operation of the generation, transmission and distribution. |
| **System Operator** | The organization/ department assigned for operating the **Transmission System** and Load Dispatch (presently **NLDC**). |
| **System Planner** | The organization/ department assigned by the government (presently **BPDB** as **Single Buyer**) for preparing Master Plan for Power Sector. |
| **Transmission License** | The **License** granted to the Transmission Company by the **Commission** as per provisions of the **Act**. |
| **Transmission System (Grid)** | The system of **EHV** electric lines and electrical equipment owned and/ or operated by the **Licensee** for the purpose of the transmission of electricity between **Power Stations**, **External Interconnections** and the **Distribution System, Bulk Power Consumers**. |

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| **User** | A person or establishment, including the **Licensee,** the **Single Buyer,** the **System Operator, Generator Distribution Utility** and **Bulk Power Consumer** who uses the **Transmission System** and who must comply with the provisions of the **Grid Code**. |

## 2.2 ABBREVIATIONS

| Term | Meaning |
|---|---|
| **AACIR** | Average Annual Customer Interruption Rate |
| **ABCB** | Air Break Circuit Breaker |
| **ACP** | Average Collection Period |
| **AFC** | Automatic Frequency Control |
| **AVR** | Automatic Voltage Regulator |
| **APSCL** | Ashuganj Power Station Company Limited |
| **B2B** | Back to Back |
| **BERC** | Bangladesh Energy Regulatory Commission |
| **BPDB** | Bangladesh Power Development Board |
| **BREB** | Bangladesh Rural Electrification Board |
| **CPGCBL** | Coal Power Generation Company of Bangladessh Limited |
| **DPDC** | Dhaka Power Distribution Company Limited |
| **DESCO** | Dhaka Electricity Supply Company Limited |
| **EBIT** | Earnings Before Interest and Taxes |
| **EGCB** | Electricity Generation Company Limited of Bangladesh |
| **EHV** | Extra High Voltage |
| **FGMO** | Free Governor Mode of Operation |
| **HP** | Horse Power |
| **HV** | High Voltage |
| **HVAC** | High Voltage Alternating Current |
| **HVDC** | High Voltage Direct Current |
| **Hz** | Hertz |
| **IEC** | International Electro-Technical Commission |
| **IEEE** | Institute of Electrical and Electronic Engineers |
| **IPP** | Independent Power Producer |
| **kA** | Kilo Ampere |
| **kV** | Kilovolt |
| **kVAR** | Kilovolt Ampere Reactive |

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|---|---|
| **kW** | Kilowatt |
| **kWh** | Kilowatt Hour |
| **LDC** | Load Dispatch Centre |
| **mG** | Milli-Gauss |
| **MPEMR** | Ministry of Power Energy and Mineral Resources |
| **MOCB** | Minimum Oil Circuit Breaker |
| **mT** | Milli-Tesla |
| **MTBF** | Mean Time Between Failures |
| **MTTR** | Mean Time To Repair |
| **MW** | Megawatt |
| **MWh** | Megawatt Hour |
| **MVA** | Megavolt Ampere |
| **MVAR** | Megavolt Ampere Reactive |
| **NESCO** | Northern Electric Supply Company Limited |
| **NLDC** | National Load Dispatch Centre |
| **NWPGCL** | North West Power Generation Company Limited |
| **PBS** | Palli Bidyut Samity |
| **PGCB** | Power Grid Company of Bangladesh Limited |
| **PPA** | Power Purchase Agreement |
| **PSA** | Power Sales Agreement |
| **RMS** | Root Mean Square |
| **ROA** | Return on Assets |
| **RPCL** | Rural Power Company Limited |
| **SCADA** | Supervisory Control And Data Acquisition |
| **SF6** | Sulphur Hexafluoride |
| **TDD** | Total Demand Distortion |
| **THD** | Total Harmonic Distortion |
| **UsoAC** | Uniform System of Accounts |
| **VRE** | Variable Renewable Energy |
| **WZPDCL** | West Zone Power Distribution Company Limited |

# 3. MANAGEMENT OF THE GRID CODE

## 3.1 INTRODUCTION

The **Licensee** is required to implement and comply with the **Grid Code** and periodically review the same and its implementation. For the above purpose a **Grid Code Review Panel** comprising of representatives of all **Users** of the **Transmission System** shall be established.

Subject to the conditions in the next paragraph of this **Section**, a specific and important feature of the **Grid Code** is that no revision or modification of the **Code**, however large or small, may be made without being discussed at the **Grid Code Review Panel** meeting and approved by the **Commission.**

The **Commission** may issue directions requiring the **Licensee** to revise the **Grid Code** in such a manner as may be specified in those directions and the **Licensee** shall promptly comply with any such directions.

This document defines the procedure to be followed by the **Licensee** in maintaining the **Grid Code** and also in pursuing any change.

## 3.2 OBJECTIVE

The objective of this procedure is to define the method of managing the **Grid Code**, submitting and pursuing of any proposed change to the **Grid Code** and the responsibilities of all **Users** to effect that change.

## 3.3 RESPONSIBILITIES

**3.3.1** The **Licensee** will be responsible for managing and servicing the **Grid Code** for discharging its obligations under the **License**.

**3.3.2** The **Licensee** shall establish and service the requirements of the **Grid Code Review Panel** in accordance with provisions of sub-**Section** 3.4 of the **Code**.

## 3.4 GRID CODE REVIEW PANEL/ PANEL

**3.4.1** The **Grid Code Review Panel** shall be maintained to undertake the following:

i. To keep and maintain the **Grid Code** and its workings under scrutiny and

review.

ii. To analyze any major **Grid** disturbances soon after the occurrence and evolve any consequent revision to the **Grid Code**.
iii. To consider all requests for amendment to the **Grid Code** which any **User** makes.
iv. To publish recommendations for changes to the **Grid Code** together with the reason for the change and any objections, if applicable.
v. To issue guidance on the interpretation and implementation of the **Grid Code**.
vi. To examine problems raised by **Users**.

**3.4.2** The **Panel** shall be chaired by the Transmission Company in its capacity as the transmission **Licensee** and consist of the following members:

1. A Chairman from the **Licensee** not below the rank of Executive Director;
2. A Technical Member (Secretary) from the **Licensee** not below the rank of Chief Engineer;
3. A Technical Member from the **System Operator** or Planning Department of the **Licensee**.

Representative from each of the following:

4. One Member to represent the **Single Buyer;**
5. One Member from **BPDB** to represent Generation;
6. One member from **EGCB/ NWPGCL/ APSCL/ RPCL/ CPGCBL** (for tenure of one year each on rotation basis);
7. One Member from **IPPs/ Private Generators** (for tenure of one year each on rotation basis to be notified by the **Licensee,** to represent all the **IPPs/ Private Generators** in Bangladesh);
8. One Member from **BPDB** to represent Distribution;
9. One Member from **BREB**;
10. One Member from **DPDC/ DESCO** (for tenure of one year each on rotation basis);
11. One Member from **WZPDCL/ NESCO** (for tenure of one year each on rotation basis).

**3.4.3** The **Licensee** will inform all **Users** of the names and addresses of the **Panel** Chairman and Technical Secretary at least seven days before the first **Panel** meeting, and shall inform **Users** in writing of any subsequent changes.

**3.4.4** Each **User** shall inform the **Panel** Technical Secretary of the name and designation of their **Panel** Representative not less than 3 working days before the first **Panel** meeting and shall inform the **Panel** Technical Secretary, in writing, of any subsequent change.

**3.4.5** The Rules to be followed by the **Panel** in conducting their business shall be formulated by

the **Panel** themselves and shall be approved by the **Commission**. The **Panel** will meet at least once in three months.

**3.4.6** Sub-meetings may be held by the **Licensee** with a **User** to discuss individual requirements and with groups of **Users** to prepare proposals for the **Panel** meeting. The **Panel** may set up sub-committees for detailed studies of related problems.

## 3.5 GRID CODE REVIEW AND REVISIONS

**3.5.1** The Technical Secretary shall present all proposed revisions of the **Grid Code** to the **Panel** for its consideration.

**3.5.2** The **Licensee** shall send to the **Commission** following reports at the conclusion of each Review Meeting of the **Panel**.

(a) A report on the outcome of such review.
(b) Any proposed revisions to the **Grid Code** as the **Licensee** reasonably thinks necessary for the achievement of the defined objectives.
(c) All written representations or objections from **Users** arising during the review.

**3.5.3** All revisions to the **Grid Code** shall require approval of the **Commission**. The **Commission** shall publish revisions to the **Grid Code** once approved by the **Commission**.

**3.5.4** The **Licensee** shall present proposals to the **Commission** to allow relaxation, where **Users** have difficulties in meeting the **Grid Code** requirements.

**3.5.5** The revision number and date of issue shall appear on every page of the **Grid Code**.

**3.5.6** Every change from the previous version shall be clearly marked in the margin. In addition, a revision sheet shall be placed at the front of the revised version that lists the number of every changed sub-**Section**, together with a brief description of change.

**3.5.7** The **Licensee** shall keep an up-to-date list of the recipients and locations of all serviced copies of the **Grid Code.**

# 4. TRANSMISSION SYSTEM PLANNING

## 4.1 INTRODUCTION

This **Section** identifies the method for data submissions by **Users** to the **Licensee** for the planning and development of the **Transmission System.** This **Section** also specifies the technical and design criteria and procedure to be applied by the **Licensee** in the planning and development of the **Transmission System.**

A requirement for reinforcement or extension of the **Transmission System** may arise for a number of reasons, including but not limited to the following:

i. Development in a **User's** system already connected to the **Transmission System**.
ii. The introduction of a new **Connection Point** between the **User's** system and the **Transmission System**.
iii. An increase in system capacity to remove operating constraints and maintain standards of security.
iv. Stability considerations.
v. Cumulative effect of any of the above.

Accordingly, the reinforcement or extension of the **Transmission System** may involve work at an entry or exit point (**Connection Point**) of a **Generator** or **Distribution Utility** or **Bulk Power Consumer** to the **Transmission System**.

Since development of all **Users'** systems must be planned well in advance to permit consents and wayleaves to be obtained and detailed engineering design/ construction work to be completed, the **Licensee** will require information from **Users** and vice versa. To this effect the Planning Code imposes a time scale, for exchange of necessary information between the **Licensee** and **Users** having regard, where appropriate, to the confidentiality of such information.

## 4.2 OBJECTIVE

The provisions of this **Section** are intended to enable the **Licensee** in consultation with the **Single Buyer, Generators** and **Users,** to provide an efficient, co-ordinated, secure and economical **Transmission System** to satisfy requirement of future demand.

## 4.3 PERSPECTIVE PLAN

**4.3.1** The **System Planner** will prepare and submit a long-term (preferably 20 years which may

be termed as planning-term) **Power System Master Plan** to the Government and to the **Commission** for generation expansion and for **Transmission System** expansion to meet the future demand.

**4.3.2** For fulfillment of the above requirement the **System Planner** and the **Licensee** shall work together to:

i. Forecast the demand for power within the **Area of Supply** in each of the succeeding planning-term and provide to the **Commission** details of the demand forecasts, data, methodology and assumptions on which the forecasts are based.

ii. Prepare a least cost generation plan for the **Power System** based on analysis of primary fuel supply availability to meet the long-term load demand as per the forecast, after examining the technical, economic, and environmental aspects of all available alternatives taking into account the existing contracted generation resources and effects of demand side management.

iii. Prepare a long-term plan for the expansion of the **Transmission System** compatible with the above load forecast and generation plan.

iv. Combine the above elements to form the **Power System Master Plan** which shall be reviewed yearly to identify any major changes/ requirements or whenever the government urges for urgent power generation and communicated to the **Commission.**

**4.3.3** The **Power System Master Plan** shall be updated periodically, preferably every 5 years and used as an input to the national plan.

## 4.4 PLANNING AND SECUIRITY STANDARDS

The **Transmission System** shall be planned in accordance with the following transmission system planning and security standards.

Voltage limits:

Normal Operating Condition:

±5% for 400 kV Bus
±6% for 230 kV and 132 kV Bus

Emergency Condition:

+/- 10 % for 400 kV Bus
+ 10/-15% for 230 kV and 132 kV Bus.

Transient voltage variation due to switching or tripping of transmission system equipment may exceed the above limit.

Minimum Contigency Criteria of Transmission Line Outages:

single contingency of a permanent three-phase outage of any one circuit element or transformer.

Stability

to be maintained stable during a fault clearance by three-phase trip within 5 cycles and followed by successful reclosure within 15 cycles.

## 4.5 PLANNING RESPONSIBILITY

**4.5.1** The primary responsibility of load forecasting within its area rests with each of the **Distribution Utilities**. The **Distribution Utilities** shall determine peak load and energy forecasts of their respective areas for each category of loads for each of the succeeding planning-term and submit the same annually by 31st March to the **Licensee** and **System Planner,** along with details of the demand forecasts, data, methodology and assumptions on which the forecasts are based. The load forecasts shall be made for each of the **Connection Points** between the **Licensee** and **User** and shall include annual peak load and energy projections and daily load curve. The demand forecasts shall be updated annually or whenever major changes are made in the existing forecasts or planning. While indicating requirements of single consumers with large demands (5 MW or higher) the **Distribution Utility** shall satisfy itself as to the degree of certainty of the demand materializing.

**4.5.2** The **Licensee** and **System Planner** are responsible for integrating the load forecasts submitted by each of the **Distribution Utilities** and determining the long term (20 years) load forecasts for the **Power System**. In doing so the **Licensee** and **System Planner** may apply appropriate diversity factors, and satisfy itself regarding probability of materialization of bulk loads of consumers with demands above 5 MW in consultation with that **Distribution Utility** concerned.

**4.5.3** The **Licensee** and **System Planner** may also review the methodology and assumptions used by the **Distribution Utility** in making the load forecast, in consultation with the **Distribution Utility**. The resulting overall load forecast will form the basis of planning for expansion of generation and the **Transmission System.**

## 4.6 PLANNING DATA REQUIREMENT

**4.6.1** To assist the **System Planner** to discharge its responsibilities, the **Licensee** and the **System Planner** shall jointly conduct system studies and prepare perspective plans for the

**Transmission System** as detailed in paragraph 4.3 of this **Section.** The **Users** shall furnish data to the **Licensee** and **System Planner** from time to time as detailed under Data Registration **Section** and categorized as Planning Data (PD).

**4.6.2** To enable **Users** to co-ordinate planning, design and operation of their plants and systems with the **Transmission System** they may seek certain salient data of **Transmission system** as applicable to them, which the **Licensee** shall supply from time to time as detailed under Data Registration **Section** and categorized as Detailed System Data (Transmission).

# 5. CONNECTION CONDITIONS

## 5.1 INTRODUCTION

**Connection Conditions** specify the technical, design and operational criteria that must be complied with by any **User** connected to the **Transmission System**.

## 5.2 OBJECTIVE

The objective of this **Section** is to ensure the following:

i. By specifying minimum design and operational criteria, to assist **Users** in their requirement to comply with License obligations and hence ensure that a system of acceptable quality is maintained.

ii. Any new **Connection** shall not impose any adverse effects on existing **Users**, nor shall a new **Connection** suffer adversely due to existing **Users**.

iii. All **Users** or prospective **Users** are treated equitably.

iv. Specify the data required by the **Licensee** and **System Operator** from **Users**.

v. The ownership and responsibility for all items of equipment is clearly specified in a schedule (Site Responsibility Schedule) for every site where a **Connection** is made.

## 5.3 SITE RESPONSIBILITY SCHEDULE

**5.3.1** For every **Connection** to the **Transmission System** for which a **Connection Agreement** is required, the **Licensee** shall prepare a schedule of equipment with information supplied by the respective **Users**. This schedule, called a Site Responsibility Schedule, shall state the following 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.

An illustrative Site Responsibility Schedule is provided at **Appendix**.

**5.3.2** The **User** owning the **Connection** site shall provide reasonable access and other required facilities to another **User** whose equipment is installed at the **Connection** site for installation, operation and maintenance, etc.

## 5.4 SYSTEM PERFORMANCE

**5.4.1** All equipment connected to the **Transmission System** shall be of such design and construction as to satisfy at least the requirements of the relevant Bangladesh Standard Specification, where no Standard exists the appropriate **IEC** Standard or other International Standard will apply.

**5.4.2** Installation of all electrical equipment shall comply with **Electricity Rules, 1937** and revisions thereof.

**5.4.3** The **Transmission System** frequency shall normally be 50.0 Hz and shall normally be controlled in the range 49.5 – 50.5 Hz (50 Hz ± 1%). The **User** shall however be subject to the **Grid** discipline directed by the **Commission**.

**5.4.4** Voltage variation on the **Transmission System** shall normally be ±5% for 400 kV, ±6% for 230 kV & 132 kV bus during normal operations and +/- 10 % at 400 kV, + 10/-15% for 230 kV, 132 kV bus during emergencies in accordance with the provisions of Planning and Security Standards for **Transmission System**.

**5.4.5** Insulation coordination of the **Users'** equipment and rupturing capacity of switchgear shall conform to applicable Bangladesh Standards/ Codes.

**5.4.6** Protection schemes and Metering shall be as detailed in the Protection & Metering **Sections** of the **Code**.

**5.4.7** For existing **Power Stations**, the equipment for communications (voice and data) and **SCADA** system shall be owned and maintained by the **Licensee**, unless alternative arrangements are mutually agreed. The **Users** shall be responsible to provide compatible **SCADA** and Communication interfaces (Voice, Data & Tele-protection) with the **System Operator SCADA** and Communication system for exchanging required system information and deliver control commands as stated in this **Grid Code**.

**5.4.8** For new **Power Stations** or **User**'s substations/ facilities, the equipment within their site for communication (voice & data), **SCADA** Control (for example RTU/ SAS) shall be installed, owned & maintained by the respective **Generator** or **Bulk Power Consumer** or other **User**.

## 5.5 CONNECTION POINT

**5.5.1 Generator**

**5.5.1.1** Voltage may be 400 kV/ 230 kV/ 132 kV or as agreed with the **Single Buyer** and the **Licensee**.

**5.5.1.2** For new **Power Stations** or **Connection**s

Unless specifically agreed with the **Licensee** and the **Single Buyer,** the **Connection Point** shall be the outgoing gantry of **Power Station** switchyard. The metering point shall be at the outgoing **Connection Point**. All the substation equipment including Protection, Control and Metering equipment owned by the **Generator** within the perimeter of the **Generator's** site shall be maintained by the **Generator**. Other **Users'** equipment shall be maintained by the respective **Users**. From the outgoing feeder gantry onwards, **the Licensee** shall maintain all electrical equipment.

**5.5.1.3** For existing **Power Stations**

The existing arrangement of maintenance of all line bay equipment installed within the substation attached to the **Power Station**, viz. Circuit Breaker, Isolator, Lightning Arrester, Current Transformer, Voltage Transformer etc., by the **Power Station**, shall continue to be with the **Generator**. However, maintenance of line protection and communication equipment shall continue to be the responsibility of the **Licensee** as before.

**5.5.2 Distribution Utility**

**5.5.2.1** Voltage may be 132 kV/ 33 kV or as agreed with the **Single Buyer** and the **Licensee**.

**5.5.2.2** The **Connection** and **Metering point** of a **Distribution Utility** shall be the outgoing 132 kV or 33 kV feeder gantry of the **Licensee's Grid** substation as agreed by the **Licensee** and the **Single Buyer**. The **Licensee** shall maintain all the terminal, communication, protection and metering equipment within the premises of the **Licensee**.

**5.5.2.3** Provided that the Metering point and **Connection Point** may be at the LV side of **Grid** Transformer when LV bus and all the outgoing feeders are owned and utilized by a single **Distribution Utility**.

**5.5.2.4** From the **Connection Point** onwards, the respective **Distribution Utility** shall maintain its own electrical line and equipment.

**5.5.2.5** Any disagreement or dispute in respect of **Connection Point**, metering point and apportion of common metering units shall be referred in writing to the **Commission** for settlement.

**5.5.3 Bulk Power Consumers**

**5.5.3.1** Voltage may be 230 kV/ 132 kV or as agreed with the **Single Buyer** and the **Licensee**.

**5.5.3.2** The **Connection** and metering point shall be the outgoing feeder gantry of the **Licensee's Grid** substation.

**5.5.3.3** From the **Connection Point** onwards, **Bulk Power Consumer** shall maintain its own electrical equipment.

**5.5.3.4** Substation at consumer's electricity utilization premises shall be built, owned and maintained by the **Bulk Power Consumer** in accordance with the design approved by the **Licensee**.

**5.5.3.5** The **Bulk Power Consumer**'s substation shall only be fed by radial feeder from nearest **Grid** substation.

**5.5.3.6** To ensure **Grid** safety, transmission lines shall not be diverted to consumer's substation i.e., Line In and Line Out (LILO) shall not be permitted by the **Licensee**.

## 5.6 DATA REQUIREMENTS

**User**s shall provide the **Licensee** with data for this **Section** as specified in the Data Registration **Section**.

## 5.7 PROCEDURE FOR APPLICATIONS FOR CONNECTION TO AND USE OF THE TRANSMISSION SYSTEM

**5.7.1** Any **User** seeking to establish new or modified arrangements for **Connection** to and/or use of the **Transmission System** shall submit the following report, data and undertaking along with an application to the **Licensee**:

i. **Power Purchase Agreement (PPA)**/ Power Sales Agreement (PSA) with the **Single Buyer.**
ii. Report stating purpose and concurrence from the **Single Buyer** for the proposed **Connection** and/ or modification, **Connection** site, description of **Apparatus** to be connected or modification to **Apparatus** already connected.
iii. Data as applicable and as listed in the Data Registration **Section**.
iv. Confirmation that the prospective installation complies with the provisions in the **Electricity Act, 2018**.
v. Construction schedule and target completion date.

vi. An undertaking that the **User** shall abide by **Grid Code** and provisions of the **Electricity Rules, 1937** and revisions thereof, for installation and operation of the **Apparatus**.

**5.7.2** For every new **Connection** sought, the **Licensee** and the **Single Buyer** jointly shall specify the **Connection Point** and the voltage to be used, along with the metering, protection, communication and **SCADA** requirements as specified in respective **Sections.**

**5.7.3** The **Licensee** shall normally make a formal offer to the **User** within 2 months of receipt of the application complete with all information as may reasonably be required, subject to provision in paragraph 5.7.6.

**5.7.4** The offer shall specify and take into account any works required for the extension or reinforcement of the **Transmission System** to satisfy the requirements of the **Connection** application and for obtaining statutory clearances, way leaves as necessary

**5.7.5** In respect of offers for modification of existing **Connection**, the terms shall take into account, the existing **Connection Agreement**.

**5.7.6**

i. If the nature of complexity of the proposal is such that the prescribed time limit for making the offer is not adequate, the **Licensee** shall make a preliminary offer within the prescribed time limit. The offer shall indicate the extent of further time required with the consent of the **Commission** for more detailed examination of the issues

ii. On receipt of the preliminary offer, the **User** shall indicate promptly whether the **Licensee** should proceed further to make a final offer within the extended time limit.

**5.7.7** All offers (other than preliminary offers) including revised offers shall remain valid for 60 days of issue of offer.

**5.7.8** The **Licensee** shall make a revised offer, upon request by a **User**, if necessitated by changes in data earlier furnished by the **User**.

**5.7.9** In the event of the offer becoming invalid or not being accepted by any **User** within the validity period, no further action shall be taken by the **Licensee** on the **Connection** applications.

**5.7.10** The **Licensee** may reject any application for **Connection** to and/ or use of Transmission System:

i. If such proposed **Connection** will violate any provisions of the **Transmission Licensee**.

ii. If the proposed works stated in the application do not lie within the purview of the **Licensee** or do not conform to any provision of the **Grid Code.**
iii. If the applicant fails to give confirmation and undertakings according to sub-**Section** 5.7.1 and 5.7.3.

## 5.8 REQUIREMENTS FOR CONVENTIONAL GENERATORS

### 5.8.1 Frequency Withstand Capability

The **Generator** shall ensure that each **Generating Unit** is capable of generating a full rated power output, within the frequency range of 49.5 to 50.5 Hz. Any decrease of power output occurring in the frequency range of 49.5 to 47.5 Hz shall not be more than the required proportionate value of the frequency decay**.**

Any variation of the system frequency within the range of 48.0 Hz to 51.5 Hz shall not cause the disconnection of the **Generating Unit**. The **Generating Unit**s shall be capable to operate, for at least 15 minutes, in case of increase in frequency within the range of 51.5 to 52 Hz; and for at least 30 minutes, in case of a decrease in frequency within the range of 48.0 to 47.5 Hz, in both cases provided the voltage at the **Connection Point** is within +/-10% for 400 kV and +10/-15% for 230 kV, 132 kV of the nominal value.

If the system frequency momentarily rises above 52.0 Hz or falls below 47.5 Hz, the **Generation Unit** shall remain in synchronism with the system for at least five (5) seconds. **The System Operator** may waive this requirement, if there are sufficient technical reasons to justify the waiver.

### 5.8.2 Voltage Withstand Capability

The **Generator** shall ensure that each **Generating Unit** is capable of supplying its full rated power output (both active and reactive) within voltage variations within the range +/- 5% for 400 kV and +/- 6% for 230 kV, 132 kV during normal operating conditions. Outside this range, and up to a voltage variation of +/-10% for 400 kV and +10%/-15% for 230 kV, 132 kV, a reduction on active and/ or reactive power is allowed, provided that this reduction does not exceed 5% of the **Generator**'s Declared Data.

### 5.8.3 Reactive Power Capability and Control

The **Generator** shall ensure that each **Generating Unit** is capable of supplying its full rated active power output within the limits of lagging and leading power factor at the **Generator** terminals as mentioned in **PPA**, and in accordance with its **Reactive Power Capability Curve**.

The **Generating Unit** shall be capable of contributing to system voltage control by continuous regulation of the reactive power supplied to the **Grid**. For such reason, it shall be fitted with a continuously acting automatic excitation control system to control the terminal voltage without instability over the entire operating range of the **Generating Unit**.

The performance requirements for excitation control facilities, including eventual **Power System Stabilizers**, where necessary for appropriate **Power System** operations shall be specified in the **Connection Agreement**.

### 5.8.4 Speed-Governing System

The **Generating Unit** shall be capable of contributing to frequency control by continuous regulation of the Active Power supplied to the system.The **Generating Unit** shall be fitted with a fast-acting speed-governing system to provide Frequency Control under normal operating conditions.

The speed-governing system shall have an overall speed-droop characteristic of five (5) percent or less. Unless waived by the **System Operator**, the speed-governing system shall be capable of accepting raise and lower signals from the control center of the **System Operator**.

### 5.8.5 Black Start Capability

The **Power System** shall have **Black Start** capability at a number of strategically located **Generating Plants**.The **Generator** shall specify in its application for a **Connection Agreement** if its **Generating Unit** has a **Black Start** capability.

## 5.9 REQUIREMENTS FOR VRE GENERATORS

### 5.9.1 Frequency Withstand Capability

The **Generator** shall assure that each **VRE Generating Unit** is capable of generating at maximum power output, depending on the availability of the primary resource, within the frequency range of 49.5 to 50.5 Hz.

The **VRE Generating Unit** shall be capable to continuously operate with any variation of the **Power System** frequency within the range of 48.0 Hz to 51.5 Hz. It shall be also capable to operate, for at least 5 minutes, in case of increase in frequency within the range of 51.5 to 52 Hz; and for at least 60 minutes, in case of a decrease in Frequency within the range of 48.0 to 47.5 Hz, in both cases provided the voltage at the **Connection Point** is within +/- 10% for 400 kV and +10%/-15% for 230 kV, 132 kV of the nominal value. In case the frequency momentarily falls below 47.5 Hz the **VRE Generating Unit** shall remain connected for at least 5 seconds. In case of increase in Frequency above 52.0 Hz the **VRE Generator** shall decide whether to disconnect the **VRE Generating Plant** and/ or its **Generating Units** from the **Grid**.

The **VRE Generation Plant** shall remain synchronized during a rate of change of frequency of values up to and including plus or minus 1.0 Hz per second measured as a rolling average over 500 milliseconds.

### 5.9.2 Voltage Withstand Capability

The **VRE Generating Units** shall be capable of generating at maximum power output, depending on the availability of the primary resource, and the interchange of reactive power at the **Connection Point**, as specified in paragraph 5.9.3, within the voltage variations within the standard limits for normal operating condition. Outside this range, and up to a voltage variation within standard limits for emergency condition, a reduction on active and/or reactive power can be allowed, provided that this reduction does not exceed 5% of the **Generator's Declared Data**.

### 5.9.3 Reactive Power Capability and Control

The **VRE Generating Plant** shall be capable of supplying reactive power output, at its **Connection Point**, within the following ranges:

- +/- 20 % of the **Generating Plant** capacity, as specified in the **Generator**'s **Declared Data**, if the active power output, depending on the availability of the primary resource, is equal or above 58% of the **Generating Plant** capacity;

- Any reactive power value within the limits of power factor 0.95 lagging to 0.95 leading, if its active power output, depending on the availability of the primary resource, is within the 10 % and 58% of the **Generating Plant** capacity;

- No reactive power interchange with the **Grid** if the active power output, depending on the availability of the primary resource, is equal or less than 10% of the **Generating Plant** capacity.

The **VRE Generating Plant** shall be capable of contributing to voltage control by continuous regulation of the reactive power supplied to the **Grid** in any of the following modes, as it will be determined by the **System Operator**:

- Maintaining constant voltage at the **Connection Point**, at a set point instructed by the **System Operator**;

- Maintain an injection of reactive power, at the **Connection Point**, at a set point instructed by the **System Operator**;

- Maintaining a constant power factor of the injected active power at the **Connection Point**, at a value prescribed by the **System Operator**; or provided the limits of reactive power output established above are not exceeded.

In order to comply with these requirements the **VRE Generating Plant** shall be equipped with an appropriate control system able to control voltage or reactive power interchange over the entire operating range, which shall not create oscillations in the **Grid**.

### 5.9.4 Active Power Control

**VRE Generating Plants** should be equipped with an active power regulation control system able to operate, at least, in the following control modes, provided that system frequency is within the range 49 Hz – 51 Hz:

a) Free active power production (no active power control): The **VRE Generating Plant** operates producing maximum active power output, depending on the availability of the primary resource.

b) Active power constraint: The **VRE Generating Plant** shall operate producing active power output equal to a value specified by the **System Operator** (set-point), provided the availability of the primary resource is equal or higher than the prescribed value; or producing the maximum possible active power in case the primary resource availability is lower than the prescribed set-point;

In cases the **VRE Generating Plant** operates in active power constraint mode, whenever any control parameter is changed, such change must be commenced within two seconds and completed not later than 30 seconds after receipt of an order to change any parameter. The accuracy of the control performed must be within ±2% of the entered value or by ±0.5% of the rated power, depending on which yields the highest tolerance.

In case the system frequency exceeds 51.0 Hz, the active power control system should reduce the active power injected to the **Grid** previously, according with the following formula:

$$\Delta P = 33 \cdot P_m \cdot \left( \frac{51.0 - f_n}{50} \right)$$

Where:

$\Delta P$: is the variation in Active Power output that should be achieved

$P_m$: is the Active Power output before this control is activated

$f_n$: is the **Grid** frequency.

The reduction in active power output shall be performed at the maximum possible gradient, provided the technical capabilities of the **VRE Generators** are not exceeded. If the active power for any **VRE Generating Plant** is regulated downward below its minimum technical limit, shutting-down of individual **VRE Generating Units** is allowed.

### 5.9.5 Performance During Grid Disturbances

The **VRE Generating Plan**t shall be able to withstand without disconnection voltage dips at the **Connection Point**, produced by fault or disturbances in the **Grid**, whose magnitude and duration profiles are within the shaded area in Figure 1. This area is defined by following characteristics:

a) If the voltage at the **Connection Point** falls to zero in any of the three phases, the PVS shall remain connected for at least 0.15 seconds*;*
b) If the voltage at the **Connection Point** drops but it is still above 20% of the nominal value, in all the three phases, the **VRE Generating Plant** shall remain connected for at least 0.625 seconds;
c) If the voltage at the **Connection Point** is equal or above 90% of the nominal value, in all the three phases, the **VRE Generating Plant** shall remain connected indefinitely, up to fault clearance;
d) For voltages between 30% and 90% of the nominal value, the time the **VRE Generating Plant** shall remain connected, shall be determined by linear interpolation between following pairs of values [voltage = 30%; time = 0.625 seconds] and [voltage = 90%; time = 3.0 seconds].

In the case of larger voltage deviations and/ or lasting longer, the Wind Farm is allowed to be disconnected from the **Grid**.

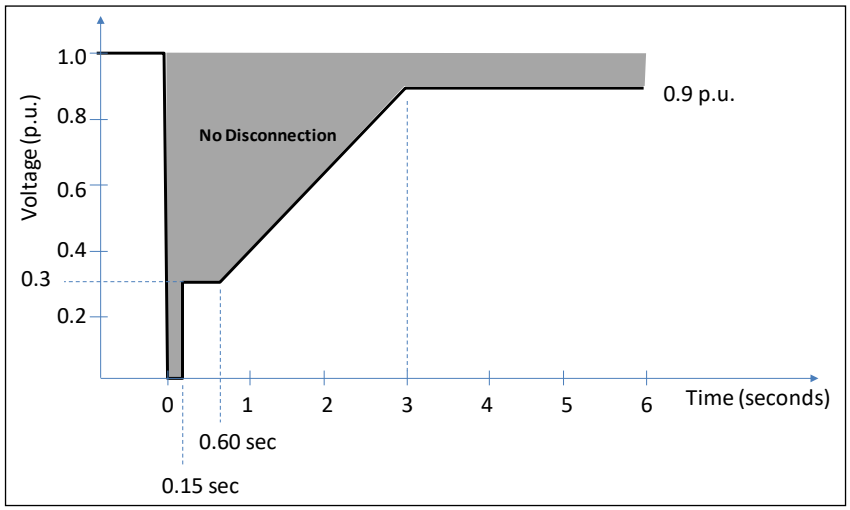


**Figure 1: Low voltage withstand capability – VRE Generating Plant**

In case of three phase faults on the **Grid**, at least the following performance should be achieved:

a) Both during the time the fault exists in the **Grid** and during the voltage recovery period after fault elimination, there should be no reactive power consumption by the **VRE Generating Plant** at the **Connection Point**. reactive power consumption is only allowed during the first 150 milliseconds after the initiation of the fault and during the 150 milliseconds immediately after fault elimination, provided that during these periods the net consumption of reactive power of the **VRE Generating Plant** is not greater than 60% of the registered nominal capacity of the facility;

b) Both during the time the fault exists in the **Grid** and during the voltage recovery period after fault elimination, there should be no consumption of active power by the **VRE Generating Plant**. Small consumptions of active power are allowed during the first 150 milliseconds immediately after the initiation of the fault and during the first 150 milliseconds immediately after the fault clearing could be allowed.

c) Both during the fault period and during the recovery period after the fault elimination, the **VRE Generating Plant** should inject into the system the maximum possible current (Itotal). This injection of current shall be carried out in such a way that the operation of the facility is situated inside of the shaded area of Figure 2, after 150 milliseconds from the initiation of the fault or the moment the fault has been eliminated.

In case of unbalanced faults (single-phase faults and/ or two-phase faults), at least the following performance should be achieved:

a) Both during the fault period and the recovery period after fault elimination, there should be no reactive power consumption by the **VRE Generating Plant** at the **Connection Point**. Small amounts of reactive power consumption are allowed during the first 150 milliseconds immediately after the start of fault and immediately after its elimination. In addition, transitory consumptions are allowed during the fault period, provided that the following conditions are met:

- Net consumption of reactive power by the **VRE Generating Plant** shall not exceed an amount equivalent to 40% of the **VRE Generating Plant** installed capacity during any 100 milliseconds period; and
- Net consumption of reactive power, in each cycle (16.6 milliseconds), shall not exceed 40% of **VRE Generating Plant** installed capacity.

b) Both during the period of existence of the fault and during the recovery period after fault elimination, there should be no consumption of active power by the **VRE Generating Plant** at the **Connection Point**. Transitory

consumption of active power is allowed, during the first 150 milliseconds after the initiation of the fault and the first 150 milliseconds after fault elimination.

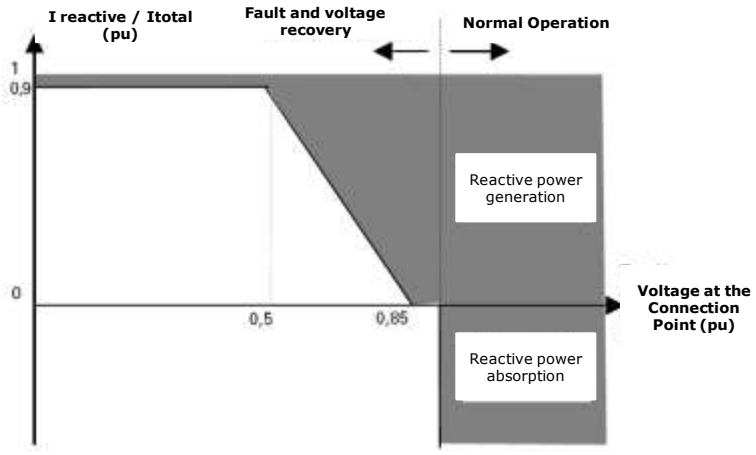


Figure 2: Allowed generation of Reactive Power during Voltage Dips

The **VRE Generator** shall demonstrate to the **System Operator** that the **VRE Generating Plant** complies with the above prescriptions through:

a) A certification issued by the **VRE Generating Unit**s manufacturer, stating that its **VRE Generating Unit**s have been tested and certified in a reputable laboratory showing compliance with the stated requirements. Copy of the laboratory certification shall be included.

b) A formal declaration from the **VRE Generator** and/ or its EPC Contractor indicating that the **VRE Generating Plant** installed protection system and their settings, do not impair the performance required by this sub-**Section**.

## 5.10 REQUIREMENTS FOR DISTRIBUTORS AND OTHER GRID USERS

### 5.10.1 Determination of the Connection Point

The **Distributor**'s or other **Grid User**'s equipment shall be connected to the **Grid** at voltage level(s) agreed to by the **Licensee,** the **Single Buyer** and the **Distributor** (or other **Grid User**) based on the studies performed by the **Licensee**.

### 5.10.2 Protection Arrangements

The **Distributor**'s or other **Grid User**'s equipment shall be connected to the **Grid** at voltage level(s) agreed to by the **Licensee** and the **Distributor** (or other **Grid User**) based on the studies performed by the **Licensee**.

**5.10.3 Reactive Power Compensation**

Reactive Power Compensation and/ or other facilities, shall be provided by concerned **Users** as far as possible in the low voltage systems close to the load points to avoid the need for exchange of reactive power to/ from the **Transmission System** and to maintain Transmission System voltage within the specified range. Concerned **Users** shall ensure/ maintain load power factor as specified by the **Commission** at **Connection Points** by providing reactive compensation facilities at their network.

## 5.11 INTERNATIONAL AND INTER-REGIONAL CONNECTION

**5.11.1** International and Inter-regional **Connection** will be:

(a) Synchronous; or
(b) Asynchronous.

**5.11.2** The procedure for International **Connection** to the **Grid** and the execution of agreement for the same shall be done by the **Licensee** in consultation with the **Single Buyer** and the Line Ministry.

**5.11.3 HVDC** Transmission

**5.11.3.1** Asynchronous **Connection** may be established by **HVDC** transmission having any of the following options:

(a) Rectifier at sending end and Inverter atreceiving-end
(b) **Back to Back** (B2B) with Rectifier and Inverter at both ends.

**5.11.3.2** **HVDC** transmission design and appropriate configuration of overhead and underground transmission **Connection**s will be determined following international standards. Configurations may be:

(a) Monopole with ground return
(b) Monopole with metallic return grounded at both ends
(c) Bipolar, opposite polarity, grounded neutral at both ends
(d) Bipolar, opposite polarity, with metallic returnconductor.

**5.11.4 HVAC** Asynchronous **Connection**

Asynchronous **Connection** may be established by **HVAC** transmission running up to **Back to Back** (B2B) interface substation.

## 5.12 CONNECTION AGREEMENTS

A **Connection Agreement** shall include, as appropriate, within its terms and conditions the following:

i. A condition requiring both parties to comply with the **Grid Code**;
ii. Details of **Connection**;
iii. Details of any capital related payments arising from necessary reinforcement or extension of the system;
iv. A Site Responsibility Schedule;

## 5.13 APPENDIX

General format for Site Responsibility Schedule.

**APPENDIX**

**CONNECTION CONDITIONS**

## SITE RESPONSIBILITY SCHEDULE

Name of Power Station/ Substation:.....

Site Owner:.....
Tel. Number:.....
Fax Number:.....

| Item of Plant/ **Apparatus** 1 | Plant Owner 2 | Safety Responsibility 3 | Control Responsibility 4 | Operation Responsibility 5 | Maintenance Responsibility 6 | Remarks 7 |
|---|---|---|---|---|---|---|
| ..... kV Switchyard | | | | | | |
| All equipment including busbar | | | | | | |
| Feeders | | | | | | |
| | | | | | | |
| | | | | | | |
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Name of Power Station/ Substation:.....

Site Owner:.....
Tel. Number:.....
Fax Number:.....

| Item of Plant/ Apparatus 1 | Plant Owner 2 | Safety Responsibility 3 | Control Responsibility 4 | Operation Responsibility 5 | Maintenance Responsibility 6 | Remarks 7 |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| **Generating Unit**s | | | | | | |
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# 6. OUTAGE PLANNING

## 6.1 INTRODUCTION

This **Section** describes the process by which the **Licensee** carries out the planning of **Transmission System Outages**, including interface coordination with **Users**.

## 6.2 OBJECTIVE

The objective of this **Section** is to define the process that will allow the **Licensee** to optimize transmission **Outages** in coordination with **Generator's** and other **Users' Outages** while maintaining system security to the extent possible.

## 6.3 DEMAND ESTIMATION

**6.3.1.** Demand estimation is necessary both in the medium time scale to ensure adequate system plant margins and ratings and in the shorter time scale to assist with frequency control (see Schedule and Dispatch **Section**).

**6.3.2.** **Distribution Utilities** shall provide to the **Licensee** their estimates of demand at each **Connection Point** for the period from July to June by 31st March on year ahead, month ahead, and day ahead basis as required.

**6.3.3.** Based on this, the **Licensee** shall make monthly peak and off peak period demand estimates for the year ahead, daily peak and off peak period demand estimates for the month ahead and hourly demand estimates for the day ahead.

**6.3.4.** **Distribution Utilities** shall provide to the **Licensee** estimates of load that may be shed, when required, in discrete blocks with the details of the arrangements of such load shedding.

**6.3.5.** All data shall be collected in accordance with procedures agreed between the **Licensee** and each **User**.

**6.3.6.** The **Licensee** shall maintain a database of demand on an hourly basis.

## 6.4 GENERATOR OPERATING COMMITTEES

**6.4.1.** The **Licensee,** the **System Operator,** the **Single Buyer** and the **Generators** shall establish

**Operating Committees**, which shall serve as a point of coordination for the respective parties.

**6.4.2.** They shall meet at least once a month and establish the procedures relating to the operational interfaces between the parties. They shall include:

(a) The coordination of programs for testing and operation of the interconnections and associated transmission **Grid** system **Apparatus**, the **Metering System** and the site;
(b) Incident coordination (i.e., force majeure events);
(c) Outage coordination;
(d) Generation Scheduling;
(e) Safety matters;
(f) Emergency Plans;
(g) Protection coordination;
(h) Frequency and voltage management;
(i) **Black Start** capabilities and procedures;
(j) Any other operational matters agreed by the Committees.

## 6.5 TRANSMISSION OUTAGE PLANNING PROCESS

**6.5.1.** The **Licensee** shall produce a yearly transmission **Outage** program for the period July to June.

**6.5.2.** All **Generators** shall provide the **Licensee,** the **System Operator** and the **Single Buyer** with their proposed **Outage** programs in writing for the year ahead (July to June) by 31st March each year.

**6.5.3.** All **Distribution Utilities** shall provide the **Licensee,** the **System Operator** and the **Single Buyer** with their proposed **Outage** programs in writing for the year ahead (July to June) by 31st March each year.

**6.5.4.** **Outage** programs shall contain identification of unit (for **Generating Units**), **Outage** start date and duration of **Outage**.

**6.5.5.** The **Licensee** shall produce a draft **Outage** program based on the information received from **Generators** and **Distribution Utilities**, taking into account demand estimation and shall carry out studies as required each year.

**6.5.6.** The **Licensee** shall interact with all **Users** as necessary to review and optimize the draft plan, agree to any changes and produce an acceptable coordinated generation and transmission **Outage** plan. The **Licensee** shall release the finally agreed transmission **Outage** plan, which takes account of **User** requirements, to all **Users** by 31st May each year**.**

**6.5.7.** The **Licensee** shall review the final **Outage** plan monthly in consultation with **Users**, who shall be informed by **Licensee** of any proposed changes.

**6.5.8.** **Users**' requests for additional **Outage**s will be considered by the **Licensee** and accommodated to the extent possible.

**6.5.9.** The **Licensee** shall inform **Users** promptly of any changes that affect them.

## 6.6 RELEASE OF CIRCUITS AND GENERATOR UNITS INCLUDED IN OUTAGE PLAN

**6.6.1.** Not withstanding provision in any approved **Outage** plan, no cross boundary circuits or **Generating Unit** of a **Generator** shall be removed from service without specific release from the **System Operator**.

**6.6.2.** Once an **Outage** has commenced, if any delay in restoration is apprehended, the **System Operator** or **User** concerned shall inform the other party promptly together with revised estimation of restoration time.

## 6.7 DATA REQUIREMENTS

**6.7.1.** **User**s shall provide the **Licensee** with data for this **Section** as specified in the Data Registration **Section**.

# 7. SCHEDULE AND DISPATCH

## 7.1 INTRODUCTION

This **Section** specifies the procedure to be adopted for the scheduling and **Merit Order** dispatch of **Generating Units** to meet system demand.

## 7.2 OBJECTIVE

The objective of this **Section** is to detail the actions and responsibilities of the **Licensee,** the **Single Buyer** and the **System Operator** in preparing and issuing generation schedules and the responsibilities of **Users** to supply the necessary data and to comply with those schedules.

## 7.3 GENERATION SCHEDULING

### 7.3.1 Yearly/ Monthly/ Weekly Schedules

**7.3.1.1.** The **System Operator** shall coordinate and prepare yearly/ monthly and weekly load-generation balance schedules and generation schedules.

**7.3.1.2.** The demand estimation for each case shall be made by the **System Operator** using the data made available by the **Distribution Utilities** and historical data maintained by the **Licensee** and the **System Operator**.

**7.3.1.3.** The **System Operator** shall prepare a yearly schedule of **net electrical output** on a monthly basis, using the information from the dependable capacity of **Generating Units**, **VRE** generation forecasts, yearly outage program and estimated demands.

**7.3.1.4.** The **Generator** shall inform the **System Operator** and the **Single Buyer** promptly of any changes to any of the **net electrical output** notifications.

**7.3.1.5.** The **System Operator** shall provide to the **Licensee**, the **Single Buyer** and **Generators** yearly estimates of requirements for **net electrical output** on a monthly basis for the year ahead (year ahead notification) not less than 60 days before the beginning of each fiscal year. The **Licensee** in turn submit the monthly estimates of net electrical output requirement to the **Commission**.

**7.3.1.6.** The **System Operator** shall prepare a monthly schedule of Generation on a day by day basis,

using any **net electrical output** changes provided by the **Generator** and estimated demands.

**7.3.1.7.** The **System Operator** shall provide to the **Licensee,** the **Single Buyer** and **Generators** monthly estimates of requirements for **net electrical output** on a day by day basis for the month ahead (month ahead notification), with provisional estimates for the following 2 months, not less than 14 days before the beginning of each month.

**7.3.1.8.** The **System Operator** shall prepare a weekly schedule of Generation on an hourly basis, using any **net electrical output** changes provided by the **Generator** and estimated demands.

**7.3.1.9.** The **System Operator** shall provide to the **Licensee,** the **Single Buyer** and **Generators** weekly estimates of requirements for **net electrical output** on an hourly basis for the week ahead (week ahead notification), with provisional estimates for the following week, not less than 60 hours before the beginning of each week.

**7.3.2 Day ahead schedule**

**7.3.2.1.** The **System Operator** shall co-ordinate and prepare day ahead schedules of Generation.

**7.3.2.2.** All **Generators** shall provide the MW/ MVAR **Declared Available Capacity** (00.00 -24.00 hours) of all **Generating Units**, to the **System Operator** during each hour of the day commencing 36 hours ahead and provisionally, for the day immediately after (plant availability notification) by 12.00 hours.

**7.3.2.3.** **VRE generators** shall provide forecasted production for the **VRE generation units** hourly MW/ MVAR availability to the **System Operator.**

**7.3.2.4.** In working out the MW/ MVAR availability, Hydro **Power Stations** shall take into account their respective reservoir levels and any other restrictions and shall report the same to the **System Operator**.

**7.3.2.5.** The **Single Buyer** shall prepare, update **Merit Order** of **Generating Units** and provide to the **System Operator**.

**7.3.2.6.** After consolidation of the data provided by the **Generators,** the **System Operator** shall produce a day ahead hourly generation schedule based on **Merit Order** of the **Generating Units.** It shall consist of availability, scheduled generation, allocated spinning reserve and **Generating Unit** standby requirements. It shall also take into account the hourly demand estimates and the following:

**Transmission System** constraints
Hourly forecasts for **VRE** generations
**Generating Units** Schedule and Dispatch parameters

Requirements for voltage control
Allocated spinning reserve/ Operating reserve

**7.3.2.7.** The **System Operator** shall provide to the **Licensee,** the **Single Buyer** and **Generators** the generation schedule requirements for **net electrical output, s**tart ups and reactive power on an hourly basis for that day, with provisional estimates for the following day, not less than 8 hours before the beginning of each day.

**7.3.2.8.** **Generators** shall promptly report to the **System Operator** and the **Single Buyer**, changes of **Generating Unit** availability or capability, or any unexpected situation that could affect its operation including updated meterogical information which may affect **VRE Generators** production.

**7.3.2.9.** The **System Operator** shall advise **Users** as soon as possible of any necessary rescheduling.

**7.3.2.10.** The **System Operator** shall instruct **Generators** to hold capacity reserves (spinning and/or standby) to the agreed **Commission** guidelines or as determined for local conditions. In normal operation, **VRE Generators** are exempted to provide spinning and/ or standby reserves.

**7.3.2.11.** The **System Operator** may also require the **Generators** to generate MVAR within their respective capability limits to hold station busbar voltages at specified levels.

## 7.4 GENERATION DISPATCH

**7.4.1.** All **Generators** will be subject to dispatch instructions and shall regulate generation according to these instructions.

**7.4.2.** In absence of any dispatch instructions by the **System Operator**, **Generators** shall generate according to the day ahead generation schedule, or in the case of **VRE Generators**, according to the available primary resources.

**7.4.3.** Dispatch instructions shall be in standard format. These instructions will recognize declared availability, **Merit Order** and other parameters that have been made available by the **Single Buyer** and **Generator** to the **System Operator**. These instructions shall include time, **Power Station**, **Generating Units**, name of operators sending and receiving the same.

**7.4.4.** Dispatch instructions include but not limited to:

i. Switching a **Generating Unit** into or out of service.
ii. Details of reserve to be carried on a unit.

iii. To increase or decrease MVAR generation to assist with voltage profile.
iv. To begin pre-planned **Black Start** procedures.
v. To hold spinning reserve.
vi. To hold **Generating Units** on standby.

**7.4.5.** The required spinning reserve of **Generators** shall be maintained to meet the performance standards of the system, except in conditions of shortfall of supply or operation restrictions. In case of any emergencies, the **Generators** shall be instructed by the **System Operator** to operate with a lower reserve margin. The **System Operator** shall promptly inform the **Licensee, Single Buyer** and **Distribution Utilities** about this matter in the most practicable way.

## 7.5 COMMUNICATION BETWEEN THE SYSTEM OPERATOR AND GENERATORS

Dispatch instructions/ feedback from **Generators** shall be issued by e-mail, tele-printer, telephone or computer to computer communication, confirmed by exchange of names of operators sending and receiving the same and logging the same at each end. All oral instructions shall be complied with forthwith and written confirmation shall be issued promptly by e-mail, Fax, tele-printer or otherwise.

## 7.6 ACTION REQUIRED BY GENERATORS

**7.6.1.** All **Generators** shall comply promptly with a dispatch instruction issued by the **System Operator** unless this action would compromise the safety of plant or personnel.

**7.6.2.** The **Generator** shall promptly inform the **System Operator** in the event of any unforeseen difficulties in carrying out an instruction.

**7.6.3.** **Generators** shall immediately inform the **System Operator** by telephone of any loss or change (temporary or otherwise) to the operational capability of any **Generating Unit (**including significant changes in **VRE** generation forecasts), which is synchronized to the system or which is being used to maintain system reserve. **Generators** shall inform the **System Operator** of any change of AVR and/ or governor control mode of service with reasons.

**7.6.4.** **Generators** shall not de-synchronize **Generating Units** without instruction from the **System Operator** except on the grounds of safety to plant or personnel, which shall be promptly reported to the **System Operator**.

**7.6.5.** **Generators** shall report any abnormal voltage and frequency related operation of **Generating Units/** feeders promptly to the **System Operator**.

**7.6.6.** **Generators** shall not synchronize **Generating Units** without instruction from the **System Operator**. In emergency situations, the **Generator** may synchronize Units with the **Grid**

without prior intimation in the interest of the operation of the **Grid** following standing instructions developed for such purpose under "contingency planning".

**7.6.7.** Should a **Generator** fail to comply with any of the above provisions, it shall inform the **System Operator** promptly of this failure.

**7.6.8.** The **System Operator** shall ensure that the **Licensee** and the **Single Buyer** is kept informed and up to date with all operation changes and deviations from the planned schedule.

## 7.7 DATA REQUIREMENTS

**Users** shall provide the **System Operator** with data for this **Section** as specified in the Data Registration **Section**.

## 7.8 SHORTFALL MANAGEMENT

In preparing the day ahead generation schedule and dispatch schedule the **System Operator** shall consider the probable shortfall in generation, if any, and apportion the available generation among the **Entities** by maintaining a definite principle approved by the **Commission**. The **Entities**, in turn, manage the demand shortfall by imposing load shedding in a systematic and rational manner by maintaining a definite principle approved by the **Commission**.

The **System Operator** and **Distribution Utilities** shall always endeavor to restrict the net drawl at the **Connection Point** from the **Grid** within the drawl schedules, whenever the system frequency is within normal operating limits. The concerned **Distribution Utilities**/ **User** shall ensure that their automatic demand management scheme to ensure that there is no over drawl when frequency is 49.5 Hz or below. **Distribution Utilities** shall establish their own **SCADA** system to impose automatic load management in 11 kV feeders in case of shortfall.

# 8. FREQUENCY AND VOLTAGE MANAGEMENT

## 8.1 INTRODUCTION

This **Section** describes the method by which all **Users** of the **Transmission System** shall cooperate with the **Licensee** in contributing towards effective control of the system frequency and managing voltage profile of the **Transmission System**.

The **System Operator** has the overall responsibility of enforcing **Grid** discipline and managing the frequency of the Power System. The **Users** are required to follow the instructions of the **System Operator** for the backing down generation, regulating load, etc. to meet the objective. The **System Operator** shall accordingly instruct **Generating Units** to regulate generation/export and hold reserves of active and reactive power, within their respective declared parameters. The **System Operator** shall also regulate load as may be necessary to meet this objective.

The **System Operator** shall optimize voltage management by adjusting transformer taps to the extent available and switching of circuits/ reactors/ capacitor banks and other operational steps. The **System Operator** will instruct **Generating Units** to regulate MVAR generation within their declared parameters. The **System Operator** shall also instruct **Distribution Utilities** to regulate demand if necessary.

The supply of quality power at proper voltage and frequency is dependent on active cooperation of **Generators** and **Distribution Utilities** as well as fulfillment of obligations of individual **Users** of the **Transmission System**.

## 8.2 OBJECTIVE

The objectives of this **Section** are as follows:

i. To define the responsibilities of all **Users** in contributing to frequency management.
ii. To define the actions required to enable the **Licensee** to maintain **Transmission System** voltages and frequency within acceptable levels in accordance with **Commission Directives**, and Planning and Security Standards for **Transmission System**.

## 8.3 FREQUENCY MANAGEMENT

The normal frequency range will be 49.5 – 50.5 (50 Hz ±1.0%). The **System Operator** shall identify frequency deviations and take the appropriate action to keep the frequency within the normal range.

## 8.4 RESPONSIBILITIES

The **System Operator** shall monitor actual generation and load-generation balance and regulate generation and demand to maintain frequency within the prescribed limits.

The **System Operator** and the **Licensee** shall continuously monitor 400 kV/ 230 kV/ 132 kV transmission **Grid** line loadings on the **Transmission System**.

**Generators** shall follow the dispatch instructions issued by the **System Operator**.

All **Generating Units** shall have the governor available and in service and must be capable of automatic increase or decrease in output within the normal declared frequency range and within their respective capability limit.

Under certain conditions the system frequency could rise to 52 Hz or fall to 47.5 Hz. All **Generating Units** should be capable of operating within the range according to the clause 5.9.1. and the **System Operator** informed promptly of any restrictions. **Generators** shall be responsible for protecting their **Generating Units** against damage should frequency excursions outside 52 Hz and 47.5 Hz ever occur. The **Generator** shall inform the **System Operator** immediately after taking such action.

**Generators** shall provide following parameters of their **Generating Units** to the **NLDC** to ensure their participation in frequency and voltage regulations:

(a) Primary Frequency Control (i.e. Droop, Dead Band, Limiter etc.);
(b) Secondary Frequency Control (the **System Operator** shall provide list for AGC/ EMS requirements);
(c) Tertiary Frequency Control (manual from the **System Operator**);
(d) Primary Voltage Control.

The **Generating Units** shall be designed to process the following capabilities:

(a) All **Generating Units** shall be frequency sensitive.
(b) Power and Frequency Control of the **Generating Units** shall be achieved with fast-acting prime mover Speed Governor.
(c) The governor shall have the capability to freely regulate the frequency with adjustable governor speed droop settings in the range of 2% to 3% for Hydro Turbine, 4% to 6% for GT & ST and up to 10 % for Nuclear plant.
(d) Capable of responding automatically to normal variation in the system frequency.
(e) Governor dead band shall be within the range of ±0.05Hz. However, the governor shall respond to full frequency deviation once system frequency deviation exceeds this specified dead band.
(f) Limiter (regulation range) setting shall be specified by the **System Operator** in collaboration with plants.

(g) If and when the **Generating Unit** is required to operate in an islanded mode, then the Governor control system shall ensure that the islanded system will operate within the frequency range.

**Distribution Utilities** and **Bulk Power Consumers** shall co-operate with the **System Operator** in managing load on instruction from the **NLDC** as required.

The **Licensee** and the **System Operator** shall ensure that under frequency and df/dt load shedding schemes are always functional.

Close coordination between **Users** and the **NLDC** shall exist at all times for the purposes of effective frequency and voltage management.

### 8.4.1 Sustained rising frequency

Under rising (from 50 Hz) frequency conditions, **Generators** having governor in service shall be capable of automatic decrease output within the normal declared frequency range (49.5 Hz to 50.5 Hz) and within their respective limit (specified limiter or regulation range) in the mode of Primary Control or Free Governor Mode of Operation (FGMO).

The governor system of the plants running on FGMO shall be fitted with adjustable droop and shall have capability to operate with droop of 4% to 6% for thermal units & 2% to 3% for hydro units. The response (decrease of output) to a change (rising state) of system frequency shall be fully available within 10 seconds of the frequency change and be sustainable for a further 30 seconds.

The selected plants shall be capable of running on Automatic Generation Control (AGC/ LFC) Mode. Therefore, those plants shall automatically reduce output as per AGC command(s) in secondary frequency regulation. Secondary response shall fully available by 30 seconds from the time of frequency change to take over from primary response, and shall be sustainable for a period of at least 30 minutes.

When the frequency rises above 50.5 Hz actions must be taken immediately by the **Generators** which are beyond AFC. The **System Operator** shall take appropriate action to issue instructions to **Generators** to arrest the rising frequency and restore frequency within normal range. Such instructions may include reducing generated output (i.e. Tertiary or manual control) or de-synchronizing **Generating Units** or adding load to system if there is any load-shed. Frequency up to 52.0 Hz **Generators** shall have frequency withstand capability as mentioned in sub-**Section** 5.8.1.

**Generators** shall be responsible for protecting their **Generating Units** against damage should frequency excursions outside 52 Hz and 47.5 Hz ever occur

### 8.4.2 Sustained falling frequency

Under falling (from 50 Hz) frequency conditions, **Generators** having governor in service shall be capable of automatic increase output within the normal declared frequency range (49.5 Hz to 50.5 Hz) and within their respective limit (specified limiter or regulation range) in the mode of Primary Control or Free Governor Mode of Operation (FGMO).

The governor system of the plants running on FGMO shall be fitted with adjustable droop and shall have capability to operate with droop of 4% to 6% for thermal units & 2% to 3% for hydro units. The response (increase of output) to a change (falling state) of system frequency shall be fully available within 10 seconds of the frequency change and be sustainable for a further 30 seconds.

The selected plants shall be capable of running on Automatic Generation Control (AGC/ LFC) Mode. Therefore, those plants shall automatically increase output as per AGC command(s) in secondary frequency regulation. Secondary response shall fully available by 30 seconds from the time of frequency change to take over from primary response, and shall be sustainable for a period of at least 30 minutes.

If the secondary control is insufficient, tertiary control operates to return frequency to target value and restore the secondary control reserve. Tertiary frequency response is normally in the form of security constrained economic dispatch.

When the frequency falls below 49.5 Hz, the **System Operator** shall take appropriate action to issue instructions to **Generators** to arrest the falling frequency and restore it within normal range. Such instructions may include dispatch commands (i.e. Tertiary or manual control) or instructions to **Generators** to increase output, to synchronize standby **Generating Units** to the **Transmission System.**

All **Generating Units** that have been declared available shall be required to be synchronized and loaded in the event of the sustained low frequency below 49.5 Hz provided local and safety conditions permit. This action shall be performed without delay after failed attempts to contact the **System Operator**. The **Generator** shall inform the **System Operator** immediately after taking such action.

**Distribution Utilities** and **Bulk Power Consumers** should not increase load when frequency is below 49.5 Hz.

When frequency falls below 49.3 Hz, the **System Operator** shall take appropriate action to issue instructions to **Distribution Utilities** to reduce load demand by appropriate manual and/ or automatic load shedding.

When the frequency falls below 49.1, the **System Operator** shall impose **SCADA** operation to open the CB of outgoing feeders to the **Distribution Utilities/ Bulk**

**Consumers** at **Connection Points** to stabilize the system frequency.

The **System Operator** shall be responsible for the coordination, selection among the feeders by rotation (provision for automatic) and settings of staged automatic relay initiated under-frequency load shedding designed for system protection.

Frequency up to 47.5 Hz, **Generator** shall have frequency withstand capability as mentioned in sub-**Section** 5.8.1.

## 8.5 VOLTAGE MANAGEMENT

The **Licensee** and the **System Operator** shall carry out load flow studies and perform voltage stability analysis from time to time to predict where voltage problems may be encountered and to identify appropriate measures to ensure that voltages remain within the defined limits as specified in sub-**Section** 4.4. On the basis of these studies the **System Operator** shall instruct **Generators** to maintain specified voltage levels at their generation bus.

All **Generating Units** shall have Automatic Voltage Regulator (AVR) in service.

**Generators** shall inform the **System Operator** of their reactive reserve capability promptly on request.

**Generators** shall make available to the **System Operator** the up-to-date **Capability Curve**s for all **Generating Units**, as detailed in **Section** 5, indicating any restrictions, to allow accurate system studies and effective operation of the **Transmission System**.

The **System Operator** and the **Licensee** shall continuously monitor 400 kV/ 230 kV/ 132 kV transmission **Grid** voltage levels at all **Grid** substations.

The **System Operator** and the **Licensee** shall regulate voltage levels within the prescribed levels.

The **System Operator** and the **Licensee** shall jointly take appropriate measures to control **Transmission System** voltages that may include but not be limited to transformer tap changing and use of MVAR reserves with **Generating units** within technical limits. These may include operation of the following equipments:

a) Synchronous **Generating Units**
b) Synchronous Condenser
c) Tap Changing Transformers
d) Auto-Transformer Tap Changing
e) Booster Transformers

f) Shunt Capacitors and Reactors

g) Static VAR Compensator (SVC)

h) Static Compensator (STATCOM)

i) Line Reactance Compensator (Series Cap)

j) Flexible AC Transmission (FACT) Devices. etc.

The **Licensee** shall co-ordinate with the **Distribution Utilities** to determine voltage levels at the **Connection Points.**

The **Distribution Utilities** and **Bulk Power Consumers** shall maintain power factor within the range 0.90 lagging and 0.95 leading at the **Connection Point.**

**Distribution Utilities** shall participate in voltage management by regulating their demand and changing tap positions on the 33/11 kV transformers as may be required.

## 8.6 MONITORING OF GENERATION

**8.6.1**

For effective operation of the **Transmission System**, it is important that a **Generator's** declared availability is realistic and that any departures are continually fed back to the **Generator** to help effect improvement. The monitoring by the **System Operator** of **Generating Unit** output, and active and reactive reserve capacity, shall be carried out to evaluate the reliability and performance of plant.

The **System Operator** shall continuously monitor **Generating Unit** outputs and bus voltages. More stringent monitoring may be performed at any time, as detailed in the Testing **Section**, when there is reason to believe that a **Generator's** declared availability may not match the actual availability or declared output does not match the actual output.

**Generators** shall provide to the **System Operator** hourly generation summation outputs where no automatically transmitted metering or **SCADA** equipment exists.

The **Generator** shall provide other logged readings, that the **System Operator** may reasonably require, for monitoring purposes where **SCADA** data is not available.

### 8.6.2 Generating Unit Tripping

**Generators** shall promptly inform the tripping of a **Generating Unit**, with reasons, to the **System Operator** in accordance with the Operational Event/ Accident Reporting **Section**. The **System Operator** shall keep a written log of all such tripping, including the reasons with a view to demonstrating the effect on system performance and identifying the need for remedial measures.

**Generators** shall submit a more detailed report of all trippings and forced outage/shut downs of each **Generating Unit** to the **System Operator** monthly.

### 8.6.3 Data Requirements

**Generators** shall submit data to the **System Operator** as listed in Data Registration **Section**, termed as Frequency and Voltage Management.

# 9. CONTINGENCY PLANNING

## 9.1 INTRODUCTION

A contingency in the **Transmission System** may arise owing to generation deficiencies, inadvertent tripping of **Transmission System** components, and failure of **Transmission System** equipment or operational errors. These may result in partial or total blackouts of the **Grid.**

This **Section** describes the recovery process to be followed by the **Licensee,** the **System Operator** and all **Users** in the event of **Transmission System** total or partial blackouts.

## 9.2 OBJECTIVE

The objective of this **Section** is to define a general guideline of the recovery process and responsibilities of all **Users** to achieve the fastest recovery in the event of a partial or total system blackout, taking into account essential loads, **Generating Units** capabilities and system constraints.

## 9.3 STRATEGY

**9.3.1** The situation prevailing prior to the occurrence of the contingency, e.g. availability of specific **Generators,** transmission circuits and load demands, will largely determine the restorations process to be adopted in the event of a total blackout. The **System Operator** shall advise all **Users** of the situation and follow the strategy as outlined below for restoration.

**9.3.2** **User's** persons authorized for operation and control shall be available at **User's** end for communication and acceptance of all operational communications throughout the contingency. Communication channels shall be restricted to operational communications only till normality is restored.

## 9.4 TOTAL SYSTEM BLACKOUT

**9.4.1** The **System Operator** shall instruct all relevant **Generators** having **Power Stations** with **Black Start** capability to commence their pre-planned **Black Start** procedure.

**9.4.2** The **System Operator** shall prepare the **Transmission System** for restoration by creating discrete power islands with no interconnection. Close coordination with concerned **Distribution Utilities** shall be maintained during the restoration process to arrange for

discrete demand blocks becoming available to stabilize **Generating Units**, as these become available in individual islands.

**9.4.3** **Generators** to whom start up power supply is made available shall sequence their start up to match their auxiliary power demand with supply available.

**9.4.4** Each discrete power island should contain at least one **Black Start Generator** capable of running on Isochronous Mode.

**9.4.5** **Generators** shall inform the **System Operator** as **Generating Units** become available to take load, in order that the **System Operator** may assess the MW demand which the **Generating Unit** is likely to pick up on circuit breaker closure.

**9.4.6** The **System Operator** shall co-ordinate with **Generators** and **Distribution Utilities** to:

(a) Form discrete power islands with one **Generating Unit** feeding some local demand.

(b) Extend islands by adding more **Generating Units** and more demand in a coordinated manner maintaining load generation balance.

(c) Synchronize islands to form a larger, more stable island.

## 9.5 PARTIAL TRANSMISSION SYSTEM BLACKOUT

**9.5.1** The **System Operator** shall ensure with the **Licensee** and **Users** that security of the healthy part of the **Transmission System** is maintained.

**9.5.2** The **System Operator** and the **Licensee** shall gradually extend the healthy system to provide start-up power to appropriate **Generating Units**.

**9.5.3** The **System Operator** and the **Licensee** with close coordination with **Distribution Utilities** and **Generators** shall gradually restore demand to match generation as it becomes available.

**9.5.4** All **Users** shall take care to ensure load-generation balance is maintained at all times under the **System Operator's** direction.

## 9.6 RESPONSIBILITIES

**9.6.1** The **Single Buyer** shall ensure sufficient **Black Start** and Fast Start capability at strategic locations in the **PPA** with the selected **Generators.**

**9.6.2** The **System Operator** shall maintain a record of **Power Station Black Start** capability and associated **Power Station Black Start** plans.

**9.6.3** The **System Operator** shall prepare, distribute and maintain up-to-date **Black Start** procedures covering the restoration of the **Transmission System** following total or partial blackout. Updated **Black Start** procedures shall be submitted to the **Commission**.

**9.6.4** **Users** shall agree regarding **Black Start** procedures with the **System Operator** and the **Licensee** and promptly inform the **System Operator** when unable to follow the procedure.

**9.6.5** The **System Operator** and the **Licensee** shall be responsible for directing the overall **Transmission System** restoration process by coordination with all **Users.**

**9.6.6** **Distribution Utilities** shall be responsible for sectionalizing the **Distribution System** into discrete, unconnected blocks of demand. They shall advise the **System Operator** of the amount of MW likely to be picked up by the synchronizing **Generator**.

**9.6.7** **Generators** shall be responsible for commencing their planned **Black Start** procedure on the instruction of the **System Operator** and steadily increasing their generation according to the demand that the **System Operator** is able to make available.

## 9.7 SPECIAL CONSIDERATIONS

**9.7.1** During the restoration process following **Transmission System** blackout conditions, normal standards of voltage and frequency shall not apply.

**9.7.2** A list of essential loads and priority of restoration is shown in the **Appendix**. Updated list of essential loads and priority of restoration shall be submitted to the **Commission.**

**9.7.3** **Distribution Utilities** with essential loads shall separately identify non-essential components of such loads, which may be kept off during system contingencies.

**9.7.4** **Distribution Utilities** shall draw up an appropriate schedule with corresponding load blocks in each case. The non-essential loads can be put on only when system normalcy is restored, as advised by the **System Operator**.

**9.7.5** All **Users** shall pay special attention in carrying out the procedures so that secondary collapse due to undue haste or in-appropriate loading is avoided.

**9.7.6** Despite the urgency of the situation, careful, prompt and complete logging of all operations and operational messages shall be ensured by all **Users** to facilitate subsequent investigation into the incident and the efficiency of the restoration process. Such investigation shall be conducted promptly after the incident.

## 9.8 APPENDIX

Essential loads and priority of restoration.

**APPENDIX**

## CONTINGENCY PLANNING

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## ESSENTIAL LOADS AND PRIORITY OF RESTORATION

| Priority | Type of Load | Name of Substation | Remarks |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

# 10. CROSS BOUNDARY SAFETY

## 10.1 INTRODUCTION

This **Section** sets down the requirements for maintaining safe working practices associated with cross boundary operations. It lays down the procedure to be followed when work is required to be carried out on electrical equipment that is connected to another **User's** system.

## 10.2 OBJECTIVE

The objective of this **Section** is to achieve agreement and consistency on the principles of safety as prescribed in the **Electricity Rules, 1937** and revisions thereof and widely practiced international rules by concern of the **Licensee** when working across a control boundary between the **Licensee** and another **User**.

## 10.3 CONTROL PERSONS

The **Licensee** and all **Users** shall nominate suitably authorized persons to be responsible for the coordination of safety across their boundary. These persons shall be referred to as **Control Persons**.

## 10.4 PROCEDURE

The **Licensee** shall issue a list of **Control Persons** (names, designations and telephone numbers) to all **Users** who have a direct control boundary with the **Licensee**. This list shall be updated promptly whenever there is change of name, designation or telephone number.

All **Users** with a direct control boundary with the **Licensee** shall issue a similar list of their **Control Persons** to the **Licensee**, which shall be updated promptly whenever there is a change to the **Control Persons** list.

Whenever work across a control boundary is to be carried out, the **Control Person**, of the **User** (which may be the **Licensee**), wishing to carry out work shall directly contact the other relevant **Control Person**. Code words will be agreed at the time of work to ensure correct identification of both parties.

Contact between the **Control Persons** shall normally be by direct telephone. Should the work extend over more than one shift the **Control Person** shall ensure that the relief **Control Person** is fully briefed on the nature of the work and the code words in operation.

The **Control Persons** shall co-operate to establish and maintain the precautions necessary

for the required work to be carried out in a safe manner. Both the established isolation and the established earth shall be locked in position, where such facilities exist, and shall be clearly identified.

Work shall not commence until the **Control Person**, of the **User** (which may be the **Licensee**), wishing to carry out the work, is satisfied that all the safety precautions have been established. This **Control Person** shall issue agreed safety documentation to the working party to allow work to commence.

When work is completed and safety precautions are no longer required, the **Control Person** who has been responsible for the work being carried out shall make direct contact with the other **Control Person** to request removal of those safety precautions.

The equipment shall only be considered as suitable for return to service when all safety precautions are confirmed as removed, by direct communication using code word contact between the two **Control Persons**, and return of agreed safety documentation from the working party has taken place.

The **Licensee, Generators** and **Distribution Utilities** shall jointly develop an agreed written procedure for cross boundary safety and continually update it.

Any dispute concerning Cross Boundary Safety shall be resolved at an appropriate higher level of authority.

## 10.5 SPECIAL CONSIDERATIONS

For cross boundary circuits all **Users** shall comply with the agreed safety rules which must be in accordance with the **Electricity Rules, 1937** and revisions thereof and widely practiced international rules.

All equipment on cross boundary circuits which may be used for the purpose of safety coordination and establishment of isolation and earthing, shall be permanently and clearly marked with an identification number or name, that number or name being unique in that substation. This equipment shall be regularly inspected and maintained in accordance with manufacturer's specification.

Each **Control Person** shall maintain a legibly written safety log, in chronological order, of all operations and messages relating to safety coordination sent and received by themselves. All safety logs shall be retained for a period of not less than 10 years.

# 11. OPERATIONAL EVENT/ ACCIDENT REPORTING

## 11.1 INTRODUCTION

This **Section** describes the requirements for reporting, in writing, incidents that were initially reported orally by/ to other **Users**.

## 11.2 OBJECTIVE

The objective of this **Section** is to define the incidents to be reported, the reporting route to be followed and the information to be supplied to ensure a consistent approach to the reporting of incidents and accidents on the **Transmission System**.

## 11.3 REPORTABLE INCIDENTS

Typical examples of reportable incidents that could affect the **Transmission System** are the following:

i. Exceptionally high/ low system voltage or frequency.
ii. Serious equipment problem, e.g. major circuit, transformer or bus-bar fault.
iii. Loss of major **Generating Unit**.
iv. Falling of Transmission line/ Tower due to natural calamity
v. System split, **Transmission System** breakaway or black out.
vi. Major fire incidents.
vii. Major failure of protection.
viii. Accidents.
ix. Equipment and transmission line overload.
x. Minor equipment alarms.

The last two reportable incidents are typical examples of those that are of lesser consequence, but which still affect the **Transmission System** and can be reasonably classed as minor. They will require corrective action but may not warrant management reporting until a later, more reasonable time.

## 11.4 REPORTING PROCEDURE

**11.4.1.**

i. All reportable incidents occurring in lines and equipment of 33 kV and above at **Grid** substations shall promptly be reported orally by the **User** whose equipment has experienced the incident (The Reporting **User**) to any other significantly

affected **Users** and to the **System Operator** who shall immediately inform the **Licensee**.

ii. Within 1 (one) hour of being informed by the Reporting **User**, the **System Operator** or the **Licensee** may ask for a written report on any incident.

iii. If the reporting incident cannot be classed as minor then the Reporting **User** shall submit an initial written report within two hours of asking for a written report by the **System Operator**. This has to be further followed up by the submission of a comprehensive report within 48 hours of the submission of the initial written report.

iv. In other cases the Reporting **User** shall submit a report within 5 (five) working days to the **System Operator**.

v. The **System Operator** shall immediately communicate all oral or written reportable incidents to the **Licensee.**

**11.4.2** The **System Operator** or the **Licensee** may call for a report from any **User** on any reportable incident affecting other **Users** and the **Licensee** in case the same is not reported by such **User** whose equipment might have been source of there portable incident.

The above shall not relieve any **User** from the obligation to report events in accordance with prevailing laws and regulations.

The format of such a report will be as agreed at the **Grid Code Review Panel**, but will typically contain the following information:

i. Location of incident.
ii. Date and time of incident.
iii. Plant or equipment involved.
iv. Supplies interrupted and duration if applicable.
v. Amount of generation lost if applicable.
vi. Brief description ofincident.
vii. Estimate of time to return to service.
viii. Name of originator.
ix. Action taken to overcome situation.

## 11.5 REPORTING FORM

The standard reporting form other than for accidents, shall be as agreed from time to time by the **Grid Code Review Panel**. When such a form has been agreed in **Grid Code Review Panel** meeting it will be included as an **Appendix** in this **Section** of the **Grid Code**. The

accepted form is to be numbered and included in the ISO/ Quality form of the users where applicable.

## 11.6 MAJOR FAILURE

Following a major failure, the **Licensee** and other **Users** shall co-operate to inquire and establish the cause of such failure and produce appropriate recommendations. The **Licensee** shall report the major failure to the **Commission** immediately for information and shall submit the enquiry report to the **Commission** within 2 (two) months of the incident.

## 11.7 ACCIDENT REPORTING

In both fatal and non-fatal accidents, the report shall be sent to the concern authorities according to section 29 of the **Electricity Act, 2018** and to the **Commission** in the prescribed form.

**APPENDIX**

## INCIDENT REPORTING

**FIRST REPORT**_____ **Date :.....**
**Time :.....**

| | |
|---|---|
| Date and time of incident | **:** |
| Location of incident | **:** |
| Type of incident | **:** |
| System parameters before the incident (Voltage, Frequency, Flows, Generation, etc.) | **:** |
| System parameters after the incident | **:** |
| Network configuration before the incident | **:** |
| Relay indications received and performance of protection | **:** |
| Damage to equipment | **:** |
| Supplies interrupted and duration, if applicable | **:** |
| Amount of Generation lost, if applicable | **:** |
| Estimate of time to return service | **:** |
| Cause of incident | **:** |
| Any other relevant information and remedial action taken | **:** |
| Recommendations for future improvement/ repeat incident | **:** |
| Name of the Organization | **:** |

# 12. PROTECTION

## 12.1 INTRODUCTION

In order to safeguard a **User's** system from faults that may occur on another **User's** system, it is essential that certain minimum standards of protection be adopted. This **Section** describes these minimum standards.

## 12.2 OBJECTIVE

The objective of this **Section** is to define the minimum protection requirements for any equipment connected to the **Transmission System** and thereby minimize disruption due to faults.

## 12.3 GENERAL PRINCIPLES

No item of electrical equipment shall be allowed to remain connected to the **Transmission System** unless it is covered by appropriate protection aimed at reliability, selectivity, speed and sensitivity. Guidelines mentioned in protection manuals may be kept inview.

All **Users** shall co-operate with the **Licensee** to ensure correct and appropriate settings of protection to achieve effective, discriminatory removal of faulty equipment within the time for target clearance specified in this **Section**.

Protection settings shall not be altered, or protection bypassed and/ or **Disconnected** without consultation and agreement of all affected **Users**. In the case where protection is bypassed and/ or **Disconnected**, by agreement, then the cause must be rectified and the protection restored to normal condition as quickly as possible. If agreement has not been reached the electrical equipment will be removed from service forthwith.

**Generator** personnel shall not work upon or alter busbar Protection, mesh corner Protection, circuit breaker fail Protection, AC or DC Wiring (other than power supplies or DC tripping associated with the **Generating Unit** itself) in the absence of a representative of the **Licensee**. Protection and relay settings shall be coordinated across **Connection Point** to ensure effective disconnection of faulty **Apparatus**.

## 12.4 PROTECTION COORDINATION

The **Licensee** shall be responsible for arranging periodical meetings between all **Users** to discuss coordination of protection. The **Licensee** shall investigate any malfunction of protection or other unsatisfactory protection issues. **Users** shall take prompt action to correct any protection malfunction or issue as discussed and agreed to in these periodical meetings.

The **Licensee** shall be responsible for carrying out any required system studies to determine the necessary protection discrimination settings.

## 12.5 FAULT CLEARANCE TIMES

From a stability consideration the maximum fault clearance times for faults on any **User's** system directly connected to the **Transmission System**, or any faults on the **Transmission System** itself, are as follows:

Target Clearance Times:

| | | | |
|---|---|---|---|
| i. | 400kV & Above | : | 80 ms |
| ii. | 230kV | : | 100 ms |
| iii. | 132kV | : | 120 ms |
| iv. | 33kV | : | 160 ms |

## 12.6 GENERATOR REQUIREMENTS

All **Generating Units** and all associated electrical equipment of the **Generator** connected to the **Transmission System** shall be protected by adequate and coordinated protection so that the **Transmission System** does not suffer due to any disturbance originating from the **Generating Unit**.

In the event of failure of the protection systems provided to meet the fault requirements detailed above, back up protection shall be provided by the **Generator** with a fault clearance time not slower than 400ms for faults on the **Generating Unit's** HV **Connection**s. The **Generating Unit's** shall remain stable for external faults & tripping in the **Transmission System.**

The protection shall also cover **EHV** lines and transformers to the standards as for the **Transmission System** and circuit breaker fail, pole slipping, loss of excitation, **Power System Stabilizer** and negative phase sequence tripping.

Busbar Protection shall be provided and maintained by the **Generators** for each generation bus and substation bus owned by the **Generators**.

## 12.7 TRANSMISSION LINE REQUIREMENTS

Every **EHV** line taking off from a **Power Station** or a substation shall have main protection and backup protection as mentioned below. The **Licensee** shall notify **Users** of any changes in its policy on protection from time to time. Protection panels for the protection of lines of the **Licensee** taking off from a **Power Station/** substation shall be owned and maintained by

the **Licensee. Power Station/** substation shall provide adequate space, **Connection** facility, and access to the **Licensee** for such purpose.

The **Generating units** shall ensure that all common facilities needed for installing required protective relaying are made available to the **Licensee.**

Requirement of reactive power compensation devices shall be considered as per system study and appropriate protection scheme shall be incorporated accordingly.

### 12.7.1 Transmission line (Overhead/ Underground) of 230 kV and 400 kV

Two distance/ line differential protections plus directional Earth-fault protection (in directional comparison scheme) shall be provided as the Main-1 and Main-2 protection respectively. One stand alone directional 3-phase directional over-current or 2-phase over-current plus one earth-fault with directional feature shall provide the backup protection. Main-1 and Main-2 protection shall be distance or differential protection recommended by **Licensee** based on the system study**.** Main-1 and Main-2 protection relays shall be from two different manufacturers if same type of protection is applied for Main-1 and Main-2. Three pole and/ or single pole single shot auto-reclosing equipment shall be fitted, as appropriate, as considered by the **Licensee**. All auto-reclosing equipment will be made inoperative for two phase trip-out and/ or back-up protection operation except Directional Earth Fault with carrier aided scheme. Both Distance and Directional Earth-fault functions shall have compatible communication aided Transfer Trip Scheme.

### 12.7.2 Transmission line (Overhead/ Underground) of 132 kV

One distance/ line differential protection plus directional Earth-fault protection (in directional comparison scheme) shall be provided as the main protection. One stand alone 3-phase directional over-current or 2-phase Over-current plus one earth-fault with directional feature shall provide the backup protection. Main protection shall be distance or differential protection recommended by **Licensee** based on the system study. Three pole and/ or single pole single shot auto-reclosing equipment shall be fitted, as appropriate, as considered by the **Licensee**. All auto-reclosing equipment will be made inoperative for three phase trip-out and/ or backup protection operation except Directional Earth Fault with carrier aided scheme. Both Distance and Directional Earth-fault functions shall have compatible communication aided Transfer Trip Scheme.

## 12.8 DISTRIBUTION LINE REQUIREMENTS

All 132 kV and 230 kV lines, not owned by the **Licensee**, at **Connection Points** shall have the same protection requirements as for the Transmission Line requirements under **Section** 12.7.1 and 12.7.2.

All 33 kV lines at **Connection Points** shall be provided with a minimum of over-current and Earth-fault protection with or without directional features as given below.

### 12.8.1 Non-Parallel Radial Feeders

Non-directional time lag Over-current and Earth-fault relay with a high set instantaneous element with suitable settings to obtain discrimination between adjacent relay stations.

### 12.8.2 Parallel Feeders/ Ring Feeders

Directional time lag Over-current and Earth-fault relays with a high set instantaneous element with suitable settings to obtain selectivity and coordination.

### 12.8.3 Long Feeders/ Transformer Feeders

For long feeders or transformer feeders, the relays should incorporate a high set instantaneous element along with the time lag Over-current and Earth-fault relays.

## 12.9 TRANSFORMER REQUIREMENTS

### 12.9.1 Generating Station/ Transmission System

All windings of auto-transformers and power transformers of **EHV** class shall be protected by two dedicated differential relays and REF relays as main protection. Differential and REF protection shall be either in one relay or separate relay. Main-1 and Main-2 protection relays shall be from two different manufacturers. In addition there shall be one backup time lag 3-phase Over-current and Earth-fault protection relay for each winding as appropriate as considered by respective authority. For parallel operation such backup protection shall have directional feature. For protection against heavy short circuits, the Over-current and Earth-fault relays should incorporate a high set instantaneous element. In addition to electrical protection, gas operated relays, winding temperature protection and oil temperature protection shall be provided. Over-voltage, thermal overload and over-fluxing protection should also be provided.

### 12.9.2 Distribution system

For smaller transformers of HV class on the **Distribution System** differential protection shall be provided for 10 MVA and above along with backup time lag Over-current and Earth-fault protection (with directional feature for parallel operations). Transformers 1.6 MVA and above and less than 10 MVA shall be protected by time lag Over-current, Earth-fault and instantaneous REF relays. In addition all transformers 1.6 MVA and above shall be provided with gas-operated relays, temperature protection and winding temperature protection and oil temperature protection.

## 12.10 SUBSTATION BUSBAR AND FIRE PROTECTION

**12.10.1** All **Users** shall provide adequate main and back-up bus zone protection incorporated with Local Breaker Backup (LBB) or Breaker Fail Protection (BFP) for busbars in all 400 kV, 230 kV and 132 kV class substations.

For 132 kV, one busbar protection system shall be implemented and for 230 kV & 400 kV levels, redundant (Main-1 & Main-2) busbar protection systems shall be implemented. Main-1 and Main-2 bus bar protection system shall be from two different manufacturers. During expansion of any substation, integration in the busbar protection system shall have to be done by the owner of the new feeders with necessary engineering works and hardware.

**12.10.2** Adequate precautions shall be taken and protection shall be provided against fire hazards to all **Apparatus** of the **Users** conforming to relevant Bangladesh Standard Specification and/ or provisions in the **Electricity Rules, 1937** and amendments thereof and other standard engineering practices.

## 12.11 DATA REQUIREMENTS

**User**s shall provide the **Licensee** with data for this **Section** as specified in the Data Registration **Section**.

# 13. METERING, COMMUNICATION AND DATA ACQUISITION

## 13.1 INTRODUCTION

This **Section** specifies the minimum operational and commercial metering, communication and data acquisition requirements to be provided by each **User** at the **Connection Points** and also at the cross boundary circuits.

## 13.2 OBJECTIVE

The objective of this **Section** is to define the minimum acceptable metering and communication and data acquisition requirements to enable the **Licensee** to manage the **Transmission System** in a safe and economic manner consistent with **License** requirements.

## 13.3 GENERATION OPERATIONAL METERING

**13.3.1** This sub-**Section** specifies the facilities that shall be provided for practices that shall be employed for monitoring output and response of **Power Stations** and **Generating Units.**

**13.3.2** The **Generator** shall install operational metering to the **Licensee's** and **Single Buyer's** specification so as to provide operational information for both real time and recording purposes in relation to each **Generating Unit** at each **Power Station** in respect of:

i. Bus Voltage
ii. Frequency
iii. MW
iv. MWhr
v. MVAR
vi. Power Factor
vii. Any other additional data as agreed between the **Licensee,** the **Single Buyer** and **Generator**.

**13.3.3** All current transformers and voltage transformers used in conjunction with operational metering shall conform to relevant Bangladesh Standard Specifications or the relevant **IEC**, of accuracy class 0.2s and of suitable rating to cater to the meters and the lead wire burdens**.** All new or replacement of current and voltage transformers shall be of accuracy class 0.2s and 0.2 respectively. Overall accuracy of the **Metering System** shall be within 0.2%. In case of failure to achieve the accuracy of individual equipment's or overall accuracy limit, correction factor will be applied to calculate correct energy**.**

**13.3.4** Metering shall be calibrated, so as to achieve overall accuracy of operational metering in the

limits as agreed between the **Licensee** and **Generator**. All new **Metering Systems** shall provide an overall measured accuracy of +/-0.2%. Records of calibration shall be maintained for reference and shall be made available to the **Licensee** upon request.

**13.3.5** **Generators** shall furnish recorded data of all electrical measurements and events recorded by the operational metering to the **Licensee** daily or as agreed between the **Licensee** and the **Generator**.

## 13.4 TRANSMISSION SYSTEM OPERATIONAL METERING

**13.4.1** This sub-**Section** specifies the facilities that shall be provided for practices that shall be employed for monitoring electrical supply and load characteristic at each substation.

**13.4.2** The **Licensee** shall install operational metering so as to provide operational information for both real time and recording purposes in relation to each feeder, transformer and compensation device at each substation in respect of:

i. BusVoltage
ii. Frequency
iii. MW
iv. MWhr
v. MVAR
vi. Power Factor
vii. Current
viii. Any other additional data as agreed between the **Licensee,** the **Single Buyer** and **Generator**.

**13.4.3** All current transformers and voltage transformers used in conjunction with operational metering shall conform to relevant Bangladesh Standard Specifications or the relevant **IEC**, of accuracy class 0.2s for CT and 0.2 for VT and of suitable rating to cater to the meters and the lead wire burdens. All new or replacement current and voltage transformers shall be of accuracy class 0.2. Accuracy class should be maintained strictly for new or replacement current and voltage transformers.

**13.4.4** The **Licensee** shall furnish such data of all electrical measurements and events recorded by the operational metering to the **Generator** as required on request or as agreed between the **Licensee** and the **Generator**.

## 13.5 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

**13.5.1** The **System Operator** and the **Licensee** shall install and make operative an operational

metering data collection system, under **SCADA** for storage, display and processing of metering data. For **Generators**, **Distribution Utilitie**s, **Bulk Consumers** and other **Users**, the equipments within their site for communication (voice & data), **SCADA** Control (for example RTU/ Gateways) shall be installed, owned & maintained by the respective **Users**.

**13.5.2** Necessary data shall be collected/ acquired, stored and real-time data is to be displayed at the **System Operator.**

**13.5.3** The responsibilities for **SCADA** are detailed in Metering, Communication and Data Acquisition **Section.**

## 13.6 COMMERCIAL (TARIFF) METERING

**13.6.1** This sub-**Section** specifies provision of commercial (Tariff) metering at **Connection Points** between the **Transmission System** and **Generating Stations,** and the **Transmission System** and **Distribution Systems**. It also specifies metering facilities that shall be provided for the measurement of electricity produced by **Generating Units** and for measurement of electricity consumed at **Power Stations**.

**13.6.2** Metering shall be installed to measure:

(a) Active energy for export.
(b) Active energy for import.
(c) Reactive energy for import.
(d) Reactive energy for export.

**13.6.3** At each commercial metering point associated with determination of energy exported or imported the **Single Buyer** shall install, own and maintain (with the assistance of the **Licensee**) a metering system defined as the **Metering System**, and **Check Metering System**.

**13.6.4** The **Generator** or **Distribution Utility/ Bulk Power Consumer** may install, own and maintain a Metering System in their premises/ substations.

**13.6.5** Minimum standard of accuracy of meters shall be of class 0.2S or as agreed between the **Single Buyer** and the **User** and shall conform to the relevant Bangladesh Standard Specification or relevant **IEC**.

**13.6.6** All current transformers and voltage transformers used in conjunction with commercial (Tariff) metering shall conform to the relevant Bangladesh Standard Specification or relevant **IEC**. Accuracy class of current transformers shall be 0.2S and voltage transformers shall be 0.2. Burden rating of CTs and VTs must be suitable to cater to the meters and the lead wire burdens.

**13.6.7** The **Metering System** and the **Check Metering System** shall be designed and installed based on Prudent Utility Practices providing a measured accuracy of +/-0.2% or as agreed between the **Single Buyer** and the **User.**

**13.6.8** Data collection shall be used to integrate impulses from meters over each integration period as per agreement, store values and transmit values to the data collection system of the **Single Buyer**. Data shall be collected from the **Metering System**.

**13.6.9** Voltage supply to the metering shall be assured with necessary voltage selection schemes. Voltage failure relays or the internal voltage monitoring feature of the Tariff Meter shall be provided which will initiate alarm on loss of one or more phases of the voltage supply to any meter.

**13.6.10** The **Single Buyer** shall ensure that the testing and calibration of the Metering System is carried out at intervals of not less than one hundred and eighty days (180). The **Single Buyer** shall give no less than fifteen days notice to the **User** according to guidelines provided in relevant Bangladesh Standard Specification or relevant **IEC** as applicable. Records of meter calibration test shall be maintained for future reference. The **User** may, at any time, request to inspect the test results and/or request a test if the **User** suspects the meter is incorrect.

**13.6.11** The **Single Buyer** and the **User** shall jointly seal the **Metering System** and the **Check Metering System**. The **Single Buyer** shall break the seals only after giving at least twenty-four (24) hours notice except under emergency conditions. The **User** may attend the breaking of the seals if considered necessary by the **User**.

**13.6.12** Any dispute arising between the parties that cannot be resolved between the parties shall be referred to a joint sub-committee convened by the **Grid Code Review Panel** Chairman and consisting of representatives of the parties in dispute and 2 independent **Grid Code Review Panel** Members representatives. If the joint sub-committee cannot resolve the dispute the **Single Buyer** shall refer it, with all supporting documentation, to the **Commission** for a decision.

## 13.7 COMMUNICATION

Independent dedicated communication links such as microwave, PLC, Optical Fiber, etc. for voice communication, for written communication and for data acquisition shall be installed between all **Power Stations**, substaions, other **User's** premises and the **NLDC**.

The **Licensee,** the **System Operator and Generators** are authorized to tape record all telephoned voice communications relating to **Declared Available Capacity** control and schedule and dispatch and shall supply at the request of the other party a copy or transcript

of any such recording.

The **Licensee,** the **System Operator** and **Users** are authorized to tape record all cross boundary safety communications and shall supply at the request of the other party a copy or transcript of any such recording.

## 13.8 DATA ACQUISITION & CONTROL

**13.8.1** For effective control of the **Transmission System**, the the **System Operator** needs real time data as follows:

i. Voltage, Current flow, Real & Reactive power of transmission line, **Generators**, **Grid** Transformers, and distribution feeders;
ii. Voltage & frequency of all buses;
iii. Digital status & control of all switching devices;
iv. Status & control of **Grid** transformers;
v. All necessary alarms;
vi. All necessary signals & controls for AGC;
vii. Digital status & control of of atleast 50% load shed feeders;
viii. Wind Speed and directioons at each Wind Generation Plant;
ix. Solar irradiations at each **PV** Plant;
x. Necessary weather data.

**13.8.2** The **Licensee** shall provide and install all the facilities and equipment for Tele- metering, communication, control and monitoring, including voice channels, between the **Connection Point** and the **NLDC.**

**13.8.3** The **Generators** shall provide and install within the complex such equipment, including power line Carrier equipment and/ or Fiber Optics Multiplexers, as needed for the complex to interconnect with the **Transmission System** equipment for Tele- metering, communication, control and monitoring, including voice channels, compatible to the **Licensee's** system or as agreed by the **Licensee**.

**13.8.4** For the **SCADA** system the **Single Buyer** shall be responsible for providing and installing the equipment including any Remote Terminal Units (RTUs)/ Gateways within the **Generator** or **Distribution Utility** or **Bulk Power Consumer** sites. The **Generator, Distribution Utility** and **Bulk Power Consumer** shall provide and install within the complex interface terminals on the Metering System and such other equipment needed to interface with the **SCADA** system.

**13.8.5** No **Power Station** and **Transmission System** substation shall be commissioned without communication & **SCADA** integration.

## 13.9 AGREED PROCEDURE FOR COMMUNICATION AND DATA TRANSMISSION

Mutually agreed procedures shall be drawn up between the **Licensee,** the **System Operator** and other **Users** outlining inter responsibility, accountability and recording of day to day communication and data transmission on operational matters.

### 13.9.1. Data Requirement

The **Licensee,** the **System Operator** and **Users** shall furnish metering data to each other, as applicable and as detailed in Data Registration **Section**.

# 14. TESTING

## 14.1 INTRODUCTION

This **Section** specifies the responsibilities and procedures for arranging and carrying out Tests which have (or may have) an effect on the **Transmission System** or the **Generation** or **Distribution Systems**.

## 14.2 OBJECTIVE

The objective of the **Section** are to establish whether **Generating Units** can operate within their Generation Schedule and Dispatch parameters as registered under the Data Registration **Section** and that the **Generator** and **Distributor/ Bulk Power Consumer** comply with the **Section** 5 "**Connection Conditions"**. It shall also establish whether each **Generating Unit's Declared Available Capacity** is as declared and that the requirements of the provisions of frequency, voltage management and reserve capability are met in accordance with the provisions of the **Grid Code**.

## 14.3 RESPONSIBILITIES

The **System Operator** is responsible for ensuring that the following procedures are carried out. All **Users** are required to fully co-operate to ensure that all the arrangements are made for smooth execution of tests.

## 14.4 PROCEDURE

The **System Operator** shall monitor the performance of **Generating Units** against the registered parameters and the compliance by the **Generator** or **Distributor** with the **Section** 5 "**Connection Conditions"** of the **Grid Code**.

The **System Operator** shall inform a **Generator**, and confirm in writing, if monitoring demonstrates an apparent persistent or material mismatch in meeting the **Generating Unit** registered parameters or breach of the **Connection Conditions**.

For all parameters, except availability, the relevant **Generator** shall, as soon as possible, provide the **System Operator** with an explanation of the reasons for the failure to meet the requirements and the details of the action it proposes to take to meet the requirements and comply with the **Grid Code**.

The **System Operator** and the **Generator** will then discuss the action and endeavor to reach agreement on the actions required.

In the event that agreement cannot be made within 10 days of the notification the **System Operator** shall be entitled to propose that a test be carried out.

For the allocation of the costs of testing the general principle shall be that the Test Proposer (the **System Operator/** the **Single Buyer**) shall bear the costs if the results show that the test was not justified and the **Generator** or **Distribution Utility/ Bulk Power Consumer** shall bear the costs if the results show the test was justified.

## 14.5 TEST PROCEDURES FOR CONVENTIONAL GENERATION

### 14.5.1 Declared Available Capacity Testing

If the **System Operator** has reasonable suspicion that the **Declared Available Capacity** of a **Generating Unit** is not as declared the **System Operator** may test that availability by issuing a dispatch instruction to the **Generating Unit** to attain the **Declared Available Capacity**. This may be instructed at any time even though it had not been previously scheduled or dispatched on **Merit Order** or system grounds.

The issue of a Dispatch instruction shall initiate the test.

The **Generating Unit** will pass the test if it can attain and maintain its load to the **Declared Available Capacity** for 2 hours.

### 14.5.2 Schedule and Dispatch Instruction Testing

If the **System Operator** has reasonable suspicion that the Scheduling and Dispatch parameters of a **Generating Unit** are not as registered and have not had notification of a temporary change to the parameters he may instruct the **Generating Unit** to demonstrate the capability of meeting its parameters. The **Generator** shall be given at least 48 hours notice of the test and the duration shall be consistent with the time taken to measure the result.

The issue of a Dispatch instruction shall initiate the test.

The performance of the **Generating Unit** shall be recorded in the presence of a representative of the **System Operator,** the **Generato**r and the **Single Buyer**.

The **Generating Unit** will pass the test if the parameters under test are within +/- 2.5% of the declared value tested.

### 14.5.3 Reactive Power Testing

If the **System Operator** has reasonable suspicion that the reactive power capability of a **Generating Unit** is not as registered and have not had notification of a temporary change he may instruct the **Generating Unit** to demonstrate the capability of meeting its registered capability. The **Generator** shall be given at least 48 hours notice of the test and the duration will be for a period up to 60 minutes. The **Transmission System** voltage at the entry point shall be maintained by the **Generator** at the voltage specified by test proposer by adjustment of reactive power on the remaining units (if available) or by the **Licensee** by appropriate tap changing at the substation, as necessary.

The issue of a Dispatch instruction shall initiate the test.

The performance of the **Generating Unit** shall be recorded in the presence of a representative of the **System Operator,** the **Generato**r and the **Single Buyer**.

The **Generating Unit** will pass the test if it is within +/- 2.5% of the registered capability. Due account shall be taken of any conditions on the system that may affect the test.

### 14.5.4 Automatic Frequency Sensitive Testing

If the **System Operator** has reasonable suspicion that the capability of the automatic frequency sensitive performance (Primary & Secondary response) of a **Generating Unit** is not as registered and have not had notification of a temporary change he may instruct the **Generating Unit** to demonstrate the capability of meeting its registered capability. The **Generator** shall be given at least 48 hours notice of the test.

The performance of the **Generating Unit** and system frequency shall be recorded in the presence of a representative of the **System Operator,** the **Generato**r and the **Single Buyer**. Where measurements of the Governor pilot oil/valve position are to be made such measurements should indicate that the Governor parameters are within limits. The **Generating Unit** will pass the test if it is within +/- 2.5% of the level of response registered.

### 14.5.5 Fast Start CapabilityTesting

If the **System Operator** has reasonable suspicion that the capability of the fast start performance of a **Generating Unit** is not as registered and have not had notification of a temporary change he may instruct the **Generating Unit** to demonstrate the capability of meeting its registered capability. The **Generator** shall be given at least 48 hours notice of the test.

The issue of a Dispatch instruction shall initiate the test.

The performance of the **Generating Unit** and system frequency shall be recorded in the

presence of a representative of the **System Operator,** the **Generato**r and the **Single Buyer**. Where measurements of the Governor pilot oil/ valve position are to be made such measurements should indicate that the Governor parameters are within limits.

The **Generating Unit** will pass the test if when synchronizing and running up to full declared availability it meets its fast start capability

**14.5.6 Black Start Testing**

The **System Operator** may, at any time require a **Generator** with **Black Start** capability to carry out a "**Black Start** Test" on a **Generating Unit** in order to demonstrate that the **Black Start Power Station** has a **Black Start** capability.

Where the **System Operator** requires the **Generator** to carry out the "**Black Start** Test" the **NLDC** shall not require the test to be carried out on more than one **Generating Unit**.

The **System Operator** shall not require a **Generator** with a **Black Start** capability to carry out a "**Black Start** Test" more than once every calendar years in respect of any particular **Generating Unit**.

When the **System Operator** requires a "**Black Start** Test" it shall notify the relevant **Generator** at least 7 days prior to the start of the test with details of the proposed test.

All "**Black Start** Tests" shall be carried out at a time specified by the **Licensee** in the notice given and shall be undertaken in the presence of a representative of the **System Operator,** the **Generato**r and the **Single Buyer.**

The **Generating Unit** will pass the test if it meets its **Black Start** capability.

**14.5.7 Synchronization Time and Ramp Rate**

If the **System Operator** has reasonable suspicion that the time required for synchronization process & Ramp Rate of a **Generating Unit** is not as registered and have not had notification of a temporary change he may instruct the **Generating Unit** to demonstrate the capability of meeting its registered capability. The **Generator** shall be given at least 48 hours notice of the test and the duration will be for a period up to 60 minutes**.**

The issue of a Dispatch instruction shall initiate the test.

The performance of the **Generating Unit** shall be recorded in the presence of a representative of the **System Operator**, the **Single Buyer** and the **Generator**.

The **Generating Unit** will pass the test if in case of synchronization; the process is achieved within +/- 5 minutes of the registered synchronization time and in case of meeting Ramp Rates (up/down), the actual Ramp Rate is within +/- 10 % of the registered Ramp Rate.

## 14.6 TEST PROCEDURES FOR VRE GENERATION

**14.6.1.** If the **System Operator** has reasonable suspicion that any **VRE Generating Plant** or **VRE Generating Unit** is not in accordance with the requirements indicated in **Section** 5 (**Connection Conditions**) it may instruct the **VRE Generating Plant** or **VRE Generation Unit** to demonstrate the capability of meeting such requirements. The **Generator** shall be given at least 48 hours notice of the required test and the duration will be for a period up to 60 minutes.

The issue of a Dispatch instruction shall initiate the test.

The performance of the **VRE Generating Plant** or **VRE Generating Unit** shall be recorded in the presence of a representative of the **System Operator** and the **Generator.**

**14.6.2.** Following tests can be performed for **VRE Generating Plants**:

a) The reactive power test shall demonstrate that the **VRE Generation Plant** meets the registered reactive power capability requirements specified in sub-**Section** 5.9.2. The **VRE Generating Plant** shall pass the test if the measured values are within ±5 percent of the indicated requirements.

b) The active power control test shall demonstrate that the **VRE Generation Plant** has the capability to control the injected power, as specified in sub-**Section** 5.9.3. The **VRE Generation Plant** shall pass the test if the measured response in is within ±5 percent of the required level of response within the time-frames indicated in such Sub-section.

c) The Voltage Control test shall demonstrate that the **VRE Generation Plant** has the capability to control the voltage at the **Connection Point**, as specified in sub-**Section** 5.9.2. The **VRE Generating Plant** shall pass the test if:

i. In voltage control mode, the **VRE Generating Plant** is capable to control the voltage at the **Connection Point** within a margin not greater than 0.01 p.u., provided the reactive power injected or absorbed is within the limits specified.

ii. Following a step change in voltage, the **VRE Generation Plant** shall be capable of achieving 90 % of the change in reactive power output within a time less than 5 seconds, reaching its final value within a time no greater than 30 seconds.

iii. In power factor control mode, the **VRE Generation Plant** is capable of controlling the power factor at the **Connection Point** within the required reactive power range, with a target power factor in steps no greater than 0.01.

d) The frequency withstand capability tests shall demonstrate that the **VRE Generation Plant** is capable to operate in the frequency ranges stated in sub-**Section** 5.9.1. The **VRE Generation Plant** shall pass the test if it is capable to maintain stable operation during at least 95% of the times stated in such sub-**Section**, provided voltage at the **Connection Point** is within +/- 5 % of the nominal values.

e) The Low Voltage Ride Through and performance under disturbances capability tests shall demonstrate that the **VRE Generation Plant** is capable to withstand voltage drops as indicated in sub-**Section** 5.9.5. The **VRE Generation Plant** shall pass the test if its performance is equal or better than the prescriptions in the said sub-**Section**. The **System Operator** and the **VRE Generator** shall agree the way that this test should be carried out.

## 14.7 FAILURE OF GENERATOR TO PASS TEST AND DISPUTES

If a **Generating Unit** fails to pass a test, the **Generator** shall provide the **System Operator** and the **Single Buyer** with a written report detailing the reasons for the failure, as far as they are known, within 3 days of the test. If a dispute arises relating to the failure the **System Operator** may, with the agreement of the **Generator**, carry out a re-test on 48 hours notice.

If the **Generating Unit** fails to pass the test or re-test and a dispute occurs, then either party may refer the dispute to the **Commission**. The decision of the **Commission** shall be binding on both parties.

If the **System Operator** and the **Generator** agree that the **Generating Unit** has failed the test, or re-test, the **Generator** shall submit in writing to the **System Operator** and the **Single Buyer** for approval the date and time by which the **Generator** shall restore the faulty unit to a condition where it would pass the test.

If the **Generating Unit** fails to pass the test or re-test the **Generator** may amend the relevant registered parameters of that **Generating Unit** to the capability achieved under test until the **Generating Unit** can achieve the previously registered values in a further re-test.

Once the **Generator** has indicated to the **System Operator** the time and date that the **Generating Unit** can achieve the previously registered parameters, the **System Operator** may either accept them or require a further test on 48 hours notice to demonstrate that they can be achieved. If a dispute occurs, then either party may refer the dispute to the **Commission**. The decision of the **Commission** shall be binding on both parties.

# 15. NUMBERING AND NOMENCLATURE

## 15.1 INTRODUCTION

This **Section** sets out the requirement that:

a. **Licensee's** HV **Apparatus** on **User's** sites and
b. **User's** HV **Apparatus** on **Licensee's** sites

shall have numbering and nomenclature in accordance with the system used from time to time by the **Licensee**.

The numbering and nomenclature of each item of HV **Apparatus** shall be included in the Operation Diagram prepared for each site.

## 15.2 OBJECTIVE

The objective of this **Section** is to ensure, in so far as possible, the safe and effective operation of the **Power System** and to reduce the risk of human error faults by requiring that the numbering and nomenclature of **User's Apparatus** shall be in accordance with the **Licensee's** system at **Connection Point** sites.

## 15.3 SCOPE

The **Section** applies to the **Licensee** and all **Users**

## 15.4 PROCEDURE

**Licensee's HV Apparatus on User's Sites**

(a) **Licensee's** HV **Apparatus** on a **User's** sites shall have numbering and nomenclature in accordance with the system used by the **Licensee**.

(b) When the **Licensee** is to install HV **Apparatus** on a **User's** site, the **Licensee** shall notify the relevant **User** of the numbering and nomenclature to be adopted for that HV **Apparatus** at least eight months before installation.

(c) The notification shall be made in writing to the relevant **User** and will consist of a proposed Operation Diagram incorporating the proposed new HV **Apparatus** to be installed, its proposed numbering and the date ofinstallation

(d) The relevant **User** shall respond in writing within one month of the notification, confirming receipt and confirming either that any other HV **Apparatus** of the **User** on the site does not have that numbering and/ or nomenclature which could be confused with that proposed by the **Licensee**, or, to the extent that it does and that the relevant numbering and/ or nomenclature will be changed before installation of the **Licensee'**s HV **Apparatus.**

(e) The relevant **User** shall not install, or permit the installation of, any HV **Apparatus** on the site which has numbering and/ or nomenclature that could be confused with the **Licensee'**s HV **Apparatus** which is either already on that site or which the **Licensee** has notified that **User** will be installed on that site.

**User'**s **HV Apparatus on Licensee'**s **Sites**

(a) **User'**s HV **Apparatus** on **Licensee'**s sites shall have numbering and nomenclature in accordance with the system used by the **Licensee**.

(b) When a **User** is to install it's HV **Apparatus** on the **Licensee'**s site, or wishes to replace existing HV **Apparatus** on the **Licensee'**s site and also wishes to adopt new numbering and nomenclature for such HV **Apparatus**, the **User** shall notify the **Licensee** of the details of the HV **Apparatus** and the proposed numbering and nomenclature to be adopted for that HV **Apparatus** at least eight months before installation or change.

(c) The notification shall be made in writing to the **Licensee** and will consist of a proposed Operation Diagram incorporating the proposed new HV **Apparatus** to be installed, its proposed numbering and the date of installation.

(d) The **Licensee** shall respond in writing within one month of the notification, confirming receipt and confirming whether or not the **Licensee** accepts the **User's** proposed numbering and nomenclature and,if they are not acceptable, shall give details of the numbering and/ or nomenclature which will be adopted for the **User'**s HV **Apparatus**.

**Changes**

Where the **Licensee**, in its reasonable opinion has decided that it needs to change the existing numbering or nomenclature of the **Licensee's** HV **Apparatus** on a **User's** site or the **User's** HV **Apparatus** on the Licensee's site:

(a) The provisions of the above paragraphs shall apply to such change of numbering of **Licensee's** HV **Apparatus** with any necessary amendments to those provisions to reflect that only a change is being made, and

(b) In the case of a change in the numbering or nomenclature of **User's** HV **Apparatus** on the **Licensee's** site, the **Licensee** shall notify the **User** of the numbering or nomenclature the **User** shall adopt for that HV **Apparatus** at least eight months prior to the change being needed and the **User** shall respond in writing to the **Licensee** within one month of the notification confirming receipt.

In either case the notification shall indicate the reason for the proposed change.

**Users** shall be provided upon request with details of the **Licensee's** current numbering and nomenclature system.

When either the **Licensee** or the **User** installs HV **Apparatus** which is subject to this **Section**, the **Licensee** or the **User**, as the case may be installing such **Apparatus** shall be responsible for the provision and erection of clear and unambiguous labeling showing the numbering and nomenclature. Where a **User** is required to change the numbering and nomenclature he shall be responsible for the provision and erection of clear and unambiguous labeling showing the numbering and nomenclature by the required date.

Where the **Licensee** changes the numbering and nomenclature of its HV **Apparatus**, under this **Section**, then the **Licensee** shall be responsible for the provision and erection of clear and unambiguous labeling showing the numbering and nomenclature by the required date.

The **Licensee** shall not change the system of numbering and nomenclature unless to reflect new or newly adopted technology or reasons of safety.

The **Licensee** shall submit the Numbering and Nomenclature to the **Commission** whenever adopted and whenever changed or revised.

# 16. DATA REGISTRATION

## 16.1 INTRODUCTION

This **Section** contains a list of all data required by the **Licensee** that is to be provided by **Users** and data required by **Users** to be provided by the **Licensee** at times specified in the **Grid Code**. Other **Sections** of the **Grid Code** contain the obligation to submit the data and defines the times when data is to besuppliedby**Users**.

## 16.2 OBJECTIVE

The objective of the **Section** is to list all the data required to be provided by **Users** to the **Licensee** and vice versa, inaccordance with the provisions of the **Grid Code**.

## 16.3 RESPONSIBILITIES

All **Users** are responsible for submitting up-to-date data to the **Licensee** in accordance with the provisions of the **Grid Code**.

All **Users** shall provide the **Licensee** with the name, address and telephone number of the person responsible for sending the data.

The **Licensee** shall inform all **Users** of the name, address and telephone number of the person responsible for receiving data.

The **Licensee** shall provide up-to-date data to **Users** as provided in the relevant schedule of the **Grid Code**.

Responsibility for the correctness of data rests with the concerned **Users** providing the data.

## 16.4 DATA CATEGORIES AND STAGES IN REGISTRATION

Data as required to be exchanged have been listed in the **Appendices** of this **Section** under various categories with cross-reference to the concerned **Sections**. The **Licensee** and **the System Operator** may prepare structured formats for the **Users** to provide required data (based on data listed in the **Appendices)** for efficient management of related software.

## 16.5 CHANGES TO USERS DATA

Whenever any **User** becomes aware of a change to any items of data that is registered with the **Licensee**, the **User** must promptly notify the **Licensee** of the changes. The **Licensee** on receipt of intimation of the changes shall promptly correct the database accordingly. This shall also apply to any data complied by the **Licensee** regarding to its own system.

## 16.6 DATA NOT SUPPLIED

**User**s are obliged to supply data as referred to in the individual **Section** of the **Grid Code** and listed out in the Data Registration **Section Appendices**. In case any data is unavailable and hence not supplied by any **User**, the **Licensee** may, acting reasonably, if and when necessary, estimate such data depending upon the urgency of the situation. Similarly in case any data is unavailable and not supplied by the **Licensee**, the concerned **User** may, acting reasonably, if and when necessary, estimate such data depending upon urgency of the situation. Such estimates will in each case, be based upon corresponding data for similar plant or **Apparatus** or upon such other information, the **User** or the **Licensee**, as the case may be, deems appropriate.

## 16.7 SPECIAL CONSIDERATIONS

The **Licensee** and any other **User** may at any time make reasonable request for extra data as necessary.

**APPENDICES**

**APPENDIX- A**

## DATA REGISTRATION

## A. STANDARD PLANNING DATA

**REFERENCE TO:**
**SECTION 4 SYSTEM PLANNING**
**SECTION 5 CONNECTION CONDITION**

### A.1 STANDARD PLANNING DATA (GENERATION)

### A.1.1 THERMAL ( FOSSIL FUEL)

#### A.1.1.1 GENERAL

| | | |
|---|---|---|
| i. | Site | Give location map to scale showing roads, railway lines, transmission lines, rivers and reservoirs if any. |
| ii. | Fossil Fuel<br>Natural Gas, Diesel, Furnace Oil, Coal etc, | Give information on means of coal transport from coal mines in case of pithead stations or means of coal carriage and handling if coal is imported.<br>[In case of other fuels, give details of source of fuel and their transport.] |
| iii. | Water Sources | Give information on availability of water for operation of the **Power Station**. |
| iv. | Environmental | State whether forest, lands mining clearance areas are affected. |
| v. | Site map (To Scale) | Showing area required for **Power Station,** coal linkage, coal yard, water pipe line, ash disposal area, colony etc. |
| vi. | Approximate period of construction. | |

### A.1.1.2 CONNECTION

| | | |
|---|---|---|
| i. | **Connection Point** | Give single line diagram of the proposed **Connection** with the system. |
| ii. | Step up voltage for **Connection** | kV. |

### A.1.1.3 STATION CAPACITY

| | | |
|---|---|---|
| i. | Total **Power Station** capacity (MW) | State whether development will be carried out in phase and if so, furnish details. |
| ii. | No. of units & unit size | MW. |

### A.1.1.4 GENERATING UNIT DATA

| | | |
|---|---|---|
| i. | Steam **Generating Unit** | State type, capacity, steam pressure, steam temperature etc. |
| ii. | Steam turbine | State type and capacity. |
| iii. | **Generator** | a) Type<br>b) Rating (MVA)<br>c) Terminal voltage (kV)<br>d) Rated Power Factor<br>e) Reactive Power Capability (MVAR) in the range 0.95 of leading and 0.85 lagging<br>f) Short Circuit Ratio<br>g) Direct axis Synchronous reactance (% on MVA rating)<br>h) Direct axis Transient reactance (% on MVA rating)<br>i) Direct axis sub-transient reactance (% on MVA rating)<br>j) Auxiliary Power Requirement (MW) |
| iv. | Generator Transformer | a) Type<br>b) Rated capacity (MVA)<br>c) Voltage Ratio (HV/LV)<br>d) Tap change Range (+% to -%) Percentage Impedance (Positive Sequence at Full load) |

## A.1.2 HYDRO ELECTRICAL

### A.1.2.1 GENERAL

| | | |
|---|---|---|
| i. | Site | Give location map to scale showing roads, railway lines and transmission lines. |
| ii. | Site map (To scale) | Showing proposed dam, reservoir area, water conductor system, fore-bay, power house etc. |
| iii. | SubmergedArea | Give information on area submerged, villages submerged, submerged forest land, agricultural land etc. |
| iv. | Approximate period of construction. | |

### A.1.2.2 CONNECTION

| | | |
|---|---|---|
| | **Connection Point** | Give single line diagram proposed **Connection** with the **Transmission System.** |
| i. | Step up voltage for **Connection** | kV |

### A.1.2.3 STATION CAPACITY

| | | |
|---|---|---|
| i. | Total **Power Station** capacity (MW) | State whether development be carried out in phases and if so furnish details. |
| ii. | No of units & unit size | MW |

## A.1.2.4 GENERATING UNIT DATA

| | | |
|---|---|---|
| i. | Operating Head (in Mtr.) | a) Maximum<br>b) Minimum<br>c) Average. |
| ii. | Turbine | State Type and capacity |
| iii. | **Generator** | a) Type<br>b) Rating (MVA)<br>c) Terminal voltage (kV)<br>d) Rated Power Factor<br>e) Reactive Power Capability (MVAR) in the range 0.95 of leading and 0.85 of lagging<br>f) Short Circuit Ratio<br>g) Direct axis Synchronous reactance (% on MVA rating)<br>h) Direct axis Transient reactance (% on rated MVA)<br>i) Direct axis sub-transient reactance (% on rated MVA)<br>j) Auxiliary Power Requirement (MW) |
| iv. | Generator Transformer | a) Type<br>b) Rated Capacity (MVA)<br>c) Voltage Ratio<br>d) HV/LV<br>e) Tap change Range (+% to-%)<br>f) Percentage Impedance (Positive sequence at full load). |

## A.1.3 WIND FARMS

### A.1.3.1 GENERAL

| | | |
|---|---|---|
| i. | Site | Give location map to scale showing roads, railway lines and transmission lines. |
| ii. | Site map (To scale) | Showing proposed Wind Farm area, location of each Wind Turbine, power house etc. |
| iii. | Approximate period of construction. | |

### A.1.3.2 CONNECTION

| | | |
|---|---|---|
| i. | **Connection Point** | Give single line diagram proposed **Connection** with the **Transmission System**. |
| ii. | Step up voltage for **Connection** | kV |

### A.1.3.3 STATION CAPACITY

| | | |
|---|---|---|
| i. | Total **Power Station** capacity (MW) | State whether development be carried out in phases and if so furnish details. |
| ii. | No of units & unit size | MW |

### A.1.3.4 GENERATING UNIT DATA

| | | |
|---|---|---|
| i. | Wind **Generating Plant** | State number of Wind Turbines, type and capacity. |

| | | | |
|---|---|---|---|
| ii. | Wind Turbines | a) | Type<br>(fixed speed/ variable speed);<br>(induction machine, double fed induction machine, synchronous **Generator**);<br>(directly coupled or coupled through inverters) |
| | | b) | Wind Turbine manufacturer |
| | | c) | Rating (MVA) |
| | | d) | Terminal voltage (kV) |
| | | e) | Rated Power Factor |
| | | f) | Reactive Power Capability (MVAR)curve |
| | | g) | Frequency tolerance range |
| | | h) | Rated wind speed (m/s) |
| | | i) | Cut-in wind speed (m/s) |
| | | j) | Cut-off wind speed (m/s) |
| | | k) | Short Circuit Ratio(% on MVA rating) |
| | | l) | Auxiliary Power Requirement (MW) |
| iii. | Generator Transformer | a) | Type |
| | | b) | Rated Capacity (MVA) |
| | | c) | Voltage Ratio HV/LV |
| | | d) | Tap change Range (+% to -%) |
| | | e) | Percentage Impedance (Positive sequence at full load) |

## A.1.4 PV GENERATING PLANTS

### A.1.4.1 GENERAL

| | | |
|---|---|---|
| i. | Site | Give location map to scale showing roads, railway lines and transmission lines. |
| ii. | Site map (To scale) | Showing proposed **PV Generation Plant** area, location of PV panels and general arrangement. |
| iii. | Approximate period of construction. | |

### A.1.4.2 CONNECTION

| | | |
|---|---|---|
| i. | **Connection Point** | Give single line diagram proposed **Connection** with the **Transmission System**. |
| ii. | Step up voltage for **Connection** | kV |

### A.1.4.3 STATION CAPACITY

| | | |
|---|---|---|
| i. | Total **Power Station** capacity (MW) | State whether development be carried out in phases and if so furnish details. |
| ii. | No of units & unit size | MW |

### A.1.4.4 GENERATING UNIT DATA

| | | |
|---|---|---|
| i. | **PV Generating Plant** | State number of solar panels, type and capacity. |
| ii. | PV solar panels | a) Type and technology<br>b) PV panels and inverter manufacturers |

| | | |
|---|---|---|
| | | c) Solar Panels Rating (MWdc)<br>d) Inverters rating (MWac)<br>e) Terminal voltage (kV)<br>f) Rated Power Factor<br>g) Reactive Power Capability (MVAR) curve<br>h) Frequency tolerance range<br>i) Auxiliary Power Requirement (MW) |
| iii. | Generator Transformer | a) Type<br>b) Rated Capacity (MVA)<br>c) Voltage Ratio HV/LV<br>d) Tap change Range (+% to -%)<br>e) Percentage Impedance (Positive sequence at full load) |

## A.2 STANDARD PLANNING DATA (TRANSMISSION)

**Note**: The compilation of the data is the internal matter of the **Licensee**, and as such the **Licensee** shall make arrangements for getting the required data from different Departments of the **Licensee** to update its Standard Planning Data in the format given below:

i. Name of line (Indicating **Power Stations** and substations to be connected).
ii. Voltage of line (kV).
iii. No. of circuits.
iv. Route length (km).
v. Conductor type and sizes.
vi. Line parameters (PU values).
    a. Resistance/km.
    b. Inductance/km.
    c. Susceptance/km (B/2).
vii. Approximate power flow expected MW & MVAR.
viii. Terrain of route - Give information regarding nature of terrain i.e. forest land, fallow land, agricultural and river basin, hill slope etc.
ix. Route map (to Scale) - Furnish to pographical map showing the proposed route showing existing power lines and telecommunication lines.
x. Purpose of **Connection -** Reference to scheme.
xi. Approximate period of Construction.

## A.3 STANDARD PLANNING DATA DISTRIBUTION

### A.3.1 GENERAL

i. Area map (to Scale)- Marking the area in the map for which Distribution License is applied for.
ii. Consumer Data- Furnish categories of consumers, their numbers and connected loads.
iii. Reference to Electrical Divisions presently in charge of the Distribution.

### A.3.2 CONNECTION

i. **Connection Points -** Furnish single line diagram showing **Connection Points**.
ii. Voltage of supply at **Connection Points.**
iii. Names of **Grid** substation feeding the **Connection Points.**

### A.3.3 LINES AND SUBSTATIONS

i. Line data- Furnish lengths of line and voltages within theArea.
ii. Substation data- Furnish details of 33/11 kV substations, 11/0.4 kV substations, capacitor installations.

### A.3.4 LOADS

i. Loads drawn at **Connection Points**.
ii. Details of loads fed at **EHV**, if any. Give name of consumer, voltage of supply, contract demand and name of **Grid** substation from which line is drawn, length of **EHV** line from **Grid** substation to consumer's premises.

## A.3.5 DEMAND DATA (FOR ALL LOADS 5 MW AND ABOVE)

i. Type of load - State whether furnace loads, rolling mills, traction loads, other industrial loads, pumping loads etc.
ii. Rated voltage and phase.
iii. Electrical loading of equipment- State number and size of motors, types of drive and control arrangements.
iv. Sensitivity of load to voltage and frequency of supply.
v. Maximum Harmonic content of load.
vi. Average and maximum Phase unbalance of load.
vii. Nearest substation from which load is to be fed.
viii. Location map (to scale)- Showing location of load with reference to lines and substations in the vicinity.

## A.3.6 LOAD FORECAST DATA

i. Peak load and energy forecast for each category of loads for each of the succeeding 20 years.
ii. Details of methodology and assumptions on which forecasts are based.
iii. If supply is received from more than one Substation, the substation wise break up of peak load and energy projections for each category of loads for each of the succeeding 20 years along with estimated daily load curve.
iv. Details of loads 5 MW and above.
    a. Name of prospective consumer.
    b. Location and nature ofload/ complex.
    c. Substation from which to be fed.
    d. Voltage of supply.
    e. Phasing of load.

**APPENDIX- B**

## B. DETAILED PLANNING DATA

**REFERENCE TO:**
**SECTION 4 SYSTEM PLANNING**
**SECTION 5 CONNECTION CONDITIONS**

### B.1 DETAILED PLANNING DATA (GENERATION) PART 1. FOR ROUTINE SUBMISSION

### B.1.1 THERMAL POWER STATIONS (FOSSIL FUEL)

#### B.1.1.1 GENERAL

i. Name of **Power Station**.
ii. Number and capacity of **Generating Units** (MVA).
iii. Ratings of all major equipments (boilers and major accessories, turbines, alternators, **Generating Unit** transformers etc.).
iv. Single line diagram of **Power Station** and switchyard.
v. Relaying and meteringdiagram.
vi. Neutral Grounding of **Generating Units**.
vii. Excitation control (What type is used? e.g. Thyristor, Fast Brushless?).
viii. Earthing arrangements with earth resistance values.

#### B.1.1.2 PROTECTION AND METERING

i. Full description including settings for all relays and protection systems installed on the **Generating Unit**, **Generating Unit** transformer, auxiliary transformer and electrical motor of major equipment listed, but not limited to above.
ii. Full description including settings for all relays installed on all outgoing feeders from **Power Station** switchyard, tie circuit breakers, incoming circuit breakers.
iii. Full description of inter-tripping of circuit breakers at the point or points of **Connection** with the **Transmission System**.
iv. Most probable fault clearance time for electrical faults on the **User's** system.
v. Full description of operational and commercial metering schemes.

### B.1.1.3 SWITCHYARD

In relation to interconnecting transformers:

i. Rated MVA.
ii. Voltage Ratio.
iii. Vector Group.
iv. Positive sequence reactance for maximum, minimum, normal Tap. (% on MVA).
v. Positive sequence resistance for maximum, minimum, normal Tap. (% on MVA).
vi. Zero sequence reactance. (% on MVA).
vii. Tap changer Range (+% to -%) and steps.
viii. Type of Tap changer. (OFF/ON).

In relation to switchgear including circuit breakers, isolators on all circuits connected to the **Connection Points**:

i. Rated voltage (kV).
ii. Type of circuit breaker (MOCB/ABCB/SF6).
iii. Rated short circuit breaking current (kA) 3phase.
iv. Rated short circuit breaking current (kA) 1phase.
v. Rated short circuit making current (kA) 3phase.
vi. Rated short circuit making current (kA) 1-phase.
vii. Provisions of auto reclosing with details.

Lightning Arresters:

Technical data.

Communication:

Details of equipment installed at **Connection Points**.

Basic Insulation Level (kV):

i. Busbar.
ii. Switchgear.
iii. Transformer bushings.
iv. Transformer windings.

### B.1.1.4 GENERATING UNITS

(a) Parameters of **Generating Units**:

i. Rated terminal voltage (kV).
ii. Rated MVA.
iii. Rated MW.
iv. Inertia constant (MW Sec./MVA)H.
v. Short circuit ratio.
vi. Direct axis Synchronous reactance (% on MVA)$X_d$
vii. Direct axis Transient reactance (% on MVA)$X'_d$
viii. Direct axis sub-transient reactance (% on MVA)$X''_d$
ix. Quadrature axis Synchronous reactance (% on MVA)$X_q$
x. Quadrature axis Transient reactance (% on MVA)$X'_q$
xi. Quadrature axis sub-transient reactance (% on MVA)$X''_q$
xii. Direct axis Transient open circuit time constant (Sec)$T'_{do}$
xiii. Directaxissub-transient open circuit time constant (Sec)$T''_{do}$
xiv. Quadrature axis Transient open circuit time constant (Sec)$T''_{qo}$
xv. Quadrature axis sub-transient open circuit time constant (Sec)$T'_{qo}$
xvi. Stator resistance (Ohm)$R_a$
xvii. Stator leakage reactance (Ohm)$X_l$
xviii. Stator time constant (Sec).
xix. Rated field current (A).
xx. Open circuit saturation characteristic for various terminal giving the compounding current to achieve the same.

(b) Parameters of Excitation Control System:

i. Type of excitation.
ii. Maximum field voltage.
iii. Minimum field voltage.
iv. Rated field voltage.
v. Details of excitation loop in block diagrams showing transfer functions of individual elements using IEEE symbols.
vi. Dynamic characteristics of over-excitation limiter.
vii. Dynamic characteristics of under-excitation limiter.

(c) Parameters of Governor:

i. Governor average gain (MW/Hz).
ii. Speeder motor setting range.
iii. Time constant of steam or fuel governor valve.
iv. Governor valve opening limits.
v. Governor valve rate limits.

vi. Time constant of turbine.
vii. Governor block diagram showing transfer functions of individual elements using IEEE symbols.

(d) Operational Parameters:

i. Minimum notice required to synchronize a **Generating Unit** from de-synchronization.
ii. Minimum time between synchronizing different **Generating Units** in a **Power Station**.
iii. The minimum block load requirements on synchronizing.
iv. Time required for synchronizing a **Generating Unit** for the following conditions:

a) Hot
b) Warm
c) Cold

v. Maximum **Generating Unit** loading rates for the following conditions:

a) Hot
b) Warm
c) Cold

vi. Minimum load without oil support (MW).

## B.1.2 HYDRO-ELECTRIC STATIONS

### B.1.2.1 GENERAL

i. Name of **Power Station**.
ii. No. and capacity of units.(MVA)
iii. Ratings of all major equipment.
   a) Turbines (HP).
   b) **Generators** (MVA).
   c) Generator Transformers (MVA).
   d) Auxiliary Transformers (MVA).

iv. Single line diagram of **Power Station** and switchyard.
v. Relaying and metering diagram.
vi. Neutral grounding of **Generator**.
vii. Excitation control.
viii. Earthing arrangements with earth resistanc evalues.
ix. Reservoir Data.

   a) Salient features
   b) Type of Reservoir
      1. Multi purpose
      2. For Power

   c) Operating Table with
      1. Area capacity curves and
      2. Unit capability at different net heads

   d) Rule Curve.

### B.1.2.2 PROTECTION

i. Full description including settings for all relays and protection systems installed on the **Generating Unit,** generator transformer, auxiliary transformer and electrical motor of major equipment included, but not limited to those listed above.

ii. Full description including settings for all relays installed on all outgoing feeders from **Power Station** switchyard, tie breakers, incoming breakers.

iii. Full description of inter-tripping of breakers at the point or **Connection Points** with the **Transmission System**.

iv. Most probable fault clearance time for electrical faults on the **User's** System.

### B.1.2.3 SWITCHYARD

(a) Interconnecting Transformers:

i. Rated MVA.
ii. Voltage ratio.
iii. Vector group.
iv. Positive sequence reactance for maximum, minimum and normal tap. (% on MVA).
v. Positive sequence resistance for maximum, minimum and normal Tap (% on MVA).
vi. Zero sequence reactance (% on MVA).
vii. Tap changer range (+% to -%) andsteps.
viii. Type of tap changer (OFF/ON).

(b) Switchgear (including circuit breakers, isolators on all circuits connected to the **Connection Points**.)

i. Rated voltage (kV).
ii. Type of Breaker (MOCB/ABCB/SF6).
iii. Rated short circuit breaking current (kA) 3phase.
iv. Rated short circuit breaking current (kA) 1phase.
v. Rated short circuit making current (kA) 3phase.
vi. Rated short circuit making current (kA) 1phase.
vii. Provisions of auto reclosing with details.

(c) Lightning Arresters: Technical data.

(d) Communications:

Details of communications equipment installed at **Connection Points**.

(e) Basic Insulation Level (kV):

i. Busbar.
ii. Switchgear.
iii. Transformer Bushings.
iv. Transformer windings.

### B.1.2.4 GENERATING UNITS

(a) Parameters of **Generator**

i. Rated terminal voltage (kV).
ii. Rated MVA.
iii. Rated MW.
iv. Inertia constant (MW sec/MVA) H.
v. Short circuit ratio.
vi. Direct axis synchronous reactance. (% on MVA) $X_d$
vii. Direct axis transient reactance (% on MVA) $X'_d$.
viii. Direct axis sub-transient reactance (% on MVA) $X''_d$.
ix. Quadrature axis synchronous reactance (% on MVA) $X_q$
x. Quadrature axis transient reactance (% on MVA) $X'_q$
xi. Quadratureaxissub-transientreactance(% on MVA) $X''_q$
xii. Direct axis transient open circuit time constant (sec) $T'_{do}$
xiii. Direct axis sub-transient open circuit time constant (Sec) $T''_{do}$
xiv. Quadrature axis transient open circuit time constant (Sec) $T'_{qo}$
xv. Quadrature axis transient open circuit time constant (Sec) $T''_{qo}$
xvi. Stator Resistance (Ohm) $R_a$
xvii. Stator leakage reactance (Ohm) $X_l$
xviii. Stator time constant(Sec).
xix. Rated Field current(A).
xx. Open Circuit saturation characteristics of the **Generator** for various terminal voltages giving the compounding current to achieve this.
xxi. Type of Turbine.
xxii. Operating Head (Mtr.).
xxiii. Discharge with Full Gate Opening (cusecs).
xxiv. Speed Rise on total Load throw off (%).

(b) Parameters of Excitation Control System: As applicable to thermal **Power Stations**.

(c) Parameters of Governor:

As applicable to thermal **Power Station**.

(d) Operational Parameter:

i. Minimum notice required to synchronize a **Generating Unit** from de-synchronization.
ii. Minimum time between synchronizing different **Generating Units** in a **Power Station**.
iii. Minimum block load requirements on synchronizing.

## B.1.3 VRE GENERATING PLANTS

### B.1.3.1 GENERAL

i. Name of **Power Station**.
ii. No. and capacity of wind turbines. (MVA)
iii. Ratings of all major equipment:
    a) Wind Turbines (MVA) or PV panels (MVA)
    b) Generator Transformers (MVA).
    c) Auxiliary Transformers (MVA).
iv. Single line diagram of **Power Station** and switchyard.
v. Relaying and metering diagram.
vi. Neutral grounding of **Generator**.
vii. Voltage control.
viii. Earthing arrangements with earth resistance values.
ix. Wind Characteristics (for Wind Power plants):
    a) Expected monthly production (MWh)
    b) Average wind and direction (monthly)
    c) Wind Turbine Operating characteristics
        1. Cut-in wind;
        2. Cut-off wind; and
        3. Wind-electrical power curve
x. Characteristics of the PV system (for PV power plants):
    a) Expected monthly production (MWh)
    b) Hourly average irradiation (for each month)
    c) PV system characteristics:
        1. Cut-in irradiation;
        2. Cut-off irradiation; and
        3. Irradiation-electrical power curve.

### B.1.3.2 PROTECTION

i. Full description including settings for all relays and protection systems installed on the **Wind Generating Plant,** generator transformer, auxiliary transformer and electrical motor of major equipment included, but not limited to those listed above.

ii. Full description including settings for all relays installed on all outgoing feeders from **Power Station** switchyard, tie breakers, incoming breakers.

iii. Full description of inter-tripping of breakers at the point or points of **Connection** with the **Transmission System**.

iv. Most probable fault clearance time for electrical faults on the **User's** System.

### B.1.3.3 SWITCHYARD

a) Interconnecting Transformers:

i. Rated MVA.

ii. Voltage ratio.

iii. Vector group.

iv. Positive sequence reactance for maximum, minimum and normal tap (% on MVA).

v. Positive sequence resistance for maximum, minimum and normal Tap (% on MVA).

vi. Zero sequence reactance (% on MVA).

vii. Tap changer range (+% to -%) and steps.

viii. Type of tap changer. (OFF/ON).

b) Switchgear (including circuit breakers, isolators on all circuits connected to the **Connection Points**):

i. Rated voltage (kV).

ii. Type of Breaker (MOCB/ ABCB/ SF6).

iii. Rated short circuit breaking current (kA) 3 phase.

iv. Rated short circuit breaking current (kA) 1 phase.

v. Rated short circuit making current (kA) 3 phase.

vi. Rated short circuit making current (kA) 1 phase.

vii. Provisions of auto reclosing with details.

c) Lightning Arresters:

Technical data.

d) Communications:

Details of communications equipment installed at **Connection Points**.

e) Basic Insulation Level (kV):

i. Busbar.

ii. Switchgear.

iii. Transformer Bushings.

iv. Transformer windings.

### B.1.3.4 VRE GENERATING UNITS

a) Parameters of **Generator**:

i. Rated terminal voltage (kV).

ii. Rated MVA.

iii. Rated MW.

iv. Inertia constant (MWsec/MVA) H. (for wind turbines directly connected)

v. Short circuit ratio.

b) Parameters of the Voltage Control System:

i. Type of control voltage.

ii. Details of the voltage control loop in block diagrams showing transfer functions of individual elements using IEEE symbols.

c) Parameters of the active power control:

i. Governor block diagram showing transfer functions of individual elements using IEEE symbols.

d) Operational Parameter:

i. Minimum notice required to synchronize a **VRE Generating Plant** from de-synchronization.

ii. Minimum block load requirements on synchronizing.

## PART 2. FOR SUBMISSION ON REQUEST BY LICENSEE

### B.1.4 THERMAL POWER STATIONS

#### B.1.4.1 GENERAL

i. Detailed Project Report.
ii. Status Report:
    a. Land.
    b. Fossil Fuel.
    c. Water.
    d. Environmental clearance.
    e. Rehabilitation of displaced persons.

iii. Techno-economic approval by the **Commission**.
iv. Approval of Bangladesh Government
v. Financial Tie-up.

#### B.1.4.2 CONNECTION

i. Reports of Studies for parallel operation with the **Transmission System**:
    a. Short circuit studies.
    b. Stability studies.
    c. Load flow studies.

ii. Proposed **Connection** with **Transmission System**:
    a. Voltage.
    b. Number of circuits.
    c. **Connection Poin**t.

## B.1.5 HYDRO-ELECTRIC POWER STATIONS

### B.1.5.1 GENERAL

i. Detailed Project Report.
ii. Status Report:
    a. Topographical survey.
    b. Geological survey.
    c. Land.
    d. Environmentalclearance.
    e. Rehabilitation of displaced persons.

iii. Techno-economic approval by the **Commission**.
iv. Approval of Bangladesh Government.
v. Financial Tie-up.

### B.1.5.2 CONNECTION

i. Reports of Studies for parallel operation with the **Transmission System**:
    a. Short circuit studies.
    b. Stability studies.
    c. Load flow studies.

ii. Proposed **Connection** with **Transmission System**:
    a. Voltage.
    b. Number of circuits.
    c. **Connection Point**.

### B.1.6 VRE GENERATING STATIONS

#### B.1.6.1 GENERAL

i. Detailed Project Report.
ii. Status Report:
    a. Topographical survey.
    b. Geological survey.
    c. Land.
    d. Environmental clearance.
    e. Rehabilitation of displaced persons.

iii. Techno-economic approval by the **Commission**.
iv. Approval of Bangladesh Government.
v. Financial Tie-up.

#### B.1.6.2 CONNECTION

iii. Reports of Studies for parallel operation with the **Transmission System**:
    a. Short circuit studies.
    b. Stability studies.
    c. Load flow studies.

iv. Proposed **Connection** with **Transmission System**:
    a. Voltage.
    b. Number of circuits.
    c. **Connection Point**.

## B.2 DETAILED SYSTEM DATA, TRANSMISSION

### B.2.1 GENERAL

i. Single line diagram of the **Transmission System** down to 33 kV bus at **Grid** substation detailing:
    a. Name of Substation.
    b. **Power Station**, connected.
    c. Number and length of circuits.
    d. Interconnecting transformers.
    e. Substation bus layouts.
    f. Power transformers.
    g. Reactive compensation equipment.

ii. Substation layout diagrams showing:
    a. Busbar layouts.
    b. Electrical circuitry, lines, cables, transformers, switchgear etc.
    c. Phasing arrangements.
    d. Earthing arrangements.
    e. Switching facilities and interlockingarrangements.
    f. Operating voltages.
    g. Numbering and nomenclature:

        1) Transformers.
        2) Circuits.
        3) Circuit breakers.
        4) Isolating switches.

**B.2.2 LINE PARAMETERS** (For all circuits)

i. Designation of Line.
ii. Length of line (km)
iii. Number of circuits.
iv. Per Circuit values:
    a. Operating voltage (kV).
    b. Positive Phase sequence reactance (pu on 100 MVA)$X_l$
    c. Positive Phase sequence reactance (pu on 100MVA)$R_l$
    d. Positive Phase sequence susceptance (pu on 100 MVA)$B_l$
    e. Zero Phase sequence reactance (pu on 100 MVA)$X_o$
    f. Zero Phase sequence resistance (pu on 100 MVA)$R_o$
    g. Zero Phase sequence susceptance (pu on 100 MVA)$B_o$

**B.2.3 TRANSFORMER PARAMETERS** (For all transformers)

i. Rated MVA.
ii. Voltage Ratio.
iii. Vector Group.
iv. Positive sequence reactance, maximum, minimum and normal (pu on 100 MVA)$X_l$
v. Positive sequence, resistance maximum, minimum and normal (pu on 100 MVA)$R_1$
vi. Zero sequence reactance (pu on 100 MVA).
vii. Tap change range (+% to -%) and steps.
viii. Details of Tap changer.(OFF/ON).

**B.2.4 EQUIPMENT DETAILS** (For all substations)

i. Circuit Breakers
ii. Isolating switches
iii. Current Transformers
iv. Potential Transformers

**B.2.5 RELAYING AND METERING**

i. Relay protection installed for all transformers and feeders along with their settings and level of coordination with other **Users**.
ii. Metering Details.

**B.2.6 SYSTEM STUDIES**

i. Load flow studies (peak and off peak loads).
ii. Transient stability studies for three phase fault in criticallines.
iii. Dynamic Stability Studies
iv. Short circuit studies (three phase and single phase toearth)
v. Transmission and distribution losses in the system**.**

**B.2.7 DEMAND DATA** (For all substations)

i. Demand Profile (Peak and off peak load)

**B.2.8 REACTIVE COMPENSATION EQUIPMENT**

i. Type of equipment (fixed or variable).
ii. Capacities and/ or inductive rating or its operating range in MVAR.
iii. Details of control.
iv. **Connection Point** to the System.

## B.3 DETAILED PLANNING DATA, DISTRIBUTION

### B.3.1 GENERAL

i. Distribution map (To scale) showing all lines up to 33 kV and 33/11 kV substations belonging to the **Distribution Utility**.

ii. Single line diagram of **Distribution System** (showing distribution lines **Connection Points** with the **Transmission System**, 132/33 kV and 33/11 kV substations).

iii. Numbering and nomenclature of lines and substations (Identified with feeding **Grid** substations of the **Transmission System** and concerned 132/33 kV and 33/11 kV substation of **Distribution Utility**).

### B.3.2 CONNECTION

i. **Connection Points** (Furnish details of existing arrangement of **Connection**).

ii. Full description of operational and commercial metering scheme.

### B.3.3 LOADS

i. Connected load - Furnish consumer details, Numbers of consumers category wise, details of loads 1 MW and above.
ii. Information on diversity of load and coincidence factor.
iii. Daily demand profile (current and forecast) on each 132/33 kV and 33/11 kV substation.
iv. Cumulative demand profile of **Distribution System** (current and forecast).

**APPENDIX- C**

## C. OPERATIONAL PLANNING DATA

### C.1 OUTAGE PLANNING DATA
**REFERENCE TO:**
**SECTION 6 OUTAGE PLANNING**

### C.1.1 DEMAND ESTIMATES

| Item | To be Submitted By |
|---|---|
| i. Estimated aggregate annual sales of energy in million units and peak and off peak demand in MW & MVAR at each **Connection Point** for the period from July of current year to June of next year. | 31st March of current year. |
| ii. Estimated aggregate monthly sales of energy in million units and peak and off peak demand in MW & MVAR at each **Connection Point** for the next month. | 15th of current month |
| iii. Hourly demand estimates for the day ahead. | 10.00 Hours every day |

### C.1.2 ESTIMATES OF LOAD SHEDDING

| Item | To be Submitted By |
|---|---|
| i. Details of discrete load blocks that may be shed to comply with instructions issued by the **System Operator** when required, from each **Connection Point.** | Soon after connection is made. |

### C.1.3 YEAR AHEAD OUTAGE PROGRAMME

(For the period July to June)

### C.1.3.1 GENERATORS OUTAGE PROGRAMME

| Item | To be Submitted By |
|---|---|
| i. Identification of **Generating Unit**. | 31st March each year |
| ii. MW which will not be available as a result of **Outage**. | 31st March each year |

| | | |
|---|---|---|
| iii. | Preferred start date and start time or range of start dates and start times and period of **Outage**. | 31st March each year |
| iv. | If outages are required to meet statutory requirements, then the latest date by which **Outage** must be taken. | 31st March each year |

**C.1.3.2 YEAR AHEAD DISTRIBUTION UTILITY'S OUTAGE PROGRAMME**

| **Item** | | **To be Submitted By** |
|---|---|---|
| i. | Loads in MW not available from any **Connection Point.** | 31st March each year |
| ii. | Identification of **Connection Point.** | 31st March each year |
| iii. | Period of suspension of drawal with start date and start time. | 31st March each year |

**C.1.3.3 THE LICENSEE'S OVERALL OUTAGE PROGRAMME**

| **Item** | | **To be Submitted By** |
|---|---|---|
| i. | Report on proposed **Outage** program | 31st April each year |
| ii. | Release of finally agreed **Outage** plan. | 31st May each year |

## C.2 GENERATION SCHEDULING DATA

**REFERENCE TO:**
**SECTION 7 SCHEDULE AND DISPATCH**

| | Item | To be Submitted By |
|---|---|---|
| i. | 36 hour ahead hourly MW & MVAR Declared Available (forecasted in case of **VRE**) Capacity (00.00 - 24.00 Hours) of all **Generator** Units. | 12.00 Hours every day. |
| ii. | Status of **Generating Unit** excitation AVR (or voltage control system) in service (Yes/ No). | 12.00 Hours every day. |
| iii. | Status of **Generating Unit** speed control system. Governor (or active power control system) in service (Yes/ No). | 12.00 Hours every day. |
| iv. | Spinning reserve capability (MW) | 12.00 Hours every day. |
| v. | Backing down capability with/ without oil support (MW) | 12.00 Hours every day. |
| vi. | Hydro reservoir levels and restrictions (rule curve) | 12.00 Hours every day. |
| vii. | **Generating Units** hourly summation outputs (MW) | 12.00 Hours every day |
| viii. | Provisional day after Declared Availability Capacity notification | |

## C.3 CAPABILITY DATA

**REFERENCE TO:**
**SECTION 8 FREQUENCY AND VOLTAGE MANAGEMENT**

| Item | To be Submitted By |
|---|---|
| i. **Generators** shall submit to the **Licensee** up-to-date **Capability Curve**s for all **Generating Units**. | On receipt of request by the **Licensee** |

## C.4 RESPONSE TO FREQUENCY CHANGE

**REFERENCE TO:**
**SECTION 8 FREQUENCY AND VOLTAGE MANAGEMENT**

i. Primary response in MW at different levels of loads ranging from minimum generation to registered capacity for frequency changes resulting in fully opening of governor valve.
ii. Secondary response in MW to frequency changes.

| Item | To be Submitted By |
|---|---|
| i. **Generators** shall provide hourly generation summation to **LDC**. | To be submitted by real time basis |
| ii. Logged readings of **Generators** to **LDC**. | As required |
| iii. Detailed report of **GeneratingUnit** tripping on monthly basis. | In the first week of the succeeding month |

## C.5 ESSENTIAL AND NON-ESSENTIAL LOAD DATA

**REFERENCE TO:**
**SECTION 9 CONTINGENCY PLANNING**

| Item | To be Submitted By |
|---|---|
| i. Schedule of essential and non-essential loads on each discrete load block for purposes of load shedding. | As soon as possible after **Connection** |

**APPENDIX- D**

## D. PROTECTION DATA

**REFERENCE TO:**
**SECTION 12 PROTECTION**

| Item | To be Submitted By |
|---|---|
| i. **Generators** shall submit details of protection requirement and schemes installed by them as referred to in B.1. **Detailed Planning Data** under sub-**Section** "Protection And Metering". | As applicable to **Detailed Planning Data** |
| ii. The **Licensee** shall submit details of protection equipment and schemes installed by them as referred to in B.2. Detailed System Data, Transmission under sub-**Section** "Relaying and Metering" in relation to **Connection** with any **User**. | As applicable to **Detailed Planning Data** |

**APPENDIX- E**

## E. METERING DATA

**REFERENCE TO:**
**SECTION 13 METERING**

| Item | To be Submitted By |
|---|---|
| i. **Generators** shall submit details of metering equipment and schemes installed by them in accordance with **PPA** as referred in B.1. **Detailed Planning Data** under sub-**Section** "Protection and Metering". | As applicable to **Detailed Planning Data** |
| ii. The **Licensee** shall submit details of metering equipment and schemes installed by them as referred in B.2. Detailed System Data, Transmission under sub-**Section** "Relaying and Metering" in relation to **Connection** with any **User**. | As applicable to **Detailed Planning Data** |
| iii. The **Distribution Utilities** shall submit details of metering equipment and schemes installed by them in accordance with **PSA** as referred in B.3. **Detailed Planning Data,** Distribution under sub-**Section** "Relaying and Metering" in relation to Connection with any **User**. | As applicable to **Detailed Planning Data** |

# 17. PERFORMANCE STANDARDS FOR TRANSMISSION

## 17.1 PURPOSE AND SCOPE

### 17.1.1 Purpose

(a) To ensure the quality of electric power in the **Grid**;
(b) To ensure that the **Grid** will be operated in a safe and efficient manner and with a high degree of reliability; and
(c) To specify safety standards for the protection of personnel in the work environment.

### 17.1.2 Scope of Application

This Chapter applies to all **Grid User**s including:

(a) The **Licensee**;
(b) **System Operator**;
(c) **Generators;**
(d) **Distribution Utilities**; and
(e) Any other **Entity** (e.g. owners of HVDC converter, **Bulk Power Conseumers,** large furnaces, etc.) with a **User** System connected to the **Grid**.

## 17.2 POWER QUALITY STANDARDS

### 17.2.1 Power Quality Problems

For the purpose of this Article, Power Quality shall be defined as the quality of the voltage, including its frequency and the resulting current, that are measured in the **Grid** during normal conditions.

A Power Quality problem exists when at least one of the following conditions is present and significantly affects the normal operation of the System:

(a) The System Frequency has deviated from the nominal value of 50 Hz;
(b) Voltage magnitudes are outside their allowable range of variation;
(c) Harmonic Frequencies are present in the System;
(d) There is imbalance in the magnitude of the phase voltages;
(e) The phase displacement between the voltages is not equal to 120 degrees;
(f) Voltage Fluctuations cause Flicker that is outside the allowable Flicker Severity limits; or

(g) High-frequency Over-voltages are present in the **Grid**.

### 17.2.2 Frequency Variations

The nominal fundamental frequency shall be 50 Hz.
The control of System frequency shall be the responsibility of the **System Operator**. The **System Operator** shall maintain the fundamental frequency within the limits of 49.5 Hz and 50.5 Hz during normal conditions.

### 17.2.3 Voltage Variations

For the purpose of this **Section**, Voltage Variation shall be defined as the deviation of the root-mean-square (RMS) value of the voltage from its nominal value, expressed inpercent.Voltage Variation will either be of short duration or long duration.

A Short Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one-half cycle of the power frequency but not exceeding one minute. A Short Duration Voltage Variation is a Voltage Swell if the RMS value of the voltage increases to between 110 percent and 180 percent of the nominal value. A Short Duration Voltage Variation is a Voltage Sag (or Voltage Dip) if the RMS value of the voltage decreases to between 10 percent and 90 percent of the nominal value.

A Long Duration Voltage Variation shall be defined as a variation of the RMS value of the voltage from nominal voltage for a time greater than one minute. A Long Duration Voltage Variation is an Under-voltage if the RMS value of the voltage is less than or equal to 90 percent of the nominal voltage. A Long Duration Voltage Variation is an Overvoltage if the RMS value of the voltage is greater than or equal to 110 percent of the nominal value.

The **Licensee** and the **System Operator** shall ensure that the Long Duration Voltage Variations result in RMS values of the voltages that are greater than 95 percent but less than 105 percent of the nominal voltage at any **Connection Point** during normal conditions.

### 17.2.4 Harmonics

For the purpose of this **Section**, Harmonics shall be defined as sinusoidal voltages and currents having frequencies that are integral multiples of the fundamental frequency. The Total Harmonic Distortion (THD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the fundamental quantity, expressed in percent.

The Total Demand Distortion (TDD) shall be defined as the ratio of the RMS value of the harmonic content to the RMS value of the rated or maximum fundamental quantity, expressed inpercent.

The Total Harmonic Distortion of the voltage and the Total Demand Distortion of the current at any **Connection Point** shall not exceed the limits given in Tables 17-1 and 17-2,

respectively.

Table 17-1 : Maximum Harmonic Distortion Factor

| Harmonic Voltage Distortion | | | |
|---|---|---|---|
| Voltage Level | THD * | Individual | |
| | | Odd | Even |
| 400 kV | 1.5% | 1.0% | 0.5% |
| 132-230 kV | 2.5% | 1.5% | 1.0% |
| 66 kV | 3.0% | 2.0% | 2.0% |

* Total Harmonic Distortion

Table 17-2 : Maximum Harmonic Distortion Factor

| Harmonic Current Distortion | | | |
|---|---|---|---|
| Voltage Level | TDD * | Individual | |
| | | Odd | Even |
| 400 kV | 1.5% | 1.0% | 0.5% |
| 132-230 kV | 2.5% | 2.0% | 0.5% |
| 66 kV | 5.0% | 4.0% | 1.0% |

* Total Demand Distortion

### 17.2.5 Voltage Unbalance

For the purpose of this **Section**, the Negative Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the negative sequence component of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent. For the purpose of this **Section**, the Zero Sequence Unbalance Factor shall be defined as the ratio of the magnitude of the zero sequence component of the voltages to the magnitude of the positive sequence component of the voltages, expressed in percent.

The maximum Negative Sequence Unbalance Factor at the **Connection Point** of any **User** shall not exceed one (1) percent during normal operating conditions.

The maximum Zero Sequence Unbalance Factor at the **Connection Point** of any **User** shall not exceed one (1) percent during normal operating conditions.

### 17.2.6 Voltage Fluctuation and Flicker Severity

For the purpose of this **Section**, Voltage Fluctuations shall be defined as systematic variations of the voltage envelope or random amplitude changes where the RMS value of the voltage is between 90 percent and 110 percent of the nominal voltage.

For the purpose of this **Section**, Flicker shall be defined as the impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time.

In the assessment of the disturbance caused by a Flicker source with a short duty cycle, the Short Term Flicker Severity shall be computed over a 10-minute period.

In the assessment of the disturbance caused by a Flicker source with a long and variable duty cycle, the Long Term Flicker Severity shall be derived from the Short Term Flicker Severity levels.

The Voltage Fluctuation at any **Connection Point** with a fluctuating demand shall not exceed one percent (1%) of the nominal voltage for every step change, which may occur repetitively. Any large Voltage Fluctuation other than a step change may be allowed up to a level of three percent (3%) provided that this does not constitute a risk to the **Grid** or to the System of any **User**.

The Flicker Severity at any **Connection Point** in the **Grid** shall not exceed the values given in Table 17-3.

Table 17-3 : MAXIMUM FLICKER SEVERITY

| | Short Term | Long Term |
|---|---|---|
| 132 kV and above | 0.8 unit | 0.6 unit |
| below 132 kV | 1.0 unit | 0.8 unit |

### 17.2.7 Transient VoltageVariations

For the purpose of this **Section**, Transient Voltages shall be defined as the high- frequency Over-voltages that are generally shorter in duration compared to the Short Duration Voltage Variations.

Infrequent short-duration peaks may be permitted to exceed the levels specified in **Section** 17.2.4 for harmonic distortions provided that such increases do not compromise service to other End-users or cause damage to any **Grid** equipment.

Infrequent short-duration peaks with a maximum value of two (2) percent may be permitted for Voltage Unbalance, subject to the terms of the **Connection Agreement** or Amended

**Connection Agreement**.

## 17.3 RELIABILITY STANDARDS

### 17.3.1 Criteria for Establishing Transmission Reliability Standards

The **Commission** shall impose a uniform system of recording and reporting of **Grid** reliability performance.

The numerical levels of performance (or targets) shall be unique and shall be based initially on the **Grid**'s historical performance.

The **Grid** shall be evaluated annually to compare its actual performance with the targets

.

### 17.3.2 Transmission Reliability Indices

The **Commission** shall prescribe a reliability index that will measure the total number of sustained power interruptions in the **Grid**. Initially the following indices will be applicable:

(a) Availability Factor
(b) AACIR - Average Annual Customer Interruption Rate
(c) MTTR - Mean Time to Repair
(d) MTBF - Mean Time Between Failures.

The **Commission** shall prescribe a reliability index that will measure the total duration of sustained power interruptions in the **Grid**.

After due notice and hearing, the **Commission** may impose other indices that will monitor the reliability performance of the **Grid**.

### 17.3.3 Inclusions and Exclusions of Interruption Events

A power Interruption shall include any Outage in the **Grid** which may be due to the tripping action of protective devices during faults or the failure of transmission lines and/ or power transformers, and which results in the loss of service to a **Grid User** or a group of **Users.**

The following events shall be excluded in the calculation of the reliability indices:

(a) Outages that occur outside the **Grid**;
(b) Outages due to generation deficit;
(c) Planned Outages where the **User**s have been notified at least seven (7) days prior to the loss of power;

(d) Outages that are initiated by the **System Operator** or Market Operator during the occurrence of Significant Incidents or the failure of their facilities;
(e) Outages caused by Adverse Weather or Major Storm Disasters which result in the declaration by the government of a state of calamity; and
(f) Outages due to other events that the **Commission** shall approve after due notice and hearing.

### 17.3.4 Submission of Transmission Reliability Reports and Performance Targets

The **Licensee** and the **System Operator** shall submit every three (3) months the monthly interruption reports using the standard format prescribed by the **Commission**.

The **Commission** shall set the performance targets after due notice and hearing.

## 17.4 SYSTEM LOSS STANDARDS

### 17.4.1 System Loss Classifications

System Loss shall be classified into three categories: Technical Loss, Non-Technical Loss, and Administrative Loss.

The Technical Loss shall be the aggregate of conductor loss, the core and copper loss in transformers, and any loss due to technical metering error.

The Non-Technical Loss shall be the aggregate of the Energy loss due to under billing, meter-reading errors etc..

The Administrative Loss shall include the Energy that is required for the proper operation of the **Grid** such as station use, consumption by auxiliaries, etc..

### 17.4.2 System Loss Cap

The **Commission** shall, after due notice and hearing, prescribe a cap on the System Loss that can be passed on to the **Grid Users.**

## 17.5 SAFETY STANDARDS

### 17.5.1 Safety Compliance

The **Licensee** and the **System Operator** shall develop, operate, and maintain the **Grid** in a safe manner and shall always ensure a safe work environment for their employees. The **Electricity Rules 1937** and revisions thereof govern the safety requirements for electrical installation, operation, and maintenance which covers electrical equipment and associated

work practices employed by the electric utility. Compliance with these **Codes** is mandatory. Hence, the **Licensee** and the **System Operator** shall at all times ensure that all provisions of these safety codes are not violated.

### 17.5.2 Measurement of Performance for Personnel Safety

Following pertinent matters are to be ensured for the measurement of performance for personnel safety that shall be applied to the **Licensee** and the **System Operator**:

(a) Exposure to work injuries shall be measured by the total number of hours of employment of all employees in each establishment or reporting unit.

(b) Employee-hours of exposure for calculating work injury rates are intended to be the actual hours worked. When actual hours are not available, estimated hours may be used.

(c) The Disabling Injury/ Illness Frequency Rate shall be based upon the total number of deaths, permanent total, permanent partial, and temporary total disabilities, which occur during the period covered by the rate. The rate relates those injuries/ illnesses to the employee-hours worked during the period and expresses the number of such injuries in terms of a million man-hour units.

(d) The Disabling Injury/ Illness Severity Rate shall be based on the total of all scheduled charges for all deaths, permanent total, and permanent partial disabilities, plus the total actual days of the disabilities of all temporary total disabilities, which occur during the period covered by the rate. The rate relates these days to the total employee-hours worked during the period and expresses the loss in terms of million man-hour units.

### 17.5.3 Submission of Safety Records and Reports

The **Licensee** and **System Operator** shall submit copies of records and reports to the **Commission**. These shall include the measurement of performance specified in sub-**Section** 17.5.2.

## 17.6 Electric and Magnetic Field (EMF)

The **Licensee** shall calculate the intensity of Electric and Magnetic Field (EMF) at the edge of right of way for different line configuration and operating voltages. The values of Electric Field shall be determined in V/m and that of Magnetic Field in mT (milli-Telsa) or mG (milli-Gauss). Actual intensity shall practically be measured in accordance with IEEE Standard-644 (latest revision) and the finding shall be submitted to the **Commission.** Safety level with respect to human exposure to electromagnetic field shall also be determined and maintained in accordance with IEEE C95.1 thru IEEE C95.6 (2002 or latest revision).

## 17.7 Noise Level

Noise level having its source at **Grid** substations and Noise level around the transmission lines shall be in accordance with the Environmental laws of Bangladesh. International standards shall be followed if boundary conditions are missing in the pertinent laws of the country.

# 18. FINANCIAL STANDARDS

## 18.1 PURPOSE AND SCOPE

### 18.1.1 Purpose

(a) To specify the financial capability standards for the **Entities** listed in sub-**Section** 18.1.2;
(b) To safeguard against the risk of financial non-performance;
(c) To ensure the affordability of electric power supply while maintaining the required quality and reliability; and
(d) To protect the public interest.

### 18.1.2 Scope of Application

This Chapter applies to the **Entities** listed below:

(a) The **Licensee**;
(b) The **System Operator**;
(c) The **Single Buyer;** and
(d) **Distribution Utilities.**

## 18.2 FINANCIAL STANDARDS FOR THE ENTITIES

### 18.2.1 Financial Ratios

The following Financial Ratios shall be used to evaluate the Financial Capability of the **Entity**:

(a) Leverage Ratios;
(b) Liquidity Ratios;
(c) Financial Efficiency Ratios; and
(d) Profitability Ratios.

### 18.2.2 Leverage Ratios

Leverage Ratios for the **Entity** shall include the following:

(a) Debt Ratio;
(b) Debt-Equity Ratio; and
(c) Interest Cover.

The Debt Ratio shall measure the degree of indebtedness of the **Entity**. The Debt Ratio shall be calculated as the ratio of total liabilities to total assets.

The Debt Ratio shall be used to measure the proportion of assets financed by creditors. The risk addressed by the Debt Ratio is the possibility that the **Entity** cannot pay off interest and principal.

The Debt Ratio can also be calculated as the ratio of Long-Term Debt plus Value of Leases to Long-Term Debt plus Value of Leases plus Equity. Equity is the sum of Outstanding Capital Stock, Retained Earnings, and Revaluation Increment.

The Debt-Equity Ratio shall indicate the relationship between long-term funds provided by creditors and those provided by the **Entity**. The Debt-Equity Ratio shall be calculated as the ratio of the sum of Long-Term Debt plus Value of Leases to Equity. Equity shall be the sum of Outstanding Capital Stock, Retained Earnings, and Revaluation Increment.

The Debt-Equity Ratio shall be used to compare the financial commitments of creditors relative to those of the **Entity**.

The Debt-Equity Ratio shall be used as a measure of the degree of financial leverage of the **Entity**.

The Interest Cover shall measure the ability of the **Entity** to service its debts. The Interest Cover shall be computed as the ratio of Earnings Before Interest and Taxes (EBIT) plus Depreciation to Interest plus Principal Payments.

The Interest Cover shall also be used as a measure of financial leverage for the **Entity** that focuses on the extent to which contractual interest and principal payments are covered by earnings before interest and taxes plus depreciation. The Interest Cover is identical to Debt Service Coverage Ratio because principal payments due during the year are included in the denominator of the ratio.

### 18.2.3 Liquidity Ratios

Liquidity Ratios shall include the following:

(a) Current Ratio; and
(b) Quick Ratio.

The Current Ratio shall measure the ability of the **Entity** to meet short-term obligations. The Financial Current Ratio shall be calculated as the ratio of Current Assets including inventories to Current Liabilities. Current Assets shall consist of cash and assets that can readily be turned into cash by the **Entity**. Current Liabilities shall consist of payments that the **Entity** is expected to make in the near future.

The Financial Current Ratio shall be used as a measure of the margin of liquidity of the **Entity**.

The Quick Ratio shall measure the ability of the **Entity** to satisfy its short-term obligations as they become due. The Quick Ratio shall be calculated as the ratio of the sum of Cash, Marketable Securities, and Receivables to the Current Liabilities.

The Quick Ratio shall be used to measure the safety margin for the payment of current debt of the **Entity** if there is shrinkage in the value of cash and receivables.

### 18.2.4 Financial Efficiency Ratios

Financial Efficiency Ratios shall include the following:

(a) Sales-to-Assets Ratio; and
(b) Average Collection Period.

The Sales-to-Assets Ratio shall measure the efficiency with which the **Entity** uses all its assets to generate sales. The Sales-to-Assets Ratio shall be calculated as the ratio of Sales to Average Total Assets. The Average Total Assets shall be determined using the average of the assets at the beginning and end of the year. The higher the Sales-to- Assets Ratio, the more efficiently the **Entity**'s assets have been used.

The Average Collection Period (ACP) shall measure how quickly other entities pay their bills to the **Entity**. The Average Collection Period shall be calculated as the ratio of Average Receivables to Daily Sales. The Average Receivables shall be determined using the average of the receivables at the beginning and end of the year. Daily Sales shall be computed by dividing Annual Sales by 365 days.

The Average Collection Period shall be used to evaluate the credit and collection policies of the **Entity**.

Two computations of the Average Collection Period shall be made:

(a) ACP with government accounts and accounts under litigation;and
(b) ACP without government accounts and accounts under litigation.

### 18.2.5 Profitability Ratios

Profitability Ratios shall include the following: (a) Net Profit Margin; and (b) Return on Assets.

The Net Profit Margin shall measure the productivity of sales effort. The Net Profit Margin shall be calculated as the ratio of Net Profits After Taxes to Sales. The Net Profits After Taxes shall be computed as Earnings Before Interest and Taxes minus Tax (EBIT – Tax). The Average Total Assets shall be computed as the average of the assets at the beginning and end of the year.

The Net Profit Margin shall be used to measure the percentage of sales that remain after all costs and expenses have been deducted.

The Return on Assets shall measure the overall effectiveness of the **Entity** in generating profits from its available assets. The Return on Assets shall be calculated as the ratio of Earnings Before Interest and Taxes minus Tax to the Average Total Assets. The Average Total Assets shall be computed as the average of the assets at the beginning and end of the year.

### 18.2.6 Submission and Evaluation

The **Entity** shall submit to the **Commission** true copies of audited balance sheet and financial statement for the preceding financial year on or before October 15 of the current year.

The **Entity** shall submit to the **Commission** the average power consumption and revenue income for each class of customers for the preceding financial year. This requirement is due on or before September 30 of the current year.

Failure to submit to the **Commission** the requirements shall serve as grounds for the imposition of appropriate sanctions, fines, penalties, or adverse evaluation.

All submissions are to be certified by a duly authorized officer.

## 18.3 UNIFORM SYSTEM OF ACCOUNTS (USOAC)

The **Entity** shall follow the accounting procedures of the **Commission** namely the Uniform System of Accounts (USoAC) in fulfilling the requirements of Financial Standard of Transmission stated in this **Grid Code**.

Anything of the Financial Standard of Transmission contradictory to the provisions/ procedures of the USoAC then the provisions/ system of the later shall prevail.