The Saudi Arabian Grid Code

2nd Electronic Update as of October 2016

Prepared by:
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Table of Contents

Foreword ix

Preface x

List of Abbreviations xii

CHAPTER 1 GENERAL CONDITIONS 1

1.1 Introduction 1

1.2 Objectives 1

1.3 Scope 1

1.4 Grid Code Implementation and Enforcement 2

1.5 Settlement of Disputes 2

1.6 Unforeseen Circumstances 2

1.7 Suspension of Grid Code Provisions 3

1.8 Illegality and Partial Invalidity 3

1.9 Force Majeure 3

1.10 The Grid Code Supervisory Committee (GCSC) 3

1.11 Grid Code Amendment or Derogation Process 5

1.12 Communication between the TSP and Users 7

1.13 Data, Notices, and Confidentiality 8

1.14 Ownership of Plant and/or Apparatus 9

1.15 System Control 9

1.16 Code Interpretation 9
- 1.16.1 **Precedence** 9
- 1.16.2 **Glossary and Definitions** 9
- 1.16.3 **Foreword, Preface, Table of Contents, and Titles** 9
- 1.16.4 **Mandatory Provisions** 9
- 1.16.5 **Plural and Gender** 10
- 1.16.6 **Person or Entity** 10
- 1.16.7 **Amendment of Standards** 10
- 1.16.8 **Figures** 10

CHAPTER 2 CONNECTION CODE 11

2.1 Introduction 11

2.2 Objectives 11

2.3 Grid Connection Procedure 11
2.3.1 **General Provisions** 11
2.3.2 **Grid Impact Studies** 13
2.3.3 **Application for a New, or Modification of an Existing, Connection** 13
2.3.4 **Processing of the Application** 14
2.3.5 **Connection Agreement** 16
2.3.6 **Submittals Prior to the Commissioning Date** 16
2.3.7 **Commissioning of Equipment and Physical Connection to the Grid** 17

2.4 Transmission System Performance 17
2.4.1 **General Provisions** 17
2.4.2 **Frequency Variations** 18
2.4.3 **Voltage Variations** 18
2.4.4 **Harmonic Distortion** 19
2.4.5 **Voltage Unbalance** 19
2.4.6 **Voltage Fluctuation and Flicker Severity** 19
2.4.7 **Transient Voltage Variations** 20
2.4.8 **Grounding** 20

2.5 Plant and Apparatus at Connection Points 20
2.5.1 **General Provisions** 20
2.5.2 **Protection Equipment/Schemes** 21
2.5.3 **Operation and Maintenance Safety Conditions** 23
2.5.4 **Metering** 24
2.5.5 **Requirements for Generators** 24
2.5.6 **Requirements for Distribution Entities and Directly-connected Customers** 32

2.6 System Services 33

2.7 Site Related Conditions 34
2.7.1 **Responsibility for Operation and Maintenance** 34
2.7.2 **Responsibilities for Safety** 34
2.7.3 **Site and Equipment Identification and Labeling** 34
2.7.4 **Connection Point Drawings** 36
2.7.5 **Site Responsibility Schedules** 39
2.7.6 **Access to Sites** 39
2.7.7 **Maintenance Procedures** 39
2.7.8 **Site Operational Procedures** 40

APPENDIX A2.1: Preparation of Site Responsibility Schedules 42
A2.1.1 **Principles** 42
A2.1.2 **Alterations to Existing Site Responsibility Schedules** 43
A2.1.3 **Responsible Managers** 44

CHAPTER 3 PLANNING CODE 46

3.1 Introduction 46

3.2 Objectives 46

3.3 Grid Planning 46
3.3.1 **Grid Planning Responsibility** 46

3.3.2 **Grid Planning Process** 47
3.3.3 **Submission of Grid Planning Data** 47
3.3.4 **Consolidation and Maintenance of Grid Planning Data** 50
3.3.5 **Planning Criteria and Standards** 50
3.3.6 **Grid Planning Studies** 50

APPENDIX A3.1: Standard Planning Data **52**
A3.1.1 **Historical Energy and Demand** 52
A3.1.2 **Energy and Demand Forecast** 52
A3.1.3 **Generating Unit/Station Data** 53
A3.1.4 **User System Data** 54

Appendix A3.2: Detailed Planning Data **58**
A3.2.1 **Generating Unit/Station Data** 58
A3.2.2 **User System Data** 61

CHAPTER 4 OPERATING CODE **63**

4.1 Chapter Overview **63**

4.2 Operational Demand Forecasts **64**
4.2.1 **Introduction** 64
4.2.2 **Definitions** 65
4.2.3 **Objectives** 65
4.2.4 **Data Required by the TSP for Operational Demand Forecasting** 65
4.2.5 **Transmission System Forecasts** 68

4.3 Outage Planning **69**
4.3.1 **Introduction** 69
4.3.2 **Definitions** 70
4.3.3 **Objective** 70
4.3.4 **Planning of Generating Unit Outages** 70
4.3.5 **Planning of Transmission System Outages** 79
4.3.6 **Data Requirements** 82

4.4 System Services **83**
4.4.1 **Introduction** 83
4.4.2 **Objectives** 83
4.4.3 **Frequency Control** 83
4.4.4 **Voltage Control** 85
4.4.5 **System Control** 89
4.4.6 **Operating Margin** 91
4.4.7 **Black Start** 95

4.5 Operational Liaison **96**
4.5.1 **Introduction** 96
4.5.2 **Objectives** 96
4.5.3 **Procedure for Notification of Operations, Events, and Significant Incidents** 97
4.5.4 **Significant Incidents** 97
4.5.5 **Yellow Alert** 97
4.5.6 **Significant Incident Reporting Procedure** 98

4.6 Operational Communication between the TSP and Users **99**
4.6.1 **Introduction** 99
4.6.2 **Objectives** 99
4.6.3 **Contact Locations and their Adequacy** 99

4.6.4 **Communication Systems and Equipment** 100
4.6.5 **Conditions of Monitoring and Recording Equipment** 101
4.6.6 **SCADA Systems** 101

4.7 Contingency Planning 102
4.7.1 **Introduction** 102
4.7.2 **Objective** 102
4.7.3 **Terms and Conditions** 103
4.7.4 **Demand Control** 104
4.7.5 **System Restoration** 105

4.8 Operational Testing 107
4.8.1 **Introduction** 107
4.8.2 **Objective** 107
4.8.3 **Operational Test Request** 108
4.8.4 **Establishing of the Test Group** 108
4.8.5 **Operational Test Program** 110
4.8.6 **Operational Test Report** 111

4.9 Testing to Monitor, Investigate, and Verify Performance 111
4.9.1 **Introduction** 111
4.9.2 **Objective** 111
4.9.3 **Monitoring** 111
4.9.4 **Investigation** 112
4.9.5 **Testing to Verify Performance** 112
4.9.6 **Commissioning Tests** 113
4.9.7 **Generating Unit Capability Tests** 114

4.10 Cross-boundary Safety Assurance 117
4.10.1 **Introduction** 117
4.10.2 **Objective** 117
4.10.3 **The Safety Rules** 117
4.10.4 **Safety at the Connection Point** 117
4.10.5 **Logs of Cross-Boundary Safety Precautions** 118
4.10.6 **Forms for Cross-Boundary Safety Precautions** 119
4.10.7 **Approval of Local Safety Instructions** 119
4.10.8 **Safety Representatives** 119
4.10.9 **Coordination on Safety Matters** 120

CHAPTER 5 SCHEDULING AND DISPATCH CODE 124

5.1 Introduction 124

5.2 Objective 124

5.3 Generation Scheduling 124
5.3.1 **Scheduling Process** 124
5.3.2 **Generator Declarations** 125
5.3.3 **Scheduling and Dispatch Parameters** 126
5.3.4 **Generator Nominations** 126
5.3.5 **Communication of Declarations and Nominations** 126
5.3.6 **The Generation Schedule** 127
5.3.7 **Issuance of Generation Schedule** 131
5.3.8 **Negative Minimum Demand Regulation (NMDR)** 131
5.3.9 **Inadequate Operating Margin** 132

5.4 Generation Dispatch 132
5.4.1 **General Provisions** 132
5.4.2 **Dispatch Instructions to Generators** 133
5.4.3 **Generation Synchronizing and Desynchronizing Times** 134
5.4.4 **Dispatch of Active Power** 135
5.4.5 **Dispatch of Reactive Power** 135
5.4.6 **Additional Dispatch Instructions** 137
5.4.7 **System Emergency Conditions** 137
5.4.8 **Generating Unit/Station Parameter Changes** 138
5.4.9 **Automatic Reactive Power or Automatic Voltage Control System Mode of Operation** 138
5.4.10 **Dispatch Instructions for Distribution Entities and Directly-connected Customers** 139
5.4.11 **Nature of Dispatch Instructions** 139

APPENDIX A5.1: Generating Block/Unit Declaration 143
A5.1.1 **Availability Notice** 143
A5.1.2 **Scheduling and Dispatch Parameters** 143

CHAPTER 6 144

DATA AND INFORMATION EXCHANGE CODE 144

6.1 Introduction 144

6.2 Objective 144

6.3 Data and Information Categories and Registration 145

6.4 Procedure and Obligations 145

6.5 Data and Information Submissions 146

6.6 Data and Information to be Registered 147

SCHEDULE FORMS 149
Schedule 1: Generating Unit Technical Data 150
Schedule 2: Generating Unit/Station Outage Data 158
Schedule 3: Generation Operation Schedule Data 159
Schedule 4: Generation Operational Planning Data 160
Schedule 5: User System Data 161
Schedule 6: Connection Point Data 165
Schedule 7: Demand Control Data 166
Schedule 8: Scheduling and Dispatch Data 167
Schedule 9: User System Load Characteristics 169
Schedule 10: Fault Infeed Data 170
Schedule 11: 171
User Demand Profiles and Active Energy Data 171
Schedule 12: Data Supplied by the TSP to Users 173

CHAPTER 7 METERING CODE 174

7.1 Introduction 174

7.2 Objective 174

7.3 Metering Responsibility 174

7.4 Metering Equipment 175

7.5 Metering Point 175

7.6 Metering Parameters 176

7.7 Metering Data Storage and Availability 176

7.8 Metering Equipment Standards 178

7.9 Testing and Inspection of Metering Installations 180

7.10 Main and Check Metering 181

7.11 Timekeeping 181

7.12 Metering Access and Sealing 182

7.13 Damage, Tampering, or Unauthorized Interference with Metering Equipment 183

7.14 Repair and Maintenance of Metering Equipment 183

7.15 Approval, Certification, and Testing of Metering Equipment 184

7.16 Meter Reconciliation 184

Glossary and Definitions 186

Chronology of Saudi Arabian Grid Code Revisions 211

Table of Figures:

No.	Figure No.	Title	Page No.
1	Figure 1.1.	Grid Code Amendment/Derogation Process	6
2	Figure 2.1.	P-Q Diagram	24
3	Figure 2.2	Maximum Output Power Reduction Diagram	25
4	Figure 2.3.	Voltage Withstand Capability Diagram	30
5	Figure 2.4.	Procedure for Connection to the Grid	41
6	Figure 4.1.	Description and time flow of various operational planning phases	66
7	Figure 4.2.	Program horizon for Generating Unit Outages	71
8	Figure 4.3.	Program Horizon for Transmission System Outages	79
9	Figure 5.1	Overview of Generation Scheduling Process	140
10	Figure 5.2	Overview of the Dispatch Process	141

List of Tables:

No.	Reference No.	Title	Page No.
1	Subsection 2.4.2	Frequency Variations	18
2	Subsection 2.4.3	Voltage Variations	19
3	Clause 2.5.2.6	Fault Clearance Times	21
4	Table A2.1.	Pro Forma for Site Responsibility Schedule	45
5	Subsection 6.6.3	Applicability of Schedules to each Category of Users	148

Foreword

This is the second electronic update of the Saudi Arabian Grid Code as of October 2016. This SAGC update includes Amendment No. 15A068. Now, there are a total of thirty one (31) approved amendments from SAGC's first issuance.

The Saudi Arabian Grid Code will continue to be a live working document. ECRA is the final authority in approving the proposed amendments based on recommendations submitted by the Grid Code Supervisory Committee. As a user of this Grid Code, it is your responsibility to ensure that you acquire the most up to date issue of the Grid Code which can be downloaded from ECRA's website **WWW.ECRA.GOV.SA**.

This Foreword is provided to Users and to prospective Users for their information only and does not constitute as part of the Grid Code.

Preface

The Saudi Arabian Grid Code has been developed to define the rules and regulations for various Participants for accessing and using the Transmission System of the National Grid $_{SA}$, a wholly-owned subsidiary of the Saudi Electricity Company. The Code has already established in the first issue the obligations of the National Grid $_{SA}$ and other Grid Users—Generators, Distribution Entities, and Directly-connected Customers—for accessing and using the Grid, in specific to: (i) define obligations, responsibilities, and accountabilities of all the parties towards ensuring open, transparent, non-discriminatory, and economic access and use of the Grid while maintaining its safe, reliable, and efficient operation; (ii) define minimum technical requirements for the Participants; and (iii) set out the information exchange obligations of the Participants.

Through its 7 chapters, the Saudi Arabian Grid Code attempts to cover matters such as defining of technical, design, and operational criteria for Grid access and use, planning for Grid development and reinforcement, System operation criteria and standards, Scheduling and Dispatch of supply and demand resources, exchange of data and information, and metering policies and systems to account for the Power and Energy transactions in the Grid.

Chapter 1, General Conditions, contains provisions which are of general nature and apply to all sections of the Grid Code. Their objective is to ensure that the various sections of the Grid Code work collectively and in harmony with each other for the benefit of all Participants.

Chapter 2, Connection Code, specifies basic principles and establishes a set of technical, design, and operational conditions for the Users for connecting to and using the Grid. It also contains information about the performance characteristics of the Transmission System at the Connection Point to enable the Users to design their own facilities and schemes accordingly.

Chapter 3, Planning Code, provides a framework for enabling the TSP and Users to interact in relation to planning and development of the Transmission System and also specifies the data and information that they have to exchange with each other for this purpose.

Chapter 4, Operating Code, covers a host of topics relating to proper operation of the Grid such as operational demand forecasting, Generation and Transmission maintenance planning, providing and managing of system support services, operational liaison between the TSP and Users and coordination of Safety, planning for and dealing with system contingencies, and organizing and conducting of various tests.

Chapter 5, Scheduling and Dispatch Code, specifies the responsibilities and obligations of the TSP and Users with respect to Scheduling and Dispatch of Generating Units and demand resources and sets out the procedure for supplying of timely and accurate information by the Users to the TSP, the TSP's preparing and issuing of Generation Schedules, and issuing of Dispatch Instructions.

Chapter 6, Data and Information Exchange Code, sets out the obligations and responsibilities of the TSP and Users in relation to the supply of data and information to each other, and also lists the various categories of data and information to be exchanged between the TSP and the Users.

Chapter 7, Metering Code, deals with metering and recording requirements for Participants and clarifies on their obligations relating to such installations. It also sets the minimum technical, design and operational criteria to be complied with by Grid Participants relating to metering and data collection Equipment and installations.

The Glossary and Definitions at the end provides brief definitions and explanation of the various terms that have been used in the various parts of the Grid Code. These terms appear in the Grid Code with their initial letters in uppercase.

The provisions of the Grid Code have been organized using an hierarchical list style numbering system. For instance, the provision numbered as 3.5.2.1, represents clause number 1 of Chapter 3, section 5, and subsection 2. Similarly, the provision numbered as 4.5.3.2 represents clause number 2 of Chapter 4, section 5, and subsection 3.

List of Abbreviations

A	ampere
AC	alternating current
ANSI	American National Standards Institute
AVR	Automatic Voltage Regulator
CT	Current Transformer
DC	direct current
DPD	Detailed Planning Data
(E)HV	(Extra) High Voltage
GCSC	Grid Code Supervisory Committee
HV	High Voltage
Hz	hertz
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ITU	International Telecommunication Union
kA	kilo ampere
KA-CARE	King Abdullah City for Atomic and Renewable Energy
kV	kilo volt
kvar	kilo var
kW	kilo watt
kWh	kilo watt hour
kvarh	kilo var hour
LV	Low Voltage
min	minute
MVA	mega volt ampere
Mvar	mega var
Mvarh	mega var hour
MW	mega watt
MWh	mega watt hour
NIOM	Notification of Inadequate Operating Margin
NMDR	Negative Minimum Demand Regulation
OD	Operational Data
P_{lt}	Flicker Severity Index (Long-term)
P_{st}	Flicker Severity Index (Short-term)
PPM	Power Park Module
PSS	Power System Stabilizer
PSS/E	Power System Simulator/Engineering
PTI	Power Technologies International
RMS	root mean square
RPM	revolutions per minute
RRG	Renewable Resource Generation
RTU	remote terminal unit
s	second
SCADA	supervisory control and data acquisition
SGU	Synchronous Generating Unit
SPD	Standard Planning Data
SRG	Sustainable Resource Generation
STPM	Short Term Planned Maintenance
TSP	Transmission Service Provider
U	Generating Unit
V	volt
VA	volt ampere

var	volt ampere reactive
VT	Voltage Transformer
W	watt
Wh	watt hour

CHAPTER 1 GENERAL CONDITIONS

1.1 Introduction

This chapter contains provisions which are of general nature and apply to all sections of the Grid Code. Their objective is to ensure, to the maximum possible extent, that the various sections of the Grid Code work collectively and in harmony with each other for the benefit of all Participants.

1.2 Objectives

The specific objectives of General Conditions are the following:

(i) clarify on the legal and regulatory framework for implementing and enforcing of the Grid Code;

(ii) specify the purpose, functions, and composition of the Grid Code Supervisory Committee (GCSC);

(iii) describe the framework for making amendments to the Grid Code and for seeking Derogations from its provisions;

(iv) define general rules regarding the communication between the TSP and Users and exchange of data and information between them; and

(v) specify the general rules for interpreting the provisions of the Grid Code.

1.3 Scope

1.3.1 The Grid Code applies to the TSP and to all Users of the Grid, including all persons/parties to whom any individual section of the Grid Code applies. In specific the following:

(i) The Transmission Service Provider (TSP);

(ii) Generators;

(iii) Distribution Entities; and

(iv) Directly-connected Customers.

1.3.2 The provisions under this Code apply to Users seeking new Connection, or modification of an existing Connection, to the Transmission System. Users currently connected to the Transmission System may have been designed to different standards and, therefore, may not be able to comply in whole or in

part with some or all of these conditions. Such Users should seek Derogation by following the procedure set out in (1.11).

1.4 Grid Code Implementation and Enforcement

1.4.1 The TSP shall be responsible for the Grid Code implementation and enforcement.

1.4.2 For the above purposes, the TSP may need access to the services and facilities of Users or to issue instructions to Users in order to implement and enforce the Grid Code (for example, to isolate or disconnect Plant or Apparatus, etc.). All Users, therefore, are required not only to abide by the letter and spirit of the Grid Code, but also to provide the TSP with such rights of access, services and facilities and to comply with such instructions as the TSP may reasonably require to implement and enforce the Grid Code.

1.4.3 Each party shall, at all times in its dealings with the other parties to the Grid Code, act in good faith and in accordance with the established Good Industry Practices.

1.5 Settlement of Disputes

In case of a dispute between the TSP and a User about any provision of the Grid Code or any issue relating to that provision, the TSP and the User shall first try to settle it bilaterally by making all reasonable endeavors for resolving the dispute. If they cannot resolve the dispute bilaterally, the dispute parties will proceed to deal with the dispute according to the procedure prescribed for this purpose in the Electricity Law or guidelines issued by the Regulator.

1.6 Unforeseen Circumstances

If circumstances arise which the provisions of the Grid Code have not foreseen, the TSP shall, to the extent practicable, consult all Affected Users in an effort to muster consensus on the action required. If agreement between the TSP and such Users cannot be reached in the time available, the TSP shall determine the best course of action. Each User shall comply with all instructions given to it by the TSP following such a determination provided that the instructions are consistent with the then current technical parameters of the relevant User’s System registered under the Grid Code. The TSP shall, as soon as reasonably practicable following the occurrence of the unforeseen

circumstance(s), notify all relevant details thereof to the GCSC for consideration as laid down in (1.10).

1.7 Suspension of Grid Code Provisions

The provisions (in part or in whole) of the Grid Code may be suspended under abnormal conditions or pursuant to any directions given by the Regulator or the Government.

1.8 Illegality and Partial Invalidity

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

1.9 Force Majeure

1.9.1 A Participant shall not be considered to be in Default with respect to that Participant's obligation(s) under the Grid Code, other than the obligation to pay money when due, if that Participant is prevented from fulfilling its obligation(s) by Force Majeure. The defaulting Participant shall give notice and the full particulars of such Force Majeure to the other concerned party (or parties) in writing or by telephone as soon as reasonably possible after the occurrence of the Force Majeure. Telephone notices given shall be confirmed in writing as soon as reasonably possible and shall specifically state full particulars of the Force Majeure, the time and date when the Force Majeure occurred, and when the Force Majeure is reasonably expected to cease. The Participant affected shall, however, exercise due diligence and all necessary efforts to remove such disability and fulfill its obligations under the Grid Code.

1.9.2 Mere economic hardship shall not be considered Force Majeure. Acts of negligence or wrongdoings shall also be excluded from Force Majeure.

1.10 The Grid Code Supervisory Committee (GCSC)

1.10.1 The TSP shall constitute and host the Grid Code Supervisory Committee (GCSC) in accordance with the guidelines of the Regulator. The GCSC shall be a standing body carrying out the functions referred to in (1.10.2) below.

1.10.2 The GCSC shall:

(i) keep the Grid Code and its working under review;

(ii) review all suggestions for amendments to the Grid Code which the Regulator or any Participant may submit to the GCSC for consideration from time to time or the GCSC initiates at its own;

(iii) make recommendations to the Regulator for amendments to the Grid Code which the GCSC feels are necessary or desirable and record the reasons for the recommendations;

(iv) issue guidance in relation to the Grid Code and its implementation, performance, and interpretation upon the reasonable request of any Participant;

(v) consider what changes are necessary to the Grid Code arising out of any unforeseen circumstances referred to it by the TSP under (1.6); and

(vi) review and make recommendation to the Regulator for final decision on any request that a Grid Participant submits to the GCSC to seek Derogation from any provision(s) of the Grid Code.

1.10.3 The GCSC shall be a stakeholder representative committee and shall consist of the following members:

(i) a Chairman and three (3) persons appointed by the TSP;

(ii) a person appointed by the Regulator;

(iii) two (2) persons representing Generators each having Generating Station with a total Registered Capacity exceeding 500 MW;

(iv) one person representing Generators each having Generating Station with a total Registered Capacity 500 MW or less;

(v) one person representing each Distribution Entity in the Kingdom of Saudi Arabia, in total four (4);

(vi) one person to represent Directly-connected Customers; and

(vii) one person to represent King Abdullah City for Atomic and Renewable Energy (KACARE).

1.10.4 The GCSC shall establish and comply at all times with its own rules and procedures relating to the conduct of its business, which shall be approved by the Regulator and published by the GCSC within three (3) months of the formation of the GCSC.

1.10.5 The TSP shall provide administrative and logistic support to the GCSC for the GCSC's functioning by establishing the Grid Code Secretariat. This decision may be reviewed by the Regulator. The Secretariat shall be accountable to the Regulator as well as to the GCSC for its activities. The detailed functions

and responsibilities, administrative structure, and modes of operation of the Secretariat will be further elaborated by the GCSC in its rules and procedure as laid down in (1.10.4) above.

1.11 Grid Code Amendment or Derogation Process

1.11.1 The Regulator is the approving authority for the Grid Code, as well as for making amendments to it and for granting any Derogation from its provisions. For approving any request for amendment or Derogation, the Regulator will be guided by the GCSC recommendations on the relevant matter.

1.11.2 Any Participant, GCSC member, or the Regulator itself may propose amendments to the Grid Code.

1.11.3 Any Participant can seek Derogation from complying with one or more provisions of the Grid Code. The Derogation may be granted by the Regulator on the following grounds:

(i) to provide for existing Plant and/or Apparatus that has not been designed in accordance with the provisions of the Grid Code;

(ii) to facilitate a smooth transition to the Grid Code from the existing situation; and/or

(iii) to ease temporary constraints that prevent compliance and necessitate exemption.

1.11.4 A Participant seeking Derogation shall make a written request to the GCSC and shall be required to justify the request in terms of both the specific circumstances and the expected duration. As a minimum, the application must include the following information:

(i) detail of the applicant;

(ii) relevant provision(s) of the Grid Code and the required performance;

(iii) a description of the relevant Plant and/or Apparatus and the nature and extent of non-compliance;

(iv) a description of the proposal for restoring compliance (where applicable) including details of actions to mitigate risks and restore compliance including timetable;

(v) a description of the reasonable alternative actions that have been considered; and

(vi) a statement of the expected duration of the non-compliance.

1.11.5 The process for seeking amendments to the Grid Code or seeking Derogation from its provisions is depicted in Figure 1.1.

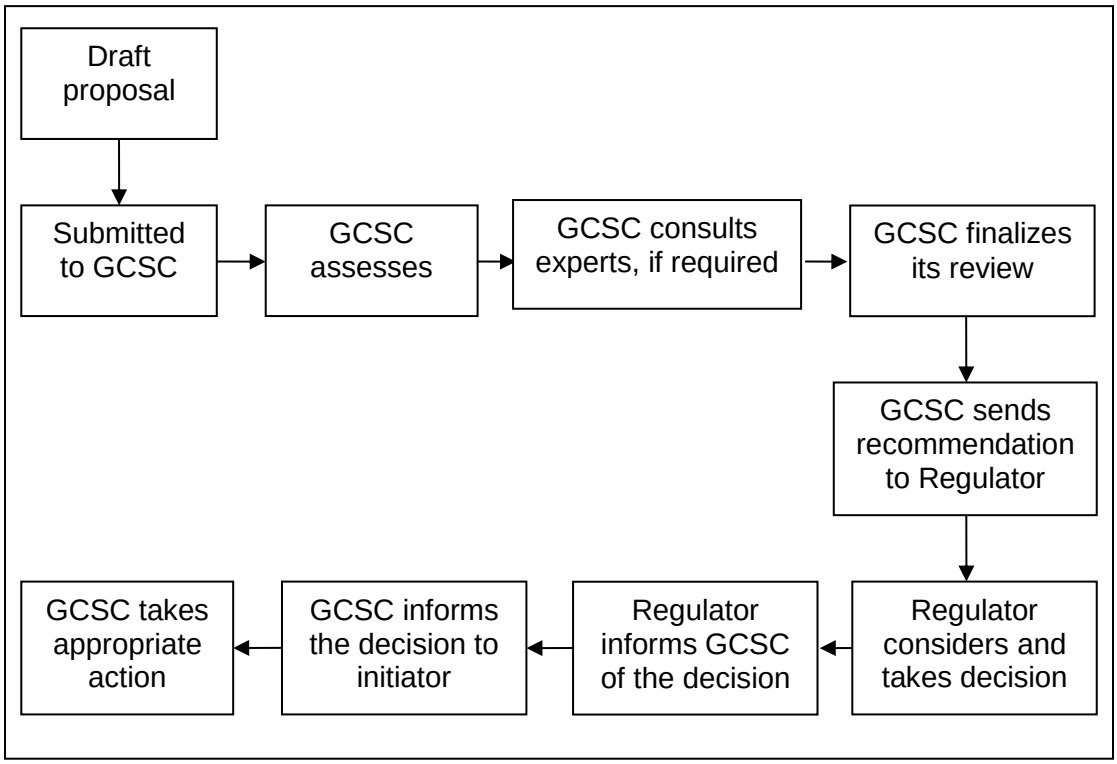

Figure 1.1. Grid Code Amendment/Derogation Process

1.11.6 On receipt of any request for Grid Code amendment or Derogation, the GCSC shall promptly consider such request (by seeking expert advice/opinion on the request, if necessary) and submit its recommendation(s) to the Regulator for a final decision.

1.11.7 The Regulator shall consider the request in light of the recommendation(s) of the GCSC, and shall decide as appropriate. In deciding on the request, the Regulator may invite the relevant Participant or any member of the GCSC to seek clarification on the request.

1.11.8 The Regulator shall communicate its final decision to GCSC for informing the relevant Participant and/or for taking further action, as appropriate.

1.11.9 If a Derogation is granted, then the relevant Participant will not be obliged to comply with the applicable provision of the Grid Code (to the extent and for the period of the Derogation) and shall comply with any alternate provision as set forth in the Derogation.

1.11.10 A Derogation from the Grid Code will normally have an expiry date in order to review its continued need and monitor performance towards compliance.

1.11.11 Every Derogation will be entered on a register maintained by the Regulator for this purpose.

1.11.12 A Derogation granted to a Participant shall be non-transferable. Therefore, if a non-compliant Plant or system is sold, the new Participant will need to seek a fresh Derogation.

1.11.13 Where a material change in circumstances has occurred, a review of any existing Derogation, and any Derogation under consideration, may be initiated by the Regulator at its own or at the request of any Participant.

1.12 Communication between the TSP and Users

1.12.1 Unless otherwise specified in the Grid Code, all instructions given by the TSP and communications (other than those relating to the submission of data and notices) between the TSP and Users (other than Generators) shall take place between the TSP Control Engineer based at the TSP Control Center notified by the TSP to each User prior to Connection and the relevant User's Responsible Engineer at the User's Control Center notified by the User to the TSP prior to Connection or such other person as the TSP or the User (as the case may be) may, from time to time, notify to the other for such purposes.

1.12.2 Unless otherwise specified in the Grid Code, all instructions given by the TSP and communications (other than those relating to the submission of data and notices) between the TSP and a Generator shall take place between the TSP Control Engineer based at the TSP Control Center notified by the TSP to each Generator prior to Connection and the Generator's Responsible Engineer at the Generator's Control Center notified by the Generator to the TSP prior to Connection or such other person as the TSP or the Generator (as the case may be) may from time to time notify to the other for such purposes.

1.12.3 Unless otherwise specified in the Grid Code, all instructions given by the TSP and communications (other than those relating to the submission of data and notices) between the TSP and Users will be by telephone, fax, or any other acceptable electronic means, with a facility to record messages permanently.

1.12.4 Where instructions or communications are given under the Grid Code by means of a communications system with a facility to record (by whatever means) messages permanently and without access to erase or modify the recorded instructions and communications, such recording (to be retained for at least one [1] year) shall be accepted by the TSP and Users as evidence of those instructions or communications.

1.13 Data, Notices, and Confidentiality

1.13.1 All data and Notices required under the Grid Code (other than data which is the subject of a specific requirement of the Grid Code as to the manner of its delivery) shall be submitted electronically or through any other suitable means agreed upon by the concerned parties. Written notices under the Grid Code shall be served either by hand delivery, registered first-class pre-paid mail, courier service, or facsimile to the TSP or the User, as the case may be.

1.13.2 All data submitted by a User to the TSP, prior to Connection or before the TSP's making an Offer of Connection, in compliance with the Grid Code provisions shall be treated as confidential.

1.13.3 Appropriate data shall be made available by the TSP when requested by a User. These data shall be used only for the purpose specified in the request and shall be treated by the User as confidential.

1.13.4 Data delivered pursuant to paragraph (1.13.1) shall:

(i) in the case of data to be submitted by a User prior to the Connection of its Plant and/or Apparatus to the Transmission System, in relation to that Plant and/or Apparatus, be addressed to Manager, Network Planning Department, at the address notified by the TSP to the User following receipt of an application for Connection to the Transmission System, or to such other department within the TSP or address as the TSP may notify to the User from time to time; and

(ii) in the case of data to be submitted by a User in respect of Plant and/or Apparatus already connected to the Transmission System, be addressed to Manager, Network Planning Department, at the address notified by the TSP to the User prior to Connection to the Transmission System, or to such other department within the TSP or address as the TSP may notify to the User from time to time.

1.13.5 Notices submitted to Users shall be addressed to such person as may be notified in writing to the TSP from time to time by the relevant User at its address(es) notified by the User to the TSP in writing from time to time for submission of data and service of Notices under the Grid Code (or failing which to the registered or principal office of the User).

1.13.6 All data items, where relevant, will be referenced to nominal voltage and frequency unless otherwise stated.

1.14 Ownership of Plant and/or Apparatus

References in the Grid Code to Plant and/or Apparatus of a User shall include Plant and/or Apparatus owned by a User and Plant and/or Apparatus used by a User under any agreement with a third party.

1.15 System Control

Where a User System (or part thereof) is, by agreement, under the control of the TSP for the purpose of communication and coordination in operational matters, the TSP can (for those purposes only) treat that User System (or part thereof) as part of the TSP System, but otherwise, it shall remain to be treated as the User System (or part thereof). This will also include any User System or facility used by the TSP as part of the TSP's Transmission path.

1.16 Code Interpretation

1.16.1 Precedence

In the event of any conflict between the provisions of the Grid Code and any contract or agreement between the TSP and a User, the provisions of the Grid Code shall govern, unless the Grid Code expressly provides otherwise.

1.16.2 Glossary and Definitions

When a word or phrase that is defined specifically and in detailed manner in the Glossary and Definitions is more particularly defined in another chapter, section, or sub-section of the Grid Code, the particular definition in that chapter, section, or sub-section shall prevail if there is any discrepancy. Such discrepancies, when noticed, will be brought to the notice of the GCSC and will be removed during the next revising of the Grid Code.

1.16.3 Foreword, Preface, Table of Contents, and Titles

The Foreword, Preface, Table of Contents, and Titles have been added for the information and convenience of the users of the Grid Code. These, therefore, shall not be considered in interpreting the provisions of the Grid Code.

1.16.4 Mandatory Provisions

The word "shall" refers to a rule, procedure, requirement, or any other provision of the Grid Code that requires mandatory compliance.

1.16.5 Plural and Gender

In interpreting any provision of the Grid Code:

(i) the singular shall include the plural and *vice versa*, unless otherwise specified; and

(ii) one gender shall include all genders.

1.16.6 Person or Entity

Any reference to a person or entity shall include an individual, partnership, company, corporation, association, organization, institution, or other similar groups.

1.16.7 Amendment of Standards

A reference to a standard in the Grid Code shall include any variation, revision, update, or replacement of that standard.

1.16.8 Figures

Figures are provided in some sections of the Grid Code for the convenience of the Users, and only to illustrate a process. In case of any discrepancy between the text and figures regarding any provision of the Grid Code, the text shall prevail. Such discrepancies, when noticed, will be brought to the notice of the GCSC and will be removed during the next revising of the Grid Code.

CHAPTER 2 CONNECTION CODE

2.1 Introduction

2.1.1 This chapter specifies certain principles and establishes a set of minimum technical, design, and operational conditions for the Users for connecting to and using the Transmission System. The purpose is to protect the TSP facilities as well as the Plant and Apparatus of the Users, and to ensure safe, stable, and secure operation of the System. This chapter also provides detail on the performance characteristics of the Transmission System at the Connection Point to enable the Users to design their own facilities accordingly and to provide suitable control and Protection Schemes for them.

2.1.2 In addition to this Connection Code, there may be additional provisions in the individual Connection Agreements between the TSP and the Users, defining, in greater detail and in more specific terms, the mutual obligations of each party.

2.2 Objectives

The objectives of this chapter are the following:

(i) to provide a set of fair and non-discriminatory basic rules and standards for accessing and using the Transmission System which must be complied with by all Users;

(ii) to specify the normal Transmission System performance standards at the Connection Point;

(iii) to specify the technical design and operational criteria at the Connection Point; and

(iv) to clearly define the technical function, operational criteria, and ownership of the Equipment connected to the Transmission System in accordance with the relevant Site Responsibility Schedule.

2.3 Grid Connection Procedure

2.3.1 General Provisions

2.3.1.1 A User seeking a new, or modification of an existing, Connection, to the Grid shall secure a proper Connection Agreement with the TSP by following the

procedure specified in this section, prior to the actual Connection to the Grid. This procedure is depicted in Figure 2.3 on page (40).

2.3.1.2 The TSP shall establish the procedures for the processing of User applications for new, or modification of an existing, Connection to the Grid. The TSP will also set out the time for Connection after receiving all the required information from the applicant.

2.3.1.3 The time periods for a User's new, or modification of an existing, Connection shall be negotiated and agreed upon upfront, between the TSP and the User, in every case. Users will be connected to the Transmission System based on Grid Impact Studies.

2.3.1.4 The conditions under this section apply to Users seeking new Connections to the Transmission System. Users currently connected to the Transmission System may have been designed to different standards and, therefore, may not be able to comply in whole or in part with some or all of these conditions. Such Users should seek Derogations in accordance with the provisions of (1.11) of Chapter 1: General Conditions. However, these conditions shall be applied to Users if new installations or modifications (e.g. in the Excitation System, etc.) are introduced on the User Site.

2.3.1.5 All Plant and Apparatus at the Connection Point shall comply with the relevant TSP standards, or in their absence, other IEC, ANSI, or IEEE standards, unless modified by any provision in the applicable Connection Agreement.

2.3.1.6 The Transmission System voltage level at which a User will be connected and the Busbar configuration which a User's System uses will depend upon, but not limited to, the following:

(i) the size of the Generating Units and the number of Generating Units comprised in the User System (for Generators);

(ii) the size of the MW Demand at the Connection Point (for Distribution Entities and Directly-connected Customers);

(iii) consistency with future development of the Transmission System as well as the coordinated planning of the Transmission System and of the Distribution System/User System;

(iv) proximity to the existing Transmission System; and

(v) the cost of the proposed Connection.

2.3.1.7 The method of Connection used may exceed the relevant standards where this is required by the User and is acceptable to the TSP.

2.3.1.8 The TSP shall deliver or take electric Energy at the Connection Point and shall not be responsible in any manner whatsoever beyond that point.

2.3.1.9 In case of a dispute, the TSP shall try first to settle it bilaterally through negotiation with the User. If cannot settle it, the TSP will deal with the dispute according to the procedures and mechanisms prescribed by the Regulator for this purpose.

2.3.2 Grid Impact Studies

2.3.2.1 The TSP shall develop and maintain a set of required technical planning studies for evaluating the impact on the Grid of any proposed Connection or modification to an existing Connection.

2.3.2.2 The TSP shall specify which of the planning studies described in (3.3.6) of Chapter 3 will be carried out to evaluate the impact of the proposed User Development on the Grid.

2.3.2.3 Based on the magnitude and complexity of the proposed User Development, the TSP may need to conduct more extensive planning studies. In such a case, the TSP will indicate in its Offer of Connection this requirement.

2.3.2.4 The User shall indicate whether it wishes the TSP to undertake additional planning studies. The User shall bear the full cost of the additional planning studies, if carried out by the TSP.

2.3.2.5 To enable the TSP to carry out the necessary detailed Grid Impact Studies, the TSP may require the User to provide some or all of the Detailed Planning Data listed in (Appendix A3.2) of Chapter 3: Planning Code ahead of the normal timescale shown there.

2.3.2.6 A User applying for a new, or a modification of an existing, Connection to the Grid shall take all necessary measures to ensure that the proposed User Development does not degrade the Grid. The TSP may disapprove an application, if the Grid Impact Studies indicate that the proposed User Development will (or may) result in the degradation of the Grid.

2.3.3 Application for a New, or Modification of an Existing, Connection

2.3.3.1 A User applying for a new, or a modification of an existing, Connection, to the Grid shall obtain the prescribed application form from the TSP available from the office of Manager, Network Planning Department of the TSP.

2.3.3.2 The User shall submit to the TSP the completed application form along with the applicable fees, published by the TSP and approved by the Regulator, for

a new, or modification of an existing Connection, to the Grid. The completed application shall include, but not limited to, the following information:

(i) name, address, phone number, and email address of the applicant;

(ii) contact information for technical information;

(iii) location of facility, including a Site plan or area map;

(iv) a general description of the proposed Connection, or modification of an existing Connection, which shall comprise the User Development at the Connection Point;

(v) a description of the Plant and/or Apparatus to be connected to the Transmission System or, as the case may be, of the modification relating to the User's Plant and/or Apparatus already connected to the Transmission System;

(vi) the relevant Grid Planning Data as provided and listed in Chapter 3: Planning Code, using the schedules provided for this purpose in Chapter 6: Data and Information Exchange Code;

(vii) the desired Connection date and Operational Date of the proposed User Development; and

(viii) demonstration of Site control.

2.3.3.3 The User shall submit the Grid Planning Data in three (3) stages, according to their degree of commitment and validation as described in section (3.3.3) of Chapter 3: Planning Code. These include: (a) Preliminary Project Planning Data; (b) Committed Project Planning Data; and (c) Registered Project Planning Data.

2.3.4 Processing of the Application

2.3.4.1 The TSP shall process the User application for new, or modification of an existing, Connection within thirty (30) days from the submission of the completed application form and settlement of the admissible fees.

2.3.4.2 After evaluating the application submitted by the User, the TSP shall inform the User whether its application is acceptable or not. The TSP will be entitled to reject a User application if:

(i) accepting of a User Development can lead the TSP to a breach of its duties under the Electricity Law, Implementing Regulations, License conditions, the Grid Code, or any other rule, regulation, or standard relating to safe and secure operation of the Grid; or

(ii) the applicant does not undertake to be bound, insofar as applicable, by the terms and conditions of the Grid Code.

If the User application is acceptable, then the provisions of (2.3.4.3) through (2.3.4.6) shall apply. If it is not, then the provisions of (2.3.4.7) through (2.3.4.9) shall apply.

2.3.4.3 If the User application is acceptable, the TSP shall make an Offer of Connection to the User. The Offer shall include the following:

(i) details of how the Connection is to be made, including details of the Plant and/or Apparatus that will be required to implement the Connection;

(ii) a description of any modification in the Transmission System that the User is required to pay for;

(iii) an indication of the Connection Date and the Operational Date; and

(iv) an estimate of all the charges/costs for the Connection that the User has to pay for.

2.3.4.4 The User shall accept the TSP's Offer within thirty (30) days, or a longer period as specified in the Offer, after which the Offer will automatically lapse.

2.3.4.5 The acceptance by the User of the TSP's Offer of Connection shall lead to the signing of a Connection Agreement or an amended Connection Agreement (as the case may be).

2.3.4.6 If a Connection Agreement or an amended Connection Agreement (as the case may be) is signed, the User shall submit to the TSP, within thirty (30) days from the signing of the agreement or a longer period if agreed to by the TSP and the User, the Standard Planning Data and Detailed Planning Data (if required by the TSP) pertaining to the proposed User Development, as specified in (Appendix A3.1) and (Appendix A3.2) of Chapter 3: Planning Code.

2.3.4.7 If the application of the User is not acceptable, the TSP shall notify the User why its application is not acceptable. The TSP shall include in its notification, where practicable, a proposal on how the User's application will be acceptable to the TSP.

2.3.4.8 The User shall accept TSP proposal within thirty (30) days, or a longer period as specified in the proposal, after which the proposal will automatically lapse.

2.3.4.9 If the TSP and the User cannot reach an agreement on the proposed Connection or modification to an existing Connection, the User's application

will be rejected. The User may refer the matter to the GCSC if the User so desires.

2.3.5 Connection Agreement

The Connection Agreement between the User and the TSP shall meet the following basic conditions:

(i) The TSP and the User shall comply with the Grid Code in letter and spirit.

(ii) The User shall submit reports containing technical and financial information as required in the various sections of the Grid Code.

(iii) The TSP shall provide the User the relevant information in accordance with its statutory and regulatory obligations.

(iv) The User shall provide to the TSP estimated details on the types of its loads and the estimated profile of each major load (e.g. air conditioning, combined heat and Power, motors, and drives, etc.).

(v) The User shall provide the TSP technical diagrams of the required Connection as stated in this chapter or the application form.

(vi) The User shall provide the TSP details of Safety and Protection schemes at the User facilities and for the Connection Point.

(vii) The Connection Agreement with the User shall also clearly specify the operation and maintenance boundary between the User and the TSP.

2.3.6 Submittals Prior to the Commissioning Date

The following shall be submitted by the User prior to the Commissioning date, pursuant to the terms and conditions and schedules specified in the relevant Connection Agreement:

(i) specifications of major Equipment not included in the Standard Planning Data and Detailed Planning Data.

(ii) details of the Protection arrangements and settings referred to in (2.5.2);

(iii) copies of all Safety Rules and instructions applicable to the User's Equipment and a list of Safety Representatives, pursuant to the requirements of (4.10.8);

(iv) Electrical Diagrams of the User's Equipment at the Connection Point as described in (2.7.4);

(v) information that will enable the TSP to prepare the Connection Point Drawings, referred to in (2.7.4);

(vi) a list of the names and telephone numbers of authorized representatives, including the confirmation that they are fully authorized to make binding decisions on behalf of the User, for Significant Incidents pursuant to the procedures specified in section 4.5: Operational Liaison in Chapter 4: Operating Code;

(vii) proposed Maintenance Program;

(viii) Commissioning Tests procedures for the Connection Point and the User Development; and

(ix) Site Test reports, clearance and readiness for Energization of the proposed Connection Plant and Equipment.

2.3.7 Commissioning of Equipment and Physical Connection to the Grid

2.3.7.1 Upon completion of the User Development, including work at the Connection Point, the Equipment at the Connection Point and the User Development shall be put to Commissioning Tests procedure as specified in (4.9.6) of Chapter 4: Operating Code.

2.3.7.2 The User shall then submit to the TSP a statement of Readiness to Connect, which shall include the Commissioning Test Reports.

2.3.7.3 Upon acceptance of the User's statement of Readiness to Connect, the TSP shall, within fifteen (15) days, issue a Technical Completion Certificate to the User if the TSP finds the Commissioning Reports to be acceptable. Otherwise, the TSP will ask the User to perform additional Tests as the TSP may consider necessary.

2.3.7.4 The physical Connection to the Grid shall be made by the TSP within ten (10) days of the issue of Technical Completion Certificate by the TSP to the User.

2.4 Transmission System Performance

2.4.1 General Provisions

2.4.1.1 The TSP shall strive to maintain the Transmission System performance within the limits and ranges specified in the Minimum National Power Quality Standards for the Saudi Arabian Transmission Grid (currently under development). Until such time, the TSP shall strive to maintain the

Transmission System performance within the limits and ranges as specified in this section.

2.4.1.2 Users shall ensure that their Plant and Apparatus at Connection Points are also designed and operated such that these operate satisfactorily within the specified limits and ranges to be set out in the Minimum National Power Quality Standards. Until such time, the limits and ranges as specified in this section shall be adhered to.

2.4.2 Frequency Variations

2.4.2.1 The Transmission System shall have a nominal frequency of 60 Hz and R-Y-B counter-clock-wise phase rotation. The TSP shall maintain it within the limits of 59.9 and 60.1 Hz during normal Grid operation.

2.4.2.2 The System frequency could rise to 62.5 Hz or fall to 57.0 Hz in exceptional circumstances. To enable the TSP to maintain the frequency within the limits specified in (2.4.2.1), the design of Generator's Plant and Apparatus must enable operation of that Plant and Apparatus in accordance with the following:

Below Nominal Frequency (Hz)	Above Nominal Frequency (Hz)	Operation Requirement
58.8 – 60.0	60.0 – 60.5	Continuous
57.5 – 58.7	60.6 – 61.5	for a period of 30 minutes
57.0 – 57.4	61.6 – 62.5	for a period of 30 seconds

Other Users should ensure that their Equipment is designed or protected for these exceptional circumstances.

2.4.3 Voltage Variations

The voltage at any point on the TSP system will normally remain within the nominal values as stated in the table below, unless abnormal conditions prevail. Under exceptional circumstances, the maximum over voltage limits stated below should not be exceeded for more than thirty (30) minutes:

Nominal Voltage (kV)	Normal Range	30-Minute Range
110 kV	± 5 %	±10 %
115 kV	± 5 %	±10 %
132 kV	± 5 %	±10 %
230 kV	± 5 %	±10 %
380 kV	± 5 %	±10 %

2.4.4 Harmonic Distortion

2.4.4.1 All Plant and Apparatus connected to the Transmission System shall be capable of withstanding the levels of Harmonic distortion expected to be present on the Transmission System.

2.4.4.2 Plant and Apparatus connected to the Transmission System shall not impose voltage Harmonics on the Transmission System which exceed the limits specified in the relevant Connection Agreement, or when no such limits are specified there, a Total Harmonic Distortion of 1.5% with no individual Harmonic greater than 1%.

2.4.4.3 Plant and Apparatus connected to the Transmission System shall not impose current Harmonics on the Transmission System which exceed the limits specified in the relevant Connection Agreement, or when no such limits are specified there, the limits specified in IEEE Standard 519-1992: *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*.

2.4.5 Voltage Unbalance

The User facility shall not cause the phase-to-phase unbalance of the System, as measured with no load and with balanced three-phase loading, to exceed by more than one (1) % at the Connection Point.

2.4.6 Voltage Fluctuation and Flicker Severity

2.4.6.1 The voltage fluctuation at any Connection Point with a fluctuating Demand shall not exceed one (1)% of the nominal voltage level for step changes which may occur repetitively. Any large voltage excursions other than step changes may be allowed up to a level of three (3)% providing that this does not pose a risk to the Transmission System or to the System of any other User.

2.4.6.2 The Flicker Severity at any Connection Point in the Transmission shall not exceed the limits of P_{st} =0.8 and P_{lt}=0.6, both 95th percentile values measured over a period of one week.

2.4.7 Transient Voltage Variations

2.4.7.1 The User Systems shall be designed and operated to include the devices that will mitigate the effects of transient over voltages and transient voltage dips on the Grid and the User System.

2.4.7.2 The User shall take into account the effect of electrical transients when specifying the insulation of their electrical Equipment.

2.4.8 Grounding

2.4.8.1 At voltages 110 kV and above, the Grid is effectively grounded with specified Ground Fault Factor below 1.4.

2.4.8.2 The TSP shall specify in the Connection Agreement the Grounding requirements and the applicable Ground Fault Factor at the Connection Points, if an exception is to be permitted in certain cases.

2.5 Plant and Apparatus at Connection Points

2.5.1 General Provisions

2.5.1.1 Each Connection between a User and the Transmission System shall be controlled by a suitable isolating device (isolating switch or circuit breaker, as determined by the TSP) capable of interrupting at the Connection Point, the short circuit currents specified in the relevant Connection Agreement.

2.5.1.2 The User shall be responsible to ensure that all the User Plant and Apparatus, including Protection Schemes, are tested and maintained and remain rated for the duty required of them.

2.5.1.3 Users shall own, operate, and maintain all the facilities beyond the Connection Point.

2.5.1.4 The TSP shall own, operate, and maintain all the facilities up to and including those at the Connection Point.

2.5.1.5 The User shall comply with the operating instructions of the TSP with regard to various systems (including all Plant and/or Apparatus) required to control electric Power and Energy to (or from) that User's facility.

2.5.2 Protection Equipment/Schemes

2.5.2.1 All Users shall be responsible for providing Protection for the Equipment and facilities at their respective sides when connected to the Transmission System.

2.5.2.2 All User Protection Schemes, relays and their settings, shall require prior coordination with and approval of the TSP's relevant Protection engineering office.

2.5.2.3 The Protection Schemes shall isolate the faulty section and Equipment in case of Fault with the dependability, selectivity, speed, and sensitivity as defined in the applicable Connection Agreement or the Grid Code.

2.5.2.4 The protective Equipment connected to the Transmission System shall be tested to achieve the specified level of dependability, selectivity, speed, and sensitivity in Fault clearing and to minimize the impacts on the Grid.

2.5.2.5 The Protection Scheme's ability to initiate the successful tripping of the circuit breaker which is associated with the faulty Equipment shall be measured by System Protection Dependability Index exceeding 99%.

2.5.2.6 Users shall comply with the following requirements for Fault clearance times (from Fault inception to circuit breaker arc extinction) by primary Protection not exceeding:

Network Category	Fault Clearance Times
110 kV	120 millisecond
115 kV	120 millisecond
132 kV	100 millisecond
230 kV	100 millisecond
380 kV	80 millisecond

The probability that these times will be exceeded for any given Fault must be less than one (1)%.

2.5.2.7 To safeguard against failure of the primary Protection Systems provided to meet the above Fault clearance time requirements, the Users shall also provide backup Protection, which shall have Fault clearance time slower than that specified for the User primary Protection. The TSP shall also provide

backup Protection, which shall have Fault clearance times slower than those of the User backup Protection.

2.5.2.8 In case of the failure to trip a User's circuit breaker provided to interrupt Fault current interchange with the Transmission System, circuit breaker fail Protection shall be provided to trip all necessary electrically adjacent circuit breakers within 300 milliseconds. The design reliability for Protection shall be equal to or greater than 99%.

2.5.2.9 **Fault Disconnection Facilities**

Where no circuit breaker is provided at the User Connection Point, the User must provide to the TSP all necessary facilities and schemes to isolate with discrimination and as necessary the Faults or Grid abnormalities, due to the User Connection, on the Transmission System. In these circumstances, for Faults on the User System, the User Protection should also trip higher voltage TSP circuit breakers. These tripping facilities shall be in accordance with the requirements specified in the relevant Connection Agreement.

2.5.2.10 **Loss of Excitation Protection for Synchronous Generating Units**

The Generator shall provide Protection to detect loss of Generating Unit Excitation and initiate a trip of the associated Generating Unit.

2.5.2.11 **Pole Slip Protection for Synchronous Generating Units**

Where, in the TSP's reasonable opinion, System requirements dictate, the TSP shall specify in the Connection Agreement and/or Use of System Agreement a requirement for Generators to fit pole slip Protection on their Generating Units.

2.5.2.12 **Access to Protection Equipment at Connection Points**

No Busbar Protection, mesh corner Protection, circuit breaker fail Protection relays, AC or DC wiring (other than Power supplies or DC tripping associated with the User's Plant and Apparatus) shall be worked upon or altered by, or on behalf of, a User in the absence of a representative of, or written authority from, the TSP.

2.5.2.13 **Automatic Switching Equipment**

Where automatic re-closing of TSP circuit breakers is required following Faults on the User System, automatic switching Equipment shall be provided in accordance with the requirements of the relevant Connection Agreement.

2.5.2.14 **Relay Settings**

(i) Protection and relay settings shall be coordinated by the TSP and User(s) across the Connection Point in accordance with the Connection Agreement to ensure effective Disconnection of faulty Apparatus. In case of a dispute between any party on such issues, the TSP shall be the final deciding authority.

(ii) The TSP may install special Protection Schemes to safeguard against collapse of the System for any foreseeable situation, e.g. during high summer load seasons. In the event of loss of major Transmission line(s) leading to voltage collapse in the Transmission System, The TSP may need to resort to a large scale load shedding to halt damaging voltage collapse which may lead to brownouts and eventual blackouts.

2.5.3 **Operation and Maintenance Safety Conditions**

2.5.3.1 All Users responsible for the operation and maintenance shall also be responsible for the Safety of Equipment, persons, and facilities at their respective sides connected to the Transmission System. On Safety issues, Users shall follow the procedures as laid down in section 4.10 of Chapter 4: Operating Code and the Safety Rules referred to in that section.

2.5.3.2 Site Responsibility Schedule as provided in (2.7.5) will specify the ownership responsibilities of each User connecting to the Transmission System for the following:

(i) ownership of the Plant/Equipment;

(ii) the responsibility for operation and maintenance;

(iii) Safety Rules and Procedures; and

(iv) control of Plant/Equipments and facilities at their respective side.

2.5.4 Metering

Metering Equipment shall be installed at Connection Points in accordance with the provisions of the Connection Agreement and the standards defined in Chapter 7: Metering Code.

2.5.5 Requirements for Generators

2.5.5.1 All Synchronous Generating Units shall be capable of supplying rated Active Power output at any point between the limits 85% Power Factor lagging and 95% Power Factor leading at the Generating Unit terminals, unless otherwise agreed expressly by the TSP in the Connection Agreement.

All Power Park Modules shall be capable of absorbing or supplying reactive power output at the connection point within the range Q = [-0.33, 0.33] of rated active power for Active Power output above 20% of rated power, unless a lower value of Active Power threshold is agreed upon expressly by the TSP in the Connection Agreement.

Power Park Modules shall be capable of limiting reactive power output at the connection point within the range Q=[-0.05, 0.05] of rated power for Active Power output below 20% of rated power, unless a lower value of Active Power threshold is agreed upon expressly by the TSP in the Connection Agreement.

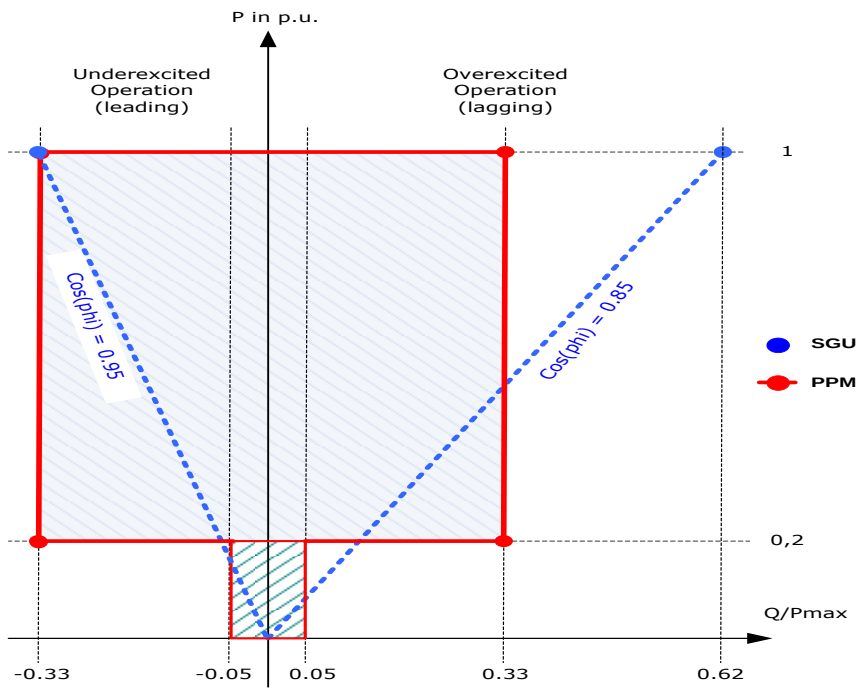

Figure 2.1 P-Q Diagram

2.5.5.2 All Generating Units must be capable of continuously supplying their rated Active Power output at the Connection Point within the System frequency range 59.5 to 60.5 Hz. Any decrease of Active Power output occurring in the frequency range 57.0 to 59.5 Hz should not be more than a proportionate decrease in the frequency as long as it is not higher than 4%/Hz.

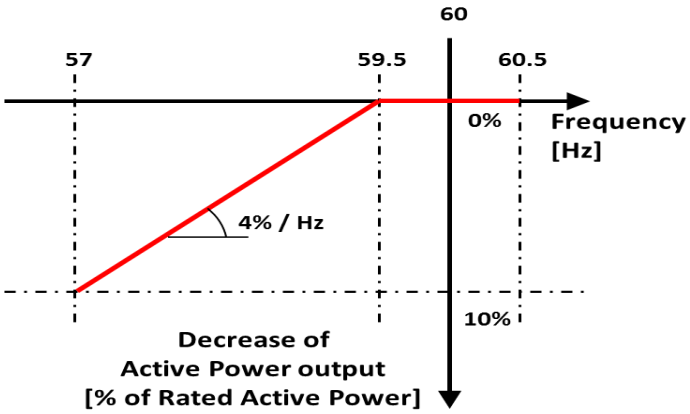

Figure 2.2 Maximum Output Power Reduction Diagram

2.5.5.3 The accuracy of frequency measurement for Frequency Regulation shall be +/- 10mHz or better.

2.5.5.4 All Synchronous Generating Units shall be capable of withstanding any rate of change of frequency up to 1Hz/s without disconnection from the network other than triggered by loss of mains protection. The rate of change of frequency shall be measured over a sliding 500ms time period.

All Power Park Modules shall be capable of withstanding any rate of change of frequency up to 2.5Hz/s without disconnection from the network other than triggered by loss of mains protection. The rate of change of frequency shall be measured over a sliding 500ms time period.

2.5.5.5 Each Power Park Module, which is not inherently capable of supplying additional Active Power to the network by its inertia and which has a Registered Capacity greater than twenty five (25) MW in aggregate, shall be capable of providing Synthetic Inertia through the supply of additional Active Power output to the network in order to limit the rate of change of frequency following a sudden system unbalance.

2.5.5.6 The Active Power output at the Generating Unit terminals under steady state conditions should not be affected by voltage changes in the normal operating range specified in (2.4.3).

2.5.5.7 Transformation ratio and the tap changer of the step up transformer and the auxiliary services transformer, the voltage range of the Generating Unit, the control capabilities and converter ratings of the Power Park Modules and Excitation of the Synchronous Generating Unit shall be designed and adjusted so that the Generating Unit is at normal operating voltage of the Grid, capable of producing or absorbing (as the case may be), continuously the Reactive Power defined by the capability curve of the Generating Unit (at Generating Unit voltage level). The Generating Unit's continuous Reactive Power capability shall not be restrained by main or auxiliary Equipment, control, Protection, or operating procedures.

2.5.5.8 The Synchronous Generating Unit shall be capable of continuously absorbing the Reactive Power (under Excitation operation) defined by the capability curve of the Generating Unit also at maximum voltages (380, 230, 132, 115, and 110 kV of the Grid) assuming that Stability is maintained.

2.5.5.9 The Reactive Power output at the Generating Unit terminals under steady state conditions and at rated Active Power should be fully available within the range ± five (5)% of nominal voltage at the Connection Point.

2.5.5.10 The TSP may require a Black Start capability from certain strategically located Generating Units/Stations. In such cases, Generators will provide Black Start capability through an agreement with the TSP. If an agreement cannot be reached on this issue, the TSP or the Generator shall refer the matter to the Regulator for resolution. Generators, committing to provide Black Start capability, shall also allow to the TSP access to their Black Start Units for testing and drills, as and when required by the TSP.

2.5.5.11 In case the System frequency momentarily rises to 62.5 Hz or falls to 57.0 Hz, all Generating Units shall remain in synchronism with the Transmission System for the operating times stated in (2.4.2) to allow the TSP to undertake measures to correct the situation. Each Generating Unit must be capable of contributing to, in a manner satisfactory to the TSP, Frequency and Voltage Control by modulation of Active Power and Reactive Power supplied to the Transmission System or a User System.

2.5.5.12 The System frequency could vary within the limits given in (2.4.2) and Generating Units are required to be capable of satisfactory operation at any frequency within this range unless the TSP has agreed in the Connection Agreement to the use of any frequency-level relays and/or rate-of-change-of-frequency relays which will trip Generating Unit within this frequency range.

2.5.5.13 Each Synchronous Generating Unit shall be fitted with a fast-acting Speed Governor System to provide Power and Frequency Control under normal operating conditions.

The Speed Governor System shall be designed and operated freely to regulate System frequency and shall have adjustable Governor Droop setting within 2% to 8%. The normal set point shall be generally at 5%.

Total Governor Deadband (inherent plus intentional) shall be 0.05 Hz or less.

The above Droop and Deadband requirement shall apply for an entire combined-cycle Generation facility. Users shall not change frequency or load related control settings of Speed Governors without the prior agreement of the TSP.

In islanding situations, the Generating Unit's Speed Governor System shall also be able to operate at frequency range between 57.5 Hz and 60.2Hz.

Each Power Park Module shall be capable of regulating its Active Power under normal operating conditions through modulation of the Active Power as a function of frequency deviations. The Active Power Droop shall be adjustable within 2% and 8%.

The normal set point shall be generally at 5%. Total Frequency Regulation Deadband (inherent plus intentional) shall be 0.05 Hz or less.

Frequency Regulation from Renewable Resource Generation shall be activated or deactivated automatically following a request from the TSP.

2.5.5.14 Each Renewable Resource Generation shall be capable of regulating its Active Power in the frequency range [60.2Hz, 62.5Hz] through modulation of the Active Power as a function of frequency deviations above 60.2Hz. The Active Power Droop shall be adjustable within 2% and 8%. The normal set point shall be generally at 4%. Output power shall be limited by the available output power and the minimum output power of the Generating Unit.

2.5.5.15 Each Renewable Resource Generation shall be capable of regulating its Active Power in the frequency range [57Hz, 59.8Hz] through modulation of the Active Power as a function of frequency deviations below 59.8Hz. The Active Power Droop shall be adjustable within 2% and 8%. The normal set point shall be generally at 4%. Output power shall be limited by the available output power and the minimum output power of the Generating Unit.

2.5.5.16 The Active Power output of the Renewable Resource Generation connected to the Network shall be controllable as long as technically feasible based on the Available Active Power.

i. The Renewable Resource Generation shall be capable of receiving a Dispatch Instruction containing a required setpoint of Active Power output, of absolute Active Power Limitation, of Active Power delta Regulation and of Active Power Gradient, manually or through automatic remote control system.

ii. Generation shall be able to manually or automatically take into account the Dispatch Instruction.

iii. As long as the Active Power Output is not limited by the Available Active Power, the accuracy of the control performed and of the setpoint shall not deviate by more than 2% of the setpoint value or by 0.5% of the rated power, depending on which yields the highest tolerance and shall be reached in less than 10 minutes after the reception of the Dispatch Instruction.

2.5.5.17 Each Synchronous Generating Unit shall be equipped with high response Excitation System with continuously acting Automatic Voltage Regulation (AVR) system to control the Unit terminal voltage. The AVR shall be designed and operated to maintain the steady-state terminal voltage within ± 0.5% of the set point in the normal voltage range as specified in (2.4.3) without instability over the entire operating range of the Unit. Ceiling voltage for static Exciters shall be at least twice, and for brushless Exciters at least 1.6 times the rated field voltage of the Generating Unit. The Excitation System shall be capable of supplying its ceiling voltage for 10 seconds. Generators shall not disable this automatic control mode without prior approval of the TSP.

Each Synchronous Generating Unit shall be required to include Power System Stabilizing (PSS) and var limiting Equipment as well.

Each Power Park Module shall, at minimum, be able to provide reactive power automatically by the following control modes during normal operation:

- Voltage control mode;
- Reactive power control mode;

The selected control mode shall maintain the steady-state terminal voltage within ± 0.5% of the normal voltage range specified in (2.4.3).

The damping ratio of the output reactive power of each Power Park Module shall be at least 0.05.

Each Power Park Modules which has a Registered Capacity greater than twenty five (25) MW in aggregate, shall be equipped with a Power Oscillation Damper (POD) capable of increasing or decreasing the output power in such a way to minimize the power oscillations in the low frequency range (0.15 – 2.0 Hz).

2.5.5.18 On-load tap changing facilities shall be required on Generator step-up transformers for Dispatch of Reactive Power. The transformer voltage ratio, tapping range, and step sizes must be such that the Reactive Power requirements specified in (2.5.5.9) are fully complied with.

2.5.5.19 The TSP shall be entitled to acquire such operational metering, control parameters, and Plant data as it may reasonably require for the purposes of discharging its statutory and regulatory obligations.

2.5.5.20 A Generating Unit shall be capable of:

a) Under Steady State Conditions: continuous uninterrupted operation for the voltage variation specified in (2.4.3).

b) Under Transient Conditions:

i. For Synchronous Generating Units withstanding Faults on the Transmission System which may cause the voltage at the Connection Point to drop to between 0% and 80% of the nominal voltage for a period of up to 300 millisecond in any one phase or combination of phases, followed by a period of one (1) second where voltage may vary in the range 80-110% of the nominal voltage, and followed by a 30-minute period where voltage may vary in the range specified in (2.4.3).

ii. For Power Park Modules: withstanding Faults on the Transmission System which may cause the voltage at the Connection Point to drop

to 0% for a period of up to 300 millisecond in any one phase or combination of phases, followed by a period where voltage may vary in a range specified by:

- at the lower side, a linear restoration of the voltage towards 80% of the nominal voltage within 1.3 second after initial voltage drop.
- and at the upper side, not exceed 120% of nominal voltage for more than 1s in any one phase, and followed by a 30-minute period where voltage may vary in the range specified in (2.4.3).

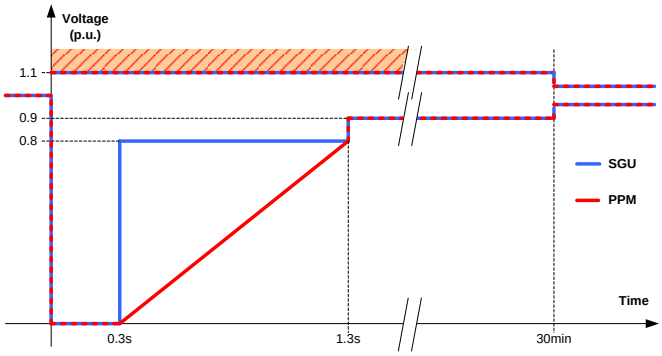

Figure 2.3 Voltage Withstand Capability Diagram

2.5.5.21 The Renewable Resource Generating Unit shall remain connected to the Network and continue stable operation if none of the phases exceeds 120% of nominal voltage for more than 1s.

2.5.5.22 Each Power Park Module which does not inherently provide short-circuit power and which has a Registered Capacity greater than twenty five (25) MW in aggregate, may be required by the TSP to provide dynamic voltage support during network disturbances. This dynamic voltage support is described by the following:

i. The magnitude of the additional reactive current injection shall be determined as a linear function of the positive or negative voltage change (ΔU) with respect to the pre-disturbance value with total reactive current injection limited to 100% of rated current.

ii. The dynamic voltage support shall not have priority over AVR and active power control of the generating units in the normal voltage range and in the 30-minutes range defined in (2.4.3).

iii. The droop of this linear function shall be adjustable on request of the TSP from 0 additional reactive current injection (minimum droop) to

an additional reactive current injection of 2% of the rated current per percent of the voltage drop (maximum droop).

iv. If necessary, the active current shall be limited to enable dynamic voltage support.

v. In case of overvoltage, the additional reactive current shall have an inductive behavior and in case of undervoltage, the additional reactive current shall have a capacitive behavior.

vi. The additional reactive current shall bring the total reactive current injection to at least 2/3 of the target value within 20ms (control response time) and this target value shall be reached with an accuracy of 10% within 60ms from the moment the voltage deviation occurs.

vii. The dynamic voltage support shall be maintained for at least 400 ms after voltage recovery in the normal voltage range, or in the 30-minutes range defined in (2.4.3).

viii. The transitions between dynamic voltage support and voltage control defined in 2.5.5.17 shall be smooth.

ix. In case of unsymmetrical faults, the dynamic voltage support shall not escalate the overvoltages of the healthy phases above the maximum voltage defined in (2.4.3).

2.5.5.23 All Power Park Modules that remain synchronized to the network following a disturbance shall be able to recover Active Power output after fault clearance or after voltage regains levels specified in (2.4.3).

The recovered Active Power output shall be higher than 90 % of the pre-fault value within 4 seconds after fault clearing unless prevented by the reduction of available active power.

2.5.5.24 Generating Units shall be capable of withstanding, without tripping, a negative phase sequence loading appropriate to their rated full load in accordance with the IEEE Standard C37.102-1995: *IEEE Guide for AC Generator Protection*. In addition they shall be required to withstand, without tripping, the negative phase sequence loading incurred by clearance of a close-up phase-to-phase Fault by backup Protection on the User System of which they are a part.

2.5.5.25 The higher voltage windings of the Generating Unit step-up transformer connecting the Generating Unit to the Transmission System must be star

connected with the star point grounded in accordance with IEEE Standard C37.101-1993: *IEEE Guide for Generator Ground Protection*. If adjacent to a TSP Substation, it shall be connected to the Grounding System of that Substation.

2.5.5.26 Generators will be responsible for protecting their Generating Units against the risk of any damage which might result from any frequency excursion outside the range 57.0 Hz to 62.5 Hz and for deciding whether or not to interrupt the Connection between his Plant and/or Apparatus and the Transmission System in the event of such a frequency excursion.

2.5.5.27 Following the disconnection from the Grid, the Synchronous Generating Unit/Station shall change over to House Load Operation for one (1) hour and, in the case of Synchronous Renewable Resource Generation, for one (1) hour or as long as it is technically feasible based on the Available Active Power.

2.5.5.28 Control Synchronizing shall be provided by Generators at circuit breakers identified by the TSP, which, depending on the Plant configuration, shall include:

(i) the Generating Unit circuit breaker; and

(ii) the Generator transformer HV circuit breaker.

2.5.5.29 The TSP will provide to the Generator signals from the TSP operated Plant and Apparatus as required to facilitate Synchronizing on the Generator transformer HV circuit breaker or the Generating Unit circuit breaker (as agreed with the TSP), in accordance with the relevant Connection Agreement. The Synchronizing facilities as stated in (2.5.5.28) shall facilitate Synchronizing under the following conditions:

(i) Transmission System frequency within the limits specified in (2.4.2);

(ii) Transmission System voltage within the limits as specified in (2.4.3).

2.5.6 Requirements for Distribution Entities and Directly-connected Customers

2.5.6.1 At nominal System voltages of 110 kV and above, the higher voltage windings of three phase transformers and transformer banks connected to the Transmission System, if star-connected, shall have their star point suitable for connection to Ground. For this purpose neutral connection must be brought out of the tank to enable external connection to Ground. The Grounding and

lower voltage winding arrangement shall be such as to ensure that the Ground Fault Factor requirement as stated in (2.4.8.1) of the Grid Code are satisfactorily met on the Transmission System at nominal System voltages of 110 kV and above.

2.5.6.2 As required in Chapter 4: Operating Code, each Distribution Entity shall make arrangements that shall facilitate automatic low frequency Disconnection of Demand. The Connection Agreement shall specify the manner in which Demand subject to low frequency Disconnection shall be split into discrete MW blocks with associated Under Frequency Relay settings. Technical requirements relating to Under Frequency Relays will be specified in the Connection Agreement or relevant standards.

2.5.6.3 The Under Frequency Relays for Automatic Load Dropping shall be provided at the Connection Point by the Users as per the Connection Agreement. The TSP may allow a User to have such schemes installed on User side of the Connection Point providing that, if considered necessary and required by the TSP, one hundred (100)% of the User load may be shed.

2.5.6.4 Distribution Entities and Directly-connected Customers, having contracted load more than 1.0 MVA should exercise all precautionary measures to maintain 85% lagging power factor. For such customers, the minimum allowable Power Factor will be 90% lagging after five years (from the date of 21-10-1433), and 95% lagging power factor after ten years from the said date. In case of any deviation from this criteria, a tariff on the reactive power consumed, exceeding the allowable limit, will be applied as per terms and conditions given in ECRA Board Resolution # 2/27/23 dated 21-10-1433.

2.5.6.5 Reactive Power compensation shall be provided by the Distribution Entities at Low Voltage System close to the load point to avoid excessive Reactive Power losses and to enable the TSP to maintain the Transmission System voltage within the limits as specified in (2.4.3).

2.6 System Services

The relevant Connection Agreement or Power Supply or Purchase Agreement (as the case may be) will contain requirements for the capability for certain System Services from the following list which may be needed for proper System operation:

(i) Voltage Control and Reactive Power Support (when used exclusively for such purpose);

(ii) Primary Control of Generating Units;

(iii) Secondary Control of Generating Units;

(iv) Black Start Capability;

(v) Operating Margin (Operating/Contingency Reserve);

(vi) Interruptible Load; and

(vii) any other System Service.

2.7 Site Related Conditions

2.7.1 Responsibility for Operation and Maintenance

In the absence of an agreement between the parties to the contrary, operation and maintenance responsibilities shall follow ownership.

2.7.2 Responsibilities for Safety

2.7.2.1 Any User entering and working on its Plant and/or Apparatus on a TSP Site shall work to the TSP Safety Rules.

2.7.2.2 The TSP entering and working on its Plant and/or Apparatus on a User Site shall work to the TSP Safety Rules. However, for User Sites where the TSP staff may be exposed to some special risks (for instance, hazardous or toxic substances or gases, etc.), the TSP, in addition to its own Safety Rules, will follow the User Safety Rules also.

2.7.3 Site and Equipment Identification and Labeling

2.7.3.1 The TSP shall provide to each User details of TSP's current numbering and nomenclature system to enable the User to plan the numbering and nomenclature of its own (E)HV Plant and Apparatus on the Connection Site.

2.7.3.2 The party installing Plant and/or Apparatus shall be responsible for providing and installing of clear and unambiguous labels showing the Site and Equipment identification at its respective System.

2.7.3.3 The numbering and nomenclature of each item of Plant and/or Apparatus shall be included in the Operation Diagram prepared for each Site.

2.7.3.4 **For TSP Plant and/or Apparatus on a User Site**

(i) If the TSP intends to install its E(HV) Plant and/or Apparatus on a User Site, it shall notify the relevant User of its intent in writing by

showing the proposed Plant and/or Apparatus, with clear numbers and nomenclature, on an Operation Diagram and by giving date of the proposed installation, at least six (6) months ahead of the proposed installation.

(ii) the relevant User will confirm to the TSP in writing within one (1) month of the receipt of such notification, either its acceptance of the TSP proposal or objection(s), if any, by stating the reasons for the objection(s).

(iii) the relevant User will not install, or permit the installation of, any (E)HV Plant and/or Apparatus on such User Site which has numbering and/or nomenclature which could be confused with that of (E)HV Plant and/or Apparatus of the TSP already on that User Site or about which the TSP has notified to that User that it intends to install on that Site.

2.7.3.5 **For User Plant and/or Apparatus on the TSP Sites**

(i) If a User intends to install its (E)HV Plant and/or Apparatus on a TSP Site, it shall notify the TSP of its intent in writing by showing the proposed Plant and/or Apparatus, with clear numbers and nomenclature, on the Operation Diagram and by giving date of the proposed installation, at least six (6) months ahead of the proposed installation.

(ii) the TSP will respond in writing to the User within one (1) month of the receipt of the notification either confirming its acceptance of the User proposed numbering and nomenclature or, if they are not acceptable, by giving details of the numbering and nomenclature which the User shall adopt for that (E)HV Apparatus.

2.7.3.6 **Changes**

If the TSP intends to change the existing numbering or nomenclature of either its own (E)HV Plant and/or Apparatus on a User Site or of the User (E)HV Plant and/or Apparatus on a TSP Site:

(i) the provisions of paragraph (2.7.3.4) shall apply to such change of numbering or nomenclature of the (E)HV Plant and/or Apparatus of the TSP with any necessary amendments to those provisions to reflect that only a change is being made; and

(ii) in the case of a change in the numbering or nomenclature of (E)HV Plant and/or Apparatus of the User on a TSP Site, the TSP shall notify the User of the numbering and/or nomenclature that the User shall adopt for that (E)HV Plant and/or Apparatus at least six (6) months prior to the change being needed and the User will respond in writing to the TSP within one (1) month of the receipt of the notification, confirming receipt.

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

2.7.4 Connection Point Drawings

2.7.4.1 Connection Point Drawings shall be prepared for each Connection Site and shall include Site layout drawings, mechanical drawings, electrical layout drawings, electrical Single Line Diagrams, common Protection/control drawings, and common services drawings.

2.7.4.2 The TSP shall specify the procedure and format to be followed in the preparation of the Connection Point Drawings for any Connection Point.

2.7.4.3 The User shall prepare and submit to the TSP, drawings for all the Equipment, circuits, and facilities on the User's side of the Connection Point, in accordance with the schedule specified in the Connection Agreement.

2.7.4.4 The TSP shall provide the User with drawings for all the Equipment, circuits, and facilities on the TSP side of the Connection Point, in accordance with the schedule specified in the Connection Agreement.

2.7.4.5 If the Connection Point is at the User's Site, the User shall prepare and distribute Connection Point Drawings for the entire Connection Point. Otherwise, the TSP shall prepare and distribute the Connection Point Drawings for the entire Connection Point.

2.7.4.6 The Connection Point Drawings shall provide an accurate record of the layout and circuit connections, ratings and identification of Equipment, and related Apparatus and devices at the Connection Point.

2.7.4.7 If possible, all the electrical Equipment at the Connection Point shall be shown in one Connection Point Drawing. When more than one Drawing is necessary, duplication of identical information shall be minimized. The Connection Point Drawing(s) shall represent, as closely as possible, the physical arrangement of the Equipment and their electrical connections.

2.7.4.8 The Connection Point Drawing shall be prepared using the Site and Equipment identification and labeling prescribed in (2.7.3).

2.7.4.9 The title block of the Connection Point Drawings shall include the names of authorized persons together with provisions for the details of revisions, dates, and signatures.

2.7.4.10 The Connection Point Drawings shall have the TSP stamp. The master copy of the Connection Point Drawings shall remain with the TSP.

2.7.4.11 If a dispute arises, a meeting shall be held between the TSP and the User to resolve the dispute at the shortest possible time.

2.7.4.12 **Preparation of Connection Point Drawings for a Connection Point at a User Site**

(i) In the case of a Connection Point at a User Site, the TSP shall prepare and submit to the User, Connection Point Drawings for the TSP side of the Connection Point in accordance with the requirements of the Connection Agreement.

(ii) The User shall then prepare, produce, and distribute, using the information provided by the TSP, Connection Point Drawings for the complete Connection Site in accordance with the requirements of the Connection Agreement for approval by the TSP.

2.7.4.13 **Preparation of Connection Point Drawings for a Connection Point at a TSP Site**

(i) In the case of a Connection Point at a TSP Site, the User shall prepare and submit to the TSP, Connection Point Drawings for the User side of the Connection Point in accordance with the requirements of the Connection Agreement.

(ii) The TSP shall then prepare, produce, and distribute, using the information submitted by the User, Connection Point Drawings for the complete Connection Site in accordance with the requirements of the Connection Agreement.

2.7.4.14 **User Changes to Site Common Drawings**

(i) A User feeling the necessity to change any aspect of the Connection Point Drawings at a Connection Site shall do the following:

(a) for a Connection Point at a User Site, the User shall prepare, produce, and distribute, after getting them approved by the TSP, revised Connection Point Drawings for the complete Connection Site; and

(b) for a TSP Site, the User shall prepare and submit to the TSP revised Connection Point Drawings for the User side of the Connection Point and the TSP shall then prepare, produce, and distribute, using the information submitted by the User, revised Connection Point Drawings for the complete Connection Site.

(ii) If the User change can be dealt with by it notifying the TSP in writing of the change and for each party to amend its copy of the Connection Point Drawings then the User shall so notify, and each party shall so amend (subject to TSP's acceptance of the proposed changes).

2.7.4.15 **TSP Changes to Site Common Drawings**

(i) The TSP feeling the necessity to change any aspect of the Connection Point Drawings at a Connection Site shall do the following:

(a) for a TSP Site, the TSP shall prepare, produce and distribute revised Connection Point Drawings for the complete Connection Site; and

(b) for a User Site, the TSP shall prepare and submit to the User revised Connection Point Drawings for the TSP side of the Connection Point and the User shall then prepare, produce and distribute, using the information submitted by the TSP, revised Connection Point Drawings for the complete Connection Site for approval of the TSP.

(ii) If the TSP change can be dealt with by it notifying the User in writing of the change and for each party to amend its copy of the Connection Point Drawings then the TSP shall so notify, and each party shall so amend.

2.7.4.16 **Validity of Connection Point Drawings**

(i) The Connection Point Drawings for the complete Connection Site prepared by the User or the TSP, as the case may be, shall be the definitive Connection Point Drawings for all operational and

maintenance and planning activities associated with the Connection Site.

(ii) If a dispute arises as to the accuracy of the Connection Point Drawings, a meeting shall be held at the Site, as soon as reasonably practicable, between the TSP and the User, and both shall strive to resolve the matter in dispute.

2.7.5 Site Responsibility Schedules

2.7.5.1 In order to inform the Site operational staff and the TSP Control Engineers of the agreed responsibilities for Plant and/or Apparatus at the Connection Point, a Site Responsibility Schedule shall be produced for the TSP and the Users with whom it will interface.

2.7.5.2 The format, principles and basic procedure to be used in the preparation of Site Responsibility Schedules are set down in (Appendix A2.1) to this chapter.

2.7.6 Access to Sites

2.7.6.1 The provisions relating to access to the TSP Sites by Users, and to User Sites by the TSP, will be set out in each Connection Agreement between the TSP and the User. In addition to those provisions, where a Site belonging to the TSP contains exposed (E)HV conductors, unaccompanied access shall only be granted to individuals holding Authority for Access from the TSP.

2.7.6.2 The User shall permit unhindered access to TSP personnel (including their tools, Equipment, and vehicles) for accessing the TSP Equipment at the Connection Point and inside the User premises as may be required during normal and contingency conditions.

2.7.7 Maintenance Procedures

2.7.7.1 User Plant and Apparatus on the TSP Sites shall be maintained adequately (not less than the TSP standards) for the purpose for which it is intended and to ensure that it does not pose a threat to the Safety of any of the TSP Plant, Apparatus, or personnel on the TSP Site. The TSP shall have the right to inspect the test results and maintenance records relating to such Plant and/or Apparatus at any time. The TSP shall also have the right to inspect the User Equipment at the Connection Point, if considered necessary by the TSP.

2.7.7.2 All the TSP Plant and/or Apparatus on User Sites shall be maintained adequately (not less than TSP standards) for the purposes for which it is

intended to ensure that it does not pose a threat to the Safety of any of the User Plant, Apparatus, or personnel on the User Site.

2.7.8 Site Operational Procedures

The TSP and the Users must make available staff to take necessary Safety Precautions and carry out operational duties as may be required to enable work/Testing to be carried out and for the operation of Plant and/or Apparatus connected to the System.

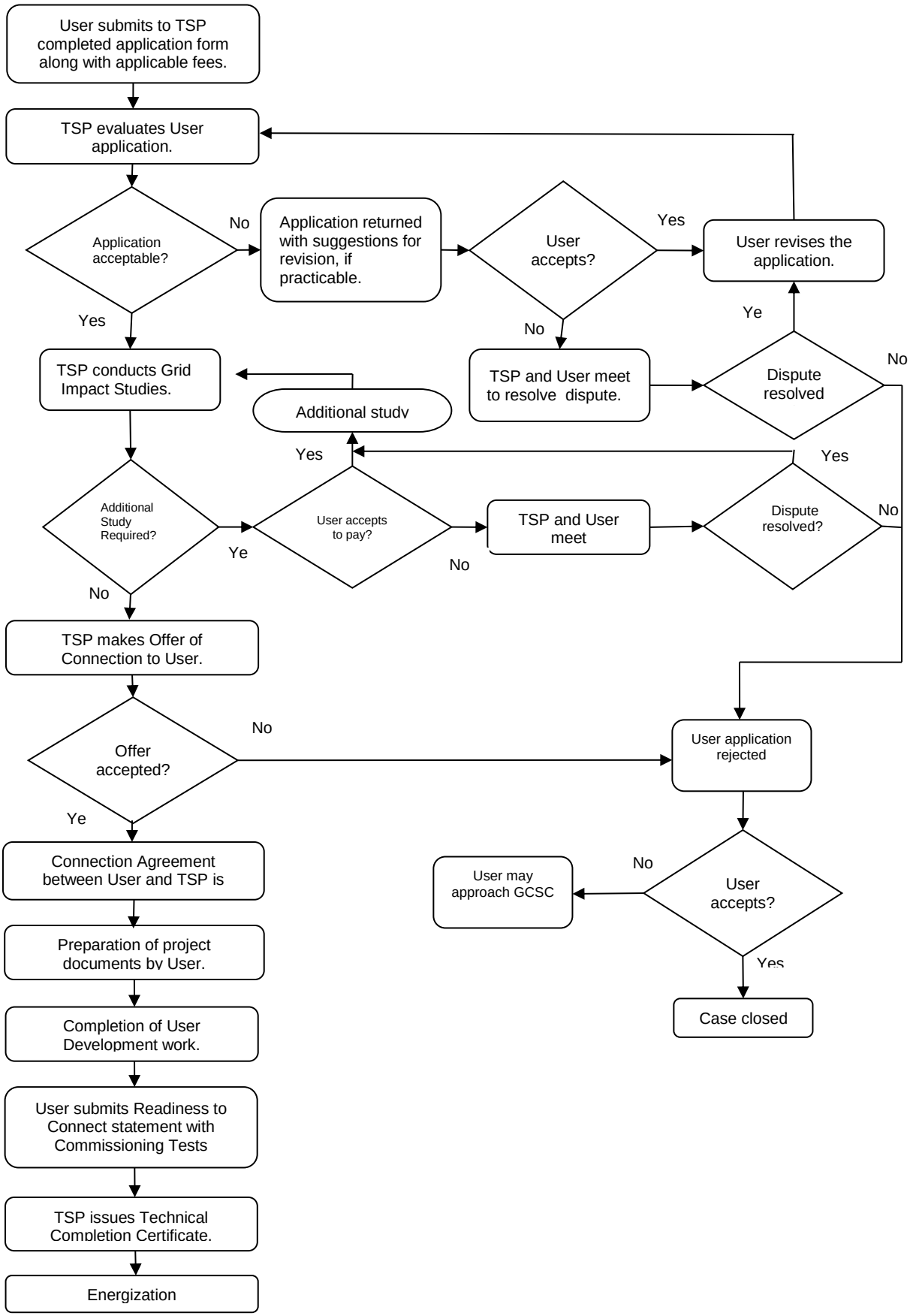

Figure 2.4. Procedure for Connection to the Grid

APPENDIX A2.1: Preparation of Site Responsibility Schedules

A2.1.1 **Principles**

A2.1.1.1 At all Sites, the following Site Responsibility Schedule shall be drawn up using the Pro forma Table A2.1 or with such variations as may be agreed between the TSP and Users. In the absence of agreement, the Pro forma Table A2.1 shall be used:

(i) Schedule of (E)HV Apparatus;

(ii) Schedule of LV Plant, Apparatus, services and supplies;

(iii) Schedule of telecommunications and measurement Apparatus.

A2.1.1.2 Each Site Responsibility Schedule for a Connection Site shall be prepared by the TSP in consultation with other Users at least one (1) month prior to the Completion Date under the Connection Agreement for that Connection Site (which may form part of a Site).

A2.1.1.3 Each User shall, in accordance with the timing requirements of the Connection Agreement, provide information to the TSP to enable it to prepare the Site Responsibility Schedule.

A2.1.1.4 Each Site Responsibility Schedule shall be subdivided to take account of any separate Connection Sites on that Site.

A2.1.1.5 Each Site Responsibility Schedule shall detail for each item of Plant and/or Apparatus:

(i) Plant/Apparatus ownership;

(ii) Responsible Manager (Controller);

(iii) Safety standards (applicable Safety Rules and standards);

(iv) Responsible person(s) responsible for coordinating on Safety matters;

(v) operations (applicable operational procedures and Control Engineer); and

(vi) responsibility to undertake maintenance.

A2.1.1.6 The (E)HV Apparatus Site Responsibility Schedule for each Connection Site must include lines and cables emanating from the Connection Site.

A2.1.1.7 Every page of the Site Responsibility Schedule shall bear the date of issue and the issue number.

A2.1.1.8 When a Site Responsibility Schedule is prepared, it shall be sent by the

TSP to the Users involved for confirmation of its accuracy.

A2.1.1.9 The Site Responsibility Schedule shall then be signed on behalf of the TSP by the Responsible Manager of the TSP (to be designated in the relevant Connection Agreement) responsible for the area in which the Site is situated and on behalf of each User involved by the Responsible Manager of the User (to be designated in the relevant Connection Agreement), by way of written confirmation of its accuracy. Once signed, two (2) copies shall be supplied by the TSP, not less than two (2) weeks prior to its implementation date, to each User who is a party on the Site Responsibility Schedule, indicating the issue number and the date of implementation.

A2.1.2 **Alterations to Existing Site Responsibility Schedules**

A2.1.2.1 When a User (identified on a Site Responsibility Schedule) becomes aware that an alteration is necessary, it must inform the TSP immediately and in any event eight (8) weeks prior to any change taking effect.

A2.1.2.2 Where the TSP has been informed of a change by a User, or itself proposes a change, it shall prepare a revised Site Responsibility Schedule by not less than six (6) weeks prior to the change taking effect.

A2.1.2.3 The revised Site Responsibility Schedule shall then be signed and shall accompany by a note indicating where the alteration has been made, the new issue number and the date of implementation.

A2.1.2.4 When a User or the TSP (as the case may be) identified on a Site Responsibility Schedule, becomes aware that an alteration to the Site Responsibility Schedule is urgently necessary to reflect, for example, an emergency situation, the User shall notify the TSP, or the TSP shall notify the User (as the case may be), immediately and shall discuss:

(i) what change is necessary to the Site Responsibility Schedule;

(ii) whether the Site Responsibility Schedule is to be modified temporarily or permanently; and

(iii) the distribution of the revised Site Responsibility Schedule.

A2.1.2.5 The TSP shall prepare a revised Site Responsibility Schedule as soon as possible, and in any event within seven (7) days of it being informed or becoming aware of the necessary alteration. The Site Responsibility Schedule shall be confirmed by the User and signed on behalf of the TSP and the User as soon as possible after it has been prepared and sent to

the User for confirmation.

A2.1.3 **Responsible Managers**

A2.1.3.1 Each User shall, prior to the Completion Date under each Connection Agreement, supply to the TSP the name of that User's manager who has been duly authorized to sign Site Responsibility Schedules on behalf of the User. The TSP shall, prior to the Completion Date under each Connection Agreement, also supply to that User the name of its own manager responsible for the area in which the Site is situated.

Table A2.1. PRO FORMA FOR SITE RESPONSIBILITY SCHEDULE

COMPANY: _____ CONNECTION SITE: _____

SCHEDULE: (Please tick in front of the applicable category)

-------- (E)HV Apparatus

-------- LV Plant, Apparatus, services, and supplies

-------- Telecommunication and measurement Apparatus

Item of Plant/ Apparatus	Plant/ Apparatus owner	Responsible Manager	Safety	Operations	Party responsible for statutory inspections, Fault investigation, and maintenance	Remarks
			Control or other responsible person (Safety Representative)	Control or other Responsible Engineer		

Signature of
TSP representative: _____

Signature of
User representative: _____

CHAPTER 3 PLANNING CODE

3.1 Introduction

3.1.1 This chapter provides a framework for enabling the TSP and Users to interact with each other in relation to planning and development of the Transmission System. It also specifies the information and data that the Users shall provide to the TSP or the TSP shall provide to the Users for this purpose.

3.1.2 All Users, existing as well as prospective, will be bound by the planning conditions laid down in this chapter prior to generating, transmitting, distributing, or consuming electricity, as the case may be.

3.2 Objectives

The objectives of this chapter are to specify:

(i) the responsibilities of the TSP and Users towards Grid planning;

(ii) the mechanism for the TSP and Users to interact with each other with respect to any proposed development on the User System that may have impact on the Transmission System;

(iii) the Power System studies required and the planning criteria and standards to be followed by the TSP to ensure efficient, safe, reliable, and economic operation of the Grid;

(iv) the data and information required from Users for use by the TSP to plan for Grid development; and

(v) the data and information to be provided by the TSP to Users to aid them to plan and decide for their own facilities.

3.3 Grid Planning

3.3.1 Grid Planning Responsibility

3.3.1.1 The TSP shall have the primary and lead responsibility for planning the Grid development, including carrying out of all necessary studies, assessments, and evaluations.

3.3.1.2 In planning for Grid development, the TSP may require a User, or a group of Users, to modify or install new Plant and/or Apparatus, where the TSP

reasonably considers that it is prudent or necessary to do so to ensure continued compliance with the requirements of the Grid Code.

3.3.1.3 The time required for the planning and development of the Grid will depend on the type, complexity, and extent of the necessary reinforcement and/or extension work, the time required for conducting appropriate studies/evaluations, and the necessary approvals and permissions from relevant agencies.

3.3.2 Grid Planning Process

3.3.2.1 Users, existing as well as prospective, will be able to assess conditions for connecting to, and using of, the Grid through the following:

(i) a forecast statement, prepared by the TSP, showing for each of the 5 succeeding years, the opportunities available for connecting to, and using of, the Grid and indicating those parts of the Grid that are most suited to new Connections and transport of further quantities of electricity; or

(ii) an offer by the TSP to enter into a Connection Agreement with a User for Connection to, or use of, the Grid.

3.3.2.2 To enable the TSP to properly plan for Grid development, Users will be required to submit to the TSP all data that the TSP may require from them for this purpose. The details of the data requirements from Users for planning purposes are set out in (3.3.3).

3.3.2.3 Any User proposing to close, retire, withdraw from service, or otherwise cease to maintain and keep available for Dispatch in accordance with Good Industry Practice any Generating Station or Generating Units with Registered Capacity greater than ten (10) MW in aggregate shall give the TSP at least twenty-four (24) calendar months' notice of such action.

3.3.3 Submission of Grid Planning Data

3.3.3.1 For the TSP to undertake planning and development of the Grid, the TSP will require the Users to provide data and information before Connection, and also afterwards at regular intervals. These data will be provided to the TSP using the schedules provided for this purpose in Chapter 6: Data and Information Code. These data and information will be treated as Grid Planning Data.

3.3.3.2 For planning purposes, Grid Planning Data will be classified into three (3) main categories: (i) Project Planning Data; (ii) Standard Planning Data; and (iii) Detailed Planning Data. These data categories are further explained below:

(i) *Project Planning Data*: The TSP will require Users applying for a new, or modification of an existing, Connection, to submit some or all of the data items listed under Standard Planning Data and Detailed Planning Data in this chapter. Such data will be treated by the TSP as Project Planning Data until a User is actually connected to the Grid.

(ii) *Standard Planning Data*: Standard Planning Data are data that must be submitted by all existing Users at regular intervals.

(iii) *Detailed Planning Data:* Detailed Planning Data are data that the TSP may require from any existing User in support of the Standard Planning Data.

3.3.3.3 As regards the Project Planning Data, the TSP may require different levels of detail and quality of information through the various stages of the User Development, as elaborated on below:

(i) At the time a User applies for a new, or modification of an existing, Connection but before the TSP makes an Offer of Connection, the data relating to the proposed User Development will be considered *Preliminary Project Planning Data* and shall contain such data as may be required by the TSP to evaluate the Connection application and, if applicable, any other data directly relevant to, and submitted in support of, the application. These data will be treated by the TSP as confidential within the scope of TSP's policy for confidentiality.

(ii) On formal acceptance by the prospective User of the Offer of Connection, the data relating to the User Development, previously submitted as Preliminary Planning Data, including any subsequent data supplied in support of its application, will become *Committed Project Planning Data*. Data at this stage will not be treated as confidential to the extent that the TSP is required to use or disclose these to discharge its contractual or regulatory obligations.

(iii) As soon as is practical, and not later than the Operational Date, all data requirements as stated in this section, not previously requested by the TSP or supplied by the User, will be submitted by the User to

the TSP. This will include confirming any estimated values assumed for planning purposes or, where practical, replacing them by validated actual values and by updating estimates for Forecast Data items such as Demand. Data provided at this stage of the project will become *Registered Project Planning Data*.

3.3.3.4 All existing Users shall submit to the TSP, each year, the Standard Planning Data referred to in (3.3.3.2) and listed in (Appendix A3.1) of this chapter. These data should be submitted by end of March each year and should cover the current year and each of the five (5) succeeding years. Where from the date of one submission to a date of subsequent submission there is no change in the data to be submitted for any given year, instead of resubmitting the data, a User may submit a written statement that there has been no change from the data submitted the previous time, pertaining to the particular year specified.

3.3.3.5 The TSP may also require additional data or information from a User referred to as Detailed Planning Data in (3.3.3.2) and listed in (Appendix A3.2) of this chapter. Where the TSP considers that this information is required, then the User shall submit the information to the TSP within thirty (30) days, or such other period as may be agreed between the TSP and the User, after the date of such request.

3.3.3.6 **Further Classification of Grid Planning Data**

Grid Planning Data are further divided into the following:

(i) *Forecast Data*: Which shall contain User's best estimate of the data, including Energy and Demand, being projected for the five (5) succeeding years;

(ii) *Estimated Equipment Data*: Which shall contain the User's best estimate of the values of parameters and information pertaining to its Equipment, Plant, and/or apparatus and which upon Connection becomes fixed (subject to any subsequent change); and

(iii) *Registered Equipment Data*: Which shall contain Plant and/or Apparatus data which upon Connection will become Registered Data, but which prior to Connection will be an estimate of what is expected, known as Estimated Equipment Data.

3.3.3.7 **Validation and Verification of Data**

(i) In cases of doubtful accuracy of the supplied data, the TSP may ask the User to supply additional information to verify the data accuracy.

(ii) The TSP may demand the User to carry out specific Tests to verify the data in conformity with applicable standards, if the information supplied pursuant to (i) above is still suspect. Where such Test or Tests are requested, they will be subject to the relevant provisions of Chapter 4: Operating Code.

(iii) If as a result of the Test(s) in (ii) above, the User data is found to be incorrect, then the User will bear the full cost of such Test(s), and the TSP will use for its studies the data values as ascertained by such Test(s). If any additional burden is imposed on the TSP in terms of repeating or performing additional studies, then the User will also bear the cost reasonably incurred by the TSP for such additional burden.

3.3.4 **Consolidation and Maintenance of Grid Planning Data**

3.3.4.1 The TSP shall collate and process the Grid Planning Data submitted by the Users into a cohesive and consolidated Grid planning dataset and shall use this for conducting the various planning studies and also for preparing any forecast statements and capacity development/reinforcement plans for the Transmission System.

3.3.4.2 If any User believes that the cohesive Forecast Data prepared by the TSP does not accurately reflect that User's planning data, it shall immediately notify the TSP of its concern. The TSP and the User shall promptly meet to address the concern of the User.

3.3.5 **Planning Criteria and Standards**

The TSP shall apply the TSP Planning Criteria and Standards (established by the TSP and approved by ECRA), in the planning and development of the Transmission System.

3.3.6 **Grid Planning Studies**

3.3.6.1 The TSP shall conduct Grid planning studies periodically or on as required basis to ensure the economic, safe, reliable, and stable functioning of the Transmission System, specifically for the following:

(i) preparation of the Transmission forecast statement for next five years;

(ii) preparation of Transmission development plans;

(iii) evaluation of Grid reinforcement/extension projects;

(iv) evaluation of any proposed User Development submitted to the TSP in accordance with an application for a new, or modification of an existing, Connection;

(v) to assess the impact on the Transmission System or on any User System of any Demand Forecast or any proposed addition or change of Equipment or facilities in the Transmission System or the User System and to identify remedial measures to eliminate the deficiencies in the Transmission System or the User System;

(vi) to assess the behavior of the Transmission System during normal and contingency conditions;

(vii) to assess the System behavior during the electromechanical or electromagnetic transients induced by disturbances or switching operations; and

(viii) any other planning assessment that may be required in the future to ensure adequate Transmission Capacity.

3.3.6.2 The Grid planning studies may include studies (as the situation or case may demand) such as load flow studies, short-circuit studies, transient Stability studies, steady state Stability studies, voltage Stability studies, electromagnetic transient studies, and Reliability studies, etc.

APPENDIX A3.1: Standard Planning Data

A3.1.1 Historical Energy and Demand

A3.1.1.1 Each User directly connected to the TSP System shall provide to the TSP its actual monthly Energy and Demand consumption at each Connection Point for the immediate past year.

A3.1.1.2 The User shall also provide the TSP with actual hourly load profiles for a TSP-specified weekday, weekend, and holiday for each season of the year.

A3.1.2 Energy and Demand Forecast

A3.1.2.1 The User shall provide to the TSP its Energy and Demand Forecasts at each Connection Point for the current year and the five (5) succeeding years. Where the User System is connected to the Grid at more than one Connection Points, the Demand Data to be provided by the User shall also include the Coincident Peak Active Power Demand.

A3.1.2.2 The Forecast Data for the first year shall include monthly Energy and Demand Forecasts, while for the remaining years shall include only the annual Energy and Demand forecasts.

A3.1.2.3 The User shall also provide to the TSP forecast hourly load profiles for a TSP-specified weekday, weekend, and holiday for each season of the year.

A3.1.2.4 The User shall provide the net values of Energy and Demand Forecast for its System at each Connection Point after any deductions to reflect the output of any Embedded/Captive Generating Units/Station. Such deductions shall be stated separately in the Forecast Data.

A3.1.2.5 Generators shall submit to the TSP their expected Demand to be served by each Generating Unit/Station. Forecast Data for Embedded/Captive Generating Units/Stations shall be submitted through the Distribution Entities, if applicable.

A3.1.2.6 In order to avoid duplication of Forecast Data, each User shall indicate the Energy and Demand requirements that it shall meet under a contract. Where the User shall meet only a portion of the Energy and Demand requirements, it shall indicate in the Forecast Data that portion of the

requirements and/or the portion of the forecast period covered by the contract.

A3.1.2.7 If the User System is connected to the Grid at a Connection Point with a bus arrangement which is, or may be operated in separate sections, the Energy and Demand Forecasts for each bus section shall be separately stated.

A3.1.3 Generating Unit/Station Data

A3.1.3.1 The Generator shall provide to the TSP data relating to the Generating Units of its Generating Station(s).

A3.1.3.2 The Distribution Entities and Directly-connected Customers shall provide the TSP with data relating to the Generating Units of each Embedded/Captive Generating Station, if applicable.

A3.1.3.3 The following information shall be provided for the Generating Units of each Generating Station or Embedded/Captive Generating Units/Station of the other Users:

(i) nominal Capacity rating;
(ii) nominal voltage rating;
(iii) maximum continuous rating;
(iv) emergency rating;
(v) minimum rating;
(vi) speed, except for the Power Park Module;
(vii) type of Generating Unit and expected running mode(s);
(viii) auxiliary Power requirements;
(ix) direct axis sub-transient reactance; except for the Power Park Module;
(x) capability curve; and
(xi) Grounding arrangement.

A3.1.3.4 For the Generating Unit step-up transformer, the following:

(i) rated Capacity;
(ii) rated voltage;
(iii) cooling stages and capacity rating at each stage;
(iv) number of windings and winding arrangement;
(v) voltage ratio;

(vi) tap changer arrangement (on-load/off-load; at HV or LV), range, and step size;

(vii) percentage impedance (positive sequence at maximum, minimum, and nominal tap);

(viii) Grounding arrangement;

(ix) basic lightning impulse insulation level;

(x) Power frequency withstand voltage, required for all (E)HV transformers;

(xi) chopped impulse withstand voltage, required for all transformers rated 230 kV and above; and

(xii) switching impulse withstand voltage, required for all transformers rated 230 kV and above.

A3.1.3.5 If the Generating Unit is connected to the Grid at a Connection Point with a bus arrangement which is, or may be, operated in separate sections, the bus section to which each Generating Unit is connected shall be identified.

A3.1.4 User System Data

A3.1.4.1 The User shall provide the Electrical Diagrams and Connection Point Drawings of its System and the Connection Point, respectively. The Diagrams and Drawings shall indicate the quantities, ratings, and operating parameters of the following:

(i) Equipment (*e.g.*, Generating Units, Power transformers, and circuit breakers);

(ii) electrical circuits (*e.g.*, overhead lines and underground cables);

(iii) Substation bus arrangements;

(iv) Grounding arrangements;

(v) Protection Schemes, their description and maintenance plans;

(vi) interrupting devices;

(vii) phase configuration;

(viii) switching facilities;

(ix) operating voltages; and

(x) numbering and nomenclature.

A3.1.4.2 The User shall provide the values of the following parameters of the overhead lines and/or underground cables from the User System Substation to the Connection Point in the Grid:

(i) rated and operating voltage;

(ii) positive sequence resistance and reactance;

(iii) positive sequence shunt susceptance;

(iv) zero sequence resistance and reactance; and

(v) zero sequence susceptance.

A3.1.4.3 For the User System transformer, the following data shall be provided:

(i) rated MVA;

(ii) rated voltages;

(iii) cooling stages and MVA rating at each stage;

(iv) winding arrangement;

(v) positive sequence resistance and reactance (at maximum, minimum, and nominal tap);

(vi) zero sequence reactance for three-legged core type transformer;

(vii) tap changer location (at HV or LV winding), range, step size, and type (on-load or off-load);

(viii) basic lightning impulse insulation level;

(ix) Power frequency withstand voltage, required for all (E)HV transformers;

(x) chopped impulse withstand voltage, required for all transformers rated 230 kV and above; and

(xi) switching impulse withstand voltage, required for all transformers rated 230 kV and above.

A3.1.4.4 The User shall provide the following information for the switchgear, including circuit breakers, Load Break Switches, and Disconnect Switches at the Connection Point and at the Substation of the User:

(i) rated voltage;

(ii) rated current;

(iii) rated symmetrical RMS short-circuit current;

(iv) rated unsymmetrical RMS short-circuit current;

(v) circuit breaker rated interrupting current;

(vi) circuit breaker rated interrupting time;

(vii) basic lightning impulse insulation level;

(viii) symmetrical short-circuit current withstand time for all circuit breakers;

(ix) Power frequency withstand voltage, required for all circuit breakers;

(x) chopped impulse withstand voltage, required for all circuit breakers and Disconnect Switches rated 230 kV and above; and

(xi) switching impulse withstand voltage, required for all circuit breakers and Disconnect Switches rated 230 kV and above.

A3.1.4.5 The User shall provide the details of its System Grounding. This shall include the rated short time withstand current, zero sequence impedance, and short time rating of the Grounding Equipment.

A3.1.4.6 The User shall provide the data on independently-switched Reactive Power compensation Equipment at the Connection Point and/or at the Substation of the User System. This shall include the following information:

(i) rated Capacity;

(ii) rated voltage;

(iii) type (*e.g.*, shunt reactor, shunt capacitor, static var compensator); and

(iv) operation and control details (*e.g.* fixed or variable, automatic, or manual).

A3.1.4.7 If a significant portion of the User Demand may be supplied from alternative Connection Point(s), the relevant information on the Demand transfer capability shall be provided by the User including the following:

(i) the alternative Connection Point(s);

(ii) the Demand normally supplied from each alternative Connection Point;

(iii) the Demand which may be transferred from or to each alternative Connection Point; and

(iv) the control (*e.g.,* manual or automatic) arrangements for transfer including the time required to effect the transfer for Forced Outage and planned maintenance conditions.

A3.1.4.8 If a User System has Embedded/Captive Generating Stations and significantly large-sized motors, the short circuit contribution of the Embedded/Captive Generating Units and the large motors at the

Connection Point shall be provided by the Distribution Entities (or the other Users). The short-circuit current shall be calculated in accordance with the TSP Standards, or in their absence, the relevant IEC Standards or their equivalent Saudi national standards.

A3.1.4.9 If the User System has fluctuating loads, the following information shall be provided to the TSP:

(i) cyclic variation of Active Power over time;

(ii) cyclic variation of Reactive Power over time;

(iii) maximum rate of change of Active Power;

(iv) maximum rate of change of Reactive Power;

(v) largest step change of Active Power; and

(vi) largest step change of Reactive Power.

A3.1.4.10 If the User System has commutating Power electronic loads, their detail such as number of pulses, maximum voltage notch, and Harmonic distortion potential (up to the 50th Harmonic) shall be provided to the TSP.

A3.1.4.11 If the Generating Units is a Power Park Module, the following additional information shall be provided to the TSP:

i. Number of modules or number of converters, their connecting topology, their expected availability and their type (Self Commutated, Line Commutated,…)

ii. The behavior in case of short circuit and a guideline of how the Power Park Module shall be considered in short circuit calculations based on the existing standards.

Appendix A3.2: Detailed Planning Data

A3.2.1 Generating Unit/Station Data

A3.2.1.1 The following additional information shall be provided for the Synchronous Generating Units of each Generating Station:

(i) de-rated Capacity on a monthly basis, if applicable;

(ii) additional capacity obtainable from Generating Units in excess of Net Declared Capability;

(iii) Minimum Stable Loading ;

(iv) stator armature resistance;

(v) direct axis synchronous, transient, and sub-transient reactances;

(vi) quadrature axis synchronous, transient, and sub-transient reactances;

(vii) direct-axis transient and sub-transient time constants;

(viii) quadrature axis transient and sub-transient time constants;

(ix) turbine and Generating Unit inertia constant ;

(x) rated field current at rated MW and MVAR output and at rated terminal voltage; and

(xi) short circuit and open circuit characteristic curves.

A3.2.1.2 The following Excitation System parameters shall be provided for each Synchronous Generating Unit:

(i) type (static or rotating);

(ii) make and model;

(iii) DC gain of Excitation loop;

(iv) rating (peak voltage/ peak current);

(v) maximum field voltage;

(vi) minimum field voltage;

(vii) maximum rate of change of field voltage (rising);

(viii) maximum rate of change of field voltage (falling);

(ix) details of Excitation loop described in a diagram form showing transfer functions of individual elements;

(x) dynamic characteristics of over-Excitation limiter;

(xi) dynamic characteristics of under-Excitation limiter;

(xii) exciter model (in IEEE or PTI's PSS/E format).

A3.2.1.3 The following Power System Stabilizer (PSS) parameters shall be provided for each Generating Unit:

(i) type of input(s);

(ii) gain for each input;

(iii) lead time constant(s) for each input;

(iv) lag time constant for each input; and

(v) Power System Stabilizer model (in IEEE or PTI's PSS/E format).

A3.2.1.4 The Users shall supply any additional special Protection relays and their settings which take effect in case other than Generating Unit component Faults such as volt/hertz Protection, etc.

A3.2.1.5 The following Speed Governor System parameters shall be provided for each reheat steam Synchronous Generating Unit:

(i) high pressure governor average gain;

(ii) speeder motor setting range;

(iii) speed droop characteristic curve;

(iv) high pressure governor valve time constant;

(v) high pressure governor valve opening limits;

(vi) high pressure governor valve rate limits;

(vii) re-heater time constant (Active Energy stored in re-heater);

(viii) intermediate pressure governor average gain;

(ix) intermediate pressure governor setting range;

(x) intermediate pressure governor valve time constant;

(xi) intermediate pressure governor valve opening limits;

(xii) intermediate pressure governor valve rate limits;

(xiii) details of acceleration sensitive elements in high pressure and intermediate pressure governor loop; and

(xiv) Governor model (in IEEE or PTI's PSS/E format).

A3.2.1.6 The following Speed Governor System parameters shall be provided for each non-reheat steam, or gas turbine Synchronous Generating Unit:

(i) Governor average gain;

(ii) speeder motor setting range;

(iii) speed droop characteristic curve;

(iv) time constant of steam or fuel governor valve;

(v) governor valve opening limits;

(vi) governor valve rate limits; and

(vii) time constant of turbine.

A3.2.1.7 The following Plant flexibility performance data shall be submitted for each Generating Unit:

(i) rate of loading following weekend Shutdown (Generating Unit and Generating Station);

(ii) rate of loading following an overnight Shutdown (Generating Unit and Generating Station);

(iii) block load following synchronizing;

(iv) rate of Load Reduction from normal rated MW;

(v) regulating range; and

(vi) Load rejection capability while still Synchronized and able to supply Load.

A3.2.1.8 The following auxiliary Demand data shall be submitted:

(i) normal station service (auxiliary) load supplied by each Generating Unit at rated MW;

(ii) auxiliary or Start-up Power requirements;

(iii) sensitivity to automatic and planned Interruptions;

(iv) non Generator related on-Site loads;

(v) each Generating Station auxiliary load other than (i) above, and where the station auxiliary load is supplied from the Grid.

A3.2.1.9 The following additional information shall be provided for each module (e.g. converter) of each Power Park Modules:

(i) main equipment model reference

(ii) nameplate AC power rating

(iii) AC output voltage

(iv) maximum AC Voltage

(v) minimum AC Voltage

(vi) maximum inrush current (ratio of inrush/rated current)

(vii) sensitivity of the active power to the voltage at the connection point (dead-band [kV] and droop [kW/kV]

(viii) sensitivity of the active power to the Network (mains) frequency: in case of over frequency (dead-band [Hz] and droop [kW/Hz]

(ix) sensitivity of the active power to the Network (mains) frequency: in case of under frequency (dead-band [Hz] and droop [kW/Hz]

(x) ability of the unit to receive an active power setpoint (upwards and downwards ramping rate [kW/s].

(xi) block diagram (transfer functions, feedback loops, dead-bands and limiters) with the related numerical data of the active power control

(xii) block diagram (transfer functions, feedback loops, dead-bands and limiters) with the related numerical data of the reactive power control

(xiii) Capability in the P(active production)-Q (reactive production) plane of the total installation for different voltage level at the connection point.

A3.2.2 **User System Data**

A3.2.2.1 For all HV motors of size 10,000 HP and above, the following for each such motor:

(i) type;

(ii) MW rating;

(iii) MVA rating;

(iv) Power Factor;

(v) full-load current rating;

(vi) starting method and starting current;

(vii) number of start ups per day;

(viii) torque/speed characteristics for the motor;

(ix) torque/speed characteristics for the relevant load;

(x) inertia constant for the motor and the driven load; and

(xi) dynamic parameters (for synchronous motors).

A3.2.2.2 For each transformer between the Transmission System and the User System, the following:

(i) MVA rating;

(ii) rated voltage ratio;

(iii) winding arrangement and vector group;

(iv) positive sequence resistance and reactance;

(v) zero sequence reactance;

(vi) tap changer type: on-load or off-load;

(vii) tap changer range and step size; and

(viii) Grounding method: direct, resistance or reactance.

A3.2.2.3 To facilitate the TSP to undertake transient over voltage and insulation coordination studies, the TSP may require from a User the following data:

(i) Busbar layout, including dimensions and geometry together with electrical parameters of any associated Current Transformers, Voltage Transformers, wall bushings, and support insulators;

(ii) physical and electrical parameters of lines, cables, transformers, reactors and shunt compensator Equipment connected at that Busbar or by lines or cables to that Busbar.

(iii) specification details of all Apparatus connected directly or by lines and cables to the Busbar including basic insulation levels;

(iv) characteristics of over voltage Protection at the Busbar and at the termination of lines and cables connected at the Busbar;

(v) Generating Unit or Station transformer details (whether three or five limb cores or single phase units) and operating peak flux density at nominal voltage.

A3.2.2.4 For any User Protection Equipment which can trip or inter-trip or close any Connection Point circuit breaker or any TSP circuit breaker, the following data:

(i) full description, including estimated settings, for all relays and Protection Systems installed or to be installed on the User System;

(ii) a full description of any auto-reclose facility installed or to be installed on the User System, including type and time delays;

(iii) a full description, including estimated settings, for all relays and Protection Systems or to be installed on the Generating Unit, Generating Unit transformer, Station transformer and their associated connections;

(iv) for Generating Units having (or intending to have) a circuit breaker at the Generating Unit terminal voltage, clearance times for electrical Faults within the Generating Unit zone;

(v) the most probable Fault clearance time for electrical Faults on any part of the User System directly connected to the Transmission System.

CHAPTER 4 OPERATING CODE

4.1 Chapter Overview

This chapter covers a range of issues relating to the proper operation of the Grid. The provisions of this chapter are organized in to the following 9 sections:

Section 4.2, Operational Demand Forecasts, specifies the procedure to be followed and the data to be supplied by Participants to enable the TSP to prepare Demand Forecasts for different operational time horizons.

Section 4.3, Outage Planning, covers the procedure for coordinating of Planned Outages and unscheduled Outages for the Transmission System and the User facilities to ensure and maintain Reliability and Security on the Grid in accordance with approved standards.

Section 4.4, System Services, deals with arranging and providing of System Services essential for the proper functioning of the Grid, specifically the following:

- Frequency Control;
- Voltage Control;
- System Control;
- Operating Margin; and
- Black Start.

Section 4.5, Operational Liaison, specifies the arrangement regarding reporting of Operations and Events among the Participants and also on the requirements regarding jointly investigating and preparing written reports on Significant Incidents.

Section 4.6, Operational Communication, covers the requirements relating to communication facilities between the Grid Participants for timely exchange of data and information to ensure proper Grid operation.

Section 4.7, Contingency Planning, specifies the necessary requirements to deal with contingencies on the Transmission System and to ensure recovery of the Transmission System from Total or Partial Shutdown.

Section 4.8, Operational Testing, specifies the procedures for arranging of Operational Tests that involve simulating of conditions or the controlled application of irregular, unusual or extreme conditions on the total or part of the System.

Section 4.9, Testing to Monitor, Investigate, and Verify Performance, specifies the procedures to enable the TSP in the monitoring and Testing of Users' compliance with their obligations under the Grid Code and to ensure that the agreed System Services are actually available.

Section 4.10, Cross-boundary Safety Assurance, covers the procedures for coordinating, establishing, and maintaining of Safety Precautions to allow work or Testing to be done across the Connection Point boundary.

4.2 Operational Demand Forecasts

4.2.1 Introduction

4.2.1.1 This section deals with Demand forecasting for operational purposes, and lays down the procedures to be followed and data to be supplied by Users to the TSP to enable the TSP to forecast Demand on the Transmission System for the period ranging from five (5) years ahead down to real time operation.

4.2.1.2 This section also deals with the provision of data on Demand Control in the Operational Planning Phase, the Programming Phase, Control Phase, and the Post Control Phase.

4.2.1.3 The TSP shall be responsible for developing Demand Forecasts for the Operational Planning Phase after taking into account the Demand Forecasts supplied by Distribution Entities and Directly-connected Customers.

4.2.1.4 In the Programming Phase and Control Phase, the TSP shall develop its own Demand Forecasts after taking into account, information to be furnished by Distribution Entities, Directly-connected Customers, and Generators.

4.2.2 Definitions

4.2.2.1 In this section, a reference to Year 0 shall mean the current calendar year, Year 1 shall mean the next calendar year, Year 2 shall mean the calendar year after Year 1, and so forth.

4.2.2.2 A reference to data being supplied on an hourly basis shall refer to it being supplied for each period of 60 minutes ending on the hour.

4.2.2.3 Reactive Power Demand shall include the series reactive losses of the User System bus but exclude any network susceptance and any reactive compensation on that System. The TSP shall obtain the lumped network susceptance and details of the reactive compensation from the data supplied by the User as provided in Chapter 3: Planning Code.

4.2.3 Objectives

The objectives of this section are to specify:

(i) the requirements for Grid Users to provide Demand and Generating Plant output data to the TSP to enable it to plan and maintain sufficient level of Generation Capacity and Operating Margin in the System to meet Demand; and

(ii) the factors which the TSP will consider when forecasting Demand during the Operational Programming and Control Phases.

4.2.4 Data Required by the TSP for Operational Demand Forecasting

4.2.4.1 Each User shall supply data to the TSP in relation to that User's Demand and Active Energy relating to various operational phases as stated in the relevant parts of this section. Figure 4.1 highlights timescales involved with each Phase.

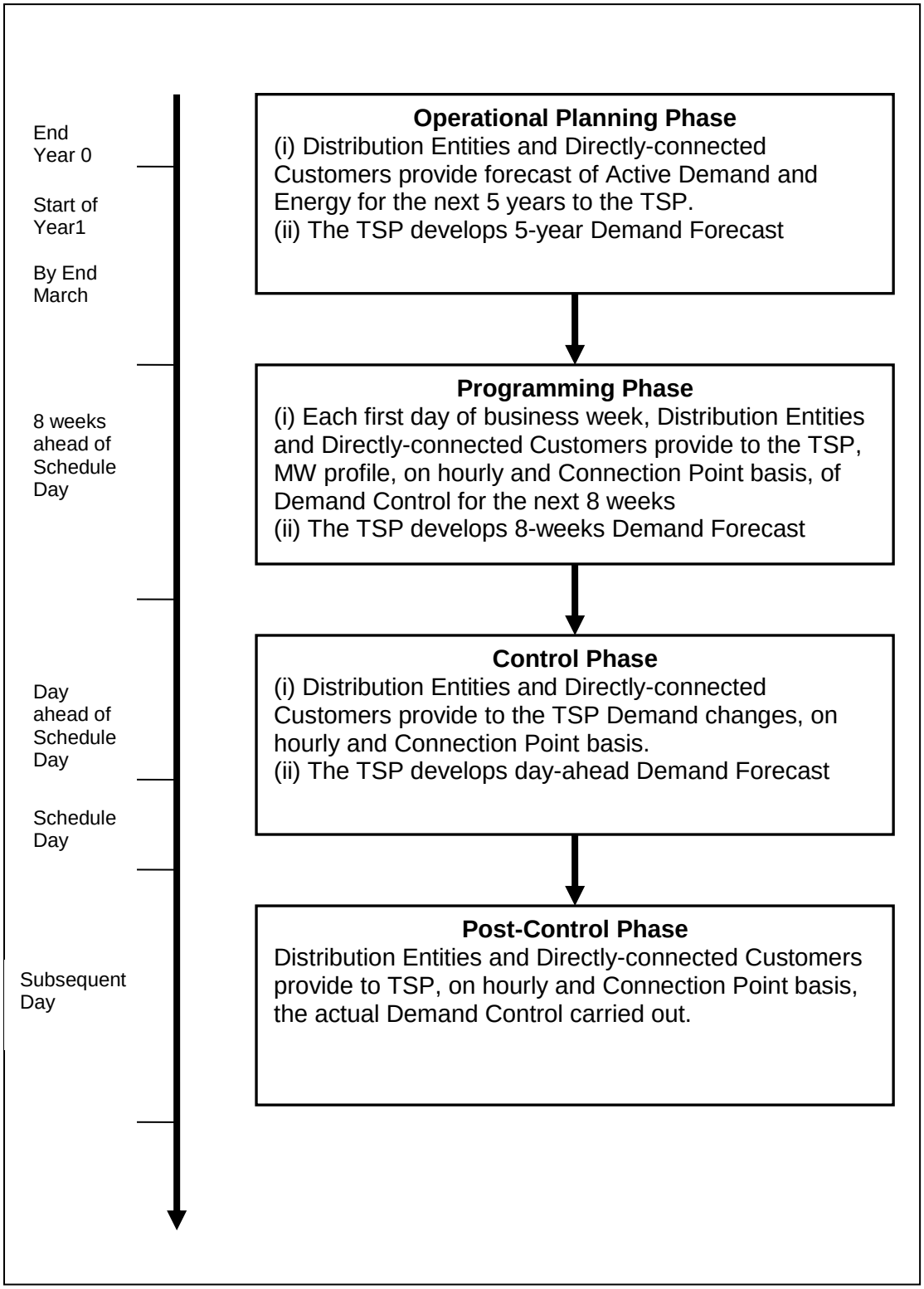

Figure 4.1. Description and time flow of various operational planning phases

4.2.4.2 **Operational Planning Phase (Year 1 to Year 5)**

(i) No later than 31 January each year, the TSP shall notify each User in writing of the following (for the current year and for each of the succeeding five (5) calendar years:

(a) the date and time of its expected annual peak Demand at Annual Maximum Demand Conditions; and

(b) the date and time of its expected annual minimum Demand at Average Conditions.

(ii) By end of March each year, every User, as further elaborated below, shall provide to the TSP in writing, the forecast information listed below for the current year and each of the succeeding five (5) calendar years:

(a) for each Distribution Entity (summed over all Connection Points) and for each Directly-connected Customers (at the Connection Point), the hourly forecast profile of Active Power Demand for the day of that User's Maximum Demand and for the specified day of the annual peak Demand of the TSP, both at their respective Annual Maximum Demand Conditions;

(b) for each Distribution Entity (summed over all Connection Points) and for each Directly-connected Customer (at the Connection Point) the annual Active Energy requirements for Average Conditions segregated into different usage categories such as, residential, commercial, Government, industrial, agriculture, street lighting, hospitals, etc., wherever practicable;

(c) for each Distribution Entity (summed over all Connection Points) and Directly-connected Customer (at the Connection Point) the hourly forecast profile of Active Demand for the specified day of the minimum Demand of the TSP at Average Conditions;

(d) individual Connection Point Demand (Active Power) and Power Factor at Annual Maximum Demand Conditions for the annual peak hour at the Connection Point and at the specified hour of the annual peak of the TSP Demand; and

(e) individual Connection Point Demand (Active Power) and Power Factor at Average Conditions at the specified hour of the annual minimum Demand of the TSP.

(iii) If the Busbar at a Connection Point is expected to be operated in separate sections, separate sets of Forecast Data for each section shall be provided to the TSP.

(iv) The TSP will use the information supplied to it in preparing Forecast Demand information for the next five years and for use in its operational planning.

4.2.4.3 **Programming Phase (1 to 8 weeks ahead of the Schedule Day)**

For 1 to 8 weeks ahead of the Schedule Day, each Distribution Entity and Directly-connected Customer shall supply to the TSP, in writing, by 10:00 hours each first day of business week, hourly MW profiles of the amount and duration of their proposed use of Demand Control which may result in a Demand change of five (5) MW or more on an hourly and Connection Point basis.

4.2.4.4 **Control Phase**

Each Distribution Entity and Directly-connected Customer shall inform the TSP of any Demand Control which may result in a Demand change of five (5) MW or more averaged over any hour on any Connection Point which is planned after 10:00 hours, and of any changes to the planned Demand Control notified to the TSP prior to 10:00 hours as soon as possible after the formulation of the new plans.

4.2.4.5 **Post-Control Phase**

Each Distribution Entity and Directly-connected Customer shall supply to the TSP in writing by 10:00 hours each day Active and Reactive Power data in terms of MW profiles for the previous calendar day of the amount and duration of actual Demand reduction achieved from the use of Demand Control of five (5) MW or more (averaged over any hour on any Connection Point), on an hourly and Connection Point basis.

4.2.5 **Transmission System Forecasts**

4.2.5.1 The following factors will be taken into account by the TSP when conducting Demand Forecasts in the Programming Phase and Control Phase:

(i) historic Demand data including Transmission System losses;

(ii) socioeconomic growth projections of the country;

(iii) weather forecasts and the current and historic weather conditions;

(iv) the incidence of major Events or activities which are known to the TSP in advance;

(v) Embedded Generating Unit/Station Schedules;

(vi) Demand Control of five (5) MW or more proposed to be exercised by Distribution Entities and Directly-connected Customers and of which the TSP has been informed; and

(vii) other information supplied by the Users.

4.2.5.2 The TSP will prepare unbiased forecasts of the Transmission System Demand using a sound forecast methodology which will take into account the above factors to the maximum possible extent.

4.3 Outage Planning

4.3.1 Introduction

4.3.1.1 This section specifies conditions, requirements, and procedures that the TSP and Users shall follow to match Generation Capacity with Forecast Demand on the Transmission System over various operational planning horizons in order to achieve, to the maximum possible degree, the Reliability and Security standards expected of the TSP.

4.3.1.2 The section mainly concerns with the following:

(i) the planning, coordination, and approval of scheduled and un-scheduled Outages of the Generating Unit and the Transmission System; and

(ii) the provision of planning parameters to the TSP by Generators for operational planning purposes only.

4.3.1.3 The provisions of this section shall apply to all proposed Outages that may affect the ability of a Generating Unit to achieve its full Registered Capacity appropriate to each Registered Fuel in accordance with its Registered Operating Characteristics.

4.3.1.4 This section also mandates the Generators to inform the TSP of any other proposed maintenance of a Generating Unit or any associated Power Station Plant or Apparatus, which can affect the availability of System Services from that Generating Unit.

4.3.1.5 In complying with the various provisions of this section, each Grid Participant shall act reasonably, in good faith, and in accordance with Good Industry Practices when planning Outages for its own system and also when coordinating the scheduling of these Outages with those of the others. This will be imperative to avoid a situation arising in which a Participant is obliged to request an Outage during the Outage Planning process as a consequence of that Participant's not having planned its Outages in accordance with Good Industry Practice.

4.3.2 Definitions

In this section, a reference to Year 0 shall mean the current calendar year, Year 1 shall mean the next calendar year, Year 2 shall mean the calendar year after Year 1, and so forth.

4.3.3 Objective

The key objective of Outage Planning is to promote the developing and implementing of an orderly Generation and Transmission Outage Program that is consistent with reliable and secure operation of the Transmission System, and also addresses the needs of the Generators for Plant maintenance and resource limitations. In specific, to define the following:

(i) the procedure for formal notification of Outages by Generators to the TSP; and

(ii) the procedures that the TSP will use to prepare, review, and notify the Indicative, Provisional, and Committed Outage Programs for the Grid.

4.3.4 Planning of Generating Unit Outages

4.3.4.1 The Outage planning process in respect of a Generating Unit shall commence not later than five (5) years prior to the scheduled Operational Date or from the date of the relevant agreements, whichever is the later. The process shall culminate in developing of the following three Programs scheduled over the time scales indicated against each:

(i) Committed Outage Program, covering real time up to end of Year 1;

(ii) Provisional Outage Program, covering Year 2-3; and

(iii) Indicative Outage Program, covering Year 4-5.

The time horizon for planning of Generation Outages is shown in Figure 4.2 below.

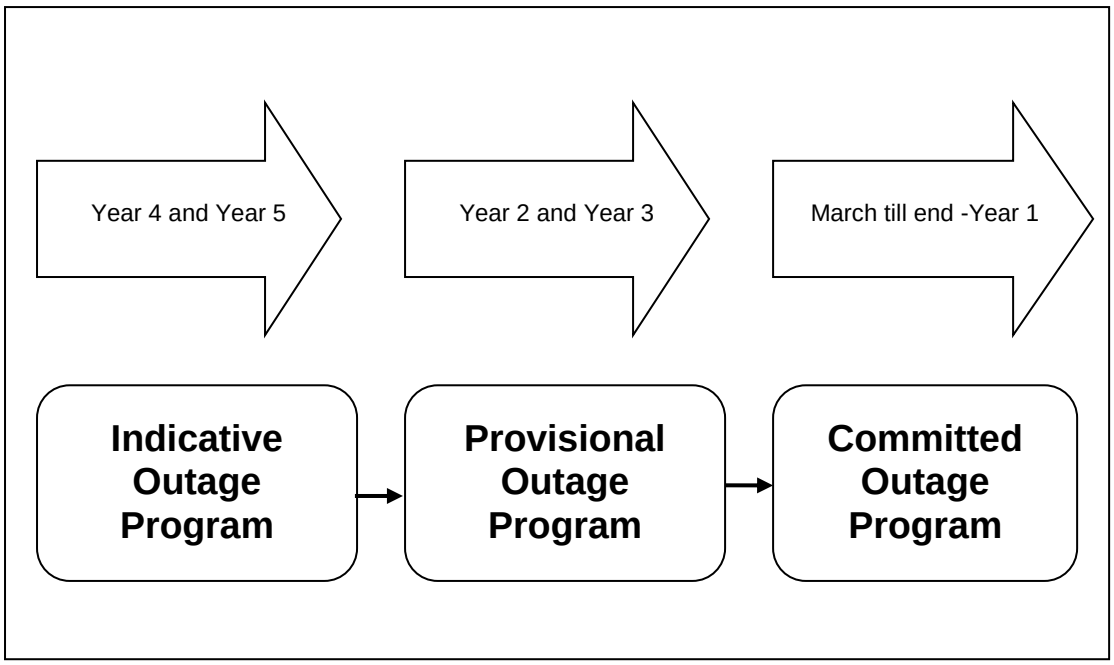

Figure 4.2. Program horizon for Generating Unit Outages

4.3.4.2 In rolling over the Generation Outage Program from one year to the next, for every year (except, in any such case, to the extent that the Generator is reasonably responding to changed circumstances), the procedure set out below is to be followed:

(i) submissions by the Generator for Year 2 should reflect the current Provisional Outage Program for Year 3; and

(ii) submissions by the Generator for Year 1 should reflect the current Provisional Outage Program for Year 2.

4.3.4.3 The procedure set out below is to be followed in each calendar year.

4.3.4.4 **By the end of March Year 0**

(i) Generators shall provide the TSP in writing, for each Generating Unit, the following details of Planned Outages and estimates of probabilities of Forced Outages for including in the Committed, Provisional, and Indicative Outage Programs as defined in (4.3.4.1) above:

(a) identity of the Generating Units concerned;

(b) MW unavailable (and MW that will still be available, if any, notwithstanding the Outage);

(c) expected duration of the Outage;

(d) preferred start date and start time or range of start dates and start times;

(e) whether the Outage is a Flexible Planned Outage or an Inflexible Planned Outage;

(f) if it is a Flexible Planned Outage, the period for which the Outage could be deferred if requested by the TSP, which shall be not less than thirty (30) days in length, and the period for which the Outage could be advanced at the request of the TSP, which shall be not less than ten (10) days in length.

(ii) In relation to (e) above, the Generator must provide the TSP with such evidence as the TSP may reasonably require in order to substantiate the declaration as an Inflexible Planned Outage. If the Generator fails to establish to the reasonable satisfaction of the TSP that the Outage is required to be an Inflexible Planned Outage, the Outage shall be deemed to have been submitted as a Flexible Planned Outage with an attendant Flexible Planned Outage period of ten (10) days for advancement and thirty (30) days for deferment.

(iii) The updates to the program for a previously submitted Year when, by the passage of time, that Year becomes a new Year (for instance, Year 3 becoming Year 2) may only reflect the Generator's reasonable response to changed circumstances and changes which, in the context of the Outage Program, are minimal in their effect on the operation of the Transmission System, otherwise it must reflect the Provisional Outage Program for that Year issued previously.

4.3.4.5 **Between the end of March and the end of September Year 0**

(i) The TSP shall conduct Reliability analysis of the Transmission System for the operational planning horizon in light of the proposed Outages, and calculate the weekly peak Generation Capacity required from Generating Unit/Station for the various planning periods (Year 0, 1, 2, etc.) by considering the following factors:

(a) Demand Forecasts;

(b) the TSP’s estimate of User Demand Control;

(c) the Operating Margin as set by the TSP;

(d) Transmission System and Distribution System constraints; and

(e) Transmission System and Distribution System Outages to ensure that, in general, these have the least restraint on Generating Unit Outages.

(ii) During this period the TSP may, as appropriate, contact any User which has supplied information to seek clarification on information received or such additional relevant information as is reasonable. The TSP shall also notify to Generators any concerns for their submitted Programs and make efforts to settle them through discussion. If these can not be resolved mutually, the TSP shall proceed to settle the issue in accordance with the Regulatory Guidelines for such matters.

4.3.4.6 **By the end of September Year 0**

(i) The TSP will, having taken into account the information notified to it and, having discussed it with Users if appropriate, or settled in accordance with Regulatory Guidelines, provide each Generator and Distribution Entity in writing with a final Outage Program showing the Generating Units that may be potentially withdrawn from service during each week of Years 0,1,2 3,4, and 5 for a Planned Outage and showing the Flexible Planned Outage Periods, by way of amendment to, or confirmation of, the suggested Outage Program submitted by the Generator.

(ii) The final Outage Program may differ from the suggested Outage Program as follows:

(a) the Flexible Planned Outages and Inflexible Planned Outages may have been moved to coordinate all Outage proposals received by the TSP or for reasons relating to the proper operation of the Transmission System. When dealing with Year 2 and subsequent Years, the TSP will give priority to including proposed Inflexible Planned Outages for the dates proposed by the Generator in the case of newly proposed Inflexible Planned Outages and for the dates included in the Outage Program prepared the previous September in the case of Inflexible Planned Outages which were included in that Outage Program; and

(b) a Flexible Planned Outage may have been re-designated as an Inflexible Planned Outage.

(iii) In situations, where the TSP could not otherwise meet its statutory or regulatory obligations, it may request that a Flexible Planned Outage or an Inflexible Planned Outage be either excluded from the Committed or Provisional Outage Program or may be re-scheduled to make it acceptable.

4.3.4.7 **Amendments to Planned Outages**

In the case of:

(i) a Flexible Planned Outages which the TSP would like to move outside the Flexible Planned Outage Period,

(ii) a Flexible Planned Outage which the TSP would like to move within the Flexible Planned Outage Period on less than seven (7) days notice, or

(iii) an Inflexible Planned Outage which the TSP would like to move,

the TSP may, upon giving the Generator a written notice, request that the start date or start time of a Planned Outage be advanced or deferred. If the Generator agrees to such advancement or deferral, or the TSP and the Generator agree to some other advancement or deferral, the Generator will take the Outage in accordance with that agreement.

4.3.4.8 **Generating Unit Substitution**

A Generator may, on reasonable grounds, by notice in writing submitted to the TSP at any time during Year 0, request that a Generating Unit for which there is a Flexible Planned Outage or an Inflexible Planned Outage, as specified in the final Outage Program, remain in service and that one of the other Generating Units at the same Power Station (having substantially the same contracted Generation Capacity and Scheduling and Dispatch Parameters) be permitted to be taken out of service during the period for which such Flexible Planned Outage or Inflexible Planned Outage has been planned. The TSP shall not unreasonably withhold its consent to such substitution and, if the TSP does consent, the final Outage Program shall be amended and the Generator shall be entitled to take the Outage accordingly.

4.3.4.9 **Short Term Planned Maintenance (STPM) Outage**

(i) A Generator may request the TSP at any time during Year 0, by giving not less than seven (7) days notice before the earliest start date, for a

Short Term Planned Maintenance (STPM) Outage. The request notice must contain the following information:

(a) identity of the Generating Unit(s) concerned;

(b) MW on Outage (and MW which would still be available, if any, notwithstanding the Outage);

(c) required duration of the Outage (which must not exceed seventy-two (72) hours); and

(d) preferred start date and start time or range of start dates and start times.

(ii) On receipt of a request, the TSP shall consider the request and shall, after discussing the position with the Generator, reply within three (3) Business Days in writing indicating:

(a) acceptance of the request, confirming the requested start time and duration of the STPM Outage;

(b) proposals for the advancement or deferment of the requested STPM Outage, indicating alternative start time and duration; or

(c) rejection of the request.

(iii) If the TSP accepts the request, the STPM Outage, if taken, must be taken by the Generator in accordance with the request. If the TSP has indicated an alternative start time and/or duration, the TSP and the Generator must discuss the alternative and any other options which may arise during the discussion. If agreement is reached, then the Outage, if taken, must be taken by the Generator in accordance with the agreement. If the request is refused by the TSP or if agreement is not reached then the Generator will not take the Outage.

(iv) If, for a particular Generating Unit, the TSP has rejected the requests on two successive occasions which were not less than seven (7) days apart, the TSP may consider accepting the third request. However, the TSP may require that such Outage, if it is to be during the three months of peak summer Demand, be deferred if in the TSP's reasonable opinion (were the Outage not to be deferred):

(a) the statutory or regulatory obligations could not be met; or

(b) there would otherwise be insufficient Generation Capacity to meet Forecast Demand and the Operating Margin.

(v) Any such deferral shall be for so long as the above circumstances exist, but shall not be beyond the end of the month following the end of the three months of peak summer Demand.

(vi) In the event that an STPM Outage is scheduled pursuant to (4.3.4.9), the TSP shall confirm the details within one (1) Business Day after the details of the STPM Outage have been settled. Such notice shall contain the following information:

(a) the identity of the Generating Unit(s) concerned;

(b) MW on Outage (and MW which would still be available, if any, notwithstanding the Outage);

(c) duration of the Outage; and

(d) the start date and start time of the Outage.

4.3.4.10 **Notified Unplanned Outages**

(i) A Generator must, if it considers that a Generating Unit will require an Outage which cannot reasonably be deferred to become a Planned Outage or a STPM Outage but of which it has some advance warning, give the TSP as much notice as is reasonably possible. Such notice must include an identification of the Generating Unit, the expected start date and start time and duration of the Unplanned Outage, and the nature of the Outage together with the MW on Outage (that is, MW which will not be available as a result of the Outage and that which will still be available, if any). The TSP will acknowledge such notice as soon as reasonably possible after the notice is received by the TSP.

(ii) The TSP may request the Generator to advance or defer the Outage. If the Generator agrees to such a request, the Generator shall send the TSP a written notice confirming this agreement. The TSP will acknowledge this notice. The Generator must then (subject to any intervening Outage) take the Outage in accordance with that agreement.

4.3.4.11 **Forced Outages**

(i) In the event that a Generating Unit suffers a Forced Outage, the Generator shall inform the TSP within ten (10) minutes of the commencement of the Outage. As soon as possible after the commencement of the Outage, the Generator shall also inform the

TSP of the cause of the Outage and the Generator's best estimate of the date and time by which the Generating Unit is likely to be repaired and restored to its full level of Availability. If the Generator is unable for any reason to comply with this requirement, the Generator shall not later than twenty-four (24) hours after the commencement of the Forced Outage, provide the TSP such information as is then known to the Generator regarding the date and time of return from such Outage and shall provide such updates thereafter as the TSP may reasonably require.

(ii) In such an event, the TSP shall have the right to inspect the Generating Unit and all relevant records on any Business Day and at a reasonable time. The Generator shall fully cooperate with the TSP during any such inspection.

(iii) A Generator shall use all reasonable endeavors to ensure that, following a Forced Outage, the Generating Unit is repaired and restored to its full level of Availability as soon as possible and in accordance with Good Industry Practice.

4.3.4.12 **Release of Generating Units**

(i) The Generators may only undertake Planned Outages with the TSP agreement in accordance with the Outage Program produced pursuant to the provisions of this section.

(ii) In real time operation, Generating Units must not be withdrawn for a Planned Outage or a Short Term Planned Maintenance (STPM) Outage without express formal permission of the TSP for such release according to the procedures set out below.

(iii) The TSP's express formal permission shall specify:

(a) the identity of the Generating Unit and MW on Outage (and MW which would still be Available, if any, notwithstanding the Outage);

(b) the duration of the Outage; and

(c) the start date and start time of the Outage.

(iv) The TSP may withhold its permission for the release of a Generating Unit for a Planned Outage or a Short Term Planned Maintenance Outage where such Outage has previously been planned in accordance with this section's provisions where, in the TSP's reasonable opinion (were such Outage not to be deferred):

(a) the statutory or regulatory obligations could not be met; or

(b) there would be insufficient Generation Capacity to meet Forecast Demand and the Operating Margin.

(v) The TSP may require the Generator to continue to defer such Outage for as long as the above situation exists.

4.3.4.13 **Return to Service and Overruns**

(i) For a Planned Outage, not later than seven (7) days before the expiry of the Flexible Planned Outage period or the Inflexible Planned Outage period, the Generator must notify the TSP either that its Generating Unit is returning to service earlier than expected, or at the time and date expected, or later than expected and if, upon return, it is expected to be fully available. Where a Generating Unit is not expected to be fully available upon its return to service, the Generator shall state the MW level at which the Generating Unit is expected to be available. In the case of a Generating Unit which is capable of firing both on gas and on oil, the Availability must be stated for each fuel.

(ii) In the case of a return from a Planned Outage later than expected, the notice of return to service must be given not later than required above and shall state the reason for the delay in the return of the Generating Unit to service and the Generator's best estimate of the date and time at which the Generating Unit will return to service.

(iii) In the case of a return from a Planned Outage earlier than expected, a notice of return to service must be given as far as possible in advance of return, but in any event not later than required above.

(iv) A Generator must use all reasonable endeavors to ensure that, in respect of each Planned Outage of the Generator's Generating Units, the Outage schedule as included in the Committed Outage Program (or as moved in accordance with the provisions of this section) is followed.

(v) Before returning from any Outage other than a Planned Outage, a Generator must inform the TSP, as far in advance as reasonably possible that its Generating Unit is returning to service. The Generator must, in addition, give an Availability Notice in accordance with the provisions of Chapter 5: Scheduling and Dispatch Code on the day

prior to the Schedule Day on which the Generating Unit is to return to service.

(vi) If at any time during an Outage the Generator becomes aware that its Generating Unit will not have been maintained, repaired or restored to be available by the expiry of the period specified for the duration of the Outage in the Committed Outage Program or as otherwise notified in the case of Outages other than Planned Outages, the Generator shall notify the TSP immediately in writing stating the reason(s) for the delay and the Generator's best estimate of the date and time by which the Generating Unit will actually have been maintained, repaired, or restored to be available in accordance with the provisions of Chapter 5: Scheduling and Dispatch Code.

4.3.5 Planning of Transmission System Outages

4.3.5.1 The procedure set out in this subsection shall be followed in each calendar year for planning of Transmission System Outages (see Figure 4.3 below).

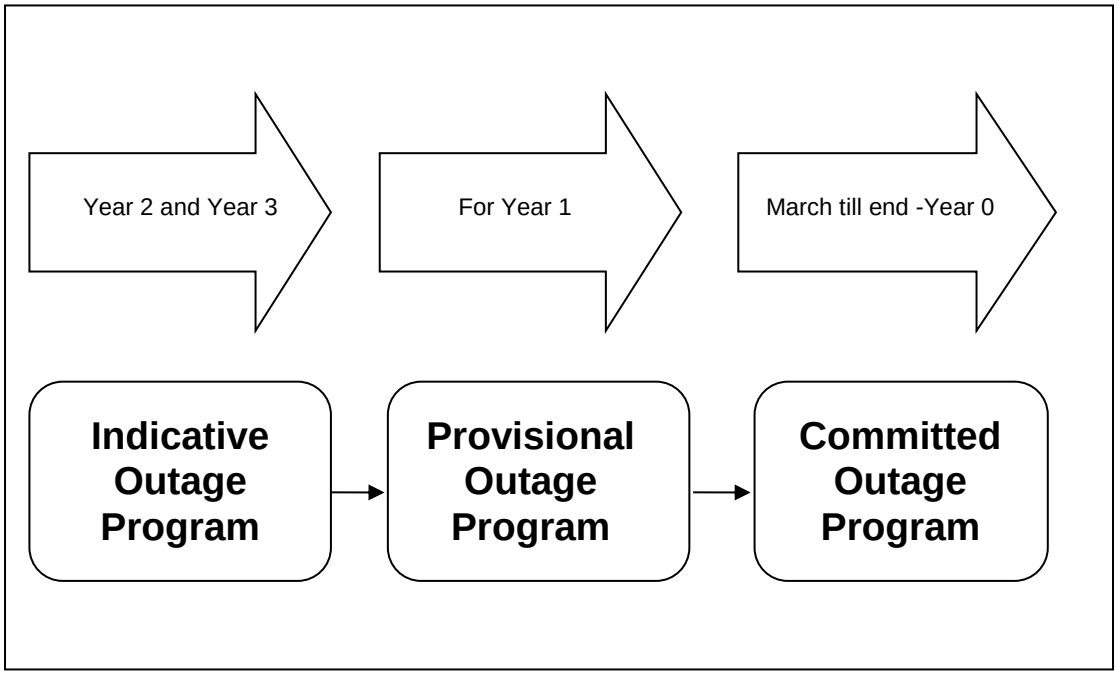

Figure 4.3. Program Horizon for Transmission System Outages

4.3.5.2 The TSP shall plan Transmission System Outages required in Years 2 and 3 as a result of construction or refurbishment works taking due account of the known requirements. The planning of Transmission System Outages required

in Years 0 and 1 ahead will, in addition, take into account Transmission System Outages required as a result of maintenance.

4.3.5.3 Transmission System Outages and Generating Unit Outages shall, during Years 2 and 3 but not in Year 1 or before, be coordinated so that, in general, the Generating Unit Outages shall take precedence over Transmission System Outages but subject always, in any particular case, to the TSP discretion to determine otherwise on the basis of reasons relating to the proper operation of the Transmission System.

4.3.5.4 **Indicative Outage Planning – Planning for Year 2 and 3**

By the end of September Year 0, the TSP will draw up a draft Transmission System Outage Program covering the period Years 2 and 3 for TSP's internal use and will notify each User in writing of those aspects of the draft plan which may operationally affect such User including, in particular, proposed start dates and end dates of relevant Transmission System Outages. The TSP will indicate to a Generator where a need may exist to use inter-tripping or other measures including restrictions on the Scheduling and Dispatch of Generating Units to allow the Security of the Transmission System to be maintained within the statutory or regulatory requirements.

4.3.5.5 **Provisional Operational Planning - Planning for Year 1**

The plan produced pursuant to (4.3.5.4) will become the draft Transmission System Outage Program for Year 1 when, by the passage of time, Year 2 becomes Year 1. Each calendar year, the TSP shall update the draft Transmission System Outage plan and shall, in addition, take into account Outages required as a result of maintenance work.

(i) **By the end of June Year 0**, the TSP will draw up a draft Provisional Transmission Outage Program and will inform each User of any potential restrictions which may affect it and generally the impact on the Transmission System in Year 1.

(ii) Where a User objects to the proposed restrictions or impact notified to it in (i) above, equivalent provisions to those set out in (4.3.4.5[ii]) will apply.

(iii) **Between the end of June and the end of September Year 0**, the TSP will draw up a final Transmission System Outage Plan covering Year 1.

(iv) **By the end of September Year 0**, the TSP will issue the final Transmission System Outage Plan for Year 1. The TSP will notify each User in writing of those aspects of the plan which may operationally affect that User including, in particular, proposed start dates and end dates of relevant Transmission System Outages. The TSP will also indicate where a need exists to use inter-tripping, emergency switching, emergency load management, or other measures including restrictions on the Scheduling and Dispatch of Generating Units to allow the Security of the Transmission System to be maintained within allowable limits.

4.3.5.6 **Committed Outage Planning - Year 0 down to the Programming Phase**

The Transmission System Outage plan for Year 1 issued under section (4.3.5.5) will become the Committed Outage Program for Year 0 when by the passage of time Year 1 becomes Year 0.

4.3.5.7 **Programming Phase**

(i) **By 14:00 hours each last day of business week,** the TSP shall update the Transmission System Outage plan for the following one (1) week period beginning on the first day of business week.

(ii) The TSP will notify each User in writing of those aspects of the plan which may operationally affect such User including in particular proposed start dates and end dates of relevant Transmission System Outage. The TSP will also indicate where a need exists to use inter-tripping, emergency switching, emergency load management, or other measures including, restrictions on the Dispatch of Generating Units to allow the Security of the Transmission System to be maintained within allowable limits.

(iii) During the Programming Phase, the User and the TSP will inform each other immediately if there is any unavoidable requirement to depart from the Outage Plan and actions determined and notified under this subsection.

4.3.6 Data Requirements

4.3.6.1 When requested initially under a Power Purchase Agreement and thereafter by end of December each calendar year, each Generator shall in respect of each of its Generating Units submit to the TSP in writing the Generator Performance Chart and the Generation Planning Parameters to be applied from the beginning of next year onwards, using the schedules provided in Chapter 6: Data and Information Exchange Code. The Generation Planning Parameters shall be used by the TSP for Operational Planning purposes only and not in Scheduling and Dispatch.

4.3.6.2 In the case of a Generating Unit which is capable of firing on two different fuels, the Generator must submit to the TSP, by separate written notifications, the Generation Planning Parameters in respect of each fuel, clearly marked to indicate for which fuel it applies, and also the primary and the standby fuel.

4.3.6.3 The Generator Performance Chart must be on a Generating Unit specific basis at the Generating Unit terminals and must include details of the Generator step-up transformer parameters and demonstrate the limitation on Reactive Power capability of the Transmission System voltage at three (3)% above nominal.

4.3.6.4 For each non-Renewable Resource Generating Unit whose performance varies significantly with ambient temperature, the Generator Performance Chart shall show curves for at least two values of ambient temperature so that the TSP can assess the variation in performance over all likely ambient temperatures by a process of linear interpolation or extrapolation. One of these curves shall be for the ambient temperature at which the Generating Unit output equals its Registered Capacity.

4.3.6.5 For each Renewable Resource Generation whose performance varies significantly as a function of non-controllable external/ environmental parameters, such as (but not limited to) temperature, quantity of dust in the air, wind, solar irradiance, the Generator Performance Chart shall show curves for at least two values for each significant parameter, so that the TSP can assess the variation in performance over all likely values of these parameters by a process of linear interpolation or extrapolation. One of these curves shall be for the reference value at which the Generating Unit output equals its Registered Capacity.

4.4 System Services

4.4.1 Introduction

4.4.1.1 This section deals with System Services which are essential to the proper functioning of the Transmission System, and which also determine the Quality of supply. This section specifically deals with the following System Services:

(i) Frequency Control;

(ii) Voltage Control;

(iii) System Control;

(iv) Operating Margin; and

(v) Black Start.

4.4.1.2 The TSP shall have control over all System Services, that is, it shall determine what System Services are to be provided, when, and by whom. In the case of RRG, the TSP shall coordinate with and instruct the SSECC in relation to System Services. The SSECC shall then implement the TSP's instructions, to the extent possible, in a timely manner.

4.4.2 Objectives

The objectives of this section are:

(i) to establish a policy to ensure Frequency Control capability in the Transmission System for operational control by the TSP, and to set out appropriate procedures to enable the TSP to control the Transmission System frequency and (insofar as possible) maintain it within the limits specified in Chapter 2: Connection Code;

(ii) to set out control strategies to be used by the TSP, in conjunction with Users where appropriate, for controlling the Transmission System voltages;

(iii) to describe the various time scales for which Operating Margins are required, the policy which will govern the Dispatch of the reserves, and the procedures for monitoring the performance of Generating Units and other reserve providers; and

(iv) to set out requirements relating to Black Start Stations to enable the TSP to recover the Transmission System from a Partial or Total Shutdown.

4.4.3 Frequency Control

4.4.3.1 The TSP will achieve Frequency Control through Primary Frequency Control and Secondary Frequency Control, as set out below:

(i) Primary Frequency Control takes place in the period of up to thirty (30) seconds after a change in frequency and is achieved by automatic corrective measures to frequency deviations occurring on the Transmission System. Automatic Primary Frequency Control Actions in response to normal frequency fluctuations, within the levels specified in (2.4.2) on the Transmission System are also commonly termed as "Frequency Regulation".

(ii) frequency deviations, outside the levels specified in (2.4.2) such as those that may occur on the loss of one or more Generating Unit(s), or other MW input into the Transmission System or the Distribution System are corrected through the use of Operating Reserve.

(iii) Secondary Frequency Control takes place in the time scale from 30 seconds up to 10 minutes after the change in frequency. It is provided by a combination of automatic and manual actions.

4.4.3.2 **Generation Speed Governor Systems of Synchronous Generating Units**

(i) To maintain Frequency Regulation capability in the Transmission System, Generators are required to comply with the provisions of this section at all times other than as permitted in exceptional circumstances as laid down in (v) below.

(ii) Generating Units when Synchronized with the Transmission System shall operate at all times under the control of a Speed Governor System, unless otherwise specified by the TSP, with characteristics within the appropriate ranges as specified in Chapter 2: Connection Code;

(iii) No time delays other than those necessarily inherent in the design of the Speed Governor System shall be introduced;

(iv) Governor Systems shall, as a minimum, be fully responsive to frequency deviations exceeding ± 0.05 Hz, except for Renewable Resource Generating Units unless Frequency Regulation is activated on request of the TSP.

(v) The Generator may only restrict the Governor action in some exceptional circumstances, to be agreed with the TSP in advance, when doing so becomes essential for any of the following situations:

(a) for the Safety of personnel and/or to avoid damage to Plant;

(b) to secure the Reliability of the Generating Unit;

(c) the restriction is agreed between the TSP and the Generator in advance;

(d) the restriction is in accordance with a Dispatch Instruction issued by the TSP.

Such actions shall be brought to the notice of the TSP immediately, and the TSP shall record them properly.

4.4.3.3 Frequency Control of Power Park Modules

(i) To maintain Frequency Regulation capability in the Transmission System, Power Park Modules are required to comply with the provisions of this section at all times unless permitted in exceptional circumstances as laid down in (v) below.

(ii) Power Park Modules when connected to the Transmission System shall operate at all times under the control of a Frequency Regulation, unless otherwise specified by the TSP, with characteristics within the appropriate ranges as specified in Chapter 2: Connection Code;

(iii) No time delays other than those necessarily inherent in the design of the Frequency Control shall be introduced;

(iv) Frequency sensitivity shall be activated for any frequency deviations exceeding ± 0.05 Hz, except for Renewable Resource Generating Units when Frequency Regulation service is not activated on request of the TSP.

(v) The Power Park Modules may only restrict the Frequency Control Action in some exceptional circumstances, to be agreed with the TSP in advance, when doing so becomes essential for any of the following situations:

(a) for the Safety of personnel and/or to avoid damage to Plant;

(b) to secure the Reliability of the Power Park Modules;

(c) the restriction is agreed upon between the TSP and the Generator in advance;

(d) The restriction is in accordance with a Dispatch Instruction issued by the TSP.

Such actions shall be brought to the notice of the TSP immediately, and the TSP shall record them properly.

4.4.4 Voltage Control

4.4.4.1 To maintain Transmission System Security and integrity, to avoid damage to the Transmission System and to User Plant, and to maintain voltages at User

Connection Points within the limits specified in Chapter 2: Connection Code, the TSP shall exercise control of the Transmission System voltages.

4.4.4.2 The TSP shall strive to maintain sufficient availability of dynamic and static Reactive Power capability in order to maintain Transmission System voltages at Connection Points within the levels specified in (2.4.3) of Chapter 2: Connection Code, at all times by means of one or more of the following measures:

(i) the charging capacitance of the Transmission System;

(ii) User Mvar Demand;

(iii) Transmission System Mvar losses;

(iv) Generating Unit Mvar production or absorption;

(v) through on-load tap changing of Generating Unit step-up transformer;

(vi) Voltage Control facilities, such as capacitor banks and reactors; and

(vii) dynamic voltage support.

4.4.4.3 **Voltage Control Policy**

The TSP shall control System voltage to minimize system losses and cost of System Services. The TSP shall determine and modify, as appropriate, general procedures for use in controlling voltage on the Transmission System. These procedures shall be formulated with due regard to minimizing cost of the Transmission System operation and optimizing System Safety and Reliability. In particular, the Voltage Control shall take cognizance of the daily, weekly and seasonal factors, and the TSP shall determine:

(i) suitable target voltages in order to limit/control the effect of Transmission capacitance;

(ii) best utilization of dedicated Voltage Control facilities; and

(iii) Mvar dynamic reserve requirements.

4.4.4.4 **Voltage Control Methods**

(i) The TSP shall continuously monitor the Transmission System voltages. Appropriate voltage monitoring points shall be determined by the TSP, taking account of the Voltage Control policy and in particular of the Transmission System conditions pertaining at the time of operation.

(ii) The TSP shall adjust Transmission System voltages, using control facilities that are available so as to achieve the Mvar Capacity

necessary in order to operate the Transmission System voltages at Connection Points within the levels specified in (2.4.3) and retain a dynamic Mvar capability to deal with changing System conditions which result from changes in Demand or changes in Transmission or Generation configuration, whether as a result of Control Actions or Faults.

(iii) The Excitation System of each Synchronous Generating Unit shall be operated under the control of a continuously acting Automatic Voltage Regulator (AVR), which shall be set so as to maintain a constant terminal voltage. The Generator may not disable or restrict the operation of the AVR except in accordance with (iv) below, in which event the Generator shall notify the TSP immediately.

The Automatic Voltage and Reactive Power Regulator System of each Power Park Module shall be operated under the control mode and with the set point agreed with the TSP (according to Ch. 2). The Generator may not disable or restrict the operation of the Automatic Voltage and Reactive Power Regulator Systems except in accordance with (iv) below, in which event the Generator shall notify the TSP immediately.

(iv) The Generator may only disable or restrict the AVR action where:

(a) the action is essential for the Safety of personnel and/or Plant;

(b) in order to (acting in accordance with Good Industry Practice), secure the Reliability of the Generating Unit; or

(c) the restriction is agreed between the TSP and the Generator in advance.

In case the TSP either agrees to a restriction in AVR action or instructs such a restriction, the TSP shall record the nature of the restriction, as well as the reason(s), time of occurrence, and the duration of the restriction.

(v) In situations when the Generating Unit is not operating under AVR, the TSP may impose restrictions on the operation of the Generating Unit in accordance with Good Industry Practice, to the extent necessary to provide for safe and secure operation of the Transmission System within prescribed standards, including where necessary instructing the Generator to De-energize the Generating Unit. Where the TSP takes

such action, the TSP shall consult with the Generator as soon as practicable in order to determine a safe operating regime, which causes minimum restriction on the operation of the Generating Unit.

(vi) The TSP shall, by means of Dispatch Instructions (as detailed in Chapter 5: Scheduling and Dispatch Code), instruct Generators to adjust the Reactive Power output of Generating Units, and the relevant provisions of Chapter 5 shall apply.

(vii) Other facilities which shall be utilized by the TSP, where appropriate, in order to exercise Voltage Control shall include one or more of the following:

(a) switching *in* or *out* of dedicated Voltage Control facilities, such as capacitor banks and reactors;

(b) tap-changing on (E)HV Transmission System transformers; and/or

(c) switching out of Transmission (E)HV cables (and occasionally Transmission lines) in order to reduce the capacitive contribution of the Transmission System.

(viii) The TSP may, occasionally, reschedule Generating Units away from their Nominations in order to achieve Transmission System voltages at Connection Points within the levels specified in (2.4.3). However, the TSP will resort to such rescheduling only to deal with emergencies or contingencies that threaten the Stability and Security of the Transmission System.

4.4.4.5 **Emergency or Exceptional Voltage Control**

Additional Voltage Control mechanisms may be utilized in the event of System Emergency Conditions. These shall include (but not limited to) the following:

(i) Generators may be requested to operate Generating Units at Mvar production or absorption levels outside their currently Declared Operating Characteristics. This will be done by agreement between the Generator and the TSP;

(ii) the TSP may also effect changes in System voltage by instructing, as a form of Dispatch Instruction, the Generators to carry out a tap-change on the main Generator transformer of several Generating Units simultaneously; and

(iii) Demand Control may be used to prevent voltage from contravening the low voltage limits as specified in (2.4.3) at the Connection Points.

4.4.5 **System Control**

4.4.5.1 In implementing the Transmission Outage Program, in normal operation of the Transmission System, and in responding to Emergency and Fault situations on the Transmission System, the TSP may need to carry out network switching and Control Actions which may, from time to time, affect the operations of Users or Security of supply to Users.

4.4.5.2 Operational network switching may be required by the TSP for a number of purposes including the following:

(i) Outages of Transmission Plant and/or Apparatus for the purposes of maintenance, new works, Operational Tests, Protection Testing, and work by Users;

(ii) Outages of Transmission Plant and/or due to suspected or potential Faults and Emergency repairs;

(iii) Voltage Control; or

(iv) limiting Power flows on the Transmission System to levels consistent with the capabilities of the Transmission Plant and System Security.

4.4.5.3 System switching may also occur automatically and without advance warning due to operation of Protection schemes in isolating or clearing of Faults on Transmission Plant or on User Plant which is connected to the Transmission System.

4.4.5.4 Automatic switching sequences may also be established to limit Power flows or voltage or frequency deviations in the event of Faults elsewhere on the Transmission System.

4.4.5.5 **Notification to Users of Control Actions**

(i) The TSP will only inform the User of a Control Action on the Transmission System if the Control Action has (or expected to have) a Material Effect for the User.

(ii) Where the TSP is unable to inform the Users prior to the Control Actions, then the provisions of (4.4.5.6) shall apply.

(iii) Where it is identified and agreed, in accordance with the terms of the Connection Agreements and/or operating agreements, between the TSP and a User that a specific Control Action (usually an action

affecting the Transmission System configuration) has an Operational Effect on a User and that there is merit in notifying the User in advance of the Control Action, then the TSP will notify the User of the Control Action (if planned and where time permits), in accordance with any standing agreement with the User.

(iv) Typical examples of actions notified in accordance with (iii) above may include:

(a) notification to Users of a significant reduction in supply Security to a Connection Point, where the User may arrange standby feeding arrangements at lower voltages; and/or

(b) notification to a Directly-connected Customer of a significant reduction in supply Security to a Connection Point (such as the Outage of one of two Connections) where the Directly-connected Customer may arrange standby supply or run in-house Generation.

4.4.5.6 **Control under Fault or Emergency Conditions**

(i) In the event of a System Fault or Protection operation or other automatic operation, it will not be possible to invoke standing procedures in accordance with (4.4.5.5) prior to the occurrence of the Control Action.

(ii) In the circumstances referred to above or in the event that the TSP needs to implement Control Actions urgently and without informing Users, then unless the situation is of a temporary nature and has been rectified to normal, the TSP shall inform Users of the occurrence of the actions**.**

(iii) The TSP shall also inform the Users as to the likely duration of the condition and shall update this prognosis as appropriate. The TSP shall additionally inform the Users when the condition no longer prevails.

4.4.5.7 **De-energization of Users by the TSP**

(i) The TSP may have to De-energize a User's Plant and Apparatus from time to time if, and to the extent, that the TSP reasonably considers it necessary in order to provide for safe and secure operation of the

Transmission System in circumstances which otherwise cause or likely to cause one or more of the following:

(a) risk to the Safety of personnel;

(b) risk to the Stability of the Transmission System;

(c) risk to the Transmission System or any User's Plant and/or Apparatus;

(d) Transmission System elements to become loaded beyond their emergency limits;

(e) voltage excursions on the Transmission System outside the ranges specified in (2.4.3) of Chapter 2: Connection Code;

(f) any behavior causing sustained operation outside the normal Transmission System operating frequency range;

(g) any material breach of a Connection Condition; or

(h) any action or inaction which places the TSP in breach of any statutory or regulatory obligation.

(ii) The TSP will notify the relevant User ahead of time about the De-energization, wherever it is practicable for the TSP, to allow the User an opportunity and reasonable time to remedy/rectify the problem. In extreme situations, however, when there is an imminent threat to the Stability and Security of the System, the TSP will not be obliged to notify the User ahead of the De-energization.

4.4.6 Operating Margin

4.4.6.1 In order to deal with Demand Forecast uncertainties and to safeguard against a sudden loss of Generation from the Transmission System, it is imperative that a suitable Operating Margin be maintained through the Control Phase. Operating Margin is required to have Capacity available in the System that can be utilized for reliable and secure balancing of supply and Demand.

4.4.6.2 Operating Margin is the additional output from Generating Plants or Demand Control which is realizable in real time to aid in containing and correcting any System frequency falling to an acceptable level due to loss of Generation or a mismatch between supply and Demand.

4.4.6.3 The Operating Margin consists of Operating Reserve (further divided into 3 categories, Primary, Secondary, and Tertiary Operating Reserve) and Contingency Reserve as further elaborated in the following paragraphs.

4.4.6.4 **Operating Reserve**

Operating Reserve's definitions relate to the time elapsed from the occurrence of an Event which has initiated a frequency disturbance. The definition of the time at which the Event is deemed to have occurred and other associated definitions are addressed in the terms and condition laid down under Operating Margin Policy.

(i) **Primary Operating Reserve**

(a) Generating Units providing Primary Operating Reserve for Frequency Regulation as a System Service shall operate in an automatic Frequency Sensitive Mode (also known as free-governor mode in the case of Synchronous Generating Units) for automatic response of the Unit's Power output to changes in frequency.

The Speed Governor Systems of the Synchronous Generating Unit shall have a maximum response time of five (5) seconds.

The Active Power response of Power Park Modules to frequency deviations (Frequency Regulation) shall respond as fast as technically feasible with an initial delay that shall be as short as possible and no greater than two (2) seconds.

The automatic change in Active Power output of a Generating Unit shall also increase or decrease in response to a System frequency decrease or increase.

(b) The Positive Primary Response is the automatic increase in Active Power output of a Generating Unit in response to a System frequency fall in accordance with the Primary Control capability and additional mechanisms for releasing Active Power. The Negative Primary Response is the automatic decrease in Active Power output of a Generating Unit in response to a System frequency rise in accordance with the Primary Control capability and additional mechanisms for reducing Active Power output.

(ii) **Secondary Operating Reserve**

Secondary Operating Reserve is the additional MW output (and/or reduction in Demand) required compared to the pre-Incident output (or

Demand), which is fully available and sustainable over the period from 15 to 90 seconds following an Event.

(iii) **Tertiary Operating Reserve**

Tertiary Reserve is further divided into Band 1 and Band 2, as explained below:

(a) **Band 1**: additional MW output (and/or reduction in Demand) required compared to the pre-incident output (or Demand) which is fully available and sustainable over the period from ninety (90) seconds to five (5) minutes following an Event.

(b) **Band 2:** additional MW output (and/or reduction in Demand) required compared to the pre-Incident output (or Demand) which is fully available and sustainable over the period from five (5) minutes to thirty (30) minutes following an Event.

4.4.6.5 **Contingency Reserve**

Contingency Reserve is the margin of available Generation Capacity over Forecast Demand, which is required in the period from twenty-four (24) hours ahead down to real time, to cover against uncertainties in availability of Generation Capacity and also against weather forecast and Demand Forecast uncertainties. Contingency Reserve is provided by Generating Plant which is not required to be Synchronized, but which must be held available to Synchronize with the System within a limited time scale.

4.4.6.6 **Operating Margin Policy**

Operating Reserve

(i) The TSP shall determine the amount of Primary Operating Reserve, Secondary Operating Reserve, and Tertiary Operating Reserve to be carried at any time to ensure system Security. Due consideration will be given to relevant factors, including but not limited to the following:

(a) the relevant TSP operating policy in existence at that time;

(b) the extent to which User Disconnections allowed under the relevant standard have already occurred within the then relevant period;

(c) the elapsed time since the last User Disconnection Incident;

(d) particular events of national or widespread significance, which may justify provision of additional Operating Reserve;

(e) the cost of providing Operating Reserve at any point in time;

(f) the magnitude and number of the largest Generation infeeds to the Transmission System at that time, including infeeds over external interconnections and also over single Transmission feeders within the Transmission System;

(g) ambient weather conditions, insofar as they may affect (directly or indirectly) Generating Unit and/or Transmission System Reliability; and

(h) the predicted frequency drop on the loss of the largest infeed as may be determined through simulation using a dynamic model of the Power System.

(ii) The TSP shall keep records of significant alterations to the Operating Margin policy as and when such alterations occur.

Responsibilities of the TSP in respect of Operating Reserve

(iii) The TSP shall, in accordance with Good Industry Practice, Dispatch Generation and otherwise operate the Transmission System in compliance with the TSP's determinations as to the Operating Margin Policy made from time to time.

(iv) The TSP's sole responsibility, having met its obligations under the preceding provisions of this subsection, shall be to, acting in accordance with Good Industry Practice, Dispatch such Generating Units as are required to meet:

(a) System Demand; and

(b) the level of Operating Reserve required by the TSP's then Operating Margin policy.

Contingency Reserve

(v) The TSP shall determine the amount of Contingency Reserve required for each time scale up to 24 hours ahead, taking due consideration of relevant factors including but not limited to the following:

(a) historical Availability and Reliability performance of individual Generating Units;

(b) notified risk to the Reliability of individual Generating Units; and

(c) Demand Forecast uncertainties.

4.4.7 Black Start

4.4.7.1 In order to recover the Transmission System from a Partial or Total Shutdown, it is necessary to have certain Generating Stations (Black Start Stations) available which have the ability for at least one of their Generating Units to Start-Up from Shutdown and to Energize a part of the System, Synchronize to the System, and Energize dead bus, upon instruction from the TSP within two (2) hours, without an external electrical Power supply.

4.4.7.2 In order to maintain Security on the Transmission System at all times, Black Start Stations are required to comply with the provisions of this subsection.

4.4.7.3 The Generating Units agreeing to provide Black Start capability must provide frequency and voltage within the prescribed limits during line Energization and remote load pick up.

4.4.7.4 The TSP shall verify the actual performance of Black Start capability in the event actual system Blackout conditions occur.

4.4.7.5 Generators providing Black Start capability will also be required to provide voice and communication facilities linked with the TSP and capable of operating without an external AC Power supply for the period as specified by the TSP in the relevant agreement.

4.4.7.6 **Requirements of Black Start Stations**

Other than as permitted in accordance with (ii) below:

(i) During a Black Start situation, instructions relating to Black Start Stations will be in the format required for instructions to Generating Units in Chapter 5: Scheduling and Dispatch Code, and will recognize any differing Black Start operational capabilities (however termed) set out in the relevant System Services Agreement in preference to the Declared operational capability as registered pursuant to Chapter 5: Scheduling and Dispatch Code. For the purposes of these instructions, the Black Start will be an emergency circumstance. For Generating Units which are not Black Start Units, Dispatch Instructions will recognize each Unit's Declared operational capability as registered pursuant to Chapter 5: Scheduling and Dispatch Code.

(ii) If during the Demand restoration process, any Black Start Unit cannot, because of the Demand being experienced, keep within its safe operating parameters, the Generator shall inform the TSP immediately. The TSP will, where possible, either instruct Demand to be altered or will re-configure the Transmission System or will instruct a User to re-configure its System in order to alleviate the problem being experienced by the Generator. However, the TSP acknowledges that any decision to keep a Unit operating outside its safe operating parameters, is one for the Generator concerned alone to make and understands that the Generator may change Generation on that Unit if it believes that it is necessary for Safety reasons (whether relating to personnel, Plant, and/or Apparatus). If such a change is made without prior notice, then the Generator shall inform the TSP as soon as reasonably practical.

(iii) The Generator shall report to the TSP all the required operational procedures to operate the Black Start Unit.

4.5 Operational Liaison

4.5.1 Introduction

This section specifies the procedure and terms and conditions of Operational Liaison between the TSP and the Users of the Transmission System to ensure that the emergencies do not jeopardize the operation of the Transmission System or the health of Plant and Equipment.

4.5.2 Objectives

The objectives of this section are the following:

(i) to provide a mechanism of coordination between all Participants to ensure that communication of Operations, Events, and Significant Incidents among them is *timely* and *effective* to minimize the implications of such events on the integrity of the Transmission System;

(ii) to specify the Significant Incident reports to be issued by the TSP to Users, and by Users to the TSP, if any Significant Incident has occurred on the Transmission System or the User System; and

(iii) to specify the procedure that the TSP shall adopt to investigate any Significant Incident that materially affected the Quality of service to another Participant.

4.5.3 Procedure for Notification of Operations, Events, and Significant Incidents

4.5.3.1 The TSP shall notify an Operation, Event, and/or Significant Incident on the Transmission System which may have an Operational Effect on the System of any other Users.

4.5.3.2 A User shall notify an Operation, Event, and/or Significant Incident on the System of that User which may have an Operational Effect on the Transmission System. On notification by the relevant User, the TSP will notify any other User(s) on whose System(s) the Operation, Event, or Significant Incident will (or, in the TSP's opinion, may) have an Operational Effect.

4.5.3.3 **Timing and Form of Notification**

A notification (via an acceptable medium) under this section shall be given as far advance as practicable and shall be of sufficient detail to describe the Operation and to enable the recipient of the notification reasonably to consider and assess the implications and risks arising and will include the name of the individual reporting the Operation on behalf of the TSP or the User, as the case may be.

4.5.4 Significant Incidents

Where a User notifies the TSP pursuant to this section of an Event which the TSP considers has had or may have had a significant effect on the Transmission System, the TSP will require the User to report that Event in writing in accordance with the provisions of this section. Such Event will be termed a "Significant Incident" and may include the following:

(i) voltage outside operational limits;

(ii) System frequency outside statutory limits;

(iii) Load Disconnection;

(iv) islanding conditions; and

(v) System instability.

4.5.5 Yellow Alert

4.5.5.1 A Yellow Alert, further defined in (4.7.4), will be issued by the TSP (subsequently to be confirmed in writing) to Users who may be affected when the TSP realizes that there is a risk of widespread and serious disturbance to the whole, or a part of, the Transmission System.

4.5.5.2 The Yellow Alert will contain such information as the TSP deems appropriate.

4.5.5.3 For the duration of a Yellow Alert, each User receiving the Yellow Alert shall take necessary steps to warn its operational staff and maintain its Plant and/or Apparatus in the condition in which it is best able to withstand the anticipated disturbance.

4.5.6 Significant Incident Reporting Procedure

4.5.6.1 A Significant Incident Notice shall be issued by the TSP or a User, as the case may be, as soon as possible after the occurrence of the Significant Incident, and shall identify the following, if possible:

(i) date, time, and location of the Incident;

(ii) brief description of the Incident;

(iii) expected impact;

(iv) expected time to restore; and

(v) cause, if known.

4.5.6.2 The TSP shall investigate any Significant Incident that materially affected the Quality of service to another User. These may include Interruptions of supply, Disconnections, under or over voltage or frequency Incidents, or Quality of supply contraventions, etc. A preliminary Significant Incident Report shall be available after fifteen (15) working days and a final Significant Incident Report within two (2) months. The TSP shall initiate and coordinate such an investigation, arrange for the writing of the report, and involve all Affected Users. The Users shall make all relevant information available to the TSP and participate in the investigation where reasonably required. The TSP shall make the report available (if requested) to any User within the confidentiality constraints.

4.5.6.3 The Users shall prepare and submit to the TSP monthly Operations Reports on Grid operation. These reports shall include an evaluation of the Operations, Events, Significant Incidents, and any other problems that occurred on the Grid during the previous month, the measures undertaken by the Users to address them, and the recommendations to prevent their

recurrence in the future. The Users shall prepare and submit to the TSP quarterly and annual Operations Reports also. These reports shall include the Operations, Events, and Significant Incidents that had a Material Effect on the Transmission System or the System of any User (as the case may be) during the past quarter or the year.

4.6 Operational Communication between the TSP and Users

4.6.1 Introduction

To ensure proper operation and control of the Transmission System, standard and efficient communication links and facilities between the Users and the TSP are imperative. This section specifies the details of the communication facilities required between the TSP and Users and also establishes the procedure to be used by the TSP and Users to ensure timely exchange of information to enable the TSP to discharge its obligations regarding the operation of the Transmission System.

4.6.2 Objectives

The objectives of this section are the following:

(i) to establish contact locations for the TSP and the User;

(ii) to detail the communication facilities required between the TSP and the User;

(iii) to establish the procedures for exchange of information between the TSP and the User; and

(iv) to establish the general procedures for the authorization of the TSP and User personnel to act on behalf of their respective entities in the communication of information between the TSP and the User.

4.6.3 Contact Locations and their Adequacy

4.6.3.1 The contact location between the TSP and the User for communicating on matters pertaining to Transmission System operation shall be the TSP Control Center for the TSP, and the User Control Center for the User.

4.6.3.2 The User is required to establish and maintain a Control Center that shall be staffed at appropriate levels at all times.

4.6.3.3 The User shall designate a Responsible Engineer at its Control Center who shall respond to communications from the TSP without undue delay. The User’s Responsible Engineer should have adequate experience and training,

and must be authorized to perform the following operations on behalf of the User:

(i) to receive and acknowledge receipt of a given instruction from the TSP; and

(ii) to accept and execute instructions from the TSP.

4.6.3.4 The User's contact locations and personnel (including their electronic mailing addresses, if any) shall be notified by the Users to the TSP prior to Connection and updated thereafter as appropriate.

4.6.3.5 If the TSP Control Center or the User Control Center is moved to another location, the TSP shall notify the Users or the relevant User shall notify the TSP (as the case may be) without delay of the new location and any changes to the communication facilities necessitated by such a move.

4.6.3.6 The communications (other than relating to the submission of data and notices) between the TSP and the User shall take place between the TSP Control Engineer and the relevant User's Responsible Engineer as provided in section (1.12) in Chapter 1: General Conditions.

4.6.3.7 Each User shall have one telephone and one facsimile unit on separate lines reserved for operational purposes only, which must be continuously attended to and answered without undue delay.

4.6.3.8 The TSP and Users shall keep all Operational Data communicated between them as confidential.

4.6.4 Communication Systems and Equipment

4.6.4.1 For communication between the TSP and Users, SCADA and other communication facilities for voice as well as data transmission shall be provided. These facilities shall be designed, maintained, upgraded, and kept compatible with the SCADA and Communication facilities of the TSP, in accordance with the terms and conditions and standards as laid down in the relevant Connection Agreement.

4.6.4.2 The TSP shall provide (at the cost of the relevant User) the SCADA system for monitoring real time information and controlling the Equipment at facilities of respective sides.

4.6.4.3 All Users shall provide a TSP approved voice communication service to provide both primary and alternate communication link between the TSP and the operator controlling the User facility.

4.6.4.4 All Users shall provide monitoring and recording instruments at their respective sides connected to the Transmission System.

4.6.4.5 All communication facilities shall be constructed, operated, and maintained according to the TSP standards for such facilities, or in their absence, to relevant standards of the International Telecommunication Union (ITU), IEC, or their Saudi national equivalents.

4.6.5 Conditions of Monitoring and Recording Equipment

4.6.5.1 The TSP shall provide SCADA outstation interface Equipment. The User shall provide such voltage, current, frequency, Active Power and Reactive Power measurement outputs and Plant status indications and alarms to the TSP SCADA outstation interface Equipment as required by the TSP in accordance with the terms and conditions of the relevant Connection Agreement.

4.6.5.2 Active Power and Reactive Power measurements, circuit breaker and Disconnector status indications from Generating Units must each be provided to the TSP on an individual Generating Unit basis.

4.6.5.3 The manner in which information is required to be presented to the outstation Equipment shall be set out in the relevant Connection Agreement.

4.6.5.4 The TSP shall provide Data Acquisition Systems, Disturbance Recorders, and/or Event Loggers (as the case may be) for recording the performance of the Transmission System.

4.6.5.5 Monitoring Equipment shall be provided on the Transmission System by the TSP to monitor the System dynamic performance.

4.6.6 SCADA Systems

4.6.6.1 The SCADA system should be capable of exchanging the System status and data from the TSP to the User, and *vice versa*.

4.6.6.2 Participants shall interface via the standard digital interfaces. Interface cabinets shall be installed in the Participant's Plant and Equipment room. The provision and maintenance of the wiring and signaling from the Participant's Plant and Equipment to the interface cabinets shall be the responsibility of the Participant.

4.6.6.3 The information exchange shall support data acquisition from remote terminal units (RTUs). The TSP should be able to monitor the system status and data via telemetry from the RTUs connected to the Users' Plant.

4.6.6.4 The TSP shall have the capability to deactivate and reactivate the scanning of a given RTU, as well as the capability of monitoring the availability of all RTUs from a central location.

4.6.6.5 All communication facilities (including SCADA) shall be secured against unauthorized access. The TSP shall agree with the User, the procedures governing security and access to the User's SCADA, computer, and communication facilities. The procedures shall allow access to the Equipment and information by the TSP or its nominated representative(s) for the purposes of maintenance, repair, testing, and reading of meters.

4.7 Contingency Planning

4.7.1 Introduction

4.7.1.1 In Emergency situations, the Security of the Transmission System can come under abnormal stresses and the electricity supply systems can suffer Partial or Total Shutdown. To deal with such eventualities, and to ensure that the System gets back to its normal state as quickly and safely as practicable, the instructions and procedure established in this section shall be followed by the TSP and Users.

4.7.1.2 The TSP shall include Generators providing Black Start capability in conducting System-wide training and drills, as considered necessary by the TSP to re-Energize the Transmission System following a Partial or Total System Shutdown.

4.7.1.3 Any emergency drills conducted by either the TSP or the User shall be coordinated between the TSP and the relevant User, and also with any other Affected User(s).

4.7.2 Objective

The objective primarily is to ensure that in the event of a Partial or Total Shutdown of the Transmission System, normal supply is restored to all the Users as quickly and safely as practicable in accordance with Good Industry Practices.

4.7.3 Terms and Conditions

4.7.3.1 Emergency Plans shall allow for quick and orderly recovery from a Partial or Total Shutdown, with minimum impacts on the Users.

4.7.3.2 All Contingency and/or Emergency Plans shall be periodically verified by actual tests to the greatest practical extent. When such tests can cause undue risk or undue cost to a User, the TSP shall take such risks or costs into consideration when deciding whether to conduct the tests or not. Tests shall be carried out at a time that is least disruptive to the Participants. The costs of these tests shall be borne by the respective asset owner(s). The TSP shall ensure the coordination of the tests in consultation with all Affected Users.

4.7.3.3 Users shall comply with the TSP's requirements for Contingency and Emergency Plans.

4.7.3.4 The TSP shall set the requirements for Automatic and Manual Load Dropping after consulting and agreeing on the schedules with the Users. The Users shall make available options and schemes to comply with these requirements.

4.7.3.5 The TSP shall be responsible for determining all operational limits on the Transmission System, updating these periodically, and making these available to the User.

4.7.3.6 The TSP shall conduct necessary system studies regularly to determine the effect that various component failures would have on the Reliability of the Transmission System. At the request of the TSP, Distribution Entities shall also perform requisite system studies on their part(s) of the network and make the results available to the TSP.

4.7.3.7 Following Emergency operations as may be necessary to protect the integrity of the Transmission System or the Safety of Equipment and human life, the Participants shall work diligently towards removing the cause of the Emergency and the supply shall be restored immediately after the Emergency Conditions have passed.

4.7.3.8 Emergency drills shall be conducted at least once a year to familiarize all staff responsible for Emergency and System Restoration activities with the Emergency and System Restoration procedures. The drills shall simulate realistic emergency situations. A drill evaluation shall be performed and deficiencies in procedures and responses shall be identified and corrected.

4.7.3.9 The TSP shall develop and maintain Contingency Plans to manage system contingencies and emergencies that are relevant to the performance of the

Transmission System. Such Contingency Plans shall be developed in consultation with all Users involved in the Transmission System, shall be consistent with internationally accepted practices, and shall include but shall not be limited to the following:

(i) under frequency load shedding;

(ii) under voltage load shedding;

(iii) disasters management (natural disasters, or other unexpected events), including the necessary minimum load requirements;

(iv) Forced Outages at all Connection Points, and

(v) supply restoration.

4.7.4 Demand Control

4.7.4.1 If Demand Control due to Generation deficiency needs to be implemented, the TSP shall issue several Alerts to the Generators, and Dispatch Control Centers. These Alerts may include a Yellow Alert, Red Alert, or Amber Alert or any other Alerts as may be agreed from time to time by the Participants.

4.7.4.2 **Yellow Alert** may be issued when a single Event would give rise to a reasonable possibility of failure to meet the Power System Demand, or of frequency or voltage departing significantly from normal, or if multiple Events are probable due to prevailing weather conditions.

4.7.4.3 **Amber Alert** may be issued when the Contingency Reserve is zero, a Generation deficiency exists, or there is a Critical Loading or imminent overloading of the Transmission lines or Equipment. Amber Alert may be issued by 15:00 hours, a day ahead. The Amber Alert Warning shall specify the amount and the period during which the Demand reduction will be required due to anticipated frequency or voltage deviation significantly from normal.

4.7.4.4 **Red Alert** may be issued when either a Partial or a Total Shutdown of the Power System has taken place.

4.7.4.5 During Demand Control, Generation Dispatch shall cease and shall not be re-implemented until the TSP has determined that it is safe to do so.

4.7.4.6 Demand Control Imminent Warning shall be issued by the TSP when a Demand reduction is expected within the next thirty (30) minutes. The

Demand Control Imminent Warning shall be effective for one (1) hour and shall be automatically canceled if it is not re-issued by the TSP.

4.7.4.7 The User shall notify the TSP of the amount of Demand reduction actually achieved after implementing the Demand Control.

4.7.4.8 In the event of a protracted shortage in Generation and when a reduction in Demand is anticipated by the TSP to be prolonged, the TSP shall notify the User of the expected duration.

4.7.4.9 The Users shall abide by the instruction of the TSP with regard to the restoration of Demand. The restoration of Demand shall be achieved as soon as possible and the process of restoration shall begin immediately after the instruction is given by the TSP.

4.7.4.10 If a User intends to implement Demand Control for the following day through a Demand Disconnection at the Connection Point, it shall notify the TSP of the hourly schedule before 10:00 hours of the current day. The notification shall contain the following information:

(i) The proposed (in the case of prior notification) and actual (in the case of subsequent notification) date, time, and duration of implementation of the Demand Disconnection; and

(ii) The magnitude of the proposed reduction by the use of Demand Disconnection.

4.7.4.11 If the Demand Control involves the Disconnection of an industrial load, Voluntary Load Curtailment or any similar scheme shall be implemented by staggering the Curtailment wherein the Customers are divided into different Curtailment Groups (e.g. Saturday Group, Sunday Group, etc.). Users participating in the Voluntary Load Curtailment shall voluntarily reduce their respective loads for a certain period of time depending on the extent of the Generation deficiency. Industrial Users who implement a Voluntary Load Curtailment shall provide the TSP with the amount of the Demand reduction actually achieved.

4.7.4.12 The User shall provide the TSP with the amount of Demand reduction actually achieved by the use of the Demand Disconnection.

4.7.5 System Restoration

4.7.5.1 To ensure that in the event of a Partial or Total Shutdown of the Transmission System, normal supply is restored to all Users as quickly and as safely as practicable, it is necessary to provide in the Grid Code a mechanism on how

such Partial or Total Shutdown of the Transmission System is to be dealt with, and to ensure that the necessary procedures and facilities are in place to support rapid re-establishing of the Shutdown parts, and to restore Supply to Users.

4.7.5.2 The Objectives of System Restoration are the following:

(i) to provide a general System Restoration strategy which will be adopted by the TSP in the event of a Partial or Total Shutdown of the Transmission System;

(ii) to establish the responsibility of the TSP to produce and maintain a comprehensive System Restoration Plan, covering both Partial and Total Shutdowns;

(iii) to establish the responsibility of Users to co-operate with the TSP in the development and execution of the System Restoration Plan; and

(iv) to ensure that the TSP and User staff who will be potentially involved with the System Restoration Plan, should be adequately trained and fully familiar with the relevant details of the Plan.

4.7.5.3 During restoration process of the Transmission System, the normal standards of voltage and frequency shall not apply.

4.7.5.4 The TSP shall conduct drills, at least once each year, to train the Users for Emergency preparedness. The date and time of execution of such drills shall be agreed by the TSP with Users in advance and the TSP shall issue a Red Alert for such a drill. The Users must cooperate with the TSP for conducting such drills/testing.

4.7.5.5 **Restoration Plan**

(i) The TSP shall issue instructions for the Generators with Black Start Capability to initiate the Start-up. The Generator providing Black Start shall then inform the TSP that its Generating Unit is dispatchable within thirty (30) minutes.

(ii) Upon receipt of the instruction from the TSP, Generating Unit providing Black Start shall Start-up immediately to Energize a part of the System and/or Synchronize with the System.

(iii) The overall strategy in restoring of the System after a Partial or Total Shutdown shall, in general, include the following:

(a) overlapping phases of restoration of islanded parts of the System;

(b) step-by-step integration of the islanded parts of the System into larger sections; and

(c) eventual restoration of the whole System.

(iv) The TSP shall coordinate the providing of Backup Reserve by thermal Generating Units so that these can be put back to the Grid without going to the full restart procedure.

(v) The TSP shall inform the Users, after completing the System Restoration procedure and the restoration of the System, that the Blackout no longer exists and that the System is back to the normal state.

(vi) The TSP will coordinate with Generators to provide start up Power (not reserve) to steam Units/Plants as the first priority.

4.7.5.6 Resynchronization of Islanded Parts of The Grid

(i) When parts of the System are not Synchronized with each other, the TSP shall instruct Users to regulate Generation and/or Demand to re-Synchronize the islanded parts of the System.

(ii) If a part of the System is not connected to the rest of the System, but there is no Blackout in that part, the TSP shall undertake the re-Synchronization/reconnection of that part to the rest of the System.

4.8 Operational Testing

4.8.1 Introduction

Operational Tests, which involve the simulation of conditions or the controlled application of unusual or extreme conditions, can have undesirable effects on the Transmission System. This section, therefore, deals with the responsibilities and procedures for arranging and carrying out of Operational Tests on the Transmission System in order to minimize any threats to the integrity of Equipment, the Security of the Grid, as well as any other detrimental effects on the TSP and other Users. Tests under this section shall exclude routine testing, Commissioning or re-Commissioning Tests, or any other tests of a minor nature.

4.8.2 Objective

The primary objectives are:

(i) to establish a process for conducting Operational Tests on the System by the TSP or other Users in such a way as to ensure that such tests, as much as possible, do not threaten the Safety or Security of the System, Equipment, or life; and

(ii) establish a procedure for conducting such tests.

4.8.3 Operational Test Request

4.8.3.1 If a User wishes to undertake an Operational Test on the Transmission System (or the User System), it shall initiate a Test Request that contains the following:

(i) the purpose and nature of the proposed test;

(ii) the extent and condition of the Equipment involved; and

(iii) a proposed Test Procedure specifying the switching sequence and the timing of the switching sequence.

4.8.3.2 The Test Proponent shall provide sufficient time for the TSP to plan the proposed test. The TSP shall determine the time required for each type of the test and the associated costs that shall be borne by the User requesting the test(s).

4.8.3.3 The TSP may require additional information before approving the proposed test if the information contained in the Test Request is insufficient or the proposed Test Procedure cannot ensure the Safety of personnel or the Security of the Grid.

4.8.3.4 The TSP shall determine and notify other Users, other than the Test Proponent, that may be affected by the proposed Operational Test.

4.8.3.5 The TSP may also initiate an Operational Test if it determines that this test is necessary to ensure the Safety, Stability, Security, and Reliability of the Transmission System.

4.8.4 Establishing of the Test Group

4.8.4.1 Within one (1) month after the acceptance of a Test Request, the TSP shall notify the Test Proponent, and the Affected Users of the proposed test. The notice shall contain the following:

(i) the purpose and nature of the proposed test, the extent and condition of the Equipment involved, the identity of the Test Proponent, and the Affected Users;

(ii) an invitation to nominate representative(s) for the Test Group to be established to coordinate the proposed test; and

(iii) if the test involves work or testing on (E)HV Equipment, the responsible person(s) for Safety Assurance shall be informed and the Safety procedures specified in section 4.10: Cross-boundary Safety Assurance shall be followed.

4.8.4.2 The Test Proponent and the Affected Users shall nominate their representative(s) to the Test Group within one (1) month after receiving the notice from the TSP.

4.8.4.3 If an Affected User fails to nominate its representative within the period stipulated in (4.8.4.2), the TSP will issue a reminder to that User asking the User to nominate his representative to the Test Group within one (1) week's time. If the User still does not nominate its representative, The TSP may decide to proceed with the proposed test and may appoint another TSP person to the Test Group to represent the interests of that User.

4.8.4.4 The TSP shall establish a Test Group and appoint a Test Coordinator, who shall act as chairman of the Test Group. The Test Coordinator may come from the TSP or the Test Proponent.

4.8.4.5 The members of the Test Group shall meet within one (1) month after the Test Group is established. The Test Coordinator shall convene the Test Group as often as necessary.

4.8.4.6 The agenda for the meeting of the Test Group shall include the following:

(i) the details of the purpose and nature of the proposed Test and other matters included in the Test Request;

(ii) evaluation of the Test Procedure as submitted by the Test Proponent and making necessary modifications to come up with the final Test Procedure;

(iii) the possibility of scheduling the proposed test simultaneously with any other test(s) and with Equipment maintenance which may arise pursuant to the Maintenance Program requirements of the TSP or the Users; and

(iv) the economic, operational, and risk implications of the proposed test on the Transmission System, and the Scheduling and Dispatch of the Generating Unit/Station.

4.8.4.7 The Test Proponent and the Affected Users (including those which are not represented in the Test Group) shall provide the Test Group, upon request, with such details as the Test Group reasonably requires for carrying out the proposed Operational Test.

4.8.5 Operational Test Program

4.8.5.1 Within two (2) months after the first meeting and at least one (1) month prior to the date of the proposed Operational Test, the Test Group shall submit to the TSP, the Test Proponent, and the Affected Users a proposed Test Program which shall contain the following:

(i) a plan for carrying out the test;

(ii) the procedure to be followed for the test, including the manner in which the test is to be monitored;

(iii) list of responsible persons, including those responsible for coordinating on Safety, when necessary, and who will be involved in carrying out the test;

(iv) allocation of all testing costs among the Affected Users; and

(v) such other matters as the Test Group may deem appropriate and necessary and are approved by the management of the Affected Users.

4.8.5.2 If the proposed Test Program is acceptable to the TSP and the Affected Users, the final Test Program shall be prepared and the test shall proceed accordingly. Otherwise, the Test Group shall revise the Test Program to make it acceptable.

4.8.5.3 If the Test Group is unable to develop a Test Program or reach a consensus in implementing the Test Program, the TSP shall determine whether it is necessary to proceed with the test to ensure the Security of the Transmission System.

4.8.5.4 The Test Coordinator shall be notified in writing, as soon as possible, of any proposed revision or amendment to the Test Program prior to the day of the proposed test. If the Test Coordinator decides that the proposed revision or amendment is meritorious, he shall notify the TSP, the Test Proponent, and the Affected Users to act accordingly for the inclusion thereof. The Test Program shall then be carried out with the revisions or amendments if the Test Coordinator receives no objections.

4.8.5.5 If conditions are abnormal on the scheduled day for the test, the Test Coordinator may recommend a postponement or rescheduling of the test.

4.8.6 Operational Test Report

4.8.6.1 Within one (1) month or a shorter period as the Test Group may agree after the conclusion of the test, the Test Proponent shall prepare and submit a Test Report to the TSP, the Affected Users, and the members of the Test Group.

4.8.6.2 After the submission of the Test Report, the Test Group shall stand dissolved.

4.9 Testing to Monitor, Investigate, and Verify Performance

4.9.1 Introduction

4.9.1.1 In order to discharge its responsibilities for safe, secure, and economic operation of the Transmission System, the TSP will need to carry out certain testing to monitor, investigate, and verify the performance of Users' Plant.

4.9.1.2 The TSP shall treat all information and data collected from User pursuant to the provisions of this section as confidential.

4.9.2 Objective

The primary objective is to establish a procedure for verifying that the Users are operating within their design, operating and other contractual requirements, as specified in the relevant Connection Agreement between the User and the TSP.

4.9.3 Monitoring

4.9.3.1 Monitoring shall be either continuous or continuous for periods of time, and shall be done by monitoring, data recording, and analysis, or by such other methods as the TSP reasonably determines to be appropriate in the circumstances. Advance notification from the TSP to Users may not be necessary in every case.

4.9.3.2 Where a data recording and analysis system is used for monitoring**,** the TSP shall inform the User that such data recording and analysis system is being

used and, on request from the User, shall make available to the User reasonable information in respect of the data recording and analysis system.

4.9.3.3 Monitoring may be carried out at any time by the TSP and may result, without the application of further testing, in the evaluation by the TSP of Users' noncompliance.

4.9.3.4 Where the User disputes a finding of non-compliance, the TSP shall provide the User any data collected during the monitoring over the period of alleged non-compliance and such other documentation as may be reasonably necessary to prove evidence of non-compliance.

4.9.3.5 Performance parameters that the TSP shall monitor may include, but not limited to, the following:

(i) compliance with Dispatch Instructions; and

(ii) compliance with Declarations including, without limitation, in respect of:

(a) Primary, Secondary, and Tertiary Operating Reserve provided by each of the Generator's Units/Station,

(b) Frequency Regulation provided by each Generating Unit;

(c) provision of static and dynamic Reactive Power; and

(d) Generating Unit capability.

4.9.4 Investigation

4.9.4.1 The TSP may, if it suspects noncompliance by the User, carry out investigation to acquire or verify information relevant to User's Plant and/or Apparatus design, operation, or other contractual requirements under the Grid Code, or the Connection Agreement.

4.9.4.2 Investigation by the TSP usually applies to information not collected on a regular basis by means of monitoring and testing. The TSP may, having given reasonable notice, send a representative or subcontractor to a User's Site to investigate any Equipment or operational procedure on or applicable to the User Site insofar as the condition of that Equipment or operational procedure is relevant to compliance with the Grid Code, Connection Agreement, and/or any other agreement(s) between the User and the TSP.

4.9.5 Testing to Verify Performance

4.9.5.1 The results of a test to verify performance may be derived from the monitoring of performance during the test.

4.9.5.2 The TSP may:

(i) for the purposes of above testing, issue a Dispatch Instruction; and

(ii) induce controlled Power System frequency or voltage conditions or variations for the purpose of determining that the Generating Unit's response is in accordance with its Declared Availability, System Service capabilities, and/or Operating Characteristics.

4.9.5.3 If the TSP subcontracts testing work on a User's Site, then the User and the TSP must be in agreement on the selection of a suitable subcontractor.

4.9.6 Commissioning Tests

4.9.6.1 Commissioning Tests is one of the final activities under project implementation which is carried out to test all Equipment, Protection Schemes and other systems to verify the correct functioning of the User Development. The TSP will witness the Commissioning Tests. After the Commissioning Tests and their acceptance by the TSP, the User facility is considered ready for Energization.

4.9.6.2 The following Commissioning Test procedure shall be followed:

(i) All the tests specified in the Connection Agreement shall be carried out in the presence of designated personnel of the TSP or its authorized representative(s). All test results must be signed by such personnel or representative(s). All tests shall be performed in accordance with the Commissioning Test schedules pre-approved by the TSP.

(ii) The User shall prepare and submit a Commissioning Test schedule/plan, specifying the acceptance criteria, for review and approval of the TSP, at least six (6) months before the schedule date for these tests.

(iii) The User shall provide test Equipment that has sufficient capacity and accuracy to properly perform the tests.

(iv) The User shall submit to the TSP the particulars of personnel assigned for the Commissioning Tests and valid calibration certificates of all the test Equipment for TSP's review and approval.

(v) The User shall fill-in any form required by the TSP and submit the same to the TSP for review and acceptance.

(vi) The TSP shall witness the Commissioning Tests, and verify all test results recorded in the Site test reports.

(vii) The TSP shall request the User to rectify deficiencies, if any, observed during the Commissioning Tests.

(viii) The User shall mark-up all the “issued for construction” drawings indicating the modifications done to wiring etc., during the Commissioning Tests.

(ix) One set of marked-up drawings shall be kept at the facility or in the control room for any trouble shooting until the "as-built" drawings are prepared and turned over by the User to the TSP.

(x) The TSP shall proceed with the routing of Energization certificate on completion of the Commissioning Tests. The facility will be ready for Energization once the Energization certificate is duly signed and issued by the TSP, subject to the User's completing of any remaining formalities.

4.9.7 Generating Unit Capability Tests

Test Requirements

4.9.7.1 Tests shall be conducted, in accordance with the agreed procedure and standards, to confirm the compliance of Generating Units for the following:

(i) capability of Generating Units to operate within their Registered Generation Planning Parameters;

(ii) capability of the Generating Units to meet the applicable requirements of the Grid Code;

(iii) capability to deliver the System Service(s) that the Generator has agreed to provide; and

(iv) Availability of Generating Units in accordance with their capability Declaration.

4.9.7.2 All tests shall be recorded and witnessed by the authorized representatives of the TSP, Generator, and/or User.

4.9.7.3 The Generator shall demonstrate to the TSP the reliability and accuracy of the test instruments and Equipment to be used in the test.

4.9.7.4 The TSP may at any time issue instructions requiring tests to be carried out on any Generating Unit. All tests shall be of sufficient duration and shall be conducted no more than twice a year except when there are reasonable grounds to justify the necessity for further tests.

4.9.7.5 If a Generating Unit fails the test, the Generator shall correct the deficiency within an agreed period to attain the relevant registered parameters for that Generating Unit.

4.9.7.6 Once the Generator achieves the registered parameters of its Generating Unit that previously had failed the test, it shall immediately notify the TSP. The TSP shall then require the Generator to conduct a new test in order to verify that the appropriate parameter has been restored to its Registered value.

4.9.7.7 If a dispute arises relating to the failure of a Generating Unit to pass a given test, the TSP, the Generator, and/or User shall seek to resolve the dispute among themselves. Failing to agree, the dispute shall be resolved in accordance with the Regulatory Guidelines for this purpose.

Tests to be Performed

4.9.7.8 *Reactive Power Test* shall demonstrate that the Generating Unit meets the registered Reactive Power capability requirements as specified in Chapter 2: Connection Code. The Generating Unit shall pass the test if the measured values are within ± five (5) percent of the Capability as registered with the TSP.

4.9.7.9 *Primary Response Test* shall demonstrate that the Generating Unit has the capability to provide Primary Response. The Generating Unit shall pass the test if the measured response in MW/Hz is within ± five (5) percent of the required level of response within five (5) seconds.

4.9.7.10 *Fast Start Capability Test* shall demonstrate that the Generating Unit has the capability to Start-up, Synchronize with the Grid within ten (10) minutes, and be loaded up to its offered capability. The Generating Unit shall pass the test if it meets the Fast Start capability requirements.

4.9.7.11 *Black Start Test* shall demonstrate that the Generating Plant with Black Start capability can implement a Black Start procedure. To pass the test, the Generating Unit shall start on its own, Synchronize with the Grid, and carry load without the need for external Power supply.

4.9.7.12 *Declared Data Capability Tests* shall demonstrate that the non-Renewable Resource Generation can be Scheduled and Dispatched in accordance with the Declared Data. To pass the test, the Unit shall satisfy the ability to achieve the Declared Data.

In case of RRG, Declared Data Capability Tests may be undertaken by continuous monitoring of the environmental conditions, Output parameters and Grid parameters or maybe Tests called at discrete points in time.

4.9.7.13 *Dispatch Accuracy Test* shall demonstrate that the Generating Unit meets the relevant Generation Scheduling and Dispatch Parameters as per new clause 2.5.5.16. The non-Renewable Resource Generation shall pass the test if:

(i) in the case of Synchronization, the process is achieved within ± five (5) minutes of the registered Synchronization time;

(ii) in the case of Synchronizing Generation (if registered as a Generation Scheduling and Dispatch Parameters), the Synchronizing Generation achieved is within an error level equivalent to ±2.5% of Net Declared Capability;

(iii) in the case of meeting Ramp Rates, the actual Ramp Rate is within ± ten (10)% of the registered Ramp Rate;

(iv) in the case of meeting Load Reduction rates, the actual Load Reduction rate is within ± ten (10)% of the registered Load Reduction rate;

(v) in the case of minimum base load Generating Units, variation of + ten (10)% will be acceptable; and

(vi) in the case of all other Generation Scheduling and Dispatch Parameters, values are within ± 1.5% of the declared values.

The Renewable Resource Generation shall pass the test if they comply with the test foreseen under (iv).

4.9.7.14 The TSP may advise the Generators one or more of the following tests also, if considered necessary by the TSP:

(i) deep voltage transient by short-circuit;

(ii) Generating Unit's changeover to House Load Operation;

(iii) Generating Unit House Load Operation for one hour;

(iv) step response of Generating Unit voltage;

(v) Power System Stabilizer (PSS); and

(vi) overload Capacity.

4.9.7.15 *System Service Acceptability Test* shall determine the committed services in terms of parameter quantity or volume, timeliness, and other operational requirements. Generators providing System Services shall

conduct the test or define the committed service. However, monitoring by the TSP of System Service performance in response to System-derived inputs shall also be carried out.

4.10 Cross-boundary Safety Assurance

4.10.1 Introduction

4.10.1.1 At times, the TSP and the Users may need to work on, or in close proximity to, each other's Systems. It will be, consequently, imperative that the TSP and Users operate strictly in accordance with approved Safety Rules and procedures to ensure Safety of life, network, and Equipment for such situations.

4.10.1.2 This section, therefore, specifies the rules and procedures to be used by the TSP and Users for coordinating, establishing, and maintaining of necessary Safety Precautions when work is to be carried out on, or in close proximity of, the Transmission System and/or the User System.

4.10.1.3 For the purpose of assurance of Safety relating to (E)HV System and Apparatus the term "Safety Precautions" means Isolation and/or Grounding.

4.10.2 Objective

The objective is to establish rules and procedures for Safety Assurance for the TSP and Users to operate in accordance with approved Safety Rules, to ensure safe working conditions for the personnel working on, or in close proximity to, the Transmission System Plant and/or Apparatus or those who may have to work at or use the Equipment at the Connection Point.

4.10.3 The Safety Rules

4.10.3.1 Safety procedures for personnel working on or in close proximity to the Transmission System Plant and/or Apparatus shall be governed by the TSP Safety Rules (or any future revision(s) of these rules), as detailed in the TSP Safety Manual.

4.10.3.2 In the event of a conflict between the provisions of this Code and the provisions of the TSP Safety Rules, the provisions of the TSP Safety Rules shall take precedence.

4.10.4 Safety at the Connection Point

4.10.4.1 A Site Responsibility Schedule referred to in Chapter 2: Connection Code for each User Site shall be developed by the TSP in consultation with the User. The Site Responsibility Schedule shall detail the demarcation of responsibility for Safety of persons carrying out work or testing at the User's Connection Site and on the circuits which cross the User's Site.

4.10.4.2 Operating instructions for each User Connection Site shall be issued by the TSP. These will include, but will not be limited, to the following:

(i) detailed switching sequences (which meet as a minimum, the requirements of the TSP Safety Rules) to be followed for voluntary, Fault, and emergency switching;

(ii) control and operational procedures;

(iii) identification of operational boundaries;

(iv) clearance and Isolation boundaries; and

(v) identity of the representatives of the TSP and the User who will attend the Transmission System and/or User system for operation, and also during emergencies.

4.10.4.3 Each User will cooperate with the TSP in developing procedures and agreement on any matters that may be relevant for ensuring overall Site Safety and, in particular, the Safety of the Connection Point Equipment.

4.10.4.4 For situations requiring either modification or a change in operational practices with potential operational impact on a User Site, the TSP and the User shall review the adequacy of overall Site Safety.

4.10.4.5 Isolation, as further detailed in the TSP's Safety Manual, shall be provided at the Connection Point to allow work to be carried out safely at the Connection Point or on either side of the Connection Point by the TSP and each User.

4.10.4.6 Where necessary, Grounding and short-circuit facilities, as further detailed in the TSP's Safety Manual, shall be applied to Plant and/or Equipment at either side of the Connection Point to allow work to be carried out safely at the Connection Point or either side of the Connection Point.

4.10.4.7 User shall be aware of clearance limits and shall perform work only within the approved clearance limits on the User side of the Connection Point. Any work at the boundary of the Connection Point shall not be performed without the supervision of a TSP representative.

4.10.5 **Logs of Cross-Boundary Safety Precautions**

The TSP and the Users shall maintain proper Logs (in chronological sequence) to record all messages relating to Safety. These Logs shall be retained for at least three (3) years.

4.10.6 **Forms for Cross-Boundary Safety Precautions**

The TSP shall develop appropriate forms to record Cross-boundary Safety Precautions to be used by the Requesting Party and the Implementing Party of Safety on (E)HV Equipment. These shall contain the following information at a minimum:

(i) Site and Equipment Identification of (E)HV Equipment where Safety Precaution is to be established or has been established;

(ii) location and means of implementing the Safety Precaution;

(iii) confirmation that the Safety Precaution has been established; and

(iv) confirmation that the Safety Precaution is no longer needed and has been cancelled.

4.10.7 **Approval of Local Safety Instructions**

4.10.7.1 For each Connection Site, the User shall supply to the TSP a copy of its Safety Rules relating to its side of the Connection Point.

4.10.7.2 The TSP will supply to each User a copy of its own Safety Rules relating to the TSP side of the Connection Point at each Connection Site.

4.10.7.3 Prior to Connection, each party must agree to the other's Safety Rules in relation to Isolation and Grounding.

4.10.7.4 If the User's Safety Rules are more stringent relating to Isolation and/or Grounding than those of the TSP, then the User Safety Rules shall apply. Otherwise, the TSP Safety Rules shall apply.

4.10.7.5 If, after agreement, a party wishes to incorporate a change in its Safety Rules relating to Isolation and/or Grounding, it shall inform the other party. If the change is to make the provisions more stringent, then the other party merely will note the changes. If the change is to make the provisions less stringent, then the other party will need to approve the new provisions and the procedures referred to above shall apply.

4.10.8 **Safety Representatives**

4.10.8.1 Each User shall nominate staff to be designated as User Safety Representative(s) to be available to Isolate and Ground, to a time scale

agreed in the applicable Connection Agreement, to meet the needs for repairs that would affect other Users. User Safety Representative will be responsible for coordinating on Safety with the TSP pursuant to the provisions of this section.

4.10.8.2 Each User shall, prior to being connected to the Transmission System, shall designate to the TSP its Safety Representative(s) and will update the TSP in writing whenever there is a change to the identity of its Safety Representative(s).

4.10.8.3 The TSP will, at the time of a User being connected to the Transmission System, inform in writing to that User of the TSP's own Safety Representative(s) (which in most cases will be the TSP Control Engineer) responsible for coordinating with the User Safety Representative(s) on Safety issues.

4.10.9 **Coordination on Safety Matters**

4.10.9.1 To carry out work on a System which requires Safety Precautions on (E)HV Apparatus, the Representative who is identified on the relevant Site Responsibility Schedule as responsible for the (E)HV Apparatus on which Safety from the System is to be achieved (the "Requesting Party") shall contact the Representative who is identified on that same Site Responsibility Schedule as responsible for the (E)HV Apparatus which is connected at the Connection Point to the (E)HV Apparatus on which Safety from the System is required (the "Implementing Party"), to coordinate the Safety Precautions.

4.10.9.2 **Agreement on Safety Precautions**

(i) When the TSP or a User wishes to carry out work on the System, the Requesting Party will contact the Implementing Party in order to agree the location at which the Safety Precautions will be implemented or applied. The Requesting Party shall specify the proposed location(s) at which Isolation and/or Grounding are to be established.

(ii) When the Implementing Party is of the opinion that Safety Precautions are required on the Requesting Party's System, the Implementing Party shall inform the Requesting Party.

(iii) When the TSP wishes to carry out work on the Transmission System, and it is of the opinion that for this to be done safely, Safety Precautions are required on the System of more than one User, the

provisions of this subsection shall be followed with regard to each User separately.

4.10.9.3 **Agreement on Isolation**

(i) The Requesting Party shall inform the Implementing Party of the (E)HV Apparatus on which Safety from the System is to be achieved and they will need to agree on the location(s) at which Isolation is to be established.

(ii) The Implementing Party shall then inform the Requesting Party of the following:

(a) for each location, the identity (by means of (E)HV Apparatus name, nomenclature, and numbering or position) of each point of Isolation;

(b) whether Isolation is to be achieved by an Isolating Device in the isolating position or by physical separation; and

(c) where an Isolating device is to be used, the isolating position will be maintained and/or secured by such a method which must be in accordance with the Local Safety Instructions of the TSP or that User.

4.10.9.4 **Agreement on Grounding**

(i) If the Requesting Party requires Grounding, it shall inform the Implementing Party of the (E)HV Apparatus on which Safety from the System is to be achieved and Grounding is to be provided. Both the parties will need to reach agreement on the location(s) at which Grounding is to be established.

(ii) The Implementing Party shall then inform the Requesting Party of the following:

(a) for each location, the identity (by means of (E)HV Apparatus name, nomenclature, and numbering or position) of each point of Grounding; and

(b) in respect of the Grounding Device to be used that it will be maintained and/or secured in position by such a method which is in accordance with the Safety Rules of the TSP or that of the User;

(c) the User's Grounding devices must be of proper size for the purpose and maintained in good working order; and

(d) implementing the Safety Ground will be the responsibility of the clearance holding party.

4.10.9.5 **In the Event of Disagreement**

If the Requesting Party and the Implementing Party are unable to agree on the location of the Isolation and (if requested) Grounding, it shall be at the closest available points on the infeeds to the (E)HV Apparatus on which Safety from the System is to be achieved as indicated on the Operation Diagram.

4.10.9.6 **Implementation of Isolation and Grounding**

Once the Location of Isolation and (if requested) Grounding has been agreed in accordance with the above provisions, the following procedure (as further detailed in the TSP's Safety Manual) shall be followed:

(i) the Implementing Party will ensure the implementation of Isolation;

(ii) the Implementing Party will confirm to the Requesting Party that the Isolation has been established on its System and that Isolation has been established on the System of any other User;

(iii) when the Implementing Party has confirmed the establishment of Isolation in accordance with (ii) above, the Requesting Party shall confirm to the Implementing Party the establishment of relevant Isolation on its System and request, if it has been required, the implementation of Grounding;

(iv) the Implementing Party will ensure the implementation of the Grounding; and

(v) the Implementing Party will confirm to the Requesting Party that the Grounding has been established on its System and that Grounding has been established on the System of any other User (if that is the case).

4.10.9.7 **Authorization of Testing affecting other Safety Representative's System**

(i) If the Requesting Party wishes to authorize a test on the (E)HV Equipment, it shall only do so after implementing the following procedures:

(a) confirmation is obtained from the Implementing Party that no person is working on, or testing, or has been authorized to work on, or test, any part of its System within the points of Isolation identified on the form;

(b) all Safety Precautions other than the current Safety Precaution have been cancelled in accordance with the procedures set out in this section; and

(c) the Implementing Party must agree with the Requesting Party on the conduct of the testing on that part of the System.

(ii) The Requesting Party will inform the Implementing Party by notice as soon as the test has been completed or cancelled.

4.10.9.8 **Cancellation of Safety Precautions**

When a Safety Precaution becomes unnecessary for any reason, the relevant Party shall inform the other Party without delay that the Safety Precaution is no longer required. Both parties shall then cancel the Safety Precaution.

CHAPTER 5 SCHEDULING AND DISPATCH CODE

5.1 Introduction

5.1.1 This chapter specifies the responsibilities and obligations of the TSP and Users with respect to Scheduling and Dispatch of Generating Units and other Demand resources. It sets out the procedure for supplying of timely and accurate information by the Users to the TSP, the TSP's preparing and issuing of Generation Schedules, and issuing of Dispatch Instructions.

5.1.2 This chapter is divided into two sections: Generation Scheduling and Generation Dispatch. Section 5.3, Generation Scheduling, deals with submitting of Availability Notices and relevant information by Generators and any modification to them subsequently, if required. The section also describes the procedure to be followed by the TSP for preparing and issuing of Generation Schedule to specify which Generating Units may be required for Dispatch. This section also details the Special Actions that the TSP may require from users to match supply with Demand and ensure the requisite Stability and Reliability on the Grid. Section 5.4, Generation Dispatch, deals with Dispatch of Generating Units and executing of other Special Actions to minimize cost of Supply procurement while ensuring the availability of adequate level of Operating Margin and other System Services.

5.2 Objective

The objective of this chapter is to enable the TSP to Schedule and Dispatch adequate Generation resources to meet electricity Demand at all times at minimum cost while ensuring the integrity of the System, as well as the requisite levels of supply Quality and Reliability.

5.3 Generation Scheduling

5.3.1 Scheduling Process

5.3.1.1 The TSP will carry out Scheduling daily to develop a Generation Schedule for the next following Schedule Day. This process will be *phased* and *iterative* to allow appropriate interactions of the TSP with Generators and other Users to match Demand with supply on an instant-by-instant basis with the requisite

levels of supply Quality and Reliability. The process of Generation Scheduling is shown in Figure 5.1 on page 131.

5.3.1.2 The Schedule Day will begin at 00:00 hours on the Schedule Day, and will last for 24 hours until 00:00 hours on the next day.

5.3.1.3 Grid Users must submit sufficient data as detailed in this chapter to allow the TSP to prepare a Generation Schedule. Since the TSP is required to match Generation, transfers, and Demand on an instant-by-instant basis, some additional information may be required by the TSP to accomplish this objective. Details of any reasonable additional information requirements will be notified by the TSP to the relevant Users, as the need arises.

5.3.1.4 Data submissions to the TSP shall normally be made electronically in accordance with the provisions of Chapter 6: Data and Information Exchange Code as well as of any agreement between the TSP and the User. In the event of failure of the electronic systems for submitting of data to the TSP, data submissions may be made by fax.

5.3.1.5 If, any changes occur after a User has supplied information to the TSP pursuant to (5.3.2, 5.3.3, and 5.3.4) below, then the User shall inform the TSP, without delay, of such changes.

5.3.1.6 Based on the Declarations and information supplied (and revised afterwards as the case may be) by the Users, the TSP will develop a Generation Schedule for the next following Schedule Day and inform the relevant Users accordingly.

5.3.2 Generator Declarations

5.3.2.1 Generators, proposing to be included in the Generation Schedule, shall submit to the TSP by 10:00 hours daily an Availability Notice in respect of each of their Generating Units, on a hourly basis, for the next following Schedule Day.

5.3.2.2 Such Declaration will replace any previous Declaration by a Generator.

5.3.2.3 Each Generator shall submit to the TSP any revisions to the Scheduling and Dispatch Parameters that it had submitted under a previous Declaration.

5.3.2.4 The Declaration by Generators shall be in accordance with (5.3.5).

5.3.3 Scheduling and Dispatch Parameters

5.3.3.1 Each Generator shall submit to the TSP, Scheduling and Dispatch Parameters relating to each of its Generating Units proposed to be included in the Generation Schedule as per the detail provided in Appendix A5.1.

5.3.3.2 Generators shall, in respect of each Generating Unit which the Generator shall have declared available, also submit to the TSP the following:

(i) details of any special factors which may have a Material Effect on the likely output of such Generating Unit;

(ii) any temporary changes, and their possible duration, to the Scheduling and Dispatch Parameters of such Generating Unit;

(iii) any temporary changes, and their possible duration, to the availability of System Services from the Generating Unit, if applicable; and

(iv) details of any Generating Unit Commissioning or re-Commissioning programs.

5.3.4 Generator Nominations

Each Non-Renewable Generation shall nominate its expected supply to the TSP for the next following Schedule Day by 10:00 hours on the day ahead of the Schedule Day. The information that the Generator shall supply as part of the Nomination shall be detailed in the Commercial/ Market Code (to be developed by the TSP).

The Saudi Sustainable Energy Control Center shall supply nominations in an agreed format to the TSP for the next following Schedule Day by 10:00 hours on the day ahead of the Schedule Day on behalf of each individual renewable Generator. The TSP may require separate nominations for each electrical zone as defined by the TSP.

5.3.5 Communication of Declarations and Nominations

5.3.5.1 Generators shall submit their Declarations/Nominations for a Schedule Day by means of an electronic interface in accordance with the requirements of the TSP data system, which the Generators shall install in each Generating Station or other Control Center as agreed between the TSP and the Generators.

5.3.5.2 In the event of failure or unavailability of the electronic interface, Declarations/ Nominations for a Schedule Day shall be made by using facsimile or any

other acceptable means as stated in (1.12.3) of Chapter 1: General Conditions.

5.3.6 The Generation Schedule

5.3.6.1 Each day by 15:00 hours, the TSP shall develop, by means of an appropriate Scheduling program or process, a Generation Schedule for the next following Schedule Day that will utilize the last valid set of Scheduling and Dispatch Parameters for the Generating Unit as applicable.

5.3.6.2 The Generation Schedule shall be prepared by the TSP to Schedule such Generating Units for which the TSP had received Availability Notice to achieve the following:

(i) minimize the cost of procuring the required Electricity in accordance with the relevant Power Purchase Agreements to match the Forecast Demand;

(ii) match at all times (to the extent possible) the Forecast Demand with an appropriate Operating Margin;

(iii) match minimum electricity Demand levels together with a sufficient Minimum Demand Regulation; and

(iv) maintain Frequency Control.

5.3.6.3 The TSP will give priority in dispatch for cogeneration plants taking into consideration the conditions under clause 5.3.6.2.

5.3.6.4 **Factors to be taken into account**

In preparing the Generation Schedule, the TSP will consider the following factors:

(i) Forecast Demand and its geographical distribution;

(ii) Declared MW capabilities of Generators;

(iii) System Services capabilities of Generators;

(iv) Operating Characteristics of Generators;

(v) System Constraints;

(vi) Generation costs of each Generating Unit;

(vii) Generating Unit Outages;

(viii) Voltage Control requirements;

(ix) System Stability factors;

(x) Operating Margin requirements;

(xi) System losses;

(xii) System Frequency Control requirements;

(xiii) any testing to be carried out;

(xiv) operation of Generating Unit to provide a sufficient Minimum Demand Regulation; and

(xv) any other factors as may be reasonably considered by the TSP to be of relevance to the Generation Schedule.

5.3.6.5 The Generation Schedule issued to each Generator by the TSP shall contain the information relating to the Generating Units of that Generator only.

5.3.6.6 The Generation Schedule will be only indicative, and will be intended to provide a guide to the expected output requirements from Generators and will not be construed as Dispatch Instructions or orders by itself.

5.3.6.7 The information contained in the Generation Schedule will indicate on an individual Generating Unit basis the period for which it is Scheduled during the following Schedule Day.

5.3.6.8 **Revision to Scheduling and Dispatch Data**

At any time between 10:00 hours each day and the expiry of the next following Schedule Day, a Generator may submit to the TSP any revisions to the submitted data:

(i) If the revised Generation Data is received by the TSP before 15:00 hours on the day prior to the relevant Schedule Day, the TSP shall, if possible, take into account the revised Availability Notice in preparing the Generation Schedule.

(ii) If the revised Generation Data is received by the TSP at or after 15:00 hours but before the end of the next following Schedule Day, the TSP shall, if it re-Schedules the Generating Units, take into account the revised Availability Notice in that re-Scheduling.

(iii) Between 15:00 hours on the day before the Schedule Day and 1 hour before real time, the Saudi Sustainable Energy Control Center may send updated Declarations on behalf of Renewable Resource Generation based on updated renewable infeed forecasts. The TSP shall update the Generation Schedule to take into account these updated Declarations.

5.3.6.9 **Procedure to be followed in the absence of a Nomination**

If a Nomination is not received, in total or in part, by the TSP in accordance with (5.3.4 and 5.3.5), then the TSP will make reasonable efforts to establish

contact with the Generator in question to check whether a complete Nomination for a Schedule Day was sent and not received by the TSP. If this is the case, the Nomination for a Schedule Day shall be resubmitted by the Generator without delay in accordance with the provisions of this Section. If no Nomination (or, as the case may be, the data necessary to complete the Nomination for a Schedule Day) is received by 12:00 hours, then the TSP will use the information provided in the Nomination for the previous Schedule Day to the extent necessary to provide the TSP with a complete Nomination. The TSP may impose appropriate sanctions or penalties (or both), as approved by the Regulator, on a Generator which repeatedly fails to submit a Nomination or does not submit the Nomination in time.

5.3.6.10 **Adjustments to the Generation Schedule**

After the completion of the Scheduling Process, but before the issue of the Generation Schedule, the TSP may consider it necessary to make adjustments to the output of the Scheduling process. Such adjustments may be made necessary by the following factors:

(i) changes to Availability and/or Operating Characteristics of Generating Units notified to the TSP after the commencement of the Scheduling process;

(ii) changes to TSP Demand Forecast;

(iii) changes to Transmission constraints emerging from the iterative process of Scheduling and System Security assessment, including:

(a) changes to the numerical values prescribed to existing constraint groups;

(b) identification of new constraint groups;

(c) changes to Generating Unit requirements within constraint groups, following reappraisal of Demand Forecast within that constraint group;

(d) changes to any conditions that would impose increased risk to the System and would therefore require the TSP to increase Operating Margin levels. Examples may be:

(1) unpredicted Equipment Outages which place more than the equivalent of one large Generating Unit at risk to a Fault;

(2) unpredicted outage of Generating Plant or Equipment which imposes increased risk to the Generating Station output;

(3) volatile weather situation giving rise to low confidence in the Transmission Demand Forecasts;

(4) severe (unpredicted) weather conditions imposing high risk to the System; and

(5) adjustments necessary to make the output of the Scheduling process to reflect the allocation of Operating Margin.

5.3.6.11 The TSP will re-optimize the Schedules when, in its reasonable judgment, a need arises. As it may be the case that no notice will be given prior to this re-optimization, it is important that Generators always keep the TSP informed of any changes of Availability and Scheduling and Dispatch Parameters relating to their facilities immediately as they occur.

5.3.6.12 Indicative Generating Unit Synchronizing and De-synchronizing times and Start-up and Shut-down times derived from the output of the Scheduling program or process used by the TSP in re-optimization of Schedules will be provided to each Generator in respect of its Generating Units.

5.3.6.13 **Special Actions**

(i) The Generation Schedule may be followed by a list of Special Actions (either pre-Fault or post-Fault) that the TSP may request a Generator to take in respect of a procedure to be followed by a Generating Unit in order to maintain the integrity of the Transmission System in accordance with the TSP operational policies.

(ii) For a Generator, such Actions may involve a load change or a change of required Notice to Synchronize, in a specific timescale on individual or groups of Generating Units basis.

(iii) For Distribution Entities and Directly-connected Customers, these Special Actions may involve load transfers between the TSP Connection Points or arrangements for Demand Control by manual or automatic means.

(iv) These Special Actions will be discussed and agreed with the concerned Generators, Distribution Entities, or Directly-connected

Customers. The actual implementation of these Special Actions will be part of the Dispatch procedure.

5.3.7 Issuance of Generation Schedule

5.3.7.1 The TSP shall issue the Generation Schedule by 15:00 hours each day for the next following Schedule Day, providing that it gets all the necessary information by 10:00 hours. However, if during the period in which the Generation Schedule is being prepared, Incidents on the System (for example, loss of Generation in a critical part of the System) occur which require a substantial amendment to the data being used in preparing the Generation Schedule, the TSP may extend the timescale for issuing of the Generation Schedule to the extent necessary as a result of such Incidents. The TSP shall also issue each update of the Generation Schedule as a result of a new declaration made by the Saudi Sustainable Energy Control Center on behalf of any Renewable Resource Generation.

5.3.7.2 The TSP may inform Generating Units before the issue of the Generation Schedule for the Schedule Day to which the Instruction relates, if the length of Notice to Synchronize requires the Instruction to be given at that time. When the length of the time required for Notice to Synchronize is within thirty (30) minutes of causing the Generating Unit to be unable to meet the indicative Synchronizing time in the Generation Schedule or a subsequent Dispatch Instruction, the Generator must inform the TSP without delay.

5.3.8 Negative Minimum Demand Regulation (NMDR)

5.3.8.1 Synchronized Generating Units shall at all times be capable of reducing output sufficient to offset the loss of the largest secured Demand on the System and shall be capable of sustaining this response. Sustainable Resource Generation shall only be chosen for reducing output if no other unit is available. The TSP will monitor the output data of the Generation Schedule against Forecast Demand to see whether the level of NMDR is sufficient. Where the level of NMDR for any period is insufficient, the TSP may contact all Generators in relation to their relevant Generating Unit/Station in the case of low NMDR and will discuss whether:

(i) any change is possible to Generating Unit inflexibility; and/or

(ii) any change is possible in declared Availability of a Generating Unit which has been notified to the TSP.

5.3.8.2 In the event that the TSP is unable to differentiate between Generating Unit Costs, the TSP shall instruct a Generator to Shutdown a specified Generating Unit based upon the following factors:

(i) effect on Power flows (resulting in the minimization of Transmission System losses);

(ii) reserve capability;

(iii) Reactive Power worth; and

(iv) in the case of localized NMDR, the effectiveness of output reduction in the management of the System constraints.

(v) a Sustainable Resource Generation shall only be chosen for Shutdown if no other unit is available.

5.3.9 Inadequate Operating Margin

5.3.9.1 In the period following 10:00 hours each day and in relation to the following Schedule Day, the TSP will monitor the output data of the Generation Schedule against Forecast Demand and the Operating Margin to see whether the anticipated level of the Operating Margin for any period is insufficient.

5.3.9.2 Where this level for any period is anticipated to be insufficient, the TSP will send a Notification of Inadequate Operating Margin (NIOM) to each Generator and Distribution Entity. The NIOM will indicate the insufficiency and the period for which the insufficiency is anticipated.

5.3.9.3 The monitoring will be regular and revised NIOMs may be sent out from time to time. These will reflect any changes in declared Availability which have been notified to the TSP, and will reflect any Demand Control which has also been so notified. They will also reflect generally any changes in the Forecast Demand and the relevant Operating Margin.

5.4 Generation Dispatch

5.4.1 General Provisions

5.4.1.1 Based on the Generation Schedule prepared and issued in accordance with the provisions of the previous section, the TSP will issue Dispatch Instructions to Generators and other Users. The Dispatch process is shown in Figure 5.2 on page 132.

5.4.1.2 Dispatch Instructions relating to the Schedule Day will normally be issued at any time during the period beginning immediately after the issue of the Generation Schedule in respect of that Schedule Day.

5.4.1.3 A Dispatch Instruction may be subsequently cancelled or varied.

5.4.2 Dispatch Instructions to Generators

5.4.2.1 Dispatch Instructions will always be issued to Generators at the Control Center for their Generating Station.

5.4.2.2 Dispatch Instruction given by the TSP to a non-Renewable Resource Generator for a specific Generating Unit may involve a change in the Active Power output, a change in the Reactive Power output, Synchronizing and De-synchronizing time (if appropriate), a change to the mode of operation, or to provide one or more of the contracted System Services.

Dispatch Instruction to Renewable Resource Generation shall be given by the TSP through the Saudi Sustainable Energy Control Center. Generation Dispatch Instructions for Active Power (sections 5.4.2, 5.4.3, 5.4.4) of Renewable Resource Generation are limited to participation in Frequency Regulation, Active Power output, Absolute Active Power Limitation, Active Power Delta Regulation and Active Power Gradient as specified in Chapter 2: Connection Code.

5.4.2.3 As Demand and Availability varies during real-time operation, the TSP will adjust Generating Unit MW output by using an economic loading order based on the Scheduling and Dispatch Parameters provided by Generators as part of their Nominations.

5.4.2.4 Dispatch Instruction will always be in accordance with Scheduling and Dispatch Parameters but shall take account of any temporary changes to these Parameters notified to the TSP under (5.3.6.8). A Dispatch Instruction given by the TSP to a Generator may be given orally, by phone, or in writing in accordance with the procedures detailed in Chapter 4: Operating Code.

5.4.2.5 A Dispatch Instruction must be formally acknowledged immediately by the Generator in respect of that Generating Unit by telephone, or a reason given immediately for non-acceptance. The reason for non-acceptance may only be on Safety grounds (relating to personnel or Plant) or because the Dispatch Instruction is not valid as detailed in the following clause.

5.4.2.6 For a Dispatch Instruction to be valid, it must observe the limits of Availability, System Service capability and Operational Characteristics as properly Declared to the TSP in accordance with the provisions in a Declaration relevant to the time and period to which the Dispatch Instruction relates, subject to provisions of System Emergency Condition (5.4.7).

5.4.2.7 Additional factors which the TSP will, however, also take into account for issuing Dispatch Instructions are the effect of those Generators which have not complied with the TSP instructions or agreed Special Actions (including Demand Control) pursuant to (5.3.6.13) and variation between forecast and actual Demand as these will have an effect on Dispatch.

5.4.2.8 Where a Generator has two or more identical Generating Units at the same Site, the Generator may notify the TSP as to the preferred Unit to be Dispatched. The TSP shall however, select the Unit to be Dispatched, taking into account its obligations in operating the Transmission System.

5.4.2.9 In the event that in carrying out the Dispatch Instruction, an unforeseen problem arises, caused on Safety grounds (relating to personnel or, Plant), the Generator will notify the TSP by telephone without delay.

5.4.3 Generation Synchronizing and Desynchronizing Times

5.4.3.1 Except in an emergency or by prior agreement, a Generating Unit/Station shall request permission of the TSP to Synchronize or De-synchronize. A Dispatch Instruction shall be issued to carry out the action.

5.4.3.2 The TSP will determine the required Synchronizing and De-Synchronizing times for the Generating Units in accordance with the times Declared in their Operating Characteristics, and will issue Dispatch Instructions to Generators accordingly.

5.4.3.3 If a Dispatch Instruction to a specific Generating Unit does not also contain a MW Output to be achieved then it shall be assumed that the Dispatch Instructions is to increase the output (following Synchronization) up to the level of Minimum Generation.

5.4.3.4 The issue of Dispatch Instructions for Active Power at the Connection Point will be made with due regard to any resulting change in Reactive Power capability and may include instruction for reduction in Active Power Generation to enable an increase in Reactive Power capability;

5.4.3.5 Where the TSP issues a Synchronizing time to a Generator for a specific Generating Unit and the Generator finds out that the Generating Unit will not

be able to Synchronize within ± ten (10) minutes of the instructed time, the Generator will immediately inform the TSP of the situation and provide a new estimate of the Synchronizing time.

5.4.4 Dispatch of Active Power

5.4.4.1 Based on the Generation Schedule, on System conditions, and on other factors as may arise from time to time, the TSP may issue Dispatch Instructions to a Generator in relation to a specific Generating Unit, which has been Instructed to be Synchronized under (5.4.3), to adjust its Active Power output at a target frequency.

5.4.4.2 On receiving and accepting a Dispatch Instruction to change the level of Active Power, the Generating Unit must without undue delay adjust the level of output of the Unit to achieve the new target within that Generating Unit's Declared Operating Characteristics.

5.4.4.3 A Unit shall be deemed to have complied with a Dispatch Instruction when it achieves an output within the allowable tolerance (as per the applicable agreement) of the Dispatched Output and within the time calculated for the change from its Declared Operating Characteristics.

5.4.4.4 The adjustment of Active Power output of a Unit operating in a Frequency Sensitive Mode for System frequency other than an average of 60Hz, shall be made in accordance with the current Declared value of the droop setting of the Active Power Frequency Regulation for Power Park Modules or Governor Droop for Synchronous Generating Units.

5.4.5 Dispatch of Reactive Power

5.4.5.1 To ensure that a satisfactory System voltage profile is maintained and that sufficient Reactive Power reserves are maintained, the TSP may issue Dispatch Instructions in relation to Reactive Power.

5.4.5.2 Mvar output: Where a Generating Unit is instructed to a specific output, the Generator shall achieve that output within a tolerance of ± two (2)% or ± one (1) Mvar (or such other figure as may be agreed with the TSP) by:

(i) on load tap changing on the Generating Unit step-up transformer; or

(ii) adjusting the setpoint of the Generating Unit Automatic Reactive Power Regulator or Automatic Voltage Regulator.

5.4.5.3 Once this has been achieved, the Generator will not tap change or adjust the setpoint of the Generating Unit Automatic Voltage Regulator without prior

consultation with and agreement of the TSP, on the basis that Mvar output will be allowed to vary with System conditions.

5.4.5.4 Target voltage levels: Where a Generating Unit is instructed to a specific target voltage, the Generators shall achieve that target within a tolerance of ± one (1) kV (or such other figure as may be agreed with the TSP) by either:

(i) on load tap changing on the Generating Unit step-up transformer; or

(ii) adjusting the Generating setpoint of the Automatic Voltage Regulator.

5.4.5.5 Under normal operating conditions, once this target voltage level has been achieved, the Generators will not tap or adjust terminal voltage again before consulting with and seeking agreement of the TSP.

5.4.5.6 Maximum Mvar production ("maximum Excitation" for Synchronous Generating Units): Under certain conditions, such as low System voltage, an instruction to maximum Mvar output ("maximum Excitation" for Synchronous Generating Units) at instructed MW output may be given, and a Generator should take appropriate actions to maximize Mvar output.

5.4.5.7 Maximum Mvar absorption ("minimum Excitation" for Synchronous Generating Units): Under certain conditions, such as high System voltage, an instruction to maximum Mvar absorption at instructed MW output ("minimum Excitation" for Synchronous Generating Units) may be given, and a Generator should take appropriate actions to maximize Mvar absorption.

5.4.5.8 The Automatic Reactive Power or Automatic Voltage Regulator shall be operated only in its constant terminal voltage mode of operation with var limiters in service, with any constant Reactive Power output control mode or constant Power Factor output control mode always disabled, unless expressly agreed otherwise with the TSP. In the event of any change in System voltage, Generators shall not take any action to override automatic Mvar response which is produced as a result of constant terminal voltage mode of operation unless instructed otherwise by the TSP or unless immediate action is necessary to comply with Stability limits.

5.4.5.9 A Dispatch Instruction relating to Reactive Power will be implemented without delay and will be achieved not later than two (2) minutes after the instructed time, or such longer period as the TSP may instruct.

5.4.5.10 On receiving a new Active Power Dispatch Instruction, no tap changing or Generator terminal voltage adjustment shall be carried out to change the Mvar unless there is a new Dispatch Instruction.

5.4.5.11 Where an instruction to Synchronize is given, or where a Generating Unit is Synchronized and a MW Dispatch Instruction is given, a Mvar Dispatch Instruction consistent with the Generating Unit's relevant parameters will also be given. In the absence of a Mvar Dispatch Instruction with an instruction to Synchronize, the Mvar output should be zero (0) Mvar.

5.4.5.12 Where a Dispatch Instruction to De-synchronize is given, a Mvar Dispatch Instruction, compatible with Shutdown, may also be given prior to De-Synchronization being achieved. In the absence of a separate Mvar Dispatch Instruction, it is implicit in the Dispatch Instruction to De-Synchronize that Mvar output should at the point of synchronism be zero (0) Mvar at De-Synchronization.

5.4.6 Additional Dispatch Instructions

In addition to Dispatch Instructions relating to Dispatch of Active Power and Reactive Power, Dispatch Instruction may also include those relating to the following:

(i) *Reserve*: Details of the reserve to be carried by each Generating Unit/ Station including specification of the timescale in which that reserve may be transferable into increased Generating Unit/Station output.

(ii) *System Services*: An instruction for a User to provide System Services.

(iii) *Secondary Control Mode*: A requirement for change to or from Secondary Control Mode for each Generating Unit.

(iv) *Tests*: An instruction to carry out tests as required under section (4.8) or (4.9) of Chapter 4: Operating Code.

5.4.7 System Emergency Conditions

5.4.7.1 In order to maintain Transmission System integrity under System Emergency Conditions, the TSP may issue Dispatch Instructions to Generators to operate outside the limits implied by the then current Declarations. When issuing such a Dispatch Instruction, the TSP shall inform the Generator that the Dispatch Instructions is being issued under System Emergency Conditions.

5.4.7.2 Where the TSP has issued a Dispatch Instructions in accordance with the provisions for System Emergency Conditions requiring operation of a Generating Unit outside the limits applied by the then applicable

Declarations, then the Generator must comply with the Dispatch Instructions.

5.4.8 Generating Unit/Station Parameter Changes

5.4.8.1 Each Generator at its Generating Unit/Station will without delay notify the TSP by telephone of any change or loss (temporary or otherwise) to the operational capability including any changes to the Scheduling and Dispatch Parameters of each Generating Unit which is Synchronized or has been instructed to Synchronize within the next three (3) hours.

5.4.8.2 If, for any reason, including a change of Availability or Scheduling and Dispatch Parameters made by the Generator, the prevailing Dispatch Instruction in respect of any Generating Unit is no longer within the applicable Availability or Scheduling and Dispatch Parameters then:

(i) the Generator will use reasonable endeavors to secure that a revised Dispatch Instruction is issued by the TSP such that the new Dispatch Instruction is within the now applicable Availability and/or Scheduling and Dispatch Parameters; and

(ii) if the TSP fails to issue such a new Dispatch Instruction within a reasonable time then the relevant Generator shall be entitled to change the operation of such Generating Unit to bring its operation within the applicable Availability and/or Scheduling and Dispatch Parameters until the TSP issues a new Dispatch Instruction within the applicable Availability and/or Scheduling and Dispatch Parameters. Prior to making such a change in operation, the Generator will use reasonable endeavors to advise the TSP (by telephone and then confirming it by fax*)* of its intended action and the timing of the intended action.

5.4.9 Automatic Reactive Power or Automatic Voltage Control System Mode of Operation

Each Generator shall operate its Generating Units with automatic voltage regulator (AVR), var limiters, and Power System Stabilizers (PSS), as required under their respective Connection Agreement, in service at all times unless released from this obligation by the TSP.

5.4.10 Dispatch Instructions for Distribution Entities and Directly-connected Customers

5.4.10.1 Dispatch Instructions to Distribution Entities and Directly-connected Customers relating to the Schedule Day will normally be issued at any time during the period beginning immediately after the issue of the Generation Schedule as a list of Special Actions in respect of that Schedule Day.

5.4.10.2 The TSP will issue Dispatch Instructions directly to the Distribution Entity or Directly-connected Customer at each Control Center in relation to Special Actions and Demand Control. Dispatch Instructions may include:

(i) a requirement for Demand Reduction and Disconnection or Restoration;

(ii) an instruction for load transfer between Connection Points; and

(iii) an instruction to switch in the load shedding scheme.

5.4.10.3 Dispatch Instructions to a Distribution Entity or Directly-connected Customer will be given by telephone (and will include an exchange of operator names) and must be formally accepted by the Distribution Entity or the Directly-connected Customer (as the case may be) by telephone. The Distribution Entity or the Directly-connected Customer (as the case may be) must comply without delay with all the Dispatch Instructions received by it.

5.4.10.4 In the event that in carrying out the Dispatch Instructions, an unforeseen problem arises, the Distribution Entity or the Directly-connected Customer (as the case may be) will notify the TSP by telephone without delay.

5.4.10.5 The Dispatch Instruction delivered verbally (by phone) shall be followed by a written confirmation afterwards.

5.4.11 Nature of Dispatch Instructions

The format of and the terms to be used by the TSP in issuing instructions together with their meanings will be provided by the TSP to participating Users.

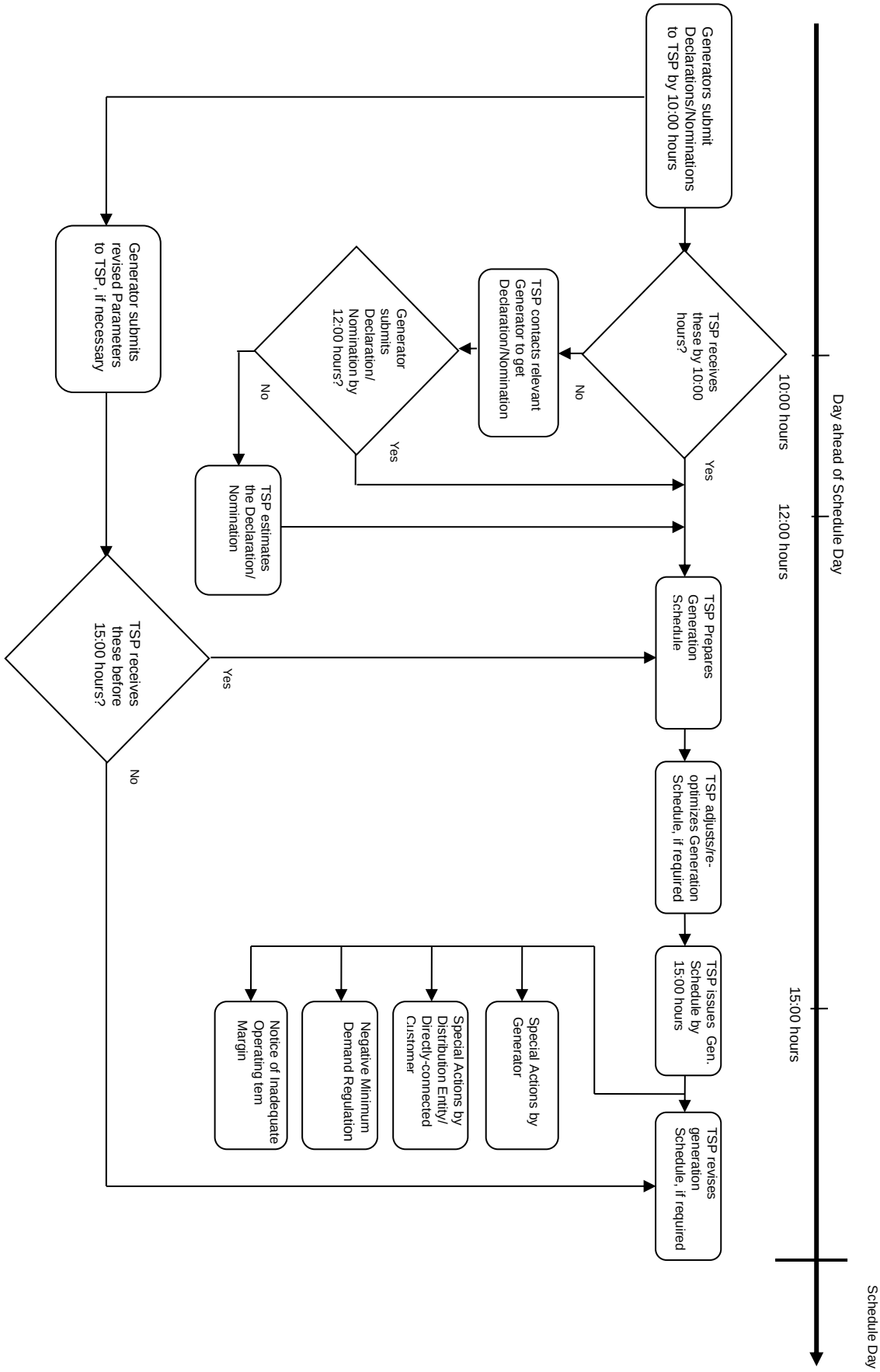

Figure 5.1 Overview of Generation Scheduling Process

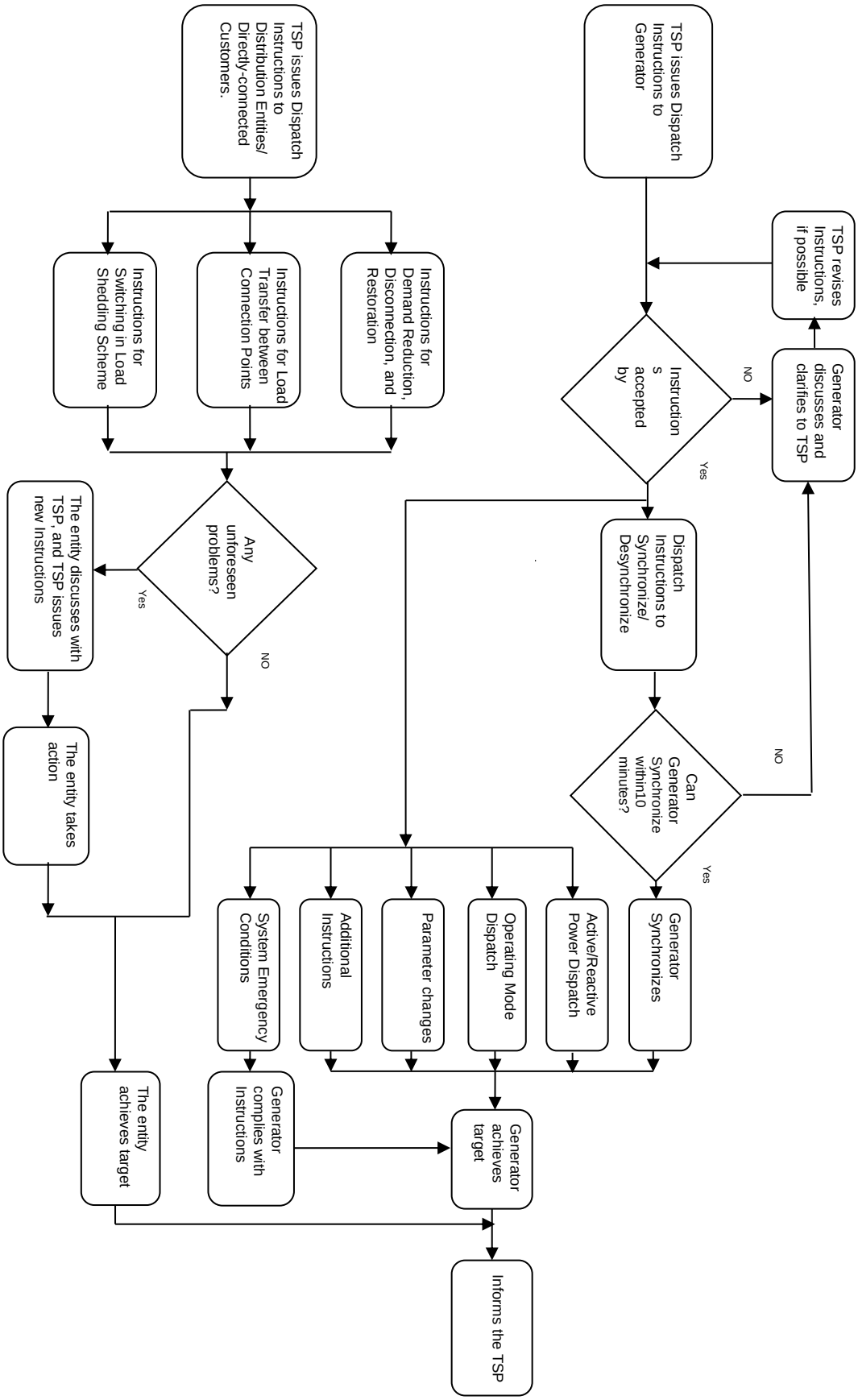

Figure 5.2 Overview of the Dispatch Process

APPENDIX A5.1: Generating Block/Unit Declaration

A5.1.1 **Availability Notice**

(i) Generating Availability, (start time and date).

(ii) Generating Unit regime unavailability, (day, start time, end time).

(iii) Generating Unit initial conditions (time required for Notice to Synchronize and from Start-up to Synchronize).

(iv) Maximum Generation increase in output above declared Availability.

(v) Any changes to Primary Response and Secondary Response characteristics.

A5.1.2 **Scheduling and Dispatch Parameters**

(i) Generating Unit inflexibility (inflexibility description, start date and time, end date and time, MW);

(ii) Generating Unit Synchronizing intervals (hot time interval, off-load time interval);

(iii) Station Generating Unit De-Synchronizing intervals;

(iv) Generating Unit basic data:

(a) Minimum Generation;

(b) Minimum Shutdown time;

(v) Generating Unit duty-cycle limitation;

(vi) Generating Unit minimum *on* time;

(vii) Generating Unit Synchronizing MW;

(viii) Generating Unit Synchronizing groups;

(ix) Generating Unit run-up rates with MW breakpoints;

(x) Generating Unit run-down rates with MW breakpoints;

(xi) Generating Unit loading rates covering the range from Minimum Generation to Net Dependable Power Capacity;

(xii) Generating Unit de-loading rates covering the range from Net Dependable Power Capacity to Minimum Generation.

CHAPTER 6

DATA AND INFORMATION EXCHANGE CODE

6.1 Introduction

6.1.1 The proper and timely exchange of data and information between the TSP and Users is critical for ensuring non-discriminatory access to the Transmission System and the safe and reliable provision of Transmission services. This chapter, therefore, sets out the obligations and responsibilities of the TSP and Users in relation to the supply of data and information to each other, and also lists the various categories of data and information to be exchanged between the TSP and the Users.

6.1.2 The data which is specified in different chapters of the Grid Code are collated here in this chapter. The relevant chapters also specify the procedures and timings for the supply of the requisite data.

6.1.3 The various chapters of the Grid Code also specify the information that the TSP will supply to Users. This information is summarized in a single schedule in this chapter.

6.1.4 The data listed in the various chapters of the Grid Code contain only the typical range of data which may be required by the TSP. The actual data required will be advised by the TSP at the time of assessment of the User application for new, or modification of an existing, Connection.

6.1.5 In the event of any inconsistency between any other chapter of the Grid Code and the Data and Information Exchange Code, the provisions of that chapter of the Grid Code shall prevail.

6.2 Objective

The objective of this chapter is to formalize the procedure for exchange of data and information between the TSP and Users and to list the typical range of information and data that the Users are required to submit to the TSP and the TSP is required to provide to the User(s) during the course of Grid operation.

6.3 Data and Information Categories and Registration

6.3.1 The following types of data and information shall be required to be registered by the User:

(i) *Standard Planning Data:* Each User shall provide to the TSP the standard data of the Equipment connected to the Transmission System for planning purposes. The detail of the required data is provided in Appendix A3.1 of Chapter 3: Planning Code.

(ii) *Detailed Planning Data:* Each User shall provide to the TSP the detailed data for the Equipment connected to the Transmission System for planning purposes. The detail of the data is provided in Appendix A3.2 of Chapter 3: Planning Code.

(iii) *Operational Data:* Each User shall provide to the TSP the operational parameters of the Equipment connected to the Transmission System for the safe and reliable operation of the system. The detail of the required data is provided in Chapter 4: Operating Code.

6.4 Procedure and Obligations

6.4.1 In accordance with the provisions of the various sections of the Grid Code, each User shall submit data and information as listed in Schedules 1 to 12 in Appendix A6.1.

6.4.2 The TSP shall be responsible for data and information storage and archiving.

6.4.3 All the data and information systems must be auditable by the Regulator or an independent agency designated by the Regulator. The systems must provide for clear and accessible audit trails on all relevant operational transactions. All requests that require an audit on a system shall be undertaken with reasonable notice to the Users.

6.4.4 The TSP shall keep all paper-based information for a period of at least five (5) years commencing from the date the information was created.

6.4.5 Participants shall ensure reasonable security against unauthorized access, use, and loss of information (i.e. have a backup strategy) for the systems that contain the information.

6.4.6 Participants shall store planning information that is kept electronically for at least five (5) years.

6.4.7 The TSP shall archive operational information, in a historical repository sized for five (5) years' data. These data shall include the following:

(i) status information, change of state alarms, and Event messages.

(ii) hourly Scheduling and Energy accounting information.

(iii) operator entered data and actions.

6.4.8 An audit trail of all changes made to the archived data shall be maintained. This audit trail shall identify every change made, and the time and date of the change. The audit trail shall include both *before* and *after* values of all content and structure changes.

6.5 Data and Information Submissions

6.5.1 The data must be submitted to the TSP's relevant contact as specified in (1.12) and (1.13) of Chapter 1. The name of the person who is submitting each Schedule of data must be included.

6.5.2 The data may be submitted via electronic means (if such a data link exists between the User and the TSP after obtaining prior written consent from the TSP), or through a computer-readable medium.

6.5.3 The Users must notify the TSP of any changes to data which are already submitted and registered in accordance with the various provisions of the Grid Code.

6.5.4 If a User fails to supply data when that User is required to provide that to the TSP, the TSP will estimate such data if and when, in the view of the TSP, it is necessary to do so.

6.5.5 If the TSP fails to supply data to a User, the User to whom that data ought to have been supplied, will estimate such data if and when, in the view of that User, it is necessary to do so.

6.5.6 Such estimates will, in each case be based upon data supplied previously for the same Plant or Apparatus or using corresponding data for similar Plant and/or Apparatus or such other information as the TSP or User, as the case may be, deems appropriate.

6.5.7 The TSP will advise a User in writing of any estimated data it intends to use relating directly to that User Plant and/or Apparatus in the event of data not supplied.

6.5.8 The User will advise the TSP in writing of any estimated data it intends to use in the event of data not supplied.

6.5.9 Any risk associated with the use of estimated data will be borne by the party that has failed to provide the required data.

6.5.10 Wherever practicable, Users, while submitting data, should identify the recognized national or international standard to which their Plant, Equipment, and/or Apparatus was designed.

6.6 Data and Information to be Registered

6.6.1 The following Schedules shall be supplied by Users (Generation, Distribution Entities, and Directly-connected Customers) to the TSP and will cover the required data for each User:

(i) ***Schedule 1: Generating Unit Technical Data***. This shall comprise Generating Unit/Station fixed parameters.

(ii) ***Schedule 2: Generating Unit/Station Outage Data.*** This shall comprise Generating Unit/Station Equipment Outage Planning Data.

(iii) ***Schedule 3: Generation Operation Schedule Data.*** This shall comprise data required for the preparation of the Generation Schedule.

(iv) ***Schedule 4: Generation Operational Planning Data.*** This shall comprise Generating Unit/Station parameters required for Operational Planning.

(v) ***Schedule 5: User System Data***. This shall comprise electrical parameters relating to Plant and Apparatus connected to the Transmission System.

(vi) ***Schedule 6: Connection Point Data.*** This shall comprise data related to Demand and Demand transfer capability.

(vii) ***Schedule 7: Demand Control Data.*** This shall comprise data relating to Demand Control.

(viii) ***Schedule 8: Scheduling and Dispatch Data.*** This shall comprise parameters required for Scheduling and Dispatch of Generating Unit/Station.

(ix) ***Schedule 9: Load Characteristics Data.*** This shall comprise estimated parameters of loads in respect of Harmonic content, sensitivity, etc.

(x) ***Schedule 10: Fault Infeed Data.*** This shall comprise data related to short circuit infeed of User Equipment to the Transmission System.

(xi) ***Schedule 11: User Demand Profiles and Active Energy Data.*** This shall comprise data related to Demand profiles.

6.6.2 The following Schedule shall be made available by the TSP to Users:

(i) ***Schedule 12: Data Supplied by the TSP to all Users.*** This shall comprise data supplied by the TSP to Users.

6.6.3 Forms for submitting various schedules are provided in Appendix A6.1 to this section. Applicability of these schedules to each category of Users is indicated in the following table:

Users	**Schedule Number**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Generators	✓	✓	✓	✓				✓		✓		✓
Distribution Entities					✓	✓	✓		✓	✓	✓	✓
Directly-connected Customers					✓	✓	✓		✓	✓	✓	✓

APPENDIX A6.1:

SCHEDULE FORMS

Schedule 1: Generating Unit Technical Data

Company Name:	Equipment/Station Location:							
Contact Name and Address:								
Phone:	City:							
Fax:	Email:							
Data Description	Data Category	Unit	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Maximum Capacity that the Generator can provide	DPD	MW						
		Mvar						
Capacity at the time of TSP peak Demand	DPD	MW						
		Mvar						
Capacity at the time of TSP minimum Demand	DPD	MW						
		Mvar						
Capacity supplied through Unit transformer at rated output	DPD	MW						
		Mvar						

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Rated Apparent Power	SPD	MVA					
Maximum continuous rating	SPD	MW					
Nominal voltage rating	SPD	kV					
Emergency rating	SPD	MW					
Minimum rating	SPD	MW					
Speed (except for PPM)	SPD	RPM					
Type of Generating Unit and expected running mode(s)	SPD	Text					
Short-circuit ratio	SPD						
Direct axis transient reactance (except for PPM)	SPD	% on MVA					
Detail of Connection Point(s) like geographical and electrical location and System voltage	SPD	Text					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Additional data (only for PPM) Number of modules or number of converters							
Connecting topology							
Expected availability							
Type (commutation type / valves type / ...)							
Contribution to short-circuit level according to standards		kA					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Additional data (only for Synchronous generation) De-rated Capacity on a monthly basis, if applicable	DPD	MVA					
Additional Capacity obtainable from Generating Unit in excess of Net Declared Capability	DPD	MVA					
Minimum Stable Loading	DPD	MVA					
Stator armature resistance	DPD	% on MVA					
Turbine and Generating Unit inertia constants	DPD	MW-s/ MVA					
Rated field current at Rated MW, Mvar, and terminal voltage	DPD	A					
Capability curve	DPD	Diagram					
Short circuit and open circuit characteristic curves	DPD	Diagram					

Impedances (only for Synchronous generation) Direct axis synchronous reactance	DPD	% on MVA					
Direct axis transient reactance	DPD	% on MVA					
Direct axis sub-transient reactance	SPD	% on MVA					
Quadrature axis synchronous reactance	DPD	% on MVA					
Quadrature axis transient reactance	DPD	% on MVA					
Quadrature axis sub-transient reactance	DPD	% on MVA					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Time Constants (only for Synchronous generation) Direct axis transient time constant	DPD	s					
Direct axis sub-transient time constant	DPD	s					
Quadrature axis transient time constant	DPD	s					
Quadrature axis sub-transient time constant	DPD	s					
Generating Unit step-up transformer Rated Capacity	SPD	MVA					
Rated voltage	SPD	kV					
Cooling stages and MVA rating at each stage	SPD	Text					
Rated base impedance	SPD	% on MVA					
No. of windings and their arrangement	SPD	Text					
Voltage ratio	SPD						
Tap changer type	SPD	On-/Off-load					
Tap changer location	SPD	At HV/LV					
Tap changer range	SPD	±%					
Tap changer step size	SPD	%					
Positive sequence reactance at max. tap	SPD	% on MVA					
Positive sequence reactance at min. tap	SPD	% on MVA					
Positive sequence	SPD	% on MVA					

reactance at nominal tap							
Positive sequence resistance at maximum tap	SPD	% on MVA					
Positive sequence resistance at minimum tap	SPD	% on MVA					
Positive sequence resistance at nominal tap	SPD	% on MVA					
Grounding arrangement	SPD	Text					
Basic lightning impulse insulation level	SPD	kV					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	···	U_n	Station
Power frequency withstand voltage, for all (E)HV transformers	SPD	kV					
Chopped impulse withstand voltage, for all transformers rated 230 kV and above	SPD	kV					
Switching impulse withstand voltage, for all transformers rated 230 kV and above	SPD	kV					
Excitation System (only for Synchronous generation) Type (static or rotating)	DPD	Text					
Make and model	DPD	Text					
DC gain of Excitation loop	DPD						
Rating (peak voltage)	DPD	V					
Rating (peak current)	DPD	A					
Maximum field voltage	DPD	V					
Minimum field voltage	DPD	V					
Maximum rate of change of field voltage(rising)	DPD	V/s					
Minimum rate of change of field voltage(falling)	DPD	V/s					
Dynamic characteristics of over Excitation limiter	DPD	V					
Dynamic characteristics of under Excitation limiter	DPD	V					
Exciter model (in IEEE	DPD	Diagram					

or PTI's PSS/E format)							
Power System Stabilizer (PSS) Type of input(s)	DPD	Text					
Gain for each input	DPD						
Lead time constant(s) for each input	DPD	s					
Lag time constant for each input	DPD	s					
Stabilizer model (in IEEE or PTI's PSS/E format)	DPD	Diagram					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	···	U_n	Station
Special Protection relays (if any) and their settings like volt/hertz Protection, etc.	DPD	Text					
Speed Governor System parameters of reheat steam Generating Units (only for Synchronous generation) High pressure governor average gain	DPD	MW/Hz					
Speeder motor setting range	DPD	Hz					
Speed droop characteristic curve	DPD	Diagram					
High pressure governor valve time constant	DPD	s					
High pressure governor valve opening limits	DPD						
High pressure governor valve rate limits	DPD						
Re-heater time constant (Active Energy stored in re-heater)	DPD	s					
Intermediate pressure governor average gain	DPD	MW/Hz					
Intermediate pressure governor setting range	DPD	Hz					

Intermediate pressure governor valve time constant	DPD	s					
Intermediate pressure governor valve opening limits	DPD						
Intermediate pressure governor valve rate limits	DPD						
Details of acceleration sensitive elements in high pressure and intermediate pressure governor loop	DPD	Text					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Governor model (in IEEE or PTI's PSS/E format)	DPD	Diagram					
Speed Governor System parameters of non-reheat steam or gas turbine Generating Unit (only for Synchronous generation) Governor average gain	DPD	MW/Hz					
Speeder motor setting range	DPD	Hz					
Speed droop characteristic curve	DPD	Diagram					
Time constant of steam or fuel governor valve	DPD	s					
Governor valve opening limits	DPD						
Governor valve rate limits	DPD						
Time constant of turbine	DPD	s					
Governor model (in IEEE or PTI's PSS/E format)	DPD	Diagram					
Plant flexibility performance data to be submitted for each Generating Unit Rate of loading	DPD	MW/min					

following weekend Shutdown							
Rate of loading following an overnight Shutdown	DPD	MW/min					
Block load following Synchronizing	DPD	MW					
Rate of Load Reduction from normal rated	DPD	MW/min					
Regulating range	DPD	MW					
Load rejection capability while still Synchronized and able to supply load	DPD	MW					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	···	U_n	Station
Auxiliary Demand data Normal station service (auxiliary) load supplied by each Generating Unit at rated MW output	DPD	MW					
Auxiliary or Start-up Power requirements	DPD	MW					
Sensitivity to automatic and planned interruptions	DPD	MW					
Non-Generator related on-Site loads	DPD	MW					
Each Generating Plant auxiliary load other than above and where the station auxiliary load is supplied from the Grid	DPD	MW					

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Modules characteristics (only for PPM) Module reference							
Nameplate AC power rating		kVA					
AC output voltage		kV					
Maximum AC voltage		kV					
Minimum AC voltage		kV					
Maximum inrush current (ratio inrush/rated current)							
Sensitivity of the active power to the Network (mains) frequency in case of over-frequency: dead-band [Hz] droop [kW/Hz]) in case of under-frequency: dead-band [Hz] droop [kW/Hz])		 Hz kW/Hz Hz kW/Hz					
ability of the unit to receive an active power setpoint upwards ramping rate downwards ramping rate		 kW/s kW/s					

Abbreviations:

SPD Standard Planning Data
DPD Detailed Planning Data
U_x Generating Unit number x

Cross References:

SPD (3.3.3.4 and Appendix A3.1)
DPD (3.3.3.5 and Appendix A3.2)

Schedule 2: Generating Unit/Station Outage Data

Company Name:	Equipment/Station Location:			
Contact Name and Address:				
Phone:	City:			
Fax:	Email:			
Data Description	Data Category	Unit	Time Covered	Update Time
Outage Program Generating Unit concerned	OD	Generating Unit ID	Next 5 years	End of March
Power not available due to Outage	OD	MW	Next 5 years	End of March
Remaining Active Power of the Plant	OD	MW	Next 5 years	End of March
Duration of Outage	OD	Weeks	Next 5 years	End of March
Start date and time or a range of start dates and times	OD	hours	Next 5 years	End of March
Flexible or Inflexible Planned Outage	OD	Flexible/ Inflexible	Next 5 years	End of March
Flexible Planned Outage Period for which the Outage could be deferred (not less than 30 days in length)	OD	Days	Next 5 years	End of March
Flexible Planned Outage period for which the Outage could be advanced (not less than 10 days in length)	OD	Days	Next 5 years	End of March
TSP issues draft Outage Program	OD	Text		End of June
TSP issues final Outage Program	OD	Text		End of Sept
Short Term Planned Maintenance Outage Generating Unit concerned	OD	Generating Unit ID	Year 0	7 Days before Schedule Day
Active Power not available as a result of Outage	OD	MW	Year 0	
Remaining Active Power of the Plant	OD	MW	Year 0	
Duration of Outage	OD	Weeks	Year 0	
Start date and time or a range of start dates and times	OD	hours	Year 0	

Abbreviation: OD Operational Data
Cross Reference: (section 4.3)

Schedule 3: Generation Operation Schedule Data

Company Name:	Generating Unit/Station Location:
Contact Name and Address:	
Phone:	City:
Fax:	Email:

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	···	U_n	Station
Programming Phase Generation Schedule for operation of Generating Unit/ Station on an hourly basis at Connection Point for 1 to 8 weeks ahead of Schedule Day, by 10:00 hours each first day of business week.	OD	MW					
Control Phase Details of any differences to Generation Schedule submitted under Programming Phase for the unexpired part of the period	OD	MW					
Post Control Phase Details of hourly Active Power and Reactive Power output sent out to the Transmission System by Generating Unit/Station	OD	MW					
		Mvar					
Details of hourly Active Power and Reactive Power output sent out to the Transmission System by Generating Unit/Station during the subsequent day	OD	MW					
		Mvar					

Abbreviations:

OD Operational Data
U_x Generating Unit number x

Cross Reference: (section 4.3.6)

Schedule 4: Generation Operational Planning Data

Company Name:	Equipment/Station Location:
Contact Name and Address:	
Phone:	City:
Fax:	Email:

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	···	U_n	Station
Steam Turbine Generating Units **Minimum Notice to Synchronize under** Hot start	OD	min					
Warm start	OD	min					
Cold start	OD	min					
Minimum time between Synchronizing	OD	min					
Minimum load required on Synchronizing	OD	MW					
Maximum loading rates from Synchronizing Hot start	OD	MW/min					
Warm start	OD	MW/min					
Cold start	OD	MW/min					
Maximum de-loading rate	OD	MW/min					
Minimum time between De-synchronizing and Synchronizing	OD	min					
Gas Turbine Generating Units Minimum notice required to Synchronize	OD	Min					
Minimum time between Synchronizing	OD	min					
Minimum load required on Synchronizing	OD	MW					
Maximum loading rates from Synchronizing for Fast start	OD	MW/min					
Slow start	OD	MW/min					
Maximum de-loading rate	OD	MW/min					
Minimum time between De-synch./ Synchronizing	OD	min					

Abbreviations: OD, Operational Data; U_x, Generating Unit number x

Cross Reference: (section 4.3.6)

Schedule 5: User System Data

Company Name:	Equipment/Station Location:
Contact Name and Address:	
Phone:	City:
Fax:	Email:

Data Description	Data Category	Unit
Electrical Diagrams and Drawings of the System and the Connection Point, indicating the quantities, ratings, and operating parameters for Equipment (Generating Units, Power transformers, and circuit breakers, etc.) Electrical circuits (overhead lines, underground cables, etc.) Substation bus arrangements Grounding arrangements Protection Schemes, their description and maintenance plans Interrupting devices Phase configuration Switching facilities Operating voltages Site and Equipment identification and labeling	SPD	Drawing
Parameters of the overhead lines and/or underground cables from the User System Substation to the Connection Point in the Grid Rated and operating voltage	SPD	kV
Positive sequence resistance and reactance	SPD	% on MVA
Positive sequence shunt susceptance	SPD	% on MVA
Zero sequence resistance and reactance	SPD	% on MVA
Zero sequence susceptance	SPD	% on MVA
Transformers between Transmission System and the User System Rated Capacity	SPD	MVA
Rated voltage	SPD	kV
Cooling stages and MVA rating at each stage	SPD	Text
Number of windings and winding arrangement	SPD	Text
Voltage ratio	SPD	
Tap changer type (on-load or off-load)	SPD	On-/Off
Tap changer location (at HV or LV winding)	SPD	HV/LV
Tap changer range	SPD	±%
Tap changer step size	SPD	%
Grounding arrangement	SPD	Text
Positive sequence reactance at max., min. and normal tap	SPD	% on MVA

Schedule 5: Page2 of 4

Data Description	Data Category	Unit
Positive sequence resistance at max., min. and normal tap	SPD	% on MVA
Basic lightning impulse insulation level	SPD	kV
Power frequency withstand voltage, required for all (E)HV transformers	SPD	kV
Chopped impulse withstand voltage, required for all transformers rated 230 kV and above	SPD	kV
Switching impulse withstand voltage, required for all transformers rated 230 kV and above	SPD	kV
Switchgears (i.e. circuit breakers, Disconnectors and isolators) on all circuits directly connected to the Connection Point including those at Substations of the User Rated voltage	SPD	kV
Rated current	SPD	A
Rated symmetrical RMS short-circuit current	SPD	kA
Rated unsymmetrical RMS short-circuit current	SPD	kA
Rated Interruption time	SPD	ms
Basic lightning impulse insulation level	SPD	kV
Interrupting current for all circuit breakers	SPD	kA
Interrupting time for all circuit breakers	SPD	s
Symmetrical short- circuit current withstand time, required for all circuit breakers	SPD	s
Power frequency withstand voltage, required for all circuit breakers	SPD	kV
Chopped impulse withstand voltage, required for all circuit breakers and Disconnect Switches rated 230 kV and above	SPD	kV
Switching impulse withstand voltage, required for all circuit breakers and Disconnect Switches rated 230 kV and above	SPD	kV
Details of User System Grounding The rated short time withstand current	SPD	kA
Zero sequence impedance	SPD	% on MVA
Short time rating of the Grounding Equipment	SPD	s
Data on independently-switched Reactive Power compensation Equipment at the Connection Point and/or at the Substation of the User System. Rated Capacity	SPD	Mvar
Rated voltage	SPD	kV
Type (*e.g.*, shunt reactor, shunt capacitor, static var compensator)	SPD	Text
Operation and control details (*e.g.* fixed or variable, automatic, or manual)	SPD	Text

Data Description	Data Category	Unit
If a significant portion of the User Demand may be supplied from alternative Connection Point(s), the relevant information on the Demand transfer capability shall be provided including the following: The alternative Connection Point(s)	SPD	Text
The Demand normally supplied from each alternative Connection Point	SPD	MW
The Demand which may be transferred from or to each alternative Connection Point	SPD	MW
The control (*e.g.,* manual or automatic) arrangements for transfer including the time required to effect the transfer for Forced Outage and planned maintenance conditions	SPD	Text
If a User System has Embedded/Captive Generating Units and significantly large-sized motors, the short circuit contribution of the Embedded/Captive Generating Units and the large motors at the Connection Point shall be provided by the Distribution Entities (or the other Users). The short-circuit current shall be calculated in accordance with the TSP standards, or in their absence, the relevant IEC or their equivalent national standards.	SPD	kA
If a User System has fluctuating loads, the following information shall be provided Cyclic variation of Active Power over time	SPD	MW/time
Cyclic variation of Reactive Power over time	SPD	Mvar/time
Maximum rate of change of Active Power	SPD	MW/s
Maximum rate of change of Reactive Power	SPD	Mvar/s
Largest step change of Active Power	SPD	MW
Largest step change of Reactive Power	SPD	Mvar
If the User System has commutating Power electronic loads, detail such as no. of pulses, max. voltage notch, and Harmonic distortion potential (up to 50th Harmonic) shall be provided to the TSP.	SPD	Text
A Single Line Diagram showing all load current carrying Apparatus at the Connection Point, specifically the following: Busbar layout(s)	DPD	Diagram
Electric circuit configurations (i.e. overhead lines, underground cables, Power transformers and similar Equipment)	DPD	Diagram
Phase arrangements	DPD	Diagram
Grounding arrangements	DPD	Diagram
Switching facilities	DPD	Diagram
Operating voltages	DPD	Diagram
Numbering and nomenclature	DPD	Diagram

Schedule 5: Page 4 of 4

Data Description	Data Category	Unit
For each HV motor Type	DPD	Text
MVA rating	DPD	MVA
MW rating	DPD	MW
Power Factor	DPD	
Full-load current rating	DPD	A
Starting method and starting current	DPD	Text, A
Number of start ups per day	DPD	Text
Torque/speed characteristics for the motor	DPD	Diagram
Torque/speed characteristics for the relevant load	DPD	Diagram
Inertia constant for the motor and the driven load	DPD	s
Dynamic parameters(for synchronous motors)	DPD	% on MVA
Transient over-voltage assessment data for undertaking insulation coordination studies Busbar layout, including dimensions and geometry and electrical parameters of any associated Current Transformers, Voltage Transformers, wall bushings, and support insulators	DPD	Diagram
Physical and electrical parameters of lines, cables, transformers, reactors and shunt compensators connected at that Busbar or by lines or cables to that Busbar	DPD	Text
Specification of all Apparatus connected directly or by lines and cables to the Busbar including basic insulation levels	DPD	Text
Characteristics of over voltage protection at the Busbar and at the termination of lines and cables connected at the Busbar	DPD	Text
The Generating Unit /Station transformer data is required: three or five limb cores or single phase units to be specified, and operating peak flux density at nominal voltage	DPD	Text
User Protection System data which can trip, inter-trip or close any Connection Point circuit breaker or any TSP circuit breaker Full description and estimated settings, of all relays/Protection systems installed or to be installed on the User System	DPD	Text
A full description of any auto-reclose facilities installed on the User System, including type and time delays	DPD	Text
Full description including estimated settings, for all relays and Protection systems installed or to be installed on the Generating Unit, Generating Unit transformer, Station transformer and their associated connections	DPD	Text
For Generating Unit having (or intending to have) a circuit breaker at the Generating Unit terminal voltage, clearance times for electrical Faults within the Generating Unit zone	DPD	ms
The most probable Fault clearance time for electrical Faults on User System directly connected to the Transmission System	DPD	ms

Abbreviations: SPD, Standard Planning Data; DPD, Detailed Planning Data
Cross References: SPD (3.3.3.4, Appendix A3.1); DPD (3.3.3.5, Appendix A3.2)

Schedule 6: Connection Point Data

Company Name:	Equipment/Station Location:
Contact Name and Address:	
Phone:	City:
Fax:	Email:

Data Description	Data Category	Unit	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Up-date Time
Annual peak hour User Demand at Annual Maximum Demand Conditions	SPD	MW							End of March
	SPD	PF							
User Demand at TSP peak Demand at Annual MD Conditions	SPD	MW							
	SPD	PF							
User Demand at minimum TSP Demand at Average Conditions	SPD	MW							
	SPD	PF							
Demand transfer capability data Name of the alternative Connection Point(s)	SPD	Text							End of March
Demand transferable	SPD	MW							
	SPD	Mvar							
Transfer arrangement (e.g. manual or automatic)	SPD	Man./ Auto.							
Time to effect transfer	SPD	hours							

Abbreviation: SPD Standard Planning Data
Cross References: (3.3.3.4 and Appendix A3.1)

Schedule 7: Demand Control Data

Company Name:	Equipment/Station Location:			
Contact Name and Address:				
Phone:	City:			
Fax:	Email:			
Data Description	Data Category	Unit	Time Covered	Update Time
Programming Phase **Demand Control which may result in a Demand change of 5 MW or more on an hourly and Connection Point basis** Demand profile	OD	MW	Weeks 1 to 8	By 10:00 hours first day of business week
Duration of proposed Demand Control	OD	hours	Weeks 1 to 8	By 10:00 hours first day of business week
Control Phase (for Distribution Entities and Directly-connected Customers) Demand Control which may result in a Demand change of 5 MW or more averaged over any hour on any Connection Point which is planned after 10:00 hours	OD	MW	Now to next 7 Days	Immediate
Any changes to planned Demand Control notified to the TSP prior to 10:00 hours	OD	MW	Now to next 7 Days	Immediate
Post Control Phase (for Distribution Entities and Directly-connected Customers) Demand Reduction achieved on previous calendar day of 5 MW or more averaged over any Connection Point, on an hourly and Connection Point basis	OD	MW		
Active Power profiles	OD	MW	Previous Day	10:00 hours Daily
Duration	OD	hours	Previous Day	10:00 hours Daily

Abbreviation: OD Operational Data
Cross Reference: (section 4.2)

Schedule 8: Scheduling and Dispatch Data

Company Name:	Equipment/Station Location:						
Contact Name and Address:							
Phone:	City:						
Fax:	Email:						
Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Generating Unit Availability Net Dependable Capacity	OD	MW					
Start time	OD	Date/time					
Generating Unit unavailability Start time	OD	Date/time					
End time	OD	Date/time					
Generating Unit initial conditions Notice to Synchronize	OD	hours					
Time required for Start-up	OD	hours					
Maximum increase in output above declared Availability	OD						
Any changes to Primary and/or Secondary Response characteristics	OD						
Scheduling and Dispatch Parameters							
Generating Unit inflexibility Description	OD	Text					
Start date	OD	Date/time					
End date	OD	Date/time					
Active Power	OD	MW					
Generating Unit Synchronizing intervals Hot time interval	OD	hours					
Off-load time interval	OD	hours					
Generating Unit De-	OD	Time					

synchronizing intervals							

Schedule 8: Page 2 of 2

Data Description	Data Category	Unit	Generating Unit/Station				
			U_1	U_2	...	U_n	Station
Generating Unit basic data Minimum Shutdown time	OD	hours					
Generating Unit duty cycle	OD						
Generating Unit minimum on time	OD	hours					
Generating Unit Minimum Generation	OD						
Generating Unit run-up rates with breakpoints	OD	MW/min					
Generating Unit run-down rates with breakpoints	OD	MW/min					
Generating Unit loading rates covering the range from Minimum Generation to Net Dependable Power Capacity	OD	MW/min					
Generating Unit de-loading rates covering the range from Net Dependable Power Capacity to Minimum Generation	OD	MW/min					

Abbreviations: OD Operational Data
U_x Generating Unit number x

Cross References: (5.3.3.1 and Appendix A5.1)

Schedule 9: User System Load Characteristics

Company Name:	Equipment/Station Location:							
Contact Name and Address:								
Phone:	City:							
Fax:	Email:							
Data Description	Data Category	Unit	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Detail of loads with characteristics considerably different than the typical range supplied	DPD	MW						
Demand sensitivity to voltage variation at peak Connection Point Demand	DPD	MW/kV						
	DPD	Mvar/kV						
Demand sensitivity to frequency variation at peak Connection Point Demand	DPD	MW/Hz						
	DPD	Mvar/Hz						
Maximum expected phase unbalance imposed on the System	DPD	%						
Average expected phase unbalance imposed on the System	DPD	%						
Maximum expected Harmonic content imposed on the System	DPD	%						
Loads which may cause Demand fluctuations greater than 5 MW at a Connection Point	DPD	MW						
Load criticality High Priority Medium Priority	DPD	MW						

Low Priority								

Abbreviation: DPD Detailed Planning Data
Cross References: (3.3.3.5 and Appendix A3.2)

Schedule 10: Fault Infeed Data

Company Name:	Equipment/Station Location:
Contact Name and Address:	
Phone:	City:
Fax:	Email:

Data Description	Data Category	Unit	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Short circuit infeed to Transmission System from the User System at a Connection Point Symmetrical three-phase short circuit current infeed at instant of Fault	DPD	kA						
Symmetrical single-phase short circuit current infeed at instant of Fault	DPD	kA						
Symmetrical three-phase short circuit current infeed after sub-transient Fault current contribution has substantially decayed	DPD	kA						
Zero sequence source impedance values as seen from the Connection Point consistent with the maximum infeed above	DPD	%on MVA						
Positive sequence X/R ratio at instance of Fault	DPD							

Abbreviation: DPD Detailed Planning Data
Cross References: (3.3.3.5 and Appendix A3.2)

Schedule 11:
User Demand Profiles and Active Energy Data

Page1 of 2

Company Name:	Equipment/Station Location:
Contact Name and Address:	
Phone:	City:
Fax:	Email:

Data Description	Data Category	Unit	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Update Time
Forecast Demand profiles for each User System (summed over all Connection Points for the Distribution Entity	SPD,OD	MW	1. On the day of User Maximum Demand at Annual Maximum Demand Conditions 2. On the day of peak TSP Demand at Annual Maximum Demand Conditions 3. On the day of minimum TSP Demand at Average Conditions						End of March
0000 : 0100	SPD,OD	MW							
0100 : 0200	SPD,OD	MW							
0200 : 0300	SPD,OD	MW							
0300 : 0400	SPD,OD	MW							
0400 : 0500	SPD,OD	MW							
0500 : 0600	SPD,OD	MW							
0600 : 0700	SPD,OD	MW							
0700 : 0800	SPD,OD	MW							
0800 : 0900	SPD,OD	MW							
1000 : 1100	SPD,OD	MW							
1100 : 1200	SPD,OD	MW							
1200 : 1300	SPD,OD	MW							
1300 : 1400	SPD,OD	MW							
1400 : 1500	SPD,OD	MW							
1500 : 1600	SPD,OD	MW							
1600 : 1700	SPD,OD	MW							
1700 : 1800	SPD,OD	MW							
1800 : 1900	SPD,OD	MW							
1900 : 2000	SPD,OD	MW							
2000 : 2100	SPD,OD	MW							
2100 : 2200	SPD,OD	MW							
2200 : 2300	SPD,OD	MW							
2300 : 2400	SPD,OD	MW							

Schedule 11: Page2 of 2

Data Description	Data Category	Unit	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Update Time
Total Demand	SPD,OD	MW							End of March
Active Energy requirement	SPD,OD	MWh							End of March
Annual MWh requirements (summed over all Connection Points) for Distribution Entities at Average Conditions Residential	SPD,OD	MWh							End of March
Agricultural	SPD,OD	MWh							End of March
Commercial	SPD,OD	MWh							End of March
Government	SPD,OD	MWh							End of March
Industrial	SPD,OD	MWh							End of March
Street Lighting	SPD,OD	MWh							End of March
Hospitals	SPD,OD	MWh							End of March
Any other identifiable categories of Users	SPD,OD	MWh							End of March
User System losses	SPD,OD	MWh							End of March

Abbreviations: SPD Standard Planning Data
OD Operational Data

Cross References: (3.3.3.4, Appendix A3.1, and section 4.2)

Schedule 12: Data Supplied by the TSP to Users

Data Description
The date and time of annual peak of TSP Demand at Annual Maximum Demand Conditions
The date and time of annual minimum TSP Demand at Average Conditions
Transmission System data including Network Topology and ratings of principal items of Equipment
Positive, negative and zero sequence data of lines, cables, transformers, etc.
Relay and Protection data
Transmission System Data as an equivalent 380kV, 230kV and 110/115kV source at the Connection Point to the User System Symmetrical three-phase short-circuit current infeed at the instant of Fault from the Transmission System
Symmetrical three-phase short circuit current from the Transmission System after the sub-transient Fault current contribution has substantially decayed
Zero sequence source resistance and reactance values at the Connection Point, consistent with the maximum infeed currents above
Pre-Fault voltage magnitude at which the maximum Fault currents were calculated
Positive sequence X/R ratio at the instant of Fault
Appropriate interconnection transformer data
Name of Safety Representatives
Provisional Outage program showing the Generating Units expected to be withdrawn from service during each week of Years 2 and 3 for Planned Outages
Draft Outage Program showing the Generating Units expected to be withdrawn from service during each week of Year 1 for Planned Outages
Maximum and minimum short circuit data relevant to the Connection Site

Cross References: (1.13.3 and 2.3.5)

CHAPTER 7 METERING CODE

7.1 Introduction

7.1.1 In order to properly account for the flow of electricity through the Transmission System, it is imperative that suitable and accurate metering and recording facilities are provided at all Connection Points on the Grid. This chapter, therefore, deals with metering and recording requirements for Participants and clarifies on their obligations relating to such installations. It also sets the minimum technical, design and operational criteria to be complied with by Users relating to metering and data collection Equipment and installations.

7.1.2 The provisions of this chapter are specifically applicable to issues relating to the following:

(i) supply, installation, and maintenance of Metering Equipment (Main as well as Check) and their testing and calibration;

(ii) collection, storage, and communication of metering data; and

(iii) competencies and standards of performance of Participants relating to metering.

7.2 Objective

The objective is to set out the responsibilities of the Participants relating to measuring and recording of Active and Reactive Power flows and Energy imports into or exports out of the Grid and also to specify the terms and conditions that will govern the metering and recording Equipment and systems employed for the above purpose.

7.3 Metering Responsibility

7.3.1 The TSP shall be responsible for managing and collecting metering information and shall ensure that all points identified as Metering Points in the relevant Connection Agreement have proper metering facilities.

7.3.2 The User shall be responsible to provide Meters and the associated Equipment and facilities at the Connection Point and offer these for installing and sealing by the TSP along with proofs of certification in respect of Meters and the CTs and VTs by an accredited laboratory as set out in (7.3.4) below.

7.3.3 The User shall also be responsible to demonstrate that its Metering Equipment meets all the technical requirements and standards set forth in this chapter.

7.3.4 Prior to making them available to the TSP for installing and sealing, the Users shall submit the Meters for certification to an independent laboratory accredited for such purposes by the Regulator.

7.3.5 The TSP shall ensure that installation, Commissioning, maintenance, auditing, and testing of Metering Equipment and allied systems are done in accordance with the standards as specified in the relevant Connection Agreement.

7.3.6 Notwithstanding (7.3.2 to 7.3.4) above, once installed, all Main Meters shall be owned and operated by the TSP.

7.3.7 The User shall also provide to the TSP all the information that the TSP will reasonably require to perform its metering duties properly.

7.4 Metering Equipment

The Metering Equipment at the Connection Point shall consist of:

(i) Meters;
(ii) Instrument Transformers;
(iii) Lightning Protection; and
(iv) All other interconnecting electric/telecommunication cables, wires, and associated devices, etc.

7.5 Metering Point

7.5.1 The Metering Point shall be at the Connection Point on the Transmission System, as specified in the relevant Connection Agreement.

7.5.2 The Actual Metering Point may differ from the Connection Point, if agreed by the TSP and the User. The accuracy requirements of the Metering Code then shall apply to the Actual Metering Point.

7.5.3 Where the Actual Metering Point and the Connection Point do not coincide, then, where necessary, compensation for Power transformer and/or line losses shall be provided. The compensation may be applied locally within the Metering Equipment or remotely. In both cases, however, compensation factors and the justification for them must be recorded.

7.6 Metering Parameters

7.6.1 Energy and Demand metering for both Active and Reactive Power shall be required at every Metering Point.

7.6.2 The Meters shall have the capability to separately record the flow of Active and Reactive Power and import and export of Energy at each Connection Point on the Grid.

7.6.3 The Meters shall have the capability to measure Power flows in all the quadrants in which such flow is possible.

7.6.4 The Meters shall be configured to record/store peak demand data in quarter-hourly integration periods.

7.7 Metering Data Storage and Availability

7.7.1 The TSP shall create, maintain and administer a metering database containing the following information:

(i) name and unique identifier of the Metering Installation;

(ii) date of installation;

(iii) the date of Commissioning of the installation and Commissioning documents;

(iv) the connecting parties at the Metering Installation;

(v) date of Energization;

(vi) Fault, repair, and maintenance history for each Metering Installation;

(vii) telephone numbers used to retrieve information from the Metering Installation;

(viii) type of the Meter at the Metering Installation; and

(ix) calibration certificates for all the Metering Equipment.

7.7.2 Data storage facilities for metering data shall be provided as follows:

(i) a storage capacity of ninety-six (96) periods per day for a minimum of thirty (30) days for all Demand Values;

(ii) the stored Demand Values shall be integer values of kW or kvar and have a resolution of at least 0.1% (at full load);

(iii) the accuracy of the Energy values derived from Demand Values shall be within ±0.1% (at full load) of the amount of Energy measured by the associated Meter;

(iv) the value of any Energy measured in a Demand Period but not stored in that Demand Period shall be carried forward to the next Demand Period;

(v) in the event of a Metering Equipment Power supply failure, the Metering Equipment shall protect all data stored up to the time of the failure, and maintain the time accuracy in accordance with (7.11);

(vi) to cater for continuous supply failures, the clock, calendar and all data shall be supported for a period of fifteen (15) days without an external supply connected;

(vii) any "read" operation shall not delete or alter any stored metered data; and

(viii) Upon request by the data collection system, the Metering Equipment shall provide any portion of the stored data.

7.7.3 The TSP shall be the owner of all the metering data and shall keep these data for at least five (5) years for audit trail purposes.

7.7.4 The TSP shall maintain in duplicate a continuous log on which shall be recorded at the end of every billing period the readings of all the Meters and instruments pertaining to delivery of, and billing for, Demand and Energy supplied by the TSP or taken by it. Such logs shall also show a brief statement giving complete facts of Interruption or other unusual Events affecting the service. The TSP shall deliver one set of the said duplicates each month to the User, upon request.

7.7.5 User’s metered data shall be considered strictly confidential and shall not be disclosed to anyone, except to that User or the Regulator.

7.7.6 The TSP shall provide a User direct access to its Meter pulse data, if required by the User. However, this access will be restricted to Check Meter data only and will be in the same format that the Main Meter supplies to the TSP Meter reading process. Any cost incurred by the TSP for this purpose shall be borne in full by the relevant User.

7.7.7 All the Metering Systems shall have the capability of electronic data transfer. However, during the transition period, on-Site meter reading and reporting may be needed.

7.7.8 If on-Site meter reading is necessary, it shall be witnessed by authorized representatives of all concerned parties.

7.7.9 The TSP shall connect a telecommunications medium to the meter/recorder that will allow for remote downloading of metering data.

7.7.10 The TSP shall be enabled to remotely interrogate a Meter or recorder on a daily basis or as mutually agreed with a User.

7.7.11 Meters shall be visible and accessible, but the access to such meters shall be authorized only by the TSP.

7.7.12 The metering data retrieval by remote link, or by on-Site method in the case of a persistent telecommunication problem, shall be a secure process whereby Meters or recorders are directly interrogated to retrieve billing information from their memories.

7.7.13 The TSP shall be responsible for the validation and substitution of metering data.

7.7.14 In principle, Check metering data, where available, shall be used to validate metering data provided that Check Metering Equipment accuracy conforms to the standards of this section.

7.8 Metering Equipment Standards

7.8.1 All Metering Equipment shall comply with the provisions set out in this Metering Code. These provisions may be revised from time to time in consultation with the Regulator to take account of changing technologies or the requirements of the industry.

7.8.2 The Metering Equipment shall be accurate within the prescribed limits for such Metering Equipment referred to in the relevant Connection Agreement or set out in the Metering Code.

7.8.3 The accuracy of the various items of Metering Equipment shall conform to the relevant IEC standards (or their equivalent Saudi national standards).

7.8.4 The Meters shall be calibrated by an independent calibrating agency accredited by the Regulator for this purpose. The User shall provide calibration certificate with expiry date of calibration.

7.8.5 **Voltage Transformers (VTs)**

(i) The Voltage Transformers shall comprise three (3) units for a three-phase set, each of which complies with IEC Standard 60044-2: *Instrument Transformers — Part 2: Inductive Voltage Transformers* (or its equivalent ANSI/IEEE/Saudi national/TSP standard) for metering, and shall be of the 0.2 accuracy class. These Voltage Transformers shall be connected in the configuration as agreed in the relevant Connection Agreement.

(ii) The voltage drop in each phase of the Voltage Transformer connections of the same accuracy and class shall not exceed 0.2 V. It shall be connected only to a Main Meter with a burden that shall not affect the accuracy of measurement.

7.8.6 Current Transformers (CTs)

(i) The Current Transformers shall comprise three (3) units for a three-phase set, each of which complies with the IEC Standard 60044-1: *Instrument Transformers — Part 1: Current Transformers* (or its equivalent ANSI/IEEE/Saudi national/TSP standard) for metering, and shall be of 0.2 accuracy class. It is preferred that two (2) Current Transformer cores with corresponding number of secondary coils per phase be provided between the connection box and the terminal of the metering element on the Meter so that the Current Transformer connections for checking Meter pulses can be completely separated from those provided for the Meters.

(ii) The Current Transformer's rated secondary current shall be either 1 or 5 amperes. The neutral conductor shall be effectively Grounded at a single point and shall be connected only to a Main Meter with a burden that shall not affect the accuracy of measurement.

7.8.7 Meters

(i) Meters shall be of the three-element type independent for each phase, rated for the required Site, comply with IEC Standard 62052-11: *Electricity Metering Equipment (AC) — General requirements, tests, and testing conditions* or IEC Standard 62053-21: *Electricity Metering Equipment (AC) — Particular requirements* (or their equivalent ANSI/IEEE/Saudi national/TSP standards), for static watt-hour meter and other types of Meters, and shall be of the accuracy class of 0.2 or equivalent. The Meters shall measure and locally display at least the kW, kWh, kvar, kvarh, and cumulative Demand, with additional features such as time-of-use, maintenance records, Power Quality monitoring, and pulse output. The pulse output for remote metering must be for all the major measurement features.

(ii) The Meters may be digital or analogue as per the agreement between the TSP and the User.

(iii) A cumulative record of the parameters measured shall be available on the Meter. Bi-directional Meters shall have two such records available. If combined Active Energy and Reactive Energy Meters are provided, then a separate record shall be provided for each measured quantity and direction. The loss of auxiliary supply to the Meter shall not erase these records.

(iv) Data storage shall be provided internally or externally to the Meter by way of a data logger which shall provide an output per measured quantity.

7.9 Testing and Inspection of Metering Installations

7.9.1 All Meters, CTs and VTs, shall be tested for accuracy at initial Commissioning. Tests shall also be carried out thereafter at intervals not less frequently than every twelve (12) months for Main Meters and not less than six (6) years for CTs and VTs, or as specified in the relevant Connection Agreement to verify that their operation is within the prescribed limits of error.

7.9.2 Test terminals shall be provided for Main and Check Meters to facilitate on site tests.

7.9.3 Meters shall be tested in service and should be tested out of service only if the accuracy is suspected to be not within the limits.

7.9.4 A User may request a test and shall bear the full cost of such testing if the Meter is found to be not operating within the prescribed limits. Tests will be organized such that all relevant parties are notified of the tests, and are invited to witness them, if required. Test results will be made available to the User involved.

7.9.5 Meters may also be tested by the TSP whenever the TSP notices or suspects an error in metering.

7.9.6 In carrying out of tests on Main Meters, any interruption to measurement will be taken account of and appropriately compensated. The testing measurement will be taken by another Meter and will be appropriately compensated.

7.9.7 Care shall be taken in carrying out tests to ensure that any Interruption to measurement is avoided or minimized.

7.9.8 Certified test Equipment and reference standards (traceable to a recognized national or international standard) shall be used in such tests and if, by

agreement, it is deemed necessary, an approved independent laboratory may be employed.

7.9.9 Where a test indicates that an error exceeds the limits of error prescribed in the applicable standards, then these errors shall be recorded before promptly adjusting, repairing or renewing the Metering Equipment (or part thereof) or replacing any defective components.

7.9.10 Pursuant to (7.9.9) above, the reading taken previously, and all charges based therein, shall be corrected on the basis of this test for a period as set in the applicable Connection Agreement.

7.9.11 The Metering Equipment shall be restored to service and proved to be operating within the prescribed limits of accuracy as soon as is reasonably practicable.

7.10 Main and Check Metering

7.10.1 For each Connection, Main and Check Metering shall be provided. Main and Check Meters shall be from different manufacturers and shall operate from separate CT and VT windings.

7.10.2 The provisions of this chapter shall apply equally to Main and Check Meters.

7.10.3 CT and VT windings and cables connecting such windings to Main Meters shall be dedicated for such purposes and such cables and connections shall be securely sealed.

7.10.4 The Main Meter, Check Meter and additional burdens shall have separately fused VT supplies.

7.10.5 The loss of voltage to the Meters should give an alarm.

7.11 Timekeeping

7.11.1 All Metering Installation shall record time, based on Saudi Arabian Standard Time.

7.11.2 The commencement of each Demand Period shall be within ±10 seconds of the true time.

7.11.3 The duration of each Demand Period shall be accurate to within ± 0.1% except where time synchronization has occurred in that period.

7.12 Metering Access and Sealing

7.12.1 Metering Equipment and associated communications Equipment shall be located in a dedicated and secure cabinet located in an area readily accessible, free from obstructions, and well-lit by artificial light(s).

7.12.2 The cabinet shall conform to service conditions as specified in TSP's Standard 01-TMSS-01. These design measures shall at least include protection from moisture and dust and from physical damage including vibration and provide appropriate temperature control.

7.12.3 The cabinet shall be equipped with a lock and shall be clear-fronted and sealed by the TSP. The control of this sealing shall conform to procedures as laid down by the TSP from time to time. This seal can only be broken by or with the consent of the TSP.

7.12.4 Internal access to Metering Equipment, enclosures, and the associated communications equipment shall be in accordance with procedures specified by the TSP.

7.12.5 The Users shall permit the TSP or its representatives, the rights to enter upon, pass through, and remain upon any part of such User property to the extent necessary for the purposes of performance under this Code. Users shall make all reasonable arrangements and provisions to facilitate the TSP or its representatives in exercising such rights.

7.12.6 The right of access provided pursuant to (7.12.5) above shall also include the right to bring any vehicles, Plants, machinery and maintenance or other materials as may be reasonably required by the TSP for the performance of obligations under the Metering Code.

7.12.7 The seals that the TSP shall use on Metering installations must be strong and durable, not prone to easy or accidental damage or early deterioration owing to weather or operating environment.

7.12.8 Seals shall be capable of being fixed easily and shall be designed and constructed to prevent undetectable tampering under normal usage and must not permit their removal or undoing without breaking.

7.12.9 Seals shall be identifiable by unique numbers and TSP logos that are legible and traceable to those affixing these.

7.13 Damage, Tampering, or Unauthorized Interference with Metering Equipment

7.13.1 The TSP shall examine Metering installations periodically to ensure that all security seals are intact and that the Metering Equipment is functioning properly and without any signs of damage, tampering, or unauthorized interference.

7.13.2 In case such signs are evident, the TSP will investigate the matter further, and if as a result, the integrity of the Metering Equipment (or any part thereof) becomes doubtful, the TSP will require the Metering Equipment (or part thereof) to be replaced or repaired, as may be appropriate, on the cost of the relevant User. In either case, the Metering Equipment (or part thereof) shall have to undergo testing, certification, and calibration as is laid down in section 7.15.

7.13.3 The TSP shall also deal with such issues of damage, tampering, and/or unauthorized interference with Metering Equipment in accordance with its standing policy for handling such cases, which shall include, but not limited to, the following:

(i) documenting of the situation and recording of all evidence pertaining to damage, tampering, and/or unauthorized interference;

(ii) determining recoverable charge from the relevant User of all reasonable costs pertaining to the unaccounted for Power and Energy for the period for which the Metering Equipment is deemed to have been abused, including imposing of a reasonable penalty; and

(iii) pursuing of any additional action against the relevant User for such unscrupulous acts in accordance with the applicable laws and/or rules and regulations in the Kingdom.

7.14 Repair and Maintenance of Metering Equipment

7.14.1 The Metering Equipment at the Connection Point shall be maintained by the TSP at the witness of the User. All test results, Maintenance Programs, and sealing records shall be kept for the life of the Metering Equipment, and for five (5) years after the retirement of the Equipment. The Equipment data and test records shall be made available to authorized parties.

7.14.2 The TSP shall repair the Metering System as soon as practical if a Metering System malfunctions or requires maintenance. The TSP shall charge for the metering services provided.

7.15 Approval, Certification, and Testing of Metering Equipment

7.15.1 The TSP has the responsibility for Meter type approval, Meter certification, and Meter testing for compliance with the provisions of the Metering Code.

7.15.2 Meter Equipment used in accordance with this Code shall be approved types. The TSP shall maintain this list and shall make it available to Users on request.

7.15.3 All Metering Equipment shall be from a manufacturer pre-qualified by the TSP.

7.15.4 The TSP shall maintain records for all Metering Equipment relating to their calibration including the dates and results of any tests, readings, and adjustments.

7.15.5 Such records shall also include any other details as may be required by the TSP. Such records shall be complete and accurate and retained for the life of the relevant item.

7.15.6 The TSP shall make arrangements to seal all Metering Equipment, data collection equipment, and associated modems and telephone links.

7.15.7 All new Metering Equipment shall be required to undergo relevant certification tests which shall be performed in accordance with the relevant international/Saudi national standards.

7.15.8 Meter Certificates shall be issued for a specified life span. The Meter Certificate duration may differ for different Meter types and may change from time to time.

7.15.9 Following certification, a certification seal will be applied. This seal must be maintained intact in order for the Meter to retain certified status.

7.15.10 Meters removed from service must be re-certified before reconnection for use.

7.16 Meter Reconciliation

7.16.1 The TSP shall make arrangement to remotely read the cumulative energy values every month for checking purposes.

7.16.2 If cumulative energy values are not available remotely, then the TSP will take manual readings each month for the above purposes.

7.16.3 Within three (3) weeks of the manual Meter reading, the TSP shall prepare a Meter Reconciliation Statement in which it will record the difference between

the two successive manual Meter readings and compare it with the total energy recorded for the same time period.

7.16.4 If any difference between the manual reading and electronically recorded reading of more that 0.1 percent is noticed, it shall be highlighted and referred to for further checking.

7.16.5 If as a result of the above check, the discrepancy is confirmed, then the TSP will inform the relevant User and take appropriate action to deal with the situation in accordance with the provisions of the Commercial/Market Code (to be developed in due course).

Glossary and Definitions

Active Energy	The integral of the Active Power with respect to time, measured in watt hour (Wh) or multiples thereof. Unless otherwise qualified, the term “Energy” refers to Active Energy
Active Power	The time average of the instantaneous power over one period of the electrical wave, measured in watts (W) or multiples thereof.
Active Power Gradient Limitation Of a Renewable Resource Generation	A control mode of the Renewable Resource Generation which limits the maximum speed by which the Active Power output can be changed in the event of changes in Available Active Power or changes in the Active Power setpoints.
Active Power Delta Regulation of a Renewable Resource Generation	A control mode of the Renewable Resource Generation which constrains the Active Power output to a required constant value in proportion to the Available Active Power.
Absolute Active Power Limitation of a Renewable Resource Generation	A control mode of the Renewable Resource Generation which constrains the Active Power output to a predefined power MW limit.
Actual Metering Point	Actual location of the Metering Point on the Transmission System.
Adequacy (in relation to Reliability)	The ability of the electric system to supply the aggregate electrical Demand and Energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled Outages of System elements.
Affected User	A User who provides evidence to the TSP and in the opinion of the TSP the evidence proves the User’s sufficient interest in the matter.
Amber Alert	An alert issued by the TSP when the Contingency Reserve is zero, a Generation deficiency exists, or there is a Critical Loading or imminent overloading of Transmission lines or Equipment.
Annual Maximum Demand Conditions	The conditions that lead to Maximum Demand on the Transmission System in the year.

Apparatus	Means all Equipment, in which electrical conductors are used, supported, or of which they may form a part. In the Grid Code it means (Extra) High Voltage electrical circuits forming part of a System on which Safety Precautions may be applied to allow work and/or testing to be carried out on a System.
Apparent Power	Power that appears to be present when the voltage and current in the circuit are measured separately. It is measured in volt amperes (VA)
Authority for Access	An authority which grants the holder the right to un-accompanied access to a Site containing (E)HV conductors.
Automatic Load Dropping	The process of automatically and deliberately removing pre-selected loads from a Power System in response to an abnormal condition in order to maintain the integrity of the System.
Automatic Reactive Power Regulator	A continuously acting automatic control system (in the case of PPM) which acts to control the reactive power exchange of the PPM with the System, according to instructed modes and set points.
Automatic Voltage Regulator (AVR)	A continuously acting automatic Excitation control system (in the case of Synchronous Generating Units) or a continuously acting automatic reactive/voltage control system (in the case of Power Park Modules) to automatically control the voltage of a Generating Unit to a desired value measured at the Generating Unit terminals.
Availability	The long-term average fraction of time that a component or system is in service and satisfactorily performing its intended function. Also, the steady-state probability that a component or system is in service.
Available Active Power of Renewable Resource Generation	The maximum Active Power that the Renewable Resource Generation could deliver at the Connection Point based on renewable primary energy conditions (e.g. solar irradiance, wind speed) at any point in time.
Availability Notice	A submission by a Generator in respect of each of its Generating Units to the TSP pursuant to the provisions of Scheduling and Dispatch Code stating whether or not such Units are available for Generation.

Average Conditions	That combination of weather elements within a period of time which is the average of the observed values of those weather elements during equivalent periods over many years.
Backup Reserve	Refers to a Generating Unit that has Fast Start Capability and can Synchronize with the Grid to provide its Declared Capacity for a minimum period as specified by the TSP.
Black Start	The process of recovery from Total System Blackout using a Generating Unit with the capability to start and Synchronize with the System without an external Power supply.
Black Start Test	A Test carried out by a Generator with a Black Start Unit, on the instructions of the TSP, to demonstrate that the Unit has the contracted Black Start capability.
Black Start Unit/Station	A Generating Unit/Station having Black Start capability.
Busbar	An electrical conduit at facilities where lines, transformers and other Equipment are connected.
Business Day	Any day on which banks are open for business.
Capacity	The rated continuous load-carrying capability of Generation, Transmission, or other electrical Equipment, expressed in megawatts (MW) or megavolt-amperes (MVA).
Check Meter	The Meter designated to provide measurements at a metering point for verification or substitution purposes.
Coincident Peak	The sum of two or more peaks that occur in the same demand period.
Commissioning	A process to ensure that all Equipment, Protection Schemes, and other systems relating to the User Development are correctly functioning.
Commissioning Report(s)	Any report(s) that are prepared to document the process and results of the Commissioning activity.
Commissioning Tests	Commissioning Tests is one of the final activities under project implementation which is carried out to test and commission all Equipment, Protection Schemes and other systems to verify the correct functioning of the User Development.

Committed Outage Program (for Generation Outages)	The Outage Program that the TSP shall prepare for the period up to end of Year 1.
Committed Outage Program (for Transmission Outages)	The Outage Program that the TSP shall prepare for the period up to end of Year 0.
Committed Project Planning Data	The data for a User Development once an Offer for a Connection Agreement or an amended Connection Agreement has been accepted by the User.
Completion Date	The date, specified in the Connection Agreement or amended Connection Agreement, when the User Development is scheduled to be completed and is ready for Connection to the Grid.
Connection	Means the installation of Connection Assets in such a way that, subject to Energization, the User may import and/or export electricity to and/or from the Transmission System at the Connection Point and “Connected” shall be construed accordingly.
Connection Agreement	An agreement between a User and the TSP, which specifies the terms and conditions pertaining to the Connection of the User System or Equipment to a new Connection Point in the Grid.
Connection Asset	The electric Power lines and electrical Equipment used to effect a connection of a User's System to the Transmission System.
Connection Date	The date on which the Commissioning Tests have to properly completed to the satisfaction of the TSP in respect of every part of the User's System, following which the TSP shall, as soon as reasonably practicable, notify the User to that effect, specifying the date of completion of such implementation.
Connection Point	The electrical point of connection where the assets of a User (Generator, Distribution Entity, or Directly-connected Customer) are physically connected to the system of the TSP. The TSP shall own, operate, and maintain all the facilities up to and including those at this Point. The User shall own, operate, and maintain all the facilities beyond this Point.
Connection Site	The site at which the Plant and Apparatus of the User at the User's side of the Connection Point is to be installed including the land, spaces, roads and any surfaces.

Contingency Plans	The plans prepared to deal with any contingencies on the Transmission System.
Contingency Reserve	It is the margin of available Generation Capacity over forecast Demand, which is required in the period from 24 hours ahead down to real time, to cover against uncertainties in Availability of Generation Capacity and also against weather forecast and Demand Forecast errors.
Control Action	An action, such as switching, whereby the Transmission System is operated.
Control Center	A location used for the purpose of monitoring, controlling, and operating of the Generator's Plant and Apparatus.
Control Engineer	The designated person of the TSP responsible for directing and controlling the operation of Transmission System.
Control Phase	The Control Phase follows on from the Programming Phase and covers the period down to real time.
Critical Loading	Refers to the condition when the loading of transmission lines or substation Equipment is between 90 percent and 100 percent of the continuous rating.
Current Transformer (CT)	Device that reduces or scales down the actual system current to proportional values of a few amperes for use by a Protection System or Meter.
Data Acquisition System	A device provided to record the sequence of operation in time, of the relays/ Equipments/system parameters at a location.
Declaration	A notice prepared by the Generator in respect of its Generating Units and submitted to the TSP pursuant to the provisions of Scheduling and Dispatch Code and setting out the values relating to Availability, System Services capabilities, Operating Characteristics. The term “Declared” shall be construed accordingly.
Declared Data	The data provided by the Generator pursuant to the provisions of Scheduling and Dispatch Code in accordance with the latest/current Generating Unit parameters.
De-energize/De-energization	The act reverse of Energize/Energization.

Default	Default shall mean the failure of a Participant to discharge its obligations in accordance with the provisions of the Grid Code.
Demand	The demand of MW and Mvar of electricity (i.e. both Active and Reactive Power), unless otherwise stated.
Demand Control	The reduction in Demand for the control of the frequency when the Grid is in an Emergency state. This includes Automatic Load Dropping, Manual Load Dropping, and Demand Reduction upon instruction by the TSP, Demand Disconnection managed by Users, and Voluntary Load Curtailment.
Demand Forecast	The projections of Power and Active Energy requirements relating to a Connection Point in the Transmission System.
Demand Period	A legal obligation of certain duration.
Demand Value	The value of the parameters requested by User or TSP.
Derogation	An order by the Regulator relieving a particular Participant from that Participant's obligation to comply with the Grid Code in specified circumstances and to a specified extent.
De-Synchronize	The process of taking a Generating Unit and/or interconnected AC Systems off the Transmission System when they were previously Synchronized with it. The term de-synchronized, de-synchronizing, and the like shall be construed accordingly.
Detailed Planning Data	The data that the TSP may require from any User in support of the Standard Planning Data.
Directly-connected Customers	Any User directly connected to the Transmission System, other than the Generator or Distribution Entities.
Disconnection	The opening of an electrical circuit to isolate an electrical System or Equipment from a Power source.
Disconnector/Disconnect Switch	A switch that is used for closing, opening, or changing the connections in a circuit or system or for purposes of Isolation.

Dispatch	The process used by the TSP to apportion the total Demand of the Grid through the issuance of Dispatch Instructions to Generators, Distribution Entities, and Directly-connected Customers in accordance with the provisions of Chapter 5: Scheduling and Dispatch Code to achieve the operational requirements of balancing Demand with supply that will ensure the Security of the Grid.
Dispatch Instruction	Refers to the instruction issued by the TSP to the Generators, Distribution Entities, Directly-connected Customers, Scheduled Generating Units and/or the Generators whose Generating Units will provide System Services to implement the final Generation Schedule in real time.
Dispatch Parameters	The electrical parameters incorporated in the Dispatch Instruction.
Dispatched Output	The net Energy delivered to the Transmission System by a Generator at the Connection Point (gross Generated energy minus auxiliary consumption).
Distribution Entity	Entity that own, operate, and distribute electricity through a Distribution System.
Distribution System	The system of wires and associated facilities belonging to a franchised Distribution Entity, extending between the delivery points on the Connection Point to the premises of the end users of electricity. Also, it is an electricity network consisting of assets operated at a nominal voltage of 69 kV or less.
Disturbance Recorder	A device provided to record the behavior of the pre-selected digital and analog values of the system parameters during an Event.
Electric Utility Industry	Means all the stakeholders responsible for the Generation, Transmission, Distribution, and use of electricity.
Electrical Diagram	A schematic representation, using standard electrical symbols, which shows the connection of Equipment or Power System components to each other or to external circuits.
Electricity Law	The “Electricity Law” of the Kingdom of Saudi Arabia.

Embedded/Captive Generating Unit/Station	A Generating Unit/Station that is connected to a Distribution System or the System of any User and has no direct Connection to the Transmission System.
Emergency	A Partial Shutdown or Total Shutdown or any other physical or operational condition and/or occurrence on the System which, in TSP's opinion, is (i) imminently likely to endanger or is endangering life or property; or (ii) is imminently likely to impair or is impairing: (a) TSP's ability to discharge any statutory, regulatory or other legal obligation and/or (b) the Safety and/or Reliability of the Power System.
Emergency Plans	TSP's plans to deal with Emergency situations or Events.
Energize/Energization	The act of operation of switching Equipment or the Start-up of a Generating Unit, which results in there being a non-zero voltage beyond a Connection Point or part of the System.
Energy	Unless otherwise qualified, refers to the Active Energy.
Equipment	All Apparatus, machines, conductors, etc., used as part of, or in connection with, an electrical installation.
Equipment Identification	The System of numbering or nomenclature for the identification of Equipment at the Connection Points in the Grid.
Estimated Equipment Data	It shall contain the User's best estimate of the values of parameters and information pertaining to its Equipment and Apparatus and which on Connection become fixed (subject to any subsequent change).
Event	An unscheduled or unplanned occurrence or an abrupt change or disturbance in a Power System due to Fault, Equipment Outage, or adverse weather condition.
Event Logger	A device provided to record the sequence of operation in time, of the relays/ Equipments at a location during an Event.
Excitation (System), Exciter	The Equipment providing the field current of a Generating Unit, including all regulating and control elements, as well as field discharge or suppression Equipment and protective devices.

Extra High Voltage EHV	A voltage level exceeding 230 kV.
Fast Start Capability	The Capability of a Generating Unit to Start-up and Synchronize with the Grid within 10 minutes.
Fault	Physical condition that causes a device, component, or element to fail to perform in a required manner.
Flexible Planned Outage	A Planned Outage which can be, at the request of the TSP, deferred or advanced by a certain period.
Flicker Severity (Long Term) or P_{lt}	A value derived from 12 successive measurements of Flicker Severity (Short Term) (over a two hour period) and a calculation of the cube root of the mean sum of the cubes of 12 individual measurements.
Flicker Severity (Short-term) or P_{st}	A measure of the visual severity of flicker derived from the time series output of a flicker meter over a 10 minute period and as such provides an indication of the risk of User complaints.
Force Majeure	Force Majeure shall mean any act of God, labor disturbance, act of the public enemy, war, insurrection, riot, fire, storm or flood, explosion, breakage or accident to machinery or Equipment, any order, regulation or restriction imposed by governmental, military or lawfully established civilian authorities, or any other cause beyond a party's control. A Force Majeure event does not include an act of negligence or intentional wrongdoing.
Forced Outage	An Outage of a Generating Unit or a Transmission facility due to a Fault or other reasons which has not been planned, also it results from emergency conditions directly associated with a component, requiring that it be taken out of service immediately, either automatically or as soon as switching operations can be performed.
Forecast Data	Those items of the Standard Planning Data and Detailed Planning Data which will always be forecast.
Frequency Control	The retention of the frequency on the Transmission System within acceptable limits.

Frequency Regulation	The automatic adjustment of Active Power output by a Generating Unit, initiated by free Speed Governor System action for Synchronous Generating Units or by Power electronic converters' control for Power Park Modules, in response to continuous minor fluctuations of frequency on the Transmission System.
Frequency Sensitive Mode	A Generating Unit operating mode which will result in Active Power output changing, in response to a change in System frequency, in a direction which assists in the recovery to target frequency.
Generating Station	An installation comprising one or more Generating Units (even where sited separately) owned and/or controlled by the same Generator, which may reasonably be considered as being managed as one generating station.
Generating Unit	An electrical generating unit within a Generating Station together with all Plant and Apparatus at that Station (up to the Connection Point) which relates exclusively to the operation of that generating unit. A Generating Unit can be either: • a Synchronous Generating Unit • a Power Park Module
Generating Unit/Station Schedules	A daily or weekly statement of Generating Plant in response to change in Availability
Generation	The process of producing electric Energy from other forms of energy; also, the amount of electric Energy produced, usually expressed in kilo watt hours (kWh) or mega watt hours (MWh).
Generation Planning Parameters	The parameters involved in the planning of Generation.
Generation Schedule	A statement prepared and issued by the TSP pursuant to Scheduling and Dispatch Code on a daily or more frequent basis setting out which Generating Units will be required during the Scheduled Day to meet demand, ensure Transmission System integrity, and have available sufficient Operating Reserve to satisfy any normal and abnormal requirements.
Generator	A legal entity licensed to engage in the production of electricity through a Generating Unit or Generating Station.

Generator Performance Chart	A diagram which shows the MW and Mvar capability limits within which a Generating Unit will be expected to operate under steady state conditions.
Good Industry Practices	Any of the practices, methods, and acts engaged in or approved by a significant portion of the Electric Utility Industry during the relevant time period which could have been expected to accomplish the desired results at a reasonable cost consistent with good business practices, reliably, safely and with expedition.
Government	The Government of Kingdom of Saudi Arabia
Governor Deadband	The total magnitude of the change in steady state speed (expressed as a range of ± Hz) within which there is no change in the position of the governing valves of the Speed Governor System.
Governor Droop	The percentage drop in the frequency of a Generating Unit that occurs when its output is increased from zero to its full load.
Grid	The High Voltage and Extra High Voltage backbone system consisting of interconnected transmission lines, Substations, and related facilities for the purpose of transporting of bulk Power and Energy. Also termed as the Transmission System.
Grid Code	The Saudi Arabian Grid Code.
Grid Code Supervisory Committee (GCSC)	The Committee constituted to supervise the functioning of the Grid Code and its modification, if required.
Ground Fault Factor	The ratio of the highest RMS phase-to-ground Power frequency voltage on a sound phase, at a selected location, during a Fault to Ground affecting one or more phases, to the RMS phase-to-ground Power frequency voltage that would be obtained at the selected location with the Fault removed.
Grounding	A conducting connection by which an electrical circuit or Equipment is connected to earth or to some conducting body of relatively large extent that serves as ground.
Harmonics	Electric current or voltage that alternates at a frequency other than, and usually an integer multiple of, the fundamental frequency.
High Voltage (HV)	A voltage level exceeding 69 kV up to 230 kV.

House Load Operation	The operation of a Generating Unit which is isolated from the Grid and is providing power supply only to the station load.
Implementing Party	The party as defined in the Operating Code responsible for implementing the Safety Precautions.
Incident (Notice)	An unscheduled or unplanned occurrence on, or relating to, a System including, Faults, Events and breakdowns and adverse weather conditions being experienced. (A notice regarding the above incident).
Indicative Generating Unit Synchronizing	A notice/indication issued by the TSP to Generator showing the Synchronization time of the Generating Units.
Indicative Outage Program (for Generation Outages)	An Outage Program for the Generating Units prepared by the TSP pursuant to Outage Planning section of Chapter 4: Operating Code, and covering years 4 and 5 ahead of the current year.
Indicative Outage Program (for Transmission Outages)	An Outage Program for the Transmission System Outages prepared by the TSP pursuant to Outage Planning section of Chapter 4: Operating Code, and covering years 2 and 3 ahead of the current year.
Inertia of a Synchronous Generating Unit	Inertia refers to energy stored in the rotational mass of the Generating Unit which maintains its state of uniform rotational motion. Its angular momentum is unchanged, unless an external torque is applied.
Inflexible Planned Outage	A Planned Outage the start date and start time of which cannot be moved by TSP under Operating Code.
Instrument Transformer	A transformer that is intended to reproduce, in its secondary circuit, a voltage or current proportional to that of its primary circuit, with its phase relations substantially preserved. These transformers are utilized to provide indication for measuring, control, or protective devices.
Interruptible Load	A load which is available to be disconnected, either manually or automatically, for restoration or control of the Power System frequency by the TSP to cater for contingency events or shortage of supply.
Interruption	The loss of service to a User or a group of Users or other facilities. An Interruption is the result of one or more component Outages.

Isolation	The complete electrical separation of a part or component from the rest of the electrical system to ensure Safety when that part or component is to be maintained or when electric service is not required.
License	Refers to a license granted or deemed to be granted by the Electricity and Co-Generation Regulatory Authority of Saudi Arabia.
Load Break Switch	A switch that is capable of interrupting only normal load currents.
Load Curtailment	The Load Reduction obtained from Users who are able and willing to curtail their usage of Power. These loads are to be curtailed within one hour of the instruction being issued by the TSP.
Load Reduction	The condition in which a Scheduled Generating Unit, Distribution Entity, or Directly-connected Customer reduces electrical Power to the System to which it is Synchronized/Connected.
Local Safety Instructions	A set of instructions regarding the Safety Precautions on HV or EHV Equipment to ensure the Safety of personnel carrying out work or testing on the Transmission System or the User System.
Low Voltage	A voltage level not exceeding 1,000 volts.
Main Meter	The Meter designated at a metering point to provide measurements at a metering point.
Maintenance Program	A set of schedules, which are coordinated by the TSP, specifying planned maintenance for Equipment in the Transmission System or in any User System.
Manual Load Dropping	The process of manually and deliberately removing pre-selected loads from the Transmission System, in response to an abnormal condition, and in order to maintain the integrity of the System.
Material Effect	A condition that has resulted or is expected to result in problems involving Power Quality, System Reliability, System Loss, Safety, or Stability. Such condition may require extensive work, modification, or replacement of Equipment in the Transmission System or the User System.
Maximum Demand	The maximum hourly integrated Energy consumption measured at the point of supply to a customer for a particular year.

Meter	A device for measuring or recording electrical Power, Energy, and related quantities at a metering point.
Meter Certificate	A certificate issued by the TSP certifying that the Meters and Metering Equipment at the Metering Point comply with the Metering Code requirements.
Meter Reconciliation Statement	A statement that provides comparison of the cumulative Energy recorded in the Meter register with the total Energy derived from the Demand values recorded remotely.
Metering Equipment/System/ Installation	Meters, time switches, Instrument Transformers, metering Protection and Isolation Equipment, circuitry and their associated data storage and data communications equipment and wiring which are part of the Active Energy and Reactive Energy measuring or recording scheme at or related to a Site.
Metering Point	The point of physical connection of the Meter to measure/record the flow of electricity and related quantities.
Minimum Demand Regulation	The margin of Active Power to provide a sufficient regulating margin for Frequency Control.
Minimum Generation	The minimum output in MW which a Generating Unit can generate, as registered with the TSP under the Scheduling and Dispatch Code.
Minimum Stable Loading	The minimum Demand that a Generating Unit can safely maintain for an indefinite period of time.
Negative Minimum Demand Regulation (NMDR)	The margin of Active Power to provide a sufficient regulating margin for Frequency Control.
Negative Primary Response	Automatic decrease in Active Power output of a Generating Unit in response to a System frequency rise.
Net Declared Capability	The maximum Active Power, expressed in whole MW, and modified for ambient limitations, that a Generating Unit can sustain less the auxiliary load, as declared by the Generator in accordance with its Operating Characteristics**.**
Net Dependable Power Capacity	The Capacity of a Generating Unit as notified to the TSP less the MW consumed by the Generating Unit through the Generator Unit transformer (the resultant expressed as a whole number of MW).

Nominations	A notice by the Generator in respect of a Generation Unit submitted to the TSP in accordance with the requirements of Scheduling and Dispatch Code.
Notice	Any formal intimation issued by the TSP to a User relating to any provision of the Grid Code.
Notice to Synchronize	The notice given by the TSP to a Generator requiring a Generating Unit to Synchronize with the Grid.
Notification of Inadequate Operating Margin (NIOM)	A notice issues by the TSP to Generators and Distribution Entities after 10:00 hours on any day pursuant to the provisions of the Scheduling and Dispatch Code in anticipation of insufficient Operating Margin in relation to the following Scheduled Day.
Offer of Connection	A quotation letter together with the unsigned Connection Agreement which forms the TSP's Offer for Connection for the User Facility to the Transmission System as the result of an application for Connection of the Facility.
Operating Characteristics	The technical capabilities, flexibilities and limitations for the operation of a Generating Unit as registered or declared in accordance with the provisions of the Grid Code.
Operating Margin	The margin of Generation over the total Demand plus losses that is necessary for ensuring Quality of supply and Security of the Grid. Operating Margin is the sum of the Operating Reserve and the Contingency Reserve.
Operating Reserve	It is the additional MW output provided by Generating Unit/Station, or reduction in Customer Demand, which must be realizable in real time to contain and correct any potential Transmission System frequency deviation to an acceptable level.
Operation	A scheduled or planned action relating to the operation of a System.
Operation Diagram	Diagrams which are a schematic representation of the HV and/or EHV Apparatus and the connections to all external circuits at a Connection Site, incorporating proper identification and labeling.
Operational Data	Data required under the Operating Code and/or Scheduling and Dispatch Code.

Operational Date	The date on which a User Connection is actually Energized by the TSP.
Operational Effect	Any effect on the operation of a System which causes the Systems of the TSP or other Users to operate differently to the way in which they would have normally operated in the absence of that effect.
Operational Planning Phase	The Operational Planning forecast for the Generating Units Outages from 1 week to 5 years ahead of the real- time operation.
Operational Tests	Tests carried out by the TSP in order to maintain and develop operational procedures, to train staff and to acquire information in respect of Transmission System behavior under abnormal System conditions, and also tests carried out by other Users for similar purposes in respect of their Plant and/or Apparatus.
Operations Report	An annual Report summarizing the occurrences of operation on the User or Transmission System.
Outage	The state of a component or system when it is not available to perform its intended function due to some event directly associated with that component or system. An Outage may or may not cause an Interruption of service to Users.
Partial Shutdown	The situation existing when all Generation has ceased in part of the Power System and there is no electricity supply from external interconnection or any other part of the System.
Participant	A legal entity registered with or licensed by the Regulator in terms of the Electricity Law, as provider or User of Transmission services.
Planned Outage	An Outage of Equipment that is requested, negotiated, scheduled and confirmed a minimum of 14(28 for Generators) days prior to the maintenance or repairs taking place.
Plant	Includes all Equipment (fixed or movable), other than Apparatus, involved in the generating, transmitting, distributing, and utilizing of electrical Energy.
Post Control Phase	The period following real time operation.
Power	Refer to Active Power
Power Factor	The ratio of Active Power to Apparent Power.

Power Park Module	A Power Park Module is a unit or ensemble of units generating electricity, which • is connected to the Network non-synchronously or through power electronics, and • has a single Connection Point to the Transmission System.
Power Purchase (Supply) Agreement	The agreement setting out the parameters and terms and condition of purchase (supply) of Power from (to) any source through legal contract.
Power System	Any power system owned or operated by a User/TSP consisting of Generating Units, Transmission System/ Distribution Systems, or any other electric lines, Plant and Apparatus.
Power System Stabilizers (PSS)	A control device placed on a Generating Unit and used in conjunction with an AVR to provide additional control of oscillations. For Power Park Modules, the corresponding term is “Power Oscillation Damper (POD)”.
Preliminary Project Planning Data	The data relating to a proposed User Development at the time the User applies for a Connection Agreement or an Amended Connection Agreement.
Primary Frequency Control	The automatic increase (decrease) in Active Power in response to a System frequency fall (rise).
Primary Response	The automatic response of a Generating Unit to frequency changes, released increasingly from zero to five seconds from the time of frequency change, and which is fully available for the next 5 seconds.
Primary Response Test	A test to verify that the Primary Response of a Generating Unit in MW/Hz is within ± five (5) percent of the required level of response within five (5) seconds.
Programming Phase	The period between Operational Planning Phase and the Control Phase. It starts 8 weeks ahead of real time and finishes with the issue of the Generation Schedule for the day ahead.
Project Planning Data	The data that the TSP will require from Users applying for a new, or modification of an existing, Connection. Project Planning Data will be further classified into Preliminary Project Planning Data, Committed Project Planning Data, or Registered Project Planning Data.

Protection (Scheme or System)	The means (scheme or system) including the Apparatus used to detect, limit, and remove Faults from the Power System.
Provisional Outage Program (for Generation Outages)	Forecast Outage Program for the Generating Units/Station prepared by TSP for the calendar year 2 and 3.
Provisional Outage Program (for Transmission Outages)	Forecast Outage Program for the Transmission System Outages prepared by TSP for the calendar year 1.
Quality (of supply/service)	With respect to electricity, technical attributes to a standard referred to in the Grid Code.
Ramp Rate	The rate, expressed in megawatts per minute, at which a Generating Unit can increase or decrease its Power output.
Reactive Energy	The integral of the Reactive Power with respect to time, measured in varh or multiples thereof.
Reactive Power	The product of voltage and current and the sine of the phase angle between them measured in units of volt-amperes reactive (var) and multiples thereof.
Reactive Power Support	The production or absorption of Reactive Power from Generators to maintain Transmission System voltage within the specified limits.
Readiness to Connect	A statement by a User, whose development is under construction in accordance with a Connection Agreement and who wishes to establish Connection with the Transmission System, made to the TSP in writing, stating readiness to connect and supplying all the requisite information and documentation that the TSP may need as per the Connection Agreement.
Red Alert	An alert issued by the TSP to notify that either a Partial or a Total Shutdown of the System has taken place.
Registered Capacity	The Capacity registered with the TSP as a Standard Planning or Detailed Planning Data requirement.
Registered Data	Those items of Standard Planning Data and Detailed Planning Data which upon connection become fixed.
Registered Fuel	The fuel(s) registered under the Planning Code of the Grid Code.

Registered Operating Characteristics	The values of a Generating Unit's Operating Characteristics for operation of the Generating Unit registered with the TSP pursuant to the Grid Code.
Registered Project Planning Data	The data submitted by a User to the TSP at the time of Connection of the User System to the Grid.
Regulator	The Electricity and Co-Generation Regulatory Authority of Saudi Arabia.
Regulatory Guidelines	Guidelines issued by the Electricity and Co-Generation Regulatory Authority of Saudi Arabia.
Reliability	The degree of performance of the System that results in electricity being delivered to customers within accepted standards and in the amount desired. Reliability can be addressed by considering two basic and functional aspects of the System: Adequacy and Security.
Renewable Resource Generation	A Generating Unit which is based on renewable resources for the generation of electricity including solar thermal, solar PV, wind, geothermal, and waste to energy. Hybrid technologies are also included when operating on renewable resource only.
Requesting Party	The party as defined in the Operating Code that requests Safety Precaution.
Responsible Engineer	A person nominated by a User to be responsible for System control for its System.
Responsible Manager	A manager who has been duly authorized by a User or the TSP to sign Site Responsibility Schedules on behalf of that User or the TSP.
Safety	Safety from the hazards arising from the live Equipment, Plant, or other facilities of the Transmission System (or User System).
Safety Precautions	Refers to the Isolation and Grounding of HV or EHV Equipment when work or testing is to be done on, or in close proximity to, the Transmission System or User System at the Connection Point.
Safety Representative	A person designated and authorized by the User or the TSP to be responsible for the coordination of Safety Precautions at the Connection Point for their respective sides when work or testing is to be carried out on a System which requires the provision of Safety Precautions for HV or EHV Equipment.

Safety Rules	The rules that seek to safeguard personnel working on the Grid (or User System) from the hazards arising from the Equipment or the Transmission System (or User System).
Saudi Arabian Grid Code	Refers to this document prepared originally by Saudi Electricity Company and revised by National Grid $_{SA}$ pursuant to the requirement of Condition 9 of the Transmission License granted by ECRA to National Grid $_{SA}$ dated 15 April 2012.
Schedule Day	The period from 0000 hours in the Schedule Day until 0000 hours on the next following Day.
Scheduling (Process)	A process to determine which Unit or Equipment will be in operation and at what loading level.
Scheduling and Dispatch Parameter(s)	The parameter(s) listed in the Scheduling and Dispatch Code under the heading Scheduling Parameters relating to Generating Units/Station.
Secondary Frequency Control	The automatic response to frequency which is fully available 30 seconds from the time of frequency change to take over from the Primary Response, and which is sustainable for at least 30 minutes.
Secondary Operating Reserve	It is the additional MW output (and/or reduction in Demand) required compared to the pre-Incident output (or Demand), which is fully available and sustainable over the period from 15 to 90 seconds following an Event.
Secondary Response	Same as Secondary Frequency Control.
Security	The ability of the Grid to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.
Short Term Planned Maintenance	Maintenance plan requested by the Generator at any time in year 0, by giving not less than 7 days notice before earliest start date.
Shutdown	The condition of the Equipment when it is De-energized or Disconnected from the System.
Significant Incident	An Event on the Transmission System, a Distribution System, or the System of any User that has a serious or widespread effect on the Grid, the Distribution System, and/or the User System.

Significant Incident Report	A report prepared after the occurrence of a Significant Incident pursuant to section 4.5, Operational Liaison, of Chapter 4: Operating Code.
Single Line Diagram	Diagram which is a schematic representation of the HV/EHV Apparatus and the connections to all external circuits at a Connection Point incorporating its numbering, nomenclature, and labeling.
Site	Refers to a Substation or switchyard in the Grid or the User System where the Connection Point is situated.
Site Responsibility Schedule	A schedule containing the information and prepared on the basis of the provisions set out in the Connection Code.
Special Action(s)	The action(s), as defined in Chapter 5: Scheduling and Dispatch Code, that the TSP may require a Generator, Distribution Entity, or Directly-connected Customer to take in order to maintain the integrity of the Grid.
Speed Governor System	A system which will result in Active Power output of a Generating Unit changing, in response to a change in System frequency, in a direction which assists in the recovery to target frequency.
Stability	The ability of the dynamic components of the Power System to return to a normal or stable operating point after being subjected to some form of change or disturbance.
Standard Planning Data	The general data required by the TSP from Users as part of the application for a Connection Agreement or amended Connection Agreement on a regular basis.
Start-up	The process of bringing a Generating Unit from Shutdown to synchronous speed.
Substation	A site at which switching and/or transformation Equipment is installed.
Supervisory Control and Data Acquisition (SCADA)	A system of remote control and telemetry used to monitor and control a Power System.
Sustainable Resource Generation	A Generating Unit which is either • a Renewable Resource Generation or • a Generating Unit for which the generation of electricity is based on nuclear power.

Synchronize	The process of connecting Generating Units and/or interconnected AC Systems when they operate at the same frequency and where the phase angle displacements between their voltages vary about a stable operating point. The term synchronized, synchronizing, and the like shall be construed accordingly.
Synchronous Generating Unit	A Generating Unit is composed of a synchronous alternator(s) coupled to a turbine and synchronously-connected to the Transmission System.
Synthetic Inertia	A facility or System Service provided by a Power Park Module to replicate the effect of Inertia of a Synchronous Generating Unit to a prescribed level of performance.
System	Refers to the Grid or Transmission System.
System Constraint	A limitation on the use of a System due to lack of Transmission Capacity or other System conditions.
System Emergency Conditions	A Partial Shutdown or Total Shutdown or any other physical or operational condition and/or occurrence on the System which, in TSP's opinion, is (i) imminently likely to endanger or is endangering life or property; or (ii) is imminently likely to impair or is impairing: (a) TSP's ability to discharge any statutory, regulatory or other legal obligation and/or (b) the Safety and/or Reliability of the System.
System Protection Dependability Index	A measure of the ability of the Protection to initiate successful tripping of circuit-breakers associated with a faulty item of Apparatus. It can be calculated using the following expression: System Protection Dependability Index = 1 – (Number of Faults when Protection failed to trip/Total number of Faults)
System Restoration	The process by TSP to achieve restoration of supply, as safely and as quickly as possible, after the occurrence of Partial or Total Shutdown of the System.
System Restoration Plan	A plan prepared and maintained by the TSP pursuant to emergency control and System Restoration setting out guidelines assisting those involved in System Restoration to achieve System Restoration as safely and as quickly as possible.

System Services	Services supplied to the TSP by Generators, Distribution Entities, or Directly-connected Customers, necessary for the reliable and secure transport of Power from Generators to Distribution Entities and other Directly-connected Customers.
Technical Completion Certificate	Shall have the meaning as defined in the relevant Connection Agreement of a User with the TSP.
Tertiary Operating Reserve	The additional MW output (and/or reduction in Demand) which is fully available and sustainable over 90 seconds up to 30 minutes after initiation of a frequency change Event on the Grid.
Test Coordinator	The coordinator appointed by the TSP pursuant to the provisions of the Operating Code.
Test Group	A group of persons who is designated by the TSP to perform or conduct the required Operational Test.
Test or Testing	Test or testing carried out by the TSP in respect of a User's Equipment, Apparatus, or facilities.
Test Procedure	A procedure that specifies the switching sequence and proposed timing of the switching sequence, including other activities deemed necessary and appropriate by the Operational Test Group in carrying out the Operational Test.
Test Program	A program to carry out test(s) or testing on the System.
Test Proponent	Refers to the TSP or the User who plans to undertake an Operational Test and who initiates an Operational Test Request.
Test Request	A request by the TSP or a User to undertake an Operational Test.
Total Harmonic Distortion	The ratio of the root-mean-square value of the Harmonic content to the root-mean-square value of the fundamental quantity, expressed in percent.
Total Shutdown	The situation existing when all Generation has ceased and there is no electricity and, therefore, the Total System has Shutdown with the result that it is not possible for the Total System to begin to function again without TSP's directions relating to a Black Start.

Transmission Service Provider (TSP)	The legal entity that is licensed to own and maintain a network on the Transmission System (or has such right by virtue of its historic existence for this purpose).
Transmission System	The Transmission System consists of all lines and Substation Equipment where the nominal voltage is ≥ 110 kV. The Transmission system consists of: • The Transmission System • Assets Connected to the Transmission System and belonging to the TSP. • Generating Stations and networks linking such Power Stations to the Transmission System • The control area for which the TSP is responsible. The Transmission System definition is not linked to specific assets, but includes those components of the electrical network that have a measurable influence, at Transmission level, on each other as they are operating as one Power System. Also, has the same meaning as Grid.
Transmission System Outage.	When Transmission System interrupts due to any reason.
Under Frequency Relay	An electrical relay that operates when the System frequency decreases to a preset value.
Unplanned Outage	Has the meaning as defined in section 4.3 of the Operating Code.
Use of System Agreement	An agreement between the TSP and a User setting out the terms and conditions relating to the use of the Transmission System.
User	A person or entity that uses the Grid and its related facilities. Also, a person or entity to which the Grid Code applies. Includes prospective Users as well.
User Development	Means either User's Plant and/or Apparatus to be connected to the Transmission System, or a modification relating to a User's Plant and/or Apparatus already connected to the Transmission System, or a proposed new Connection or modification to the existing Connection.
Voltage Control	The strategy used by the TSP, Distribution Entity, Generator, or User to maintain the voltage of the Grid, Distribution System, or the User System within the limits prescribed in the Grid Code.

Voltage Transformer (VT)	Device that reduces system voltage down to proportional values of 120 volts or less for use by a Protection System or Meter.
Voluntary Load Curtailment	The agreed self-reduction of Demand by identified Users to assist in Frequency Control when Generation deficiency exists.
Yellow Alert	An alert issued by the TSP to the Users when a single Event would give rise to a reasonable possibility of failure to meet the System Demand, or of frequency or voltage departing significantly from normal, or if multiple Events are probable due to prevailing weather conditions.

Chronology of Saudi Arabian Grid Code Revisions

Sr. No.	Revision No.	Date	Detail of the Revision
1	15A068	29 May 2016	Amendment 15A068 pertains to the replacement of the terms “Saturdays” and “Wednesdays” with “first day of the business week” and “last day of the business week” respectively. The amendments can be seen in clauses 4.2.4.3, 4.3.5.7, Figure 4.1 and Schedules 3 and 7.