Key Functions of Indian Electricity Grid Code

Dr. S. K. Agrawal
General Manager
POWERGRID

Presentation Outline

- Power system operation-Macro Choices
- Introduction
  - Definition, Ownership & Scope
  - Enforcement of Grid Code
  - Management of grid code
- Grid Code Contents
- Discussion

Key Words

- CERC:Central Electricity Regulatory Commission
- IEGC: Indian Electricity Grid Code
- ISGS: Inter State Generating Station
- ISTS: Inter State Transmission System
- CTU: Central Transmission Utility
- STU: State Transmission Utility
- RPC: Regional Power Committee
- STOA : Short Term Open Access

Power System Operation

Definition of Control Area

"An electric system bounded by inter-utility metering and telemetry, capable of controlling and maintaining interchange schedule with other control areas and contributing to frequency regulation of the power system"

The macro choices before us

Category	Choices
Transmission planning	National, Regional or State level
Frequency	Floating or flat
Scheduling	Decentralized or Centralized
Power Pool	Loose or Tight
Deviations from schedule	Priced or un priced

Documents

Document	Issuer
Electricity Act	Parliament
National Electricity Policy	Government of India
National Electricity Plan	CEA
Grid Standards	CEA
Connectivity Standards	CEA
Metering Standards	CEA
Electricity Grid Code	CERC
Operating Procedures	RLDC
Black start Procedure	RLDC

Grid Standards & Grid Code

- Grid Connectivity Standards
  - To be specified by CEA
  - Relevant for any player wishing to get connected to the grid
  - Specifies the technical standards for construction of electrical plants, lines and its connection with the grid
- Grid Standards
  - To be specified by CEA
  - Relevant for transmission licensee during O & M phase
  - Technical benchmark
- Grid Code
  - Specified by CERC/SERC
  - Benchmark for grid operation
  - Applicable for everyone who is using the grid

Introduction to the Grid Code

What is IEGC?

- *"Describes the philosophy and the responsibilities for planning and operation of Indian power system specified by the Commission in accordance with sub section 1(h) of Section 79 of the Act."*

- Technical Rules
- Guidelines
- Operational Standards

Evolution of IEGC

- First draft prepared by POWERGRID as CTU in Mar-99
- Approved by CERC in Jan 2000 after public hearing
  - Enforced w.e.f 01st Feb 2000
- First revision by IEGC review panel
  - Issued on 22nd Feb 02, enforced w.e.f 01st April 2002
- Second revision
  - Draft issued by CERC-June 2005, enforced from 1st April 2006
- Amendment
  - Public notice dated 23rd June 2006 by CERC
  - Comments/suggestions invited in respect of Regional Energy Accounting (REA)

How does Regulator come into picture?

Electricity Act 2003

Section 79 subsection (1) clause (h)

"The Central Commission shall discharge the following functions…

(a)…

(h) To specify Grid Code having regard to Grid Standards…"

Section 86 subsection (1) clause (h)

"The State Commission shall discharge the following functions…

(a)…

(h) Specify State Grid Code consistent with the Grid Code specified under clause (h) of subsection (1) of section 79"

Objectives of IEGC

- Documentation of the principles and procedures
- Defines the relationship between the various Users of the inter-State transmission system (ISTS), as well as the Regional and State Load Despatch Centres
- Facilitation of the operation, maintenance, development and planning of economic and reliable Regional Grid
- Facilitation for beneficial trading of electricity by defining a common basis of operation of the ISTS, applicable to all the users of ISTS

Scope

- All parties that connect with and/or utilize the ISTS
- Damodar Valley Corporation (DVC) treated similar to an STU/SEB
- Generating stations Bhakra Beas Management Board (BBMB) and Sardar Sarover Narmada Nigam Ltd. (SSNNL) shall be treated as intra-State generating stations, but their transmission systems shall be a part of the ISTS.

On whom is IEGC applicable?

- All parties connected with and/or utilize ISTS
  - Is it applicable to-
    - Govt of India/CERC/CEA
    - CTU/STU/Interstate transmission licensee/State Tr. licensee
    - RLDC/SLDC/Sub-LDC
    - ISGS/ BBMB/DVC/SSNNL?
    - A state owned generator/IPP/CPP?
    - A distribution company/A large industrial load?
    - A domestic, commercial or agricultural consumer?
    - An electricity trader?
    - Inter regional generator synchronized with our grid
      - Tala HEP, Kurichu HEP?

Contents of the Grid Code

What does IEGC contain?

- Role of various organizations and their linkages
  - Role of RLDC/RPC/CTU/CEA/SLDC/STU
- Planning Code for inter-state transmission
- Connection Conditions
- Operation Code for Regional Grids
  - Operating philosophy, System security aspects
  - Demand management, Periodic reports
  - Operation liaison,Outage planning
  - Recovery procedures
  - Event information

What does IEGC contain?

- Scheduling & Despatch Code
  - Introduction, objective, Scope
  - Demarcation of responsibilities
  - Scheduling and despatch procedure
  - Reactive Power Control and Voltage Control
- Complementary commercial mechanism
- Regulatory requirements of special energy meters
- Payment of reactive energy exchanges on state-owned lines
- Inter-regional Exchange Code
- Management of IEGC

Role of various agencies

- Regional Load Despatch Centre
- Regional Power Committee
- Central Transmission Utility
- Central Electricity Authority
- State Transmission Utility
- State Load Despatch Centre

Role of RLDC

- 2.2.1 According to sections 28 and 29 of Electricity Act, 2003, the functions of RLDCs are as follows:
  - "The Regional Load Despatch Centre shall be the apex body to ensure integrated operation of the power system in the concerned region…"
  - "Every licensee, generating company, generating station, substation and any other person connected with the operation of the power system shall comply with the directions issued by the Regional Load Despatch Centres…"
  - "Dispute be referred to Central Commission for decision.."

Role of RPC

- Undertake operation analysis for improving grid performance
- Facilitate inter-state/inter-regional transfer of power
- Facilitate all functions of planning relating to inter-state/ intrastate transmission system with CTU/STU
- Coordinate planning of maintenance of generating machines & transmission system on monthly basis
- Undertake operational planning studies including protection studies for stable operation of the grid
- Review of reactive compensation requirement & monitoring of installed capacitors
- Evolve consensus on all issues relating to economy and efficiency in the operation
- Relay setting coordination
- Identify critical locations where bus bar protection needs to be provided, if not available.
- Carry out periodic inspection of the under frequency relays and maintain proper records of the inspection

Role of Member Secretary, RPC

- Investigation & grievance resolution (2.3.4)
  - All complaints regarding unfair practices, delays, discrimination, lack of information, supply of wrong information or any other matter related to open access in inter-state transmission shall be directed to the Member
  - Matter to be reported to the Central Commission for a decision in case MS RPC is unable to resolve
- Certification for payment of transmission charges/ capacity charges and incentives (2.3.5)
  - Availability of Regional AC & HVDC transmission system
  - Availability and Plant Load Factor for ISGS (Thermal)
  - Capacity Index for ISGS (Hydro)

Role of CTU

- Undertake transmission of electricity through inter-State transmission system
- Discharge all functions of planning and co-ordination relating to ISTS with STU, Central Government, State Governments, Generating companies, Regional Power Committees, CEA, Licensees
- Ensure development of an efficient, coordinated and economical system of ISTS for smooth flow of electricity from generating stations to the load centres
- Provide non-discriminatory open access
- Operate RLDCs

Neutrality of CTU

- provide non-discriminatory open access to its transmission system (2.1.c)
- “Until a Government company or authority or corporation is notified by the Central Government, the CTU shall operate RLDC” (2.4.1.2)
- “CTU shall not engage in the business of generation of electricity or trading in electricity” (2.4.2)

Role of CEA

- Formulate short-term and perspective plans
- Specify/prepare/notify
  - Safety requirements for construction, operation and maintenance
  - Grid Standards
  - Conditions for installation of meters
  - National Electricity Plan once in five years
- Promote & assist in the timely completion of schemes and projects
- Collect and record data
- Carry out studies relating to cost, efficiency, competitiveness
- Carry out investigation

Planning Code

- Membership of the Standing Committee for Transmission Planning
- Dovetailing of the interstate transmission planning with long-term Open Access approvals
- Planning Criteria
  - N-1 contingency-Outage of series compensated line
  - Special Protection Scheme for Bipole trip
  - Reduction of transmission losses
  - Reconfiguration of transmission lines
  - Transition from 400 kV to 765 kV
  - Categorization of zones for generation investment/load growth

Planning Criteria

(a) The planning criterion are based on the security philosophy on which the ISTS has been planned. The security philosophy may be as per the Transmission Planning Criteria and other guidelines as given by CEA. The general policy shall be as detailed below:

i) As a general rule, the ISTS shall be capable of withstanding and be secured against the following contingency outages without necessitating load shedding or rescheduling of generation during Steady State Operation:

- Outage of a 132 kV D/C line or,
- Outage of a 220 kV D/C line or,
- Outage of a 400 kV S/C line or,
- Outage of single Interconnecting Transformer, or
- Outage of one pole of HVDC Bipole line, or
- Outage of 765 kV S/C line.

Planning criteria

ii) The above contingencies shall be considered assuming a pre-contingency system depletion (Planned outage) of another 220 kV D/C line or 400 kV S/C line in another corridor and not emanating from the same substation. All the Generating Units may operate within their reactive capability curves and the network voltage profile shall also be maintained within voltage limits specified.

Connection Condition

- Communication facilities-Data & Speech
- Data acquisition system, Distribution Recorder, Event Logger, Fault Locator
- Bus bar protection points
- Free Governor mode of Operation
- Installation of energy meters
- Drawings

(b) **Fault Clearance Times**

i) The fault clearance time when all equipments operates correctly, for a three phase fault (close to the bus-bars) on agencies equipment directly connected to ISTS and for a three phase fault (close to the bus-bars) on ISTS connected to agencies equipment, shall not be more than:

a) 100 milli seconds (ms) for 800 kV class & 400 kV

b) 160 milli seconds (ms) for 220 kV & 132 kV

Operating Code

- Operator credentials, training and certification
- Unit synchronization/ de-synchronization timing
- Manual load shedding threshold
- Spinning reserve
- Inter-regional UI exchanges
- Redundancy of communication channels and reliability of auxiliary power
- Ensuring reliability of real time data
- Transmission of energy data to RLDCs
- Information on the public domain

Scheduling & Despatch Code

- Scheduling timeline
- Ramping Rate for peak
- MW quantum of schedule revisions
- Intra day open access
- Termination transactions during congestion
- Chopping of generation- 101 % & 105 % rule

Complementary Commercial mechanism

- Regional Energy Accounting
- Operation of the UI Pool & Reactive Pool
- Priority of UI charge payment
- Disbursements from reactive pool account
- Reactive Energy charges for intra-state ABT
- Testing of Special Energy Meter
- Payment of reactive energy exchange on state owned lines

Inter-regional exchanges

- Functions of NLDC
- Inter-regional STOA
- Scheduling of Inter-regional and cross border generators
- Inter regional schedules- link based or aggregate

Few examples of grid indiscipline

- Non-compliance of RLDC instructions
- Switching of ISTS elements without RLDC permission (except under emergency)
- Manning of control centres by inadequately qualified & untrained trained personnel
- Deliberately isolating part of the grid from the rest of the regional grid
- suddenly reducing generating unit output by more than one hundred (100) MW (20 MW in case of North-Eastern region)
- Sudden increase in its load by more than one hundred (100 MW) (20 MW in case of North-Eastern region)

Few examples of grid indiscipline

- Not ensuring providing of RTU and other communication equipment for sending real-time data to SLDC/RLDC at least before date of commercial operation of the generating stations or sub-station/line being connected to ISTS
- Protection systems unable to isolate the faulty equipments within the specified fault clearance time with reliability, selectivity and sensitivity
- Not sending information/data including disturbance recorder/sequential event recorder output etc., to RLDC for purpose of analysis of any grid disturbance/event.

How is IEGC enforced?

- Non-compliance by RPC/RLDC
  - Matter to be reported to CERC by any agency
- Non-compliance by constituents other than RLDC/RPC
  - Matter to be reported to Member Secretary, RPC (Sec 1.5)
  - MS to take up with the defaulting agency
  - In case of inadequate response matter referred to CERC
- CERC may take appropriate action

How is the grid code managed?

- Earlier
  - IEGC Review panel
  - Director (Operation), PGCIL as its Chairman & convenor
- Present
  - Review Panel disbanded
  - Responsibility now vests with CERC
  - Chapter- 8: Review request to be sent to Secretary CERC