In-house Study on "**Defining Minimum Set of Standardized Technical Data Required for Regional Power Interconnections and Regional Power Trading**"

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Abbreviations:

ADB	:	Asian development Bank
BERC	:	Bangladesh Electricity Regulatory Authority
CBET	:	Cross Border Electricity Trade
CERC	:	Central Electricity Regulatory Commission
DAM	:	Day Ahead Market
DisCos	:	Distribution Companies
GenCos	:	Generating Companies
ICT	:	Information Communication technology
IEGC	:	Indian Electricity Grid Code
IPP	:	Independent Power Producer
ISO	:	Independent System Operator
KEPCO	:	Korean electric Power Company
KPX	:	Korean Power Exchange
KWh	:	Kilo Watt Hour
MIT	:	Massachusetts Institute of Technology
MO	:	Market Operator
MWh	:	Million Watt Hour
NEA	:	Nepal Electricity Authority
NEPRA	:	National Electricity Power Regulatory Authority
NLDC	:	National Load Dispatch Centre
NTDC	:	National Transmission & Despatch Company
OECD	:	Organization for Economic Co-operation and Development
PPIAF	:	Public Private Infrastructure Advisory Facility
RERA	:	Regional Electricity Regulators' Association of Southern Africa
RLDC	:	Regional Load Dispatch Centre
SAARC	:	South Asian Association for regional Cooperation
SAPP	:	South African Power Pool
SLDC	:	State Load Despatch Centre (SLDC).

TAM	:	Term Ahead Market
TransCos	:	Transmission companies
TransCos	:	Transmission Companies
WAPDA	:	Pakistan Water & Power Development Authority. Pakistan Water and Power Development Authority
WB	:	World Bank

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Executive Summary

The SAARC (South Asian Association for Regional Cooperation) Member States, namely Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka had signed SAARC Framework Agreement for Energy Cooperation (Electricity) dated on 27th November 2014. Objective of the agreement is to enable cross border trade of electricity on voluntary basis subject to laws, rules and regulations of respective member States and based on bilateral/ trilateral/mutual agreements between the concerned member states.

Focusing on Article 5: Data Updating and Sharing of the Framework Agreement (**Member States may share and update technical data and information on the electricity sector in an agreed template**.), it is evident that before updating and sharing such data, consensus on nature and frequency of data is identified and agreed upon by the concerned Member States.

The data and information exchange are essential pre-condition for the physical exchange of electricity and the exchange of electricity services between industry participants across the supply chain. The data system-the way data is collected, processed, stored and exchanged shall be largely decentralized. All industry participants, such as retailers, large consumers, generators and distributors, each collect and produce data as part of their everyday activities. Exporting and importing countries are required to share technical data on generation and transmission aspects (regional generation adequacy and transmission planning) incidental to bilateral/ multilateral cross border power trade.

Internal electricity market in SAARC member states are in different stage. India is in advanced stage while Pakistan, Bangladesh and Sri Lank are in developed sate other are in primitive stages. Electricity grid code and other electricity related laws, rules and regulations defined the information and data for planning, trade and system operation. Grid codes of SAARC member states defined the format for necessary data and information to be exchanged but no code had defined for bilateral or regional power trade purposes.

Harmonization of code vis-à-vis standard template for information and data is mandatory for economic, efficient, safe and reliable electricity trade in bilateral/sub regional and regional level. Consequently, this in-house study is aimed initiating development of minimum set of standard data set template for smooth implementation of the SAARC Framework Agreement and promote regional electricity trade in South Asia. This study had overviewed the existing data exchange format in internal and bilateral trade in SAARC member states. And, also covered best practices of data and information exchange practices outside SAARC region like Southern African Power Pool (SAPP), Spanish Power Exchange Market Operator (Compañia Operadora del Mercado Español de Electricidad COMEL) and Korea Exchange Market.

For, establishment of South Asia Regional Power exchange Market, proper market shall be designed and as per market type required data shall be defined. Study had recommended minimum set of standard Data and information must be shared needed at interconnection for scheduling, metering, accounting and billing of electricity shall be done for the purpose of cross border trade of electricity. Similarly, for operation of proposed Regional Power Exchange Market operation, Standard data set must be developed for Bidding, Matching, Price determination, Imbalance Settlement etc.

1. Introduction to the Study

1.1 Background (Related to Framework Agreement, 2014)

The SAARC (South Asian Association for Regional Cooperation) Member States, namely Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka had signed SAARC Framework Agreement for Energy Cooperation (Electricity) dated on 27th November 2014. Objective of the agreement is to enable cross border trade of electricity on voluntary basis subject to laws, rules and regulations of respective member States and based on bilateral/ trilateral/mutual agreements between the concerned member states.

The agreement recognized electricity as an important commodity for promoting economic growth and betterment of life and initiated to promote regional power trade, energy efficiency, efficiency, energy conservation and development of efficient conventional and development of labeling and standardization of applicants and sharing of knowledge.

For increasing economic cooperation and creating new opportunities in electricity sector, framework agreement had been signed for Cross Border Electricity Trade (CBET) and Exchange of Power among the SAARC member states that will lead to optimal utilization of regional electricity generating resources, enhanced grid security, and electricity trade arising from diversity in peak demand and seasonal variations.

The framework agreement carries the spirit of solidarity and mutual cooperation and subject to laws, regulations and international obligations of the Member states and includes

- Duties and Taxes Exemption
- Data Updating and Sharing Promoting completion
- Planning of Cross Border Inter Connection
- Build, Operate and Maintain
- Transmission Service Agreement
- Electricity Grid Protection
- System Operation and Settlement Mechanism
- Transmission Access
- Facilitating Buying and Selling Entities
- Knowledge sharing and Joint Research in Electricity Sector
- Regulatory Mechanism
- Dispute Settlement

The framework agreement has been ratified by Bangladesh, Bhutan, India and Nepal. Other countries are in on the way to ratify the agreement. SAARC Energy Centre (SEC) is the regional excellence in this sector and this study is proposed on the way to facilitate the implementation of the agreement.

Focusing on Article 5: Data Updating and Sharing of the Framework Agreement (**Member States may share and update technical data and information on the electricity sector in an agreed template**.), it is evident that before updating and

sharing such data, consensus on nature and frequency of data is identified and agreed upon by the concerned Member States.

The data and information exchange are essential pre-condition for the physical exchange of electricity and the exchange of electricity services between industry participants across the supply chain. The data system—the way data is collected, processed, stored and exchanged shall be largely decentralized. All industry participants, such as retailers, large consumers, generators and distributors, each collect and produce data as part of their everyday activities. Exporting and importing countries are required to share technical data on generation and transmission aspects (regional generation adequacy and transmission planning) incidental to bilateral/ multilateral cross border power trade.

Electricity generation source are different in different SAARC member countries. Bhutan and Nepal have hydro dominated system, Bangladesh and India have natural gas and coal dominated, Sri Lanka and Pakistan have mixed system. Internal electricity market in SAARC member states are in different stage. India is in advanced stage while Pakistan, Bangladesh and Sri Lank are in developed sate other member states are in primitive stages. Electricity grid code and other electricity related laws, rules and regulations defined the information and data exchange. Harmonization of code vis-à-vis standard template for information and data is mandatory for economic, efficient, safe and reliable electricity trade in bilateral/sub regional and regional level. Consequently, this in-house study is aimed initiating development of minimum set of standard data set template for smooth implementation of the SAARC Framework Agreement and promote regional electricity trade in South Asia.

1.2 Objectives (Related to Framework Agreement, 2014)

Major objective of this in-house study is to define a set of minimum/vital/standard data and information for and establishment of SAARC Regional Power Interconnections and Power Trading via facilitation and implementation of the SAARC Framework Agreement on Energy Cooperation (Electricity).

1.3 Scope

The study report may cover, but not limited to, regional as well as international data pertaining to cross border electricity trade to be shared among the power exporting and importing Member States including existing generation facilities, transmission network, generation additions and retirements, transmission developments/augmentations.

1.4 Methodology

- SEC shall undertake this task in-house and reviewed internally.
- Relevant data/template corresponding to bilateral power trade in South Asia, if available and accessible collected and reviewed.
- Relevant data/template corresponding to international practices (regional/cross border electricity trade in region other than South Asia) collected and reviewed.
- Draft report/data template will be prepared based on the data collected and reviewed from SAARC as well as international practices

- The developed set of standard technical data and information will be shared among the Member States for their comments and suggestions.

1.5 Limitations

This study is based on the publicly available policies, rules, regulations, grid codes, Power Market operation rules of SAARC member states and rest of world.

2. Electricity Market:

a. Competitive Power Market: Objectives & Scope:

For most of the twentieth century, when consumers wanted to buy electrical energy, they had no choice and have to buy from utility and held the monopoly for the supply of electricity in the area where these consumers were located. Utility organization were vertically integrated i.e. generated the electrical energy, transmitted it from the power plants to the load centers and distributed it to individual consumers.

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In open Electricity Market, consumers have choices and Buyers and sellers can do trade on the basis of market principle i.e. law of demand and supply. Regionally integrated electricity market creates opportunities economic and financial benefits.

- **Economic Factors**
  - Large economies of the region have the greatest shortages looming. Resource rich countries can benefit
  - Larger unit sizes and more efficient generation capacity will be possible
  - Load shapes and time differences can be effectively utilized (India has a flatter and more flexible demand curve than neighbors)
  - Intermittent resources will be supported (e.g. Sri Lanka)
  - Interconnections unlikely to be expensive in relative terms
  - Hydro dominated nations (particularly Bhutan, Nepal) will gain from thermal power in lean seasons and peak hours
  - The markets will help utilize the power when the economic value is the highest

- **Investment Factors**
  - Markets create a mechanism to address governance issues that otherwise dog capacity procurement decisions
  - Market access likely to attract private capital on much larger scale
  - Transparent market prices provide an effective reference
  - Renewable energy (intermittent renewable resources like wind can be harnessed through the markets)

Major objective of competitive electricity market national/bilateral/trilateral/sub regional/regional is to crate opportunity for investor to recover their cost and enjoy benefits and provide consumers at safe, reliable, quality electricity supply at most economic tariff.

b. Market Participants, Roles and Responsibilities:

Market Participants and Market Facilitators are major drivers/actors of electricity market.

- **Electricity Market Participants**
  - Producer (Generator)
  - Trader

- Supplier (retailer, marketer, load-serving entity etc.)
- Consumer

- **Market Facilitators**
  - Transmission System Operator
  - Market Operator
  - Distribution System Operator

Roles and responsibilities of actors of electricity market are highlighted below.

- **Generating Companies (GenCos)**
  - produce and sell electrical energy.
  - may also sell services such as regulation, voltage control and reserve that the system operator
  - needs to maintain the quality and security of the electricity supply.
  - can own a single plant or a portfolio of plants of different technologies.
  - coexist with vertically integrated utilities are sometimes called independent power producers (IPP)

- **Distribution Companies (DisCos)**
  - own and operate distribution networks.
  - have a monopoly for the sale of electrical energy to all consumers connected to their network (in traditional environment)
  - sale of energy to consumers is decoupled from the operation, maintenance and development of the distribution network (in fully regulated environment).
  - retailers compete to perform this energy sale activity and may be a subsidiary of the local distribution company

- **Retailers**
  - buy electrical energy on the wholesale market and resell it to consumers who do not wish, or are not allowed, to participate in this wholesale market.
  - do not have to own any power generation, transmission or distribution assets.
  - some retailers are subsidiaries of generation or distribution companies.
  - all the customers of a retailer do not have to be connected to the network of the same distribution company

- **Market Operator (MO)**
  - typically runs a computer system that matches the bids and offers that buyers and sellers of electrical energy have submitted
  - takes care of the settlement of the accepted bids and offers
  - forwards payments from buyers to sellers following delivery of the energy.

- markets that close some time ahead of real time are typically run by independent market operators.

- **Independent System Operator (ISO)**
  - has the primary responsibility of maintaining the security of the power system?
  - called independent because in a competitive environment, the system must be operated in a manner that does not favor or penalize one market participant over another.
  - normally own only the computing and communications assets required to monitor and control the power system.
  - usually combines its system operation responsibility with the role of the operator of the market of last resort.
  - load and generation are balanced in real time.

- **Transmission Companies (TransCos)**
  - own transmission assets such as lines, cables, transformers and reactive compensation devices.
  - operate this equipment according to the instructions of the independent system operator.
  - sometimes subsidiaries of companies that also own generating plants.
  - transmission company that does not own generating plants and also acts as an independent system operator.

- **The Regulator**
  - is the governmental body responsible for ensuring the fair and efficient operation of the electricity sector?
  - determines or approves the rules of the electricity market and investigates suspected cases of abuse of market power.
  - sets the prices for the products and services that are provided by monopolies.

- **Small Consumers**
  - buy electrical energy from a retailer and lease a connection to the power system from their local distribution company
  - their participation in the electricity market usually amounts to no more than choosing one retailer among others when they have this option.

- **Large Consumers**
  - will often take an active role in electricity markets by buying their electrical energy directly through the market.
  - some of them may offer their ability to control their load as a resource that the ISO can use to control the system.
  - sometimes connected directly to the transmission system.

2.1 Electricity Market Design, Models and Type of Electricity Market

a. Design and Models of Power Market

Depending upon roles and responsibilities of market players i.e. generation, transmission, distribution, trader companies, consumers, regulator and pricing mechanism, Power Market may be categorized as Monopoly, Purchasing Agency, Wholesale competition and Retail competition.

Model 1: Monopoly

The Monopoly model, which is shown in Figure 2.1, corresponds to the traditional monopoly utility.

Sub model (a) corresponds to the case where the utility integrates the generation, transmission and distribution of electricity.

In sub model (b), generation and transmission are handled by one utility, which sells the energy to local monopoly distribution companies.

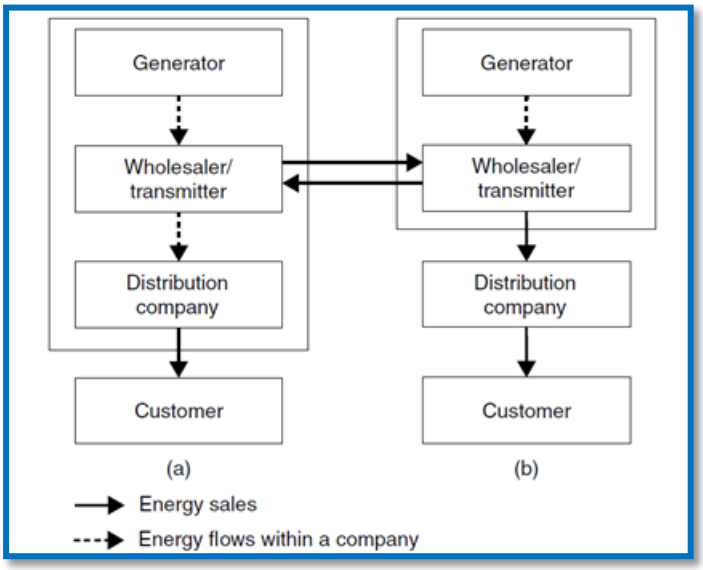

Figure 2- 1 Monopoly of Electricity Market. Sub model (a): Completely Vertically Integrated, Sub model (b): distribution is handled by one or more than one companies

Model 2: Purchasing Agency

Utility may be designate as power purchasing from generation companies. Figure 2-2 shows a possible first step toward the introduction of competition in the electricity supply industry.

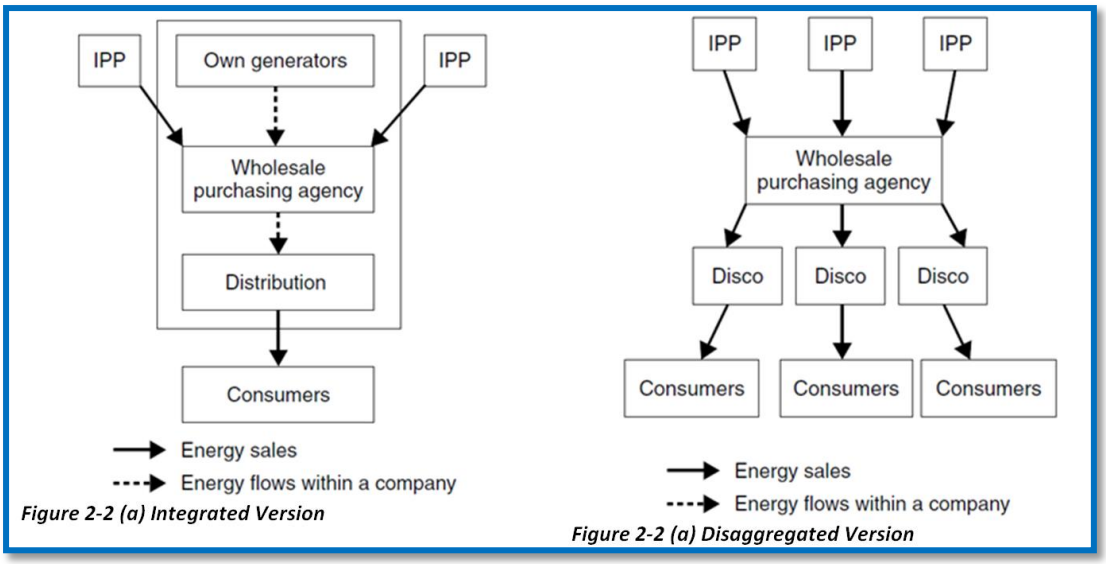

Figure 2- 2 Purchasing Agency Model of Electricity Based: Integrated Version & Disaggregated Version

In the integrated Version of Purchasing Agency of electricity market as shown in Fig2-2(a), the integrated utility no longer owns all the generation capacity. Independent power producers (IPP) are connected to the network and sell their output to the utility that acts as a purchasing agent.

In the disaggregated version of Purchasing Agency of electricity market as shown in Fig2-2(b), shows further evolution of this model where the utility no longer owns any generation capacity and purchases all its energy from the IPPs. The distribution and retail activities are also disaggregated. Discos then purchase the energy consumed by their customers from the wholesale purchasing agency. The rates set by the purchasing agency must be regulated because it has monopoly power over the discos and monopsony power toward the IPPs.

This model does not discover a cost-reflective price in the same way that a free market does, however, it has the advantage of introducing some competition between generators without the expense of setting up a competitive market as in the more complex models.

Model 3: Wholesale Competition

In the wholesale Competition model, which is shown in Figure 2-3, no central organization is responsible for the provision of electrical energy. Instead, discos purchase the electrical energy consumed by their customers directly from generating companies. These transactions take place in a wholesale electricity market.

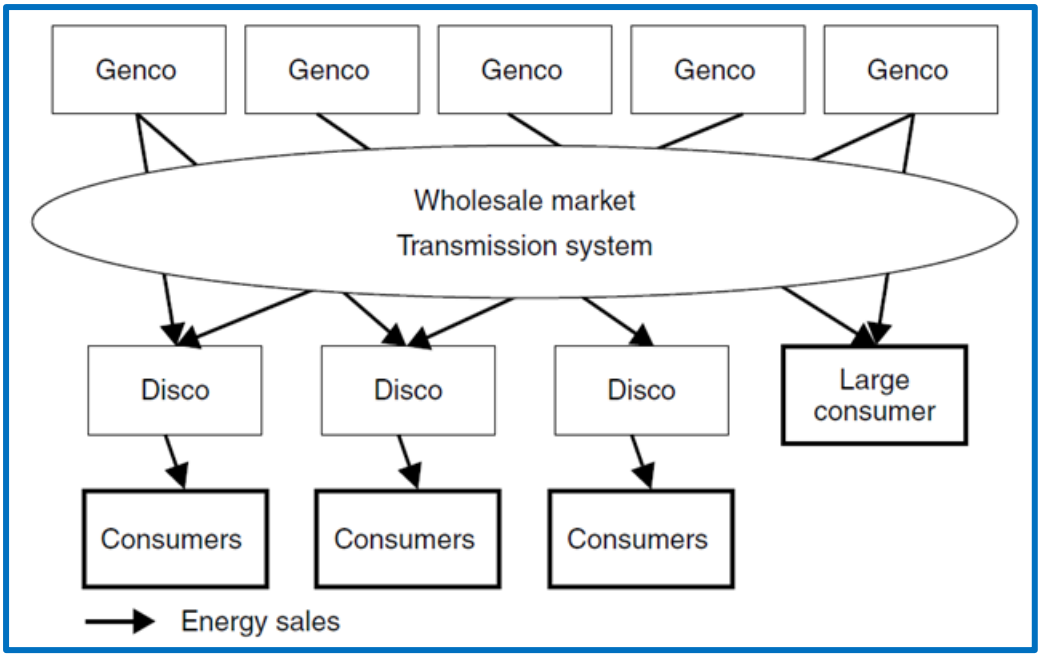

Figure 2- 3 Wholesale Competition Model of Electricity Market

This wholesale market can take the form of a pool or of bilateral transactions. At the wholesale level, the only functions that remain centralized are the operation of the spot market, and the operation of the transmission network. At the retail level, the system remains as centralized and discos not only operates the distribution network in its area but also purchases electrical energy on behalf of the consumers located in its service territory.

This model creates considerably more competition for the generating companies because the wholesale price is determined by the law of supply and demand. Big consumer can directly purchase electricity form wholesale market. For welfare of small consumers, the retail price of electrical energy must remain regulated because small consumers cannot choose a competing supplier if they feel that the price is too high.

Model 4: Retail competition

Figure 2-4 explains the ultimate form of competitive electricity market in which all consumers can choose their supplier.

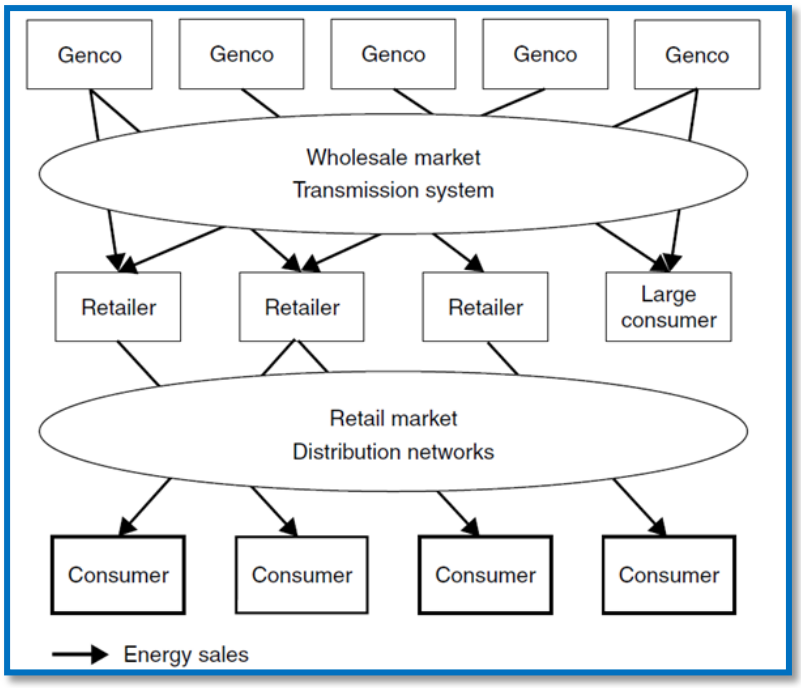

Figure 2- 4 Retail competition model of electricity market

In Purchasing Agency model of electricity market, because of the transaction costs, only the largest consumers choose to purchase energy directly on the wholesale market and most small and medium consumers purchase it from retailers, who in turn buy it in the wholesale market. In this model, the "wires" activities of the distribution companies are normally separated from their retail activities because they no longer have a local monopoly for the supply of electrical energy in the area covered by their network.

Once sufficiently competitive markets have been established, the retail price no longer has to be regulated because small consumers can change retailer when they are offered a better price and from an economics perspective this model is the most satisfactory because energy prices are set through market interactions. Implementing this model, however, requires considerable amounts of metering, communication and data processing.

In this model, the only remaining monopoly functions are thus the provision and operation of the transmission and distribution network and the cost of the transmission and distribution networks is still charged to all their users. This is done on a regulated basis because these networks remain monopolies

b. Types of Markets

Power markets Is a mechanism for matching the supply and the demand for electricity through the discovery of an equilibrium price. For Power market operation, it is need to agree on the quality, quantity and price of the goods, three other important matters must be decided when a buyer and a seller arrange a trade:

- The time and date of delivery of the goods
- The mode of settlement (Technical and Financial)
- Any conditions that might be attached to this transaction.

How buyers and sellers settle these matters defines the type of contract that they conclude and hence the type of market in which they participate.

Spot market

In a spot market, the seller delivers the power immediately and the buyer pays for them "on the spot" and no conditions are attached to the delivery.

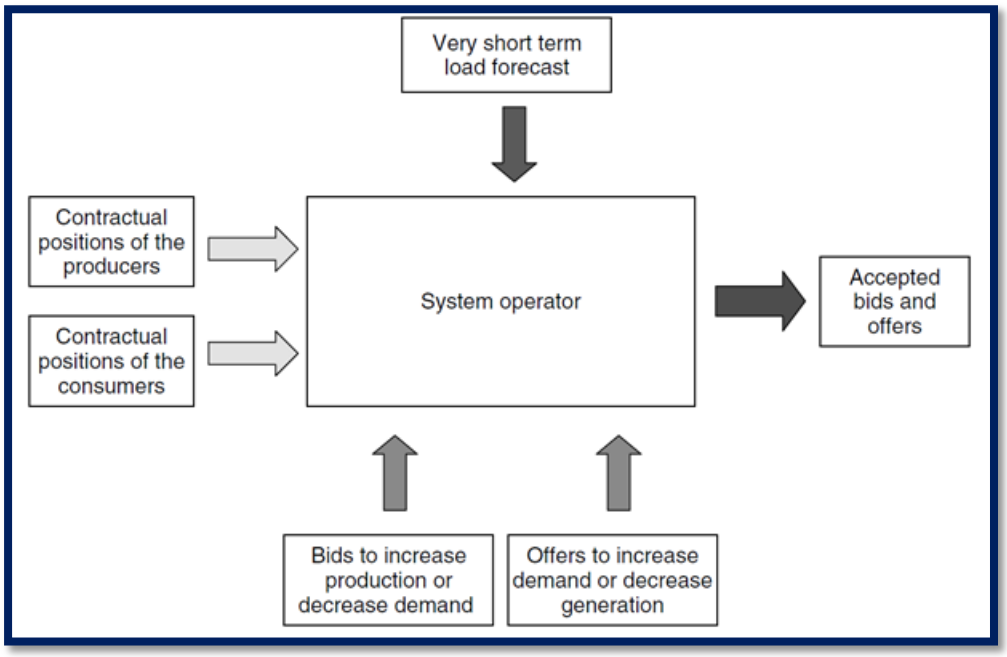

Figure 2- 5 Schematic diagram of operation of managed Spot Market for electricity

- A spot market has the advantage of immediacy. Seller can sell exactly the amount as available and buyer can purchase exactly the amount needed.
- Prices in a spot market tend to change quickly. A sudden increase in demand (or a drop in production) sends the price soaring because the stock of goods available for immediate delivery may be limited.
- Similarly, a glut (excess) in production or a dip (fall) in demand depresses the price. Spot markets also react to news about the future availability of a power.
- Changes in the spot price are essentially unpredictable because if they were predictable, the market participants would anticipate them.

Forward Contracts and Forward Markets

This *forward contract* specifies the following:

- quantity and quality of the what to be delivered
- date of delivery
- date of payment following delivery

- penalties if either party fails to honor its commitment
- price to be paid.

Future Contracts and Futures Markets

A market in which all participants act as price takers is said to have *perfect competition.* Achieving or approximating perfect competition is a very desirable goal from a global perspective because it ensures that the marginal cost of production is equal to the marginal value of the goods to the consumers.

- Such a situation encourages efficient behavior on both sides.
- These interactions progressively lead to an equilibrium in which the price clears the market, that is, the supply is equal to the demand.

If electrical energy is to be traded according to this free-market ideal, the equilibrium between the production and the consumption of electrical energy should be set through the direct interaction of buyers and sellers

Open Electrical Energy Markets

- ***Bilateral trading***
  Bilateral trading involves only two parties: a buyer and a seller. Participants thus enter into contracts without involvement, interference or facilitation from a third party.
  Depending on the amount of time available and the quantities to be traded, buyers and sellers will resort to different forms of bilateral trading:

- ***Customized long-term contracts*** the terms of such contracts are flexible since they are negotiated privately to meet the needs and objectives of both parties. They usually involve the sale of large amounts of power (hundreds or thousands of MW) over long periods of time (several months to several years).

- ***Trading "over the counter"*** These transactions involve smaller amounts of energy to be delivered according to a standard profile, that is, a standardized definition of how much energy should be delivered during different periods of the day and week.

- ***Electronic trading***
  Participants can enter offers to buy energy and bids to sell energy directly in a computerized marketplace. All market participants can observe the quantities and prices submitted but do not know the identity of the party that submitted each bid or offer.

  When a party enters a new bid, the software that runs the exchange checks to see if there is a matching offer for the period of delivery of the bid. If it finds an offer whose price is greater than or equal to the price of the bid, a deal is automatically struck and the price and quantity are displayed for all participants to see.

If no match is found, the new bid is added to the list of outstanding bids and will remain there until a matching offer is made or the bid is withdrawn or it lapses because the market closes for that period. A similar procedure is used each time a new offer is entered in the system. This form of trading is extremely fast and cheap.

A flurry of trading activity often takes place in the minutes and seconds before the closing of the market as generators and retailers fine-tune their position ahead of the delivery period.

The essential characteristic of these three forms of bilateral trading is that the price of each transaction is set independently by the parties involved and there is thus no "official" price.

The details of negotiated long-term contracts are usually kept private, some independent reporting services usually gather information about over the-counter trading and publish summary information about prices and quantities in a form that does not reveal the identity of the parties involved. This type of market reporting and the display of the last transaction arranged through electronic trading enhance the efficiency of the market by giving all participants a clearer idea of the state and the direction of the market.

- **Electricity pools**

  Rather than relying on repeated interactions between suppliers and consumers to reach the market equilibrium, a pool provides a mechanism for determining this equilibrium in a systematic way.
  While there are many possible variations, a pool essentially operates as follows:

  - Generating companies (Seller Entities) submit bids to supply a certain amount of electrical energy at a certain price for the period under consideration.
    These bids are ranked in order of increasing price. From this ranking, a curve showing the bid price as a function of the cumulative bid quantity can be built. This curve is deemed to be the supply curve of the power market.
  - The demand curve of the market can be established by asking consumers to submit offers specifying quantity and price and ranking these offers in decreasing order of price.
    Since the demand for electricity is highly inelastic, this step is sometimes omitted and the demand is set at a value determined using a forecast of the load. In other words, the demand curve is assumed to be a vertical line at the value of the load forecast.

  - The intersection of these "constructed" supply and demand curves represents the market equilibrium.

All the bids submitted at a price lower than or equal to the market clearing price are accepted and generators are instructed to produce the amount of energy corresponding to their accepted bids.

The market clearing price represents the price of one additional megawatt-hour of energy and is therefore called the system marginal price or SMP. Generators are paid this SMP for every megawatt-hour that they produce, whereas consumers pay the SMP for every megawatt-hour that they consume, irrespective of the bids and offers that they submitted.

Exchange of Data and Information:

The electricity industry, and electricity markets, collect, process, store and exchange significant volumes of data each day. The data is essential for the physical exchange of electricity and the exchange of electricity services between industry participants across the supply chain.

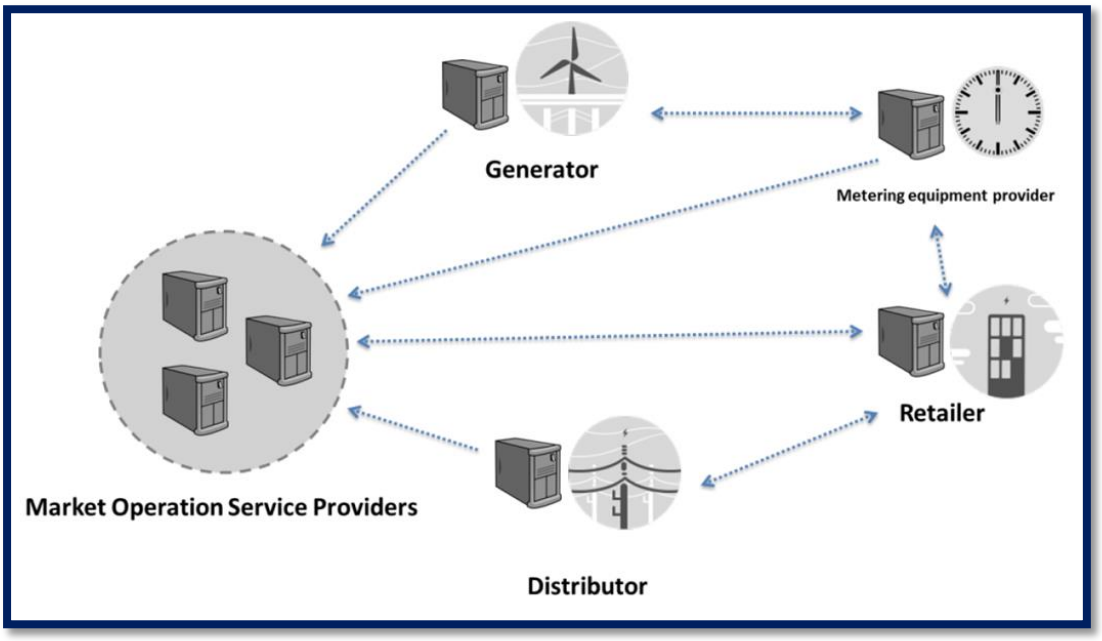

Figure 2- 6 Overview of the data system and data exchange

The data system should be designed and developed defined way data is collected, processed, stored and exchanged—is largely decentralized. All industry participants, such as retailers, large consumers, generators and distributors, each collect and produce data as part of their everyday activities. They must also exchange data between themselves and through market operator to enable transactions between participants. The Market Operator provides the platform for the electricity market and the exchange of electricity services between participants.

Robust mechanism for exchange of data and information is mandatory for electricity trade market and data and data exchange arrangements may be required to:

- promote innovation and more participation in the electricity industry
- promote competition in, reliable supply by, and efficient operation of the electricity industry for the long-term benefit of consumers
- ensure that participants pay or are paid the correct amount for the electricity

and electricity services they use and produce.

- reduce barriers to entry and making it easy for parties to enter and operate in the electricity industry
- reduce the transactions costs of industry arrangements and working in a well-organized manner
- use more standardized approaches promotes competition and efficiency by reducing the cost of doing business.
- enable mass participation and multiple trading relationships.

More standardization of formats and processes, in particular, would minimize barriers to entry by making it easier to interface with other participants in the data system. Standard set of data to be exchanged in electricity trade upon type of electricity market. Electricity Market operation guideline define set of data and information, frequency, utilization and protection of data and information.

Article 5 Data updating and sharing Member of SFAEC (Electricity) highlighted that SAARC states may share and update technical data and information on the electricity sector in an agreed template. Article 7 suggested to plan the cross-border grid interconnections through bilateral/trilateral/mutual agreements between the concerned states based on the needs of the trade in the foreseeable future through studies and sharing technical information required for the same. Articles 9,10 1nd 11 described Transmission Service Agreements, Electricity Grid Protection and System Operation and Settlement Mechanism respectively. For planning purposes and coordinated procedures for the secure and reliable operation of the inter-connected grids and to prepare scheduling, dispatch, energy accounting and settlement procedures for cross border trade standardized templates for minimum data set to be shared is mandatory.

Data for Planning Purpose: Following data may needed for Power generation and Transmission line projects planning purposes

- Load Data
- Existing Imports/Exports
- Existing base and peak hydro data
- Existing thermal data
- Committed and future system

Data for Cross-Border Intersection: It may depend upon type of interconnections namely HVDC or ACAC cross border interconnection.

- Structural data
- Scheduled Data
- Fore Casting Data
- Real time data
- Individual instruction by operators

Data for electricity Market Operation: Type of data, frequency a schedule of data to be shared among or between buyer/seller/trader/market Operator/System operator/Transmission Companies/Consumers depend upon type of market i.e.

Contract Market, Term ahead Market, Day a head Market and Intra Day Market.

- Data for Buyers, Sellers, Traders registration: Copy Full Name, Short Name, Contact Details, Username and Password, ID no. etc.
- Data for Bid from Seller: Production unit details, reserve capacity, Maximum installed capacity, energy and selling price
- Data for Bid from Buyer: energy and buying price
- Data of Matching i.e. price determination
- Data for Market Trend (Price and Demand, Supply Availability)
- Data for Scheduling and load settlement
- Data for Financial Settlement
- Metering Data
- Etc.

Data for Grid Operation:

- Capacity Available
- Bid Data from Buyers and sellers and selection of potential/viable bids
- Others:
  - voltage, frequency
  - incident record
  - outage planning

2.2 Cross Border Power Interconnection

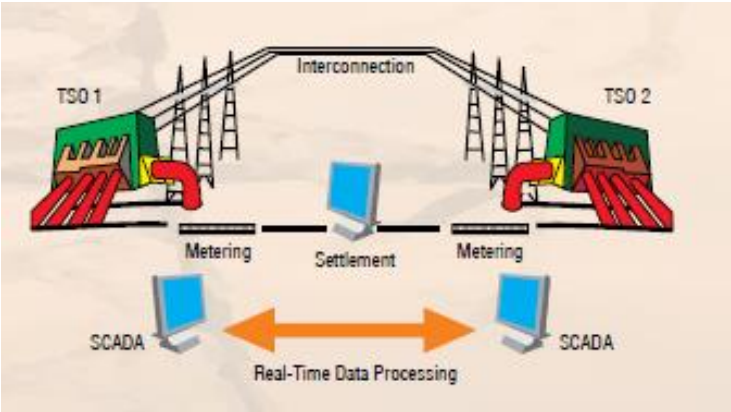

Figure2-7: Cross-Border Interconnection Facility

A cross-border interconnection facility basically allows electric power to be interchanged between two or more national power grids and such facility comprises not only a transmission line, but also ancillary facilities (switchgears, and control and protection equipment) in the adjacent substations or elsewhere in the national power grids to be connected.

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The operability of the interconnected national power grids do not depend only on technical properties, but also on decisions the responsible transmission system operators (TSOs) need to take on key nontechnical issues. TSOs perform a number of key functions in real-time, including"

- monitoring, control, and coordination of operations and
- scheduling and settlement of energy exchanges between national power grids.

To accomplish those tasks, Transmission System Operators of both countries rely on real-time data processing hardware and software systems, comprising supervisory control and data acquisition **(SCADA)** and energy management system **(EMS)**.

3. Data and Information Exchange for Cross Border Electricity Trade:

3.1 Data and Information Exchange in SAARC Member States:

3.1.1 Afghanistan

Da Afghanistan Breshna Sherkat (DABS) is responsible for electricity Generation, Transmission, System Operation and Distribution.

No country Specific code exist in Afghanistan and Power Services Regulation Act, 2016 has mentioned about data and information requirements.

- **Confidential Information**: the technical, financial and business documents and information belonging to design, restoration of insurance status, activities, planning, maintenance, management and financing of energy services and other activities related to the electricity facilities of suppliers, users and consumers.

- **Publication of Documents through Website:**
  (1) The Department may publish the notifications, decisions, licenses, suggestions and agreements related to interpersonal network connection and other such non-confidential documents through the relevant website.
  (2) The Departments may make available to the applicants the copy of documents set forth in paragraph of this article in exchange of price specified by law.

3.1.2 Bangladesh

Bangladesh Energy Regulation Commission Electricity Grid Code (**Grid Code**), 2012 has defined data and information requirements for power market operation in Bangladesh.

- Bangladesh Energy Regulation Commission Electricity Grid Code (Grid Code), 2012must be complied by Entities including the Buyer, Generator, Licensee, Supplier, System Operator, System Planner and User, who uses the Transmission System
- **National Load Despatch Centre (NLDC):** The control room situated in Dhaka, operating round the clock for the purpose of managing the operation of the **Transmission System** and coordination of generation and distribution on a real-time basis.
- **Site Responsibility Schedule:**
  Data for Site Responsibility Schedule includes:
  - Name of Power Station/Substation:
  - Site Owner:
  - Tel. Number:
  - Fax Number:
    - Item of Plant/Apparatus
    - Plant Owner
    - Safety Responsibility
    - Control Responsibility

- Operation Responsibility
- Maintenance Responsibility
- Remarks

For further detail please refer Appendix Bangladesh "Data Format for Site Responsibility Schedule"

- Despatch instructions shall be in standard format. These instructions will recognize declared availability, economic data and other parameters that have been made available by the Generator to the NLDC. These instructions shall include time, Power Station, Generating Units, name of operators sending and receiving the same.
  Despatch instructions include but not limited to:
  i. Switching a Generating Unit into or out of service.
  ii. Details of reserve to be carried on a unit.
  iii. To increase or decrease MVAR generation to assist with voltage profile.
  iv. To begin pre-planned Black Start procedures.
  v. To hold spinning reserve.
  vi. To hold Generating Units on standby.

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

- **Contingency Planning:** User's persons authorized for operation and control shall be available at User's end for communication and acceptance of all operational communications throughout the contingency. Communication channels shall be restricted to operational communications only till normality is restored. During the restoration process following **Transmission System** blackout conditions normal standards of voltage and frequency shall not apply. Despite the urgency of the situation, careful, prompt and complete logging of all operations and operational messages shall be ensured by all **Users** to facilitate
  A list of essential loads and priority of restoration shall be prepared in standard format which includes:
  - Priority
  - Type of Load
  - Name of Substation
  - Remarks

For further detail Please refer Appendix Bangladesh "Data format for Contingency Planning"

- **Cross Boundary Safety:** The **Control Persons** shall co-operate to establish and maintain the precautions necessary for the required work to be carried out in a safe manner. Both the established isolation and the established earth shall be locked in position, where such facilities exist, and shall be clearly identified. Each Control Person shall maintain a **legibly written safety log, in chronological order, of all**

operations and messages relating to safety coordination sent and received by themselves.

- **Operational Event / Accident Reporting:** Typical examples of reportable incidents that could affect the **Transmission System**
  are the following:
    i. Exceptionally high/low system voltage or frequency.
    ii. Serious equipment problem, e.g. major circuit, transformer or bus-bar.
    iii. Loss of major **Generating Unit**.
    iv. Falling of Transmission line/Tower due to natural calamity
    v. System split, **Transmission System** breakaway or **Black Start**.
    vi. Major fire incidents.
    vii. Major failure of protection.
    viii. Equipment and transmission line overload.
    ix. Minor equipment alarms.

  The format of such a report will be as agreed at the **Grid Code Review Panel**, but will typically contain the following information:
    - Date and time of incident
    - Location of incident
    - Type of incident
    - System parameters before the incident (Voltage, Frequency, Flows, Generation, etc.)
    - System parameters after the incident
    - Network configuration before the incident
    - Relay indications received and performance of protection:
    - Damage to equipment:
    - Supplies interrupted and duration, if applicable
    - Amount of Generation lost, if applicable:
    - Estimate of time to return service:
    - Cause of incident:
    - Any other relevant information and remedial action taken
    - Recommendations for future improvement/ repeat incident:
    - Name of the Organization

For further Detail please refer Appendix Bangladesh "Standard format for Incident reporting"

- **Metering:** The Generator shall install operational metering to the Licensee's and Buyer's specification so as to provide operational information for both real time and recording purposes in relation to each Generating Unit at each Power Station in respect of:
    i. Bus Voltage
    ii. Frequency
    iii. MW
    iv. MWhr
    v. MVAR

vi. Power Factor
vii. any other additional data as agreed between the Licensee, Buyer and
Generator.

- Transmission System Operational Metering: The Licensee shall install operational metering so as to provide operational information for both real time and recording purposes in relation to each feeder, transformer and compensation device at each substation in respect of:
  i. Bus Voltage
  ii. Frequency
  iii. MW
  iv. MWhr
  v. MVAR
  vi. Power Factor
  vii. Current
  vii. any other additional data as agreed between the Licensee and Generator

- **Generation / Commercial (Tariff Metering):** commercial (Tariff) metering at **Connection** points between the **Transmission System** and **Generating Stations,** and the **Transmission System** and **Distribution Systems**. Metering shall be installed to measure:
  - Active energy for export.
  - Active energy for import.
  - Reactive energy for import.
  - Reactive energy for export.

- **Data Acquisition:** For effective control of the **Transmission System**, the **NLDC** needs real time data as follows:
  - MW generated in each Power Station
  - MW consumed at each Grid substation.
  - MVAR generated or absorbed in each Power Station.
  - MVAR consumed at each Grid substation.
  - Voltage at all system buses.
  - Frequency in Transmission System.
  - MW & MVAR flow in each transmission line.

- **Standard Planning Data (Generation)**
  For system planning two Type of Data needed:
  A. For Routine Submission
    - Power Stations (thermal or Hydropower)
      - General
      - Protection and Metering
      - Switchyard: (a) Interconnecting Transformers, b) Switchgear (including circuit breakers, isolators on all circuits connected

to the points of Connection.) (c) Lightning Arresters, (d) Communications: (e) Basic Insulation Level (kV)
    - Generating Units: (a) Parameters of Generating Units, (b) Parameters of Excitation Control System, (c) Parameters of Governor, (d) Operational Parameters

B. For Submission on Request by Licensee: Thermal and Hydro-Electric Power Stations

- General
- Connection
- Equipment details
- Relaying and Metering
- System Studies

For further details please refer Annex Bangladesh "Format for Detailed Planning Data (Generation)"

- **Standard Planning Data (Transmission)**

System Planning following Detailed System Data, Transmission is needed:

- General:
    - Single line diagram of the Transmission System down to 33 kV bus at grid Substation detailing:
    - ii. Substation layout diagrams showing
- Line Parameters (For all circuits)
- Transformer Parameters (For all transformers)
- Equipment Details (For all Substations)
- Relaying and Metering
- System Studies
- Demand Data (For all Substations): Demand Profile (Peak and off-peak load)
- Reactive Compensation Equipment

For further Detail please refer Annex Bangladesh Standard Data Format for Detailed System Data (Transmission)

- **Standard Planning Data (Distribution)**

For System Planning following Detailed System Data, Transmission is needed:

- General
- Connection: Points of Connection (Furnish details of existing arrangement of Connection), Details of metering points of Connection.
- Loads'. Connected load, ii. Information on diversity of load and coincidence factor, iii. Daily demand profile (current and forecast), Cumulative demand profile of Distribution System

For further details please refer Annex Bangladesh "Format for Detailed Planning Data (Distribution)"

- **Operational Planning Data**
- **Standard Format for Operational Planing Data (Outage Planing Data)**

  For System Planning following Operational Planing Data (Outage Planing Data):

  - General
  - Demand Estimates
  - Estimates of Load Shedding
  - Year Ahead Outage Programme
  - Generation Outage Programme
  - Year Ahead Distribution Utility's Outage Programme
  - Generation Schedule Data
  - Licensee's Overall Outage Programme

  For further details please refer Annex Bangladesh "Standard Format for Operational Planning Data (Outage Planning Data)"

- **Standard Format for Operational Planing Data (Schedule and Despatch Data)**

  For Planing Schedule and Depatch following data needed:

  - 36 hours ahead hourly MW & MVAR Declared
  - Availability Capacity
  - Status of Generating Unit
  - Status of Generating Unit speed control system.
  - Governor in service (Yes/No).
  - Spinning reserve capability (MW)
  - Backing down capability with/without oil support (MW)
  - Hydro reservoir levels and restrictions
  - Generating Units hourly summation outputs (MW)
  - Provisional day after Declared Availability Capacity notification

  For further details please refer Annex Bangladesh "Standard Format for Operational Planning Data (Schedule and Despatch Data)"

- **Standard Format for Operational Planing Data (Response to frequency Change Data)**

  For Planing Response to frequency following data needed:

  - Hourly Generation Summation
  - Logged readings of Generators
  - Detailed report of Generating Unit tripping on monthly basis

  For further details please refer Annex Bangladesh "Standard Format for Operational Planning Data (Response to frequency Change Data)

3.1.3 Bhutan Electricity Authority Grid Code Regulation 2008.

- Under the terms of the Grid Code Regulation, the System Operator and Transmission Licensee shall receive information from Users relating to their systems in respect of their generation or supply business.

- The System Operator and Transmission Licensee shall not, other than required by the Grid Code Regulation, disclose such information to any other person without the prior written consent of the User concerned, unless required by the Ministry or the Authority.
    - co-ordinate the power supply system to obtain instantaneous balance between generation and consumption of electricity;
    - be responsible for dispatching generation installations;
    - co-ordinate the transmission outages;
    - monitor the import and export of electricity;
    - prepare forecasts of generation requirements;
    - prepare regulations, with approval of the Authority, for the dispatch of generation installations; and
    - perform such other functions as may be prescribed by the Authority in the License or by regulations

- System Operator with all requested data and technical and economical characteristics on design, construction and operation of facilities to be connected to the Transmission Grid. **Data and notices** to be submitted to the System Operator under this Grid Code Regulation shall be delivered in writing either by hand or sent by registered post unless otherwise specified in the Regulations.
- **Planning Policy: The** Transmission Licensee shall consider the data of authenticated nature collected from and in consultation with all the utilities of the Power System. The following shall also be referred:
    - The Power System Master Plan developed by the Ministry;
    - Any transmission planning criteria and guidelines of the Ministry; and
    - Power data, hydrological statistics and other reports issued by the Ministry, which are relevant to the development of the Transmission System
- **Planning Data:** All Licensees and Users shall provide all data as required by the System Operator to execute the coordinated planning of the operation and expansion of the system. Such data should include, but not necessary be limited to:
    - Load forecasts;
    - Technical and economical characteristics of generation units, including capital and operational costs of the units; and
    - Technical and economical characteristics of the relevant transmission and distribution systems.
- **Site Responsibility Schedule (SRS):** At the connection site where equipment of both entities, i.e., the Transmission Licensee and the Distribution Licensee are installed, the Distribution Licensee shall furnish required data to the Transmission Licensee which shall prepare SRS. At a generating station, the Transmission Licensee shall furnish the necessary data to the Generation Licensee who shall prepare SRS. The following information shall be included in the SRS:
    - Schedule of HV apparatus;
    - Schedule of plant, LV / MV apparatus, services and supplies;

- Schedule of telecommunications and measurement apparatus; and
- Safety rules applicable to each plant/apparatus
- The ownership of equipment;
- The responsibility for control of equipment;
- The responsibility for maintenance of equipment;
- The responsibility for operation of equipment;
- The manager of the site;
- The responsibility for all matters relating to safety of persons at site; and
- The responsibility for all matters relating to safety of equipment at site.

- Site Common Drawings shall be prepared by the owner company (Transmission Licensee or User) using the information furnished by the other company (User or Transmission Licensee) containing the following information:
  (i) Connection site equipment layout;
  (ii) Electrical layout;
  (iii) Common protection and controls; and
  (iv) Common services (water, compressed air, telephone, electricity supply for lighting and another appliance, etc.)

- **Operations and Operational Planning: Overall** real-time operation of the Transmission System shall be supervised by the System Operator from the National Load Despatch Centre (NLDC) located at Thimphu.
  - The control rooms of the NLDC, Eastern Grid Data Centre, and Western Grid Data Centre, all Generating Power Plants, HV (66 kV and above) sub-stations and any other control centers of the constituents shall be manned round the clock by qualified and adequately trained personnel or otherwise they are controlled remotely but the remote control centre must be manned.
  - Each Licensee shall provide an adequate and reliable communication facility internally and with the System Operator to ensure exchange of data information. Wherever possible, redundancy and alternate path shall be maintained for communication along important routes.
  - Each Licensee shall send data including Disturbance Recorder and sequential Event Recorder output to the System Operator for purpose of analysis of any Transmission System Event; No Licensee shall refuse provision of any data or information required by the System Operator for maintaining reliability and security of the Transmission System and for analysis of an Event.

- **Outage Planning:** All Licensees shall provide the System Operator their proposed outage plans for the next financial year by 1st December of each year. These shall contain identification of each generating unit/line/interconnecting

transformers (ICTs), the preferred date for each outage and its duration and where there is flexibility, the earliest start date and latest finishing date.

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

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

- **Periodic Reports:** A quarterly report shall be issued by the System Operator to all Licensees, Authority and the Ministry, and shall cover the performance of the Transmission System for the previous quarter. The report shall contain the following but not limited to:
    - Performance of Generating Stations;
    - Peak demand, energy availability and requirement for the country;
    - Export and import of electricity to/ from neighboring countries;
    - Frequency profile: Maximum and minimum frequency recorded and the frequency duration in different frequency bands;
    - Voltage profile of selected substations;
    - Major generation and transmission outages;
    - Transmission constraints
    - Instances of persistent or significant non-compliance with the Grid Code Regulation.
- **Event Information:** Any Event on the other User's system having an operational effect on Transmission System shall be reported by the concerned User to the System Operator. The reportable incidents that require reporting are as follows:
    - Tripping of any inter-connecting transformer (ICT), transmission line or capacitor bank;
    - Tripping of any generating units;
    - Major protection failure;
    - Exceptionally high/low voltage frequency; (v) Serious equipment problem i.e. major circuit
    - breaker, transformers, bus-bar fault etc.;
    - Overloading of equipment or transmission lines;
    - Activation of any alarm or indication of abnormal operating condition;
    - Breakdown or faults or temporary changes in the capabilities of the plant and/or apparatus; and
    - Loss of load.

- **Form of Written Reports**: A written report shall be sent to the System Operator or a Licensee, as the case may be, and shall confirm the oral notification together with

the following details of the Event:

- Time and date of Event;
- Location;
- Plant and/or equipment directly involved;
- Description and cause of Event;
- Antecedent conditions;
- Demand and/or generation (in MW) interrupted and duration of interruption;
- All relevant system data including copies of records of all recording instruments including data from Disturbance Recorders and Event Recorders;
- Sequence of tripping's with time;
- Details of relay flags;
- Remedial measures and recommendation for future improvement; and
- Any other relevant information.

- **Scheduling and Dispatch Code**
  - The entire Bhutan Grid operates in synchronism with the Indian Grid and the major generation in Bhutan is envisaged to be exported to the Indian Grid as per Memorandum of Understanding between the Royal Government of Bhutan and Government of India.
  - The Scheduling and Dispatch Code for Bhutan has to be technically compatible with the Scheduling and Despatch Code of the Indian Electricity Grid Code Regulation. Demarcation of interface responsibilities with the Eastern Regional Load Despatch Centre(ERLDC), Kolkata (West Bengal), for export/import schedule at the India-Bhutan border
  - Scheduling of the various generating stations in Bhutan, export to India and drawal by various Distribution Licensees within the country on a daily basis with the modality of flow of information between the agencies involved in the process.
  - The Power System shall be operated as a Tight Pool in which the System Operator shall have complete responsibility for:

    (i) centralized scheduling and centralized dispatch of generation;

    (ii) scheduling the drawals of the Distribution Licensees and export to India;

    (iii) regulating the demand of the Distribution Licensees; and

    (iv) arranging any bilateral interchanges
  - It shall be incumbent upon the generating stations to declare the plant capabilities faithfully, i.e., according to their best assessment. The generating stations based on the past historical data/records as well as with the data gauge available for inflows

shall estimate the hourly inflow pattern for declaration of the day-ahead plant capability in terms of energy and power.

- Format for Availability Declaration by generators to be sent to system operators includes:
    - MSG NO_____
    - DATE_____
    - Power Station: Tala, Chukha, Basochhu, Kurichhu
    - Expected Maximum Ex-Power Plant Power (MW)
    - Expected Ex-Power Plant Energy (MWh)
    - Anticipated in-flow (m3/s)
    - Anticipated line constraints/ outages / other constraint, if any

For further Detail of Format for Aavailability Declration by the Generators, polease refer ANNEX Bhutan, Format for Aavailability Declration by the Generators

- Every day, generating stations directly connected to transmission system should advise their respective energy station-wise Ex- Power Plant demand and energy capabilities. Format for Anticipated Hourly Ex-Power Plant availability for the day (MW) contents

    Hour : at One hour interval
    Projects : Tala Chukha Basochhu Kurichhu

For further Detail of Format for Anticipated Hourly Ex-Power Plant availability for the day (MW) contents, please refer ANNEX Bhutan, Format for Anticipated hourly Ex-Power Plant availability for the day (MW) contents.

- The capabilities of each of the generating stations and the corresponding hourly estimated demand of the entire Power System shall be compiled by the System Operator every day for the following day in the standard format that shall be forwarded by the System Operator to ERLDC.A format for compilation for such information by the System Operator includes:
    - MSG NO_____
    - DATE_____
    - TOO: _____(BST)
    - EXPECTED TRANSMISSION SYSTEM AVAILABILITY FOR DATE_____
    - Hours
    - Total Ex- Power Plant Availability
    - Total Ex- Transmission System
    - Domestic Transmission System Losses
    - Total available for Export Ex- Power Plant
    - Export Transmission System Losses
    - Total available for export at border

For further Detail of Format for EXPECTED TRANSMISSION SYSTEM AVAILABILITY, please refer ANNEX Bhutan ,Format for EXPECTED TRANSMISSION SYSTEM AVAILABILITY

3.1.4 India

Indian Electricity Grid Code (IEGC) defined roles and responsibilities of Regional Load dispatch Centres (RLDCs) and State Load dispatch Centres (SLDCs).Central Electricity Regulatory Commission (Open Access in inter-State Transmission) Regulations, 2008 and Short-Term Open Access in Inter-State Transmission (Collective Transaction), 2008 had defined standard format for exchange of Data and Information between/among concerned authorities for Power Trade in India.

Central Electricity Regulatory Commission (Open Access in inter-State Transmission)

- **Submission of Application [Short-term Open Access]**
  - short-term customer or the power exchange (on behalf of buyers and sellers) intending to avail of [short-term open access] for use of the transmission lines or associated facilities for such lines on the inter-State transmission system, shall make an application to the nodal agency in accordance with these regulations. The application for a bilateral transaction shall contain the details, such as

    Application No. and Application Name
    - Schedule Request (Date, time (Hours) and MW
    - Buyer/Seller Details
    - Application route (from Injection point to drawl point)
    - If re-routing to be considered, please specify the alternate Route(s)
    - Payment details of Non-Refundable Application
    - Declaration

For format of Application for Open Access – Scheduling Please refer ANNEX INDIA: Bilateral Trade, Format of Application for Open Access – Scheduling

- **Concurrence of State Load Despatch Center**
  - Wherever the proposed bilateral transaction has a State utility or an intra-State entity as a buyer or a seller, concurrence of the State Load Despatch Centre shall be obtained in advance and submitted along with the application to the nodal agency. The Format of concurrence of the State Load Despatch Centre contain:
    - Application No., Name and registration Code
    - Buyer / Seller Details: Injecting Entity and Drawer Entity, Date, time (Hours) and MW
    - Concurrence Accorded by SLDC (Where point of injection / Point of Drawl is located) : Date, time (Hours) and MW

For format of Application for Open Access – Scheduling Please refer ANNEX INDIA: Bilateral Trade, The Format of concurrence of the State Load Despatch Centre (SLDC).

- **Affidavit: Applicant** while making application for Scheduling of Bilateral Transactions shall submit to the nodal agency an affidavit, duly notarized, as per the enclosed format

  For format affidavit submitted to the nodal agency Please refer ANNEX INDIA: Bilateral Trade, the Format of Affidavit submitted to the nodal agency

- **Concurrence of Regional Load Despatch Center**
  - RLDC shall first consider the Applications received by them, as nodal Agency, before giving concurrence / indicating constraint, to other RLDCs, for the Applications received, by the later. In case of denial of access, the RLDC concerned shall furnish reasons for the same, in writing.
  - Concurrence from RLDCs includes:
    - **Concurrence Requested**
      - Applicant/ Trader
      - Application
      - Entity: Injecting, Drawee
      - SLDC: Injecting Entity and Drawee Entity
      - OA request for scheduling: Date, Hour, MW
    - **Concurrence Approved**
      - Applicant/Trader
      - Concurrence issued from …. RLDC: Date, Hours, MW
      - Reason of curtailment if any

  For format Concurrence of RLDC Please refer ANNEX INDIA: Bilateral Trade, Format for Concurrence from Regional Load Dispatch Centre.

- **Procedure for Advance Scheduling of Bilateral Transaction**
  - An Application for Advance Scheduling for a Bilateral Transaction may be submitted to the nodal RLDC up to the fourth month, considering the month in which an Application is made being the first month
  - In case of perceived congestion in transmission corridor, nodal RLDC on next day (i.e. 2nd day after the applicable last date for submission of Application) will inform the concerned applicant(s) as per contents:
    - Transmission Corridor
    - Congestion Period (Date, Hours)
    - Margin Available original route (MW)
    - Total Schedule applied by all the applicants (MW)
    - Margin Available on alternate route – 1 **(_____)** (MW)
    - Margin Available on alternate route – 2 **(_____)** (MW)

  Format for Congestion Information-Advance Scheduling please refer ANNEX INDIA: Bilateral Trade, Format for Congestion Information-Advance Scheduling.

  - By next day (i.e.; 3rd day after applicable last date for submission of Application) latest by 11:00 Hrs., the Applicants must inform the nodal RLDC

for *Request for Revision of Schedule- Due to Congestion* as per format that contents: *[FORMAT-V: "Request for Revision of Schedule- Due to Congestion"]*,

- Transmission Corridor
- Congestion Period (Date, Hours)
- Applied Schedule (MW)
- Revised Schedule on original route (MW)
- Revised Schedule on alternate route -1 (_____) (MW)
- Revised Schedule on alternate route -2 (_____) (MW)

Format for Request for Revision of Schedule- Due to Congestion refer ANNEX INDIA: Bilateral Trade, Format for Congestion Information-Advance Scheduling- Due to Congestion.

- The nodal RLDC shall convey its acceptance or otherwise to the Applicant in five days from the last date of submission, as per enclosed format *"Acceptance for Scheduling"* that contents:
  - Name of applicant Registration Code:
  - Name of injecting Entity /State /Region
  - Name of Drawee Entity /State /Region
  - Wheeling Region(s)
  - Open Access Scheduling Requested: Date, Hours, MW, Route, Total MW
  - Open Access Scheduling Accepted: Date, Hours, MW, Route, Total MW
  - Bidding Details: Transmission System, From Date, To Date , Applicable Bid Rate (Rs./MWh)
  - Payment Schedule
  - Transmission Charges
  - Operating Charges
  - Non-Refundable application fee (if not paid earlier)

Format for Acceptance for Scheduling Please refer ANNEX INDIA: Bilateral Trade, Format for "Acceptance for Scheduling".

- **E-Bidding Procedure:** Any Applicant intending to participate in bidding for Short-Term Open Access shall register and obtain the "User ID" and initial "Password" in advance from the RLDC for its Authorized User(s). The "Registered Users" will be issued a system generated "User ID" and initial "Password' by RLDC to enable them to submit their 'Bid' electronically. Upon receipt of the User Id and initial password, the User shall immediately change the password. It shall be the responsibility of such Applicant to maintain its confidentiality/security and to prevent its misuse.

- **Procedure for Scheduling of Bilateral Transaction on "FIRST-COME-FIRST-SERVED" Basis**

  - **Terms of Payments**

- All payments associated with Bilateral Transaction shall be made by the Applicant to the Nodal RLDC. The Applicant shall make the following payment to the Nodal RLDC within three working days from the date of acceptance of Bilateral Transactions. The charges for scheduling of Bilateral Transactions will be worked out on the basis of total MWh approved at the point of injection.
    - **Application Fees (as per Para 7 of Regulation)**
    - **Transmission charges (as per Regulation 16)**
    - **Operating charges (as per Regulation 17)**

  The transaction wise payment details shall be submitted as per format which includes:
    - Name of Applicant
    - Registration Code
    - Ref. No.
    - Date: -Payment for the period: From (date) _____ To _____
    - Acceptance No. & Date
    - Application No. & Date
    - Payment Due (Rs.)
    - Payment Due date
    - Amount Paid (Rs.)
    - Details of Bank Draft / Cheque:
        - Name of Bank with address: -
        - Draft / Cheque No. & Date: -
        - For Amount Rs. _____ in favour of " ___RLDC Short-Term Open Access " payable at _____
        - In case payment through ECS, details

Format for Details of Payment Please refer ANNEX INDIA: Bilateral Trade, Format for "Details of Payment".

General Conditions

- The Entities which are making Application for the first time or intend to make, must submit the "One- Time" information as per format for ""Registration Form" to the concerned nodal RLDC. In case of any change in the existing information, the same shall be intimated to the concerned nodal RLDC. Format for Registration includes:
    - Registration code (if already registered)
    - Name of Applicant:
    - Address for correspondence
    - Status of Applicant (Trader/SEB/Authorized agency /ISGS /IPP/ Discom/CPP/Others (Pl. specify))
    - Contact Details
        - Name
        - Designation
        - Phone (Off) (Res)
        - Mobile Fax
        - E-Mail

- Trading license number and type (If trader) _____
- Concerned SLDC (if applicable) _____
- Connectivity details to the grid (if Applicant is a CPP/IPP/Discom etc.)- to be enclosed (Details of boundary meters shall also be furnished in such cases)
- Declaration

Format for Registration Form, please refer ANNEX INDIA: Bilateral Trade, Format for "Registration Form".

Short-Term Open Access in Inter-State Transmission (Collective Transaction)

- State Utilities and intra-State Entities proposing to participate in trading through Power Exchange(s) shall obtain "Standing Clearance"/ "No Objection Certificate" from the respective State Load Despatch Centres (SLDCs), as per the defined format that contents:

    - Name of the SLDC issuing NOC:
    - Region: North / West / South / East / North-East
    - Name of the Entity
    - Status of Entity (e.g.; State Utility/CPP/IPP/Discom etc.)
    - Point(s) of Connection:
    - Max. MW ceiling allowed for Injection*:
    - Max. MW ceiling allowed for Drawal*:
    - Validity Period: From: << Date >> To: <<Date >>
    - Transmission losses (besides Regional Transmission losses)
        - State Transmission losses
        - Distribution Licensees losses
        - Any other losses
    - Transmission charges (besides Regional Transmission charges)
        - State Transmission Charges
        - Distribution Licenses
        - Any other charges
        -

Format for No Objection Certificate, Please refer ANNEX INDIA: Collective Transaction, Format for "No Objection Certificate".

- Each RLDC, on their website, shall display the list of Regional Entities of the Region. Similarly, each SLDC, on their website, shall display the list of the intra-State Entities of their State.
- All Entities participating in the Power Exchange(s) shall be identifiable with a Unique Code on the basis of Bid Area, sub Bid Area (if any), Regional Entity; Intra-state Entity etc. Power Exchange (s) shall finalize the coding methodology in consultation with National Load Despatch Centre (NLDC) at least 15 days prior to commencement of the operation.

- All data between NLDC and Power Exchange(s) shall be exchanged electronically through a dedicated communication channel.
- The Power Exchange(s) shall ensure that the necessary infrastructure for data exchange/communication with NLDC/RLDCs and SLDCs is put in place prior to commencement of the operation. The Power Exchange(s) shall be responsible for the day to day maintenance of the same.
- Power exchange(s) shall furnish by 13:00 Hrs, the interchange on various interfaces/control areas/regional transmission systems as intimated by NLDC (Para 3.1 above). Power Exchange(s), shall also furnish the information of total drawal and injection in each of the regions.
- Based on the information furnished as per Para 3.2 by Power Exchange(s), NLDC shall check for congestion. If there is no congestion, the Power Exchange(s) shall submit the application as per clause 3.5. However, in case of congestion, NLDC shall inform the exchange(s) by 14:00 Hrs. about the period of congestion and the available limit for scheduling of collective transaction on respective interfaces/control areas/transmission system(s) during the period of congestion for scheduling of Collective Transaction through that respective Power Exchange. The limit for scheduling of collective transaction for respective Power Exchange shall be worked out in accordance with CERC directives.
- Power Exchange(s) shall ensure that "Scheduling Request for Collective Transaction" is within the limits (as per Para 3.3 above) for each time block as intimated by NLDC. Further, Power Exchange(s) shall ensure that the Scheduling Request is within the limits for each time block specified by respective SLDCs in the "Standing Clearance"/"No Objection Certificate" (submitted by State Utilities/intra-State Entities to Power Exchange(s)).

- The Application for Scheduling of Collective Transaction shall be submitted by the Power Exchange(s) by 15:00 Hrs. each day, to the NLDC as per defined format that contents:
    - Application No.
    - Date:
    - Name of Power Exchange:
    - Scheduling Request for
        - Region: Northern, Western, Southern, Eastern, North-Eastern
        - Sum of Injection by all Sellers (MWh)
        - Sum of Drawal by all Buyers (MWh)
        - Net Injection (+) / Drawal (-) (MWh)
        - Number of Regional Entities involved:
            - Injection) (Drawal)
            - (Drawal)
    - Open Access Charges:
        - Application Fee:
        - Transmission Charges:
        - Operating Charges:

Format for Application for Scheduling of Collective Transaction, please refer ANNEX INDIA: Collective Transaction, Format for "Application for Scheduling of Collective Transaction".

- The details for Scheduling Request for Collective Transaction shall be submitted by Power Exchange (s) to the NLDC as per the defined format that contents:

    - DATE:
    - TIME:
    - Scheduling Request for: << Date next day>>
    - Time Period
    - Region: Northern, Western, Southern, Eastern, North-Eastern and TOTAL
        - Sum of Injection by all Sellers in the Region
        - Sum of drawal by all Buyers in the Region
        - Net Injection (+)/Drawal (-) from/in the Region

    Scheduling Request for Inter-Regional Corridors for Collective Transaction

        - Time Period
        - Region: NR-WR ER-NR SR-WR ER-SR ER-WR NER-ER

    Regional Entity Wise Scheduling Request for Collective Transactions << For all concerned Regional Entities

        - Bid Area <<Name & Code>>
        - Regional Entity <<Name & Code>>
        - Time Period
        - Sum of Injection(MW) by all Sellers within the State
        - Sum of Drawal (MW) by all Sellers within the State

- The individual transactions for State Utilities/intra-State Entities shall be scheduled by the respective SLDCs. Power Exchange(s) shall send the detailed breakup of each point of injection and each point of drawl within the State to respective SLDCs by 18:00 Hrs. after receipt of acceptance from NLDC. The details for Scheduling Request for Collective Transaction shall be submitted by Power Exchange (s) to the respective SLDCs as per defined format which contents:

    - Scheduling Request for: << Date next day>>
    - Name of the Regional Entity:
    - Code of the Regional Entity

- Summary of Injection/Drawal for Scheduling of Collective Transaction through Power Exchange:
    - Time Period Sum of injection by all entities within the State Trade Schedule (MW)
    - Sum of Drawal by all entities within the State Trade Schedule (MW)
- Details of each point of Injection (-) /Drawal (+):
    - Time Period
    - Name ….1, 2,3,4…
    - Code
    - Trade Schedule (MW)

Format for Application for Scheduling Request for Collective Transaction, please refer ANNEX INDIA: Collective Transaction, Format for "Scheduling Request for Collective Transaction".

3.1.5 Maldives

Country Specific Grid Code and Policies, Laws and Regulation of Maldives regarding standard format for data and information exchange regarding power trade and system operation not available in public domain.

3.1.6 Nepal

Nepal Electricity Authority (NEA) is responsible for Purchasing Power from Private sector Importing from India, Self-generation and Transmission. NEA Grid code 2005 has defined standard formats for data and information exchange for Power Generation and transmission.

- **Standard Planning Data and information:** For Standard Planning Purposes, System operator for Planning shall be provided information and data as:
    - About the power station (Location map and site map, Approximate construction period; Total installed capacity in MW, Transmission voltage and point of connection with Grid)
    - Generating unit (Maximum and minimum operating head; Type and capacity of turbine; Generator,
    - Grid Data (Name of line (Indicating Power Stations and sub-stations to be connected); Voltage of line (kV); No. of circuits; Route length (km); Conductor sizes; Line parameters (PU values); etc.)
    - Substation Data (Substation layout, Electrical circuits; Grounding arrangements; Phasing arrangements; Switching arrangements, Conductor sizes etc.
    - Details of the Transformer: Rated primary and secondary voltage (kV); Winding arrangement; Tap changer type, number of steps, and size; Positive sequence resistance and reactance at max., min. and nominal tap position; Zero sequence reactance for three-legged core-type transformer; BIL value (kV).
    - Details on switchgear, circuit breakers and disconnect switches installed at the Connection Point or

- Details of these equipment (capacitors, reactors, static var compensators),

For further Details please refer Annex Nepal, NEA's Standard format for Standard Planning.

- **Detailed Planning Data and information**: For Detailed System planning, the system operator shall be provided following data:
  - General Data (Name of Power Station; Number and capacity of Generating Units(MVA); Single line diagram of Power Station and switchyard; Neutral Grounding of Generating Units; and Earthing arrangements)
  - Protection and Metering with following details (Full description including settings for all relays and protection systems, settings for all relays installed, of inter- tripping of circuit breakers, estimated fault clearance time, full description of operational and commercial metering schemes)
  - Generating Unit Data with following details: (Parameters of Generator and Turbine, Parameters of Excitation Control System, Parameters of Governor, Operational Parameter,
  - Switchyard with following details (Step-up transformer with following details, Circuit Breakers and Isolators)
  - Loads

For further Details Please refer Annex Nepal, NEA's Standard format for Detailed Planning Data.

- **Annual Outage Programme:** Power generator shall prepare annual outage plan form maintenance and shared with System Operator. Such annual plan should consist of:
  - Name of Generating Plant
  - Name of generating Company
  - Month wise (four weeks):
    - Generating units (1,2,3….)
    - Power Transformer
    - Unit Circuit Breaker
    - Line Circuit Breaker
    - Other equipment etc.
    -

For further Details Please refer Annex Nepal, NEA's Standard Format for "Annual Outage Program".

- **Monthly Availability Declaration of Power on Weekly Basis:** Generation Companies shall provide data and information regarding month wise scheduled power generation plan as:
  - Power Availability:
    - Average Discharge Available
    - Average MW Available in Month
    - Max MW Available in Peak in the Month
    - Min MW Available in the Month

- Energy Availability:
    - Average MWh / Day available the Month
    - Peaking facility MWh / Day
    - Total declared MWh in the Month
    - Design MWh for the Month

For further Details Please refer Annex Nepal, NEA's Standard Format for "Annual Availability Declaration of Power".

- **Monthly Generation Outage Programme:** Generation companies have to submit week wise Generation Outage Plan for a month.
    - Name of Generating Plant
    - Name of generating Company
    - Weekly (four weeks):
        - Generating units (1,2,3….): Outage Hours and Outage MW
        - Power Transformer: Outage Hours and Outage MW
        - Unit Circuit Breaker: Outage Hours and Outage MW
        - Line Circuit Breaker: Outage Hours and Outage MW
        - Other equipment etc.: Outage Hours and Outage MW
    - Residual Previous Works
    - Partial Last week

For further Details Please refer Annex Nepal, NEA's Standard Format for "Annual Availability Declaration of Power".

- **Weekly generation Outage Programme**: Generation companies have to submit day wise Generation Outage Plan for a week (seven Days).

    - Name of Generating Plant
    - Name of generating Company
    - Weekly (four weeks):
        - Generating units (1,2,3….): From …. Hours. To…Hours, MW Differed
        - Power Transformer: From …. Hours. To…Hours, MW Differed
        - Unit Circuit Breaker: From …. Hours.to…Hours, MW Differed
        - Line Circuit Breaker: From …. Hours.to…Hours, MW Differed
        - Other equipment etc.: From …. Hours.to…Hours, MW Differed

For further Details Please refer Annex Nepal, NEA's Standard Format for "Weekly Generation Outage Program".

- ***Schedule Outage Request:*** Formal request for power plant shutdown in Standard format shall be submitted to Sytem operator seven business day a head for maintainance. It contents:
    - Location
    - Description of Works

- Start date and time
- Finish Date and Time
- Duration of Shutdown Requested

For further Details Please refer Annex Nepal, NEA's Standard Format for "Schedule Outage Request Form".

- ***Forced / Mainteace Outage Request:*** Formal request for power plant shutdown in Standard format shall be submitted to Sytem operator 48 hour for forced/ maintainance. It contents:
  - Start Date
  - Start Time
  - Location and Description of works
  - Finish date
  - Finish Time
  - Duration of Shutdown

For further Details Please refer Annex Nepal, NEA's Standard Format for "Forced / Maintenance Outage Request Form".

- ***Transmission Line Shutdown Implementaion:*** Generator may request for shutting down transmission for maintainance and formal request for such works cantains:
  - A. Shutdown Request:
    - Shutdown Requested By
    - Date of Shutdown
    - Earliest Start Time and Latest Completion Time
    - Description of Work
    - Type of Outage
  - B. Shut Down Placement:
    - Disconnection End….
      - ……. Shall Open Circuit Breaker
      - ……Shall Open Isolator
    - Grounding:
      - User Shall Close Ground Switch at end -1
      - NEA Shall close ground switch at end-2
  - C. Shut Down release: Lock No, User SO, Locj=k No, ISO
  - Open Grounding sitch and end ….
  - Remove the lock isolator at end …
  - Verify CB is open at end…

For further Details Please refer Annex Nepal, NEA's Standard Format for "Transmission Line Shutdown Implementation Form".

- ***Monthly Availaibility Declearation on weekly Basis:*** Generation Companies shall provide data and information regarding a month wise scheduled power generation plan on weekly basis as:

- Power Availability:
    - Average Discharge Available
    - Average MW Available in Month
    - Max MW Available in Peak in the Month
    - Min MW Available in the Month
- Energy Availability:
    - Average MWh / Day available the Month
    - Peaking facility MWh / Day
    - Total declared MWh in the Month
    - Design MWh for the Month

For further Details Please refer Annex Nepal, NEA's Standard Format for "Monthly Availability Declaration on weekly Basis"

- ***Monthly Availaibility Declearation on Hour to Hour Basis:*** Generator company shall povide completse schedule MW produced in every hour of ecah day of the month.
    - Date: 1, 2, 3….
    - Time hour: 0:00 to 24:00

For further Details Please refer Annex Nepal, NEA's Standard Format for "Monthly Availability Declaration on Hour to Hour Basis".

- ***Weekly Availability Deceleration:*** Generator company shall povide completse schedule MW produced in every hour of ecah day of the week.
    - Date: Sunday, Monday….
    - Time hour: 0:00 to 24:00

For further Details Please refer Annex Nepal, NEA's Standard Format for "Weekly Availability Deceleration".

- ***Daily Availaibility Declearation:*** Generator company shall povide completse schedule MW of Individual Unit produced in a day.
    - Unit: Unit 1, Unit 2, Unit 3, ….
    - Remarks for Shutdown.
    - Time hour: 0:00 to 24:00

For further Details Please refer Annex Nepal, NEA's Standard Format for "Daily Availability Declaration".

- ***Verbal dispatch Instruction Confirmation:*** Load Dispatch Cntre (LDC) may instruct Generators verbally.Such instrunctions shall be recorded officially in standard format that conatins –
    - ***Time: Fro ….to,,,***
    - ***Verbal Instrcution***
    - ***Verbal Instruction given by***

For further Details Please refer Annex Nepal, NEA's Standard Format for "Verbal dispatch Instruction Confirmation".

- ***Daily Generation Report Form:*** Power Producers are responsible for maintaining report of Daily Power production of plants
    - Energy Meter Reading Previous
    - Energy Meter Reading Present
    - MW: Unit 1, Unit 2, Unit 3, …. Total
    - Reactive MVAR
    - Calculated MVA
    - PF
    - Time hour: 0:00 to 24:00

For further Details Please refer Annex Nepal, NEA's Standard format for Daily Generation Report Form.

- ***Daily Generation Log Sheet:*** It Includes-
    - Time: 00:00 to 24:00
    - Frequency
    - Units 1,2,3…
        - Generation (MW)
        - MVAR
        - PF
    - Total Generation
        - Active MW
        - Reactive MVAR
    - Transmission Voltage kV
    - Step up Transformer (AMP)

For further Details Please refer Annex Nepal, NEA's Standard format for Daily Generation Log Sheet

- ***Fault Registration Form:*** It incudes-
    - Date
    - Time
    - Affected Parts of the Power Plant
    - Description of the Fault
    - Causes
    - Tripped Breaker
    - Alarms & Indications on Protection Relay
    - Outage Time
    - Loss of Generation

For further Details Please refer Annex Nepal, NEA's Standard format for Fault Registration Form.

- ***Monthly Generator Performance Form:*** It includes-
    - Unit 1,2….
    - Transformer 1, 2….
    - Particulars:
        - Present Reading at ……. Hrs. On…
        - `Previous Reading at ……. Hrs. On…
        - Difference
        - Multiplying Factor
        - Energy (MWh)
        - Cumulative from Beginning of the Year
        - Total Energy Supplied to Interconnection Point
        - Total Hours in Month
        - Percentage running hours
        - Average Power Production(MW)
        - Maximum Demand
        - Plant Load factor
        - Number of Tripping on Plant Side
        - Type of Tripping
        - Number of tripping on System of transmission Line
        - Types of tripping on site

  For further Details Please refer Annex Nepal, NEA's Standard format for Generator Performance Report Form.

- **Monthly Generation Report**: It includes-
    - Date 1,2,3….
    - Total Generation MWh
    - Delivery in the Interconnection Point (MWh)
    - Local Distribution (MWh)
    - Demand Generation of NEA and outages and refined output (MWh)
    - Demand of Generation of Plant Outage and Reduced Outputs (MWh)

  For further Details Please refer Annex Nepal, NEA's Standard Format for Monthly Generation Report Form.

- **Monthly Outage and Reduced Output Report:** It Includes-
    - Monthly Outage and Reduced Output: It includes-
    - Date: 1,2,3……
    - NEA outage and reduced output
    - From Hrs.,
    - To Hrs.,
    - Produced hours
    - Load before event (MW)
    - Load After Event (MW)

- Demand generation losses
- Description of event

For further Details Please refer Annex Nepal, NEA's Standard Format for Monthly Outage and Reduced Output Report.

- **Maintenance Output Report:** It includes-
  - Type of outage (maintenance or forced)
  - Actual start date and time of outage
  - Actual finish date and time of outage
  - Length of outage
  - MW output before outage
  - MW output during Outage
  - Description of work

For further Details Please refer Annex Nepal, NEA's Standard Format for Maintenance Output Report.

- **Loading Status and Scheduled Outages**: It includes-
  - Substations
  - Voltage level and feeders name
  - Maximum Load-
  - First week, second week, third week
    - Amp
    - Date
    - Time
  - Frequency of –
    - Shut Down
    - Load shedding
  - Duration
    - Shut Down
    - Load shedding

For further Details Please refer Annex Nepal, NEA's Standard Format Loading Status and Scheduled Outages.

- **Forced Outage of Transmission Lines and System Failures:** It Includes
  - Station
  - Voltage level and feeders Name
    Tripping's:
  - Terminal related
    - Relay operated (Main Protection, E/F+ O/C)
    - Outage (Frequency, Duration)
  - Line Related
    - Relay operated (Main Protection, E/F+ O/C)
    - Outage (Frequency, Duration)

- Total Forced Frequency

For further Details Please refer Annex Nepal, NEA's Standard Format for Forced Outage of Transmission Lines and System Failures.

- **NEA's Standard Format for Meter Reading Form:** it includes-
    - This Month Reading
    - Difference
    - Meter Multiplier
    - Feeder – 1, 2...
        - Main Meter (To Grid and From Grid)
        - Check Meter (To Grid and From Grid)
        - % Difference (To Grid and From Grid)

For further Details Please refer Annex Nepal, NEA's Standard Format Meter Reading Form.

3.1.7 Pakistan

National Electric Power Regulatory Authority (NEPRA) is designated regulatory authority of Pakistan and grant licenses for transmission and distribution of electric power. National Transmission & Dispatch Company (NTDC) responsible for construction, Maintenance and operation of transmission lines and load dispatch.

NTDC Grid Code, 2005 is to facilitate the development of operation and maintenance of an efficient, coordinated, safe, reliable and economical system for the transmission electric power. The code has defined standard data for Generators, Distributors Companies, Transmission Connected Consumers, any other person with a User System directly or indirectly connected to the NTDC Transmission System to which Power Plants and / or Consumer are connected, Externally-connected Parties, Externally- connected Consumers and Special Purpose Transmission License (SPTL).

The System Operator (SO) shall establish, operate and maintain a web site, proving, necessary, information about the transmission system status, pricing, congestion, operating procedures, technical and operational committee meetings and other relevant information and data. The code has categorized data as:

1. Standard Planning Data(PC)
2. Detailed Planning Data(PC)
3. Operational Data (OC)
4. Scheduling Dispatch Code Data (SDC)
5. Connection Code Dada(CC)

All data required by NTDC from user and by user from NTDC are following data area

1. Generating Unit Technical data
2. Generation Planning Parameters and Generation Offer Data
3. Generating plant outage programmes, output usable and inflexibility information

4. Independent Generating Plant Output Forecast
5. User's data System Data
6. User outage information
7. Load characteristics (directly or indirectly connected to NTDC System)
8. Connection Point Demand and Active Energy Data of users directly or indirectly connected to NTDC system and Generation Summary
9. Data Supplied by NTDC to user

Generating Unit Technical data

The generators are required to submit to NTDC/ System operator technical information on each of their generating units. The information must include a realistic performance chart for each unit. By 10:00 a.m. one week prior the operational day, each user must inform the System Operator of changes to circuit details as per defined in the code.

Weekly Operational Policy: The system operator shall issue each generator in respect to its power plants a weekly Operational policy which shall cover Generators that are available from standstill to start by low frequency relay settings of which be determined from time to time by system operator. It includes:

- Response data for Frequency changes
- Primary Response to frequency Fall
- Secondary Response to Frequency Fall
- High Response to Frequency Rise
- Generators, Governor and Droop Characteristics
- Unit Control Options
- Control of Load Demand

For Detail Please refer ANNEX PAKISTAN, Generating Unit Technical data, Weekly Operational Policy.

System Warnings: Exchange of information relating to Operational and events on the Total System of NTDC includes advise on equipment, plant and appreciation tests. The system warning shall be issued relating to inadequate Plant availability, subsequent load demand control, and to advise of a risk of major system disturbance.

System Warning contents:

- Warning type,
- To: For Action,
- Consequences and
- Response from Recipients /Code Participants

For Detail Please refer ANNEX PAKISTAN, Generating Unit Technical Data, and System Warnings.

Report of Major event: Formal exchange of reports relating to Events that have already occurred on the system shared between system operator, distribution

companies, operators of power plants, transmission connected consumers and operators of externally connected system arties. The report includes:

- Time and date of Major event
- Location
- Plant/ Apparatus Involved
- Description of the Major Event
- Demand/ generation lost
- Generating Unit Frequency
- Generating Unit MVAr performances
- Estimated duration of non-availability of power Plant or that of demand interruption

For Detail Please refer ANNEX PAKISTAN, Generating Unit Technical Data, and Report of Major event.

Planning Data: For planning of future works, which include the development of new facilities, reinforcements, up-rating, extensions and augmentation of existing facilities, standard planning data is required. Standard planning data includes:

- User's System Data
- Generating Unit Data
- Rated Parameter Data
- Network Operational Data
- Etc.

For Detail Please refer ANNEX PAKISTAN, Generating Unit Technical Data, Planning Data Generating plant outage programmes, output usable and inflexibility information.

Short Term Planning of Generation Outage (0 Year):

Generator and System Operator shall exchange information on a quarterly basis. Generator is required return their most update outage proposals, thereby enabling the system operator to open generator availability as per the generation requirement.

For detail please refer ANNEX PAKISTAN Generating Plant Outage Programmes, Output Usable and Inflexibility Information, Short Term Planning Timetable for Generation Outage (Year 0)

Medium Term Planning of Generation Outage (1-2 Year):

Medium term is two financial years 0 or Years 1 & 2. There shall be an exchange of information concerning the Final Generation Outage Programme between each Generator and the System Operator on a financial Year basis.

For detail please refer ANNEX PAKISTAN Generating Plant Outage Programmes, Output Usable and Inflexibility Information, Medium Term Planning Timetable for Generation Outage (Year 1-2)

Long Term Planning of Generation Outage (3-5 Year):
Long Term is for three-year period causes 3, 4 and 5. The system operator shall notify respective Generator of any forecasted outage on the NTDC transmission System for construction maintenance work.

For detail please refer ANNEX PAKISTAN Generating Plant Outage Programmes, Output Usable and Inflexibility Information, Long Planning Timetable for Generation Outage (Year 3-5).

User's System Data

User System data consists electrical parameter as:

- Single line diagram with information like Rated voltage (kV), Operating voltage (kV), Line Length (km), Conductor Name, Type of tower, Positive phase sequence reactance and resistance, susceptance, zero phase reactance/resistance/ susceptance
- User's equipment installed at a site like Switchgear, Substation Infrastructure, reactive compensation equipment etc.

For detail please refer ANNEX PAKISTAN, User's System Data, and Reference User's System Data.

Data Supplied by NTDC to user: NTDC's Notification of its Forecasted Annual System Peak Demand (Active Power) and Annual Minimum Demand (Active Power) and the Total Active Energy of the NTDC in the preceding NTDC Financial Year along with a Forecasted Active Energy Requirement for the Current Financial Year.

NTDC System Demand and Energy Forecast incorporating all the data supplied by the Network users and Network operators.

Operating Response and Frequency Response: Amount of reserve which make up the Operating Margin that the System Operator may make use of under certain operating conditions to cover for the availability / unavailability or sudden outage of generation and transmission facilities. Response capability of Generator which used to provide operating reserve and frequency response shall be made available to the System Operator by the Operators of Power Plants.
For operating Response and Frequency Response following data needed:

- Frequency Response Capability Profile
- Primary Response to Frequency Fall
- Secondary Response to Frequency Fall
- High Response Frequency Rise
- Generator, Governor and droop Characteristics
- Unit control
- Control of Load demand

For detail please refer ANNEX PAKISTAN Data Supplied by NTDC to User, Operating Response and Frequency Response.

Inter Safety Precautions Form: For the co-ordination, establishment and maintenance of necessary Safety Precautions, specific the standard procedure in needed. Form of Record of Inter-System Safety Precautions shall include:

- Identification of HV Apparatus, Location, Isolation
- Identification and safety Precautions Established

For detail please refer ANNEX PAKISTAN Data Supplied by NTDC to User, Inter Safety Precautions Form.

<u>Generation Scheduling Data</u>

Generation Scheduling and Dispatch Parameters: For Generation Scheduling and Dispatching, following parameters shall be shared:

- Basic data: Minimum Generation (MW), Governor Dro(%), Sustained Response Capability
- Two shifting limitations
- Minimum on time
- Block Load
- Maximum Loading rates
- Maximum number of changes

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Generation Scheduling and Dispatch Parameters.

Power Plant Daily Scheduling Notice: For deceleration of availability of power plants, following data shall be shared:

- Settlement period: 0000 To 2400 at 30 minute time interval.
- Units: Oil, Gas,
- Contracted Capacity
- Available Capacity

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Generation Scheduling and dispatch Parameters.

Generation Scheduling and Dispatch Parameter (GSDP) Revision: If power production subjected to vary form scheduled and relevant to Power Purchase agreement, or Power Station Operation & Dispatch Agreement (PSODA), revised data shall be shared for scheduling and Dispatch purposes as:

- Unit ID
- Generation Scheduling and Dispatch Parameter affected
- Contracted Value Revised Value
- Time : From …. To…

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Generation Scheduling and Dispatch Parameter (GSDP) Revision.

Notification of Revised Availability: For notification of revised availability, following information shall be shared:

- Settled Period: 0000 to 2400 at 30 minutes time interval.
- Units: Oil, Gas, Turbine units 1,2,3…

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Notification of Revised Availability.

Power Plant-Daily Scheduling Notices: Power Plants shall share daily scheduling information includes:

- Availability Notice
- Energy Bid Price Notice
- Scheduling and dispatch parameters
- Relevant data etc

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Power Plant-Daily Scheduling Notices.

Notification of Revision of Power Plant-Daily Scheduling: Power Plants shall notified followings:

- Unit Range ID
- Declared MW
- Revised MW
- **Valid : From… to …**
- Reason for Change

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Notification of Revision of Power Plant-Daily Scheduling.

Unit Nomination: For Participating Power Plant for generation details of units shall be shared.

- Name of Participating Generator
- Name of Generating Unit
- Date on which Scheduling Day commences
- Settlement Period : Start ….End…. at 30 minutes interval
- Unit Nominations (Kwh)

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Generator Participating- Unit Nomination.

Supplemental Energy Bids:

Supplemental bids include:

- Name of Participating Generator
- Name of Generating Unit
- Date of Scheduling Day Comments
- Supplemental Energy Bid:
    - Startup Price (Rs.)
    - Fixed Price (Rs/Hour)
    - Incremental Price (Rs/MWh)
    -

For detail please refer ANNEX PAKISTAN Generation Scheduling Data, Format for Supplemental Energy Bid.

3.1.8 Sri Lanka

For Sri Lanka, Grid Code 2015 describes the format for Data and Information for electricity trade and System operation

- **Preliminary Project Planning Data:** Transmission Licensees, Generation Licensees, Distribution Licensees and Transmission Bulk Customers have to provide data for preliminary project planning. Following data and information to be made available by the Transmission Licensee to a prospective User:

    (a) Single line diagram of the Transmission System indicating the existing lines and proposed lines.
    (b) Relevant data on plant and equipment of the Transmission System.
    (c) Transmission Licensee's connection requirements.
    (d) Map of Sri Lanka showing the existing lines of the Transmission System and proposed lines.
    (e) Data related to Grid Substations indicating 33 kV (in case of 132/33kV or 220/33 kV Grid Substations), 11kV (in case of 132/11kV Grid Substations) outlets as applicable.
    (f) Long Term Transmission Development Plan.
    (g) Long Term Generation Expansion Plan

For further detail, please refer ANNEX SRI LANKA Planning Data, Preliminary Project Planning Data.

- **Committed Project Planning Data:** Transmission Licensees, Generation Licensees, Distribution Licensees and Transmission Bulk Customers have to provide data for committed project planning.

For further detail, please refer ANNEX SRI LANKA Planning Data, Committed Project Planning Data.

- **Standard Planning Data:** Transmission Licensees, Generation Licensees, Distribution Licensees and Transmission Bulk Customers have to provide data for Standard Project Planning.
    - Generation Licensees with generation from conventional resource-data to be furnished to Transmission Licensee has to provide:
        - Generation
            - Thermal Connection
              A. Connection
              B. Station Capacity
              C. Generating Unit Data
              D. Auxiliaries and Start up data
            - Hydroelectric
                Connection
                A. Station Capacity
                B. Generating Unit Data

For further detail, please refer ANNEX SRI LANKA Planning Data, Standard Project Planning Data.

- **Grid Operation Data:** For grid Operation (A) Annual Generator Outage Plan from Generation Licensees (B) Annual Generator Outage Plan from System operator and (C) Release of Generating Units data are needed.

For further detail, please refer ANNEX SRI LANKA Grid Operation Data, Grid Operation Data from Generation Licensees.

- **Grid Dispatch Information and Data:** Rolling dispatch plan needs information and data from Transmission Licensee, Generators, Hydropower Stations, Distribution Licensee, and Transmission Customers.
    - Transmission Licensee shall provide Annual maintenance plan, transmission restrictions, ancillary service requirements, new transmission capacity to be commissioned during the year, decommissioning, etc.
    - Generation Licensees shall provide Generator's contract prices, annual maintenance plan and other foreseen restrictions fuel availability and fuel prices
    - Transmission Customers shall provide Demand: load forecast for the calendar year, total and discriminated by delivery points to each Transmission Customer, including monthly energy demand, peak capacity

For further detail, please refer ANNEX SRI LANKA, Dispatch data, Grid Dispatch Information and Data.

- ***Grid Metering Data:*** The Transmission Licensee will establish a database for metering data, and for each meter installation. The information and data will include:
    - Name of the Licensee/customer/account number
    - Unique identification number for the installation
    - Site-specific adjustment factors to be applied
    - All metering data such as demand, energy, at specified intervals as required by the Transmission Licensee and the relevant tariff decisions of PUCSL
    - All information related to meters and instrument transformers
    - Test certificates of the metering equipment
    - Communication details
    - Date of commissioning and commissioning documents
    - Testing, calibration history and the persons who carried out the work
    - Fault, repair, and maintenance history of the installation
    - Contact details of the User representatives

For further detail, please refer ANNEX SRI LANKA, Metering Data, Format for Metering Data

3.2 Data and Information Exchange between SAARC Member States:

3.2.1 Afghanistan and Central Asia

Afghanistan meets a major part of electricity demand through imports from Iran, Turkmenistan, Uzbekistan and Tajikistan. Currently, the carrying capacity of total installed transmission lines is 326MW from Uzbekistan, 164 MW from Iran, 433 MW from Tajikistan, and 77 MW from Turkmenistan. The national grid is not synchronized with the systems of the four countries from which Afghanistan imports power, resulting in higher costs and reduced reliability of supply.

There are five transmission lines used for power import which feed into NEPS from Turkmenistan, Uzbekistan and Tajikistan. Three lines import power from Iran. None of these import sources are interconnected to other power systems.

Construction of the 500 kV CASA 1000 transmission line between Sangtuda (Tajikistan) and Nawshehra (Pakistan) through Torkham (Afghanistan) commenced in May 2016. Afghanistan announced last year that it would abandon its proposed 300 megawatt share of energy imports via the CASA-1000 project due to a lack of demand. Its allocation would then be transferred to Pakistan, which is now set to receive 1,300 megawatts, rather than the initial 1,000 megawatts proposed. Thus Pakistan would be the main importer of energy under the CASA-1000 project.

3.2.2 Bangladesh and India

Bangladesh and India agreed bilateral electricity trade. NVVN is the Nodal Agency for trading of power with Bangladesh. NVVN has signed an agreement with Bangladesh

(Bangladesh Power Distribution Board (BPDB)) for supply of 250 MW power for 25 years from various central generating stations of NTPC. The supply has commenced from October 2013 after completion of the transmission link between India & Bangladesh. Power Purchase Agreement has being signed between BPDB and NVVN and back to back Power Supply Agreements have also been signed with Tripura State Electricity Corporation Ltd (TSECL) for supply of 100MW power to BPDB under radial mode.

The present bilateral agreements between India and Bangladesh do not provide for any arrangements or provisions for taxes & duties for CBET between the two countries.

3.2.3 Bhutan and India

The framework "Inter-Governmental Agreement between the Royal Government of Bhutan and the Government of the Republic of India concerning development of Joint Venture Hydropower Projects through the Public-Sector Undertakings of the two Governments" was signed on 22 April 2014 in Thimphu by Secretary, Ministry of Economic Affairs, Royal Government of Bhutan and Secretary, Ministry of Power, Government of India.

The Inter-Governmental agreement provides the framework for implementing four HEPs totaling 2120 MW, subject to completion of the due process of appraisal of their DPRs including techno-economic viability, on a Joint Venture-model between Public Sector Undertakings of the two countries, as follows: -

Hydro Electric Project	Capacity	JV partners
Kholongchu HEP	600 MW	SJVN Ltd. of India and Druk Green Power Corporation (DGPC) of Bhutan (50:50 JV, 70:30 DER)
Bunakha HEP (with 230 MW downstream benefit from Tala, Chukha and Wangchu HEPs)	180 MW	THDC Ltd. of India and Druk Green Power Corporation (DGPC) of Bhutan (50:50 JV, 70:30 DER)
Wangchu HEP	570 MW	SJVN Ltd. of India and Druk Green Power Corporation (DGPC) of Bhutan (50:50 JV, 70:30 DER)
Chamkarchu HEP	770 MW	NHPC Ltd. of India Druk Green Power Corporation (DGPC) of Bhutan (50:50 JV, 70:30 DER)
Source: PIB, MEA		

Three hydro-electric projects (HEPs) totaling 1416 MW, viz., the 336 MW Chukha HEP, the 60 MW Kurichhu HEP, and the 1020 MW Tala HEP, are already operational in Bhutan and are supplying electricity to India. Three more HEPs totaling 2940 MW, i.e., the 1200 MW Punatsangchhu-I HEP, the 1020 MW Punatsangchhu-II HEP and the 720 MW Mangdehchhu HEP, are under construction, and are scheduled to be commissioned by 2018.

3.2.4 Nepal and India

Nepal imports power from India:

- As per Bilateral Agreements/Treaty (Kosi Agreement, Gandak Agreement, Mahakali Treaty)
- Power trade from 22 radial mode inter connection
- Dhalkebar- Mujaffpur 400kV Transmission Line

Article 2.III of Kosi Agreement has provision

HMG shall be entitled to obtain for use in Nepal any portion up to 50 percent of the total hydro-electric power generated by any Power House situated within a 10- mile radius from the barrage site and constructed by or on behalf of the Union, as HMG shall from time to time determine and communicate to the Union:

Provided that: - ***HMG shall communicate*** *to the Union any increase or decrease in the required power supply exceeding 6,800 KW at least three months in advance:*

Article 2.b of Makali Agreement

"*a supply of 70 million kilowatt-hour (unit) of energy on a continuous basis annually, free of cost, from the date of the entry into force of this Treaty. For this purpose, India shall construct a 132-kV transmission line up to the Nepal-India border from the Tanakpur Power Station" (which has, at present, an installed capacity of 120,000 kilowatt generating 448.4 million kilowatt-hours of energy annually on 90 percent dependable year flow)*

Format of "Schedule for Power for Nepal through Tanakpur-Mahndra Nagar Line ", as per provision of the treaty is presented in ANNEX INIDIA NEPAL Schedule Tanakpur-Mahendranagar.

Agreement between the Government of Nepal and the Government of India on electric power trade, cross border transmission inter connection and grid connectivity signed on 21 October 2014.

ARTICLE-II (a) The Parties shall mutually work out a coordinated procedure for secure and reliable operation of the national grids interconnected through cross border transmission interconnection(s) and prepare scheduling, dispatch, energy accounting, settlement and procedures for cross-border power trade and unscheduled interchange.

ARTICLE-IV (d) The Parties shall put their best efforts to ensure unrestricted flow of power subject to safety, security, stability and reliability requirements of their power grids as per the applicable standards.

These articles highlight importance of developing standard data format for power trade.

The Govt. of India has appointed NVVN as the Nodal Agency for Cross-Border power trading with Nepal. A PPA was signed between NVVN and Nepal Electricity Authority

for supply of 80MW power to Nepal through the Muzafferpur-Dhalkabar transmission line.For importing power form India, Nepal Electricity Authority Load Dispacth Center and counter part in India communicate as per format defined by Laws of India. Sample of data formate is presented in ***ANNEX INIDIA NEPAL, Open Access (Bilateral Transaction).***

3.2.5 Pakistan and Iran

Pakistan imports electricity from Iran to serve the demand in Baluchistan province. The system is operated in a radial mode. As per their bilaterl agreement in 2002 agreement , Pakistan can import up to 39 MW. In June 2006, WAPDA signed an MOU with Iran to increase the supply by 100 MW to meet Gwadar port area demand and plans to increase to 1000 MW. Pakistan now imports 74MW after Jakigur 230/63 kV substation project was commissioned.

3.2.6 Indian Power/Energy Exchanges

- The Indian Energy Exchange is an electronic system based power trading exchange which provides a competitive wholesale market where the buyers and sellers of the Indian power sector come together to trade in energy. IEX was launched by Financial Technologies (India) Limited (FTIL) along with Power Trading Corporation of India Limited (PTC). The Exchange conducts transactions in various product/ product segments as permitted by the Commission under the Electricity Act, 2003.
- INDIAN ENERGY EXCHANGE LTD. (IEX) is India's premier power trading platform. Providing a *transparent, neutral, demutualized and automated platform for physical delivery of electricity, IEX enables efficient price discovery and counter-party risk management for participants of the electricity market, including industries eligible for open access*
- *Today, about 4,000 participants across utilities from 29 States, 5 Union Territories (UTs), 1,000+ private generators (both commercial and renewable energy) and more than 3,500 open access consumers are leveraging the Exchange platform to manage their power portfolio in the most competitive and reliable way.*
- **Product Segments**

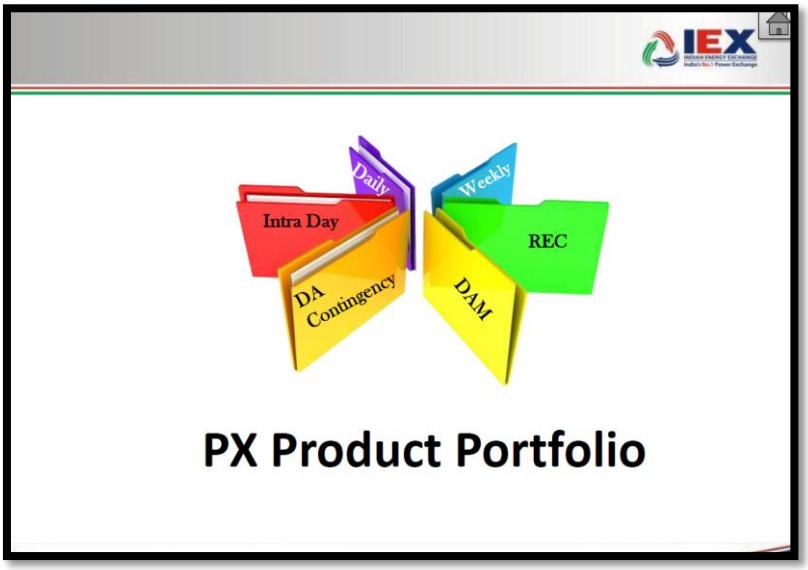

Figure 3- 1 IEX Power Exchange Portfolio

1. **Day-Ahead Market (DAM)**
   Launched in June, 2008, in this segment, participants transact electricity on 15-minutes block basis, a day prior to the delivery of electricity. Both buyers and sellers submit their anonymous bid electronically during the bid call session. The Market Clearing Price (MCP) is determined on the basis of intersection point of demand and supply curve and is common for both selected buyers and sellers.

2. **Term-Ahead Market (TAM)**
   Launched in September 2009, contracts under TAM cover a range for buying/selling electricity for a duration of up to 11 days. It enables participants to purchase electricity for the same day through intra-day contracts, for the next day through day-ahead contingency, on daily basis for rolling seven days through daily contracts, and on weekly basis through weekly contracts.

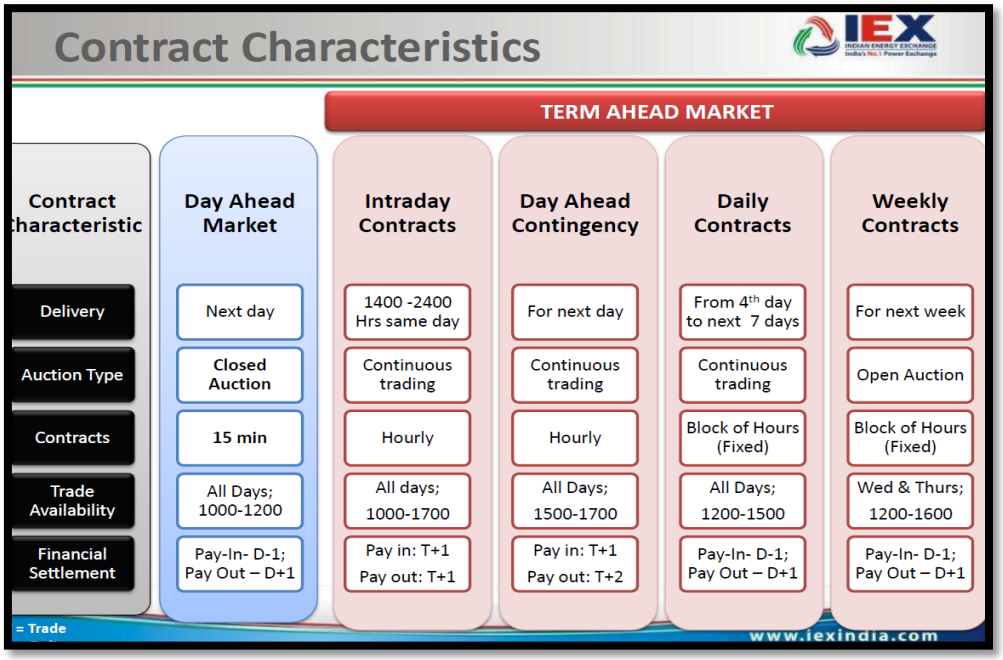

Figure 3- 2 IEX Contact Characteristic

- **Features of Day Ahead Market:**
  Day Ahead Market includes Bidding, Matching, review Corridor and Funds Availability, Results, Confirmation and Scheduling.

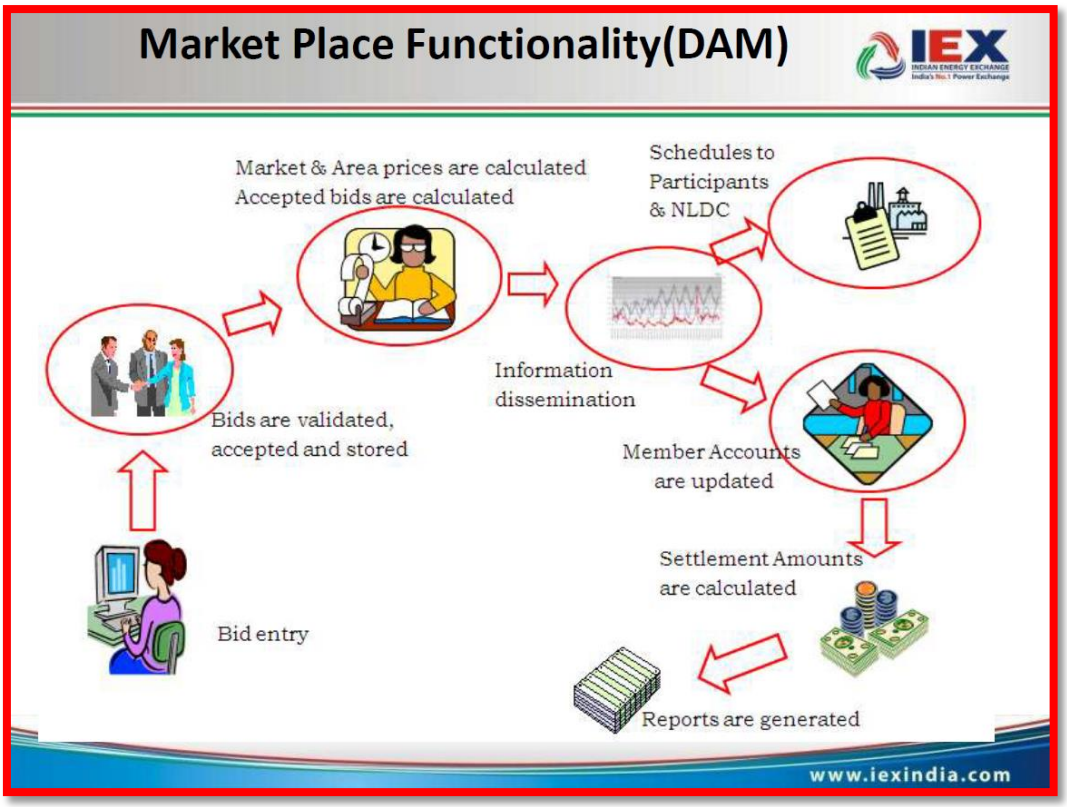

Figure 3- 3 IEX Market Place Functions

Figure 3- 4 IEX Day Ahead Market (DAM) Trading Process

Bidding:

- Participants enter bids for sale or purchase of power for delivery on the following day. (T+1 day)
- Bids for a total of 96 blocks of 15 minute each can be entered.
- Bidding session: 1000 hrs. 1200 hrs.
- Bids can be single and/or block including linked bids:
    - **Single bids:** 15 Minute bids for different price and quantity pairs can be entered through this type of order. Partial execution of the bids entered is possible.
    - **Block bids:** Relational Block Bid for any 15min block or series of 15min blocks during the same day can be entered. Although no partial execution is possible i.e. either the entire order will be selected or rejected.
- The bids so entered are stored in the central order book. The bids entered during this phase can be revised or cancelled till end of bid call period (i.e.1200 hrs. of trading day)

Matching:

- At the end of the bidding session, bids for each 15-minute time block are matched using the price calculation algorithm. (available in IEX byelaws)
- All purchase bids and sale offers are aggregated in the unconstrained scenario. The aggregate supply and demand curves are drawn on Price Quantity axes.
- The intersection point of the two curves gives the market clearing price (MCP) and market clearing volume (MCV) corresponding to price and quantity of the intersection point.
- MCP and MCV are determined for each block of 15 minutes as a function of demand and supply which is common for the selected buyers and sellers.
- Selected members are intimated about their partially or fully executed bids and other trade related information.
- By 1300 hrs., transmission corridor required to fulfill successful transactions are sent to NLDC.

Transmission Corridor and funds availability:

- Preliminary MCP and MCV are used to calculate the provisional obligation of the selected participants and the provisional power flow.
- Funds available in the settlement accounts of the participants are verified based on the provisional obligation.
- In case of insufficient funds in the account, the bids entered by such a participant are deleted.
- Required corridor capacity and provisional power flow is sent to NLDC for scrutiny and corridor allocation is requisitioned based on availability.

- By 1400 Hrs, NLDC reverts with actual transmission corridor availability during all 15 minutes time blocks across congestion prone bid areas.

Results

- Based on the reserved transmission capacity intimated by NLDC, IEX recalculates MCP and MCV as well as area clearing price (ACP) and area clearing volume (ACV).
- ACP is used for the settlement of the contracts. On receipt of final results, obligations are sent to the Clearing Banks for Pay In from buying Members at 14:30 hrs. and the bank is asked to confirm the same.

Confirmation

- Final results for confirmation and application for scheduling of collective transactions are sent to NLDC.
- NLDC sends the details of the schedule to respective SLDCs.

Scheduling

- RLDCs /SLDCs incorporate Collective Transactions in the Daily schedule.
- A scheduled transaction is considered deemed delivery.
- Deviations from schedules are dealt under UI or Deviation Settlement or Imbalance Settlement regulations. The Regional Entities (those connected at ISTS networks) are governed by CERC Regulations and Embedded Entities (those connected to state transmission or distribution network) are governed by respective State Commission's regulations.

- **Term Ahead Market (TAM):**

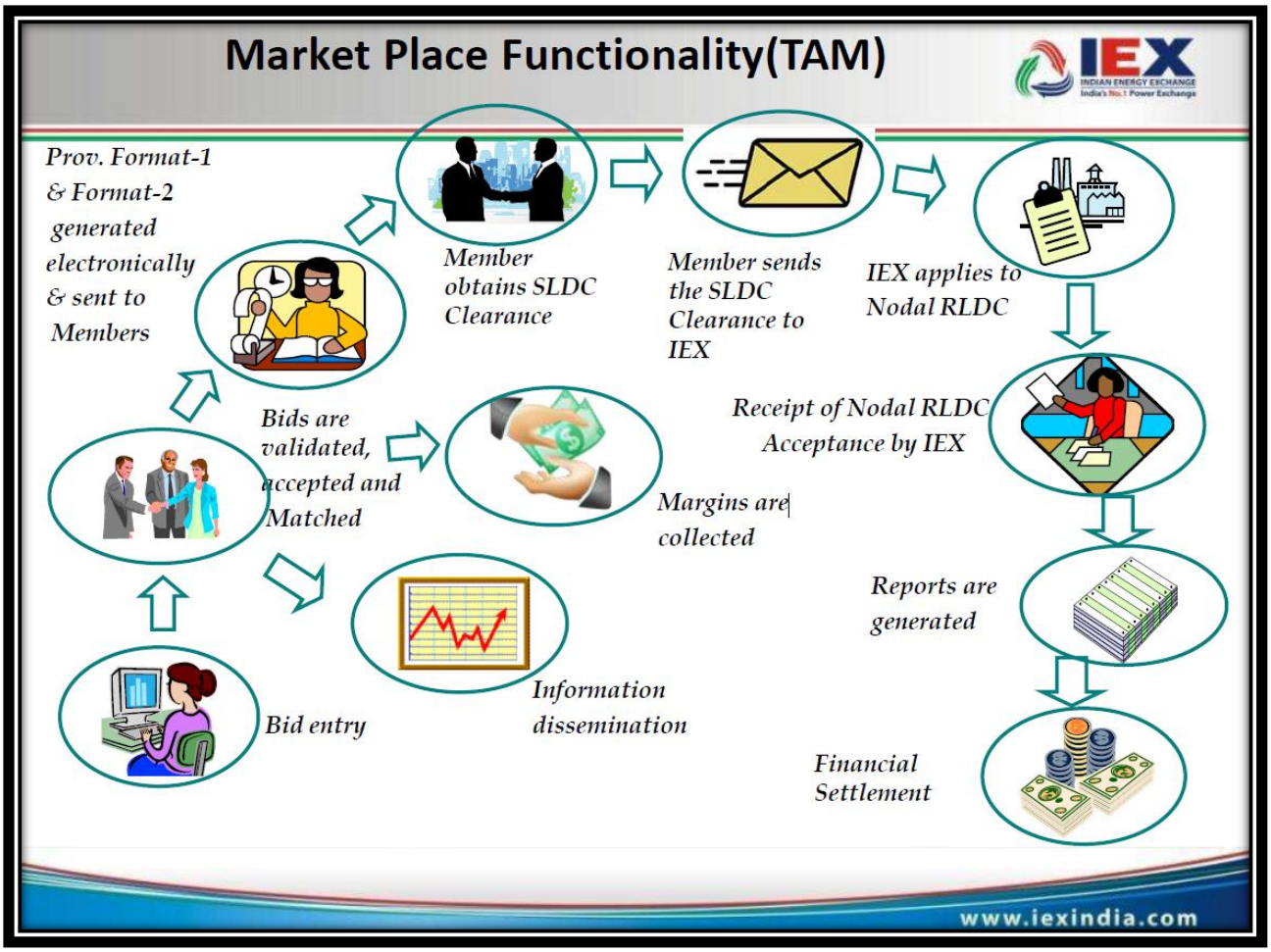

Figure 3- 5 IEX Term Ahead Market (TAM) Trading Process

Term Ahead Market (TAM) operating procedure includes:

- Bid Entry,
- Bids are Validated accepted and Matched includes Bid Entry
- Member obtains SLDC Clearance
- Member Sends the SLDC Clearance to IEX
- IEX Applies to Nodal RLDC
- Receipt of Nodal RLDC Accepting by IEX
- Reports Generated
- Financial Settlement

3.2.7 Guidelines on Cross Border Trade of Electricity

Ministry of Power, Government of India had introduced **Guidelines on Cross Border Trade of Electricity, 2016**. This Guideline shall facilitate cross border trade of electricity between India and neighboring countries and Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perceptions of regulatory risk**.**

As per **Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2017 (Draft)**,

- **Designated Authority** shall facilitating the process of approval and laying down the procedure for cross border transaction and trade in electricity. The Designated Authority shall be responsible for coordination with the nodal agency of the neighboring country for all purposes as stated in the Guidelines on Cross Border Trade of Electricity issued by Ministry of Power.

- **Settlement Nodal Agency (SNA)** shall be responsible for settling all charges pertaining to grid operations including operating charges, charges for deviation and other charges related to transactions with a particular neighboring country in the course of cross border trade of electricity.

- **National Load Dispatch Centre (NLDC)** shall be responsible for granting and facilitating short-term open access with respect to cross border trade of electricity between India and its neighboring country. It shall also be responsible for billing, collection and disbursement of the transmission charges for short term open access transactions.

- **Central Transmission Utility (CTU)** shall be responsible for granting and facilitating long-term access and medium-term open access with respect to cross border trade of electricity between India and its neighboring countries. It shall also be responsible for billing, collection and disbursement of the transmission charges.

- **Indian Power Exchange(s):**with approval of the Designated Authority, after complying with the relevant regulations of the Commission, shall be eligible for cross border trade of electricity through Indian Power Exchange(s) under the categories of Term Ahead Contracts, Intra Day Contracts and Contingency

Article 21: Data and Communication Facilities

Reliable and efficient voice and data communication systems shall be provided to facilitate necessary communication and data exchange, and supervision/control of the grid by the NLDC/ RLDC, under normal and abnormal conditions. Such Communication must be established from generating station to control room of System Operator of a neighboring country and from there to control room of System Operator of India.

The cross border transmission link shall necessarily be established along with adequate data and communication facilities.

All Users and CTU shall install data and communication facilities to telemeter power system parameter such as flow, voltage and status of switches/ transformer taps etc. in line with interface requirements as per the applicable Regulations of CERC. The associated communication system to facilitate data flow up to appropriate data collection point on CTU‟s system shall be established by the concerned User as specified by CTU in the Connection Agreement.

Article 22 : System Recording Instruments

Recording instruments including Data Acquisition System/Disturbance Recorder/Event Logging Facilities/Fault Locator (including time synchronization equipment) shall be

provided and shall always be kept in working condition in the ISTS and transmission system of the neighboring country for recording of dynamic performance of the system. All Users and CTU shall provide all the requisite recording instruments and shall always keep them in working condition.

Article27 : Scheduling

The following procedure shall be followed for scheduling and despatch of cross border trade of electricity transactions between India and a neighboring country:

(a) Scheduling of electricity shall be carried out as per agreed quantum in the contracts between the buying entity and selling entity.

(b) Scheduling shall be carried out for each 15-minute time period in a day.

(c) Transmission System Losses shall be borne in kind by the buying entity/selling entity as per the quantum declared by the concerned System Operator of India or the neighboring country.

Article 28: Energy Accounting

(1) The Settlement of accounts of all electricity imported from a neighboring country to India or exported from India to a neighboring country shall be at the respective interconnection points.

Article 29: Declaration of Transfer Capability

The Total Transfer Capability (TTC), Transmission Reliability Margins and Available Transfer Capability (ATC) for the cross border trade of electricity transactions shall be assessed in advance by System Operators in India and the neighboring country and lower of the two values of ATC assessed by the two countries shall be considered for allowing cross border trade of electricity transactions.

Article 36: Event Information

(1) Events like tripping of elements impacting the electricity flow across the cross border transmission links, complete / partial blackout etc. would be reported by the concerned System Operator of India to the system operator of a neighboring country and vice versa.

(2) A written communication shall be exchanged covering the date and time of the event, location, plant/equipment affected and any other relevant detail (for example, may include Flags, disturbance recorder and sequence event recorder output etc.) as may be necessary.

Article 28: **Data Updating and Sharing**

(1) The entities of neighboring country shall be required to share and update technical data and information to the CEA as per the format to be specified by Designated Authority. A copy of the PPA shall be submitted to the DA within 30 days of signing of the PPA.

(2) If required by the Designated Authority, the developer shall submit the commercial and financial information to the CEA.

4. Best International Practices on Data and Information Exchange:

4.1 South African Power Pool (SAPP)

The Southern African Power Pool (SAPP) was created with the primary aim to provide reliable and economical electricity supply to the consumers of each of the SAPP members, consistent with the reasonable utilization of natural resources and the effect on the environment.

- **Mission Statement**
  - Aim to provide the least cost, environmentally friendly and affordable energy and increase accessibility to rural communities.
- **Methodology:**
  - Development of consistent market mechanisms.
  - Efficient price signals for the procurement and transmission of electricity.
  - Assurance of fair and open access to the transmission system.
  - Optimization of generation & transmission capacity.

- **DAM features**

- **Market for secure, effective and non-discriminatory trade of electricity:**
  - Trading to be concluded daily for delivery next day
  - Forward bidding up to 10 days
  - Participants submit bids (purchase) & (sale) offers
  - Closed market – only market operator and participant know the details of the bid / offer
  - Price discovery
- **Provides a neutral reference price**
  - Open and competitive market
  - Provides platform to manage demand & supply fluctuations
  - Gives price signals to policy makers
  - Stable & Liquid market will give investor confidence
- **Supports an auction-trading model**
  - All sales & demand bids are aggregated at a fixed time
  - The balance price is valid for all trades
  - Tool for managing grid congestion
  - System price (no grid congestion)
  - Area prices (if transmission capacity is exceeded)

- **Conditions of Trade**

Participants can only trade directly on the DAM market upon:

- Having been licensed or given permission by the host country to undertake cross border trading
- Acceptance as a Market Participant by SAPP Executive Committee
- Being party to a TSO connected to a SAPP Control Area and have arrangements for Balance Responsibility

- Signing the DAM governance documents
- Opening of the requisite accounts for trading purposes and having the requisite security for trading purposes
- Have at least two trained Traders

- **Trading Arrangements**

Bilateral Trading

- Trading arrangements mutually agreed between bilateral parties
- Volumes and Prices are the key parameters
- Transmission path to be secured in advance
- Can be firm or non-firm
    - **Firm contracts**
        - Have penalties for non-delivery and
        - Generally, not interruptible – reliability premium
    - **Non-Firm contracts**
        - Are interruptible with notice
        - If notice given, no penalties
        - Generally, less than 75% reliable.

- **Billing and Settlement of Bilateral trades in SAPP**
    - **Pricing of Bilateral contracts**
        - The parties agree to both capacity and energy charges.
        - The prices are negotiated by both parties.
        - Wheelers are notified and confirm path
    - **Billing**
        - Direct billing from seller to buyer.
        - Billing is on schedules and not on actuals.
    - **Metering and settlement**
        - Actual meter readings done on monthly basis.
        - Inadvertent energy management is done using SAPP agreed methodology.
    - **Trading Timelines**

    - **Declaration, Scheduling and Reporting for Bilateral Trades**
        - Bilateral trades shall be declared, scheduled and reported as given below:
        - By 0900 bilateral parties shall request wheeling path to TSOs for the following day
        - At 1100 TSOs shall confirm wheeling paths for the following day
        - By 1130, estimated bilateral trades are declared to the Market Operator for the following day
        - By 1145 Market Operator notifies the relevant TSOs the bilateral transactions declared to the MO by sellers
        - By 1300 utilities shall submit schedules to their control areas
        - At 1500 bilateral schedules are finalized for the following day
        - By 1530 final bilateral trades are submitted by sellers

- By 1600 Control Areas shall submit tie line interchange schedules for the following day to the Market Operator.

- **Declaration, Scheduling and Reporting for the Day Ahead Market (DAM) trading**

  DAM trades shall be subject to the following trading timelines:

  - By 0900 on the trading day, the Market Operator shall publish the applicable exchange rate for trading between the United States dollar and South African Rand. These are the two currencies that shall be used for DAM trading by participants and financial settlements by the Market Operator
  - By 1100 on the trading day, TSOs shall confirm available transmission capacities for power wheeling through their systems for the following day. In the event that TSOs fail to declare such capacities by 1100 hours, the Market Operator shall use the default transmission capacities entered onto the DAM trading platform or the previous day transmission capacities whichever is higher.
  - By 1130 on the trading day, sellers on bilateral and OTC trading platforms shall declare their hourly sale volumes for the following day to the Market Operator. In the event that these are not declared, by 1130 hours, the Market Operator shall assume zero volumes for the following day for such registered bilateral and OTC contracts.
  - By 1145 on the trading day, the Market Operator shall calculate and publish Available Trading Capacities to be allocated for DAM trades for the following day.

- **Guidelines for Regulating Cross-border Power Trading in Southern Africa April 2010**

- **Information sharing is one of strategic objective mentioned as:**
  Capacity Building & Information Sharing
  Facilitate electricity regulatory capacity building among Members at both a national and regional level through information sharing and skills training

- **Meetings between Regulators**

  Prior to making any decision on cross-border trading, the Regulator will consider whether meetings with regulators in other countries affected by the proposed cross-border transaction would be valuable, and the Regulator will be available to meet with other regulators to(a) Share information (subject to any confidentiality requirements), so that each Regulator can develop a full and accurate understanding of all terms and conditions of proposed cross-border agreements; and (b) Discuss any principles or substantive terms and conditions where there may be a difference of opinion, in order to reach a consistent or common approach to their decisions on the cross-border transaction.

- **The license will impose requirements to provide certain information to the Regulator**
    a. That will be required for the Regulator to make other regulatory decisions in relation to the cross-border transaction;
    b. To enable the Regulator to monitor compliance with the law or the terms of the license
    c. To notify the Regulator of any major problems that may result in termination or renegotiation of a cross-border agreement;
    d. To notify the Regulator of any subsequent change to a cross-border agreement that affects the approved tariff or risk allocation under the cross-border transaction; and
    e. As per the reasonable request of the Regulator.

- **The South African Grid Code - The System Operation Code Version 7.0**

    Artilce16 defined Communication of system conditions, operational information and *IPS* performance.

    - The System Operator shall monitor and/or determine system conditions from time to time, and communicate these, or changes from a previous determination, to all participants.
    - The System Operator shall be responsible for providing participants with operational information as may be agreed with the affected participants. This shall include information regarding planned and forced outages on the IPS as determined by the market rules.
    - The System Operator shall inform participants of any network condition that is likely to impact the short and long-term operation of that participant.
    - The System Operator shall timeously communicate any changes or modifications to the TS to the relevant participant.
    - The System Operator shall report on both technical and energy aspects of IPS performance monthly and annually. This reporting shall include daily demands, energies, losses, interruptions and QOS aspects as detailed in the Information Exchange Code. This information shall be available to all participants on request.
    - The System Operator shall annually publish expected fault levels, including the rupturing capacity of relevant NTC equipment, for each point of supply.
      Article 17 Telecontrol

    - Article 17 mentioned where telecontrol facilities are shared between the System Operator and other participants, the System Operator shall ensure that operating procedures are established in consultation with the participants.

- **The South African Grid Code the Information Exchange Code *Version 7.0***
    - The Information Exchange Code defines the reciprocal obligations of parties with regard to the provision of information for the implementation of the Grid Code. The information requirements, as defined for the service

providers, the National Energy Regulator of South Africa (NERSA) and customers, are necessary to ensure non-discriminatory access to the transmission system (TS) and the safe, reliable provision of transmission services.

- **Confidentiality of information:** Information exchanged between parties governed by this code shall not be confidential, unless otherwise stated. For protection of information, confidential information shall not be transferred to a third party without the written consent of the information owner. Parties receiving information shall use the information only for the purpose for which it was supplied and the information owner may request the receiver of information to enter into a confidentiality agreement before information, established to be confidential, is provided.

For a standard format for Information Confidentiality agreement, please refer ANNEX SAPP Data, Standard Format for Information Confidentiality agreement.

- The information requirements are divided into **planning information, operational information and post-dispatch information**

- **System planning information**
  - Customers shall provide such information as the National Transmission Company (NTC) may reasonably request on a regular basis for the purposes of planning and developing the *TS*. *Customers* shall submit the information to the *National Transmission Company (NTC* without unreasonable delay. Such information may be required so that the *NTC* can plan and develop the *TS*, monitor current and future power system adequacy and performance, and fulfill its statutory or regulatory obligations.

- ***Distributor and End Use Customer Data***: Unless otherwise indicated, the following information shall be supplied to the NTC prior to connection and then updated as and when changes occur.
  a) Demand and network data
  b) Transmission system connected transformer data
  c) Shunt capacitor or reactor data requirements
  d) Series capacitor or reactor data requirements
  e) FACTS devices and HVDC data
  f) Information on customer networks

For further details, please refer SAPP Data Information Exchange, Standard format for Distributor and End Use Customer Data.

- ***Generator Planning Data :*** Power Generation company should provide information about power plants provided to the NTC prior to connection and then updated as and when changes occur. It shall include**:**
  a) Power station data
  b) Unit data
  c) Reserve capability

d) Unit parameters
e) Speed governor system, turbine and boiler models
f) Control devices and protection relays
g) Pumped storage
h) Unit forecast data
i) Mothballing of generating plant:

For further details, please refer SAPP Data Information Exchange, Standard format for Generator Planning Data.

- ***Generation Maintenance Plan:*** Generator companies shall submit annual maintenance plan.
    a) The 52-weeks-ahead maintenance plan per week
    b) The annual maintenance/outage plan per generator
    c) A monthly variance reports
    d)

For further details, please refer SAPP Data Information Exchange, Standard format Generation Maintenance Plan.

- **Operational Data:** For SCADA database, definition for each electrical configuration (ELC) or electrical object in the station ELC type, e.g. transformers, units, feeders, etc., and is accompanied by a picture showing the ELC and all its associated devices as they would be indicated on the system operator. It includes Device , category, Type , Control, Generator, Hydro units and Distributor and end-use customer like Transmission equipment ,Interruptible load etc.

For further details, please refer SAPP Data Information Exchange, Standard format for the Operational Data

- **Market operational schedules:** Following information/data shall be givento System operator

    (a) Energy market schedules

    The following parameters shall be specified:
    - Unit Minimum Generation in MW (Mingen)
    - Unit incremental prices (INC0 - INC4) in R/MWh
    - Unit elbow points (Elbow 0, Elbow 1, Elbow 2, Elbow 3) in MW (these are outputs at which the incremental price changes)
    - Unit Maximum Continuous Rating in MW (MCR)
    - Unit Price for Emergency Generation in R/MWh (treated as the last incremental price INC4) also referred to as Emergency Bid Price (EMBP)

    (b) Ancillary services market schedules

    The following parameters shall be specified:
    - The unit identification number
    - Contract hour
    - Instantaneous reserve contract
    - Flexibility Boolean 'F'/'I'
    - Flag for being contracted for AGC

- AGC Regulation contracted
- Regulation contracted down
- 10-minute reserve contract
- Reserve available from 10-minute
- Reserve demand-side resources
- Reserve available for 10-minute
- Reserve from supply-side resources
-

For further details, please refer SAPP Data Information Exchange, Standard format for the Market Operational Schedule.

- **Post-dispatch information:** The System Operator shall provide the minimum operational information in near real time and as historic data in relation to each unit at each power station:
    - Unit high limit
    - Unit low limit
    - Unit AGC mode
    - Unit AGC status
    - Unit set-point
    - AGC pulse
    - Unit sent out
    - Unit auxiliary
    - Unit contract
    - Unit spinning

  The system operator shall provide the following minimum operational information in near real time in relation to the overall dispatch performance:
    - ACE area control error
    - Average ACE previous hour
    - HZ system frequency
    - Frequency distribution current hour
    - Frequency distribution previous hour
    - System total generation
    - Control area total actual interchange
    - Control area total scheduled interchange
    - System sent out
    - System spinning reserve
    - AGC regulating up
    - AGC regulating down
    - AGC regulating up assist
    - AGC regulating down assist
    - AGC regulating up emergency
    - AGC regulating down emergency
    - AGC mode
    - AGC status
    - Area control error output
    - System transmission losses
    - Cahorra Bassa tie-lines

- BPC tie-lines
- Zesa tie-lines
- Nampower tie-lines
- AGC performance indicators
-

For further details, please refer SAPP Data Information Exchange, Standard Format for Post – Dispatch Information.

- **Generator Performance Data:** For evaluation of Generation following parameters are needed:
    - Measurement of availability
    - Components of the energy availability factor (EAF)
    - Unplanned capability loss factor (UCLF)
    - Other capability loss factor (OCLF)
    - Planned capability loss factor (PCLF)
    - Unit capability factor (UCF)
    - Measurement of availability and reliability
    - Unplanned automatic grid separations per 7 000 operating hours (UAGS/7000h)
    - Successful Start-up Rate (SSUR)
    - Protection management
    - Ability to island
    - Excitation system management
    - Reactive capabilities
    - Multiple-unit trip risks
    - Governing requirements
    - Restart after station blackout capability
    - Black start capability
    - Intermediate load capability
    - External supply disturbance withstand capability
    - Loading rates

For further details, please refer SAPP Data Information Exchange, Standard Format for Generator Performance Data.

- **Planning schedules:** Demand forecasted done for ten years.
    - **Schedule 1: Ten-year demand forecast:** It Includes Year wise GWh, Maximum demand (MW, MVAr), Expected minimum demand (MW, MVAr)
    - **Schedule 2: Embedded generation > 50MVA:** It Includes Generator, Tx substation name at closest connection point, Operating power factor, Installed Capacity (MW), Plant type, On-site usage (Normal, Peak), Net sent out (Normal, Peak), Generation net sent out contribution at peak (Year 1, 2, 3……,10)
    -

For further details, please refer SAPP Data Information Exchange, Standard Format Standard Format for Planning Schedules.

- **Generator HV yard information:** The *TNSP* shall provide the following information to *generators* about equipment and systems installed in HV yards from the *NTC*. The *NTC* shall provide the stability criteria.
    - Circuit breaker
    - CT and VT
    - Surge arrestor
    - Protection
    - Power consumption
    - Link
    - Outgoing feeder
    - Transformer
    - Compressed air system
    - Fault recorder

For further details, please refer SAPP Data Information Exchange, Standard Format for Generator HV yard Information.

4.2 Korean Power Exchange Model

- **General Information:**

Korea Power Exchange strives to grow and mature with nation

- Korea Power Exchange (KPX) in control of the operation of Korea's electricity market and the power system, as well as the execution of the real-time dispatch and the establishment of the basic plan for supply-demand.
- At KPX, electricity is traded with hourly pricing across more than 900 generation companies - including the 6 major ones - 24 hours a day, 365 days a year.
- KPX establishes operation plans for the generators and the power grid all over the country, and monitors them in real time in order to quickly respond to any anomalies. This ensures that the customers are mitigated from blackouts or brownouts 24 hours a day, 365 days a year.
- KPX is now putting its efforts into demand resource trading, Renewable Energy Certificates(REC), Energy Storage System(ESS), and Smart Grid to strengthen the electricity business platform initiatives and invigorate the national economy.

- **Key Roles & Functions:**

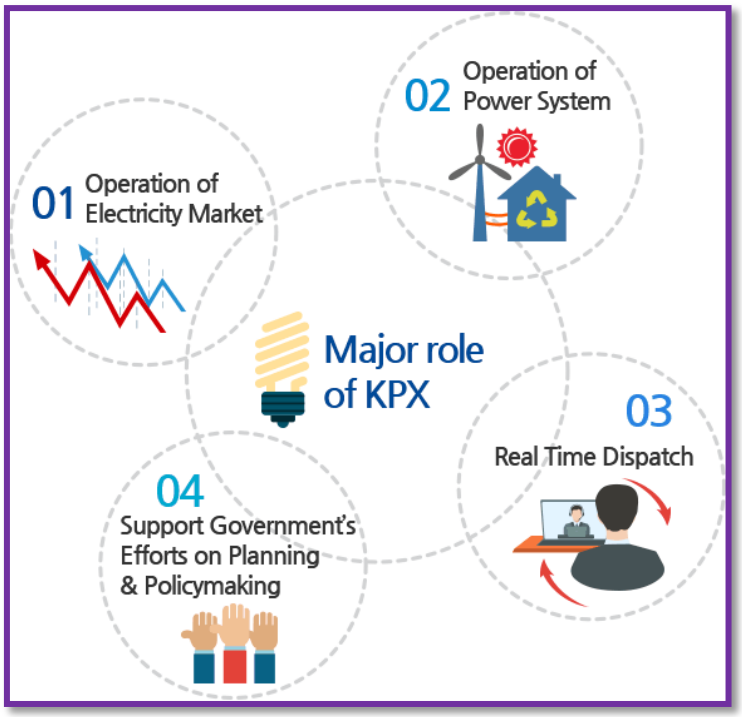

Figure 4- 1 Korean Power Exchange

- ***Operation of Electricity Market:***
    - Management of electricity market, including bidding, metering, settlement, and payment, as well as enact & revise market rules

- **Operation of Power System:**
    - Short and long-term transmission network stability assessment, power system operation planning, and preparation for contingencies

- **Real Time Dispatch:**
    - Balancing the real-time supply and demand, and 24-hour monitoring & control of the power system

- **Support Government's Efforts on Planning & Policymaking:**
    - Set up short and long-term supply-demand plans and devise / Run demand forecasting models

- **Vision & Strategy:**
    - **Vision:** Reliable Power Business Platform
    - **Mission:**
        - Reliable System Operation
        - Fair Transparent Market Operation
        - **Value:** reliable, Pioneering, Fair, Global

    - **Electricity Market Trading Process**

KPX operates the power market where sellers, power generating companies (74 members as of 2006), and the single buyer(KEPCO) participate. The power market is dubbed the pool, suggesting that the electricity generated from all power plants converges in one place for trading. KPX conducts fair and transparent market operations from bidding, settlement, metering, market surveillance, and information dissemination to dispute resolution in accordance with the Pool Rule. In general, the power trading volume and price are determined by the supply-demand curve.

- **Power trading procedure**

  The power market will be evolved in several phases until 2009. Currently, KPX operates the cost-based pool, where power is traded as follows:

Figure 4- 2 Korean Power Exchange (KPX) Trading Procedure

When the wholesale market is introduced, market prices and trading volume shall be determined based on the price bidding without having to classify costs into fixed and variable costs. Currently, however, both fixed (capacity payment) and variable costs for each generating unit are examined monthly by the Generation Cost Assessment Committee (GCAC) based on the documents submitted by the generators.

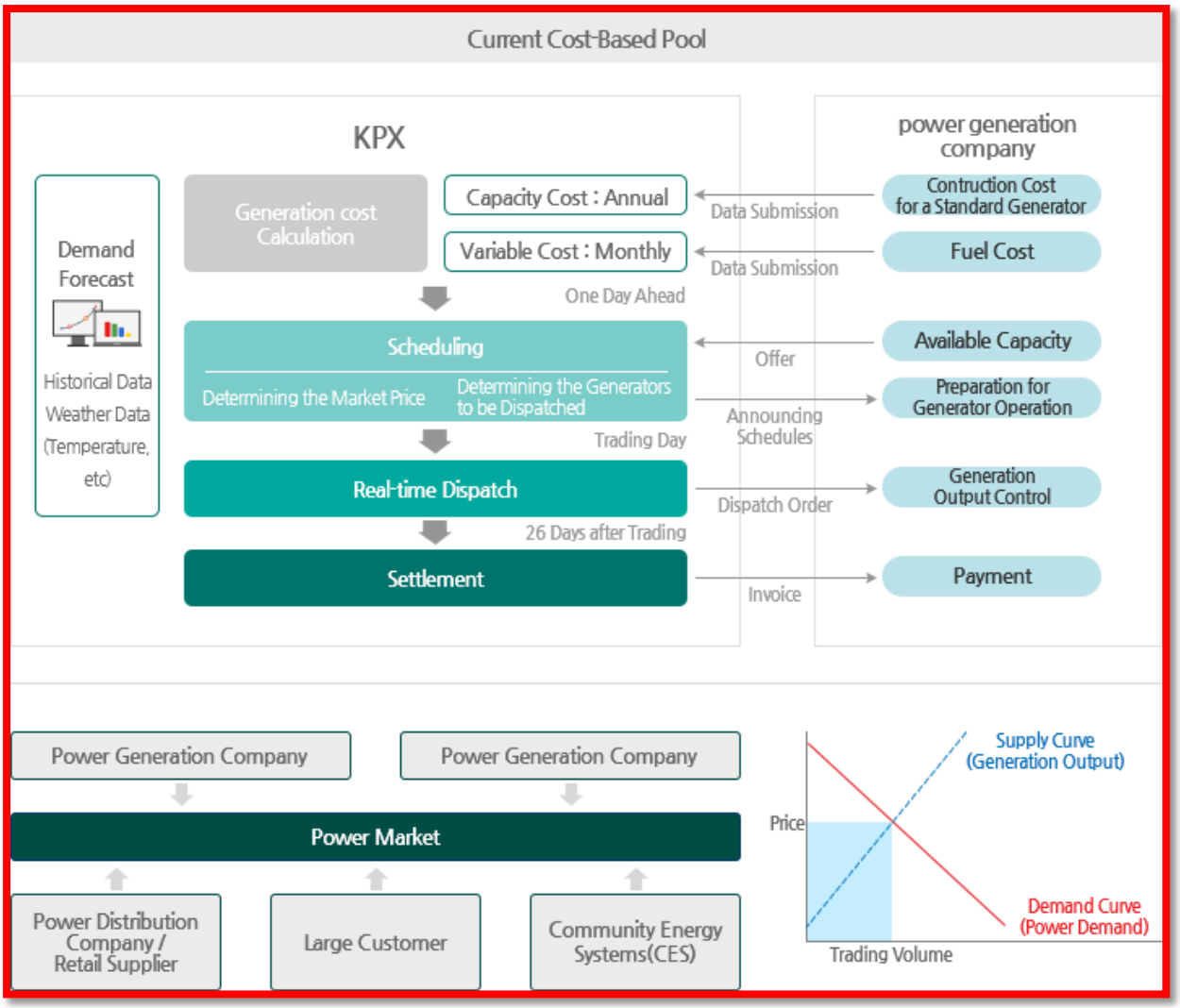

Figure 4- 3 Korean Power Exchange (KPX) Electricity Market Trading System

- **Electricity Market Trading System**
  KPX carries out complicated power trading from bidding to settlement promptly and accurately using various computer systems. Moreover, market participants and interested customers can access the necessary information anytime, anywhere through the Internet.
  - **Bidding System**
    - Bidding through exclusive terminal units
    - Posting of available capacity results on the Internet
    - Various statistics and management data for power trading
  - **Scheduler System**
    - Establishes a Price Setting Schedule(PSS) and calculates the marginal price (SMP/BLMP) a day ahead according to the demand forecast of the trading day; publishes an operation schedule considering various fuel and transmission constraints
  - **Metering System**
    - Performs remote measurement of hourly volume generation through electronic meters installed on all generating units

- **Settlement System**
  - Performs initial and final settlement, adjusts payments upon the request of market participants, and issues bills
- **Energy Management System(EMS)**
  - Exercises supervisory control and carries out data acquisition on generation plants and substations, maintains real-time demand/supply balance, controls generator outputs and system stability, and monitors ancillary service capability and simulates system disturbances for dispatcher training

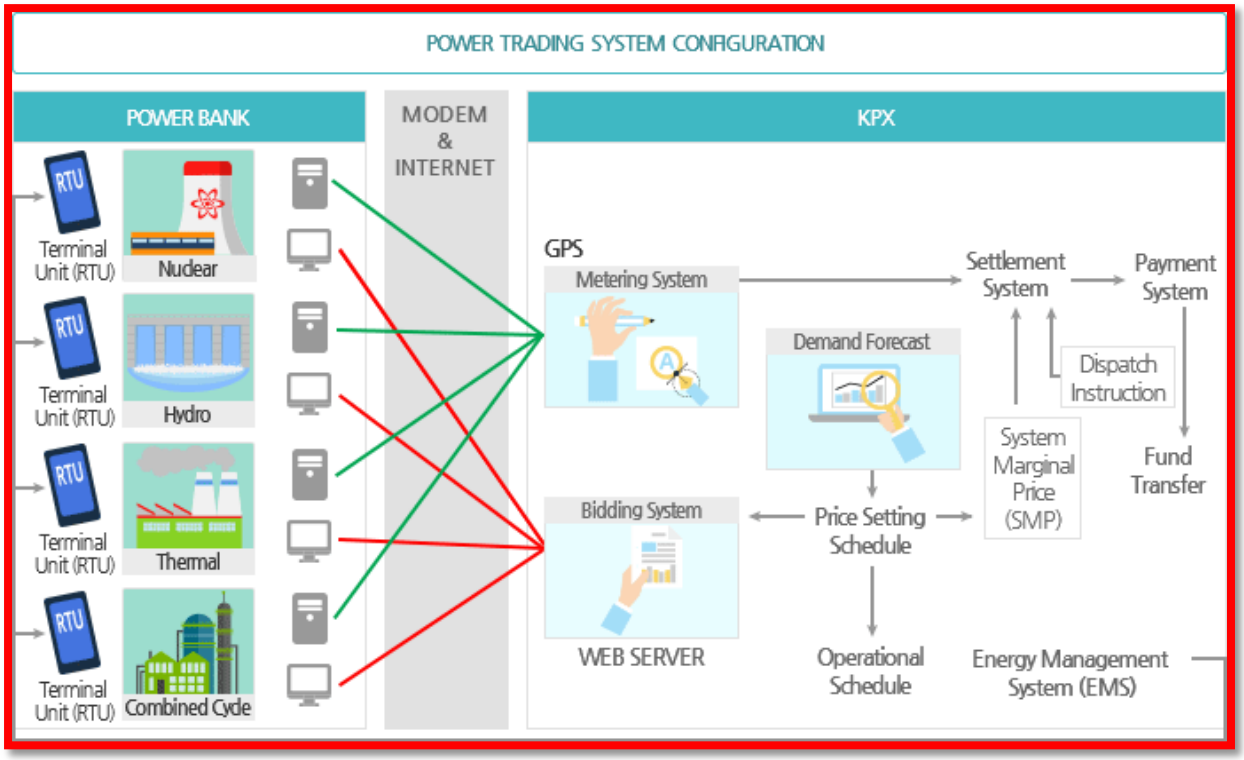

Figure 4- 4 Korean Power Exchange (KPX) Power Trading System Configuration

- **Market Price Determination**

  The principle by which the electricity price is set in the power market is identical to the principle behind determining the prices of general commodities — balance of supply and demand.

- **Market Price**

  The market price is composed of the system marginal price (SMP) and capacity payment (CP). Capacity payment is the price paid to a generating unit that has declared its availability during the day. Price cap is imposed on the energy price of base load generating units such as coal and nuclear energy.

- **Method of Determining the System Marginal Price**

  The system marginal price (SMP) refers to the cost of the most expensive generating unit included in the Price Setting Schedule (PSS). PSS is set up by a computer program that can minimize the total production cost of generating

units including the startup cost and incremental fuel cost. During some hours, certain generating units are not entitled to set the market price owing to their technical characteristics such as ramping rates, minimum output level, etc.

- **Market Price Setting Procedure**

  KPX forecasts the demand for the trading day and receives offers for available capacity from generation companies one day ahead. It then determines the market price by producing a Price Setting Schedule (PSS). In the PSS, the SMP values for each trading hour are calculated to meet the demand for each hour. Note that congestions or generation constraints such as fuel limitation and district heat supply are not considered in this procedure. Thus, establishing an efficient Operation Schedule that determines the unit commitment (merit order) and output level of generating units is essential to minimizing the total production cost while meeting the necessary demand.

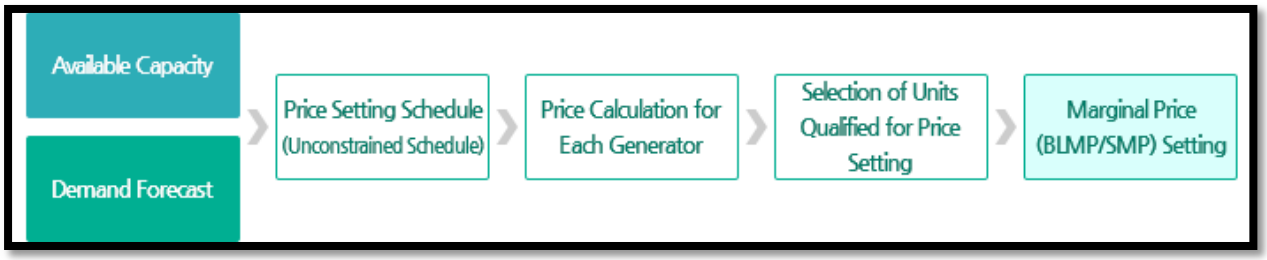

Figure 4- 5 Korean Power Exchange (KPX) Price Determination Procedure

- **Grid Operation**
  - **Power trading procedure**

    KPX operates the necessary bulk power system to transmit the generated electricity to the load centers. The power system mainly consists of generators, transmission lines and substations, and distribution lines.

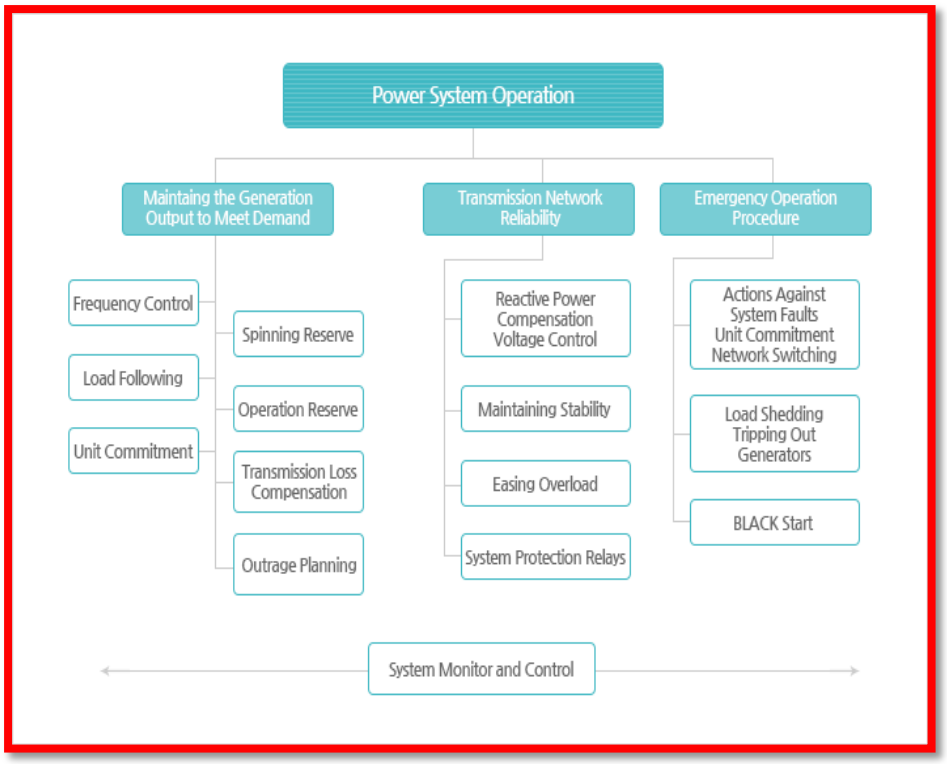

Figure 4- 6 Korean Power Exchange (KPX) Power System Operation

- **Grid Operation**

  To prevent overload and to maintain the system voltage at appropriate levels, KPX manages the transmission network operational planning in advance by analyzing the power flow.

  In preparation for failures of power facilities or outages, KPX establishes contingency plans for reliable system operation by performing fault analysis, power flow calculation, stability analysis, and outage schedule adjustment. Together, they guarantee the secure operation of the transmission network.

  In case major transmission lines connected to a large generation complex experience a failure, all generating units in the complex may stop operating. In preparation for this scenario, appropriate countermeasures are established through stability analysis. By installing a control circuit that can immediately separate the faulty unit from the system, other generating units can sustain normal operating conditions.

4.3 Spanish Electricity Exchange Market

Since January, 1st, 1998, the new Spanish Electricity Market started operations. All generators, distributors, commercialization companies, and final consumers negotiate all power exchanges through the spot market. The Spanish Power Exchange Market Operator (Compañia Operadora del Mercado Español de Electricidad COMEL) is responsible for the management of the market and for the economic settlement of all transactions between market participants.

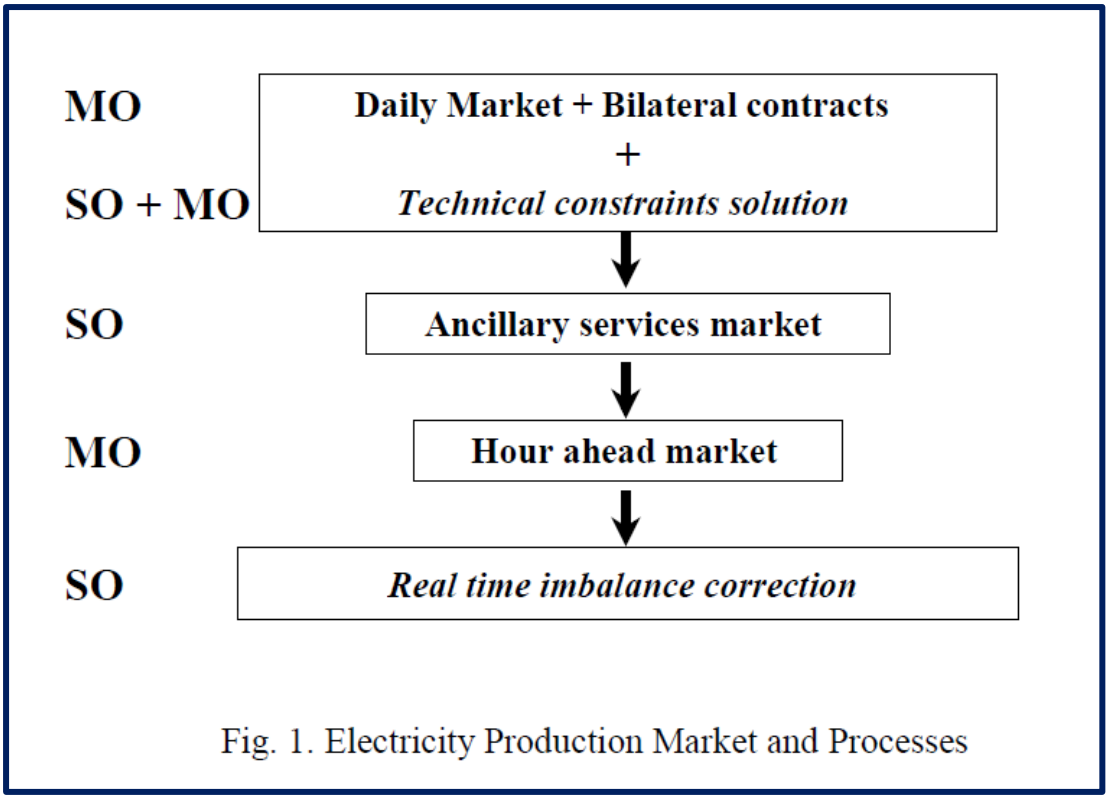

Figure 4- 7 Spanish Electricity Exchange Market –Electricity Production and Process

The electricity production market is composed by four independent, although interrelated markets and processes shown in Figure 4-5

- **The daily market**, managed by the Market Operator (MO), This is the fundamental Spanish electricity market and all the rest of the markets and processes are based on its results. The bilateral physical contracts are also integrated on it. This market also includes the technical constraints solution process that is done in cooperation by the MO and the System Operator (SO).
- **The ancillary services market**, managed by the SO that handles the necessary ancillary services
- **The hour ahead market**, managed by the MO. It gives the agents the opportunity to adjust the previous market results to the changes on the delivery/production situation.
- **The real-time imbalance correction process**, managed by the SO. It takes care of the generation/load imbalances that appears on real time.

Power Exchange Market

The two main markets operated by the MO are the day ahead market (Daily Market) and the hour ahead market.

A. **Daily market organization**:

The market is organized as a day ahead market, therefore, prior to 10 a.m., each day, all the energy bids for the following day must be presented by the agents to the MO. The market is organized on an hourly basis so the bids and the energy assigned will be in hourly energy blocks. The results are given to all participants prior to 11 a.m. including the daily energy values that the

parties of the bilateral contracts communicate to the market that they will execute.

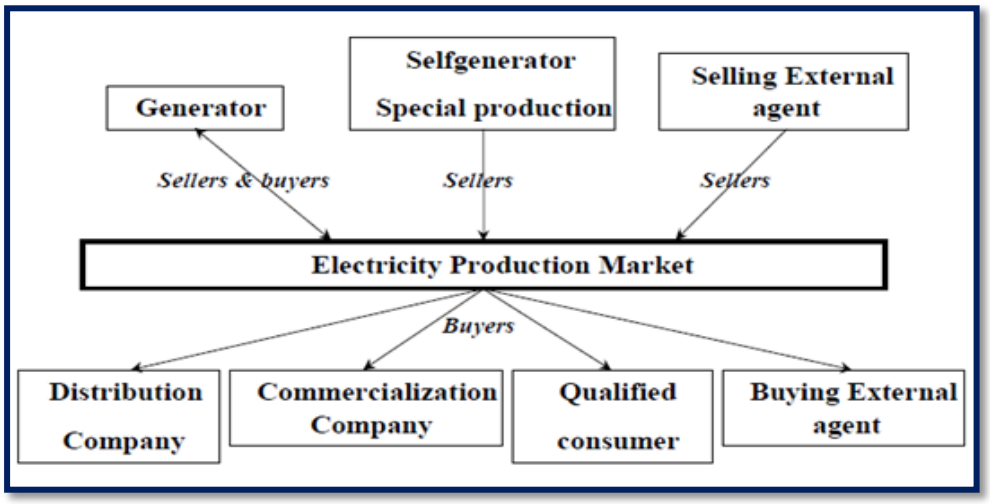

Figure 4- 8 Agents in the Spanish Electricity Production Market

- In the daily market sellers and buyers present only one bid per bidding unit.
- Each daily market bid could be divided in up to 25 hourly energy blocks for each hour of the next day (the maximum number of energy blocks that a bidding unit can submit is 24x25).
- Energy/marginal price determination process (matching process) done without interpolation between the blocks and they will be treated independently.
- For selling bids the price of the blocks need to be increasing with the energy bided on the hour, and for purchasing bids the price of the blocks need to be decreasing with the energy requested on the blocks.

B. Daily market price determination (matching process):

The objective of this process is to provide marginal prices for each hour and energy assigned each hour to each biding unit.

- The solution to the daily market, including the hourly marginal prices is the unconstraint solution, without taking into account the network situation.
- These hourly unconstrained prices will be the ones fixed for the daily market and it will be the prices paid by all buyers and earned by all sellers in each hour.

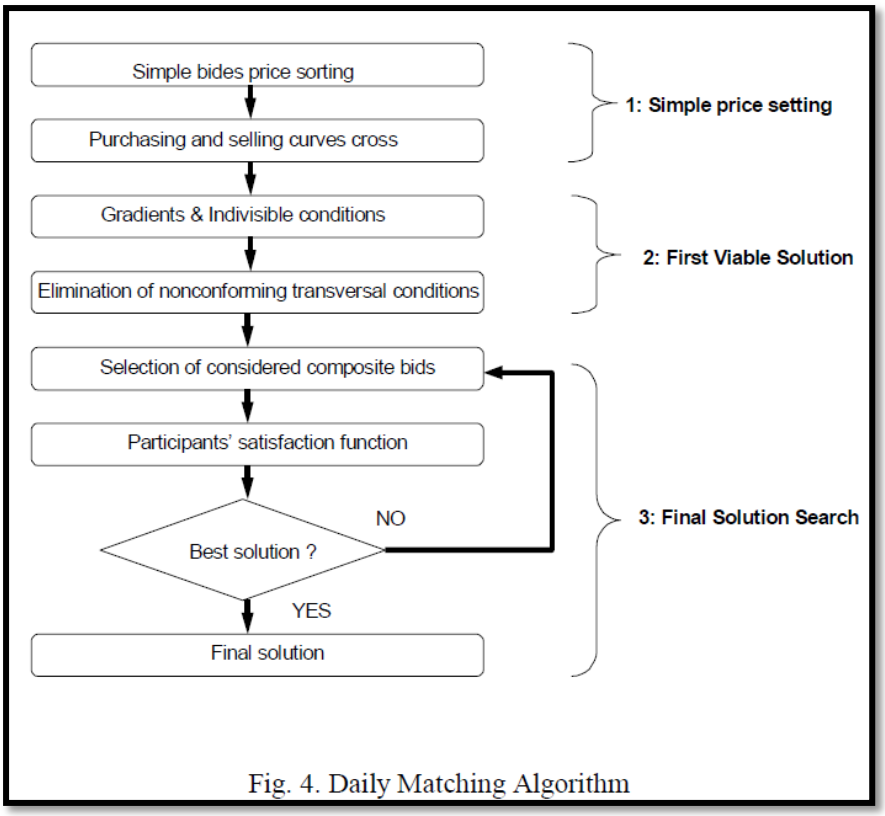

Figure 4- 9 Daily Matching Algorithm in Spanish Electricity Exchange Market

C. Hour ahead market organization:

Once there is a technically viable daily schedule published, the MO starts to run several sessions of the hour ahead market, to provide the agents with a market in which to negotiate the voluntary adjustments that they wish to. The hour ahead is a voluntary market where no agent has the obligation to participate.

D. Hour ahead market price determination (matching process):

The objective of this process is to obtain marginal prices for each hour of the session horizon and the corresponding bid energy assignments. As in the daily market, the solution will not take into account any network constraints. The matching process is similar, but it is important to note that in order to fulfill a complex condition of the hour ahead assignment, it is not possible to remove any of the previous markets assignments since, as indicated, all transactions are firm in all markets and processes.

Power exchange Information System (PEIS):

Internet based system developed to provide a platform for buyers and suppliers. System also designed for market operation, data analysis and settlement and shown in figure 4-8.

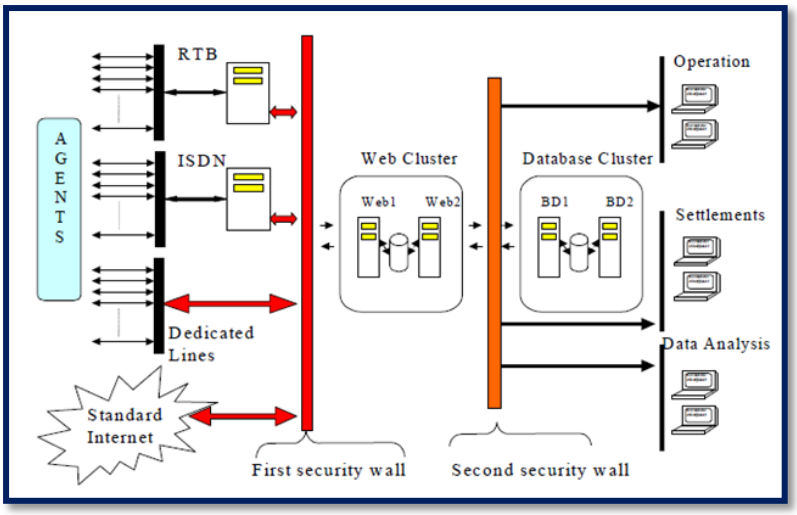

Figure 4- 10 Spanish electricity Exchange Market's System Configuration

The system includes the following functionalities:

- Receive purchasing and selling bids
- Obtain the market price for each of the considered periods
- Provide market agents with all information needed
- Produce all settlements and clearinghouse activities
- Interchange information with external bodies (SO, mainly)

Daily Market

- The purpose of the daily market, as an integral part of the electric power production market, is the execution of electric power transactions for the following day through the submittal of electric power sale and purchase bids by market participants. These bids shall be submitted to the market operator, and shall be included in a matching procedure effective for the daily scheduling horizon, corresponding to the day following the market session, and comprehending twenty-four consecutive hourly scheduling periods (twenty-three or twenty-five periods on days when clocks are changed to go on or off Daylight Savings Time).

The daily market shall be structured in one single session for each daily scheduling horizon.

Power Sale Bids

- In order to be able to act as sales agents, those market participants who hold the status of resellers shall provide evidence of their registration in the Administrative Register of Distributors, Resellers and Qualified Consumers, in the section on resellers of the said Register.

- Sellers of electric power in the daily market shall submit electric power sale bids to the market operator for each of the production units they own, and for the hourly scheduling periods of one

and the same daily scheduling horizon in the daily market.

Market Operator

- Sale bids shall be submitted to the market operator.

Recording of Production Unit data in the Market Operator's Information System:

- The system has Administrative Registry of Power Production Plants, or in the Administrative Registry of Distributors, Resellers and Qualified Customers with the data regarding the administrative authorizations, and with the information supplied by the production unit holding participant.
- Also included:
  - Document certifying, with sufficient reliability, the legal capacity and powers of the person signing the application as well as the individual who will eventually sign the Contract of Adherence.
  - Taxpayer Identification Number of the entity submitting the application.
  - Any other documentation that may be required in accordance with the applicable laws and regulations, especially documents relative to authorizations by government bodies and registrations in any registers that may be necessary.
- The market operator shall register production units in the market operator's information system by entering the data that the production unit holding participant

- The data regarding production units stored in the market operator's information shall be:
  - production unit code (defined by the market operator)
  - description of the production unit
  - type of production unit
  - type of bid (sale or purchase)
  - code of the electric system to which it belongs
  - minimum and maximum hourly power in MWh
  - maximum rising, maximum descending gradient, start-up and stop gradient, in MW/minute.
  - if no value is given, it shall be understood that it has no limit.
  - indication of whether the hydroelectric management unit is made up of run-of-the-river hydro units.

- **Types of Bids in Daily Market**

  The electric power sale bids submitted by sellers to the market operator can be simple or complex, depending on their content.

  - **Simple Bids**

    For purposes of the provisions of the Market Activity Rules, simple bids are defined as those electric power sale bids which sellers submit for each hourly scheduling period and production unit they own, with the expression of a price and an amount of power. For each hourly scheduling period within the same daily scheduling horizon, there can be as many as 25 power blocks for the same production unit, with a different price for each of the said blocks,

with the prices increasing from block to block. Simple bids may not include any additional terms to be considered in the matching process.

- **Complex Bids**
  For purposes of the provisions of the Market Activity Rules, complex bids are defined as those electric power sale bids which, while complying with the requirements governing simple bids, including the conditions which are to be considered in the matching process.

- **Time and Place of submittal of sale bids:**
  Sale bids must be received in the market operator's information servers before the close of the bid acceptance period, via the electronic medium that is set up and authorized for this purpose.
  The electronic media available for the reception of bids from the date the Market Activity Rules comes into effect shall be one or more of the following:
  - Access through Internet
  - Access through Basic Network Telephone Lines (Spanish abbreviation: RTB)
  - Access through Integrated Services Digital Network lines (Spanish abbreviation: RDSI)
  - Access through leased lines, for those market participants requesting it.

- **Format for Submitting Sale Bid:**
  In the electric power sale bids, they submit to the market operator, sellers shall include the data listed below for each production unit and scheduling period.
  - production unit code
  - description of the bid
  - type of bid, which will obligatorily be a sale bid
  - daily scheduling horizon date
  - default bid

- **Information from Market Operator to Sellers:**
  The market operator shall inform sellers in the daily market of the following:
  - automatic confirmation of the reception of the electric power sale quotation by means of the procedures established in these Rules
  - placement of the bid content information at the market participants' disposal in such a way as to allow them to reproduce the matching process in their computer systems as from the end of the predetermined period of confidentiality
  - verification, according to the terms established in this Rule, of the electric power sale quotation made by the seller, and automatic notification of the verification result
  - acceptance of the electric power sale bid if the result of the verification set out in the preceding section is positive, and inclusion of the said bid in the matching process
  - inclusion or non-inclusion in the matching results, and, as appropriate, the reasons for the exclusion according to the terms stated in these Rules, when the participant requests this justification

- **Buyer Bid:**
  - Purchase bids shall be submitted to the market operator.
  - The market operator shall register the purchasing units in the market operator's information system, recording the data which the purchasing unit owner shall have registered in the Administrative Register of Distributors, and Consumers of the Ministry of the Economy, as well as the information provided by the said unit owner. The data to be recorded in the market operator's information system shall be:
    - purchasing unit code (defined by the market operator)
    - description of the purchasing unit
    - type of purchasing unit
    - type of bid (sale or purchase)
    - code of the electric system to which it belongs
    - minimum and maximum hourly power in MWh, expressed to no more than one decimal place.
  - The market operator shall notify the system operator of the contents of the base matching schedule, and shall inform the market participants of the schedule that corresponds to their production or purchasing units, according to the terms established in these Rules.
- **Bilateral Contracts:**
  The market operator shall include, in its information system, the following data provided by the participants who sign physical bilateral contracts:
  - Production units involved, and maximum hourly power, and minimum hourly power if appropriate, of each of the production or purchasing units participating in the bilateral contract. This value must be lower than the maximum recorded in the market operator's information system. The value shall be expressed in MWh to no more than one decimal place.
  - Maximum and minimum hourly power to be exchanged in the bilateral contract, expressed in MWh to no more than one decimal place.
  - Contract commencement and termination dates.
  - Consumption and supply points, busbars where the bilateral contract will be executed.

- **Notification of Bilateral contract**
  The participant who is responsible for notifying the execution of the physical bilateral contract shall send this notification before the close of the daily market session if flows through international tie-lines are involved, and within an hour after the close of the corresponding daily market session if the said tie-lines are not involved. The data that must be transmitted by the responsible participant are the following:
  - code of the physical bilateral contract to which the notification of the daily execution of the physical bilateral contract makes reference
  - hourly production schedule of the production units, in MWh with no more than one decimal place
  - hourly purchasing schedule of the purchasing units, in MWh to a maximum of one decimal place

- date on which the daily execution of the physical bilateral contract comes into effect
- code defining default execution

- Distributors shall send data through the market operator's information system, either via screen or file transfer. The data to send for a scheduling period are the following:
  - special-regime producer's code
  - date when the data will come into effect (effective date)
  - description of the information
  - hourly values of surplus forecasts, in MWh to no more than one decimal place.

- Market participants shall send the market operator the supplies that are to be made in each of the grid connection busbars to satisfy the demands accepted in the matching result
  - Each market participant shall send the market operator a file containing each purchasing unit's supplies within two hours of the close of the daily market session.
  - The supply files shall contain, for each purchasing unit or set of resellers' units, the split factors expressed as percentages with a maximum of four decimal places.
  - The supplies must be received before the deadline hour established. Those not received before the deadline shall be processed based on factors deduced from an equivalent previous day.
  - If errors are found in a purchasing unit's split factors (if they do not add up to 100), they shall be modified by standardizing them.
  - The market operator shall inform the system operator of the purchasing units' supplies by busbar in MWh with no more than one decimal place, and shall indicate whether the supplies were sent by the corresponding participant or were calculated based on an equivalent previous day.

Settlement and Credit and debit notes

- After making the monthly settlement, the market operator shall notify the market participants who had acted as buyers or sellers, by whatever means or medium which leaves a record of the transmittal and reception of the notification, of the provisional debit and credit notes indicating the payments and collections which they are to make or receive, respectively, in each monthly settlement period. The market operator shall issue the debit and credit notes at least three days before their due dates.

Publication from Market Operator

Publication by the market operator of the following information:

- the aggregate supply and demand curves of the daily and intra-day markets, with explicit splitting of each of the points that make up the curves, as well as modifications derived from process of solving technical constraints, including, in this case, the affected bilateral contracts;

- the sales capacities and intra community and international exchanges by border;
- on a monthly basis, the results of the power schedules, aggregated by participant and calendar month, of the electric power production market, published one month after the last day of the month described in the results;
- on a monthly basis, the bids submitted by the participants in each of the daily and intraday markets, published three months after the end of the month reported.

Coordination between Market Operator and System Operator

- This information shall be contained in files, and its format and transmittal shall be defined by both operators, and the information pertaining to each participant shall be placed at the latter's disposal.
- As soon as the process or market whose information the files contain is completed, the files shall be sent to the system or market operator, as appropriate, and simultaneously the market participants shall be sent the data corresponding to their purchasing and production units.

Information the System Operator must supply to Market Operator

The information that the system operator shall send is the following:

Daily Market:

- Information relative to the instances of unavailability of production units.
  This file shall be sent by the system operator each time this information is updated.
- Demand forecast file.
  This file shall be sent by the system operator whenever the information it contains is modified.
- Information sent before the close of the session:
- Demand forecast file.
  This file contains the best demand forecast for the following day, at least.
- Bids pertaining to long-term international contracts

Information which the market Operator must supply to the System Operator

The market operator shall provide the following information to the system operator:

Daily Market

Base matching schedule (PBC)

- This file contains the result of the assignment of power as a solution of the daily
- Daily market marginal prices.
- File containing the marginal prices resulting from matching.

Daily market bid data

- This file contains all the valid bids—both matched and unmatched—received in daily market process.
- Daily market order of financial precedence

- This file contains the completely matched, partially matched and unmatched bids arranged in order according to the criteria established in the pertinent rule.

Physical bilateral contract data

- This file contains the physical bilateral contracts received by the market operator and the cost information in pesetas / kWh for the purchase of the capacity available in the tie-line, in case restrictions arise in the said tie-line.
- Base daily operating schedule (PBF)

Coordination of the production and purchasing unit information

- Production and purchasing units in the market operator's information system. Any change that may affect the transmittal of information regarding production and purchasing units must be agreed between the market operator and the system operator, who shall jointly set the date on which any concerted changes shall go into effect.

Publication of information

- All the information provided by the market operator to a market participant on another participant or participants in compliance with these rules, and whose transmission does not arise from the existence of a claim or complaint, shall be given to the general public, except the information supplied to distributors giving the data that are exclusively pertinent to their distribution system, aggregated for each of their busbars as defined and notified by the system operator, which the distributors must maintain confidential.

- To disseminate information to the general public, the market operator may make use of its public website

5. Proposal for Minimum Set of Standardized:

5.1 Data to be exchanged between operators for cross border links observable area

For inter-connection studies the requester shall make a request for connection in the planning stage to the Appropriate Transmission Utility. In case a requester is seeking interconnection to a distribution system, such a request will be made to the distribution licensee. The Appropriate Transmission Utility or distribution licensee shall carry out the interconnection study to determine the point of inter-connection, required interconnection facilities and modifications required on the existing grids, if any, to accommodate the interconnection. The study may also address the transmission system capability, transient stability, voltage stability, losses, voltage regulation, harmonics, voltage flicker, electromagnetic transients, machine dynamics, ferro resonance, metering requirements, protective relaying, sub-station grounding and fault duties, as the case may be.

- General Structural Information
  - Substations' regular topology and other relevant data by voltage level
  - Transmission lines
  - Transformers connecting the DSO's, demand facilities or power generating facilities
  - Maximum and minimum active and reactive power of power generating modules
  - Phase-Shifting Transformers
  - High Voltage DC lines
  - Reactors, capacitors, and static VAR compensation
  - Operational security limits
  - Type of regulation concerning tap changes
  - Voltage regulation range
  - Regarding HVDC lines and FACTS device, the dynamic models of the device and its associated regulation suitable for large disturbances
  - Topology of transmission system > 400kv
  - Model or equivalent of transmission system < 400 kV having significant impact on its transmission system
  - Protection set points of the lines included as external contingencies in neighboring operator's contingency lists

- Generator specific structural data for dynamic stability analysis
  - Electrical parameters of the alternator suitable for dynamic stability analysis, including Inertia
  - Protection Models
  - Protection models
  - Step up transformers description
  - Minimum and maximum reactive power
  - Prime movers and excitation system models suitable for large disturbances

- Scheduled data
  - The forecasted aggregate sum by primary energy source of injection and withdrawal in every

in every node of the transmission system for different time frame

- Real Time between all operators via an IT Tool
  - Frequency
  - Frequency restoration control error or an equivalent parameter
  - Measured active power exchange between LFC area
  - Aggregated generation in feed
  - System state
  - Set –Value of the FR controller
  - Power Exchange via the virtual tie-lines

- Real Time data only between operators within its observability area
  - Actual Substation Topology
  - Active and Reactive power in bay, including transmission, distribution and lines connecting significant grid user
  - Active and reactive power in transmission bay , including transmission, distribution and significant grid user connecting transformers
  - Regulating positions of transformer, including phase-shifting transformers
  - Measured or estimated bus bar voltage
  - Reactive power in reactor and capacitor bay or from a static VAR compensator
  - Restrictions on active and reactive power supply capabilities with respect to the observability area

Data to be provided to transmission Operators by distribution Operators of each Transmission connection distribution systems in the observable area

- Structural Information (Every 6 Months)
  - Substations by voltage
  - Lines that connect the sub-stations
  - Transformers from the sub-stations
  - Significant grid users
  - Reactors and capacitors connected to the substations
  - Total aggregated generating capacity, the related information concerning the frequency behavior and best possible estimate of power generating modules, by primary energy source.

- Real Time data
  - Actual sub-station topology
  - Active and reactive power in line bay
  - Active and reactive power in transformer bay
  - Active and reactive power injection in power generating facility bay
  - Tap positions of transformers connecting to the transmission system
  - Bus Bar voltages
  - Reactive power in reactor and capacitor bay
  - Best available data for aggregated generation in the DSO area
  - Best available data for aggregated consumption in the DSO area
  - Actual Sub-station topology

- Active and Reactive power in line bay
- Active and reactive power in transformer bay
- Active and reactive power injection in power generating facility bay
- Best available data for aggregated consumption in the DSO area

Data to be provided to operators by owners of each generation facility directly to the transmission network in the observable area

- Structural Data
  - General data, including installed capacity and primary energy source
  - Data for short-circuit calculation
  - FCR, FRR and RR data for power generating facilities offering or providing this service
  - Protection Data
  - Voltage and reactive power control capability
  - Data and models necessary for performing dynamic simulation
  - Power generating facility transformers data for generators
  - Turbine and power generating facility data including time for cold and warm start for generators
  - Data necessary for restoration for restoration of generators

- Scheduled Data
  - Day ahead and intra-day basis of its active power output and active power reserve amount and availability and availability and its scheduled unavailability or active power capability restriction\
  - Any forecasted restriction in the Reactive Power control capability

- Real time Data
  - Position of the circuit breakers at the connection point or another point of interaction agreed with the operator
  - Active and reactive power at the connection point or another point of Interaction agreed with Operator
  - In the case of power generating facility with consumption other than auxiliary consumption, net active and reactive power

Data to be provided to operator by owners of interconnectors and other lines connected directly to the transmission network

- **Structural data**

  HVDC Owner to Provide:
  - Name and Plate data of the Installation
  - Transformer data
  - Data on filters and filter banks
  - Reactive compensation data
  - Active power control capability
  - Reactive power and voltage control capability
  - Active or reactive operational mode prioritization if it exist
  - Frequency Response capability

- Dynamic models for dynamic simulation
- Protection Data
- Fault ride through capability
- AC line and interconnection or Owners to provide
- Name plate data of the installation
- Electrical parameters
- Associated protections

- **Scheduled Data**

  HVDC owners to Provide:
  - On a day–ahead and intra-day basis, its active power schedule and active power reserve and availability
  - Without delay its scheduled unavailability or active power restriction
  - Any forecasted restriction in the reactive power or voltage control capability

  AC line and interconnector owners to provide the scheduled unavailability or active power restriction data

- **Real Time Data**
  - Position of the circuit breakers
  - Operational status
  - Active and reactive power

Data provided to operator by transmission facilities directly Connected to transmission network in the observable area

- **Structural Data**
  - Electrical data of the transformers connected to the transmission system
  - Characteristics of the load of the demand facility
  - Characteristics of the reactive power control
  - Its behavior at the voltage ranges

- **Schedule Data**
  - Scheduled active and forecast reactive consumption on a day ahead and intraday basis, including any changes of these schedules or forecast
  - Any forecast restriction in the reactive power control capability
  - Minimum and Maximum power to be curtailed in demand response

Data to be exchanged between operators for cross –border links observable area:

Real-time Data
- Active and reactive power at the connection point
- Minimum and Maximum power to be curtailed

Data provided to operator by Transmission facilities directly connected to distribution networks or aggregators within the observable area

- **Structural Data**
  - Structural minimum and maximum active power available for demand side response

- Maximum and minimum duration of any potential usage of this power for demand side response

- **Scheduled Data**
  - Forecast of unrestricted active power available for any planned demand side response

- **Real time Data**
  - Active and reactive power at the connection point
  - Confirmation that the estimated actual values of demand response are applied

5.2 Data for Power Market/ Electricity exchange

- **For Registration in Market Information System:**

Data Format for Supplier

- Full Name
- Short Name
- Owner of Company
- Full Address
- Contact: email and phone number
- Contact person:
  - Full Name Designation,
  - contact number
  - email
- Country of company Registration
- Company Registration Certificate
- Tax Clearance
- Details of Power Plants:
  - Type of Plant
  - Geographical Location,
  - Maximum Generation Capacity,
  - Generation Units and Capacity
- Nearest Connection point (Substation)
- Location of Metering
- Bank Details for transaction and guarantee
  - Full Name Designation,
  - contact number
  - email

Data Format for Supplier

- Full Name
- Short Name
- Owner of Company
- Full Address
- Contact: email and phone number
- Contact person:

    - Full Name Designation,
    - contact number
    - email
- Country of company Registration
- Company Registration Certificate
- Tax Clearance Document
- Details of Industry/Consumptions:
    - Geographical Location,
    - Maximum Demand Capacity,
    - Peak Demand
    - Off peak Demand
- Nearest Connection point (Substation)
- Location of Metering
- Bank Details for transaction and guarantee
    - Full Name Designation,
    - contact number
    - email

Data Format for Electricity Trader

- Full Name
- Short Name
- Owner of Company
- Full Address
- Contact: email and phone number
- Contact person:
    - Full Name Designation,
    - contact number
    - email
- Country of company Registration
- Company Registration Certificate
- Tax Clearance Document

Data Format for Electricity Transmission Company

- Full Name
- Short Name
- Owner of Company
- Full Address
- Contact: email and phone number
- Contact person:
    - Full Name Designation,
    - contact number
    - email
- Country of company Registration
- Company Registration Certificate
- Tax Clearance Document
- Details of Transmission Lines:
    - Geographical Location

- Length
- Type of Conductor
- Type of Insulator
- Maximum Transmission Capacity (MW)
- Transmission Voltage

- **Data format for Bid Submission by Buyer and Supplier:**

Data Format for Bidding by Supplier

- Code number of Supply Bid
- Location of Bid Submission
- Name of Supplier (Name and ID)
- Name of Bid Submitter
  - Designation
  - Contact No.
  - Email
- Verifications:
  - Check Valid Company Registration
  - Check Valid Tax Clearance
  - Check Valid Market Operator membership
- Power Plant
  - Plant ID
  - Location of Plant
  - Maximum Installed Capacity
  - Delivery Point
- Declared Maximum Generation Capacity MWh
- Electricity Supply Quantity in defined time blocks
- Cost of Electricity per unit ($$/MWh) in defined time blocks
- Bank details
  - Name of Bank
  - Amount of Guarantee
  - Contact Person
    - Designation
    - Contact No.
    - Email

Data Format for Bidding by Buyer

- Code number of Buying Bid
- Location of Bid Submission
- Name of Buyer (Name and ID)
- Name of Bid Submitter
  - Designation
  - Contact No.
  - Email
- Verifications:
  - Check Valid Company Registration

        - Check Valid Tax Clearance
        - Check Valid Market Operator membership
    - Use of Power
        - Industry
        - Distribution
        - Trade
        - Connection Point
        - Maximum Demand
    - Declared Maximum Buying Capacity MWh
    - Electricity Buying Quantity in defined time blocks
    - Price of Electricity per unit ($$/MWh) in defined time blocks
    - Bank details
        - Name of Bank
        - Amount of Guarantee
        - Contact Person
            - Designation
            - Contact No.
            - Email

- **Data format for Bid Reception conformation by Market Operator:**
    - Name of Buyer or Supplier
    - Purchasing code or Selling Code
    - Declared Maximum Buying Capacity or Selling MWh
    - Electricity Buying or selling Quantity in defined time blocks
    - Rate offered for Buying or selling Electricity per unit ($$/MWh) in defined time blocks
    - Time of Bid Submission
    - Location of Bid Submission

- **Data format for Bid Matching:**
    - Total Number of Participants
    - List of Matched Bids (selling and buying)
    - Volume of Matched Electricity Demand and Supply
    - Matching Available best tariff
    - Total Amount of Transaction

- **Data format for Financial Settlement**
    - Name of Buyer or Supplier
    - Purchasing code or Selling Code
    - Volume of Transacted Electricity Trade in defined time blocks
    - Rate offered for Transacted Electricity per unit ($$/MWh) in defined time blocks
    - Total Volume of Transacted electricity
    - Total Amount of Transaction
    - Recommendation of bank Transfer

6 Recommendations and the Way Forward

- Institutional Set Up to be Established:

    a. Regional Power Trade Committee (Lead Head of States of SAARC member Countries) for approval process.

    b. Coordination Committee (Lead by Secretaries of Ministries related to power) for coordination.

    c. Panel of Experts for designing electricity market model, market operation rules, grid code and relevant policies.

    d. Regional Electricity Regulation Authority managing Regional Power Trade Committee, Coordination Committee, Panel of Experts.

    e. Regional Level institute for Utilities, Market Operators, Buyer and Sellers, Traders, Grid Operators etc.

- Panel of experts shall propose viable electricity market and market operating guidelines where standard data shall be proposed and designed.

- For regional level planning, long term and short term planning shall be shared among countries. These plans should be compiled by regional regulatory authority and shared to stakeholders

- Skilled personnel should be engaged for designing standard format for regional competitive power market.

- Necessary infrastructure and quality of infrastructure like dedicated internet, cyber security, protection system etc. shall be defined and developed accordingly.

- Roles of Regional System Operator, National System Operator and Transmission Line Operators shall be clearly defined.

- Communication shall be done between Regional Market Operator, Regional System Operator and National System Operators and Regional Transmission Line Operators.

- Guideline/Policy of data and information exchange shall be defined. And standard format for exchanging data and information shall be developed with consensus and harmonized manner.

- Data designed by CERC, India are in used for bilateral electricity trade. Such format can be used to come up for the design of the practical oriented format as a first step.

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