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"MODERNIZATION OF THE AC TRANSMISSION SYSTEM IN INDIA"

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Abstract: This paper describes the works of India on power modernization that has given way to growing demands for electrical energy. As we know, that power or energy is the basic key for growth of any country's economy. In India, 99.7% (9 Jan 2019) of household has been electrified which is a remarkable feat considering India has a population of 1.3billion and because of population its load or consumption will increase rapidly.

In case of developing countries like India load will increase rapidly, remote generation and system interconnections have made it necessary to transmit more power over longer distances, efficiently and easily. This long distance bulk power transfer is possible only with Extra High Voltage (EHV) and Ultra High Voltage (UHV) transmission lines. In transmission system we need to modernization to improve its efficiency, decrease volume of conductor, increase transmission capacity, economical to interconnect the power system on a large scale, reduction of electrical losses, improvement of voltage regulation.

Keywords: Need of modernization, use of FACTS, Opt. for Higher voltages, satellite imagery technique, multi circuit tower, use of compact Gas Insulated Substation, High strength polymer insulator.

1. Introduction :

As we know, India is the world's 3rd largest producer and consumer of electricity. India having growth day by day. Due to this reason in the electric power system, we are facing more stress due to fundamental changes in both supply and demand technologies. On the supply side like gas-fired turbines as well as renewable or variable resources.On the other hand demand side, distribution depends on its increasing load like use of electronic converter in buildings, industrial equipment, and consumer devices etc. This task not only demands contributions from generation and distribution utilities but the transmission utilities also.A power transmission line might be connected to a source of energy.It is an intregal part of the power sector and is as vital as power generation.

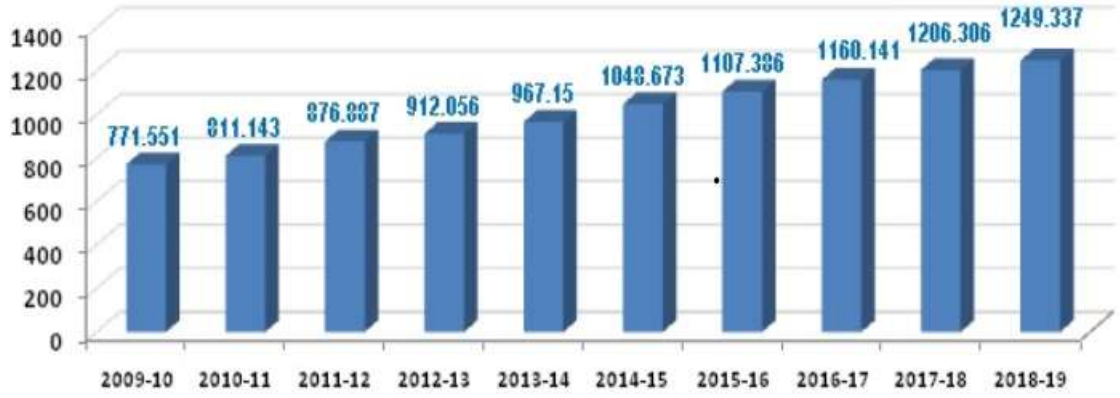

Fig 1 - **Generation (Billion Units)**

1.1 Need Of Modernization:

As we know the first demostration of electric light in Calcutta was conducted on 24 July 1879 but now total electricity generation in India was 1,574 TWh. On 30 and 31 July 2012, two severe power blackouts in recent Indian history. This blackouts affected over 400 million people most of northern and eastern India and this is the largest power outage in the world.The main reason for this blackout was due to demand-supply mismatch.

In electrical power system has basically three principle divisions: Generating station, Transmission system and Distribution system. On the basis of electrical energy sources uses by industrial and domestic.Generating station where is the process of generate primary energy from the sources for the utilities in the electrical power industries.This generating station, is basically an industrial location that is utilized for generate energy and distribute of electric power.

Here a big challenge in the power system to transmit bulk amount of energy from generation station to distribution.So electric power transmission is the bulk movement of electrical energy.Transmission is the process which delivering generated electricity to the consumers for utilization or we can say, transmission lines are used to transport electricity from place to place. Transportable same as like hydro-electric and conventuional thermal power.

India faces about 32% of transmission and distribution losses on the other hand developed countries have compartively less amount of transmission and distribution losses approx 6 to 11%. Modernization of the transmission system is necessary to resolve or reduce the following problems:

1.1.1 Corona loss: Corona loss is caused by the ionization of air molecules near the transmission line conductors. Coronas don't spark across lines but it carry current in the air along the wire. It is not only a source of power loss but it is also a source of interference with radio and television.
Corona loss depends on many different factorssuch as system frequency, system voltage, air conductivity, air density, conductor radius, condutor surface, load condition, atmospheric condition, etc.Corona is a phenomenon associated with all transmission lines. This problem mostly happening in case of EHV transmission.

1.1.2 Radio interference : Electromagnetic interference, also called radio frequency interference.It is a noise caused by other wireless transmissions on the same channel or on near by channels. Radio interefrence in UHV AC substations mainly comes from corona, sparks and similar effects associated with a high voltage transmission system.

1.1.3 Heavy supporting structures and erection difficulties: Due to bundle conductors, transmission lines carry large mechanical loadings on towers and erection is the procedure for transmission towers is similar to that of poles, but now tower create more problems.There are mainly four type methods of erection which is mentioned below:
-Build-up method or Piecemeal method
-Section method
-Ground assembly method
- Helicopter meyhod

1.1.4 Insulation requirements: Insulator length is related to line voltage while conductor sag to its current rating. The level of insulation required depends on the magnitude of likely voltage surges. To take care of switiching overvoltage's either its temporary or atmospheric overvoltages, line insulation is designed. Switching surges are more dangerous.

1.1.5 Resistive losses in the conductor or Skin effect: For alternating current, resistive losses occur in the conductor or skin effect when current density decreases exponentially from the surface towards the inside.This depends on the frequency of the current and the electrical and magnetic properties of the conductor.

1.1.6 Vibration damage: Transmission tower line system are inclined to the dynamic excitation, such as wind, earthquake, and iced shedding.It is a common problem of vibration due to rotating unbalance.

1.1.7 Farantee Effect: This type of effect mainly occurs because of light load or open circuit at the receiving end. Capacitance and inductance are the main parameter of the transmission lines having length 240km or above.In electrical power engineering this refers to equipment designed for more than 345KV between conductors.Overhead power transmission lines are classified in the electrical power industry by its voltages range:
Low Voltage : less than 1000Volts
Medium Voltage: between 1KV and 69KV
High Voltage : Subtransmission less the 100KV, subtransmission or transmission at voltages such as 115KV and138KV
Extra High Voltage: from 345KV, up to about 765KV, used for long distance , very high power transmission.

Ultra High Voltage : higher than 765KVIn modern trend is to use Extra High Voltage (EHV) and Ultra High Voltage (UHV) for transmission of huge blocks of power over long distances.Extra High Voltage (EHV) transmission is defined as between 345KV and 765KV for AC. EHV transmission lines are used to transmit or move large amount of electric power over long distance.

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2. Modernized the technicque to resolve issues:

2.1 Use of FACTS: Flexible alternating current transmission system (FACTS) is a system composed of static equipment and it is used for ac transmission of electrical power. FACTS has ability to transfer ac power is in a limit by many different factors such as Thermal limit, transient stability limit, voltage limit, etc. Maximum electrical energy which can be efficiently transmitted through the transmission line. It is basically used to provide the controllability of high voltage side of the network. That is mainly four types of FACTS : Series Controller, Shunt Controller, Shunt- Series Controller, Series- Series Controller. Adoption of FATCS devices, such as TCSC wherever feasible on 400KV and etc.

2.2 Opt for Higher Voltages: There is a big strain on the Transmission lines because of rapid growth of the power system and the voltage are being stepped-up day by day. To opt for higher transmission voltage exceeding the extra high voltage range from 345KV to 765KV. In India, transmission voltage 765KV has been introduced in the year 2007.Power Grid will launch a 1,200-Kv ultra-high voltage (UHV) test station along with experimental lines in Bina, Madhya Pradesh.

Fig 2- 1200 Kv Test Substation (Source – Power Grid)

2.3 Satellite imagery Technique: Satellite imagery technique is enhance the transmission line survey. It is also called earth oberavation imagery or spaceborne photography because it collected the images of earth or other planets by imaging satellite but its operated by the government.

The application of satellite imagery technology for rerouting electric power transmission lines. Satellite images produced by using ESVI software. By using photographs from LANDSAT ETM, we can extracted information from remote sensing and geographical information system. Survey techniques are improved trough GIS and Airbone Laser Terrain Maping (ALTM) or Light Detection and Ranging (LiDAR).
Satellite imagery, also used for monitoring the transmission line, repair it and modification activities.

2.4 Multi Circuit Tower: Transmission tower is the main supporting unit of overhead transmission line. POWERGRID has designed & developed multi circuit tower in house and the same are implemented in many transmission system. Multi circuit tower used in Kudankulam and RAPP-C transmission system which is designed and implemented by POWERGRID. In Fig.3 A power transmission tower consists of the following parts:

2.4.1 Peak of transmission tower is the portion above the top cross arm. Mostly earth shield wire connected to the tip of the peak.

2.4.2 Cross arm of transmission towerused to hold the transmission conductor. Its dimensions depends on the level of transmission voltage, configration and minimum forming angle for stress distribution.

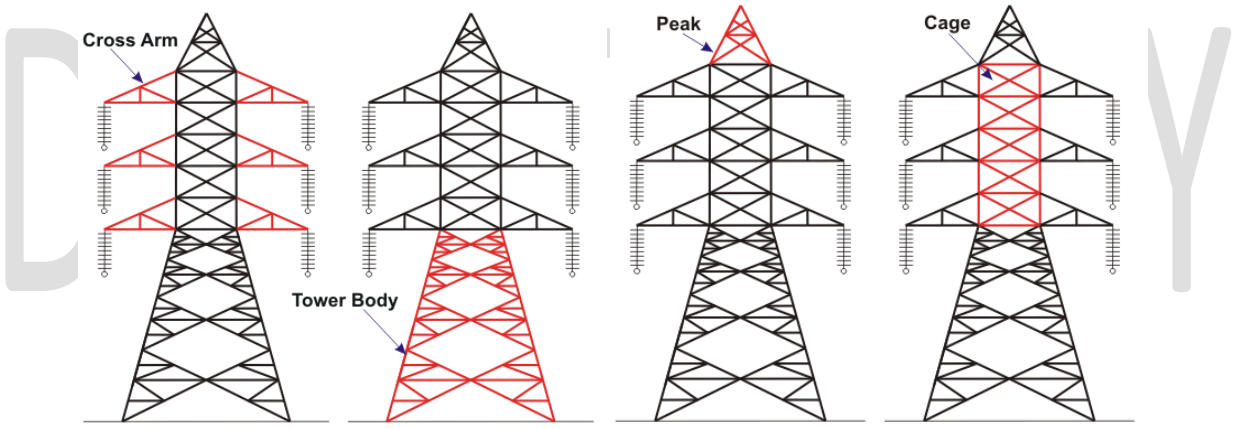

Fig.3: Diagram of power transmission tower

2.4.3 Boom of transmission toweris the portion connected to the lower body to support mechanically to the power conductor. It a rectangular beam of the cross section in middle tapered in the end section.

2.4.4 Cage of transmission toweris the portion between tower body and peak of the transmission tower, which is hold the cross arms.

2.4.5 Transmission tower bodyis the portion from bottom cross arms up to the ground level and this play a vital role for maintaing required ground clearence of the bottom conductor of the transmission line.

2.4.6 Leg of transmission toweris also called mountaionous tower. The POWERGRID expanding more coverage with the development of power industries because our country India has large mountainous area, so the large number of transmission line must across the mountains. In the mountainous areas, the wind is afftected by topography and the law of motion in mountain wind is complicated.

2.4.7 Stub/Anchor Bolt and Base plate assembly of transmission tower

2.5 Conductor: As we know that a transmission line consists of a set of conductors. Conductors carrying electrical energy in bulk and transmitting it from power station to primary substation. In the early day, we were using copper as a conductor but now it's replacing by aluminium for overhead lines because its lower in cost, lighter weight and the larger

diameter. Aluminium has the same conductivity that will be offered by copper. Atomic structure of the copper and number of free electrons that is in a square meter of copper dwarfed that of aluminium, so copper is better conductor but when we analyse with its cost, radius, specific gravity, availability etc , aluminium is the best choice for the transmission line.When the contruction of conventional conductor can be modified to enhance its performance and it may be desirable of the following properties:

-Increased Thermal rating
-Increased self-damping ability to dissipate Aeolian Vibration
- Increased Line Tension to reduce sag

2.6 Use of compacts Gas Insulated Substation: GIS (Gas Insulated Substations) have come up as being saver, low weight, maintanence free, more reliable with fewer outages. It is a flexible alternative to overhead transmission lines substartion . As in Fig.4, It takes much less space (like a normal or small houses or room) while providing the same power transmission.

GIS (Gas insulated substation) is a high voltage substation and its major structures contained in a sealed environment and here sulfur hexafluoride gas as the insulating medium.

BETAL in Madhya Pradesh and Navsari In Gujrat, both substations completely manufatured in India with 400KV. Now In India GIS replcing earlier substations.

Fig.4:Gas Insulated Substation (Source- Power Grid)

2.7 High strength polymer insulator: Polymer insultion unit is made of fiberglass and its protective ribbed mold is made of silicon organic rubber. Polymer insulator is an electrical device which is made of polymer materials and metal fittings. Long-term operation under various climatic conditions.
-Insulation Section
-Insulation Core Section
-Insulator Fittings

3. Result of Rennovation and modernization:

- Development of natinal grid
- Strengthened role of renewable energy in the power sector

- Implementation of modern techniques for the electric power conservation
- Introducing cogeneration systems
- Maintaining stability of the system by the Grid
- Increase in transmission capacity
- Remodeling the energy scenario of the global market
- Improves other performances such as advanced communication, protocol, architecture with fast data exchange.

4.Opportunities:

Power Grid Corporation of India Limited and a Navratan company operating under ministry of power, which is working on power transmission business. POWERGRID appointed a panel of international consultant for ecpert guidence and in its nest phase of project, POWERGRID has established 1200kv bay, single circuit line and double circuit line for the test station.

In smart transmision system, POWERGRID has also implemented synchrophaser technology (in its Wide area measurement system) . POWERGRID, play role as 'nodal point' in prestigious " INDIA SMART GRID TASK FORCE". Recently ISRO scientist Shri. Sivathanu Pillai was speaking in an event that "ISRO was planning the whole of process of mining Helium from Moon, producing energy and transporting it back to earth". Nowdays, we'll use optical fiber for the internet and communication on the peak of transmission tower by its earthing wire.

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