

Paper published on the topic –

“Smart Grid in India- Stability, Security and Network Reliability”

Preamble:-

Power sector in India is governed by an Act called as **The Electricity Act 2003**.

Under Sec.3 of the EA 2003, the Central Government shall from time to time prepare the National Electricity Policy and tariff policy in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources and same shall be published. Further the same shall be revised or reviewed from time to time.

Accordingly the CTU i.e. Central Transmission Utility at the centre has been constituted to undertake the development of inter- State Transmission network in a coordinated and in an efficient manner.

State Transmission Utility at each State level has been constituted to undertake the development of transmission Network at that state level in coordination with CTU and in an efficient manner. For the sake of smooth and efficient operation of the system, the grid in India was divided into two Grids called as-

1. NEW grid, North, East, West and North-East and
2. Southern Grid.

Now both the grids have been synchronized on **31st December 2013**, forming a National Grid. With this development the complexity of the grid operation has been increased in many folds. Further this has been aggravated by the Open access transactions, power exchange, and appreciable quantum of infirm power like wind and solar. There is also large seasonal variation in the regional power demand and therefore the system operation has become more challenging and critical too. With latest announcement of Central Government the share of renewable especially from solar and wind by 2022 is going to the tune of 1, 50,000MW in addition to the existing one.

So with the mix of firm and infirm power the role and responsibility of system operations of grid across the nation has become very critical and challenging. Unless until system operators are provided with the latest technology tools they will not be in a position to operate it efficiently and maintain the stability. Of course the existing structure load despatch Centres like NLDC, RLDC and SLDCs are trying to cope with the demand of the situation.

However there is an acute need of handling the existing grid (Power flow of 180,000MW) smartly. For that the working group on Power for 12th Plan (2012-2017) has recommended some suggestions, so that the grid could operate within the specified parameters without loss of Stability.

Stability:-

Stability of a power system can be defined as a system capable transmitting the maximum power within the specified parameters.

$$P(\max) = \frac{E_1 * E_2 \sin \delta}{X}$$

Where- E1 sending end voltage, E2 receiving end voltage δ angle between two buses

And X reactance of the system

For a given system, the sending end and receiving end voltages remain same (more or less). Further the reactance of the system also remains the same. Thus the variable to be controlled in a grid/system is the δ which is called as power angle. Due to the presence of numerous buses in the system, the power angle plays very vital role in the efficient and stable governance of the grid.

Normally the system is mainly controlled by voltage control and frequency control.

Manual control of the modern grid is just impossible; therefore tools like **WAMS-Wide Area Measurements System** are used widely now a days. This comprises-

1. Phasor Data Concentrators (PDC)
2. Robust communication System
3. Remedial Action Scheme
4. System integrated protection schemes.

1. Phasor Data Concentrators (PDC):-

To be installed at National Regional and major State Load Despatch Centres having 400kV transmission system. Phasor Measurement Units(PMUs) to be located at strategic locations to measure the voltage, current, power angle, frequency, df/dt , power factor, reactive and active power flow, etc. The data of such PMUs being concentrated at PDCs and transmitted on real time basis i.e. without any time lag. Accordingly the corrective action is taken by the system operators. Earlier the SCADA was the tool being used but the information was reaching to the System operators with time lag and therefore was not that help as the event was already passed without any remedial action.

2. Robust Communication:-

In order to reach the information of voltage, current, power angle, frequency, df/dt , power factor, reactive and active power flow, of strategic locations of grid to the system operators, a robust and efficient communication system is the need of the modern grid. The flow of information must be consistent and without any interruption and time lag. This will facilitate the system operators to undertake the remedial measures through a system. This will facilitate situational awareness especially dynamic state of the grid in terms of angular stability and voltage stability control and regulation of power flow to maintain grid parameters at preset values.

Special protection system, WAMS technology, SCADA system and remote operations require an effective communication system. Such as **optic fibre**.

Getting real time data of various power system elements i.e. substations, generating plants, HVDC links, Inter-State Transmission lines has become an essential prerequisite for successful operations of modern grid/System.

3. Remedial Action Scheme:-

Once the real time information is made available to the system operators then task of him become very easy. He can take the appropriate decisions and communicate to others in order to run the grid without losing its stability. The parameters can be controlled within the permissible limits and so on.

4. System integrated protection schemes:-

Because large and sudden variations in the load demand and penetration or loss of the infirm power in the grid, the need of special protection schemes are badly needed so that the grid may not lose its stability and the loading of lines or equipments remain within permissible limits. This special protection schemes take the precaution of overloading of the lines or equipments so that the grid run perfectly under normal condition.

Reliability Standards and indexing:-The working group on Power for 12th plan (2012-2017) has recommended that the POSOCO may constitute a Standing Committee for Reliability Standards and approval from CERC may be taken.

In fact Reliability Standards is the indicator of the performance of grid/system. So that appropriate action can be taken in order to increase the level of reliability. The National Electricity Policy in its Aims and Objectives stipulates that-

Power Supply shall be reliable, quality of specified standards with reasonable rates.

So in order to achieve these objectives, we should strive hard and take the help of latest/modern tools available in the market. As in the absence of ample but reliable, quality and reasonable priced power supply we hardly will compete with the global players. Our national economy solely depends on these aspects. Power is a prime mover.