Grid Failure

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Grid is a link which connects all power plants alongwith their connected loads under the same network in a particular region. For e. g. the Eastern Regional Grid of India consists of all power plants in West Bengal, Assam, Bihar, Orissa, Sikkim, i. e. WBSEB, BSEB, OSEB, ASEB, CHUKHA, DVC, DPL, CESC, etc. are all tied together alongwith their loads. The great advantage of grid connection is that surplus power of a particular region can be easily carried to an area with deficit of power, thus making the system optimal and economic. As power cannot be stored, grid connection prevents wastage of surplus power. As an example in the off Peak Load period (say from 1.00 a.m. to 6.00 a.m.) the surplus power of Bandel Thermal Power Station (BTPS) is supplied to BSEB. Thus BSEB is benefitted in this process as they run, during this period of time, under deficit of power. BTPS is also benefitted as they are able to keep their plants running. Because at this period, load demand decreases to a very small percentage of the peak demand. In BTPS generation of power is also reduced by using a fuel mixture of bitumen coal and diesel oil, thus reducing steam imput to turbine. Otherwise, due to low demand of power, the authority would have been forced to stop generation i. e. the plant had to be shut down. This would have given rise to a difficult situation as it is not possible for a power generating station, specially a thermal power station, to bring the plant under operation again within few hours of shut down.

The great disadvantage of the grid is that the total grid may collapse due to a failure occurring in any part of the grid. In the early December of 1995, due to Grid failure that occurred in the Western grid, four States - Maharastra, Madhya Pradesh, Goa & Gujarat – came under severe power cut and normal life got completely paralysed. Such type of power failure is not at all unprecedented in Eastern Region too. In Eastern Grid, in three consecutive years fron 1990 to 1992, grid failure occurred delivering a severe jolt to the daily life. In the month of July, 1995 such a massive grid failure again occurred in the Eastern Grid disrupting formal life like never before.

But why does this grid failure occur? Let us try to understand the matter with an example. We can cite the instance of the grid failure which occurred in July,1995 (29.07.1995). Damodar Valley Corporation (DVC) pulled excess power from the Eastern Grid than its own quota. As a result a high tension line tripped near Jaypur at Orissa. OSEB and CESC quickly isolated themselves from the Eastern Grid. But the WBSEB power plants in West Bengal experienced a great shock due to this. At about 8.30 p. m. the whole of West Bengal was immersed in darkness.

The origin of this incident developed in Chandrapura Power Station under DVC in the morning of 29th July. Due to some explosion there, the last functioning unit of capacity 90 MW suffered a shut down. Other units of this plant had tripped before. Simultaneously, generation in Bokaro and Durgapur plants also drooped. As a result, total power generation of DVC decreased

a great deal. As DVC had to supply some continuous loads to such agencies as DSP, Collieries etc. it could not make up this deficit by creating load shedding in some areas only. Intense pressure was generated on other plants of DVC also. Frequency fell beyond the specified limit. DVC tried to make up for this by taking extra power from Jaypur-Jaynagar supply line of Orissa - Farakka net work of Eastern Grid. In the evening session power demand had increased in all the states of the Eastern Grid. EREB (Eastern Regional Electricity Board) quickly foresaw the trouble and disconnected itself. Similarly, OSEB also realised the matter soon and disconnected themseleves from the Eastern Grid. As a result, a tremendous deficit in power was observed due to an unbalance between power demand and power generation. A great fall in frequency was observed.

It must be mentioned here that frequency is a measure which determines the balance between power generation and load demand. Frequency falls when generation is reduced but load is fixed or load is increased but generation is fixed. Generally 50 H_z is the normal frequency maintained in the plants with a tolerance of 1% i. e. it must exist between 49.5 to 50.5 H_z. The lower limit of 48 H_z also is not very rare. Sometimes it is observed that 47 H_z or even 46H_z frequency is maintained in the plants, although it is very very rare. Under frequency has some severe effects on power plants and their connected load. Due to this, power plants cannot, and should not, be run at under frequency plant condition. So when frequency goes down beyond a specified value the relays start working and the plant shuts down.

In the evening of 29th July, 1995 WBSEB and PDCL were taking 300 MW instead of 392 MW from the Eastern Grid. Still line frequency at that time was observed at 44.1 H_3. So the Grid collapsed. Bokaro, Durgapur, Chandrapura, Kolaghat, Bandel, Santaldih, Farrakka, Chukha, Jaldhaka – all these power plants tripped one after another. The whole state came under power cut condition.

From above discussion we may conclude that when generation of power is much less than the power demand and by decreasing frequency within a threshold value this unbalancing situation cannot be managed, then grid will fail. In other words, if there is a simultaneous shut down of a few plants, the connected loads of these plants must be disconnected from the main grid, otherwise due to fall in frequency all the plants wil be tripped in a cumulative process.

How could CESC and OSEB disconnect themselves from the grid while WBSEB could not? CESC is connected with the Main Grid at Liluah. In that sub-station they use an under-frequency relay. This relay initiates disconnection of CESC and Main Grid Link automatically when frequency falls beyond the specified value. But WBSEB and PDCL are connected with the main Grid by 8 circuits at different places. So CESC could isolate itself by disconnecting only one circuit. But WBSEB and PDCL were required to disconnect not only 8 circuits but they were to disconnect these 8 circuits at the same time at different places which was not practically possible. On the other hand OSEB was situated at the end of Main Grid, so it was possible for them too to isolate from the Grid quickly.

How is a Grid brought back to normal again? To start a plant some amount of power is required to operate the auxiliary plant supply. This amount of power is collected from the running plant. In

this way all the plants are first started and then they are connected to the main Grid.

How can we avoid this crisis? The following steps can be taken :

(1) It is very wise to disconnect the connected loads of the tripped plant from the Grid. It is better to use under frequency relay for this purpose.

(2) In a grid all types of power plants should be connected. Ideal Grids are those which are constituted with 40% hydel power and 60% thermal power.

(3) New transmission lines should be set up so that too much stress is not experienced by any one line, which may be an old one and is thus liable to fail at any moment.

(4) Semi-automatic or manual governor should be replaced by automatic governor.

To the engineer falls the work of creating from the dry bones of scientific fact the living body of industry. It is he whose intellect and direction bring to the world the comforts and necessities of family life. Unlike the doctor, his is not the constant struggle to save the weak. Unlike the soldier, destruction is not his prime function. Unlike the lawyer, quarrels are not his daily bread. Engineering is the profession of creation and construction of stimulation of human effort and accomplishment.

— Herbert Hoover
Ex- U. S. A. President