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International Grid: New Way to Prevent Blackouts

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***Abstract*— Nowadays the conventional grids are facing lots of problems like poor efficiency, unaffordable maintenance, high power loss, overloads and blackout or power outages. The main objective of this paper is to present the new concept of International Grid and to root out the problems which are prominent in conventional grids. The evolution of International Grid is a smart way to ensure the prevention of blackouts which are drastically increasing even with the advent of new technologies. The International Grid concept is introduced to highlight alternative, automated technologies that may bring significant benefits to the transmission and distribution networks. The real time application of International Grid is not only easily feasible but also requires less number of components for installation. We are presenting the structure and efficient working along with synchronization of International Grid with various components.**

***Index Terms*— Blackouts, International Grid, Central Monitoring System (CMS), Synchronization, Parallel Backup System (PBS), Smart Grid .**

I. INTRODUCTION

FOR both developed and developing countries uninterrupted power supply is required. But still with the advancement in technologies problems of blackouts are prevailing. As we all know that the whole industrial setup and manufacturing units are dependent on power supply and thus the economy of the country, so any interruption in power supply will cost huge loss to the economy of the country like in case of blackouts in past few years which we will take later on. For this problem many new approaches have been developed but the problem still remains in the power system. So here we are taking a new concept along with the introduction of new technology named International Grid System in the power system whose sole purpose is to overcome all the problems related to the blackout so as to make power system more efficient and reliable for the whole world.

II. BLACKOUTS PROBLEMS IN CONVENTIONAL GRIDS

Power outage (also known as a power cut, power failure, power loss, or blackout) is a short- or long-term loss of the electric power to an area. There are many causes of power failures in an electricity network, including, faults at power stations, damage to power lines, substations or other parts of the distribution system, a short circuit, or the overloading of electricity mains. There are millions of people affected due to blackouts on large scale across the world. This is the huge problem which the power world faces as shown in figure-1 [1-19]. Figure-1 shows the major blackouts with the number of people affected and how long it stays in the system.

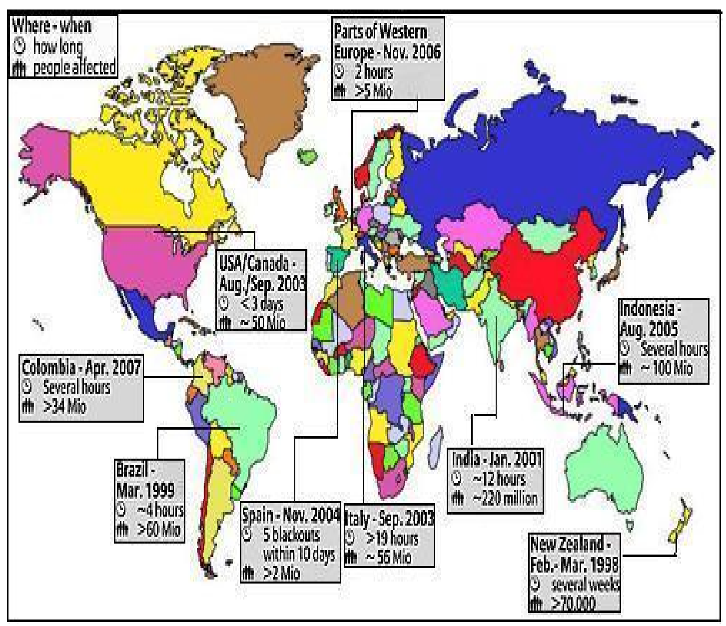

Fig. 1 major blackouts across the world

The analysis of the major blackouts is as shown in the table below in fig-2[1-19]. The table shows the time duration and brief causes of Blackout problem occurs in last fifteen years. The Blackout suddenly spread on large scale by the chain reaction from the tiny cause or fault in any part of power system affects the peoples in millions for the time ranges from hours to weeks. Technical failures, overloading, chain reactions and natural calamities are the major cause of Blackouts.

COUNTRY	DATE	TIME DURATION	CAUSE	PEOPLE EFFECTED
NEW ZEALAND	20th FEB 1998	4 WEEKS	Technical failure, a chain reaction caused by line failure	70,000
BRAZIL	11th MAR 1999	5 HOURS	Chain reaction due to lightening	97 m
INDIA	2nd JAN 2001	12 HOURS	Failure of substations	226 m
USA (NORTH EAST) + CANADA (CENTRAL)	14th AUG 2003	4 DAYS	Lack of maintenance, human error and equipment failure	50 m
ITALY (EXCEPT SARDINIA)	29th SEP 2003	18 HOURS	Technical failure due to separation of Italian system from rest of European grid	56 m
SPAIN	29th NOV 2004	10 DAYS	Technical failure & Overloading of transmission lines	2 m
INDONASIA (JAVA ISLAND)	18th AUG 2005	7 HOURS	Failure of electrical system	100 m
SOUTH-WEST EUROPE (GERMANY, FRANCE, ITALY, BELGIUM, SPAIN & PORTUGAL)	4th NOV 2006	2 HOURS	Insufficient communication, Overloading of transmission lines	15 m
BRAZIL (MOST STATES) + PARAGUAY	10th NOV 2009	7 HOURS	Natural calamities	87 m

Fig. 2 Major Blackouts Analysis

1) Brazil and Paraguay Blackout 2009: The 2009 Brazil and Paraguay blackout was a power outage that occurred throughout much of Brazil and for a short time the entirety of Paraguay, on Tuesday, November 10, 2009, at approximately 22:15. The blackout affected an estimated 60 million people in Brazil. Heavy rains and strong winds caused three transformers on a key high-voltage transmission line to short circuit, cutting the line and automatically causing the complete loss of 14 GW of power and the shutdown of the Itaipu Dam for the first time in its 25-year history [1] [2].

2) Java Bali Black out 2005: The 2005 Java–Bali Blackout was a power outage across Java and Bali on 18 August 2005. Affecting some 100 million people, it is to date the largest and most wide spread power outage in history. Power went off at around 10:23 AM on 18 August 2005 across most areas of the two islands [3].

*3)North east Blackout 2003: T*he Northeast Blackout of 2003 was a widespread power outage that occurred throughout parts of the Northeastern and Midwestern United States and Ontario, Canada on Thursday, August 14, 2003. At the time, it was the second most widespread blackout in history the blackout affected an estimated 50 million people in eight U.S. states (New York, Michigan, Ohio, Pennsylvania, New Jersey, Connecticut, Vermont and Massachusetts) and 10 million people in Ontario as shown in figure-3 and figure-4 respectively [4].

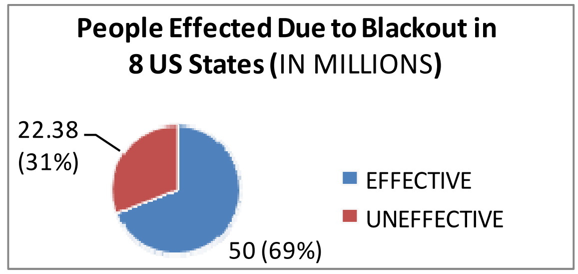

Fig. 3 people affected in 8 US states

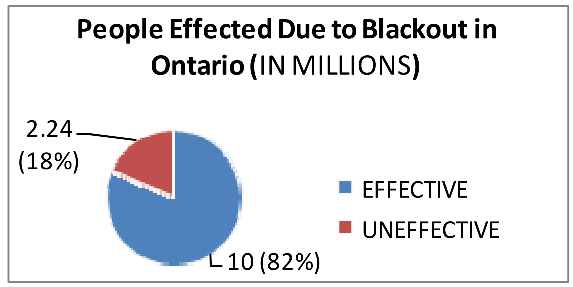

Fig. 4 people affected in Ontario (Canada)

III. ECONOMIC IMPACTS

Estimation of economic impacts of power outage has become more prevalent as in case of North East Blackout as shown in figure-5[6].

1) Workers and investors lost $4.2 billion in income, due to reductions in wage and salary earnings and profits. This is the largest source of the overall economic loss.

2) Consumers and Industry also lost between $380 million and $.94 billion in goods due to spoilage or waste. The largest portion of this loss was in perishable foods.

3) Government agencies and their taxpayers will bear a significant cost in additional police and emergency service costs. The estimate net cost at between $15 and $100 millions.

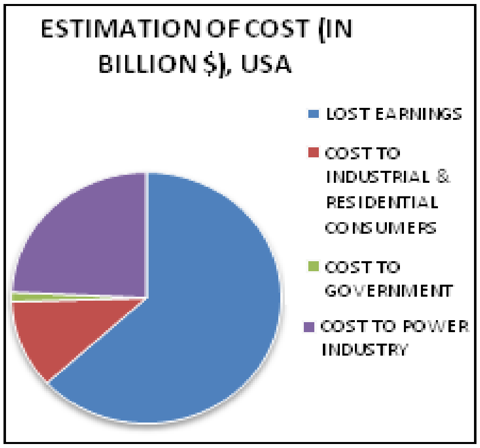

Fig. 5 Estimation of costs

IV. INTERNATIONAL GRID SYSTEM

The idea of INTERNATIONAL GRID is a way to prevent problems of blackouts or power outages and various problems which arises due to grid failure and results into loss of millions of dollars. Since due to blackout there is a huge amount of money loss which can't be prevented in any case until blackouts are prevented. As a result various techniques were invented to cure this problem. The International Grid is the advanced phase of the grid system, where one led the evolution of other as shown in the figure-6. The evolution of INTERNATIONAL GRID is International Grid system is a special and rather effective technique in power transmission, as it not only provides us a backup system but also a way to utilize the technology effectively. Since this is an advanced form of smart grid [7], here smart means intelligent enough to detect fault and take necessary decision to check losses and prevent blackouts.

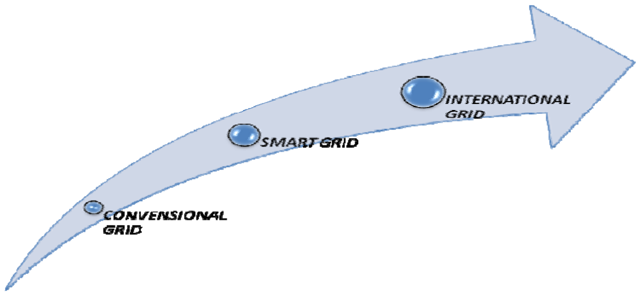

Fig.6. Evolution of International Grid

V.STRUCTURE

Under this system there will several grids working independently under normal conditions. There will be transmission lines which will work in parallel to each individual grid system. Thus as the fault occurs in any of the grid or overloading condition come in picture the affected grid will take up the power supply from its neighboring grids and the problem can be overcome easily and effectively as shown in figure-7. So in this way working with more than one grid at a time will increase reliability, efficiency and durability of the power system. Under this, the whole system is advancement in smart grid i.e. each grid will act as generating units (like grid 1, grid 2, grid 3, grid 4 etc.) and rest will act as the other components of the power grid. As it is clear from the figure-7 that there can be 'N' number grids working to form INTERNATIONAL GRID. It will require only the cost of installation of transmission network thus can be implemented effectively in the blackout prone regions.

There is a Central Monitoring System (CMS) for monitoring the whole system and its various components viz. Auxiliary Substations (AS), smart meters (M), Parallel Backup System (PBS) and transmission system. It will work with the Parallel Backup System (PBS) for providing backup if the main system fails to operate.

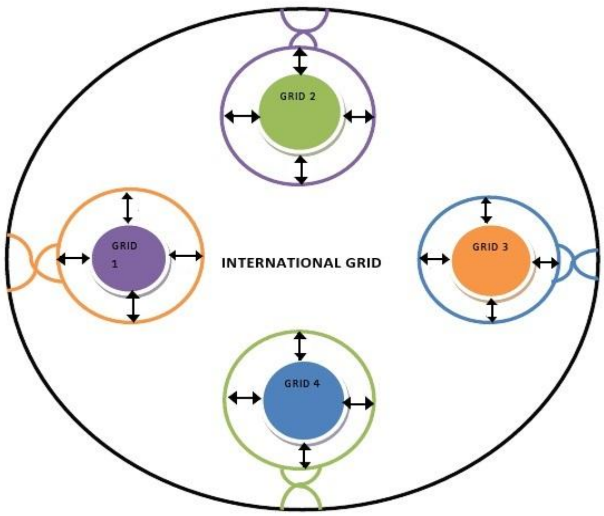

Fig.7. Schematic layout of International Grid

VI. WORKING

Here several grids will work in combination with each other as shown in figure-8. As mentioned earlier that international grid is an integration of several grids which will work independently under normal conditions. But if any grid fails then it will take power supply from its neighboring grids to fulfill its requirement. There is a Central Monitoring System (CMS) whose sole purpose is to control and manage the whole system so as to fulfill the objective of International Grid and to minimize the conflicts if arises. The CMS will act like a brain of the system and not only controls but also establishes synchronization between all the components of the system. Auxiliary Substations (AS) is present between every two individual units of the system. Its main objective is to distribute power in such a manner so as to make system capable of dealing with fault arises more than one place at a time and to ensure the equal distribution of power among the grids. AS also works when fault occurs in the main system and various smart meters are installed so as to record consumption of electric energy in intervals of an hour or less and communicate that information at least daily back to the utility for monitoring and billing purposes. Smart meters enable two-way communication between the meter and the CMS. Unlike home energy monitors, smart meters can gather data for remote reporting. Advanced Metering Infrastructure (AMI) differs from traditional Automatic Meter Reading (AMR) in that it enables two-way communications with the meter [8].

In case there is fault between any two points in any individual grid, then unlike conventional grid the region will take power from parallel transmission network leaving rest of the system untouched and thus make the grid capable to cope up with the fault immediately with the help of International Grid. And suppose if the main system fails there is a provision for it i.e. Parallel Backup System (PBS).

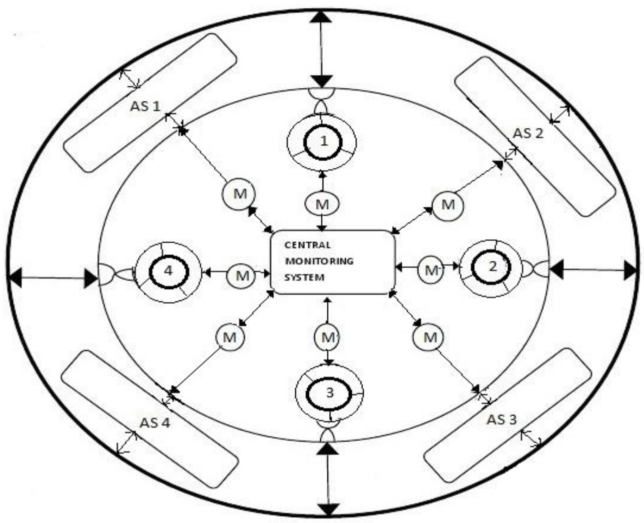

Fig.8-Functional Layout of International Grid

VII. SYNCHRONIZATION

Synchronization means the inter-correlation between various components of the system which works collectively to form the system called International Grid. The schematic layout shows how CMS is connected to various other components in a synchronized manner so as to control the power flowing in and out of the individual unit (grid). The power is generated by the individual units which are then rotating throughout the system providing supply to the deficient areas. Between the generating units (grids) and PBS there is an AS system which ensures the flow of power from generating units to the regions where power is required as shown in figure-9.

If fault occurs in any particular grid then the power generated by another individual grid can be used by that grid. The power flows through the auxiliary substation (AS) and CMS decides where the power is to be delivered and in what quantity. The CMS commands to AS and the required power is then delivered to region where power is required. If there occurs some problem in transmission then there is PBS works which is perfectly synchronized with the AS and CMS.

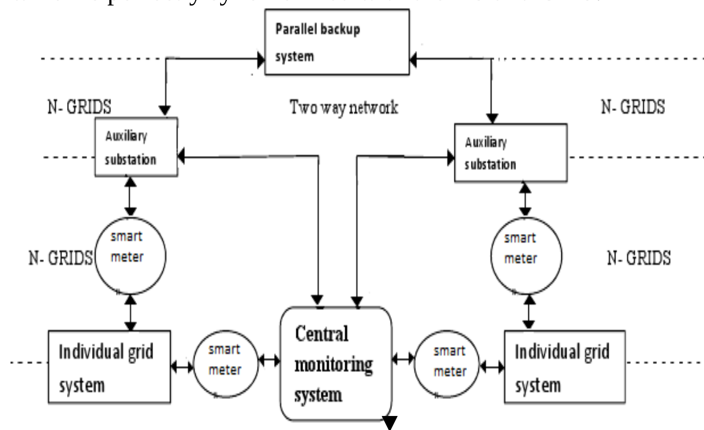

Fig.9 Block diagram of synchronization

VIII. CONCLUSION

With the advent of International Grid problems like blackouts, overloading, power losses etc. can be easily overcome. As International Grid is a combination of several grids, thus problems occurring in these conventional grids can be taken into consideration and solution can be easily implemented. It is a cheaper substitute as it only includes the transmission network. The International Grid works with various components whose sole purpose is to root out the problems prevailing in conventional grids, with the help of synchronization. Since the components used in International Grid has been individually implemented already. So this shows that the concept can be implemented effectively.

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