BLACKOUTS POWER: EFFECT OF NORTHERN POWER GRID FAILURE ON DOMESTIC AREA & BUSINESSES

Mukesh Kumar*

Bharti Saini**

ABSTRACT

Power is very necessarty source in our life. Northern Regional Grid was a major grid disturbance in Northern Region at 02.33 hrs on 30-07-2012. Northern Regional Grid load was about 36,000 MW at the time of disturbance. Subsequently, there was another grid disturbance at 13.00 hrs on 31-07-2012 resulting in collapse of Northern, Eastern and North-Eastern regional grids. This is possibly the first time that all three grids have collapsed simultaneously. Till late in the evening, around 25000 MW of the total 50,000 MW had been restored. About 13,000 MW has been restored in the Northern region and about 4,000 MW in the Eastern region. Supply to the affected regions is being extended from western and southern Grids.The total load of about 48,000 MW was affected in this black out. The northern grid covers a vast region that is home to 28 percent of India's 1.2 billion populations, and includes the states of Jammu and Kashmir, Punjab, Rajasthan and Uttar Pradesh. A massive power cut blacked out northern India Monday, leaving more than 1.2 million people without power, shutting down water plants and stranding hundreds of trains in the worst outage in a decade. Indian company that specializes in selling power backup inverters claims to have 100 million "satisfied customers On 31 July 2012, Monday, 370 million people lost power for hours when the northern grid collapsed. On Tuesday, 620 million had no electricity after the grid collapsed again, dragging down two neighboring grids. This article is about accidental power failures. For intentionally engineered ones, see rolling blackout.

Keywords: *NAPS , NER, NR, ER, PMU, CEA.*

* Pursuing B.Tech from P.M. College of Engg. Electrical Engg.

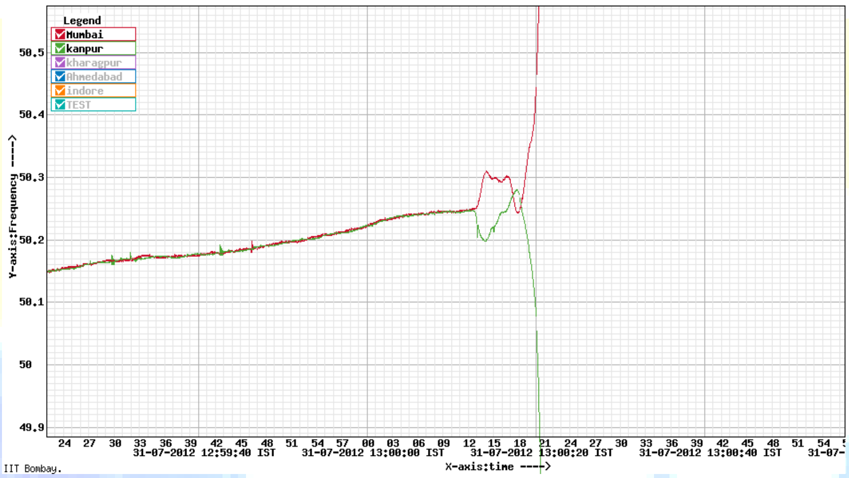
** Assistant Professor, Hindu college of engg. Sonipat, Haryana, India

INTRODUCTION

There are many causes of power failures in an electricity network. Many companies are unprepared for business disruptions caused by power blackouts, and are often unaware of the true costs and impact that they can have on their operations. Examples of these causes include faults at power stations, damage to electric transmission lines, substations or other parts of the distribution system, a short circuit, or the overloading of electricity mains. Hundreds of millions of Indians have no access to electricity anyway. On 30 and 31 July 2012, India was hit by a massive power outage that affected three major electricity grids covering the north, east and north-eastern regions. Many who do were insulated from the blackouts' effect by the coping systems they use to handle the smaller power cuts that are routine across the country. Two blackouts in 31 July 2012. According to World Bank statistics. [10] July 31, 2012 on that time, a cascading effect saw the collapse of the Eastern and North Eastern power grids as well. This affected the states of West Bengal, Odisha, Jharkhand, Bihar, Sikkim, Assam, Mizoram, Manipur, Nagaland, Meghalaya and Arunanchal Pradesh. In what's being termed as the biggest ever power failure in Indian history, three inter-state transmission networks collapsed together, plunging most of north India into darkness and disrupting the daily lives of over 600 million people. [1] India lost 6.6 per cent of sales due to power outages in 2006, the last year statistics were available. By contrast China's losses were 1.3 in 2003, the latest data available. Northern grid collapsed for six hours shortly after 2:00 am (2030 GMT Sunday), causing chaos in nine states including the capital New Delhi. The last serious power outage in India was in 2001, when the northern grid crashed for around 12 hours, costing industry an estimated $110 million in lost production.[6] in this report ,detail & characteristic of power failure of northern grid. [7] In this article on two areas interconnected power system is represented using new state variables namely frequency deviation and its derivative as state variables in both the areas without integral control of frequency in each case.[8] in this paper we used MDNN controller for LFC. This controller has dynamic neurons in its structures and demonstrates that have good results against CNN controller. Also NN-emulator was applied for consideration the sensitivity of plant. [13] All the grids are being run by the state-owned Power Grid Corporation, which operates more than 95,000 circuit km of transmission lines.One circuit km, refers to one kilometre of electrical transmission line.[14] India now faces 8-12 per cent peak power deficit, according to the Central Electricity Authority (CEA).

CONCEPT

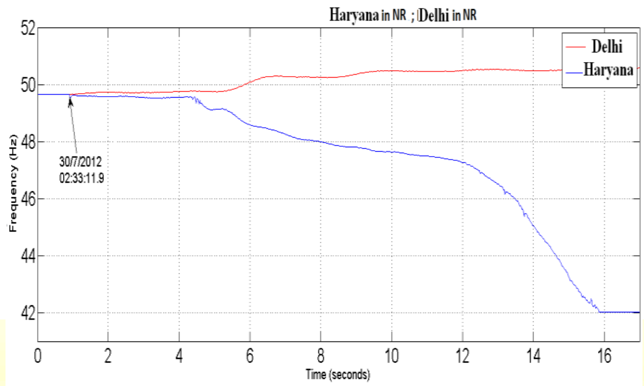
The first disturbance which led to the collapse of Northern Regional Electricity grid occurred at 02.33 hrs on 30th July, 2012, in which all states of Northern Region viz. Uttar Pradesh, Uttarakhand, Rajasthan, Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Delhi and Union Territory of Chandigarh were affected. Northern Regional Grid's load was about 36,000

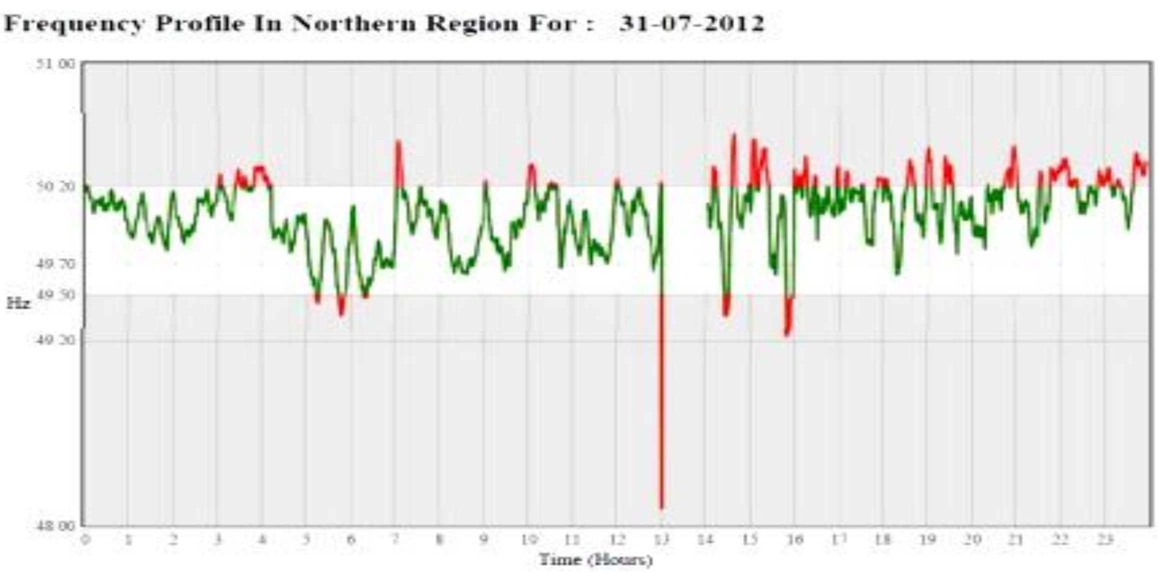


MW at the time of disturbance. Small islands which comprised of three units of BTPS with the load of approximately 250 MW in Delhi, NAPS on houseload, Area around Bhinmal (Rajasthan) with approximate load of 100 MW connected with Western Region survived the blackout. Restoration was completed by 16.00 hrs. The characterstics of power failure of first day 30 july 2012.

The second incident which was more severe than the previous one occurred at 13.00 hours on 31.7.2012, leading to loss of power supply in three regions of the country viz. Northern Region, Eastern Region and North Eastern Region affecting all states of Northern Region and also West Bengal, Bihar, Jharkhand, Odisha, Sikkim in Eastern region and Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura in North-Eastern region. The total load of about 48,000 MW was affected in this black out. Islands comprising of NAPS, Anta GPS, Dadri GPS and Faridabad in Northern Region, Ib TPS / Sterite, Bokaro steel and CESC survived in Eastern Region. It has been reported that major part of the system could be restored in about 5 hrs, 8hrs and 2 hrs in Northern, Eastern and North-Eastern regions respectively. The characterstics of power failure of second day 31 july 2012.

Detail of power issued by northern Grid to state :





[2] The data indicate that the blackout occurred around 13.00 hours. Note that the frequency is oscillating before and after the event.

[3] The following series of figures are of the scheduled vs. actual withdrawals in cities in the Northern Region. As can be observed from the figures, several states in the Northern Region were drawing significantly higher power than their scheduled flows. The frequency in the region also appears to be oscillating as shown in Figure 3 above. The changes in frequency can actually be tracked quite well with the change in the power being drawn by each of the states. It appears that close to 13.00 hours there was grid disturbance as reported in the two grid disturbance reports in the Appendices 1 and 2. The report in Appendix 1 is from the NRLDC while the report in Appendix 2 is from the ERLDC. The reports were obtained from their respective websites. The initial outage led to significant cascading and a blackout of both the Northern Region and

the Eastern Region. Appendix 3 provides frequency plots of PMU data from the Northern and Western Regions.Below output show as sequence

1.Punjab, 2.Haryana , 3.Delhi, 4.Himachal Pardesh, 5.Chandigarh.

Pre-

Disturbance Conditions

[6] The details of the generation-demand and power export/import scenario in the four regions of the NEW grid on 30.07.2012 at 02:00 hrs are given below.

S.No.	Region	Generation	Demand	Import	Remarks
1	NR	32636 MW	38322MW	5686MW	

2	ER	12452 MW	12213MW	(-)239MW	Bhutan import 1127 MW
3	WR	33024 MW	28053MW	(-)6229MW	
4	NER	1367 MW	1314MW	(-) 53MW	
5	NEW Grid	79479 MW	79902MW		

Pre-Disturbance Conditions on 31st July 2012

[6] The details of the generation-demand as well as import/export of power in each of the four regions in the NEW grid on 31.07.2012 at 12:30 hrs are given below.

S.No.	Region	Generation	Demand	Import	Remarks
1	NR	29884MW	33945MW	4061MW	
2	ER	13524MW	13179MW	(-) 345MW	Import from Bhutan 1114 MW.
3	WR	32612MW	28053MW	(-)4559MW	
4	NER	1014MW	1226MW	212MW	
Total	NEW Grid	76934MW	76403MW		

How the electric grids work & Capacity in India

[10] The Power Grid Corporation of India oversees the distribution of power via its transmission network spread across the country. It has 95,009 circuit-km of transmission network, 1, 36,358 MVA transformation capacity and approximately 28,000 MW inter-regional power transfer capacity. India is divided into five electrical regions, namely, Northern (NR), Eastern (ER), Western (WR), Southern (SR) and North-Eastern (NER). Of these, the four zones NR, ER, WR and NER are inter-connected, and form what is known as the New Grid. The Southern zone is synchronously interconnected to the New Grid. (The further division of states is shown in the info graphic). Every zone is then responsible for the power needs of the states that fall under it. There is a load dispatch centre in every zone that oversees the transfer of power from the generating plant to the states and further. Depending on the need, every state then buys power and has to adhere to the withdrawal limit. , we have a very complex power transmission network

in place. But it's functioning; from power generation to power distribution is more or less the same across all regional zones. In each zone, power from various power plants is subjected to inter-state transmission, wherein the regional load dispatch centres monitor and control its distribution to the various states in each zone as scheduled. The next step is intra-state transmission, wherein the state load dispatch centre allocates power to various areas within the state, and then at local level. (View diagram in the info graphic). The power is generated at very high voltage, but stepped down at each substation.[11] The National Load Dispatch Centre and the Regional Load dispatch Centre's - entities that plan supply of power from one region to another, will give us revised schedules for delivery in view of the grid failure

Reason of power failure

The Northern Regional Grid has no single factor was responsible for grid disturbances on 30th and 31st July 2012. After careful analysis of these grid disturbances, the Committee has identified several factors, which led to the collapse of the power systems on both the days. [9] Power failures are particularly critical at sites where the environment and public safety are at risk. Institutions such as hospitals, sewage treatment plants, mines, and the like will usually have backup power sources such as standby generators, which will automatically start up when electrical power is lost. Other critical systems, such as telecommunications, are also required to have emergency power. Telephone exchange rooms usually have arrays of lead-acid batteries for backup and also a socket for connecting a generator during extended periods of outage.

1. Factors that led to the initiation of the Grid Disturbance on 30th July, 2012

1.1 **Weak Inter-regional Corridors due to multiple outages:** The system was weakened by multiple outages of transmission lines in the WR-NR interface. Effectively, 400 kV Bina-Gwalior-Agra (one circuit) was the only main AC circuit available between WR- NR interface prior to the grid disturbance.

1.2 **High Loading on 400 kV Bina-Gwalior-Agra link:** The overdrawal by some of the NR utilities, utilizing Unscheduled Interchange (UI), contributed to high loading on this tie line.

1.3 Inadequate response by SLDCs to the instructions of RLDCs to reduce overdrawal by the NR utilities and

underdrawal/excess generation by the WR utilities.

1.4 **Loss of 400 kV Bina-Gwalior link:** Since the interregional interface was very weak, tripping of 400 kV Bina-Gwalior line on zone-3 protection of distance relay caused the NR system to separate from the WR. This happened due to load encroachment (high loading of line resulting in high line current and low bus voltage). However, there was no fault observed in the system.

2. Factors that led to the initiation of the Grid Disturbance on 31st July, 2012

2.1 Weak Inter-regional Corridors due to multiple outages: The system was weakened

by multiple outages of transmission lines in the NR-WR interface and the ER network near the ER-WR

interface. On this day also, effectively 400 kV Bina-Gwalior-Agra (one circuit) was the only main circuit

available between WR-NR.

2.2 High Loading on 400 kV Bina-Gwalior-Agra link: The overdrwal by NR utilities, utilizing

Unscheduled Interchange, contributed to high loading on this tie line.Although real power flow in this line

was relatively lower than on 30th July, 2012, the reactive power flow in the line was higher, resulting in

lower voltage at Bina end.

2.3 Inadequate Response by SLDCs to RLDCs' instructions on this day also to reduce overdrawl by the NR

utilities and underdrawal by the WR utilities.

2.4 Loss of 400 kV Bina-Gwalior link: Similar to the initiation of the disturbance on 30th July, 2012, tripping of 400 kV Bina-Gwalior line on zone-3 protection of distance relay, due to load encroachment, caused the NR system to separate from the WR system. On this day also the DR records do not show occurrence of any fault in the system.

Effect of power failure on Domestic & Bussiness

1.1 Train & airort : [1] During the grid disturbances which occurred on 30th & 31st July 2012, Railways and Delhi Metro services were also affected. During the disturbance on 30th July 2012, Delhi Metro services were affected in the morning to the extent that services were delayed as the disturbance had occurred at 2:35 hours when metro services were off. This did not trouble the passengers. However, during second disturbance at 13:00 hours, the trains were in operation, and the passengers faced difficulties because of sudden stoppage of services. Delhi Metro Rail Corporation (DMRC) have 200 trains running on 185 Kms metro rail network in Delhi fed from 13 nos. 220 kV substations, out of which one each was fed from UP and Haryana side and rest from DTL's 220 kV network in Delhi. DMRC was using its own 33 kV network for feeding stations and 25 kV network for meeting traction load. The distance between two metro power stations was in the range of 15 to 17 Kms as higher distance resulted in voltage drop and poor traction. The peak load of Delhi Metro was 120 MW with 50 MW station load and 70 MW traction load.

1.2 Communication: [9] Cell phones must be charged, and will eventually run out of battery power without a way to recharge them (which is easily done). Cell phones require a cell phone tower to be functioning in the area for communication to work. Some towers have generators or battery backup systems, but will only function for a limited amount of time in a longer power outage emergency. Land lines will often function in short term power outages. In the past, the Land Line Phone system was independent from other methods of communication. Standard phone lines receive the electrical current they need from a phone junction centres. However to further complicate things; in the era of modern communication phone lines have started using satellite uplinks, internet connections, and wireless communication to connect one call to another. Local radio stations often will be able to broadcast during a short term power outage, if they have a generator. Depending on how wide spread the power outages are some radio stations may be functioning when others are not. Satellite services may be functioning and may provide key information from around the world. However it requires a power source to receive the signal locally.

1.3 Sewage removal and processing: In some areas the sewage is transported uphill using a pressurized system. In other areas, electricity is used to move sewage through treatment centres and various gateways. Some sewage systems will become backed up during extended power outages. Some areas are more fortunate, and the sewage system is gravity driven and will continue to function simply by pouring water in the toilet to flush them even after the power is out.

1.4 Banking & ATMs: Many banks have battery backups for the computer systems. However today banking is not just a closed system within a bank. Banks ability to cash a check; check account balances, make withdrawals or deposits are all dependent on the communication between banks in a secure financial version of the internet. There are power outage contingency plans, but how long will they continue to function during a power outage is unknown. The power outage in the North Eastern United States in 2003 was the first real world test of this system, and it passed.

Although banks may have been closed locally for customers locally, the banking system nationwide was only affected to a minor degree. As people left New Orleans they were unable to access funds in banks within that area. ATMs will not function. Banks only have very limited cash on hand. In the event of an emergency with a power outage in other areas, even if banks are fully functional.

Protecting the power system from outages

[9] Under certain conditions, a network component shutting down can cause current fluctuations in neighboring segments of the network leading to a cascading failure of a larger section of the network. This may range from a building, to a block, to an entire city, to an entire electrical grid. Modern power systems are designed to be resistant to this sort of cascading failure, but it may be unavoidable. Moreover, since there is no short-term economic benefit to preventing rare large-scale failures, some observers have expressed concern that there is a tendency to erode the resilience of the network over time, which is only corrected after a major failure occurs. It has been claimed that reducing the likelihood of small outages only increases the likelihood of larger

ones. In that case, the short-term economic benefit of keeping the individual customer happy increases the likelihood of large-scale blackouts.

Drawbacks of renewable energy

[12] While renewable energy is on the rise in many countries, a major drawback is the "volatility" of supply. This leads to several challenges. The unsteady production of energy, especially from wind or solar power, strains the stability of the network. Further, if wind turbines need to be stopped for safety reasons in extreme weather conditions, this can cause power gaps equal to the loss of two nuclear power plants within just one hour. In such cases, conventional reserve power plants would need to step in instantly. Last but not least, renewable energy has to be transmitted from sparsely populated areas to the metropolitan centres of demand.

To handle these enormous technical challenges, grids need to become much smarter. "Governments should develop new grids with metering, control and communication functions to handle the future growth of renew able energies," says Larry Hunter. They should also promote storage facilities for excess energy such as pumped storage hydropower plants or underground vaults for compressed air.

Overhauling national grids comes at a considerable cost. Estimates suggest that European Union (EU) member states need to invest between €23 and €28 billion over the next five years in their national grid networks, particularly as the demand for power supply is now cross-border. However, the fact that the European electricity grid consists of multiple regulatory bodies, owners and operators makes it difficult to form a consensus on prioritizing areas for investment – and responsibility.

More widely, the International Energy Agency (IEA) says that the world will need to invest US$13.6 trillion between now and 2030 to boost power supply to meet increasing demand. The IEA says that 50 percent of this amount needs to be invested in transmission and distribution and another 50 percent in the generation of electricity.

Develop and test scenarios

While energy companies and governments try to tackle the problems surrounding aging infrastructures, industrial clients also need to take steps to minimize their exposure to electricity supply failures. Michael Bruch, Risk Consultant at Allianz Global Corporate & Specialty (AGCS), says that organizations need to check their vulnerability to power blackouts and what contingencies they have in place. He also believes that companies need to make sure that the various risk scenarios of power failures are clearly included in their business continuity management (BCM) strategies and that scenario and mitigation solutions are regularly tested.

“Controlling that risk should not just be limited to having emergency back-up generators or being able to relocate their operations and workforce – it also needs to take into account the effect that a power cut could have on their supply chains as well. Risk managers need to ensure that their suppliers have equally robust measures in place as well,” he says.

Limited coverage available

Bruch says that there is a much greater burden on companies to evaluate their exposure to power blackouts as currently there is very little available coverage in the insurance market to offset the risk. “There are policies that cover business interruption but usually they are only triggered by physical damage, such as a fire on site, which covers on average just 20 to 25 percent of the business interruption losses.”

As a result of this gap in the market, AGCS has developed a non-damage business interruption product. “Power cuts are going to become more frequent and the financial losses can be very severe. As their insurer we need to provide suitable coverage for our clients, but organizations also need to be aware that they will need to make their own contingency plans to mitigate the risks,” says Bruch.

Conclusions

Haryana, Uttar Pradesh and Punjab faced severe power crisis this summer due to unavailability of fuel for their power plants. The peak time power deficit in these states was recorded at 16.3%, 9.7% and 11.5% respectively. India's fast-growing economy is heavily dependent on highly pollutant coal and imports of crude oil. Less than three percent of India's electricity comes from nuclear power but it hopes to raise the figure to 25 percent by 2050.We know that renewable energy source is available in large quality our nature. When the grid collapsed last time, in 2001, the supply snapped at midnight, and normality was restored by 4.30 p.m. So that time we can use this type of source. We can save energy & water

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Author's Detail:

1.*MUKESH KUMAR, B.A, MBA from MDU Rohtak University, Pursuing B.tech in Electrical Engg from P.M College of Engg. Kami, Sonipat

2. BHARTI SAINI
Assistant Professor,
Hindu College of Engg.
Sonipat