



# STUDY OF THE GRID DISTURBANCE IN THE INDIAN GRID

(A Case Study)

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**Abstract** : This paper state the analysis of the Grid disturbance in the Indian Grid in July, 2013. Also discussed are certain remedial actions that can be used for improving the Grid disturbance. Last but not the least latest threats perceived in the power sector due to increased use of computers and communication in relaying and protection is discussed thoroughly. The emerging challenges to grid security in view of the increased use of renewable resources are also discussed. Both these are discussed under the chapter "Future Challenges".

**IndexTerms** -Grid, Power, Planning, Generation, Demand, Disturbance.

## I. INTRODUCTION

There was a major grid disturbance in the Northern Region at 02.33 hours on 30-07-2012. Northern Regional Grid load was at nearly 36,000 MW at the time of disturbance. Subsequently, there was another grid disturbance at 13:00 hours on 31-07-2012 resulting in collapse of Northern, Eastern and North-Eastern regional power grids. Due to the blackout total load of 48,000 MW was affected. On both the days few are survived from blackout. Ministry of Power constituted an Enquiry Committee, who will analyse the causes of these disturbances and will suggest measures which will avoid recurrence of such disturbance in coming times. With the grid recovering from the blackout of 30-07-2012, there was another major disturbance on 31-07-2012 in the NEW grid at 13:00:13 hours that led to the separation of the NR, NER and ER from the WR as a result led to the collapse of the NR, ER and NER power grids. The pre-disturbance conditions, sequence of the events and analysis of the disturbance are described below.

## II. BRIEF SEQUENCE OF EVENTS LEADING TO THE GRID COLLAPSE ON 30TH AND 31ST JULY 2012:

On 30-07-2012, as soon as NR got separated from WR due to tripping of 400 kV in Bina-Gwalior line, the power swing in the system was caused when, the NR loads were met through WR-ER-NR connections. The NR system was isolated from the rest of the NEW grid system, because the center of swing was in the NR-ER interface and the corresponding tie lines were tripped. Due to under frequency and further power swing within the region the NR grid system collapsed.

On 31st July, 2012, after NR got separated from WR due to tripping of 400 kV Bina-Gwalior line. The NR loads were met through WR-ER-NR route, which caused power swing in the system. On this day the center of swing was in the ER, near ER-WR interface, and, hence, after tripping of lines in the ER itself, a small part of the ER (Ranchi and Rourkela), along with WR, got isolated from the rest of the NEW grid. This caused power swing in the NR-ER interface and ensure in the further separation of NR from the ER+NER system. Subsequently, all the three grids collapsed because of multiple tripping attributed to the internal power swings, under frequency and overvoltage at different places.

The WR system, however, survived because tripping of few generators in this region on high frequency on both the days.

The Southern Region (SR), which was receiving power from ER and WR, also survived on 31st July, 2012 with part loads remained fed from the WR and the operation of few defense mechanisms, such as AUFLS and HVDC power upholding.

On both the days, no proof of any cyber-attack has been found by the Committee.

## III. FACTORS CONTRIBUTING TO GRID DISTURBANCES ON 30TH AND 31ST JULY 2012:

As with most system failures, not any particular factor was responsible for grid disturbances on 30th and 31st July'12. After careful analysis of these grid disturbances, the Committee has identified several factors that initiated the collapse of power

systems these days. The Committee has also identified factors that could have saved the grids from destruction. These factors are given below: :

1. Depleted Transmission Network
2. Overdraws Attributable to Frequency Control through Commercial Signals
3. Inability to Control Flow on 400 kV Bina-Gwalior-Agra Line

#### IV. PRE-DISTURBANCE CONDITIONSON 30THAND 31<sup>ST</sup>JULY 2012:

Table 4.1:

S.No.	Region	Generation	Demand	Import	Remarks
1	NR	32636 MW	38322 MW	5686 MW	
2	ER	12452 MW	12213 MW	(-)239 MW	Bhutan import 1127 MW
3	WR	33024 MW	28053 MW	(-)6229 MW	
4	NER	1367 MW	1314 MW	(-)53 MW	
<b>Total</b>	<b>NEW Grid</b>	<b>79479 MW</b>	<b>79902 MW</b>		

Table 4.1 displays the details of generation-demand and power export/import scenario in the four regions of the NEW grid on 30.07.2012 at 02:00 hours.

Table 4.2:

S.No.	Region	Generation	Demand	Import	Remarks
1	NR	29884 MW	33945 MW	4061 MW	
2	ER	13524 MW	13179 MW	(-)345 MW	Bhutan import 1114 MW
3	WR	32612 MW	28053 MW	(-)4550 MW	
4	NER	1014 MW	1226 MW	212 MW	
<b>Total</b>	<b>NEW Grid</b>	<b>76934 MW</b>	<b>76403 MW</b>		

Table 4.2 displays the details of generation-demand and power export/import scenario in the four regions of the NEW grid on 31.07.2012 at 12:30 hours.

#### V. SEQUENCE OF EVENTS ON 30TH JULY, 2012:

The committee thoroughly studied the data provided by various SLDCs, RLDCs /NLDC, POWERGRID and generation utilities to analyze the sequence of events leading to the blackouts in the Northern grid on 30<sup>th</sup> July'12. The committee experienced some difficulty analyzing the available information because of the time synchronization problems at various stations. The committee, however, established the sequence of events supported correlation of the info from various sources like Disturbance Recorders (DRs), Event Loggers (ELs), few Phasor Measurement Units (PMUs) in the NR and WR at different stations and Wide Area,

Frequency Monitoring System (WAFMS) of IIT Bombay.

It may be noted that the NEW grid was operating in an insecure condition thanks to an outsized number of line outages, particularly near the WR-NR interface.

#### VI. SEQUENCE OF EVENTS ON 31ST JULY, 2012:

It may be noted that the NEW grid was operating in an insecure condition even on 31st July 2012 due to a huge number of line breakdown. Specifically near the WR-NR and ER-WR interfaces. Though an exhaustive list of lines under outage, it may be mentioned that the following lines had tripped within an interval of a few hours before the grid disturbance.

1. 400 kV Zerda-Bhinmal
2. 400 kV Zerda- Kankroli
3. 220 kV Badod-Modak- tripped a few minutes before the event
4. 220 kV Badod-Kota- tripped a few minutes before the event

#### VII. RECOMMENDATIONS

Recommendations of the Enquiry Committee Constituted by MOP, GOI on the Grid disturbance of 2012

- Review of Protection Systems
- Frequency Control through Generation reserves/Ancillary services
- Ensuring proper functioning of defence mechanism
- Ensuring primary frequency response from generators
- Revising Total Transfer Capability (TTC) based on the change in system conditions
- Coordinated outage planning of transmission elements

- Reactive power planning
- Review of penal provisions of the Electricity Act, 2003
- Optimum utilization of available assets
- Deployments of WAMS
- Need of Dynamic Security Assessment and review of State Estimation
- Implementation of islanding schemes
- Autonomy to Load Despatch Centres
- Development of Intra-State transmission system
- Network visualization
- Reduction in Start-up time for Generators:
- Review of Transmission Planning Criteria
- Strengthening of system study groups in various power sector organizations:
- Formation of a task force to study the grid security issues:

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