IMPLEMENTATION OF SYNCHROPHASOR TECHONOLOY IN INDIAN GRID SYSTEM

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Abstract

Synchrophasor technology is a strong and vigorous device for diagnosing, preventing and curing the grid system. These Synchrophasors work at a level of high speed with the device of actual time synchronizing measurement, which is exploited for finding the fitness of electrical grid and is also regarded as extreme fast measurement system of grid parameters, since it is 100 times speedier than the current system of SCADA. With the data of Synchrophasor, the obtainable power can be used more and more capably and efficiently by the electrical services which drive more power with the current grid system. It decreases the possibilities of power interruptions such as false tripping and cascade tripping which results in BLACK-OUTS. The Power grid system has been recommended to go in a huge level with WAMS (Wide Area Management Systems) throughout the country. On the experimental project basis in Northern grid four Synchrophasors have been installed namely; **(1) Kanpur (2)Dadri** (**3) Vindhyachal 4) Moga**, along with the 400 KV substations which are being observed at NRLDC, DELHI. The outcomes are very positive and encouraging. This paper illustrates the technology related to synchrophasor and its benefits over present SCADA system and how services can be combined with the synchrophasor data in existing SCADA/EMS. In the process of developing the early warning system, WAMS technology using PMU (Phasor Measurement Unit) data is found instrumented along with wide area protection system and many other applications.

Key words: Synchrophasor Technology, SCADA /EMS (Electrical Measurement Systems), NRLDC (North Regional Load Dispatch Center).WAMS

Introduction:

Indian Grid System is one of the fourth biggest grid systems in the world (USA, EUROPE, CHINA& INDIA) in transferring the power through five regional grids and as well as national grid with transmitting of voltage extending from 132/220/400/765 KV Ac and $\pm$500 KV HVDC transmitting system by intersecting the local grids with the Inter link system of HVDC Transmission. However, for grid data processing and monitoring, our grid system exploits SCADA/EMS system. In May 2010in northern grid the Power Grid has installed four Synchrophasors at 1) Kanpur (2) Dadri(3) Vindhyachal(4) Moga. Whereas, the PMU data is being analyzed and monitored by NRLDC at Delhi. Since it is 100 times quicker than existing SCADA system. This technology has not only decreased any probability of future BLACK OUTS of systems but also enables us to observe the inner view of the grid system as well as facilitates us to examine the interruptions of the grid system. Synchrophasors can produce phasor measurements taken together synchronously at the same time.

A phasor is an intricate number that signifies both immensity and phase direction of the waves of electricity. The measurements of Synchrophasors can be taken exactly with synchronization by a specified device named (PMUs) i e Phasor Measurement Unit. They are to be synchronized with the support of GPS. These measurements are supposed to be taken at a level of high speed normally with 25 or 50 inspections per second. Each measurement is timely managed in accordance with the general time provided.

PRESENT POWER STATUS OF COUNTRY

With the present installed Power Generation capacity, Indian power system has been increasing at high rate and has already reached to the level of 2, 53,000 MW by the end of 31-3-2015. Power is produced by 2000Nos, forming units to supply the power to the grid. However in the production of thermal, the size of production is about 30 MW to 660MW, in case of Hydel this is about 10MW to 150MWper each unit. However we generate 67% from the Thermal Power stations over the country and this is only 20% of total Power through Hydel and we are able to produce only 3% from the Nuclear Power and from Non-conventional Renewable Power Generation it is 10% only, generally it is more possible through the wind power and biomass. Solar PV is opening their accounts now. Transmission system is having 132/220/400 KV apart from the 765 KV AC system ±500 kV through HVDC inter connected systems. Whereas the 1200 KVAC and 800 KV HVDC systems are about to be launched by year 2015 in near future at the same time the complications arising during the operations of the grid system will also be additionally increased.

THE GRID CODE-2010 OF INDIAN ELECTRICITY

According to the Grid code of Indian Electricity 2010-clause no 4.6.2

"The dependable and competent Speech and the communication System connected to data" will be made available to provide the needed communication by exchanging of data for managing or controlling of the grid by the RLDC, under the usual and unusual situations. All users, including STUs and CTU shall be given the systems related to telemeter power system parameter to examine and identify the current, voltage and the position of transformers/ switches, taps, other necessities and procedures made available by RLDC. The related communication system in order to provide a suitable data in relation to the CTUs system will also be set up by the correlated user or STU as indicated by CTU in connection to the agreement. All services as well as STUs along with the cooperation of CTU will have to offer the requisite services within their limits as stated in their Agreement. The definition of Synchrophasor and its measurements and applications have been coded in IEEE –1344 and IEEE-C37.According to 118–2005 standards in power systems the exact measurement of time reaches up to 1 micro second. Since the inner view of the power system is regarded as more energetic, the required precautionary steps need to be taken by the system operators in order to get rid of the interruptions like cascade tripping and black outs.

Loading dispatch centers at National, State and regional level: Geologically the country is separated into five areas namely North, East, West, North-Fast and South Region. As per the power system point of view the first four out of the five regional grids serving in synchronous method with southern region are interrelated with the connections of asynchronous with the help of (RLDC) local load dispatch centers by sharing the information and data with the (SLDC) State Load Dispatch Centers that takes place with ICCP connectivity between RLDC&SLDC for Combined grid operation along with the inter-area connectivity with the EHV and HVDC B2B Transmission Network. However, in integrated manner there are nearly 33 control centers and 315 RTUs locations in northern grid itself.

NATIONAL GRID

Achieving Nation's vision of a Combined National Grid with the finest and economical dispatching of current between regions/states is a forceful thing besides hoping dispatching of load and communicating the Project for the country, along with the competence, rapid system renovation, post interruptions and examination of data. The responsibility regarding the fulfillment and implementing the load of dispatch& Communication Project has been assigned to the Power Grid by the Government of India. The National Grid, with the relationship of its constituents focuses mainly on to combine the Network of Power Transmission over the countrywide and along with the other organizers at National, state regional and area load dispatching centers

1. **WIDE AREA PROTECTION SCHEME** (WAPS) Detecting and analyzing transfer
2. **COMPONENTS OF WAMS TECHNOLOGY**

2.1 PMU's
2.2 (PDC) Phasor Data Concentrator
2.2.1(SPDC)Substation Phasor Data Concentrator
2.2.2 (MPDC) Master Phasor Data concentrator
2.2.3 System Architecture for WAMS in India.

3. The measurements of **PMU** carry actual time quantity of electrical measurement such as Voltage, MW, MVAR, Current; Phase direction of voltage, Power aspects etc. Therefore its application incorporates validation, modeling, stability, magnitude and maximum power transfer. It receives:

1. Recording of faults
2. Installation of Dynamic system monitoring and its continuity.
3. Sequence recordings of events
4. Quality Power
5. Fault location
6. Syncrophasor's data sending with C.37.118, system

4. INSTALLATION OF THE MACHINERY OF 'PMU' INPUT:

(1) PM UNIT- (SEL-451)

- 3 nos of voltage Input
- 3 nos of current inputs from chosen CTS, CVTS, of preferred feeders.

(2) GPS UNIT- (SEL-2404) International place

- Precise time
- Coordinated time

A Case study of AP state:

AP State Estimator to State Measurement State Estimator (SE) tools currently have been installed in SCADA system using measurements such as MVAR, MW, energy magnitude except, Phase angle measurement etc., which is done in case of Synchrophasors along with wide application and conventional safety standards System. These applications have different sampling & signal processing requirements other than usual security applications.

5. SALIENT FEATURES OF THE ULDC/SLDC SCHEME

EMS/SCADA

For obtaining genuine time data in order to check, control and study the Power Management System and manage and deal with and acquirement of System with five hierarchical directing centers combining with RTUs positioned at 125 well planned substations are extended over A.P. Grid

6. HIERARCHICAL MANAGING CENTERS ALONG WITH LOAD DISPATCHING CENTERS

(National Load Dispatch Centre) **NLDC.** Delhi

RLDCs (Regional Load Dispatching Centers)

(1) ERLDC

(2) NRDC

(3) WRLDC

(4) SRLDC

(5) NERDC

SLDCs (State Load Dispatch Centre. AP)
CPCC-Pondy,
TNEB- AP, Karnataka, Kerala
ALDCs-- (Area Load Dispatch Centers .AP)
WGL-HYD, VJA, CDP
RTUs --1TO 32, 1TO 19, 1TO 31, 1TO 34

TECHNOLOGY RELATED TO SYNCROPHASOR WITH GPS SYSTEM:

At a distance of 16000 km from Earth 24 nos. Satellites have been initiated in 24 orbits. However, there are 6 orbits which are observed all times giving exactness of time per one micro second.

The advancements in the machinery and the technology of computers have made it feasible in protecting and transmitting the sampling synchronization in one second with initiation of Satellite reliable time managing system. These transmits can now facilitate synchronized Phasor measurements which can reduce the requirement to have various utensils for saving, controlling and analyzing electrical system with broad and conventional applications

EXAMINATION OF POWER SYSTEM
NLDC: NORTHERN LOAD DISPATCH CENTER

Substation	Estimation of installation at NLDC(terminals)	Offline mode (terminals)
765 KV	2	2
400 KV	275	284
220 KV	34	1315
TRANSMISSION LINES		
765 KV	2	2
400 KV	611	622
220 KV	51	3034
Transformers	794	2031
Load	834	2672
Generator	263	557

Table no: 1

A comparison of truncated state estimator network and All India Network, used offline studies is given above.

PMU's have been installed at Dadri, Kanpur, Vindhyachal & Moga. Data is to be compared with the estimated angles in order to develop the results

Comparison of PMU Estimated Angles

Places of deployment of PMU	**PMU estimated angle**	**Actual Angles**
Dadri - Moga.	11.47	12.68
Kanpur - Dadri	11.62	13.44
Kanpur - Moga	23.09	22.10
Vindhyachal - Dadri	32.97	35.23
Vindhyachal - Kanpur	21.35	23.49
Vindhyachal - Moga	44.44	46.12

Table no: 2

Technology connected to Synchrophasors

The phasor measurements taken together with synchronization at the same point of time can be regarded as Synchrophasors. Phasor is a intricate number which signifies both extent and phase angle of energy waves as displayed in figure.

Further to above four more places have been chosen they are:

(1) 400 KV substation located at Hissar
(2) 400 KV substation located at Bassi
(3) 400KV substation situated at Agra
(4)400 KV substation located at Kishnapur

Benefits of adopting Synchrophasor Technology

(1) WIDE AREA MEASURE–whole country

Throughout the country, power flow parameters can be visualized, supervised and managed by (NLDC) National Load Dispatch Center–located at Delhi. However by the end of 2012, thirty seven thousand (37,000 MW) flow would be controlled by NLDC and 1,00,000 MW by end year 2017.

Stage 2 Advantages:

(2) Monitoring of power quality
(a) Unbalance
(b) Harmonics
(c) Sag & swell
(d) Monitoring Interruptions

(3) System Integrated Protection Schemes
(4) Network Model Validation & Parameters Finalization for better Grid Management System.

Stage 3:

(1) strengthening the range of observation & control
(2) State Estimator

Conclusion:

The synchrophasor's technology facilitates a broad area of the synchronized time and time stamped measurements usually known as synchrophasor measurements. However, the existing SCADA/EMS measurements have the capacity of providing only steady condition system/grid's view. Whereas synchrophasor's technology works extensively and energetically in wide areas with actual time visualization, monitoring safety, security of the grid in an effective manner with the advancements in communication and IT sector. However, to face the future challenges, various programs and proposals are going to be taken since there is an increasing need of complex grid solutions and its visibility. As grid is moving one step forward towards smart grid.

REFERENCES:

1 WWW.CEA.GOV.IN
2 INDIAN ELECTRICITY GRID CODE 2010
3 WWW.POWERGRID INDIA .COM
4.UNIFIED REAL TIME DYNAMIC STATE MEASUREMENT SYSTEM.
5.POWER GRID CORPORATION OF INDIAA LIMITED.

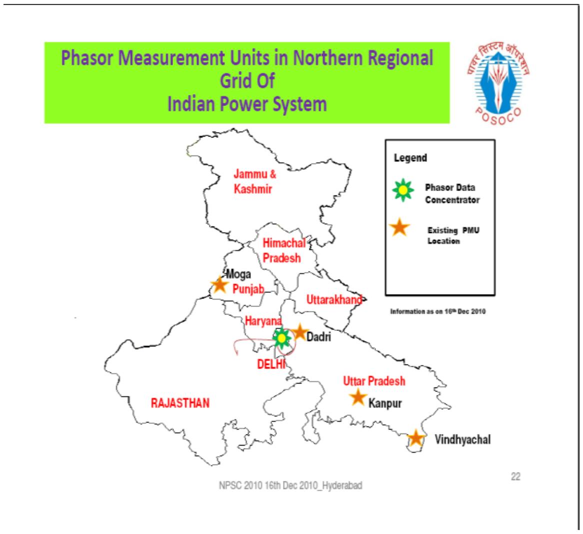
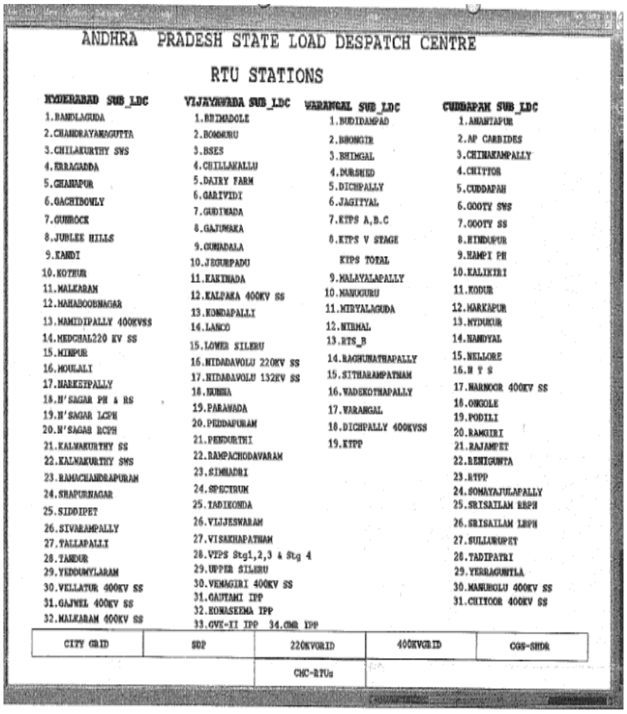


Fig 1



ANDHRA PRADESH STATE LOAD DESPATCH CENTRE

RTU STATIONS

HYDERABAD SUB_LDC
1.BANDLAGUDA
2.CHANDRAYANAGUTTA
3.CHILAKURTHY SWS
4.ERRAGADDA
5.GHANAPUR
6.GACHIBOWLY
7.GUNROCK
8.JUBLEE HILLS
9.KANDI
10.KOTHUR
11.MALKARAM
12.MAHABOOBNAGAR
13.MAMIDIPALLY 400KVSS
14.MEDCHAL220 KV SS
15.MINPUR
16.MOULALI
17.MARKETPALLY
18.N'SAGAR PH & RS
19.N'SAGAR LCPH
20.N'SAGAR RCPH
21.KALWAKURTHY SS
22.KALWAKURTHY SWS
23.RAMACHANDRAPURAM
24.SHAPURNAGAR
25.SIDDIPET
26.SIVARAMPALLY
27.TALLAPALLI
28.TANDUR
29.YEDDUMYLARAM
30.VELLATUR 400KV SS
31.GAJWEL 400KV SS
32.MALKARAM 400KV SS

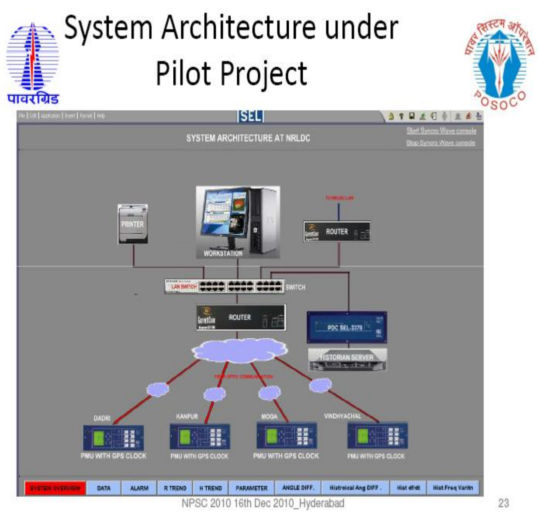
VIJAYAWADA SUB_LDC
1.BRIMADOLE
2.BOMMURU
3.BSES
4.CHILLAKALLU
5.DAIRY FARM
6.GARIVIDI
7.GUDIWADA
8.GAJUWAKA
9.GUNADALA
10.JEGURPADU
11.KAKINADA
12.KALPAKA 400KV SS
13.KONDAPALLI
14.LANCO
15.LOWER SILERU
16.NIDADAVOLU 220KV SS
17.NIDADAVOLU 132KV SS
18.NUNNA
19.PARAWADA
20.PEDDAPURAM
21.PENDURTHI
22.RAMPACHODAVARAM
23.SIMHADRI
24.SPECTRUM
25.TADIKONDA
26.VIJJESWARAM
27.VISAKHAPATNAM
28.VIPS Stg1,2,3 & Stg 4
29.UPPER SILERU
30.VEMAGIRI 400KV SS
31.GAUTAMI IPP
32.KONASEEMA IPP
33.GVK-II IPP 34.GMR IPP

WARANGAL SUB_LDC
1.BUDIDAMPAD
2.BHONGIR
3.BHIMGAL
4.DURSHED
5.DICHPALLY
6.JAGITYAL
7.KTPS A,B,C
8.KTPS V STAGE
KTPS TOTAL
9.MALAYALAPALLY
10.MANUGURU
11.MIRYALAGUDA
12.NIRMAL
13.RTS_B
14.RAGHUNATHAPALLY
15.SITHARAMPATNAM
16.WADEKOTHAPALLY
17.WARANGAL
18.DICHPALLY 400KVSS
19.KTPP

CUDDAPAH SUB_LDC
1.ANANTAPUR
2.AP CARBIDES
3.CHINAKAMPALLY
4.CHITTOR
5.CUDDAPAH
6.GOOTY SWS
7.GOOTY SS
8.HINDUPUR
9.HAMPI PH
10.KALIKIRI
11.KODUR
12.MARKAPUR
13.MYDUKUR
14.NANDYAL
15.NELLORE
16.N T S
17.NARNOOR 400KV SS
18.ONGOLE
19.PODILI
20.RAMGIRI
21.RAJAMPET
22.RENIGUNTA
23.RTPP
24.SOMAYAJULAPALLY
25.SRISAILAM RBPH
26.SRISAILAM LBPH
27.SULLURUPET
28.TADIPATRI
29.YERRAGUNTLA
30.MANUBOLU 400KV SS
31.CHITOOR 400KV SS

CITY GRID	SDP	220KVGRID	400KVGRID	CGS-SHDR
		CMC-RTUs		

Fig 2



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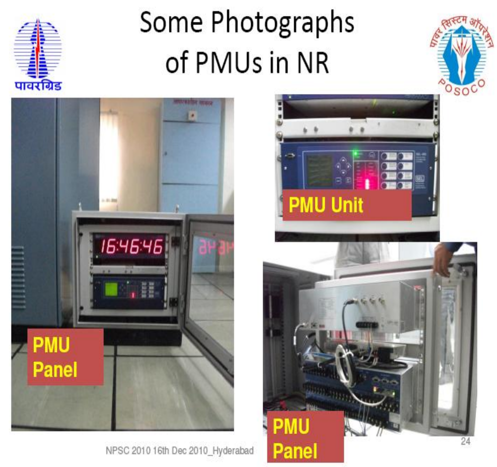

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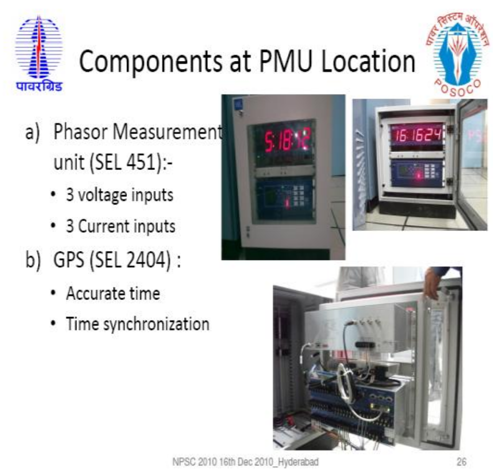

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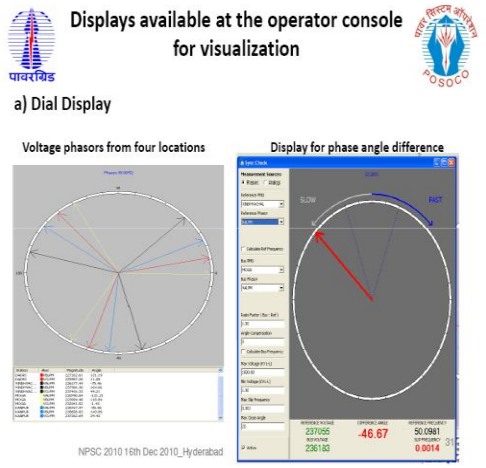

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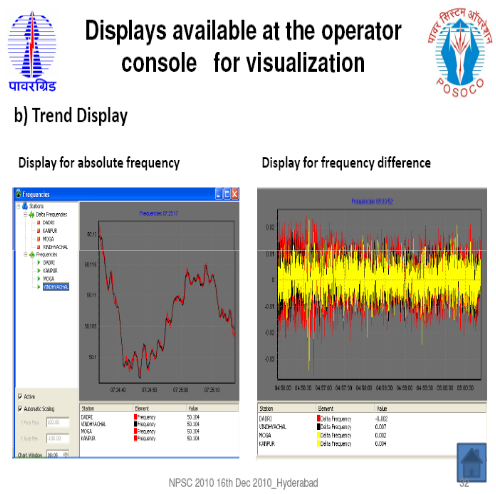

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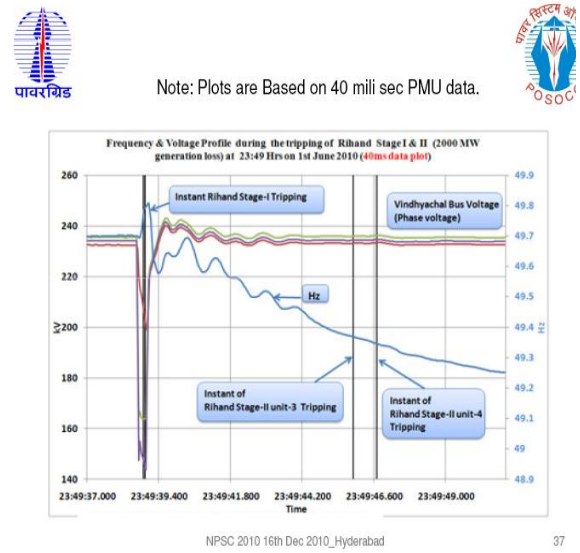

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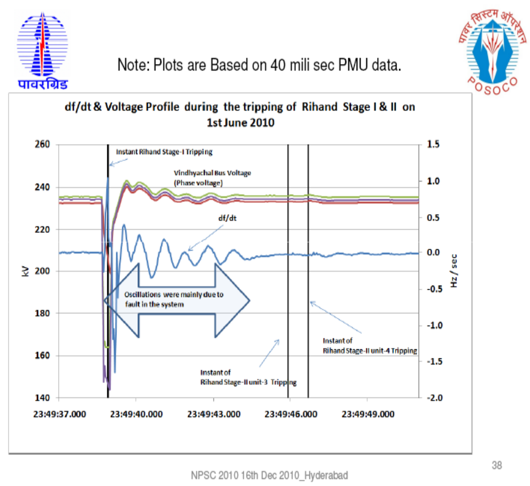

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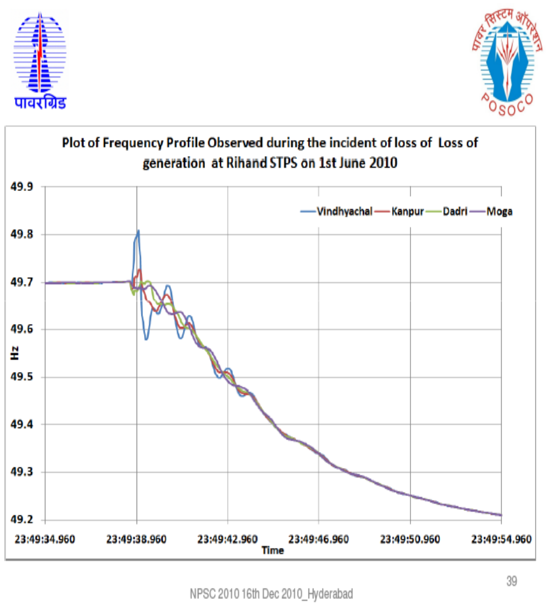

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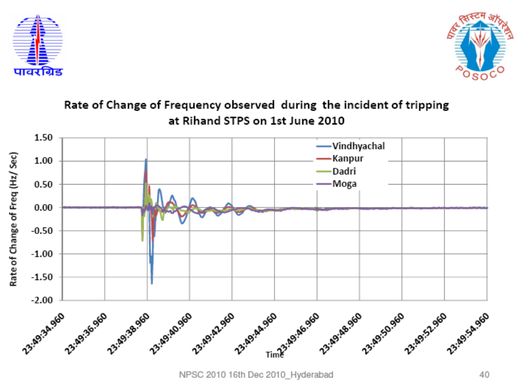

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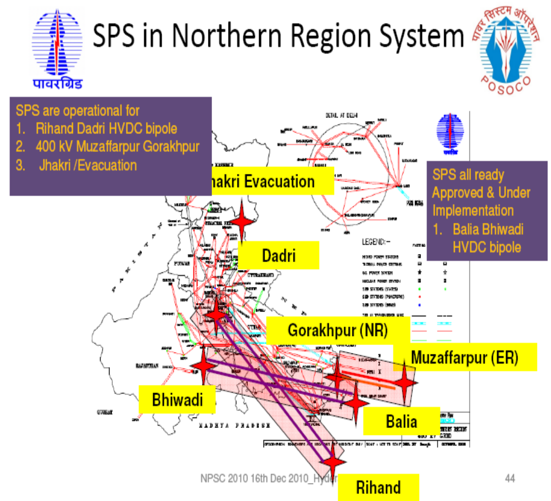

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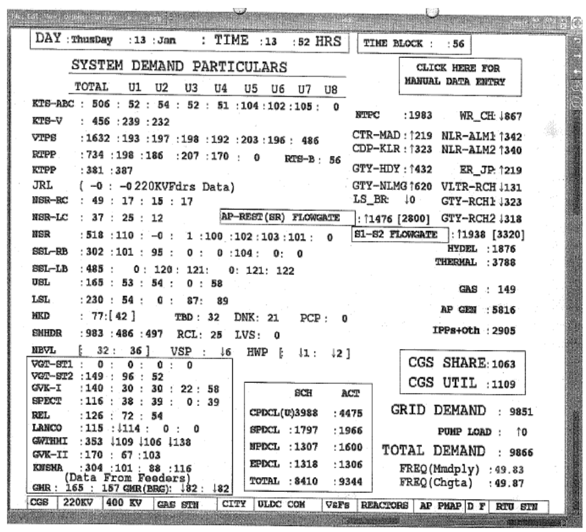

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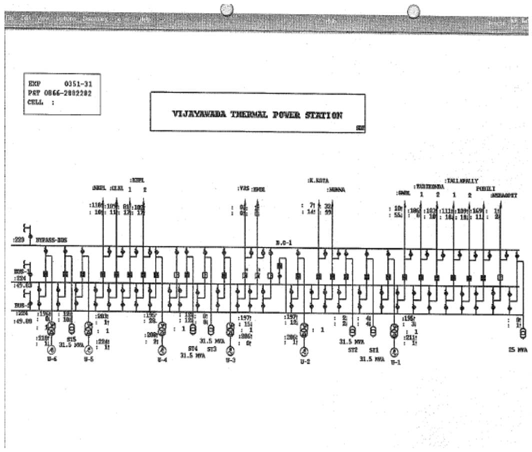

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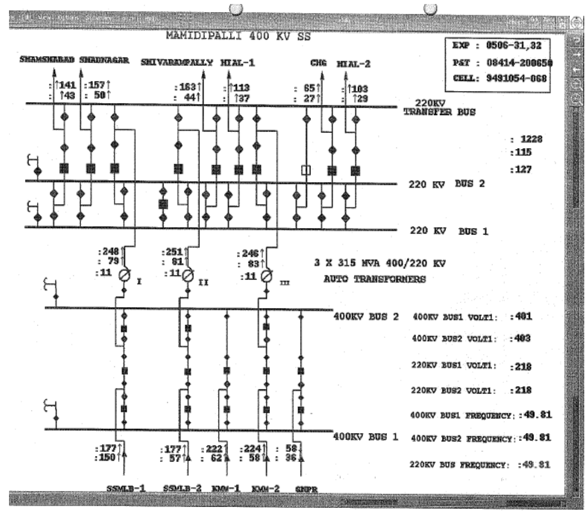

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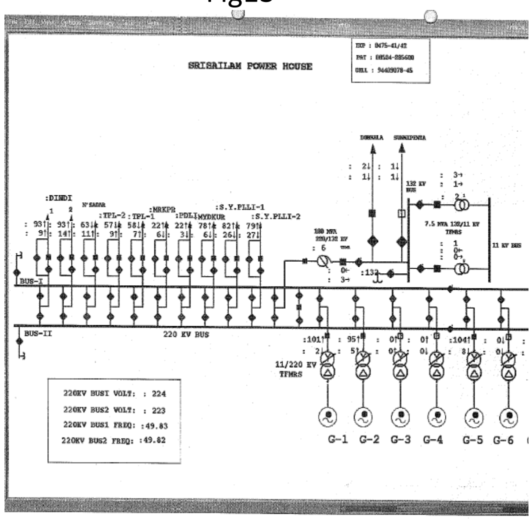

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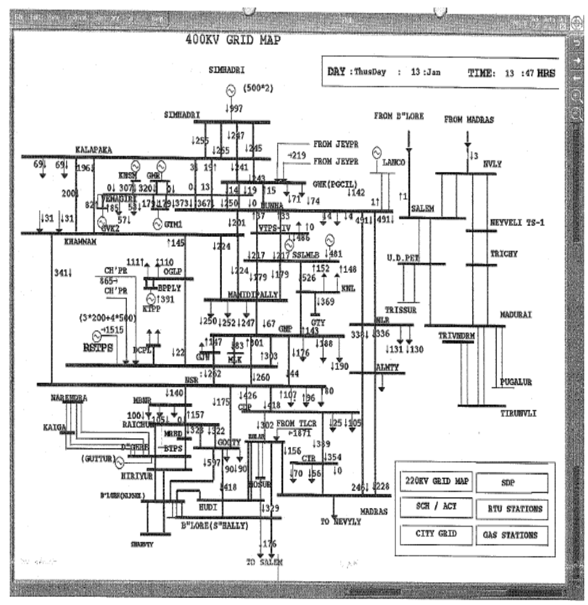

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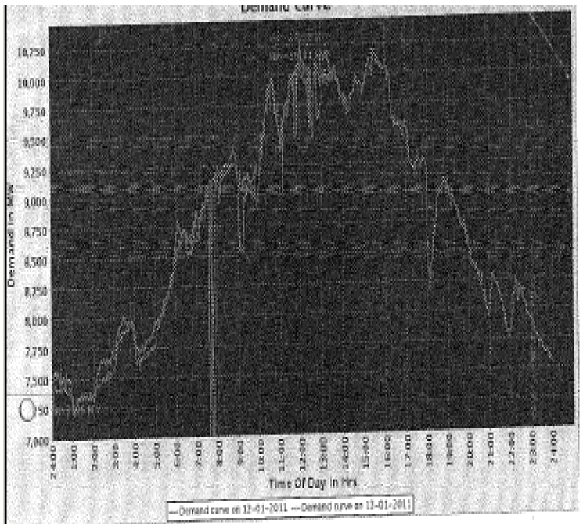

Fig 17

