



INDIAN INITIATIVE IN ADOPTION OF SMART GRID TECHNOLOGY

(A CASE STUDY OF PUDUCHERRY FIRST PILOT PROJECT)

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ABSTRACT

Smart grid is a rationalized power grid that utilizes technical communication as well as data between the supplier and the customer relation in a mechanized approach to progress system competence, dependability, concentrating in allocation areas which are facing high transmission fatalities. The involvement of customers regarding this technology is considerably employed for the supervision of the power and the management of the grid and during the time of peak stage of load, outage administration, and demanded side management to increase the value of supply to the consumer. There is bilateral communication between consumer & supplier based on information fed in the system. The technology related to the Smart grid has been adopted worldwide as cost effective & way to improve quality of supply to the consumer. However, after having been applied this technology top 10 highly developed countries got advantaged in a considerable way.

Therefore, India has taken up this project to confirm the advantages this technology connected to the smart grid and initiated 14 projects on pilot basis situated in the 5 areas of grids. By creating an agreement of MOU between Electricity Department & Power Grid Corporation Puduchery, considered as the first pilot project India, was begun on 2nd march 2013. Indian Government has also established the smart grid commission to monitor the development of pilot projects by taking 5 working groups namely:

Working group 1: Aimed for trials & pilots on new technological advances.

Working group 2: Will monitor loss reduction & thievery, data acquiring & analysis.

Working group 3: energy to remote areas & its reliability & quality, power to urban areas.

Working group 4: Distributed generation & renewable integration with power grid & its impact.

Working group 5: Physical cyber security & standardization of smart grid technology.

By operating in sequence, milestones will be attained in most efficient & seamless operation in the grid system. The information presented in this paper of AMI infrastructure & implementation methodology is discussed to obtain numerous advantages of the technology connected to smart grid which is being implemented in our country. The technology of Smart Grid gives an assurance for the finest using of the energy & supply facilitates us an enhanced preparation for outage response & recovery facility along with the combination of heterogeneous technology around the grid, such as renewable energy system, electrical vehicle net works & smart home, smart energy grids by encountering enormous engineering challenges including instant billing, error statement remote metering & substation operation. Consumers servicing through internet & telephone call centers

Key Words: Smart Grid Technology, Working Groups, Modernization of Electrical Grid, Information & Communication Technology & Worldwide Adoption.

1. INTRODUCTION ABOUT PUDUCHERRY

- It is capital of Puducherry State under Union Territory.
- It has a population of 12,44,464 as per 2011 census.

- It is the Union Territory consisting of 4 small unconnected districts namely Pondicherry, Karikal, Yaman, Mahe.
- City of Puducherry was planned on the source French architecture with perpendicular streets.
- State Bird – Koel
- State Animal – Squirrel
- State Flower – Cornival
- State Tree – Bael.

2. MW GAS POWER PLANT IN KARIKEL

- Puducherry has Geographical area of 293 Sqkms.
- Karikel 160 Sqkms, Mahe-9 Sq kms, Yaman-30 Sq kms.
- All districts are located on coastal areas.
- Puducherry and Karikel are near Tamilnadu coastal, Yaman near AP, Mahe near Kerala.
- Linguistics – Tamil 89%, Malayalam -4.8%, Telugu-2.9% and others-3%.
- From year 1673- 1954 it was called as French India.
- India's capital consumption is 900 units per Year, while that of Puducherry state consumption is 1800 units per year.
- India's installed capacity in power generation is 2,15,000 MW, while Puducherry's is 230 MW
- There are 2,30,000 electricity consumers, from that 87,000 shall be smart consumers in next 5 years.
- At present, around 1400 consumers are installed with smart meters.
- On the 2nd March of 2013 the Power Grid Corporation India Ltd Signed MOU with Puducherry Electricity Dept to implement first the project related to Smart Grid in the Country on Pilot Basis. The Indian Govt. has established Smart Grid mission to monitor the Progress.
- This Would be extended to total fourteen city of the country (refer table No. 1). This Pilot Project related to Smart Grid would Cost about 77 cores for Puducherry Project, from which 25 crores will be given by Central Government & 52 crores would by State Govt. of Pondicherry.
- This scheme will include the Installation of highly developed metering infrastructure in Synchronous with central data control centers.
- This would avail exact billing amount on the spot time and accordingly Electricity board would monitor power uses and detect mall practice or power thievery.
- It is expected that electricity board would produce an extra income of 12.25 Crores per year without any investment. This paper will give us present status of

project of our country and whole world. This will give us infrastructure and the implementation procedure and lastly the profits I relation to this technology. This paper will describe Indian task force and working groups which have been constituted to take up different task correlated to Smart Grid activities.

- WG1 – Trials/Pilot on new technologies.
- WG2 –decreasing of Loss and thievery, collecting of data and scrutiny.
- WG3 – Electricity to remote places and dependability & valuable power to urban areas.
- WG4 – Dist Generation & renewable.
- WG5- Physical cyber security, standard and Spectrum.

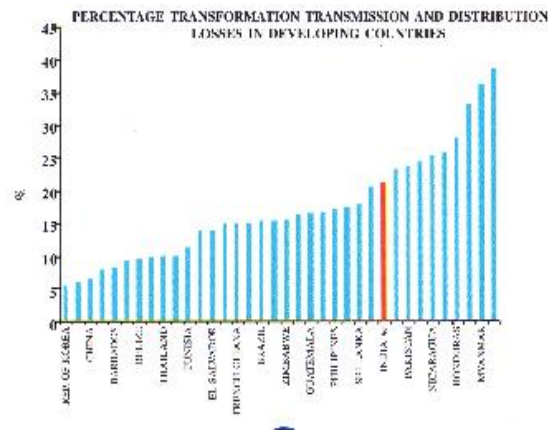


Fig 1: India At & C Losses 28%

The states and province of India by established ability of power services are hereby listed in this figure in a method of power production broke-up as of 30 June 2012 and 31 Jan 2013 showing through figures in millions of watts (Megawatts).

3. INDIA SMART GRID TASK FORCE

- The Task Force of Indian Smart Grid is an inside missionary group and which works as a crucial part of the Govt. to carry on various duties connected to the Smart Grid
- The chief responsibilities of ISGTF relevant to the Smart Grid are:
 - a) To make sure of the alertness of management and cooperation in carrying various duties associated with the Smart Grid Technology.



- b) Practices & services for research & development of Smart Grid.
- c) Coordinates, combines and works together with other related inter governmental activities.
- d) Collaborates on interoperability framework.
- e) Review & validate recommendations from Indian Smart Grid Forum etc.
- f) This Project includes highly developed metering communications in synchronous with central data control centers.
- g) This would avail exact billing amount at any spot of time and accordingly Electricity board would monitor power uses and detects mall practices or power thievery. Expected that electricity board generally produces extra income of 12.25 Cr per annum without any investment.

4. FEATURES OF SMART GRID

The technology related to the smart grid stands for the gathering of existing and planned reactions and to face the targets and challenges while supplying the power. Since it has different range of aspects there are several challenging classifications and it has no particular universal definition. Nevertheless, one possible categorization is given here.

4. RELIABILITY

Without interference of technicians the technologies related to smart grid can be utilized for the improvement of the fault directions by allowing the self-healing of the system. This will definitely give a guarantee for the more consistent supply of power, and can decrease delicateness against natural calamities or attacks.

5. COMPONENTS OF SMART GRID

CONTROL CENTER AT PUDUCHERRY

5.1. Smart Meters

5.2. (DCU) Data Concentrator Unit

5.3 (MDAS) Meter Data Acquisition System

5.4 (MDMS) Meter Data Management System

5.5 (OMS) Outage Management System

These components will interact with SACADA system & billing section.

Presently 1400 smart meters from different manufacturers along with 6 DCU are working on three different communication techniques viz. PLC (POWER LINE CARRIER), RF-1 (RADIO FREQUENCY) 865 MHz, RF-2 4GHz.

Data from smart meters are fed to MDAS and further

MDMS through GPRS system.

DCU will work in group of 40 to 50 meters.

Data from smart meters are regularly monitored & analyzed to have better insight into consumer use pattern.

6. SMART HOMES

Smart homes use advanced technological solution to undertake more rational electricity consumptions of home appliances viz . Television, Fridge, Microwave, Heaters, Gysers, Mixers Air Conditioners etc. which can be operated remotely. This allows us to protect more power thereby to save our natural resources. A model of smart home was established at Puducherry near Smart Grid Control Center, to demonstrate its functionality in the Network of Smart Grid.

7. SMART GRID AND ITS ADVANTAGES

The smart grid will speed-up the implementation of innovative technologies, in creating jobs, offering digital valuable power, minimizing the delivery costs of power, preventing blackouts and brownouts, pollution.

It developing effective supply of power, and encourages the progress of allotted and renovation of resources.

An intellectual, self-repairing grid which expects and prevents natural disorders or man-made troubles and significantly decreases expensive blackouts and interruptions in power supply.

It is an inexpensive and at a low economical price the best power supplying generators and transmitting of related information

A fresh grid that works more speedily to fetch renovate and finest distributing production.

Micro-grids - Smart energy management technologies also bring in numerous potentialities for micro grids not available to the larger grid. They might supply DC power instead of standard AC, which is a tremendous energy and cost saver since digital equipment which typically runs on DC containing an expensive power transmission technology. Micro Grids can also be mechanically operated by Electronical intelligence in conjunction with building energy management systems and smart equipment, thus reducing operating costs.

Lot of governments, in order to update their existing systems of communications at national level in worldwide, are encouraging smart grid initiatives as a cost effective way while providing the combination of resources at low level energy of carbon (like solar ,wind, biomass) & customer



participation in the system management.

8.1 USA Under AMERICAN RECOVERY & REINVESTMENT ACT (ARRA) 2009

A combined investment of over 8 billion \$ in smart grid capabilities is expected.

LIST OF TOP 10 SMART GRID PROJECTS IN USA ARE BASED ON NUMBER OF METERS INSTALLED IS GIVEN BELOW.

S.NO.	PLANT NAME	CAPACITY
1.	Florida Power & Light Company (Energy Smart Florida)	23,59,736
2.	Center Point Energy Houston Electric LCC (Smart Grid Project)	21,25,678
3.	NV Energy	9,02,272
4.	Detroit Edison Company (Smart Current)	6,25,468
5.	Sacrament Municipal Utility District(SMART SACRAMENT)	6,17,502
6.	Central Marine Power Company (CMPC Advanced Metering)	6,06,164
7.	Duke Energy Smart Grid Development	4,67,619
8.	Salt River Project	4,31,913
9.	Idaho Poma Company (IPC-Smart Grid Project)	3,80,928
10.	Pepco Holiday Inc-Dc(Smart Grid Project)	2,57,224

Table 1: List of Top 10 Smart Grid Project in USA

8.2 SOUTH KOREA JEJU SMART GRID DEMONSTRATION PROJECT (3 STAGE PROGRAM)

I Stage Testing station - 2012

II Stage S G Infrastructure focus on consumers between Korea's Metropolitan area-2020

III rd Stage Nationwide Smart Grid would be completed by 2030.

8.3 JAPAN MINISTRY OF ECONOMY TRADE & INDUSTRY

National committee 2008-2009

T&D infrastructure 2009-2010

Tohoku earthquake March 2011

8.4 UK SMART GRID INITIATIVE

SMART GRID GAS METRES 6,00,000(0.6 million already installed in 2012)

53 MILLION to be installed by 2019

8.5 MALAGA SMART CITY PROJECT(SPAIN)

Malaga was the first European trial city in 2009

Local residents will be having smart meters-can manage remotely & make consumption more efficient - smart houses.

COMPARISON BETWEEN EXISTS SYSTEM & SMART GRID SYSTEM

S.NO.	CONVENTIONAL	SMART SYSTEM
1.	Electromagnetic metering	Digital metering
2.	One way communication	Two way communication
3.	Centralized Generation	Distributed Generation
4.	Few sensors in the system	Sensor throughout the system
5.	Manual monitoring & Restoration	Self Monitoring & Healing
6.	Frequent Interruptions & Blackouts	Adoptive IS Landing
7.	Limited Control	Pervasive Control
8.	Passive Consumers	Active Consumers

Table No 2: Comparison Between Exists System & Smart Grid System



Fig 2: Pondicherry City Map

Smart Grid Pilot Projects in Power Distribution Sector in India

S.No.	Utility Name	Area Proposed	Functionality Proposed*	Initial Consumer Base
1	CESC, Mysore, Karnataka	Mysore Additional City Area Division	AMI R, AMI I, OM, PLM, MG/ DG	21,824
2	APCPDCL, Andhra Pradesh	Jeedimetla Industrial Area	AMI R, AMI I, PLM, OM, PQM	11,904
3	APDCL, Assam	Guwahati Project Area	PLM, AMI R, AMI I, OM, DG, PQM	15,000
4	UGVCL, Gujarat	Naroda / Deesa	AMI R, AMI I, OM, PLM, PQM	39,422
5	Maharashtra	Baramati, Pune	AMI R, AMI I, OM	25,629
6	UHBVN, Haryana	Panipat City SubDivision	AMI R, AMI I, PLM	30,544
7	TSECL, Tripura	Electrical Division No. 1, Agartala	AMI R, AMI I, PLM	46,071
8	HPSEB, Himachal Pradesh	ESD Kala Amb Under Electrical Division, Nahau	AMI I, OM, PLM, PQM	650
9	Puducherry	Div 1 of Puducherry	AMI R, AMI I	87,031
10	JVVNL, Rajasthan	VKIA Jaipur	AMI R, AMI I, PLM	2,646
11	Chattisgarh	Siltara, Chattisgarh	AMI I, PLM	508
12	PSPCL, Punjab	Mall Mandi City Sub-Division Amritsar	OM	9,000
13	KSEB, Kerala		AMI I	25,078
14	WBSEDCL, West Bengal	Siliguri town, Darjeeling District	AMI R, AMI I, PLM	4,404

*Legend:

S.No.	Functionality Abbreviation	Functionality
1	AMI R	Advanced Metering Infrastructure for Residential Consumers
2	AMI I	Advanced Metering Infrastructure for Industrial Consumers
3	OM	Outage Management
4	PLM	Peak Load Management
5	PQM	Power Quality Management
6	MG	Micro Grid
7	DG	Distributed Generation

Fig 4: Distribution Sector of Indian Smart Grid Pilot Project

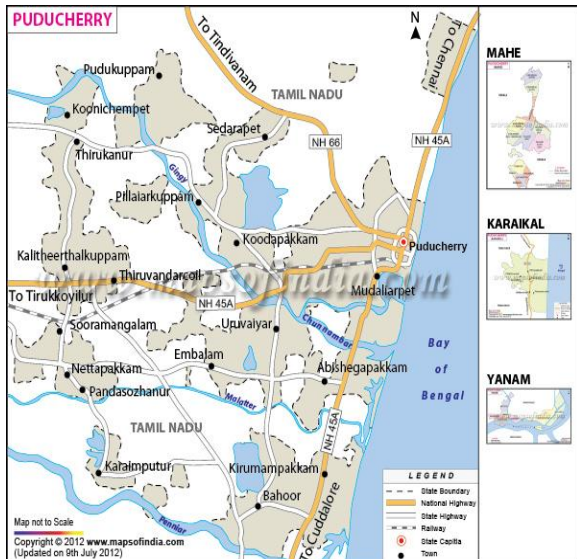


Fig 3: Puducherry, Karaikal, Mahe & Yanam Map

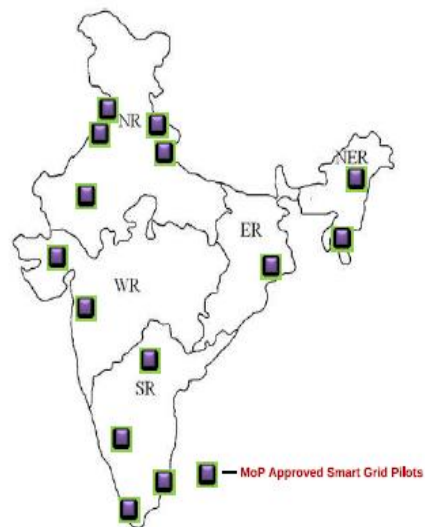


Fig 5: Regional Smart Grid pilot projects in India

Smart Grid : Milestones

POWERGRID has appointed a Panel of Experts to advise upon WAMS Implementation in Indian Power System.

PMU installation as Pilot project for each region in the country underway

- Northern Region (9 PMUs) - Already installed
- Northern Region phase 2 - (14 PMUs)
- Southern Region (6 PMUs)
- North Eastern Region (6 PMU)
- Western Region (6 PMUs)
- Eastern Region (8 PMUs)

Distribution Reforms Six Level Intervention Strategy

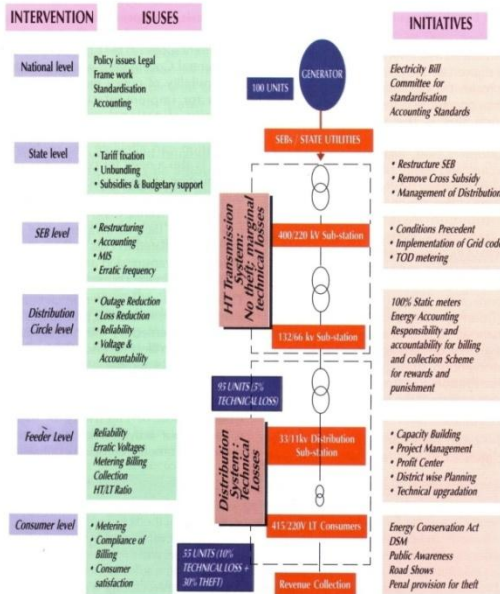
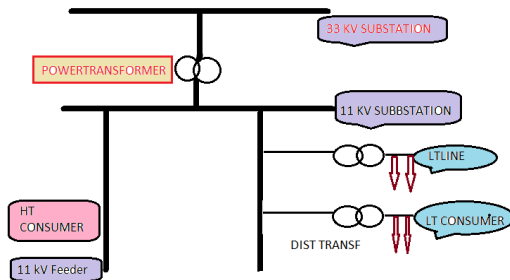


Fig 6: 33 KV Distribution Systems to Lt. Consumer

Fig 7: Smart Grid Digital Meter

Smart Grid - the future Conservation of Energy



Outcome of the Distribution Reforms

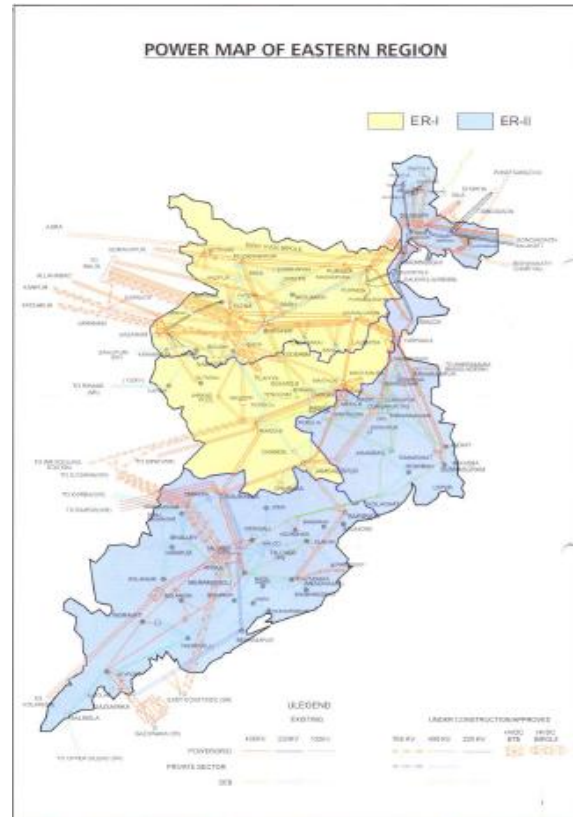
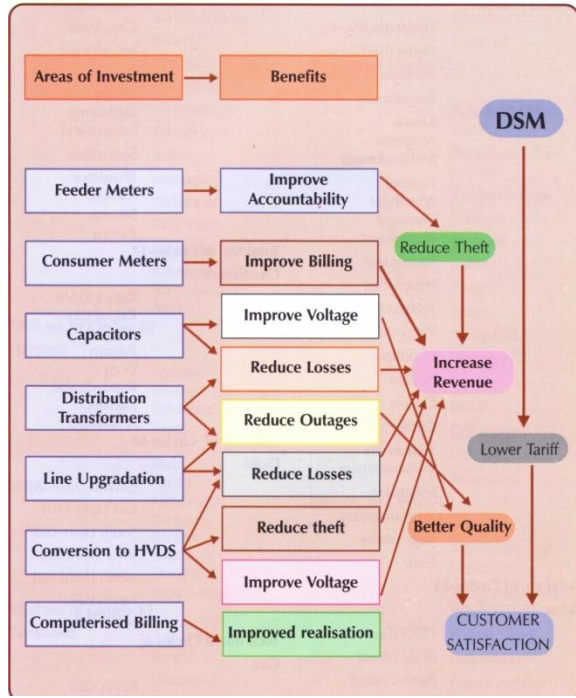
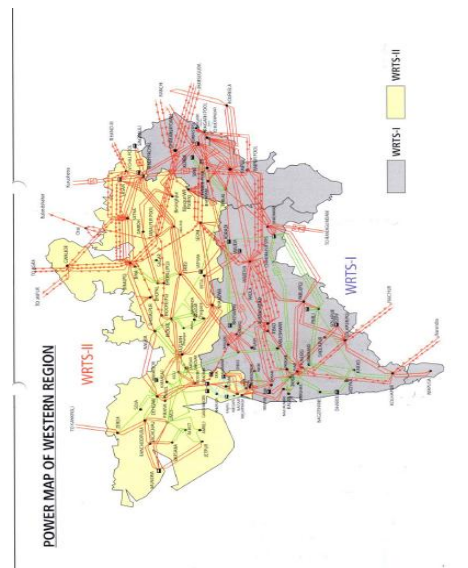


Fig8: The outcome of Distribution Reforms

- Smart Grid with 1400 smart meters is already installed at puducherry smart grid project.
- At least 15% energy saving has been done.
- Our object is to ensure energy conservation and help to enhance fineness of life in society.

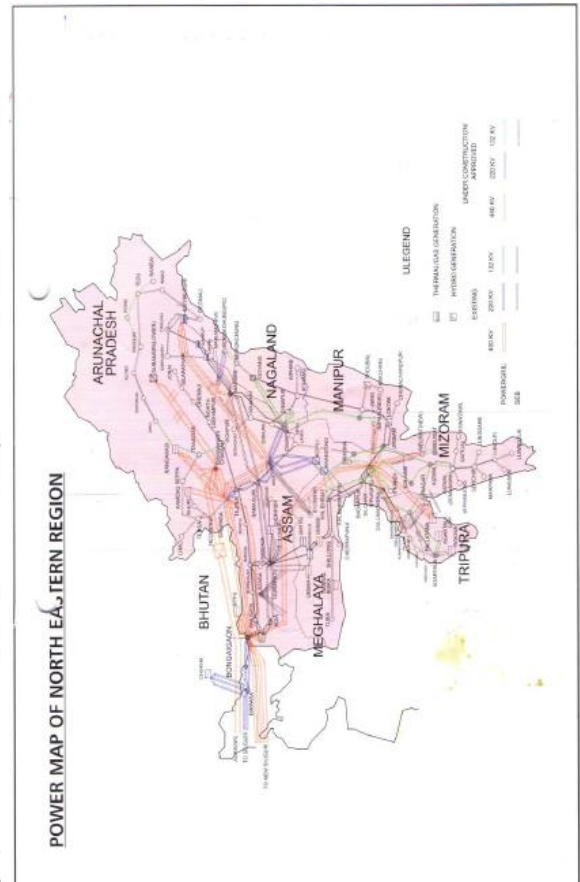
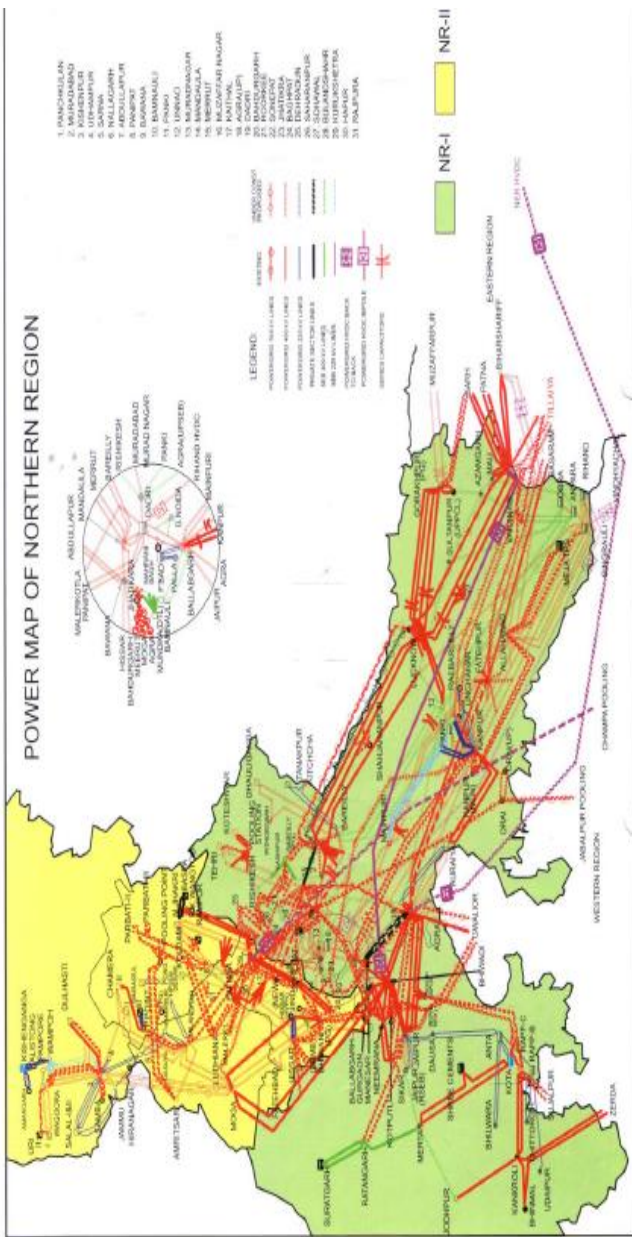
Map1: Power Map of Eastern Region



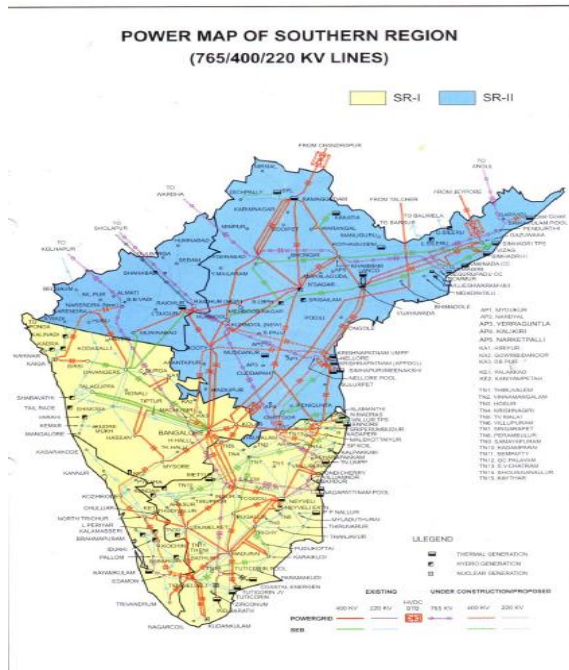
Map 2: Power Map of Western Region

Fig 11: Power Map of Northern Region

Map 3: Power Map of Northern Region



Map 4: North Eastern Region



Map 5: Southern Power Grid

CONCLUSION:

The exploitation of Smart Grid System makes it robust, stable. Smart grids in a long run can reduce power cuts in India. Currently there are 14 pilot projects (Details in Table No.1) which were proposed of which, Puducherry project is first of its kind and completed with around 1400 smart meters installed in Ist Phase by 30th November 2013. The results of the same are being analyzed in Industrial & residential sectors. The crucial goals have been attained in reduction of Aggregate Transmission & Commercial losses (AT & C) from 26.16% to 8.88%. Consumers are very conscious of their consumption & Billing procedure through Smart Metering Infrastructure. In the smart grid project of Puducherry power grid has

developed consumer utility center interactive with pilot project of smart grid that covered the following advantages.

It enables us to integrate multiple ways project of modernizing power sources namely solar, wind & fuel cells, smart metering, controlling of electricity with highly developed metering technology, management of supplying quality power, controlling of Peak load levels, outage management system. Micro grid, storage technology and electrical vehicle station. The above projects are to implement for the security of public, transport system, waste management, E-Public services, smart building & smart homes.

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