37

STANDING COMMITTEE ON ENERGY

(2012-13)

FIFTEENTH LOK SABHA

MINISTRY OF POWER

Development of National Grid

THIRTY SEVENTH REPORT

LOK SABHA SECRETARIAT
NEW DELHI

May, 2013/Vaisakha, 1935 (Saka)

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(FIFTEENTH LOK SABHA)

MINISTRY OF POWER

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Presented to Hon'ble Speaker on 25.05.2013

Presented to Lok Sabha on .....

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LOK SABHA SECRETARIAT
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31. Shri Motilal Vora

SECRETARIAT

1	Shri Brahm Dutt	Joint Secretary
2	Shri N.K.Pandey	Director
3.	Shri Manish Kumar	Executive Assistant

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* Passed away on 1st March, 2013
@ Ceased to be Member of the Committee w.e.f. 01.05.2013
# Nominated as member of the Committee w.e.f. 28.03.2013

ACRONYMS

AC	-	Accelerated Current
AT&C	-	Aggregate Technical and Commercial Losses
BTPS	-	Badarpur Thermal Power Station
CCGT	-	Combined Cycle Gas Turbine
CEA	-	Central Electricity Authority
CERC	-	Central Electricity Regulatory Commission
CESC	-	Calcutta Electric Supply Corporation
cKm	-	Circuit Kilometers
CPP	-	Captive Power Plant
CTU	-	Central Transmission Utility
D/C	-	Direct Current
DMRC	-	Delhi Metro Rail Corporation
DR	-	Disturbance Recorder
DTL	-	Delhi Transco Limited
DVC	-	Damodar Valley Corporation
EHV	-	Extra High Voltage
ER	-	Eastern Region
FOR	-	Forum of Regulators
GW	-	Giga Watt
HCPTC	-	High Capacity Power Transmission Corridor
HEP	-	Hydro Electric Power
HVDC	-	High Voltage Direct Current
Hz.	-	Hertz
IEGC	-	Indian Electricity Grid Code
IEX	-	Indian Energy Exchange
IPP	-	Independent Power Producer
ISTS	-	Inter State Transmission System
J&K	-	Jammu & Kashmir
kV	-	Kilovolts
kWh	-	Kilowatt hour
MMRE	-	Ministry of New and Renewable Energy
MoP	-	Ministry of Power
MU	-	Million Unit
MVA	-	Mega Volt Ampere
MW	-	Mega Watt
NALCO	-	National Aluminium Company
NDMC	-	New Delhi Municipal Council
NER	-	North Eastern Region
NEW Grid	-	Northern, Eastern, North-Eastern and Western Grid
NLDC	-	National Load Despatch Centre
NR	-	Northern Region
NRLDC	-	Northern Regional Load Despatch Centre
NRPC	-	Northern Regional Power Committee

PMU	-	Phasor Measurement Unit
POSOCO	-	Power System Operation Corporation Limited
PSB	-	Power Swing Blocking
PSS	-	Power System Stabilizer
PXIL	-	Power Exchange of India Limited
RE	-	Renewable Energy
RES	-	Renewable Energy Source
RLDC	-	Regional Load Despatch Centre
RoW	-	Right of Way
RPC	-	Regional Power Committee
RPO	-	Renewable Purchase Obligation
RSTCL	-	Raichur Sholapur Transmission Company Limited
S/C	-	Single Circuit
SEB	-	State Electricity Board
SHP	-	Small Hydro Power
SLDC	-	State Load Despatch Centre
SR	-	Southern Region
STU	-	State Transmission Utility
TPS	-	Thermal Power Station
UFR	-	Under Frequency Relay
UHVAC	-	Ultra High Voltage Alternating Current
UI	-	Unscheduled Interchange
URTDSM	-	Unified Real Time Dynamic State Measurement
UT	-	Union Territory
WAMS	-	Wide Area Monitoring Systems
WR	-	Western Region

INTRODUCTION

I, the Chairman, Standing Committee on Energy having been authorized by the Committee to present the Report on their behalf, present this Thirty Seventh Report on Development of National Grid pertaining to the Ministry of Power.

2. The Committee took evidence of the representatives the Ministry of Power on 1st November, 2012 and 19th December, 2012. The Committee wish to express their thanks to the representatives of the Ministry of Power for appearing before the Committee for evidence and furnishing the information, desired by the Committee in connection with the issues relating to the subject.

3. The Report was considered and adopted by the Committee at their sitting held on 7th May, 2013.

4. The Committee place on record their appreciation for the valuable assistance rendered to them by the officials of the Lok Sabha Secretariat attached to the Committee.

5. For facility of reference and convenience, the observations and recommendations of the Committee have been printed in bold letters in Part-II of the Report.

NEW DELHI
07th May, 2013
Vaisakha 17, 1935 (Saka)

MULAYAM SINGH YADAV
Chairman,
Standing Committee on Energy

REPORT

PART – I

NARRATION ANALYSIS

I. INTRODUCTORY

The exploitable energy resources are not uniformly distributed in the Country. As a result, some regions do not have adequate natural resources for setting up power plants to meet power requirements, whereas, others have abundant natural resources. Since, the generating power stations development is based on natural resources, therefore, there is a need to transport bulk power across various regions of the Country efficiently and economically. This necessitates setting up of the National Grid which connects various regions of the Country in a continuous network of transmission lines integrated into one grid so as to transmit power from resource rich areas to deficit areas as well as to facilitate scheduled and unscheduled exchange of power.

1.2 In 1989, transmission wings of Central generating companies were separated to set up Power Grid Corporation of India Limited (PGCIL) to give thrust to implementation of transmission system associated with Central generating stations and Inter-Regional transmission programme based on perspective planning done by CEA. Till then, the generation and transmission systems in the country were planned and developed on the basis of regional self sufficiency and the initial set of inter-regional links developed under the Centrally sponsored programme for building inter-state infrastructure of State utilities, was utilized to facilitate exchange of operational surpluses among the various Regions in a limited manner because the Regional Grids operated independently and had

different operating frequencies and the power exchanges on these inter-regional links could take place only in radial mode.

1.3 Since the advent of the current century, the focus of planning the generation and the transmission system in the Country has shifted from the orientation of regional self-sufficiency to the concept of optimization of utilization of resources on all-India basis. Generation planning studies carried out by CEA had indicated that the capacity addition planned on all-India basis is less than planned on regional basis. Further, a strong all-India integrated national grid enables harnessing of unevenly distributed generation resources in the Country. Recognizing the need for development of National Grid, thrust was given to enhance the capacity of inter-regional links in a phased manner.

1.4 Considering the operational regime of the various Regional Grids, it was decided around 1990s to establish initially asynchronous connection between the Regional Grids to enable them to exchange large regulated quantum of power. Accordingly, a 500 MW asynchronous HVDC back-to-back link between the Northern Region and the Western Region at Vindhyachal was established. Subsequently, similar links between Western Region and Southern Region and between Eastern Region and Southern Region and between Eastern Region and Northern Region were established.

1.5 In 1992, the Eastern Region and the North-Eastern Region were synchronously interconnected through Birpara-Salakati 220kV double circuit transmission line and subsequently by a 400 kV D/C Bongaigaon -Malda line. Western Region was interconnected to ER-NER system synchronously through

400kV Rourkela-Raipur D/C line in 2003 and thus the Central India system consisting of ER-NER-WR came in to operation. In 2006 with commissioning of Muzaffarpur-Gorakhpur 400kV D/C line, the Northern region also got interconnected to this system making an upper India system having the NR-WR-ER-NER system. In 2007 NR was also synchronously interconnected with WR through Agra-Gwalior 765kV S/C line-1 400kV operation. Now, the Government has planned synchronous interconnection of Southern Grid with North, West, East and North-Eastern Grid (NEW Grid) through two high capacity lines by March, 2014.

1.6 The following major benefits have been envisaged by establishment of a National Grid:

(i) It would enable optimal setting, development and utilization of power potential through coal, hydro and other resources, in the overall interest of the Nation.

(ii) It would enable bulk exchange of electricity from one part of the Country to another part.

(iii) It would be beneficial in optimization of generation capacity requirement due to various factors like time diversity, spinning reserves requirements, improvement of hydro-thermal mix of connected regions.

(iv) It would extend economies of scale by enabling setting up of large sized pit-head based power stations and considerably cheaper cost of transmission of power compared to transportation of fuel.

(v) It would enable exchange of power amongst the regions for optimization of generation resources, meeting commercial obligations and meeting emergencies in other regions.

(vi) Improve economy, reliability and quality of power supply.

II. Synchronous Inter-connection of Southern Grid with NEW Grid

1.7 The development of National Grid has been a gradual process involving the setting up of five regional grids namely Northern Grid (NR), Eastern Grid (ER), Western Grid (WR), Southern Grid (SR) and the North-Eastern Grid (NER) with interconnection between these regional grids. This process involved setting up of asynchronous interconnections between the above regional grids initially and then establishing synchronous interconnections with All-India integrated planning. Four regional grids viz. Northern Grid (NR), Eastern Grid (ER), Western Grid (WR) and the North-Eastern Grid (NER), also known as NEW Grid, are interconnected in synchronous mode, whereas, Southern Region is presently connected to NEW Grid through HVDC (asynchronous) link with 4000 MW capacity.

1.8 When asked about the concept of grid inter-connection in synchronous and asynchronous mode, it was elaborated that in synchronous mode two buses are interconnected by an AC (Alternating Current) line, while an HVDC interconnection is called an asynchronous interconnection. When a synchronous interconnection is established, the two substations and their grids are combined to form one grid and all substations in the combined grid would have the same frequency and events like faults, contingencies, voltage conditions etc. in any part of the grid would have an impact on the entire grid.

1.9 In a synchronous interconnection, power flow through the synchronous link depends upon laws of physics and cannot be controlled. In case of an asynchronous link, the power is converted from AC to Direct Current (DC) power and then converted back into AC power again. Hence, the parameters of individual grids remain as they were before interconnection.

1.10 Benefit of asynchronous inter connection is that we can connect two grids having different frequencies through asynchronous link. Also, we can control the power flow through the link, unlike a synchronous link. Drawback of asynchronous link is that the conversion of AC to DC and back to AC would require installation of converters which are cost intensive. Such a link is cost effective for transmission of power over a long distance. Further, it is used for point-to-point long distance transmission of power.

1.11 Synchronization of Southern Region with NEW Grid is under implementation through two 765 kV lines connecting Solapur (WR) to Raichur (SR). One of the circuits is being implemented by a private company selected through competitive bidding route. The other circuit is being implemented by PowerGrid. These links will pave the way for interconnection of all five regional grids in synchronous mode having same frequency.

1.12 Replying to a query raised by the Committee about the time period for the completion of these projects, the Secretary, Ministry of Power, deposed before the Committee:

> "One of the points that came up last time was the inter-connection of Southern region with the rest of the country. We informed last time that two lines were being developed to connect the Southern region with the rest of the country. These two lines of 765 KV between Raichur and Sholapur are being developed. This work is likely to be completed by January 2014."

1.13 The cost of one circuit of 765 kV Raichur-Sholapur line, being implemented by Raichur Sholapur Transmission Company Limited (RSTCL), at the time of bidding was estimated at Rs.440 crores. The cost of second circuit of 765 kV

Raichur-Sholapur line being implemented by POWERGRID has been estimated at Rs.246.37 crores. In regard to arrangement of funds for these projects, it was stated that the respective companies would finance the project through internal resources and debt from the market.

1.14 The status of progress of work of the above projects as furnished by the Ministry of Power is given below:

Line being implemented by	Line Length (km)	Tower Location (Nos.)	Stub Completed (Nos.)	Tower erected (Nos.)	Stringing Completed (KM)	Problem being faced
RSTCL	208	541	218	9	0	Right of Way problem at 18 locations in Afjalpur area and 12 locations at Jewergi area in Karnataka. RSTCL is taking action to resolve the problem.
POWER GRID	208	547	75	8	0	-

1.15 When the Committee asked about the details of Right of Way (RoW) problems and the remedial action taken by the RSTCL, it was stated that now, RSTCL has resolved ROW issues at all the 18 locations in Afjalpur area in Karnataka. As regard 12 locations facing ROW problems in Jewergi area in Karnataka, issues have already been resolved at 6 locations. The land owners at other locations have been demanding higher compensation for their land for which action is being taken by RSTCL. It was further stated that all projects under competitive bidding are being monitored by the Government periodically and whenever the intervention of the Government is requested for by the company it is extended appropriately.

III. Strengthening of National Grid

1.16 All India installed capacity (in MW) of power stations located in the regions of main land and islands as on 31.03.2013 is as follows:

SL. NO.	REGION	THERMAL				Nuclear	HYDRO (Renewable)	R.E.S.@ (MNRE)	TOTAL
		COAL	GAS	DSL	TOTAL				
1	Northern	32413.50	4781.26	12.99	37207.75	1620.00	15467.75	5589.25	59884.75
2	Western	49257.01	8988.31	17.48	58262.80	1840.00	7447.50	8986.93	76537.23
3	Southern	25032.50	4962.78	939.32	30934.60	1320.00	11353.03	12251.85	55859.48
4	Eastern	23457.88	190.00	17.20	23665.08	0.00	3981.12	454.91	28101.11
5	N. Eastern	60.00	1187.50	142.74	1390.24	0.00	1242.00	252.68	2884.92
6	Islands	0.00	0.00	70.02	70.02	0.00	0.00	6.10	76.12
7	All India	130220.89	20109.85	1199.75	151530.49	4780.00	39491.40	27541.71	223343.60

Captive Generation Capcity in Industries having demand of 1 MW or above, Grid interactive(as on 31-03-2011)=34444.12 MW

@ Renewable Energy Sources (RES) includes Small Hydro Project(SHP),Biomass Power(BP), Urban & Industrial waste Power(U&I), Wind Energy and Solar Power.

1.17 Capacity addition to the tune of 88,537 MW has been envisaged for the 12th Plan from conventional source. Besides, a target of 30,000 MW has been set for New and Renewable sources. Being aware of the fact that National Electricity Policy emphasize for setting up more and more pit head power plants, the Committee enquired about the locations of the upcoming coal based thermal projects. In reply to that it was informed that coal based thermal Projects totaling to 97,720 MW are under construction. Out of this 37,380 MW are located at Pithead, 14,910 MW are at coastal location, and 45,430 MW are at other locations.

1.18 Considering the fact that the transmission of electricity from one place to another is cheaper than that of transportation of coal, the very reason that necessitated the need for creation and development of a National Grid, the Committee asked as to why coal based thermal plants are still being planned at places other than the pit head or coastal locations. The Ministry in their written reply have stated as under:

"It has been inter-alia stipulated in the National Electricity Policy that:

(i) Imported coal based thermal power stations, particularly at coastal locations would be encouraged based on their economic viability.

(ii) Significant lignite resources in the country are located in Tamil Nadu, Gujarat and Rajasthan and these should be increasingly utilized for power generation.

(iii) For thermal power, economics of generation and supply of electricity should be the basis for choice of fuel from among the options available. It would be economical for new generating stations to be located either near the fuel sources e.g. at pithead locations or load centers.

For locating a thermal power station, availability of a large area of land, availability of large quantity of water for cooling and other infrastructure facilities like road and rail connectivity for transportation of equipments and coal are required. Thermal power projects are being set up in different states depending upon availability of land, water and other infrastructure facilities. Some plants near load centres are also considered necessary for energy security of those states."

1.19 The Secretary, Ministry of Power during the evidence, further explained the reasons for setting up of thermal power plants at locations other than pit heads or coastal areas as under:

"Transporting power is definitely cheaper than transporting coal. There is no dispute in that. When you are developing a huge system, you need also to take some technical factors into consideration. The experts in the power system believe that although you are trying to incentivise setting up of power plant near pitheads, yet, there should be a balance in terms of generation capacities coming up both near the pitheads as well as the load centres. The power experts feel that if all the generating stations are going to come up near the pitheads, this would not be in the best interest of the development of the Grid. So, they attempt to see the balance between the plants coming up near the pitheads as well as plants coming up from the load centres. This is how the power planning is done with the assistance and advice of technical experts. The additional point is that today, the generation activity in itself is delicensed. Nobody needs to take license; he can set up a plant of his choice subject to getting other clearances. Two things would operate here – one is the overall requirement of grid security, stability, etc. and other technical considerations which would expect you to plan a balanced development of generation plus you already have a delicensed activity where a person can choose that a place where he wanted to set up generation."

1.20 National Grid, which consists of Intra-State, Inter-State and Inter-Regional transmission network, is expressed in terms of total circuit kilometers of the transmission lines and the total transmission capacity of the sub-stations. At present about 2,70,000 circuit kilometers (ckm.) of transmission lines & about 4,20,000 MVA substation capacity is existing at the voltage level of 220kV and above.

1.21 Inter-Regional capacity of National Grid which was about 14,100 MW at the beginning of the 11th Plan was enhanced to 27,750 MW at the end of 11th Plan. The figure of 27,750 MW is capacity of inter-regional transmission links and it only gives an indication of the strength of bond between regional grids. These inter-regional links are used to facilitate the exchange of power among various regions. Details of the inter-regional capacity are as follows:

- **NR to ER - 12130 MW**
- **NR to WR - 4220 MW**
- **WR to SR - 1520 MW**
- **WR to ER - 4390 MW**
- **ER to SR - 3630 MW**
- **ER to NER - 1260 MW**
- **Other Inter-Regional links - 600 MW**

1.22 It was informed that strengthening of National Grid is being done to meet the requirement of inter-regional transfer of power from various generation projects being set-up in the country with beneficiaries across the regions. Earlier, generation/ transmission planning was being done on regional self-sufficiency basis. However, as the generation resources in the country are concentrated in a few pockets, with load centres located at far-off locations, need was felt for bulk transfer of power across the regions. Accordingly, inter-regional interconnections

were established among the regions in a phased manner depending upon the requirement of power transfer across the regions.

1.23 The inter-regional transmission capacity is planned to be enhanced to about 66,000 MW from 27,750 MW by adding 38,400 MW during the 12th Plan. It was informed that it is in consonance with the requirement of generation addition during the plan. In addition, intra-State transmission system is being added/ planned by State transmission Utilities for implementation to cater to power transfer within the State. At 220 kV & above level, about 1,07,000 circuit kilometers of transmission lines, sub-stations of 2,70,000 MVA and HVDC terminals of about 12,750 MW capacity are planned to be added to meet the 12th Plan requirement.

1.24 In regard to the targets of transmission capacity addition during the 12th Plan, the Secretary, Ministry of Power, during the evidence stated as under:

> "In the Twelfth Plan, the generation capacity addition is expected to be about eighty eight thousand five hundred megawatts. On this basis, an assessment has been done as to what will be the inter-regional transfer capacity required and with this estimation, we are planning to develop inter-regional capacity of thirty eight thousand four hundred megawatts in the Twelfth Plan. This will be in addition to the transmission lines that will be built both for inter-region or intra-state during the Twelfth Plan."

1.25 *The Committee was informed that the fund requirement for development of transmission system proposed for the 12th Plan is estimated to be of the order of Rs. 2,00,000 crore. When the Committee desired to know as to how this huge amount of fund will be arranged, the Secretary, Ministry of Power deposed before the Committee as under:*

> "We will get the viability gap funding. The Planning Commission also agreed to the power sector getting it. Intra-State power transmission projects will be eligible for viability gap funding. If you look at Rs. 200,000 crore figure that is mentioned there, there are three components – Central

Transmission Utility, that is, PowerGrid, private licencees and State Transmission Utilities. CTU will not have any difficulty in raising the money and they do not need viability gap funding. The same will hold good for licencees. It could be the State Transmission Utilities which could be in need of viability gap funding, which they will get. There will not be a problem. For the State Transmission Utility, which constructs intra-State transmission systems, will be eligible for viability gap funding."

1.26 *When the Committee asked about the details of the transmission projects proposed for the 12th Plan, in a written reply the Ministry have stated as under:*

"A number of inter-regional transmission links have been planned to be added during the 12th Plan period. These links have been planned either as associated with the generation projects or as system strengthening schemes. Their implementation would depend upon the progress of associated generating stations. Details of Inter-Regional Transmission links planned for XII Plan is given below:

Details of Inter-Regional Transmission links planned for XII Plan	
Inter-Regional Link	**Transmission Capacity in MW**
ER –NR :	
Gaya-Varanasi 765kV S/C	2,100
Barh-Gorakhpur 400kV D/C quad	1,600
Sasaram-Fatehpur 765kV S/C - line#2	2,100
ER-NR total	**5,800**
ER - WR :	
Ranchi – WR(Bilaspur)Sipat Pooling Point 765kV S/C via Dharamjaigarh	2,100
Ranchi- Dharamjaigarh 765kV S/C	2,100
Jharsuguda -Dharamjaigarh-765kV D/C	4,200
ER-WR total	**8,400**
ER - NER :	
Bongaigaon-Siliguri 400kV D/C Quad to be LILOed at Alipurduar	1,600
ER-NER total	**1,600**
NR - WR :	
Agra-Gwalior 765kV S/C line-1 at 765 kV(earlier at 400kV)	1,000
Agra-Gwalior 765kV S/C line-2 at 765kV(earlier at 400kV)	1,000
Gwalior-Jaipur 765kV S/C#1	2,100
Gwalior-Jaipur 765kV S/C#2	2,100
RAPP C&D- Shujalpur 400kV D/C	1,000
Champa-Kurukshetra ±800kV 6000MW HVDC bipole line, Ph.-I	3,000
NR-WR total	**10,200**
WR-SR :	
Narendra(Kudgi) (GIS) – Kolhapur (new) 765kV D/C line (initially charged at 400 kV)	2,200

Details of Inter-Regional Transmission links planned for XII Plan	
Raichur-Sholapur 765kVS/C #1	2,100
Raichur-Sholapur 765kV S/C #2	2,100
WR-SR total	**6,400**
NER/ER-NR/WR :	
Bishwanath Chariyali – Agra ±800 kV, 3000 MW HVDC bipole.	3,000
LILO of ± 800kV Bishwanath Chariyali – Agra HVDC Bipole at new pooling station in Alipurduar and addition of second 3000 MW HVDC	3,000
NER/ER-NR/WR total	**6,000**
TOTAL ALL INDIA	**38,400**

1.27 *When the Committee asked about the problems/ hindrances being faced in implementation of transmission projects, the Ministry in their written reply have stated as under:*

> "Transmission projects are cross country and their implementation is greatly dependent on availability of Right of Way (RoW), apart from timely availability of forest clearances. While advance actions have been/ are being initiated for submission of forest clearance proposals and other requisite approvals, RoW resolution is progressing as the work progresses. Specific problems presently being faced in various Inter-regional lines are enumerated below:
>
> 765 KV single circuit (S/C) Ranchi – WR Pooling Station Line: Project involves about 316 hactares (ha) of forest, out of which clearance for 302 ha of forest area in Chhattisgarh is still awaited, which is affecting implementation of the project.
>
> 2xS/C 765 KV Gwalior – Jaipur Line: Project involves Great Indian Bustard and Chambal Wild Life Sanctuary. Considering that approval involves clearance from Hon'ble Supreme Court, through National Wild Life Board (NWLB), which is a long drawn process, timely availability of clearance would be critical for implementation of the link.
>
> Biswanath Chariali - Agra +/- 800 kV, 3000 MW HVDC Bi-pole: The link is meant to transfer power from various generation projects in North Eastern Region to Northern/ Western Region. It is gathered that the associated generation projects (Lower Subansiri & Kameng Hydro Electric Project (HEP) are affected due to agitation in Assam against large hydro project which may ultimately delay the generation project. The agitation coupled with militancy is also affecting associated evacuation lines. These are likely to affect implementation of the inter-regional link."

1.28 The Committee were informed that one of the major issues being faced in the laying of transmission line is the Right of Way (RoW). In this context, the Secretary, Ministry of Power before the Committee deposed:

"This is a matter [RoW] which is gaining a lot of importance now. We are finding it more and more difficult to get right of way. To get over this issue the Powergrid is adopting different strategies. They are going for higher and higher voltages to see that the right of way issues are reduced, and we have more transformation capacity per metre of right of way. The Powergrid is going in for higher voltages like 765 kV AC, HVDC and so on. They are also looking at innovative tower designs; they are looking at use of multi-circuit towers and so on to reduce the difficulties of right of way."

1.29 List of inter-regional links planned in XII Plan as furnished by the Ministry having issues and their status is given below:

Inter-regional link (Capacity)	Target	Status	Remarks (Issues, if any)	Actions taken to resolve the issues
Ranchi - WR Pooiling Station 765kV S/c line(2100 MW)	2013-14	Under implementation [Transmission System for DVC & Maithon Generation Projects]	Forest clearance for Chhattisgarh Portion of line is critical	Line is recommended in Forest Advisory Committee (FAC) and proposal is put up for approval of MEF. Matter is being followed-up constantly.
Gwalior-Jaipur 765kV 2xS/c lines (4200 MW)	2014-15 2015-16	Under implementation [one line in Orissa-C and other in Vindhyachal-IV & Rehiand-III TS	Line passing through Wild Life Sanctuary (Clearance Critical)	Wild life clearance for crocodile sanctuary for Rajasthan Portion discussed and recommended by NBWL in a meeting held on Dec.12, 2013. For MP portion it will be discussed in the next NBWL meeting. Matter is being followed-up constantly. After wild life clerance POWERGRID will move to Supreme Court for their permission.
Biswanath Chariali - Agra +/- 800 kV, 3000 MW HVDC Bi-pole (3000 MW)	2015-16	Under implementation [Tr. System for Lower Subansiri and Kameng HEPs]	Matching implementation of associated Generation Project in NER (Lower Subansiri & Kameng HEP), affected due to agitation against large hydro projects. Immediate evacuation lines also affected due militancy.	Matter is being followed-up constantly to implement transmission system matching with the progress of hydro generation projects.

1.30 In regard to address the problem it was stated that PowerGrid is pursuing with the concerned authorities and the Ministry of Environment & Forest (through Ministry of Power) to expedite approvals for forest clearances.

1.31 The Committee pointed out that Eastern Grid Region having direct transmission connectivity to all other regional grids, has population of about 24 crore – about 20% of the total population of the Country, whereas, the power generation capacity in the region is only 26,838 MW – only about 12% of the total power generation capacity of the Country. *When the Committee desired to know as to how the development of a National Grid will help in minimizing regional imbalances in terms of energy availability and to protect the interests of underdeveloped and economically weaker States, the Ministry in a written reply stated as under:*

> "As per Planning Commission, capacity addition target of 88,537 MW is being planned from conventional sources during 12th Five Year Plan on an all-India basis. With this level of capacity addition the demand for power on all-India basis is likely to be met by the terminal year of 12th Plan (2016-17). With the National Grid likely during 12th Plan, planning for generation capacity addition is done on an all-India basis. As per the tariff policy, all future requirement of power should be procured competitively by distribution licencees. The Government has advised various States to tie up power through Case I bidding (from project developers or traders) or set up power plants to meet their requirement, based on their anticipated demand supply scenario."

1.32 In regard to grid congestion, when asked whether any constraint was felt in transmission of electricity due to limited grid connecting transmission capacity, it was stated that congestion during 2011-12 has been faced mainly in the import of power to Southern Grid from the rest of the country. As per the Annual Report for 2011-12 by the Market Monitoring Cell of CERC, in the Power Exchanges, congestion has been observed in short term on day-to-day basis. No congestion has been faced for long term access. In the recent past congestion has been

observed for short term / medium term export from the Chhattisgarh area where a large no. of generators have come upwithout the generators planning for medium to long term supplies, which has caused the power transmission problem. It was further stated that this is now being addressed by construction of new transmission lines to evacuate the power from the region.

1.33 With the synchronous integration of Southern Grid with the NEW Grid, the complexities, in ensuring the seamless transmission of electricity throughout the Country at a desirable frequency, are bound to increase. When the Committee enquired whether any review of the total regional grid transfer capability has been done or proposed to cope up the significant changes in the system, the Ministry in their reply have stated:

> "CEA has convened three meetings to discuss loadability of transmission lines, i.e. on 18th August 2012, 14thSeptember 2012 and 26thSeptember 2012. The matter was also discussed in the eighth meeting of the Forum of Load Despatchers (FOLD) held on 3rdOctober 2012. POSOCO has submitted a comprehensive report to CERC on 18thOctober, 2012 regarding loadability of transmission lines, which is under consideration of CERC. The loading limits of individual lines (about 800 important lines) have been worked out line by line based on CEA planning criteria & CERC regulations, which is under consideration of CERC.

IV. High Capacity Corridors/ Green Energy Corridor

1.34 For integrated development of transmission system for transmission of power from generation projects coming-up in resource rich/coastal States, i.e. Odisha, Jharkhand, Sikkim, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Andhra Pradesh in the private sector, 11 high capacity power transmission corridors have been planned at an estimated cost of about Rs. 75,000 crore. Out of this PowerGrid is mandated to implement HCPTCs work of about Rs. 66,000 crore. The balance work is envisaged to be implemented through private participation/ tariff based competitive bidding process. Implementation of these corridors has been taken up in a phased manner matching with generation projects.

1.35 Explaining it further, the Secretary of Ministry of Power stated during the evidence as under:

> "There are certain States where generation capacity is to come up in a big way, States like Odisha, Jharkhand, Chhattisgarh, Tamil Nadu, Andhra Pradesh etc. From these States we need to make arrangements for evacuation of power. So, 11 high capacity corridors are being planned. About Rs.75,000 crore is the estimated investment in these eleven corridors. Most of these corridor works is going to be done by Power Grid. And these projects are planned to progressively come in different years of the 12th Plan. All these projects except for one have been bid out and they are under different stages of construction."

1.36 Status of implementation of HCPTCs, as furnished by the Ministry of Power is given below:

Corridor	Schedule	Status
HCPTC - 1 (IPPs in Odisha)	Progressively from March, 2013 to March, 2014	- All awards placed. - Engineering, survey and construction in progress - Private portion of corridor through Tariff Based Competitive Bidding (TBCB) awarded to Sterlite. -
HCPTC - 2 (IPPs in Jharkhand, West Bengal)	Progressively from November, 2013 to October, 2014	- About 50% works awarded. - In awarded packages engineering, survey and construction in progress

Corridor	Schedule	Status
		- Award of balance 50% packages under progress and expected in 2012-13 progressively. - Private portion of corridor through Tariff Based Competitive Bidding (TBCB) awarded to Sterlite.
HCPTC - 3 (IPPs in Sikkim)	Progressively from January, 2013 to November, 2013	- All works awarded. - Engineering, survey and construction in progress
HCPTC - 4 (IPPs in Chattisgarh & Madhya Pradesh)	November, 2013	- All works awarded. - Engineering, survey and construction in progress
HCPTC - 5 (IPPs in Chattisgarh)	Progressively from August, 2013 to June, 2015	- 70% works awarded. - In awarded packages, engineering, survey and construction in progress - Award of balance 30% packages under progress and expected in 2012-13 progressively. - Private portion of corridor through Tariff Based Competitive Bidding (TBCB) awarded to Sterlite.
HCPTC - 6 (IPPs in Krishnapatnam, AndhraPradesh)	August, 2014	- All works awarded. - Engineering, survey and construction in progress
HCPTC - 7 (IPPs in Tuticorin, Tamil Nadu)	Progressively from April, 2014 to September, 2014	- All works awarded. - Engineering, survey and construction in progress
HCPTC - 8 (IPPs in Srikakulam, Andhra Pradesh)	Progressively from June, 2015 to December, 2015	- 50% works awarded. - In awarded packages engineering & survey recently commenced - Award of balance 50% packages under progress and expected to be awarded in 2012-13 progressively.
HCPTC - 9 (Common Corridor for transfer of power SR IPPs to WR/NR)	2016-17	On hold due to poor progress of southern region independent power producers (IPPs).
HCPTC - 10 (IPPs in Vemagiri, Andhra Pradesh)	Progressively from April, 2015 onwards	- Tendering under progress. - Awards likely to be placed progressively from December, 2012 - Part of private portion of corridor through Tariff Based Competitive Bidding (TBCB) awarded to POWERGRID.
HCPTC - 11 (IPPs in Nagapattinam, Tamil Nadu)	Progressively from April, 2015 onwards	- Tendering under progress. - Awards likely to be placed progressively from December, 2012 - Part of private portion of corridor through Tariff Based Competitive Bidding (TBCB) awarded to POWERGRID.

1.37 When the Committee enquired about the steps being taken to ensure co-ordinate development of cost effective transmission corridors it was informed that these corridors are being implemented in a phased manner based on the progress of associated generating plants. For this regular monitoring of the progress of IPP generators in Joint Coordination Committee meetings are being carried out. Further, States have been asked to identify and implement the end links in a time bound manner to facilitate drawl of power from these corridors.

Green Corridors

1.38 India has huge potential of renewable energy (RE) resources such as wind, solar, hydro etc. Most of the renewable capacity is in the states of Tamil Nadu, Karnataka, Andhra Pradesh, Gujarat, Maharashtra, Rajasthan, Himachal Pradesh and Jammu & Kashmir. These States contribute about 80% to 90% of total renewable capacity installations in the country. Various policy initiatives and fiscal incentives have created interest in developing renewable energy (RE) generation. Regulatory initiatives have also been taken to promote sale of RE power. Till recently, the quantum of RE power was small and it was presumed that connectivity with the nearest grid substation of State Transmission Utility (STU) would suffice for power evacuation and the RE power is consumed locally.

1.39 Now emphasis has been given to harness RE power on a large scale as soon as possible to supplement the capacity addition from conventional sources as well as for clean development. It is envisaged to add about 30,000 MW renewable generation capacity during the 12th Plan period. The renewable energy (RE) resources are generally located in remote locations and confined in few

states only. Grid infrastructure is needed to be sufficient to transport the renewable energy to the load centres. Further, distribution licensees in each state, Captive Power Plants (CPP) and Open Access Consumers must meet certain percent of their annual energy consumption through RE generation as part of their Renewable Purchase Obligations (RPO).

1.40 The Committee were also informed that in future scenarios, it is envisaged that home states would not be able to consume entire RE power within the state beyond their RPO requirements and therefore RE power has to be transmitted to other states. Therefore, development of transmission corridors, both intra and inter-state transmission system to meet the needs of large scale renewable energy are extremely necessary. Without significant increase in transmission capacity, all the renewable energy generated cannot be accommodated in the power system. The transmission system strengthening and other infrastructures required to facilitate integration of renewable energy sources and smooth transfer of power from RES (which is environmental friendly) to home states as well as other states is termed as “Green Energy Corridors”.

1.41 Vindicating the need for the development of Green Energy Corridor, the Secretary of the Ministry of Power deposed before the Committee:

> “In the 12th Plan we are likely to have about 30,000 MW more of renewable energy capacity. These capacities will come up in a few States. The power from these capacities will have to be brought out of the State. For this, the Powergrid has made out a comprehensive plan. This plan is of about Rs.43,000 crore. This consists of inter/intra State transmission systems and other related infrastructure that are required. We are in touch with the concerned Ministries to find out ways of funding this.”

1.42 When the Committee enquired as to how the Green Corridors is different from the conventional energy corridors, it was informed that besides development of transmission facilities for interconnection of Renewable Energy Resources (RES) into grid as well as onwards transfer of power, the Green Energy Corridors also involve other infrastructures to address intermittency and variability features of renewable generation unlike conventional generation. It includes installation of forecasting tools, establishment of Renewable Energy Management Centres, energy storage technology, dynamic compensation etc.

1.43 Recognizing the importance of promotion of renewable generation and its integration into the grid, POWERGRID on the advice of CERC/Forum of regulators (FOR) and MNRE has evolved a comprehensive scheme comprising Intra State as well as Inter-state transmission strengthening(s) and other related infrastructure to address challenges associated with large scale renewable integration, for the envisaged renewable capacity in the 12th Plan. The outcome of the studies is presented in the report entitled "*Green Energy Corridors*". The main features of the Report are given below:

- Presently, about 25,700MW grid interactive (Wind-17,875 MW, Solar-1041 MW, SHP-3,422 MW others-3,365 MW) as well as 754 MW off grid Renewable Energy (RE) generation capacity is available in the country [*As on 31.07.12:Source-MNRE*].

- As per the information provided by the respective State Nodal Agency(SNA)/STU, envisaged renewable generation capacity addition during 12th Plan period is about 42 GW [Wind (30 GW), Solar (9.5 GW) and SHP (2 GW)].
- The capacity addition is mainly concentrated in the renewable potential rich states viz. Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan and Small hydro in Himachal Pradesh, Karnataka and J&K.

- RE Generation especially wind is characterized by its intermittent & variable characteristics. It has been observed that generally wind

generation peaks out in other than peak demand hours. Solar generation, in the event of cloud cover and rain can also go down drastically on its generation. Further, Solar generation is not available after evening hours to cater to peak demand requirements.

- Renewable energy generating stations are connected with the grid normally at 33kV, 66kV, 110kV & 132 kV level. The EHV transmission system beyond first connection point is either at 132kV, 220kV or 400kV depending on the quantum of power being pooled at EHV Substations. However large size generating stations are directly connected with the grid normally at 132kV, 220kV level.

- For large scale grid integration of RE generation, Transmission system strengthening at Intra as well as Interstate level is proposed:
  - **Intra State strengthening (STU)**- Transmission system required for absorption of power within same area or host state
  - **Inter-state transmission system (ISTS)** - Transmission system required for transfer of power from RE rich state to other states and system strengthening within state for conveyance of ISTS power

- **Implementation Strategy** for proposed transmission strengthening:

(a) Intra State Strengthening

- Implemented by respective STUs.
- Support may be provided by some expert agency having extensive experience in design, tendering, implementation etc. for common design, standards and speedy implementation.

(b) ISTS strengthening

- Implementation of ISTS, by agency having sufficient experience in development of high end technologies in Transmission System with sound project management skills
- Proposed Measures to address intermittency and variability of generation:

Following measures are proposed to take care of intermittency and variability of grid connected RE generation:

a. Strong Grid interconnections
b. Flexible generation, Ancillary Services, Reserves etc. for supply-balancing
c. Demand Side management, Demand Response and Storage for load balancing
d. Forecasting of Renewable generation & Forecasting of Demand
e. Establishment of Renewable Energy Management Centers (REMC) equipped with advanced forecasting tools along with reliable communication infrastructure
f. Deployment of Synchrophasor technology, i.e. PMUs/WAMS on pooling stations and interconnection with centralized control centre through Fiber Optic Communication for real time information, monitoring and control

V. Grid Management

1.44 The Electricity Act, 2003 provides that the Central Government may make region-wise demarcation of the country and from time-to-time to make such modifications therein as it may consider necessary for the efficient, economical and integrated transmission and supply of electricity, and in particular to facilitate voluntary inter-connections and coordination of facilities for the inter-State, regional and inter-regional generation and transmission of electricity.

1.45 In this connection the Electricity Act, 2003 requires Central Government to establish a Centre for each region to be known as the Regional Load Despatch Centre having territorial jurisdiction as determined by the Central Government in accordance with this Act. It also requires the Central Government to establish a centre at the national level, to be known as National Load Despatch Centre for optimal scheduling and despatch of electricity among the Regional Load Despatch Centres. At the State level, the Act requires establishment of State Load Despatch Centre by the State Government for the purposes of exercising the powers and discharging the functions under this Part.

1.46 In compliance of the Electricity Act, 2003, the Country has been divided geographically in five regions Northern, Eastern, Western, North-Eastern and Southern each having a Regional Load Despatch Centre (RLDC), which is the apex body, as per the Electricity Act, 2003, to ensure integrated operation of the power system in the concerned region. The National Load Despatch Centre (NLDC), constituted as per Ministry of Power (MOP) notification in 2005,

supervises the RLDCs to ensure integrated operation of the national power system. NLDC and RLDCs are managed and operated by Power System Operation Corporation Ltd (POSOCO), a wholly owned subsidiary of the Power Grid Corporation of India Limited (PGCIL).

1.47 Every State of the Country has a State Load Despatch Centre (SLDC), which is the apex body to ensure integrated operation of the power system in the State. SLDCs are owned, operated and managed by the respective State Transmission Utility (STU) or the State Electricity Board (SEB) as the case may be.

1.48 On being asked about the measures being taken to reinforce SLDCs for ensuring functional autonomy like taking up the State related issues at FOR meeting etc., the Committee were informed that institutional strengthening including deployment of appropriate manpower for efficient functioning of SLDC are within the purview of respective State Governments. Amendments to the Electricity Act 2003 are being brought to facilitate the States and matter is being taken-up with Appellate Tribunal for Electricity (APTEL). However given the federal structure in the country and electricity being a concurrent subject, this is not an easy task. Accordingly, the matter of ring fencing the State load dispatch centers is being taken up with the States. Institution building must go through many processes which have to be taken up in a step by step manner so as to ensure a smooth transition and avoid any major issues.

1.49 Elaborating the complexity in coordination among Regional Load Despatch Centre and State Load Despatch Centres, the Secretary, Ministry of Power deposed before the Committee as under:

> "We are in a federal set-up and we are operating from Delhi. There is a State Load Despatch Centre and a lot of powers are with the States. The Regional Load Despatch Centre does not have any control on the SLDC. They can only provide directions to SLDC and if SLDC does not obey, they file a petition in the CERC. What we have been doing in the CERC is to see that CERC expedites the decisions on this. After the recent grid disturbances, the CERC has decided to fine those people who are responsible for overdrawal and that process is on."

1.50 The Secretary, Ministry of Power have further added:

> "Today, the RLDC has no powers. The RLDC will tell the SLDC. One thing is that powers are less. RLDC cannot directly act against them. What can be done is one thing which we are looking into. Now CERC also has powers to fine them and so on. You might recall that in one of the earlier meetings of this Committee, we were also quite concerned with fines being imposed and not being paid. This is a matter which had come up….. We are examining this issue as to how the RLDCs can be given more teeth. We are also looking into the scheme of how the Electricity Act can be amended to ensure that the penalties for over-drawl are increased, penalties are recovered in a faster way and the actual punishment to the offender is done very quickly."

1.51 In the context of *autonomy in the grid operations, the Committee enquired as to how SLDCs can be made more efficient and independent in discharge of their duties. Replying the question the Secretary, Ministry of Power stated:*

> "Making the SLDC independent would be the work of the State Government. So, we have taken up the matter with them. There are some administrative issues in making the SLDCs independent. There are definitely some resistance from the States from the point of view of administration and organisational issues. In the meantime, the personnel in the SLDC are being trained. We have trained nearly 700 people. The people who man the SLDCs are not really very well trained or conversant with the latest techniques in operations that should be used. So, we have started training them. In the last few months, about 700 people have been trained. This will improve the capabilities of these people who man SLDCs."

1.52 He further added:

"Coming for training or getting this certification is in any way not going to benefit those employees in terms of their pay or allowances. So, there is not too much of interest to come to these training programmes. What we thought is that we will offer them a one-time incentive of Rs. 20,000 to participate in this training programme. That is what we have started and people who participate in this programme will get Rs. 20,000 as incentive. This is to attract the people to get trained. We actually would like the State Governments or the State Transmission Utilities should sponsor people, who work in the SLDCs, to offer them some kind of an incentive so that these people can go and work in an SLDC. That has not happened. If Maharashtra has done that, I think it is a welcome step. We would like other State Governments to do that. From our side, to encourage people to come for training, we are offering them some incentive so that they can be better qualified."

VI. Grid Discipline

1.53 The Indian Electricity Grid Code (IEGC) is a regulation made by the Central Commission in exercise of powers under clause (h) of sub-section (1) of Section 79 read with clause (g) of sub-section (2) of Section 178 of the Electricity Act 2003. The IEGC also lays down the rules, guidelines and standards to be followed by various persons and participants in the system to plan, develop, maintain and operate the power system, in the most secure, reliable, economic and efficient manner, while facilitating healthy competition in the generation in the generation and supply of electricity.

1.54 Managing seamless transmission of electricity from one corner to another in a vast country like ours in no way an easy task. There are numerous advantages of having a synchronously interconnected National Grid, at the same a vast interconnected transmission network makes it more vulnerable for collapse and large scaled blackouts as it happened on 30th and 31st July, 2012.

1.55 As per information furnished by the Ministry of Power, approximately 36,000 MW of load was lost and power supply in Northern region was not available for around 13 hours on 30th July 2012 and on 31st July 2012, approximately 48,000 MW of load was lost and power supply was not available for about 5 hours, 8 hours and 2 hours in Northern, Eastern and North-Eastern regions, respectively.

1.56 Due to high load and failure of monsoon, Northern Region utilities were drawing a large quantum of power from neighboring Western and Eastern Grids. Due to the rains in Western Region, demand was less and it was under-drawing leading to a much skewed load generation balance among the regions. A large quantum of power was flowing from the Western Grid to the Northern Grid and thus, this was affecting the reliability and stability of the interconnected grids.

1.57 The Enquiry Committee constituted by the Ministry of Power after the grid disturbances on 30th and 31st July 2012 has found that reasons for the events on 30th and 31st July 2012 are not attributable to any single factor. Rather, it is a combination of several factors. The major factors identified by the Enquiry Committee for Grid Disturbances are as follows:

(i) 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.

(ii) High loading on 400 kV Bina-Gwalior-Agra link: The overdrawl by NR utilities, utilizing Unscheduled Interchange (UI), 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.

(iii) Inadequate response by SLDCs to RLDCs' instructions to reduce overdrawl by the NR utilities and underdrawl by the WR utilities.

(iv) 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 Disturbance Recorder (DR) records do not show occurrence of any fault in the system.

1.58 The Enquiry Committee constituted on grid disturbances on 30th and 31st July 2012 have given many recommendations for ensuring the smooth functioning of the Grid. Recommendations of the Committee have been summarized and are given below:

i) An extensive review and audit of the Protection Systems should be carried out to avoid their undesirable operation.

ii) Frequency control through generation reserves/ancillary services should be adopted, as presently employed UI mechanism is sometimes endangering the grid security. The present UI mechanism needs a review in view of its impact on recent disturbances.

iii) Primary response from generators and operation of defense mechanisms, like under frequency & df/dt based load shedding and Special Protection Schemes, should be ensured in accordance with provisions of the grid code so that grid can be saved in case of contingencies.

iv) A review of Total Transfer Capability (TTC) procedure should be carried out, so that it can also be revised under any significant change in system conditions, such as forced outage. This will also allow congestion charges to be applied to relieve the real time congestion.

v) Coordinated outage planning of transmission elements need to be carried out so that depletion of transmission system due to simultaneous outages of several transmission elements could be avoided.

vi) In order to avoid frequent outages/opening of lines under over voltages and also providing voltage support under steady state and dynamic conditions, installation of adequate static and dynamic reactive power compensators should be planned.

vii) Penal provisions of the Electricity Act, 2003 need to be reviewed to ensure better compliance of instructions of Load Despatch Centres and directions of Central Commission.

viii) Available assets, providing system security support such as HVDC, Thyristor Controlled Series Compensation (TCSC), Static Var Compensator (SVC) controls, should be optimally utilized, so that they provide necessary support in case of contingencies.

ix) Synchrophasor based Wide Area Monitoring Systems (WAMS) should be widely employed across the network to improve the visibility, real time monitoring, protection and control of the system.

x) Load Despatch Centres should be equipped with Dynamic Security Assessment and faster State Estimation tools.

xi) There is need to plan islanding schemes to ensure supply to essential services and faster recovery in case of grid disruptions.

xii) There is need to grant more autonomy to all the Load Dispatch Centres so that they can take and implement decisions relating to operation and security of the grid.

xiii) To avoid congestion in intra-State transmission system, planning and investment at State level need to be improved.

xiv) Proper telemetry and communication should be ensured to Load Despatch Centres from various transmission elements and generating stations. No new transmission element/generation should be commissioned without the requisite telemetry facilities.

xv) Start up time of generating stations need to be shortened to facilitate faster recovery in case of grid disruptions.

xvi) There is a need to review transmission planning criteria in view of the growing complexity of the system.

xvii) System study groups must be strengthened in various power sector organizations.

xviii) It was also felt that a separate task force may be formed, involving experts from academics, power utilities and system operators, to carry out a detailed analysis of the present grid conditions and anticipated scenarios which might lead to any such disturbances in future. The committee may identify medium and long term corrective measures as well as technological solutions to improve the health of the grid.

1.59 When the Committee asked about the penal action taken against the erring persons/ authorities responsible for the grid collapse, the Ministry in their reply stated that CERC in response to the petition and interlocutory applications filed by Northern Region Load Despatch Centre (NRLDC), in its order dated 17.8.2012 has directed the staff of the Commission to process the case for initiation of action under Section 142 of the Act against the officers in charge of STUs/SLDCs of the States of Uttar Pradesh, Uttarakhand, Haryana, Rajasthan, Punjab and Jammu & Kashmir for imposition of penalty for non-compliance with NRLDC directions and the provisions of the Act and the Grid Code.

1.60 *When the Committee desired to know about the measures being taken to ensure that the incidences of blackouts are not repeated in future, the Secretary of Ministry of Power deposed before the Committee:*

> "We are ensuring that more and more links are available between the regions to see that the capacity to transfer power between regions is increased. We are also ensuring that the sudden outage that takes place because of pollution affecting the insulating system does not repeat. We are changing the insulating system. A lot of it has already been done. And it is progressively being done. We are also ensuring that when planned outages take place, they are discussed in the Regional Power Committee and they are taken in a coordinated manner. Like I mentioned, inter-regional capacity being increased to 38,000 MW, would also ensure that between regions there will be more links which will be available.

1.61 The Enquiry Committee on grid disturbances have recommended "There is a need to review protection schemes. This Committee concurs with recommendation of previous enquiry Committees that a thorough third party protection audit need to be carried out in time bound manner. This exercise should be repeated periodically and monitored by RPCs."

1.62 The Protection scheme involves protection equipments like relays, instrument transformers and circuit breakers installed in the sub-stations. These protection systems isolate a faulty line by disconnecting it (tripping it) from the rest of the system which can continue to function normally. It typically concerns long length high voltage individual lines and are hence important for secure grid operation. The Ministry informed that in view of the recommendation of the Enquiry Committee on Grid Disturbances, the Regional Power Committees (RPCs) in association with Central Transmission Utility (CTU) and State Tranmsission Utilities (STUs) is conducting the audit of identified important sub-stations belonging to various entities such as POWERGRID, State/Private Transmission Utiltites and Generation Utilities in all the states/UTs of the country.

This audit is being monitored on regional basis by the Regional Power Committees of the five regions covering the entire country.

1.63 The status of audit conducted by Regional Power Committee of each region, as furnished by the Ministry is given below:

> "**Northern Region (NR):** The audit of all 132 important substations in the Northern Region has been completed on 15th November 2012. The audit has identified deficiencies such as lack of adequate bus bar protection, DRs, EL, etc.. Also there is a need to replace static type relays with Numerical Relays. Audit report has been circulated to all concerned for further follow-up action.
>
> **Southern Region (SR):** Protection Audit has been completed in all 194 important substations of the States in the region by 22nd December 2012. Audit report has been circulated to all States for follow up action for replacement of faulty equipment.
>
> **Eastern Region (ER):** Audit of 30 out of 40 important Sub-stations has been completed in the concerned states. The balance 10 will be completed by end Feb – 2013. The Audit report will thereafter be circulated to the States concerned for follow up action for replacement of faulty equipment.
>
> **North Eastern Region (NER):** In NER, audit of 135 important substations has to be conducted in the States of the North Eastern Region. In case of Tripura, all the 11 important sub-stations have been audited. In the other states, the audit will be completed by end – February 2013.
>
> **Western Region (WR):** The audit of all important substations in the Western Region is underway. In Gujarat, the audit was completed by a third party earlier in 2010 itself and all deficiencies rectified. In Maharashtra, audit is being regularly done through audit engineers drawn from circles which are different from the circle which is being audited. Presently, the audit has been completed in 82 out of 118 important substations. Balance would be completed by end February, 2013. Audit has been started in MP. In case of Chhattisgarh, Goa & UTs, the process of audit is being finalized."

1.64 When the Committee desired to know the reasons for delay in undertaking third party audit by RPC in the Eastern and Western Regions, it was informed that Decision to undertake third party audit is taken by the respective RPCs in their

meetings. Accordingly, protection audits were taken up in Eastern and Western Regions after meetings of the Eastern Regional Power Committee and Western Regional Power Committee held.

1.65 In regard to defense mechanism, the Secretary, Ministry of Power, during the evidence deposed before the Committee as under:

> "We have a lot of defence mechanism and protection mechanisms which should have operated and prevented this kind of a grid collapse. If you see frequency as the most important thing and if the frequency is falling, then the defence mechanism that is actually provided in the electrical system should have operated and should have ensured that load has been shed which should have brought up the frequency. This did not work..... We have got inspected 80 per cent of all the defence mechanisms which are in place in the northern region and we have filed a report with the CERC. This report will show as to which particular station and defence mechanism was not in service or had been bypassed and action will be taken against them. So, this is one thing that has not been taken seriously. .....In fact, this is a matter for complacency. Nothing happened in ten years. I think everybody was complacent. If you look at many other Departments and many other spheres of life, the last thing that is paid attention is protection mechanism. That also happened here. Normally, protection mechanisms should be in service and they should be audited regularly. We must see to it that they are in position. That did not happen. We have got them audited. Since the major part of the difficulty was in the northern region, we got the northern region audited. 80 per cent has been done and it is with the CERC. Now, we will get the concerned utilities to see that these protection systems are put in place and not put out of service and so on. This is going to be a very big thing for us to see that if tomorrow, even if there is a overdrawal, this kind of failure of grid will not take place.

1.66 The Under Frequency Relays and df/dt relays are installed in distribution substations of State Utilities for automatic tripping of distribution lines connected to a load centre which forms part of the distribution network. In reply to a specific query of the Committee regarding findings of the protection audit done by PowerGrid in Northern Region, it was stated as under:

> "POWERGRID conducted an audit of all these relays in 175 substations of the Northern Region in Aug., 2012. As per audit, 36 substations did not have the UFRs and df/dt relays, in 99 substations the relays did not operate on the date of disturbance as per log book maintained by the substation itself. The relays operated in only 40 substations on date of

disturbance. Following the Audit, petition had been filed by NRLDC with CERC in September, 2012 on which CERC has ordered on 20.12.2012 directing the Commission staff to serve show cause notices to the States on this account for violation of the Grid Code.

Apart from above, NRPC has also advised the states of the Northern Region to provide status report on functioning of UFRs and df/dt relays by December, 2012. As per report of NRPC, various states in the Northern Region have reported in December, 2012, following status:

- In Delhi and Himachal Pradesh, all UFRs are functional.
- In UP, defective relays are being replaced by procurement in next three to four months.
- In Punjab, Rajasthan and Haryana also, steps are being taken to procure and replace defective relays.
- The states of Uttarakhand& J&K is being complied."

1.67 On being asked about the measures taken for grid disciplines, the Ministry also stated that the following measures are being taken with a view to enforce grid discipline:

(a) Constituents violating the grid discipline are penalized as per the CERC regulations on Unscheduled Interchange as amended from time to time and

(b) In case the violation continues the designated feeders may be opened to curb the over drawl as per the CERC direction.

(c) CERC can also issue notice to persistent grid defaulters.

1.68 When the Committee asked about the reasons of ineffectiveness of Unscheduled Interchange (UI) mechanism in enforcing grid discipline, the Secretary, Ministry of Power, stated during evidence:

"We have also seen as to why overdrawal is resorted to. A lot of States are using the UI mechanism as another source of supply whereas it is not intended to be a source of supply. It is expected to be an adjustment mechanism. But the rates that have been fixed for UI seem to encourage drawal at particular points of time. What has been done is, the tightening of the frequency band did not give that kind of incentive that people have for overdrawal today. The kind of disincentive that they have for excess drawal will start operating at lower frequencies. For instance, if I am going to tighten the frequency from 49.5 to 49.7, the charges that will be applicable because of overdrawal will start operating from 49.7 instead of 49.5. This, we expect would be commercial unviable for the many distribution companies to go ahead and overdraw. If you look at the entire thing as to why did all this happen, we see a combination of factors. Many

of these have been happening earlier also. It is not that overdrawal is a new thing. All of them probably came together on one day and this is what caused this. If you look at why all this is happening, it is simply because of lack of discipline. There is a grid code. Everybody knows that he should or should not do this. Despite this, overdrawal takes place. So, the attempt to ensure that commercially it becomes difficult for them to overdraw is one point. The second thing that is being done is that the extra charges that we can levy on overdrawal is also being done. Thirdly, there is only one mechanism where a person who does not follow the grid code or who does not obey the schedules, he can only be brought before the CERC for punishment or penalty. We are pursuing with them to see that that is done at the earliest. We are also trying to look at the Act to see if there is anything that we can do to make this tighter and more stringent."

1.69 On finding the present UI mechanism ineffective in posing deterrence in overdrawl, the Committee enquired about the steps to make overdral of power commercially unviable by effecting necessary changes. The Ministry replied in a note as under:

"POSOCO / NLDC had filed a petition for Amendment to CERC (UI Charges and related matters) Regulations, 2009 (208/MP/2012) on 10th Sept. 2012. The directions sought from CERC were as follows:

- Frequency band tightening so that system operates close to 50 Hz. (50 Hz +/- 0.1 Hz). UI Price vector to be declared with 0.01 Hz. step size.
- Impose limits on UI injection / withdrawal and make it inadvertent interchange only.
- Introduction of locational bias in UI settlement rate.

Hon'ble Commission vide order dated 5th Dec. 2012, directed staff of the Commission to consider the petition as proposal by NLDC and initiate amendment process."

1.70 It was informed that operational frequency band has been tightened to 49.7 – 50.2 Hz through revised IEGC and UI Regulations which have been implemented as from 17th Sept. 2012 after dismissal of Writ Petitions filed by Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) by Chennai High Court. Another petition had been filed by POSOCO on 10th September, 2012 with CERC for further tightening of frequency band to 49.9 -

50.1 Hz. Following close follow-up, the CERC has directed the Commission Staff *vide* its order dated 29.11.12 to consider the POSOCO petition and prepare a proposal for further action. *When the Committee desired to know the possibility of doing away with the UI mechanism as the monetary penalty provisions have been proved inefficacious in curbing the problem of overdrawl, it was stated as below:*

> "CERC in its order dated 30.07.2012 had directed NRLDC to identify feeders in each of the State control areas, which can be opened/ disconnected in case of any danger to the grid. NRLDC was also directed to take necessary steps to open the identified feeders to the constituent States in order to reduce the overdrawal and restore the grid to the safe operating frequency band, in the event of non-compliance of NRLDC direction regarding overdrawal by the constituent State. Thus, the action like opening/ disconnection of feeders is also envisaged to stop overdrawal by the States."

1.71 When the Committee enquired about the proposal for use of new technology for preventing the problem of over drawl by power utilities and to ensure the safe and smooth functioning of the grid, it was informed by the Ministry as under:

> "POWERGRID is in the process of developing a Grid Security Expert System (GSES) which involves laying of optical fibre network for reliable communication and control of under-frequency & df/dt relay based load shedding, etc. This system will cater to substations of 132 kV level and above.To ensure safe & smooth functioning of the grid, POWERGRID has initiated first of its kind nation-wide large scale Wide Area Measurement System (WAMS) & Phasor Measurement Units (PMU) Project namely Unified Real Time Dynamic State Measurement(URTDSM) Project for implementation in Indian Power Sector. Under this project, equipment will be installed at 400kV & important 220kV sub-stations, generating stations and control centres. The first Phase of the Project will be completed during 2014-2015 and second phase will be completed one year thereafter. The PMU data shall be utilized for better grid management & improving power system operation using advanced analytical functions which will be developed subsequently."

1.72 The Committee further asked about installing of some system to minimize the impact of grid failure if at all it happens and shielding of important cities such as national capital from that. The Ministry informed that the Ministry that Islanding Scheme has been introduced to ensure power supply to essential services in the event of grid failure.

1.73 Islanding Scheme is designed to isolate a part of the interconnected system from the rest of the grid in case of a contingency. The island so created comprises of the load and matching generation such that it is able to operate independently and survive a contingent /disturbance situation.

1.74 When the Committee asked about the details and progress made in regard to implementation of Islanding Scheme in Delhi, the following information was furnished by the Ministry of Power:

> "In order to design/ review the islanding scheme for Delhi a study group was constituted by CEA. This study group comprised representatives from Delhi SLDC, DTL, NRLDC, POWERGRID(CTU), NTPC, NRPC, CEA and an expert from IIT. Experts from Tata Power and CESC were also consulted who have past experience of successful formation of islanding scheme in their system. The islanding scheme prepared by DTL in consultation with CEA, POWERGRID and NRPC, is based on the deliberations in the meetings of the study group. The scheme is under approval of NRPC/ CEA. Delhi being the Capital city of the country, the importance of maintaining the uninterrupted power supply to essential services etc..
>
> There is already an existing scheme as per which two islands were envisaged in Delhi system. The Pragati & GT island forms at 47.8 Hz. alongwith the VVIP load of NDMC area. BTPS forms separate island with Okhla, Gazipur, Mehrauli and Vasant Kunj load. These islands have not been successful in the past and also do not meet the total essential load requirement of Delhi. Therefore, existing islanding scheme has been reviewed.
>
> The proposed islanding scheme for Delhi has been developed with following objectives in mind:

(i) to isolate Delhi's power system from the regional grid when grid disturbance is imminent and,

(ii) after isolation, continue to meet at least emergency loads of essential services etc.. Present quantum of essential load spread across various distribution companies of Delhi is about 930 MW.

(iii) to extend start up supply to generating stations in adjoining area to facilitate early restoration."

1.75 It was further stated that the islanding scheme envisages that fall of frequency to 47.9 Hz will be taken as indication that grid disturbance is imminent and islanding will be initiated. Ideally one island is preferred but due to peculiar network considerations of Delhi and limitation imposed by Rithala CCGT, there is no option but to create four (4) islands, capable of meeting about 3400 MW of load during peak conditions, as listed below:

(i) Dadri- - Jajjhar- Pragati (part) Island (Peak load 2315 MW)
(ii) Bawana CCGT Island (Peak load 600 MW)
(iii) BTPS-Pragati (part) Island (Peak load 500 MW)
(iv) Rithala CCGT Island (Peak load 20 MW)

1.76 Further, the scheme is based on frequency measurement. This measurement will be done at nine (9) substations/switchyards where switching is to be done. These locations are Dadri, Mandola, Bamnauli, Jhatikara, Mundka, Bawana, Maharani Bagh, Jhajjar and BTPS. Two frequency sensing relays (Numerical type) of different make will be installed at each substation/switchyard. These relays will be installed at different buses. If both the relays record the frequency of 47.9 Hz or below, then only identified circuits at that substation/switchyard will be opened and the simultaneously send trip signal through optical fibre to the adjoining connected substations falling within the same island. In order to control frequency in the islands from load side, further load

shedding will be carried out with a time delay of 2 sec through frequency sensing relays, if frequency dips to 47.7 Hz. This load shedding will be over and above that carried out under the defense mechanism finalized by NRPC. Efforts to control frequency from generation side will also have to be made. For this purpose, one generating station in each island will have to be operated in frequency control mode.

1.77 Also, during the islanded operation, Delhi SLDC will have overall responsibility of operation of the islanded systems. All the generating companies, distribution licensees, DTL and POWERGRID sub-stations which are part of the islands, will comply with advice of Delhi SLDC who will be the single agency responsible for the islands. The latter will be in regular communication with NRLDC. The connectivity of Delhi with rest of the system is far more complex than Tata system of Mumbai and CESC system of Kolkata, which have only few connections with rest of the system and meet considerable demand from embedded resources. Further, power injection to Delhi system is at different voltage levels comprising of 765kV, 400kV, 220kV and 66kV. During islanding condition, the isolation at different voltages is required at different locations at the same time and managing such complex dynamic situation involving lot of switching operations is a challenge.

1.78 The Committee were also apprised that the following additional measures will be taken to increase probability of success of Delhi islanding scheme:

- Deployment of Numerical Relays.
- Development of intelligent system for load shedding while forming islands.
- Development of facility for centralized manual load disconnection and reconnection.

- Development of centralised system for decision making regarding islanding.
- DMRC to adopt SCOTT connections at drawl point.
- Dynamic simulation of islanded operation so as identify additional steps, if any, which need to be taken for enhancing success rate of islanding.
- Augmentation of generation at load centres of Delhi.
- Regular preventive maintenance and mock testing.
- Periodic review of islanding scheme.
- Dual supply to Delhi Airport and other essential services.
- Training of system operators at Delhi SLDC.
- Development of procedure by Delhi SLDC for system operation during islanded conditions.
- Augmentation of adequate and trained manpower at DTL substations and Delhi SLDC.
- Proper setting of PSS, Pole slip, PSB, back up impedance protection at generating stations."

1.79 When the Committee asked about the progress of the implementation of the Islanding Scheme in other cities/ regions, the Ministry in their written reply have stated as below:

"**Northern Region:** Narora Atomic Power Station (NAPS) and Rajasthan Atomic Power Station (RAPS) islanding schemes are already functional. Islanding scheme for Delhi has been finalised by DTL in October 2012 and the same is under implementation. Haryana and Rajasthan are also understood to have taken up preparation of islanding schemes in the respective states. UP has sought assistance of POWERGRID in preparation of islanding schemes around Parichha, Unchahar, Tanda and Roza thermal power stations. Punjab has also sought assistance from POWERGRID to prepare islanding schemes for Ludhiana, Gobindgarh, Bathinda and Ropar Thermal Power Station (TPS).

Western Region: Mumbai, Ahmedabad, Gas Turbine Power station (GTPS) Uran islanding schemes are already functional. Islanding schemes for State capitals viz. Bhopal & Raipur, which were functional earlier, are planned to be restored and those for other cities are under study. All Captive Power Plants (CPPs) are planned for islanding at a slightly higher frequency than 48.8 Hz so that these stations are available for extending startup power.

Eastern Region: Calcutta Electric Supply Corporation (CESC) and many CPPs like Bokaro Steel, NALCO, etc. already have islanding schemes. Three islanding schemes viz. Bakreshwar with West Bengal load, Farakka with Lalmatia load and Bandel TPS with Adisaptagram load, are under consideration / study.

Southern Region: Islanding schemes for Hyderabad and Chennai are already functional. 14 islanding schemes in the States of Andhra Pradesh, Karnataka, Tamil Nadu, Kerala around power stations located in these states have been taken up for study by the respective State Transmission Utilities (STUs).

North-Eastern Region: An islanding scheme around Namrup TPS in Assam is already functional. Eight new islanding schemes have been taken up for study / examination."

VII. Transaction of Electricity

1.80 The Electricity Act, 2003, recognizes trading as an independent activity and accordingly prescribes issue of trading licences by the CERC for inter-state trading. This paved the way for Open Access and Power trading. Accordingly, the Central Electricity Regulatory Commission (CERC) issued guidelines for grant of permission for setting up operation of power exchanges within an overall regulatory framework. Since generation and consumption of Power is not evenly distributed in India, the concept of Power trading enables surplus generation from one region to flow to another region which is deficit in power or within the same region.

1.81 At present, there are two power exchanges in the Country, Indian Energy Exchange (IEX) and Power Exchange India Ltd. (PXIL). These power exchanges are helpful in short and medium term electricity transactions.

1.82 As per the Report of CERC on Short-term Transaction in India, during the month of December 2012, of the total electricity generation, 8250.56 MUs (10.79%) were transacted through short-term, comprising of 4455.79 MUs (5.82%) through Bilateral (through traders and term-ahead contracts on Power Exchanges and directly between distribution companies), followed by 2,314.61MUs (3.03%) through day ahead collective transactions on Power Exchanges (IEX and PXIL) and 1,480.16MUs (1.93%) through UI. Of the total short-term transactions, Bilateral constitute 54.01% (40.84% through traders and term-ahead contracts on Power Exchanges and 13.17% directly between distribution companies) followed by 28.05% through day ahead collective

transactions on Power Exchanges and 17.94% through UI. There were 40 trading licensees as on 31.12.2012, of which only 21 have engaged in trading during December 2012. Top 5 trading licenses had a share of 69.74% in the total volume traded by all the licensees.

1.83 The CERC Report has also noted that average weighted price of electricity transacted through traders during the month of December, 2012 was Rs. 4.39/kWh, whereas the average weighted price of electricity transacted through power exchanges i.e. IEX and PXIL was Rs. 3.90 and 3.08 (per kWh) respectively.

1.84 The CERC Report has further concluded that in the month of December 2012, congestion occurred in both the power exchanges ("congestion" means a situation where the demand for transmission capacity exceeds the available transfer capability). During the month, the volume of electricity that could not be cleared in the power exchanges due to congestion was 17.43% and 156.59% of the actual cleared volume in IEX and PXIL, respectively. In terms of time, congestion occurred was 99.97% and 98.59% in IEX and PXIL, respectively.

1.85 When the Committee enquired about the efforts being made by the Government to make short term transaction capacity between power exchanges and bilateral contracts more transparent, it was stated as under:

> "The following information is available on National Load Despatch Center (NLDC) and Regional Load Despatch Center (RLDCs) websites for all types of transactions for all stakeholders in accordance with the provisions of the CERC Regulations:
>
> - Available Transfer Capacity (ATC) -3 months ahead
> - Past & current transactions
> - Injection & drawl schedules

- Frequency trend
- Urgent market information – unit tripping, load crash, contingencies
- 52 week ISTS pooled losses
- Procedures”

1.86 When the Committee asked about the congestion in Power Exchange Transactions, it was informed by the Ministry that there have been instances of congestion in Power Exchange transactions, which are essentially short-term in nature. These congestions are caused due to lack of adequate availability of margins in the transmission network after accommodating long term requirements.

VIII. Modernization/Technological up-gradation of Grid

1.87 Dimensions of Indian power system are growing manifolds and their complexity is increasing in all fronts. With the proposed synchronous operation of Southern Regional grid with NEW grid, a single grid of more than 250 GW capacity shall be operated in coming years. Maintaining grid safety, security and reliability of such geographical spread grid is a great challenge in the new regime of open electricity market. This necessitates application of modern tools for monitoring on real time basis to give confidence to the system planner as well as operators to bring efficiency in system operation.

1.88 Further, large scale integration of renewable generation has been envisaged in coming years mainly in the form of wind and solar generations. They have their own intermittency and variability characteristics. The ability of the system operators to take decisions is dependent on their "situational awareness" derived from the data/information available with them in real time. All the above require better visibility of grid system and fast update of operating scenario integrated with intelligent computation to capture dynamic behavior of power system towards safe, secure and reliable operation on real time basis.

1.89 *When the Committee desired to know about the proposals in regard to modernization/ technological up-gradation of the National Grid by the introduction of latest technologies as adopted by the developed nations, it their written reply the Ministry of Power furnished the following information:*

> "With the ever expanding transmission network in the country, complexities of grid operation are also increasing. Keeping this in mind, the facilities at all the five Regional Load Despatch Centers

(RLDCs) and National Load Despatch Centre (NLDC) are being upgraded continuously through deployment of latest technology.

POWERGRID has taken the initiative for implementation of Smart Grid Technology in the country and has implemented Phasor Measurement Units (PMUs) using wide area measurement systems (WAMS) in Northern Region Grid, for the first time in India. Unified Real Time Dynamic State Measurement (URTDSM) project for installation of PMUs, Phasor Data Concentrators (PDCs) etc. has been formulated. The first test lab for PMU and PDC testing in India is being established at Bhiwadi in Northern Region.

POWERGRID is now working on higher transmission voltages of ±800kV HVDC & 1200kV UHVAC.

Implementation of ±800kV, 6000 MW HVDC Bi-pole of length around 2000 km from North Eastern Region (Biswanath Chariali in Assam) to Northern Region (Agra in Uttar Pradesh) is under construction. This line shall facilitate high quantum of power transfer and it shall be amongst the longest ±800kV HVDC multi-terminal line in the world.

To meet the long-term bulk power transfer requirement, an overlaying super grid with 1200kV UHVAC system has been envisaged. The 1200kV Ultra High Voltage AC (UHVAC) technology, the highest voltage level in the world, is being developed in collaboration with 35 Indian manufacturers. This is one of the unique R&D projects in public-private partnership model. The pilot 1200kV lines are successfully test charged at 1200kV UHVAC National Test Station at Bina, Madhya Pradesh."

1.90 Smart Grid is confluence of Information, Communications & Electrical/ Digital technologies. Smart Grid, apart from facilitating real time monitoring and control of power system will help in reduction of AT&C losses, peak load management/ demand response, integration of renewable energy, power quality management, outage management etc.. Smart Grid will act as a backbone infrastructure to enable new business models like smart city, electric vehicles, smart communities apart from more resilient and efficient energy system and tariff structures.

1.91 In regard to Countries already using the Smart Grid Technology successfully, it was stated that worldwide many utilities in North America, Europe, China, Russia and Brazil have started using/developing the Smart Grid technology using WAMS to harness potential benefits of this new technology in operating large electrical grids. In 2006, China's Wide Area Monitoring Systems (WAMS) for its six grids had 300 PMUs installed mainly at 500kV and 330kV substations and power plants. Presently China has installed more than 1000 PMUs in their Grid. By 2012, China plans to have PMUs at all 500kV substations and all power plants of 300 MW and above. In U.S. there are ten (10) synchrophasor projects underway involving 57 utilities and grid operators across the country and installing about 850 networked PMUs. By 2013, the devices will be operating in nearly all regions of the country. Further, other countries like South Africa, Brazil, Russia, and some European countries have deployed/ planning to deploy a large no. of PMUs in their system.

1.92 The Committee were informed that PowerGrid has taken initiative for implementation of Smart Grid Technology in the Country. In this connection, the company has implemented Smart Grid Pilot Project using Wide Area Measurement Systems (WAMS) in Northern Region Grid for the first time in India. When the Committee asked about the experience of Pilot Project in Northern Regional Grid, the Ministry informed as under:

> "Phasor Measurement Unit (PMU) Pilot Project in Northern Region has helped a lot for understanding the new technology and system operation in real time, protection co-ordination, disturbance analysis etc.. Case study is available to demonstrate better transmission system utilization with reliability for evacuation of Karcham-Wangtoo hydro generation along with Baspa and Jhakri Hydro generation during the monsoon season in 2011 with the help of PMU based

measurements. Delay in Special Protection Scheme (SPS) settings was identified and then rectified. PMU also helped in detection of oscillations on 765kV Tehri-Meerut line (Charged at 400kV). Based on PMU data tuning of Power System Stabilizers (PSS) was done to avoid such oscillations. During foggy winter nights, large number of auto-reclosure operation took place and its detection in real time by system operator helped a lot in effective real time monitoring and control of the grid. PMU technology is a kind of meta tool that will create new tools in future."

1.93 *When the Committee desired to know about the planning of the Government to implement the Smart Grid Technology throughout the Country, it was stated as under:*

"Keeping in view the potential of Wide Area Measurement Systems (WAMS) technology for measurement of dynamic behavior of integrated power system which is need of the hour for Indian grid, a comprehensive "Unified Real Time Dynamic State Measurement (URTDSM) scheme is formulated for Wide Area Monitoring on real time basis. It involves installation of about 1740 PMUs along with other intelligent devices in control centres. This shall also facilitate to estimate the transmission capability in a more realistic way which shall bring efficiency in operation as well as economy in cost of power supply. The scheme will be implemented in two stages. In the stage-I, Phasor Measurement Unit (PMUs) will be placed at those locations where fiber optic communication link is either available or would be made available. In stage-II, PMUs would be installed at balance locations along with communications links. Implementation of URTDSM scheme is under progress."

Part - II

RECOMMENDATIONS/ OBSERVATIONS OF THE COMMITTEE

Synchronous Inter-connection of Southern Region Grid with NEW Grid

2.1 The Committee note that the whole country is divided into five regional grids namely, Northern Region, Western Region, Eastern Region, North Eastern Region and Southern Region. The first four regional grids are collectively called NEW (Northern, Eastern, North Eastern and Western Region) Grid. At present all the regional grids, except Southern Region, are synchronously interconnected with each other and run at one frequency. However, the Southern Region Grid is connected asynchronously to NEW Grid through HVDC and has different frequency. The Committee further note that Synchronization of Southern Region with NEW Grid is under implementation through two 765 kV lines connecting Solapur (WR) to Raichur (SR). One of the circuits is being implemented by a private company Raichur Sholapur Transmission Company Limited (RSTCL), selected through competitive bidding route. The other circuit is being implemented by PowerGrid. These links will pave the way for interconnection of all five regional grids in synchronous mode having same frequency. The work on these lines is expected to be completed by January, 2014. During the examination by the Committee it came out that one of the link being implemented by RSTCL has been facing Right of Way (RoW) problems at 18 locations in Afjalpur area and at 12 locations at Jewergi area in Karnataka. Though, later it was informed that RSTCL has resolved issues at all 18 locations in Afjalpur area and at 6 locations at Jewergi area. But still there are 6 locations at Jewergi area where the RoW issue is yet to be

resolved. Further, the scrutiny of the Committee have revealed that in respect of project being implemented by RSTCL only 9 towers have been erected out of 541 towers proposed for the entire link having a length of 208 km., while, the work of PowerGrid is even slower as only 8 towers have been erected. The Committee express their concern over the slow progress of the project which will enable the interconnection of all the grids of the Country for running at same frequency and making the National Grid fully functional. The interconnection of the Southern Grid with NEW grid will benefit the power deficit Southern Region by facilitating it to draw more power from other regions. The Committee therefore, strongly recommend the Government to ensure that RSTCL resolve the remaining RoW issues at earliest. It should also be ensured that the other construction work related to the project be expedited by both the organization i.e. RSTCL and PowerGrid lest this important project get delayed.

(Recommendation Sl. No.1, Para No.2.1)

Strengthening of National Grid

2.2 The Committee note that the exploitable energy resources are not uniformly distributed in the Country. Some States have abundant natural resource while some are deprived of the adequate resources to set up power plants. This reason has necessitated the shift in focus of planning the generation and the transmission system in the Country from the orientation of regional self-sufficiency to the concept of optimization of utilization of resources on All-India basis. The Committee further note that the Government has accordingly planned a National Grid by interconnecting

of all the existing five regional grids. It has been stated that through establishment of National Grid, optimal setting, development and utilization of power potential through coal, hydro and other resources has been envisaged in the overall interest of the Nation. It is also expected that National Grid would enable exchange of power amongst the regions for optimization of generation resources – transmission of surplus power to deficit region, dealing commercial obligations and meeting emergencies in other regions. During the examination of the subject it came out that at present the Eastern Grid is the only grid which has direct transmission links with the rest of four regional grids. Theoretically, this region, due to favorable transmission interconnection should have been in a better position in terms of the availability of electricity. Ironically, in reality the States of this region have energy deficit as high as 30%. The situation indicates that a National Grid *per-se* is not a solution for the regional imbalances in the Country in terms of availability of electricity. Rather, if not regulated by a fair policy, it could become an instrument for further aggravating the regional imbalance as economically sound States/utilities will be able to grab the electricity meant for the less developed States by bidding at higher rates. In North-Eastern Region, where there is immense potential for hydro power, a high capacity transmission line to facilitate the evacuation of electricity from the region to northern region is underway, whereas the region itself reels under power shortages. Eastern Region, where about 20% population of the Country resides, have only 12% of the total power generation capacity. Furthermore, on the basis of a misconception that the region does not have much demand, a part of that little generated power is being transmitted to other regions. The Committee

are not averse to the idea of evacuation of electricity from the regions having power potential to deficit regions, but they have strong objection in regard to depriving the people of that region of their right for having fair amount of electricity. The inclusive growth of the Country is the duty of the Centre. The Committee believe that by creating a National Grid, the Government has done only half part of the task, remaining should be accomplished by formulation of a policy which can effectively address existing regional imbalances in regard to the availability of electricity in the different States/Regions of the Country. The Committee also recommend that the Government should allocate more electricity from the central pool to the economically weaker Regions/States having acute shortages so that they can also be able to contribute in overall development of the Nation.

(Recommendation Sl. No.2, Para No.2.2)

2.3 The Committee note that the Country has about 2,23,000 MW installed power generation capacity. Further, for the 12th Plan period, a target of generation capacity addition to the tune of, 88,537 MW has been envisaged from the conventional sources and 30,000 MW from the Renewable Energy sources. Thus, the total generation capacity at the end of the 12th Plan would be about 3,40,000 MW. Against this backdrop the Committee also note, that the Country's present total inter-regional links to facilitate the exchange of power among various regions is only 27,750 MW, which in view of the Committee is not adequate considering the present installed capacity and the planned addition. The Government has stated that they are planning to enhance this to 66,000 MW by adding transfer capacity of 38,400

MW during the 12th Plan. They have also stated that about 1,07,000 circuit kilometers of transmission lines, sub-stations of 2,70,000 MVA and HVDC terminals of about 12,750 MW capacity at 220 kV and above level are planned to be added in the existing capacity of about 2,70,000 circuit kilometers of transmission lines and about 4,20,000 MVA sub-station capacity at the voltage level of 220kV and above. The Committee feel that the massive addition in generation capacity envisaged for the 12th Plan and the proposed synchronous operation of All-India National Grid warrants proportionate augmentation of transmission links as well as increase in number of sub-stations and their capabilities. For the efficacious functioning of the National Grid, it is important that the proposed increase in transfer and transmission capabilities actually takes place in consonance with the growth of generation sector. The Committee, therefore, recommend that the Government besides, augmenting the transmission capabilities to match the proposed generation capacity, should simultaneously enhance and strengthen the relevant infrastructure of National Grid also for its smooth functioning.

(Recommendation Sl. No.3, Para No.2.3)

2.4 The Committee note that it has been envisaged by establishment of a National Grid to extend economies of scale by enabling setting up of large sized pit-head based power station and considering cheaper cost of transmission of power compared to transportation of fuel. Even National Electricity Policy stipulates that imported coal based thermal power stations, particularly at coastal locations should be encouraged based on their economies. Further, it would be economical for new generating

stations to be located either near the fuel sources e.g. at pit head locations or load centers. In this connection the Committee are surprised to note that out of total 97,720 MW coal based thermal projects which are under construction, 37,380 MW projects are located at Pithead, 14,910 MW projects are located at coastal location, and 45,430 MW are at other locations. In regard to reasons for setting up projects at locations other than coastal or pit heads it has been stated that for locating a thermal power station, availability of a large area of land, availability of large quantity of water for cooling and other infrastructure facilities like road and rail connectivity for transportation of equipments and coal are required. Thermal power projects are being set up in different states depending upon availability of land, water and other infrastructure facilities. Some plants near load centres are also considered necessary for energy security of those states. Further, it was stated that power generation being a delicensed activity, a person can choose a place wherever desires to set up generation project. Though, the Committee do understand that there are several factors which decisively matter be considered for setting up of power plants, and hence all the power plants cannot be set up at pit heads or coastal areas. However, the fact that surprises the Committee is that almost half of the coal based power projects are coming up at places other than pit heads or coastal areas. The factors like sufficient availability of land, water, and road connectivity and other essential infrastructures can be explored near and around the fuel sources. This will not only cut the cost of fuel but will also be a vital factor for the relevance and importance of transmission network. The Committee feel that this defeats the very purpose of developing a National Grid for transmission of electricity from one corner to another of the country saving cost of

transportation of coal for the power stations. Generation of power at the pit head or coastal areas (for imported coal based plant) and transmission of electricity to load centre is certainly more cost effective. The Committee, therefore, strongly recommend that the Government should encourage setting up of coal based thermal power projects at pit heads or coastal areas for projects dependent on imported coal as the case may be by facilitating and incentivizing them as ultimately the consumer will have to bear the increased cost of electricity due to irrational planning of power generation sites.

(Recommendation Sl. No.4, Para No.2.4)

2.5 The Committee note that fund requirement for the development of transmission system proposed for the 12th Plan is estimated to be order of Rs. 2,00,000 crore. In regard to arrangement for this huge fund the Ministry of Power has stated that Intra-State power transmission projects will be eligible for viability gap funding. They have also stated that the figure of Rs. 200,000 crore has three components – Central Transmission Utility, that is, PowerGrid, private licencees and State Transmission Utilities. CTU will not have any difficulty in raising the money and they do not need viability gap funding. The same will hold good for licencees. It will be the State Transmission Utilities which may require viability gap funding. The Ministry have stated that there will not be any problem in arrangements of funds for the transmission projects planned for the 12th Plan. Considering the importance that these projects hold for the overall development of the nation, it would not be prudent to become lax in regard to the in arrangement of the required fund. The Committee, therefore, recommend

that the Government should not become complacent in arrangement of the required fund.

(Recommendation Sl. No.5, Para No.2.5)

2.6 The Committee note that with the synchronous integration of Southern Grid with the NEW Grid, the complexities are bound to increase in ensuring the seamless transmission of electricity throughout the Country at a desirable frequency. In regard to review of the present regional grid transfer capability in view of the synchronous integration of the Southern Grid with NEW Grid, the Ministry has stated that Central Electricity Authority (CEA) has convened three meetings during August-September, 2012 to discuss this matter. The matter was also discussed in the Eighth meeting of the Forum of Load Despatchers (FOLD) held in October 2012. POSOCO has submitted a comprehensive report to CERC in October, 2012 regarding loadability of transmission lines, which is under consideration of CERC. The Committee are happy to note that the Government has started some review of the transmission network, nonetheless, they believe that integration of all the grids for operating at one frequency and massive growth proposed in transmission network will only make the job more challenging. Thus it becomes imperative to reassess the transmission network system and transfer capabilities thoroughly by a team of experts on a larger scale. The Committee, therefore, recommend that the outcomes of the Report of POSOCO whenever approved by CERC should be implemented with sincerity and expeditious manner. The Committee also expect that they will be apprised about the outcome of the POSOCO Report as approved by the CERC at time of Action Taken Report. Simultaneously, the Government

should further plan a thorough review of the transmission networks on a larger scale keeping in view the future developments, necessities and complexities by involving experts not only of the Country but also from abroad having expertise in this field.

(Recommendation Sl. No.6, Para No.2.6)

High Capacity Corridors

2.7 The Committee note that there are certain States *viz*. Odisha, Jharkhan, Chhattisgarh, Tamil Nadu, Andhra Pradesh etc. where massive generation capacity has been planned. To evacuate this large amount of electricity, 11 High Capacity Power Transmission Corridors (HCPTCs) at an estimated cost of ₹ 75,000 crore have been planned. They further note that most of this Corridor work will be done by the PowerGrid and same is proposed to be implemented through private participation/tariff based competitive bidding process. Implementation of these corridors has been taken up in a phased manner matching with generation projects. The Committee feel that the high capacity corridors have greater importance for the power sector as these line are meant for evacuation of the large quantum of electricity from the generation stations of Independent Power Producers (IPPs) to load centres across the States and Regions. The High Capacity Transmission lines are futuristic technology of transmission sector as they have numerous benefits such as low AT&C losses due to high voltage, cost effectiveness, reduced need of RoW etc. The Committee believe that the project will yield dual benefit, firstly, evacuation of huge amount of electricity will be helpful in bridging the gap between demand

and supply of power caused by ever growing energy need of the Country, secondly, it will boost the confidence of private sector for more active participation in power generation field due to assurance of proper evacuation of electricity generated. The Committee, therefore, recommend the Government to ensure that these projects are implemented as scheduled by providing all necessary assistance and effective intervention in resolution of the problems being faced or anticipated. The Committee also recommend that the transmission projects specially HCPTCs should be accorded environment and forest clearance more liberally and in a time bound manner as the laying of transmission lines have negligible impact on forest/ environment and there is no change in land use patterns. As, the HCPTCs project has huge fund requirements, the Committee, also desire the Government to ensure that paucity of fund does not become a reason for delay in implementation of these corridors.

(Recommendation Sl. No.7, Para No.2.7)

Green Energy Corridor

2.8 The Committee note that the renewable energy (RE) resources are generally located in remote locations and confined in few states like Tamil Nadu, Karnataka, Andhra Pradesh, Gujarat, Maharashtra, Rajasthan Himachal Pradesh and Jammu & Kashmir which contribute about 80% to 90% of total renewable capacity installations in the country. Presently, the renewable energy generation capacity in the Country is about 26,000 MW. Till recently, the quantum of Renewable Energy was small and it was being consumed locally. It was presumed that connectivity with the nearest grid substation of State Transmission Utility (STU) would suffice for evacuation

of Renewable Energy. Now, the emphasis has been given to harness Renewable Energy on a large scale to supplement the capacity addition from conventional sources and for clean development as well. In this connection it is envisaged to add about 30,000 MW renewable energy generation capacity during the 12th Plan period. The Committee have been informed that for recognizing the importance of promotion of renewable generation and its integration into the grid, a comprehensive plan called Green Energy Corridors has been made by the PowerGrid costing about Rs. ₹ 43,000 crore. The Secretary, Ministry of Power informed the Committee that concerned Ministries are in touch to find out ways of funding this project. As Renewable Energy sources have intermittency and variability features which make it challenging for their grid inter connection, the Committee are heartened to note that a corridor dedicated for the evacuation of renewable energy and its integration with main grid is being planned. The Committee also believe that in future energy producing States would not be able to consume entire Renewable Energy produced within the State beyond their Renewable Purchase Obligation (RPO) requirements, so it has to be transmitted to other States. The Committee, therefore, feel that the Green Energy Corridor is in consonance with the growth in the field of renewable energy in the recent years and their massive future projections. The Committee recommend that the Green Energy Corridor should be given utmost priority in terms of according various clearances, arrangement of funding and other technical support whenever needed. The Committee also recommend that the Ministry of Power and the Ministry of New and Renewable should chalk out the modelities for early implementation of time completing this project. The Committee believe that providing monetary

incentives in this project would go a long way in ensuring proper funding in Green Energy Corridor.

(Recommendation Sl. No.8, Para No.2.8)

Grid Management

2.9 The Committee note that Regional Load Despatch Centres (RLDCs) are the apex bodies, as per the Electricity Act, 2003, to ensure integrated operation of the power system in their concerned region. RLDCs are responsible for carrying out real time operation of grid control and despatch of electricity within the region in accordance with the Grid Standards and Grid Code. Whereas, the State Load Despatch Centres (SLDCs) have to perform functions similar to RLDCs except the area of jurisdiction, which in case of SLDCs is the State. The Committee further note that there is one National Load Despatch Centre (NLDC) for overall supervision of scheduling and despatch of electricity across various regions. The Committee feel that for economic, secure and uninterrupted functioning of National Grid, effective coordinating system among NLDC, RLDCs and SLDCs is of paramount importance. During the examination of the subject, the Committee found that the coordination between RLDC and SLDCs is not as desired. RLDCs do not have adequate power to control erring SLDCs, who are under great control of the respective State Governments, except for giving directions. If any SLDC does not obey these directions, RLDC files a petition in the Central Electricity Regulatory Commission (CERC) who can fine them if found at fault. The Committee during the examination of the subject 'Functioning of CERC' found that in most of the cases even the fine imposed by the CERC have not been realized. As whole of the Country's

transmission system will now be synchronized soon, any dereliction/under-performance of SLDCs will have cascading effects and its impact could extend upto entire Country. The Committee, therefore, believe that in view of the growing complexities due to expansion of National Grid it is crucial that there is an effective control mechanism for better coordination between RLDCs and SLDCs for enforcing strict grid discipline. The Committee, therefore, strongly recommend that the Government should bring out necessary amendments in The Electricity Act, 2003 for giving much needed clout to RLDCs/CERC to deter the erring SLDCs and ensure stricter grid discipline.

(Recommendation Sl. No.9, Para No.2.9)

2.10 The Committee observe that the SLDCs still do not enjoy the due autonomy and are under influence of State Governments which hampers their efficacious and neutral discharge of the assigned duties provided under the Electricity Act, 2003. This often leads to lack of their coordination with RLDCs. The Committee are of the view that for better coordination between RLDC and SLDC, providing functional autonomy to SLDCs is important so that they can be made neutral and more efficacious in discharge of their duties. The Committee, therefore, also recommend that under proposed amendments in the Act SLDCs should be granted more functional autonomy to play a role of integral component of a National Grid rather of a representative of a particular State.

(Recommendation Sl. No.10, Para No.2.10)

2.11 The Committee appreciate the initiative of the Ministry for giving training to 700 employees of various SLDCs to converge them with the latest techniques of grid operations. It is envisaged that the training will improve the capabilities and efficiency of the personnel who man SLDCs. The Committee also endorse the planning of the Ministry to offer one-time incentive of Rs. 20,000 to participate in this training programme to attract more and more personnel of SLDCs to get trained. The Committee feel that though these efforts are praiseworthy, lot more needed to be done in regard to modernizing and reforming the SLDCs. The Committee, therefore, recommend the Government that apart from carrying on and intensifying the said training programme, the State Governments and State Transmission Utilities should be persuaded to sponsor SLDCs personnel for the training and able to provide incentives on successful completion of the same.

(Recommendation Sl. No.11, Para No.2.12)

Grid Discipline

2.12 The Committee note that the Country witnessed two massive grid failure on 30th and 31st July, 2012, the second failure being bigger and more severe in impact. The Committee were informed that approximately 36,000 MW of load was lost and power supply in Northern region was not available for around 13 hours on 30th July 2012 and 31st July 2012, approximately 48,000 MW of load was lost and power supply was not available for about 5

hours, 8 hours and 2 hours in Northern, Eastern and North-Eastern regions, respectively. The Ministry of Power constituted an Enquiry Committee to analyse the causes of these disturbances and to suggest measures to avoid recurrence of such disturbance in future. The Enquiry Committee brought out that no single factor was responsible for grid disturbances but several factors such as weak inter-regional corridors, loss of 400 KV Bina-Gwalior-Agra link, inadequate response by SLDCs to RLDCs' instructions etc. led to the collapse of the power systems on both the days. The Committee are aghast by the findings of the Enquiry Committee as it has pointed out several lapses and deficits in defense mechanism. The Electricity Act, 2003 provides for various grid safety measures to be taken with a view to ensure the well functioning and safety of the grid which have not been adhered to by the authorities. This Committee are of the view that the decade long absence of any major grid disturbance has set in complacency and lackadaisical approach in regard to regular examination and revamping of transmission systems in the Country. Due to inattention for a long period, the transmission and grid system in the Country could not match the pace of massive capacity addition in the recent years and ultimately collapsed. The Committee feel that for fulfillment of the vision 'Electricity for All', there is an urgent need not only for quantum increase in generation capacity but also for refurbishment and strengthening of the transmission network of the Country to match the increase in generation capacity for smooth and reliable transmission of electricity from one corner to another. The Committee, therefore, strongly recommend the Government to show utmost urgency in implementation of all the recommendations of the Enquiry

Committee in their letter and spirit and in time bound manner to ensure non-repetition of such blackouts in future.

(Recommendation Sl. No.12, Para No.2.12)

2.13 The Committee note that the Under Frequency Relays and df/dt relays are installed in distribution substations of State Utilities for automatic tripping of distribution lines connected to a load centre which forms part of the distribution network. PowerGrid conducted an audit of all these relays in 175 substations of the Northern Region in August, 2012. As per audit, 36 substations did not have the UFRs and df/dt relays, in 99 substations the relays did not operate on the date of disturbance i.e. 30th & 31st July, 2012 as per log book maintained by the substation itself. The relays operated in only 40 substations on date of disturbance. The Committee are indignant to note the negligence in regard to up keep of safety devices which are critical for prevention of grid breakdown of a large scale. Had these devices been working, it was very much possible that the blackouts could have been averted. The absence/malfunctioning of such a large number of devices have lead the Committee to believe that the safety audits of the transmission/ grid network is a rare affair otherwise the faults would have been detected and rectified earlier. The Committee, therefore, strongly recommend that provisions should be made for safety audit at a regular intervals and their findings should be implemented in a time bound manner to ensure safe, reliable and efficient transmission network in the Country. Also there should be unambiguous division of roles and responsibilities in

ensuring the installation and upkeep of safety devices/measures so that accountability can be fixed in case of any mis-happenings.

(Recommendation Sl. No.13, Para No.2.13)

2.14 The Committee during the examination of the subject 'Functioning of CERC' had pointed out that Unscheduled Interchange (UI) charges for the period 2002-03 to 2011-12 have cumulative value of Rs. 74,181 crore. The figure itself speaks volume about the misuse of the mechanism. The Committee had also noted that the frequency had dipped to as low as 48.7 Hz. The Committee infer that UI mechanism, actually legitimize the power overdrawl by utilities by paying a little price for it, therefore, instead of enforcing grid discipline, have encouraged the overdrawl of power by the utilities who are ready to pay, leaving the safety of the grid at stake. The Committee are against the idea of generation of revenue through UI mechanism at the cost of grid safety and reliability. The Committee find that UI mechanism has miserably failed to enforce grid discipline and deter overdrawl of electricity by Discoms rather it encourage Discoms to use UI mechanism as an alternative of short term electricity trading. The Committee, therefore, strongly recommend that there is a need for formulation of a regulation which can replace UI mechanism and ensure stricter enforcement of grid discipline by deterring the Discoms to overdraw after a certain frequency. The Committee further recommend that the Government, besides exploring the possibility of adopting disconnection

clause in extreme cases, should also incorporate harsh penal provisions for repeated offenders of overdrawl in the said regulation.

(Recommendation Sl. No.14, Para No.2.14)

2.15 The Committee note that with the proposed synchronous interconnection of Southern Region with NEW grid, a single grid of about 2,50,000 MW capacity shall be operated in coming years thereby maintaining grid safety, security and reliability of such geographical spread would be a great challenge. The Committee, therefore, strongly believe that in that scenario any grid malfunctioning, as happened in July, 2012, would have the cascading effect making it more severe by affecting one and all regions. In this scenario, the Committee feel shielding of important cities from blackout in case of grid failure becomes absolutely necessary. The Committee have been informed that Islanding Scheme for various parts of the Country including Delhi is under consideration. The Committee recommend that the proposal of Islanding Schemes for Delhi, other important cities/parts of the Country, as proposed by the Government, should be finalized expeditiously and be implemented within a fixed timeframe.

(Recommendation Sl. No.15, Para No.2.15)

Transaction of Electricity

2.16 The Committee note that Power Exchanges are the platform for short and medium term transaction of electricity. At present there are two power

exchanges in the Country, and more exchanges are being planned. The Committee further note that of the total electricity generation, 10.79% were transacted through short term trading. The Committee also note that average weighted price of electricity transacted during the month of December, 2012 through traders, Indian Energy Exchange and Power Exchange of India Limited was Rs. 4.39/kWh, 3.90k/kWh and 3.08/kWh respectively. It was also observed that on several occasions congestion in both the Exchanges was felt due to limitation in transmission transfer capabilities. The Power exchanges were constituted in order to provide inclusive, transparent and nation-wide competitive platform for better price discovery of electricity. The objective of Power Exchanges is to optimize the available generation capacity at national level, facilitating both, generators and the purchasers of the electricity. As it can be seen that the average weighted price of electricity transacted through exchanges are relatively low than that of through traders. The Committee believe that power exchanges facilitate implementation of the Open Access in transmission and meeting short term and medium term electricity demands of the power utilities which cannot be predicted in advance. The Committee also find that though more than four years have been elapsed since the inception of power exchanges, yet there are several issues that remain to be addressed. The volume of electricity transacted through these exchanges is not much; moreover, most of the transactions are being done through only one exchange. The Committee feel that the reason for the less volume could be the congestion due to the limitations in transmission capabilities. The Committee also find that the top five trading licensees had a share of about 70% in the total volume traded by all the licensees indicating that most of the trading

players are not getting participation in these exchanges for whatever reasons. The Committee feel that domination of few players in the power exchanges would defeat the very purpose of creating these platforms. The Committee, therefore, recommend the Government to take some remedial measures to ensure that the power exchanges, existing as well as proposed, should work in a fair and transparent manner and allow the inclusive and active participation of all trading players. Needless to emphasize that the problem of congestion which obstacle the transaction of electricity through these exchanges should be dealt expeditiously by suitable measures.

(Recommendation Sl. No.16, Para No.2.16)

Smart Grid Technology

2.17 The Committee note that the power systems in the Country have grown manifolds and their complexities are increasing. With the proposed synchronous interconnection of Southern Region with NEW Grid, there will be a single grid of about 2,50,000 MW capacity operating at one frequency. The Committee feel that maintaining grid safety, security and reliability of such geographical spread is of great challenge. Moreover, the proposed grid interconnection of Renewable Energy, having intermittent and variability features will certainly necessitate technological changes and up gradation of the grid. Against this backdrop, the Committee have been informed that PowerGrid has taken initiative for implementation of Smart Grid Technology in the Country and has implemented Phasor Measurement Units (PMUs) using Wide Area Measurement Systems (WAMS) in Northern

Region Grid for the first time. It is envisaged that the Smart Grid Technology will help in substantially bringing down the AT&C losses, improvement in quality of power supply, effective management of peak demand and supply response and grid integration of Renewable Energy. The Committee feel that the Smart Grid Technology, though expensive, is an advanced technology which is being used by many developed countries successfully. They, therefore, recommend the Government to go ahead and expedite the implementation of this technology throughout the Country. The Government should also ensure that lack of funds does not hinder the implementation of this ambitious project. The Committee expect that the Government will provide details about the proposals and progress made in implementation of Smart Grid Technology in the Country in their action taken reply.

(Recommendation Sl. No.17, Para No.2.17)

New Delhi;
07th May, 2013,
Vaisakha 17, 1935 (Saka)

MULAYAM SINGH YADAV
Chairman,
Standing Committee on Energy

Annexure-I

MINUTES OF THE SECOND SITTING OF THE STANDING COMMITTEE ON ENERGY (2012-13) HELD ON 1ST NOVEMBER, 2012 IN COMMITTEE ROOM '53' PARLIAMENT HOUSE.

The Committee met from 1100 hrs. to 1300 hrs.

PRESENT

Shri Mulayam Singh Yadav - Chairman

LOK SABHA

2. Shri Gadhvi Mukesh Bhairavdanji
3. Shri Jagdambika Pal
4. Dr. Padamsinha Bajirao Patil
5. Shri Nityananda Pradhan
6. Shri A.Raja
7. Shri Nripendra Nath Roy
8. Shri C.L. Ruala
9. Shri Sushil Kumar Singh
10. Shri Radha Mohan Singh
11. Shri Jagada Nand Singh
12. Shri Bhishma Shankar alias Kushal Tiwari

RAJYA SABHA

13. Shri V.P. Singh Badnore
14. Shri Shyamal Chakraborty
15. Shri Y.S. Chowdary
16. Shri Bhagat Singh Koshyari
17. Shri Kiranmay Nanda
18. Prof. Anil Kumar Sahani
19. Shri Motilal Vora

SECRETARIAT

1. Shri Brahm Dutt - Joint Secretary

LIST OF WITNESSES

Ministry of Power

1.	Shri P. Uma Shankar	Secretary
2.	Shri Ashok Lavasa	Addl. Secretary
3.	Shri Devendra Chaudhry	Addl. Secretary
4.	Smt. Jyoti Arora	Joint Secretary
5.	Shri I.C.P. Keshari	Joint Secretary
6.	Shri G. Sai Prasad	Joint Secretary
7.	Shri B.N. Sharma	Joint Secretary
8.	Smt. Rita Acharya	Joint Secretary
9.	Shri Rakesh Jain	Joint Secretary & F.A.
10.	Shri Manoranjan Kumar	Economic Advisor

Central Electricity Authority

1.	Shri A.S. Bakshi	Chairperson

Public Sector Undertakings/ Autonomous Bodies/Statutory Bodies

1.	Shri R.N. Nayak	CMD, Powergrid
2.	Shri G. Sai Prasad	CMD, NHPC
3.	Shri Rajeev Sharma	CMD, REC
4.	Shri Satnam Singh	CMD, PFC
5.	Shri R.P.Singh	CMD, SJVNL
6.	Shri R.S.T. Sai	CMD, THDC
7.	Shri P.C. Pankaj	CMD, NEEPCO
8.	Shri R.N.Sen	Chairman, DVC
9.	Shri A.B. Agrawal	Chairman, BBMB

2. At the outset, the Chairman welcomed the Members of the Committee and the representatives of the Ministry of Power to the sitting of the Committee and apprised them of the provisions of Directions 55(1) and 58 of the Directions by the Speaker regarding confidentiality of the proceedings of the Committee.

3. Thereafter, the representatives of the Ministry made a power-point presentation on Development of National Grid.

4. The Committee *inter-alia* discussed with the representatives of the Ministry of Power the following important points:-

i) Need for a National Grid – to enable harnessing of resources to their optimum potential, improve economy, reliability and quality of power supply and to bridge the gap between demand and supply in deficit area.

ii) Development of National Grid – transmission capacity addition during 11th Plan and plans to enhance transmission capacity to 66,000 MW by the end of 12th Plan.

iii) Grid Failure – factors responsible for the grid failure on 30th & 31st July, 2012, recommendations given by the independent technical Committee and action taken/ proposed by the Government thereon ensuring that Grid failure is not repeated.

iv) Role of CERC in Grid discipline.

v) Introduction of latest technology to ensure the smooth functioning of the Grid by strictly adhering to more precise grid frequency and to effectively check the malpractice of overdrawl by enforcing Grid discipline.

vi) Need for policy in regard to development of more pit head power plants to save transportation cost and fine-tuning of the policy with a view to make the National Grid beneficial to all areas including backward States/ Regions.

vii) Implementation of Islanding scheme for Delhi/ other States.

The Members sought clarifications on various issues relating to the subject and the representatives of the Ministry responded to the same. The Committee directed the representatives of the Ministry to furnish written replies to the queries which could not be responded to by them.

5. A verbatim record of the proceedings of the sitting of the Committee has been kept.

The Committee then adjourned.

Annexure-II

MINUTES OF THE FIFTH SITTING OF THE STANDING COMMITTEE ON ENERGY (2012-13) HELD ON 19th DECEMBER, 2012 IN COMMITTEE ROOM 'C' PARLIAMENT HOUSE ANNEXE, NEW DELHI

The Committee met from 1500 hrs. to 1700 hrs.

PRESENT

Shri Motilal Vora - In the Chair

LOK SABHA

2. Shri Jagdambika Pal
3. Shri Ravindra Kumar Pandey
4. Dr. Padamsinha Bajirao Patil
5. Shri Gutha Sukhender Reddy
6. Shri Baju Ban Riyan
7. Shri C.L. Ruala
8. Shri Sushil Kumar Singh
9. Shri Jagada Nand Singh
10. Shri Vijay Inder Singla
11. Shri Bhishma Shabnkar *alias* Kushal Tiwari

RAJYA SABHA

12. Shri Kiranmay Nanda
13. Prof. Anil Kumar Sahani

SECRETARIAT

1. Shri Brahm Dutt - Joint Secretary
2. Smt. Abha Singh Yaduvanshi - Director
3. Shri N.K. Pandey - Additional Director

LIST OF WITNESSES

MINISTRY OF POWER

Sl. No.	Name	Designation
1.	Shri P. Uma Shankar	Secretary
2.	Shri Ashok Lavasa	Addl. Secretary
3.	Shri Devendra Chaudhry	Addl. Secretary
4.	Shri B.N. Sharma	Joint Secretary
5.	Smt. Jyoti Arora	Joint Secretary
6.	Shri I.C.P. Keshari	Joint Secretary
7.	Shri G. Sai Prasad	Joint Secretary
8.	Shri Rakesh Jain	Joint Secretary & F.A.
9.	Smt. Rita Acharya	Joint Secretary
10.	Shri Manoranjan Kumar	Economic Advisor

CENTRAL ELECTRICITY AUTHORITY

1.	Shri A.S.Bakshi	Chairperson

PSUS, AUTONOMOUS BODIES, STATUTORY BODIES, ETC.

1.	Shri Arup Roy Choudhury	CMD, NTPC
2.	Shri R.N. Nayak	CMD, Powergrid
3.	Shri G. Sai Prasad	CMD, NHPC
4.	Shri Rajeev Sharma	CMD, REC
5.	Shri Satnam Singh	CMD, PFC
6.	Shri R.P.Singh	CMD, SJVNL
7.	Shri R.S.T. Sai	CMD, THDC
8.	Shri P.C. Pankaj	CMD, NEEPCO
9.	Shri R.N.Sen	Chairman, DVC
10.	Shri A.B. Agrawal	Chairman, BBMB
11.	Shri S.K. Soonee	CEO, POSCO

2. In the absence of the Chairman, the Committee chose Shri Motilal Vora, a Member of the Committee to act as Chairman for the sitting in accordance with Rule 258(3) of the Rules of Procedure and Conduct of Business in Lok Sabha.

3. At the outset, the Chairman welcomed the Members of the Committee and the representatives of the Ministry of Power to the sitting of the Committee and apprised them of the provisions of Directions 55(1) and 58 of the Directions by the Speaker regarding confidentiality of the proceedings of the Committee.

4. After introducing themselves to the Committee, the Secretary, Power briefly spelt out various facets of the subjects. He also replied to the aspects raised by the Members during the earlier sitting of the Committee held on 01st November, 2012.

5. The Committee, thereafter, inter-alia discussed with the representatives of the Ministry of Power the following important points:-

i) Norms for wheeling of electricity from one State to another.

ii) Achievement during 11th Plan in development of Inter-State, Intra –State and Inter-Regional transmission system and proposal for 12th Plan.

iii) Fund requirement for strengthening of transmission system and Development of National Grid.

iv) Findings of the Technical Committee on grid disturbances in June, 2012 – Action taken/ proposed by the Government on the recommendations of the Committee.

v) Allocation of Electricity produced by Central Sector to various States – deficiency of electricity in Eastern Region States.

vi) Development of more pit head power plants – their benefits and limitations.

vii) Islanding of important cities to avert any blackouts in the event of grid malfunctioning.

viii) Need for physical and technological upgradation of power stations and load centres.

ix) Roadmap for implementation of Smart Grid Technology in Transmission in the Country.

6. The Members sought clarifications on various issues relating to the subject and the representatives of the Ministry responded to the same. The Committee directed the

representatives of the Ministry to furnish written replies to the queries which could not be responded to by them.

7. A verbatim record of the proceedings of the sitting of the Committee has been kept.

The Committee then adjourned.

Annexure-III

MINUTES OF THE NINTH SITTING OF THE STANDING COMMITTEE ON ENERGY (2012-13) HELD ON 07TH MAY, 2013 IN COMMITTEE ROOM 'C' PARLIAMENT HOUSE ANNEXE, NEW DELHI

The Committee sat from 1500 hrs. to 1530 hrs.

PRESENT

Shri Motilal Vora - In the Chair

LOK SABHA

2. Shri P.C. Chacko
3. Shri Jagdambika Pal
4. Shri Ravindra Kumar Pandey
5. Dr. Padamsinha Bajirao Patil
6. Shri Baju Ban Riyan
7. Shri C.L. Ruala
8. Shri Jagada Nand Singh

RAJYA SABHA

9. Shri V.P. Singh Badnore
10. Shri Y.S. Chowdary
11. Shri Bhagat Singh Koshyari
12. Dr. Anil Kumar Sahani
13. Shri K.C. Tyagi

SECRETARIAT

1.	Shri Brahm Dutt	-	Joint Secretary
2.	Shri N.K. Pandey	-	Director
3.	Smt. L. Nemjalhing Haokip	-	Under Secretary

2. In the absence of the Chairman, the Committee chose Shri Motilal Vora, Member of the Committee to act as Chairman for the sitting in accordance with Rule 258 (3) of the Rules of Procedure and Conduct of Business in Lok Sabha.

3. At the outset, the Chairman welcomed the Members of the Committee and briefly apprised them of the Agenda for the sitting. The Committee then took up for consideration of the following draft Reports:

i) Thirty-Sixth Report on 'International Cooperation in New and Renewable Energy Sector' relating to Ministry of New and Renewable Energy.

ii) Thirty-Seventh Report on Development of National Grid relating to the Ministry of Power.

4. After discussing the contents of the Reports in detail, the Committee adopted the aforementioned draft Reports with slight modifications.

5. The Committee placed on record their appreciation for the officials of the Secretariat attached to the Committee.

6. xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

7. The Committee also authorized the Chairman to finalise the above-mentioned Reports taking into consideration the factual verification by the concerned Ministries and present the same to both the Houses of Parliament in the current Session.

The Committee then adjourned