

**CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI**

**Petition No. 129/MP/2012
with I.A. 18/2012**

**Coram:
Shri V.S. Verma, Member
Shri M. Deena Dayalan, Member**

**Date of Hearing: 9.4.2013
Date of Order : 6.9.2013**

In the matter of:

Petition under Central Electricity Regulatory Commission (Grant of Regulatory Approval for Execution of Inter-State Transmission Scheme to Central Transmission Utility) Regulations, 2010 read with Central Electricity Regulatory Commission (Grant of Connectivity, Long Term Access and Medium term Open Access to Inter-State transmission system and related matters) Regulations, 2009 for grant of regulatory approval for execution of Unified Real Time Dynamic State Measurement (URTDSM).

And

In the matter of:

Power Grid Corporation of India Ltd., Gurgaon
Vs

....Petitioner

1. Bihar State Electricity Board, Patna
2. West Bengal State Electricity Board, Kolkata
3. Grid Corporation of Orissa Ltd., Bhubaneswar
4. Damodar Valley Corporation, Kolkata
5. Power Deptt., Govt. of Sikkim, Gangtok
6. Jharkhand State Electricity Board, Ranchi
7. Assam State Electricity Board, Guwahati
8. Meghalaya State Electricity Board, Shillong
9. Govt. Of Arunachal Pradesh, Itanagar
10. Power & Electricity Deptt., Govt. of Mizoram, Aizwal
11. Electricity Deptt., Govt. of Manipur, Imphal
12. Department of Power, Govt. of Nagaland, Kohima
13. Tripura State Electricity Corporation Ltd., Agartala
14. Rajasthan Rajya Vidyut Prasaran Nigam Ltd., Jaipur
15. Ajmer Vidyut Vitran Nigam Ltd., Ajmer
16. Jaipur Vidyut Vitran Nigam Ltd., Jaipur
17. Jodhpur Vidyut Vitran Nigam Ltd, Jodhpur



18. Himachal Pradesh State Electricity Board, Shimla
19. Punjab State Electricity Board, Patiala
20. Haryana Power Purchase Centre, Panchkula
21. Power Development Deptt., Govt. of Jammu and Kashmir, Srinagar
22. UP Power Corporation Ltd., Lucknow
23. Delhi Transco Ltd., Delhi
24. Chandigarh Administration, Chandigarh
25. Uttarakhand Power Corporation Ltd., Dehradun
26. BSES Yamuna Power Ltd., Delhi
27. BSES Rajdhani Power Ltd., Delhi
28. North Delhi Power Ltd., Delhi
29. New Delhi Municipal Corporation, New Delhi
30. North Central Railway, Allahabad
31. Karnataka Power Transmission Corporation Ltd., Bangalore
32. Bangalore Electricity Supply Company Ltd., Bangalore
33. Gulbarga Electricity Supply Company Ltd., Gulbarga
34. Hubli Electricity Supply Company Ltd., Hubli
35. Mangalore Electricity Supply Company Ltd., Mangalore
36. Chamundeshwari Electricity Supply Corporation Ltd., Mysore
37. Transmission Corporation of Andhra Pradesh Ltd., Hyderabad
38. Eastern Power Distribution Company of Andhra Pradesh Ltd.,
Visakhapatnam
39. Southern Power Distribution Company of Andhra Pradesh Ltd., Tirupati
40. Central Power Distribution Company of Andhra Pradesh Ltd., Hyderabad
41. Northern Power Distribution Company of Andhra Pradesh Ltd., Warangal
42. Kerala State Electricity Board, Thiruvananthapuram
43. Tamil Nadu Electricity Board, Chennai
44. Electricity Deptt., Govt. of Puducherry, Puducherry
45. Electricity Deptt., Govt. of Goa, Goa
46. Madhya Pradesh Tradeco, Jabalpur
47. MP Audyogik Kendra Vikas Nigam Limited, Indore
48. Maharashtra State Electricity Distribution Co. Ltd, Mumbai
49. Gujarat Urja Vikas Nigam Ltd., Baroda
50. Electricity Deptt., Daman & Diu, Daman
51. Electricity Deptt., Dadra Nagar Haveli, Silvassa
52. Chhattisgarh State Electricity Board, Raipur

.....Respondents

Parties Present:

1. Shri Y.K. Sehgal, PGCIL
2. Shri Subir Sen, PGCIL
3. Shri Sanjeev Singh, PGCIL
4. Shri R.B. Sharma, Advocate, BRPL
5. Shri S. Vallinayagam, Advocate, TANTRANSCO



ORDER

The petitioner, Power Grid Corporation of India Limited has filed this petition for grant of regulatory approval under Central Electricity Regulatory Commission (Grant of Regulatory Approval for Execution of Inter-State Transmission Scheme to Central Transmission Utility) Regulations, 2010 read with Central Electricity Regulatory Commission (Grant of Connectivity, Long Term Access and Medium term Open Access to Inter-State transmission system and related matters) Regulations, 2009 (hereinafter referred to as 'Regulatory Approval Regulations' and 'Connectivity Regulations' respectively) for execution of Unified Real Time Dynamic State Measurement scheme.

2. Power Grid Corporation of India Limited (PGCIL) has made following prayers among others:

"(a) Grant Regulatory approval for implementation of Unified Real Time Dynamic State Measurement (URTDSM) Scheme;

(b) Grant approval for inclusion of the assets for which the transmission charges are to be recovered through the Point of Connection charges methodology or any other sharing mechanism notified by CERC from time to time;

(c) Grant approval for inclusion of system under Schedule 2 of TSA approved by CERC;

(d) Approve the reimbursement of expenditure by the beneficiaries towards petition filing fee, and publishing of notices in newspapers in term of Regulation 42 of CERC (Terms and Conditions of Tariff) Regulations, 2009, and other expenditure (if any) in relation to the filing of petition;"



3. The petitioner has also filed an Interlocutory Application No.18/2012 for issue of necessary order on urgent basis permitting the petitioner to go ahead with the execution of the Agreement for implementation of the proposed scheme as prayed in the main petition.

4. The scope of work covered under Unified Real Time Dynamic State Measurement scheme (URTDSM scheme) is as under:

(a) Installation of Phasor Measurement Unit (PMU) at 581 sub-stations under STUs and ISTS network at 400 kV and above level, and 220 kV generation switchyard;

(b) Installation of PMU on 3199 transmission lines under STUs and ISTS network at 400 kV and above level, and 220 kV generation switchyard;

(c) Installation of Phasor Data Concentrator (PDC) at each SLDC, RLDC, NLDC, NTAMC (National Transmission Asset Management Centre) and Nodal level in various States (59 nos.);

(d) Installation of Remote Consoles at each RPC, UTs, CEA, CTU, Sikkim and four (4) NER States (16 nos.);

(e) Installation of fibre optic communication links along with terminal equipment on various STU/ISTS transmission corridors (5000 km Fibre Optic cable).

5. The petitioner has submitted that the objective of the URTDSM scheme is real time measurement, monitoring and visualization of power system as well as taking preventive/corrective control actions in the regime of grid management with improved efficiency. The proposed scheme would also address increasing complexity in Indian power system, facilitate increased penetration of renewable generation into grid as well as optimal utilization of resources, real time state measurement of the entire grid being the need of the hour. The URTDSM scheme involving application of synchrophasor technology at STUs and ISTS levels in a unified manner would help in inclusive and intelligent measurements, monitoring, analysis, control and communication capabilities in order to improve reliability and efficiency of available resources. The petitioner initially indicated the estimated cost of the scheme as Rs.500 crore and the estimated impact on tariff for the next five years as Rs.147 crore per annum.

6. The petitioner has submitted that the scheme was discussed and finalized in the Joint Meeting of all the five Regional Standing Committees on Power System Planning held on 5.3.2012 which was convened under the aegis of Central Electricity authority. In the said meeting, it was agreed that the URTDSM scheme would be implemented by PGCIL as system strengthening and cost thereof would

be added to the National Transmission Pool account and would be shared by all Designated ISTS customers as per the PoC mechanism under the Central Electricity Regulatory Commission (Sharing of Transmission Charges and Losses) Regulations, 2010. The scheme was agreed to be implemented by PGCIL in the following manner:

(a) In Stage-I, PMUs would be placed at those locations where fibre optic communication links are either available or would be made available under microwave frequency vacating programme and regional strengthening programme by the year 2014-15 along with installation of Phaser Data Concentrator (PDCs) at all SLDCs, RLDCs, NLDC, NTAMC, strategic locations in States, remote consoles at RPCs, CEA, CTU and other locations. Nodal PDC shall be provided for collection of data from 40 PMUs in a cluster.

(b) In Stage-II, PMUs would be installed at remaining locations along implementation of URTDSM scheme in association with premier academic with communication links. Analytics would be developed in parallel with the institutions and in consultation with POSOCO, CEA , RPCs and some of the STUs.

(c) The stage-wise deployment of PMUs and PDCs would be carried as per the programmes indicated in Table-1 and Table 2 below:

Table-1: Stage-I Implementation Programme (Tentative)

Region	Sub-stations		Transmission Lines		PMUs		Nodal PDC	Master PDC	Super PDC	Main & B/U NLDC
	ISTS	STU	ISTS	STU	ISTS	STU				
NR	74	42	394	224	206	120	6	9	1	
WR	49	18	456	135	234	71	11	4	1	
ER	51	31	395	149	202	79	4	5	1	
SR	57	16	338	90	178	47	6	4	1	
NER	9	5	69	24	36	13	0	3	1	
Total	240	111	1652	622	856	330	27	25	5	
	351		2274		1186		57			2

Table-2: Stage-II Implementation Programme (Tentative)

Region	Sub-stations		Transmission Lines		PMUs	
	ISTS	STU	ISTS	STU	ISTS	STU
NR	9	55	40	211	21	111
WR	11	58	64	280	33	145
ER	-	13	-	50	-	26
SR	3	55	10	199	5	105
NER	9	17	26	45	14	23
Total	32	198	140	785	73	410
	230		925		483	

(d) The details of cost estimates for the above scope of work are as under:

(Rs in crore)

S No.	Item	Unit (Nos.)	Unit Rate	Estimated Cost
1	Phase-1			
1.1	PMU including GPS & Panel for mounting PMU	1186	0.1	118.6
1.2	Nodal PDC (27), Master PDC(25) and Super PDC (5) at RLDC, 2No PDC at Main & Back up NLDC including Workstation, Operator console	59	0.15	8.85

	& Printers, Panels.			
1.3	Data archiving server with storage & Recovery server and visualization software	59	0.25	14.75
1.4	Communication interfaces, routers/switch and misc items	410	0.01	4.1
1.5	Advanced Fire wall and intrusion detection	59	0.01	0.59
1.6	Miscellaneous including Remote Console	L.S.		2.5
1.7	Capacity building –Training of Central & State utilities/operators	L.S.		5.0
			Sub-total (a)	154.39
1.8	Contingency	10% of (a)		15.43
			Total (b)	169.82
2	Phase-2			
2.1	PMU including GPS & Panel for mounting PMU	483	0.1	48.3
2.2	Communication interfaces, routers/switch and misc	230	0.01	2.3
2.3	FO length-OPGW (in km)	10000	0.02	200
2.4	STM-16 SDH (2 Gpbs)	230	0.07	16.1
2.5	Miscellaneous	L.S.		2
			Sub-total (c)	268.7
2.6	Contingency	10% of (c)		26.87
			Total (d)	295.57
			Grand Total (b+d)	465.39
FO- Fibre Optic, STM- Synchronous Transport Module, SDH-Synchronous Digital Hierarchy				

(e) Considering the broad estimated cost of development of analytical software as Rs.35 crore, total cost of the URTDSM scheme was pegged at Rs. 500 crore.

7. In the RoP for the hearing on 17.5.2012, the petitioner was directed to submit the following information:

(a) Copy of the scheme approved by Regional Power Committee;

(b) Results of the pilot schemes already approved by the Commission;

(c) Cost-benefit analysis of the whole scheme; and

(d) Whether the present proposed scheme would be feasible as the Commission in various petitions filed by Regional Load Despatch Centers for approval of fees and charges of the RLDCs has already approved the additional capital expenditure for installation of PMUs.

8. The petitioner in its affidavit dated 15.6.2012 has submitted the point-wise replies as under:

(a) The URTDSM scheme was discussed, deliberated and firmed up in the joint meeting of all the Regional Standing Committees on Power System Planning held on 5.3.2012 wherein the members of all the Regional Power Committees, STU/SLDC, NLDC and RLDCs participated.

(b) As regards the results of the Pilot Schemes, it has been submitted that synchrophaser technology at inter-State level was introduced in 2011-12 through a pilot project in Northern Region. Subsequently, PMUs have also been placed in some selected stations in Southern and Western Regions. The PMUs located in different regions are presently being utilized for certain real time and post dispatch applications. The experiences gained from the

project have been compiled by POSOCO in a report titled “Synchrophasers Initiative in India” which includes such aspects as the enumeration of features available in present projects installed in different regions, identification of the applications available and used in real time and off line analysis, and itemization of case studies for each applications.

(c) As regards the cost benefit analysis of the scheme, it has been submitted that URTDSM scheme would enable synchronous measurement of real time grid parameters across the widely spread grid with low latency in data transfer to control centres for reliable, secure and economical grid operation and facilitate integration of the intermittent and variable renewable generation into the grid. The scheme would also facilitate estimation of the transfer capability in a more realistic way to bring efficiency in grid operation and economy in cost of power supply. The petitioner has explained the benefit of the scheme with the help of the following example:-

"For example, the cumulative transmission capacity of all the inter-regional corridors by 2012 is around 28,000 MW. However, the Transfer capability based upon voltage/angular stability consideration as well as off-line simulation studies declared in the Month of March, 2012 is about 8,500 MW. On implementation of URTDSM scheme, conservative side if 10% of the Total Transfer Capability is increased on the inter-regional corridors only, additional 850 MW power can be exchanged. Such quantum of power shall translate into annual energy of about 2978 MU [Energy in MU= $(850 \times 0.40 \times 8760) / 103$].

If we consider cheapest rate of energy at Rs. 2 per unit on the conservative side then the total annual energy cost comes out to be about Rs. 595 Crs. In other words, the subject scheme whose annual estimated transmission charges is of Rs. 147 Cr. shall enable the grid to handle additional energy whose cost is of the order of Rs. 595 Cr.

Hence, the subject scheme shall be a good proposition from cost-benefit point of view. Besides above, it would facilitate reliable, secure and stable operation of very large spread grid in new regime."

(d) As regards the additional capital expenditures sanctioned to RLDCs for installation of PMUs as part of RLDC fee and charges, it has been submitted that the PMUs under the pilot schemes for RLDCs approved by the Commission have already been excluded from the proposed URTDSM scheme.

9. Replies to the petition have been filed by BSES Rajdhani Power Limited (BRPL) and Bihar State Electricity Board vide their affidavits dated 9.7.2012 and 12.7.2012 respectively. The replies of both the respondents are identical. The gists of the submissions are discussed as under:

(a) The objective of the proposed scheme is real time measurements, monitoring and visualization of power system as well as taking preventive/corrective control action in the new regime of grid management and grid efficiency. Since the existing system is operating at more than 99% availability of the transmission network, the proposed scheme should make the transmission system capable of operating at 100% performance level. The respondents are agreeable to the proposal provided the petitioner agrees to a 100% performance level of its transmission network and any performance below 100% may result in decrease @ 1% of equity for each percentage point of decrease from 100% availability.

(b) As regards the second objective of the scheme to facilitate increased penetration of renewable generation into the grid as well as optimal utilization of resources, it has been stated that these objectives are generic in nature and no specific or quantifiable performance increase has not been claimed to assure the beneficiaries of the benefits from the project.

(c) A large investment has been made in the Regional Load Despatch Centres at the cost of the beneficiaries. A huge amount of Capital Expenditure has been allowed to POSOCO for the control period 2009-14. The petitioner has also been allowed fees and charges for the communication systems retained by it after formation of POSOCO. The proposed expenditure of Rs. 500 crore over and above the investment already made is a huge burden on the beneficiaries.

(d) Only the State Transmission Utilities attended the joint meeting of the Regional Standing Committees on Power System Planning for firming up the URTDSM Scheme and the beneficiaries who would be required to bear the charge of such investment were not invited in the meeting.

10. During the hearing on 10.7.2012, learned counsel for the BRPL reiterated its submission made in its reply to the petition and submitted that proposed scheme should be discussed with all stakeholders. The Commission had clarified that in accordance with the Regulatory Approval Regulations, consultation with the

beneficiaries is required and accordingly, directed the petitioner to discuss the URTDSM scheme in the RPCs.

11. The petitioner in its affidavit dated 13.2.2013 has submitted the status of discussion in the Regional Power Committee meetings as under:

(a) URTDSM scheme was discussed in the 20th SRPC meeting held on 28.9.2012 in Hyderabad and after deliberation, the scheme was approved.

(b) In the 23rd TCC and 26th meeting of NRPC held on 13.7.2012, the first stage of the proposed scheme was approved for installation of PMUs only at those buses which were connected by wide band network. In NR, out of 460 PMUs, 330 have been approved in stage-I. In the 24th TCC and 27th RPC meeting held on 29.11.2012, stage-II (remaining part) was also approved. During this meeting of NRPC, PGCIL was advised to carry out pilot project on PMU based Zone-3 blocking scheme on the line of recommendations of the Enquiry Committee Report.

(c) URTDSM scheme was discussed and deliberated in the 20th WRPC Meeting held on 18.5.2012 at Indore. WRPC noted that WR WAMS project would be integrated effectively in URTDSM scheme on all India basis as decided in the Joint standing committee meeting and the installation of PMUs by WRLDC.

WRPC further decided that MSETCL would examine inclusion of Mumbai for PMU placement.

(d) In special TCC NERPC meeting held on 9.2.2013, NERPC agreed in principle for implementation of proposed scheme.

(e) In the 22nd ERPC meeting held on 25.8.2012, the members of the Committee felt that (i) fresh investment in any scheme could be made only after ascertaining its cost benefit analysis and (ii) deliberation on such new scheme could be more fruitful if it could be done in comparison to effectiveness of present SCADA and ULDC schemes. Chairman, JSEB in his capacity as Chairperson, ERPC while welcoming any technological advancement observed that keeping in view the fund constraints of ER States, the project might be funded by PSDF. ERPC decided that each constituent would separately communicate its views in the matter to CERC. The petitioner was also requested to circulate a draft paper on proposed scheme as to how it would prevent the grid collapse along with cost benefit analysis.

12. During the course of hearing on 9.4.2013, learned counsel for the BRPL submitted that the regulatory approval can be granted under the Regulatory Approval Regulations for expansion of transmission line and not for the improving the grid parameters, which is the responsibility of system operator. Learned

counsel for TANTRANSCO requested for one week time to file its reply, which was allowed. However, TANTRANSCO has not filed any reply.

13. The petitioner vide its affidavit dated 12.7.2013 has submitted the revised cost estimates of phase-I and phase-II of the proposed scheme as under:

Estimated Cost of URTDSM Scheme

URTDSM	Cost (Rs in crore)
<p style="text-align: center;">PHASE-I</p> <ul style="list-style-type: none"> • Installation of 1186 PMUs along with 32 PDCs at control centers • Development of analytics etc. 	278.89
<p style="text-align: center;">PHASE-II</p> <ul style="list-style-type: none"> • Installation of 554 PMUs, 11000 km OPGW along with associated terminal equipment etc. 	377.09
TOTAL	655.98

14. We have considered the submissions of the petitioner, respondents and POSOCO. First of all, we deal with the objections of the learned counsel for BRPL that the regulatory approval cannot be granted under Regulatory Approval Regulations for improving grid parameters. Regulation 3 of the Regulatory Approval Regulations provides as under:

"3. Scope and applicability

(1) These regulations shall apply to:

(i) an ISTS Scheme proposed by Central Transmission Utility, for which generators have sought long-term access as per the Central Electricity Regulatory Commission (Grant of Connectivity, Long-Term Access and Medium-Term Open Access to the Inter-State Transmission and Related Matters) Regulations, 2009, and for which consultation with Central

Electricity Authority and beneficiaries if already identified has been held for setting up the ISTS Scheme, but for which Power Purchase Agreements with all the beneficiaries have not been signed on the date of application.

(ii) an ISTS Scheme for system strengthening/up-gradation, identified by Central Transmission Utility to enable reliable, efficient, co-ordinated and economical flow of electricity within and across the region for which consultation with Central Electricity Authority and beneficiaries if identified has been held.

(2) These regulations shall not apply to ISTS Scheme, for which all the beneficiaries/respective STUs have signed Bulk Power Transmission Agreement to share the transmission charges."

In our view, the URTDSM scheme is required for system strengthening for enabling reliable, efficient, coordinated and economical flow of electricity by improving system parameters and is therefore covered under Regulation 3(ii) of the Regulatory Approval Regulations. The petitioner has made the application in accordance with Regulation 4 of the Regulatory Approval Regulations. The petitioner has consulted Central Electricity Authority and the Regional Power Committees. The petitioner has published a notice in the newspapers in accordance with the Regulatory Approval Regulations. In response to public notice, no suggestions/objections have been received.

15. The Indian power system is growing manifolds and complexity is increasing in all fronts viz. generation, transmission and distribution. New regime of open electricity market also poses challenge in maintaining grid security and reliability. On the one hand, non-conventional energy resources must be developed and need to be integrated with the grid for sustainability. On the other hand, increasing

emphasis on Renewable Energy Sources, which are beset with variability and intermittency in their output, contribute to challenges in system operation. Indian power system now has 4000 MW single power stations, high capacity 765 kV transmission lines and single generation units of 1000 MW and 800kV HVDC transmission system feeding large cities and various critical loads are on the anvil. The incidents like natural calamity, etc., even on a single element of this capacity, have the potential to cause a major grid disturbance. The highest order of real time measurements, monitoring and control system is a must to avoid or mitigate impact of such incidences. To address these issues, introduction of intelligence in transmission system through smart grid applications is inevitable. The application of synchrophasor technology using Phasor Measurement Unit (PMU), integrated with Phasor Data Concentrators (PDC) and fibre optic communication links has emerged to address the growing and emerging challenges in the grid. In this context, the proposed "Unified Real Time Dynamic State Measurement" (URTDSM) scheme would help in identifying and developing modules for more inclusive and intelligent measurements, monitoring, analysis and control and communication capabilities with aim to improve reliability and efficiency of available resources. In the joint meeting of all the five Regional Standing Committees on Power System Planning held on 5.3.2012, IIT Mumbai highlighted that the benefits of synchrophasor technology for system monitoring and control have been made possible due to technological developments in the field of GPS, communication and computation. This technology has capability of measuring and monitoring the power system in real time, which would be helpful in better

visualization of the system and utilization of existing transmission assets with reliability, security and economy.

16. The synchrophasor technology at inter-State level was introduced in India in 2011-12 through pilot project in Northern Region. Subsequently PMUs have also been placed in some selected stations in Southern and Western Regions. The PMUs installed in different regions are presently being utilized for certain real time and post dispatch applications. The experiences of the pilot/demo/ complementary projects undertaken in Northern, Western, Southern regional power systems in India have been compiled by POSOCO in a report of POSOCO titled 'Synchrophasors Initiatives in India'. The petitioner has placed on record a copy of the report which indicates that ability of the system operators to take decisions in real-time is dependent on their 'situational awareness' derived from the data/information available with them in real-time. Conventionally, the analog and digital information related to the power system, such as circuit breaker status, frequency, voltage and power flow (MW/MVAr) measured at the substation and power station level is presented in the Load Despatch Centre through the Supervisory Control and Data Acquisition/Energy Management System (SCADA/EMS). In India, there is a hierarchical architecture of SCADA system through which the information is routed and updated (every 10 seconds) at the respective Load Despatch Centre. However, the synchrophasor technology along with the high speed wideband communication infrastructure from substation to control centre, called Wide Area Measurement System (WAMS), has now

overcome the above limitation. With the help of WAMS it is now possible to monitor the phase angles at the control centre. In addition, this technology enables visualization of magnitude and angle of each phase of the three phase voltage/current, frequency, rate of change of frequency and angular separation at intervals of the order of say 40 milliseconds at the Load Despatch Centre.

17. It is observed that there are many other benefits like validation of Auto-reclose of EHV lines, validation of measurement cycle of df/dt relays, validation of Disturbance Recorder (DR)/ Event Loggers (EL), validation of the operation of System Protection Scheme (SPS), validation of steady state SCADA and offline network model, Validation of Offline simulation study, detection of oscillations and validation of transfer capability, Spectral Analysis using fast fourier transform, study of Ringdown oscillations and Computation of System Inertia constant.

18. We have also considered the practical applications of PMUs submitted by the petitioner and they are primarily for the purpose of visualization of phasors, sequence components, angular separation, inter area oscillations, df/dt, voltage dip during fault, voltage recovery after clearance of fault, synchro check and can also be used in computation of Frequency Response Characteristics, detection of inter area/ local area mode oscillations. However, there is a need for development of more Analytics like running of real time EMS and assessment of system stability and generation of control signal etc. The real time analysis done through the output of WAMS has been used for PSS tuning at generating stations. As per

above report of POSOCO, Oscillations were observed from Ramagundam (NTPC) generating station in SR whenever the power-flow from the Western Region to Southern Region through HVDC Bhadrawati increased to 900MW and above. These were captured by PMUs. On analysis of PMU output, following possibilities were considered:

- (i) Oscillations generated by the HVDC Link due to inadequate damping by HVDC Control System.
- (ii) Inter-Area Oscillations.
- (iii) Intra-Plant Oscillations in Western Region.
- (iv) Intra-Plant oscillations in Southern Region. PMU plots of second scenario (inter-area oscillations) were further analysed to identify the mode of low frequency oscillation.

As the oscillations seem to be originating on account of intra-plant oscillations at Ramagundam, it was suggested to take up tuning of PSS at Ramagundam. Damping controllers which are normally provided at HVDC Bipole stations might also be proposed for HVDC Back to Back Bhadrawati which will help to address inadequate damping. It is understood that PSS Tuning at Karcham Wangtoo HEP and Tehri power plants have been successfully done based on the output of WAMS.

19. The petitioner has sought to install PMU at all sub-stations of 400 kV and above level sub-stations and 220 kV generation switchyard and all feeders of

STU, ISTS separately. It has been clarified that each PMU can measure one 3 Phase voltage and two 3 phase currents. Thus, the same PMU should be used for measurement of line currents on two feeders and bus voltage of the bus the feeders are connected to. However, PMUs with more number of phasor inputs are now available in the market. It is expected that the petitioner will utilize best technology and optimize number of PMUs to be installed at a location. The petitioner is advised to avail best possible configuration with an endeavor to reduce the project cost without affecting reliability.

20. The analytics are important for optimum utilization of PMU outputs. The details of some applications have been provided by the petitioner in the present petition. We are of the opinion that the petitioner should develop requisite analytics (applications) in consultation with IIT, POSOCO, CEA and RPCs and some of the STUs in a time bound manner for optimal utilization of the scheme and implementation of analytics must be done in the Phase-I. The petitioner should also ensure that EMS applications are available in real time in due course.

21. In joint meeting of all the five Regional Standing Committees on Power System Planning held on 05.03.2012, the broad cost estimates of this scheme was around Rs. 355 Cr. In the Project Inception Report (PIR) cost estimated for this scheme was around Rs. 500 Cr which included installation of 1669 PMUs, 59 PDCs and Optical Fibre Ground Wire (OPGW) of 10,000 km. Later in submission, vide affidavit dated 12.7.2013, the petitioner has submitted estimated cost for

Phase-I as ₹ 278.89 crore and for Phase-II as ₹ 377.09 crore. Phase-I consists of installation of 1186 PMUs along with 32 PDCs at control centers and development of Analytics etc. Phase-II involves installation of balance 554 PMUs and 11,000 km of OPGW along with associated terminal equipments.

22. The petitioner in PIR had initially estimated ₹ 204.82 crore for Phase-I including development of analytics/ application software which has subsequently been revised to ₹ 278.89 crore as per affidavit dated 12.07.2013. Similarly, for Phase-II, cost of ₹ 377.09 crore has been estimated now as compared to ₹ 295.57 crore estimated in PIR. The Petitioner has not given any rationale for reduction in number of PDCs and increase in length of optical fibre.

23. Further, we observe that Phase-I involves work and can be initiated immediately. The desired benefit of the scheme shall also be visible in a diminutive period. As proposed, PMUs will be placed at those locations where fibre optic communication link is either available or would be made available under microwave frequency vacating programme and regional strengthening programme by 2014-15 along with installation of PDCs at all SLDCs, RLDCs, NLDC, NTAMC, strategic locations in State, remote consoles at RPCs, CEA, CTU and other locations as proposed by the petitioner. Phase-II mainly involves laying down of OPGW along with associated terminal equipment and installation of balance PMUs in sub-stations not connected to wide band area network.

24. Accordingly we grant in-principle approval for Phase-I of the scheme. As proposed and agreed in CEA meeting dated 05.03.2012, PMUs will be placed at those locations where fibre optic communication link is either available or would be made available under microwave frequency vacating programme and regional strengthening programme by 2014-15 along with installation of PDCs at all SLDCs, RLDCs, NLDC, NTAMC, strategic locations in State, remote consoles at RPCs, CEA, CTU and other locations as proposed.

25. Phase-II of the scheme mainly involves laying down of Optical Fibre Cables. Communication being back bone of power system operation, the petitioner is granted liberty to file a composite scheme for laying of OPGW required for execution of URTDSM and Grid Security Expert System (GSES) as proposed by the petitioner in Petition No 265/MP/2012 as well as other communication requirements. The petitioner shall provide full details in respect of OPGW of aforementioned schemes to enable due priority to the communication system for power system operation. CEA may also be consulted before submitting the scheme to the Commission. The Commission also accords in-principle approval for providing PMU for Phase-II commensurate with the approval of OPGW for the said phase. The petitioner is directed to apprise the Commission the progress and benefit of Phase-I along with the updated cost estimates of PMUs for Phase-II.

26. The petitioner is directed to submit progress of implementation of scheme to National Power Committee (NPC) for review of progress and submit the progress report of the project to CERC on quarterly basis.

27. Some of the beneficiaries like BSEB and BRPL have submitted that regulatory approval should be accorded only if the petitioner assures that the transmission system would achieve 100% availability after implementation of the URTDSM scheme. In this connection, we intend to clarify that the primary purpose of the URTDSM scheme is to improve the visibility and security of the grid and to mitigate the probability of the grid failure and cannot prevent the physical faults like earth fault, line to line fault, etc. It may not be possible to achieve 100% availability as the forced outage in the system cannot be ruled out.

28. BRPL and BSEB have suggested that the funding for the scheme should be met through Power System Development Fund (PSDF). We are in agreement with the said suggestion. In our view, the projects should be funded through debt and equity in the ratio of 70:30. PGCIL shall contribute the equity and the debt portion shall be funded from the PSDF. PGCIL shall make an application before the Managing Committee of PSDF for reimbursement of funds equivalent to the loan amount. Since there is a possibility of time lag between making of the application by PGCIL to PSDF and actual reimbursement of the fund, PGCIL shall arrange for loan for the matching amount, which shall be repaid on receipt of the funds from PSDF. It is clarified that the execution of the scheme should not be affected in any

way on account of the time taken for getting the funds from PSDF. The tariff of the URTDSM scheme shall be worked out accordingly.

29. We observe that the URTDSM shall be part of smart grid. The petitioner shall share all relevant information and co-ordinate with SMARTGRID forum and help them in capacity building. Central and State Power Utilities personnel shall also be involved in the capacity building by POWERGRID through training/workshop in all five regions and POSOCO shall provide operational feedback for these workshops in the form of case studies.

30. It is further observed that NRPC in its 24th TCC and 27th RPC meeting held on 29.11.2012 advised the petitioner to carry out pilot project on PMU based Zone-3 blocking scheme in line of recommendation of Enquiry Committee report. For this, the petitioner is directed to include pilot project on PMU under Development of Analytics proposed under phase-I of the scheme.

31. The petitioner has sought reimbursement of fee paid by it for filing the petition. In terms of our order dated 11.1.2009 in Petition No. 109/2009, reimbursement of filing fee and expenses on publication in the present petition cannot be allowed.

32. Since, we have disposed of the main petition, I.A. No. 18/2012 has become infructuous.



33. This order disposes of Petition No. 129/MP/2012.

Sd/-
(M. Deena Dayalan)
Member

sd/-
(V.S. Verma)
Member

