सत्यमेव जयते

भारत सरकार/Government of India

विद्युत मंत्रालय/Ministry of Power

केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority

एन.पी.सी. प्रभाग/National Power Committee Division

Ist Floor, Wing-5 ,West Block-II, RK Puram, New Delhi-66

No. 4/MTGS/NPC/CEA/2021/40-57

Date:04thFebruary 2022

To

(As per distribution list)

विषय: NPC की 11 वीं बैठक के लिए मीटिंग नोटिस के सम्बन्ध में।

Subject: Meeting Notice for the 11th Meeting of NPC-Reg.

महोदया/महोदय,

एनपीसी की 11वीं बैठक **28.02.2022 को दोपहर 02:00 बजे** वीडियो कांफ्रेंसिंग के माध्यम से होने वाली है। बैठक का एजेंडा शीघ्र ही जारी किया जाएगा। मीटिंग के एक दिन पहले मीटिंग का वेब लिंक शेयर किया जाएगा.

कृपया बैठक में भाग लेने के लिए सुविधाजनक बनाएं।

The 11th meeting of NPC is scheduled to be held on **28.02.2022 at 02:00 PM** through video conference. The Agenda of the meeting will be issued shortly. The meeting web link will be shared one day before the meeting.

Kindly make it convenient to attend the meeting.

भवदीय/Yours faithfully

4/2/2022

(ऋषिका शरण/Rishika Sharan)

मुख्य अभियन्ता एवं सदस्य सचिव,रा.वि.स /

Chief Engineer & Member Secretary, NPC

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Distribution List (Members of NPC):

1. Shri Neiphui Rio, Chairman, NERPC & Hon'ble Chief Minister & I/C of Power, Govt. of Nagaland, Nagaland Civil Secretariat, Kohima-797004. [Email: cmngl@nic.in]
2. Sh. Anil Kumar, Chairperson, NRPC & TCC (NR), Managing Director, Power Transmission Corporation of Uttarakhand Limited. (PTCUL) Vidyut Bhawan, Near ISBT Crossing, Saharanpur Road, Majra Dehradun-248002 [e-mail: md@ptcul.org]
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5. Shri Sanjeev Hans, IAS, Chairperson, Eastern Regional Power Committee, and Chairman - Cum- Managing Director, Bihar State Power Holding Company Limited, Vidyut Bhavan, 1st Floor, Jawaharlal Nehru Marg, Patna-800 001 [E-mail: cmd.bsphcl@gmail.com]
6. Shri Upendra Pande, Chairman, TCC & Managing Director, Gujarat Energy Transmission Corporation Ltd. (GETCO). [Email- md.getco@gebmail.com]
7. Shri S Shanmugam Chairperson TCC & MD, TANTRANSCO 6 th floor, TANTRNSCO Building, 144,Anna Salai, Chennai - 600 002 Office Phone Number: 044- 28521057 [e-mail: mdtantransco@tnebnet.org]
8. Shri A.K. Sinha, Chairperson, TCC(ERPC) & Director (Technical), BSPGCL-cum-PMC, BSPHCL [Email: dtbspgcl@gmail.com]
9. Shri Penrithung Yanthan, Chairman, TCC (NERPC) & Chief Engineer (T & G), Department of Power Govt. of Nagaland, Kohima-797001. [Email: encpowerkma@gmail.com]
10. Shri Naresh Bhandari, Member Secretary, NRPC, 18-A, Shaheed Jeet Singh Marg, Katwaria Sarai, New Delhi-110016.[Email: ms-nrpc@nic.in]
11. Shri Satyanarayan S., Member Secretary, WRPC, Plot No. F-3, MIDC Area, Marol, Opp. SEEPZ, Central Road, Andheri (East), Mumbai-400093. [Email: ms-wrpc@nic.in]
12. Shri Asit Singh, Member Secretary, SRPC, No.29, Race Course Cross Road, Bengaluru-560009. [Email: mssrpc-ka@nic.in]
13. Shri N. S. Mondal, Member Secretary, ERPC, 14, Golf Club Road, ERPC Building, Tollygunje,Kolkata-700 033.[Email: mserpc-power@nic.in]
14. Shri B. Lyngkhoi,, Member Secretary, NERPC, NERPC Complex, Dong Parmaw, Lapalang, Shillong-793006. [Email: ms-nerpc@gov.in]

Special Invitees:

1. CMD, POSOCO, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi -110016.
2. COO, CTU, Saudamini, Plot No.2, Sector-29, Guragon-122001.

Copy for kind information to:

1. Chairperson, CEA, New Delhi
2. Member (G&OD), CEA, New Delhi

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सत्यमेव जयते

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एन.पी.सी. प्रभाग/National Power Committee Division

Ist Floor, Wing-5 ,West Block-II, RK Puram, New Delhi-66

No. 4/MTGS/NPC/CEA/2021/ 58-75 Date: 08th February 2022

To

(As per distribution list)

विषय: एनपीसी की 11वीं बैठक का एजेंडा के सम्बन्ध में।

Subject: Agenda of the 11th Meeting of NPC-Reg.

महोदया/महोदय,

हमारे पत्र संख्या 4/एमटीजीएस/एनपीसी/सीईए/2021/40-57 दिनांक 04.02.2022 की निरंतरता में, कृपया जानकारी और आवश्यक कार्रवाई के लिए एनपीसी की 11वीं बैठक का एजेंडा संलग्न है। यह सीईए की वेबसाइट पर भी उपलब्ध है।

In continuation of our letter No. 4/MTGS/NPC/CEA/2021/40-57 dated 04.02.2022, the Agenda of the 11th meeting of NPC is enclosed for kind information and necessary actions please. The same is also available on CEA website.

भवदीय/Yours faithfully

Enclosure: As Above.

8/2/2022

(ऋषिका शरण/Rishika Sharan)

मुख्य अभियन्ता एवं सदस्य सचिव,रा.वि.स /

Chief Engineer & Member Secretary, NPC

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Copy for kind information to:

1. Chairperson, CEA, New Delhi
2. Member (G&OD), CEA, New Delhi

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केंद्रिय विधुत प्राधिकरण

Central Electricity Authority

राष्ट्रीय विधुत समिति

National Power Committee (NPC)

Agenda Notes - 11th Meeting of

National Power Committee

To be held on 28th February 2022

(through VC/Online)

CONTENT

केंद्रिय विधुत प्राधिकरण
Central Electricity Authority
राष्ट्रीय विधुत समिति
National Power Committee (NPC)

Agenda Notes - 11th Meeting of National Power Committee to be held on 28.02.2022

1. Introduction

The 11th Meeting of the National Power Committee (NPC) is scheduled to be held on 28.02.2022 at 02:00 PM through video conference. The meeting Link will be shared subsequently through email.

2. Confirmation of Minutes of 10th meeting of NPC

The Minutes of 10th meeting of NPC held on 09th April 2021 through video conference was circulated vide letter No. 4/MTGS/NPC/CEA/2020 dated 23.07.2021. No comments has been received from the members.

The Committee may confirm the minutes of the 10th meeting of NPC.

NEW AGENDA ITEM

3. Issuance of Regional Energy Account (REA)

3.1 NTPC vide letter dated 16th November 2021 **(ANNEXURE-I)** requested that provisional REA may be issued by RPCs as early as possible, preferably on 1st of the following month. NTPC, in its letter, informed that REA is uploaded on websites of RPCs generally on 4th-5th of each month for the energy supplied in the previous month and the energy bills are being presented to the DISCOMS on 5th or 6th of every month. Due to time taken in issuance of REA after end of the month, carrying cost of 5-6 days for the billing amount is borne by the generating company. NTPC's annual billing in FY 2020-21 was over Rs. 1 Lakh Crores. Therefore, the financial implication of the carrying cost of 6 days at interest rate of 10% per annum works out to around Rs. 165 crores. Further, in its letter, NTPC suggested that since REA issued in the first week of each month for energy supplied in the previous month is provisional & issuance of final REA takes time and as the REA is based on DC and SG, which are available at the end of the month, issuance of provisional REA on 1st of month is possible. If there is requirement of some actual data for preparation of REA, the same can be taken provisionally for previous 30 days ending on 26th of the month. Changes, if any, can be made at the time is issuing final REA.

3.2 NPC Secretariat vide letter No. 4/MTGS/NPC/CEA/2021/405-415 dated 23.11.2021 sought views/comments of RPCs/NLDC/RLDCs on issuance of provisional REA as early as possible, preferably on 1st of the following month. From the inputs, the following has been emerged:

(a) Based on the inputs received from RPCs, it is observed that in the FY 2021-22 (till Dec 2021), the provisional REA has been issued by RPCs either on the same working day or the next working day from the date on which inputs has been received from RLDCs.

(b) NTPC figure of Rs. 165 crore at interest rate 10% seems to be at higher level and not clear, the basis of 10% hence needs to be further clarified.

(c) It is pertinent to note the following relevant CERC Regulations:

(i) Regulation 6.5.29 of IEGC (Indian electricity Grid Code),
"After the operating day is over at 2400 hours, the schedule finally implemented during the day (taking into account all before-the fact changes in dispatch schedule of generating stations and drawl schedule of the states) shall be issued by RLDC. These **schedules shall be the datum for commercial accounting**….."

(ii) Regulation 6.1 (d) (10) of CERC(IEGC) Regulations stipulates as below:
"Regional Energy accounting on monthly basis shall be prepared and issued by the RPC Secretariats for the purpose of billing and payment of various charges. Regional Energy Account for a month shall be issued in the **following month based** on the data provided by RLDC."

(iii)Regulation 6.1 (d) (8) of CERC(IEGC) Regulations stipulates as below:
"All Regional Energy Accounting calculations carried out by RPC Secretariats shall be open to all regional entities for any checking/verification for a period of 15 days. In case any mistake is detected, RPC Secretariats shall forthwith make a complete check and rectify the mistakes."

In view of above clauses of CERC (IEGC), 2010 Regulations (and its amendments time to time), RPCs are issuing Provisional monthly REA on the basis of monthly data (previous month) submitted by RLDCs. There is no such provision for issuance of REA account on the 1st day of the following month by taking data up to 26th of the accounting month and the rest of the data from the previous month. Further, there is no regulatory provision in IEGC to issue REA account without the actual data of the complete month.

In addition, issuance of REA by considering data of 2 months without regulatory provision will create problem whenever there will be an outage of the plant or share allocation changes in the last 4-5 days of the month which may happen due to re-allocation of surrendered share to needy states even on a short term basis, will contribute to wrong energy accounting and subsequently Discoms may suffer

In view of the above, RPCs and RLDCs are issuing the REA in line with the current CERC regulations. However, to reduce the delay in issuance of provisional REA, the following suggestions may be followed:

(a) The inputs for preparation of REA may be submitted by RLDCs on **first calendar day** of the month (preferably in Forenoon) and provisional REA could be issued by RPCs on the **next calendar day** for billing purpose.

(b) NTPC expedite to do the cross-check of accounts issued by RPCs by **2nd day itself** and issue subsequent accounts to utilities/Discoms by 2nd day itself which may remove delay at NTPC end.

(c) NTPC can **approach Hon'ble CERC** for amendment in the CERC Regulations and get permission to raise the monthly provisional bills based on the pro rata basis. This will facilitate presenting the bills by NTPC to DISCOMs on 1st of every month.

Members may like to deliberate on the subject issue.

AGENDA ITEMS FROM PREVIOUS MEETINGS

4. Telemetry of real time active power (MW) data to SLDCs

4.1 After implementation of CERC (Deviation Settlement Mechanism and related matters) Regulations 2014 and subsequent amendments, many constituents had raised the issue of difference between SCADA data and IEM data. As per present practice, the utilities take decisions of their drawal management, based on real-time MW SCADA data visible at control room. However, the commercial settlement is based on the IEM data and on account of the difference in SCADA Vs IEM data, the decision taken during real time based on the SCADA data is not justified and led to increase in DSM penalty.

4.2 The issue was raised by utilities of SRPC, NRPC and WRPC in their respective forums. To mitigate this problem, the utilities suggested to get the real time active power (MW) data to SLDCs through IEMs. As the existing IEMs in service are not capable of telemetry of realtime MW data, the issue of installing additional energy meter in series with existing IEMs or Provision of real time MW data to SLDCs in the technical specification of the new 5/15minute IEMs to be supplied and installed was emerged.

4.3 A meeting was convened on 19.11.2020 by MS, NPC on the issue which was chaired by Chairperson CEA. In the meeting followings were decided:

a. *All the existing IEMs shall be replaced with new technology IEMs having facility to communicate recorded data to LDCs in real time. The modalities for the project shall be decided later on.*
b. *All future IEMs at ISTS interface points shall have the feature of user configurable 5/15 min time block along with real time streaming of 1 min (at least) instantaneous data. A reliable communication system (preferably OFC) would be adopted while finalizing the Technical specifications. In order to harmonize the new age end-to-end metering solution, the Technical Specifications (TS) of the new technology IEMs shall be followed on Pan-India basis.*
c. *A Joint Committee (JC) comprising members from all RPCs, CEA, and CTU / POWERGRID & POSOCO shall be formed to deliberate and finalize the above TS.*
d. *To minimize DSM penalties during the interim period, the state utilities may put additional meters in series with the existing meters at the ISTS locations at their own cost in consultation with CTU (POWERGRID). With a view to help the States / DISCOMs to take decision in this regard, it was decided with the consent of GETCO that they (GETCO) shall carry out the pilot project for real time monitoring of metering data at ISTS points of their state at their own cost and share the outcome of the project with NPC. Subsequently, similar project may be taken up by other interested states if they find outcome of the Pilot Project commercially beneficial to them.*
e. *POSOCO would assess the feasibility of placing new AMR-MDP system at its RLDCs/NLDC and make efforts to arrange the same, or suggest a techno-economic solution to collect the metered data at RLDCs/NLDC from the AMR-MDP system.*

4.4 Accordingly, NPC Secretariat vide letter No. 4/MTGS/NPC/CEA/2020/94-104 dated 02.12.2020 had constituted the Joint Committee (JC) comprising members from each RPC, CEA, and CTU, POWERGRID & POSOCO to deliberate and finalize the Technical Specifications of IEMs.

4.5 So far, four meetings (including special meeting) of the Joint Committee were held on 05.02.2021, *14.04.2021 and 16.07.2021* through VC. In these meetings, the draft Technical Specification of Interface Energy Meters (IEMs) with Automatic Meter Reading (AMR) and Meter Data Processing (MDP) was discussed. In the 3rd meeting on JC held on *16.07.2021, i*t was agreed that CTU and POSOCO shall finalise their respective part of TS in line with

the decisions taken in the various meetings of JC. **The final draft of TS was received from CTU and POSOCO. NPC Secretariat vide letter dated 21.01.2022 circulated the final Draft of TS to the members of the Joint Committee for their comments.**

This is for information to the Committee.

5. Guidelines for locating PMU for URTDSM Phase II project

5.1 Indian grid has grown manifolds and complexity has also increased. Managing grid safety, security and reliability is a great challenge. To address this, intelligence through smart grid technology application of Wide Area Measurement System (WAMS) is used to provide better visualization and situational awareness to operator.

5.2 Accordingly, a Pilot Project was implemented with 52 Phasor Measurement Units (PMUs) installed all over the Country progressively from 2008 to 2010. Based on the experience gained in Pilot Projects, a Feasibility Report was prepared for Nation-wide development of WAMS namely Unified Real Time Dynamic State Measurement (URTDSM) Project. The Project was agreed for implementation in a Joint Meeting of all the five Regional Standing Committees on Power System Planning held on 5th March, 2012 **(ANNEXURE -II)**. During the meeting, following PMU placement philosophy was decided:

1. All 400 kV stations in State and ISTS grids.
2. All generating stations at 220 kV and above.
3. HVDC terminals and inter-regional and inter-national tie lines.
4. Both ends of all the transmission lines at 400kV and above: State and ISTS sector

5.3 In addition to the PMU deployment, six (6) analytical software such as Line Parameter Estimation, Online Vulnerability Analysis, Linear State Estimation, CT/CVT Calibration, Supervised Zone-3 Distance Protection and Control Schemes for Improving System Security were also proposed to be developed by IIT Bombay.

5.4 A Detailed Project Report (DPR) was prepared in 2012 for implementation of 1740 PMUs on Pan -India basis. Based on communication availability, URTDSM Project has been taken up in two phases as follows:

- **Phase-I :** 1186 PMUs at 351 substations(communication existing) - Rs. 278.89 crs
- **Phase-II:** 554 PMUs at 301 substations (with installation of 11,000 Kms OPGW) - Rs.377 crs.
- Phasor Data Concentrators with 6 Analytical Software at 32 Control centres considering requirement of both i.e. Phase-I & Phase-II.

5.5 CERC granted in-principle approval for the project in Sept'2013 with 70% funding from PSDF & 30% equity from POWERGRID. CERC granted in-principle approval for the implementation of URTDSM Phase-I and advised to take up Phase-2 after receiving feedback on Phase-I performance from POSOCO.

5.6 POWERGRID has taken up the implementation of URTDSM Project in Jan'2014 and 1409 PMUs were installed under the Project. The increase in quantity of PMUs is due to addition of new bays etc.at the substations.

5.7 The feedback on URTDSM Phase-I performance is received from POSOCO **(ANNEXURE –III)**.

5.8 In line with agreed philosophy in Joint Meeting of all the five Regional Standing Committees on Power System Planning, POWERGRID taken up the requirement of URTDSM Phase – II in all Regional Power Committees. During the discussion on finalization of PMU quantity for URTDSM phase–II, requirement of additional measurements by PMU has emerged.

POSOCO has also desired additional Analytical software using PMU data.

5.9 NRLDC (in 45th TCC, 48th NRPC meeting) and SRLDC (in TCC & 37th SRPC meeting) proposed additional PMU locations beyond the already agreed philosophy in standing committee:

5.10 The number of PMUs initially envisaged in Phase II would increase, if the above philosophy is taken under consideration. This quantum increase in number of PMUs will also affect the performance of Phasor Data Concentrator (PDC) and other equipment such as Historian etc.at the Control Centre Location at SLDC, RLDC and NLDC, RPCs/NPC which may also need upgradation / installation. The additional WAMS analytics shall also require additional hardware.

5.11 **In the 10th meeting of NPC, it was decided that a Sub-Committee would be formed under the Chairmanship of Member Secretary, WRPC with representatives from POSOCO, CTU, POWERGRID, all RPCs/NPC.** The Sub-Committee shall discuss on the uniform philosophy of PMU locations, new analytics and requirement of up gradation of Control Centre under URTDSM project and submit its recommendations to the NPC.

5.12 Accordingly, NPC Secretariat vide letter No. 4/MTGS/NPC/CEA/2021/285-298 dated 20.09.2021 **(ANNEXURE-IV)** has constituted the Sub Committee. The first meeting of the Sub Committee was held on 10.12.2021 through VC.

WRPC may update the status to the Committee.

6. Review of Status of Islanding schemes

6.1 On 28th December 2020, Hon'ble Minister of State (IC) for Power and New & Renewable Energy reviewed the Islanding Schemes through video conference.

6.2 As per the directions of the Honourable Minister in the review meeting on Islanding Schemes held on 28th December 2021 and further directions from Secretary (Power) in the meeting held on 31st March 2021, 16th April 2021 and 19th August 2021 the Islanding Schemes (IS) in Indian Power system were reviewed. In the meeting taken by Secretary (Power) on 19th August 2021, the following decisions were taken:

(i) It was decided for setting up separate display of Islanding Schemes on SCADA of respective states LDCs/Sub SLDs and RLDCs for real time monitoring of participating generators & critical loads.

(ii) Categorization of Islanding Schemes may be done based on Category 'I' for major cities, sensitive generation or strategic loads and Category 'II' for remaining schemes.

(iii) An MIS report regarding the status of the Islanding Scheme under Category 'I' and 'II' may be furnished by the CEA to MoP. Priority efforts be made towards updating/preparing Category 'I' IS.

(iv) It was decided that the new Islanding Schemes may be funded through PSDF.

Further, in the meeting taken by Secretary (Power) on 19th August 2021, the Standard Operating Procedure (SOP) **(ANNEXURE-V)** for the Islanding Schemes was presented and discussed. NPC Secretariat via email date 12th Oct 2021 circulated the SOP to the RPCs for compliance.

6.3 Further, a meeting on "Status of Islanding Schemes" was held on 07th Oct 2021 under the Chairmanship of Hon'ble Minister of Power and New & Renewable Energy. The MoM of the meeting are attached at **ANNEXURE-VI**

6.4 The status of the Islanding Schemes (as on 10.01.2022) is given below:

Overview of the status of Islanding Scheme in all Regions						
Regions	**Total Number of Islanding Schemes**	**No. of Implemented /In-service IS**	**No. of IS which are Under Implementation**	**No. of Newly proposed Islanding Scheme which are under design/Under Implementation stage**	**No. of Newly proposed Islanding Scheme which are Implemented/ Inservice**	**No. of IS having SCADA visibility**
SR	7	5	1	1	2	7
ER	10	4	4	2	0	5
NR	11	2	2	7	0	4
WR	12	6	1	5	0	0
NER	3	0	2	1	0	3
	43	**17**	**10**	**16**	**2**	**19**

6.5 RPCs are requested to expedite the process of implementation of the newly proposed Islanding Schemes which under various stages of implementation as the progress of the same has been observed slow.

6.6 RPCs are also requested to review the already In service Islanding schemes as per SOP (six monthly).

6.7 In this regard as per the directions of Secretary, Ministry of Power MIS Report was prepared. The MIS report as on 10.01.2022 is enclosed herewith as **ANNEXURE-VII.**

Members may like to deliberate on the subject issue.

7. Automatic Under Frequency Load Shedding (AUFLS) Scheme and Mapping of Feeders

(A) Review of AUFLS Settings

7.1 As per the decision in the 2nd meeting of NPC held on 16th July 2013, the following AUFLS scheme at four (4) stages of frequency viz. 49.2 Hz, 49.0 Hz, 48.8 Hz & 48.6 Hz had been implemented in all the regions:

AUFLS	**Frequency (Hz)**	**Load relief in MW**					
		NR	**WR**	**SR ***	**ER**	**NER**	**Total**
Stage-I	**49.2**	2160	2060	2350	820	100	7490
Stage-II	**49.0**	2170	2070	2360	830	100	7530
Stage-III	**48.8**	2190	2080	2390	830	100	7590
Stage-IV	**48.6**	2200	2100	2400	840	100	7640
Total (MW)		**8720**	**8310**	**9500**	**3320**	**400**	**30250**

****SR grid not integrated with NEW grid at that point of time***.

The existing Region-wise/State-wise details of AUFLS and df/dt settings are given at **ANNEXURE - VIII.**

7.2 In the 10th meeting of NPC it was decided that the AUFLS scheme (with 4 stages) viz. 49.4, 49.2, 49.0 & 48.8 Hz with existing quantum of load shedding shall be implemented in all the Regions. The quantum of load shedding would be reviewed based on the recommendation of the Sub- Committee to study the AUFLS scheme.

7.3 SRPC via email dated 12.01.2022 informed that the settings of AUFLS scheme had been raised by 0.2 Hz (4 stages - viz. 49.4, 49.2, 49.0 & 48.8 Hz) by all SR Constituents. NERPC via email dated 04.02.2022 informed that identifications of feeders for AUFLS is under process & review in the OCC forum and the status shall be shared with NPC soon. NRPC via email dated 03.02.2022 informed that NR states/constituents agreed to raise the AUFR settings by 0.2 Hz in 47th TCC/49th NRPC meetings. The compliance of revised setting is being monitored in monthly OCC meetings of NRPC.

RPCs may update the implementation status of raising the AUFR settings by 0.2 Hz.

7.4 **As per 10th NPC meeting a Subcommittee was formed to review the AUFLS scheme. The 2nd meeting of AUFLS** study committee was held on 07.12.2021.

WRPC may update the status of study/report of the Sub Committee to the Committee.

(B) <u>Mapping of Feeders</u>:

7.5 In the 10th Meeting of NPC held on 09.04.2021, it was reiterated that each RPC would submit the details/progress of feeder mapping on SCADA to NPC Secretariat regularly on a quarterly basis. However, no data is being received in NPC on quarterly basis.

7.6 Further, as per the Standard Operating Procedure (SOP) of the Islanding Schemes, the monitoring of vital parameters having significant role for successful Island formation.

7.7 The status of Mapping of feeders furnished by RPCs in the meetings of NPC is summarized below:

S.No.	RPC	Status (As informed in the 10th meeting of NPC held on 9th April 2021)
1	SRPC	Mapping of around 89% of feeders on SCADA.
2	ERPC	95% mapping of feeders achieved.
3	WRPC	WRPC will update the status shortly.
4	NRPC	UFR - Main : 47%;Standby availability :81.25%, df/dt - Main : 71% ;Standby availability:90%. NRPC informed that they will update through Email.
5	NERPC	NERPC informed that they will update the status shortly.

7.8 SRPC via email dated 12.01.2022 informed that SCADA mapping status is being updated in monthly OCC Meetings and the following is the status update in the 186th Meeting of OCC held on 10.01.2022:

State			AP	TS	KAR	KER	TN	PUD	SR
Recommended	MW	A	1582	1686	2328	826	2993	91	9506
Implemented	MW	B	1602	1826	2384	962	3121	91	9986
	%	B/A	101	108	102	114	104	100	105
Mapped Quantum as on 31st December 2021	MW	C	1528	1581	2357	942	2765	82	9255
Mapped Quantum & wrt Implemented	%	C/B	95	87	99	98	89	90	93

7.9 NERPC via email dated 04th Feb 2022 informed that due to inadequate communication facilities at 33kV and 11kV feeders and difficulties in feeders separation to implement various defence mechanisms (UFRs, SPSs, ADMS etc.), implementation of mapping of feeders in NER is very difficult at the moment.

7.10 NRPC via email dated 03.02.2022 informed state-wise status of feeder mapping (received from NRLDC) attached as **ANNEXURE-IX**

RPCs are requested to expedite the mapping of feeders on SCADA.

RPCs may update the status to the Committee.

8 Ensuring Proper Functioning of Under Frequency Relays (UFR) & df/dt Relays.

8.1 RPC Secretariats were mandated to carry out periodic inspection in line with the provisions of IEGC. The frequency of site inspection was proposed to be up to six months and the inspection reports were to be furnished by RPCs to NPC Secretariat. RPCs were requested to update the status of periodic inspection of UFR and df/dt relays quarterly, however, no inputs have been received.

8.2 Further, as per the Standard Operating Procedure (SOP) of the Islanding Schemes, the Inspection/ audit of all essential components like UFR and df/dt relays shall be carried out regularly (by third party) by RPCs.

8.3 SRPC via email dated 12.01.2022 updated the status of periodic inspection of UFR and df/dt relays **(ANNEXURE-X).**

8.4 NERPC via email dated 04.02.2022 informed that Status & Operation of UFR Relays are being regularly monitored in OCC Meetings. Further, periodical inspection and testing of UFRs are being carried out by NERPC along with other utilities.

8.5 NRPC via email dated 03.02.2022 informed that utilities submit report of mock exercises for healthiness of UFRs on quarterly basis to NRPC Secretariat. The compliance is monitored in monthly OCC meetings.

RPCs may update the status to the Committee.

9 Implementation of Automatic Generation Control (AGC) in India (at Inter-State level)

9.1 CERC in its order dated 13.10.2015 in Petition No. 11/SM/2015 had reiterated the need for mandating Primary Reserves as well as enabling Secondary Reserves, through Automatic Generation Control (AGC) as follows:

"(a) All generating stations that are regional entities must plan to operationalize AGC along with reliable telemetry and communication by 1st April, 2017. This would entail a one-time expense for the generators to install requisite software and firmware, which could be compensated for. Communication infrastructure must be planned by the CTU and developed in parallel, in a cost-effective manner.

(b) On the other hand, National/Regional/State Load Dispatch Centers (NLDC/RLDCs/SLDCs) would need technical upgrades as well as operational procedures to be able to send automated signals to these generators. NLDC /RLDCs and SLDCs should plan to be ready with requisite software and procedures by the same date.

(c) The Central Commission advises the State Commissions to issue orders for intrastate generators in line with this timeline as AGC is essential for reliable operation of India's large inter-connected grid."

9.2 In the 09th meeting on NPC, it was agreed that all RPCs and NLDC shall provide the updated information on status of implementation of AGC, regularly to NPC Secretariat on a quarterly basis.

9.3 A meeting to discuss the Ancillary Services was held on 21.01.2021 in Ministry of Power. There, Hon'ble Minister of State (I/C) for Power and NRE has given the direction that the implementation of AGC needs to be expedited and should cover all generators including the intra state generators in the grid.

9.4 In the 10th meeting of NPC, GM, NLDC informed that as per CERC's directions the AGC Pilot project was first Commissioned in Dadri during January 2018. Then the AGC was extended to one Plant (CGS), as a pilot project in in all the 5 regions of the country. As per CERCs directions the AGC to be implemented in all ISGS stations. They had conducted various meetings with the generators and CTU to implement the scheme . As of now **35 GW of ISGS stations were selected for AGC**. The AGC implementation is in progress in various stages of implementation in Inter/Intra state Generating stations. He also informed that signal for AGC for ISGS will be sent from NLDC and for Intra state Generators the AGC signals will be sent from SLDCs.

9.5 The information provided by RPCs on the status of implementation of AGC is as follows:

S.NO	RPC	Status (As informed in the 10th meeting of NPC held on 9th April 2021)
1	ERPC	ERPC informed that they were discussing the issue in OCC meetings. Due to Covid situation the implementation of AGC schemes is delayed. They are reviewing the implementation. The updated status would be submitted to NPC.
2	SRPC	MS, SRPC informed that extensive AGC implementation programme is going on in SR. He informed that AGC has been implemented in Shimadri. The implementation of AGC is completed on 31.03.2021 in NTPC Ramagundam stg II. In state sector in Karnataka, Sharavathi Generating station, it was implemented under USAID with 10% of Generation control under AGC. In Kerala in Kuttiadi Station, AGC is operational for 50 MW control. In other ISGS of SR, AGC implementation is in progress and are at various stages of implementation. He informed that the update will be submitted to NPC.
3	NERPC	The updated status of AGC implementation would be submitted to NPC shortly.
4	NRPC	MS, NRPC informed that the updated status of AGC implementation would be submitted to NPC shortly.
5	WRPC	MS, WRPC informed that the AGC implementation would be taken up in the OCC meetings of WRPC.

9.6 SRPC via email dated 12.01.2022 updated the status of implementation of AGC **(ANNEXURE-X).**

9.7 NERPC via email dated 04.02.2022 informed that AGC is fully functional in Bongaingaon TPP (NTPC) and Loktak HEP (NHPC).

9.8 NRPC via email dated 03.02.2022 informed the status received from NLDC is attached as **ANNEXURE-XI**

RPCs/NLDC may update the status to the Committee.

10 Scheme for Protection System Data Base Management System (PDMS) in RPCs

10.1 The Task Force headed by Shri V. Ramakrishna had submitted the Report on "Power System Analysis under Contingencies" which had recommended for creation of database for relay settings as under:

"10.12.3 There is also a need for creating and maintaining data base of relay settings. Data regarding settings of relays in their network should be compiled by the CTU and STUs and furnished to the RLDC and SLDC respectively and a copy should also be submitted to RPC for maintaining the data base."

10.2 The schemes of ERPC, NERPC and SRPC for the said purpose had been sanctioned grant from Power System Development Fund (PSDF) by Ministry of Power (MoP).

10.3 In the 07th meeting of NPC held on 08.09.2017, WRPC had informed that they would like to go for in-house development of the data base which could be in excel or SQL format and if any needs arises they would opt for development through third party.

10.4 The grant was sanctioned from PSDF for implementing PDMS in Northern Region. However, in the 09th meeting of NPC, NRPC informed that NLDC has been requested for cancellation of the sanctioned grant of Rs. 28 Crore from PSDF as there were very few bidders and Chairperson (NRPC) raised apprehension on awarding the works to the same agency involved in other regions. NRPC further informed that there was discussion with Power Grid for developing a Data Base System for relay setting for NR.

10.5 The status of implementation of PDMS as available with the NPC Secretariat is summarized below:

S.NO	RPC	Status (As informed in the 10th meeting of NPC held on 9th April 2021)
1	ERPC	Protection System Data Base has been implemented and it is **in service** from 31.10.2017.
2	SRPC	The Protection Management System (PMS) project **will be Go-Live** in April-May 2021.
3	NERPC	The PDMS project was awarded in September,2018, and the project is **completed**.
4	NRPC	MS, NRPC informed that almost 85-90 percent data of relay settings was available with NRPC in excel sheet. A committee has been constituted for preparing comprehensive specifications of relay setting parameters for having Web based database in NRPC. The committee has also been tasked to give its recommendations on modalities for web based PDMS in NR. The said committee will summit its recommendation/report by June 2021. After which NRPC will decide on next **line of action** and the same would be communicated to NPC.

5	WRPC	MS, WRPC informed WRPC has all required data of relay settings in excel sheet, but it is not in database format. However, the **in-house development** of protection database for **WRPC is in good progress**.

10.6 NRPC via email dated 03.02.2022 informed that the status of the Protection setting Data Base in being regularly monitored in the Protection sub-committee meetings of NRPC. Upon deliberation in various Protection sub-committee meetings, it was decided to start data collection in a phase manner by initially collecting protection setting data for 400 kV & above lines, reactors as well as ICTs of 400/220kV level and nominations of Nodal officer from each Utility was requested who will co-ordinate for submitting new as well as updating the settings. Currently, 80-90% Protection setting data of 400 kV and above system has been collected and utilities are being followed up for submission of 220kV system data at the earliest. Majority of data for 400 kV and above Transmission lines, ICTs and reactors has been collected, the process of Web based Protection setting database will be initiated. Hence, it was decided to first constitute a committee for preparing comprehensive specifications for relay setting parameters for Web based database. Thereafter, cost estimation for the work and funding options may be explored. Accordingly, a committee was constituted and ToR of the committee has been framed vide letter dated 06.04.2021. Subsequent, due to transfer of majority of members of the committee, the committee has been reconstituted vide letter dtd 27.01.2022 for submission of report. The Committee meeting is scheduled in Feb'22.

RPCs may update the status to the Committee.

11 Monitoring of Schemes Sanctioned Grant from PSDF

11.1 The Committee was apprised that MoP has sanctioned grant of around ₹12191.56 Crore (174 Schemes as on 31.12.2021) to States/ Central Power utilities/RPCs from Power System Development Fund (PSDF).

11.2 The region wise summary of schemes funded through PSDF is given below:

S. No.	Region	No. of Schemes	Grant Sanctioned (Rs. Crores)	Grant Disbursed (Rs. Crores)	Grant Disbursed (%)
1	Northern	37	2339.88	1104.36	47.19
2	Western	34	1150.86	276.54	24.03
3	Southern	37	2204.97	1244.87	56.46
4	Eastern	26	1079.09	587.35	54.43
5	North Eastern	32	834.44	475.77	57.02
6	All India Schemes (PGCIL,REC, BBMB, DVC)	8	4582.32	4254.88	92.85
Total		174	12191.56	7943.77	65.16

11.3 It was observed that the utilization of grant by state utilities in different regions, was not satisfactory vis-a-vis central sector utilities.

11.4 Further, Project Monitoring group of PSDF has reviewed the progress of projects sanctioned in WR and NR in its 19th and 20th meetings held on 16.11.2021 and 17.11.2021 respectively. It was found that the utilization of grant by state utilities was not satisfactory (particularly in WR).

Member may like to deliberate on the subject issue.

12 National Energy Account (NEA)

12.1 NLDC vide letter dated 09th November 2018 **(ANNEXURE-XII)** furnished the Agenda Note on National Energy Account & National Deviation Pool Account. NLDC was of the view that there is a need for implementing a National Deviation Pool Account based on the National Energy Account, for streamlining the accounting and settlement at national level. Further, suitable changes/modifications were required to be effected in the Indian Electricity Grid Code (IEGC) and Deviation Settlement Mechanism (DSM) Regulations apart from recognizing the functions of NPC in the regulatory framework. In the 8th meeting of NPC held on 30.11.2018, it was decided that the said proposal may be discussed in all the RPCs as an agenda item in their upcoming meetings for deliberations and the observations of RPCs be furnished to NPC Secretariat.

12.2 As per discussion's in the 8th meeting of NPC, the summary of the proposed methodology is as follows:

(a) **Scheduling:** Scheduling interregional transactions on a net basis for each region. NLDC shall communicate the net inter-regional schedules to the NPC for accounting.

(b) **Metering:** SEM data shall be collected by the RLDCs, processed meter data shall be made available to NPC through NLDC.

(c) **Accounting & Settlement:** Based on the scheduling and meter data provided, NPC shall prepare the National Energy Account (NEA) including the National Deviation Account for the inter-regional and trans-national transactions. The NEA will reflect

the payables/receivables for each region on a net-basis and this amount shall be payable/receivable to the National Deviation Pool Account which shall be operated by NLDC. The NEA shall also reflect the trans-national transactions and the neighboring countries shall be paying/receiving to/from the National Deviation Pool Account operated by NLDC. Payment to the National DSM Pool shall have the highest priority.

(d) **Handling Surplus/Deficit in Regional Pool Accounts and transfer of residual to PSDF:** Once the National DSM Pool becomes operational, all residual/surplus amount in the regional DSM pools shall be transferred to the National DSM pool account. The NPC accounts would also facilitate the transfer of funds from the surplus available in the National DSM pool to the deficit regional DSM pool accounts as a single transaction thereby simplifying the process. Once all liabilities have been met, any residual in National DSM Pool shall be transferred periodically to the PSDF in accordance with the extant CERC Regulations. Suitable changes/modifications are required to be carried out in the IEGC and DSM Regulations and the functions of NPC need to be recognized in the regulatory framework.

12.3 NLDC vide letter dated 12th Feb 2021 **(ANNEXURE-XIII)** have informed following:

(i) National Energy Account (NEA) & National Pool Account related feedback have been submitted to Honorable CERC through various feedback report from time to time. CERC, being a quasi-judicial body, does not normally respond to such feedback through letters etc. A petition may be required to be filed either suo-moto or by

respective parties, for getting the appropriate directions from CERC. Introduction of the NEA needs the notification of the Regulatory Framework by CERC through appropriate Regulations, which also needs pre-publication, stakeholder consultation and final notification.

(ii) NLDC has also mentioned that CERC has mentioned the National Pool account in SCED order Petition No. 02 /SM/2019 (Suo-Motu) Date of Order: 31st of January, 2019. The same is reproduced below:

Quote

"10.(c) POSOCO has suggested implementation of the National Pool Account to take care of changes in injection schedule for each region due to optimisation process. There would be a need for pay-in/pay- out from the National Pool Account for incremental changes In schedules (Up/Down). As per the present mechanism, the generators receive their variable charges based on the schedules issued by the concerned RLDC. Optimization would result in incremental/decremental changes in the existing schedules of generators and these would need to be settled through the National Pool Account mentioned above."

Unquote

(iii) As per the direction of CERC, National Pool Account (SCED) is maintained and operated by NLDC for settlement of SCED.

(iv) Similarly, National Deviation Pool Account for Deviation Settlement (DSM) can also be maintained/operated by NLDC in case of any direction received from the appropriate Commission.

12.4 In the 10th meeting of NPC, MS, NPC briefed the forum regarding the National Energy Accounting. The proposed functions of NPC Secretariat regarding NEA is as follows:

(a) Collection of data from NLDC on weekly basis (Interregional and International scheduled energy and actual energy data).
(b) Preparation of Weekly NDSM and Reactive Energy Account (if required)
(c) Preparation of monthly NEA

12.5 In the 10th meeting of NPC, the views of RPCs/POSOCO were sought and placed below:

13.5.1 MS, SRPC stated that existing practice of settling the accounts at regional level needed to be continued. The comments from constituents were yet to be received and on the receipt of same the views would be shared with NPC.

13.5.2 MS, NRPC informed that National Pool Account may be maintained by NLDC for settlement of inter-regional and cross border transactions.

13.5.3 ERPC informed that existing practice to be continued.

13.5.4 NERPC informed that existing practice to be continued for Regional Accounting, however Inter regional and international transactions accounts can be in NEA's purview.

13.5.5 Director POSOCO, informed that the proposed process for accounting of NEA was shared with NPC for clarification/understanding. He proposed that a mock drill of the same can also be shown to RPCs and beneficiaries at RPCs level. This would help to understand the process and in clarifying the doubts of beneficiaries wrt to NEA.

12.6 In the 10th meeting of NPC, Chairperson, CEA recommended that a mock accounting of the proposed National Energy Accounting (NEA) may be carried out by NLDC. After that a detailed discussion at RPC level and then at NPC level are required. Then the issue may be taken up with Regulatory Commission for having mandate on NEA.

Member may like to deliberate on the subject issue.

13 Power System Stabilizers (PSS) tuning

13.1 The Enquiry Committee constituted by Govt. of India to enquire into the grid disturbances of July, 2012, had inter-alia recommended proper tuning of electronic devices and PSS of generators.

13.2 In the 9th meeting of NPC, it was decided that a Sub-group may be constituted comprising of representatives of Protection Sub-Committee of respective RPCs, NPC, NLDC, CTU, NTPC and NHPC, to finalize a common procedure for Power System Stabilizers (PSS) Tuning.

13.3 NPC Secretariat vide letter dated 08.02.2021 has formed the Sub-Committee under the chairmanship of MS, WRPC to finalize a common procedure for Power System Stabilizers (PSS) Tuning.

13.4 SRPC via email dated 12.01.2022 informed that it is following a specific plan for the PSS tuning exercise, and is regularly pursued with SRPC generating Stations. As on date Nine Meetings were conducted with generators to analyze the PSS test reports. Recommendations were communicated to each generator after the Meetings. The generators are being advised for retuning of the unit/resubmission of the report based on the analysis. It is noted that 12 Units had carried out PSS testing during 2021-22 (from April 2021) till date.

13.5 1st Meeting of PSS tuning subgroup was held on 15.04.2021.

WRPC may update the status to the Committee.

14. Date and Venue of next meeting

Depending upon the circumstances during the next meeting of NPC, it may be convened through virtual mode or the physical meeting as per the roster adopted in the 5th meeting of NPC held on 08.04.2016. As per the roaster ERPC to host the next NPC meeting.

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LIST OF ANNEXURES

Annexure	DESCRIPTION
I	NTPC letter dated 16th November 2021 on REA
II	MoM of Joint Meeting of Regional Standing Committees on Power System Planning held on 5th March, 2012.
III	Feedback on URTDSM Phase-I performance received from POSOCO vide their letter dtd. 06-10-2020 and dated 20.03.2021.
IV	NPC Secretariat letter No. 4/MTGS/NPC/CEA/2021/285-298 dated 20.09.2021 Sub Committee constitution for PMU Philosophy.
V	Standard Operating Procedure (SOP) for the Islanding Schemes.
VI	MoM of meeting held on 07th Oct 2021 under the Chairmanship of Hon'ble Minister of Power and New & Renewable Energy.
VII	MIS report of Islanding Scheme.
VIII	Region-wise/State-wise details of AUFLS and df/dt settings.
IX	NRPC-status of feeder mapping
X	SRPC updated the status of periodic inspection of UFR and df/dt relays and Status of implementation of AGC.
XI	NRPC-Status of implementation of AGC.
XII	NLDC's letter dated 09th November 2018 regarding Agenda Note on National Energy Account & National Deviation Pool Account.
XIII	NLDC letter dated 12th Feb 2021 on issue of NEA.

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ANNEXURE-I to 11th NPC

एनटीपीसी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)

केन्द्रीय कार्यालय/ Corporate Centre

Ref. No: 01:CC:CD:701
Date: 16 Nov 2021

Chief Engineer and Member Secretary NPC,
National Power Committee,
1st Floor, Wing-5, West Block-II,
R K Puram, New Delhi - 110066

Sub: Issuance of Regional Energy Account on the 1st of the month.

1. As you are kindly aware, generating utilities raise energy bills for sale of electricity to the beneficiaries / Discoms based on Regional Energy Accounts (REA) issued on monthly basis by the respective Regional Power Committee (RPC). Further, CERC Tariff Regulations, 2019 provide the framework for tariff determination of stations under Section 62 of the Electricity Act. As per these Regulations, receivables for 45 days is considered for computation of the working capital and accordingly, a period of 45 days from date of presentation of bills is allowed to Discoms for making payment of energy bill.
2. Issuance of Regional Energy Account (REA) by respective RPCs is pre-requisite for issuance of monthly energy bills. REA is uploaded on websites of RPC generally on 4th - 5th of each month for the energy supplied in the previous month. Accordingly, the energy bills are being presented to the Discoms on 5th or 6th of every month.
3. Due to time taken in issuance of REA after end of the month, carrying cost of 5-6 days for the billing amount is borne by the generating company. NTPC's annual billing in FY 2020-21 was over Rs. 1 Lakh crores. Therefore, the financial implication of the carrying cost of 6 days at interest rate of 10% per annum works out to around Rs 165 crores.
4. In some regions, the REA issued in the first week of each month for energy supplied in the previous month is provisional and issuance of final REA takes time. As the REA is based on DC and SG which are available at the end of the month, issuance of REA on 1st of month is possible. If there is requirement of some actual data for preparation of REA, the same can be taken provisionally for previous 30 days ending on 26th of the month. Changes, if any, can be made at the time is issuing final REA. Such arrangement can remove the lag between last day of the month and issuance of provisional REA and enhance the efficiency of the process.

It is therefore requested that REA may be issued by RPCs as early as possible, preferably on 1st of the following month.

Thanking you,

Yours faithfully,

16-11-2021

(ANIL NAUTIYAL)
ED(Commercial)

CC: 1.Joint Secretary (R&R), MOP
2.Chairperson, NPC

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
सेवा भवन आर के पुरम नई दिल्ली-110066
Sewa Bhawan, R. K. Puram, New Delhi-110066

[ISO: 9001-2008]

No.200/5/2012/SP&PA/ 310-362 **Date/दिनांक:** 15-03-2012

To

(As per List attached)

Subject: Minutes of Joint Meeting of all the regional Standing Committees on Power System Planning for firming up the 'Unified Real Time Dynamic State Measurement (URTDSM)' scheme as part of Smart Transmission Grid development.

विषय: विद्युत प्रणाली के आयोजन की सभी क्षेत्रीय स्थायी समितियों की संयुक्त बैठक – स्मार्ट पारेषण ग्रिड विकास हेतु 'यूनिफाईड रियल टाईम डाईनमिक स्टेट मैजरमेन्ट' की योजना रिपोर्ट पर चर्चा

A Joint Meeting of all the five Regional Standing Committees on Power System Planning was held **on March 5, 2012 (Monday) at 10.30 am at Conference Room, Fifth Floor, Power Grid Corp. of India Ltd., Plot No:2, "Saudamini", Sector-29, Gurgaon, Haryana-122001**.

Minutes of the meeting are enclosed. It is also available at CEA's website (www.cea.nic.in).

भवदीय /Yours faithfully,

15/3/2012

(प्रदीप जिंदल)/ (Pardeep Jindal)
निदेशक(प्र यो एवं प मू प्रभाग)/ Director (SP&PA)
(Telephone: 011 26198092, Fax No. 011 26102045)

Address List

1. The Director (Projects) Power Grid Corp. of India Ltd., "Saudamini", Plot No. 2, Sector-29, **Gurgaon-122001** Fax 0124-2571760/2571932	2. CEO,POSOCO B-9, Qutab Institutional Area, Katwaria Sarai, **New Delhi-110016** Fax 011-26852747
3 Director (Projects), National Thermal Power Corp. Ltd. (NTPC), NTPC Bhawan, Core-7, Scope Complex, Lodhi Road, **New Delhi-110003.** FAX-011-24360912	4. Director (Technical) NHPC Office Complex, Sector – 33, NHPC, **Faridabad - 121 003** (Fax-0129-2277941)
5. Director (Operations), NPCIL, 12th Floor,Vikram Sarabhai Bhawan, Anushakti Nagar, **Mumbai – 400 094**. FAX : 022- 25991258	

Northern Region

1. Member Secretary Northern Region Power Committee, 18-A Shajeed Jeet Singh Sansanwal Marg, Katwaria Sarai, **New Delhi – 110016** (Fax-011-26865206)	2. Member (Power) BBMB, Sectot-19 B Madya Marg, **Chandigarh-160019** (Fax-0172-2549857)
3. Managing Director, HP Power Transmission Corporation Ltd. Himfed Bhawan, Panjari, old MLA Quarters, **SHIMLA-171004** (Fax-0177-2626284, 2626283)	4. Director (Transmission) UPPTCL, Shakti Bhawan Extn, 3rd floor, 14, Ashok Marg, **Lucknow - 226 001** (Fax-0522-2288410)
5. Director (Transmission) Urja Bhawan, Kawali Road, Dehradun,**Uttarakhand - 248 001** (Fax-0135-2762460)	6. Director (Operations) Delhi Transco Ltd. Shakti Sadan, Kotla Marg, **New Delhi - 110 002** (Fax-011-23234640)
7. Director(Technical) Punjab State Transmission Corp. Ltd. (PSTCL) Head Office The Mall, **Patiala - 147 001** (Fax-0175-2304017)	8. Director (Projects) HVPNL , Shakti Bhawan, Sector -6, **Panchkula - 134 109** (Fax-0172-2560640)
9. Development Commissioner (Power), Civil Secretariat, **JAMMU - 180 001** (Fax-0191-2545447, 2530265)	10 Director (Transmission) RRVPNL, Vidyut Bhawan, Janpath, Jyoti Nagar, Jaipur ,**Rajasthan** Fax-0141-2740794

11. Chief Engineer (Operation) Ministry of Power, UT Secretariat,Sector-9 D **Chandigarh - 161 009** (Fax-0172-2637880)	12. Director(Technical) THDC Ltd. Pragatipuram, Bypass Road, Rishikesh, **Uttarakhand- 249201** (Fx-0135-2431519)

Western Region

1. The Member Secretary, Western Regional Power Committee, MIDC Area, Marol, Andheri East, **Mumbai** Fax 022 28370193	2. Chairman and Managing Director, MPPTCL, Shakti Bhawan, Rampur, **Jabalpur-482008** Fax 0761 2664141
3. The Managing Director, Chhattisgarh State Power Transmission Corporation Ltd.(CSPTCL) , Dangania, **Raipur (CG)-492013.** Fax 0771 2574246/ 4066566	4. The Managing Director, GETCO, Sardar Patel Vidyut Bhawan, Race Course, **Baroda-390007.** Fax 0265-2338164
5. Director (Operation), MAHATRANSCO, 'Prakashgad', Plot No.G- 9, Bandra-East, **Mumbai-400051.** Fax 022-26390383/26595258	6. The Chief Engineer, Electricity Department, The Government of Goa, **Panaji**, **Goa** Fax 0832 2222354
7. Executive Engineer (Projects) UT of Dadra & Nagar Haveli, Department of Electricity , **Silvassa .** Ph. 0260-2642338/2230771	8. Executive Engineer Administration of Daman & Diu (U.T.) Department of Electricity **Moti Daman-396220** . Ph. 0260-2250889, 2254745

Southern Region

1.The Member Secretary, Southern Regional Power Committee, 29, Race Course Cross Road, **Bangalore 560 009.** FAX: 080-22259343	2. The Director (Grid Operation), Transmission Corp. of Andhra Pradesh Ltd., Vidyut Soudha, **Hyderabad – 500 082**. FAX : 040-66665137/ 66665133
3.The Director (Transmission), Karnataka State Power Transmission Corp.Ltd., Cauvery Bhawan, **Bangalore 560 009.** FAX : 080 -22228367	4. The Member (Transmission), Kerala State Electricity Board, Vidyuthi Bhawanam, Pattom, P.B. No. 1028, **Thiruvananthapuram - 695 004.** FAX : 0471-2444738

5. Member (Distribution), Tamil Nadu electricity Board (TNEB), 6th Floor, Eastern Wing, 800 Anna Salai, **Chennai - 600002.** FAX : 044-28516362	6. The Superintending Engineer –I, First Floor, Electricity Department, Gingy Salai, **Puducherry – 605 001.** FAX : 0413-2334277/2331556
7.The Director (Power), Corporate Office, Block – I, Neyveli Lignite Corp. Ltd., **Neyveli** , **Tamil Nadu – 607 801.** FAX: 04142-252650/ 252570	

Eastern Region

1. Member Secretary, Eastern Regional Power Committee, 14, Golf Club Road, Tollygange, **Kolkata-700033**.	2.Director (System), Damodar Valley Corporation DVC Towers, VIP Road, **Kolkata-700054.**
3. Member (Transmission), Bihar State Electricity Board Vidyut Bhavan, Baily Road, **Patna-800021.**	4. Director (Transmission), Orissa Power Transmission Corporation Jan path, **Bhubaneshwar-751022.**
5. Director (System Operation), West Bengal State Electricity Transmission Company Ltd., Vidyut Bhavan, 5th Floor, Block-D, Bidhannagar, Sector-**II Kolkata-700091.**	6.Member (Transmission), Jharkhand State Electricity Board, In front of Main Secretariat, Doranda, **Ranchi-834002.**
7. Principal Chief Engineer cum Secretary, Power Department Government of Sikkim, **Sikkim**	

North Eastern Region

1. The Member Secretary, North Eastern Regional Power Committee, Meghalaya State Housing Finance Cooperative Society Ltd. Building, Nongrim Hills Shillong **(Meghalaya) 793003** Fax: 0364 – 22520030	2. The Chairman and Managing Director, North Eastern Electric Power Corporation Ltd Brookland Compound, Lower New Colony, **Shillong (Meghalaya) – 793003**. Fax: 0364 – 2226417

3. The Managing Director, Assam Electricity Grid Corporation Limited, Bijulee Bhawan; Paltan Bazar, Guwahati **(Assam) – 781001** Fax: 0361 – 2739513 & 0361 – 2739989	4. The Chairman-cum-Managing Director, Meghalaya Energy Corporation Limited, Lum Jingshai, Short Round Road, Shillong **(Meghalaya) – 793001**. Fax: 0364 – 2590355
5. The Chief Engineer (Power), Electricity Department, Keisampat, **Imphal (Manipur)** Fax: 0385 – 2220702	6.The Chief Engineer, Department of Power, Nagaland, **Kohima** Fax: 0832 – 2222354
7. Engineer-in-Chief Power & Electricity Department, Govt. of Mizoram, Tuikhuahtlang, **Aizawl (Mizoram)** Fax:0389-2320862	8. The Chief Engineer (Power), Vidyut Bhawan, Department of Power, Zero Point Tinali, Itanagar **(Arunachal Pradesh) – 791111.** Fax: 0360 – 2217302
9. The Chairman-cum-Managing Director, Tripura State Electricity Corporation Limited, Bidyut Bhavan, Banamalipur, **Agartala, Tripura**. Fax: 0381 – 2319427	

Copy to:

1.The Chairman & Managing Director Power Grid Corp. of India Ltd., "Saudamini", Plot No. 2, Sector-29, **Gurgaon-122001** Fax 0124-2571760/2571932	2. Executive Director (Smart Grid) Power Grid Corp. of India Ltd., "Saudamini", Plot No. 2, Sector-29, **Gurgaon-122001** Fax 0124-2571760/2571932
4. SA to Chairperson, Central Electricity Authority, Sewa Bhawan, R. K. Puram, **New Delhi-110066**.	3.The Member (PS), Central Electricity Authority, Sewa Bhawan, R. K. Puram, **New Delhi-110066**.
5. Prof S.A Soman, Department of Electrical Engineering, Indian Institute of Technology Bombay, **Powai, Mumbai-400076**	

Minutes of Joint Meeting of all the five Regional Standing Committees on Power System Planning was held on March 5, 2012 (Monday) at 10.30 am at Conference Room, Fifth Floor, Power Grid Corp. of India Ltd., Plot No:2, "Saudamini", Sector-29, Gurgaon, Haryana-122001

1.0 List of participants is given at Annex-I.

2.0 Chairperson CEA in his address emphasized the need of modern tools for reliable, secure and economical system operation on real time basis to give confidence to the system planner as well as operators to bring efficiency in system operation. He highlighted that dimension of Indian power system is growing manifolds and their complexity is increasing in all fronts viz. generation, transmission and distribution. Maintaining grid safety, security and reliability is a great challenge in the new regime of open electricity market. He informed that for sustainability, non-conventional energy resources must be developed and needs to be integrated with the grid in one hand, while variability & intermittency in their output is a new challenge in system operation on the other. He mentioned that India would soon be having 1000 MW single generating units, 4000 MW single power plants, high capacity 765 kV and 800kV HVDC transmission system feeding large cities and various critical loads. Any incident - natural calamity etc., even on single element of this capacity, has the potential to cause a major grid disturbance. Highest order of real time measurements, monitoring and control system is a must to avoid or to reduce the impact of such incidences. To address these issues, he emphasized that introduction of intelligence in transmission through Smart Grid applications is inevitable. Application of synchrophasor technology using Phasor Measurement Unit (PMU), integrated with Phasor Data Concentrators (PDC) and fibre optic communication links has emerged to address above critical developments in the grid. In this context proposed "Unified Real Time Dynamic State Measurement" (URTDSM) scheme would help in identifying and developing modules for more inclusive and intelligent measurements, monitoring, analysis, control and communication capabilities with aim to improve reliability and efficiency of available resources. He requested all the members of the regional standing committees to join hands together for implementation of this much needed scheme quickly.

3.0 CMD POWERGRID shared his experience of implementation of Unified Load Dispatch and Communication (ULDC) scheme throughout the country. He also informed about the upcoming large number of EHV network specially 765 kV substations and transmission lines. He informed that by 2014, all the five(5) regions of the country will be synchronized together. Within coming five year plan about 30,000 MW of Renewable Energy mainly in the form of Wind and Solar generation will be added to the existing 23,000MW of Renewable Energy generations in the country. He stressed the requirement of better visibility of system and fast update of operating scenario for safe, secure and reliable operation on real time basis as well as for system planning. To keep ourselves abreast with the latest technology, he urged that early implementation of this "Unified Real Time Dynamic State Measurement" (URTDSM) project is a

necessity. He emphasized that looking at the large number of PMUs deployment in the country, it is necessary that about 10 to 15% of PMUs shall be manufactured and supplied from India, towards indigenization of this technology to cater to future requirement. He also emphasized that a PMU test certification laboratory may be setup in India to certify the PMUs of various manufacturers to be deployed in the grid. He stressed upon the research work required in collaboration with premier academic institutions for analytics development based on the PMUs data for improved situational awareness, decision support tools and control actions in Indian context to be taken up in parallel.

4.0 Member (PS), CEA informed that country has good institutional mechanism for handling power system related issues and the market mechanism is evolving. Technical aspects of grid safety and security in real time, however, still need to be strengthened. He informed that synchrophasor technology using PMU and PDC through fiber optic communication channel having low latency would be very effective in reliable, secure and economical grid operation. He also informed about how PMU has helped in reliable evacuation of Karcham-Wangtoo hydro generation during the monsoon season of 2011. Large quantum of renewable capacity is going to be integrated with the system in coming years. To take care of uncertain characteristics of renewable generation, he emphasized the need of adoption of latest technology like synchrophasor measurement for informed decision making in real time. 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. He informed that cost of the proposed "Unified Real Time Dynamic State Measurement (URTDSM)" is meager in comparison to the cost of one EHV transmission line. He informed that in future all the substations and generating stations, including those of IPPs shall be provided with PMU along with fiber optic communication link by the respective developer.

5.0 CEO POSOCO made a presentation on the need of synchrophasor measurements for system monitoring and control. He shared the experience of PMU pilot project in Northern Region. He described how the Indian power sector has been benefited by taking preventive actions based on synchrophasor measurements in advance avoiding large scale disturbances and operating the system in a more reliable manner. PMU pilot Project in Northern Region has helped a lot understanding the new technology and in system operation in real time, protection co-ordination, disturbance analysis and network model validation. He informed that wide band communication is the basic necessity for PMU installation. He presented the case of 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. PMU also helped in detection of oscillations on 765kV Tehri-Meerut line (Charged at 400 kV). Based on PMU data PSS tuning 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. He informed that PMU technology is a kind of meta tool that will create new tools in future. Expertise needs to be developed for handling large volume of data generated by PMUs through capacity building exercise.

6.0 Prof S. A. Soman from IIT Bombay presented the need and benefits of synchrophasor technology for system monitoring and control that has been made possible due to technological development in the field of GPS, communication and computation. He emphasized that this technology has capability of measuring & monitoring the 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. He emphasized that in the Indian context PMUs need to be installed in such a way that voltage phasor of each substation and current phasor at both ends of each transmission line can be monitored to take care of redundancy in outage of PMU, associated communication link etc. for wide area measurement and control. He highlighted the possible utilization of PMU data through following analytical software; supervised zone-3 blocking, dynamic (linear) state estimator, CVT/CT validation, angular stability, emergency control like frequency control, voltage instability, network parameter validation, transient stability model validation etc.

7.0 POWERGRID presented the "Unified Real Time Dynamic State Measurement (URTDSM)" project details. The approach adopted for deployment of PMU and PDC at State and Central sector stations and transmission lines in a unified manner was presented as under:

Approach on PMU Placement:

i. All 400 kV stations in State and ISTS grids

ii. All generating stations at 220 kV and above

iii. HVDC terminals and inter-regional and inter-national tie lines

iv. Both ends of all the transmission lines at 400kV and above: State and ISTS sector

7.1 POWERGRID informed that PDCs would collect data from PMUs and other PDCs and time aligns these data. Approach on PDC placement –

i. One number of Nodal PDC is proposed for more than 40 PMUs in a State

ii. Data from all Nodal PDC are to be sent to Master PDC proposed at each SLDC

iii. Data from all Master PDC will be sent to Super PDC proposed at each RLDC

iv. Data from all Super PDC are to be sent to PDC proposed at NLDC

It was informed that by 2014-15 altogether about 581 sub-stations (272 ISTS and 309 State sector) and about 3199 transmission lines (1792 ISTS and 1407 State Sector) at 400 kV and above level including 220 kV generating stations are expected to be in place. It was informed that considering the PMUs with three(3) analog input channels total number of PMUs required would be around 1669.

7.2 Further, it was highlighted that as the installation of PMU requires Fiber Optic communication channel, the installation of PMUs and PDCs is proposed in two stages;

Stage-I: Installation of PMUs at the locations where Fiber Optic communication is available or would be made available under microwave frequency vacating program and regional strengthening program 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.

Stage-II: Installation of PMUs at balance locations along with communications links. The stage wise deployment of PMUs and PDCs was given as under.

Table 1: Proposed Stage- I

Region	Sub-stations		No of Transmission line		PMU		Nodal PDC	MPDC	SPDC	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 : Proposed Stage- II

Region	Sub-stations		No of Line		PMU	
	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***	

It was informed that to effectively utilize the synchrophasor technology, capacity building through training is required. For this purpose training of engineers from

State utilities, RPCs, CEA, CTU, POSOCO are proposed as part of this URTDSM project.

Broad estimated cost of this URTDSM scheme is about Rs. 355 Crore for both Stage-I and Stage-II.

7.3 In addition development of analytical software and hardware as informed by IIT Bombay are to be taken up in parallel. List of analytics proposed to be developed in association with premier academic institution like by IITs and other agencies are as under:

- Vulnerability analysis of distance relays.
- PMU based state estimator.
  - Enable system operator to understand if the system is in secure, alert or emergency state from both steady state and dynamic perspective.
  - Along with steady state contingency analysis tools, one can also use dynamic security assessment tools.
  - Enable monitoring of system unbalances.
  - Enable monitoring of power swing and supervisory control of backup protection scheme i.e., adaptive protection.
- CVT/CT validation
- PMU based supervised zone-3 tripping/blocking
- Assessment of angular, voltage and frequency stability and control through PSS, FACTS devices and HVDC controls.
- Development of improved restoration schemes
  - Synchrophasor check is available at control center itself.
- Network parameter validation, dynamic(transient stability) model validation

7.4 Towards indigenization of this technology, about 10 to 15 % of PMUs shall be manufactured and supplied from India. Further, a PMU test and certification laboratory is also proposed to be setup in India to certify the PMUs of various manufacturers to be deployed in the grid.

8.0 Participants of the regional Standing Committees on Power System Planning deliberated on the proposed “Unified Real Time Dynamic State Measurement (URTDSM)” scheme for implementation by POWERGRID.

Gist of the deliberations are as under:

8.1 RVPNL said that PMU placement should be accompanied with fiber optic communication link so that real time measurement benefit can be derived. Therefore, emphasis shall be given for placement of PMUs at those locations where fiber optic communication links are available. Wherever fiber links are not available the actions need to be taken to install the fiber optic link along with PMU in a time bound manner.

It was clarified that realizing the need for fiber optic communication to facilitate data transfer from PMU on real time basis the entire URTDSM project has been planned for implementation in a 2 stages. Stage-1 involves placement of PMU at those locations which are either already connected through FO or likely to be

connected by 2014-15 at the control centers along with installation of PDCs. In the next stage the PMUs shall be placed at those locations where fiber optic link are to be installed simultaneously.

8.2 On the issue of inclusion of already on-going PMU deployment plan in different regions under WAMS project with this URTDSM project, it was agreed that while finalizing the scheme necessary care will be taken to integrate the existing PMUs of the on-going project.

8.3 Members inquired about the methodology of investment. It was clarified that the cost of the project shall be added in the National transmission pool account and to be shared by all the Designated ISTS Customers(DICs) as per the POC mechanism under the CERC regulation.

8.4 NTPC enquired about provision of RTUs under ULDC scheme, whether they will continue or it will be replaced by the PMUs. It was clarified that, initially, the URTDSM project will not affect the provision of RTUs under ULDC scheme and upgradation of ULDC scheme would continue as planned. Later on, when PMU based measurements get matured, installation of RTUs can be reviewed.

8.5 BBMB enquired about necessity of current measurement of transmission line as the state of the system can be determined with Voltage magnitude and angle only. It was clarified that along with voltage and phasor measurement, measurement of current is also very important for validation of CT, CVT and distance protection and also for network parameters of the system.

8.6 Maharashtra SLDC enquired about using numerical relays as PMUs as most of the numerical relays have such capability. It was clarified that technically there is not any issue in using such relays provided that a phasor measurement unit alongwith GPS clock is available in the numeric relay.

8.7 Rajasthan raised the issue of error in PMU measurement due to limited inaccuracy in CT / CVT. On this issue it was clarified that PMU on its own does not introduce any error and sensors have certain errors. To filter out this errors State Estimation would be carried out.

8.8 Gujarat SLDC enquired about current measurement of ICTs. It was clarified that presently it has not been included; however, in subsequent stages this aspect may be deliberated. Gujarat also suggested that hierarchy of data transfer for central sector PMUs may be through SLDC PDC. It was clarified that going through SLDC PDCs would increase latency of information from ISTS network reacing at RLDC/NLDC and hence may not be desirable..

8.9 Delhi enquired about availability of fast protection and control mechanism that can act within say 40 ms. It was clarified that PMU based protection and control mechanisms are not going to replace the primary protection, it will only be used to enhance the backup protection based the global information and suitable for the system as a whole.

9.0 It was agreed that the scheme would be implemented in the following manner:

i) The URTDSM scheme will cover placement of PMU at sub-stations and both ends of transmission lines at 400kV and above level including generating stations at 220 kV level under State and Central Sector coming up by 2014-15 time frame.

ii) The proposed URTDSM scheme will be implemented in two stages. In the stage-I PMUs will be placed at those locations where fiber optic communication link is either available or would be made available under microwave frequency vacating program and regional strengthening program 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. Nodal PDC shall be provided for collection of data from 40 PMUs in a cluster.

In stage-II, PMUs would be installed at balance locations along with communications links. Summary of the stage wise deployment of PMUs and PDCs is given in Table1 and Table-2 above.

iii) For effective utilization of synchrophasor technology national and international level training programs will be arranged for engineers from State utilities, RPCs, CEA, CTU and POSOCO under the URTDSM scheme.

10.0 After deliberations, members of regional Standing Committees on Power System Planning agreed that “Unified Real Time Dynamic State Measurement (URTDSM)” scheme to be taken up for implementation. It was also agreed that scheme is to be implemented by POWERGRID as system strengthening and cost shall be added in the National transmission pool account and to be shared by all the Designated ISTS Customers(DICs) as per the POC mechanism under the CERC regulation.

11.0 It was agreed that POWERGRID shall file a petition with CERC for getting regulatory approval for this project. It was also requested that all the constituents/States would support POWERGRID in CERC.

12.0 As the Analytics are to be developed in parallel with implementation of the URTDSM scheme, it was agreed that these would be developed in association with premier academic institutions (like by IITs) and in consultation with POSOCO, CEA and RPCs and some of the STUs. It was also agreed that cost of development of the Analytics would be added in the National transmission pool account.

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Annex-I

List of participants:

S.No	Organization	Name (S/Shri)	Designation
	Central Electricity Authority		
1	CEA	Ravinder	Member (PS)
2	CEA	K.K Arya	CE(I/c)
3	CEA	Pardeep Jindal	Director
4	CEA	B K Sharma	Director
5	CEA	AK Yadav	Dy. Director
6	CEA	Manoj Chaturvedi	Dy. Director
7	CEA	Nageswara Rao M	Engr.
	Regional Power Commitees		
8	NRPC	P K Pahwa	Member Secretary
9	WRPC	S D Taksande	Member Secretary
10	WRPC	Satyanarayana	SE
11	SRPC	S R Bhat	Member Secretary (I/c)
12	SRPC	Satbir Singh	SE
13	ERPC	A K Bandopadhyay	Member Secratary (I/c)
14	ERPC	B Sarkhel	Superitending Engineer
15	ERPC	J Bandyopadhyay	SE
16	NERPC	P D Siwal	Member Secretary (I/c)
17	NERPC	AK Mishra	SE
	Central Transmission Utility		
18	POWERGRID	R. N. Nayak	CMD
19	POWERGRID	I. S. Jha	Dir (Projects)
20	POWERGRID	Y. K. Sehgal	Exe. Director (Smart Grid)
21	POWERGRID	Pankaj Kumar	Exe. Director (SEF,CE,ERP&IT)
22	POWERGRID	BS Pandey	Exe. Director (Engg.)
23	POWERGRID	NS Sodha	Exe. Director (LD&C)
24	POWERGRID	R K Sarkar	GM (Engg.)
25	POWERGRID	A S Kuswaha	AGM (LD&C)
26	POWERGRID	Subir Sen	AGM (Smart Grid)
27	POWERGRID	Dilip Rozekar	DGM (SEF)
28	POWERGRID	Manoj Gupta	DGM (SEF)
29	POWERGRID	H Aggarwal	CM
30	POWERGRID	M K Tiwari	CM
31	POWERGRID	RK Gupta	CM
32	POWERGRID	Sunita Chouhan	CM
33	POWERGRID	Vineta Agarwal	CM
34	POWERGRID	Rajesh Kumar	CM
35	POWERGRID	M.S Rao	Manager
36	POWERGRID	Kashish Bhambhani	Manager
37	POWERGRID	Anil Kr. Meena	Dy. Mgr
38	POWERGRID	Pradeep Varun	Engr.
39	POWERGRID	Sandeep Kumawat	Engr.
40	POWERGRID	Ankit Rastogi	Officer
41	POWERGRID	Debajyoti Majumdar	ET
42	POWERGRID	G Sreenivasan	Resident Engineer
	POSOCO		
43	POSOCO	S. K. Soonee	CEO
44	NLDC	VK Agrawal	GM
45	NLDC	SR Narasimhan	DGM

46	NLDC	N Mishra	Engr.
47	NLDC	Pradeep Reddy	Engr.
48	NRLDC	PK Aggarwal	DGM
49	NRLDC	Rajeev Porwal	CM
50	WRLDC	P Pentayya	GM
51	WRLDC	Abhimanyu Gartia	DGM
52	SRLDC	P Bhaskar Rao	AGM
53	SRLDC	T Srinivas	CM
54	ERLDC	UK Verma	GM
55	ERLDC	SK Chandrakar	Mgr. (SLDC)
56	NERLDC	TS Singh	AGM
	Central PSUs & Multi State Agencies		
57	BBMB	Naveen Gupta	Dy. Director
58	DVC	BK Yadav	SE
59	IIT - Bombay	S A Soman	Professor
60	NHPC	DP Bhargava	Director (I&B)
61	NHPC	Nain Singh	ED (Des.I & M)
62	NPCIL	Devendra singh	Shift Charge Engr.
63	NPCIL	Sandeep Gupta	Sr. Maint Engr.
64	NTPC	Abhijeet Sen	AGM
65	NTPC	S S Mishra	DGM
66	THDC	Sarosh Majid Siddiq	Sr. Mgr. (Comml)
	State Transmission Utilities / SLDCs		
67	AEGCL (Assam)	N C Das	CGM
68	AEGCL (Assam)	GK Bhugan	Manager
69	AP TRANSCO (Andhra Pr.)	M Balasubramanyam	Divisional Engineer
70	AP TRANSCO (Andhra Pr.)	M Jaganmohan Rao	Asst. Div. Enginer
71	AP TRANSCO (Andhra Pr.)	S Harish	Superitending Engineer
72	DTL (Delhi)	Roop Kumar	GM (SLDC)
73	DTL (Delhi)	AK Ghyant	Mgr. (SLDC)
74	Me ECL (Meghalaya)	F E Kharshing	EE (SLDC)
75	Elect. Deptt., DNH	HM Patel	EE
76	HPPTCL(Himacghal Pr.)	K Kapoor	DGM
77	HPPTCL(Himachal Pr.)	S K Chauhan	DGM
78	HVPNL (Haryana)	RK Arora	Director (Tech.)
79	HVPNL (Haryana)	Sunil Seth	SE
80	KPTCL (Karnataka)	Suresh Kumar	Exe. Engineer (SCADA)
81	KPTCL(Karnataka)	Gajanana Sharma	Superitending Engineer
82	KSEB (Kerala)	MA Rawther	Member (T&GO)
83	KSEB (Kerala)	VG Manoharan	Chief Engr. (P&C)
84	Manipur Elect. Deptt	B Lalneisang Saiate	Ex. Engr.
85	MPPTCL (Madhya Pr.)	SK Tiwari	EE
86	MSETCL (Maharashtra)	H M Sahara	SE
87	MSLDC (Maharashtra)	VD Pande	EE
88	PSTCL (Punab)	Rajbir Singh Walia	Sr. Exe. Engr.
89	RVPNL (Rajasthan)	Y K Raizada	Director
90	RVPNL (Rajasthan)	l N Mimawat	SE
91	SLDC (Chhattisgarh)	KS Manothiya	CE
92	SLDC GETCO (Gujarat)	BB Mehta	ACE
93	SLDC GETCO (Gujarat)	PB Sathar	DE
94	SLDC MPPTCL (Madhya Pr.)	AP Bhainve	CE
95	TSECL (Tripura)	Subhas Chakraborty	DGM
96	UPPTCL (Uttar Pr.)	VP Tewari	SE
97	WB SETCL(West Bengal)	Subrata Nag	Director (operations)

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पावर सिस्टम ऑपरेशन कॉर्पोरेशन लिमिटेड
(भारत सरकार उद्यम)
POWER SYSTEM OPERATION CORPORATION LIMITED
(A Government of India Enterprise)

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संदर्भ: एनएलडीसी-पीजीसीआईएल-यूआरटीडीएसएम-001 तिथि: 22 मार्च 2021

सेवा मे,

वितरण सूची के अनुसार

विषय: पोसोको द्वारा यूआरटीडीएसएम फेज-I परियोजना के उपयोग पर परिचालन प्रतिक्रिया

संदर्भ: यूआरटीडीएसएम फेज-I परियोजना के तहत स्थापित पीएमयू का प्रदर्शन

महोदय,

पोसोको द्वारा यूआरटीडीएसएम फेज-I परियोजना के उपयोग पर संलग्न परिचालन प्रतिक्रिया प्राप्त करें।

सादर धन्यवाद

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POSOCO FEEDBACK ON URTDSM PROJECT

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Contents

Operational Feedback on the usage of URTDSM Project by POSOCO

1. Introduction

Wide Area Situational Awareness of the power system at sub-second resolution has been introduced in the Indian power system through implementation of regional and national Wide Area Monitoring System (WAMS) pilot projects since 2010. Under these pilot projects, around 64 nos. of PMUs were integrated with National Phasor Data Concentrator (PDC) at NLDC and has been used for Real-time decision making and event analysis. These Pilot projects have been used for fault detection, classification and its analysis, Low frequency oscillations and its mitigation, Coherence group detection, Synchronization and islanding monitoring in the grid, validating the dynamic models, PSS tuning, and Monitoring system during natural disasters etc. The reports on utilization of synchrophasors by POSOCO are available at https://posoco.in/reports/other-reports/.

Based on these WAMS pilot projects experience, a full-fledged Synchrophasor Project was envisaged and implemented by POWERGRID in Indian Power System known as Unified Real Time Dynamic State Measurement System (URTDSM). Under the URTDSM project, Wide Area Management Systems (WAMS) have been installed nationwide along-with commissioning of about 1669 Phasor Measurement Units (PMUs) (physical) across pan-India and their reporting to respective control centres. URTDSM scheme at NLDC has been commissioned and taken over from POWERGRID on 19th Dec 2019. The utilization of PMU by POSOCO has been shared with power system fraternity across the globe via technical papers, articles, journals etc. published in various conferences of IEEE and CIGRE. The notable contribution on the subject by POSOCO is also available at CIGRE C2.17, Technical Brochure (750), Wide area monitoring systems – Support for control room applications.

URTDSM project is implemented in a hierarchical manner, PDCs in state control centres are integrated with regional level PDC which further integrated with national level PDC/super PDC for the exchange of required PMUs data which covered thirty-four states, five regional and one national control centre (with main and backup). The installation and commissioning of URTDSM system has already been completed at all control centres. The PMU installed under different pilot projects have also been integrated with the URTDSM system.

2. Present functionalities under URTDSM:

Data of these PMUs are also being utilized by power system operators as an analytical tool for better system operation in real time as well as for off-line analysis. Operators are also utilizing various facilities provided under the project. The various usages of URTDSM data at RLDCs and NLDC are described below:

a. **Real Time Monitoring and Applications:**

The main goal of real-time monitoring is to provide the operator with on-line situational awareness of system conditions. The high-resolution data provided by WAMS and reporting nearly at real-time provides exact status of the power system. This status awareness improved the operational efficiency under normal system conditions, and allows the operator to detect, anticipate, and correct problems during abnormal system conditions. PMU based visualization helps not only operators of affected control areas, but also in alerting neighboring operators of a stressed grid. In the real time grid operation, PMUs data are being utilized for following various purposes:

i. Real time event and alarm processing: WAMS System provides spatio-temporal aggregation of the events like large generator trip, fault on a transmission line etc. by using fundamental time synchronization aspect of PMU data, similarly magnitude related violations in frequency, Positive Sequence Voltage Magnitude, Rate of Change Frequency (ROCOF) and Angle Difference are processed in real time at each second in batch processing to alert the operator.

ii. Frequency, Rate of change of frequency, Voltage, Power flows and Angle difference monitoring through trending at high resolution which helps in taking early actions by control room.

iii. The angle difference data helps in assessing the stress across any two nodes in synchronously interconnected power system. Observing real-time angular separations enables the operators to distinguish between normal operating state and alert operating state and also helps to take corrective actions in a given operational scenario. Real time monitoring, and analysis permits the continuous evaluation of operating conditions. The ability of PMUs to directly obtain angle differences allows operators to reduce error margins and operate transmission corridors closer to their real stability limits while maintaining a safe security level. The direct impact of confident operation of high-density transmission corridors closer to their security margins is to reduce the need for investment in expensive upgrades to the existing transmission facilities.

iv. Geographical network diagram provides information about the system through visual objects representing network elements, contours, rubber band zooming, panning, flyouts and pods. Geographical view provides aggregated view of grid

through sub second resolution measurements and its variation in real time.

v. Contour display allows overview of the voltage/frequency profile for the entire grid to be seen at a glance and draws attention to areas of abnormally high voltages in case of voltage contour which can then either identified as a genuine problem in the associated areas or can be used to highlight errors in data. Voltage Contour visualization depict the slope of voltage profile across the geographical spread of grid and helps in finding the high and low voltage pockets in the grid. Voltage contour variation before and after generator trip or similar events provides insight of grid characteristics at different nodes. Real time monitoring of voltages across all the nodes are more suitable with PMUs and system dynamics can be tracked to avoid voltage instability issues.

vi. Similarly, frequency contour helps in identifying the coherent group of generators during incidents of low frequency oscillations in the grid. The amplitude and direction of modes at particular station help in zero down of possible source of oscillation.

vii. For post event analysis and engineering evaluation, replay mode is available, it fetches the data from the historian for all PMU's for the specified duration, max 5 minutes. This feature facilitates the operators to play-and-replay the selected events to understand the various sequences/contingencies occurred during that period.

viii. The utilization of PMU helped in synchronization of NEW-SR grid, the access of high-resolution data in real time to the control room operator helped in taking appropriate decisions in time. The same has been noted in CIGRE C2.17, TB-750 as "*POSOCO (India) has utilized the Synchrophasor data for the course correction during large grids synchronization. This has assisted them in synchronizing large grids of 90 GW without any difficulty, and with a 30 GW grid and its controlled separation when required .*"

ix. The availability of angular difference between nodes helped in carrying out synchronization or configuration changes with constant supervision and control. One of the notable case where availability of PMU helped control room in taking timely informed decision was "Online changeover of Rihand Stage-III generating units from NR to WR. The PMU utilization during the event may be accessed in POSOCO Operational Feedback. https://posoco.in/download/nldc-operational-feedback_january_2018_q3/?wpdmdl=16163.

x. The availability of PMU visualization also helped in taking informed decisions in real time when any abnormality was observed in PMU placed on AC side of HVDC converter station. In HVDC Rihand-Dadri, PMU is placed at AC feeders at both ends i.e. 400 kV Rihand STPS-Rihand HVDC D/c & 400 kV Dadri TPS-Dadri HVDC- D/c. In one incident, the 400 kV AC lines tripped due to various line faults in the lines and a combination of relay mis-operations led to the

generating units getting islanded with HVDC link. The island sustained for approximately 90 seconds after formation with frequency varying between 52.89 Hz and 51.11 Hz. There were wide variations in the frequency before the system finally collapsing. The PMU at AC bus captured the islanded operation with voltage and frequency oscillations visible distinctly.

xi. The availability of PMU data at LV side of pooling station of RE based generation sources helped in monitoring the operation in real time. The various power electronic based controls in RE generation plant for low voltage ride through (LVRT), reactive support at pooling station and power park control are closely monitored using PMU data.

xii. The transmission system has also observed integration of state of art power electronic devices, these devices act in time span of milliseconds. The response can be observed at control centres with availability of PMU data. The FACTS devices like STATCOM and SVC provide the response to system dynamics (faults, fluctuations etc.) and are also desired to provide power oscillation damping (POD). The response of FACTS devices are observed well with PMU placed at coupling transformer of STATCOM/SVC.

xiii. **Oscillatory Stability Management (OSM):** Oscillation Stability Management (OSM) helps in monitoring the low frequency oscillations or small signal stability issues in the system, the oscillation frequency related information like, dominant mode frequency, energy and damping helps the operator in taking real time necessary actions by identifying root cause of oscillation. The OSM provides the information pertaining to negatively damped modes and thereby provide real-time alert for a possible contingency. OSM module extracts oscillatory stability parameters from small, random movements of the power system that are continuously occurring, mainly due to load changes in configured frequency, angle difference and active Power signals. Low frequency oscillations and damping ratios are obtained using Auto Regressive Moving Average (ARMA) analysis of the measured signal. The dominant modes of oscillation are extracted, and key parameters identified – mode frequency, amplitude and decay time. It also shows the mode shape (Right Eigen Vector) and mode chart for better Analysis of Oscillation in the system. OSM module includes two processes (PDX1-3 and PDX2-20). PDX1-3 takes every 3 minutes window of data and analyze the data and publish the result after every 5 seconds, PDX2-20 takes every 20 minutes window of data and analyze the data and publish the result after every 20 seconds. The short window analysis (PDX1-3) is expected to quickly detect a poorly damped system condition and is used to drive the OSM alarms. The PDX2-20 analysis has a longer window size of 20 minutes, and expected to provide more accurate results, but a slower response.

xiv. **Power-system restoration**: The smooth and controlled restoration of system post any contingency is also one of the major requirements of system operation. During power restoration, system operators often encounter an excessive standing phase angle (SPA) difference across a breaker, which connects two adjacent stations. Closing a circuit breaker on a large SPA difference can adversely impact the power system causing severe equipment damage, and possibly a recurrence of the system outage. The PMUs are well-suited for on-line monitoring of angles, and thus are helpful for the operator during a power restoration. The PMUs are helpful in reducing the time needed during a restoration process.

b. **Off-line Applications/usages:**

The PMU data provided by URTDSM is used in various off-line applications. The insights obtained from data-analysis helps in providing necessary feedback to system planners and operators. The various grid code compliances are also monitored using the PMU data. The some of the off-line usages are given as follows:

i. Primary frequency Response assessment is one of the most important aspects for reliable system operation. The correct assessment requires high resolution data of frequency for any event. The monitoring of pattern of frequency post any incident involving load/generation imbalance helps in identifying the percentage of ideal response achieved in event. Though response of synchronously connected all India system (including Bhutan, Nepal & Bangladesh) is obtained using PMU data, it is important to have PMU at all inter-state and inter-regional points for assessing primary frequency response of individual control areas. Similarly PMU placement at generator end is required for assessing primary response.

ii. The oscillation detection, using UTRDSM system is used to provide necessary feedback to generators for taking corrective actions. The poorly damped oscillations indicate the review of controller settings in power system stabilizers of units.

iii. The high sampling rate of PMU data helps in validations of responses of various power system elements. The simulation model parameters are fine tuned to match the exact response as observed in PMU.

iv. The high-resolution data helps in validating the actions of system protection schemes implemented across the grid. The SPS actions which act with small time delays after parameter variations can be easily validated post facto by PMU data.

v. The high-resolution data helps in monitoring the operation of various transmission line protection schemes which operate in sub-second time horizon. The high fault clearing times observed in any event are reported to entity along with RPC for early resolution.

vi. Synchrophasor has helped to find the issues in time synchronization in event loggers, disturbance recorders details submitted by utilities also for checking of sequence of operation of the events etc. Therefore, it has significantly reduced the time required for analyzing an event and root cause of the event.

vii. PMU also helped in RLDCs in validating the Power system stabilizer tuning process with high sampled data. It has provided feedback in form of oscillation/power swing where PSS tuning is required to be carried out and based on these generators had been informed. Further after PSS tuning, the same was also validated.

viii. PMU data was utilized in monitoring of power system during site testing of power transformers at National High Power Testing Laboratory (NHPTL) at Bina station. PMU data based results helped in providing inputs to the studies carried out to assess the impact of tests on the grid. Power transformers upto 500 MVA at 400 kV level and 330 MVA at 765 kV level were tested. The transient stability was monitored for the period of test shot. The PMU based data provided inputs on fault clearing time, faulty phases and short circuit MVA during tests. The PMU placed on the test station used protection core of the current transformers (CT), owing to the nature of fault current expected to be measured.

ix. **Post-Disturbance Analysis**: The goal of a post-mortem or post-disturbance analysis is to reconstruct the sequence of events after a power-system disturbance has occurred. To achieve the objective, it is required to assemble and study the signals from various PMUs that are dispersed throughout the grid. The time-synchronized PMU data from different locations of grid, helps in understanding and reconstructing the event.

c. **Existing features of URTDSM**

i. Time Series Derivation Framework (TDF)

TDF is the user interface of the Historian Application provided by OEM M/s GE, being used in Control room to plot the events which Occurred during last one year (at NLDC, six months at RLDCs level) to analyse details of Events and its characterization. Data Storage limitations are constraints in storing historian data for longer duration.

ii. Spectral Analysis (using E-Tera Phasor Analytics)

The power system quantities contain several frequency components from different sources. Spectral analysis of PMU data enables revealing which frequencies occur in system and how they change as a function of time. Spectral analysis provides an intuitive and visual way of representing changes in power system parameters at

different frequency and time instances. Mainly three types of spectral trends are provided in e-terra Phasor Analytics:

- **Power Spectral Density (PSD)**: Power Spectral Density (PSD) is very useful tool if we want to identify oscillatory signals in time series data and their amplitude. It also tells us at which frequency ranges variations are strong that might be quite useful for further analysis.
- **Coherency**: Coherency, is a measure of frequency domain correlation between two signals. Coherency is always greater than zero and less than one, if two signals are loosely correlated in the frequency domain, the coherency is tends to be close to zero. If there is strong correlation, the coherency tends to be close to unity.
- **Cross Spectral Density (CSD)**: Cross spectral Density as a measure of frequency domain covariance between two signals and is related to transfer function between two signals.

3. Analytical Application Software developed by IIT Bombay:

IIT Bombay (IITB) and POWERGRID have initiated a joint project "Synchrophasors Analytics for Electrical Transmission Systems". Under the project, development of following six analytics by IITB was envisaged:

1. Line Parameter Estimation
2. Online Vulnerability Analysis of Distance Relays
3. Linear State Estimator
4. CT/CVT Calibration
5. Supervised Zone-3 Distance Protection
6. Control Schemes for Improving System Security

Out of six applications, only first four applications have been installed at regional and national control centres. Further, Linear State Estimator (LSE) and Line Parameter Estimation are installed but the performance is not satisfactory. The summary and limitations of first four installed applications is given below:

i) Line Parameter Estimation

Application of total least squares (TLS) method is used to estimate line parameters moving window technique to use voltage, current, active and reactive power measurements from PMUs and other measuring devices to estimate the positive sequence parameters of an equivalent pi(π) model.

ii) ONLINE VULNERABILITY ANALYSIS

PMU measurements can be used to identify relays that are vulnerable to insecure tripping. In this application, each PMU on Transmission line measurements shall create a virtual relay mimic and relays are termed as vulnerable relays if the margin between their operating characteristics and the distance protection zone boundary is very low, a vulnerability index is presented where the vulnerable relays are ranked based on their risk. The errors get introduced when input relay settings are not validated. **LINEAR STATE ESTIMATION**

PMU has the capability to directly measure the magnitude and angle of bus voltage and current. If enough voltage and current phasors are measured to make the network observable, state estimation could become linear. The measurements are voltage phasor and current phasor, and states are voltage phasor. A state estimator, essentially, removes the errors from the measurements and converts them into states. The control centre can make use of it, to make decisions on system economy, quality and security. So far, the application is working with some errors and further testing is under progress to identify the bugs.

iii) CT/CVT CALIBRATION

It is difficult to ascertain accuracy of any instrument transformer at site, once it is installed. State estimation techniques can perform "soft calibration" of these instruments to reduce errors in state estimation and identify any gross error if present in instrument transformer.

4. Scope of Improvements in existing features

The URTDSM scheme has benefitted the system operation in many ways as described in previous sections. At the same time while using the various applications/functionalities available in present system, it is felt that if some improvement could have been done/considered, it would have been utilized more. List of such improvements are mentioned below, which are purely based on operational experience of existing system:

a. Improvement required in the visualization/GUI

i. Adding trends of phase voltage and current : It is only possible to plot trend of positive sequence voltage, frequency, df/dt, angle difference, MW and MVAr in real-time. It shall be possible to plot trend of phase voltages and currents also in real-time. Need to display phase voltage instead of positive sequence voltage. The phase voltages are required to identify the faulty phase and helps in real time in understanding the issue.

ii. Capability to visualize data for larger time window: Real-time trend given to operator has the capability of plotting real-time values up to the interval of 15 minutes only at its native resolution (25 samples/sec). For the data beyond 15

minutes duration operator has to be go TDF application to fetch data and see the details. TDF application is not very user friendly which leads to inconvenience to Real-time operator. There should be a single user interface, through which user can visualize real-time as-well-as historical data as per their interest and interval/duration.

iii. Trending system is having a capability to have show effectively only 8 signals and if additional signal are added in same trend window then it results in freezing or display crash causing limited overview of the system.

iv. PMU with high sampling rate required at few locations: General data storage/display rate of PMU is 25 samples/sec, so as per Nyquist criteria oscillation of 12.5Hz can be detected. However, the PSD display in Phasor Analytics detects modes upto 4Hz only. OSM should be able to captures oscillation upto 12.5 Hz. It is needed to extend the monitored frequencies, to also cover sub-synchronous resonance, very low frequency governor modes and control modes. Higher sampling rate is needed for these applications. In addition, PDC should have capabilities to store data of higher sample rate PMU aprt from existing 25 Hz. Present system allow only storage of 25 Hz data only.

v. Option to select reference angle: There should be option to the selection of reference angle by the user (real-time as-well-as historical) and visualization of other data w.r.t same. Data stored in historian must be RAW data, so that visualization can be done as per the user requirement w.r.t any station. The angular difference values are in reference to a particular node and when the data is dumped in excel for analysing any past event it is important that reference node is known, however in many cases it is not available so make it difficult to find the reference node.

vi. Font and axis size: Formatting of PMU Snapshots arrangements should be user friendly so that it could efficiently utilized for Daily reporting control room shift. The auto-scaling and adequate font size need to be ensured in PMU

vii. Portability of display: Visualization is an essential part for URTDSM system which requires better interface and flexibility for real time operation. This needs advanced development platforms for retrieval and visualisation of phasor data based on the requirement of the operator in real time. Portability of display to be used in different applications may be ensured for easy reporting

viii. Non-generation of alarms: The real time applications sometimes fail to detect the oscillations. The Modes Applet and Analyst chart show normal state and Alarm/ Alert states are not observed even though Oscillations were present in the system. E-terra vision is having an issue of alarm processing as per user requirement, as and when alarm detects in a group of signals and returns to

normal values in few sets of signals in group, then this alarm processing engine is clueless, what to report to operator.

ix. Freezing of display: Visualization screen gets sluggish on certain occasion, when trending feature and replay feature is heavily used by operators.

x. Integration with different make of PMU : Interoperability of different PMU manufacturers has been a concern and is progressively taken up post-commissioning through firmware upgrades etc. This interoperability aspect may be addressed.

xi. Logic based analytical tools: Logic based analytical tools may be implemented for enhanced situational awareness. Further improvement in alarm based features with the different mathematical and logical conditions can be carried out.

xii. Modal analysis issues in URTDSM Analytics:

- Baselining of modes from OSM engine is a separate engineering activity and is must to set limits for mode amplitude, damping and selecting mode bands for alerting operators. However, this activity was not part of the current system.
- High noise in PMU: It has been observed that higher order frequency (near to 4 Hz) shows low damping and lower order frequency (near 0.1 Hz) shows high damping. High Noise in some of the PMU's data is another issue and the same has been flagged to GE also. The severity of noise in data is quite high in some cases. Such noisy data will result in bad Analytics and poor performance and utilization and confidence in the system. Some automated tool to be developed for such type of error detection.

b. **OSM related issues:**

i. Right Eigen Vector plot of modes not observed though it is seen that during that time Inter, Intra, Local and Intra Plant modes were present in the system as reported by existing pilot PMUs. Move upwards in oscillation section.

ii. Availability of statistical functions like a) Mean b) Median c) Standard Deviation d) Maximum e) Minimum and f) Average Values against each of the available parameters in PMUs. Also, the user should be able to generate Box & Whisker plots against each of the available parameters in PMU.

c. Infrastructure related issues

i. Voltage discrepancy in voltage measurement is observed in some PMU's, it's almost 5 to 10 kV difference in consecutive phases due to that positive sequence voltage is not accurate to take the decision by operator in real time. Some

logic/tool must be developed to detect such measurement errors and generate alarms as well. Utilities need to be sensitized for managing issues related to measurement devices.

ii. Implementation of physical redundant communication links in URTDSM project between PMU to PDC as well as PDC to PDC located at different locations. Standby communication links have not been implemented in URTDSM project. In case of any issue with communication channel, data loss has been observed on several occasions. Considering the importance of PMUs data in real time grid operation and post facto grid event analysis, it is recommended to implement main and standby philosophy in data communication between PMU & PDC and between PDC & PDC to avoid any data loss.

iii. Frequent time synchronization issues arise in PMU's data due to the GPS issue. In few Stations GPS time synchronization source was shared among the PMUs with some intermediate converters/extenders, which use to have record of going faulty, so there is need for strengthening of GPS source and stringent daily monitoring by substation on daily basis.

iv. Loss of PPS (Pulse per second) is a common cause in case of URTDSM PMUs, mainly due to the disturbance of PPS cable during maintenance activities. Infra issue

v. Dead band defined in PMU data for frequency, voltage and df/dt, it sometimes lead to discrepancy in values.

vi. Linear State Estimator Application is not having sub second measurements from ICTs, GTs, bus couplers and bus sectionalizes, due to which most of the time LSE is creating many electrical islands, and the voltage estimates at each bus are not matching the measurements from the same bus. Due to deviation in estimates and less user-friendly application, acceptability in real time operation is very low.

vii. Further, the network database is not updated constantly and the state estimation with incomplete data becomes difficult. Data base should be taken from existing EMS system. Sub seconds measurements need to be taken.

d. Future Requirements of URTDSM:

i. Overall the URTDSM being a big data system with so many number of PMUs require heavy automation feature, high speed with flexibility in usage to reduce manual effort in analyzing the data and trends. The present feature in existing URTDSM lack such features which is limiting its full potential utilization in control centers.

ii. An application is required to identify of the source, which causes the oscillations in the system and accordingly give an alarm to the operator. This requirement becomes important in identifying the source of forced oscillations in the grid as such oscillations do not follow the characteristics of regular oscillations.

iii. PMU Waveform's should be available for at-least 24 Hrs in single trend window with 25 Hz sampling frequency.

iv. It should also have capability of trending longer duration of signal with down sampling of data. This helps in analysisng the weekly and monthly trend of various parameters.

v. Guidelines for URTDSM Historian Data storing capability and sophisticated techniques which can compress large amount of data with minimal loss of data quality to enhance utilization of data storage capacities.

vi. The more real time and offline applications are required for improvements in planning, better and validated system dynamic models. In order to confirm the mathematical model correctness used for simulation studies, model validation using PMU data plays a key role. International grid standards like NERC Reliability standards requirements have accepted synchrophasor based model validation as an effective way to verify generator real and reactive power capability and control systems and assure their appropriate responses during system disturbances. Synchro phasor-based model validation is more economical and accurate than validation methods that take the model off-line for performance testing. The list of applications required for Indian power system is enclosed as Annexure I.

vii. The data exchange between PMU to PDC uses the communication system. The communication system must have cyber secure and reliable infrastructure.

viii. PMUs provide a lot of data, but this data should be transformed into valuable information or generate reports and highlight the important events. A tool of event detection and generation of automated report may be helpful for system operation.

ix. To get the full benefit of linear state estimation i.e., speed of calculation, it is required that digital status for topology processing should also be obtained from PMUs at the same rate as the Synchrophasor measurements. The LSE also needed various measurements like ICTs, GTs, bus couplers and bus sectionalizers. It is important for correct topology processing the status of disconnectors is also included.

x. System Operating Limits: Advancement in determining accurate, dynamic system operating limits for phase-angle differences and oscillations, in addition to existing baselining techniques, will facilitate increased use of synchrophasor

data for real-time decision making in the control room environment.

xi. The most of the analytical applications provided by IIT Bombay are not a real-time application. There is a need for analytical applications which can be used in Real-time by operators for smooth grid operation and security.

xii. Need applications for improvements in operational planning, better and validated system dynamic models. The detection and analysis of all inter-area oscillations modes in the system could be used to improve the existing dynamic system models. The improved models will increase the confidence level on system dynamic studies. These enhanced models can then be used to optimize the location and fine tuning of existing system stabilizers.

xiii. Applications for online Zone-3 protection require placement of more PMUs for better performance.

xiv. The stations/bays needed for PMU placement shall cover all power electronic devices installed at various locations, HVDC links, RE generators, all inter-state and inter-regional transmission links. The detailed description of requirements in PMU placement is given as Annexure-II.

xv. There is a need for standardizing signal list for phasor data acquisition in power system, such uniform list is proposed in the recent document "POSOCO Draft Interface Guidelines" had a dedicated section for PMU signal list which can be considered for reference. The list of PMUs signals to be acquired from various type of stations are listed at Annexure-III.

xvi. In addition to this, the control application from measurement class PMU should also be considered. These may include implementation of dynamic control of HVDC/FACTS based on wide area signal analysis, Wide area SPS schemes.

xvii. In cases where high fault current are required to be monitored, the use of protection core of CT or P-class PMU may be explored. The placement of PMUs where it is expected that high fault current would be observed shall take the measurement from protection core. Using measurement core of the CT can lead to issues like saturation while measuring high fault current.

xviii. Some key application can be automatic islanding detection and digital synchroscope, voltage stability monitoring, online inertia assessment etc.

5. Way Forward:

i) The benefit of the WAMS is the ability of providing immediate indication of the power system status based on synchrophasor measurements and results of the on-line applications. As observed for various other systems, the initial deployment of WAMS can use two different approaches:

i. Bottom-up: PMUs are available first, and the applications are developed or integrated later
ii. Top-down: PMUs are specified and installed following the application requirements

The first case is found when PMUs are installed before the deployment of the applications [1]. This can happen, for example, when the PMU functionality is integrated into protection or control devices, and the advanced applications are not considered at the time of the installation of the PMUs, or for stand-alone PMUs in pilot projects. In the second approach the allocation of PMUs, and their installation, is defined based on the foreseen applications intended for the power system, i.e., the PMU locations are derived based on the deployment of the applications. The second approach is more advanced approach and the considerations of PMU to be installed are taken in advance. However, all functionalities specific to a particular feature are not observed if second approach is considered.

ii) The architecture of WAMS infrastructure and placement of PDC is an important aspect for consideration. WAMS networks must be designed and operated as accurate reporting systems. It is important to time-stamp data and get it delivered in a strictly time-bounded manner. These requirements make the WAMS communication network an integral part of the measurement. Communication network performance is a key component of grid performance, reliability and resilience. Implications of this growth in potential uses of PMU technology require new guidelines in the architecture and design of PMU networks. Constant streaming of PMU data results in large amounts of data in motion and large accumulations of data – all of which much be managed , routed, stored, protected, and made accessible under controlled conditions. Phasor data concentration is therefore an important function and the allocation of this function to actual system components is a significant architectural decision. NASPInet 2.0 Architecture Guidance Version 1.19, September 2019, [3] mentions that "*over-the-top networks (networks imposed on an underlying core network) should be avoided, as applications and their associated functions should be located at the edge. Such considerations mean that PDC stacking can and should be eliminated, as PDC stacking imposes an unnecessary network on top of the core communication network.23 Converting PDC devices to their essential functions and separating the functions (aggregation and time synchronization) for appropriate allocation to devices and systems provides the needed flexibility to avoid the stacking problem.*"

iii) PMU placement can be optimized to maximize the value and usefulness of the data given the relatively high cost of undertaking the PMU and software

deployment effort. Many large power systems across the world have significant experience with PMU design and installation [5]. There are over 2,000 PMUs deployed across North America (420 PMU in North-Eat, 400 PMU in Midwest, 150 PMU in South, 120 PMU in Texas, 500 PMU in WECC and approx. 300 PMU in Mexico). Chinese power grid has installed over 3000 PMUs in the practical system.

iv) WAMS shall ensure high data quality of parameter measurements. WAMS data quality in the context of analysis includes presence and usability of data. Data quality related issues are wide in scope and may cover the following:

a. Loss of data in communication and processing systems
b. Data not sent by the PMU
c. Corruption of data in communication and processing
d. Incorrect identification of measurements
e. Excessive latency

The appropriate mechanism may be ensured to assess and report the issues related to data quality in WAMS. The feature of generating periodic report on data quality may be included in WAMS itself.

v) Synchrophasor measurements transmitted from PMUs at various locations of an interconnected power system are communicated to Phasor Data Concentrators (PDCs) over a wide area communication network. PDCs in a synchrophasor network are arranged in a hierarchical manner and are categorized as local, central, and super PDCs. Local PDCs are located close to the PMUs at the substations. They collect, time align, and send the synchrophasor data from PMUs to higher level PDCs. Central PDCs are located at control rooms and receive data from local PDCs or multiple PMUs. PDCs can provide time-aligned data to wide-area monitoring applications. Data can be stored at each level, however central and super PDCs level control centres are more likely to store data since they concentrate large amount of information. Therefore, functionalities need to be developed so that whenever required Super PDC can interact with local PDC to fetch data and can store for a required period.

vi) Storing synchrophasor data requires a much greater amount of storage space compared with conventional SCADA storage used by electric utilities. Due to the volume from data and significantly faster sample rates, synchrophasors can use up storage space quickly. NERC Reliability Guideline "PMU Placement Guideline | December 2016" mentions that "*a utility data historian system may generate archive files of a particular size for timeframes of about a week or so. In*

comparison, synchrophasor archives create archive files every 6-8 hours, or about 25 times more often than the conventional SCADA system". Therefore, the understanding of storage requirements of historian is to be estimated in advance.

vii) PMU data has wide applicability and the potential users of such data do not all reside inside the same entity that produces it. In case separate entities do integration of PDC; proper standards, protocols, cyber security shall follow a uniform protocol. The archival schemes and data compression techniques are used for storing data in an optimal fashion. Historian applications allow the users to set parameters for exception and compression processing that removes noise and errors from the signal without losing any significant meaning from the data. This frees up disk space, reduces network traffic, and improves overall performance of the historian applications. NERC Guidelines mention that the combination of exception (stores data if the data changes outside a pre-defined deadband limit, which should be set to a value less than the precision of the metering equipment supplying the data) and compression processing (similar although in this case the changing data can have a slope and deviations from the slope drive what samples are stored and what samples are not stored) can significantly reduce the amount of data stored.

viii) State estimation is the process of deriving a best estimate of system state (voltage magnitudes and phase angles) based on a set of measurements from the system. The state estimator (SE) produces a state estimate using measured quantities and status such that bad data or errors are flagged through redundant measurements. Usually, state estimation is based on minimizing the sum of squares of the differences between estimated and measured values of a function. The placement of measurement devices (PMU) assumes importance under such scenario. Observability analysis determines if a unique estimate for the system state can be found using the available set of measurements. The system is considered observable if the number of measurements exceeds the number of system states. System observability depends on the number of measurements, locations of measurements, and topology of the system. This requires state estimation to be carried out at all levels in system to maintain redundancy , however observability is different at each level.

Distributed state estimation has several advantages over legacy centralised state estimation. This will facilitate area level/station level implementation which will further lead to following:

a) Reduced dimensionality and faster computational performance
b) Facilitates use of more accurate models (three phase, dynamic)

c) Reduced communications burden and associated time latencies
d) Easier bad data detection, identification, rejection

The station level state estimation defines voltage phasor at each bus of the substation as well as the voltage at the boundary bus of neighbouring substation. Owing to small size and having advantage of substation automation, the data and model validation becomes easier. The scheme for implementation of PMU shall also emphasise on station level state estimation.

The area level state estimation implementation can be achieved with functional state estimation from station level. The area level state estimation requires PMU at the boundary buses for the neighboring buses to be observable. The computed state vector is only sent to the central location. No need for measurements to be communicated and this would help in synthesizing system state vector from the individual areas' state vector without need of additional state estimation. This would help in minimising the PMU reporting at central control centre and reduce the storage and communication requirements.

ix) The points discussed above are also available in NASPI 2020 Survey of Industry Best Practices for Archiving Synchronized Measurements, North American Synchrophasor Initiative Technical Report ,NASPI Data Network Management Task Team, November 3, 2020,[4] following are major takeaways:

a) *Question 1: Describe your overall synchronized measurement network architecture (i.e., PDC network configuration)?*
Conclusion from Survey: There was an equal split in the use of individual architectures with three (25%) using intermediate substation PDCs only and three (25%) using direct control center transmission only. There were five (42%) respondents who used a mixture of architectures possibly for dedication of certain synchrophasor signals for direct control room use. One respondent specified a unique structure: foreign substation PMU to TSO PDC to own TSO PDC. This would be a foreign utility PMU transported through TSO connections to the respondent utility PDC.

b) *Question 2: What product do you use for your archive?*
Conclusion from Survey: Six (35%) of the respondents use in-house proprietary software while six (35%) of the respondents use OSISoft PI for their archive solutions. Nine (75%) of the respondents reported using multiple archive solutions.

c) *Question 3: What is the format of your archived synchronized measurements (i.e., file folder, binary, SQL database)?*
Conclusion from Survey: Most respondents had a custom storage style. Even those that responded with the same response category stored its data in slightly differently ways.

For example, the time-series respondents were using a mixture of custom storage methods such as compression methods, proprietary methods, flat files, and others.

d) *Question 4: Archive Type?*
Conclusion from Survey: Most respondents are keeping a fixed amount of data before deletion. Only two respondents are expanding their data storage to keep longer-term data. Also, only one respondent has chosen to keep a 2-week data repository.

e) *Question 5: Current Storage Capacity (TBs)?*
Conclusion from Survey: The size of storage needed can vary according to many factors, such as the number of PMUs, compression methods, resolution, and frequency of PMU data.

f) *Question 6: Current Storage Duration (in years)?*
Conclusion from survey: Most respondents are keeping their data for more than a year, with only two indicating for less than that. Many respondents indicated that exciting events are saved in different locations for permanent review.

g) *Question 7: Data accessibility?*
Conclusion from survey: Most, if not all, respondents can access PMU data online. The only offline response referred to archived data. Old archived data was only available offline for many other responders. One respondent stated that data is accessible only to operators.

h) *Question 8: Data Granularity?*
Conclusion from survey: Many respondents are recording data in a raw format. This may be due to the low cost to storage as well as the immediate access to data that raw files provide.

i) *Question 9: Data Sampling Rate (Hz)?*
Conclusion from survey: Most respondents are sampling at half the line frequency (25-30 Hz). Also noted was that, 6 (35%) of the respondents sample at multiple sample rates.

j) *Question 10: Describe tools used for synchronized measurement data quality assurance and lost signal alarming and mitigation?*
Conclusion from survey: Most respondents used commercial software like EPG RTDMS, EPG DataNXT, PI Datalink, and XM Data Quality App to name a few. Most do not send alarms. One respondent indicated they had extensive PMU coverage, and the loss of data from isolated units was not problematic, not requiring alarming.

k) *Question 11: What types of data do you archive?*
Conclusion from survey: All respondents record synchrophasor data. Of the 17 respondents 64% report recording only synchrophasor with 3 respondents mixing other data sources such as Digital Fault Recorder and Power Quality data into their archives.

l) *Question 12: What features would you like to see in a next-generation synchrophasor data service platform?*
Conclusion from survey: Most respondents were interested in on-board data analytics and multiple data source collections. Both of these items are features that some respondents have already implemented. This shows the respondents' need for quick access to raw data and summary data for simplified decision making. This also speaks to the respondents' desire to have capabilities to quickly develop and obtain quick new insights into what information their synchrophasor data can provide

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Annexure I

URTDSM Applications Required in Indian Power System		
S.No.	**Application Name**	**Used in**
1	Voltage Stability Monitoring: Measurement based dynamics provide voltage sensitivities; monitoring of key corridors or load pockets; scatter plots for power-voltage and power-angle monitoring.	Austrian Power Grid, Red Electrica de Espana
2	Detection of disturbances: Recognition of short circuits by watching the currents, and indication of loss of load, or loss of generation by watching the frequencies.	Red Electrica de Espana, FINGRID
3	Online monitoring of Inertia.	AEMO
4	Identification of source of Oscillation.	ISO New England
5	Identification of stressed corridors	-
6	ROCOF calculation over variable window	WECC
7	Island identification/detection	MISO, Red Electrica de Espana, Swissgrid, North American power grid
8	Locating contributions to poorly damped or unstable oscillations	WECC
9	Model Validation	MISO , Austrian Power Grid, GCC Interconnection Authority
10	Higher frequency sub-synchronous oscillation analysis and early warning of resonance	-
11	Big Data Analytics	-

Annexure - II

Suggestions on Placement of PMUs and consideration of signals under URTDSM Phase-2 Project

During the implementation of URTDSM Phase I, the following criteria have been adopted as a philosophy for the placement of PMUs in Indian electricity grid:

1. Generating stations at 220 kV and above
2. HVDC terminals,
3. inter-regional and
4. inter-national tie lines
5. Both ends of 400kV and above transmission lines at State and ISTS sector

This was considered for facilitating Synchrophasor data acquisition through adequate numbers of PMUs, as per the URTDSM Phase- I PMU placement criteria, only limited set of signals and few elements in a Substation/Generating Station as the case was considered. The philosophy needs to be reviewed as per the current trends of Power System Operation and changes brought in the dispatch patterns with increasing Renewable penetration of the present as well as future considerations.

Accordingly, while deciding placement of PMUs and acquisition of signals from the stations under URTDSM Ph-II project, following facts may be considered:

I. Importance of PMUs in Model validation:

In order to confirm the mathematical model correctness used for simulation studies, model validation using PMU data plays a key role. International grid standards like NERC Reliability standards requirements have accepted Synchrophasor based model validation as an effective way to verify generator real and reactive power capability and control systems and assure their appropriate responses during system disturbances. Synchro phasor-based model validation is more economical and accurate than validation methods that take the model off-line for performance testing. Hence placement of PMUs on GT LV side for thermal/gas/nuclear based generation for 132kV and above generating station is recommended.

With respect to Wind/Solar Plants, placement of PMU on LV side of incoming feeder in addition to PMUs on evacuating lines of wind/solar plant. PMU measurement for validation of the dynamic response of the respective inverter/WTG type in the plant, CT summation of 33kV feeders with same inverter/WTG type can be used, considering the single machine / multi machine

(due to different Inverter/WTG model) aggregated model representation of Wind/Solar plant used for simulation. Hence, validation of complete plant response and individual inverter/WTG model can be achieved with observability at 33kV collector system in the Wind/Solar Plant.

II. Regulatory Requirements in respect of PMU Placement

Sub-regulation (4), after clause (g) of Draft Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Amendment Regulations, 2019 mandates that PMU shall be placed at sub-stations operating at 400kV and above, switchyard of generating stations at 220kV & above, AC side of converter bays of HVDC stations and pooling point of renewable energy generation of 50MW and more.

From above CEA Technical Standards, it is evident that, PMUs placement on Interconnecting Transformers (ICT) is inherently mandated as ICTs are integral part of Substation and PMU placement on Transformers is also recommended internationally and relevant standards or procedures are in place.

III. Importance of Isolators and Recommendation of panel of Expert on Smart Grid implementation

It was recommended by Panel Experts (Dr. Arun. G. Phadke, Mr. Ken Martin and Dr. D. Karlsson) that for better topology processing isolator status is also to be monitored in PMUs in Phase II of URTDSM Project.

Further, the issues on incomplete observability of phasor measurements system are brought out by IIT, Mumbai on their paper published by G. R. Gajjar, P. V. Navalkar and S. A. Soman, "Considerations on measurement locations for WAMS based linear state estimation of power systems," *2017 7th International Conference on Power Systems (ICPS)*, Pune, 2017, pp. 671-676, doi: 10.1109/ICPES.2017.8387376. (https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8387376)

As per the findings & recommendations reported in above referred paper are summarised below:

- *one should consider measurement of currents of generator transformers (GT), interconnecting transformers (ICT). At the same time digital status of circuit breakers and disconnectors associated with GTs and ICTs should also be monitored.*
- *it is required that at least the digital statuses of all components associated with the substation is available with the analytics. Hence, status monitoring of bus couplers and bus sectionalizers should be considered. Moreover, status of bus reactors and line reactors may also be taken in to account.*
- *Measurements of current through bus couplers and bus sectionalizers could be considered as they aid in development of supervisory protection schemes based on synchrophasor measurements.*

- *There is tendency to accept the unreliability of disconnector status. This is a short-sighted view and should be avoided. The importance of successful running of state estimation is very high, and it should not be allowed to be degraded due to unreliability of few disconnector statuses. In spite of taking care of proper design of making all disconnector status available through PMU measurements, if the linear state estimation still suffers from unreliable measurements and resulting topology errors then it should be an unacceptable situation. Big investment of engineering effort goes in vain for want of little maintenance to ensure reliable disconnector status measurements.*

From above it can be concluded that to get full benefit of linear state estimation i.e., speed of calculation, it is required that digital status including disconnectors / isolators for topology processing should also be obtained from PMUs at the same rate as the Synchrophasor measurements.

IV. International Practices in placement of PMUs:

As per NERC Reliability Guideline on PMU Placement and Installation, December 2016, it can be appreciated that Wind & Solar power plant controller operating modes like Voltage Control, Power Control can be monitored through PMUs (voltage magnitude, active and reactive power flow) for confirming compliance of correct control mode operation as instructed by Load Despatch Centre.

Further, section 6.1.3 of the ERCOT Nodal Operating Guides, describes requirements for Phasor Measurement Recording equipment. As per the guide, the following elements/assets shall be provided with PMUs:

1) "New generation facilities over 20 MVA aggregated at a single site placed into service after January 1, 2017;
2) generating stations connected at or above 100 kV or
3) with individual nameplate rating above 500 MVA or
4) with individual nameplate rating above 300 MVA where the plant aggregate nameplate rating is more than or equal to 1000 MVA.
5) each terminal of a high-voltage, direct current (HVDC) circuit with a nameplate rating greater than or equal to 300 MVA, PMUs shall be installed on the alternating current portion of the converter and same shall be made available by July 1, 2022."
6) flexible AC transmission system devices at or above 100 kV, and energized after July 1, 2015.

In view of the above, PMU placement and signals to be acquired in URTDSM Phase-II project, is required to be reviewed holistically and following criteria may be adopted for facilitating Synchrophasor data acquisition through adequate numbers of PMUs:

1. **Inter-Regional and Tie Lines Lines:** It is very important to monitor the power flow on inter regional lines, though the SCADA provides this data but high sampling rate data furnished by PMUs would help in getting accurate frequency response of regions as well as proper functioning of automatic generation control. Therefore, PMU need to be placed on all inter-regional lines so that power flow can be assessed.

2. **HVDC and FACTS devices:** With the large integration of HVDC and FACTS devices in the system, it is very important that their interaction with existing system is monitored. The high sampling rate data provided by PMU would help in understanding the controller interactions and getting insights into their features. The PMUs need to be placed at AC-DC boundary and converter transformer or coupling transformer. With more numbers of power electronic devices in grid, it is possible that sub-synchronous resonance may be observed at various locations.. The reporting rates of samples need to be higher to capture the SSR phenomenon. Hence PMUs having ability to measure SSR frequencies can be installed at strategically locations.

   Elements to be covered:

(i) At Both ends of Inter connecting lines between HVDC side AC switchyard with connecting AC Sub Station.
(ii) All Converter Transformer (HV side)
(iii) At STATCOM/SVC station Coupling Transformer (LV & HV sides) including the individual STATCOM/SVC.

3. **Renewable Energy Generation Pooling points**: The RE generation is coming across all Indian power system at very fast pace, the monitoring of RE generation is very important considering must-run status of this generation. RE based generation are required, by CEA Technical Standards of Connectivity to the Grid, to perform various dynamic performances such as LVRT, HVRT etc. The performance can be assessed better if high resolution data will be available and PMU placement at low voltage side of transformer at pooling station would help in providing that.

   With Upcoming Ultra Mega Green Solar Power Project integrations in EHV grid, change in angle variations are expected on existing transmission system and the consequences in respect to operating constraints in evacuations especially in pockets where concentrated Renewable Generation. Moreover, these changes occur very fast due to the inherent intermittency of RE sources, particularly wind and solar, as well as other associated weather influences. As a sample case, in Western Region, Rewa Solar Park has an Installed Capacity of 750 MW, and the

angular separation pattern is closely following the Solar Generation pattern as shown
below:

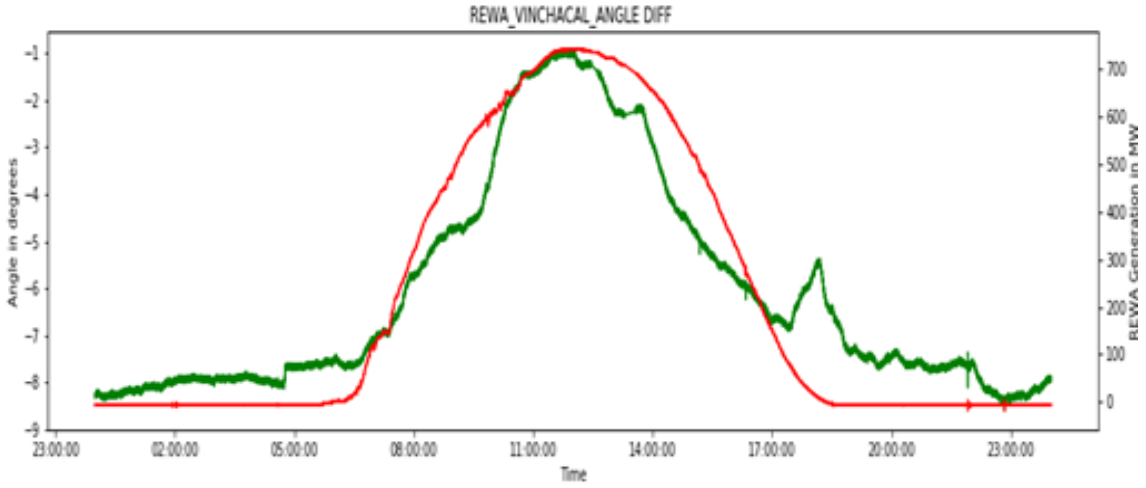

Figure: REWA Solar UMPP Angular Difference Correlation with Solar Generation

There is a variation of about 8 degrees is observed in the between Rewa and Vindyachal nodes in the span of three hours. This emphasises the importance of PMU data at solar stations. Currently PMUs are installed at 400 kV side only however PMUs are equally important at 220 kV level as well.

Elements to be Covered:

(i) On all outgoing feeders including bus sectionalizer or tie line between two stages of generating stations having different tariffs or different ownership or both
(ii) High Voltage (HV) side & Low Voltage side of Transformers
(iii) Reactive Power sources & Sinks shall be measured through Synchrophasor
(iv) All CB and isolators shall be wired to Synchrophasor device as digital signals.

4. **Islanding, Separation & Restoration:** The expected benefits from PMU installations at strategic locations include early detection of islanding conditions and remedial action by SPS (special protection scheme). Key placements can assistance with the restoration process, and resynchronization back into the main grid. Black-start investigations of alternative system configurations, including operation of transmission lines at reduced voltages with bypassing of transformers are enabled with detailed phasor measurements of potential overvoltage locations. Similarly, the PMU data can be utilized for resynchronization with data for bus and line voltage magnitude and angle along-with frequency.

Elements to be Covered: At both ends of line connected black start stations or

restoration path lines (both ends including CB and isolators).

5. **State Estimation errors:** The observability of the complete system is very important therefore, the locations where the state estimation errors are high and continuously show such behavior may be the candidate locations**.**

   Further, during URTDSM Phase-I, PMUs are envisaged only on 400 kV and 765 kV lines only. Linear State Estimator (LSE) application developed by IITB and installed under URTDSM Phase-I at various control centre i.e. RLDCs/NLDC/SLDC. After the configuration and setting up of linear state estimator, it is observed that two islands are being formed for each voltage level (400 kV & 765 kV). To avoid multiple network islands, PMU should also be placed on Interconnecting Transformers (ICT) at EHV level

   Elements to be Covered:

   a) Substation shall have Three phase Bus voltage measurements through PMUs & Circuit breakers and isolator position shall be wired to PMU for Linear State Estimator for topology processing and full observability.
   b) Reactive Power sources & Sinks shall be measured through Synchrophasor to avoid MVAR mismatch in Linear State Estimation.
   c) All 765/400 kV, 400/220 kV Inter Connecting Transformers (ICT) should have PMU on both sides (LV & HV).

6. **Power Flow Gates:** The high-power corridors after large generating complexes like Sikkim hydro, Mundra UMPP, Vindhyachal-Sasan-Rihand complex etc. The power flow on these gates need to be monitored therefore the lines emanating from these complexes can have PMU placement.

7. **Major load centers:** Load models are important for off-line stability studies as well as real time monitoring. It is difficult from simulation programs models to select a proportion of load to be of induction motor type. In addition, electronic load is growing whereas incandescent lighting (resistive load) is decreasing. However, load simulation programs do not often reflect the changing nature of power loads with respect to changes in the electrical behavior and penetration of power electronic devices. While PMUs placed at load centers will not reveal changes in the makeup of loads, they can reveal changes in the electrical characteristics and behavior of aggregated loads. PMUs should be installed at appropriate radial load feeding substations so that the load sensitivities to system frequency and voltage changes can be monitored. FIDVR (Fault Induced Delayed Voltage Recovery) based events can be better analysed.

8. **Angular Difference monitoring locations:** Phase angle difference is directly correlated with system stress, and can be used as a strategic measurement of grid

security both pre- and post- contingency. For improved wide-area phase angle difference monitoring and situational awareness, it is useful to monitor the angle difference across major transmission interfaces across the grid, including both on a local- and wide-area basis. These interfaces are defined by key stress patterns driving the need to monitor these interfaces. The PMUs which will be the most valuable for angle difference monitoring need to be identified for PMU placement.

9. **Major Generating Stations**: In a generation station, it is desirable to measure all the line currents (including the step-up transformer) and both the high-side and low-side voltages. The PMU placement at these locations in generators will provide good insights into governor frequency control, excitation control, PSS tuning etc.

   In order to confirm the mathematical model correctness used for simulation studies, model validation using PMU data plays a key role. International grid standards like NERC Reliability standards requirements have accepted Synchrophasor based model validation as an effective way to verify generator real and reactive power capability and control systems and assure their appropriate responses during system disturbances. Synchro phasor-based model validation is more economical and accurate than validation methods that take the model off-line for performance testing.

   Hence placement of PMUs on GT LV side for thermal/gas/nuclear based generation for 132kV and above generating station is required/recommended.

   Elements to be covered:

   (i) At 400 kV and above Generating stations (132 kV in case of NER).

   (ii) Individual Unit of rating 200MW and above for Coal/lignite, 50MW and above for gas turbine and 25 MW and above for Hydro units shall have PMU placed at the terminals of the generator(s) at either the HV or LV side of the Generator Transformers.

   (iii) In case of plant having multiple units ,PMU can be placed on 50 percent of the units

10. **System Protection Scheme monitoring:** The monitoring of the inputs for SPS activation is also very important; it can also help in validating the accuracy of SPS action. SPS operation can be very well validated using the PMU data. Therefore, all the points where SPS based scheme inputs are derived may be allocated PMUs.

11. **Experience based locations known for small signal stability related issues**: The nodes in the grid which have in history observed the cases of Low frequency Oscillations negative damping, Ferro resonance, Sub-synchronous resonance, out

of step protection etc. shall be considered for PMU placement. A high-resolution data capturing may be recommended for such PMUs.

Annexure-III

PMU Signal List

Sl. No	Description	Analog Points	Digital Points
1	Line	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F , DF/DT	-Main Breaker status -Tie Breaker status -Isolators
2	Bays		- Breaker -Isolators
3	Main Buses, Transfer Buses	- **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} F, DF/DT	Bus Sectionalizer, Bus Coupler Breaker
4	Transformer/Coupling Transformer/Converter Transformer	- **VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW/MVAR for HV& LV Side	-Breaker -Isolators
5	Reactor	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MVAR	-Breaker -Isolators
6	FSC/TCSC	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA,	-Bypass Breaker - -FSC ON/OFF Status

		IPA} MVAR	
7	SVC	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MVAR	Breaker
8	Generator	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT for HV& LV Side	-RGMO/FGMO ON/OFF Status Breaker Status -Isolators - For RE plants, LVRT/HVRT trigger signal can be taken from Power Plant controller similar to M1/M2 protection relay signals
9	STATCOM	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} MW, MVAR, F, DF/DT	- CB OF EACH MODULE MSR, MSC
10	Phase Shifter	**VOLTAGE** {VRM, VYM, VBM, VPM, VRA, VYA, VBA, VPA} **CURRENT** {IRM, IYM, IBM, IPM, IRA, IYA, IBA, IPA} HV & LV MW / MVAR F, DF/DT	- CB

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CIN NO : U40105DL2009GOI188682

दक्षिण क्षेत्रीय भार प्रेषण केन्द्र, 29, रेस कोर्स क्रास रोड, बेंगलूर 560 009.

दूरभाष : कार्यालय : 080–2225 0047, 2235 2850, 2225 4525, 2225 1169, 2225 5962 फैक्स : 080 2226 8725, 2225 9219

Southern Regional Load Despatch Centre, 29 Race Course Cross Road, Bangalore 560 009.

Tel : Off : 080- 2225 0047, 2235 2850, 2225 4525, 2225 1169, 2225 5962, Fax : 080 2226 8725, 2225 9219 www.srldc.org / www. posoco.in

संदर्भ संख्या / Ref. No.

दिनांक / Date :

Ref SRLDC/URTDSM/10-20/02 5119

Dated 06-10-2020

To,

Chief General Manager (Asset Management),
Southern Regional Transmission System-II,
Power Grid Corporation of India Ltd.
Yelahanka-Dodaballapur Road
Bengaluru-560064

Sub: OPERATIONAL FEEDBACK OF URTDSM PROJECT PHASE-1 IN SOUTHERN REGION
Ref: - SRTS-2/RTAMC/URTDSM/20/237

Dear Sir

This is in reference to your above cited letter dated 30.09.2020 regarding operational feedback of the URTDSM project phase -1 as commissioned in southern region.

URTDSM project phase-1 was commissioned successfully and is in operation since 28.09-2018 in southern region. The system is used in real time grid operation for monitoring dynamic behaviour of power system and also in post-dispatch tripping analysis. The feedback is enclosed in the given format as (Annexure -1)

It is desirable to include real time analytical applications for enhancing efficiency and reliability of the grid operation in phase –II of URTDSM project. It would be better to consult real time grid operators at national, regional and state levels for ascertaining the real time grid requirements.

Thanking you

Yours faithfully

(Abhimanyu Gartia)
6/10/2020

(EXECUTIVE DIRECTOR, SRLDC)
अभिमन्यु गर्तिया/ABHIMANYU GARTIA
कार्यपालक निदेशक/Executive Director
पोसोको / POSOCO
एस. आर. एल. डी. सी / SRLDC
29, रेस कोर्स क्रास रोड / 29, Race Course Cross Road
बेंगलूर–560 009 / Bangalore - 560 009.

Copy:
1. Member Secretary, SRPC
2. Executive Director, NLDC, WRLDC,NRLDC,ERLDC,NERLDC POSOCO
3. Executive Director, SRTS-II/SRTS-1, POWERGRID

ANNEXURE -1

Operational Feedback of Unified Real time dynamic state measurement project

Name of the Project	Unified Real Time Dynamic State Measurment Project
Date of commercial operation	28.09.2018
LOA No	CC-CS/363-WR1/SCADA-2162/3G1/R/CA-1/4859 (Supply) dated 31.03.2014.
Contractor	M/s GE T&D ltd(Erstwhile M/s Alstom T&D)

Sl No	Decsription of item	From	To	Operational feedback(Satisfactory/Non Satisfactory)	Remarks
1	HARDWARE for Real Time PDC & Analytical Applications,PDS server ,Historian & Data archiving,Infrastructure management,work station consoles ,remote consoles,printer,GPS receivers etc	28.09.2018	30.09.2020	SATISFACTORY	
2	Phasor Measurement Units(PMUs) and associated hardware ,panels and cabling	28.09.2018	30.09.2020	SATISFACTORY	
3	Super PDC Software,Analytical Applications - Oscillation Monitoring System (OMS),Programming Development System (PDS) Software,Software for Remote Consoles,Software for Historian & Data Archiving,Software for Network Management System & Centralised Management System,Patch Management Software,Identity Server Software,Antivirus Software for all machines in the Control center	28.09.2018	30.09.2020	SATISFACTORY	
4	Networking Hardware like Firewall,WAN Routers,Layer3 switches,PDC LAN,Historial LAN,Infrastructure Management LAN at Control center	28.09.2018	30.09.2020	SATISFACTORY	
5	IITB ANALYTICAL APPLICATION 1. Linear State Estimator - LSE 2. Vulnerability Analysis of Distance Relay - VADR 3. CT/CVT calibration 4. line parameter estimation 5.Supervised Zone-3 Distance protection 6. Control scheme for improving system security	28.09.2018	30.09.2020	1. INSTALLED - OPERATION NOT SATISFACORY 2. INSTALLED- SATISFACTORY 3. INSTALLED - NOT APPLICABLE FOR GRID OPERATION 4. INSTALLED- OPERATION NOT SATISFACTORY 5. PROTOTYPE INSTALLED NOT FUNCTIONAL 6. NOT INSTALLED	FUTURE REQUIREMENT REAL TIME APPLICATIONS IS DESIRED AS MOST OF THE APPLICATIONS IN PHASE 1 ARE NOT REAL TIME

Date 06-10-2020

6/10/2020

EXECUTIVE DIRECTOR, SRLDC

ARVINDER SINGH GARTIA
कार्यपालक निदेशक / Executive Director
पोसोको / POSOCO
एस. आर. एल. डी. सी / SRLDC
29, रेस कोर्स क्रास रोड / 29, Race Course Cross Road
बेंगलूरु-560 009 / Bangalore - 560 009.

ANNEXURE-IV to 11th NPC

सत्यमेव जयते

भारत सरकार/**Government of India**

विद्युत मंत्रालय/ **Ministry of Power**

केन्द्रीय विद्युत प्राधिकरण/**Central Electricity Authority**

राष्ट्रीय विद्युत समिति प्रभाग/**National Power Committee Division**

1st Floor, Wing-5, West Block-II, R.K. Puram, New Delhi-66

No. 4/MTGS/NPC/CEA/2021/ 285 - 298 दिनांक:20.09.2021

To
(As per distribution list)

विषय : "यूआरटीडीएसएम (URTDSM) परियोजना के तहत पीएमयू (PMU) स्थानों के समान दर्शन, नए विश्लेषण और नियंत्रण केंद्र के उन्नयन की आवश्यकता पर उप-समिति" का गठन-के सम्बन्ध में।

Subject: Constitution of "Sub-Committee on the uniform philosophy of PMU locations, new analytics and requirement of up gradation of Control Centre under URTDSM project"-reg.

Madam/Sir,

In the 10th meeting of NPC held on 09th April 2021, it was decided that a Sub-Committee would be formed under the Chairmanship of Member Secretary, WRPC with representatives from POSOCO, CTU, POWERGRID and all RPCs/NPC. The Sub-Committee shall discuss on the uniform philosophy of PMU locations, new analytics and requirement of up gradation of Control Centre under URTDSM project and submit its recommendations to the NPC.

Accordingly, the nominations has been sought from RPCs, POSOCO, CTU and POWERGRID via email dated 01st Sept 2021. Based on the nominations received, the Constitution of "Sub-Committee on the uniform philosophy of PMU locations, new analytics and requirement of up gradation of Control Centre under URTDSM project" is as follows:

1	Member Secretary, WRPC	Shri Satyanarayan S.	Chairperson
2	Chief Engineer, NPC	Smt Rishika Sharan	Member
3	Superintending Engineer, NRPC	Shri Saumitra Mazumdar	Member
4	Superintending Engineer, ERPC	Shri Shyam Kejriwal	Member
5	Superintending Engineer, WRPC	Shri P. D. Lone	Member Convener

6	Superintending Engineer, TS SLDC Executive Engineer, (P&C II) TANTRANSCO Executive Engineer, SRPC	Shri P Suresh Babu Shri T Sivakumar Shri Len J.B.	Member
7	Deputy Director, NERPC	Shri Srijit Mukherjee	Member
8	Deputy Director, NPC	Shri Himanshu Lal	Member
9	Sr. GM(LD&C),PGCIL	Dr. Sunita Chohan	Member
10	General Manager, NLDC Chief Manager, SRLDC	Shri Vivek Pandey Shri Abdulla Siddique	Member
11	General Manager, CTUIL	Ms Nutan Mishra	Member

ऋषिका
30/9/2021

(ऋषिका शरण/Rishika Sharan)
मुख्य अभियन्ता एवं सदस्य सचिव,रा.वि.स /
Chief Engineer & Member Secretary, NPC

Distribution list:

1. Member Secretary, WRPC
2. Shri P. D. Lone, SE, WRPC
3. Shri Saumitra Mazumdar, SE, NRPC
4. Shri Shyam Kejriwal, SE, ERPC
5. Shri P Suresh Babu, Superintending Engineer, TS SLDC, TSTRANSCO, Vidhuth Soudha, Khairthabad, Hyderabad, Telangana
6. Shri T Sivakumar, Executive Engineer, (P&C II) TANTRANSCO, Chennai, TN
7. Shri Len J.B., Executive Engineer, SRPC, 29, Race Course Cross Road, Bengaluru
8. Shri Srijit Mukherjee, Deputy Director, NERPC
9. Shri Abdulla Siddique, Chief Manager, SRLDC
10. Shri Vivek Pandey, General Manager, NLDC, B-9 (1st Floor), Qutab Institutional Area, Katwaria Sarai, New Delhi
11. Dr. Sunita Chohan, Sr. GM(LD&C),PGCIL, Plot No.2, Near, IFFCO Chowk, Sector 29, Saudamini, Haryana 122001
12. Ms Nutan Mishra, General Manager, CTUIL, PGCIL, Plot No.2, Near, IFFCO Chowk, Sector 29, Saudamini, Haryana 122001

Copy to:
1. Chairperson, CEA
2. Member (GO&D), CEA

*****

Standard Operating Procedure for Islanding Schemes

1. Design Protocol

i. As per Clause 10 of the Central Electricity Authority (Grid Standards), Regulations, 2010:

*"Islanding Schemes.- (1) The **Regional Power Committees** shall prepare Islanding schemes for separation of systems with a view to save healthy system from total collapse in case of grid disturbance. (2) The Entities shall ensure proper implementation of the Schemes referred to in sub regulation (1)."*

ii. As per Indian Electricity Grid code amended from time to time, all regional constituents shall ensure that the islanding schemes are always functional.

iii. Islanding Schemes may be designed:

- for survival of some predefined generations and loads at the time of grid disturbance to avoid total blackout and quicker restoration of failed grid.
- for major cities having loads of VIP areas, Defence, Space, Airport, Metro, ports and important industries etc.

iv. Ministry of Defence(MoD) may be consulted to include their defense loads in such Islanding schemes. In case MoD requests any of their locations for which Islanding schemes is to be designed, the same would be considered. Only those defence establishments may be included in the Islanding Schemes for which MoD is agreed. The Ministry of Defence/Dept. of Military Affairs shall furnish information regarding their requirements as per format given at **Annexure I**. All the existing islanding scheme may be reviewed to include the Defence load in the scheme. Defence load of small capacity (upto 2 MW) not falling under any major cities may be continued with their arrangement of backup supply.

v. The Essential loads falling under an Islanding schemes may be taken under consideration while designing Islanding schemes. Generally the essential loads are classified into two categories (i) Super critical Load and (ii) Critical loads. The super Critical load may cover the loads of Defence area, Raj Bhawan, Parliament house, residence of VIPs, Metro rails etc. The Critical loads may consist of loads of hospitals, Airport, Railways, Important Industries etc falling under the area covered in Islanding schemes. The critical and super critical load of the major city may be considered in consultation with the DISCOMs/SLDC and MoD.

vi. If there is need to establish a power plant in/around such a city for the purpose, the proposal may be submitted for consideration of the concerned State /Utility under intimation to MoP. Possibility of installation of storage system at such location may also be explored. This provision may be suitably qualified for extremely sensitive loads only.

vii. Islanding Schemes are to be formed with anticipated load-generation balance and with tripping of predetermined feeders/ ICTs/ generators. In every islanding scheme, adequate automated mechanism should be implemented for achieving load generation balance in the islanded sub-system.

viii. Islanding schemes should not be taken as a system for continued supply to important loads. Necessary arrangement for emergency supply to important critical loads must be made separately.

ix. Studies are to be carried out for verifying the operation of the Islanded system.

x. The cyber security in the power system for Islanding schemes must be in accordance with the guidelines issued by Government of India.

2. Monitoring of Vital Parameters

i. Since formation of Island can take place at any time, monitoring of the following vital parameters, which have a significant role in on successful Island formation, is of paramount interest:
   a. Anticipated/ actual Generation within the electrical boundary of the Island.
   b. Anticipated/ actual Load within the electrical boundary of the Island.
   c. Voltage, Frequency & Power Flows along the peripheral lines which are required to be tripped to form the Island.

ii. Above parameters are to be monitored in real-time basis in the Control Room/ Despatch Centre (i.e Sub SLDCs/SLDC/RLDC/NLDC) of the area by creating a dedicated page specific to the Islanding Scheme in the SCADA display. To accomplish this, provision should also be made, if required, for installing adequate measuring instruments (like PMU) at suitable locations within the Island.

iii. The data in the formats at Annexures –II (Format I) may be submitted by RLDC/SLDCs to RPCs on monthly basis to certify the healthiness of communication system for monitoring the vital parameters of Islanding Schemes.

3. Certification of Healthiness of Islanding Scheme:

i. Since healthiness of an integrated system depends on the healthiness of its constituting components, healthiness of Islanding Scheme has to be ascertained/ ensured by seeking monthly certificate for healthiness of batteries, installed at all Substations located within the electrical boundary of the Islanding Scheme.The idea is since these battery banks provide power supply to Relays, RTUs and PLCC equipment, healthiness of the former is critical to operation of the latter when called for.

ii. It is to confirm the healthiness of islanding schemes by participating Generators as well as concerned transmission utilities for their respective portion in the monthly OCC meeting.

iii. The data in the formats at **Annexures –II** (Format II to IV) may be submitted by Generators/Transmission utilities/Discoms etc to RPCs on monthly basis to certify the healthiness of Islanding Schemes.

4. Role and Responsibility and Coordination Activities:

i. The Role and Responsibility of the Organizations / Officers/Officials in designing and operating the Islanding Schemes is defined at Annexure-III.

ii. This is proposed to be achieved by having a Nodal Officer for each participating Utility in the Island [i.e., those who own assets (Generating stations, substations, transmission lines, distribution lines, etc.) within the Island], and a Chief Nodal Officer from the concerned Despatch/ Control Centre. The Chief Nodal Officer from LDC and Utility-specific Nodal Officers ensure free flow of information among them w.r.t. Islanding Scheme Operational status, and ensure correct & prompt communication between the SCADA Control Centre and various stations (Generating Stations/ Substations). There will be a coordination officer in each region from each RLDCs.

iii. An updated list of contact details of all Nodal Officers as mentioned above shall be maintained with LDC & all Utilities involved. The Details of officials as mentioned above may be obtained in the in the Format V of Annexures –II:

5. Sensitization and Training of Officers involved:

i. Even though chances of Island formation in a strongly integrated grid are remote, since the Islanding schemes are designed to protect major critical loads/ sensitive generation in the unfortunate event of failing of all other defence mechanisms, The Nodal Officers & concerned field staff associated with O& M of various stations (generating stations as well as substations) within the electrical boundary of the Island should be sufficiently sensitized about the colossal loss of those critical assets on account of Island failure, and consequent disruption to various sectors & businesses.

ii. To ensure this, apart from conducting periodic orientation training programmes, the concerned Officers/ staff should also be involved in the activities concerning management of grid under stressed conditions, SCADA control, communication upkeep, and in the activities relating to audit/ inspection of critical loads & sensitive stations within the Island.

iii. The Officials and Officers in the Generating Station/Substation/Utilities / LDC/ RLDC / RPCs would be sensitized about the (concerned) Islanding Scheme. They also to be trained to handle the Critical and Emergency Load Management in the system.

iv. Training shall be focused on individual Islanding Schemes and integration of Islanding schemes with rest of the grid until restoration of normalcy to the regional grid.

v. All the concerned utilities shall organise periodic training program for the nodal officers and concerned field officers. The training programs shall be in consultation and coordination with the RPCs. The training and sensitization program may be conducted once in six months.

6. Periodic Inspection/ Audit of Essential Components:

Inspection/ audit of all essential components as given below shall be carried out regularly (by third party) and inspection/Audit report may be submitted to respective RPCs:

i. Under Frequency Relays (UFR) on Island forming elements (Lines & ICTs) – Quarterly.
ii. Associated communication equipment at all stations within Island - Bi-monthly.
iii. Associated DC supply for Control panel & communication system-Bi- monthly.

7. Review Plan of Islanding Schemes:

i. Considering the fact that Network Changes (additions/ deletions/ reconfigurations of transmission elements & generators) in an evolving grid such as Indian electrical grid are unavoidable/ inevitable, it is but necessary to review the Islanding scheme operation w.r.t. prevailing grid conditions at regular intervals, and incorporate requisite changes so as to make them reliable & dependable.
ii. In such review, all details as used in the existing scheme have to be re-collected including the new changes for studying the modifications to be carried out in the In-service Island. These details, among others, include participating generators, anticipated generation, participating loads, anticipated load, elements (lines and/ or ICT's) to be tripped to form the modified Island, geographical map & SLD of the modified Island, AUFR load relief, df/dt load relief, pumped loads details, etc. Using these details, system studies also need to be carried out to verify stability (including voltage profile & line loadings profile) of the modified Island.
iii. It is recommended to carry out above review of the In-Service Islanding scheme once in six months by all concerned utilities. However, the review may also be carried out as soon as any network change, which may affect the operation of the Islanding Scheme, comes to notice.

8. Identification of Short-comings & Remedial action:

Based on the shortcomings noticed as a result of the activities performed in monitoring of vital parameters of the Island, ascertaining healthiness of Island, carrying out periodic inspection/ audit of essential components of the Island, prompt remedial action shall be taken to redress the observed deficiencies. The period of redressal from the instant of noticing shortcomings shall be at most one week/ fortnight. The compliance report may be submitted to RPCs in this regard.

9. Post Islanding survival:

In every islanding scheme, adequate automated mechanism should be implemented for achieving load generation balance in the islanded sub-system. Also, for frequency control of islanded subsystem there should be generating units in the island on restricted/ free governor mode of operation. Also, load connection/ disconnection should be possible remotely from the dispatch centre of the islanded sub-system. Health of all facilities in the islanding scheme should be closely monitored so as keep necessary electrical, mechanical, electronics and communication systems in good health all the time.

10. SOP Template for Islanding Schemes is at Annexure-IV

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Annexure –I

MINISTRY OF POWER
CENTRAL ELECTRICITY AUTHORITY

Details of information to be furnished by Defence installations for the purpose of designing the Electrical Islanding schemes:

Item No.	Description	Details
1	**Basic Details:**	
1.1	Service: Army/Navy/Airforce/MES etc.	
1.2	Name of the Establishment	
1.3	Location (State, District, Taluk & Village)	
1.4	Name of the nearest City & Distance from it	
2.	**Power Supply Details:**	
2.1	Name of the DISCOM (Power Supply Distribution Company) from which supply is being availed:	
2.2	Name of the DISCOM Substation from which supply is being availed:	
2.3	Number of incoming lines/feeders of supply and Voltage level	
3	**Load Details:**	
3.1	Contracted Capacity in kVA/MVA	
3.2	Maximum Demand in kVA/ MVA	
3.3	Connected Load in kW/MW	
3.4	Critical Load(kW/MW)/ Non Critical Load(kw/MW)	
3.5	Any other information on Load details	
4	**Backup Power Supply:**	

4.1	Details of DG sets: (Number of DG sets & their Rating in kVA/MVA & No. of hours they can run/sustain)	
4.2	Battery Banks/ UPS Rating:	
4.3	In-house Solar Generation in kW/MW	
4.4	Captive Generation, if any, in kW/ MW	
5	**Specific Requirement from Ministry of Power, CEA/RPCs, NLDC, RLDC, ST, SLDC and Discoms wrt uninterrupted power supply to Defence installation**	
6	**Other Relevant Information, if any**	

***

Annexure-II

Formats for collection of information regarding Islanding Schemes:

a. Format - I for RLDC/SLDCs

S.NO	Name of Islanding Scheme	Healthiness of Communication channel

b. Format - II for Generating Station

S.NO	Name of Islanding Scheme	Healthiness of Islanding Relay	Healthiness of Communication channel

c. Format - III for Transmission Utility/ DISCOMs

S.NO	Name of Islanding Scheme	Elements considered for tripping to from Island	For communication based tripping logic of feeders	For UFR based tripping logic of feeders	
			Healthiness of Communication channel	Healthiness of PT Fuse and status of DC supply to UFR relay*	Healthiness of Relay#

* Where dedicated UFR relay have been installed for tripping of the feeders under islanding scheme

Where UFR function have been enabled within backup protection relay of the line

d. Format - IV for collecting Relay details of the Islanding scheme.

The following format may be used to get Relay details of the Islanding scheme:

S.NO	Description	UFRs-for load relief (A)	df/dt -for load relief (B)	Relay for Island creation(C)
1	Relay location (S/s name)			
2	Relay make & model			

3	Frequency setting of the relay (at which load shedding is envisaged)			
4	Feeder name (voltage level and source-destination name) signalled by the Islanding Relay for separation /load shedding/separation from outside grid			
5	Quantum of load relief due to tripping of feeder (as per state's peak of previous year)			
6	Quantum of load (Min, Avg, Max in MW) on the feeder (as per state's peak of previous year)			

e. Format - V for Contact details of all Nodal Officers

Utility Name &Location	Name	Designation	Organization	Email ID	Mobile No.

***

Annexure –III

Roles and Responsibilities of Officers involved in Islanding Schemes:

1.	**RPCs**	i. In comply with CEA(Grid Standards) 2010 and its amendments, MS, RPCs shall be responsible for preparation of Islanding Schemes. The designing/ implementation and Review of Islanding Scheme may be discussed in appropriate Committee/Sub-Committee of RPCs or a separate Sub-group may be formed. ii. MS, RPC may Nominate Officer at the level of Superintending Engineer for Coordinating the Islanding Schemes in the Region. iii. MS, RPCs shall be responsible for periodic review of the Islanding Schemes to accommodate the network changes, load generation balance or constraints, if any. iv. MS, RPC shall be responsible for third party audit of the components of an Islanding Scheme.
2.	**RLDCs**	i. There shall be a nodal officer at the level of General Manager & above appointed by the appropriate Authority of the RLDC. Nodal officer of RLDCs may act as Coordinating Nodal officer. ii. The Nodal officer of RLDCs shall coordinate the Chief Nodal officers of SLDCs in their respective regions. iii. Coordinating Nodal Officer shall ensure monitoring of the vital parameters of operational/implemented Islanding Schemes in their region, which have a significant role in successful Island formation at their SCADA system. iv. To ensure proper monitoring, measuring instruments (like PMUs etc.) and communication systems may be recommended by Co coordinating nodal officer to the concerned utility. v. Coordinating Nodal officers shall monitor and ensure the healthiness of the components involved in the Islanding Scheme like SCADA system, communication channel etc. at their end. vi. Coordinating Nodal officer shall conduct monthly self-certification of healthiness of the communication systems at their end and communicate it to the concerned RPCs in the format prescribed in the SOP. vii. Coordinating Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPCs in a time bound manner.
3.	**Nodal officer of LDCs**	i. There shall be a nodal officer at the level of Chief Engineer & above for all Islanding Schemes in the respective state appointed by the appropriate Authority of the LDCs. ii. Nodal officer of LDCs shall act as Chief Nodal officers for nodal officers of DISCOMs, TRANSCOS & GENCOs of the

			state and shall ensure proper communication among all the nodal officers.
		iii.	The Chief Nodal officer shall coordinate and responsible for implementation of newly designed Islanding Schemes in coordinated manner with all utilities involved.
		iv.	Chief Nodal officer is responsible for collection of data from the concerned utilities and submission the same to committee for study purpose in respect of existing/new IS for review/design purpose.
		v.	Chief Nodal Officer shall ensure monitoring of the vital parameters of operational/implemented Islanding Schemes in the state, which have a significant role in successful Island formation.
		vi.	To ensure proper monitoring, measuring instruments (like PMUs etc.) and communication system etc. may be recommended by nodal officer to the concerned utility
		vii.	Chief Nodal officers shall ensure the healthiness of the components involved in the Islanding Scheme like SCADA system, communication channel etc. at their end.
		viii.	Chief Nodal officer shall conduct monthly self-certification of healthiness of the components at their end involved in the Islanding scheme and communicate it to the concerned RPC in the format prescribed in the SOP.
		ix.	Chief Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPC in a time bound manner.
4.	**Nodal officer of Participating GENCOs**	i.	There shall be a nodal officer at the level of General Manager / Chief Engineer & above for Islanding Schemes appointed by the appropriate Authority of the Generation Company.
		ii.	Nodal officers shall be responsible for the implementation of newly designed Islanding Schemes for Genco's part and submission of data to Study committee wrt Islanding scheme.
		iii.	Nodal officer is responsible for submission of data for Genco part to committee for study in respect of existing/new IS for review/design purpose.
		iv.	Nodal officers shall ensure the healthiness of the components involved in the operational Islanding Scheme like Generating Units, Substations /Switch yards, Relays, communication channel etc. at their end.
		v.	Nodal officer shall conduct monthly self-certification of healthiness the components at their end involved in the Islanding scheme and communicate it to the concerned RPCs in the format prescribed in the SOP.
		vi.	Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPCs in a time bound manner.

5.	**Nodal officer of STUs/PGCIL**	i. There shall be a nodal officer at the level of General Manager / Chief Engineer & above for all the Islanding Schemes appointed by the appropriate Authority of the Transmission Company. ii. Nodal officers shall be responsible for the implementation of newly designed Islanding Schemes at transmission part. iii. Nodal officer is responsible for submission of data to committee for study in respect of existing/new IS for review/design purpose for Transmission part . iv. Nodal officers shall ensure the healthiness of their components involved in the operational Islanding Scheme like Substations, Transmission Lines, Relays, communication channel etc. at their end. v. Nodal officer shall conduct monthly self-certification of healthiness of the components at their end involved in the Islanding scheme and communicate it to the concerned RPC in the format prescribed in the SOP. vi. Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPC in a time bound manner.
6.	**Nodal officer of DISCOMs**	i. There shall be a nodal officer at the level of General Manager /Chief Engineer & above for each Islanding Schemes appointed by the appropriate Authority of the Distribution Company. ii. Nodal officer shall be responsible for identification of essential loads and defence load for the Islanding Scheme. iii. Nodal officers shall be responsible for the implementation of newly designed Islanding Schemes at their end. iv. Nodal officer is responsible for submission of data for their part to committee for study in respect of existing/new IS for review/design purpose. v. Nodal officers shall ensure the healthiness of the components involved in the Islanding Scheme like Feeders, Relays, communication channel etc. at their end. vi. Nodal officer shall conduct monthly self-certification of healthiness of the components involved in the Islanding scheme at their end and communicate it to the concerned RPC in the format prescribed in the SOP. vii. Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPC in a time bound manner.

***

Annexure-IV

SOP Template for Islanding Schemes:

1. Purpose
2. Design
    i. Generation
        a. Coal
        b. Gas
        c. Nuclear
        d. Hydro
        e. Solar
        f. Wind
        g. Total generation
        h. PLF or availability /scheduling
        i. Generation considered
        j. Generators on prolonged outage
        k. Probability of the anticipated generation
        l. Pumped storage?
        m. ISGS
        n. SGS
        o. IPP/MPP
    ii. Load
        a. Drinking water
        b. Irrigation
        c. Agriculture
        d. Industrial
        e. Commercial
        f. Domestic
        g. Hospital
        h. Railways/Metro
        i. Defence
        j. Lift Irrigation System/Scheme
    i. Load relief
        a. df/dt-I
        b. df/dt-II
        c. AUFR-I
        d. AUFR-II
        e. AUFR-III
        f. AUFR-IV
    ii. Transmission lines in the islanded area
        a. 765 kV
        b. 400 kV
        c. 220/230 kV
        d. 132/110 kV
        e. 66 kV

f. 11/22/33 kV
g. Inter regional lines
h. Inter-state lines
i. Intra-state lines o Substations in the area
j. CTU
k. STU
l. ISTS

iii. Transmission lines that get disconnected on operation of df/dt and AUF relays
- 220/230 kV
- 132/110 kV
- 66 kV
- 11/22/33 kV

iv. Transmission lines to be tripped for forming Island
a. 765 kV
b. 400 kV
c. 220/230 kV
d. 132/110 kV
e. 66 kV
f. 11/22/33 kV

v. Name of the cities covered
a. 10 million
b. 1 million
c. Defence locations

vi. Diagrams
a. SLD map of the island
b. Geographical map of the island with boundary
c. Major cities/critical loads/defence loads marked
d. Substations marked

3. SCADA mapping
Island generation and island loads on the SCADA display
4. Constraints
a. Generation limits
b. Line loading limits
c. ICT loading limits o Frequency set points
d. df/dt-I
e. df/dt-II
f. AUFR-I
g. AUFR-II
h. AUFR-III
i. AUFR-IV
j. LIS relief frequency
k. RE generation disconnection frequency
l. Islanding frequency
5. Controlling generation in islanded area

a. AGC
b. RGMO/FGMO

i. Controlling load in islanded area
   a. Automatic
   b. Flow based
   c. Voltage based
   d. Frequency based
   e. Manual

ii. Validation check list
   - Generation > Load?
   - Non-Hydro only islanding?
   - Less number of disconnecting lines?
   - All disconnecting lines with AUFR?
   - RE-solar/wind excluded?
   - LIS loads excluded?
   - LF studies for islanded area, converging?
   - In the converged LF studies, line loadings profile & voltage profile are within permissible limits?
   - All critical load/defence loads included?
   - Critical/defence loads are not part of SPS, df/dt or AUFR schemes?
   - Islanding frequency - (47.9 Hz)?
   - Adequate margin between lower frequency of IEGC band and first stage AUFR?
   - Adequate margin between islanding frequency and AUFR last stage?
   - Scheme was discussed & approved in OCC/ PCC?
   - Scheme approved in RPC?

50.20		
50.10		
50.05		
50.00		IEGC band
49.90		
49.80		
49.70		Urgent load Mgt.
49.60		
49.50		

49.40		Emergency Load Mgt.
49.30		
49.20		
49.10		
49.00		UFR load shedding
48.90		
48.80		
48.70		
48.60		
48.50		
48.40		
48.30		
48.20		
48.10		
48.00		
47.90		Islanding Frequency
47.80		

*** *Above values are subject to change as per newly adopted frequency settings in NPC*

6. Operation
   i. Successful
      - Generation in the islanded area
      - Load in the islanded area
      - Date & time island formation
      - Date & time of island closed/shutdown
      - Frequency of the islanded area
      - Voltage profile of the buses
      - Flows/ Loadings on critical lines
      - Duration of island survival
      - Whether anticipated generation was there?
      - Whether anticipated load was there?

- All the lines were disconnected as per the plan?
- Reason for islanding success
- Any measures to further improve

ii. Failure

a. Generation in the islanded area
b. Load in the islanded area
c. Date & time island formation
d. Date & time of island closed/shutdown
e. Duration of island survival
f. Whether anticipated generation was there?
g. Whether anticipated load was there?
h. All the lines were disconnected as per the plan?
i. Reason for islanding failure
j. Remedial measures

7. Review plan
   i. Island formed and approved date
   ii. Change in generation
      - Addition
      - Deletion
      - Alteration
   iii. Change in load
      a. Addition
      b. Deletion
      c. Alteration
   iv. Change of the lines to be disconnected
   v. Any new lines to be included for disconnecting
   vi. Requirement of additional df/dt & AUFR relays

8. Nodal officers of Islanding Scheme
   i. RLDC
   ii. SLDC
   iii. STU
   iv. SGS
   v. ISGS
   vi. ISTS (SR-I, SR-II)

9. Sensitization Training of nodal officers
   i. Training by RLDC
   ii. Training by NPTI/PSTI
   iii. Training by SLDC
   iv. SRPC special meetings

10. Periodic Inspection of Essential components of Islanding Scheme
   i. Inspection of UF relays of disconnecting lines
   ii. Ensuring adequate relief under df/dt and AUFR stages

iii. Ensuring relays for disconnecting RE sources
iv. Ensuring relays for disconnecting LIS
v. Ensuring critical/defence loads are not under df/dt & AUFR stages
vi. Monitoring the anticipated generation and load in the islanded area

11. Mock drill

i. Mock drill to follow any major or near miss incidents
ii. Frequent heavy over drawl by states
iii. Frequent Very low frequency of operation
iv. Before peak period of the region
v. Before peak period of the state
vi. Loss of many lines due to cyclone/weather
vii. Loss of generating plants due to cyclone/weather
viii. RE is highest and entirely absorbed by states

12. Certifications of healthiness of IS

i. Batteries
ii. Relays
iii. Lines within the islanded area

13. Identifications of short comings

14. Further updations.

*****

ANNEXURE-VI to 11th NPC

सं. 22-1306/37/2020-ओएम
भारतसरकार
Government of India
विद्युत् मंत्रालय
Ministry of Power
श्रमशक्तिभवन, रफ़ीमार्ग, नयीदिल्ली-110 001
Shram Shakti Bhawan, Rafi Marg, New Delhi-110 001

Dated 09th November, 2021

OFFICE MEMORANDUM

Subject:- Minutes of the Meeting on "Status of Islanding Scheme" held on 7th October, 2021 under the Chairmanship of Hon'ble Minister of Power and New & Renewable Energy -reg.

****

Please find enclosed herewith a copy of the minutes of the meeting on the above subject held on 07.10.2021 under the Chairmanship of Hon'ble Minister of Power and New & Renewable Energy for necessary action.

Encl: as above

(Raja Ramaswamy)
Under Secretary to Govt. of India
Telefax: 23719229
Email: opmonitor-power@nic.in

Distribution: As per list annexed

Copy to:

PS to Hon'ble Minister/ Sr.PPS to Secretary/Sr. PPS to JS (OM)/ PS to DS(OM)

Minutes of the Meeting on "Status of Islanding Scheme" held on 7th October, 2021 under the Chairmanship of Hon'ble Minister of Power and New & Renewable Energy

1. A Meeting on "Status of Islanding Scheme" was held on 7th October, 2021 under the Chairmanship of Hon'ble Minister of Power and New & Renewable Energy. The list of participants is given at **Annexure**.

2. Shri Ghanshyam Prasad, Joint Secretary, Ministry of Power introducing the subject of discussion said that during the meeting under the Chairmanship of Secretary, Ministry of Power, Central Electricity Authority (CEA) was entrusted with the task of operationalizing the existing Islanding Schemes and formulating new Islanding Schemes where they are required. Ms. Rishika Saran, Chief Engineer, Central Electricity Authority then made a Presentation on the Status of Islanding Scheme.

3. After a detailed discussion, the following action points emerged , which are required to be completed :

(i) Islanding Scheme operates during extreme emergency situations so that electricity continues to flow uninterruptedly. This principle must be adhered to by all utilities while designing the Islanding Scheme. Cost of electricity should not be an impediment in such extreme conditions.

[Action: **CEA/POSOCO/ States**]

(ii) Regarding Mumbai Islanding Scheme, all the planned additional infrastructure and the additional sub-station in Navi Mumbai is to be commissioned by July, 2023. Shri S.Satyanaryan, Member Secretary, WRPC was asked by Hon'ble Minister to brief him about the matter separately.

[Action: PGCIL, CEA, **Member-Secretary, WRPC**]

(iii) During exigencies like the recent power outage in Mumbai, there should not be any hesitation to clip the non-critical loads so that the essential services like railways and health services are not affected. Hon'ble Minister directed that the possibility of carrying out rehearsals and drills in all major cities in this context and bringing out a mechanism that will inform people of such activities be explored.

[Action: **MoP, CEA**]

(iv) Hon'ble Minister directed that while considering Islanding Schemes, consultations should also be held with the Engineering Branch of Ministry of Defence. Hon'ble Minister also said that he will hold consultation with the Chiefs of the Air Staff and the Army Staff about the requirement for strengthening of power system in any area.

[Action: **MOP**]

(v) Regarding funding of the projects, it was suggested that the funding may be done through Power System Development Fund (PSDF). In this context, Hon'ble Minister has directed that if there are problems with allocation of the funds, other sources of funds can be identified for the purpose.

[Action: **MoP (OM), CEA, NLDC**]

4. The Meeting ended with thanks to the Chair.

Annexure

List of Participants

1.	Hon'ble Minister of Power and New & Renewable Energy – Chairman
	Ministry of Power
1.	Shri Ghanshyam Prasad, Joint Secretary
2.	Shri Devashis Bose, Deputy Secretary
3.	Shri Arun Kumar Garg, Deputy Secretary
	Central Electricity Authority
1.	Shri Dinesh Chandra, Chairperson
2.	Shri B.K. Arya, Member
3.	Ms. Rishika Sharan, Chief Engineer
	Western Regional Power Committee
1.	Shri S. Satyanaryan, Member-Secretary
	Eastern Regional Power Committee
1.	Shri N.S. Mondal, Member-Secretary
	Southern Regional Power Committee
1.	Shri N.R.L.K. Prasad, Member-Secretary
	Northern Regional Power Committee
1.	Shri Naresh Bhandari, Member-Secretary
	Northern Regional Load Despatch Centre
1.	Shri N. Nallasaran, In-Charge
	Southern Regional Load Despatch Centre
1.	Shri V. Suresh, Executive Director
	POSOCO
1.	Shri K.V.S. Baba, CMD
2.	Shri S.R. Narashiman, Director (Systems Operation)
	PGCIL
1.	Shri K. Sreekant, CMD

ANNEXURE-VII to 11th NPC

Overview of the status of Islanding Scheme in all Regions						
Regions	**Total Number of Islanding Schemes**	**No. of Implemented/Inservice IS (Green Color)**	**No. of IS which are Under Implementation (Yellow Color)**	**No. of Newly proposed Islanding Scheme which are under design/Under Implementaion stage (Red Color)**	**No. of Newly proposed Islanding Scheme which are Implemented/Inservice**	**No. of IS having SCADA visibility**
SR	7	5	1	1	2	7
ER	10	4	4	2	0	5
NR	11	2	2	7	0	4
WR	12	6	1	5	0	0
NER	3	0	2	1	0	3
	43	**17**	**10**	**16**	**2**	**19**

Central Electricity Authority
National Power Committee Division
MIS report - Islanding Scheme (IS) of Sothern Region (SR)

status as on 10.01.2022

S.No. (Color code for Islanding Scheme)	Name of Islanding Scheme	Category A/B	Sub Category- (City/Major Town/ Strategic Load/Sensitive Generation)	Status (Category A -In-Service/ Under Review/ Reviewed & Under Implementation) (Category B-DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Timeline for completion of Review/ Reviewed & Under Implementation for Category A Timeline for implementation for Category B (DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Progress of the scheme	Healthiness of the scheme	Timeline for SCADA Visibility in Sub SLDC/ SLDC/ RLDC	Remarks, if any (Major Change in the scheme may also be intimated)
	I	II	III	IV	V	VI	VII	VIII	IX
					Category I				
1	Hyderabad IS	A	City/Major Town/ Strategic Load	Implemented/Inservice	Review completed on 05.03.2021. The reviewed scheme put into service in July, 2021	NA	Healthy	Completed in November, 2021	__
2	Chennai IS	A	City/Major Town/ Strategic Load	Reviewed scheme under Implementation	Review completed on 18.05.2021. Reviewed scheme will be implemented by February, 2022.	TANTRANSCO: Installation & settings of Trip Relays completed in all boundary Island forming elements completed. The same is under progress for certain elements within the Island (completed for 41 feeders out of total 47 such feeders). As such TANTRANSCO sought time-extension up to February, 2022 PGCIL SR-II completed the works and implemented the scheme.	Healthy	Completed in November, 2021. (Further modifications to the SCADA display created were suggested & would be implemented by January, 2022).	__
3	Kudankulam IS	A	City/Major Town/ Strategic Load/ Sensitive Generation	Implemented/Inservice	Review completed on 18.08.2021. Target Date for Implementation: December, 2021 Reviewed scheme put into service in December, 2021	KSEBL: Completed all works including relays settings. TANTRANSCO: Completed installation & settings of all boundary trip relays except one feeder. (Pending for want of new UFR relay). However, confirmed that Islanding would be achieved due to impelemntation of the trip setting at the other end of the said feeder. PGCIL SR-II completed the works and implemented the scheme.	Healthy	Completed in December, 2021. (Further modifications to the SCADA display created were suggested & would be implemented by January, 2022).	__
4	Bengaluru IS	B	City/Major Town/ Strategic Load	Under implementation	The Scheme was identified in December 2020. Design completed and the scheme is expected to be implemented by January, 2022.	Implementation of the finalized scheme except **NTPC-Talcher** completed by all stake-holding Utilities. NTPC-Talcher was requested to complete implementation from their side by January, 2022.	NA	Completed in December, 2021. (Further modifications to the SCADA display created were suggested & would be implemented by January, 2022).	__
					Category II				
5	Neyveli IS	A	City/Major Town/ Strategic Load	Implemented/ In-Service	Review completed on 04.06.2021; Reviewed scheme put into service w.e.f. 01.11.2021.	Implementation of the reviewed scheme completed by all stake-holding Utilities. TANTRANSCO: Completed for all elements except one feeder; however stated that Islanding would be achieved due to implementation of the tripping at the other end of the said feeder	Healthy	Completed in November, 2021. (Further modifications to the SCADA display created were suggested & would be implemented by January, 2022).	__
6	Visakhapatnam IS	B	City/Major Town/ Strategic Load	Implemented/In-Service	The Scheme was identified in Jan 2020, but owing to Covid-19 pandemic, the scheme was taken up for implementation in January, 2021. The scheme put into service in July, 2021.	NA	Healthy	Completed in November, 2021.	__
7	Vijayawada IS	B	City/Major Town	Implemented/In-Service	The Scheme was identified in April 2021. Design completed and the scheme IS put into service in November, 2021.	NA	Healthy	Completed in November, 2021.	__

Category of Islanding Schemes:

Category 'A' IS	Islanding Schemes which are existing or already planned and in implementation stage.
Category 'B' IS	Islanding Schemes which are newly proposed.

Category-'I' IS	Islanding Schemes which are designed for the major cities, senstive generation or strategic loads.
Category-'II' IS	Islanding Schemes other than category I are Category II IS
Colour codes of Islanding Schemes:	
Green	Implemented/In service Islanding Scheme
Yellow	Under review/ Under Implementation Islanding Scheme
Red	Newly proposed Islanding Scheme which are under design/under implementaion stage

NA	**Not Applicable**

Central Electricity Authority
National Power Committee Division
MIS report - Islanding Scheme (IS) of Northern Region (NR)

status as on 10.01.2022

S.No. (Color code for Islanding Scheme)	Name of Islanding Scheme	Category A/B	Sub Category- (City/Major Town/ Strategic Load/Sensitive Generation)	Status (Category A -In-Service/ Under Review/ Reviewed & Under Implementation) (Category B-DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Timeline for completion of Review/ Reviewed & Under Implementation for Category A Timeline for implementation for Category B (DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Progress of the scheme	Healthiness of the scheme	Timeline for SCADA Visibility in Sub SLDC/ SLDC/ RLDC	Remarks, if any (Major Change in the scheme may also be intimated)
	I	II	III	IV	V	VI	VII	VIII	IX
Category I									
1	Delhi IS	A	City/Major Town/ Strategic Load	In service/ Under revision	Reviewed scheme will be completed by January, 2022.	—	Healthy	Visible in Delhi SLDC	—
2	NAPS IS	A	Sensitive Generation	Implemented/Inservice	The review of IS has been done with peak load of Summer and Winter 2019-20 and no operational constraints found.	NA	Healthy	Visible in UP SLDC	—
3	Lucknow (Unchahar) IS	A	City/Major Town	Under Design Stage	—	UP has sent the request to CPRI vide letter dtd 09.11.2021 to provide the techno-commercial offer for stability study and hardware requirement of Islanding Schemes.	NA	Visible in UP SLDC	UPSLDC has identified the load in co-ordination with UPPTCL. UPSLDC has requested STU to carry out studies on Unchahar Islanding scheme and provide timeline for implementation.
4	RAPS IS	A	Sensitive Generation	Implemented/Inservice	Review of IS has been done in view of last Peak/off-peak loading and no operational constraints found.	Rajasthan SLDC has created SCADA display of Islanding scheme.	Healthy	Visible in Rajasthan SLDC	—
5	Dehradun IS	B	City/Major Town/ Strategic Load	Planning / Design Stage	—	—	NA	Sept 2022	Uttarakhand SLDC is conducting steady state study for the scheme.
6	Agra IS	B	City/Major Town/ Strategic Load	Planning / Design Stage	—	UP has sent the request to CPRI vide letter dtd 09.11.2021 to provide the techno-commercial offer for stability study and hardware requirement of Islanding Schemes.	NA	Sept 2022	UPSLDC has identified the load in co-ordination with UPPTCL. UPSLDC has requested STU to carry out studies on Unchahar Islanding scheme and provide timeline for implementation.
7	Jodhpur-Barmer-Rajwest IS	B	City/Major Town/ Strategic Load	Planning / Design Stage	The Planning/design of the scheme is in progress.	NRPC Sectt. has forwarded the scheme to NRLDC for examination on 26.10.2021	NA	Sept 2022	RVPN will propose to avail PSDF funding. Rajasthan has submitted Study to NRPC on 22.10.2021.
8	Nabha Power Rajpura IS	B	City/Major Town/ Strategic Load	Planning / Design Stage	Scheme design is being finalized and will be submitted to CPRI for study	Punjab has sent the offer to CPRI for study of Islanding Schemes.	NA	Sept 2022	—
9	Pathankot-RSD IS	B	City/Major Town/ Strategic Load	Planning / Design Stage	Scheme design is being finalized and will be submitted to CPRI for study	Punjab has sent the offer to CPRI for study of Islanding Schemes.	NA	Sept 2022	—
10	Suratgarh IS	B	Strategic Load	Planning / Design Stage	The Planning/design of the scheme is in progress.	NRPC Sectt. has forwarded the scheme to NRLDC for examination on 26.10.2021	NA	Sept 2022	RVPN will propose to avail PSDF funding. Rajasthan has submitted Study to NRPC on 22.10.2021.
Category II									
11	Talwandi Sabo IS	B	City/Major Town	Planning / Design Stage	Scheme design is being finalized and will be submitted to CPRI for study	Punjab has sent the offer to CPRI for study of Islanding Schemes.	NA	Sept 2022	—

Category of Islanding Schemes:	
Category 'A' IS	Islanding Schemes which are existing or already planned and in implementation stage.
Category 'B' IS	Islanding Schemes which are newly proposed.

Category-'I' IS	Islanding Schemes which are designed for the major cities, senstive generation or strategic loads.				
Category-'II' IS	Islanding Schemes other than category I are Category II IS				
Colour codes of Islanding Schemes:					
Green	Implemented/In service Islanding Scheme				
Yellow	Under review/ Under Implementation Islanding Scheme				
Red	Newly proposed Islanding Scheme which are under design/under implementaion stage				

NA	**Not Applicable**

Central Electricity Authority
National Power Committee Division
MIS report - Islanding Scheme (IS) of Western Region (WR)

status as on 10.01.2022

S.No. (Color code for Islanding Scheme)	Name of Islanding Scheme	Category A/B	Sub Category- (City/Major Town/ Strategic Load/Sensitive Generation)	Status (Category A -In-Service/ Under Review/ Reviewed & Under Implementation) (Category B-DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Timeline for completion of Review/ Reviewed & Under Implementation for Category A Timeline for implementation for Category B (DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Progress of the scheme	Healthiness of the scheme	Timeline for SCADA Visibility in Sub SLDC/ SLDC/ RLDC	Remarks, if any (Major Change in the scheme may also be intimated)
	I	II	III	IV	V	VI	VII	VIII	IX
Category I									
1	Mumbai Islanding Scheme	A	City/ Strategic Load	Implemented/Inservice	Last reviewed on 04.04.2021 and no operational constraints found.	NA	Healthy	Jan 2022	System study is being carried out at IITB and further review, if any, to be taken after outcome of study. Draft report has already submitted by IITB to Tata Power and final report is expected by January 2022.
2	Uran Islanding Scheme	A	City/Major Town	Implemented/Inservice	Scheme last reviewed on 04.04.2021 and no modification required and no operational constraint found.	NA	Healthy	Jan 2022	—
3	Surat Islanding Scheme	A	City/Major Town	Implemented/Inservice	Scheme last reviewed on 04.04.2021 and no modification required and no operational constraint found.	NA	Healthy	Jan 2022	—
4	Ahmedabad City Islanding Scheme	A	City/Major Town/ Strategic Load	Implemented/Inservice	Scheme last reviewed on 04.04.2021 and no modification required and no operational constraint found.	NA	Healthy	Jan 2022	—
5	KAPS 1&2 Islanding Scheme.	A	Sensitive Generation	Implemented/Inservice	Scheme last reviewed on 04.04.2021 and no modification required and no operational constraint found.	NA	Healthy	Jan 2022	—
6	KAPS 3&4 Islanding Scheme.	A	Sensitive Generation	Under Implementation	Last reviewed on 04-07 June, 2021.	—	Healthy	Jan 2022	—
7	Nagpur Islanding Scheme	B	City/Major Town/ Strategic Load	Design/Engineering Stage.	Schematic design finalised on during discussion on 01.04.2021, 24.06.2021, 26.06.2021	Detailed engineering is under progress.	NA	NA	—
8	Jamnagar Islanding Scheme	B	City/Major Town/ Strategic Load	Design/Engineering Stage.	Schematic design finalised on during discussion on 01.04.2021, 24.06.2021.	Detailed engineering is under progress.	NA	NA	—
9	Bhuj(Anjar-Kukma) Islanding Scheme.	B	City/Major Town/ Strategic Load	Design/Engineering Stage.	Schematic design finalised on during discussion on 01.04.2021, 24.06.2021.	Detailed engineering is under progress.	NA	NA	—
10	Jabalpur Islanding Scheme	B	City/Major Town/ Strategic Load	Design/Engineering Stage.	Schematic design finalised on during discussion on 01.04.2021, 24.06.2021.	Detailed engineering is under progress.	NA	NA	—
11	Raipur Islanding Scheme	B	City/Major Town	Design/Engineering Stage.	Schematic design finalised on during discussion on 01.04.2021, 24.06.2021, 28.06.2021.	Detailed engineering is under progress.	NA	NA	—
Category II									
12	Vadodara/GIPCL Islanding Scheme.	A	Nandesari Industrial Load	Implemented/Inservice	Scheme last reviewed on 04.04.2021 and no modification required and no operational constraint found.	NA	Healthy	Jan 2022	—

Category of Islanding Schemes:	
Category 'A' IS	Islanding Schemes which are existing or already planned and in implementation stage.
Category 'B' IS	Islanding Schemes which are newly proposed.
Category-'I' IS	Islanding Schemes which are designed for the major cities, senstive generation or strategic loads.
Category-'II' IS	Islanding Schemes other than category I are Category II IS
Colour codes of Islanding Schemes:	
Green	Implemented/In service Islanding Scheme
Yellow	Under review/ Under Implementation Islanding Scheme
Red	Newly proposed Islanding Scheme which are under design/under implementaion stage

NA	**Not Applicable**

Central Electricity Authority
National Power Committee Division
MIS report - Islanding Scheme(IS) of Eastern Region (ER)

status as on 10.01.2022

S.No. (Color code for Islanding Scheme)	Name of Islanding Scheme	Category A/B	Sub Category- (City/Major Town/ Strategic Load/Sensitive Generation)	Status (Category A -In-Service/ Under Review/ Reviewed & Under Implementation) (Category B-DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Timeline for completion of Review/ Reviewed & Under Implementation for Category A Timeline for implementation for Category B (DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Progress of the scheme	Healthiness of the scheme	Timeline for SCADA Visibility in Sub SLDC/ SLDC/ RLDC	Remarks, if any (Major Change in the scheme may also be intimated)
	I	II	III	IV	V	VI	VII	VIII	IX
Category I									
1	Kolkata (CESC) IS	A	City/Major Town/ Strategic Load	Implemented/ In-Service.	The scheme was last reviewed in February, 2021. No operational constraints have been reported.	NA	Healthy	Implemented on 13.11.2021	—
2	Patna IS	B	City/Major Town/ Strategic Load	DPR Preparation	Review of islanding study & designing of the logic: Completed Implementation of Islanding Scheme: By June'2022	DPR under preparation	NA	June 2022	—
3	Ranchi IS	B	City/Major Town/ Strategic Load	DPR Preparation	Review of islanding study & designing of the logic: Completed Implementation of Islanding Scheme: By Feb'2022	Tender had been finalized and the DPR would be placed by Jan 2022	NA	February 2022	—
Category II									
4	Bakreswar TPS IS	A	Industrial and Railway load	Implemented/ In-Service.	The scheme was last reviewed in February, 2021. No operational constraints have been reported.	NA	—	Implemented in January, 2022	—
5	Haldia (Tata Power) IS	A	Industrial areas of Haldia and Port	Implemented/ In-Service.	The scheme was last reviewed in February, 2021. No operational constraints have been reported.	NA	—	Implemented in January, 2022	—
6	Howrah (Bandel) IS	A	Industrial load	Implemented/ In-Service.	The scheme was last reviewed in February, 2021. No operational constraints have been reported.	NA	—	Implemented in January, 2022	—
7	IB valley TPS IS	A	MCL Load	Under-implementation.	The scheme is under implementation and expected to complete by April 2022	In 186th OCC Meeting held on 22.12.2021 OPTCL representative informed that the installation and commissioning work of DTPC at both Budhipadar and IB TPS end are in progress and would be completed shortly. Further, coordination with M/s ABB regarding the commissioning work had also been done and the work is expected to be completed by the end of January 2022.	NA	April, 2022	—
8	Farakka STPS, NTPC IS	A	Industrial & ECL Load	Under revision	—	—	NA	Implemented in December'2021	Under revision due to change in network (220 kV FSTPS-Lalmatia S/C line has been out because of collapse of several towers in the storm in April,2021
9	Chandrapura IS of DVC System	A	Industrial load	Under revision	The scheme is under Review and scheme is expected to complete by September 2022.	In 186th OCC Meeting held on 22.12.2021 DVC representative submitted that the project is in the process of approval and the NIT would be floated within a month.	NA	September, 2022	Discussed in Special Meeting of ERPC held on 06.08.2021. Original scheme was with stage A of CTPS (3x120 MW). As stage A of CTPS has been retired, this scheme is being evolved considering the stage B of CTPS (2x250 MW).
10	KBUNL IS of Bihar	A	Industrial & Station Load	Under Implementation.	The scheme is under implementation and expected to complete by February 2022.	In 186th OCC Meeting held on 22.12.2021 KBUNL representative submitted that the bus sectionalizer erection work is under progress and would be completed in another 3-4 months.	NA	March 2022	—

Category of Islanding Schemes:	
Category 'A' IS	Islanding Schemes which are existing or already planned and in implementation stage.
Category 'B' IS	Islanding Schemes which are newly proposed.
Category-'I' IS	Islanding Schemes which are designed for the major cities, senstive generation or strategic loads.

Category-'II' IS	Islanding Schemes other than category I are Category II IS
Colour codes of Islanding Schemes:	
Green	Implemented/In service Islanding Scheme
Yellow	Under review/ Under Implementation Islanding Scheme
Red	Newly proposed Islanding Scheme which are under design/under implementaion stage

NA	**Not Applicable**

Central Electricity Authority
National Power Committee Division
MIS report - Islanding Scheme (IS) of North Eastern Region (NER)

status as on 10.01.2022

S.No. (Color code for Islanding Scheme)	Name of Islanding Scheme	Category A/B	Sub Category- (City/Major Town/ Strategic Load/Sensitive Generation)	Status (Category A -In-Service/ Under Review/ Reviewed & Under Implementation) (Category B-DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Timeline for completion of Review/ Reviewed & Under Implementation for Category A Timeline for implementation for Category B (DPR Preparation/Study/ Design/ Approval/Procurement/Commissioning/Implementation)	Progress of the scheme	Healthiness of the scheme	Timeline for SCADA Visibility in Sub SLDC/ SLDC/ RLDC	Remarks, if any (Major Change in the scheme may also be intimated)
	I	II	III	IV	V	VI	VII	VIII	IX
Category I									
1	Tripura Islanding Scheme.	A	City/Major Town	Reviewed Scheme under implementation	The scheme was reviewed and revised on 29.09.2021. 7 out of 20 additional UFRs already installed. The balance UFRs would be installed by January, 2022.	—	—	Completed	—
2	Upper Assam (Assam-I) Islanding Scheme.	A	City/Major Town	Reviewed Scheme under implementation	The scheme was reviewed on 29.09.2021 and the Revised scheme would be implemented by January, 2022.	—	—	Completed	—
3	Guwahati (Assam-II) Islanding Scheme	B	City/Major Town	Planning / Design Stage.	Design reviewed on 15.12.2021. DPR preparation by January, 2022. The Scheme is scheduled to be implemented by July, 2022.	—	NA	Completed	—
Category II									
No Islanding Scheme under this Category									

Category of Islanding Schemes:	
Category 'A' IS	Islanding Schemes which are existing or already planned and in implementation stage.
Category 'B' IS	Islanding Schemes which are newly proposed.
Category-'I' IS	Islanding Schemes which are designed for the major cities, senstive generation or strategic loads.
Category-'II' IS	Islanding Schemes other than category I are Category II IS
Colour codes of Islanding Schemes:	
Green	Implemented/In service Islanding Scheme
Yellow	Under review/ Under Implementation Islanding Scheme
Red	Newly proposed Islanding Scheme which are under design/under implementaion stage

NA	**Not Applicable**

A. Regionwise / Statewise AUFLS:

1. Northern Region:

S.No	State/UT	Relief Quantum in MW			
		49.2 Hz	49.0. Hz	48.8 Hz	48.6 Hz
1.	Punjab	400	402	406	408
2.	Haryana	308	309	312	314
3.	Rajasthan	390	392	395	397
4.	Delhi	258	259	262	263
5.	UP	551	554	559	561
6.	Uttarakhand	77	77	78	78
7.	HP	77	77	78	78
8.	J & K	83	84	84	85
9.	Chandigarh	16	16	16	16
Total		2160	2170	2190	2200

2. Western Region:

S.No	State/UT	Relief Quantum in MW			
		49.2 Hz	49.0. Hz	48.8 Hz	48.6 Hz
1.	Gujarat	580	580	580	590
2.	Madhya Pradesh	460	460	460	465
3.	Chattisgarh	150	150	155	155
4.	Maharashtra	805	810	815	820
5.	Goa	25	25	25	25
6.	Daman & Diu	10	15	15	15
7.	TPC(Tata Power)	30	30	35	35
Total		2060	2070	2085	2105

3. Southern Region:

S.No	State/UT	Relief Quantum in MW			
		49.2 Hz	49.0. Hz	48.8 Hz	48.6 Hz
1.	Andhra Pradesh	392	393	418	399
2.	Telangana	422	432	430	542
3.	Tamil Nadu	796	771	787	767
4.	Karnataka	580	587	597	595
5.	Kerala	254	234	277	221
6.	Puducherry	27	24	22	18
Total		2471	2441	2531	2542

4. Eastern Region:

S.No	State/UT	Relief Quantum in MW			
		49.2 Hz	**49.0. Hz**	**48.8 Hz**	**48.6 Hz**
1.	Bihar	98	99	99	101
2.	Jharkhand	61	62	61	62
3.	DVC	134	135.5	136	137
4.	Odisha	181.5	183.5	184	186
5.	WBSETCL & CESC	345.5	350	350	354
Total		**820**	**830**	**830**	**840**

5. North Eastern Region:

S.No	State/UT	Relief Quantum in MW			
		49.2 Hz	49.0. Hz	48.8 Hz	48.6 Hz
1.	Ar.Pradesh	5.00	5.00	5.50	4.50
2.	Assam	54.50	61.00	59.00	57.00
3.	manipur	5.00	6.00	5.00	4.00
4.	Meghalaya	15.00	15.00	15.00	15.00
5.	Mizoram	5.09	5.31	5.10	5.20
6.	Nagaland	6.00	4.50	5.00	4.50
7.	Tripura	11.00	10.00	14.50	12.50
Total		**101.59**	**106.81**	**109.10**	**102.70**

B. df/dt Settings (Region-wise):

1. Northern Region:

S.No	State/UT	Load Relief in MW		
		Stage-I 49.9Hz& 0.1Hz/sec	**Stage-II 49.9Hz&0.2Hz/sec**	**Stage-III 49.9Hz&0.3Hz/sec**
1.	Punjab	430	490	490
2.	Haryana	280	310	310
3.	Rajasthan	330	370	370
4.	Delhi	250	280	280
5.	UP	500	280	280
6.	Uttarakhand	70	70	70
7.	HP	50	70	70
8.	J & K	90	90	90
9.	Chandigarh	0	50	50
TOTAL		2000	2010	2010

2. Western Region:

S.No	State/UT	Load Relief in MW		
		Stage-I 49.9Hz& 0.1Hz/sec	**Stage-II 49.9Hz&0.2Hz/sec**	**Stage-III 49.9Hz&0.4Hz/sec**
1.	Gujarat	1006	905	1001
2.	Madhya Pradesh	371	355	392
3.	Chattisgarh	27	37	120
4.	Maharashtra	546	621	686
5.	TPC (Tata Power)	60	82	273
TOTAL		2000	2010	2472

Gujarat additional df/dt setting at 49.9Hz & 0.3Hz/sec= 399MW
TPC additional df/dt setting at 49.9Hz & 0.5Hz/sec = 931MW

3. **Southern Region:**

S.No	State/UT	Load Relief in MW	
		Stage-I 49.5Hz& 0.2Hz/sec	**Stage-II 49.3Hz&0.3Hz/sec**
1.	Andhra Pradesh	345	855
2.	Telangana	369	992
3.	Tamil Nadu	578	417
4.	Karnataka	480	741
5.	Kerala	235	175
6.	Puducherry	12	6
TOTAL		2019	3186

4. **Eastern Region:**
5. **North Eastern Region:**

Not Implemented.

State Name	Defense Scheme	Stage	Planned Relief	Main feeders Mapped (%)	Main feeders real-time availabilty (%)
UP	UFR	Stage-1	551	56%	25%
		Stage-2	554	21%	16%
		Stage-3	559	26%	10%
		Stage-4	561	15%	8%
		Total	**2225**	**27%**	**14%**
	df/dt	Stage-1	500	24%	19%
		Stage-2	280	98%	78%
		Stage-3	280	56%	41%
		Total	**1060**	**55%**	**42%**
State Name	**Defense Scheme**	**Stage**	**Planned Relief**	**Main feeders Mapped (%)**	**Main feeders real-time availabilty (%)**
Rajasthan	UFR	Stage-1	390	0%	0%
		Stage-2	392	0%	0%
		Stage-3	395	0%	0%
		Stage-4	397	NM	NM
		Total	**1574**	**0%**	**0%**
	df/dt	Stage-1	330	100%	87%
		Stage-2	370	100%	100%
		Stage-3	370	100%	91%
		Total	**1070**	**100%**	**91%**
Punjab	UFR	Stage-1	400	59%	47%
		Stage-2	402	56%	56%
		Stage-3	406	56%	23%
		Stage-4	408	25%	25%
		Total	**1616**	**50%**	**35%**
	df/dt	Stage-1	430	41%	16%
		Stage-2	490	100%	92%
		Stage-3	490	52%	48%
		Total	**1410**	**60%**	**47%**
Haryana	UFR	Stage-1	308	68%	64%
		Stage-2	309	100%	100%
		Stage-3	312	90%	80%
		Stage-4	314	89%	86%

		Total	**1243**	**84%**	**80%**
	df/dt	Stage-1	280	100%	100%
		Stage-2	310	72%	68%
		Stage-3	310	90%	81%
		Total	**900**	**82%**	**76%**
State Name	**Defense Scheme**	**Stage**	**Planned Relief**	**Main feeders Mapped (%)**	**Main feeders real-time availabilty (%)**
Delhi	UFR	Stage-1	258	43%	43%
		Stage-2	259	81%	23%
		Stage-3	262	100%	0%
		Stage-4	263	83%	50%
		Total	**1042**	**81%**	**42%**
	df/dt	Stage-1	250	93%	0%
		Stage-2	280	84%	0%
		Stage-3	280	67%	0%
		Total	**810**	**81%**	**0%**
HP	UFR	Stage-1	77	64%	0%
		Stage-2	77	62%	23%
		Stage-3	78	100%	50%
		Stage-4	78	20%	0%
		Total	**310**	**61%**	**14%**
	df/dt	Stage-1	50	100%	50%
		Stage-2	70	100%	100%
		Stage-3	70	100%	50%
		Total	**190**	**100%**	**67%**
Uttarakhand	UFR	Stage-1	77		
		Stage-2	77		
		Stage-3	78		
		Stage-4	78		
		Total	**310**	**0%**	**0%**
	df/dt	Stage-1	70		
		Stage-2	70		
		Stage-3	70		
		Total	**210**	**0%**	**0%**
J&K	UFR	Stage-1	83		
		Stage-2	84		
		Stage-3	84		
		Stage-4	85		
		Total	**336**	**0%**	**0%**
	df/dt	Stage-1	90		
		Stage-2	90		

		Stage-3	90		
		Total	**270**	**0%**	**0%**
Chandigarh	UFR	Stage-1	16		
		Stage-2	16		
		Stage-3	16		
		Stage-4	16		
		Total	**64**	**0%**	**0%**
	df/dt	Stage-1	0		
		Stage-2	50		
		Stage-3	50		
		Total	**100**	**0%**	**0%**

SOUTHERN REGIONAL POWER COMMITTEE

ITEM No. 7 Ensuring Proper Functioning of Under Frequency Relays (UFR) & df/dt Relays

Updates: The following S/Ss where the functionality testing was completed:

2021-22 (AUFR &df/dt functionality testing)		
State/Utility	**AUFR-Substation**	**df/dt- Substation**
Andhra Pradesh/ APTRANSCO	220/132 kV Chilakkallu	132 kV Guntur
	220/132 kV Parchur	220 kV Nagiri
Karnataka/ KPTCL	220 kV Hosakote	220 kV Hosakote
	220 kV Somanahalli	220 kV Somanahalli
Kerala/ KSEBL	220 kV Kanhirode	220 kV Kanhirode
	220 kV Pallom	110 kV Pathanamthitta
Tamil Nadu/ TANTRANSCO	110 kV Pugalur	110 kV Pugalur
	110 kV Arasur	110 kV Arasur
Telangana/ TSTRANSCO	220/132 kV Mahaboobabad	220 kV Bheemgal
	220/132 kV kVBhoothpur	220 KV Kalwakurthy
Puducherry/ PED	230 kV Bahoor	
	110 kV Kalapet	

ITEM No.8 Implementation of Automatic Generation Control (AGC) in India (at Inter-State level)

The status is being monitored in monthly meetings of OCC and the **update** in the 186th Meeting of OCC held on 10.01.2022 is as follows: a) **Central Sector implementation:**

Entity	Generator	Status
NTPC	Simhadri STPS Stage- II (2 x 500 MW)	Implemented on 18.11.2018
	Ramagundam STPS Stage- II (4x500 MW)	Commissioned on 31.03.2021.
	Simhadri STPS Stage- I (2 x 500)	
	Ramagundam STPS Stage-I (3x200 MW)	AGC implementation works would be taken after the maintenance/ renovation works.
	Talcher STPS (4 x 500)	
NTECL	Vallur TPS (3 x 500 MW)	AGC is in place from 14.06.2021.
NLCIL	TPS II (7 x 210 MW)	Works under progress (M/s ABB) By end of January 2022
	TPS I Expn(2 x 210 MW)	Connectivity Testing with NLDC completed. Will be implemented by end of January 2022
	TPS II Expn (2 x 250 MW)	
	NNTPS (2 x 500 MW)	

NTPL	NTPL (2 x 500 MW)	In operation from 14.06.2021.
NP-Kunta	Solar in AP AGC :5 blocks of 50 MW i.e. 5 x 50 = 250 MW	Due to COVID-19 Pandemic implementation is getting delayed.

b) AGC at state Level- Pilot Project identification & Implementation:

State	Generator	Status
Andhra Pradesh	Krishnapatnam (2 x 800 MW)	APTRANSCO vide communication dated 05.08.2021 had informed that implementation of AGC at SDSTPS, Krishnapatnam is under examination and pending with AP & not pending in Hon'bleAPERC.After finalization at
		management level in coordination with generator M/s.APPDCL and AP Disoms, the proposal will be submitted to the Hon'ble APERC for approval to implement the AGC scheme at Krishnapatanam.
	In addition to Krishnapatnam planning AGC at VTPS, RyTPP, Upper Sileru& Lower Sileru.	
Karnataka	Sharavathy Generating Station (1035 MW)	Implementation of AGC Pilot under USAID GTG Scheme completed. Available MW for AGC is 10 % of Live load up to maximum of 100MW (10% 0f 1035 MW). KPTCL informed that at Sharavathi testing is over. In coordination with KPCL the units would be put under AGC operation.
	Varahi Under Ground Power House(4 x 115 MW)	Hardware & software deployment and configuration completed (Nov 2020)Golive pilot completed (Jan 2021).Available MW for AGC is 20% of live load upto maximum of 80 MW as per the programme planned. KPTCL informed that at Varahi testing is over. In coordination with KPCL the units would be put under AGC operation.
Kerala	Kuttiady Unit No. 5 (50MW)	Operational State Regulator has been approached for putting AGC on regular basis
	Idukki Unit No.1 (130MW)	AGC would be implemented once the Optical Fibre link from SLDC to Idukki PH is established

Tamil Nadu	North Chennai TPS Stage-II (one unit i.e. 2 x 600 MW)	Price bid opened. Only one party appeared. Approval is awaited.
	MTPS - II (1 x 600 MW)	Technical bid is opened. After clearing the clarification price bid would be opened and works would be awarded shortly.
Telangana	KTPS- VI (500 MW) Kothagudem E (132 MW) downward)	Testing had been carried out for 25 MW(both from SLDC and Generator. At present Unit is under COH and will be put in to regular operation as and when Unit comes back on bar.

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Status of Implementation of Automatic Generation Control (AGC) in NR

S. No.	States	NLDC/SLDC	Participating Generators (MW)	Status of Implementation: Operational/Planned	Remarks, if any
1	Uttar Pradesh	NLDC	Dadri-2 (980 MW)	Planned	Migration to new AGC software under implementation
2	Uttarakhand	NLDC	Koteshwar (400 MW)	Operational	Added to new AGC software from Nov 2020
3	Himachal Pradesh	NLDC	Nathpa Jhakri (1500 MW)	Operational	Added to new AGC software from Feb 2021
4	Himachal Pradesh	NLDC	Chamera-3 (231 MW)	Operational	Added to new AGC software from Feb 2021
5	Jammu & Kashmir	NLDC	Dulhasti (390 MW)	Operational	Added to new AGC software from Feb 2021
6	Uttarakhand	NLDC	Tehri (1000MW)	Operational	Added to new AGC software from Mar 2021
7	Himachal Pradesh	NLDC	Chamera-II (300MW)	Operational	Added to new AGC software from Mar 2021
8	Madhya Pradesh	NLDC	Vindhyachal-IV (1000MW)	Operational	Added to new AGC software from Mar 2021
9	Madhya Pradesh	NLDC	Vindhyachal-III (1000MW)	Operational	Added to new AGC software from Mar 2021
10	Rajasthan	NLDC	Anta Gas Power Project GF (419.33MW)	Operational	Added to new AGC software from Mar 2021
11	Uttarakhand	NLDC	Dhauliganga (280MW)	Operational	Added to new AGC software from Mar 2021
12	Uttar Pradesh	NLDC	Rihand TPS Stage – II (1000MW)	Operational	Added to new AGC software from Mar 2021
13	Uttar Pradesh	NLDC	Rihand TPS Stage – I (1000MW)	Operational	Added to new AGC software from Mar 2021
14	Uttar Pradesh	NLDC	Rihand TPS Stage – III (1000MW)	Operational	Added to new AGC software from Mar 2021
15	Himachal Pradesh	NLDC	Chamera-I (540MW)	Operational	Added to new AGC software from Mar 2021
16	Uttar Pradesh	NLDC	Unchahar TPS Stage – IV (500MW)	Operational	Added to new AGC software from June 2021
17	Uttar Pradesh	NLDC	Unchahar TPS Stage – III (210MW)	Operational	Added to new AGC software from June 2021
18	Uttar Pradesh	NLDC	Singrauli STPS (2000MW)	Operational	Added to new AGC software from Dec 2021
19	Himachal Pradesh	NLDC	Bairasiul (180MW)	Operational	Added to new AGC software from Sep 2021
20	Uttar Pradesh	NLDC	Unchahar TPS Stage – II (420MW)	Operational	Added to new AGC software from Nov 2021

S. No.	States	NLDC/SLDC	Participating Generators (MW)	Status of Implementation: Operational/Planned	Remarks, if any
21	Haryana	NLDC	Indra Gandhi STPS (1500MW)	Operational	Added to new AGC software from Dec 2021
22	Uttar Pradesh	NLDC	Auraiya Gas Power Project GF (663.36MW)	Operational	Added to new AGC software from Aug 2021
23	Uttar Pradesh	NLDC	Tanda TPS Stage – II (660MW)	Operational	Added to new AGC software from Sep 2021
24	Uttar Pradesh	NLDC	Unchahar TPS Stage – I (420MW)	Planned	Planned for Jan-Apr 2022
25	Uttar Pradesh	NLDC	Dadri Gas Power Project GF (829.78MW)	Planned	Planned for Jan-Apr 2022
26	Uttar Pradesh	NLDC	Dadri TPS Stage – I (840MW)	Planned	Planned for Jan-Apr 2022
27	Jammu & Kashmir	NLDC	Uri Stage – I (480MW)	Planned	Planned for May-July 2022
28	Jammu & Kashmir	NLDC	Salal (690MW)	Planned	Planned for May-July 2022
29	Uttarakhand	NLDC	Tanakpur (94.2MW)	Planned	Planned for May-July 2022
30	Himachal Pradesh	NLDC	Parbati III (520MW)	Planned	Planned for May-July 2022
31	Jammu & Kashmir	NLDC	Sewa-II (120MW)	Planned	Planned for May-July 2022
32	Jammu & Kashmir	NLDC	Uri Stage – II (240MW)	Planned	Planned for May-July 2022
33	Uttarakhand	NLDC	Koldam (800MW)	Planned	Planned for May-July 2022
34	Himachal Pradesh	NLDC	Pong (396MW)	Planned	Planned for May-July 2022
35	Himachal Pradesh	NLDC	Dehar (990MW)	Planned	Planned for May-July 2022
36	Himachal Pradesh	NLDC	Bhakra complex (1379MW)	Planned	Planned for May-July 2022

पावर सिस्टम ऑपरेशन कॉर्पोरेशन लिमिटेड
(भारत सरकार का उद्यम)
POWER SYSTEM OPERATION CORPORATION LIMITED
(A Govt. of India Enterprise)

पंजीकृत एवं केन्द्रीय कार्यालय : प्रथम तल, बी-9, कुतुब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली-110016
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संदर्भ संख्या: पोसोको/एनएलडीसी/2018/ दिनाँक: **09th November, 2018**

सेवा मे,

Director,
National Power Committee,
NRPC Building,
3rd Floor, Katwaria Sarai,
New Delhi-110016

(Kind Attn: Sh. Irfan Ahmad)

विषय: Agenda Note on National Energy Account & National Deviation Pool Account for 8th Meeting of National Power Committee.

संदर्भ: NPC letter no: 4/MTGS/NPC/CEA/2018/1122-1123 dtd. 01st Nov, 2018

महोदय,

With reference to the above mentioned NPC communication dated 01st November 2018, an Agenda note on National Energy Account & National Deviation Pool Account for the forthcoming 8th Meeting of National Power Committee is enclosed.

सादर धन्यवाद,

भवदीय,

समीर सक्सेना
09/11/18.

(एस. सी. सक्सेना)
उप महाप्रभंधक (एन एल डी सी)

Encl: As above

Copy to: Chief Engineer, National Power Committee, NRPC Building, 3rd Floor, Katwaria Sarai, New Delhi-110016

National Energy Account & National Deviation Pool Account

Agenda Note for 8th Meeting of the National Power Committee (NPC)
30th November 2018, Guwahati

1. Establishment of National Grid

In the sixties, the country's electricity grid was demarcated into five electrical regions and Regional Electricity Boards were formed. In order to facilitate inter-state power transactions and the development of regional grids, Govt. of India funded construction of a number of inter-state lines. Subsequently multi-beneficiary Central Sector generating stations were developed by utilities like NTPC, NHPC etc. along with associated transmission system for evacuation of power. The concept of regional energy accounting (earlier known as global accounting) was developed with boundary metering of all control areas.

Till late nineties, power system was planned on regional self-sufficiency basis and there were very few inter-regional links. With more and more inter-regional inter-connections coming up, the focus now shifted to formation of a strong National Grid. Initially, HVDC was used to interconnect two regions, e.g., NR-WR, NR-ER, WR-SR, etc. Gradually, AC interconnections also came up and by August 2006, all regional grids except SR were interconnected synchronously into two synchronous systems known as NEW and SR Grids. The strong HVDC links connecting the NEW grid to Southern region are extensively used for optimizing power flows in the NEW grid. With strong AC connections between the regions constituting the NEW grid as well as extensive use of HVDC links in real time operation, inter-regional schedules lost any physical relevance. All the five regional grids in the country were progressively interconnected using AC links and these are now operating as one synchronism system since December 2013. The situation has become more complicated with direct HVDC connections between NER and NR.

2. Existing Scheduling, Metering, Accounting and Settlement Systems

Availability Based Tariff (ABT) was implemented in stages, starting with Western Region in July 2002. With implementation of ABT, the concept of Unscheduled Interchange (UI) pool came up and all RLDCs started operating regional UI pool accounts, which were subsequently known as the "Regional Deviation Accounts". Deviations from the schedules are computed using the net injection/drawal for using boundary metering for each control area. Based on deviations from schedule, utilities pay UI charges to or receive UI charges from the regional UI pool account.

Short-term open access in inter-state transmission was introduced in May 2006 and with this, scheduling of market-based trades/transactions also commenced. Further, in 2008, multiple Power Exchanges were also implemented. Corridor wise margin declaration for market-based transactions was carried out along with net import/export capability for regions for administering the short-term open access transactions. Later from 2009 onwards, long-term and medium-term transactions also commenced within one region and between different regions. Corresponding scheduling on the inter-regional links was carried out for these transactions on a corridor-wise basis e.g., WR-NR, ER-SR, etc. Presently, while corridor wise TTC/ATC are being declared, net import/export margins for the region are being used for administration of short-term transactions.

Special energy meters have been installed at both ends of inter-regional / inter-state tie lines and all inter-connections of CTU system with ISGS as well as states / other entities whose accounting is done at regional level. As specified in the IEGC, meter readings are sent to respective RLDCs by different sub-stations of CTU / ISGS / states. The meter readings are processed at RLDCs and forwarded to respective RPC secretariat for preparation of weekly deviation account. The RPC secretariats issue deviation accounts based on which different utilities pay /receive deviation charges to / from deviation pool account. These also included settlement of inter-regional deviations between neighboring regions. The regional UI pools are being operated satisfactorily and have successfully served the purpose for the last many years.

The deviation rate vector is declared upfront by the CERC from time to time. Prior to 2008, with uniform rates for deviation, the total payable and receivables were supposed to be equal making it a zero-sum game. However, due to difference in estimated loss and actual loss as well as metering errors, total UI/deviation charges payable did not match with total UI/deviation charges receivable. Based on methodology decided in RPC forum, suitable adjustment is done to make total UI charges payable equal to the UI charges receivable. Thus, the UI pool accounts had been zero balance accounts traditionally since introduction of ABT up to 2008.

Regional UI pool accounts became a non-zero sum game since 7th January 2008 with introduction of UI rate cap for Central generating stations with coal or lignite firing and stations burning only APM gas. UI rate cap was retained in the UI regulations, 2009. Further, as per the UI regulations, 2009, additional UI charge is payable by over-drawing or under-injecting utilities based on specified volume limits and frequency bands. Thus a surplus is generated in the UI/deviation pool.

An important feature of the UI accounts issued by RPCs is treatment of inter-regional transactions. The following methodology is followed by the RPCs in this regard:

- No adjustment is done in UI charges payable to / receivable from other regions (otherwise this may lead to an iterative process)
- UI charges payable to other regions has highest priority i.e. UI charges received in UI pool account is used first to clear dues to other regions.

Schedules are reconciled between RLDCs and thereafter final schedules are issued. Moreover, same meter readings are used by both connected regions for computation of UI/deviations. Hence it is expected that normally there should not be any mismatch between UI charges payable / receivable by adjacent regions connected through AC links.

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Settlement of UI/deviation charges is done between the regions on one to one basis. For example, UI/deviation pool of ER has to pay to or receive from 4 different UI pools (NER, NR, SR, WR). This leads to multiple financial transactions in terms of money flow between regions. There are

instances of circular flows of funds between regions which needs to be avoided. An example of such circular flow of funds between the regions is illustrated in Annex – 1.

The above methodology is gradually losing its relevance with the five regions connected synchronously as power can flow from one region to another via a third region leading to circular and multiple fund transactions. These 'tandem' money transactions between the regions at times also leads to issues in disbursal within the regions.

3. Mandate for NLDC

Section 26 of Electricity Act, 2003 mandates the following:

"Section 26. (National Load Despatch Centre): --- (1) The Central Government may establish a centre at the national level, to be known as the National Load Despatch Centre for optimum scheduling and despatch of electricity among the Regional Load Despatch Centres.

(2) The constitution and functions of the National Load Despatch Centre shall be such as may be prescribed by the Central Government:

Provided that the National Load Despatch Centre shall not engage in the business of trading in electricity.

(3) The National Load Despatch Centre shall be operated by a Government company or any authority or corporation established or constituted by or under any Central Act, as may be notified by the Central Government."

Subsequently vide notification dated 2nd March 2005, the Central Government has notified National Load Despatch Centre Rules 2004, which prescribes functions of NLDC. The functions include following (relevant extracts):

- *Scheduling and dispatch of electricity over inter-regional links in accordance with grid standards specified by the Authority and Grid Code specified by the Central Commission in coordination with Regional Load Despatch Centres.*
- *Coordination with Regional Load Despatch Centres for achieving maximum economy and efficiency in the operation of National Grid.*
- *Supervision and control over the inter-regional links as may be required for ensuring stability of the power system under its control*
- *Coordination with Regional Load Despatch Centres for the energy accounting of inter-regional exchange of power*
- *Coordination for trans-national exchange of power*

From the above mandate it is evident that just as the RLDCs/RPCs are responsible for scheduling, metering, accounting and settlement at the Regional level, NLDC has been made responsible at the inter-regional and trans-national levels. The corresponding roles pertaining to inter-regional and trans-national transactions accounting and settlement need to be taken up at the National level by the NLDC and NPC.

4. Trans-National/Cross-Border Interconnections

At present, India has cross-border interconnections with Nepal, Bhutan, Bangladesh and Myanmar. Briefly, the connectivity of these countries with various regional grids in India is as follows:

- Nepal: With Northern region and Eastern Region
- Bhutan: With Eastern region
- Bangladesh: With Eastern region and North-Eastern region
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In future, other neighboring SAARC countries like Bangladesh and Pakistan may have connectivity with two different regions of India. For the purpose of cross-border interconnections, the country needs to be treated as a single control area for the purpose of transnational exchanges and transactions have to be reconciled on National basis. Further, in line with the mandate provided, NLDC is responsible for all trans-national exchanges.

5. Changing Scenario & Increasing Complexities

A vibrant electricity market is functioning in the country and many regulatory changes have been implemented to address new challenges from the changing scenario which is also leading to increased complexities. Some of the significant changes that have already been implemented at the National level and some future challenges are briefly discussed below.

(a) **Collective Transactions through Power Exchanges:** Open Access Regulations, 2008 issued by CERC paved the way for functioning of power exchanges. As per the Regulations and procedures issued pursuant to the Regulations, collective (i.e. power exchange) transactions are coordinated by NLDC. Two Power Exchanges are functioning at present and another is in the offing. NLDC accepts scheduling request for collective transactions after checking for congestions, and forwards the same to RLDCs for scheduling. Curtailment, if any, has to be done by NLDC in coordination with RLDCs. Accounting and settlement of the Collective Transactions is carried out by NLDC.

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(e) **Proposals under various stages of implementation/deliberations:** Some of the other proposals which are under various stages of deliberations or implementation are as follows:

- Replacement of thermal generation by RE generation (Ministry of Power, April 2018)
- Real Time Markets (CERC, July 2018) for facilitating balancing closer to the time of delivery
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- Security Constrained Economic Despatch (POSOCO, September 2018) to achieve economy in despatch at the national level

Almost all of the above-mentioned proposals are intended for scheduling, despatch, accounting and settlement at the national level. The complexity in settlement needs to be streamlined at the national level keeping in view the changing paradigm and new challenges.

6. National Energy Account and National Deviation Pool Account

In order to streamline the accounting and settlement at the national level there is a need for implementing a National Deviation Pool based on the National Energy Account. In this regard, the following methodology is proposed.

(a) **Scheduling:** Corridor-wise (e.g., ER-NR, etc.) scheduling of inter-regional transactions is presently being carried out. However, actual power flows as per the laws of physics. In case of collective transactions, one to one correspondence of source and sink is not there and scheduling on a particular inter-regional corridor may at best be notional. Hence, there is a need to migrate to scheduling inter-regional transactions on a net basis for each region. However, while accepting the transactions for scheduling, corridor-wise TTC/ATC/available margin etc. may be duly taken care of. Inter-regional corridor-wise schedules may also be continued based on the physical power flow patterns as the same is useful for grid security monitoring and checking for any discrepancies. NLDC shall communicate the net inter-regional schedules to the NPC for the purpose of accounting.

Schedules for cross-border transactions shall also be prepared by NLDC on a net-basis to facilitate accounting of cross-border transactions by the NPC. However, individual schedules of

the concerned neighboring country with different region regions shall also be continued at RLDC level for the purpose of grid security monitoring and checking for discrepancies.

(b) **Metering:** The existing practice for metering of the inter-regional points shall continue as per the IEGC and the SEM data shall be collected by the RLDCs, processed and made available to the RPCs. In addition, the processed meter data shall also be made available to the NPC through NLDC. A similar practice shall be adopted for the cross-border metering locations, where the processed meter data shall be provided by the respected RLDCs to the RPCs and NPC (through NLDC).

(c) **Accounting & Settlement:** Based on the scheduling and meter data provided, NPC shall prepare the National Energy Account (NEA) including the National Deviation Account for the inter-regional and trans-national transactions. The NEA will reflect the payables/receivables for each region on a net-basis and this amount shall be payable/receivable to the National Deviation Pool Account which shall be operated by NLDC. The NEA shall also reflect the cross-border or trans-national transactions and the neighboring countries shall be paying/receiving to/from the National Deviation Pool Account operated by NLDC. Payment to the National DSM Pool shall have the highest priority.

In the future, multi-lateral transaction between neighboring countries are also envisaged under the SAARC framework e.g., Bangladesh may purchase power from Nepal or Bhutan through India. Neighboring countries may also participate in a designated Power Exchange for cross-border transactions in the future. For scheduling and settlement of such transactions, the all-India loss figures would need to be declared upfront by NLDC.

(d) **Handling Surplus/Deficit in Regional Pool Accounts and transfer of residual to PSDF:** As has already been mentioned above, sometimes the regional DSM pool may face shortfalls on account of disbursals for reliability support such as RRAS, FRAS, AGC, etc. in accordance with the relevant regulations of CERC. Once the National DSM Pool becomes operational, all residual/surplus amount in the regional DSM pools shall be transferred to the National DSM pool account. The NPC accounts would also facilitate the transfer of funds from the surplus available in the National DSM pool to the deficit regional DSM pool accounts as a single transaction thereby simplifying the process. Once all liabilities have been met, any residual in National DSM Pool shall be transferred periodically to the PSDF in accordance with the extant CERC Regulations.

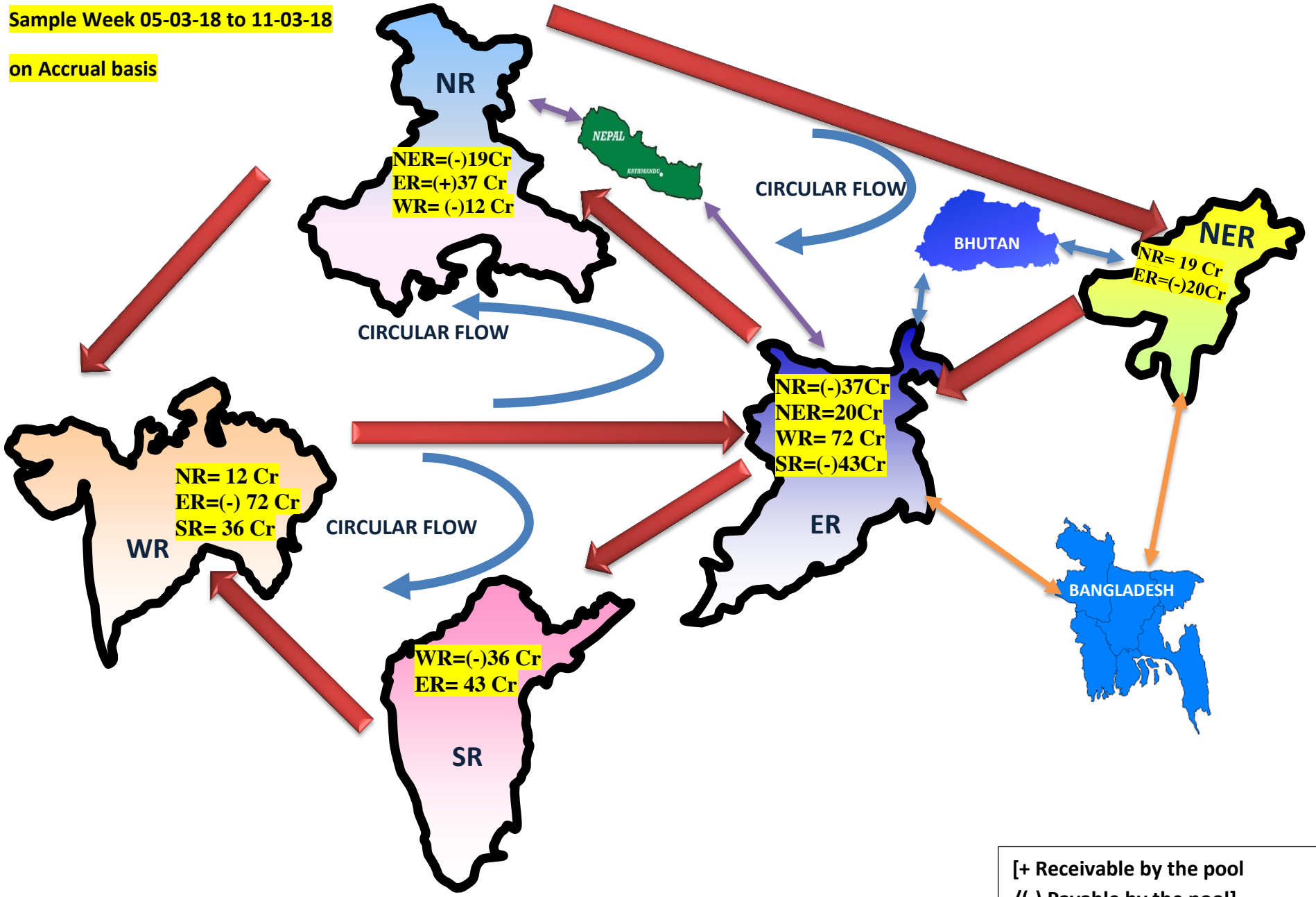
A sample illustration of the flow of funds between different regional DSM pool accounts to the national DSM pool account and that with the neighboring countries is shown at Annex – II.

Suitable changes/modifications are required to be carried out in the IEGC and DSM Regulations and the functions of NPC also need to be recognized in the regulatory framework.

Annex - I

Sample Week 05-03-18 to 11-03-18

on Accrual basis

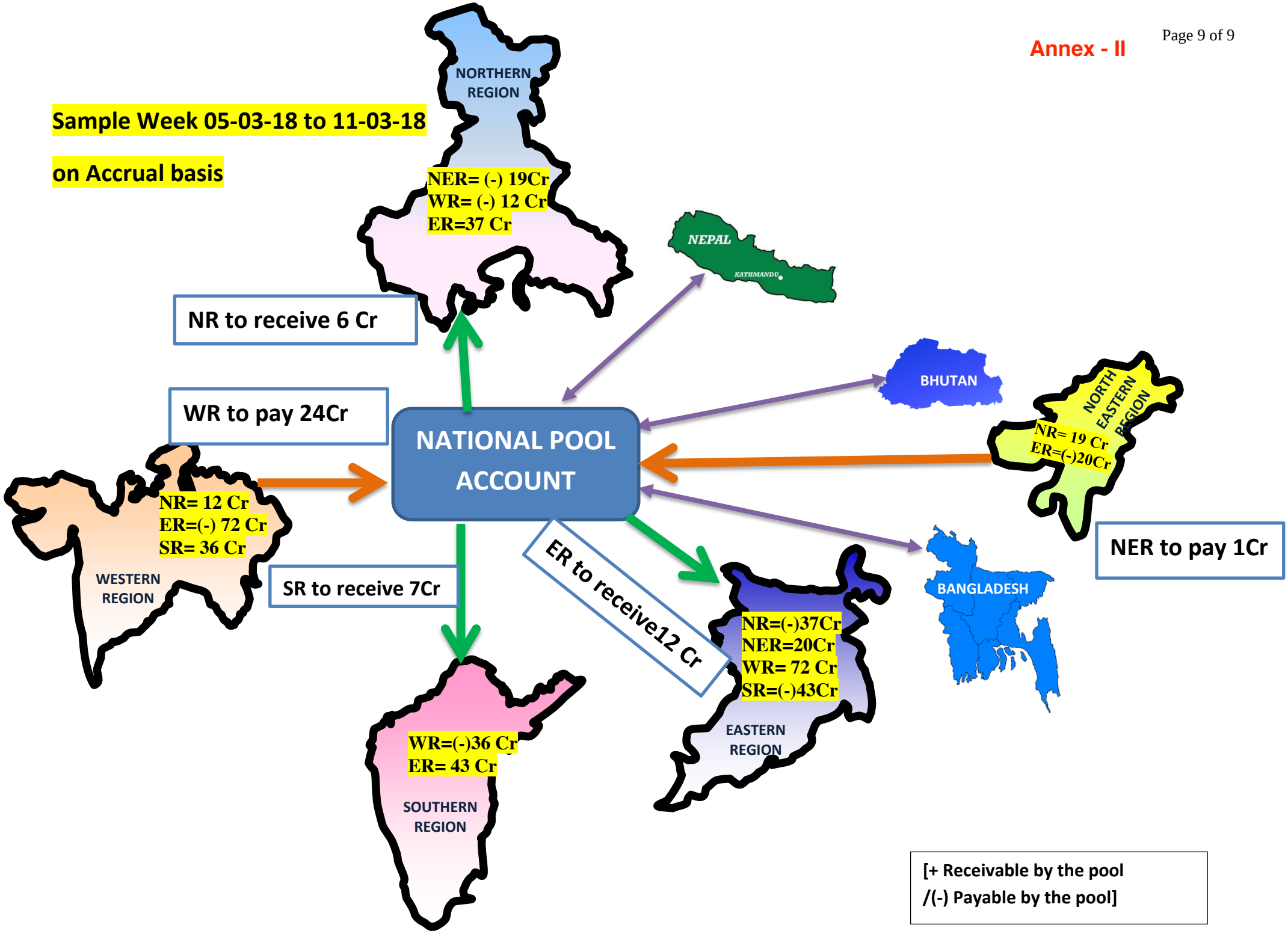


[+ Receivable by the pool
/(-) Payable by the pool]

Annex - II

Sample Week 05-03-18 to 11-03-18

on Accrual basis



[+ Receivable by the pool
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पावर सिस्टम ऑपरेशन कॉर्पोरेशन लिमिटेड
(भारत सरकार का उद्यम)
POWER SYSTEM OPERATION CORPORATION LIMITED
(A Govt. of India Enterprise)

पंजीकृत एवं केन्द्रीय कार्यालय : प्रथम तल, बी-9, कुतुब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली-110016
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CIN : U40105DL2009GOI188682, Website : www.posoco.in, E-mail : posococc@posoco.in,Tel.: 011- 41035696, Fax : 011- 26536901

संदर्भ संख्या:पोसोको/एनएलडीसी/2021/97 दिनाँक: 12th फरवरी, 2021

सेवा मे,

Chief Engineer,
National Power Committee,
Central Electricity Authority,
01st Floor, Wing-5, West Block-II,
R.K.Puram, New Delhi-66

विषय: **NPC Agenda on National Energy Account(NEA).**

संदर्भ:1.**POSOCO Communication: पोसोको/एनएलडीसी/2018/329 dated 09th Nov'2018**

2.NPC email National Energy Account (NEA)_9th NPC meeting follow up-reg. dated 29th Jan'2021

महोदय,

In order to streamline and harmonize the accounting and settlement at the national level, POSOCO has submitted the agenda of "National Energy Account (NEA)" for discussion on 08th National Power Committee (NPC) (Annex-1).

As per the above-mentioned proposal, it is envisaged that NPC shall prepare the National Energy Account (NEA) comprising of the interregional and trans-national transactions. The NEA shall reflect the payables/receivables for each region on a net-basis and this amount shall be payable/receivable to the National Deviation Pool Account which shall be operated by NLDC. The NEA shall also reflect the cross-border or transnational transactions and the neighbouring countries shall be paying/receiving to/from the National Deviation Pool Account operated by NLDC.

National Energy Account (NEA) & National Pool Account related feedback have been submitted to Honourable CERC through various feedback report from time to time. CERC being a quasi-judicial body, does not normally respond to such feedback through letters etc. A petition may be required to be filed either suo-moto or by respective parties, for getting the appropriate directions from CERC. It may also be appreciated that introduction of the NEA needs the notification of the Regulatory Framework by CERC through appropriate Regulations, which also needs pre-publication, stakeholder consultation and final notification.

In this regard, it is pertinent to mention that CERC has mentioned the National Pool account in SCED order Petition No. 02 /SM/2019 (Suo-Motu) Date of Order: 31st of January, 2019. The same is reproduced below

Quote

"10.(c) POSOCO has suggested implementation of the National Pool Account to take care of changes in injection schedule for each region due to optimisation process. There would be a need for pay-in/pay-out from the National Pool Account for incremental changes in schedules (Up/Down). As per the present mechanism, the generators receive their variable charges based on the schedules issued by the concerned RLDC. Optimization would result in incremental/decremental changes in the existing schedules of generators and these would need to be settled through the National Pool Account mentioned above."

Unquote

As per the direction of CERC, National Pool Account (SCED) is maintained and operated by NLDC for settlement of SCED. Similarly National Deviation Pool Account for Deviation Settlement (DSM) can also be maintained/operated by NLDC in case of any direction received from the appropriate Commission.

In 08th NPC Meeting it was decided that RPCs may provide their observation/views after deliberations in the respective RPCs meeting. Accordingly, it is suggested that considering the suggestions received from the RPCs, a framework for implementation of NEA/National Pool Agenda can be finalized in the next NPC Meeting. Once this is agreed upon, POSOCO would submit the necessary feedback once again to the Hon'ble CERC for consideration & further directions.

सादर धन्यवाद,

भवदीय

देबाशिस

देबाशिस दे

कार्यपालक निदेशक, रा.भा.प्रे.के.

Enclosures: As above

पावर सिस्टम ऑपरेशन कॉर्पोरेशन लिमिटेड
(भारत सरकार का उद्यम)
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संदर्भ संख्या: पोसोको/एनएलडीसी/2018/ 329 दिनाँक: **09th November, 2018**

सेवा मे,

Director,
National Power Committee,
NRPC Building,
3rd Floor, Katwaria Sarai,
New Delhi-110016

(Kind Attn: Sh. Irfan Ahmad)

विषय: Agenda Note on National Energy Account & National Deviation Pool Account for 8th Meeting of National Power Committee.

संदर्भ: NPC letter no: 4/MTGS/NPC/CEA/2018/1122-1123 dtd. 01st Nov, 2018

महोदय,

With reference to the above mentioned NPC communication dated 01st November 2018, an Agenda note on National Energy Account & National Deviation Pool Account for the forthcoming 8th Meeting of National Power Committee is enclosed.

सादर धन्यवाद,

भवदीय,

समीर सक्सेना
09/11/18.

(एस. सी. सक्सेना)
उप महाप्रभंधक (एन एल डी सी)

Encl: As above

Copy to: Chief Engineer, National Power Committee, NRPC Building, 3rd Floor, Katwaria Sarai, New Delhi-110016

National Energy Account & National Deviation Pool Account

Agenda Note for 8th Meeting of the National Power Committee (NPC)
30th November 2018, Guwahati

1. Establishment of National Grid

In the sixties, the country's electricity grid was demarcated into five electrical regions and Regional Electricity Boards were formed. In order to facilitate inter-state power transactions and the development of regional grids, Govt. of India funded construction of a number of inter-state lines. Subsequently multi-beneficiary Central Sector generating stations were developed by utilities like NTPC, NHPC etc. along with associated transmission system for evacuation of power. The concept of regional energy accounting (earlier known as global accounting) was developed with boundary metering of all control areas.

Till late nineties, power system was planned on regional self-sufficiency basis and there were very few inter-regional links. With more and more inter-regional inter-connections coming up, the focus now shifted to formation of a strong National Grid. Initially, HVDC was used to interconnect two regions, e.g., NR-WR, NR-ER, WR-SR, etc. Gradually, AC interconnections also came up and by August 2006, all regional grids except SR were interconnected synchronously into two synchronous systems known as NEW and SR Grids. The strong HVDC links connecting the NEW grid to Southern region are extensively used for optimizing power flows in the NEW grid. With strong AC connections between the regions constituting the NEW grid as well as extensive use of HVDC links in real time operation, inter-regional schedules lost any physical relevance. All the five regional grids in the country were progressively interconnected using AC links and these are now operating as one synchronism system since December 2013. The situation has become more complicated with direct HVDC connections between NER and NR.

2. Existing Scheduling, Metering, Accounting and Settlement Systems

Availability Based Tariff (ABT) was implemented in stages, starting with Western Region in July 2002. With implementation of ABT, the concept of Unscheduled Interchange (UI) pool came up and all RLDCs started operating regional UI pool accounts, which were subsequently known as the "Regional Deviation Accounts". Deviations from the schedules are computed using the net injection/drawal for using boundary metering for each control area. Based on deviations from schedule, utilities pay UI charges to or receive UI charges from the regional UI pool account.

Short-term open access in inter-state transmission was introduced in May 2006 and with this, scheduling of market-based trades/transactions also commenced. Further, in 2008, multiple Power Exchanges were also implemented. Corridor wise margin declaration for market-based transactions was carried out along with net import/export capability for regions for administering the short-term open access transactions. Later from 2009 onwards, long-term and medium-term transactions also commenced within one region and between different regions. Corresponding scheduling on the inter-regional links was carried out for these transactions on a corridor-wise basis e.g., WR-NR, ER-SR, etc. Presently, while corridor wise TTC/ATC are being declared, net import/export margins for the region are being used for administration of short-term transactions.

Special energy meters have been installed at both ends of inter-regional / inter-state tie lines and all inter-connections of CTU system with ISGS as well as states / other entities whose accounting is done at regional level. As specified in the IEGC, meter readings are sent to respective RLDCs by different sub-stations of CTU / ISGS / states. The meter readings are processed at RLDCs and forwarded to respective RPC secretariat for preparation of weekly deviation account. The RPC secretariats issue deviation accounts based on which different utilities pay /receive deviation charges to / from deviation pool account. These also included settlement of inter-regional deviations between neighboring regions. The regional UI pools are being operated satisfactorily and have successfully served the purpose for the last many years.

The deviation rate vector is declared upfront by the CERC from time to time. Prior to 2008, with uniform rates for deviation, the total payable and receivables were supposed to be equal making it a zero-sum game. However, due to difference in estimated loss and actual loss as well as metering errors, total UI/deviation charges payable did not match with total UI/deviation charges receivable. Based on methodology decided in RPC forum, suitable adjustment is done to make total UI charges payable equal to the UI charges receivable. Thus, the UI pool accounts had been zero balance accounts traditionally since introduction of ABT up to 2008.

Regional UI pool accounts became a non-zero sum game since 7th January 2008 with introduction of UI rate cap for Central generating stations with coal or lignite firing and stations burning only APM gas. UI rate cap was retained in the UI regulations, 2009. Further, as per the UI regulations, 2009, additional UI charge is payable by over-drawing or under-injecting utilities based on specified volume limits and frequency bands. Thus a surplus is generated in the UI/deviation pool.

An important feature of the UI accounts issued by RPCs is treatment of inter-regional transactions. The following methodology is followed by the RPCs in this regard:

- No adjustment is done in UI charges payable to / receivable from other regions (otherwise this may lead to an iterative process)
- UI charges payable to other regions has highest priority i.e. UI charges received in UI pool account is used first to clear dues to other regions.

Schedules are reconciled between RLDCs and thereafter final schedules are issued. Moreover, same meter readings are used by both connected regions for computation of UI/deviations. Hence it is expected that normally there should not be any mismatch between UI charges payable / receivable by adjacent regions connected through AC links.

At present, RPCs of each region prepare and issue UI/deviation accounts considering neighboring region as control areas (similar to states within the region). Sometimes, there are cases of mismatch between UI/deviation payable/receivable as per accounts issued by two RPCs of adjacent Regions and reconciliation of accounts by RPCs prior to issuance is required to be done.

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From the above mandate it is evident that just as the RLDCs/RPCs are responsible for scheduling, metering, accounting and settlement at the Regional level, NLDC has been made responsible at the inter-regional and trans-national levels. The corresponding roles pertaining to inter-regional and trans-national transactions accounting and settlement need to be taken up at the National level by the NLDC and NPC.

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In future, other neighboring SAARC countries like Bangladesh and Pakistan may have connectivity with two different regions of India. For the purpose of cross-border interconnections, the country needs to be treated as a single control area for the purpose of transnational exchanges and transactions have to be reconciled on National basis. Further, in line with the mandate provided, NLDC is responsible for all trans-national exchanges.

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A vibrant electricity market is functioning in the country and many regulatory changes have been implemented to address new challenges from the changing scenario which is also leading to increased complexities. Some of the significant changes that have already been implemented at the National level and some future challenges are briefly discussed below.

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In order to streamline the accounting and settlement at the national level there is a need for implementing a National Deviation Pool based on the National Energy Account. In this regard, the following methodology is proposed.

(a) **Scheduling:** Corridor-wise (e.g., ER-NR, etc.) scheduling of inter-regional transactions is presently being carried out. However, actual power flows as per the laws of physics. In case of collective transactions, one to one correspondence of source and sink is not there and scheduling on a particular inter-regional corridor may at best be notional. Hence, there is a need to migrate to scheduling inter-regional transactions on a net basis for each region. However, while accepting the transactions for scheduling, corridor-wise TTC/ATC/available margin etc. may be duly taken care of. Inter-regional corridor-wise schedules may also be continued based on the physical power flow patterns as the same is useful for grid security monitoring and checking for any discrepancies. NLDC shall communicate the net inter-regional schedules to the NPC for the purpose of accounting.

Schedules for cross-border transactions shall also be prepared by NLDC on a net-basis to facilitate accounting of cross-border transactions by the NPC. However, individual schedules of

the concerned neighboring country with different region regions shall also be continued at RLDC level for the purpose of grid security monitoring and checking for discrepancies.

(b) **Metering:** The existing practice for metering of the inter-regional points shall continue as per the IEGC and the SEM data shall be collected by the RLDCs, processed and made available to the RPCs. In addition, the processed meter data shall also be made available to the NPC through NLDC. A similar practice shall be adopted for the cross-border metering locations, where the processed meter data shall be provided by the respected RLDCs to the RPCs and NPC (through NLDC).

(c) **Accounting & Settlement:** Based on the scheduling and meter data provided, NPC shall prepare the National Energy Account (NEA) including the National Deviation Account for the inter-regional and trans-national transactions. The NEA will reflect the payables/receivables for each region on a net-basis and this amount shall be payable/receivable to the National Deviation Pool Account which shall be operated by NLDC. The NEA shall also reflect the cross-border or trans-national transactions and the neighboring countries shall be paying/receiving to/from the National Deviation Pool Account operated by NLDC. Payment to the National DSM Pool shall have the highest priority.

In the future, multi-lateral transaction between neighboring countries are also envisaged under the SAARC framework e.g., Bangladesh may purchase power from Nepal or Bhutan through India. Neighboring countries may also participate in a designated Power Exchange for cross-border transactions in the future. For scheduling and settlement of such transactions, the all-India loss figures would need to be declared upfront by NLDC.

(d) **Handling Surplus/Deficit in Regional Pool Accounts and transfer of residual to PSDF:** As has already been mentioned above, sometimes the regional DSM pool may face shortfalls on account of disbursals for reliability support such as RRAS, FRAS, AGC, etc. in accordance with the relevant regulations of CERC. Once the National DSM Pool becomes operational, all residual/surplus amount in the regional DSM pools shall be transferred to the National DSM pool account. The NPC accounts would also facilitate the transfer of funds from the surplus available in the National DSM pool to the deficit regional DSM pool accounts as a single transaction thereby simplifying the process. Once all liabilities have been met, any residual in National DSM Pool shall be transferred periodically to the PSDF in accordance with the extant CERC Regulations.

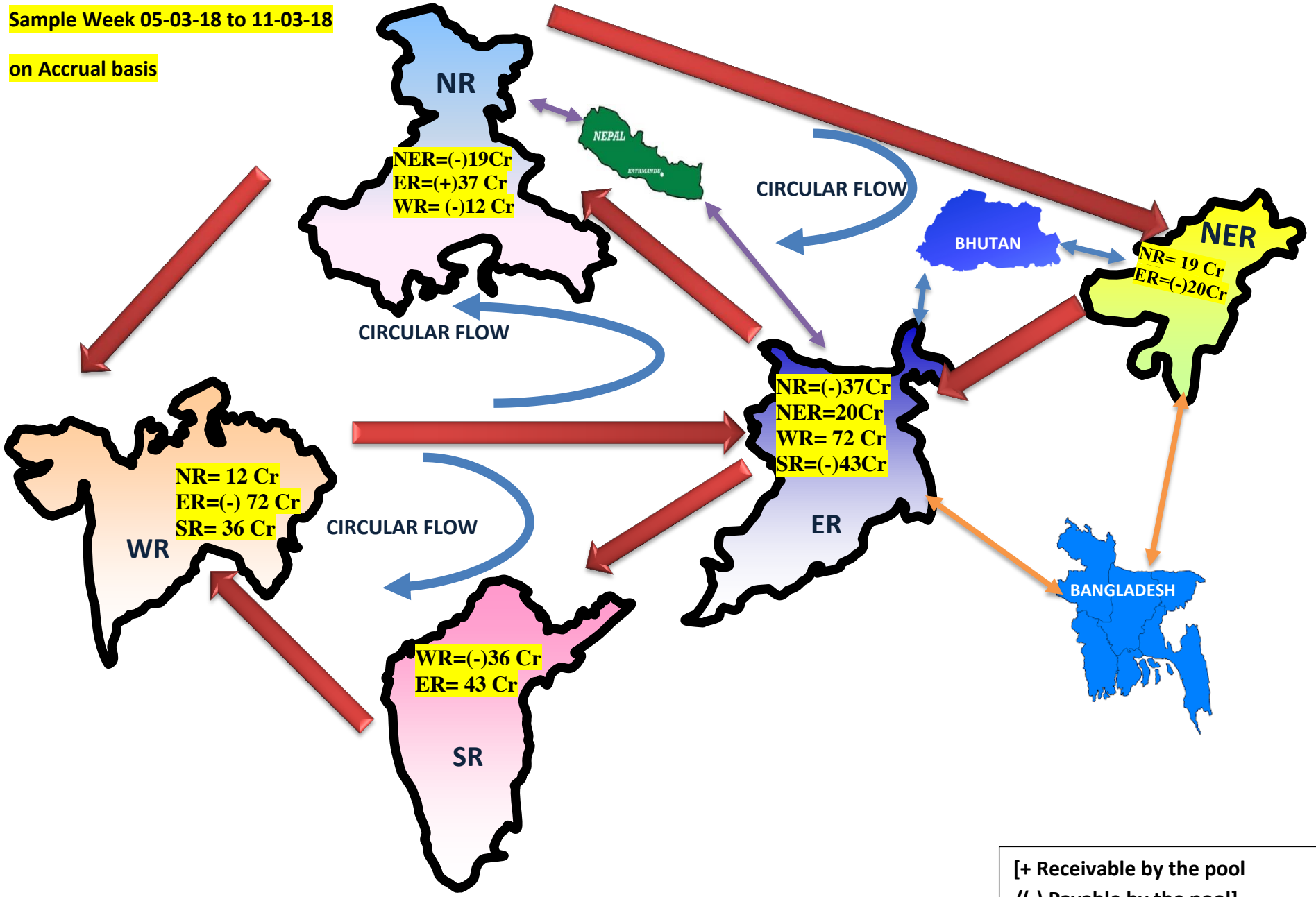
A sample illustration of the flow of funds between different regional DSM pool accounts to the national DSM pool account and that with the neighboring countries is shown at Annex – II.

Suitable changes/modifications are required to be carried out in the IEGC and DSM Regulations and the functions of NPC also need to be recognized in the regulatory framework.

Annex - I

Sample Week 05-03-18 to 11-03-18

on Accrual basis

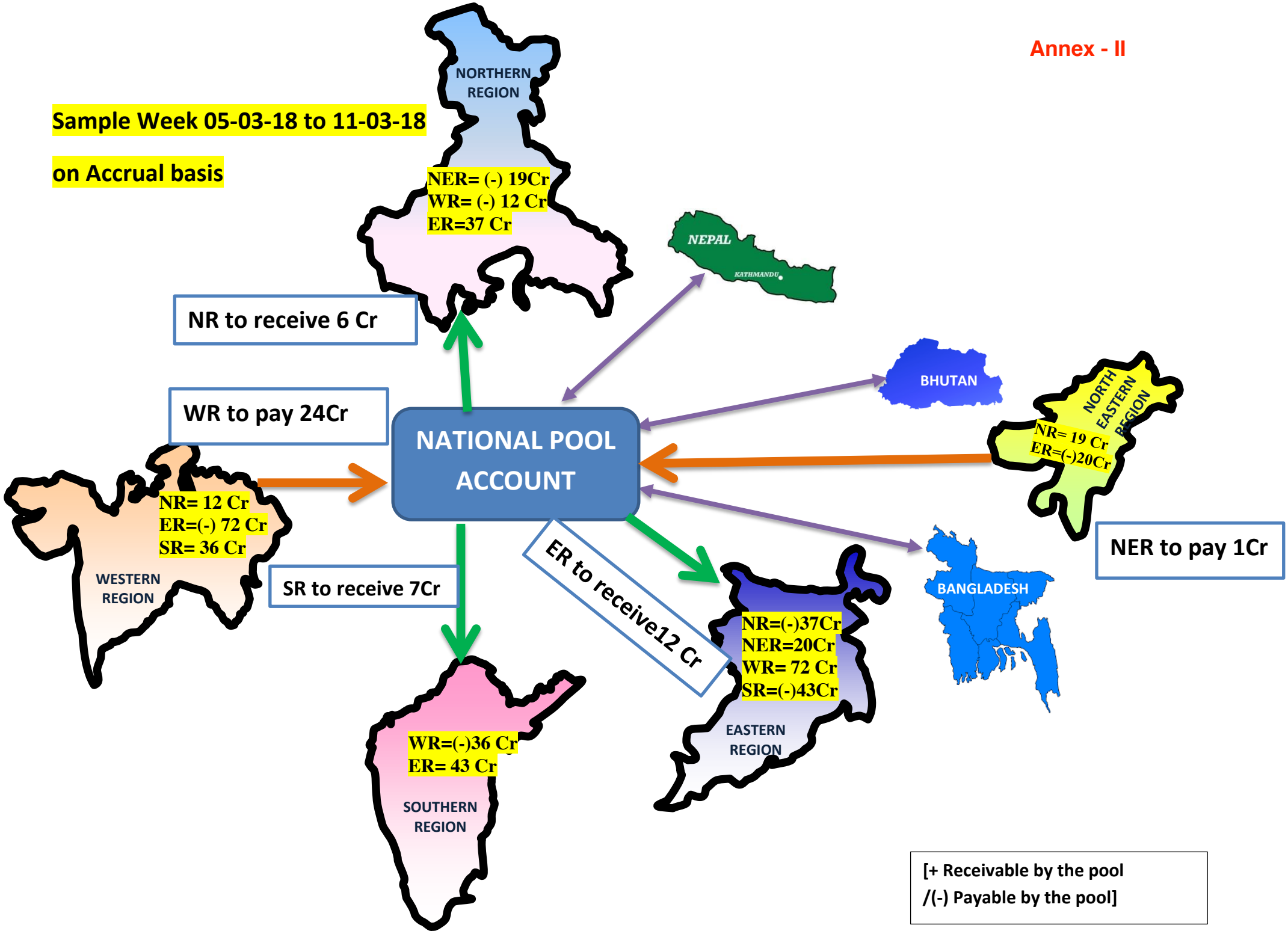


[+ Receivable by the pool
/(-) Payable by the pool]

Annex - II

Sample Week 05-03-18 to 11-03-18

on Accrual basis



[+ Receivable by the pool
/(-) Payable by the pool]