सत्यमेव जयते

भारत सरकार/Government of India

विद्युत मंत्रालय/Ministry of Power

केंद्रीय विद्युत प्राधिकरण/Central Electricity Authority

राष्ट्रीय विद्युत समिति /National Power Committee

सं.: 4/MTGS/NPC/CEA/2018/ 1098 – 1117 दिनांक: 31.10.2018

To

As per the distribution list.

Subject: Meeting Notice for the 8th Meeting of NPC-Regarding

Sir,

The Eighth (08th) meeting of the National Power Committee (NPC) is scheduled to be held **on 30th November 2018 at 10:00 am in Guwahati**

The meeting is being hosted by NERPC. The venue of the meeting shall be intimated in due course.

Agenda Note shall be circulated shortly.

Kindly make it convenient to attend the meeting.

Yours faithfully

31/10/2018

(प्रदीप जिंदल/Pardeep Jindal)

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

Chief Engineer & Member Secretary, NPC

Distribution List (8th Meeting of NPC)

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2. Shri A. Venu Prasad Chairperson, NRPC & Principal Secretary, Local Government and in addition CMD, PSTCL, Regd. Office, PSEB Head Office, The Mall, Patiala, Punjab – 147001. Email: cmd@pstcl.org
3. Shri I.C.P. Keshari, Chairman, WRPC & Principal Secretary, Dept. of Energy Govt.of M.P.& Chairman of MPPTCL, Room No. 97, Ground Floor, Mantralaya, Vallabh Bhawan, Bhopal (MP) – 462001. Email: i.keshari@gmail.com, secyenergy@mp.gov.in
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7. Shri Sanjay Kumar Shukla, Chairman TCC(WRPC) & MD, MP Power Management Co. Ltd., Jabalpur /Chairman, M.P. Paschim Kshetra Vidyut Vitaran Co. Ltd., Indore, Shakti Bhawan, Chairman Block, Rampur, Jabalpur, M.P.-482008. Email: shukla.sanjay@mppmcl.com, pa.md@mppmcl.com
8. Shri Y. Adam, Chairperson TCC(SRPC) & Director (Grid and Transmission Management), APTRANSCO, Vidyuth Soudha, Gunadala, Eluru Road, Vijayawada, A.P.-520004. Email: dir.grid@aptransco.gov.in
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10. Shri E.W.Nongrum, Chairman, TCC(NERPC) & Director, MePGCL, Lumjingshai, S.R.Road, Shillong, Meghalaya-793002. E-Mail: ewnong@yahoo.com
11. Shri MAKP Singh, Member Secretary, NRPC, 18-A, S.J.S.S. Marg, Katwaria Sarai, New Delhi-110066. **Email:** ms-nrpc@nic.in
12. Shri A.Balan, Member Secretary, WRPC, Plot No. F-3, MIDC Area Marol, Andheri (East), Mumbai-400093. **Email:** ms-wrpc@nic.in
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14. Shri S. R. Bhat, Member Secretary, SRPC, No.29, Race Course Cross Road, Bengaluru-560009 **Email:** mssrpc-ka@nic.in
15. Shri P.K.Mishra, Member Secretary, NERPC, NERPC Complex, Dong Parmaw, Lapalang Shillong-793006, E-mail: nerpc@ymail.com

Special Invitees:

16. CEO, POSOCO, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi -110016.
17. Director (Operation), PGCIL, Saudamini, Plot No.2, Sector-29, Guragon-122001
18. Chief Engineer, GM, CEA, New Delhi

Copy for Kind information to:

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

सत्यमेव जयते

भारत सरकार/Government of India

विद्युत मंत्रालय/Ministry of Power

केंद्रीय विद्युत प्राधिकरण/Central Electricity Authority

राष्ट्रीय विद्युत समिति /National Power Committee

सं.: 4/MTGS/NPC/CEA/2018/ 1135–1154 **दिनांक**: 12th November 2018

To

As per the distribution list.

Subject: Agenda Notes for the 8th Meeting of NPC-Regarding

Sir,

In continuation to NPC letter dated 31st October 2018, Agenda Notes for the Eighth (08th) meeting of the National Power Committee (NPC) scheduled to be held **on 30th November 2018 at 10:00 AM in Guwahati** is enclosed for kind information please. The same is also available on CEA web site.

Meeting Venue: Hotel Radisson Blu, NH-37, Guwahati-781033

Kindly make it convenient to attend the meeting.

Yours faithfully,

12/11/2018

(प्रदीप जिंदल/Pardeep Jindal)

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

Chief Engineer & Member Secretary, NPC

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3. Shri I.C.P. Keshari, Chairman, WRPC & Principal Secretary, Dept. of Energy Govt.of M.P.& Chairman of MPPTCL, Room No. 97, Ground Floor, Mantralaya, Vallabh Bhawan, Bhopal (MP) – 462001. Email: i.keshari@gmail.com, secyenergy@mp.gov.in
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15. Shri P.K.Mishra, Member Secretary, NERPC, NERPC Complex, Dong Parmaw, Lapalang Shillong-793006, E-mail: nerpc@ymail.com

Special Invitees:

16. CEO, POSOCO, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi -110016.
17. Director (Operation), PGCIL, Saudamini, Plot No.2, Sector-29, Gurugram-122001
18. Chief Engineer ,GM Division, CEA, New Delhi

Copy for Kind information to:

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

CENTRAL ELECTRICITY AUTHORITY
NATIONAL POWER COMMITTEE

AGENDA NOTES FOR THE EIGHTH MEETING OF NATIONAL POWER COMMITTEE TO BE HELD ON 30th NOVEMBER 2018

1. CONFIRMATION OF MINUTES OF 7TH MEETING

The Minutes of 7th meeting of NPC held on 08th September 20167 held at Indore was circulated vide letter No. 4/MTGS/NPC/CEA/2017/758-77 dated 10th November 2017. The Minutes of 7th Meeting of NPC may please be confirmed.

2. Consideration of request from CTU for Membership in National Power Committee (NPC)

2.1 Keeping in view the ever growing complexity of Power System, NPC was established by Ministry of Power vide order dated 25th March, 2013, to evolve a common approach on issues related to reliability and security of the grid, at National level. Chairperson, CEA is the Chairperson of NPC. Member (GO&D), CEA, Member Secretaries and Chairpersons of RPCs, the Chairpersons of Technical Co-ordination Sub Committees (TCC) in five regions are members of NPC. Chief Engineer (NPC), CEA is Member Secretary of NPC.

2.2 A proposal mooted in the 2nd meeting to include **NLDC as the member of NPC was agreed in the 4th meeting of NPC** after the concurrence of RPCs. Accordingly, Member Secretary (NPC) had taken up with MoP the necessary amendment in the order of establishment of NPC and Conduct of Business Rules of NPC. Amendment in this regard is awaited from MoP.

2.3 In the 7th meeting of NPC, CTU had requested to include **CTU as a permanent member of NPC**. CTU was advised to submit a detailed proposal with justification in this regard to NPC Secretariat for deliberation in the next NPC meeting.

Accordingly, CTU vide letter dated 14th June 2018 (**Annexure-I**) has submitted the proposal with following justification:

" Keeping in view the critical role being played by CTU in development of Indian Power Sector as well as electricity market while discharging its functions as statutory body for Inter-State Transmission System (ISTS) grid related aspects at National level, it would be prudent to include Director (Operations), CTU as a permanent member in NPC to address challenges of Power System, facilitate common approach in all the regions and adopt uniform best practices across the regions for smooth development of National Grid".

The Committee may like to deliberate.

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

(A) Review of AUFLS Settings

3.1 As per the decision in the 2nd meeting of NPC held on 16th July 2013, the following AUFLS scheme with 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.

Region wise/State wise Details of AUFLS and df/dt settings are given at **Annexure-II**

3.2 In the 7th meeting of NPC held on 08th September 2017, it was agreed that there is need for review of the quantum of load shedding without introduction of additional slabs/stages of frequency. And therefore, RPCs may deliberate on additional slabs of frequency as well as raising the set frequency for UFR operation and inform us about the outcome. The views of RPCs would be put up in next meeting of NPC.

3.3 During the presentation of Consultants Reports on Package A&B on power system analysis under contingencies held at CERC on 05th March 2018, CERC has advised to assess if there is a need to revisit the setting of UF relays at 49.2 Hz in consultations with stakeholders.

3.4 Subsequently, WRPC has intimated that a meeting to review the stages and quantum in the existing Automatic Under Frequency Load Shedding Scheme was held on 13.03.2018 at WRPC Mumbai. In general it was agreed that the frequency setting of 1st stage of AUFLS be raised from existing 49.2 Hz to 49.4Hz.and to keep state-wise load shedding quantum same as existing.

3.5 Subsequently, SRPC vide letter dated 18.05.2018 had requested NPC to suggest the UFR quantum to be adopted by Southern Region in the current grid environment.

In view of the above and considering the change in grid size etc., NPC Secretariat vide letter dated 30.05.2018 (**Annexure-III**) the following two options UFR quantum were communicated to RPCs for consideration:

(a) **AUFLS scheme with 4 stages of frequency viz. 49.2, 49.0, 48.8 & 48.6 Hz**

AUFLS	Frequency (Hz)	Load relief in MW					
		NR	**WR**	**SR**	**ER**	**NER**	**Total**
Stage-I	**49.2**	3920	3360	3170	1380	170	12000
Stage-II	**49.0**	3950	3380	3190	1380	170	12070
Stage-III	**48.8**	3970	3400	3210	1390	170	12140
Stage-IV	**48.6**	4000	3430	3230	1400	170	12230
Total (MW)		**15840**	**13570**	**12800**	**5550**	**680**	**48440**

(b) AUFLS scheme with 4 stages of frequency viz. 49.4, 49.2, 49.0 & 48.8 Hz

AUFLS	Frequency (Hz)	Load relief in MW					
		NR	**WR**	**SR**	**ER**	**NER**	**Total**
Stage-I	**49.4**	3900	3340	3150	1370	170	11930
Stage-II	**49.2**	3920	3360	3170	1380	170	12000
Stage-III	**49.0**	3950	3380	3190	1380	170	12070
Stage-IV	**48.8**	3970	3400	3210	1390	170	12140
Total (MW)		**15740**	**13480**	**12720**	**5520**	**680**	**48140**

3.6 SRPC vide letter dated 07.06.2018 (**Annexure-IV**) has communicated their views. The salient points are given below:

i. SR constituents have implemented UFR quantum of 10.653 MW against recommended quantum of 9,500 MW based on average loading of the feeders, around 11% more than the recommended quantum.

ii. It may need to be ascertained and ensured that all Regions are proportionately contributing towards arresting any frequency decay during contingency, based on average loading of the feeders.

iii. Since the load relief being worked out on average basis, and daily load fluctuation factor is already been considered the power number considered for SR, that is 1,849 MW/Hz may kindly be reviewed.

iv. Further, SR constituents have also provided around 5,610 MW under df/dt scheme. There may be a need to optimize df/dt locations, quantum and set points for all Regions.

3.7 POSOCO vide letter dated 02nd July 2018 (**Annexure-V**) has stated that the quantum of load shedding through UFLS to the tune of 48GW suggested appears sufficient. POSOCO has proposed following aspects for consideration for modification of AUFLS scheme for Indian power system:

(a) Raise the reference frequency of operation of each stage of AUFLS by 0.4Hz, and set the revised AUFLS scheme in 4 stages at 49.6 Hz, 49.4 Hz, 49.2 Hz and 49.0 Hz.

(b) Limit the total trip time of modified AUFLS to 200 milliseconds (including measurement time, relay operation time and breaker operation time).

(c) Design AUFLS scheme for at least 25% load generation mismatch in Indian power system.

(d) Define the terms 'Synthetic Inertia' or 'Fast Frequency Response' and include appropriately in the gird standards.

(e) Co-ordinate under frequency trip relays of Pump storage plants in pumping mode with modified AUFLS scheme, and set the trip frequency to around 49.8 Hz.

(f) Geographically distribute the AUFLS trip relays to prevent over voltages.

3.8 NERPC, in its 146th meeting of OCC held on 17th July 2018 has noted that the revised scheme should be at 49.4 Hz, 49.2 Hz, 49.0 Hz & 48.8 Hz. It was decided that the state wise quantum would be prepared and presented in the next meeting for ratification.

3.7 ERPC vide e-mail dated 07.08.2018 has informed that the issue was discussed in 146th & 147th meetings of OCC. Comments on the proposal are given below for kind consideration of the NPC:

i. OCC in principle agreed for raising frequency stages of AUFLS scheme viz. 49.4, 49.2, 49.0 and 48.8 Hz except DVC and WBSETCL.

ii. DVC and WBSETCL would like to continue with the existing frequency stages. However, DVC and WBSETCL stated that they had no objection if the upward revision of frequency stages is agreed in NPC.

iii. Regarding quantum of load shedding, OCC opined that sufficient quantum of radial feeders might not be available for AUFLS scheme as some of the radial feeders are already covered under ADMS scheme and islanding scheme. OCC felt that 63% raise in total quantum of load shedding w.r.t 2013 may not be appropriate. Raise in quantum of load shedding might be considered as 30% for first two years and rest 33% for next two years.

3.8 NRPC vide letter dated 10.09.2018 (**Annexure-VI**) has informed the following recommendations of the Committee constituted for review of targets fixed for load relief from operation of df/dt & UFR relays in NR and AUFLS for discussion in the 8th meeting of NPC:

i. It was agreed that frequency setting of the Stage-I shall be increased to 49.4Hz with subsequent margin of 0.2Hz for each stage with Stage-IV at 48.8 Hz.

ii. Required load relief calculations should be revised considering increased power number around 15000 and calculated in MW rather MW/Hz i.e. load relief calculated in each stage shall be multiplied by corresponding frequency deviation from 50Hz.

iii. It was also recommended to calculate the load relief on pan India basis but for region and its states, seasonal variations in the demand of the states may be considered.

iv. Committee was of the view that methodology for calculating load relief according the Zalte Committee report may be reviewed mainly with respect to Voltage Correction factor and daily load fluctuation factor, if deemed necessary by the states.

3.9 SRPC vide letter dated 20.09.2018 in response to NPC letter dated 05.09.2018 has informed that the issue regarding review of UFR quantum/additional slabs was discussed in the 138th meeting of OCC held on 11.12.2017 wherein, states had opined that there is no need for additional slabs of frequency as well as raising the said frequency for UFR operation. TCC had endorsed these decisions of OCC. In the 33rd meeting of SRPC held on 17.02.2018, constituents had expressed concern regarding paucity of additional radial feeders (without overlap) and also since islanding loads could not be identified for any of the relief schemes. Being large integrated grid, chances of fall of frequency were less and system should be provided space for self-healing before df/dt or UFR sets in. Regarding quantum (based on Power Number), the SR share was being complied as and when the same was being communicated. In the 34th meeting of SRPC held on 11.08.2018, it had been concluded that existing settings may be retained and the same be recommended to NPC.

3.10 Summary of the views/ input are as follows:

NRPC: Frequency setting of the Stage-I shall be increased to 49.4Hz with subsequent margin of 0.2Hz for each stage with Stage-IV at 48.8 Hz.

Methodology for calculating load relief according the Zalte Committee report may be reviewed mainly with respect to Voltage Correction factor and daily load fluctuation factor, if deemed necessary by the states.

WRPC: The frequency setting of 1st stage of AUFLS be raised from existing 49.2 Hz to 49.4Hz.and to keep state-wise load shedding quantum same as existing.

SRPC: There is no need for additional slabs of frequency as well as raising the said frequency for UFR operation. Existing settings may be retained.

ERPC: OCC in principle agreed for raising frequency stages of AUFLS scheme viz. 49.4, 49.2, 49.0 and 48.8 Hz except DVC and WBSETCL.

Raise in quantum of load shedding might be considered as 30% for first two years and rest 33% for next two years.

NERPC: OCC has noted that the revised scheme should be at 49.4 Hz, 49.2 Hz, 49.0 Hz & 48.8 Hz

POSOCO: The quantum of load shedding through UFLS to the tune of 48GW suggested appears sufficient.

The Committee may like to deliberate.

(B) Mapping of Feeders:

In the 7th Meeting of NPC, it was agreed that each RPC would submit the details / progress of feeder mapping to NPC secretariat.

The status furnished by the RPCs are as follows:

SRPC has informed that 84 % *mapping of feeders on SCADA had been completed in SR (AP=59%, TS=78%, KAR =100%, KER=98%, TN=86% & PUDU=92%).*

ERPC has informed that the mapping of feeders was yet to start in view of deficiencies in the communication/ telemetry infrastructure. However the operation of UFRs is being monitored in every OCC meetings.

WRPC has informed that the issue of mapping of feeders was discussed in OCC several times in recent past. In the 493rd OCC all the constituents were requested to initiate the process of mapping of AULFS feeders in SCADA system as most of these feeders are not covered by SCADA. During the discussion, the Western Region constituents normally raised the following concerns:

- Maharashtra: AULFS wired feeders are at 66kV, 33kV and even at 11 kV level and these feeders are not covered under SCADA at present.
- Gujarat: Most of the AULF wired feeders are at 66kV which is not yet covered under SCADA and therefore these cannot be mapped at present.
- The views of remaining constituents are same as above.

RPCs may update the status.

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

In the 7th meeting of NPC, it was decided that mock test is good enough to test the healthiness of the UFR & df/dt relays. The frequency of site inspection was proposed to be up to six months. RPC Secretariat shall carry out periodic inspection, in line with the provisions of IEGC. RPC secretariat to furnish the inspection reports to NPC Secretariat.

The information furnished by the RPCs are as follows:

SRPC:

UFR & df/dt were inspected in 03 substations of TSTRANSCO and 11 substations of TANTRANSCO after 7th meeting of NPC.

WRPC:

WRPC Secretariat carry out periodic inspection of operation of UFR and df/dt relay at various sub-stations of Western region and maintain records of inspection as per provision under section 5.2 (n) of IEGC.The issue of Ensuring Proper Functioning of

UFR & df/dt Relays is a regular item of discussion in OCC and in one of the OCC, it was also agreed by the constituents to carry out periodical inter-circle inspection by themselves.

ERPC:

In ER, a sub-group has been constituted for carrying out site inspection of UFR relays installed in Eastern Region regularly using secondary injection kit. During inspection, all the inspected UFRs are found working as per the requirement. All the constituents are submitting the healthiness certificate of UFRs installed in their control area in monthly OCC meetings.

RPCs may update the status.

5. Guidelines on Availability of Communication System as per CERC (Communication System for Inter-State Transmission of Electricity), Regulations,2017.

5.1 CERC has entrusted NPC to prepare Guidelines on "Availability of Communication System" in terms of Regulation 7.3 (i) of CERC (Communication System for Inter-State transmission of electricity) Regulations, 2017. In this regard, a Working Group has been constituted with members from RPCs, POSOCO, CTU, CEA, PGCIL and NTPC. Three meetings of the working group were held and a draft guidelines on availability of communication system was finalized in the 3rd meeting held on 06th August 2018.

5.2 As required under CERC Regulations, the draft guidelines were uploaded on CEA's website on 06th September 2018 for comments by 20th September 2018 from the general public and stakeholders. Additionally, NPC has requested RPCs to circulate the guidelines among the constituents for wider publicity and comments. Comments has been received from NRPC and NERPC. The comments received from NRPC and NERPC are at **Annexure-VII.**

5.4 A copy of the guidelines is at **Annexure- VIII**. The guidelines finalized by NPC shall be submitted to CERC for approval.

NPC may approve the guidelines.

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

6.1 CERC in its order dated 13.10.2015 in Petition No. 11/SM/2015 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 operationalise 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 Centres (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 intra-state generators in line with this timeline as AGC is essential for reliable operation of India's large inter-connected grid."

6.2 In the 7th meeting of NPC, POSOCO had shared the experience in implementation of AGC at Dadri Station of NTPC in NR. It was decided that AGC would be discussed in detail in a special meeting in respective RPcs. The discussions would include aspects of implementation of primary and tertiary controls also. For this, the agenda would be sent by POSOCO and routed through NPC Secretariat to have a commonality and national perspective.

6.3 Accordingly, agenda on AGC was submitted by POSOCO and the same was sent to all RPCs for deliberation in the respective RPC forums.

6.4 A special meeting on AGC issues had been conducted on 28th March 2018 in SRPC and on 17th September 2018 in WRPC. The Minutes of the meetings are available on the website of respective RPCs.

Extract from the Minutes of 34th Meeting of SRPC, record notes of AGC meeting held on 17.09.2018 at WRPC and minutes of 41st meeting of NRPC is at **Annexure-IX.**

RPCs may update the status.

7. Grid Events reported by RLDCs, Analysis and Remedial Measures recommended by RPCs.

7.1 Regulation 13(2) of Central Electricity Authority (Grid Standards), Regulations, 2010 which provide that: "The grid disturbance resulting in failure of power supply to large areas in a State shall also be reported by the Regional Load Despatch Centre to the Authority within twenty-four hours of the occurrence of the grid disturbance." The work related to grid disturbances on regional/national basis in CEA is being dealt in the National Power Committee (NPC) Division. Accordingly, all the RLDC were requested to sent any occurrence of the grid disturbance to NPC Division, CEA with a copy to Member (GO&D), CEA.

7.2 As per Regulation 15(6) of Central Electricity Authority (Grid Standards) Regulations, 2010 "Regional Load Despatch Centre shall classify the grid incidences and grid disturbances according to Regulation 11, analyse them and furnish periodic reports of grid incidences and grid disturbances to the Regional Power Committee which shall recommend remedial measures to be taken on the report of Regional Load Despatch

Centre to prevent recurrence of such grid incidence and grid disturbances."

7.2 Accordingly, RPCs are being requested to send a copy of the analysis report on those grid events reported by RLDCs to CEA, along with remedial measures recommended to prevent the recurrence of such incidences and disturbance. The list of number of trippings reported by RLDCs during the months of July to October 2018 is at **Annexure-X.**

7.3 Total number of Grid Disturbances (GD)/Grid Incidences (GI) from 2014-15 to 2018-19 (up to September) is as follows:

Year	Total No. of GD	Total No. of GI	Total
2014-15	245	102	**347**
2015-16	483	192	**675**
2016-17	569	390	**959**
2017-18	542	348	**890**
2018-19*	306	276	**582**

* Up to September 2018

Year	NR			WR			SR			ER			NER		
	GD	GI	Total	**GD**	GI	Total	**GD**	GI	Total	**GD**	GI	Total	**GD**	GI	Total
2014-15	**75**	23	98	**30**	38	68	**22**	23	45	**56**	17	73	**62**	NA	62
2015-16	**116**	84	200	**30**	70	100	**31**	26	57	**70**	12	82	**236**	NA	236
2016-17	**119**	109	228	**49**	93	142	**46**	58	104	**65**	17	82	**290**	113	403
2017-18	**84**	102	186	**36**	88	124	**31**	21	52	**122**	17	139	**269**	120	389
2018-19 *	**90**	96	186	**11**	72	83	**19**	13	32	**39**	10	49	**147**	85	232

* Up to September 2018

RPCs may appraise the action taken.

8. Schemes for Protection System Data Base in RPCs

8.1 Ramakrisha Task Force Report on Power System Analysis Under Contingencies had recommended for creation of data base for relay settings.

"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."

8.2 The scheme of ERPC and SRPC for above purpose have been sanctioned grant from PSDF by MoP. In the 6th meeting of NPC, it was agreed that NRPC, WRPC & NERPC would also create data base of relay setting in their regions as per the scheme finalized by ERPC / SRPC.

8.3 In the 7th meeting of NPC, NRPC and NERPC had informed that they were in the process of submission of DPR for funding from PSDF. 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

8.4 Subsequently, the proposals submitted by NRPC and NERPC submitted PDMS proposal for funding from PSDF and the Monitoring Committee of PSDF approved the schemes.

8.5 The status furnished by the RPCs are as follows:

ERPC: Protection System Data Base has been implemented and it is in service from 31.10.2017.

SRPC: Protection Management System(PMS) is under implementation in SR. The project was awarded to M/s PRDC Ltd. on 09.08.2017. The execution period of the project is about 18 months from LoA and is followed by an Extended Technical Services period of 5 years. Automated Fault Analysis System (AFAS) envisaged under PMS project was successfully implemented for the 400/230-110 kV Palavadi SS (Pilot station) and was put under service with effect from 18th April 2018.

WRPC: Work related to relay setting data base of Western Region is under progress.

RPCs may update the status.

9. Monitoring of Schemes Sanctioned Grant from PSDF

MoP has sanctioned grant of around Rs.10894 Crores (117 Schemes as on 31.10.2018) to States/ Central Power utilities/RPCs from PSDF. The details of the schemes are at **Annexure-XI**. Region wise summary is given below:

Sr. No.	Region	No. of Schemes	Grant Sanctioned in Rs. Crores	Grant Disbursed in Rs. Crores
1	Northern	24	1906.5	437.84
2	Western	30	1103.7	114.72
3	Southern	27	2230.3	390.26
4	Eastern	20	1623.08	513.19
5	North Eastern	13	646.12	242.45
6	All India Schemes (PGCIL,REC)	03	3384.27	195.77
	Total	**117**	**10894.02**	**1894.23**

It was agreed in the 5th meeting of Project Monitoring Group of PSDF held on 24.10.2017 that the project monitoring meetings would be carried out at regional level

with participation of all the concerned entities in the region to review the progress of the project/schemes being funded from PSDF, to expedite there implementation.

Accordingly, meetings on regional basis were conducted in all regions: SR (on 05.01.2018), WR (on 09.02.2018), NR (on04.05.2018), ER (on 08.06.2018) and in NER (on 13.09.2018).

The actual disbursement is quiet less due to slow implementation of projects by entities. The slow progress in implementation of the schemes is a matter of concern because it may reduce the fund release by MoP, which in turn create fund shortages with NLDC for disbursement to the entities.

10. Status of Compliance of Enquiry Committee Recommendations

10.1 There was a major grid disturbance in Northern Region at 02.33 hrs on 30.07.2012. Northern Regional Grid load was about 36,000 MW at the time of disturbance. Subsequently, there was another grid disturbance at 13.00 hrs on 31.07.2012 resulting in collapse of Northern, Eastern and North-Eastern regional grids. The total load of about 48,000 MW was affected in this black out. On both the days, few pockets survived from black out. Ministry of Power constituted an Enquiry Committee, to analyse the causes of these disturbances and to suggest measures to avoid recurrence of such disturbance in future.

10.2. **Factors contributed to initiation of grid collapse:**

i. Depleted transmission network mainly in the NR-WR interface.
ii. Overdrawals by some states attributable to frequency control through commercial signals
iii. Inability to control flow on 400 kV Bina-Gwalior-Agra line
iv. Non-compliance of directions of RLDCs by SLDCs
v. Protection System Issues

10.3 **Measures recommended to avoid re-occurrence in future:**

1) An extensive review and audit of the Protection Systems should be carried out to avoid their undesirable operation.
2) Frequency Control through Generation reserves/Ancillary services should be adopted, as presently employed UI mechanism is sometimes endangering the grid security. The present UI mechanism needs a review in view of its impact on recent disturbances.
3) Primary response from generators and operation of defense mechanisms, like Under Frequency & df/dt based load shedding and Special Protection Schemes, should be ensured in accordance with provisions of the grid code so that grid can be saved in case of contingencies.
4) A review of Total Transfer Capability (TTC) procedure should be carried out , so that it can also be revised under any significant change in system conditions, such

as forced outage. This will also allow congestion charges to be applied to relieve the real time congestion.

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

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

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

8) Available assets, providing system security support such as HVDC, TCSC, SVC controls, should be optimally utilized, so that they provide necessary support in case of contingencies.

9) Synchrophasor based WAMS should be widely employed across the network to improve the visibility, real time monitoring, protection and control of the system.

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

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

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

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

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

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

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

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

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

The information furnished by the RPCs are at **Annexure-XII.**

RPCs may update the status.

11. National Energy Account (NEA)

11.1 In the 7th meeting of NPC, MS, SRPC had expressed concern on the proposal of amendment in CBR in respect of inclusion of Preparation and issuance of **National Energy Account (NEA)** for inter-regional and inter-national energy transactions by NPC Secretariat, as the same was not deliberated in RPC forums. Member Secretary, NPC had clarified that while processing the proposal of membership of NLDC in NPC, MoP had raised some quires/observations and sought comments of CEA. One of the observation was that *considering the changing scenarios, the functions of NPC may also be broadened including the functions of maintain the National Energy Account involving the inter-national and inter-regional transmission transactions.* Accordingly, comments of CEA had been furnished to MoP.

11.2 NLDC had informed that the issue of creation of National Pool account was under deliberation in various forums in view of the formation of all India grid. Inter-regional transactions needed to be accounted at national level and with the formation of National Power Committee it is possible also.

11.3 Chairperson, NPC had suggested that an agenda in this regard with detailed procedure / institutional arrangement etc. could be presented by NLDC in the next meeting of NPC, and the same was agreed.

11.4 NLDC vide letter dated 09th November 2018 (**Annexure-XIII)** has furnished agenda note on National Energy Account & National Deviation Pool Account. NLDC has stated that in order to streamline the accounting and settlement at national level there is a need for implementing a National Deviation Pool based on the National Energy Account. 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 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.

(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.

11.5 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 frame work..

The Committee may like to deliberate.

12. ANY OTHER ISSUE WITH PERMISSION OF CHAIR

13. DATE AND VENUE OF NEXT MEETING

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LIST OF ANNEXURES

No.	DESCRIPTION
I	CTU letter dated 14th June 2018 on Membership in NPC
II	Region wise/State wise Details of AUFLS and df/dt settings
III	NPC Secretariat letter dated 30.05.2018 on AUFLS
IV	SRPC letter dated 07.06.2018 on AUFLS
V	POSOCO letter dated 02nd July 2018 on AUFLS
VI	NRPC letter dated 10.09.2018 on AUFLS
VII	Comments of NRPC & NERPC on draft Guidelines on "Availability of Communication System"
VIII	Guidelines on "Availability of Communication System"
IX	Extract from the Minutes of 34th Meeting of SRPC, record notes of AGC meeting held on 17.09.2018 at WRPC and minutes of 41st meeting of NRPC
X	The list of number of line tripping reported by RLDCs during the month of July to October 2018
XI	Details of the schemes Sanctioned grant from PSDF
XII	Status of Enquiry Committee Recommendations.
XIII	NLDC note on National Energy Account & National Deviation Pool Account

पावर ग्रिड कारपोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
POWER GRID CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)
पावरग्रिड

केन्द्रीय कार्यालयः "सौदामिनी" प्लॉट सं. 2, सैक्टर–29, गुडगाँव–122 001, (हरियाणा) दूरभाषः 0124-2571700-719, फैक्स : 0124-2571762,
"Saudamini" Plot No. 2, Sector-29, Gurgaon-122 001, (Haryana) Tel. : 0124-2571700-719, Fax : 0124-2571762, Web.: www.powergridindia.com

CIN : L40101DL1989GOI038121

Ref. No.: C/CTU/N/00/NPC

Date: 14.06.2018

Shri Pardeep Jindal
CE & MS (NPC)
NRPC Building, 3rd Floor,
Katwaria Sarai, New Delhi-110016

Sub. : 8th Meeting of National Power Committee (NPC) - Reg.

Sir,

We write with reference to your letter No. 4/MTGS/NPC/CEA/2018/530-531dated 11.06.2018 regarding proposal for inclusion of CTU as permanent member of NPC. In this regard, proposal for inclusion of CTU as permanent member of NPC is attached for your kind consideration please.

Thanking you,

Yours faithfully,

Ashok Pal.

Ashok Pal
GM (CTU Planning)

Proposal for inclusion of CTU as permanent member in NPC

1. POWERGRID has been notified as the Central Transmission Utility (CTU) by the Government of India in December, 1998. Further, as per the notification issued by the GoI in 2003, POWERGRID continues to be the CTU.

2. In accordance with the Section 38 of Electricity Act, 2003, the functions of CTU are:
   a) to undertake transmission of electricity through Inter-State transmission system;

   b) to discharge all functions of planning and co-ordination relating to inter-State transmission system with -

      i) State Transmission Utilities;
      ii) Central Government;
      iii) State Governments;
      iv) generating companies;
      v) Regional Power Committees;
      vi) Authority;
      vii) licensees;
      viii) any other person notified by the Central Government in this behalf;

   c) to ensure development of an efficient, co-ordinated and economical system of Inter-State transmission lines for smooth flow of electricity from generating stations to the load centres;

   d) to provide non-discriminatory open access to its transmission system for use by
      i) any licensee or generating company on payment of the transmission charges; or
      ii) any consumer as and when such open access is provided by the State Commission under sub-section (2) of section 42, on payment of the transmission charges and a surcharge thereon, as may be specified by the Central Commission

3. Similarly, State Transmission Utilities (STUs) have been entrusted with the similar functions to be performed within a particular State in accordance with the Section 39 of Electricity Act, 2003. Thus, two tier structure has been created one at the State Level and the other at National Level and concerned STUs at State level and CTU at the central level have been envisaged to discharge various functions related to transmission system, including but not limited to planning & co-ordination, development of an efficient, co-ordinated & economical transmission system, non-discriminatory open access to its transmission system.

4. Further, in accordance with the Electricity Act, 2003, to take care of regional issues, Regional Power Committees (RPCs) for each region were established in

May, 2005 for facilitating integrated operation of the power system in that region which inter-alia includes facilitating all functions of planning relating to inter-state/ intra-state transmission system with CTU/STU. In RPCs, Director (Operations), POWERGRID is a permanent member.

5. In addition, keeping in view the ever growing complexities of Power System, synchronous mode of operation of the entire grid of the country and to evolve a common approach on issues related to reliability and security of the grid, National Power Committee (NPC) at the central level was established by GoI in March, 2013, whose functions includes:

   (I) To resolve issue among RPCs; and

   (II) Discuss and resolve issues referred to NPC requiring consultation among one or more RPCs, concerning inter-alia inter-regional implications or any other issue affecting more than one region or all regions.

6. In the 7th meeting of National Power Committee (NPC) held on 8th September, 2017, deliberations were held regarding inclusion of CTU as permanent member of NPC. It was decided that CTU may be advised to submit a detailed proposal with justification in this regard to NPC secretariat for deliberation in the next meeting of NPC.

Proposal:

The NPC is deliberating various key issues relating to planning and operation of the National Grid and also addressing many policy issues affecting the power sector across all the regions.

CTU function includes planning and co-ordination of inter-State transmission system with STU, Generating Companies, Authorities and other Stakeholders. Its role also includes to ensure development of an efficient, co-ordinated and economical system of inter-State transmission lines for smooth flow of electricity from generating stations to the load centres. It is also nodal agency for providing Connectivity, Long Term Access, Medium Term Open Access to ISTS. Further, it is also playing vital role for development of Cross-border inter-connections, Integration of Renewable generations etc.

Keeping in view the critical role being played by CTU in development of Indian Power Sector as well as electricity market while discharging its functions as statutory body for Inter-State Transmission System (ISTS) grid related aspects at National level, it would be prudent to include Director (Operations), CTU as a permanent member in NPC to address challenges of Power System, facilitate common approach in all the regions and adopt uniform best practices across the regions for smooth development of National Grid.

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.

सत्यमेव जयते

भारत सरकार/Government of India
विद्युत मंत्रालय/Ministry of Power
केंद्रीय विद्युत प्राधिकरण/Central Electricity Authority

राष्ट्रीय विद्युत समिति/National Power Committee

सं.: 4/MTGS/NPC/CEA/2018/475 - 481 दिनांक: 30.05.2018

सेवा में/To

1. **सदस्य सचिव, उत्तर क्षेत्रीय विद्युत समिति/** Member Secretary, NRPC, 18-A, S.J.S.S. Marg, Katwaria Sarai, New Delhi-110016.	2.**सदस्य सचिव, पश्चिम क्षेत्रीय विद्युत समिति/** Member Secretary, WRPC, Plot No. F-3, Andheri (East), Mumbai-400093.
3. **सदस्य सचिव, पूर्वी क्षेत्रीय विद्युत समिति/** Member Secretary, ERPC, 14, Golf Club Road, ERPC Building, Tolly Gunge, Kolkata-700 033.	4.**सदस्य सचिव, दक्षिण क्षेत्रीय विद्युत समिति/** Member Secretary, SRPC, No.29, Race Course Cross Road, Bengaluru-560009
5.**सदस्य सचिव, उत्तर-पूर्वी क्षेत्रीय विद्युत समिति/** Member Secretary, NERPC, NERPC Complex, Dong Parmaw,Lapalang Shillong-793006,	6. **महाप्रबंधक (रा.भा.प्रे.के.)/** General Manager(NLDC), POSOCO, New Delhi-110016.

विषय: Review of UFR Quantum-Reg.

संदर्भ: SRPC letter dated No. SRPC/SEII/2018/ dated 18.05.2018

Sir,

SRPC vide letter dated 18.05.2018 (copy enclosed) has requested the UFR quantum to be adopted by Southern Region in the current grid environment. In this regard, the following are submitted for kind information and needful please:

1. In the 2nd meeting of NPC held on 16th July 2013 it was decided to implement the following AUFLS scheme with 4 stages of frequency viz. 49.2, 49.0, 48.8 & 48.6 Hz and the same has 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**

2. In the 7th meeting of NPC held on 08th September 2017, it was agreed that there is need for review of the quantum of load shedding without introduction of additional slabs/stages of frequency. And therefore, RPCs may deliberate on additional slabs of frequency as

well as raising the set frequency for UFR operation and inform us about the outcome. The views of RPCs would be put up in next meeting of NPC.

Subsequently, NPC Secretariat vide letter dated 02.02.2018 requested RPCs to furnish the status of the decision taken in the 7th meeting of NPC.

3. Status furnished by the RPCs on AUFLS is as follows:

3.1 **SRPC**:

The issue was discussed in the 138th OCC Meeting held on 11.12.2017 wherein, all the states opined that there is no need for additional requirement/ raising of the set points of AUFR. It was also mentioned in that letter that this is also included as an agenda item for the 32nd TCC / 33rd SRPC Meeting scheduled to be held on 16/17.02.2018.

It is observed in the minutes of the 32nd meeting of TCC that "*TCC endorsed these decisions of OCC that there was no need presently for additional slabs of frequency as well as raising the said frequency for UFR operation. Regarding quantum (based on Power Number) the SR share was being complied as and when the same was being communicated*". This TCC deliberation was noted by SRPC in its 33rd Meeting.

3.2 **WRPC:**

In general, it was agreed by WRPC that the frequency setting of 1st stage of AUFLS be raised from *existing 49.2 Hz to 49.4 Hz. The proposed revised stages are:*

AUFLS	Existing frequency (Hz)	Proposed frequency (Hz)	Quantum of load shedding (MW)
Stage-I	49.2	49.4	Same as per existing quantum
Stage-II	49.0	49.2	
Stage-III	48.8	49.0	
Stage-IV	48.6	48.8	

3.3 **ERPC:**

The issue was placed in 142nd OCC Meeting held on 23rd February 2018. The outcome will be communicated after the OCC meeting.

It is observed in the Minutes of the OCC meeting that "*Members opined that it is more appropriate to decide the quantum of load shedding and stages of frequency for AUFLS at National level*".

3.4 **NRPC:**

NRPC has decided to form a committee under the chair of MS, NRPC to look into the issue of reviewing the load relief and the slabs.

3.5 **NERPC:**

The issue was discussed in the 142nd Meeting of OCC held on 14th March 2018 and it was decided to review the AUFLS after recommendations of M/s Powertech Labs are submitted.

4. During the presentation of Consultants Report on Package A&B on power system analysis under contingencies held at CERC on 05th March 2018, CERC has advised to

assess if there is a need to revisit the setting of UF relays at 49.2 Hz in consultations with stakeholders.

5. In view of the above and considering the change in grid size etc. the following two options UFR quantum assuming **Power Number of 7,000** are proposed for consideration:

5.1 **AUFLS scheme with 4 stages of frequency viz. 49.2, 49.0, 48.8 & 48.6 Hz**

AUFLS	Frequency (Hz)	Load relief in MW					
		NR	WR	SR	ER	NER	Total
Stage-I	**49.2**	3920	3360	3170	1380	170	12000
Stage-II	**49.0**	3950	3380	3190	1380	170	12070
Stage-III	**48.8**	3970	3400	3210	1390	170	12140
Stage-IV	**48.6**	4000	3430	3230	1400	170	12230
	Total (MW)	**15840**	**13570**	**12800**	**5550**	**680**	**48440**

5.2 **AUFLS scheme with 4 stages of frequency viz. 49.4, 49.2, 49.0 & 48.8 Hz**

AUFLS	Frequency (Hz)	Load relief in MW					
		NR	WR	SR	ER	NER	Total
Stage-I	**49.4**	3900	3340	3150	1370	170	11930
Stage-II	**49.2**	3920	3360	3170	1380	170	12000
Stage-III	**49.0**	3950	3380	3190	1380	170	12070
Stage-IV	**48.8**	3970	3400	3210	1390	170	12140
	Total (MW)	**15740**	**13480**	**12720**	**5520**	**680**	**48140**

5.3 The above computations are based on the agreed principles as decided in the 2nd meeting of NPC. However, any different principle for computation of load relief by RPCs/NLDC are most welcome.

6. Comments on the proposal may please be furnished to NPC Secretariat at the earliest. Based on the inputs from RPCs, the matter would be included for deliberation in the next meeting of NPC. **Your response on above by 10th June 2018 would be appreciated.**

Thanking You.

Yours faithfully,

30/05/2018

(प्रदीप जिंदल/Pardeep Jindal)
मुख्य अभियन्ता एवं सदस्य सचिव, रा.वि.स /
Chief Engineer & Member Secretary, NPC

Copy for kind information to:

Chairperson, CEA, New Delhi

Computation- AUFLS

NPC

Freqn dependence = 1.5 **Assumed Power Number (P) = 7,000**

Frequency (A)	Deviation from 50 Hz (B)=50-(A)	% Change in Freq. (C) =(B/50)*100	% Change in MW (D) =FD*C	Freq. Factor Correction(E) = 100/(100-D)	Voltage correction factor (F)= 1/0.855	Daily load fluctuation factor (G) = 1/0.7)	Overall Correction factor (H) = E*F*G	Required Load Relief = P*H
49.2	0.8	1.6	2.4	1.025	1.17	1.43	1.7142	**12000**
49.0	1	2	3	1.031	1.17	1.43	1.7248	**12074**
48.8	1.2	2.4	3.6	1.037	1.17	1.43	1.7356	**12149**
48.6	1.4	2.8	4.2	1.044	1.17	1.43	1.7465	**12225**

Region	MW (Peak) met in 2017-18	Ratio % (Region to all India)	Load Relief in MW				
			49.2 Hz	49.0 Hz	48.8 Hz	48.6 Hz	Total
NR	58,448	32.70	**3920**	**3950**	**3970**	**4000**	15840
WR	50,085	28.02	**3360**	**3380**	**3400**	**3430**	13570
SR	47,210	26.41	**3170**	**3190**	**3210**	**3230**	12800
ER	20,485	11.46	**1380**	**1380**	**1390**	**1400**	5550
NER	2,520	1.41	**170**	**170**	**170**	**170**	680
Total	**178,748**	100.00	**12000**	**12070**	**12140**	**12230**	**48440**

Computation- AUFLS

NPC

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Total	**178,748**	100.00	**12000**	**12070**	**12140**	**12230**	**48440**

भारत सरकार केंद्रीय विद्युत प्राधिकरण दक्षिण क्षेत्रीय विद्युत समिति बेंगलूरु - 560 009		Government of India Central Electricity Authority Southern Regional Power Committee Bengaluru - 560 009	
Web site: www.srpc.kar.nic.in	e-mail: mssrpc-ka@nic.in	Ph: 080-22287205	Fax: 080-22259343

सं/No.	SRPC/SEII/2018/ 3171-72	दिनांक / Date	18.05.2018

1. Chief Engineer, Grid Management, CEA, New Delhi.
2. Chief Engineer, NPC, CEA, New Delhi.

Sir,

SRPC had earlier received directions from CEA about the total UFR quantum to be adopted by Southern Region. Based on this figure, SRPC had in turn apportioned the UFR quantum to be actually implemented by the states / UT of Southern Region.

However, based on change in grid size, etc. the UFR quantum may need to be reviewed. It is therefore, requested that the UFR quantum to be adopted by Southern Region in the current grid environment may please be intimated to us for further needful.

Thanking you.

भवदीय Yours faithfully,

(एस.आर. भट्ट/S.R. BHAT)
सदस्य सचिव / Member Secretary

दिनांक 28/5

फ़ैक्स/स्पीड पोस्ट /FAX/SPEEDPOST

भारत सरकार केंद्रीय विद्युत प्राधिकरण दक्षिण क्षेत्रीय विद्युत समिति बेंगलूरु - 560 009		Government of India Central Electricity Authority **Southern Regional Power Committee** Bengaluru - 560 009	
Web site: www.srpc.kar.nic.in	e-mail: mssrpc-ka@nic.in	Ph: 080-22287205	Fax: 080-22259343
सं/No. SRPC/SE-II/2018/		दिनांक / Date	07.06.2018

Chief Engineer
National Power Committee
CEA
NEW DELHI

Sub: Review of UFR quantum - reg

Sir,

NPC vide letter dated 30th May 2018 had sought comments on two options of UFR quantum assuming power number of 7,000 with set points at 49.2, 49.0, 48.8 & 48.6 Hz in Option-1 and set points at 49.4, 49.2, 49.0 & 48.8 Hz in Option-2. The above has been included as an Agenda for the 144th Meeting of OCC scheduled to be conducted on 12th June 2018. Outcome of the deliberations of the SRPC-OCC would be communicated after that Meeting.

However, on the matter, following is put up for kind consideration:

- SR constituents have implemented UFR quantum of 10,653 MW against recommended quantum of 9,500 MW based on average loading of the feeders. This is around 11% more than the recommended quantum.
- Average loading had been considered based on Order dated 19.12.2013 of Hon'ble CERC in respect of Petition No.263/MP/2012. Relevant extract are reproduced below please:

  13. We have heard the parties and perused the pleadings. We are in agreement with the petitioner that there is a need to review and estimate the actual load ***on the feeders and the constituents should consider average load in the feeders for computation of target relief on identified feeders****. As sufficient load relief has not been achieved, the respondents are directed to identify more feeders for installation of UFR and df/dt relays and submit the details to SRPC.*

14. We would like to emphasize that ***no complacency shall be accepted for ensuring safety and security of the Grid****. Also according to Enquiry Committee constituted by the Ministry of Power, the response from generators and operation of defense mechanism like Under Frequency and df/dt based load shedding and special protection schemes should be ensured in accordance with provisions of the Grid Code so that Grid can be saved in case of contingencies. Further, as the SR Grid is going to be integrated with NEW Grid, urgent action by the respondents is all the more essential.*

- Following extract of Order dated 24.12.2014 of Hon'ble CERC in respect of Review Petition No.7/RP/2014 in Petition No. 263/MP/2012 is given below:

37(c)……NLDC has submitted that at present in ***Eastern, Northern and North Eastern Regions, maximum load in the feeders is being considered for computation of load relief****. However, in Western Region load relief is being calculated on average value.*

(d) ***CEA has opined that as the grid security is of paramount importance,*** *AUFLS Scheme is required to be implemented by all Stations faithfully to avoid grid collapse in case of any severe contingency. Since excursion of frequency to the level of 49.2 Hz does not occur under normal system operation and implementation of AUFLS is unlikely to create any difficulty to the consumers, it is desirable that all stations provide load relief under ULFLS scheme at least equivalent to the quantum as intimated by the respective RPC* ***on the basis of the average load on the feeders*** *covered in the scheme during the previous year.*

38……. Therefore, we feel that ***UFR setting on average load is implementable*** *and accordingly, we do not find any sufficient reason to review our order dated 19.12.2013.*

- In view of the above, it may kindly be needed to be ascertained and ensured that all Regions are proportionately contributing towards arresting any frequency decay during contingency, based on average loading of the feeders.
- Present quantum of recommended relief to be provided by different Regions is given below:

Region	Recommended relief in MW	Percentage
NR	8,720	28.83%
WR	8,310	27.47%
SR	9,500	31.40%

ER	3,320	10.98%
NER	400	1.32%
TOTAL	30,250	100.00%

It can please be noted that SR was recommended to provide around **31.40%** of the total quantum of relief.

Considering the present scenario, NPC has suggested the following percentages of relief to be provided by each of the Regions based on the ratio of maximum demand met during 2017-18, as given below:

Region	Percentage
NR	32.70%
WR	28.02%
SR	26.41%
ER	11.46%
NER	1.41%
TOTAL	100.00%

Therefore, it is requested that SR may kindly be recommended to provide 26.41% of relief of the quantum finalized by the NPC, even if it is ultimately agreed not to enhance the total UFR quantum.

- With assumed power number of 7,000, the SR contribution works out to about 1,849 MW/Hz.(26.41%). However, the average demand for SR for the year 2017-18 was around 36,491 MW and taking the inertial response of 4 % (as being considered in FRC computation) it works to around 1,460 MW/Hz. Keeping some margin, 1,650 MW/Hz is the power number presently being utilized for SR in consultation with SRLDC and states. It may also be kindly noted that daily fluctuation factor of 1.43 has already been considered in overall correction factor. Since the load relief is being worked out on average basis, and the daily load fluctuation factor is already been considered the power number considered for SR that is 1,849 MW/Hz may kindly be reviewed.
- Further, SR constituents have also provided around 5,610 MW under df/dt scheme. There may be a need to optimize df/dt locations, quantum and set points for all Regions.

- In the interim period, it may thus kindly be advised whether this additional quantum recommended could be shifted from df/dt scheme to UFR scheme.

धन्यवाद /Thanking you,

भवदीय / Yours faithfully

(एस.आर. भट्ट/S.R. BHAT)
सदस्य सचिव / Member Secretary

Copy for kind information to:

Member (GO&D), CEA, New Delhi

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
Registered & Corporate Office : Ist Floor, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi -110016
CIN : U40105DL2009GOI188682, Website : www.posoco.in, E-mail : posococc@posoco.in,Tel.: 011- 41035696, Fax : 011- 26536901

Ref: NLDC/SO/NPC/AUFLS

Date: 02nd July 2018

To
The Chief Engineer,
National Power Committee (NPC),
NRPC Building, 18-A,
Shaheed Jeet Singh Marg, Katwaria Sarai,
New Delhi – 110016

Sub: Review of Automatic Under-frequency Load shedding relay (AUFLS) settings in Indian power system
Ref: NPC letter 4/MTGS/NPC/CEA/2018/475-481 dated 30th May 2018

Sir,

I. This is in reference to the above communication from NPC. A reference has been made to the 7th meeting of NPC on 08th September 2017, wherein it was agreed that the present AUFLS scheme in Indian power system need to be reviewed.

II. Under-frequency load shedding relays are meant to act in cases of grid frequency dip below a set level due to significant mismatch of load-generation in the system. The present UFLS scheme in Indian power system is set to operate in 4 stages of 0.2 Hz steps, viz. at 49.2 Hz, 49.0 Hz, 48.8 Hz, 48.6 Hz. Recent events in the Indian power system indicate that frequency response characteristic (FRC) has improved from around 5000 MW/Hz in 2015 to 15000 MW/Hz at present. Trend of All India FRC over the years is enclosed at **Annexure-I.**

The calculations for UFLS relays in Indian grid can be considered accordingly corresponding to FRC of 15000 MW/Hz.

III. Plot of frequency response of grid in recent events indicate that it is very unlikely that frequency dips due to credible contingencies of loss of large generation complexes or loss of tie-lines would cause operation of UFR relays at the present setting. A plot of nadir frequencies observed in Indian grid in past events is as per **Annexure-II**.

IV. Simulations were carried out in the model of Indian power system to assess the minimum expected frequency in the grid. Loss of a 4000 MW generation complex (such as conventional UMPPs or large generation complexes such as Vindhyachal, APL Mundra, etc.) is a credible grid contingency. Simulation corresponding to loss of 4000 MW generation at CGPL Mundra & APL Mundra complexes resulted in minimum frequency of **49.841 Hz**.

V. Loss of nearly 10000 MW generation at nearby generating complexes such as outage of APL Mundra, CGPL Mundra and renewable generation in Bhuj area or outage of generation at Sasan UMPP, Vindhyachal NTPC, Essar Mahan & Jaypee Nigrie can be a larger credible contingency. Simulation corresponding to outage of 10000 MW generation at Sasan UMPP, Vindhyachal NTPC, Essar Mahan & Jaypee Nigrie indicates the nadir frequency as **49.733 Hz**. Plot of simulations are enclosed at **Annexure-III**.

VI. In Section 4.3 of Task-III report and Section 4.4.3 of Task-IV report of POWERTECH labs Inc., it is stated that the starting frequency of UFLS relays (49.2 Hz) appears quite lower than the expected minimum frequency in Indian grid. The same is corroborated by results of simulation as indicated in (IV) above. It is thus proposed to raise the reference frequency of operation of each stage of UFLS by 0.4 Hz, viz. set the revised AUFLS scheme in 4 stages at 49.6 Hz, 49.4 Hz, 49.2 Hz and 49.0 Hz.

VII. Report of ENTSOE titled 'Technical background for the Low Frequency Demand Disconnection requirements' of November 2014 vintage recommends to limit total trip time of load-shedding relays to 150 milli-seconds to ensure their effectiveness. Copy of report is enclosed at **Annexure-IV** for reference. For the modified AUFLS scheme in Indian power system, the total trip time can be limited accordingly to around 200 msec (measurement time + relay operation time + breaker operation time) to ensure effectiveness.

VIII. With higher renewable energy integration in the future, natural directly connected rotating inertia (primarily coal fired thermal generators) will decrease. Higher inertia means more kinetic energy and more time for the controls to react to the power deficit and begin restoration of the frequency before the grid frequency hits the under frequency load shed threshold. High inertia will provide time for the mechanical controls of the plant like governor dead band, main steam control valve for steam turbines, the combustor for gas turbines, or the gate valve for hydro turbines to move and provide primary response. During this time delay before the governor response begins, the inertia converted into power limits the rate of change of frequency. Other literature such as the IEEE Technical Report on Measurement, Monitoring and Reliability issues related to primary

frequency response and Report of Expert Group to review and suggest measures for bringing power system operation closer to National Reference Frequency (Volume-I) also highlight the importance of inertia and the 'nadir' frequency (the instantaneous frequency drop following a contingency). Considering the above, as a long term measure for system reliability, 'Synthetic Inertia' or 'Fast Frequency Response' term must be defined and incorporated suitably in the Grid Standards considering the anticipated penetration of renewables to arrest the rate of change of frequency decline.

IX. Section 3.2 of Task-III report of POWERTECH Labs Inc. indicates that UFLS relays are generally designed for upto 25% load-generation mismatch. For Indian power system, Northern region (NR) with peak demand of around 60 GW imports close to 15 GW from other regions, Southern Region (SR) with peak demand of around 45 GW imports close to 10 GW, and North-Eastern Region (NER) with peak demand of around 2.5 GW imports close to 600 MW. The imbalances in load-generation in these regions are thus close to 25%.

For Indian power system with peak demand of around 170 GW, 25% mismatch corresponds to nearly 43 GW. Accordingly at least 43 GW of load shedding is necessary through UFLS. The quantum of load shedding through UFLS to the tune of 48 GW, as suggested in 5.2 of the letter from NPC as referred above, thus appears sufficient.

X. Pumps from hydro-pump storage plants can also contribute to the load-shedding scheme, if co-ordinated with load-shedding relays. The under-frequency trip settings of pump-storage hydro plants in pumping mode may thus be co-ordinated with AUFLS relays so that they are taken out of service prior to operation of load-shedding relays, say at 49.8 Hz.

XI. The AUFLS relays may be evenly distributed geographically across the power systems so that tripping of loads do not cause significant voltage rise in the grid at nearby points. Voltage excursions in an already depleted system may cause undesirable trippings and further weaken the system.

XII. CEA Technical Standards for Connectivity of Distributed Generation Resources regulations, 2013, mandates distributed renewable generation connected at 33 kV or below to be designed to operate in the band of 47.5 Hz to 50.5 Hz with a clearing time of upto 200 milli-seconds. The proposed AUFLS will thus operate prior to disconnection of distributed RE generation. But there is no clear standard for grid connected RE above 33 kV level. These aspects become important while examining pockets which could get islanded and have high penetration of renewable energy generation.

For modification of AUFLS scheme for Indian power system, the following aspects can thus be considered:

a) Raise the reference frequency of operation of each stage of AUFLS by 0.4 Hz, and set the revised AUFLS scheme in 4 stages at 49.6 Hz, 49.4 Hz, 49.2 Hz and 49.0 Hz.

b) Limit the total trip time of modified AUFLS to 200 milliseconds (including measurement time, relay operation time, and breaker operation time)

c) Design AUFLS scheme for at-least 25% load-generation mismatch in Indian power system

d) Define the terms 'Synthetic Inertia' or 'Fast Frequency Response' and include appropriately in the Grid Standards

e) Co-ordinate under-frequency trip relays of Pump storage plants in pumping mode with modified AUFLS scheme, and set the trip frequency to around 49.8 Hz

f) Geographically distribute the AUFLS trip relays to prevent overvoltages.

Thanking you,

Yours faithfully,

Narasimhan 2/7/2018

(S R Narasimhan)
General Manager, NLDC

Copy To:

1. **Executive Director, WRLDC / ERLDC / NERLDC**
2. **General Manger, NRLDC / SRLDC**

Annexure-I

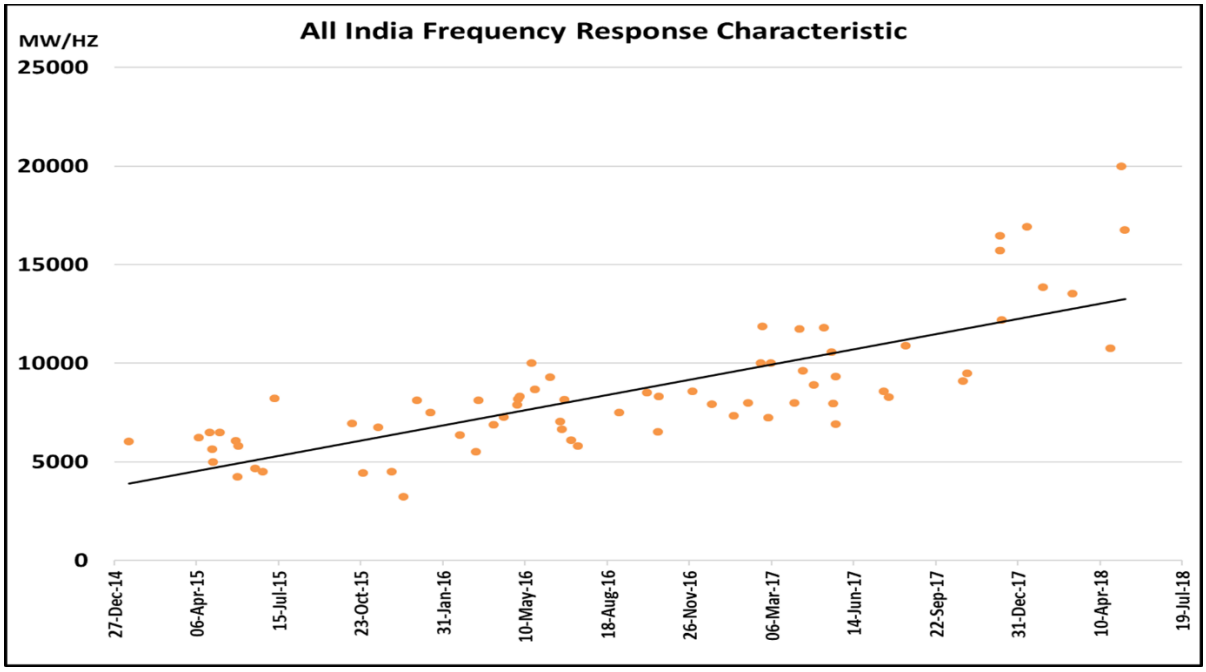


Figure: All India Frequency Response Characteristic (FRC) from January'2015 to Present

Annexure-II

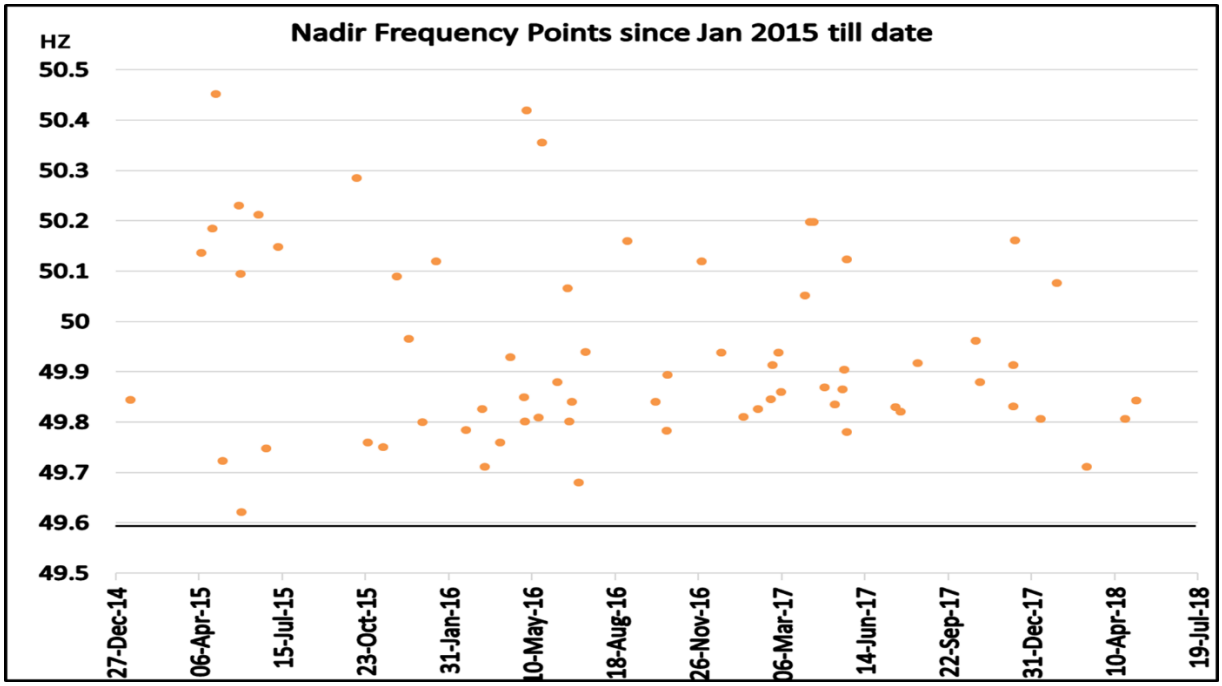
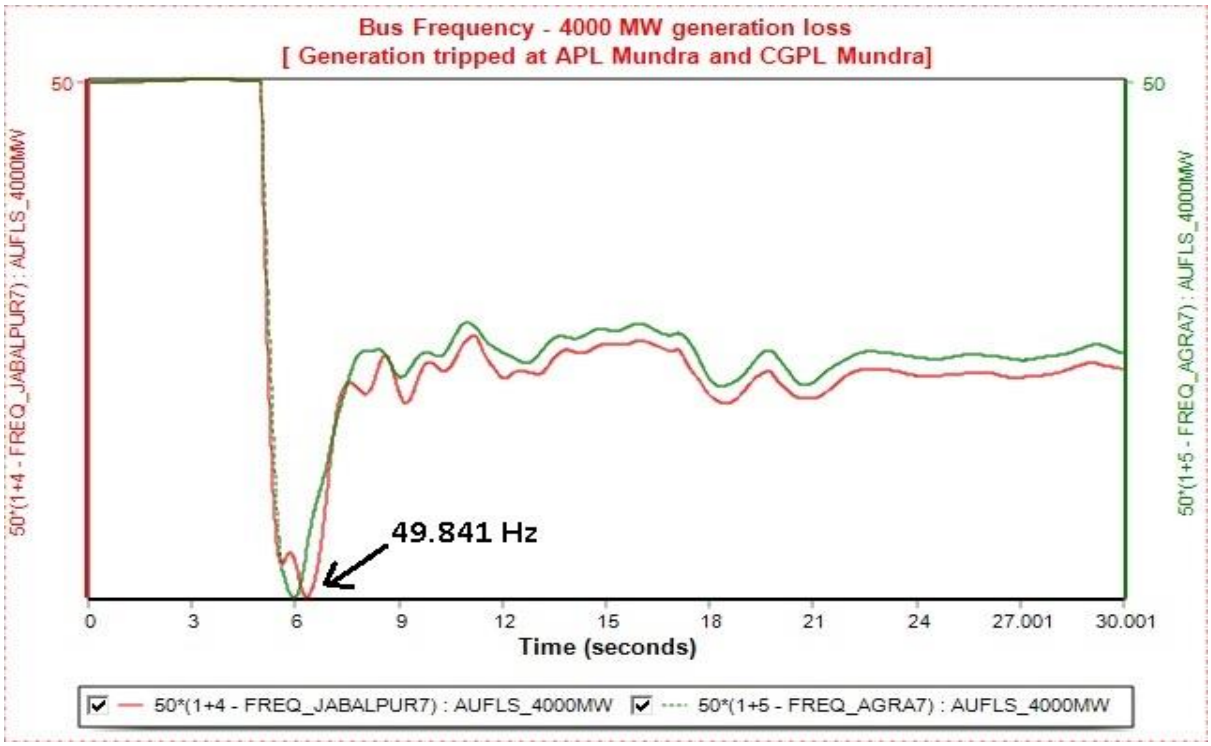


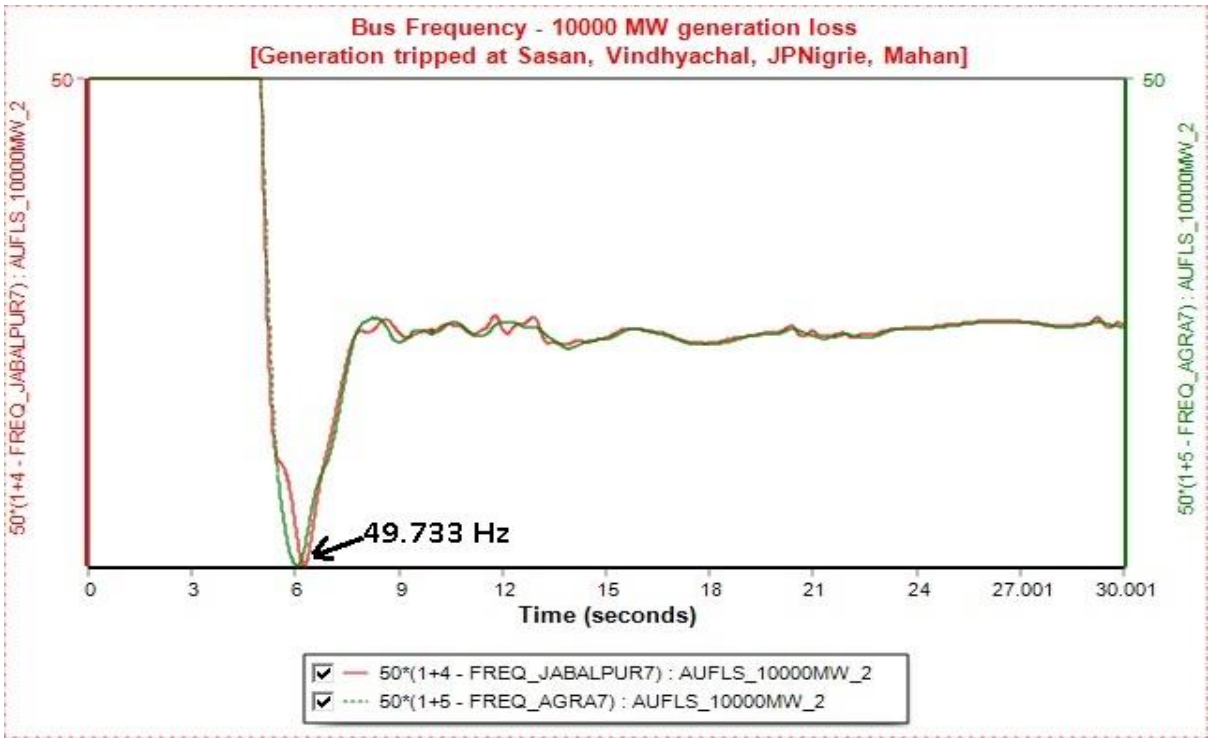
Figure: Nadir Frequency Points for events in Indian grid from January'2015 to Present

Annexure-III

a) Frequency response for contingency of 4000 MW generation :



b) Frequency response for contingency of 10000 MW generation :



European Network of
Transmission System Operators
for Electricity

entsoe

Technical background for the Low Frequency Demand Disconnection requirements

November 2014

Content

1. Introduction

The main scope of this report is to evaluate different load shedding strategies with the aim to define binding requirements for the coordinated under frequency load shedding plans of Continental Europe.

The under frequency load shedding (UFLS) approach represents a compromise between a quasi-linear control target and a rigid fixed pre-set load disconnection. The modern technical solutions (e.g. digital frequency relays, phasor measurement) give many possibilities to develop and realise effective UFLS schemes. An efficient UFLS plan shall be designed on the basis of the following general principles:

- Evenly geographically distributed and effective shed load between TSOs as well as within a TSO area,
- Same reference for frequency and shedding load steps across the interconnected system,
- Ability to compensate the maximum credible active power deficit of the system,

- System implementation ensures the effectivity of UFLS: it means a minimal necessary shedding of load,
- Compensate disconnection of dispersed generation at unfavourable frequencies [5],
- Avoid over frequency (overcompensation), overvoltage and power transients that can lead to an additional loss of generation.

The proposed review of the current UFLS plan has to take the next additional conditions into consideration:

- Compensate statistical failed trip by load shedding relays and conventional generation lost during the under frequency transient,
- Avoid splitting of network by intervention of line protection and, if necessary control network splitting scenarios,
- Duly consider the net effect of losing embedded generation located on the load feeders subject to load shedding

This document is planned to deliver useful input and technically support for the NC Emergency and Restoration [2] and OH Policy 5 [1] drafting teams.

A few basic considerations reflect the main principles that must drive the load shedding strategy design:

The first decision is the *range* of the load shedding action delimited by the frequency value of start of load shedding and the final step level. At frequencies below this threshold the system depends on TSOs individual extreme actions (Special Protection Schemes, islanding schemes) as a last defence before the permitted trip of all generating units.

Another important parameter is the *total load quantity* that will be activated if all steps of the load shedding plan are triggered. In addition the load quantity of the first and the subsequent steps must be defined jointly with frequency threshold with the aim to consider the activation delay which depends on relay technology (algorithm, measuring and filters, auxiliary relays).

Pumps from hydro-pump storage plants can also contribute to the load shedding scheme, if coordinated with load shedding; in this sense pumps could anticipate or compensate the loss of generation. However, as they act outside the standard UFLS scheme their consideration is out of the scope of this study.

At the end, also the frequency derivative steps (using ROCOF function) play an important role, because the frequency derivative has the advantage to anticipate the frequency transient. A proper range is fundamental to avoid false tripping i.e. due to local faults, where the frequency derivative is very sensitive. The application of this functionality shall be restricted to TSOs with a regular high import power balance.

By means of system simulations, the following recommendations will be established for:

- Optimal total shedding load in percentage of reference load (PSL,total),
- Optimal frequency stepping for a system with dispersed frequency relays implemented (fi, n),
- Optimal number of load shedding stages in percentage of reference load (Pi).

Additionally, some general considerations will be given for:

- Acceptable time delay,
- Optional use of frequency gradient (ROCOF function) and other additional inputs.

The study does not consider settings related to
- Load shedding schemes based on under voltage
- Load shedding schemes based on frequency derivative
- Pump storage control
- HVDC frequency support

The statistical dispersion of thresholds value and/or frequency measurements across the system, but in the conclusions chapter some corresponding recommendations will be given.

2. System modelling

The system is represented with a mean frequency model compliant with normative regulation and contribution from loads[1].

The model (represented in schematic way in Figure 1) is an ad hoc model for internal use implemented and fine-tuned by SPD experts.

Inertia of the system is adjusted according to the quantity of inverter based generators, in order to properly represent their influence on system behaviour.

The primary regulation and load contributions are referred to design hypothesis reported in ENTSO-E Policy 1.

Three kinds of production technologies are considered:
- Conventional plants (Primary regulation): the production from the synchronous generators including thermal and hydro power is considered by one equivalent group, with proper rate limiter function.
- PV production: frequency disconnection thresholds are modelled both for over and underfrequency
- Wind production: this production is represented by an equivalent group for the entire area with tripping threshold in underfrequency in way to emulate the particular settings on some TSOS (typically 49.5 Hz, see [5]); for these plants no threshold in over frequency.

Simulations are done with the dispersed generation capacity remaining at risk after full implementation of the German and Italian retrofit programs.

The PV and wind models are able to emulate:
- The percentage of power tripped in over/under frequency with associated threshold
- Over frequency regulation
- The tripping time, i.e. the time between the detection of the exceeding of the threshold and the effective triggering group.

[1] According to normative model, load dependance from voltage is not considered; it is represented. only load self-regulating power

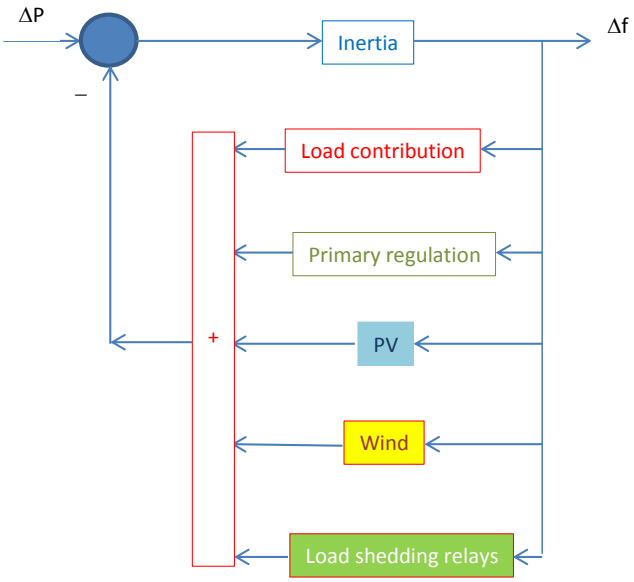


Figure 1: Overall block structure of the simulation model

2.1 Load shedding relay modelling

The maximum number of steps implemented into the model is equal to 10. For each step, a threshold and a percentage of disconnected load is associated, jointly with a delay that represent the internal computational time and time to execute and open the load feeder circuit breaker.

The implemented equations and more details can be found in the report “Dispersed generation impact on CE regions security” [5].

The self-regulation impact of the load k_{PF} (load contribution) was considered to be 2%/Hz

The same simulation model was used for [5] and validated by related comparison between measurement and simulation.

3. Scenarios

"Reference load" defines the "per unit base" of the load subject to UFLS while the simulations will be done on high and load scenarios deviating from the "reference load".

In the past the reference load determination was based on typical load situations as e.g. high load condition during winter or low load condition during summer. Due to the increasing impact of distributed generation this principle is no longer applicable for the reference load definition. Therefore the TF has decided to use the same principle as defined in [3]. The details of defining the correct reference load are described in the conclusions chapter.

In the following the specific distribution of load and generations for each TSO is not considered.

The simulations are based on the following 4 situations:

		Case 1a High load, no RES	Case 1b High load, high RES	Case 2a Low load, no RES	Case 2b Low load, high RES
Load	GW	440	440	220	220
Firm synchronous generation	GW	440	170	220	50
Wind	GW	0	181	0	75
PV	GW	0	75	0	80
"Other" at risk	GW	0	14	0	14

Table 1 Scenarios used to evaluate the UFLS performance.

Within this report the Wind and PV infeed is summed up as distributed (DG) generation.

4. General modelling assumptions

As explained in previous chapters, the system is modelled with a design oriented approach; this means that the system frequency response is analysed for different levels of imbalance. The following steps of lost generation related to total system load are imposed:

- 1 %, 5 %, 10 %, 20 %, 30 %, 40 %, 50%, 60%

The following ranges are assumed

The first step of load shedding is fixed at 49.0 Hz.	The reason is to reserve a range between 50 Hz and 49 Hz (1 Hz) where primary reserve is trying to recover the effect from the power deficit. The same range is also usable by TSOs to compensate other effects mainly due to the additional imbalances that could happen in their system. For example, a TSO could choose to shed load (i.e. pumping storage plants or interruptible customers) in order to compensate generator trips due to non-compliant frequency disconnection settings.
The last step is activated at 48.0 Hz	This choice provides a range of 1 Hz to control the underfrequency transient by loads shedding. Below this frequency there is a certain margin (around 0.5 Hz) where generating units can operate and hopefully recover without trip.

5. Simulation cases

In order to determine the recommendations, 16 different scenarios are assessed. As a reference case, the current implemented ULFS is also being simulated (case 0). A number of variables have been taken into account as described hereunder to define the different scenarios (case 1-15). Finally, the incident of November the 4th 2006 was simulated, since this incident can be used as reference to determine a likely contingency which provoked a network split on Continental Europe (case 16) and as good validation test of the model.

5.1 "Current" case simulation (UFLS plan 0)

The “curent” situation has been simulated in order to evaluate the present behaviour expected in case of load shedding. The global load has been distributed among the TSOs proportionally to the value of primary reserve . See Table 2.

Frequency (Hz)	Load shedding (%)	Cumulative (%)
49.2	0.03	0.03
49.0	13.29	13.32
48.9	0.81	14.13
48.8	2.31	16.44
48.7	7.29	23.73
48.6	2.41	26.14
48.5	4.76	30.90
48.4	8.56	39.46
48.3	0.41	39.87
48.2	1.53	41.4
48.1	1.12	42.52
48.0	5.44	47.96
47.7	0.18	48.14

Table 2 System load shedding based on UFLS settings of each country.

The current load shedding relays settings are derived from an internal questionnaire compiled by TSOs.
Load shedding plan and primary reserve distribution between each TSO are combined in order to estimate the proportion of load shedding for each threshold.
For example, REE first threshold represents 15% of its load. In order to know how many “MW” it represents at peak load, we can use primary reserve: 385 MW of 3000 MW and applying the same proportion for peak load scenario we found 56.47 GW of 440 GW. Then these values are used to know the load shedding at 49 Hz: 15% of 56.47 GW is equal to 8.47 GW.
The same approach is done for each threshold and each TSO. Then all the “MW” disconnected at each threshold are summed up: for example we have 58.49 GW lost at 49 Hz, which represents 13.29% of 440 GW. It is important underline that this is a criterion to put all load shedding plans under the same basis in terms of MW; simulations results are not influenced by this, because all the system is modelled in normalised (p.u.) of peak load.

To get these values the following assumptions have been made:

- The average value is calculated when an interval has been given. For example 12.5% when the table’s value is "10-15%".
- No load shedding is taken into account for TSOs without data (West Ukraine and Albania).

5.2 Simulated Cases (UFLS plan 1-15)

The total load shed is parametrically tested from 20% to 60% of total load with step increase of 10%; the number of steps is varied from 4 to 10.
The first step is evaluated testing the system response from 4% to 12% and size of intermediate and final step is simulated between 2% and 10%.
Finally the load shedding is related to the theoretical load that does not include distributed generation.
An overview of all the applied scenarios is given in Table 3.

5.3 "4th November 2006 West area" case (UFLS plan 16)

As final verification a real event is selected with the aim to reproduce a load shedding; in particular the 4th November, 2006 was the last Continental Europe load shedding triggering.
In this case, only the following countries from west area have been taken into account:

- Belgium,
- Switzerland,
- Denmark,
- Spain,
- France,
- Italy,
- Netherlands,
- Portugal,
- Slovenia,
- Germany (3/4 of total load of the country),
- Austria (1/2 of total load of the country),
- Croatia (1/2 of total load of the country).

These countries represent around 2/3 of total RGCE Primary Reserve (estimated 2000 MW): it is assumed that they represent 2/3 of global load at peak load to estimate the proportion of load shedding at each threshold.
It should be noted that the simulation is done based on the load values represented in Table 6.

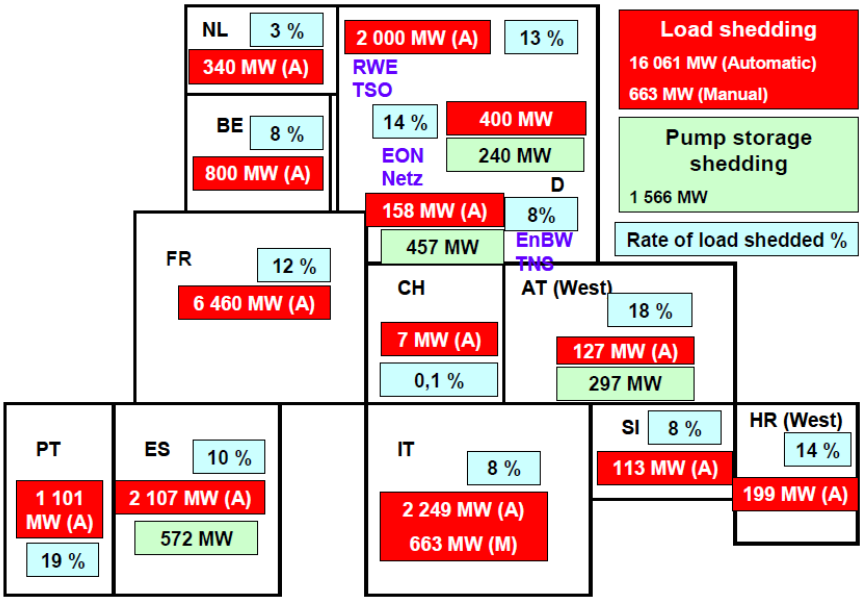


Table 3 - ULFS for 4th of November 2006 (West Area)

This case is only used to simulate the 4th November 2006 when:

- total load of the west area was 190 GW,
- the initial imbalance was 8,940 GW (mainly exchange from East to West areas)
- due to the low frequency 10,909 GW of production tripped (not only renewable):

Figure 2 shows a comparison between simulation (left) and real recording (WAMS); the model seems adequate and realistic.

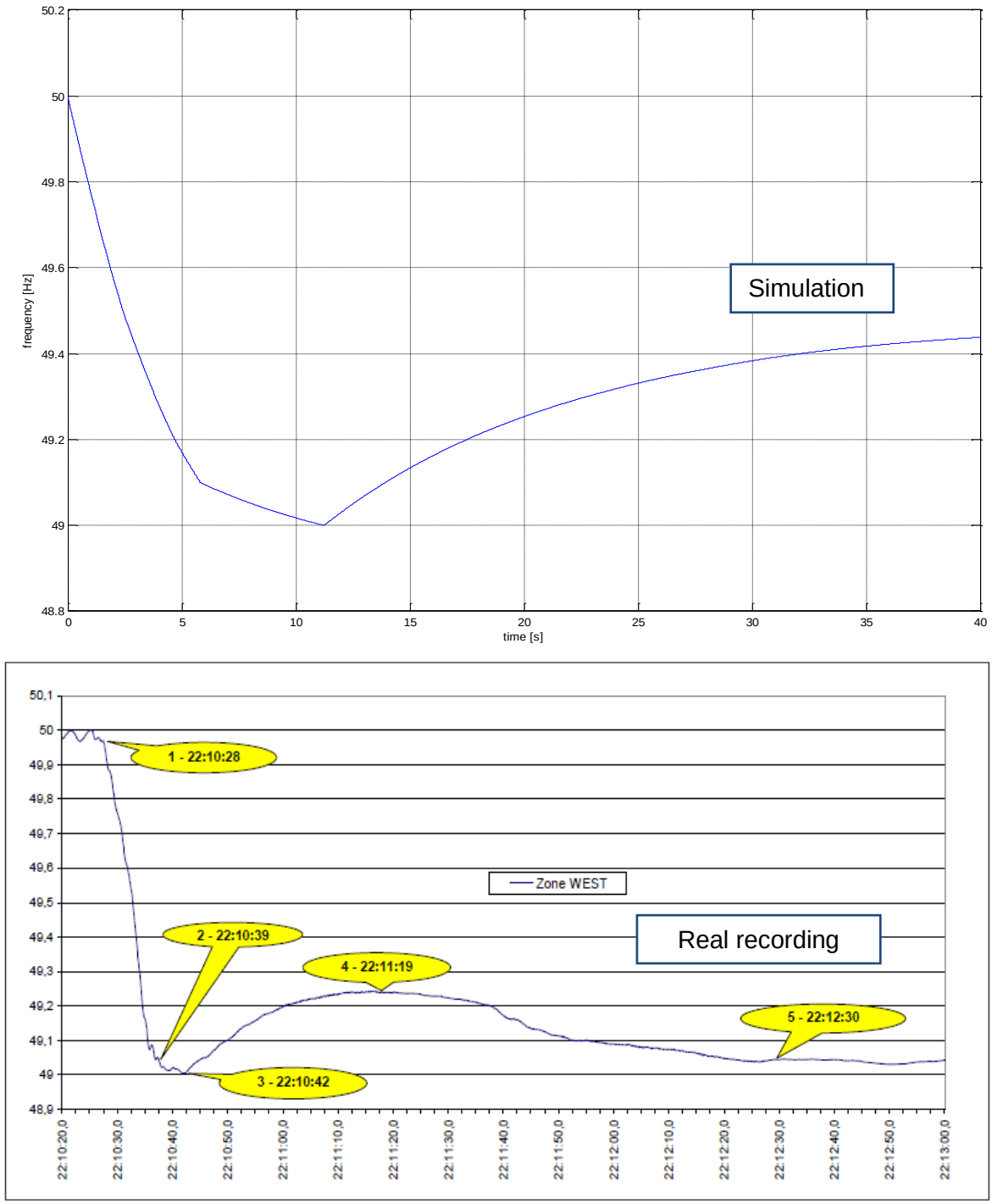


Figure 2: Comparison between 4th November 2006 West area frequency recording and simulation

Scenario	# thresholds	Frequency of activating threshold						
		% of load shed per threshold						
UFLS plan 1	n=6	49.0 Hz	48.8 Hz	48.6 Hz	48.4 Hz	48.2 Hz	48.0 Hz	Total
		2%	4%	6%	8%	10%	10%	40%
UFLS plan 2	n=4	49,0 Hz	48.7 Hz	48.4 Hz	48.2 Hz			
		5%	9%	11%	15%			40%
UFLS plan 3	n=4	49,0 Hz	48.8 Hz	48.6 Hz	48.4 Hz			
		12.5%	12.5%	12.5%	12.5%			50%
UFLS plan 4	n=4	49,0 Hz	48.7 Hz	48.4 Hz	48.2 Hz			
		15%	11%	9%	5%			40%
UFLS plan 5	n=6	49.0 Hz	48.8 Hz	48.6 Hz	48.4 Hz	48.2 Hz	48.0 Hz	
		10%	10%	8%	6%	4%	2%	40%
UFLS plan 6	n=8	49.0 Hz	48.87Hz	48.74Hz	48.61Hz	….	48.1 Hz	
		2.5%	2.5%	2.5%	2.5%	…..	2.5%	20%
UFLS plan 7	n=8	49.0 Hz	48.87Hz	48.74Hz	48.61Hz	….	48.1 Hz	
		3.75%	3.75%	3.75%	3.75%	….	3.75%	30%
UFLS plan 8	n=8	49.0 Hz	48.87Hz	48.74Hz	48.61Hz	….	48.1 Hz	
		5%	5%	5%	5%	…..	5%	40%
UFLS plan 9	n=8	49.0 Hz	48.87Hz	48.74Hz	48.61Hz	….	48.1 Hz	
		6.25%	6.25%	6.25%	6.25%	…..	6.25%	50%
UFLS plan 10	n=8	49.0 Hz	48.87Hz	48.74Hz	48.61Hz	….	48.1 Hz	
		7.5%	7.5%	7.5%	7.5%	…..	7.5%	60%
UFLS plan 11	n=10	49.0 Hz	48.9 Hz	48.8 Hz	48.7 Hz	….	48.1 Hz	
		2%	2%	2%	2%	…..	2%	20%
UFLS plan 12	n=10	49.0 Hz	48.9 Hz	48.8 Hz	48.7 Hz	….	48.1 Hz	
		3%	3%	3%	3%	…..	3%	30%
UFLS plan 13	n=10	49.0 Hz	48.9 Hz	48.8 Hz	48.7 Hz	….	48.1 Hz	
		4%	4%	4%	4%	…..	4%	40%
UFLS plan 14	n=10	49.0 Hz	48.9 Hz	48.8 Hz	48.7 Hz	….	48.1 Hz	
		5%	5%	5%	5%	…..	5%	50%
UFLS plan 15	n=10	49.0 Hz	48.9 Hz	48.8 Hz	48.7 Hz	….	48.1 Hz	
		6%	6%	6%	6%	….	6%	60%

Table 4 - Overview simulated scenarios

Figure 3 resumes from graphical point of view all the simulation results. It is possible do the following considerations:

- the blue lines represent the Policy 5 UCTE prescriptions and delimit an area
- some plans (i.e. 6, 11, …) are completely out of the blue delimited area
- some other plans (i.e. 15) partially are included into the area, but, requiring more (or less) load to be shed, are in the last part, outside
- other plans are within the area (i.e. 9)

In conclusion it is easy to see the “investigation area” of the study, demonstrating also a large comparison range between different strategies.

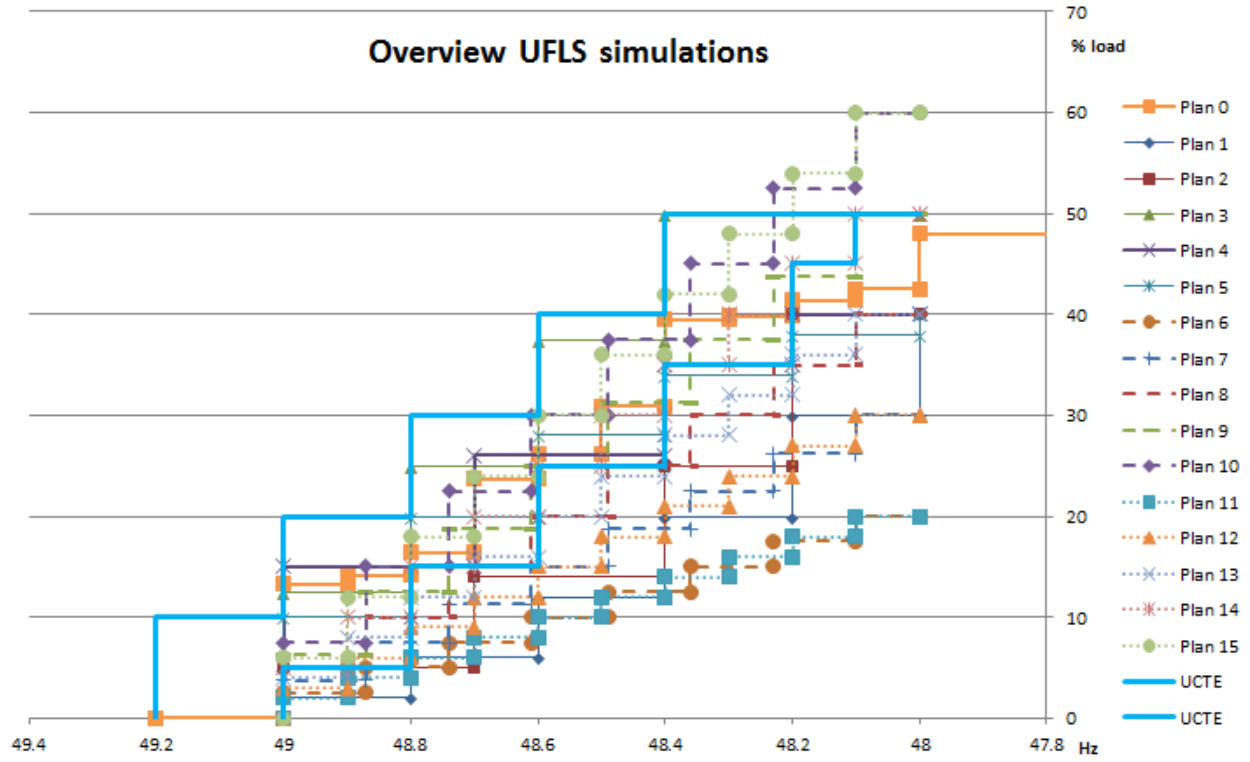


Figure 3: Overview UFLS simulations

6. Discussion on simulations results

Results have been analysed and assessed with the following acceptance criteria:

	Accepted when a) final frequency in the range 49.9 Hz – 50.1 Hz and b) maximum overshoot below 50.2 Hz
	Critical when c) final frequency out of the range 49.9 Hz – 50.1 Hz but within 49.2 Hz – 50.2 Hz, OR d) maximum overshoot reaches 50.2 Hz
	Rejected e) final frequency out of the range 49.2 Hz – 50.2 Hz and f) overshoot reaching 50.2 Hz

Table 5 Evaluation criteria for simulation results. Final frequency is measured at t=40 s.

Here are examples of each case:

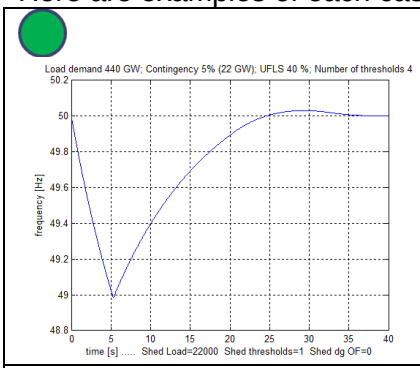


Figure 4: Correct behaviour as expected

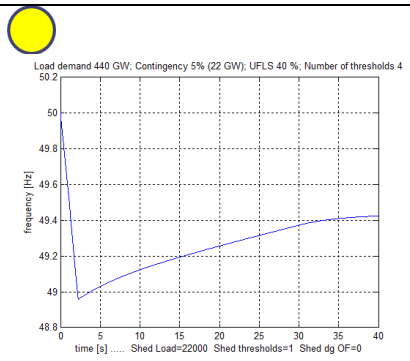


Figure 5: Low end frequency

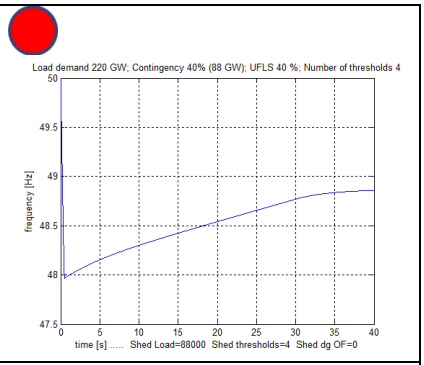


Figure 6: Too low end frequency

The green traffic light indicates the ideal load shedding behaviour; the yellow response is acceptable in emergency although it does not always guarantee a full frequency recovery and hence requiring additional load shedding actions or generation increase.

The red cases mark unacceptable load shedding strategies either due to practically absent frequency recovery or frequency overshoots due to overreaction.

The simulation results tabular output can be found in Annex, therein the corresponding criteria for ranking are depicted on this traffic light classification concept.

6.1 Current scenario - UFLS plan 0

This scenario represent the situation “as is”. The results show that load shedding plan works, but confirm the need to be optimized in order to comply better the criteria of acceptance previously described.

With the smaller contingencies (1% - 10%), the final frequency is too high, and for the higher contingencies (30% - 40%) the end frequency is not sufficiently recovered.

The renewable infeed has a mixed impact: results are worse for smaller contingencies and better for the high contingencies.

In conclusion it is advisible that even for the current situation of dispersed generation infeed additional load shedding shall be in operation in order to compensate the current undesired disconnection of generation during an automatic under frequency load shedding event.

6.2 Variable thresholds UFLS plans 1 to 5

Plan 1 is an example of an increasing step-size scheme, with a very limited size of load shedding during the first steps (2, 4, 6, 8, 10, 10%).
With the given acceptance criteria, the UFLS Plan 1 gives acceptable results for high values of contingencies (10% or more) at peak load without renewable energy infeed.
On the other hand, "small contingencies" (less than 10% of global load), which are much more probable, the final frequency is never acceptable. If only one threshold is triggered, the frequency does not recover to an acceptable value. For the smaller contingencies, the end frequency becomes too high when the third threshold (with increasing size) is reached.
For the minimum load cases, the results are quite similar (acceptable for bigger contigencies, not acceptable for smaller contingencies).
The impact of infeed of renewable energy is limited on the final results. There is only a weak impact due to the overfrequency disconnection thresholds.

Plan 2 also reflects an increasing step-size situation: the results are less acceptable than in the previous case. Only a few cases at peak load situation are acceptable, all the other situations create an unacceptable end frequency which is too high. Only cases with low contigency (5%) or the biggest contingency (40%) obtain the green status. This is linked with the increasing step-size. With the small contigencies, only 1 threshold is triggered. With the biggest contingency, all thresholds are being activated. The intermediate contingencies provoke the shedding of the second / third threshold, which are too big to avoid the overfrequency at the end.
Due to the overfrequency shedding of dispersed generation, the end frequency is a bit lower, but still unacceptable high.

In plan 3, the end frequency never reaches an acceptable value for all the peak load situations. Due to the big steps (12,5%), too much load is shed with each step, which leads to an overshoot of the end frequency.
The disconnection of renewable energy at the overshoot will lead to a lower end frequency, but still too high to be acceptable.

Plan 4 is an example of a decreasing step-size case. Only the biggest contigencies, where all thresholds are activated, are acceptable. Due to the biggest steps are being used first, the end frequency is too high in the other situations.
The shedding of dispersed generation gives a little lower end frequency, but still unacceptable.
The biggest contingency with activation of the four thresholds is now unable to recover to 50 Hz, due to the limited amount of conventional generation.

Plan 5 is also a decreasing step-size case, but with a smaller first step than the previous case, and with an equal size for the first two steps.

Due to the big (10%) first step, the low contingency situations create an frequency overshoot, even in the cases with dispersed generation being shedded at overfrequency.
Only the mid-range contigencies (10%-20%) are accepted if no dispersed generation is in the grid. With DG, these scenarios also become unacceptable.
The biggest contingencies (30%-40%) lead to an end frequency which is not recovered (more with DG infeed), due insufficient load shedded even with the activation of all the thresholds.

In conclusion it can be stated that non-linear load shedding schemes does not contribute in a positive way to reach a desirable system balance. Therefore, a symmetrical distribution of load over all load shedding stages is the recommended option.

6.3 8 thresholds UFLS plans 6 to 10

The following 5 cases have 8 equally sized steps, but with different amount of total shedded load

In plan 6 only a limited amount of contingency cases are acceptable. Even with the activation of all steps, the end frequency is never fully recovered. The minimum load cases (1%-5%) have a slightly better behaviour, but only a few cases are satisfactory. The impact of renewable infeed is very limited.

In plan 7, due to the increase of the total shedded load (30%), the results are a little bit better than with the previous plan. But still at higher contigencies (above 10%), the frequency is not able to recover to an acceptable level. Like in the previous plan, the impact of renewables is limited.

In plan 8, all results are acceptable without infeed of dispersed generation and for all contingencies the end frequency returns to 50Hz. If the dispersed generation is taken into account, the results become critical in most cases. In the situation with minimum load and large contigencies (30%-40% of load demand), the frequency is not able to fully recover. The overfrequency disconnection has almost no impact on the results. This plan is a good reference candidate in case of complete retrofit program extended to all RGCE TSOs.

In plan 9 the results are less acceptable in terms of quality than in the previous UFLS planWith the increase of the maximum shedded load to 50%, the end frequency becomes too high for the cases without renewable infeed. If the dispersed generation is taken into account, the final frequency tends to improve.

In plan 10 with the further increase up to 60% of load to be shedded with activation of all the thresholds, the results are almost never acceptable, as either the end frequency is too high, or not fully recovered. In general, the minimum load results are better than the maximum load cases.
The impact of renewables infeed is very limited, and does not improve the outcome.

6.4 10 thresholds UFLS plans 11 to 15

The following 5 plans contain 10 equally sized steps evenly distributed between 49 Hz and 48 Hz

In plan 11 without and with renewable infeed, the results are either critital or unacceptable for all the contingencies bigger than 10% of the load demand. The end frequency is never able to recover to 50 Hz, even by activating all steps. The results are slightly better at the minimum load situations, but never satisfactory.

In the plan 12, the final frequency is higher due to the increase of the total volume of load that can be shed (in comparison with previous case), but still not adequate. Only a few case are acceptable for small contigencies if renewable energy is taken into account.

Referring to plan 13, with the increase up to 40%, the results are more correct, especially at mimimum load. Only for the largest contingency (40%) the end frequency is not restored. The infeed of renewable energy has a positive impact for the peak load situations. Also this plan can be judjed a good reference candidate.

In plan 14 all results are correct without dispersed generation and critical (**Error! Reference source not found.**) when taken into account. Overfrequency disconnection of the renewable infeed has no real impact on the results (only very limited amount is lost).

Plan 15 demonstrate that if the total size of the UFLS scheme is further increased until 60%, results are worse than the previous case. Most simulations lead to too high end frequency. This is especially the case for the small contingencies (5%-10% and the big contingency (40%).
The impact of renewable infeed is mixed, but still not acceptable.

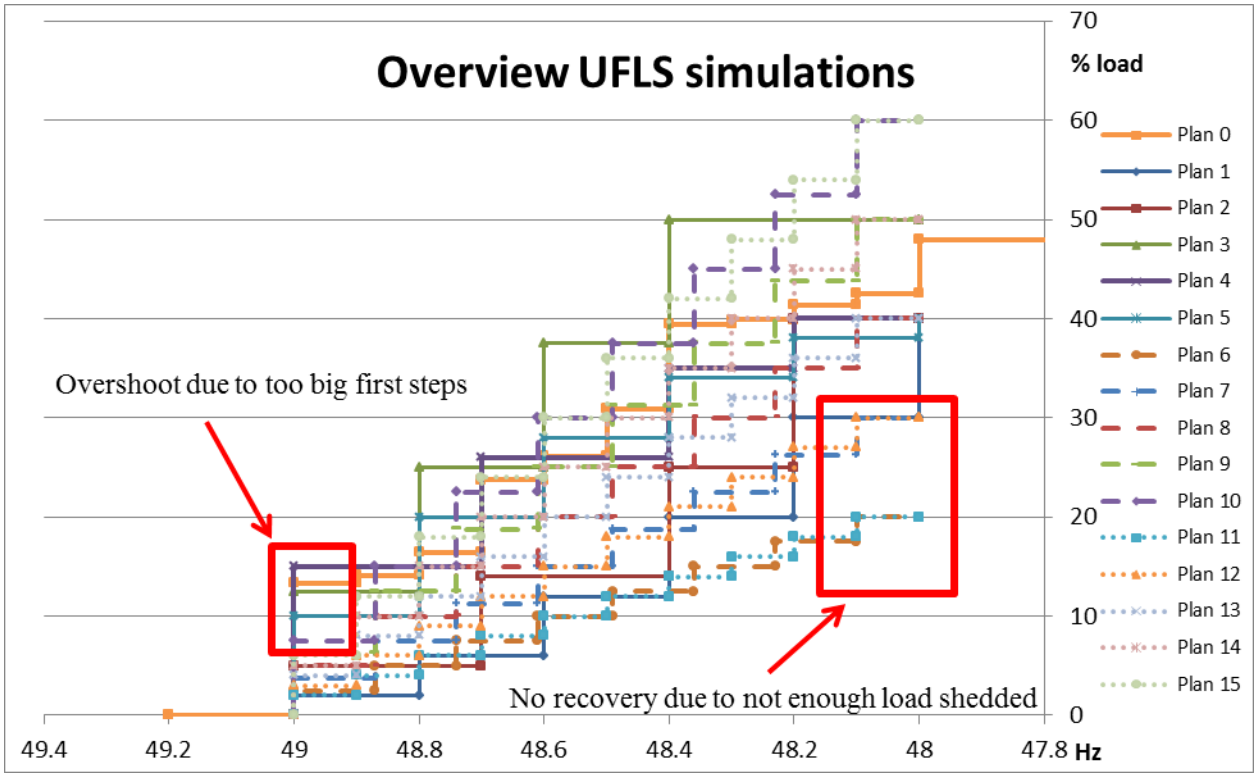


Figure 7: Overview results.

Figure 7 underline the “zones” where the choise of total quantity to be shedded has influence; from simulation we conclude that the only acceptable range is between 40% and 50% of total system load.
As can be desumed from figure 8, the more efficient plans are 8, 13, 14; the common factors are:

- number of thresholds (range between 8 and 10)
- maximum acceptable magnitude of a single step: 10%
- maximum total shedded load (range between 40% and 50%)

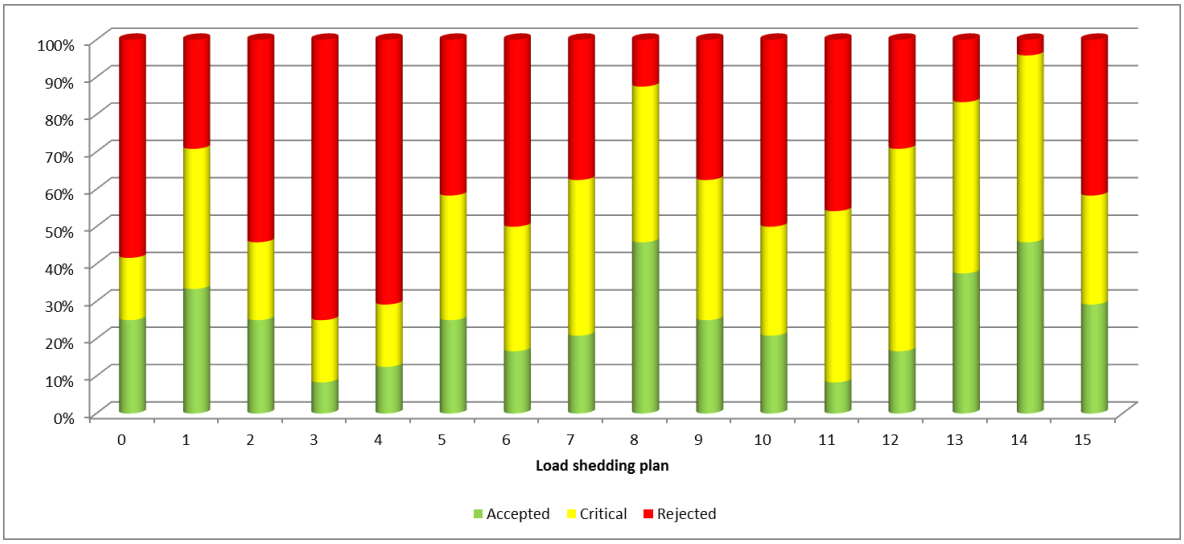


Figure 8: Classification of results for the simulations per UFLS plan

In conclusion, these results are used applying a certain “tolerance” in the way to be implemented in all the practical realities of RGCE, taking also into account different sizes of systems and trying to reduce the gap between existing situations and desired load shedding design.

7. Conclusions and Recommendations

7.1 Reference Load Definition

Based on the fact that within the majority of the CE TSOs the current underfrequency load shedding relays are located at the interface between the transmission and distribution system. Therefore, the most appropriate document in order to define the reference load reported [3]; reference load is:

- Yearly average net load consumption, while:
  - In the corresponding summation only those feeder are considered which do not have any dispersed generation infeed or those with only low dispersed generation
  - Mixed feeders with loads and high dispersed generation infeed are not considered in the summation process

This concept of calculating the reference load will have to be considered when each TSO has to implement his load shedding scheme. However it is foreseen that due to the further increase of decentralised infeed the shift of UFLS relays to lower voltage levels will be required and the number of relays will also have to increase correspondingly.

7.2 UFLS plan design recommendations

A general finding from the simulations which all parties should bear in mind is the fact that a load shedding plan is the last resort. This means that in some situations load shedding leads from a less than optimum state of the system to not optimal final state, and in few cases, does not avoid a system black out.

This conclusion is in line with the state-of-the-art experience and it is a consequence of the behaviour under extreme circumstances. Many local problems such as voltage stability, loss of units due to false tripping by protection, grid splitting, can produce unexpected situations within the system. These particular effects can be studied with more detailed models, but experience shows that uncertain information about parameters and real grid configuration at moment of the transient studied can lead to results which are even more inconsistent.

So starting from these considerations, the study was based on a normative model that guarantees an adequate degree of conservative approach without deviating to far from the real system behaviour.

The maximum value of total load that shall be shed per single TSO is 50% of the reference load for the whole system; the minimum value that shall be shed per single TSO is 40% of the reference load; Figure 9 illustrates the “permitted area” where the expected general system behaviour of load shedding plan is shown. Two load shedding plans 8 (blue) and 14 (orange) are shown. The black surve delimits the boundary of maximum load that can be shedded (clearly in whole frequency range must be considered the constraint about maximum step amplitude, equal to 10 %).

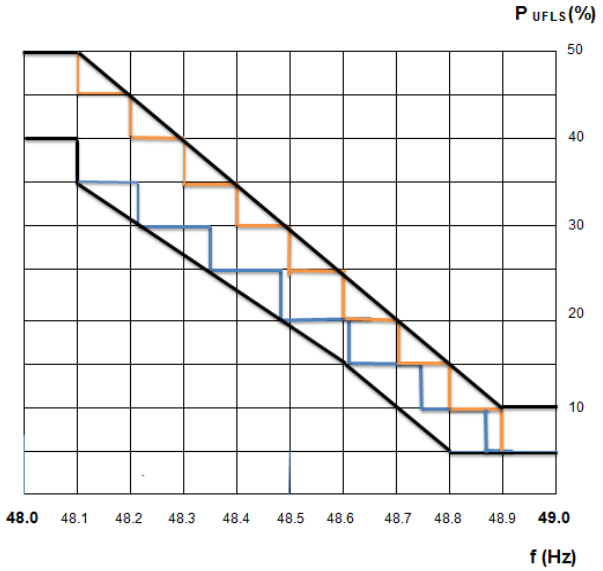
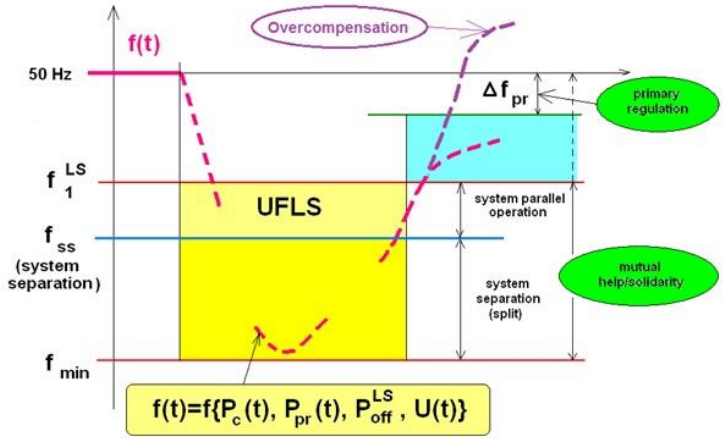


Fig. 9: Practical load shedding boundaries (black). Recommended load shedding plan 8 (blue) and plan 14 (orange) are also displayed.

The number of steps and the value of the total shed load is chosen in order to avoid overcompensation or frequency stagnation at low values. The appropriate ideal frequency to the system after load shedding intervention could be in the band of ± 200 mHz around 50 Hz; but this is not possible or feasible in all studied cases; the Figure 10 illustrates graphically it.



P_c : consumption, load
P_{pr} : primary regulation
P_{off}^{LS} : shed load
U : voltage

f_1^{LS} : the first (starting) step of UFLS
f_{min} : the permissible minimal operating frequency
f_{ss} : frequency value of the probable system split (separation)

Fig. 10: Underfrequency load shedding principle

The amplitude of each step shall be in the range of 5-10%. The minimum mandatory number of steps for single TSO is 6; this value is a compromise between the equal linear theoretical setting and the optimal practical solution. If the maximum permitted amplitude of single step is exceeded, the TSO must increase the number of steps in order to comply with it. The suggested maximum number of steps is 10 due to UFLS relay tolerances. The qualitative explanation of effect of step selection (varying the size) is showed in following Fig. 11; this can help to better understand simulation results.

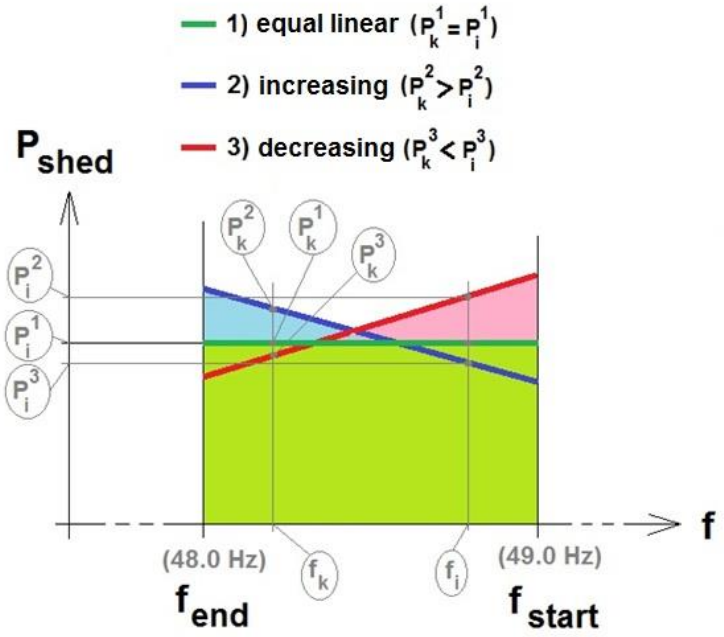


Fig.11: Underfrequency step size variation

Selected operating frequency range of the automatic UFLS is 49.0 - 48.0 Hz. The highest value is determined by the minimal frequency value of the automatic disconnection of pump-storage generating units from pumping mode (e.g. 49.3 Hz) taking into consideration a necessary security margin. The lowest value is determined by the minimal required operating frequency value (47.5 Hz) of the generating units taking into consideration a small frequency band also with necessary security margin for an individual additional load shedding of TSOs if it is needed. This additional load shedding can be important after a network split in case of island operation.

Additional recommendations are:

1. The TSOs should carefully evaluate the expected **total tripping time** of load shedding relays, considering measure and time, trip action of auxiliary circuits and circuit breaker opening time: it is highly recommended to use set the total time to less than or equal to **150 ms** and, in any case, **300 ms** should not be exceeded.
2. The TSOs should, based on the maximum level of accuracy of relays, select **100 mHz - 200 mHz as range** of frequency **between each step**. Current state-of-the art underfrequency relays ensure a measurement accuracy of +/- 30 mHz.

7.3 Special Cases

Based on the inventory of current frequency relays settings, it is clear that some applications in use with single TSOs are at the limit between load shedding plan and Special Protection Schemes; in some cases the TSOs use frequency relays to cut parts of the system or shed load in order to compensate for a loss of generation or for local problems. Some general rules can be reported (out of the scope of the present study simulation, but necessary to avoid confusion of system criteria and parameters).

The shedding of equivalent load by storage devices, pumps or load it is recommended to be applied below 49.8 Hz (optionally via ROCOF use and eventually with intentional delays) only if the TSO documents it to RG CE, demonstrating that this is a “balancing” emergency action that does not disturb the system.

References

[1] Operation Handbook Policy 5: Emergency Operations, 2nd release (2010).
[2] ENTSO-E Network Code on Emergency and Restoration, Working Draft, June 2014
[3] FNN/VDE, Technische Anforderungen an die automatische Frequenzentlastung, June, 2012
[4] New OH 5 WG – Questionnaire
[5] "Dispersed generation impact on CE regions security" https://www.entsoe.eu/fileadmin/user_upload/_library/publications/entsoe/RG_SOC_CE/130322_DISPERSED_GENERATION_final_report.pdf
[6] Final Report, System Disturbance on 4 November 2006, UCTE https://www.entsoe.eu/fileadmin/user_upload/_library/publications/ce/otherreports/Final-Report-20070130.pdf

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केन्द्रीय विद्युत प्राधिकरण,
नई दिल्ली

विषय : एनआर क्षेत्र में डीएफ/डीटी और यूएफआर रिले के संचालन से लोड राहत के लिए निर्धारित लक्ष्य और आवृत्ति लोड शेडिंग स्कीम (एयूएफएलएस) की समीक्षा के लिए गठित समिति की सिफारिशें ।

उपरोक्त विषय से संबंधित पत्र आवश्यक कार्यवाही हेतु संलग्न हे ।

10/09/18
(उपेंद्र कुमार)
अधीक्षण अभियंता (प्रचालन)

भारत सरकार
उत्तर क्षेत्रीय विद्युत समिति
18-ए, श.जीत सिंह मार्ग, कटवरिया सराय
नई दिल्ली- 110016

Government of India
Northern Regional Power Committee
18-A, S. Jeet Singh Marg, Katwaria Sarai,
New Delhi-110016

No: NRPC/OPR/107/2018/10584 Dated: 10th September, 2018

To
Chief Engineer (NPC),
Central Electricity Authority,
New Delhi - 110016

Subject: Recommendations of the Committee constituted for ''Review of Targets fixed for Load Relief from operation of df/dt & UFR relays in NR region & Automatic under frequency Load shedding Scheme (AUFLS)"

Sir,

The reference is invited point No. 8 (A) of Minutes of the 7th NPC meeting vide which RPCs were asked to deliberate on additional slabs of frequency as well as raising the set frequency for UFR operation. In pursuance of the same, a committee was constituted under the chairmanship of MS, NRPC, for review of Targets fixed for Load Relief from operation of df/dt & UFR relays in NR region & Automatic Under Frequency Load Shedding scheme (AUFLS). The issues were deliberated by the Committee in its two meetings held on 06.06.2018 and 16.08.2018 at NRPC Sect, New Delhi respectively.

The following are the recommendations of the above committee for discussion in the 8th NPC meeting:

1. Regarding additional slabs of frequency as well as raising the set of frequency, it was agreed that frequency setting of the stage-I shall be increased to 49.4 Hz with subsequent margin of 0.2 Hz for each stage with stage IV at 48.8 Hz as given in the table below:

   Proposed stages:

AUFLS	Existing Frequency (Hz)	Proposed Frequency (Hz)
Stage-I	49.2	49.4
Stage-II	49.0	49.2
Stage-III	48.8	49.0
Stage-IV	48.6	48.8

However, Haryana was of view that "Introducing of additional slabs of frequency as well as raising the said frequency of UFR operation may not be required presently."

2. With reference to NPC letter No. 4/MTGS/NPC/CEA/2018/475-481 dated 30.05.2018 committee has recommended that required load relief calculations should be revised considering increased power number around 15000 and calculated in MW rather than MW/Hz i.e. load relief calculated for each stage shall be multiplied by corresponding frequency deviation from 50 Hz.
3. It was also recommended to calculate the load relief on pan India basis but for region and its states, seasonal variations in the demand of the states may be considered.
4. Committee was of the view that methodology for calculating load relief according the Zalte Committee report may be reviewed mainly with respect to Voltage Correction factor and Daily load fluctuation factor, if deemed necessary by the states.

Regards,

10/09/2018

(Upendra Kumar)
Superintending engineer (O)

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

No. NRPC/OPR/119/04/2018/ 11746 **Dated: 08.10.2018**

To,

Chief Engineer,
National Power Committee,
NRPC Building,
3rd Floor, Katwaria Sarai,
New Delhi-110 016

Subject: - Comments on the draft of "Guidelines on Availability of Communication System"-reg.

Sir,

This is in reference to your letter dated 07.09.2018 vide which comments of the RPCs were sought on the draft **"Guidelines on Availability of Communication System".**

The draft of the guidelines was deliberated in the 152nd OCC meeting with the constituents and the comments of the OCC were obtained and the same is presented below for your information:

In the meeting, OCC decided to propose that "*The actual availability (duration for which the communication system was actually available) & deemed availability of the communication system may be calculated separately. However, for commercial purposes, the sum of the two shall be used.*"

राष्ट्रीय विद्युत समिति
डा.सं. 351
दिनांक 09-10-18

Sincerely,

(M A K P Singh)
Member Secretary, NRPC

Gmail **CE NPC <cenpccea@gmail.com>**

Fw: Comments by NERPC on Draft Availability of Communication System

1 message

Pardeep Jindal <jindal_pardeep@yahoo.co.in> 8 October 2018 at 18:01
To: CE NPC <cenpccea@gmail.com>

Pardeep Jindal

Begin forwarded message:

On Monday, October 8, 2018, 5:32 PM, BRIEFLEE LYNGKHOI <brieflee.lyngkhoi@gmail.com> wrote:

> Dear Sir,
>
> PFA herewith the comments from NERPC on above draft sent by your good office to Hon'ble CERC. Kindly look into the matter and considers the same.
>
> Regards,
>
> B. Lyngkhoi, IES
> Director/SE(O),
> NERPC, Shillong,
> Govt. of India, Ministry of Power
> O. 0364-2534039
> M.-09436163419

Comments on Draft Avaialbility of Communication.docx
18K

Ref.	Description	Ref
Comment 1	Maintenance Shutdown will be allowed 24 hrs per Optical OPGW/FO end to end Link per year which will not be considered in outage as shown in draft.	The matter was discussed in 10th NETeST under item **B.14, Draft CEA Technical Standards for Communication System in Power Sector) Regulations, 2018;** Page no.25 of the MOM. Based on feedback from State utilities & other utilities in NER, the shutdown requirement was discussed in detailed (for annual maintenance period-{SOS/Planned} of 24hrs per link per year as required should be considered beyond outage/ reliability calculation and to be considered as deemed available)
Comment 2	That calculation may be done on yearly basis or at most half yearly basis.	Feedback taken from other states viz. Tripura , Assam etc. utilities of NER

Note: The above is proposed keeping in view hindrances/difficulties faced in maintaining communication systems in NER which includes tough terrain, difficult road & geographical conditions, infrastructure, some highly sensitized zones, remote-ness & high time taken to reach sites for any restoration etc.

GUIDELINES

ON

AVAILABILITY OF COMMUNICATION SYSTEMS

FOR

INTER-STATE TRANSMISSION OF ELECTRICITY

DRAFT

AUGUST 2018
NEW DELHI

NATIONAL POWER COMMITTEE DIVISION

CENTRAL ELECTRICITY AUTHORITY

GUIDELINES ON AVAILABILITY OF COMMUNICATION SYSTEM FOR INTER-STATE TRANSMISSION OF ELECTRICITY

1. **INTRODUCTION**:

1.1 As per regulation 7.3 (i) of Central Electricity Regulatory Commission (Communication System for Inter-State transmission of Electricity), Regulations, 2017, National Power Committee (NPC) has been entrusted to prepare Guidelines on Availability of Communication System in consultation with RPCs, NLDC, RLDC and other stakeholders.

1.2 The relevant provisions in the CERC (Indian Electricity Grid Code) Regulations, 2010 and Central Electricity Authority (CEA) (Technical Standards for Connectivity to the Grid), Regulations, 2007 in respect of Communication System as follows:

1.2.1 **Regulation 4.6.2 of the Indian Electricity Grid Code (IEGC)** stipulates that *´Reliable and efficient speech and data communication systems shall be provided to facilitate necessary communication and data exchange, and supervision/ control of the grid by the RLDC, under normal and abnormal conditions. All Users, STUs and CTU shall provide Systems to telemeter power system parameter such as flow, voltage and status of switches/ transformer taps etc. in line with interface requirements and other guideline made available by RLDC. The associated communication system to facilitate data flow up to appropriate data collection point on CTU's system shall also be established by the concerned User or STU as specified by CTU in the Connection Agreement. All Users/STUs in coordination with CTU shall provide the required facilities at their respective ends as specified in the Connection Agreement. ´*

1.2.2 **Regulation 6(3) of the CEA (Technical Standards for Connectivity to the Grid)** stipulates that *'the requester and user shall provide necessary facilities for voice and data communication and transfer of online operational data, such as voltage, frequency, line flows and status of breaker and isolator position and other parameters as prescribed by the appropriate load dispatch centre.'*

2. DEFINITIONS:

2.1 Words and expressions used in this methodology shall have the same meaning assigned in the Electricity Act, Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulation ,2007, CEA (Technical Standards for Communication System in Power System Operation) Regulations, 2018, CERC (Indian Electricity Grid Code) Regulations, 2010 & (Communication System for Inter-State transmission of Electricity), Regulations, 2017 and amendments thereof.

2.2 Other words have been explained as per the context in these guidelines.

3. SCOPE AND APPLICABILITY:

3.1 As per Regulation 5. (i) of CERC (Communication System for Inter-State transmission of Electricity), Regulations, 2017, "*These regulations shall apply to the communication infrastructure to be used for data communication and tele -protection for the power system at National, Regional and inter-State level and shall also include the power system at the State level till appropriate regulation on Communication is framed by the respective State Electricity Regulatory Commissions.*"

3.2 As such, in case of ISTS i.e. for the communication system to be provided at RLDCs/NLDC, these guidelines shall be applicable for CTU and in case of State Transmission System i.e. for the communication system to be provided at SLDC, these guidelines shall be applicable to the respective State Transmission Utility (STU).

[The CTU (or STU as the case may be) shall have back to back co-ordination/agreement with transmission licensees, generators, dedicated transmission line owners for providing power system communication on their network]

4. TREATMENT OF COMMUNICATION SYSTEM OUTAGES:

4.1 Outage time of communication system elements (i.e. channels) due to acts of God and force majeure events beyond the control of the communication provider shall be considered as deemed available. However, onus of satisfying the Member Secretary, RPC that element outage was due to aforesaid events shall rest with the communication provider.

4.2 Any outage of duration less than or equal to 1 minute in a time-block shall be treated as deemed available provided such outages are not more than 10 times in a day.

(Explanation: (a)If a channel is out for a duration of more than 1 minute in a time-block, the channel shall be considered out for the whole time-block. (b) If a channel is out for a duration up to 1 minute in a time-block, and such outages are more than 10 times in a day, then such outages shall not be exempted under 4.2 of the guidelines and all the time-blocks with such outages shall be considered outages).

5. METHODOLOGY FOR COMPUTATION OF AVAILABILITY OF COMMUNICATION SYSTEM:

5.1 Availability of Communication System **(A_{CS})** shall be calculated as under:

$$A_{CS} = \frac{\sum_{i=1}^{N}(A_i)}{N}$$

Where - N is total number of communication channels which is based on the requirement of RLDCs/NLDC and the same would be decided in consultation with respective RPCs/NPC.

- A_i is Availability of i^{th} Channel which shall be calculated as given in 5.2 (b)

5.2(a) If a channel is out for some time in a particular time-block as defined in IEGC (presently 15 minutes), for calculation of availability of communication system, it would be considered as not available during the whole block.

5.2(b) Availability of i^{th} Channel (A_i) shall be arrived as under:

$$A_i = \frac{B_T - B_{Ni}}{B_T} \times 100$$

Where B_T is Total number of time-blocks in a month

B_{Ni} is the total number of time-blocks, in which *i^{th} channel was not available after considering deemed availability status of 4.1.*

$B_{Ni} = B_{ANi} - B_{Gi}$,

Where-B_{ANi} is absolute number of time-blocks in which the i^{th} channel was 'not available' on account of any reason after due consideration of provisions under 4.2.

-B_{Gi} is Number of time-blocks out of B_{ANi}, in which *i^{th} channel was 'not available' on account of act of god as specified in 4.1 above.*

[For example, if there are 2880 time-blocks (B_T) in a month, and a particular channel is not available for a total of 70 (B_{ANi}) time-blocks; and out of this, this channel was not available for 20 (B_{Gi}) time-block due to act of god, then-B_{Ni}=70-20=50, and A_i = (2880-50)/2880 = 98.26%]

***

13.4 SRPC noted the above.

14 ROADMAP TO OPERATIONALISE RESERVES IN THE COUNTRY

14.1 In the 29th Meeting of SRPC it had been noted that in the matter of Roadmap to operationalize Reserves in the country, Hon'ble CERC vide Order dated 13.10.2015 on Petition No. 11/SM/2015 had directed as follows:

(b) The Commission reiterates the need for mandating Primary Reserves as well as Automatic Generation Control (AGC) for enabling Secondary Reserves.

(i) All generating stations that are regional entities must plan to operationalize AGC along with reliable telemetry and communication by 1st April, 2017.

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

(c) To start with, a regulated framework in line with the Ancillary Services Regulations would need be evolved for identification and utilizing of spinning reserves and implemented with effect from 1st April, 2016. This framework may continue till 31st March, 2017.

……

(d) In the long term, however, a market based framework is required for efficient provision of secondary reserves from all generators across the country. For this, NLDC/POSOCO is directed to commission a detailed study through a consultant and suggest a proposal to the Commission for implementation by 1st April, 2017, giving due consideration to the experience gained in the implementation of Spinning Reserves w.e.f. 1st April, 2016.

14.2 In earlier Meetings the following had been noted:

- Hon'ble CERC in Petition No. 79/RC/2017 had passed Order dated 6th December, 2017 in the matter of '*Automatic Generation Control (AGC) pilot project*'.
- NLDC had informed that in respect of AGC at Simhadri, offer had been received from M/s Siemens. They would convene a Meeting with NTPC on 20th February and then the Order would be placed with implementation schedule of 5 to 6 months. Regarding AGC at NP Kunta, M/s USAID had agreed to take the AGC implementation under GTG project. On 10.02.2018, after assessment it had been concluded that AGC implementation at NP Kunta was feasible. AP utilities as well as SERC were required to be consulted in this regard.

14.3 A Meeting on AGC issues had been conducted at SRPC on 28th March 2018 (MOM available on SRPC website). The following highlights may be kindly noted:

- Better Load Forecasting and RE framework (forecasting, scheduling & settlement) would naturally result in lesser reserve requirement and needs to be pushed through FOR.
- Scheduling software for unit commitment, meeting the ramps (+)/(-), ramps of generators, fast start up and shutdowns of generators, errors in load and RE forecast, technical minimum, meeting peak demand, meeting minimum demand, net load,

pump operation etc is required for resource optimization and proper decision support.

- Forum opined that there was a need for a Procedure to quantify Secondary/Tertiary Reserves. Procedure should also include a mechanism to monitor these reserves in real time manner for replenishment of these reserves.
- Sharing of these secondary/tertiary reserves, and including those available with States, could lead to optimization of reserve requirement. However, the mechanism of sharing and associated cost needs further analysis and discussions.
- While there was lot of focus on positive reserve, during large RE ingress, negative reserve is also required. This needs to be covered prominently in the reserve ambit.
- It was strongly felt that secondary and tertiary reserves should always be available with system operator and cannot be dynamic with URS availability (diminishing during peak hours) or with all units are running in Technical Minimum (no negative reserve). Whether this could be achieved through Market based reserve or through regulatory mandatory market needs to be studied?
- There needs to be a mechanism in place for sharing of secondary/tertiary reserves available with the states. These reserves are to be made available with the system operator.
- A time bound implementation of ABT in the states is also necessary for AGC (Secondary)/Tertiary Reserves to take off.
- Forum (except NLDC/SRLDC) was of the view that Gate Closure already exists (30 minutes prior to the delivery) as per IEGC. This issue needs to be further examined.
- Forum opined that proposed Bias Setting requires further review.
- It was noted that in the Report on National Reference Frequency it has been recommended that the dead band of +/-0.03 Hz (ripple factor in IEGC) may be gradually phased out as is being done in ERCOT Texas and Europe'. Generators strongly opined that the dead band of +/-0.03 Hz (ripple factor in IEGC) may need to be retained.
- For SCADA veracity it was noted that it was joint responsibility of all the entities of SRPC forum to take proactive and appropriate steps to ensure consistency in data. The issue needed due attention it deserves as it is critical in grid operation. The entities needed to have dedicated team with 24x7 support specifically at SLDC/RLDC/NLDC/CTU/STU.
- It was noted that the Optical Fibre Connectivity could be assessed and action plan could be finalized by CTU/STU.
- There is a need to have AGC pilot projects in all the SLDCs. It was thus recommended that each SLDC could have a AGC standalone infrastructure with one or two stations wired for AGC as Pilot Project. This approach would enable faster implementation of AGC upto the state level. This would ensure hands on experience at State Level at a faster pace along-with the development of infrastructure facility at SLDCs.
- IEGC provision that the schedules should not exceed capacity on bar less Normative Auxiliary Consumption need to be implemented pan India for all generators- ISGS, State generators, IPPs, MPPs etc.
- The forum strongly advocated for AGC also for RE generators. There would be need

for both positive and negative reserves provision for RE also. There is need to have a well laid down procedure including commercial settlement, which could also be a market based mechanism.

14.4 In the OCC Meetings the following had been noted:

- KPCL had informed that M/s Andritz for Varahi and M/s ABB for Sharavathy have been identified for the AGC implementation by USAID / PRDC for which, KPCL has given approval. This was expected to be completed by December 2018. Further, AGC for 10 MW of Solar project at Sivasamudram was also under consideration.
- Simhadri, NTPC informed that the infrastructure readiness for AGC was likely to be in place by August 2018.
- A Workshop had been conducted on 15Th May 2018 at APSLDC by NLDC on AGC at NP Kunta.

14.5 The following had been deliberated in the TCC Meeting:

- APTRANSCO had informed that APGENCO is willing to speed up the AGC activity since more RE has to be integrated. Some lead by SRLDC & SRPC Secretariat would expedite the Pilot Projects.
- KSEBL had suggested to explore the possibility of obtaining funding for implementation of AGC for utility owned generators and to create suitable market mechanism.
- NLDC had informed that States need to take action as per the Regulations/Orders. Simhadri AGC may be in place by mid-September, for Mouda (WR), Barh (ER) & Bongaigaon (NER) tender specification had been rolled out and tender would be floated by end of August 2018. Detailed road map for Phase I & Phase II had been submitted to Hon'ble CERC. For other Pilot Projects, approval of CERC would be sought shortly. NLDC SCADA is being upgraded with AGC software to include Stations for which tariff is determined by the Commission and NLDC would be approaching Commission for approval.
- SRLDC had observed that as per CERC Regulation/Order, the AGC should takeoff in the state generators also. Considering the high RE penetration in SR, TCC could suggest on AGC pilot project implementation in each state.
- NLDC had informed that stand alone AGC software was available. From existing system tie line flow and frequency data was an input. A communication link to the generating station was required along-with the protocol compatibility to be included in LOA. Hardware and software was available. Licensee cost would increase with number of units wired for AGC. The protocol between SCADA and AGC software has to be established.
- NPC had opined that stand alone system may be sufficient for all the generators and not only for those in the Pilot Project.
- **As noted in Meeting held on 28.03.2018, Pilot Project on AGC was agreed to be implemented in all the states. States could approach the State Regulators and commence the Pilot Project**.

- NLDC had agreed to assist on technical aspects in the AGC implementation.
- It was also agreed that a Committee with participation from State SLDCs, GENCOs, SRLDC and NLDC would be formed to facilitate Pilot Project implementation in the states.

14.6 SRPC noted the above.

15 TTC/ATC

15.1 ATC/TTC computations by SLDCs

The following had been noted in earlier Meetings:

- APSLDC had assured that the system would be in place before the next SRPC Meeting.
- KAR-SLDC had informed that the converged case was being furnished, while Nodal Officer details would be furnished within a week.

The following is the status in this regard:

State	5 months LGB	Converged PSSE Base case	ATC/TTC Computation furnished to SRLDC	ATC/TTC Computation posted on SLDC website	Nodal Officer Status	Study Group
AP	Yes	No	No	No	No	Yes
TS	Yes	Yes	No	No	Yes	Yes
KAR	Yes	Yes	No	No	No	Yes
TN	Yes	Yes	Yes	No	Yes	Yes
KER	Yes	Yes	Yes	No	Yes	Yes

The following had been noted in the OCC Meetings:

- APSLDC had constituted a Study Group. While one DE had been posted, supporting staff was to be posted.
- SRLDC had assured of cooperation in training of the officials in this regard.

TCC deliberations

- APSLDC informed that from August 2018 onwards, PSSSE base case would be furnished.

SRPC noted the above.

15.2 Harmonization of Philosophy of Computation of Total Transfer Capability (TTC) by POSOCO and CTU between ER-SR & WR-SR

In a Special Meeting convened by NPC on 23rd October 2017, members had agreed for the approach for preparing base load flow case to compute TTC/ATC for the purpose of operationalization and grant of MTOA.

SRPC/TCC had requested NPC to similarly kindly finalize procedure for base case preparation by POSOCO, in respect of STOA.

In line with the decision taken in the 32nd TCC meeting, SRPC Secretariat had taken up the issue of finalizing the procedure for base case preparation by POSOCO in respect of STOA with NPC vide letter dated 05.03.2018 (**Annexure-XXVI).**

Record Notes of the meeting on AGC held on 17.09.2018 at WRPC Mumbai.

The meeting on AGC was held on 17.09.2018 at WRPC, Mumbai, the list of participants is enclosed at Annexure-I. MS, WRPC welcomed all the participants. He informed that the meeting is being held in line with the decision taken in 7th Nation Power Committee held on 08th September, 2017 at Indore and subsequent discussions in 36th WRPC meeting on 23rd June, 2018 at Ahmedabad.

In his opening remark, MS, WRPC informed that around year 1990 onwards training on AGC concept was imparted to power engineers on DTS (Despatcher Training Simulator) lab at PSTI, Bangalore (then under CEA). The issue of having reserves and AGC was discussed in the 3rd meeting of National Reliability Council for Electricity (NRCE) on 1.8.2014. The issue was highlighted by CERC in 2015 by specifying road map for reserves. Many meetings and workshops related to AGC were held in the regions. In the year 2017, there was a petition by NLDC before CERC for AGC implementation, which resulted in a pilot project at NTPC Dadri that is being functional since January, 2018. It is known that after disturbance, system inertia plays a role on frequency, followed by primary response (governor action), secondary response (e.g. AGC) and tertiary response (e.g. RRAS). Though governor action will improve the frequency, but a secondary response is required to restore the frequency to its nominal value. 175 GW of RE is expected by 2022 which would take the penetration level above 50%. So, this issue demands some better control of frequency and interchanges for system reliability and security. The meeting is being conveyed for obtaining the views and feedback from the constituent members for further course of action.

After opening remarks by MS, WRPC, discussion on agenda points followed which is given below:

1	**Need for AGC, infrastructure and regulatory requirements, implementation impact etc.**
	Need for AGC: NLDC representative informed that the frequency profile was having wide variations till the first half of this decade and has stabilized recently. However there is no secondary control in place and the primary response is not giving the desired results. The Hon'ble CERC has mandated to have secondary control reserves for all the regions. In WR the secondary reserves to be maintained is 800MW (largest Unit in region) and all India 3600MW. The frequency variation needs to be regulated/smoothened, through secondary control of Generators within a very narrow band to serve quality power to the consumers. Detailed plan has been submitted by NLDC to Hon'ble

	CERC on 14th July 2017 for using Secondary Control as an Ancillary Service. **Infrastructure and regulatory requirements & implementation impact etc.:** The details of these aspects are covered in the NLDC presentation and are given in the next sections.
2	**Sharing of experiences of NLDC (POSOCO) pilot projects on AGC at Dadri, Simhadri, and a solar project.**
	NLDC representative informed the following regarding implementation of AGC pilot projects of Dadri and Simhadri. • Primary (droop) control ➢ Obligatory, Automatic response • Secondary (AGC) control ➢ Spinning reserve, NLDC/RLDC/SLDC controlled, Automatic Generation Control (AGC) • Tertiary control ➢ Tertiary Reserve and response from State, Manual. He explained in brief about the Dadri NTPC AGC pilot project. Unit 5 & 6 is controlled through AGC. The MW control limit for AGC has been set to ± 50MW for the pilot project. The details of architecture are given in the presentation enclosed at Annexure-II. **The principle used is given below:** Region considered as an Area for secondary control. • ACE = (Ia - Is) + 10 * Bf * (Fa - 50) Where: o Ia = Actual net interchange, negative for NR meaning import by NR o Is = Scheduled net interchange, negative for NR meaning import by NR o Bf = Frequency Bias Coefficient in MW/0.1 Hz, positive value o Fa = Actual System Frequency • ACE positive means NR is surplus and NR internal generation has to back down • ACE negative means NR is deficit and NR internal generation has to increase • Tie line bias mode and Frequency bias only mode both possible • Interchange scaled using a factor of 15, changeable.

The salient points of the NLDC presentation is as follows:

Essential requirements for Secondary Control:

- Generator shall bear the cost of secondary control hardware at the plant end
  - Including the cost of the fibre optic cable
- Shall share DC and Schedule like ISGS generators on day ahead basis
  - Subsequent revisions with RLDCs
- The generating units shall have working control systems for turbine, boiler and governor
  - Governor response plots/graphs of past incidents have to be submitted to RLDC
- Existing wide band communication node
  - Within a radius below 30-40 km from the plant
  - Detailed survey is given in Annexe-VI of the report.

AGC on other plants:

- Karnataka Power Transmission Corporation Limited (KPTCL)
  They are in advance stage of implementation of AGC at Varahi , Sharavati & NP Kunta Solar power project.
- NTPC Simhadri
  - Letter of Award issued for the supply, testing and commissioning
  - 18th May 2018 LOA, September-October 2018 commissioning
- Mauda, Barh, Bongaigaon
  - Tendering phase
- National Power Committee (NPC) meeting held at Indore on 8th September 2017
  - Agenda on AGC sent for discussion in RPCs for preparedness
- Contracting issues
- NLDC SCADA up gradation
  - October 2017 to March 2019

Target to have AGC on several phase-I plants by 2021

3	**Proposed plan for implementation of pilot project at NTPC, Mouda.**

NTPC Mouda representative informed the followings:

- Tendering/LOI process will be done within a week's time.
- 800 meter of cable laying is required to be done from switch yard to control room.
- The AGC logic shall be based on Dadri experience.
- The detailed presentation on road map regarding implementation shall be updated in the OCC.

4	**States views/participation on implementation of AGC (road map i.e. identification of unit & proposed plant by State Genco.)**
	a) Madhya Pradesh representative informed the following: • The AGC project is being implemented and is at an initial stage of information gathering like technical data, commercial data etc. • They have selected at present Singhaji Stage-I unit I and II for AGC pilot project. This is based on their MOD (Merit order dispatch) • They have requested for budgetary offer from GE and BHEL and offer is still awaited. Further they have estimated one year for completion of the pilot project. • They have requested NTPC and NLDC to offer guidance and support for the project. b) SLDC, Chattisgarh, representative informed that the issue of AGC is under discussion with the Management and the outcome of the decision shall be intimated later. c) Mahagenco representative informed that they would discuss with their management and revert back. d) SLDC, Gujarat representative informed that any unit from Wanakbori 4, 5 and 6 or Ukai 6 may be considered for AGC pilot project. e) NLDC representative informed that ISGS whose tariff is determined /adopted by the Hon'ble commission are considered under Phase-I and other IPP's shall be considered under phase-II.

The meeting ended with thanks to chair.

****

B.13.6 NRLDC representative also mentioned that since, Rihand-III is now connected to WR, outage of inter-regional lines (Rihand III – Vindhyachal pool) would be taken care by NLDC in consultation with NRLDC and WRLDC. In case of constraint in Vindhyachal complex, the curtailment of Rihand stage 3 would be done similar to other stations in Vindhyachal complex. Scheduling of Rihand-III would be continued by NRLDC.

B.13.7 NRLDC representative informed that based on approvals in OCC, the System Restoration Procedure has been modified to include utilisation of Rihand stage 3 and Rihand stage 2 bus coupler in the similar manner as AC bypass at Vindhyachal back to back.

B.13.8 However, NRLDC representative emphasized that the issue of higher vibration is Rihand stage 3 units during mono pole ground return operation of Rihand-Dadri HVDC need to be addressed. He said that as decided in OCC meeting, NTPC shall come out with past data as well as grounding measurements at all the stages of Rihand.

B.13.9 NTPC representative informed the forum that as per report from field officers, they have no past history such vibrations at any of the stages during mono pole ground return HVDC operation.

B.13.10 TCC recommended formation of a committee with members from POWERGRID, CTU, CEA, NTPC, POSOCO and NRPC to look into the issue of high vibrations during mono pole ground return operation for corrective actions.

NRPC deliberation

B.13.11 NRPC noted the delibration held in TCC and approved the formation of Committee recommend by TCC.

B.14 AGC Implementation

TCC deliberation

B.14.1 NRLDC representative informed the house that Hon'ble CERC order dated 13th October 2015, highlighted the need for implementing Automatic generation control in machines. In this direction, first pilot project of Automatic Generation Control (AGC) in India has been officially commissioned by POSOCO and NTPC. This pilot project is controlling the generation of Dadri Stage 2 (980 MW IC) with reference to the Area Control Error (ACE) of Northern Region from 04.01.2018 onwards.

B.14.2 Further, Hon'ble CERC has asked POSOCO to replicate similar AGC pilot projects in other regional grids. Implementation of AGC is crucial at this juncture as it would help adding of renewable capacity in the grid which is happening at an unprecedented

scale and speed (both large-scale grid connected projects as well as several distributed energy resources primarily in the form of rooftop solar).

B.14.3 The NRLDC representative also mentioned that there is separate agenda item from NPC on the subject and a detailed presentation on AGC would be made on that agenda.

B.14.4 TCC noted the development.

NRPC deliberation

B14.5 NRPC noted the information

B.15 Summer Preparedness – 2018

B.15.1 NRLDC representative gave a detailed presentation on the summer preparation. He gave regional and statewise trends of Demand (MW) and Energy for last 4-5 years and based on these drew conclusions on rise in demand with rise in temperature, demand increase trajectory etc. He also put forth the issues specific to summer/monsoon months for Northern Region. He stated that the summer and monsoon months are very crucial months for system in view of highest demand being met in NR during these months. He presented the high temperature forecast by Indian Meteorological Department (IMD) for summer months wherein about 1-2 degrees higher temperatures have been predicted in NR while the same around 1 degree higher in the rest of country. He also mentioned that the hydro generation at present is lower than the past year though reservoir position is almost similar to last year. The representatives of hydro stations also informed that house that this these is less snow and therefore hydro generation is on lower side.

B.15.2 He mentioned following characteristics of summer/monsoon power system operation of NR:

- High Demand
- High loading/ High Reactive Power Requirement
- High hydro generation
- Thunderstorm during summer
- Silt during Summer/Monsoon
- Transfer Capability violations

On each of the above points, NRLDC gave past statistics to highlight the issues. He also stated that fuel shortage this year combined low hydro generation could be difficult and therefore, requested all the utilities to buildup enough fuel stock for increasing the internal generation in NR and for also for keeping reserves in the each of control area.

B.15.3 He also mentioned following Action plans:

- Meticulous load forecasting and portfolio management
- TTC/ATC calculations, keeping margins, Network
- Tower strengthening, New network commissioning
- Keeping fuel reserves
- Keeping reserves (generation in control areas for contingencies)

Annexure-X

List of Number of line tripping reported by RLDCs during the month of June to October -28.10.2018						
		No. of Trippings in Region				
Month	**Voltage Level (in kV)**	**NR**	**WR**	**SR**	**ER**	**NER**
June	765	6	0	0	0	0
	400	42	2	10	2	5
	220 or 230	51	1	8	5	1
	132 or 110	37	0	1	8	7
Total		**136**	**3**	**19**	**15**	**13**
July	765	0	0	0	0	*
	400	10	10	4	4	*
	220 or 230	17	0	0	1	*
	132 or 110	0	0	0	4	*
Total		**27**	**10**	**4**	**9**	*****
August	765	0	0	0	0	0
	400	14	61	6	0	0
	220 or 230	25	38	0	5	0
	132 or 110	0	4	0	6	3
Total		**39**	**103**	**6**	**11**	**3**
September	765	0	0	0	0	*
	400	15	6	0	0	*
	220 or 230	21	15	4	8	*
	132 or 110	1	0	0	11	*
Total		**37**	**21**	**4**	**19**	
October	765	0	0	14	0	*
	400	20	2	4	1	*
	220 or 230	58	0	5	7	*
	132 or 110	0	5	0	0	*
Total		**78**	**7**	**23**	**8**	
				* No Reporting		

NORTHERN REGION SCHEMES FUNDED FROM PSDF

(Amount in Rs. Crores) (As on 31.10.2018)

Sr. No.	State / UT	No. of Schemes	Scope of Work (Scheme)	Approved Cost	Grant Sanctioned	Date of Sanction	Funds Released	% of fund Disbursed against grant Sanctioned
1	**Jammu & Kashmir**	2	Renovation and Upgradation of protection system in the substations of Jammu.	140.04	**140.04**	28/10/2015	26.4110	18.86 %
			Renovation and Upgradation of protection system of substations in Kashmir area.	146.12	**146.12**	17/03/2016	0.0000	0.00 %
2	**Punjab**	3	Installation of Bus bar protection scheme in the state of Punjab	18.21	**16.39**	17/03/2016	0.0000	0.00 %
			Provision of second DC Source at 220 kV & 132 kV Grid Sub Stations of PSTCL	15.30	**13.78**	2/1/2017	3.0090	21.84 %
			Reliable Communication and Data Acquisition system upto 132kV substations.	66.10	**33.05**	27/07/2018	0.0000	0.00 %
3	**Himachal Pradesh**	3	Renovation and Upgradation of Protection System of substations of HPSEBL.	55.44	**55.44**	5/1/2016	34.4430	62.13 %
			Strengthening of Transmission System incidental to Intra-State Transmission System in the state	24.38	**24.38**	27/07/2018	0.0000	0.00 %
			Providing communication equipment, DCPS system RTUs and OPGW	18.64	**9.32**	27/07/2018	0.0000	0.00 %
4	**Uttrakhand**	2	Renovation and Upgradation of Protection System of substations in PTCUL.	125.05	**125.05**	17/03/2016	101.7500	81.37 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	37.46	**18.73**	15/11/2017	0.00	0.00 %
5	**Haryana**	1	Renovation and Modernization of distribution system of DHBVN, Haryana.	364.27	**273.20**	5/9/2016	28.3520	10.38 %
6	**Rajasthan**	5	Renovation and Upgradation of protection system of 220kV and 400kV substations in the state of Rajasthan in order to rectify Protection related deficiencies	159.53	**143.58**	31/12/2014	14.8511	10.34 %
			Installation of 1 no each new 400kV, 125MVAR Bus Type Shunt Reactor at 400kV Hindaun and 400kV GSS Merta City, alongwith shifting of 400kV, 50MVAR Bus Type shunt reactor from 400kV Merta City to 400kV Bhilwara and associated bays at these stations.	23.87	**21.48**	31/12/2014	19.3300	89.99 %
			Smart Operation Mamgement System (STOMS)-RVPNL	13.18	**11.86**	19/05/2017	1.1860	10.00 %
			Communication Backbone "Smart Transmission Network & Asset Management System " -RVPNL	569.77	**284.89**	22/05/2017	56.9690	20.00 %
			Renwable Energy Integration Real Time data Acquisition System for monitoring & Control of Transmssion under STNAMS(PartA-I)	185.19	**92.60**	15/11/2017	0.0000	0.00 %

NORTHERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sr. No.	**State / UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
7	**Delhi**	1	Rectification and Upgradation of protection system and replacement of outlived equipments in DTL substations	125.98	**113.38**	17/03/2016	20.7530	18.30 %
8	**Northern Regional Power Committee (NRPC)**	2	Study program on the integration of renewable energy resources of NRPC	6.45	**6.45**	28/10/2015	4.4860	69.55 %
			Develoment of Protection Data Base Management System	28.00	**28.00**	27/07/2018	0.0000	0.00 %
9	**Uttar Pradesh**	4	Installation of Capacitors banks in the state of Uttar Pradesh in order to improve Voltages	39.29	**35.36**	11/5/2015	29.7685	84.19 %
			Renovation and Upgradation of Protection and control Systems, UFR Mapping and Islanding scheme in the state of Uttar Pradesh to rectify Protection related deficiencies	202.94	**182.65**	11/5/2015	89.4657	48.98 %
			Replacement of the existing ACSR Conductor by HTLS Conductor for relieving congestion by UPPTCL #	80.00	**60.00**	17/03/2016	0.0000	0.00 %
			Reconductoring of 11 Nos of 132kV Lines of the state network of UPPTCL for Relieving Congestion	63.31	**47.48**	16/05/2017	4.7400	9.98 %
10	**BBMB**	1	Renovation and Upgradation of the protection and control system.	25.86	**23.27**	15/11/2017	2.33	10.00 %
TOATAL		**24**		**2534.38**	**1906.5**		**437.8413**	22.97 %

NOTE: One scheme of Uttar Pradesh for relieving congestion (Rs. 60 crores sanctioned grant during 2015-16) is not eligible as the LoA has already been placed before the approval of the scheme.

220 kV DC lines from Greater Noida (400) to Noida sector 20 & Sector 129 (one ckt. Only) , 132 kV SC lines Mohaan Road to Sonik & TRT and 132 kV SC SGPGI - Gomatinagr line.

WESTERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sr. No.	**State / UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
1	**Madhya Pradesh**	8	Implementation of Integrated system for ABT, Open Access and MIS for MP-SLDC.	4.00	**3.6**	17/03/2016	2.4429	67.86 %
			Renovation and Upgradation of protection system of substations of MPPTCL	103.00	**92.7**	17/03/2016	52.9310	57.10 %
			Renovation Upgradation of protection system of substations in MPPGCL	52.34	**47.11**	05/9/2016	9.0120	19.13 %
			Installation of 125MVAR Bus Bar Reactors at 400kV substation of MPPGCL(SSTPP Khandwa substation)	6.21	**5.59**	05/9/2016	0.5590	10.00 %
			Installation of 50 MVAR Line Reactor at 400kV substation at STPS -MPPGCL	7.45	**6.71**	22/05/2017	0.6700	9.99 %
			Installation of Bus Reactor at Shree Singaji TTP and Birsinghpur **(2schemes)**	14.52	**13.07**	27/07/2018	0.0000	0.00 %
			Implementation of OPGW based reliable communication at 132kV and above substations.	413.79	**206.89**	27/07/2018	0.0000	0.00 %
2	**Chhattisgarh**	3	Scheme for Replacement/ renovation/Upgradation of protection system and Switchyard Equipment of EHV substations in CSPTCL.	68.52	**61.67**	05/9/2016	0.0000	0.00 %
			Implementation of Automatic Demand Management Scheme (ADMS) by CSPTCL	5.03	**4.53**	16/05/2017	0.0000	0.00 %
			Implementation of OPGW based reliable communication at 132kV and above substation	145.91	**72.96**	27/07/2018	0.0000	0.00 %
3	**Gujarat**	9	Installation of Automatic Demand Management System in the state of Gujarat in order to improve grid discipline	1.67	**1.5**	11/5/2015	1.3500	90.00 %
			Load Forecasting Scheme in the state of Gujarat	3.70	**3.7**	04/08/2015	0.0000	0.00 %
			Wind generation forecasting in the State of Gujarat.	1.62	**1.62**	17/03/2015	0.3245	20.03 %
			Installation of Super Conducting Fault Current Limiter (SCFCL) at	32.37	**29.13**	02/01/2017	2.9130	10.00 %
			Installation of automatic switched capacitors on 11kV Feeders of MGVCL	28.39	**25.55**	22/05/2017	0.0000	0.00 %

WESTERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sr. No.	**State / UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
			Installation of automatic switched capacitors on 11kV Feeders of UGVCL	15.65	**14.07**	22/05/2017	0.0000	0.00 %
			Installation of automatic switched capacitors on 11kV Feeders of DGVCL	15.77	**14.19**	22/05/2017	0.0000	0.00 %
			Installation of automatic switched capacitors on 11kV Feeders of PGVCL	63.32	**56.99**	22/05/2017	0.0000	0.00 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	507.89	**253.95**	15/11/2017	25.40	10.00 %
4	**Mharashtra**	10	Replacement of existing 0.15 ACSR wolf conductor of 132kV Balapur-Patur-Malegoan corridor and 0.2 ACSR wolf conductor of 132kV Khapri-Besa (Nagpur Ring Main Line) by High Ampacity (HTLS) Conductor **(2scheme)**	46.15	**34.61**	16/05/2017	4.5360	13.11 %
			Installation of Data Concentrators in MSETCL	10.41	**9.37**	16/05/2017	0.9370	10.00 %
			Installation of RTUs for 132 kV Substations of MSETCL	25.65	**7.70**	16/05/2017	0.0000	0.00 %
			Installation of Capacitor Banks at HV & EHV level at various EHV subatations under Nashik & Pune zones in MSETCL	15.72	**14.15**	22/05/2017	1.4150	10.00 %
			Implementation of Automatic Demand Management Scheme (ADMS) on 33/11kV HV feeders in Maharashtra	32.58	**29.32**	22/05/2017	2.9320	10.00 %
			Installation of shunt bus reactors at 400kV Solapur, Kolhapur, Karad,Akola, Bhusawal II, Nanded, Koradi, Khaparakhade, Chandrapur II ,Lonikand II, Chakan & Kudus Substations of MSETCL **(4schemes)**	103.38	**93.04**	22/12/2017	9.3040	10.00 %
TOATAL		**30**		**1579.13**	**1103.72**		**114.7214**	**10.39** %

SOUTHERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sr. No.	**State/ UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
1	**Andhra Pradesh**	4	Renovation and Upgradation of protection and control system of EHT substations in APTRANSCO	125.27	**112.74**	05/09/2016	22.4740	19.93 %
			Upgradation of control and protection system replacement different substations of APGENCO	44.42	**39.98**	05/09/2016	7.0820	17.71 %
			Reliable communication and Data acquisition system upto 132kV of APTRANSCO	284.96	**142.48**	23/05/2017	0.0000	0.00 %
			Implementation of Scheduling, Accounting, Metering and Settlement of Transmission in electricity (SAMAST).	21.48	**19.33**	27/07/2018	0.0000	0.00 %
2	**Karnataka**	3	Renovation and Upgradation of protection system of substations of KPTCL in the state of Karnataka.	67.13	**60.42**	17/03/2016	36.2510	60.00 %
			Renovation and Upgradation of protection and control systems of 400/220/132kV Switchyards of KPCL Generating substations in the state of Karnataka to rectify protection related deficiencies	19.18	**17.85**	11/'05/2016	8.7184	48.84 %
			Implementation of OPGWbased reliable communication at 132kV and above substation	253.57	**126.79**	27/07/2018	0.0000	0.00 %
3	**Kerala**	6	Upgradation and Renovation of protection system of 400 and 220kV substations in Kerala to rectify protection related deficiencies	91.46	**82.31**	31/12/2014	46.8247	56.89 %
			Implementation of Automatic Demand Management scheme (ADMS) at 322 substation of KSEBL upto 33 kV	5.30	**4.77**	02/01/2017	0.4770	10.00 %
			Construction of Multi-Circuit Multi-voltage transmission Lines (Madakathara - Areekode 400/220 kV & Nallalam to Kizhisseri 220/110 kV MCMV lines).	371.03	**333.93**	16/05/2017	100.1780	30.00 %

SOUTHERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sr. No.	**State/ UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
			Up-rating Kakkayam - Nallalam 110kV line & Upgrading Nallalam- Chevayur-Westhill-Koyilandy110kV Single Circuit line in to Double Circuit line	89.13	**66.85**	16/05/2017	16.6700	24.94 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	147.52	**73.76**	15/11/2017	0.0000	0.00 %
			Renovation & Upgradation of various 220 kV switchyard equipment.	22.42	**20.18**	15/11/2017	2.0200	10.01 %
4	**Tamil Nadu**	4	Renovation and Upgradation of protection and control systems in the state of Tamil Nadu to rectify protection related deficiencies	138.28	**124.45**	4/8/2015	23.0890	18.55 %
			Establishment of Technical and IT Infrastructure for implementation of intra state ABT in Tamilnadu	13.31	**11.98**	02/01/2017	1.2000	10.02 %
			Renovation and Modernization of Protection System of 400kV, 230kV & 110kV Stations of TANTRANSCO	186.09	**167.48**	16/05/2017	16.7500	10.00 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	310.96	**155.48**	15/11/2017	0.0000	0.00 %
5	**Telangana**	5	Renovation and Upgradation of protection system in the substations of Telangana	59.97	**53.97**	28/10/2015	12.2878	22.77 %
			Project on Commissioning of 400kV, 125MVAR Bus Reactors in 400kV Grid Substations in TSTRANSCO(Mahaboobnagar, Mamidipally, Malkaram, Gajwel and Shankarpalli).	53.63	**48.27**	5/9/2016	36.9912	76.63 %
			Renovation and Upgradation of protection system of Thermal generating substations of TSGENCO	7.27	**6.54**	16/05/2017	0.6540	10.00 %
			Relieving of Transmission Congestion of existing Overloaded 220kV Lines in Hyderabad	78.84	**59.13**	22/05/2017	0.0000	0.00 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	159.63	**79.82**	15/11/2017	0.0000	0.00 %

SOUTHERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sr. No.	**State/ UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
6	**Puducherry**	2	Renovation and Upgradation of protection and control systems in the state of Puducherry to rectify protection related deficiencies	10.56	**9.50**	04/08/2015	0.9500	10.00 %
			Implementation of OPGW based reliable communication at 132kV and above substations.	7.37	**3.69**	27/07/2018	0.0000	0.00 %
7	**PGCIL**	1	Installation of STATCOM in SR at Hyderabad, Udumalpet & Trichy substations of POWRGRID	472.55	**378.04**	22/05/2017	37.8000	10.00
8	**SRPC**	2	Study Programme on the Integration of Renewables Energy Resources into the Grid in Southern Region	5.50	**5.50**	02/01/2017	3.9194	71.26 %
			Procurement Web Based Management Software and Protection setting calculation tool for Southern Region	25.09	**25.09**	02/01/2017	15.9185	63.45 %
TOATAL		**27**		3071.92	**2230.33**		**390.255**	17.50 %

EASTERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sl. No.	**State/ UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
1	**Bihar**	3	Renovation and Upgradation of protection and control systems of 220/132kV grid substations in the state of Bihar in order to rectify protection related deficiencies	71.35	**64.22**	11/05/2015	56.0400	87.26 %
			Installation of capacitor bank for improvement of voltage profile in BSPTCL, Bihar.	20.98	**18.88**	05/09/2016	0.0000	0.00 %
			Renovation and Upgradation of the protection and control system of 12 nos 132/33 kV Grid Sub Station	54.69	**49.22**	02/01/2017	0.0000	0.00 %
2	**Odhisa**	4	Renovation and Upgradation of protection and control systems of substations in the state of Odisha in order to rectify protection related deficiencies	180.56	**162.5**	11/05/2015	38.0897	23.44 %
			Renovation and Upgradation of protection and control system by OHPCL	24.83	**22.35**	22/05/2017	2.2350	10.00 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	51.22	**25.61**	15/11/2017	0.0000	
			Installation of 125 MVAR Bus Reactor at 400kV Grid S/S of Mendhasal, Meramundali & New Duburi	30.26	**27.23**	27/07/2018	0.0000	0.00 %
3	**West Bengal**	6	Renovation and Upgradation of protection system of 400 and 220kV substations to rectify Protection related deficiencies	120.67	**108.6**	31/12/2014	37.7380	34.75 %
			The Renovation and Modernization of STPS switch yard and implementation of Substaion Automation System.	26.09	**23.48**	05/09/2016	2.3480	10.00 %

EASTERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sl. No.	**State/ UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
			Implementation of Islanding scheme at Bandel Thermal Power Station (BTPS) of WBPDCL	1.54	**1.39**	16/05/2017	1.2470	89.71 %
			Installation of switchable reactor & Shunt capacitors by WBSETCL	48.19	**43.37**	22/05/2017	6.5970	15.21 %
			Renovation & Modernization of Transmission System for relieving congestion in intra-state transmission system of WBSETCL	93.51	**70.13**	22/05/2017	21.0400	
			Renewation and Modernisation of Switchyard and related protection system of different power stations.	50.18	**45.16**	27/07/2018	0.00	30.00 %
4	**Jharkhand**	1	Renovation and Upgradation of the protection system.	153.48	**138.13**	15/11/2017	0.00	0.00 %
5	**DVC**	2	Renovation and Upgradation of control and protection system and replacement of substation Equipment of 220 kV/132 kV/33 kV Ramgarh substation of Damodar Valley Corporation	28.85	**25.96**	02/01/2017	2.5960	10.00 %
			Renovation and Modernization of control and protection system and replecement of equipment at Parulia, Durgapur, Kalyanewari, Giridhi Jamsedpur, Barjora, Burnpur, Dhanbad and Bundwan substation	144.71	**140.5**	16/05/2017	14.0500	10.00 %
6	**PGCIL**	1	Installation of STATCOMs in Eastern Region (at Ranchi-New,Rourkela, Kishanganj and Jeypore substations of POWERGRID)	700.31	**630.28**	05/01/2016	316.3780	50.20 %
7	**ERPC**	3	Creation and Maintanance of Web based Protection Database Management	20.00	**20.00**	17/03/2016	14.8342	74.17 %

EASTERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sl. No.	**State/ UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
			Training programm for Power System Engineers of various constituents of Eastern Region	0.61	**0.61**	27/07/2018	0.0000	
			Study programme on power trading at NORD POOL Academy for Power System Engineers of Eastern Region.	5.46	**5.46**	27/07/2018	0.0000	
TOTAL		**20**		**1827.49**	**1623.08**		**513.1929**	31.62 %

NORTH EASTERN REGION SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sl. No.	**State / UT**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
1	**Arunachal Pradhesh**	1	Rectification of deficiencies and renovation of the grid substations of Arunachal Pradesh	18.21	**18.21**	05/09/2016	0.00	0.00 %
2	**Assam**	2	Renovation and Upgradation of protection & control systems of Sub Stations in the state of Assam in order to rectify protection related deficiencies	299.37	**299.37**	11/05/2015	88.29	29.49 %
			Installation of Bay control Unit (BCU) in the state of Assam	53.52	**53.52**	28/10/2015	18.67	34.88 %
3	**Manipur**	3	Renovation and Upgradation of the Grid Substations in MSPCL	33.50	**33.50**	05/09/2016	3.35	10.00 %
			33kV system Integration with SLDC system in Manipur.	13.37	**13.37**	22/05/2017	1.34	10.00 %
			Implementaion of OPGW based reliable communication at 132 kV and above substations	8.15	**4.08**	15/11/2017	0.41	10.00 %
4	**Meghalaya**	2	Renovation and Upgradation of Protection and Control Systems in the state of Meghalaya to rectify Protection related deficiencies.	69.19	**69.19**	04/08/2015	44.21	63.90 %
			Renovation and Upgradation of Protection System of substations in Meghalaya GENCO (MePGCL)	32.53	**32.53**	05/01/2016	15.74	48.38 %
5	**Mizoram**	1	Renovation and Upgradation of protection and control systems of 132kV substations in the state of Mizoram in order to rectify protection related deficiencies.	26.84	**26.84**	28/10/2015	8.00	29.81 %
6	**Nagaland**	1	Renovation and Upgradation of protection and control systems of 132kV substations in the state of Nagaland in order to rectify protection related deficiencies.	39.96	**39.96**	11/05/2015	32.90	82.33 %
7	**Tripura**	1	Renovation and Upgradation of Protection System in the substations in the state of Tripura.	31.05	**31.05**	05/01/2016	26.10	84.06 %
8	**NERPC**	2	Study programme on the Integration of Renewables Energy Resources (RES) into the Grid in North Eastern Region	6.50	**6.50**	16/05/2017	3.44	52.96 %
			Develoment of Protection Data Base Management System	18.00	**18.00**	27/07/2018	0.00	0.00 %
TOATAL		**13**		**650.19**	**646.12**		**242.4489**	37.52 %

ALL INDIA SCHEMES FUNDED FROM PSDF

				(Amount in Rs. Crores)				(As on 31.10.2018)
Sl. No.	**UTILITY**	**No. of Schemes**	**Scope of Work (Scheme)**	**Approved Cost**	**Grant Sanctioned**	**Date of Sanction**	**Funds Released**	**% of fund Disbursed against grant Sanctioned**
1	**PGCIL**	2	Unified Real Time Dynamic State Measurement (URTDSM) Scheme (Installation of PMUs)	374.63	**262.24**	31/12/2014	173.99	66.35 %
			Transmission system Associated with "North East - Northern/Western Interconnector-I Project" and "Transmission system for development of pooling station in Northern Part of West Bengal and transfer of power from Bhutan to NR/WR (Funding BNC-Agra HVDC)	5778.00	**2889.00**	10/03/2017	0.00	0.00 %
2	**PGCIL/ RECTPCL**	1	11 kV Rural feeder Monitoring Scheme	233.03	**233.03**	10/03/2017	21.78	9.35 %
TOATAL		**3**		**6385.66**	**3384.27**		**195.7720**	5.78 %

Annexure-XII

Status of the Implementation of the Recommendations of the Enquiry Committee on Grid Disturbance in NR, ER & NER during 2012

Recommendation		Fully completed (FC) / Partially Completed(PC)	Responsible Entity
No.	**Content of recommendation**		
2	**Frequency control generation reserve/ancillary services**		
2.1	Frequency band tightened and brought close to 50 Hz	FC	CERC
2.2	Review of UI mechanism	PC	CERC
5.1	Congestion regulation due to forced outages and UI	FC	POSOCO, CERC
8	**Review of penal provision (UI) of Electricity Act, 2003**	PC	Indian Parliament, MOP
15.1	Grid Connectivity Standards (communication and telemetry facilities)	FC	CEA
17	**Review of Transmission Planning Criteria**	FC	CEA
19	**Task force to study security issues**	FC	MOP, CEA

Recommendation		Fully completed (FC) / Partially Completed(PC) / Not Completed(NC)					Responsible Entity
No.	**Content of recommendation**	**NR**	**WR**	**SR**	**ER**	**NER**	
1	**Review of Protection System**						
1.1	Third party protection audit	FC	PC	PC	PC	PC	Powergrid, STU, GEN
1.2	Review of zone-3 philosophy	PC	FC	FC	PC	PC	Powergrid, STU, GEN
1.3	Synchro phasor measurements /PMUs & deploy of SPSs	PC	FC	FC	FC	FC	RPC, RLDC, Powergrid, STU, GEN
1.4	Time synchronization of DRs/ELs/PMUs	FC	FC	FC	FC	FC	Powergrid, STU, GEN
3	**Defense mechanism - f_{min} and df/dt - load shedding schemes**	PC	FC	FC	FC	PC	STUs, RPCs, POSOCO
4	**Ensuring primary frequency response from generators**	PC	PC	PC	NC	PC	POSOCO, RPC, Generators
5	**Revising TTC based on change in system conditions**						
5.2	Real-time security desk caring TTC calculations	FC	FC	FC	FC	FC	NLDC and RLDCs
6	**Coordinated outage planning of transmission elements**	FC	FC	FC	FC	FC	NLDC and RLDCs

Annexure-XII

Recommendation		Fully completed (FC) / Partially Completed(PC) / Not Completed(NC)					Responsible Entity
No.	**Content of recommendation**	**NR**	**WR**	**SR**	**ER**	**NER**	
7	**Reactive power planning -**	FC	FC	FC	FC	FC	Powergrid, STU, GEN
9	**Optimum utilization of availability assets**						
9.1	Regulatory provision - absorption of reactive power by generators	PC	PC	PC	FC	NC	POSOCO, RPC, Generators
9.2	Audit of HVDC, TCSC, SVA and PSS	PC	PC	PC	PC	NC	CTU, STUs,Generators
9.3	Functioning of existing PMU and availability of their output to RLDC	FC	FC	FC	FC	FC	CTU, POSOCO
10	**Deployments of WAMS**						
10.1	Synchro phasor based WASM employing PMUs	PC	PC	PC	PC	PC	CTU
10.2	Possible of voltage collapse prediction	PC	NC	NC	NC	NC	RPCs
11	**Dynamic security assessment and review of state estimation**	NC	NC	NC	NC	NC	POSOCO
12	**Implementation of islanding schemes**	PC	PC	FC	PC	PC	CEA, RPCs, Powergrid, STUs, SLDCs, Generators
13	**Autonomy to Load Dispatch Centers**						
13.1	Organization of the Load Dispatch Centers reviewed and entrusted to ISO	PC	PC	PC	NC	NC	Govt. Of India, State Govt.
13.2	Training and certification of system operators need to be given focused attention	PC	PC	PC	NC	PC	Govt. Of India, State Govt.
14	**Development of Intra-state transmission system**	PC	PC	PC	PC	PC	STUs
15	**Network visualization**						
15.2	Fiber optic communication system	PC	PC	PC	PC	PC	CTU, STUs
15.3	RTUs and communication equipment should have uninterruptible power supply with proper battery back up	PC	PC	PC	PC	PC	CTU, STUs
15.4	Telemetry facilities will be install for all generation station and transmission element without these	PC	PC	PC	PC	PC	RPCs, POSOCO
16	**Reduction in Start-up time Generators**	PC	PC	PC	PC	PC	CEA, Generators, RLDCs

Annexure-XII

Recommendation		Fully completed (FC) / Partially Completed(PC) / Not Completed(NC)					Responsible Entity
No.	**Content of recommendation**	**NR**	**WR**	**SR**	**ER**	**NER**	
18	**Strengthening of system study groups in various power sector organization**	PC	PC	FC	PC	PC	CEA, CTU, STU
20	**Improved telecom infrastructure for cyber security**	PC	PC	PC	PC	PC	MOP, CEA

Note: Status as per the following communications from RPCs

1) NRPC: Email dated 23.08.2018
2) WRPC: Letter dated 24.04.2018
3) SRPC: 14.09.2018
4) ERPC: Email dated 20.02.2018
5) NERPC: Not received

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
Registered & Corporate Office : Ist Floor, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi -110016
CIN : U40105DL2009GOI188682, Website : www.posoco.in, E-mail : posococc@posoco.in,Tel.: 011- 41035696, Fax : 011- 26536901

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.

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.

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
- Myanmar: With North-Eastern region

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.

(b) **Ancillary Services (RRAS):** The Regulatory Framework for implementation of Ancillary Services has been provided by the Hon'ble CERC in August 2015 and these have been implemented from April 2016. As per the present framework for ancillary services, available generation (thermal) reserves are dispatched by NLDC across regions on a pan-India basis. In the scheduling process, a virtual entity has been created in each regional pool to act as a counterparty to the ancillary schedules (beneficiaries schedules are not disturbed in the ancillary despatch process). Settlement of ancillary transactions is carried out on a regional basis from the DSM Pool. There are times, when the regional DSM pool faces shortfall and NLDC facilitates transfer of funds from a surplus regional pool to the deficit regional pool as per the provisions of the relevant CERC regulations. Again, this involves multiple fund transfers at times.

(c) **Fast Response Ancillary Services (FRAS):** CERC vide suo-motu order dated 16th July 2018 has directed the implementation of FRAS and pilot project for 5-minute metering. The framework for FRAS provides for fast response ancillary services using the flexibility of hydro generation. The dispatch under FRAS is with the primary objective of obtaining regulation services from hydro while at the same time honoring all the hydro constraints. Scheduling, accounting and settlement of FRAS is to be carried out by NLDC across multiple regions (NR, ER and NER).

(d) **Secondary Frequency Control through Automatic Generation Control (AGC):** Based on the directions of CERC a pilot project for AGC has been implemented at Dadri – Stage II in January 2018. The AGC signals are being sent to the generating station from NLDC and the accounting and settlement for the AGC is being facilitated by NLDC. Based on the experience gained by this pilot project, AGC implementation is being taken up at one generating station in each of the other regions. A second pilot implementation of AGC is expected to be commissioned at Simhadri in November 2018. Implementations in other regions are also coming up progressively. Accounting and settlement of all such implementations have to be facilitated at the national level.

(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
- Flexibility in scheduling of thermal generation (Ministry of Power, August 2018) to achieve economy in despatch at the national level
- 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.

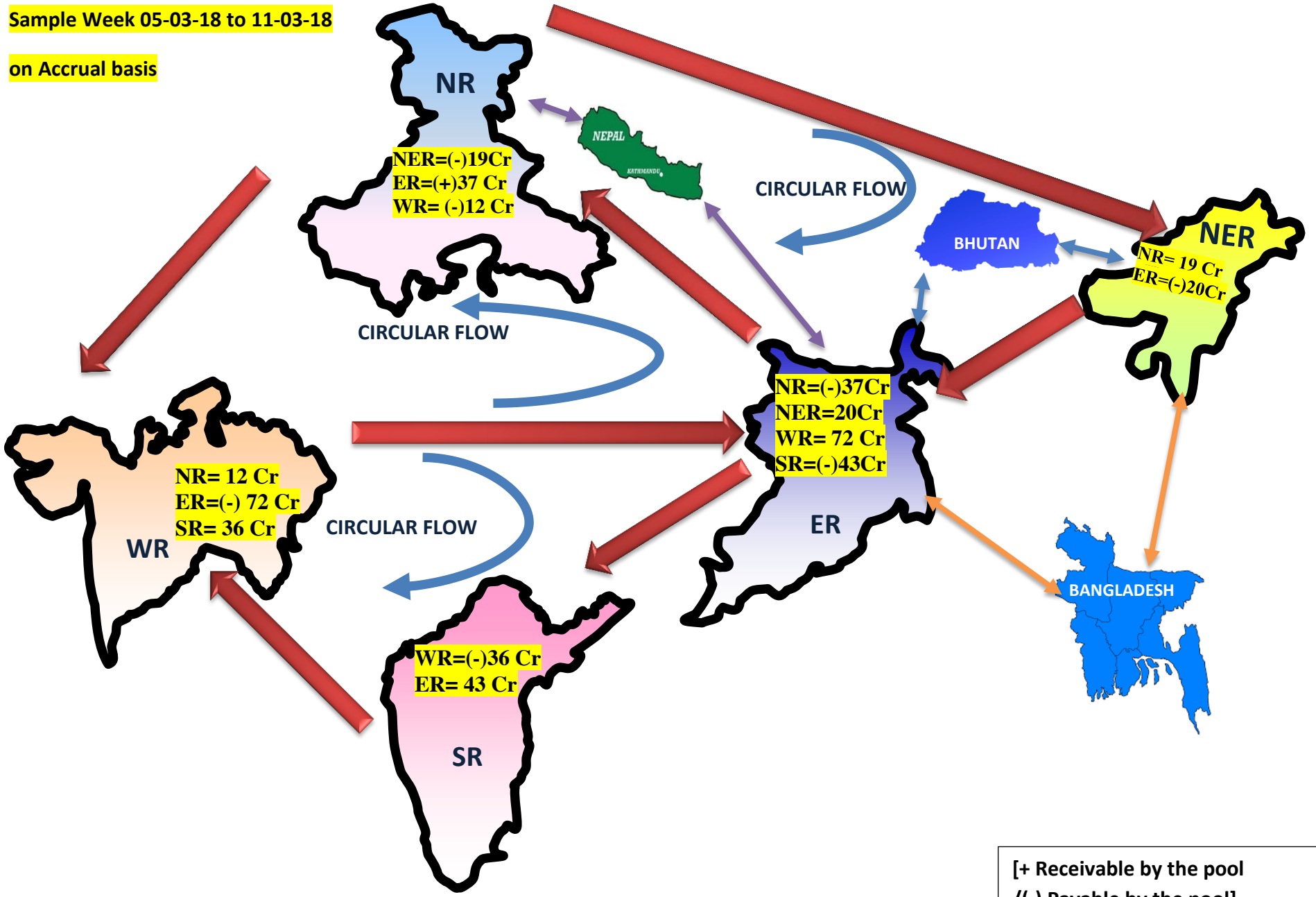
A sample illustration of the flow of funds between different regional DSM pool accounts to the national DSM pool account and that with the neighboring countries is shown at Annex – II.

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

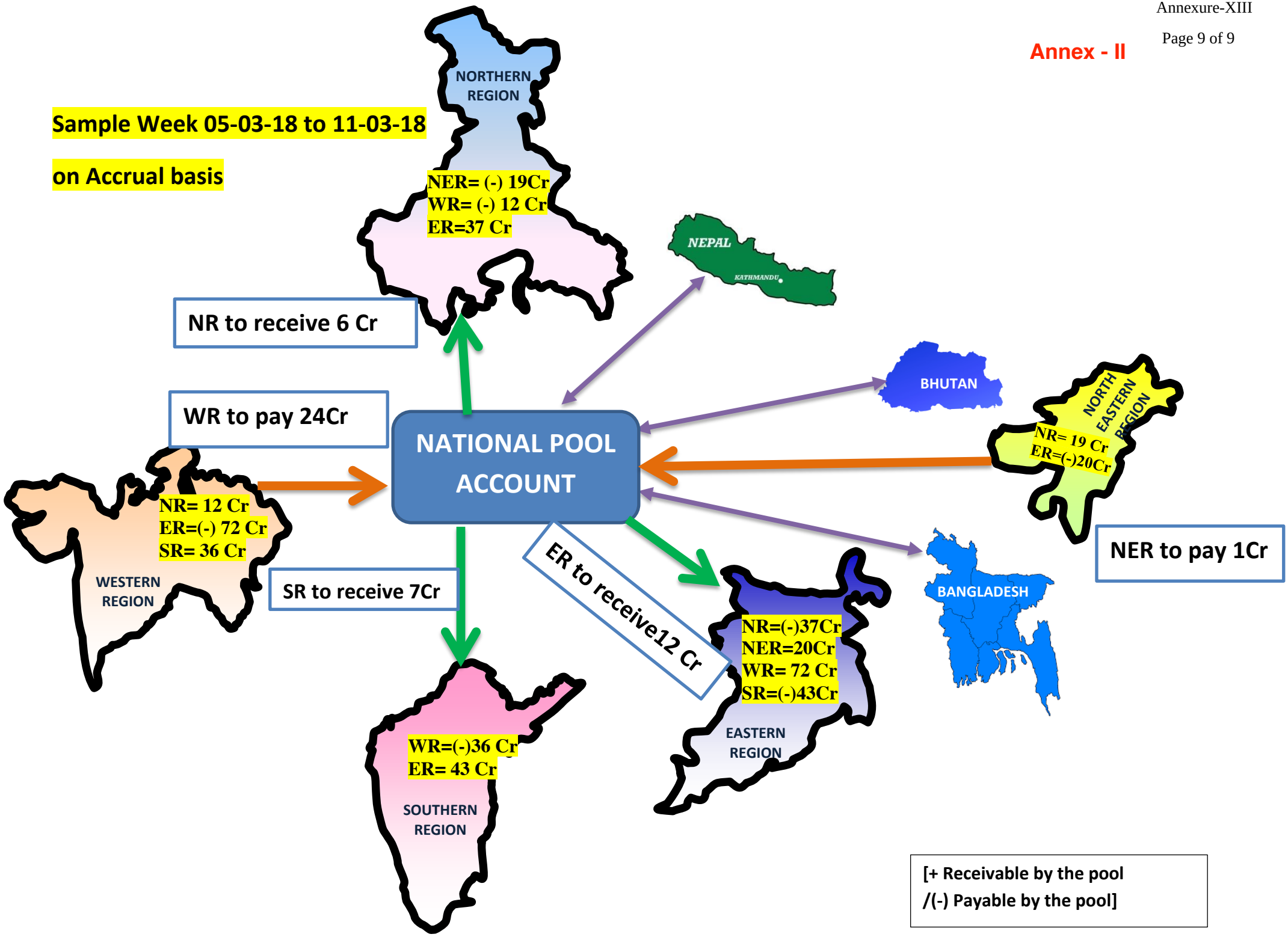
Sample Week 05-03-18 to 11-03-18

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
NORTHERN REGION
NER= (-) 19Cr
WR= (-) 12 Cr
ER=37 Cr
NEPAL
KATHMANDU
NR to receive 6 Cr
BHUTAN
NORTH EASTERN REGION
NR= 19 Cr
ER=(-)20Cr
WR to pay 24Cr
NATIONAL POOL ACCOUNT
NER to pay 1Cr
NR= 12 Cr
ER=(-) 72 Cr
SR= 36 Cr
WESTERN REGION
SR to receive 7Cr
ER to receive12 Cr
BANGLADESH
NR=(-)37Cr
NER=20Cr
WR= 72 Cr
SR=(-)43Cr
EASTERN REGION
WR=(-)36 Cr
ER= 43 Cr
SOUTHERN REGION
[+ Receivable by the pool
/(-) Payable by the pool]