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/2019/ 121 – 140 **दिनांक**: 28.01.2019

To

As per the distribution list.

**विषय: Minutes of the 08th Meeting of NPC-reg**

Sir,

The minutes of the 08th meeting of NPC held on 30th November 2018 at Guwahati is enclosed for kind information and necessary action please. The same is also available on CEA website.

Yours faithfully

28/01/2019 28/01/2019

**(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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15. Shri P.K.Mishra, Member Secretary, NERPC, NERPC Complex, Dong Parmaw, Lapalang Shillong-793006, E-mail: nerpc@ymail.com

**Special Invitees:**

16. ED (NLDC), 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 Div.), CEA, New Delhi

Copy for Kind information to:

1. Chairperson, CEA, New Delhi
2. Member (GO&D), CEA, New Delhi

**CENTRAL ELECTRICITY AUTHORITY**
**NATIONAL POWER COMMITTEE**

**MINUTES OF THE EIGHTH MEETING OF**
**NATIONAL POWER COMMITTEE HELD ON 30th NOVEMBER 2018**

## 1. INTRODUCTION:

1.1 The 08th Meeting of the National Power Committee was held on 30th November 2018 at Guwahati. The list of the participants is at **Annexure-I**.

1.1 Shri Pardeep Jindal, Member Secretary, NPC welcomed all members and the participants. He expressed deep gratitude to Mr. James K. Sangma, Minister of Power, Government of Meghalaya for sparing time from his busy schedule to attend the 08th meeting of NPC. He requested Mr. James K. Sangma to address the august forum.

1.2 Shri James K. Sangma, Hon'ble Power Minister, Government of Meghalaya & Chairman, NERPC expressed privilege and honor to address the eighth meeting of NPC. He said that Meghalaya was one of the states, which was instrumental in the formation of National Power Committee to address issues related to the grid at National level. He wished all the participants for healthy and fruitful discussions in the meeting.

1.3 Shri P.S.Mhaske, Chairperson, CEA & NPC welcomed all the participating members from RPCs, Member Secretaries of RPCs and other participants in the meeting. He thanked Member Secretary (NERPC) and his team for the excellent arrangement for the conduct of the meeting. He said that this is his first meeting of NPC as Chairperson, CEA & NPC. He appreciated the various decisions taken in earlier meetings of NPC for the secure and reliable operation of the All India Grid.

He informed that NPC, in its present form, was constituted through MoP order, however as per the amendment of Electricity Act, 2003, which is under process in Ministry of Power, NPC has to be established through Act and by resolution as in the case of RPCs. He stated that as the main objective of NPC is to resolve inter-regional operational issues of the all India grid, all RPCs should involve NPC on all inter-regional issues and refer such issues to NPC, so that a coordinated common approach is developed.

He observed that the Committee has already accepted membership of POSOCO in NPC; and similarly, CTU is also required to be a member of the committee, keeping in view the critical role being played by CTU in development of Indian Power Sector as statutory body for ISTS grid related issues at National level.

He added that NPC, on direction from CERC, has finalized "*Accounting methodology for bilateral short term and collective transaction in case of grid disturbances*" and has submitted to CERC. NPC has also prepared draft guidelines on "Availability of Communication System" in terms of CERC (Communication System for Inter-State

transmission of electricity) Regulations, 2017. The same is to be approved in this meeting of NPC.

He said that several other issues pertaining to secure and reliable grid operations are to be discussed during the meeting and requested, Member Secretary, NPC to take up the agenda items.

Agenda items were taken up for deliberation and are as follows:

## 2. CONFIRMATION OF MINUTES OF 7TH MEETING

2.1 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. No comments have been received from the members.

2.2 The Committee confirmed the minutes of the 07th meeting of NPC.

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

3.1 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.

3.2 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.

3.3 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-II**) 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".*

3.4 **Deliberation / Decision in the meeting:**

i) MS (NPC): Request of NLDC as permanent member of NPC was deliberated and agreed by members of NPC and the proposal was submitted to MoP. 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 NPC meeting. Formal decision/acceptance on membership of any entity in NPC lies with MoP.

ii)CTU/PGCIL: We are involved in planning and coordination of ISTS and play a crucial role in the development of All India Transmission System. NPC deals with inter-regional issues for reliable and secure operation of grid, Director (Operations), PGCIL is needed to be included, as a member of NPC.

iii) MPPTCL: NPC was constituted vide MoP order. Hence any constitutional/structural change in NPC should come from MoP and not through decisions of NPC. CTU may approach MoP to include them as a member in NPC.

iv)NERPC: Addition/deletion of members is a recurring process in any kind of forum. Any change in the constitution of NPC shall come from MoP. Though CTU, could directly approach MoP for including as a permanent member in NPC. However, it is always better to discuss and deliberate the matter first among the members of NPC. In the case of NER, instead of Chairman, NERPC, representative of Chairman, NERPC is a member of NPC was also discussed and decided in NPC meetings.

v) ERPC: CTU is already a member of all the RPCs. As NPC is to resolve issues referred to NPC requiring consultation of one or more RPCs, views of CTU are inherently included at regional level itself. Further, CTU is mainly involved in planning, whereas issues referred to NPC are generally, operational in nature. Hence, the practice of inviting CTU or any other entity, as a special invitee is appropriate, as of now.

vi) MS (NPC): Generally, issues of operational nature are discussed in NPC. As such, as proposed by CTU, Director (operations), PGCIL, who looks into operational issues, could be considered for including as a permanent member of NPC rather as a special invitee to the meetings of NPC.

vii) Chairperson, CEA&NPC: It is better to deliberate any technical issues/ policy issue among the members first before referring to MoP. If CTU approaches directly to MoP with a proposal to include CTU as a member of NPC, MoP may refer the proposal to CEA/NPC.

viii) NLDC: It is NLDC and not POSOCO was included as a member, to avoid any commercial interest. CTU is involved in interface metering, PSS tuning, Protection co-ordination activities etc. as per IEGC, it is advantageous to include CTU as a member of NPC. In addition to that, CTU is a statutory body like NLDC.

**The committee accepted the proposal of CTU to include it as a member of NPC. It was decided that Member Secretary (NPC) shall take up with MoP for necessary amendment in the constitution of NPC.**

**Action: NPC Secretariat.**

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

### (A) Review of AUFLS Settings

4.1 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-III**

4.2 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.

4.3 During the presentation of Reports of the Consultants 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.

4.4 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.

4.5 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-IV**) the two options (Frequency Slab: 49.2 to 48.6 Hz and 49.4 to 48.8Hz) and UFR quantum was communicated to RPCs for consideration/comments.

4.6 SRPC vide letter dated 07.06.2018 (**Annexure-V**) 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 as per existing scheme.

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.

4.7 POSOCO vide letter dated 02nd July 2018 (**Annexure-VI**) has stated that the quantum of load shedding through UFLS to the tune of 48GW suggested by NPC Division, CEA 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.

4.8 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.

4.9 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.

4.10 NRPC vide letter dated 10.09.2018 (**Annexure-VII**) 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.

4.11 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.

4.12 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.

4.13 **Deliberation / Decision in the meeting:**

i) MS (NPC): AUFLS is the last resort measure to save the grid from complete grid collapse. The quantum of load shedding from AUFLS was computed/decided in the year 2013 (when SR grid was not connected). Being an interconnected All India Grid, with increasing generation capacity/load, there is a need to review the stages as well as the quantum of load shedding under AUFLS. He further added that the size of the grid may increase further at the time of implementation of the proposed settings (computed based on the present size of the grid). He requested RPCs to share their views on it.

ii) SRPC: Andhra Pradesh, Karnataka and Tamil Nadu had agreed for the AUFLS scheme with 4 stages of frequency viz. 49.4, 49.2, 49.0 & 48.8 Hz. SRPC Secretariat had requested KSEBL & TSTRANSCO to concur for revised settings in view of grid security requirements. Kerala & Telangana may agree in due course of time.

He stated that regarding POSOCO's suggestion on 'Synthetic Inertia' and 'Fast Frequency Response', could be defined and adequately incorporated in the Grid standards and the implementation of the same should be at the disposal of the system operator through CERC/SERCs.

iii) NLDC: Pumped storage hydro power plant should get disconnected even before UFRs. In response that representative from SRPC observed that availability of pumped storage power plant on bar is for limited time only. Hence it is not very reliable to use pumped storage as a defense mechanism.

iv) NERPC: The AUFLS scheme with 4 stages of frequency viz. 49.4, 49.2, 49.0 & 48.8 Hz have been agreed by the constituents of NER.

v) WRPC: The quantum of relief computed and circulated by NPC Secretariat needs a little correction. The required load relief needed to be computed to achieve frequency at 50 Hz only and not one Hz on each stage as proposed. For Stage-I, load relief to be computed for raising frequency by 0.6 Hz and for Stage-II by 0.8 Hz.etc. for the AUFLS scheme with 4 stages of frequency viz. 49.4, 49.2, 49.0 & 48.8 Hz. In this regard, MS (NPC) mentioned that the power system doesn't behave in a linear manner. The required jerk to increase the frequency by 1Hz may, in reality, leads to a jerk of less than that. Hence, if we envisage uplifting frequency by 0.6 Hz (for stage-I), we may not be able to arrest the falling frequency in real time situation.

vi) NRPC: The feeders, which were identified for AUFLS earlier, are not radial now, and further other defense mechanisms like SPS have come into picture and the entities have to manage all such defense mechanism with the available number of feeders. The Zalte Committee based on which NPC Secretariat recommended the quantum, is old and needs to be reviewed. At that time, frequency used to be low, hence frequency deviation of 1.5 which is taken, may be reconsidered. Nowadays, frequency deviation are very less. Also, the voltage correction factor of 1.085 may also be re-worked out. The load which is distributed on pro-rata basis should be reviewed considering season variation. In states like Punjab, Haryana; load to be shed is more than maximum load of the states, hence if scheme operates, entire states will go dark.

A detailed study needs to be done by academic experts/consultants to find out the required quantum relief for AUFLS. He requested to keep the quantum and stages of AUFLS unchanged until the study is completed. NRPC proposed that they can appoint a consultant from their own resources and the report would be submitted to NPC within six months.

vii) Chairperson, CEA& NPC: Advised NRPC to appoint a consultant/ involve academicians for studying the quantum and stages under AUFLS for the Indian Grid and to submit the report within six months. NRPC agreed to conduct the study by funding form own source and to submit the study report to Chairperson CEA&NPC within six months.

viii) NLDC: As per international practice, 25% of the total load is kept for operation under AUFLS. For Indian Grid, presently 43GW of load shedding is enough to restrain the fall in frequency.

ix) MS (NPC): As per the computation of NPC secretariat, the quantum comes out to be about 48GW which is close to the quantum as recommended by NLDC. The existing settings could not arrest the fall in frequency because of the increased grid size as compared to the year 2013. By the time of implementation, the grid size may increase further. It is, therefore, recommended to implement the 2nd option as of now. In case, the consultant (to be appointed by NRPC) recommends a different quantum, the same could be implemented.

**After deliberation, the committee, agreed for the AUFLS scheme with 4 stages and raising the frequency by 0.2 Hz viz. 49.4, 49.2, 49.0 & 48.8 Hz. The**

**quantum for AUFLS would be reworked by NPC Secretariat based on the deliberation.**

**It was also decided that, NRPC may appoint a Consultant from their own resources as proposed by MS (NRPC) for studying the AUFLS scheme for Indian grid and submit the study report to NPC Secretariat within a time of six months.**

**Action: NRPC**

**The revised load relief for AUFLS computed by NPC Secretariat would be discussed along with the report of Consultant appointed by NRPC (if available), in the next meeting of NPC which would be held in the month of May, 2019.**

**Action: NPC Secretariat**

**(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.

4.14 **Deliberation / Decision in the meeting:**

i) MS (NPC): Emphasized the need of mapping of feeders identified for operation under AUFLS in SCADA system. He appreciated the efforts of Southern Region for having achieved mapping of about 84% of feeders in SCADA.

ii) ERPC: informed that mapping of feeders have been started in Odisha.

iii) WRPC: In the absence of adequate communication facilities, mapping is yet to be started. However, a pilot project has been started in Chitrakoot substation of MPPTCL in state of Madhya Pradesh.

iv) MPPTCL: All the feeders (upto 33kV) identified for AUFLS have been mapped and are visible on SCADA. Mapping of feeders in MP is 100%.

v) NRPC: The matter is being discussed in sub-committee meetings of NRPC and the details are available in the minutes of the meeting.

vi) MS (NPC): observed that there is a need for proper co-ordination among the constituents and its respective RPCs. A consolidated and updated status is to be presented in the meeting, so that any progress is not left unacknowledged.

vii) Chairperson, CEA&NPC: The status sought by NPC Secretariat is needed to be furnished by all the RPCs on a regular basis to have an updated overview before discussion in the meetings of NPC.

**After deliberation, it was agreed that each RPC would submit the details / progress of feeder mapping to NPC secretariat on a regular basis (quarterly).**

**Action: All RPCs**

## 5. 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.

5.1 **Deliberation / Decision in the meeting:**

i) ERPC: All the constituents are submitting the healthiness certificate of UFRs installed in their control area in monthly OCC meetings. For df/dt, they are not left with any feeders after implementation of AUFLS. Hence there is no df/dt scheme in ER.

ii) WRPC: Total of 34 Nos. of AUFLS relays (08 S/s in MP, 08 S/s in Maharashtra, 05 S/s in Gujarat, 07 S/s in Chattisgarh, 04 S/s in DD, 02 S/s in DNH) have been tested since September 2017.

iii) SRPC: UFR & df/dt were inspected in 03 S/s of TSTRANSCO and 11 S/s of TANTRANSCO, 3 substations of KPTCL and 3 substations of KSEBL after 7$^{th}$ meeting of NPC.

iv) MS (NPC): informed that except NRPC and NERPC, all other RPCs have furnished the details regarding testing the healthiness of the UFR & df/dt relays. He further said that the df/dt schemes are different in NR, WR & SR and suggested to have a uniform sheme of df/dt.

(Present df/dt relay settings implemented across regions are at **Annexure-VIII**)

**After deliberation, it was agreed that NRPC and NERPC shall also furnish the details of mapping of feeders to NPC secretariat.**

**It was also decided that NPC Secretariat would work out a common approach for df/dt settings in all the five regions and bring the same in the next meeting of NPC.**

**Action: NRPC/NERPC/NPC Secretariat**

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

6.1 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. A copy of the guidelines is at **Annexure- IX**.

6.2 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.

6.3 The comments were received from NRPC & NERPC on 08.10.2018 and from SRPC on 20.11.2018 (**Annexure-X**). Summary of the comments are given below:

| NRPC | NERPC | SRPC |
|---|---|---|
| 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. | 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. That calculation may be done on yearly basis or at most half yearly basis. | A new clause 4.1 to be added as given below (Other clauses of 4 to be numbered accordingly): The RPC Secretariat shall certify the availability of communication equipment for CTU, ISGS, RLDCs, NLDC, SLDCs based on the data furnished by RLDC. For the concerned entities for whom the Availability of Communication System is to be certified by RPC, RLDC shall verify the outage details and availability and submit to RPC. |

6.4 **Deliberation / Decision in the meeting:**

i) NERPC: The periodicity of computation of availability of communication system may be done on yearly basis or at most half yearly basis. Maintenance Shutdown will be

allowed for Optical OPGW/FO end to end link which would not be considered in outage as shown in draft guidelines.

ii) MS (NPC): The working group has agreed to compute the availability of communication system on a monthly & on regional basis in line with the transmission availability computation. However, the treatment of the availability, so computed, is in the purview of CERC in their Terms and Conditions of Tariff Regulation.

iii) PGCIL: As per CERC Regulations, all users of CTU, NLDC, RLDCs, SLDCs, and STUs shall maintain the communication channel availability at 99.9% annually. As such, there is no need to compute availability block-wise. The total outage time could be summed up and then availability should be calculated annually.

iv) MPPTCL: They have not received the draft guidelines for comments. As such, they may be allowed to submit their comments on the draft guidelines.

v) MS (NPC): All the RPCs were requested to circulate the draft guidelines to the constituents of respective regions (as sent by NPC vide letter dated 07th September 2018 to all RPCs).

vi) Chairperson, CEA & NPC: decided that RPCs may be given 15 to 20 days more time to furnish comments on the draft guidelines.

**Accordingly, NPC Secretariat shall address a letter to all Member Secretaries of RPCs, with a copy to ED (NLDC) and ED (LD&C), PGCIL requesting to furnish the comments by 20th December 2018 to NPC Secretariat.**

**Action: NPC Secretariat/All RPCs**

**After deliberation, it was decided that NPC Secretariat would review the draft guidelines considering the comments received from RPCs/NLDC/PGCIL and shall forward the revised guidelines to CERC with the approval of Chairperson, CEA & NPC.**

**Action: NPC Secretariat**

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

7.1 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."*

7.2 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.

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

7.4 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-XI.**

7.5 **Deliberation / Decision in the meeting:**

i) ERPC: NLDC had presented the agenda in ERPC. Further, two pilot projects have been initiated in Eastern Region. However, states are of the view of implementing AGC in Central Sector Generating Units first and then in State Sector Generating Units.

ii) NERPC: A meeting for discussing the issue is scheduled in the month of January, 2019.

iii) NRPC: In the process of calling a special meeting for discussing implementation of AGC in the region. However, he is of the view that, if required primary response is available via RGMO, then dependence on AGC would be minimum. Further, the mark-up price of 50 paise proposed by NLDC shall be a burden on the

customer in the end. He said that the 50 paise mark-up proposed by NLDC is without taking inputs from any DISCOM or any RPC and it should not be imposed both up and down. He was of the opinion that after implementation of Reserves Regulation Ancillary Services (RRAS), AGC is not needed urgently.

MS (NRPC) informed that as per CEA Standards, Generator should have ramp up rate of 3% and it is declared during COD furnished by all the generating stations which also includes letter by their Board of Directors and CMD, but POSOCO had informed NRPC that most stations have ramp up rate of 1% and few of them have ramp up rate of 1.7%. He requested that a meeting of generators could be called to discuss the issue.

iv) NLDC: The mark up price is under the purview of CERC. Presently only pilot projects have been implemented. To check the actual effect of AGC, larger generation units shall be required to be equipped with AGC on a widespread scale.

v) SRPC: Pilot project at NTPC-Simhadri Stage-II in both the units is operational from 16th November 2018 and NP Kunta AGC pilot project is expected in March 2019.The constituent states have also identified the projects for AGC implementation. Andhra Pradesh has identified Krishntapattnam STPS, Karnataka at Sharavathi & Varhai, Kerala at Iddukki and Panniyar and Tamil Nadu one unit at North Chennai Stage-II and Mettur Stage-III.

vi) WRPC: NLDC had participated in the special meeting for implementation of GC on 17th September 2018. Pilot projects have been implemented in the State of Madhya Pradesh. However, states were of the view that the implementation of AGC shall be taken up only when the State Commission initiates step (amendment in SERC regulation) in this direction.

**After deliberation, it was agreed that all RPCs and NLDC shall provide updated information on status of implementation of AGC, to NPC secretariat.**

**Action: All RPCs and NLDC**

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

8.1 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 send any occurrence of the grid disturbance to NPC Division, CEA with a copy to Member (GO&D), CEA.

8.2 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."

8.3 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.

8.4 Total number of Grid Disturbances (GD)/Grid Incidences (GI) from 2014-15 to 2018-19 (up to October) 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* | 333 | 300 | **633** |

* Up to October 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 *** | **97** | 103 | 200 | **12** | 78 | 90 | **23** | 14 | 37 | **44** | 12 | 56 | **157** | 83 | 240 |

* Up to October 2018

Year wise comparative trend of total number of Grid Disturbances (GD) in regional grids from the year 2014-15 to 2018-19 (Upto October 2018) is at **Annexure-XII.**

8.5 A statistics on Grid Disturbance (GD) vs Number of Protection Sub-Committee Meetings in RPCs is given below:

| RPC | NRPC | | WRPC | | SRPC | | ERPC | | NERPC | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | GD | PSC | GD | PSC | GD | PSC | GD | PSC | GD | PSC |
| 2014-15 | 75 | 4 | 30 | 4 | 22 | 11 | 56 | -NA- | 62 | 12 |
| 2015-16 | 116 | 1 | 30 | 3 | 31 | 09 | 70 | 12 | 236 | 10 |
| 2016-17 | 119 | 3 | 49 | 2 | 46 | 13 | 65 | 12 | 290 | 4 |
| 2017-18 | 84 | 1 | 36 | 3 | 31 | 11 | 122 | 11 | 269 | 4 |
| 2018-19* | 97 | 2 | 12 | 2 | 23 | 07 | 44 | 08 | 157 | 1 |

* Upto 30th November 2018
PSC = Number of meetings of Protection Sub-Committee

8.6 **Deliberation / Decision in the meeting:**

i) MS (NPC): In the 2nd meeting of NPC, held on 16th July 2013, Chairperson, CEA & NPC had directed RPCs to ensure that whenever there is an incidence of tripping of multiple critical transmission/generation elements in the grid, it should be got investigated and analyzed on immediate basis and remedial action should also be taken in a time-bound manner under intimation to NPC secretariat / Grid Management Division of CEA.

In this regard, NPC Secretariat, is furnishing the tripping details on weekly basis received from RLDCs/NLDC to concerned RPCs, requesting to send a copy of the analysis report on these grid events, along with remedial measures recommended to prevent the recurrence of such incidences and disturbances. He, further, added that detailed analysis report/remedial actions have been received from SRPC. WRPC has also sent analysis report of once incident. No analysis reports are received from any other RPCs. All RPCs may deliberate all the trippings in their protection sub-committee meetings and suitable remedial measures may be evolved to safe and secure grid operation.

ii) NRPC: All the trippings were discussed regularly in their PSAG meetings and Protection Sub-Committee (PSC) meetings are conducted on quarterly basis.

iii) Chairperson, CEA & NPC: All the incidence of multiple tripping of critical transmission/generation elements in the grid should be got investigated and analyzed on immediate basis and remedial action without fail.

**After deliberation, it was agreed that all RPCs would conduct regular protection meetings for analyzing all the trippings and take remedial actions and the same would be furnished to NPC Secretariat on a regular basis.**

**Action: All RPCs**

## 9. Schemes for Protection System Data Base in RPCs

9.1 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."*

9.2 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.

9.3 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

9.4 Subsequently, NRPC and NERPC has been sanctioned grant from PSDF for implementing PDMS in their region.

9.5 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.

9.6 **Deliberation / Decision in the meeting:**

i) MS (NPC): ER was the first region to implement Protection system database. Other RPCs to update the status regarding implementation of Protection system database.

ii) SRPC: The scheme is likely to be completed by February 2019.

iii) NERPC: The project have been awarded & work started. The project is likely to complete by March 2020.

iv) NRPC: The NIT was floated on 30th August 2018. As there were very few bidders, re-tendering is proposed. He also informed that Chairperson (NRPC) while approving the proposal, raised apprehension on awarding the works to the same agency involved in other regions.

v) WRPC: The in-house development of protection database is in a very good progress. Work of around 30% is over. They would be implementing the scheme in WR before next meeting of NPC and would share the experience in the next meeting of NPC.

**Chairperson, CEA & NPC appreciated the efforts of WRPC for in-house development of the database. He suggested that NRPC may also seek the assistance of WRPC, in case no bidders come up after re-tendering.**

**It was agreed to complete the scheme of Protection Database Management System (PDMS) in a timely manner.**

**Action: NRPC, WRPC**

## 10. 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-XIII**. 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.

10.1 **Deliberation / Decision in the meeting:**

i) MS (NPC): Meetings for monitoring of schemes on regional basis were conducted in all the regions. 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 may create fund shortages with NLDC for disbursement to the entities.

ii) ERPC: Expressed concern in delay in disbursement of funds to the project entities by NLDC.

iii) NLDC: As on date, requisitions for Rs. 3452.42 crore are pending with NLDC for disbursement. NLDC is pursuing with MOP for early release of the funds. It is requested that the management of the project entities may also take up with MoP for early release of funds.

**It was decided that RPCs may advise all the state utilities to address a letter to Chief Engineer (OM), MoP, New Delhi for speedy disbursement of funds to NLDC and the project entities.**

**Action: All RPCs**

## 11. Status of Compliance of Enquiry Committee Recommendations

11.1 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.

11.2 **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

11.3 Measures recommended by Enquiry Committee to avoid re-occurrence in future is at **Annexure-XIV**.

11.4 The status available with NPC Secretarial is as per the following communications from RPCs:

a)NRPC: Email dated 23.08.2018
b)WRPC: Letter dated 24.04.2018
c)SRPC: 14.09.2018
d)ERPC: Email dated 20.02.2018
e)NERPC: Not received

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

11.5 **Deliberation / Decision in the meeting:**

i) MS (NPC): In the presentation on the report of Consultants on Package A & B at MoP on 28th February 2018, it was observed that the status of the recommendations under Task I of Package A had not been updated since 2015. Joint Secretary (Trans.), MoP suggested that the updated status may be compiled by NPC/CEA. In this regard, NPC Secretariat had requested all the RPCs to furnish the updated status of implementation of the recommendations of the Enquiry Committee. The updated data have been received from all the RPCs except NERPC. He requested all the RPCs to update the status on a regular basis.

**Chairperson, CEA & NPC advised that all the RPCs may update the status of implementation of the recommendation of the Enquiry Committee on quarterly basis and furnish the same to NPC Secretariat.**

**Action: All RPCs**

## 12. National Energy Account (NEA)

12.1 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.

12.2 The following was noted in the 07th meeting of NPC:

- ✓ 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.
- ✓ 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.

12.3 NLDC vide letter dated 09th November 2018 (**Annexure-XVI)** 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.

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.

12.4 **Deliberation / Decision in the meeting:**

i) MS (NPC): While processing the proposal of membership of NLDC in NPC, MoP had raised some queries/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*. The proposed functions of NPC Secretariat regarding NEA are (i) collection of data from NLDC on weekly basis (Interregional and International scheduled energy and actual energy data), (ii) preparation of Weekly NDSM & Reactive Energy Account (if required) and (iii) preparation of monthly NEA.

12.5 NLDC: Made a presentation on the proposal. The presentation is at **Annexure-XVII.** 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.

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.

ii) NRPC: As per CBR of NPC, agenda for NPC meeting shall be put up after discussions in RPCs. As such, the proposal should be first discussed in RPCs before taking up in the meeting of NPC.

iii) Other RPCs endorsed the view of NRPC.

iv) MS (NPC): As per clause (7.4) of CBR of NPC, *Member Secretary, NPC may also put any agenda involving urgent matters/policy issue directly in consultation with Chairperson, NPC.* The proposal on NEA was obtained from NLDC and put up for deliberation in the meeting, after considering the fact that it is a policy issue. The same was also decided in the 07th meeting of NPC. This was also endorsed by Chairperson, CEA & NPC.

**After deliberation, it was decided that the proposal may be discussed in all the RPCs and the observations of RPCs may be furnished to NPC Secretariat. The observations of RPCs may be put up for consideration in the next meeting. RPCs may include the proposal as an agenda item in their upcoming meetings for deliberations and RPCs agreed for the same.**

**Action: All RPCs/ NPC Secretariat**

## 13. Agenda proposed by NRPC:

13.1 NRPC vide letter dated 19.11.2018 (**Annexure-XVIII**) proposed the following items for deliberation in the 08th meeting of NPC:

13.2 (a) **Periodicity of Third Party Protection Audit:**

NRPC informed that third party protection audit should be carried out periodically and frequency of the same should be 5 years and that after finalization it should be deliberated in the NPC for uniformity at national level. The issues were further

deliberated at length in the 39th TCC/42nd NRPC meetings held on 27.06.2018 and 28.06.2018 respectively. TCC recommended and thereafter NRPC approved the recommendations of 35th Protection Sub Committee, 5 years periodicity of third party audit and that the audit can be carried out through any agency out of the list of reputed agencies carrying out protection audit as drawn by Power Sub Committee of RPCs.

13.2 (b) **Deliberation/Decision in the meeting:**

i)NRPC: NRPC in its 42nd Protection sub-committee meeting held on 28th June 2018, had approved 5 years periodicity of third party audit and that the audit can be carried out through any agency out of the list of reputed agencies carrying out protection audit as drawn by Power Sub Committee of RPCs. He requested the views of RPCs about the periodicity and agency to be authorized for Third Party Protection Audit for uniformity at National level.

ii) WRPC: For third party protection audit a suitable format is to be developed first.

iii) NLDC & SRPC: The formats available in the reports of M/s Tractebel, Romania could be used.

iv) ERPC: Periodicity, priority of protection audit in a region, either engaging consultant or auditing by the team formed by RPCs, should be at the discretion of respective RPCs. SRPC endorsed the views of ERPC.

**After deliberation, it was decided each RPC could have their own arrangements for carrying out the third party protection audit. They may use the audit format template in the reports of Consultant M/s Tractebel Engineering S.A., Romania (Annexure-XIX).**

**Action: All RPCs**

13.3 (a) **Uniform timeline for issuance of Availability Certificate:**

NRPC informed that the timeline for certification of TAFM as approved in the 12th meeting of Commercial sub-committee of NRPC dt. 08.06.2009 is as under:

1)POWERGRID/Transmission Licensee would send the Transmission System availability to NRLDC with copy to NRPC by 2nd of the month

2)NRLDC would put the data on its website on the same day and invite comments on the data from constituents with 10 days. In case of non-receipt of the comments by the time period, it will be taken as no comments from the constituents.

3)NRLDC would then verify the data taking into account the comments received from

the constituents and furnish the same to MS (NRPC) by 18th day of the month.

4)MS (NRPC) would certify the TAFM by 25th of the month.

In the 36th CSC meeting of NRPC held on 11th June 2018, POWERGRID stated that the time lines were not being followed for last few months.

NRPC informed that NRLDC was facing practical difficulties in following the timelines. It was stated that since 2009 the number of transmission licences as well as number of elements have increased multi fold. Hence, the timelines specified in the 12th CSC meeting for verification of outage are not sufficient. The forum was requested to review the timeline specified in the procedure keeping in view the number of Transmission Elements and new Transmission Licensees.

13.3 (b) **Deliberation/Decision in the meeting:**

**It was observed that there was no issue in other regions in respect of timeline for issuance of availability certificate, and the issue proposed by NRPC is purely regional in nature. NRPC may review the timeline specified in the procedure.**

**Action: NRPC/NRLDC**

13.4 (a) **<u>Uniformity in methodology for Open Cycle Certification</u>**:

NRPC informed the following:

i) In the 36th CSC meeting held on 11th June 2018, NTPC stated that the guidelines /procedure finalized for certification of open cycle generation of gas based generating stations in the Northern Region does not cover certification of open cycle generation in the following instances:

- During stopping of GT (i.e. the duration when GT is disconnected with ST and then stopped) - The same is being certified by WRPC as per NTPC
- Starting of GTs under RRAS (an incentive of 50 paisa is already being provided) and mechanism of commercial settlement of the same.

The CSC decided that the matter may be referred to NPC to ensure a uniform practice in all regions regarding open cycle certification of CCGT stations by different RPCs.

ii)During the months of September-November 2017, there were several instances when NTPC gas based stations were operated under open cycle mode when schedule was given under RRAS. Since the units were operated under instructions of NRLDC, NTPC has claimed for certification of open cycle generation in those instances.

NTPC started submitting variable charges for open cycle mode of operation in AS1 formats submitted to NRPC from 16.11.2017. Before that, only one rate of variable cost for each fuel type was being submitted and merit order prepared accordingly. Certifying open cycle generation revised billing according to this would result in post facto revision in variable charges.

iii) As such, certification of open cycle generation in under RRAS may be discussed in NPC meeting to ensure uniformity in methodology to be adopted by all RPCs.

13.4 (b) **Deliberation / Decision in the meeting:**

**After deliberation, it was decided that the issue may be discussed in the respective forum of all the RPCs and the outcome would be communicated to NPC Secretariat for inclusion in the next meeting of NPC.**

**Action: All RPCs/NPC Secretariat**

**iv) <u>Agenda proposed by GRIDCO: Double charging the DICs in PoC regime:</u>**

GRIDCO presented the agenda. The presentation is at **Annexure-XX.**

i) <u>ERPC</u>: The issue was deliberated in the meeting of ERPC and a note on this is under preparation. The same would be shared to all Member Secretaries of RPCs.

**Action: ERPC/GRIDCO**

**The committee observed that as the issue was pertaining to CERC, the entity may take up the issue appropriately.**

**v) <u>DATE AND VENUE OF NEXT MEETING</u>**

As per the roster for hosting the NPC meeting the next meeting is to be hosted by NRPC. MS (NRPC) agreed to host the 09$^{th}$ meeting of NPC. The date and venue of 09$^{th}$ meeting would be intimated in due course.

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# LIST OF ANNEXURES

| No. | DESCRIPTION |
|---|---|
| **I** | List of Participants |
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| **XIX** | Audit format template in the reports of Consultant M/s Tractebel Engineering S.A., Romania |
| **XX** | Presentation by GRDICO on Double charging the DICs in PoC regime |

**ANNEXURE – I**

**List of Participants in the 08th Meeting of NPC held on 30th November 2018 at Guwahati**

**Central Electricity Authority (CEA)**

1.Shri Prakash S. Mhaske, Chairperson CEA & NPC
2.Shri Pardeep Jindal, Chief Engineer & Member Secretary NPC
3.Shri Irfan Ahmad, Director, NPC
4.Shri Vikaram Singh, Director, GM
5.Shri K.P. Madhu, Deputy Director, NPC
6.Shri Deepanshu Rastogi, Assistant Director-I, NPC

**North Eastern Region Power Committee (NERPC)**

1.Shri P.K.Mishra, Member Secretary, NERPC
2.Shri B.Lyngkhoi, Superintending Engineer, NERPC
3.Shri S.M. Aimol, Executive Engineer, NERPC
4.Shri Srijit Mukherjee, Assistant Executive Engineer, NERPC

**Northern Region Power Committee (NRPC)**

1.Shri M A K P Singh, Member Secretary, NPC
2.Shri Upendra Kumar, Superintending Engineer, NRPC

**Western Region Power Committee (WRPC)**

1.Shri A.Balan, Member Secretary,WRPC
2.Shri P.D.Lone, Executive Engineer, WRPC
3.Shri P.A.R Bende, MD, MPPTCL
4.Shri Rajeev Keskar, CGM, MPPMCL

**Eastern Region Power Committee (ERPC)**

1.Shri Joydeb Bandyopadhyay, Member Secretary, ERPC
2.Shri Manas Kumar Das, Director(Comm.) & Chairperson, TCC (ERPC)
3.Ms Harapriya Behera, AGM (Elec.), GRIDCO
4.Shri Sanjit Kumar Maharana, AGM (Elec.), GRIDCO
5.Shri J.G. Rao, Executive Engineer, ERPC

**Southern Region Power Committee (SRPC)**

1.Shri Y Adams, Director (Grid & Tr. Mgmt), APTRANSCO & Chairperson, TCC (SRPC)
2.Shri Asit Singh, Superintending Engineer, SRPC
3.Shri Anil Thomas, Executive Engineer, SRPC

**Power System Operation Corporation Ltd. (POSOCO)**

1.Shri S.R.Narasimhan, Director (System Operation)
2.Shri S.C.Saxena, Deputy General Manager, NLDC
3.Shri Amaresh Mallick, Deputy General Manager, NERLDC.

**Power Grid Corporation of India Ltd. (PGCIL)**

1.Smt Seema Gupta, Director (Operations), CTU.
2.Shri Sunil Agrawal, ED (LD&C), CTU
3.Shri D.S.Yadav, ED (NER),

***

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

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** |

| भारत सरकार<br>केंद्रीय विद्युत प्राधिकरण<br>दक्षिण क्षेत्रीय विद्युत समिति<br>बेंगलूरु - 560 009 | | Government of India<br>Central Electricity Authority<br>Southern Regional Power Committee<br>Bengaluru - 560 009 | |
|---|---|---|---|
| Web site:<br>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

149
21/5

फ़ैक्स/स्पीड पोस्ट /FAX/SPEEDPOST


| भारत सरकार<br>केंद्रीय विद्युत प्राधिकरण<br>दक्षिण क्षेत्रीय विद्युत समिति<br>बेंगलूरु - 560 009 | | Government of India<br>Central Electricity Authority<br>**Southern Regional Power Committee**<br>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**

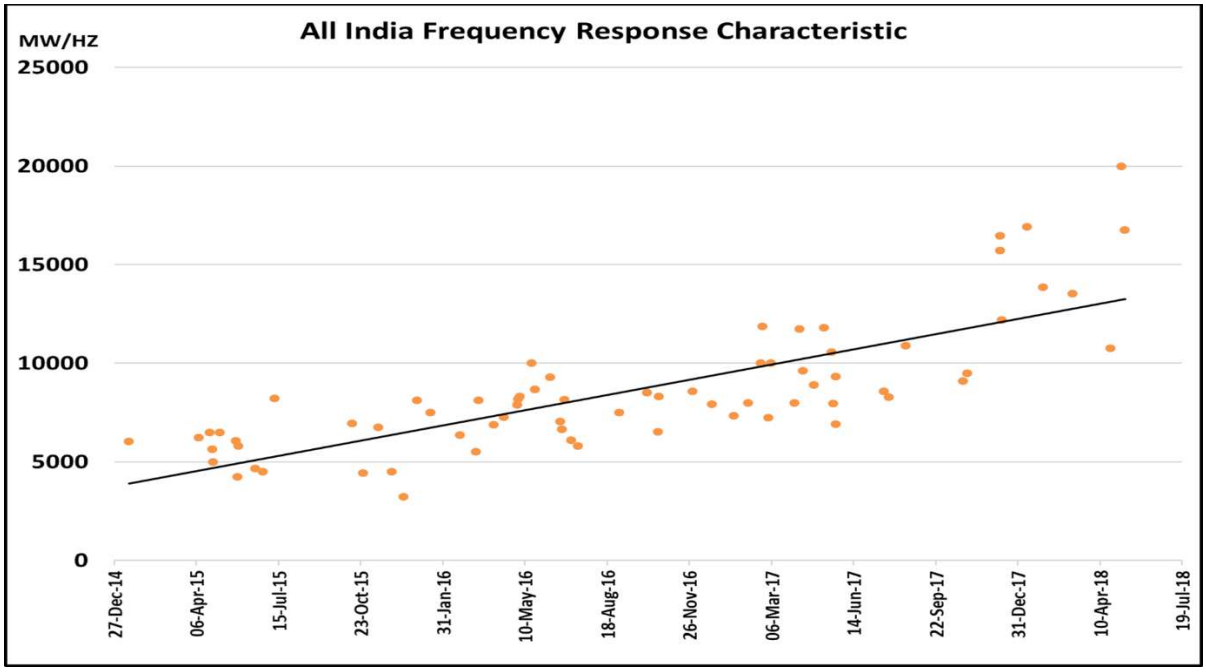



**Figure: All India Frequency Response Characteristic (FRC) from January'2015 to Present**

**Annexure-II**

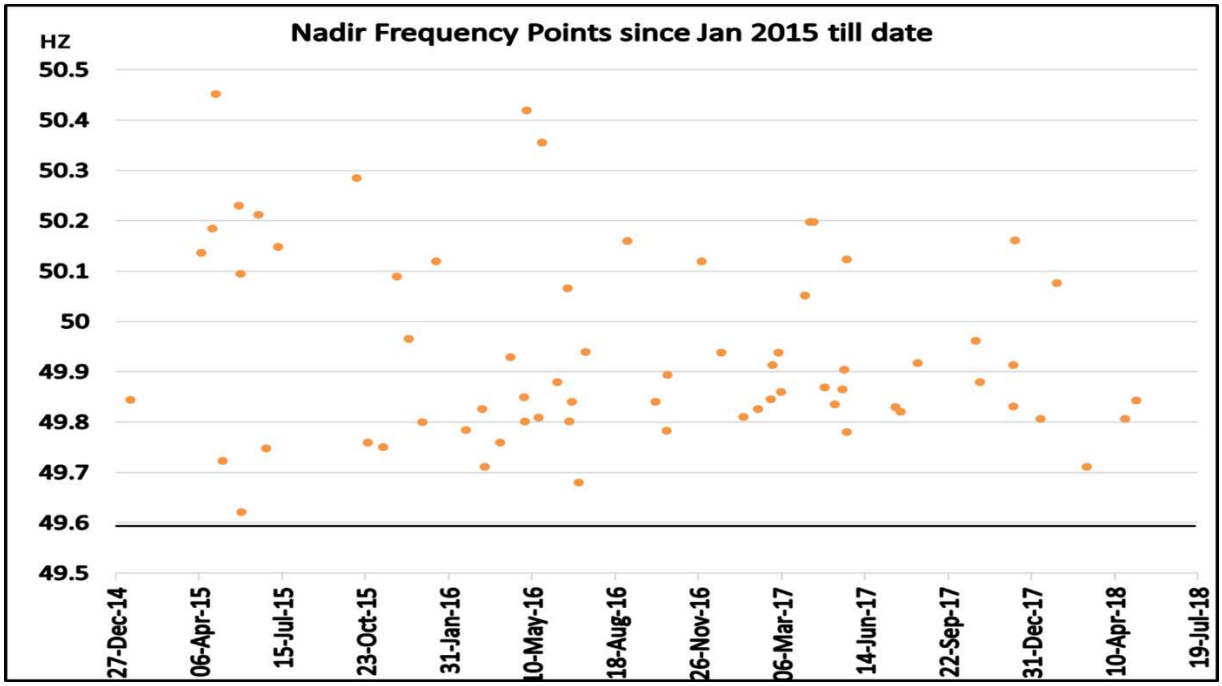
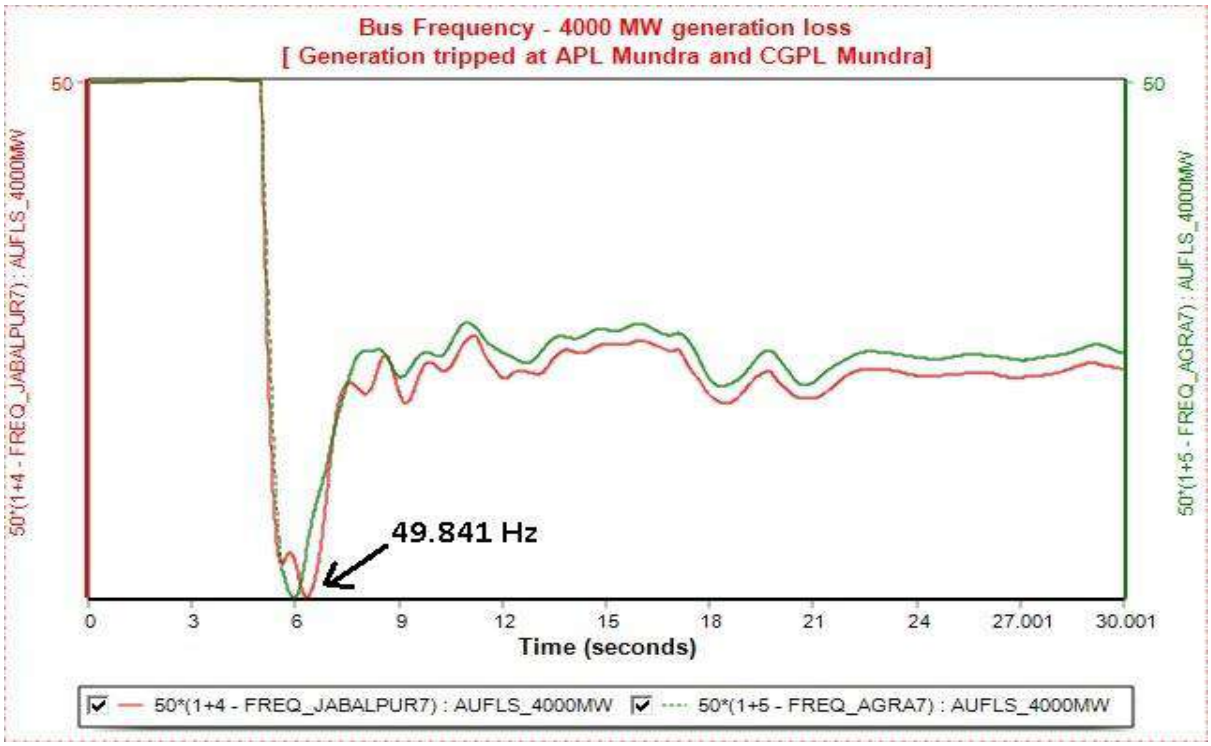


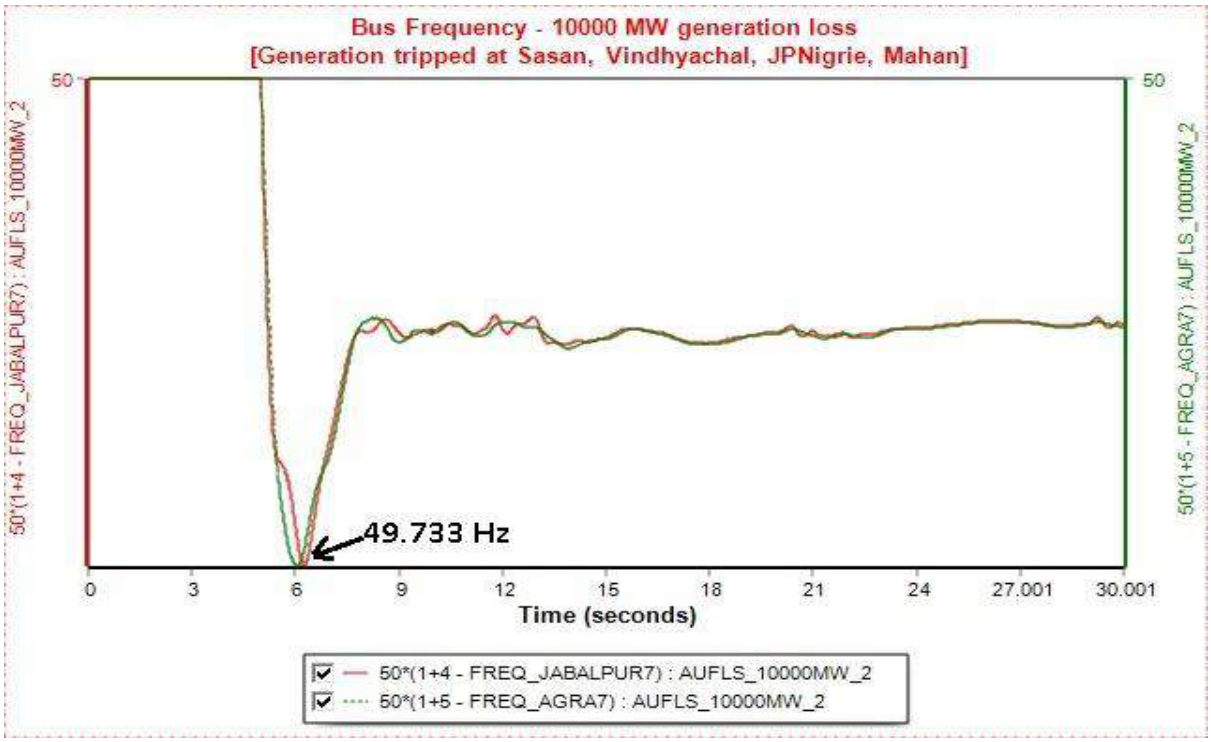

**Figure: Nadir Frequency Points for events in Indian grid from January'2015 to Present**

**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

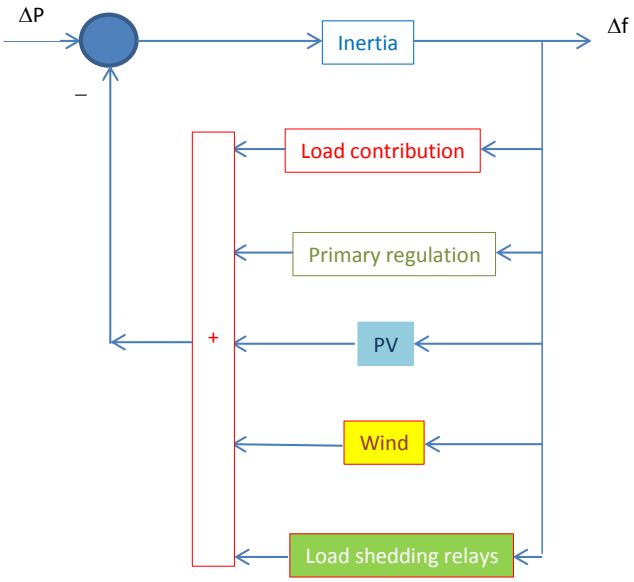



Figure 1: Overall block structure of the simulation model

## 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.

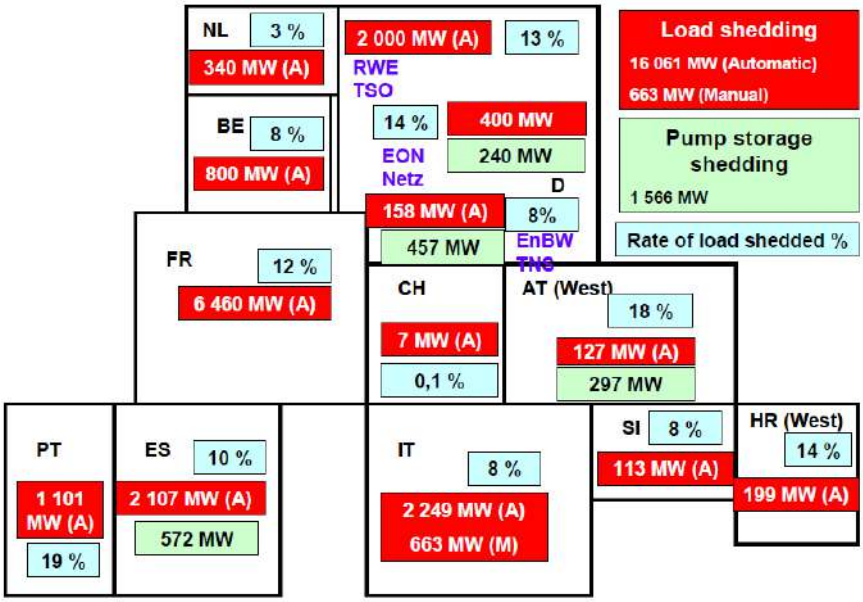



Table 3 - ULFS for 4th of November 2006 (West Area)

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.

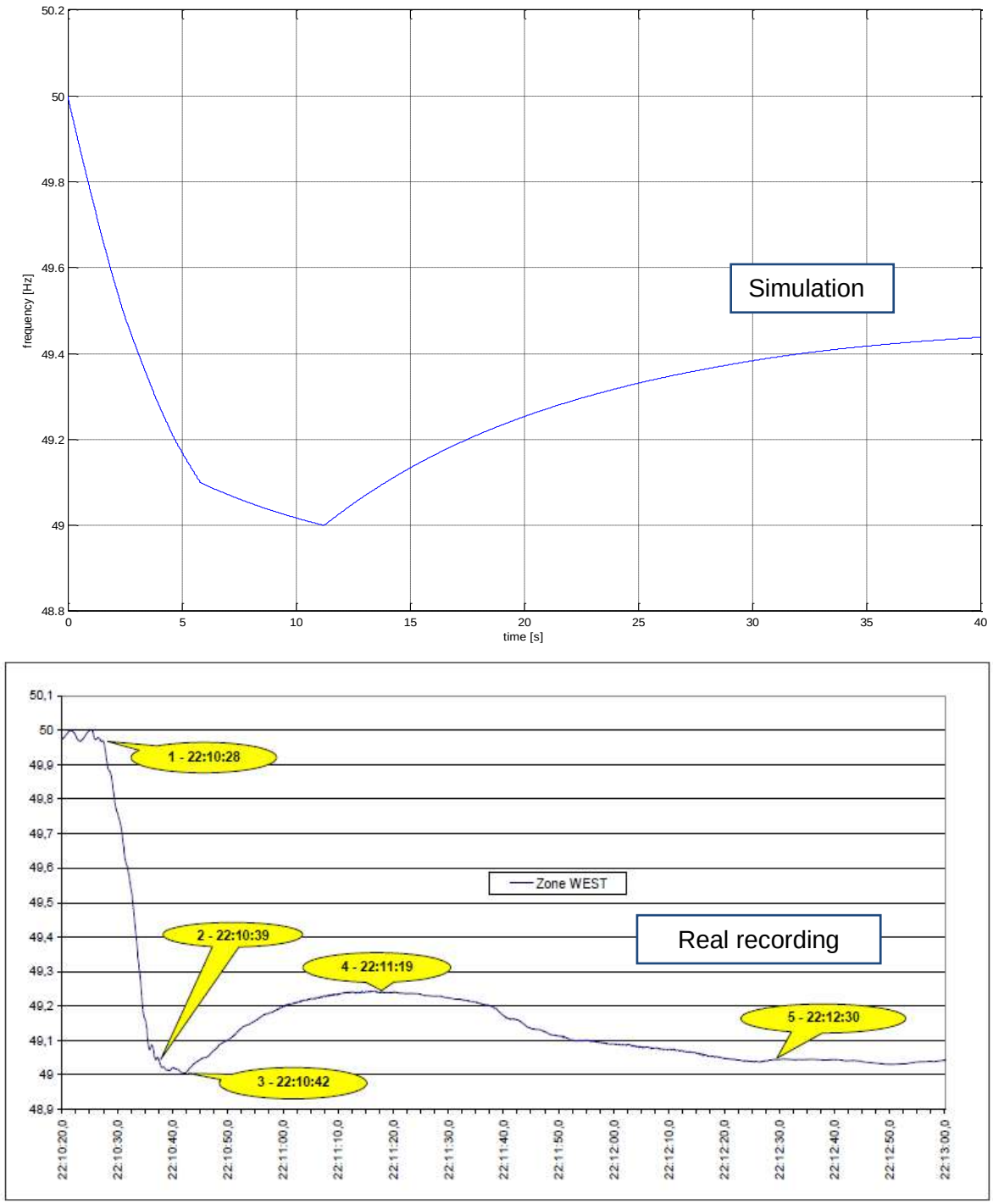



Figure 2: Comparison between 4th November 2006 West area frequency recording and simulation

| 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.

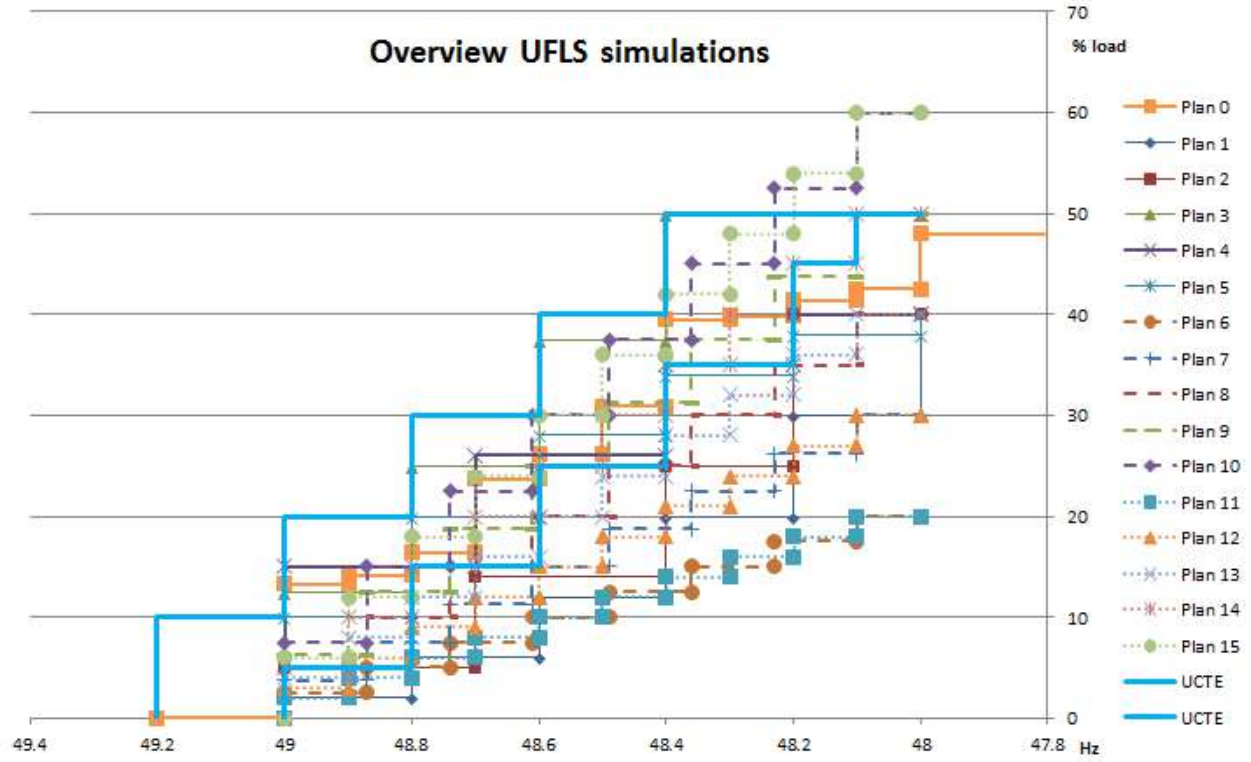



Figure 3: Overview UFLS simulations

## 6. Discussion on simulations results

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

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

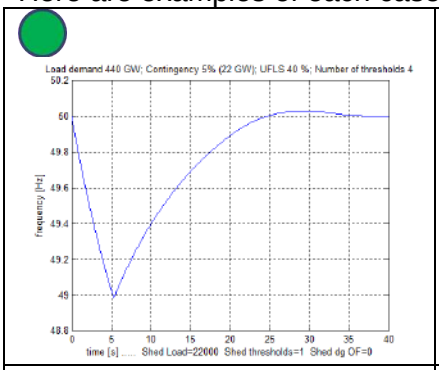



Figure 4: Correct behaviour as expected

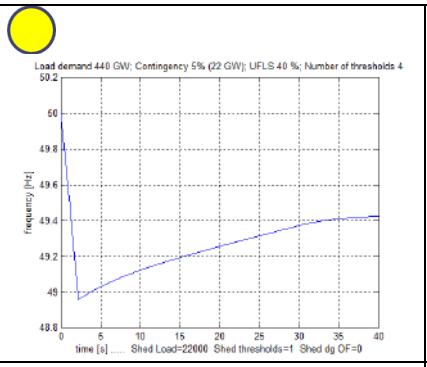



Figure 5: Low end frequency

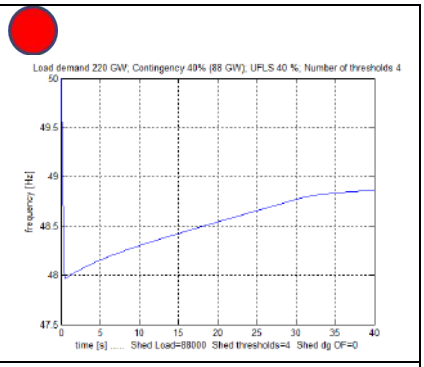



Figure 6: Too low end frequency

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.

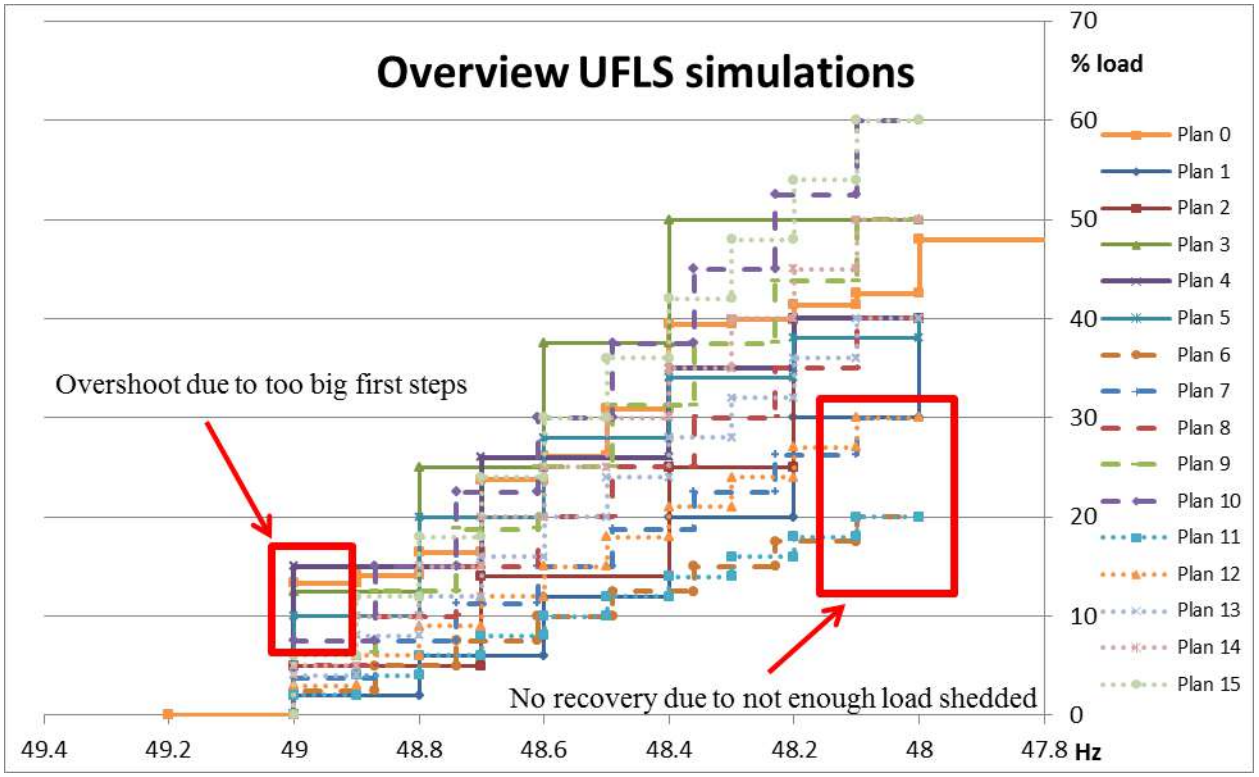


Figure 7: Overview results.

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%)

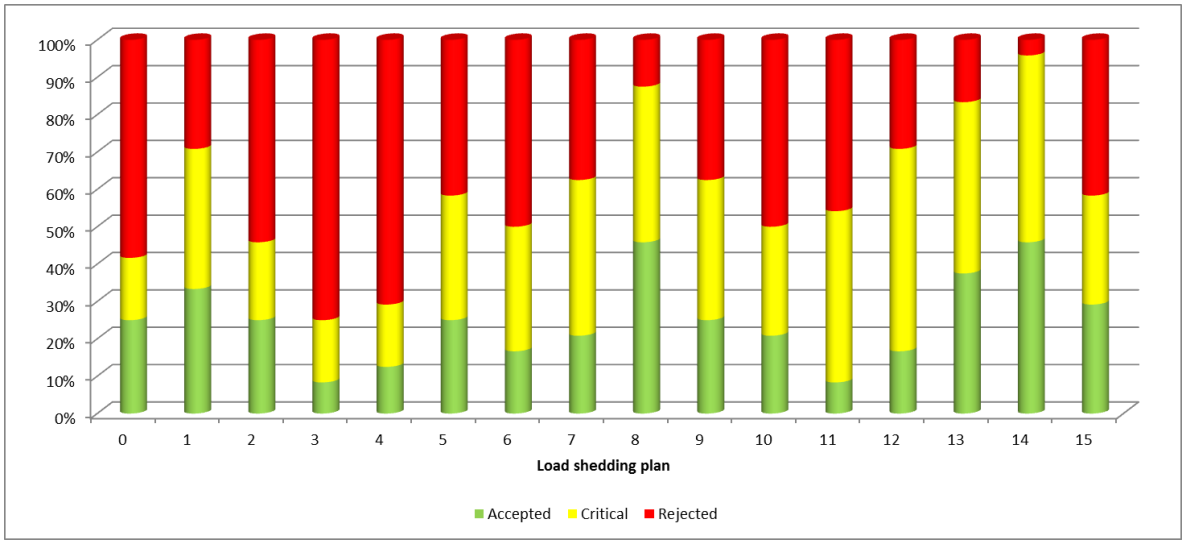



Figure 8: Classification of results for the simulations per UFLS plan

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 %).

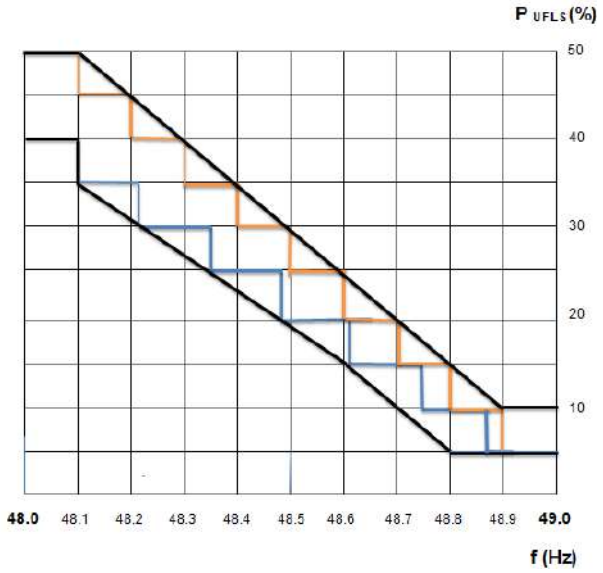



Fig. 9: Practical load shedding boundaries (black). Recommended load shedding plan 8 (blue) and plan 14 (orange) are also displayed.

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.

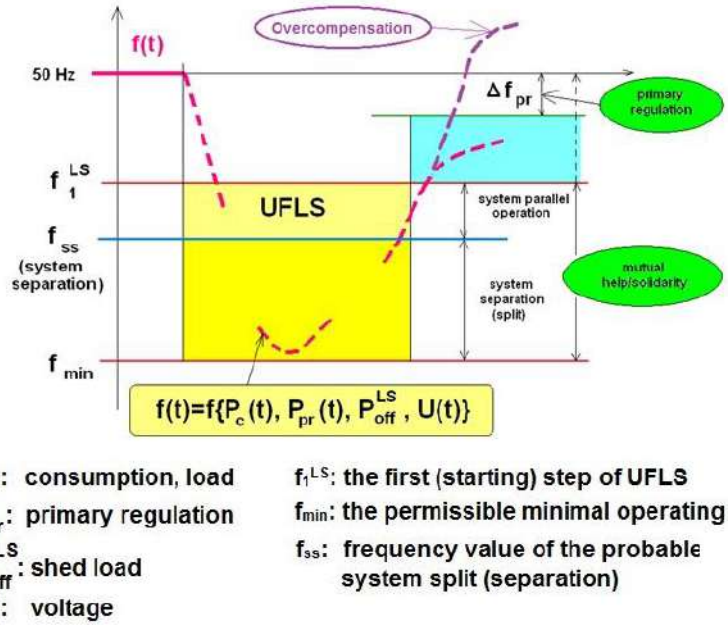



Fig. 10: Underfrequency load shedding principle

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.

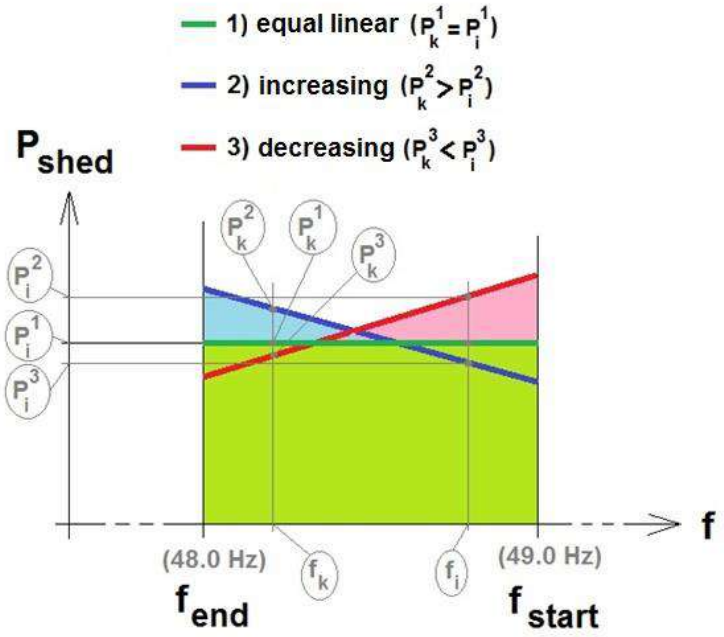



Fig.11: Underfrequency step size variation

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).
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[4] New OH 5 WG – Questionnaire
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[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)

## 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.

# 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%]

***

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.*"

उत्तर क्षेत्रीय 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.

Gmail

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

# SRPC secretariat comments on Draft Guidelines for Availability of Communication System

1 message

**Srpc Operation** <srpc.operation@gmail.com> 20 November 2018 at 12:33
To: CE NPC <cenpccea@gmail.com>, Chief Engineer NPC <cenpc-cea@gov.in>, jindal_pardeep@yahoo.co.in
Cc: SRPC-MADHU <kpmadhu64@yahoo.co.in>, member Secretary SRPC <mssrpc@yahoo.com>

Sir
Please find attached SRPC Secretariat's comments on Draft Guidelines for Availability of Communication System for kind consideration.
Regards,
Operation Division, SRPC

**SRPC-CSA_guidelines.docx**
14K

**SRPC secretariat comments on Guidelines on "Availability of Communication System" for Interstate transmission of electricity**

A new clause 4.1 to be added as given below (Other clauses of 4 to be numbered accordingly):

The RPC Secretariat shall certify the availability of communication equipment for CTU, ISGS, RLDCs, NLDC, SLDCs based on the data furnished by RLDC. For the concerned entities for whom the Availability of Communication System is to be certified by RPC, RLDC shall verify the outage details and availability and submit to RPC.

**Reason**

**As stipulated in the Regulation, the certification by RPC is to be done based on the data furnished by RLDC. Even in Transmission System Availability the outage data and availability certificate is to be verified by RLDC before submitting to RPC. RLDC/SLDC would be having the data in this regard besides NMS consoles are to be provided at NLDC/SLDC/RLDC/NTAMC (However, the operating rights shall be decided by CTU in consultation with NLDC/RLDCs).**

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 15$^{Th}$ 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:**<br><br>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.<br><br>**Infrastructure and regulatory requirements & implementation impact etc.:**<br>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.<br>• Primary (droop) control<br>➢ Obligatory, Automatic response<br>• Secondary (AGC) control<br>➢ Spinning reserve, NLDC/RLDC/SLDC controlled, Automatic Generation Control (AGC)<br>• Tertiary control<br>➢ Tertiary Reserve and response from State, Manual.<br><br>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.<br><br>**The principle used is given below:**<br><br>Region considered as an Area for secondary control.<br>• ACE = (Ia - Is) + 10 * Bf * (Fa - 50)<br>Where:<br>o Ia = Actual net interchange, negative for NR meaning import by NR<br>o Is = Scheduled net interchange, negative for NR meaning import by NR<br>o Bf = Frequency Bias Coefficient in MW/0.1 Hz, positive value<br>o Fa = Actual System Frequency<br>• ACE positive means NR is surplus and NR internal generation has to back down<br>• ACE negative means NR is deficit and NR internal generation has to increase<br>• Tie line bias mode and Frequency bias only mode both possible<br>• 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:<br>• The AGC project is being implemented and is at an initial stage of information gathering like technical data, commercial data etc.<br>• 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)<br>• 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.<br>• They have requested NTPC and NLDC to offer guidance and support for the project.<br><br>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.<br><br>c) Mahagenco representative informed that they would discuss with their management and revert back.<br><br>d) SLDC, Gujarat representative informed that any unit from Wanakbori 4, 5 and 6 or Ukai 6 may be considered for AGC pilot project.<br><br>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.

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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

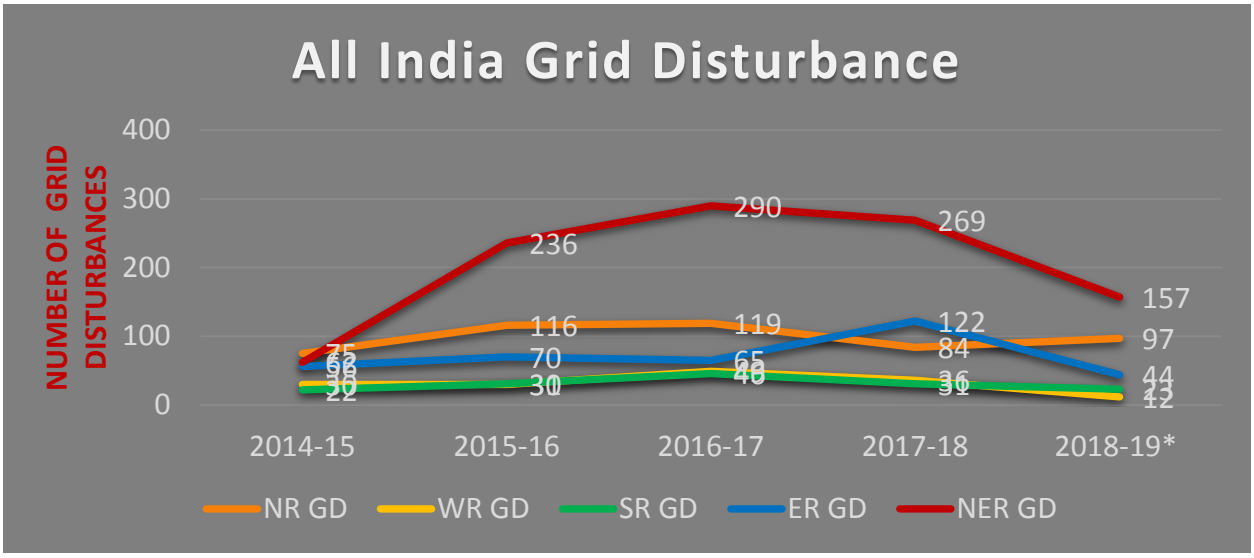
On each of the above points, NRLDC gave past statistics to highlight the issues. He also stated that fuel shortage this year combined low hydro generation could be difficult and therefore, requested all the utilities to buildup enough fuel stock for increasing the internal generation in NR and for also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

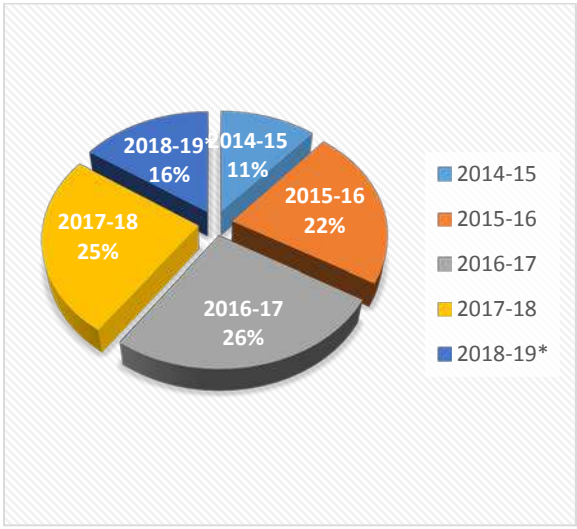
B.15.3 He also mentioned following Action plans:

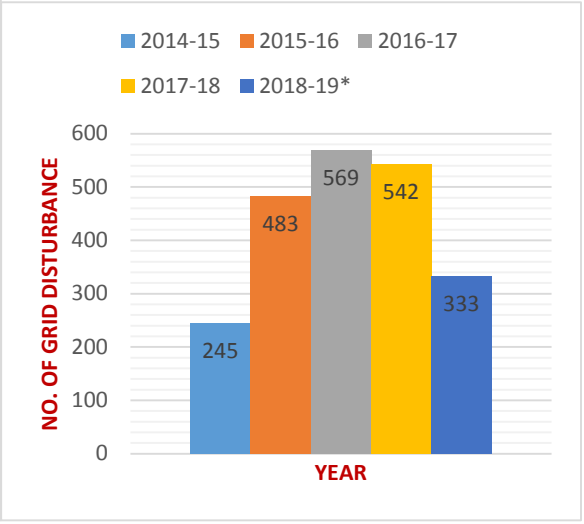
- Meticulous load forecasting and portfolio management
- TTC/ATC calculations, keeping margins, Network
- Tower strengthening, New network commissioning
- Keeping fuel reserves
- Keeping reserves (generation in control areas for contingencies)

**Annexure-XII**

**Year wise comparative trend of total number of Grid Disturbances (GD) in regional grids:**



## 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 % |

**Measures recommended by Enquiry Committee to analyse the causes of grid disturbances during July 2012**

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.

**Annexure-XV**



## 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) / 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 |
| **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 |

| Recommendation | | Fully completed (FC) / Partially Completed(PC) / Not Completed(NC) | | | | | Responsible Entity |
|---|---|---|---|---|---|---|---|
| **No.** | **Content of recommendation** | **NR** | **WR** | **SR** | **ER** | **NER** | |
| **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 |
| **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
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CIN : U40105DL2009GOI188682, Website : www.posoco.in, E-mail : posococc@posoco.in,Tel.: 011- 41035696, Fax : 011- 26536901

**संदर्भ संख्या**: पोसोको/एनएलडीसी/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 7$^{th}$ 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 16$^{th}$ 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.

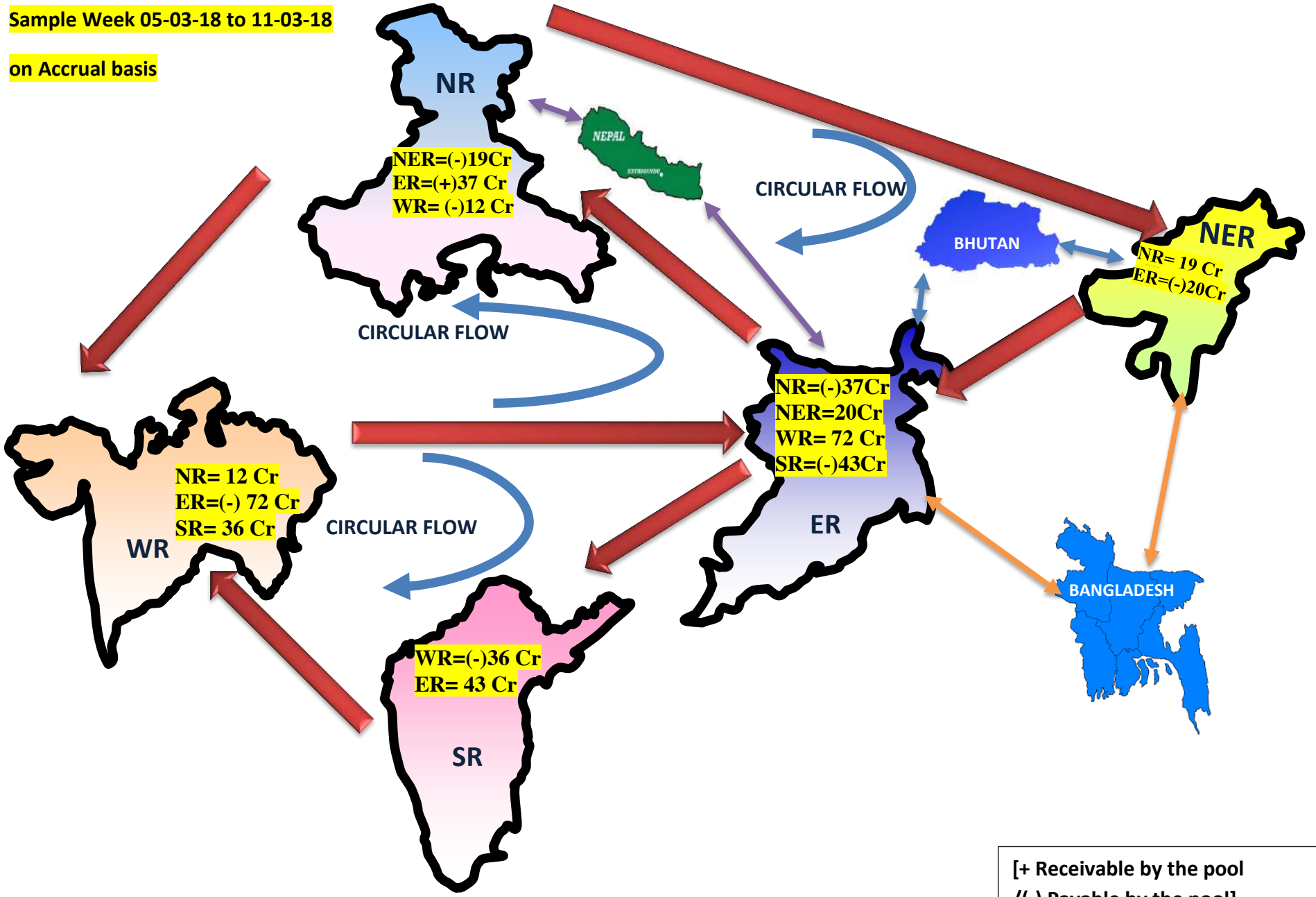
A sample illustration of the flow of funds between different regional DSM pool accounts to the national DSM pool account and that with the neighboring countries is shown at Annex – II.

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**

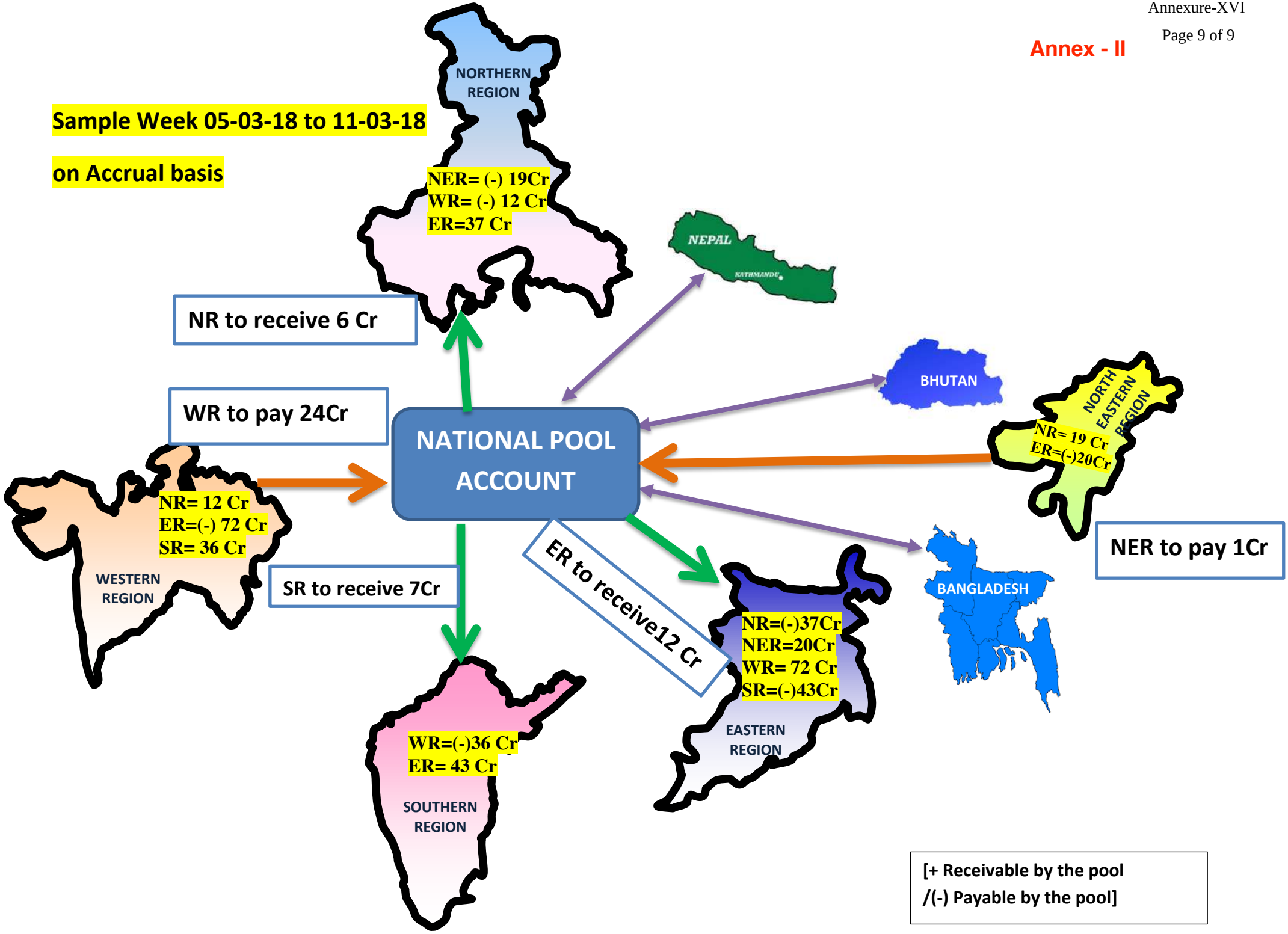



[+ Receivable by the pool
/(-) Payable by the pool]

Annex - II

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

**on Accrual basis**




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

National Power Committee Meeting

30th November, 2018 - Guwahati

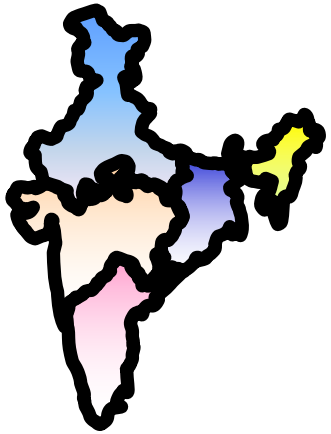
Agenda No.11

# National Energy Account

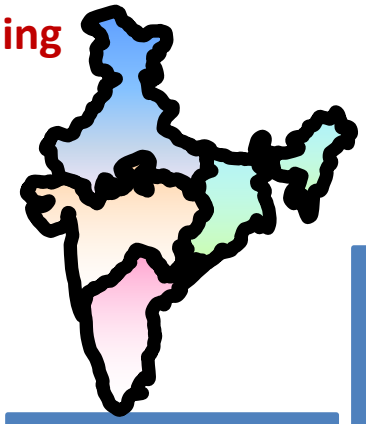
National Load Despatch Centre

# Evolution of Indian Grid and Electricity Market

2004: Open Access
2008: Power Exchange
2009: Imbalance (UI)
2009: Congestion Management
2009: Trading License
2009: Connectivity, LTA and MTOA
2010: Power Market, REC
2011: Transmission Pricing (POC)
2012: 15 Min Bidding
2014: Deviation
2015: RE Framework
2015: Ancillary Services
2016: 55% - Flexibility
2016: X-Border
2017: Storage
2018: AGC

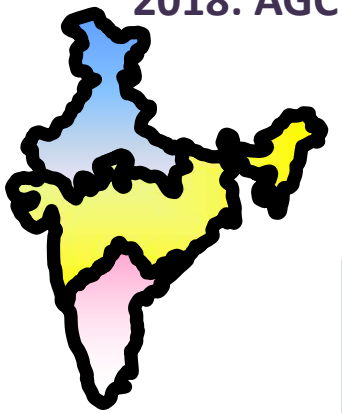


Pre 1991:
Five Regional Grids - Five Frequencies



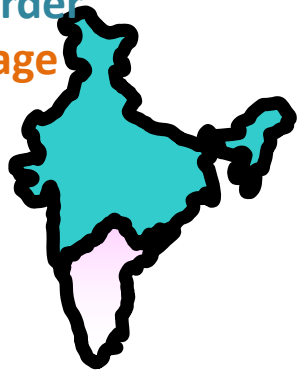
October 1991: East and Northeast synchronized

Merchant Power



March 2003: West synchronized with East & Northeast

Electricity Act, 2003



August 2006: North synchronized with Central Grid

Merging of Markets

Dec 2013: All India Synchronized Grid

1000 MW units and HVDC, 765 kV, UMPP, Common Carrier - Transmission

175 GW Renewables, Cross Border Interconnections, Distribution System Operators (DSOs), Storage, Electric Vehicles, Micro-Grids

Maps not to scale

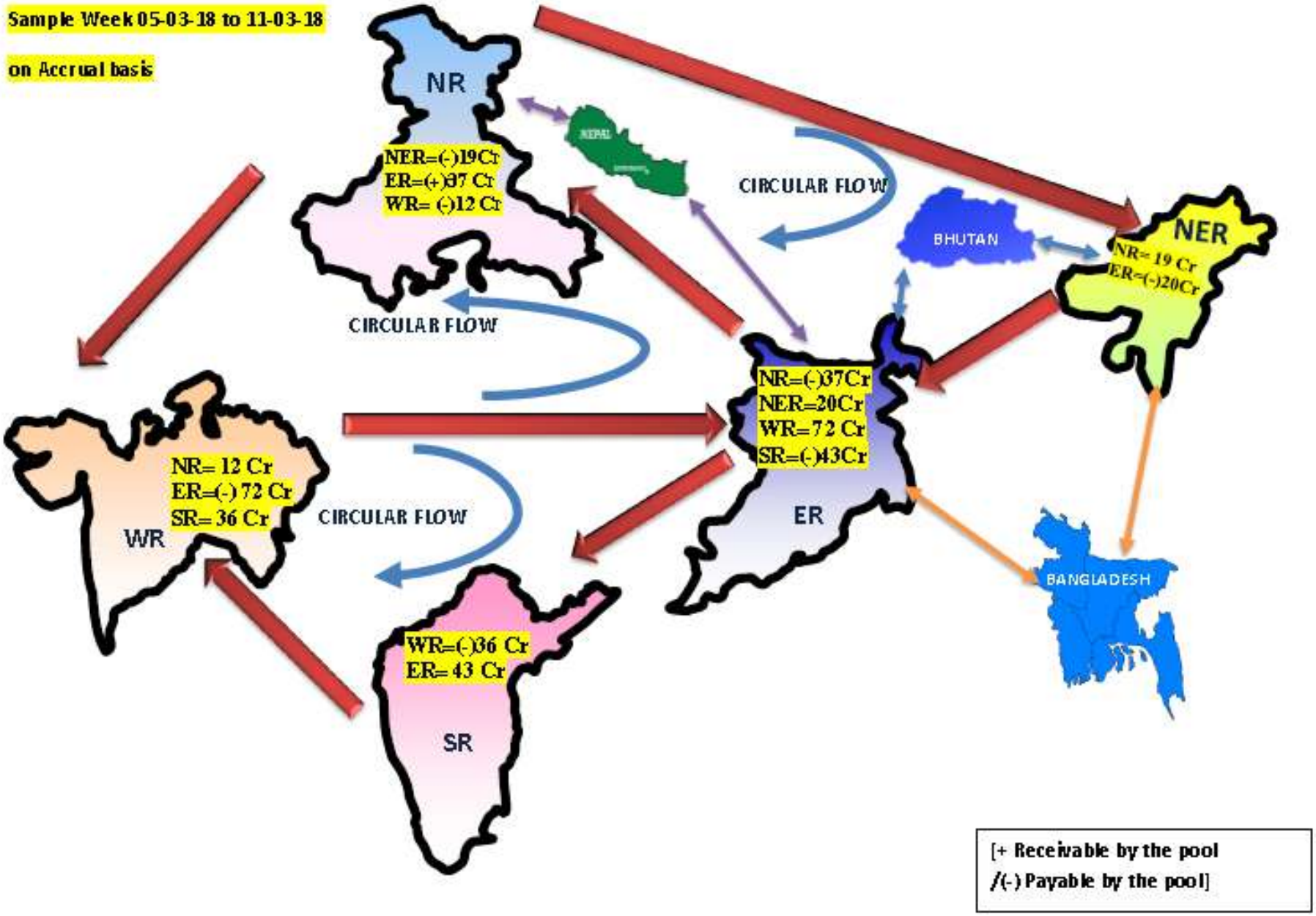
# Existing Scheduling, Metering, Accounting and Settlement Systems…(1)

- Meter readings processed at RLDCs
- RPCs issue weekly deviation account.
  - Settlement of inter-regional deviations
- Regional DSM pool accounts
  - Non-zero sum game since 7th January 2008 (rate cap)
  - Surplus generated in the deviation pool.
- Treatment of inter-regional transactions
  - No adjustment is done in DSM charges payable to / receivable from other regions
  - DSM charges payable to other regions has highest priority
  - Schedules reconciled between RLDCs for final schedules
  - Same meter readings are used by both connected regions
  - Normally, there should not be any mismatch between DSM charges payable / receivable by adjacent regions

# Existing Scheduling, Metering, Accounting and Settlement Systems…(2)

- Sometimes, cases of mismatch between deviation payable/receivable
  - Need for reconciliation of accounts by RPCs prior to issuance
- Settlement of UI/deviation charges between the regions
  - One to one basis
  - Multiple financial transactions - money flow between regions
  - Instances of circular flows of funds between regions
- Need for change in methodology
  - All the five regions connected synchronously
    - Circular and multiple fund transactions.
    - ‘Tandem’ money transactions between the regions at times
    - Issues in disbursal within the regions

# Circular Flow of Funds



# Provisions of Electricity Act, 2003

- Section 26

*"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.*

- *National Load Despatch Centre Rules, 2004*

*"…Coordination with Regional Load Despatch Centres for the energy accounting of inter-regional exchange of power*

*…Coordination for trans-national exchange of power…"*

# Provisions of IEGC

- 2.2 Role of NLDC

*"b) scheduling and despatch of electricity over inter-regional links in accordance with Grid Standards specified by the Authority and Grid Code specified by Central Commission in coordination with Regional Load Despatch Centers."*

*"g) coordination with Regional Load Despatch Centers for the energy accounting of inter-regional exchange of power."*

*"i) coordination for trans-national exchange of power."*

- Annexure-1((Refer section 6.1 (d))

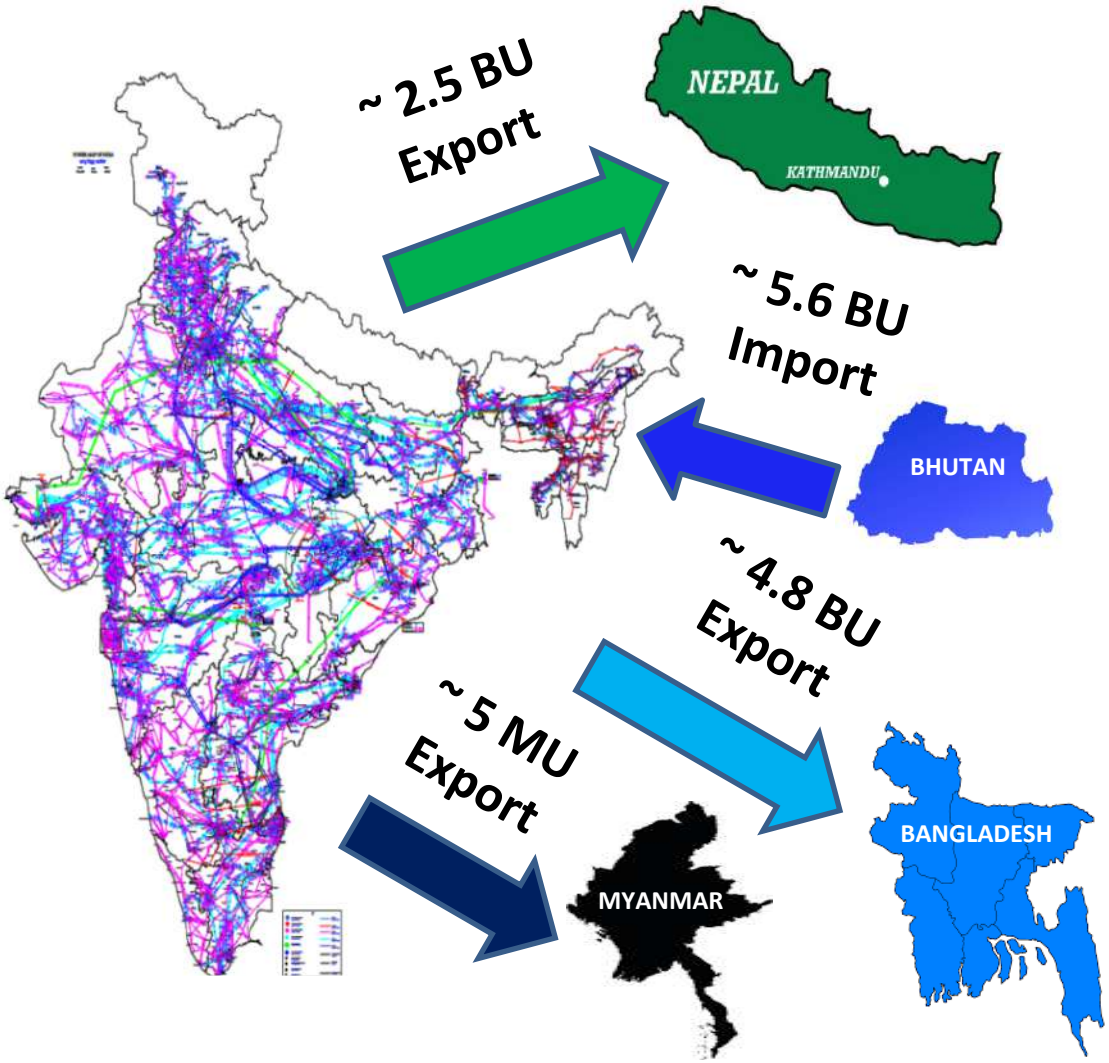
*Complementary Commercial Mechanisms*

*"16.2 No attempt shall be made to split the inter-regional schedules into link-wise schedules (where two regions have two or more interconnections)."*

Scheduling, metering, accounting and settlement

- Responsibility of RPCs & RLDCs at Regional level – being done
- Need for responsibility to be taken up by NPC & NLDC at inter-regional and trans-national level

# Cross Border Footprint Expansion




- In future, neighboring countries may have connectivity with two different regions of India.
- Country needs to be treated as a single control area
- Transactions need to be reconciled on National basis

# Increasing Scale of RE

- Renewables under regional jurisdiction **~ 1250 MW**
  - NR - 30 MW
    - Additional 750 MW coming up by end of the year
  - WR - 406.8 MW
  - ER - 10 MW
  - SR - 800 MW

**Upcoming ~ 24 GW**

- Andhra Pradesh – 4160 MW
- Gujarat – 6200 MW
- Himachal Pradesh – 1000 MW
- Karnataka – 2000 MW
- Madhya Pradesh – 2750 MW
- Maharashtra – 1805 MW
- Odisha – 1000 MW
- Rajasthan – 4331 MW
- Tamil Nadu – 1000 MW

***Source: MNRE List of Solar Parks, June 2018***

# Changing Scenario & Increasing Complexities…(1)

## Significant changes implemented at National level:-

### a) Collective Transactions through Power Exchanges

i. 2-Power Exchanges -another is in the offing.

ii. Curtailment at National level, if any, done by NLDC in coordination with RLDCs

iii. Accounting and settlement of the Collective Transactions by NLDC.

### b) Ancillary Services (RRAS):

i. Ancillary Services dispatched by NLDC across regions on a pan-India basis.

ii. Payment through DSM Pool.

iii. During shortfall in DSM pool towards payment of RRAS,NLDC facilitates transfer of funds from a surplus regional pool to the deficit regional pool.

# Changing Scenario & Increasing Complexities..(2)

## c) Fast Response Ancillary Services (FRAS):

i. CERC vide suo-motu order dated 16th July 2018 directed the implementation of FRAS and pilot project for 5-minute metering.

ii. FRAS implemented from 26th Nov'18.

iii. FRAS is to be carried out by NLDC across multiple regions (NR, ER and NER).

## d) Automatic Generation Control (AGC):

i. AGC has been implemented at

   I. Dadri – Stage II in January 2018

   II. Simhadri in November 2018

ii. the accounting and settlement for the AGC is being facilitated by NLDC.

iii. Implementations in other regions are also coming up.

iv. Accounting and settlement at the national level.

# Changing Scenario & Increasing Complexities..(3)

**e) Proposals under various stages of implementation/deliberations**

- 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

**Above-mentioned proposals are intended for**

- **Scheduling, despatch, accounting and settlement at the national level.**
- **Changing paradigm and new challenges- settlement needs to be streamlined at the national level.**

## National Energy Account and National Deviation Pool Account..(1)

To streamline the accounting and settlement at the national level the following methodology is proposed.

**a) Scheduling:**

i. Inter-regional transactions on a net basis for each region.

ii. NLDC shall communicate the net inter-regional schedules to the NPC for the purpose of accounting.

iii. Schedules for cross-border transactions by NLDC on a net-basis to facilitate accounting of cross-border transactions by the NPC.

**b) Metering:**

i. For the cross-border metering locations, the processed meter data shall be provided by the respective RLDCs to the RPCs and NPC (through NLDC).

# National Energy Account and National Deviation Pool Account..(1)

c**) Accounting & Settlement:**

i. 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.

ii. 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

iii. 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.

iv. Payment to the National DSM Pool shall have the highest priority.

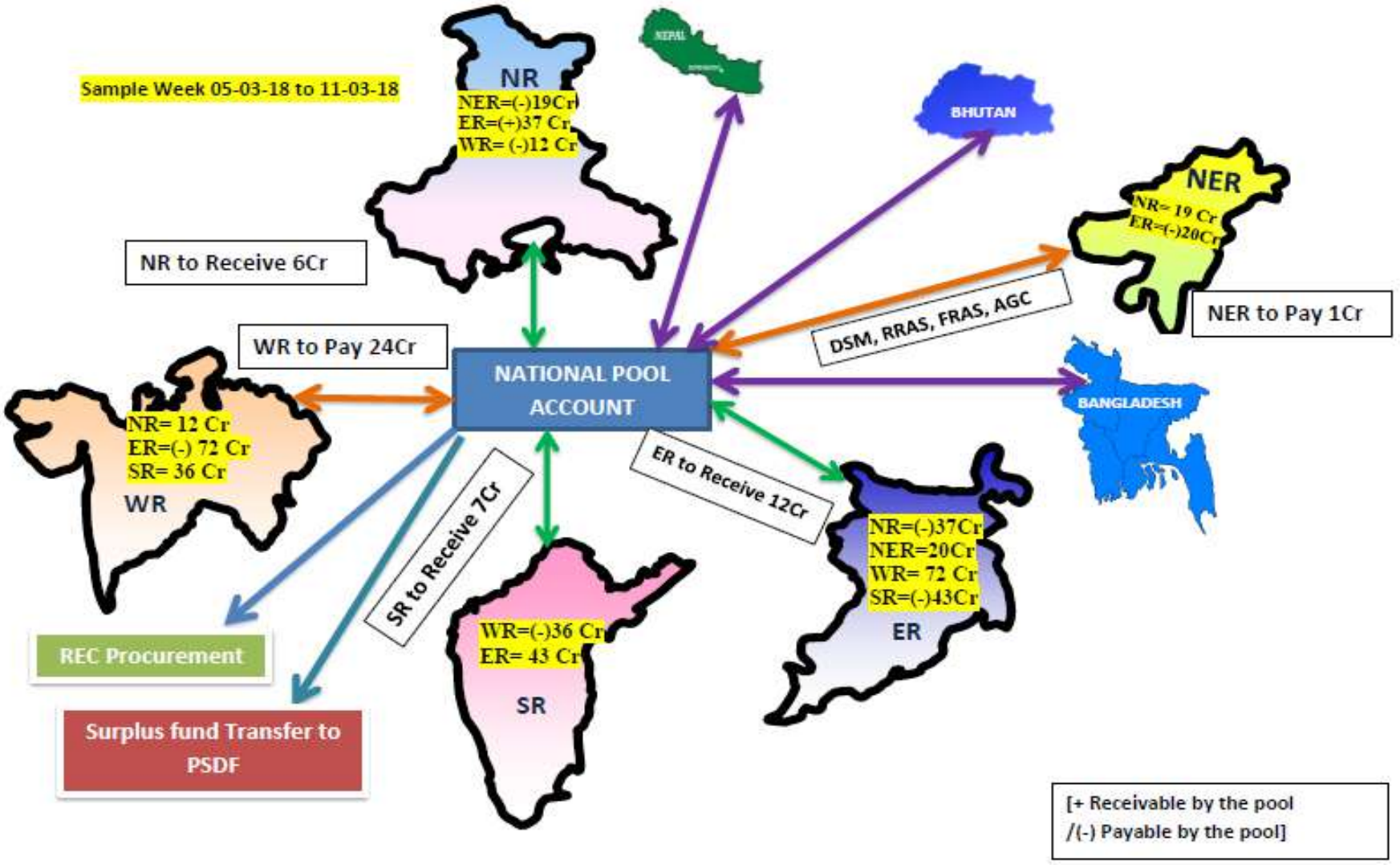
d) **Handling Surplus/Deficit in Regional Pool Accounts and transfer of residual to PSDF**

i. Residual/surplus amount in the regional DSM pools shall be transferred to the National DSM pool account.

ii. 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.

iii. Any residual in National DSM Pool shall be transferred periodically to the PSDF .

# Illustration: flow of funds between regional DSM pool accounts to the national DSM pool account and that with the neighboring countries



# National Energy Account
# and
# National Deviation Pool Account

# Establishment of National Grid

- 1960s - Regional Electricity Boards **(Monolithic Framework)**
- 1970s - 1980s
  - Inter-state lines
  - Multi-beneficiary Central Sector generating stations
    - Associated transmission system
  - Concept of regional energy accounting (global accounting)
  - Boundary metering of all control areas.
  - Planning on regional self-sufficiency basis
  - Very few inter-regional links.
- 1990s onwards **(Competitive Framework)**
  - Inter-regional inter-connections
  - Formation of a strong National Grid.
    - HVDC and AC Interconnections
  - More complications - direct HVDC connections between NER & NR

# Existing Scheduling, Metering, Accounting and Settlement Systems…(1)

- Availability Based Tariff (ABT)
- Concept of Unscheduled Interchange (UI) regional pool account
  - Presently Regional Deviation Pool Account
- Short-term open access - May 2006
  - Multiple Power Exchanges – 2008
- Long-term and medium-term transactions – 2009 onwards
  - Within one region and between different regions.
  - Corresponding scheduling on the inter-regional links
    - Corridor-wise basis
- Corridor wise margin declaration for market-based transactions
  - Net import/export capability for regions

सत्यमेव जयते

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

**Subject: - NRPC agenda items for the 8th meeting of NPC.**

**Reference: -**

1. NPC letter No. 4/MTGS/NPC/CEA/2018/212-17 dated: 09.03.2018.
2. NPC letter No. 4/MTGS/NPC/CEA/2018/1098-1117 dated 31.10.2018.

With reference to the above, enclosed please find NRPC agenda items for deliberation in the 8th meeting of National Power Committee scheduled to be held at Guwahati on 30.11.2018.

This issues with the approval of Member Secretary, NRPC.

Encl: As Above

(उपेन्द्र कुमार)
(Upendra Kumar)
अधीक्षण अभियंता
Superintending Engineer

Chief Engineer, NPC Division, Central Electricity Authority, 18-A, SJS Marg, Katwaria Sarai, New Delhi-110016

No. NRPC /OPR/ 13149 Dated: 19th November, 2018

# ***Agenda Items for the 8th NPC meeting***

## ITEM-1 **Periodicity of Third Party Protection Audit**

The enquiry committee constituted by Govt of India to enquire into grid disturbances that occurred on 30th and 31st July, 2012 had recommended that a thorough third-party protection audit needs to be carried out in time bound manner and should be repeated periodically. Accordingly, the issue of third party audit is being deliberated regularly in OCC/PSC as well as TCC/NRPC meetings. Following points were deliberated in 35th Protection Sub-Committee of NRPC held on 20th June, 2018 to review the protection audit periodically:

- Periodicity of Third Party Protection Audit.
- Agency authorized to carry out Third Party Protection Audit.

In the 35th PSC, members suggested that Third Party Protection audit can be carried out either by a team of Protection Engineers of the power utilities drawn from the list of protection engineers finalized by the Protection Sub-Committee. It was also deliberated that considering large number of substations and limited manpower at CPRI, third party protection audit may be carried out from any reputed agency working in the field of Power System protection also. The list of reputed agencies would be regularly updated in the PSC meeting based on the feedback received from the utilities in the country.

Members also agreed that the exercise of third party protection audit should be carried out periodically and frequency of the same should be 5 years and suggested that after finalization it should be deliberated in the NPC for uniformity at national level. The issues were further deliberated at length in the 39th TCC/42nd NRPC meetings held on 27.06.2018 and 28.06.2018 respectively. TCC recommended and thereafter NRPC approved the recommendations of 35th Protection Sub Committee, 5 years periodicity of third party audit and that the audit can be carried out through any agency out of the list of reputed agencies carrying out protection audit as drawn by Power Sub Committee of RPCs.

**Members may deliberate about the periodicity and agency to be authorized for Third Party Protection Audit for uniformity at National level.**

## ITEM-2 **Uniform timeline for issuance of Availability Certificate**

In compliance of Regulation 38 and Appendix–III of CERC (Terms & condition of Tariff) Regulation, 2014-19, the transmission Licensee is to raise bill for transmission charges (inclusive of incentive) for a month based on TAFM certified by the Member Secretary of RPC.

Transmission system availability factor for a calendar month (TAFM) is being certified by the Member-Secretary, Regional Power Committee of the region concerned, separately for each AC and HVDC transmission system and grouped according to sharing of transmission charges.

The timeline for certification of TAFM as approved in the 12th meeting of Commercial sub-committee of NRPC dt. 08.06.2009 is as under:

1) POWERGRID/Transmission Licensee would send the Transmission System availability to NRLDC with copy to NRPC by 2nd of the month
2) NRLDC would put the data on its website on the same day and invite comments on the data from constituents with 10 days . In case of non-receipt of the comments by the time period , it will be taken as no comments from the constituents,.
3) NRLDC would then verify the data taking into account the comments received from the constituents and furnish the same to MS(NRPC) by 18th day of the month.
4) MS( NRPC ) would certify the TAFM by 25th of the month.

In the 36th CSC meeting of NRPC held on 11th June 2018, POWERGRID stated that the time lines were not being followed for last few months.

NRLDC informed that there were practical difficulties in following the timelines. It was stated that since 2009 the number of transmission licences as well as number of elements have increased multi fold. Hence, the timelines specified in the 12th CSC meeting for verification of outage are not sufficient. The forum was requested to review the timeline specified in the procedure keeping in view the number of Transmission Elements and new Transmission Licensees.

The CSC of NRPC decided that the matter may be referred to NPC to bring uniformity amongst the RPCs.

**Members may kindly deliberate and approve the timelines for issuance of availability certificate by all RPCs.**

## ITEM-3 Uniformity in methodology for Open Cycle Certification

**Issue 1**

In compliance with Regulation 30(6)(b) of Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2014 NRPC Secretariat certifies open cycle generation for gas based generating station in the Northern Region. Regulation 30(6)(b) states that

*"Energy charge rate for a gas/liquid fuel based station shall be adjusted for open cycle operation based on certification of Member Secretary of respective Regional Power Committee for the open cycle operation during the month."*

Accordingly, guidelines for certification of open cycle generation of gas based generating stations in the Northern Region were discussed and finalized in the 35th CSC meeting held on 19th February 2018 and are attached in Annexure-1. In the 36th CSC meeting held on 11th June 2018, NTPC stated that the procedure finalized does not cover certification of open cycle generation in the following instances:

(1) During stopping of GT (i.e. the duration when GT is disconnected with ST and then stopped) - The same is being certified by WRPC as per NTPC

(2) Starting of GTs under RRAS (an incentive of 50 paisa is already being provided) and mechanism of commercial settlement of the same.

The CSC decided that the matter may be referred to NPC to ensure a uniform practice in all regions regarding open cycle certification of CCGT stations by different RPCs.

**Issue 2**

During the months of September-November 2017, there were several instances when NTPC gas based stations were operated under open cycle mode when schedule was given under RRAS. Since the units were operated under instructions of NRLDC, NTPC has claimed for certification of open cycle generation in those instances.

However, CERC (Ancillary Services Operations) Regulations, 2015, para 13.3 state that:

*"…. Provided that, the fixed and variable charges allowed by the Commission and as applicable at the time of delivery of RRAS shall be used to calculate the payment for this service and no retrospective settlement of fixed or variable charges shall be undertaken even if the fixed or variable charges are revised at a later date"*

NTPC started submitting variable charges for open cycle mode of operation in AS1 formats submitted to NRPC from 16.11.2017. Before that, only one rate of variable cost for each fuel type was being submitted and merit order prepared accordingly. Certifying open cycle generation revised billing according to this would result in post facto revision in variable charges according to the above-mentioned regulation.

**Certification of open cycle generation in under RRAS may be discussed to ensure uniformity in methodology to be adopted by all RPCs.**

**Annexure-I**

## Guidelines/Procedure for Certification of Open Cycle Operation of Combined Cycle Gas Based Generating Stations

1. When operating under full module, if the schedule of generation given by NRLDC is less than 55% of the MCR loading of the module, one GT may go under Reserve shutdown and the unit may operate under part-module condition. Subsequently, when the injection schedule for the station is more than the on bar declared capacity of the part-module, GT under RSD may be brought on bar. Open Cycle Generation for the 2nd GT may be certified up to a maximum of 1.0 hrs in case of hot start up, 2.0 hrs in case of warm start up and 2.5 hrs in case of cold start up.

2. When operating under half module, if the injection schedule given by NRLDC is less than 55% of the MCR loading of the part-module, the entire module may go under Reserve shutdown. Subsequently, when schedule received is more than 55% of the MCR loading, then one or more GT may be brought back in operation. Open Cycle Generation for the 1st GT may be certified up to a maximum of 1.0 hrs in case of hot start up, 2.5 hrs in case of warm start up and 4.0 hrs in case of cold start up. For 2nd GT, the time certified for Open Cycle Generation would be same as in case of (1) above.

3. When operating under full module, if the schedule of generation given by NRLDC is less than 55% of the MCR loading of the part module, all GTs may go under Reserve shutdown. The procedure for open cycle certification shall be as in case (2) above.

4. No maintenance activities on unit under RSD shall be undertaken by the Generating station, otherwise Open Cycle Generation shall not be certified.

5. When a GT is started within 3 hours of shutdown, it would be considered as a hot start-up, 3 to 24 hours warm start-up, and beyond 24 hours cold start-up.

6. Open Cycle Generation shall also be certified when:

    a. If STG is under outage and instruction for running GT(s) on Open Cycle is given by NRLDC.

    b. If the unit is re-started after tripping due to grid contingencies.

    c. If the unit is re-started after scheduled OEM inspection and/or statutory boiler inspection duly approved in the OCC meetings and schedule is given for running these units.

7. The generating station shall submit the requisite data to NRPC Secretariat for the period for which it seeks certification of open cycle generation.

# AUDIT FORMAT TEMPLATE

# PROTECTION AUDIT REPORT

## General information

| | |
|---|---|
| Substation name: | |
| SS voltage level: | |
| Fault level of all equipment (for that voltage level) | |
| Date of commissioning of the substation: | |
| Region: | |
| Audit date: | |
| Name of utility which owns the substation (e.g POWERGRID, MSETCL, ADANI POWER, etc.) | |

## Audit Team

| Name | Company name |
|---|---|
| | |
| | |

## Client Team

| Name | Company name |
|---|---|
| | |
| | |
| | |

## Regional representatives:

| Name | Company name |
|---|---|
| | |
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| | |

## Attached documents:

1. List of the faults that was/were not eliminated by the protection;
2. Record of previous trippings for last six months and associated fault analysis.
3. Single/three pole auto-recloser events, if any in last six months;
4. Details on periodicity of relay testing and latest relay test report
5. Communiction from concerned department for the revised settings and record for implementation of the revised settings.
6. CT characteristics at all taps in case of multi-ratio CTs
7. df/dt, UFR relay details and settings if its available
8. Special Protection Schemes details if applicable. (Including test results & last operation records), implemented schematic diagram for SPS
9. Single Line Diagram

# CONCLUSIONS OF PROTECTION AUDIT REPORT

| Item no. | Issues | Remarks |
|---|---|---|
| **1** | **Recommandations of last Protection Audit** | **Status of works&reason for pending/suggestions** |
| | | |
| | | |
| | | |
| **2** | **Review of Existing Settings at Substations** | |
| | Any inadvertently enabled settings/functions observed. (Yes/No) | |
| | | |
| | | |
| | | |
| **3** | **Disturbance recorder - list of 3 tippings in last 6 months** | **Recommended action** |
| 3.a | DR as well as EL records for the trippings available (Yes/No) | |
| 3.b | Records available for Tripping analysis and corrective actions taken (Yes/no) | |
| 3.c | Time Synch Matched Between EL signals and DR signals (Yes/No) | |
| 3.d | Digital Signals of DR named properly (main CB Trip, Z1 Trip etc.) (Yes/No) | |
| | | |
| **4** | **Chronic reason of tipping, if any** | **Recommended action** |
| | | |
| | | |
| | | |

| Item no. | Issues | Remarks |
|---|---|---|
| 5 | Existing process for record of changes incorporated in the relay settings | See attached corespondence |
| | | |
| | | |
| | | |
| 6 | Overvoltage grading for parallel line (time&pick up grading, provided or not) | Recommended action |
| | | |
| | | |
| | | |
| 7 | Other deficiences/Nonconformity observed (including the major non-conformaties mentioned in the audit format. ex: Single AC source etc.) | Recommended action |
| | | |
| | | |
| | | |

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# Line distance protection - check list

| | Audited data | | | | |
|---|---|---|---|---|---|
| ***No.*** | ***Relay configuration - Line distance protection*** | | | | |
| 1 | Name and length of line | | | | |
| 2 | Series compensated? Y/N | | | | |
| 3 | Is this a cable feeder/line feeder/composite feeder (line+cable)? | | | | |
| 4 | Which mode of communication is used (PLCC/OPGW) | | | | |
| | | | | | |
| | ***Details of type relays*** | | ***Main-1 Relay*** | ***Main-2 Relay*** | ***Other Relays (Back-up relays, DR, FL etc.)*** |
| 5 | **Details of composite type numerical relays** | | | | |
| | Relay make and model | **for ex: Siemens 7SA522** | | | |
| | Whether the relay is functional? | Yes/ No | | | |
| | Date of testing | | | | |
| | Mention all the active protections-21, 87L, 67, 67N, 51, 51N | 21/87L/67/67N/51/51N | | | |
| | Mode of Carrier aided scheme for 21<br>( If POR scheme is used whether Current Reversal Guard Logic implemented?) | Accelerated Under reach/<br>Permissive Under reach/<br>Intertripping Under reach/<br>Permissive Overreach/<br>Blocking Over reach/<br>Phase Comparison Protection (for PLCC) | | | |
| | Carrier aided scheme active for 67/67N | Yes/ No | | | |
| | Mode of Carrier aided scheme for 67/67N | Directional Comparison Protection (Permissive)/<br>Directional Comparison Protection (Blocking) | | | |
| | For 87L which scheme is used? (Pilot wire communication/digital communication) | | | | |
| | Power swing/out of step active? | Yes/No | | | |
| | SOTF active? | Yes/No | | | |
| | Auto Reclose (79) active? | Yes/No | | | |
| | Breaker failure active | Yes/ No | | | |
| | Load Encroachment active | Yes/ No | | | |
| | Stub Protection active | Yes/ No | | | |
| | Fault locator active? | Yes/No | | | |
| | Disturbance Recorder active? | Yes/No | | | |
| 6 | Relay Connected to Trip Coil-1/Trip Coil-2 or both? | | | | |
| 7 | Feed from DC supply 1/DC Supply 2 | | | | |
| 8 | Connected to Dedicated CT core?<br>Define CT core no. to which the relay is connected | | | | |
| 9 | CT ratio selected | | | | |
| 10 | VT ratio selected | | | | |

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# Line distance protection - check list

| | Audited data | | |
|---|---|---|---|
| ***No.*** | ***Relay configuration - Line distance protection*** | | |
| | **Details of separate relays if applicable** | | |
| | Relay 1 make and model | | |
| | Functions available in Relay 1 | Auto reclose/Breaker Failure/67/67N/51/51N | |
| | Relay 1 Functional | Yes/ No | |
| | Date of Testing | | |
| | Relay 2 make and model | | |
| | Functions available in Relay 2 | Auto reclose/Breaker Failure/67/67N/51/51N | |
| | Relay 2 Functional | Yes/ No | |
| 11 | Date of Testing | | |
| | Relay 3 make and model | | |
| | Functions available in Relay 3 | Auto reclose/Breaker Failure/67/67N/51/51N | |
| | Relay 3 Functional | Yes/ No | |
| | Date of Testing | | |
| | Relay 4 make and model | | |
| | Functions available in Relay 4 | Auto reclose/Breaker Failure/67/67N/51/51N | |
| | Relay 4 Functional | Yes/ No | |
| | Date of Testing | | |
| 12 | VT Fuse failure protection present & used to block distance function operation? | Yes/No | |
| 13 | Overvoltage protection available | Yes/ No | |
| | Functional with two stage protection | Yes/No | |
| 14 | Are all the auxiliary relays (94) considered for Line protection (Main-1/Main-2/Backup) provided with supervision relays (74/94)? | Yes/No | |
| 15 | Do the Line Protection protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2)? | Yes/No | |

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# Transformer protection audit - check list

| | Audited data | | | | | | |
|---|---|---|---|---|---|---|---|
| ***No*** | ***Relay configuration - Power Transformers protections*** | | | | | | |
| 1 | Name, voltage, power | | | | | | |
| 2 | Are used 2 groups of protections (Group A and Group B) for transformer protection? | Yes/No | | | | | |
| 3 | Are Group A and Group B protections connected to separate DC sources for power transformers? | Yes/No | | | | | |
| 4 | Do the Group A and Group B protections have separate lockout relays? | Yes/No | | | | | |
| 5 | **Details of type relays** | | ***Main*** | | ***Back up*** | | ***Other Protections*** |
| | | | ***A*** | ***B*** | ***A*** | ***B*** | |
| | **Details of composite type numerical relays** | | | | | | |
| | Relay make and model | | **for ex: RET670 ABB** | **for ex: RET670 ABB** | **for ex: REL670 ABB** | **for ex: RET670 ABB** | |
| | Whether the relay is functional? | Yes/No | | | | | |
| | Date of testing | | | | | | |
| | Mention all the active protection | | | | | | |
| | differential protections | | | | | | |
| | REF protection | | | | | | |
| | Back-up directional O/C +E/F protection | | | | | | |
| | Overfluxing protection | | | | | | |
| | Connected to Trip Coil 1/Trip Coil2/Both | | | | | | |
| | Feed from DC supply 1/DC supply2 | | | | | | |
| | Breaker failure active | Yes/No | | | | | |
| | Disturbance Report active | Yes/No | | | | | |
| | Connected to dedicated CT core?<br>Define CT core no. to which the relay is connected | | | | | | |
| | CT ratio selected | Yes/No | | | | | |
| | Is CT supervision enabled or not in case of Transformer differential protection ? | Yes/No | | | | | |
| 6 | Are all the Lock out relays (86) considered for Transformer protection provided with supervision relays (74/86) ? | Yes/No | | | | | |
| 7 | Do the Transformer protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2)? | Yes/No | | | | | |
| 8 | OTI/WTI working | Yes/No | | | | | |
| 9 | Bucholz/PRD working | Yes/No | | | | | |
| 10 | LA rating HV side | Yes/No | | | | | |
| 11 | LA rating IV side | Yes/No | | | | | |

# Synchro-check protection audit - check list

| Audited data | | | |
|---|---|---|---|
| ***No*** | ***Relay configuration - Synchro-check protections*** | | |
| | **Details of type relays** | | |
| | **Details of composite type numerical relays** | | |
| 1 | Relay make and model | | |
| 2 | Whether the relay is functional? | Yes /No | |
| 3 | Date of testing | | |
| 4 | Voltage measurement | P-Por P-N | |
| 5 | What is the set value of voltage difference (ΔU) ? | % | |
| 6 | What is the set value of Phase angle difference (Δφ ) ? | ° | |
| 7 | What is the set value of frequency slip? (Δf) | mHz | |
| 8 | What is the set time delay of output relay? (DELAY) | sec | |
| 9 | Settings value for dead bus/line | % | |

# Shunt reactor protection audit - check list

| | Audited data | | | | | | |
|---|---|---|---|---|---|---|---|
| ***No*** | ***Relay configuration - Shunt reactor protections*** | | | | | | |
| 1 | Are used 2 groups of protections (Group A and Group B) for shunt reactors protection? | Yes/No | | | | | |
| 2 | Are Group A and Group B protections connected to separate DC sources for shunt reactors? | Yes/No | | | | | |
| 3 | Do the Group A and Group B protections have separate lockout relays? | Yes/No | | | | | |
| 4 | **Details of type relays** | | ***Main*** | | ***Back up*** | | ***Other Protections*** |
| | | | ***A*** | ***B*** | ***A*** | ***B*** | |
| | **Details of composite type numerical relays** | | | | | | |
| | Relay make and model | | **for ex: RET670 ABB** | **for ex: RET670 ABB** | **for ex: REL670 ABB** | **for ex: REL670 ABB** | |
| | Whether the relay is functional? | Yes/No | | | | | |
| | Date of testing | | | | | | |
| | Mention all the active protection | | | | | | |
| | differential protection | | | | | | |
| | REF protection | | | | | | |
| | Back-up directional O/C +E/F protection | | | | | | |
| | Overfluxing protection | | | | | | |
| | Connected to Trip Coil 1/Trip Coil 2/Both | | | | | | |
| | Feed from DC supply 1/DC supply 2 | | | | | | |
| | Breaker failure active | Yes/No | | | | | |
| | Disturbance Recorder active | Yes/No | | | | | |
| | Connected to dedicated CT core?<br>Define CT core no. to which the relay is connected | | | | | | |
| | CT ratio selected | | | | | | |
| | Is CT supervision enabled or not in case of Reactor differential protection? | Yes/No | | | | | |
| 5 | Are all the Lock out relays (86) considered for Reactor protection provided with supervision relays (74/86) ? | Yes/No | | | | | |
| 6 | Do the Reactor protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2)? | Yes/No | | | | | |
| 7 | OTI/WTI indications working | Yes/No | | | | | |
| 8 | Bucholtz/PRD working | Yes/No | | | | | |
| 9 | LA rating HV side | Yes/No | | | | | |

# BB protection audit - check list

| | Audited data | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No** | ***BB and BF protection*** | | **220 kV** | | | | **400 kV** | | | | **765 kV** | | | | | |
| | **BUSBAR PROTECTION** | | | | | | | | | | | | | | | |
| 1 | Main BB available or not? | Yes/No | | | | | | | | | | | | | | |
| 2 | Back-up busbar protection to be provided by either of the following: | For 132 kV & 220 kV | | | | | N/A | | | | N/A | | | | | |
| | - Remote -end distance relay overreaching elements (second zone) | Yes/No | | | | | N/A | | | | N/A | | | | | |
| | - Reverse looking element of the local distance relay | Yes/No | | | | | N/A | | | | N/A | | | | | |
| | - Directional back-up overcurrent relays at remote end. | Yes/No | | | | | N/A | | | | N/A | | | | | |
| 3 | Redundant BBP available or not? | Yes/No | | | | | | | | | | | | | | |
| 4 | Type of bus Bar arrangement (Select from the choices) | 1 and 1/2 Circuit Breaker scheme | | | | | | | | | | | | | | |
| | | Single busbar | | | | | | | | | | | | | | |
| | | Double busbar | | | | | | | | | | | | | | |
| | | Main-1, Main-2 & Transfer | | | | | | | | | | | | | | |
| | | | **Busbar 1 (BB1)** | | **Busbar 2 (BB2)** | | **Busbar 1 (BB1)** | | **Busbar 2 (BB2)** | | **Busbar 1 (BB1)** | | **Busbar 2 (BB2)** | | | |
| 5 | Main 1 relay Make | for ex: REB 500 | | | | | | | | | | | | | | |
| | Main 1 relay functional | Yes/No | | | | | | | | | | | | | | |
| | Main 1 relay type | Low/High impendance | | | | | | | | | | | | | | |
| | Connected to Trip Coil 1/Trip Coil 2 | | | | | | | | | | | | | | | |
| | Feed from DC supply 1/DC supply 2 | | | | | | | | | | | | | | | |
| 6 | Main 2 relay Make | for ex: REB 500 | | | | | | | | | | | | | | |
| | Main 2 relay functional | Yes/No | | | | | | | | | | | | | | |
| | Main 2 relay type | Low/High impendance | | | | | | | | | | | | | | |
| | Connected to Trip Coil 1/Trip Coil 2 | | | | | | | | | | | | | | | |
| | Feed from DC supply 1/DC supply 2 | | | | | | | | | | | | | | | |
| 7 | Trip to both coils in case of one BBP | Yes/No | | | | | | | | | | | | | | |
| | | | **BB1 Main-1** | **BB1 Main-2** | **BB2 Main-1** | **BB2 Main-2** | **BB1 Main-1** | **BB1 Main-2** | **BB2 Main-1** | **BB2 Main-2** | **BB1 Main-1** | **BB1 Main-2** | **BB2 Main-1** | **BB2 Main-2** | | |
| 8 | Dedicated CT core for each BB protection | Yes/No | | | | | | | | | | | | | | |
| 9 | *To be filled for High Impedance busbar protection* | | | | | | | | | | | | | | | |
| | a) Is the high impedance protection used for simple busbar arrangement like 1 and 1/2 breaker scheme or single busbar arrangement | Yes/No | | | | | | | | | | | | | | |
| | b) Whether the CT ratios and charcteristics are same (Vk etc.) | Yes/No | | | | | | | | | | | | | | |
| | c) Whether stability check has been conducted? | Yes/No | | | | | | | | | | | | | | |
| | d) Is CT supervision relay provided or not? | Yes/No | | | | | | | | | | | | | | |
| | e) In case of busbar protection where isolator contacts are used for zone selectivity/ CT selection, please fill the below items: | | | | | | | | | | | | | | | |
| | - Is check zone enabled or not? | Yes/No | | | | | | | | | | | | | | |
| | - Is Check zone measurement connected to separate CT cores? | Yes/No | | | | | | | | | | | | | | |
| | - If check zone Is not enabled, Is the relay setting increased to value higher than the heaviest loaded feeder current. | Yes/No | | | | | | | | | | | | | | |

# BB protection audit - check list

| | Audited data | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No** | ***BB and BF protection*** | | **220 kV** | | | | **400 kV** | | | | **765 kV** | | | | | |
| 10 | *To be filled for Low Impedance busbar protection* | | | | | | | | | | | | | | | |
| | a) Centralised BBP | Yes/No | | | | | | | | | | | | | | |
| | b) or discentralized BBP with peripheral units? | Yes/No | | | | | | | | | | | | | | |
| | b) Whether stability check has been conducted? | Yes/No | | | | | | | | | | | | | | |
| | c) Is CT supervision enabled or not? | Yes/No | | | | | | | | | | | | | | |
| | d)In case of busbar protection where isolator contacts are used for zone selectivity/CT selection, please fill the below items: | | | | | | | | | | | | | | | |
| | - Is check zone enabled or not? | Yes/No | | | | | | | | | | | | | | |
| | - If check zone Is not enabled, Is the relay setting increased to value higher than the heaviest loaded feeder current. | Yes/No | | | | | | | | | | | | | | |
| 11 | One zone for one bus | Yes/No | | | | | | | | | | | | | | |
| 12 | Are all the Busbar protection Lock out relays (86 BB) provided with supervision relays (74/86BB)? | Yes/No | | | | | | | | | | | | | | |
| 13 | Do all the Busbar protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2)? | Yes/No | | | | | | | | | | | | | | |
| | **BREAKER FAILURE PROTECTION** | | | | | | | | | | | | | | | |
| 14 | Breaker failure included in BB protection | Yes/No | | | | | | | | | | | | | | |
| 15 | Breaker failure included in Line/transformer protections | Yes/No | | | | | | | | | | | | | | |
| 16 | Separate BFP provided | Yes/No | | | | | | | | | | | | | | |
| 17 | If separate BFP is provided, furnish Make/ Model | | | | | | | | | | | | | | | |
| 18 | BFP relay functional | Yes/No | | | | | | | | | | | | | | |
| 19 | BFP conditons: Current presence | Yes/No | | | | | | | | | | | | | | |
| 20 | BFP conditons: CB closed position | Yes/No | | | | | | | | | | | | | | |
| 21 | BFP retrip active (first stage) | Yes/No | | | | | | | | | | | | | | |
| 22 | Tripping time for BFP (second stage) 0.2 s< t <0.3 s | Yes/No | | | | | | | | | | | | | | |
| 23 | Are Breaker Failure potection auxiliary relay for Stage-1 (94BF) and Lock out relay for Stage-2 (86BF) provided with supervision relays (74/94BF & 74/86BF) | Yes/No | | | | | | | | | | | | | | |
| 24 | Do all the Breaker Failure protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2) | Yes/No | | | | | | | | | | | | | | |

# DC system audit - check list

| | Audited data | | | | | |
|---|---|---|---|---|---|---|
| ***No*** | ***DC supply systems*** | | ***220V DC 1*** | ***220V DC 2*** | ***48V DC 1*** | ***48V DC 2*** |
| 1 | Type of Batteries | Non Sealed/<br>Sealed lead with recombination of gas/<br>Nickel-Cadmium/<br>Other | | | | |
| 2 | Number of Cells per bank | | | | | |
| 3 | Date of procurement/ commissioning of the Battery | | | | | |
| 4 | Is the battery functional and in good condition? | Yes/No | | | | |
| 5 | Availability of Battery Charger | Yes/No | | | | |
| 6 | Date of procurement/ commissioning of the Charger | | | | | |
| 7 | Is the Charger functional ? | Yes/No | | | | |
| 8 | Used combination for charging | Two sets of battery and charger /single battery with charger /one battery with two chargers | | | | |
| 9 | Measured voltage (to be measured at the farthest panel) | | | | | |
| | Positive to Earth | | | | | |
| | Negative to Earth | | | | | |
| 10 | Availability of Battery Ground Fault Detectors? | Yes/No | | | | |
| 12 | The protection relays and trip circuits are segregated into two independent system feed through fuses from two different DC sources | Yes/No | | | N/A | N/A |
| 13 | **Maintenance/Testing Plan** | | | | | |
| | What is the maintenance/testing plan/schedule followed by the utility for maintenance of battery and charger? | | | | | |

# AC system audit - check list

| | Audited Data | | | |
|---|---|---|---|---|
| ***No*** | ***AC Supply System*** | | ***Supply I*** | ***Supply II*** |
| 1 | Source of AC HT supplies | name of source | | |
| | In case of two AC HT supplies,the supplies are arranged from independent sources | Yes/No | | |
| | Voltage/Source of supply | | | |
| | Supply changeover method between Supply I and Supply II | Auto/Manual | | |
| 2 | **DG** | | | |
| | DG available | Yes/No | | |
| | DG: Make and rating power | | | |
| | What loads are supplied by the DG ? | | | |
| | DG starting is Auto/manual | Auto/Manual | | |
| | Supply changeover method between Normal AC Supply and DG | | | |
| 3 | The SS to furnish the supply changeover scheme/single line diagram | | | |
| 4 | **Maintenance/ Testing Plan** | | | |
| | What is the maintenance plan/ schedule followed by the utility for maintenance of DG ? | | | |

# Communication system - check list

| | Audited data | | | | | |
|---|---|---|---|---|---|---|
| ***No*** | ***Communication System*** | | ***765 kV System*** | ***400 kV System*** | ***220 kV System*** | ***132 kV System*** |
| 1 | a) Type of communication for Main-1 Protection | PLCC/OPGW | | | | |
| | b) Type of communication for Main-2 Protection | PLCC/OPGW | | | | |
| | c) Mode used for Data communication | | | | | |
| | d) Mode used for Speech communication | | | | | |
| 2 | **PLCC Details** | | | | | |
| | a) Do you use PLCC for teleprotection of distance relays ? | Yes/No | | | | |
| | b) Specify type of Coupling | Ph-Ph/Ph-G/Inter-Circuit | | | | |
| | c) Whether redundant PLCC channels provided for 400 kV & 765 kV lines | Yes/No | | | | |
| | d) Specify number of PLCC channels per circuit | One/Two | | | | |
| | e) No. of protection channels<br>No. of data channels<br>No. of speech channels | | | | | |
| | f) Whether dependability & security of each tele-protection channel measured and record kept? | Yes/No | | | | |
| | g) Is the PLCC equipment and channels healthy & functional | Yes/No | | | | |
| 3 | **OPGW Details** | | | | | |
| | a) Redundancy maintained by providing two sets of Fibre Optic Equipment | Yes/No | | | | |
| | b) Card level redundancy (Power supply card, protection card, CPU board) maintained in each fibre optic equipment | Yes/No | | | | |
| | c) Separate DC battery supply or common DC battery supply separately fused for each fibre optic equipment. | Yes/No | | | | |
| | d) Are the Fibre Optic equipment and channels healthy & functional | Yes/No | | | | |
| 4 | **Time Synchronization Equipment Details** | | | | | |
| | a) Whether GPS based time synchronizing equipment is provided at the substation for time synchronizing of Main relays/ DR/ Event logger/ SAS/ PMU/ Line Current Differential Relays | Yes/No | | | | |
| | b) Are Time Synchronization Equipment (TSE) complete with antenna, all cables, processing equipments etc. provided to receive synchronizing pulse through Global Positioning system (GPS) compatible for synchronization of event logger, disturbance recorder and SCADA/ automation system. | Yes/No | | | | |
| | c) Are the Main Relays/ DR/ Event Logger/SAS/ PMU/ Line current differential relays time synchronized. | Yes/No | | | | |
| 5 | **Disturbance Recorder and Event Logger Details**<br>Check all these items for individual relay. | | | | | |
| | a) Is the Disturbance recorder provided on all the feeders of 765kV, 400 kV & 220 kV Substations? | Yes/No | | | | |
| | b) Is the Fault locator provided on all the line feeders of 765kV, 400 kV & 220 kV Substations? | Yes/No | | | | |
| | c) Whether the Disturbance recorder is Standalone or part of main relay | Yes/No | | | | |
| | d) Whether Disturbance Recorder is having automatic fault record download facility to a central PC | Yes/No | | | | |
| | e) Disturbance Recorders functional? | Yes/No | | | | |
| | f) Whether substation (765, 400, 220 kV) is having Event Logger facility (stand alone or built-in-SAS) | stand alone/built-in-SAS | | | | |
| | g) Event Logger functional? | Yes/No | | | | |

# Circuit breaker - check list

| | Audited data | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **No.** | **CB ID Bay Name** | **CB** | **CB** | **CB** | **CB** | **CB** | **CB** | **CB** | **CB** |
| 1 | CB Rated voltage (kV) | | | | | | | | |
| 2 | Make & Model | | | | | | | | |
| 3 | Date of commissioning | | | | | | | | |
| 4 | Type of CB (SF6/MOCB/ABCB etc.) | | | | | | | | |
| 5 | Is the Breaker healthy/ functional (Yes/No) | | | | | | | | |
| 6 | Rated Breaking current (kA) | | | | | | | | |
| 7 | Number of closing coils | | | | | | | | |
| 8 | Healthiness of closing coil | | | | | | | | |
| 9 | Number of tripping coils | | | | | | | | |
| 10 | Healthiness of Tripping Coil | | | | | | | | |
| 11 | Trip Circuit Supervision Relay available for monitoring Trip Circuit -1 & Trip Circuit-2 with breaker in both open and closed condition (Yes/No) | | | | | | | | |
| 12 | Are the Trip Circuit Supervision realys functional/healthy | | | | | | | | |
| 13 | One/three pole operation | | | | | | | | |
| 14 | For breakers with single poles, is pole discrepancy relay provided? | | | | | | | | |
| 15 | Does the Pole discrepancy relay have facility for Stage-1 (own breaker tripping) & Stage-2 (Boundary breaker tripping) | | | | | | | | |
| 16 | What monitoring devices are provided for checking the dielectric medium of the breaker? (for eg. Gas pressure low etc.) | | | | | | | | |
| 17 | What action is initiated by each of different Stages of these devices (Alarm/ Block tripping) | | | | | | | | |
| 18 | PIR (Available/Not) | | | | | | | | |

# Current transformer - check list

| Audited data | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No** | **CT ID Bay Name** | **Voltage level** | **CT core** | **Protection / Metering** | **CT ratio (All available ratios for a multi-ratio CT)** | **Ratio Adopted** | **Connected to which relays / meters?** | **In case of a protection CT, is the relay setting calculation done based on the CT Ratio adopted at site** | **Date of CT Testing** | **Ratio measured** | **Error Calculated** | **Knee Point Voltage** |
| 1 | **CT** | **132 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| 2 | **CT** | **132 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| 3 | **CT** | **132 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| 4 | **CT** | **220 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| | | | Core - 5 | | | | | | | | | |
| 5 | **CT** | **220 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| | | | Core - 5 | | | | | | | | | |
| 6 | **CT** | **220 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| | | | Core - 5 | | | | | | | | | |
| 7 | **CT** | **400 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| | | | Core - 5 | | | | | | | | | |
| 8 | **CT** | **400 kV** | Core - 1 | | | | | | | | | |
| | | | Core - 2 | | | | | | | | | |
| | | | Core - 3 | | | | | | | | | |
| | | | Core - 4 | | | | | | | | | |
| | | | Core - 5 | | | | | | | | | |

**Note**: Please specify special cases when the phases have different parameters.

# Voltage transformer - check list

| Audited data | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No** | **CVT/VT ID Bay Name** | **CVT/VT core** | **Protection/ Metering** | **Ratio** | **Accuracy Class** | **Connected to which relays?** | **Is the relay setting calculation and relay configuration files based on the VT Ratio? (Applicable for VTs connected to distance protection/ synchro check relays)** | **For Synchrocheck relays, is the VT Input connected Ph-Ph or Ph- Neutral (Which phases R/Y/B?)** | **Date of VT Testing** | **Ratio measured** | **Error Calculated** |
| 1 | **VT** | Core - 1 | | | | | | | | | |
| | | Core - 2 | | | | | | | | | |
| | | Core - 3 | | | | | | | | | |
| | | Core - 4 | | | | | | | | | |
| 2 | **VT** | Core - 1 | | | | | | | | | |
| | | Core - 2 | | | | | | | | | |
| | | Core - 3 | | | | | | | | | |
| | | Core - 4 | | | | | | | | | |
| 3 | **VT** | Core - 1 | | | | | | | | | |
| | | Core - 2 | | | | | | | | | |
| | | Core - 3 | | | | | | | | | |
| | | Core - 4 | | | | | | | | | |
| 4 | **VT** | Core - 1 | | | | | | | | | |
| | | Core - 2 | | | | | | | | | |
| | | Core - 3 | | | | | | | | | |
| | | Core - 4 | | | | | | | | | |
| 5 | **VT** | Core - 1 | | | | | | | | | |
| | | Core - 2 | | | | | | | | | |
| | | Core - 3 | | | | | | | | | |
| | | Core - 4 | | | | | | | | | |
| 6 | **VT** | Core - 1 | | | | | | | | | |
| | | Core - 2 | | | | | | | | | |
| | | Core - 3 | | | | | | | | | |
| | | Core - 4 | | | | | | | | | |

**Note**: Please specify special cases when the phases have different parameters.

# HVDC audit - check list

| | Audited data | | | | | | |
|---|---|---|---|---|---|---|---|
| **No** | ***HVDC configuration system*** | | ***Colected value*** | | | | |
| 1 | Configuration nework type | Back to back/Bipolar/Monopolar | | | | | |
| 2 | Configuration type of bus switching scheme | Double bus scheme with one and half breaker switching/Double bus scheme with two breaker switching | | | | | |
| 3 | Transmission distance | | | | | | |
| 4 | Type of plant | Underground cable/Submarine cable/Overhead line | | | | | |
| 5 | Type of semiconductors | IGBT/GTO | | | | | |
| 6 | Voltage AC level | | | | | | |
| 7 | Voltage DC level | | | | | | |
| 8 | Power of HVDC transmission | | | | | | |
| 9 | Convertors type | | | | | | |
| 10 | Firing angle(α) | $0^0/45^0/60^0/90^0/150^0$ | | | | | |
| 11 | ***Details for converter transformer protection*** | | ***Main*** | | ***Back up*** | | ***Other Protections*** |
| | | | ***A*** | ***B*** | ***A*** | ***B*** | |
| | Relay make and model | | **for ex: RET670 ABB** | **for ex: RET670 ABB** | **for ex: REL670 ABB** | **for ex: RET670 ABB** | |
| | Whether the relay is functional? | Yes /No | | | | | |
| | Date of testing | | | | | | |
| | Mention all the active protection | 87/67/67N/51/51N… | | | | | |
| | - differential protection | | | | | | |
| | - REF protection | | | | | | |
| | - Back-up directional O/C +E/F protection | | | | | | |
| | - Overfluxing protection | | | | | | |
| | Connected to Trip Coil 1/Trip Coil2/Both | | | | | | |
| | Feed from DC supply 1/DC supply2 | | | | | | |
| | Breaker failure active | Yes /No | | | | | |
| | Disturbance Report active | Yes /No | | | | | |
| | Connected to dedicated CT core?<br>Define CT core no.to which the relay is connected | Yes /No | | | | | |
| | CT ratio selected | | | | | | |
| | Is CT supervision enabled or not in case of Converter Transformer differential protection? | Yes /No | | | | | |
| 12 | Are all the Lock out relays (86) considered for Converter Transformer protection provided with supervision relays (74/86) ? | Yes/No | | | | | |
| 13 | Do the Converter Transformer protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2)? | Yes/No | | | | | |
| 14 | OTI/WTI indications working | Yes /No | | | | | |
| | Bucholtz/PRD working | Yes/No | | | | | |

# HVDC audit - check list

| | Audited data | | | | | | |
|---|---|---|---|---|---|---|---|
| **No** | ***HVDC configuration system*** | | ***Colected value*** | | | | |
| 15 | **Details of filter bank protections** | | ***Main*** | | ***Back up*** | | ***Other Protections*** |
| | | | ***A*** | ***B*** | ***A*** | ***B*** | |
| | Relay make and model | | for ex: RET670 | for ex: RET670 | for ex: REL670 | for ex: RET670 | |
| | Whether the relay is functional? | Yes /No | | | | | |
| | Date of testing | | | | | | |
| | Mention all the active protection | | | | | | |
| | - differential protection | | | | | | |
| | - Overcurrent protection | | | | | | |
| | - Unbalance protection | | | | | | |
| | Used like Main or Back-up protection | | | | | | |
| | Connected to Trip Coil 1/Trip Coil2/Both | | | | | | |
| | Feed from DC supply 1/DC supply2 | | | | | | |
| | Breaker failure active | Yes /No | | | | | |
| | Disturbance Report active | Yes /No | | | | | |
| | Connected to dedicated CT core?<br>Define CT core no.to which the relay is connected | Yes /No | | | | | |
| | CT ratio selected | | | | | | |
| | Is CT supervision enabled or not in case of differential protection ? | Yes /No | | | | | |
| 16 | Are all the Lock out relays (86) considered for Filter Bank protection provided with supervision relays (74/86) ? | Yes/No | | | | | |
| 17 | Do the Filter Bank protection panels have supervision relays for DC supply-1 & DC supply-2 (74/DC-1 & 74/DC-2)? | Yes/No | | | | | |

# General remarks

| Bay name / Bus | Voltage | Protection / Element / Equipment / System auditated | Remarks / Deficiences / Nonconformity observed | Recommended actions to be taken |
|---|---|---|---|---|
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# Double charging the DICs in PoC regime

# BACKGROUND

# Mandate in the Extant PoC Regulations



- 3rd proviso of Regulation 11.9 of Sharing regulation 2010 :

  *"The injection PoC charge/Withdrawal PoC charges for Short term open access given to a DIC shall be offset against the corresponding injection PoC charges or Withdrawal PoC charges to be paid by the DICs for Approved injection/ Approved withdrawal corresponding to Net withdrawal (load minus own injection) considered in base case."*

- 4th proviso of Regulation 11.9 of Sharing regulation 2010 :

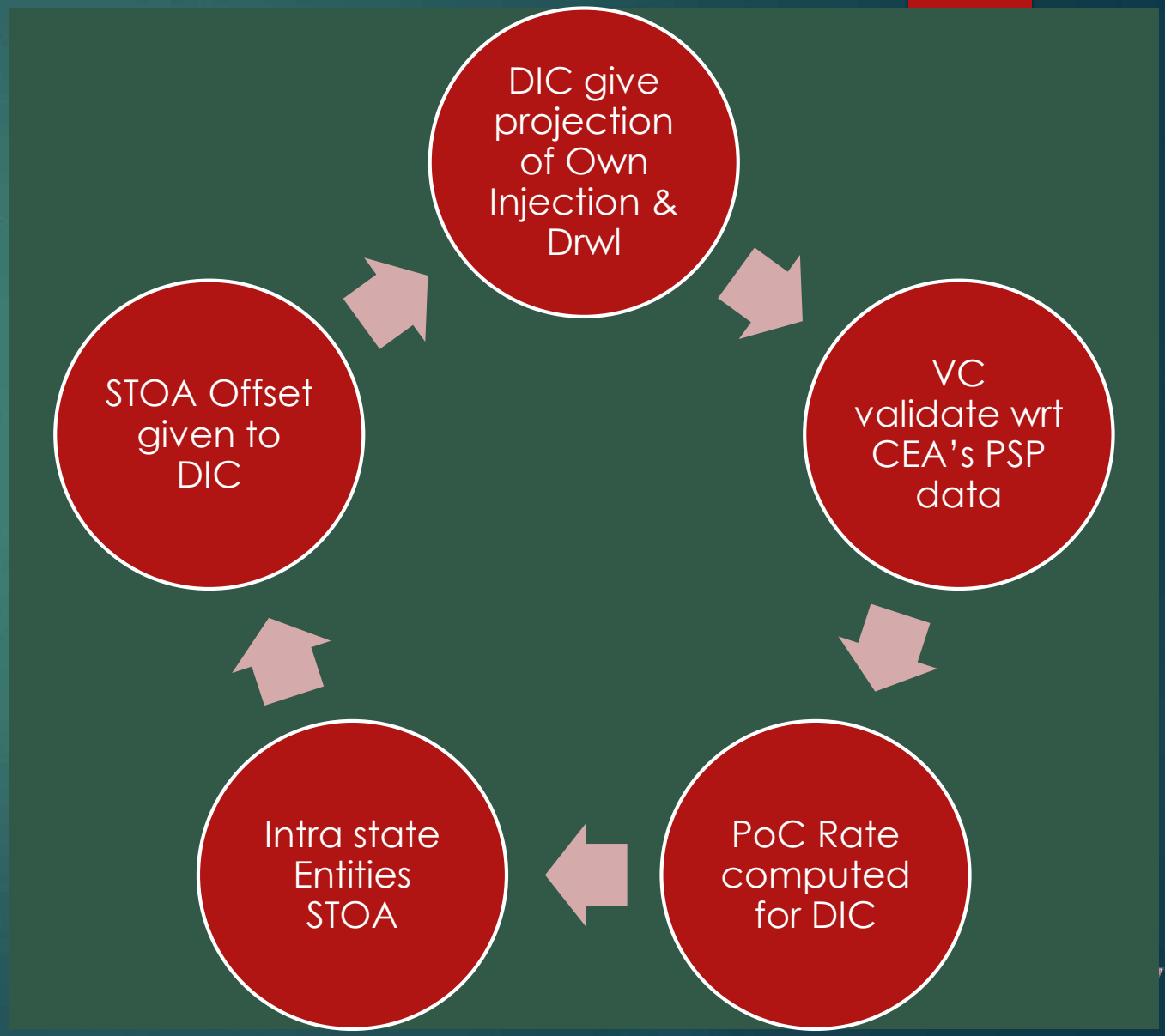
  *"For withdrawal DIC, this adjustment is given only for STOA transaction by DIC and not applicable to other intra-State entity embedded in State and engaged in STOA.*

# The Unguarded Issue ...



**The PoC computation Fallacy :**

- **Base case Usage data for withdrawal DICs Vis a Vis CEA's PSP where in all type of Usage is captured (LTOA+MTOA+ STOA+ Deviation)**
- **PoC Rate computation Vrs Return of STOA**
- **Double Charging DICs**



# DIC's constraint because of Intra state Entities



*4th Proviso says For withdrawal DIC, this adjustment is given only for STOA transaction by DIC and not applicable to other intra-State entity embedded in State and engaged in STOA.*

- More Intra state entities availing Inter state STOA, More is the PoC Rate for respective DICs.
- DIC / state consumer pay higher rate w.r.t Higher Usage of ISTS.
- DIC Get back only STOA Offset only for STOA availed by State not by Intrastate entities

# Case Study



| | | |
|---|---|---|
| Base Case Net Withdrawal (MW) | A | 2000 |
| App. withdrawl as per RTA for (MW) | B | 1500 |
| Difference i.e. the STOA entitlement of DIC (MW) | C =A-B | 500 |
| STOA Rate (Rs./MWH) | D | 311.8 |
| Total STOA quantum procured by Gridco (MW) | E | 100 |
| STOA charges Paid by Gridco towards such direct procurement (Cr) | F | 2.32 |
| Total STOA quantum procured by Embedded customers of state (MW) | G | Customer 1- 300 MW<br>Customer 2- 400 MW<br>700 |
| STOA charges Paid by Embedded customers towards such STOA procurement (Cr) | H | 16.24 |
| Double Charges Paid by Odisha (Cr) | I = C*D | 11.60 |
| Already reimbursed by PGCIL through STOA Offset (Cr) | J | 2.32 |
| Unpaid Quantum towards double charges (MW) | K = C-E | 400 |
| Unpaid STOA charges (towards double charges) (Cr) | L | 9.28 |