सत्यमेव जयते

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

No: NRPC/OPR/106/01/2019/225-266 **Dated: 03.01.2018**

विषय: - उत्तर क्षेत्रीय विद्युत समिति की प्रचालन समन्वय उप-समिति की 154 वीं बैठक का कार्यवृत I
Minutes of 154th OCC meeting of NRPC.

उत्तर क्षेत्रीय विद्युत समिति की प्रचालन समन्वय उप-समिति की 154 वीं बैठक 18.12.2018 को आयोजित की गयी थी। उक्त बैठक का कार्यवृत्त उत्तर क्षेत्रीय विद्युत समिति की वेबसाइट http://www.nrpc.gov.in पर उपलब्ध है। यदि कार्यवृत पर कोई टिप्पणी हो तो कार्यवृत जारी करने के एक सप्ताह के अन्दर दे सकते हैं I

154th meeting of the Operation Co-ordination Sub-Committee of NRPC was held on 18.12.2018. The Minutes of this meeting have been up-loaded on the NRPC web-site http://www.nrpc.gov.in. Any comments on the minutes may kindly be submitted within a week of issuance of the minutes.

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(उपेन्द्र कुमार)
अधीक्षण अभियंता(प्रचालन)

संलग्न: उपर्यक्त / Enclosures : As above.

सेवा में,
प्रचालन समन्वय उप-समिति के सभी सदस्य

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Minutes of the 154th Meeting of the Operation Coordination Sub-Committee (OCC) of NRPC held on 18.12.2018 at NRPC Secretariat, New Delhi.

154th meeting of OCC of NRPC was held on 18.12.2018 at NRPC Secretariat, New Delhi. The list of participants of the meeting is attached at **Annexure-A**

MS, NRPC welcomed all the members of the sub-committee to the 154th OCC meeting.

MS, NRPC briefed the OCC members on following issues:

- New Thermal power plants in India will now have to comply with' human health environment criteria" as part of their mandatory environmental clearance procedures. The Union environment ministry has notified a new list of standard conditions, bringing for the first time an exclusive health assessment as an essential point to give green nod to such plants.
- Under its new order, the company will have to take into account chronic exposure to air and noise pollution which may adversely affect health of not only workers but also of people living in its vicinity.
- All staff manning SLDC/Sub –stations/Generating stations should be sensitized about the situations during the foggy conditions. Effective & experienced personnel should be made available at important station during foggy nights. Operators at all sub stations generating stations etc shall follow the instructions of NRLDC / SLDC immediately during the foggy conditions.
- During the foggy conditions or otherwise when the grid is critical, SLDCs may ensure that loading of major trunk lines is controlled with adequate safety margin. NRLDC may reduce loading of lines in North-west part of NR system during foggy weather period. The operators at SLDC may follow the instructions of NRLDC to reduce the drawl from the grid, maintain the system parameters particularly the voltage at the grid sub stations. Al the utility, must be prepared to meet the even more N-2 contingency under such operating conditions of the grid.
- All STUs and CTU should furnish the information of pollution zone & information if insulators have been cleaned or not.
- All HYDRO & GT generating stations should be ready for black start in case of any emergency. All concerned officers should be reappraised of their duties and action to be taken during such instances.
- All the utilities have to submit the details of tripping and related information along with the DR & ELs output to NRPC/NRLDC. In the absence of these details it is not possible to analyze the exact cause of the failure and behavior of the system during the incident.
- Many tripping cannot be avoided due to non –availability operation of auto reclosure schemes in NR. Information of all such locations be furnished to NRPC/ NRLDC.
- NRLDC/SLDCs should write to all utilities if their RTUs are not reporting to them.
- With the tightening of frequency band, it is the right time to switch to FGMO in India. Grid operation of such a large sized grid is extremely channeling in the case of muted primary response from the generators. The initiative of NLDC to act as facilitator for testing and of RGMO in all machines.

PART-A: NRPC

1. Confirmation of Minutes:

The minutes of the 153rd OCC meeting held on 15.11.2018 and 16.11.2018 at New Delhi were issued vide letter of even number dated 06.12.2018.

Sub–Committee confirmed the minutes of the 153rd OCC meeting.

2. Review of Grid operations of November 2018

2.1. Anticipated vis-à-vis Actual Power Supply Position (Provisional) November 2018.

Sub Committee was informed that there was more than 5.0% variation in the Anticipated vis-à-vis Actual Power Supply Position (Provisional) during the month of November, 2018 in terms of Peak demand for Haryana, J&K, & UP and in terms of Energy requirement for Chandigarh, Delhi, HP & UP.

Delhi

Decline in demand in terms of MU to the extent of 1839 MU in actual against anticipations of 1960 MU attributes to warmer weather during November month.

Haryana

Haryana representative informed that the demand was actually 6593 MW. Decline in demand in terms of MW to the extent of 6593 MW in actual against anticipations of 7033 MW attributes to miscalculation in anticipated demand by state on account of festive season of November.

Himanchal Pradesh:

Decline in demand in terms of MUs to the extent of 790 MUs in actual against anticipations of 870 MUs attributes to warmer weather and load shedding during November month.

Uttar Pradesh:

Decline in demand in terms of MUs to the extent of 8290 MUs in actual against anticipations of 9900 MUs and decline in demand in terms of MWs to the extent of 15627 MWs in actual against anticipations of 19000 MWs attributes to mild weather during November month and late pick up of irrigation land.

The Sub-Committee requested all SLDCs to furnish the provisional and final power supply position in prescribed formats by 2nd and 15th day of the month respectively in compliance to the provision 5.3 of IEGC.

2.2. Power Supply Position for NCR:

2.2.1. The Sub-Committee was informed that the NCR Planning Board (NCRPB) is closely monitoring the power supply position of National Capital Region. Monthly power supply position for NCR till the month of October, 2018 is placed on NRPC website (www.nrpc.gov.in).

2.3. The highlights of grid operation during November, 2018 are as follows: -

Frequency remained within the IEGC band for 79.88% of the time during November 2018, which is more than that of last year during same month when frequency (within IEGC band) remained 75.53% of the time. The maximum frequency recorded was 50.22Hz (22.11.2018 at 21:55 Hrs).During the month of November 2018 8.76% of the time frequency remained above the band & 09.21% of the time it remained below the band.

Major Frequency profile deviation was observed in the state of Haryana, HP & Rajasthan in the month of November 2018.These states were requested to look into the issue and take measures at their end to decrease the deviation. Rajasthan representative stated that due to Rabi crop growing the Over drawl was there All other utilities were requested to take necessary action to further improve the frequency regime viz. by not changing abruptly the loads at block boundaries and assuring primary response from the generators.

Maximum and minimum demand met for the region during November 2018 were 45816 MW (05.11.2018 at 18:00 Hrs) and 27792 MW (08.11.2018 at 04:05 hrs).

The average consumption, of the Northern Region, for November 2018, increased by only 5.14% (43.4 MU per day) with respect to the corresponding month in previous year. The reason for the same attributed to the weather conditions.

The average thermal generation in November, 2018 showed an increase of 05.64% (32 MU/day) with respect to the corresponding month in previous year.

The average Hydro generation in November 2018 showed an increase by 17.55 MU/day with respect to the corresponding month in previous year.

The average Renewable generation in November, 2018 increased by 24.48 MU/Day with respect to the corresponding month in previous year. All utilities were requested to send the data for renewable generation regularly. The reason for the increase was highlighted as capacity addition, better sunshine & wind. Also, it was added that the telemetry of renewable had improved. The state wise break up is as under:

	Wind MU/DAY	Solar MU/DAY	Bio mass MU/DAY
राजस्थान	7.04	13.32	0.57
पंजाब	-----	3.84	7.99
उत्तराखंड	-----	0.38	-----
उत्तर प्रदेश	-----	2.49	----
हरियाणा	-----	0.11	0.71
एनटीपीसी	------	0.12	------

The average nuclear generation in November, 2018 was decreased by 5.21 MU/day per day as compared to corresponding month in previous year.

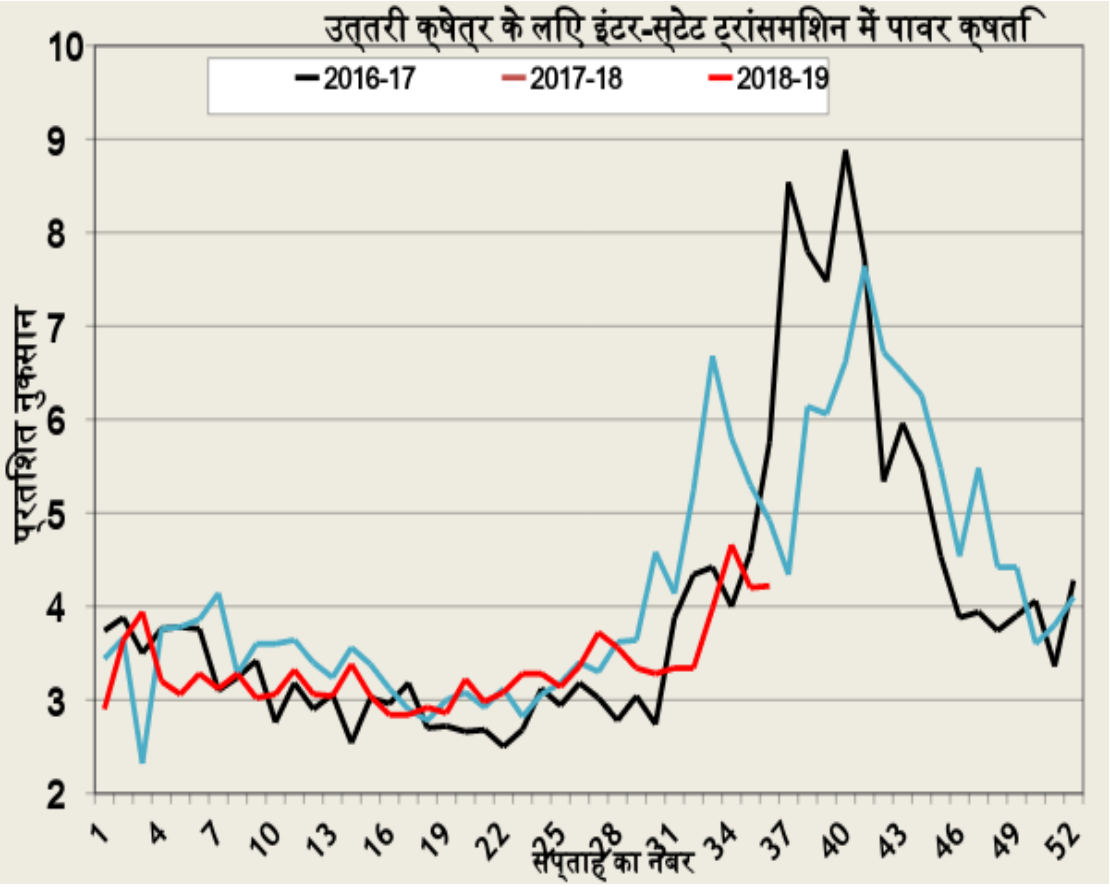
The net average Inter-Regional, import showed a decrease of 17.37 MU/day during the month of November, 2018 as compared to the corresponding month in previous year.

The net average Import from WR showed an decrease of 12.85 MU/day during November, 2018 as compared to corresponding month in previous year.

The net average import from ER decreased by approximately 4.63 MU/day during November, 2018 as compared to corresponding month in previous year.

Net average import from NER increased by 0.02 MU/day during November, 2018.

The major reasons for decrease in the import, from other regions was reduced demand in power on account of the weather conditions.
The transmission losses are depicted below:



The details of the variation in data of Drawl by states SEM VS SCADA for the month of November 2018 is given below:

संख्या	राज्य	% अंतर
1	पंजाब	0.14%
2	हरियाणा	0.55%
3	राजस्थान	0.57%
4	दिल्ली	0.62%
5	उत्तर प्रदेश	1.04%
6	उत्तराखंड	8.27%
7	हिमाचल प्रदेश	0.47%
8	जम्मू और कश्मीर	1.18%
9	चंडीगढ़	5.24%

Rajasthan was requested to look into the variation and rectify the same.

Long outages of transmission lines were discussed and all constituents were requested to revive the elements under long outages at the earliest **(Annexure-2 A).**

It was intimated by UP representative that Paricha TPS is expected for revival in 14.1.2019. Also it was highlighted that units in reserve shut down should be bought back into the system. POWERGRID representative stated that the Koteshwar FSC is expected to be in the system by March 2019.

The new elements charged during the month were discussed and the list is attached at **Annexure -2 (B).**

Total outages during November 2018 were 758 including planned S/D (478) and forced S/D (Trippings-147+Emergency S/D-133).
On specific enquiry from NTPC regarding outcome of discussions in NPC for certification of MOPA under RRAS, MS, NRPC stated that NRPC has made a presentation in NPC meeting held on 30.11.18 on the subject. NPC has asked other regions to study the same and the matter will be discussed in next NPC meeting expected in Feb/Mar 2019. Regarding progress on Compensation Procedure for Gas Stations, MS, NRPC stated that a meeting was held at CERC regarding the same and the procedure is expected to be notified by CERC shortly in line with Coal Stations procedure.
Citing example of delay in completion of planned transmission system outage in Delhi Ring, NRLDC expressed concern that utilities must strive for completing planned outages within approved span of time. MS, NRPC stated that in-ordinary delays shall be reported to CERC.
NTPC informed that due to reduction of VAT on NG from 26% to 10% by UP Govt, ECR of Dadri-Gas and Auraiya station has been reduced by about 30 p/kwh on APM & more than 100 p/kwh on RLNG. The reduction in VAT was shared with all beneficiaries. However, except peak hours, running gas stations are not being scheduled fully w.r.t DC being declared on domestic gas. He stated that current APM gas for NCR is "zero" but about 1.2 MMSCMD gas is being diverted from WR to NCR for the benefit of NR beneficiaries. Utilization of diverted gas is being monitored by MOP. Since permission for inter-regional diversion of domestic gas is allowed by MOP on year to year basis based on diverted gas utilization, it is prudent to fully requisition the capacity declared on domestic gas. UP stated that they are unable to requisition their allocated share on domestic gas currently because of low demand in the state. MS, NRPC asked all beneficiaries to ensure availing power offered on domestic gas by NTPC to the maximum extent.

3. Maintenance Programme of Generating Units and Transmission Lines

3.1. Maintenance Programme for Generating Units.

3.1.1. The maintenance programme for Generating Units for the month of January, 2019 was discussed on 17.12.2018 at NRPC Secretariat, New Delhi. The approved outages of generating units as per deliberations held in OCC has been issued vide letter of even no dated 26.12.2018.

3.2. Outage Programme for Transmission Elements.

3.2.1. The Outage programme of transmission elements for the month of January, 2019 was discussed on 17.12.2018 at NRPC Secretariat, New Delhi. The approved outages of transmission elements as per deliberations in OCC has been issued vide letter of even no dated 26.12.2018.

The outage of NAPS Unit -1 along with connected lines as proposed was discussed and approved subject to real time conditions.
Also the outages of ICT & Transmission lines (For Insulator cleaning) as proposed by PSTCL were approved subject to real time conditions

MS NRPC stated that the NRLDC should appoint a Reliability coordinator for giving the final outage approval in the real time after studying the system as a whole.

4. Planning of Grid Operation:

4.1. Anticipated Power Supply Position in Northern Region for January, 2019 (As per 15th LGBR Sub-committee meeting)

The Anticipated Power Supply Position in Northern Region for December, 2018 as updated is enclosed at **Annexure 4.**

5. Information about variable charges of all the generating units in the Region.

SE (O) stated that the variable charges details for different generating units are available on the Merit Order Portal and all SLDCs should update VC on MoD regularly. He added that all SLDCs should confirm if the process of Scheduling is being done as per Merit Order Despatch and in case of variations the reasons may please be furnished.
NTPC representative stated that the charges of power from Auraiya & Dadri gas had been reduced by 40P and has come at par with that of Anta. He requested all beneficiaries especially UP to schedule gas stations as much as possible. He added that at present scheduling is being done at Technical Minimum by NRLDC only. He added that the diverted gas needs to be utilized failing which the same will not be diverted in future. UP representative stated that they would look into the issue.

6. Reactive compensation at 220 kV/400kV level

6.1 In the 38th TCC & 41st NRPC following elements in NR were approved:

a) 500 MVAr TCR at 400 kV bus at Kurukshetra S/S of Powergrid.

b) 30 no. 220 kV bus reactors at 220 kV sub-stations and 18 no. 400 kV bus reactors at 400 kV sub-stations subject to the availability of space.

POWERGRID:

Representative of POWERGRID had informed that for the bids for 500 MVAr TCR at Kurukshetra price bids have been opened and the LOA is expected to be placed by **last week of December 2018** with commissioning schedule of 2 years from the issue of LOA.

Regarding the 125 MVAr reactor being installed at Kurukshetra to compensate for the prevailing high voltage conditions until the TCR gets commissioned, it was informed by POWERGRID that the reactor has been charged on 28.09.2018.

Regarding the installation of the bus reactors at 400 kV ISTS substations which is to be done through TBCB route as per the MoP Gazette Notification dated 08.05.2018, POWERGRID representative was again requested to update the progress of the same from CTU.

DTL:

DTL has informed that as per the revised approval of SCPSPNR held on 22.06.2018, DTL will install 7 no. bus reactors, six 25 MVAR, 220 kV bus reactors at Mundka, Harsh Vihar, Peeragarhi, Electric lane, Bamnauli & Indraprastha substation and 1 no. 125 MVAR, 400 kV bus reactor at Mundka substation. DTL has submitted that these reactors would be commissioned by **December 2020.**

The updated status as submitted in the meeting by DTL is placed at Annexure 6.

PSTCL:

Technical bid for 400 kV bus reactor at Dhuri substation has been opened and Price bid has been put on hold due to pending PSDF approval. As regards 220 kV bus reactors at Dhuri and Nakodar substation, tender has been opened on 15-06-2018 (technical bid) & is Price bid opening has been put on hold due to PSDF approval. DPR for installation of 400 kV and 220 kV bus reactors has been submitted for PSDF funding. It was informed that there were certain observations of TESG of PSDF to which the clarifications have been reverted on 07.09.2018. Order shall be placed after securing the approval for PSDF funding.

Uttarakhand:

125 MVAR reactors at Kashipur: Technical bid has been opened and is under evaluation.

Rajasthan:

The DPR for 3 Nos. each of 25 MVAR reactors (Akal, Bikaner & Suratgarh) i.e. total 75 MVAR reactors has been submitted for PSDF funding on 27.04.2018. Further the reply of observations raised by NLDC has been submitted on 28.07.2018 and approval is under process at their end. The installation process of these 3 reactors shall be started on receipt of approval by PSDF.

The MS NRPC advised that 450 MVAR (13x25+1x125MVAR) agreed in the standing committee should have been got installed even if the locations had changed in revised study / proposal. In this context it is to submit that the revised DPR for 450 MVAR approved Reactor after separating STATCOM has been sent to POSOCO for approval vide letter dtd. 12.10.2018.

Regarding status of 150 MVAR (25 MVAR at Barmer and 125 MVAR at Jodhpur), it is to submit that reactors at these locations are already included in proposal of 450 MVAR reactors of Rajasthan, approved in the 39th SCPSPNR.

Rajasthan representative stated that the PSDF approval was awaited for 25 MVAR reactors (Akal, Bikaner & Suratgarh) i.e. total 75 MVAR reactors. Representative of NPC in the meeting informed that the same has been approved by the Appraisal committee and the minutes of the meeting shall be issued shortly.

7. System Study for Capacitor Requirement in NR for the year 2019-20.

38th TCC & 41st NRPC meeting: NRPC approved that the capacitor requirement study of NR shall be conducted at 11/33 kV level from CPRI so as to obtain the true requirement of capacitor for FY 2018-19.

7.1. **39th TCC and 42nd NRPC** approved the Techno Commercial offer of CPRI at **Rs. 32 lakhs (Rs. 20 lakhs for previous study and Rs. 12 lakhs for additional assignment) excluding taxes** for conducting the capacitor study. In the meeting the format for data submission was shared with the members and they were requested to ensure timely submission of the data so that the study may be carried out in the stipulated time frame.

7.2. In the **150th OCC meeting**, members expressed concerns on the nature of the format and submitted that the format being lengthy would require some time for better understanding of the format and submission of data accordingly.

7.3. To address the concerns of the members of OCC forum, in the **151st OCC meeting**, representative of CPRI made a detailed presentation explaining the format in the meeting and based on the inputs received from the members, the format has been revised and has already been sent to the respective SLDC's through e-mail dated 24.09.2018. CPRI has also shared a video of the presentation explaining the format which can be viewed on Youtube at https://youtu.be/QTXx7owPF3g.

7.4. Members were also requested to initially fill the data format for any one 220 kV or 132 kV substation and send it to CPRI (manoharsingh@cpri.in) to check its suitability for utilization in carrying out the study and further action.

7.5. **152nd OCC meeting:** No progress has been made so far for submission of data. All the utilities were again requested to make efforts to do the needful.

7.6. **40th TCC & 43rd NRPC meeting:** Members were requested to expedite submission of the data to CPRI in the format prescribed for studies to be conducted for Capacitor requirement in NR for the year 2019-20.

7.7. **153rd OCC meeting:** MS, NRPC expressed his concerns as no data in the specified format has been received from any of the state even for a single substation which was desired to verify its suitability for utilization in carrying out the capacitor study.
Representative of Haryana stated that they had submitted data to which the representative of CPRI replied that the data submitted by Haryana was not in the format as decided in the 151st OCC meeting which was forwarded to all the utilities via e-mail dated 24.09.2018.
Representative of Rajasthan SLDC stated that the load data at 11 kV substations was not being maintained. Therefore, it was not possible for them to furnish the same.
EE (O), NRPC and representative of JVVNL stated that the load data was maintained at 11 kV sub-station and the same may be made available.
Representative of Rajasthan SLDC stated that the same would be verified and the data shall be submitted at the earliest.

7.8. The issue of non-submission of data for system study of capacitor requirement in NR for the year 2019-20 has been taken up with the highest management of DISCOMs, STUs and SLDCs. The letter regarding the same dated 06.11.2018 is enclosed at Annexure – Agenda item no 7 of the Agenda of the 154th OCC meeting, for reference.

7.9. **154th OCC meeting:** SE (O) stated that the matter is being pursued with the top management of the DISCOMs (refer Annexure – Agenda item no 7 of the Agenda of the 154th OCC meeting). He stated that all SLDCs should take up the issue with their respective DISCOMs for submission of the data as desired at the earliest**.**

8. Phase nomenclature mismatch issue with BBMB and interconnected stations

8.1 The Protection Sub-Committee while discussing multiple elements tripping at 400/220/132kV Dehar HEP of BBMB in its 34th meeting held on 21.04.2017 recommended inter-alia that BBMB should modified nomenclature of phase sequencing at Dehar as Y-B-R instead of R-Y-B. The issue was further deliberated in the 138th OCC meeting held on 23.08.2017, wherein it was observed that nomenclature of phases at

BBMB end has inadvertently been marked as outlined below:

Phase of the grid	Corresponding nomenclature of the phase at BBMB end
R Phase	B Phase
Y Phase	R Phase
B Phase	Y Phase

The BBMB was asked to rectify the nomenclature issue at their end accordingly.

8.2 However, BBMB raised concern that the issue could not be resolved in one go, as coordination would be required from all the concerned utilities to carry out this activity and requested NRPC to form a committee comprising of BBMB and its partner states, utilities with which BBMB has interconnection, NRPC Secretariat and POWERGRID for the same. NRPC in its 41st meeting held on 28th February, 2018 approved the proposed formation of the committee and advised BBMB to resolve the issue within six months.
BBMB drew a draft action plan which was duly deliberated by the Committee in its 1st meeting held on 04.06.18. The action plan was circulated to all the concerned utilities for - their comments and concurrence. The execution of the action plan was tentatively planned during month of November-December, 2018.

8.3 HPSEB and PSTCL agreed with action plan, however, PSTCL was of the view that 400kV Dehar-Rajpura line is owned by PGCIL and hence the work is to be executed by them. Comments on the action plan were also received from NTPC and POWERGRID BBMB has agreed with the comments from NTPC and has given their reply on the comments of POWERGRID.

8.4 The reply of BBMB vis-à-vis the comments of POWERGRID were deliberated in the 151st OCC meeting wherein members were of the view that reply of BBMB was generally in order. However, POWERGRID representative stated that the matter pertains with NR-I and NR-II region of POWERGRID and final decision regarding the same is to be taken up at the level Executive Directors of respective regions.

8.5 Accordingly, the matter was taken up vide letter of even number dated 07.10.2018 for POWERGRID consent to the action plan. However, reply of the same is still awaited.

8.6 **152nd OCC meeting:** POWERGRID representative assured that the issue will be resolved with BBMB.

8.7 SE (O) requested POWERGRID to give their consent at the earliest so as the BBMB could execute the work in the upcoming months of November & December as per the decision of NRPC.

8.8 **40th TCC & 43rd NRPC meeting:** In the meeting POWERGRID stated that they have reservation regarding the action plan submitted by BBMB, as for a single circuit line it may not be optimal plan to change the Jumper configuration in view of requirement for long shut down & material. He further stated that a similar issue was encountered in Rajasthan wherein same problem was mitigated for a Double circuit line.MS NRPC had requested POWERGRID to submit all their reservations in writing, highlighting the issues which may be encountered at the time of implementation of above. In the meeting it was stressed that the work should be completed in the lean period of November-December 2018

8.9 **153rd OCC meeting:** POWERGRID updated that the site visit is planned shortly top resolve the issue. As desired in the 43rd NRPC meeting POWERGRID submitted all their reservations in writing (Annexure 8 of MoM of 153rd OCC meeting). Further MS NRPC requested POWERGRID to resolve the matter immediately so that the work can be done by BBMB in the lean period. BBMB representative also requested for the same as once the clearance from POWERGRID IS received thereafter also the matter has to be approved by their Protection Committee.

8.10 **154th OCC meeting: POWERGRID submitted the details (Annexure 8) of the issues/ difficulty which would be faced while completing the phase nomenclature mismatch work. POWERGRID intimated that the site visit had been done by their site officials. MS, NRPC stated that the completion of the phase mismatch issue work is very important and it should be completed during the lean period.**

8.11 **After deliberations it was decided that a joint visit by POWERGRID, BBMB, NRLDC and NRPC would be conducted on 15/01/2019 so as to figure out the difficulties that would be faced in order to rectify the issue as listed out by POWERGRID.**

9. Follow up of issues from previous OCC Meetings – Status update

The detail of the updated status of Agenda items as discussed in the 154th OCC meeting is enclosed at **Annexure –Agenda item no 9.**

10. Status of FGD installation vis-à-vis installation plan at identified TPS.

10.1 The list of FGDs to be installed as finalized in the 36th TCC (Special) meeting held on 14.09.2017 was enclosed as Annexure-13 with the Agenda of the 144th OCC meeting. All SLDCs are regularly being requested since 144th OCC meeting to take up with the concerned generators where FGDs is to be installed and submit the progress of FGD installation on monthly basis regularly to NRPC in the available format on the NRPC website.

10.2 **151st OCC meeting:** MS NRPC stated that in the meeting CEA held a meeting with generators on 28.08.2018 in which CE, TR&M, CEA informed that the FGD installation deadlines have been advanced for stations falling in NCR and also for the stations above 500 MW capacity or in stations located in the area having population density more than 400 persons per square km or are in critically polluted area. He further added that many IPPs like NPL are waiting for guidelines from the SERCs regarding the FGD installation cost adjustment. In this regard, he briefed the sub-committee that Ministry is concerned about the issue and a policy decision is being made about the cost to be adjusted duly and CERC is being directed in this regard to pass an order to the SERCs. He asked all the generators to seriously make efforts to meet the deadline of installation of FGD.
All constituents are again requested to update the desired information in soft copy in excel format on a regular basis. All the utilities (except PSPCL) should give the contact details of the officer who is concerned with FGD installation so that the information can be expeditiously collected directly from him/her. All SLDCs shall coordinate and submit the information.

10.3 **152nd OCC meeting:** SE(O) NRPC informed that in June, 2018, MoP in a letter to the CERC stated that investment in the installation of emission control technology like FGDs in TPPs in compliance to MoEF&CC norms will be considered for pass through in tariffs and TPPs can approach appropriate commission for the approval of additional capital expenditure and compensation for the increased cost on account of this change-in-law event.

The Sub-Committee was also informed about revised phasing plan received from TR&M Division of CEA placed at Annexure-10(A) of the MoM of the 152nd OCC meeting**.** He requested all utilities to look into the same and implement the installation plan accordingly and update.

10.4 **153rd OCC meeting:** All utilities were requested to review the revised phasing plan that was attached at **Annexure-10(A) of the MoM of the 152nd OCC meeting.**
PSPCL intimated that the Work order for carrying out the Detailed Feasibility Study for Installation of FGD at GGSSTP, Rupnagar & GHTP, Lehra Mohabbat has been placed upon M/s NTPC Consultancy Services and work is in progress.

10.5 **154th OCC meeting:** All utilities were requested to review the revised phasing plan that was attached at **Annexure-10(A) of the MoM of the 152nd OCC meeting.**
NTPC was requested also to intimate the progress of the FGD installation. The updated status as received is enclosed at **ANNEXURE 10.**

MS NRPC stated that the issue is being regularly monitored by the TRM division of CEA.

11. LVRT compliance by wind generators.

11.1 Installation of LVRT needs to be ensured at the time of "connection" of the wind generators. The CEA(Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2013 provide that wind generating station connected at voltage level of 66 kV and above shall remain connected . LVRT is the capability of the electrical device to operate through periods of lower grid voltage. LVRT mechanism boosts the terminal voltage of the point of connection of the wind machine when there is a fault at the remote location to provide transient stability support.

Many wind generation operates without LVRT/FRT feature thereby adversely responding at low voltage either due to high load condition at wind pockets or any fault condition in different parts of the grid and becomes a source for grid incident. The installed capacity having LRVT, their setting are not uniformly matching with the provisions of the Central Electricity Authority (Technical standards for connectivity to the Grid) Regulation, 2007 as amended from time to time (CEA Technical Standards for Connectivity Regulations).

Regulation B2.(3) of the CEA (Technical Standards for Connectivity) Regulations provides that Low Voltage Ride Through (LVRT) is compulsory for machines installed after 15.04.2014, but for existing wind power generating stations, LVRT should be mutually discussed. It does not exempt any station from installing LVRT. STUs/DISCOMs/SLDCs should take up the matter of getting compensation for additional capitalization on account of installing LVRT to be made "pass through "with their concerned State Electricity Regulatory Commissions.

LVRT is technical requirements from the point of view of the safety and security of the grid and its usefulness cannot be overlooked in view of the cost involved in retrofitting of

LVRT. CERC has already directed all WTGs of capacity equal to or more than 500kW except Stall Type WTGs to comply with LVRT.

With regard to monitoring of the installation and performance of LVRT installed on existing WTGs, CERC has directed SLDCs to prepare quarterly reports and submit it to RPCs . RPCs are directed to validate the reports submitted by SLDCs in consultation with RLDCs and report any deficiency and non-compliance to the Commission in accordance with law.

As LVRT are not installed in many of the wind turbines in State of Rajasthan, the issue is being regularly raised in the various meetings of NRPC so far without any result.

38th TCC/41st NRPC meeting: LVRT compliance was a pre-requisite according to CEA connectivity standards and these wind generators should not have been provided the connectivity in the first place itself. NRPC directed Rajasthan to issue a notice to all the LVRT non-compliant wind generators specifying a time period within which they need to get the LVRT compliance beyond which they would be constrained to deny scheduling to these generators.

145th OCC meeting: RRVPNL submitted the letter from the Ministry of New & Renewable Energy in this regard in which the following is stated regarding LVRT compliance:

"*A Concerned WTG manufactures may apply for LVRT testing to any internationally accredited testing body or NTWE by 15.3.2018, which should include the following:*

i An affidavit that the manufacturer would comply with CEA Technical standards for connectivity to the grid.

ii A bank guarantee of Rs 1 crore per model, which would be returned on producing the compliance certificate for LVRT and other technical standards as stipulated by CEA."

147th OCC meeting: MS, NRPC stated that all the wind generators shall be LVRT complaint for which retro fitment needs to be done & it shall be responsibility of Rajasthan SLDC to get it enforced. Rajasthan should comply with the decision of 38th TCC/41st NRPC meeting & write letters to wind generators communicating the decision of NRPC.

148th OCC meeting: MS, NRPC apprised the Committee that the above reference order facilitates WTG manufactures to obtain statement of compliance/confirmation standard for demonstrating the compliance to applicable CEA Technical standards for connecting to the Grid for their WTG models which were unable to get LVRT compliance certificate from accredited testing agencies. He further stated that the time period for applying for LVRT testing to any internationally accredited testing body or NIWE stands expired on 15.3.2018. He added that notice should be issued to all Wind generators who have not done the needful. Rajasthan SLDC representative has intimated the same has been issued (Copy of the letter was placed at Annexure 11 of the MoM of the 148th OCC meeting). MS, NRPC added that as per 38th TCC and 41st NRPC decision, SLDC should not schedule the wind generators which are not LVRT complaint. Also he added that due to LVRT non compliance on part of the wind generators has lead to a near voltage collapse instances but luckily the grid survived. NRLDC representative also added that the

compliance of the wind generators is mandatory for the safety of the grid as 2-3 incidents have already occurred in the grid which could have resulted in the catastrophe.

149th OCC meeting: Rajasthan representative intimated that a meeting of wind turbine manufacturers was held on 05.07.2018 to sort out the issue of LVRT and to get its compliance expeditiously. Further, the assessment of manufacturer wise non complied WTG has been identified and enclosed at Annex- XI of the MOM of the 149th OCC meeting. He informed the Sub-Committee that 638 generators are LVRT complaint & 106 do not require as per regulation. He further added that 2641 generators need to be LVRT complaint. The capacity of generators that are non – complaint is 3019 MW. He also informed that the cost of installing LVRT was 25-40 lakh per generator for which the generators will have to make arrangements. MS, NRPC stated that the cheaper solutions are available and they should be explored cost needs to be reviewed. MS NRPC requested that Rajasthan should submit these details to their SERC. He informed additionally that the wind generators had requested for scheduling of power till they review the time line for getting work done. Rajasthan representative also informed that the next meeting with WTG manufacturers is scheduled for 23.7.2108 for further deliberating the actions in this regard. Director, GM division, CEA representative added that LVRT compliance is mandatory as per connectivity regulation requirement of CEA. He added that a single LVRT solution can be used on the plant which will be cheaper.

150th OCC meeting: Rajasthan representative intimated that in line with the discussions in the last OCC meeting the WTG manufacturers in the meeting on 23.07.2018 has been advised to review the possibility of having a single LVRT for a plant. MS, NRPC requested that the MOM of the meeting may be shared so that the progress in this regard can be monitored.

11.2 151st OCC meeting:

The MOM of the meeting held on 23.07.2018 stands shared (Annexure 11 of the Agenda of the 151st OCC meeting).
MS NRPC briefed the forum that M/S Suzlon and Inox have filed a petition for waiver of installation of LVRT on account of the additional cost involved.

RRVPNL representative intimated that the next meeting with the WTG manufacturers is scheduled tentatively for 05.10.2018**.**

11.3 152nd OCC Meeting:

RRVPNL representative intimated that a meeting along with presentation from LVRT solution provider (M/s Enerfra) has been convened on dated 09.10.2018. MOM of said meeting are attached as Annexure-XI of the Minutes of The 152nd OCC meeting**.**. During the meeting, he informed that it was also decided by MS, NRPC that a meeting of WTG Manufacturers and generators will be convened at NRPC on dated 23.10.2018 to discuss bottlenecks issues in implementation of LVRT in Rajasthan control area.

11.4 In a **meeting held on 23.10.2018 at NRPC with the WTGs** GSS/PSS level solution like STATCOM was discussed. M/s Siemens would provide voltage relief graph which would be superimposed on the system voltage profile at any S/s, If it matches with that provided by the LVRT device then Siemens would explore further possibility of having LVRT devices**.** Siemens was also requested to explore any other alternative for their own WTG to

make them LVRT compliant. WTGs were requested to take up for "Pass-through tariff" under "change in law" with SERC**.**

11.5 40th TCC & 43rd NRPC meeting: In the meeting it was advised to Rajasthan SLDC to enforce the decision of 42nd NRPC of not scheduling LVRT non- compliant WTGs commissioned after the date as mentioned in the CEA (Connectivity Regulation) amendment dated 15.10.2013.

CEA stated that SLDCs may file a petition with respective SERCs indicating problem being faced by the WTGs in installation of LVRTs.

MS, NRPC informed the TCC that NRPC along with Rajasthan SLDC, WTGs, OEMs is in the process of finding economic way to ensure LVRT compliance

11.6 153rd OCC meeting: RRVPNL representative updated that WTGs are in the process of finding economic way to ensure LVRT compliance.

11.7 154th OCC meeting: Representative of Rajasthan informed that petition to be filled to SERC was put up for approval but as per Central Electricity Authority (Tec.hnical Standards for Connectivity to the Grid) Amendment Regulations, 2013 B.3 which states that "The generating company and the licensee of the electricity system to which the generating station is connected shall mutually discuss and agree on the measures which can be taken to meet the standards specified in (B 1) and (B2) subject to technical feasibility", management has intimated that matter would be taken up by STU.

Director (GM), CEA told that compliance of not only CEA regulations but also CERC order needs to be ensured. He requested Rajasthan to refer CERC petition no. 420/MP/2014 for clarifications, if any.

MS, NRPC told that CERC has directed SLDCs to prepare quarterly reports and submit it to RPCs and RPCs are directed to validate the reports submitted by SLDCs in consultation with RLDCs and report any deficiency and non-compliance to the Commission in accordance with law. Accordingly, he asked SLDCs to submit the quarterly reports and report non-compliance to SERC. He requested SLDC to file to petition at the earliest and implement NRPC's decision of not scheduling non-compliant WTGs.

12. System Protection Scheme (SPS) in NR

12.1 Revised System Protection Scheme (SPS) for 765 kV Agra-Gwalior line:

In 39th TCC and 42nd NRPC meeting: MS, NRPC informed that there were 2 issues involved which needed to be discussed. One was for the utilization of CB signal from both the ends (Gwalior and Agra) in the logic and the other was for incorporating additional 1000 MW load for load shedding in the already approved scheme.

Regarding the additional 1000 MW load, MS stated that the same has been identified and were now pending at POWERGRID's end for wiring with the logic.

POWERGRID representative informed that the material has been received at the site and for 2 locations viz. Dadri and Bhiwadi the scheme was almost completed. Regarding other locations under the ownership of other utility, POWERGRID requested to provide the details of nodal officers with whom they may coordinate. He further stated that, once the details of the nodal officers were received, additional load of 1000 MW shall be wired

within 02 months (tentatively by end of August 2018).

MS, NRPC assured POWERGRID of all possible support by the utilities and to provide them with the list of nodal officers for each substation location identified for additional load shedding.

Regarding the issue of utilizing CB from both the ends (Gwalior & Agra) in the logic of SPS, MS, NRPC stated that even though the decision was already taken in NRPC/TCC forum, the issue of booking the cost of the scheme was again raised in the OCC forum. To this, Members expressed concerns and stated that once a decision has already been taken at NRPC/TCC forum, the issue shall not be raised again in any sub-committee of NRPC.

149th OCC meeting: It was also informed that a report has to be submitted to CERC on the status of implementation of the SPS scheme. Accordingly, CERC has been intimated the current status of implementation and CERC has also informed that a mock testing for the revised 765 kV Agra- Gwalior SPS will be carried out after integration of additional 1000 MW load shedding.

151st OCC meeting: POWERGRID informed that substations in Delhi, UP & Haryana were completed and 7 locations in Punjab & 6 locations in Rajasthan were remaining which are expected to be completed by October 2018. The mock testing for the Revised 765 kV Agra- Gwalior SPS will be carried out in November, 18 as communicated to CERC. (only after integration of additional 1000 MW load shedding that is to be carried)

152nd OCC meeting: POWERGRID updated that the work will be completed in totality by November end. He added that physical installation will be completed within this month and testing of the 21 number of links will start thereafter.

NRLDC representative stated that the mock testing would be planned thereafter in the first week of December, 2018.

In 40th TCC & 43rd NRPC meeting: POWERGRID representative informed the following**:**

- Physical installation at DTPC completed at all the locations.
- Communication link of all hardware would be done by November, 2018.
- RoW issue on 765kV Gwalior-Satna for stretch of 25km is faced. Expected to be resolved by December, 2018.
- Signal Extension to Sasan over OPGW from Agra has been completed. Repeaters installation is in progress and expected by November, 2018.
- Mock testing would be done in January, 2019.

153rd OCC meeting: POWERGRID updated that the connectivity work has been done on ten stations and the work on the rest of stations of Rajasthan & Punjab would be will be completed by 15.12.2018. He further ensured that as agreed in the 43rd NRPC meeting they will target to go ahead with the mock testing in 01/2019.

154th OCC meeting: POWERGRID representative informed that modifications related to CB ON/OFF status have been completed at both Agra and Gwalior end. He told that DTPC installation has been completed and the end to end testing has also been done for 20 links out of 21. He further stated that end to end testing is remaining only for Bhiwadi-Heerapura-Bhilwara-Chittorgarh link. He further requested the concerned states to terminate the links at the designated feeder on which the load shedding is required to be done. He told that end connections with Trip relay of the feeder to be done States. He assured that as targeted the mock testing will be planned to be carried out in 01/2019.

Representative of NRLDC requested POWERGRID to coordinate with states and keep NRPC/NRLDC in loop for early completion of the scheme. MS NRPC requested POWERGRID to coordinate with nodal officers of the concerned states for early termination of the links at their end.

12.2 SPS for ICTs at 765 kV Unnao sub-station:

144th & 145th OCC meeting: UPRVUNL update: "Offer to incorporate the logic of SPS at Anpara "D" is pending with BHEL. The efforts are underway to get the offer from BHEL. The work is expected to be completed by 31.03.2018. The cost of the logic of SPS at Anpara "D" is to be indemnified by UPPTCL".
150th OCC meeting: It was informed that on continuous pursuance of matter with BHEL, negotiated offer for SPS has been received from BHEL on 16.08.2018 (ANNEXURE 12 of the MOM of the 150th OCC meeting) and the order for the same shall be placed within a week with completion target of September, 2018**.**

The copy of the LOI placed on BHEL is placed at Annexure 12 of the Agenda of the 151st OCC meeting.

151st OCC meeting: UPRVUNL updated that order has been placed on M/s BHEL vide letter no 310/C&D-VI /DTPP/T-1 dated 20.08.2018. The work is to be completed in around 40days. The cost of the work would be 54.20 lac & UPPTCL has been intimated about the same**.**

152nd OCC meeting: UPRVUNL updated that they will complete the work by November end. UPPTCL representative stated that the work at their end and LANCO is complete and once the UPRVUNL completes the work mock testing will be done. It was further added by representative of UPRVUNL and UPPTCL that only action at Anpara D is pending and therefore with the commissioning of scheme at Anapara D, entire scheme would stand commissioned.

153rd OCC meeting: UPRVUNL updated that the work is under progress. BHEL they intimated has given a list of MAX-DNA Hardware to be procured by department. The offer stands received and procurement process is being done. He further added that BHEL is developing the software logic of the SPS. As on date it is expected that the work would be completed by December 2018

154th OCC meeting: UPRVUNL updated that all the hardware required has been arranged at site. BHEL Engineer will be available at site from 22/12/2018 to finalize the design of logic in 15 days. Thereafter implementation will be done in next 7-8 days. The implementation of logic is expected to be completed by 1/2019.

12.3 SPS for Kawai – Kalisindh - Chhabra generation complex:

146th OCC meeting: RRVPNL updated as under:

"The communication scheme is being reviewed on PLCC/Optical fiber in place of earlier GPS scheme as tripping time on GPS scheme was higher. Tender is likely to be floated by 5/2018."

147th OCC meeting: RRVPNL representative intimated that feeder identification has been done & tendering will be done shortly. He added that further communication scheme is being reviewed on PLCC/Optical fiber in place of earlier GPS scheme as tripping time on GPS scheme was higher. Tender is likely to be floated by May-18.

148th OCC meeting: RRVPNL representative intimated that the Technical specification is under preparation & communication link are under review. Tender is likely to be floated in July 2018.MS NRPC expressed concern over inordinate delay & requested RRVPNL to take up the issue with the communication wing expeditiously or else NRPC Secretariat will take up the matter with higher management**.**

149th OCC meeting: RRVPNL representative intimated that the details from the communication wing stand received. & the tender will be floated positively by next month. He explained that the details of the OPGW involved have been accounted for in the details received from the communication wing**.**

150th OCC meeting: RRVPNL representative intimated that the Technical Committee has rejected the proposal on the basis that the reliability of the PLCC system proposed for the load shedding at the time of outage of Kawai-Kalisindh units along with Anta–Phagi line is not present. It was added by the Committee that till March 2019 the OPGW will be laid in the entire network (12000 Kms) & the same can be used for the purpose.

MS NRPC requested RRVPNL to submit the written communication from their STU in this regard.

151st OCC meeting: RRVPNL representative submitted the written communication from their STU in this regard is enclosed at Annexure 12A of the MOM of the 151st OCC meeting It has been intimated that the Technical specification for implementation of Automatic load shedding scheme under SPS for Kawai Kalisindh generation complex is under process of approval and the whole procedure till award of contract may be completed within 4-5 months and complete implementation of above scheme may take further at least 6-7 months.

152nd OCC meeting: RRVPNL representative submitted a letter from SE (Procurement-I), RVPN, Jaipur Annexure-XII of the MOM of the 152nd OCC meeting, vide which it has been intimated that the Technical specification for implementation of Automatic load shedding scheme under SPS for Kawai Kalisindh generation complex is under approval. Further, it was intimated that the contract will be awarded within 4-5 months and complete implementation of above scheme may take further 6-7 months. SLDC Rajasthan representative confirmed that Chabra STPS units have also been wired to the SPS.

153rd OCC meeting: RRVPNL representative stated that the order will be placed in 1/2019 positively for completion of work in 6-7 months thereafter.

154th OCC meeting: RRVPNL representative stated that the tender would be done by the end of the month.

13. Automatic Demand Management System

Since 147th OCC utilities were being requested to update on the action plan & status of implementation of the ADMS in their utility as it is mandatory requirement of IEGC. Statewise status is as follows:

Punjab:

147th OCC meeting :

Punjab representative intimated that at SLDC level they were doing remote tripping for 96 locations. He added that the ADMS at 11 kV feeder level is to be implemented by Distribution Company. He added that the Tender specification had finalized and it has been targeted to be complete by 2020.

148th OCC meeting :

Punjab SLDC representative stated that 26 locations remote tripping from SLDC has been tested. Around 10 percent of the running load can be disconnected through these locations. The latest status regarding implementation of ADMS by PSPCL is as under:

The matter of engaging a consultant for preparation of DPR of ADMS at balance location is under consideration with the higher authorities and work of ADMS would be implemented within stipulated time.

TDDPL: Fully Implemented

TDDPL representative stated that the ADMS system is working well in their organization as per the latest regulations since last more than 5 years. He added that the scheme is also working in Rajadhani & Yamuna Power distribution companies.

Rajasthan:

149th OCC meeting :

That approval of PSDF for STNAMS (Smart Transmission Network & Assets Management System) project which is consisting of Automatic Demand Management System (ADMS) functionality at the level of 33 feeders at EHV Substation of RVPN under SCADA / EMS part of project has been received. Bid documents prepared and under final approval with the CMD, RVPN. Bidding process will be initiated immediately on approval as above. Tentative timeline is as under:-

1. Issue of NIT – June, 2018
2. Finalization of Tender / Purchase order issued – August, 2018
3. Proposed timeline to complete the work – 18 months from date of issue of LOI/NOA

Further, the Automatic Demand Management System (ADMS) functionality at 11 kV feeders from 33/11 kV substation are under the jurisdiction of the Discoms and matter is being perused with discoms authorities.

152nd OCC meeting :

Rajasthan representative has also added that tender for Smart Transmission Network & Assets Management System having ADMS part has been floated and Techno commercial bid has been opened on 30.08.2018. Financial Bid has also been opened and financial bid analysis is yet to be submitted for approval of WTD. Work order is expected to be placed by December-18 after expiring of model code of conduct for assembly election in Rajasthan.

UP:

The remote operation of 132 kV feeders under ADMS has been done, but for the down below network they have taken up the issue with the DISCOMs.

154th OCC meeting: RRVPNL representative stated that the work order for Smart Transmission Network & Assets Management System having ADMS part has been issued on 12/12/2018

14. Status of implementation of recommendations of Enquiry Committee on grid disturbances on 30 & 31.7.2012

All the utilities were requested to update the information as per the letter enclosed at Annexure 18 with the Agenda of the 146th OCC meeting. The information has been submitted by NTPC(NCR), BBMB, Punjab, Rajasthan, THDC, HPGCL, NPCIL, POWRGRID (NR-2 & NR-1), POSOCO & NHPC has been received.

SE(O) NRPC stated that in the last NPC meeting the non-submission of this information was highlighted and a serious concern was shown regarding the same. Hence, he again requested all utilities other than mentioned above to submit updated status without any further delay.

15. Planning, procurement and the deployment of Emergency Restoration System.

The updated status as per the 154th OCC meeting is enclosed as Annexure – Agenda item no 15.

The guidelines have been issued vide which the Ministry of Power has directed that for 5000 ckt kms minimum 2 numbers of ERS are required (Annexure 16 of the MOM of the 150th OCC meeting).
All other utilities were again requested to review & update in view of the Annexure 16 of the MOM of the 150th OCC meeting.

16. Cleaning and Replacement of porcelain insulators

16.1 Northern Regional power transmission lines are exposed to the high pollution levels along their routes. Such pollution levels with the onset of the winter season, lead to the frequent trippings and finally to breakdown and long outages of the transmission lines. These outages make the grid weak, thereby endangering the grid reliability and security. Therefore, in order to avoid/mitigate trippings of lines during foggy (smog) weather in winter season, preventive actions like cleaning/washing of insulators, replacement to conventional insulators with polymer insulators has been recommended and are being taken every year.

16.2 It being a regular activity, all the transmission licensees in the Northern Region are being requested in monthly OCCM since the 148th Meeting to plan insulator replacement work from September 2018 onwards.
The meeting for cleaning and replacement work of conventional insulator was held on 15.10.2018. The minutes of the meeting stand issued vide letter dated 12.11.2018.

16.3 All utilities are requested to stick to the timeline as brought out in the meeting to mitigate fog related trippings during winter season and to ensure proper submission of data regarding progress of the cleaning/ replacement work in line with the discussions held in the meeting. It is stressed that the cleaning of porcelain insulators in the polluted/fog prone area also be taken up expeditiously.
The data as per MoM of the meeting stands submitted by POWER GRID (NR3), BBMB, DTL, HVPNL, PSTCL.

POWER GRID NR 1 submitted the data. POWERGRID NR 2 submitted that the replacement of porcelain insulators on all critical stretches stands completed. RRVPNL & UPPTCL were requested to submit information as per MOM issued, failing which outages for cleaning/replacement of insulator may not be approved. Further, all the utilities were requested to intimate the progress of the cleaning/ replacement work completed may also be intimated.

17. Cyber Security Preparedness Monitoring

In the **37th TCC and 40th NRPC meeting** held on 27th and 28th October, Chief Engineer IT, CEA and Chief Information Security Officer, MoP, Sh. Vijay Menghani, gave a detailed presentation on potential cyber threats for power sector, the agencies working on this aspect, recent incidents of cyber attacks on and the action points to prevent the cyber threat. It was stated that in view of increasing incidents of cyber-attacks and threat to the integrated grid operation, all utilities need to monitor action being taken in regard to the following points and report the status to respective Computer Emergency Response Teams (CERTs):

a. Appointment of organization-wise Chief Information Security Officers and its status.
b. Identification of organization-wise Critical Infrastructure and its status.
c. Preparation of organization-wise Crisis Management Plan and its status.
d. Status of Cyber Security Mock Drill activity in coordination with CERT-In.
e. Status of Training / Workshops on Cyber Security organized / participated by power sector entities.
f. Status of action taken on CERT-In / NCIIPC advisories.

The status of the information received from the following utilities:

NTPC, NHPC, Tata Power, THDC, PTCUL, NPCIL RAPS, NAPS, PSTCL, DTL, Rajasthan & PTCUL.

All other utilities (except from those mentioned above) were again requested to update.

POWERGRID was also requested to update regarding the guidelines they have to frame on CERT-In. He added that the guidelines once finalized will be followed by the STUs.

He added that NHPC & NTPC have prepared CERT-In for Hydro & Thermal generators.

18. Requirement of Data for the GIS based Energy map being developed by Energy division of NITI Aayog.

Geographical Information System (GIS) based energy map for India (https://vedas.sac.gov.in/powergis_main/index.jsp) is being implemented by NITI Aayog. This would provide true locations of all energy resources including power plants and transmission lines, etc. on a map of India which would be hosted on NITI Aayog's

website. CEA is a designated nodal agency for collecting power sector data and accordingly power utilities and DISCOMs were requested to submit the requisite data to CEA for onward transmission to NITI Aayog. The details required are - name, voltage level, capacity, longitude and latitude of all s/s of 33 kV and above; longitude and latitude of origin and terminating points of lines of 33 kV and above. DISCOMs and other power utilities are requested to submit the requisite data to CEA through cedpd-cea@gov.in email id at the earliest. The item is under follow up since the 147th OCC meeting held on 15.05.2018 at NRPC Secretariat, New Delhi.

All SLDCs except Punjab were again requested to take note and furnish the details at the earliest.

19. TTC assessment considering temperature dependent rating of lines/terminal equipment

For conducting studies in PSSE for assessment of inter control area transfer capability, POSOCO considers thermal ratings of lines as specified in CEA's 'Manual on Transmission Planning criteria- 2013' considering ambient temp. of 45^{o}C for terminal equipment ratings of both ends of the lines.

As there is a scope for considering temperature adjusted thermal ratings for these lines in the PSSE studies, NRCE has decided to finalize the methodology for computation of TTC/ATC/TRM taking into a/c variation in thermal capability of lines wrt variation of ambient temp.

Therefore, POSOCO is in the process of populating the temp. adjusted thermal ratings in these lines in the PSSE study case.

All STUs and transmission licensees are requested to furnish terminal equipment ratings at all lines at 400kV and above for fully implementing the temp adjusted TTC to ensure that there is no gap in security assessment. The matter is under regular follow up since 152nd OCC meeting, still no data is received so far.

SE(O) stated that no information has been received till date and he requested all STUs and transmission licensees for expeditious submission of information.

20. Expediting Construction of 132kV supply for railway traction substation for railway electrification projects in states in NR region.

Ministry of Railways has accorded high priority to railway electrification projects for reducing dependence on imported petroleum based fuel thereby enhancing energy security of nation. However, it is observed progress of ongoing transmission line and substation works being executed by SEBs is not matching with the targets for railway sections planned to be commissioned on electric traction. It is found that the work of transmission line for 31 traction sub stations (UP 19, Haryana 5, Punjab 1, and Rajasthan 5 & J&K 1) is yet to be completed. Further tender for transmission line work for 14 traction sub stations(UP 5,Haryana 2,Punjab 2, Rajasthan 5) is yet to be awarded and estimate for10 traction sub stations(UP 1,Punjab 2, Rajasthan 7) are yet to be received by Railways from respective SEBs. The details are enclosed at Annexure – Agenda item no 20 of the Agenda of the 154th OCC meeting.

SE(O) stated that early **commissioning of transmission line works and substation across the nation is required, so as to harness full potential of electrification**.

Members were requested to take up the matter with concerned utilities to expeditious completion of the transmission line works and substation and regularly update the progress of the work in monthly OCC meeting.

On deliberations it was observed that for expeditious action RAILWAY authorities should be request to present in detail the pending works.

MS NRPC agreed to the same and it was decided that in the next OCC meeting Railways representative would be invited to give the detailed presentation on the issues highlighted in the Annexure referred.

21. Problem of excessive vibrations in GTs of Rihand Stage – III and Vindhyachal Stage-IV during operation of Rihand - Dadri HVDC, on monopole mode with ground return.

148th OCC meeting:

NTPC representative highlighted as under:

- Shifting of 2x500MW Rihand Stage-III units (Unit# 5&6) from NR Grid to WR Grid through Vindhyachal Pooling Station was successfully done on 28th Nov' 17 with coordination in real time between POSOCO, NTPC and POWERGRID (WRTS-II).
- With Rihand stage-III units connected to Vindhyachal Pooling Station, problem of excessive vibrations in GTs of Rihand stage III (and Vindhyachal Stage-IV also) has been observed whenever Rh- Dadri HVDC is run on single pole in ground return mode. The observations during the period 27th Nov'17 to 5th March'18 at Rihand is enclosed in the attached sheet (ANNEXURE AA of the Additional Agenda OCC 148th Meeting).
- The issue was briefly discussed in the 142nd OCC Meeting against agenda point no 18 and where it was decided that system study was required to be done to further deal with this problem. Previous experience of NTPC in this regard was also sought which was subsequently provided to NRLDC by Rihand station.
- It is apparent that DC current passes through these GTs during above situation which is detrimental for the GTs and which may lead to their failure.
- It is therefore requested that a solution may kindly be arrived to deal with the above situation at the earliest.

The issue was deliberated in light of the discussions held earlier in the 142nd OCC meeting NTPC was requested to check transducer at Vindhyachal end as there was huge mismatch in MVAr and also get assessment of earthing system at Rihand done. Further it was decided that as per decision in the 38th TCC & 41st NRPC meeting the committee will look into resolving the issue.

Nominations from CEA, CTU/ POWERGRID, NTPC, POSOCO were received and the first meeting of the committee **(**Minutes attached at Annexure -Agenda item no. 21**)** was held prior to the 152nd OCC meeting.

154th OCC: NTPC and POWERGRID was again requested to submit all the information as requested during 1st meeting of the committee at the earliest.

22. Validity of OCC approved Outage for Availing actual Shut down

POWER GRID representative stated that as per existing practice the shutdown of planned nature, approved in one OCC are valid to be availed for next two months, depending on the site/ system constraints.

Recently NLDC rejected to consider the s/d approval for some 765kv bays & ICTs requested in early Dec'18, which were approved in 152nd OCC meeting for the month of Nov'18, this resulted in wastage of all the efforts mobilized for essential maintenance of Grid Equipment and loss in time and money as well.

It may please be appreciated that maintenance of grid elements is necessary for the safety and security of the grid network and we are committed for maintaining the healthiness of our grid network accordingly.

Necessary cooperation in facilitation of such shut down should therefore be extended from NRLDC/NLDC in the interest of system healthiness as per existing practice.

154th OCC: NLDC representative stated that procedure for "Transmission Elements Outage Planning" was approved in 30th TCC/ 34th NRPC meeting. NLDC representative stated that in the document in section 5.2 it is mentioned that "Indenting agency shall submit the proposed shutdown for NRLDC oversight transmission assets for the next calendar month latest by 8th day of the current month to NRPC Secretariat as per Format IA /Format IB."

MS, NRPC stated that a committee may be constituted with representative of POWERGRID, NLDC and NRLDC to resolve the issue at the earliest.

23. Islanding scheme of Delhi

Following the massive grid disturbance occurred in the grid on 30th & 31st July 2012, the Islanding Scheme was envisaged to take care of the essential load of Delhi in the event of occurrence of such events. The Islanding Scheme has been revised from time to time depending upon the load generation scenario. Revised Islanding Scheme of Delhi was discussed in detail in 32nd PSC held on 30.11.2016 and was found to be in order. The same was also approved in 35th TCC & 39th NRPC.

153rd OCC meeting:

POWERGRID intimated that the 400/220 kV Tughlakabad Substation stands commissioned and the necessary action can be taken for implementation of the revised islanding scheme. DTL representative stated that as per revised scheme the isolation is to be done now at Tughlakabad S/s. He added that the matter is being taken up with the OEM for providing the new panel. However, it will take 3-4 Months hence a temporary arrangement is proposed to be done in the relays of POWERGRID at Tughlakabad S/s so that the isolation can be done in case of any problem.

MS NRPC stated that the issue may be resolved at the earliest as December month is very crucial as Grid disturbance are expected in this period. He further added that the time frame in which the arrangement would be made be reported so that GM division can be intimated accordingly.

154th OCC meeting:

POWERGRID & DTL representative confirmed that on 17.12.2018 the work regarding the Islanding scheme stands completed at 400/220 kV Tughlakabad Substation.

MS NRPC stated that Mock Test should be planned in coordination with NRPC so that the report of the same can be send to GM division.

24. Electricity Generation Program FY 2019-20

State wise demand projection and generation outage plan for FY 2019-20 has been forwarded to OPM Division CEA. The same is attached as Annexure – Agenda item No. 24 of the Agenda of the 154th OCC meeting.

Members noted the information.

PART-B: NRLDC

1. Reliability issues in the grid

Rajasthan: NRLDC representative stated that in 153rd OCC meeting, suggestion based on simulation study was presented to lower the loading of 400kV Anta-Kota line. It was suggested that the main bays of Anta-Kota and Chhabra-Anta are kept open only at Anta substation so that the power flows directly from Chhabra to Kota bypassing Anta substation (through its tie-bay). Rajasthan SLDC had incorporated the same from 26th Nov'18 for few days and after that main bays at Anta station were again closed. It can be observed from the graph that the flow on Chhabra-Kota was in the range of 300-500 MW whereas, it was 600-900 MW on Anta-Kota **(Annexure-I).**

He added that 400kV and 220kV lines such as 400 kV Kota-RAPP C, 400 kV Kota-Merta and 220 kV Kota-Bhilwara lines have been opened on some occasions to control the loading on Anta-Kota line. This complex already has several reliability issues like N-1-1 non-compliance at 765 kV Anta-Phagi lines, N-1 compliance issue at 765/400 kV Phagi ICTs during high loading period. Hence, opening of 400 kV lines for power regulation at the time of high generation in this region may pose threat to the grid security. Apart from this, when Chhabra Supercritical is generating close to its full capacity (2*660MW), loading of 400kV Anta-Kota rises. Thus, there is need for more concrete solution to this issue of high loading of 400kV Anta-Kota.

Rajasthan representative stated that they had opened main bays of 400kV Anta-Kota and Anta-Chhabra lines for few days. However, during that time loading of 400kV Kawai-Chhabra was high (~500-600MW) especially under low generation at Chhabra. Therefore, they had again closed main bays at Anta Substation.

MS NRPC and NRLDC representative suggested that since loading on Kawai-Chhabra is not reaching very high limits (close to thermal limits) thus, main bays at Anta for 400kV Anta-Kota and Anta-Chhabra may be kept open. And, whenever loading of 400kV Kawai-Chhabra is nearing unsafe limits then the main bays can be closed depending on real-time conditions. Rajasthan SLDC representative agreed to implement this suggestion.

NRLDC representative stated that few other suggestions were provided by Rajasthan SLDC and these shall be taken up with STU. MS NRPC stated that Rajasthan can bring those suggestions in next OCC and then those can be further taken up in standing committee meetings.

Issue of N-1 non-compliance at 765/400kV Phagi ICTs, 400/220kV Jodhpur ICTs, 400/220kV Merta ICTs and only single ICT at Rajwest, Chhabra and Kalisindh was highlighted. ***Rajasthan representative informed that tender has been placed for 3rd ICT at Phagi.***

UP: Commissioning of **765kV Bara-Mainpuri ckt 1** needs to be expedited. Commissioning of **765kV Hapur-Mainpuri** line would provide additional evacuation path for 765kV Mainpuri (apart from 765kV Mainpuri- G. Noida) under N-1 contingency of 765/400 ICT at Mainpuri and hence needs to be expedited.

Early commissioning of **765kV Anpara D-Unnao S/C** would help to reduce the loading of 400kV Anpara-Sarnath D/C, Anpara-Obra & Anpara-Mau.

N-1 non-compliance at Azamgarh ICTs

2. Deviation by NR states

It has been discussed in number of previous meeting that load forecast should be carried out accurately and subsequently states shall plan their load generation balance so that deviations remain within permissible limits in real time. Deviation of NR utilities is being shown in every OCC meeting to sensitize the issues on regular basis still it has been observed that NR utilities are continuously over/under drawing from the Grid on various instances. Deviation violations (average number of blocks of overdrawl/ underdrawl) for the month of July-November 2018 were presented in the meeting (attached as **Annexure-II)** along with deviations observed based on SCADA data.

NRLDC representative highlighted that there was significant improvement in average number of blocks for overdrawl in HP. There was also slight improvement (reduction) in overdrawl/ underdrawl deviations by other states. However, this needs to be further improved upon.

MS NRPC added that zero crossing violations are high and utilities shall plan to reduce them. He added that with new IEGC amendment these violations would increase if no steps are taken by utilities.

OCC agreed that more concrete actions are required by states for restricting overdrawl/ underdrawl and thus better grid management.

3. Requirement of power flow and dynamics data for modeling of units as per various CEA /CERC regulations

NRLDC representative stated that it is well known that many new renewable (solar and wind) generators are being commissioned especially in Rajasthan state control area. Although details about capacity of solar and wind generators connected have been provided by Rajasthan, but for modelling the same, generator parameters are also required. Performance of wind generators during dynamic conditions including low voltage ride-through could also be tested using simulation. NRLDC representative explained format regarding what type of data would be required for power flow as well as dynamic modelling of renewable generators. Format attached as **Annexure-III.**

MS NRPC stated that renewables are being integrated at fast pace in the grid and therefore proper studies to assess its impact on the grid operation becomes very important. Thus, it is necessary to model the same and hence respective SLDCs(especially Rajasthan)/ utilities shall expedite gathering of data from RE

developers and submit it to NRLDC possibly within one month so that due consideration for impact of RE generators is taken into account.

NRLDC representative stated that dynamic modelling of system to understand system behavior for present and future scenarios is very important. For development of proper models, complete and accurate dynamic data of all generators is required. Further, dynamic data is required for simulating different scenarios to understand the dynamic response of the system. Status of present data at NRLDC submitted by generators was attached as Annexure in 154th OCC agenda.

With regard to data available at NRLDC, utilities were requested to submit any additional information available with them to NRLDC/NRPC as soon as possible for compliance to CEA/CERC regulations. If there are any changes to model parameters for Exciter, Governor & Stabilizer that also may be intimated. OCC agreed for the same.

4. SCADA display for monitoring of temperature and humidity from stations

NRLDC representative stated that weather monitoring has been very significant in assessing the forecasted load in short term / long term period basis and therefore helps in better load portfolio management. During winter, sudden rainfall, snowfall, hailstorm, fog, cold wave etc. is very common phenomena and these directly affect the load pattern. Therefore, weather monitoring is a good indicator for load behavior and helps in forecasting the load. IMD developed dedicated website for Northern region (link: http://amssdelhi.gov.in/NRLDC/main/MAIN.html) is highly effective in weather monitoring and can be utilized by utilities.

In previous three OCC meetings, it was highlighted that SLDCs/ RLDC are having SCADA display for monitoring of temperature and humidity from stations. However, temperature and humidity data from most of the stations is not available or either suspect. Telemetry has improved for some Powergrid stations but data from state substations is yet to be corrected. The temperature and humidity data is especially useful during winter months to identify fog affected areas and becomes critical considering upcoming highly fog prone weeks in Northern region. It was highlighted that generally relative humidity >80% and temperature <10°C is considered as fog-prone condition of the area. Telemetry of temperature and humidity available at NRLDC was attached as Annexure-5 of NRLDC agenda.

MS NRPC asked utilities to take steps to ensure correct and reliable temperature and humidity data at NRLDC/SLDCs.

5. Reactive power management in the grid

i. *Reactor utilization:*

Utilities were requested to confirm whether line reactors can be used as bus reactor in 151st, 152nd and 153rd OCC meeting as well; however, information is only received from **POWERGRID NR-1, NR-2, NR-3, Rajasthan, JSW, NHPC**. **Other constituents were**

also requested to confirm the same as soon as possible to utilize it for voltage regulation.

Further, it was discussed that since in winter months high voltages are observed frequently and many lines are opened for voltage regulation. So, utilities shall try to ensure that line reactors which can be charged as bus reactor are taken in service under outage of line.

NRLDC representative added that list of lines that may be/ are opened to control high voltages where the provision of using line reactor as bus reactor could be extended was attached as Annexure of OCC agenda (prepared based on data available at NRLDC).

MS NRPC suggested that for these list of lines, utilities shall assess feasibility of providing facility of using line reactor as bus reactor under outage of line at individual utility level and then shall put the proposal for approval in the standing committee meeting. POWERGRID NR-1 representative stated that they have explored options of using line reactor as bus reactor at all stations in Northern region.

ii. Reactive power performance of generators

NRLDC representative stated that in 153rd OCC, it was agreed that:

- States shall develop MVAr vs voltage plots for generators under their jurisdiction.
- Work to improve telemetry of MVAr data

Graphs submitted by NTPC for Dadri Thermal stations were presented in the meeting. ***MS NRPC suggested that based on graphs it seems that units are absorbing MVAr above 420-425kV while generating MVAr below 420-425kV. However, considering the high voltage period in Northern region more absorption of MVAr by units within its capability limit is required. NTPC Dadri representative agreed to look into the matter.***

NRLDC representative stated that in 153rd OCC meeting MS NRPC had suggested that MW vs MVAr plots for generators alongwith Voltage vs MVAR plots be developed so that their operation based on capability curve be also assessed. MW vs MVAR and Voltage vs MVAR graph for units of Talwandi Saboo and Rihand were presented in the meeting. He added that similar exercise would be carried out for all other generators as well.

From the plots for Talwandi Saboo station it seemed that units are absorbing MVAr above 420kV and generating MVAr below 420kV. Units are operating well-within capability curve limits and absorbing MVAR most of the time. From the plots for Rihand station it seemed that units are absorbing MVAr above 400kV and generating MVAr below 400kV. Units are operating well-within capability curve limits and absorbing MVAR most of the time.

Reactive power response of other generators in respect of MVAr vs Voltage for past 30 days as per NRLDC SCADA data were presented in the meeting (attached as **Annexure-IV)**.

NRLDC representative stated that generators (specially those under state control) need significant improvement in reactive power response as per its capability curve. In addition, telemetry (sign and magnitude of MVAR) of various generating station is yet to

be corrected. The matter has been discussed in numbers of OCC/TCC meetings, still actions are to taken.

MS NRPC stated that states and generators shall also develop MVAr vs voltage plots at their end and take actions to provide better MVAr response. OCC agreed for the same.

6. Frequent forced outages of transmission elements

NRLDC representative highlighted that the following transmission elements were under frequent forced outages during the month of **Nov'18**:

S. NO.	Element Name	No. of forced outages	Utility/SLDC
1	765 kV Meerut(PG)-Moga(PG)	5	POWERGRID
2	400 kV Aligarh(UP)-Panki(UP)	3	UP
3	400 kV Anpara(UP)-Obra(UP)-Sultanpur(UP)	3	UP
4	400 kV Azamgarh(UP)-Gorakhpur(UP)	3	UP
5	400 kV Bareilly(UP)-Unnao(UP) ckt-1	3	UP
6	400 kV Chamera II(NHPC)-Kishenpur(PG)	3	POWERGRID/NHPC
7	400 kV Kishenpur(PG)-New Wanpoh(PG) ckt-1	3	POWERGRID

The complete details were attached at Annexure-8 of NRLDC Agenda**.** The frequent outages of such elements affect the reliability and security of the grid. Hence, Utilities were requested to look into such frequent outages and share the remedial measures taken/being taken in this respect.

The following were the discussion on the trippings:

- 765 kV Meerut(PG)-Moga(PG): POWERGRID representative informed that due to PLCC problem leading to DT received and driver issue in Reactor the line tripped multiple times. He stated that the problems have been rectified. NRLDC representative also asked about the outage occurred on 18-Nov-18 at 19:50hrs in which no fault was observed as per PMU data. POWERGRID representative stated that the information related to this would be provided.
- 400 kV Aligarh(UP)-Panki(UP): UP representative informed that bus bar protection at Aligarh is out of service. NRLDC representative requested UP to bring bus bar protection in service at the earliest. Further, any such outage needs to be reported to SLDC/RLDC.
- 400 kV Anpara(UP)-Obra(UP)-Sultanpur(UP): NRLDC representative informed that as per PMU data, line didn't auto-reclose in all three tripping incidents. UP was requested to look into the changes in protection setting which were to be done after bypassing Obra(UP) station.
- 400 kV Azamgarh(UP)-Gorakhpur(UP): UP representative informed that auto-reclosing is not working at Gorakhpur(UP). The panel is being replaced. NRLDC representative requested UP to enable auto-reclosing feature at Gorakhpur(UP) at the earliest and inform the date by which the the same would be enabled.
- 400 kV Bareilly(UP)-Unnao(UP) ckt-1: UP representative inform there was some over voltage problem in the line which has been rectified. NRLDC representative requested UP to look into the reason and rectification of auto-reclosing and PLCC problem also as reported in other two incidents.

- 400 kV Chamera II(NHPC)-Kishenpur(PG): NRLDC representative requested POWERGRID to provide details w.r.t. the tripping.
- 400 kV Kishenpur(PG)-New Wanpoh(PG) ckt-1: POWERGRID representative informed that there is crossing of 220kV Kishenpur-Mirbazar line under the LiLo portion of 400kV Kishenpur-Wanpoh ckt. The earth wire of 220kV Kishenpur-Mirbazar creates spark though galloping under snow. Last year the earth wire was loosened to avoid such incidents. However, after that OPGW stringing the problem again occurred. The earth wire is again loosened.

NRLDC representative requested all the constituents to provide time for all the remedial measure to be adopted for mitigation of such tripping incidents. Members agreed to the same.

7. Multiple element tripping events in Northern region in the month of Nov'18:

A total of **14** grid events occurred in the month of Nov'18 of which **3** are of GD-1 category. The preliminary report of all the events was issued from NRLDC. A list of all these events along with the status of details received by 06-Dec-18 was attached at Annexure-9 of NRLDC Agenda**.**

Maximum Fault Duration was **4000ms** in the event of multiple element tipping at Aligarh(UP) substation on 06th Nov 2018 at 18:13hrs.

Delayed clearance of fault (more than 100ms for 400kV and 160ms for 220kV system) observed in total **4** events out of 14 events in the month.

NRLDC representative stated that the compliance of reporting details of events has improved but is still below the desired level. He showed and stated that no information received from Haryana, NTPC, Greenko, NPCIL, HP and Uttarakhand.

Members were requested to take expeditious actions to avoid such tripping in future. Moreover, utilities were requested to impress upon all concerned for providing the Preliminary Report, DR/EL & Detailed Report of the events in line with the regulations.

8. Details of tripping of Inter-Regional lines from Northern Region for Nov'18:

NRLDC representative highlighted that a total of **3** inter-regional lines tripping within a month occurred in the month of Nov'18. The list was attached at Annexure-10 of NRLDC Agenda. The status of receipt of preliminary reports, DR/EL within 24hrs of the event and fault clearing time as per PMU data has also been mentioned in the table. The non-receipt of DR/EL & preliminary report within 24hrs of the event is in violation of various regulations. As per regulations, all the utilities shall furnish the DR/EL, flag details & preliminary report to RLDC/RPC within 24hrs of the event. They shall also furnish the detailed investigation report within 7 days of the event if fault clearance time is higher than mandated by CEA (Grid Standard) Regulations.

It could be observed from attached table that no information was received from Rajasthan w.r.t. tripping of 220kV Sakatpura-Badod. Further, in other two trippings, DR/EL received from POWERGRID. However, Preliminary report was not received. NRLDC representative mentioned that as pointed out in 153rd OCC meeting, the DR/EL are being received from constituents mainly due to SoPR reporting. However, preliminary reports are still not being sent for all the events by the constituents.

NRLDC representative appreciated the improved reporting and further requested constituents to provide the Preliminary report also for multiple element, inter-regional tripping incident.

9. Mock black start exercise in NR:

As per Indian Electricity Grid Code (IEGC) clause 5.8(b) "Mock trial runs of the procedure for different sub-systems shall be carried out by the Users/ CTU/ STU at least once every six months under intimation to the RLDC".

Mock Black-start exercise of power stations therefore needs to be carried out in-order to ensure healthiness of black start facility. The winter months are off peak hydro period and therefore good time to carry out such exercises.

NRLDC representative presented the following schedule of mock exercise:

Hydro Power Stations:

Date	Revised Date	Name of stations	Remarks
18-Oct-18	NA	Kishanganga (new plant)	NHPC reported to intimate date separately. It is proposed to carry out the exercise with Uri, L.Jhelum, Pampore and U. Sindh.
24-Oct-18	NA	Malana-2	Exercise was not successful. It is proposed to carry out the exercise again with AD Hydro.
26-Oct-18	15-Jan-19	Dhauliganga	Revised date by NHPC
2-Nov-18	NA	Salal	Exercise carried out successfully. However, due to less load on account of bad weather, frequency kept on varying and island could not be synchronized with grid.
13-Nov-18	21-Jan-19	Nathpa Jhakri & Rampur	Revised date by SJVNL
16-Nov-18		*Uri-I, II HEP, Lower Jhelum HEP, Pampore GT's & Upper Sindh	To be carried out after 15-Dec-18 due to load management by J&K and shutdown of 400kV Amargarh-Uri-1 ckt-2.
19-Nov-18		Budhil	To be carried out after 15-Dec-18.
28-Nov-18		Chamera-3	To be carried out after 15-Dec-18 as per Chamera-3 request.

30-Nov-18	6-Dec-18	Sewa-2	NHPC confirmed. Date revised by J&K. Exercise was partially successful. Unit went under emergency stop twice.
3-Dec-18	NA	Chamera-1 & Chamera-2	Exercise was partially successful. Large variation in frequency observed in islanded operation with Chamera-1. Chamera-2 unit could not be able to synchronize to the island.
11-Dec-18	19-Dec-18	Parbati-3	NHPC confirmed. HP revised the date. To be carried out after 15-Dec-18. Proposed date 19-Dec-18.
14-Dec-18		Bairasiul	As reported by NHPC, Power House shall be under complete shutdown since 01/10/2018 for R&M of power house.
19-Dec-18	20-Dec-18	Koteshwar	
28-Dec-18		AD Hydro	
4-Jan-19		Tehri	
8-Jan-19		Karcham Wangtoo & Baspa	
11-Jan-19		Koldam	

** Mock black-Start exercise not carried out during Year 2017-18.*

NRLDC representative stated that this season also, the adherence to the schedule by the generating utilities is not much which has resulted into concentration of mock blackstart exercises in the latter part of the winter season. It was again requested to the utilities that any change in schedule to be informed well in advance.

NHPC representative stated that the collective blackstart exercise of Uri-I, II HEP, Lower Jhelum HEP, Pampore GT's & Upper Sindh HEP can be carried out in January-2019. In respect of Kishanganga HEP, he stated that as the plant is new, first mock exercise is planned in presence of OeM (BHEL). The date for the same would be communicated after confirming with OeM. NRLDC representative stated that since the above power plants fall in J&K area, due to proper coordination with J&K utilities, the tentative date needs to be provided well in advance and adhered to.

Mock black start exercise of Gas power stations viz. Auraiya, Dadri, Anta also to be carried out. NTPC representative reported that the block load needs to be identified by SLDC/RLDC near the generating station. NRLDC/SLDC agreed to the same.

SLDC's were requested in 152nd, 153rd and 154th OCC meetings to carryout mock black-start of station in their respective control area & inform the tentative dates to the OCC as well as outcome of these exercises. During last winter, SLDCs had been requested to carry out mock drills and share their experiences. However, the information was received from HP (Sainj, Baspa) and Rajasthan (only schedule of exercises) only.

The following information was reported by SLDCs w.r.t the proposed Hydro Power Stations to undergo the exercise:

S. NO.	Utility	Hydro Power Station	Installed Capacity(MW)	Tentative Date as reported by SLDC
1	J&K	Baglihar	3x150	
2		Baglihar stage-2	3x150	
3		Lower Jhelum	3x35	
4		Upper Sindh	2x11+3x35	
5	HP	Sainj	2x50	In coordination with NRLDC
6		Larji	3x42	Jan-19
7		Bhabha	3x40	
8		Malana -I	2x43	Jan-19
9		Baspa	3x100	To be clubbed with Karcham
10	Punjab	Anandpur Sahib	4x33.5	
11		Ranjit Sagar	4x150	
12	Rajasthan	Mahi-I&II	2x25+2x45	Mar-19
13		Rana Pratap Sagar	4x43	Mar-19
14		Jawahar Sagar	3x33	
15		Gandhi Sagar	5x23	
16		Dholpur GPS	3x110	Plant under outage
17		Ramgarh GPS	1x35.5+2x37.5+1x110	
18	UP	Rihand	6x50	Carried out in Aug-18. Report to be submitted
19		Obra	3x33	Plant under outage
20		Vishnuprayag	4x100	
21		Srinagar (Alaknanda)	4x82.5	
22	Uttarakhand	Gamma Infra	2x76+1x73	
23		Shravanti	6x75	
24		Ramganga	3x66	
25		Chibro	4x60	
26		Khodri	4x30	
27		Chilla	4x36	
28		Maneri Bhali-I&II	3x30+4x76	
29	Delhi	IP Extn GTs	6x30+3x30	
30		Pragati GPS	2x104.6+1x121.2	
31		Rithala	3x36	
32	Haryana	Faridabad GPS	2x137.75+1x156.07	Shared the procedure

SLDCs were requested to inform about the schedule of remaining plants and provide the complete report of the exercise after carrying out the same.

10. Revision of document for Reactive Power Management and System Restoration Procedure for Northern Region:

Reactive Power Management document and System Restoration Procedure for Northern region is due for revision. The last updated document link has already been shared with the constituents.

In 153rd OCC meeting, constituents were requested to provide feedback, suggestion and updated information by 15th December 2018.

Constituents were requested to go through the document and provide any modification/addition in respect of their system. SLDC/Generating utilities were also requested to update and share the restoration procedure in respect of their state/generating station. The updates were requested to be sent be sent by 15th December 2018.

The following status of details received till 18-Dec-18 was shown:

Reactive Power Document		
Data Received from	Data Not received from	
THDC	Malana-II	J&K
Rosa-Reliance	Adani	APCPL
NHPC	UP	JAYPEE
POWERGRID NR-1	Delhi	POWERLINK
POWERGRID NR-2	NTPC	PKTCL
POWERGRID- NR3	Punjab	Shree Cement
Rajasthan	Railway	SJVNL
AD Hydro	Haryana	Others…
Greenko Budhil	Uttarakhand	
Karcham (JSW)	BBMB	
Malana-I	Chandigarh	
	Haryana	
	NPCIL	
	HP	

System Restoration Procedure		
Data Received from	Data Not received from	
NHPC	Delhi	SJVN
THDC (Tehri)	Rajasthan	HP
	Rosa (Reliance)	J&K
	Greenko Budhil	Malana-I
	NTPC	JAYPEE
	POWERGRID	POWERLINK
	Railway	PKTCL
	UP	Shree Cement
	BBMB	Karcham (JSW)
	Chandigarh	AD Hydro
	APCPL	Malana-II
	Adani	Uttarakhand
	Haryana	Punjab
	NPCIL	Others…

Members were again requested to provide the details w.r.t. updation of documents at the earliest.

Extra Points discussed during 154th OCC meeting:

Additional Points:

Frequency Response Characteristics (FRC):
NRLDC representative presented the information w.r.t. calculation of FRC in a control area. The following points were also discussed:

- Hon'ble CERC in its order in petition 47/MP/2013 dated 03-May-13 approved the "Procedure for Assessment of Frequency Response Characteristic (FRC) of Control Areas in Indian Power System".
- Hon'ble CERC in above order directed POSOCO to give wide publicity to the procedure for information of and compliance by all concerned.
- Generally, a sudden load/generation change of 1000MW or sudden frequency change of 0.1Hz in the grid is considered as an FRC event.
- NRLDC sends calculated FRC to constituents upon occurring of any such event.
- SLDC to provide the details of FRC within one week to RLDC.

Members acknowledged the presentation and agreed to calculate the FRC of their respective control area upon occurring of FRC based event and provide details to SLDC/RLDC.

11. Multiple element tripping at 400 kV Dadri TPS and tripping of HVDC Rihand-Dadri Pole-2:

NRLDC representative stated the following:

- As reported, B-N (LG fault) fault followed by R-Y phase to phase ground fault (LLG fault) occurred very near to gantry of the Dadri end of 400 kV Dadri-G. Noida line and Dadri-Maharani Bagh line on 08th December 2018, at 17:41:22 and 17:41:27 Hrs respectively.
- In antecedent condition 400 kV Maharani Bagh-Ballabhgarh ckt and G. Noida-Nwada ckt was already under shutdown and 400 kV Dadri-G. Noida ckt was in Non-auto mode due to ongoing work on OPGW wire.
- At 17:41:22hrs, 400 kV Dadri-G. Noida ckt tripped. Z-3 start in 400 kV Dadri-Maharani Bagh and Z-2 start in 400 kV Dadri-Mandaula ckts.
- At 17:41:27hrs, 400 kV Dadri-Maharani Bagh ckt tripped. Along with Dadri-Maharani Bagh, 400 kV Dadri-Mandaula ckt-1 & 2 also tripped.
- HVDC Rihand-Dadri Pole-2 also blocked on excessive delay angle protection. (protection send blocking command if alpha angle is more than 40 degrees for 10 second or more)
- Because of blocking of Pole-2, HVDC Rihand-Dadri SPS case-2 (load reduction more than 500 MW) also operated and resulted into load shedding in C& D load group.
- In Punjab, rate of change of frequency (RoCoF) protection operated and resulted load shedding in Punjab control area. (more than 500MW load loss on account of SPS and df/dt operation)
- In recent past, number of tripping has increased due to snapping of OPGW wire or during maintenance of earth wire/ OPGW wire. Utilities shall take special precautions in this regard.

- Shutdown of 400 kV Maharani Bagh-Ballabhgarh ckt and 400 kV G.Noida-Nwada was extended for more than 22 days from its approved time. It is serious cause of concern and NRLDC already wrote a letter to POWERGRID.
- Load relief for load group C&D in case of SPS operation of HVDC Rihand-Dadri Pole-II was very low compare to planned load shedding of 520MW.
- Unwanted operation of RoCoF protection in Punjab is cause of concern as it is a clear failure of last defence mechanism.

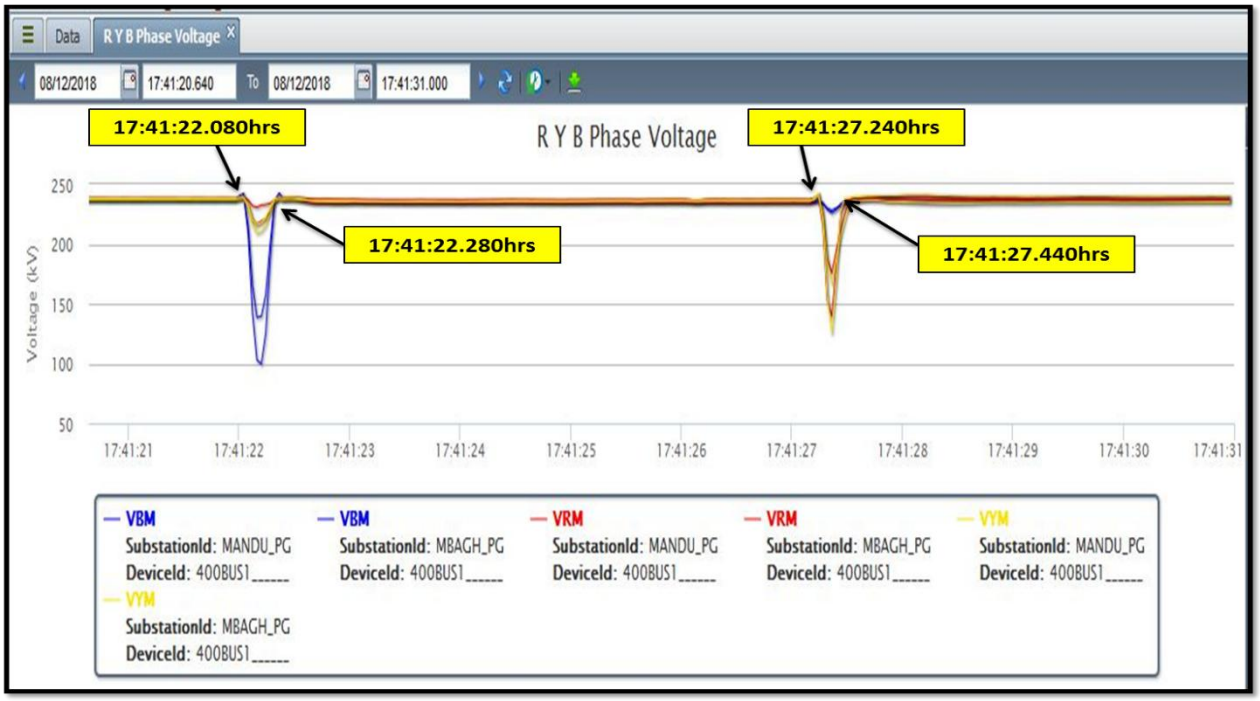
The PMU plot and NRLDC SCADA data and SoE are as follows:

PMU Plot of frequency at Mandaula(PG)

17:41hrs/08-Dec-18

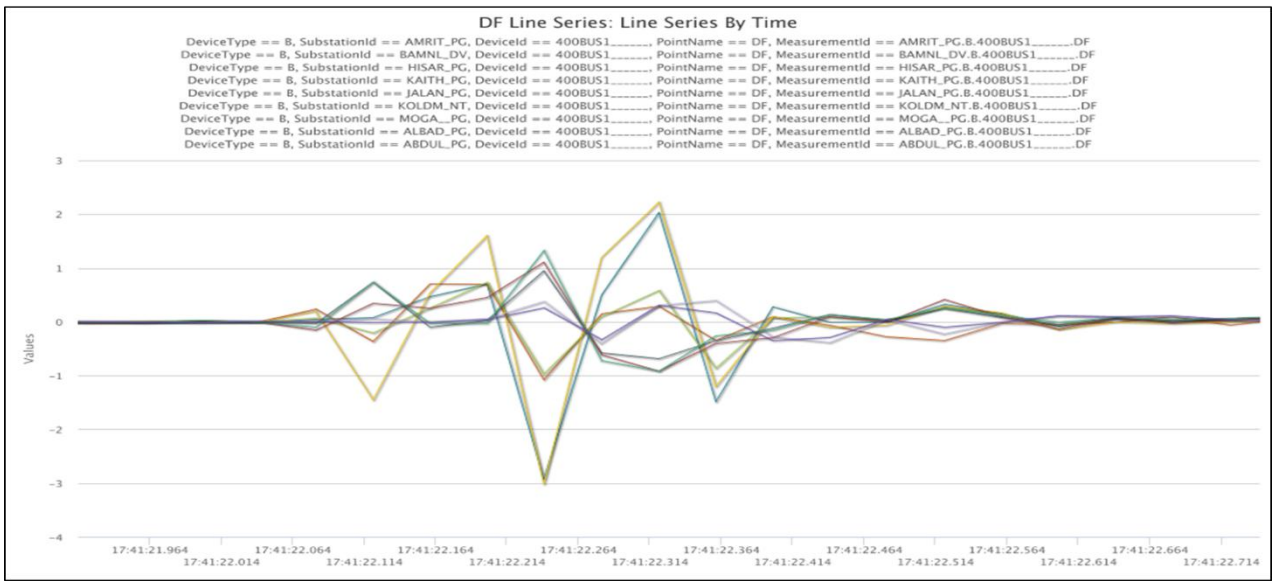
PMU Plot of phase voltage magnitude at Maharani Bagh(PG)

17:41hrs/08-Dec-18

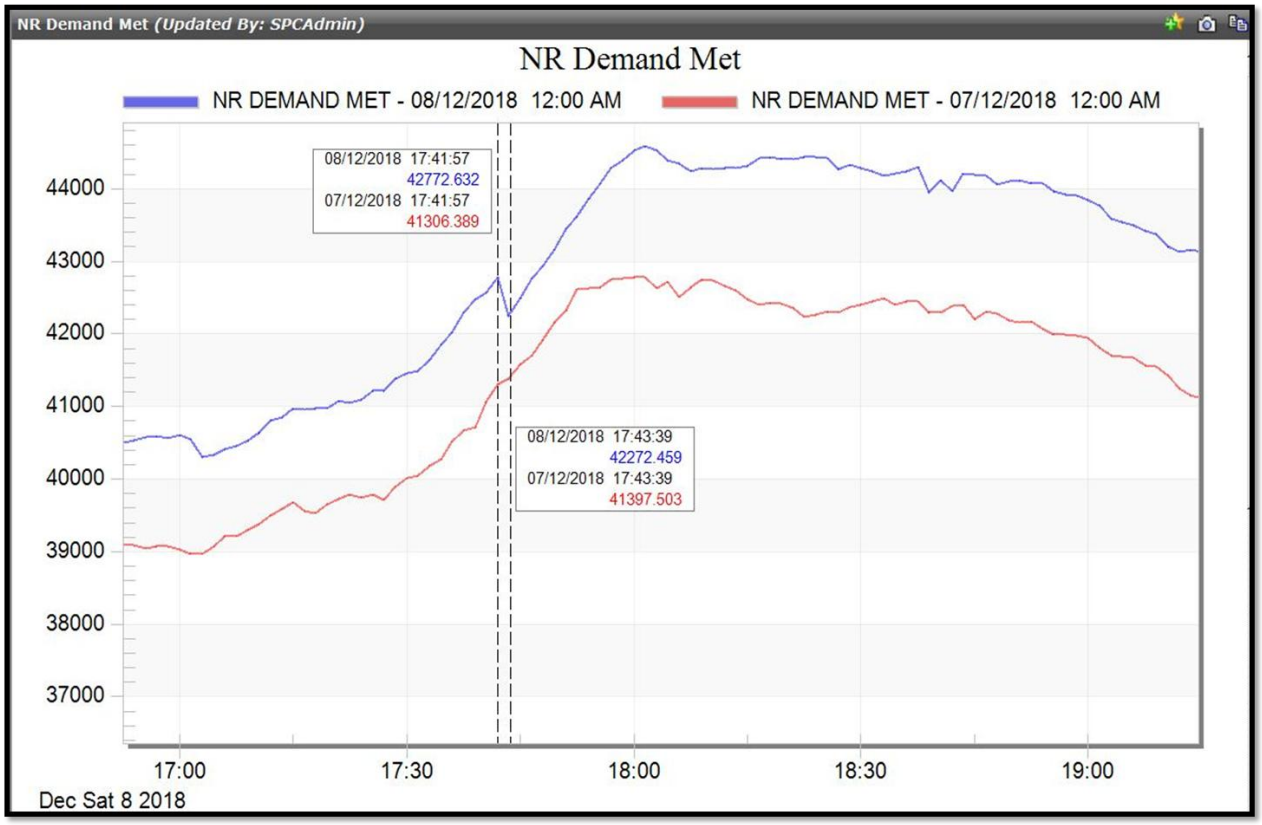


PMU Plot of df/dt

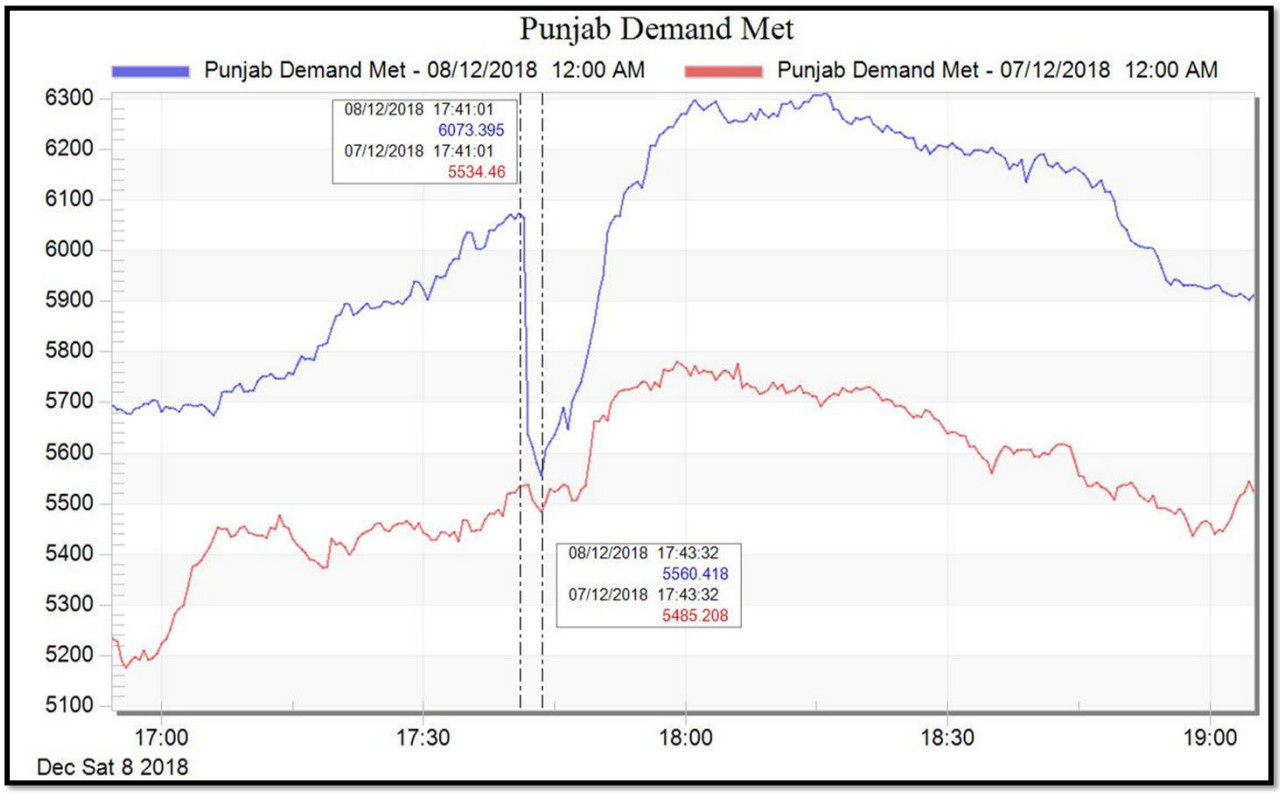
17:41hrs/08-Dec-18



NR demand met



Punjab demand met



Time	Station Name	Voltage Level (in kV)	Element Name	Element Type	Status
17:41:12,408	DADRI (TH)	400kV	21GNODA1	Circuit Breaker	Open
17:41:12,408	DADRI (TH)	400kV	20GN1MA2	Circuit Breaker	Open
17:41:17,589	DADRI (TH)	400kV	24HARSH2	Circuit Breaker	disturbe
17:41:17,608	DADRI (TH)	400kV	23MB1HR2	Circuit Breaker	Open
17:41:17,613	DADRI (TH)	400kV	22MBAGH1	Circuit Breaker	Open
17:41:23,054	PREET_D	220kV	07T2	Protection Trip	App
17:41:23,054	PREET_D	33kV	13T2	Circuit Breaker	Open
17:41:23,055	PREET_D	220kV	07T2	Circuit Breaker	Open
17:41:23,173	DADRI (TH)	400kV	BB2	Loss Of Voltage	Disp
17:41:26,126	DADRI_UP	132kV	D_03(DADRI-1)	Circuit Breaker	Open
17:41:27,326	MANDAULA	400kV	21DTHM1	Circuit Breaker	Open

Constituent Details are as follows:

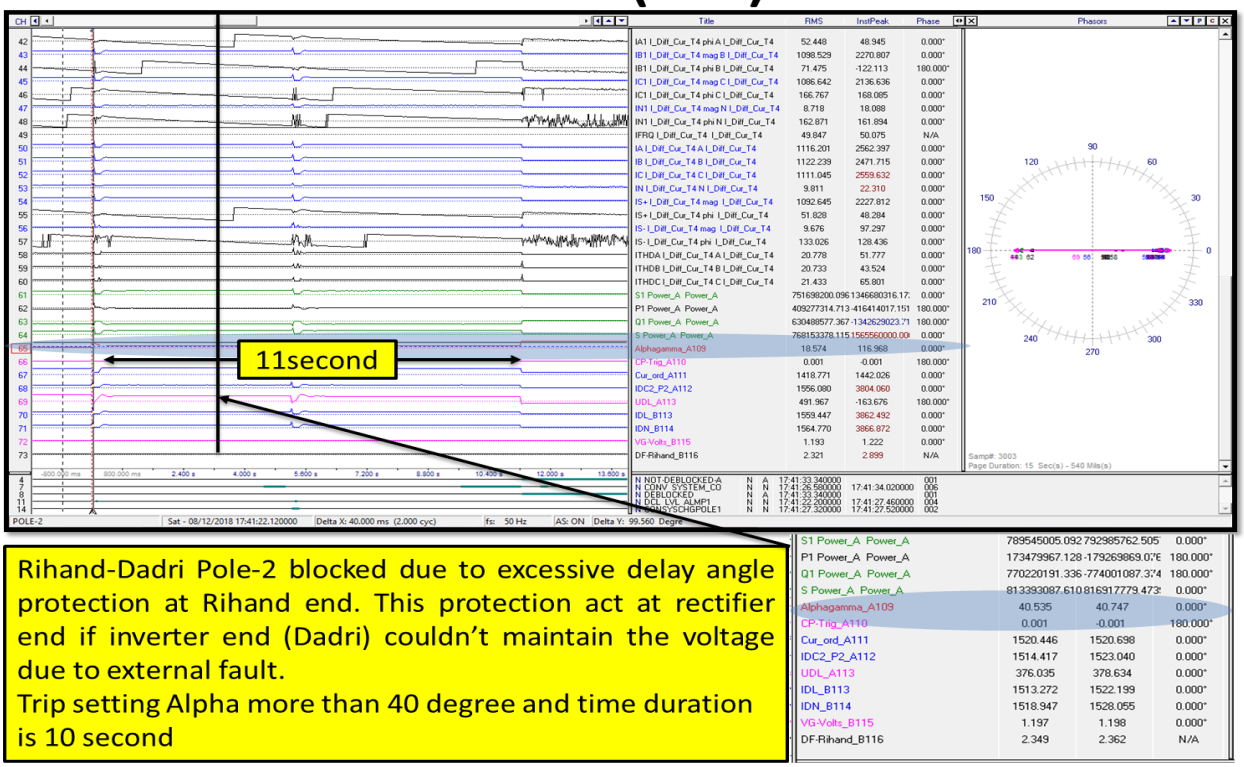
Vibration details of Dadri stage-II units

Record of Dadri Unit Vibrations with Fault in the system

S.No.	Date	Time	Line Tripped	Max. Voltage Dip (PMU/ DR details)	Nature of fault	Generation		Unit Displacement(in micron)			
						Unit-5	Unit-6	Unit-5		Unit-6	
24	08.11.2018	17:01 hrs	NO Line Disturbance Found	Not triggered			287			6Y- 26 to 130	7X 171 to 235
25	26.11.2018	1.55 hrs	Dadri -Greater noida line & Panipat 2 line tripped	Not triggered		310	309	6Y 14 to 71	6Y 28 to 108	6Y- 26 to 82	6X 28 to 103
26	27.11.2018	20:39:15 hrs	NO Line Disturbance Found				446			7Y- 30 to 114	7X 171 to 240
27	04.12.2018	3:07:44	Dadri-Panipat-1 & 2			300	288	6X 17 to 41	6y 29 to 47	6Y- 25 to 59	6X 28 to 70
28	08.12.2018	17:41	Greater Noida & Maharani bagh line tripped			396	416	6X 75 to 192	6y 39 to 190	6Y- 82 to 186	6X 185 to 207

UNIT#5				UNIT#6			
BUS VOLTAGE	Field current	STATOR CURRENT	STATOR VOLTAGE	BUS VOLTAGE	Field current	STATOR CURRENT	STATOR VOLTAGE
431 to 345 kv	1998 to 1792 amp	8.4 to 11.6 KA	21.2 to 19.3kv	426 to 350kv	1437 to 1339amp	8.45 to 13.14KA	21.08 to 19.95 kv
				NO CHANGE		NO CHANGE	NO CHANGE
				NO CHANGE	1255 to1343	NO CHANGE	NO CHANGE
415 to 398kv	3429 to 2822amp	10.91 to 13.50KA	17.84 TO 21.67kv	414 to 191kv	2120 to 977amp	11.69 to 16.15KA	21.18 to 20.01

DR of HVDC Rihand (end)-Dadri Pole-2



Rihand-Dadri Pole-2 blocked due to excessive delay angle protection at Rihand end. This protection act at rectifier end if inverter end (Dadri) couldn't maintain the voltage due to external fault.
Trip setting Alpha more than 40 degree and time duration is 10 second

EL of HVDC Rihand (end)-Dadri Pole-2

TIME	EVENT		
08-12-2018 17:41:28.842	10.078 KPP.11, P1 PC, RUNCBACK CONTROL,RUNBACK LIMIT ACTIVATED	5487/5512	-WARN OFF
08-12-2018 17:41:28.861	20.078 KPP.21, P2 PC, RUNCBACK CONTROL,RUNBACK LIMIT ACTIVATED	9487/9512	-WARN OFF
08-12-2018 17:41:28.947	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910	-MINOR OFF
08-12-2018 17:41:28.985	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR ON
08-12-2018 17:41:29.197	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910	-MINOR ON
08-12-2018 17:41:30.735	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR OFF
08-12-2018 17:41:31.734	21.043 KPB.21, P2 CC-A CP-B, EXC DEL ANGLE PROT, CHANGEOVER	10176/10240	-MINOR ON
08-12-2018 17:41:31.738	21.076 KPB.22, P2 CC-A,CONVERTER CONTROL OTHER SYSTEM ACTIVE	10179/10274	-SET
08-12-2018 17:41:31.738	22.076 KPB.25, P2 CC-B,CONVERTER CONTROL OTHER SYSTEM ACTIVE	10379/10474	-RESET
08-12-2018 17:41:31.808	22.043 KPB.24, P2 CC-B CP-B, EXC DEL ANGLE PROT, CHANGEOVER	10376/10440	-MINOR ON
08-12-2018 17:41:31.843	21.043 KPB.21, P2 CC-A CP-B, EXC DEL ANGLE PROT, CHANGEOVER	10176/10240	-MINOR OFF
08-12-2018 17:41:32.827	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910	-MINOR OFF
08-12-2018 17:41:33.088	30.053 KB.11, BC-A, VOLT & REAC POWER CONTROL ALARM (MON-1)	4512.6/3388	-MINOR ON
08-12-2018 17:41:33.112	30.069 KB.12, BC-B, BIPOLE CONTROL-B ACTIVE	4512.8/3656	-RESET
08-12-2018 17:41:33.113	30.057 KB.11, BC-A, BIPOLE CONTROL-A ACTIVE	4512.6/3656	-SET
08-12-2018 17:41:33.148	30.044 KB.12, NO BIPOLE CONTROL SYSTEM STANDBY	4512.4/3656	-MINOR ON
08-12-2018 17:41:33.150	30.044 KB.12, NO BIPOLE CONTROL SYSTEM STANDBY	4512.4/3656	-MINOR OFF
08-12-2018 17:41:33.152	30.044 KB.12, NO BIPOLE CONTROL SYSTEM STANDBY	4512.4/3656	-MINOR ON
08-12-2018 17:41:33.154	30.044 KB.12, NO BIPOLE CONTROL SYSTEM STANDBY	4512.4/3656	-MINOR OFF
08-12-2018 17:41:33.157	30.044 KB.12, NO BIPOLE CONTROL SYSTEM STANDBY	4512.4/3656	-MINOR ON
08-12-2018 17:41:33.312	22.044 KPB.24, P2 CC-B CP-B, EXC DEL ANGLE PROT, Y-BLOCK	10376/10440	-EMERGN ON
08-12-2018 17:41:33.340	41.143 BLOCK INDICATION POLE-2		-EMERGN ON
08-12-2018 17:41:33.341	10.104 KPP.11, P1 PC, PPC CURRENT ORDER LIMITED		-MINOR ON
08-12-2018 17:41:33.343	41.144 DEBLOCK INDICATION POLE-2		-RESET
08-12-2018 17:41:33.372	21.016 KPB.21, P2 CC-A CP-A, DC LINE PROT, LEVEL ALARM	10174/10212	-MINOR ON
08-12-2018 17:41:33.390	20.025 KPP.21, P2 PC, POLE POWER CONTROL ALARM (MONITOR-3)	9475/9507	-MINOR OFF
08-12-2018 17:41:33.423	21.016 KPB.21, P2 CC-A CP-A, DC LINE PROT, LEVEL ALARM	10174/10212	-MINOR OFF
08-12-2018 17:41:33.442	22.044 KPB.24, P2 CC-B CP-B, EXC DEL ANGLE PROT, Y-BLOCK	10376/10440	-EMERGN OFF
08-12-2018 17:41:33.442	22.043 KPB.24, P2 CC-B CP-B, EXC DEL ANGLE PROT, CHANGEOVER	10376/10440	-MINOR OFF
08-12-2018 17:41:33.478	31.048 NR GRID SPECIAL PROTECTION SCHEME CASE-2 EXECUTED		-EMERGN ON
08-12-2018 17:41:33.805	21.017 KPB.21, P2 CC-A CP-A, DC LINE PROT, CHANGEOVER	10174/10212	-MINOR ON
08-12-2018 17:41:33.857	21.016 KPB.21, P2 CC-A CP-A, DC LINE PROT, LEVEL ALARM	10174/10212	-MINOR ON
08-12-2018 17:41:33.904	21.017 KPB.21, P2 CC-A CP-A, DC LINE PROT, CHANGEOVER	10174/10212	-MINOR OFF
08-12-2018 17:41:33.908	21.016 KPB.21, P2 CC-A CP-A, DC LINE PROT, LEVEL ALARM	10174/10212	-MINOR OFF

150ms

POWERGRID representative informed that internal decision has been taken to do OPGW work in offline mode at critical location of highway and railway crossing. Such type of location is also dangerous for human safety. Special precautions would also be taken in future work in online mode. DR/EL has been shared for all the tripped elements. Detailed report and remedial measures report would be shared separately.

POWERGRID representative further informed that both 400 kV lines, 400 kV Maharani Bagh-Ballabhgarh and G. Noida-Nwada ckt would be revived on or before 23rd Dec 2018.

NTPC representative informed that again vibration observed during fault in the system. This time, maximum vibration was of 207 microns and die down immediately after fault clearance. NTPC representative once again requested forum to provide the solution for observation of high vibration in Dadri stage-II units.

RLDC representative once again stated that oscillation/ vibration was not captured in electrical parameter through PMU data. NRLDC also wrote a letter to CTU/ CEA for further analysis of the event. After that this matter was also discussed in separate meeting held between CTU, NTPC, NRPC and NRLDC.

MS, NRPC requested NTPC to submit all the generator details to CTU for further studies with a copy to NRPC/ NRLDC.

POWERGRID was requested to kindly look into the following:

- Minimize tripping/ fault during OPGW installation.
- Expedite the revival of 400 kV Ballabhgarh-Maharani Bagh ckt as import margin is not available for Delhi to handle any contingency within state control area.
- Unwanted tripping of 400 kV Delhi-Mandaula ckt-1 & 2 from Mandaula end and remedies taken
- Reason of HVDC Rihand-Dadri Pole-II tripping and remedial measures taken. (is it due to commutation failure or dropping of auxiliary supply at Dadri end)
- SPS signal sending details from Rihand and Dadri and receipt of signal from remote end. (Time stamped signal of SPS)
- Co-ordinate with Punjab for non-operation of SPS feeders in Punjab
- Check the unnecessary tripping of 220 kV Samaypur-Palwal feeders from Ballabhgarh (PG) end.
- Detailed report of the incident covering all the aforesaid points shall be shared to NRPC/ NRLDC within 7days.

NTPC was requested to kindly look into the following:

- Reason of tripping of three auxiliary bus at Dadri TPS.
- Voltage drop relay setting for auxiliary bus contactor needs to be checked.

Punjab was requested to kindly look into the following:

- Exact reason of operation of RoCoF relays in the region and remedial measures taken.
- Co-ordinate with POWERGRID to check and correct the reason of non-tripping of feeders comes under SPS load group.
- Detailed report of the incident.

Rajasthan, Haryana, UP was requested to kindly look into the following:

- SPS operation details and analysis for lower load relief and remedial measures taken report.

Multiple element tripping at 400 kV Dadri was a near miss event and it would have further added into major catastrophe in case of cascade tripping of one or more line in the system. HVDC pole blocking and distance protection over reaching is also alarming and indicate

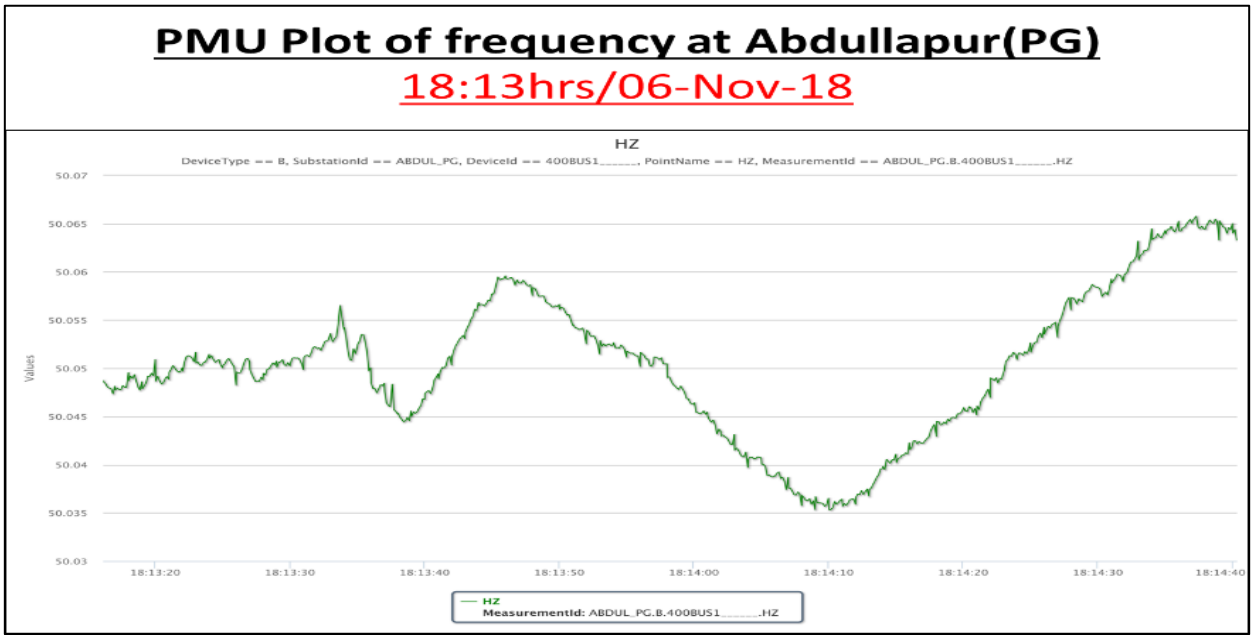
towards an immediate and in depth analysis. **All the concerned utilities were once again requested to look into the event and send a report on above points, take remedial measures to avoid such incidents in future.**

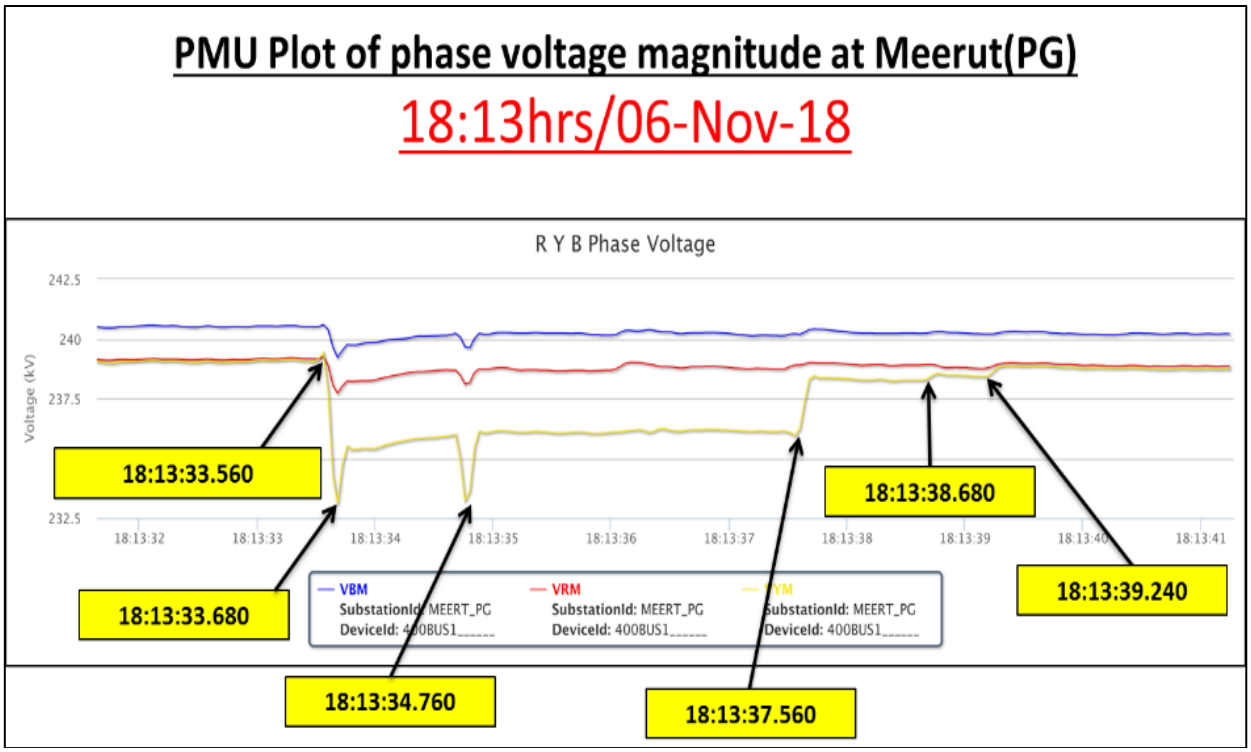
12. Tripping of all 400kV elements at 400/220kV Aligarh(UP):

NRLDC representative stated the following as per gathered information:

- 400 kV Aligarh (UP) is connected with Mainpuri D/C, Sikandrabad D/C, Muradnagar S/C, Panki S/C and two 500MVA 400/220 kV ICT's. It has one and half breaker scheme.
- Y-N fault occurred resulted in tripping of all 400kV ckts from Aligarh(UP) along with both 400/220kV ICTs. 400kV Muradnagar-Ataur, 765/400kV ICT #1 at Mainpuri(UP) and 400kV Sikandrabad-G.Noida both ckts also tripped. 400kV Sikandrabad-Aligarh hand tripped.
- Line fault in 400 kV Aligarh-Muradnagar ckt, during fault main and tie CB both were in service. During fault, tie CB tripped but main CB didn't trip at Aligarh (UP) end. It further resulted into LBB operation but bus bar protection at 400 kV Aligarh (UP) was not healthy thatswhy all the elements tripped from remote end of the Aligarh (UP). It resulted into delayed clearance of fault.
- 400 kV Sikandrabad- G. Noida ckt-1 & 2 tripped on DT received at Sikandrabad end. It occurred due to spurious pulse generated from telecom panels. Further, it is observed that certain control cables are getting earthed and causing DC leakage. (Remedial measures taken: arrested the DC leakage and replaced the faulty cables).
- 400 kV Mainpuri-Aligarh ckt-1 & 2 tripped from Mainpuri end:- distance Z-3 protection operated.
- 765/400 kV 1500MVA ICT at Mainpuri (UP) also tripped:- directional earth fault over current protection.
- 400/220 kV 500MVA ICTs at Aligarh (UP) end tripped on back up over current earth fault protection.
- As per PMU, fault cleared in 4000ms. As per NRLDC SCADA SoE, elements tripped in sequential manner in around 5000ms.

A preliminary report of the event has been issued from NRLDC. The PMU plot and NRLDC SCADA SoE are as follows:




PMU Plot of phase voltage magnitude at Meerut(PG)
18:13hrs/06-Nov-18
R Y B Phase Voltage
Voltage (kV)
242.5
240
237.5
232.5
18:13:32
18:13:33
18:13:34
18:13:35
18:13:36
18:13:37
18:13:38
18:13:39
18:13:41
VBM
SubstationId: MEERT_PG
DeviceId: 400BUS1
VRM
SubstationId: MEERT_PG
DeviceId: 400BUS1
YM
SubstationId: MEERT_PG
DeviceId: 400BUS1
18:13:33.560
18:13:33.680
18:13:34.760
18:13:37.560
18:13:38.680
18:13:39.240

Time (hrs)	Station	Voltage (kV)	Element	Protection/ Device	Status	Remarks	Reference Time
18:13:33.560	B-N fault occcurred as seen from PMU data.						0ms
18:13:33,697	ALIGR_UP	400	LIMUR1N	Protection Trip	App	Aligarh-Muradnagar opened from Aligarh end	190ms
18:13:33,750	ALIGR_UP	400	02TIE	Circuit Breaker	Open		
18:13:34,472	MURADNGR-1	400kV	F_03(PANK1)	Circuit Breaker	Close	Aligarh-Muradnagar closed from Muradnagar end	910ms
18:13:34,862	MANP1_U	765	LIAT1	Protection Trip	App	765/400kV ICT #1 at Mainpuri(UP) tripped	1345ms
18:13:34,904	MANP1_U	765	03AT1	Circuit Breaker	Open		
18:13:34,906	MANP1_U	400	03T1	Circuit Breaker	Open		
18:13:34,907	MANP1_U	400	02T1ORI	Circuit Breaker	Open		
18:13:34,973	MURADNGR-1	400kV	F_01(MUZA1)	Circuit Breaker	Open	Muradnagar-Ataur opened from Muradnagar end	1410ms
18:13:35,104	SHARN_UP	132kV	D_03(DEOBD)	BusBar Isolator 2	Close		1545ms
18:13:35,161	ATAUR_U	400	04MUR1N	Circuit Breaker	Open	Muradnagar-Ataur opened from Ataur end	1600ms
18:13:36,022	ALIGR_UP	400	LIT1	Protection Trip	App	400/220kV ICT #1 at Aligarh tripped	2550ms
18:13:36,068	ALIGR_UP	400	LIT2	Protection Trip	App		
18:13:36,082	ALIGR_UP	400	09T1	Circuit Breaker	Open		
18:13:36,090	ALIGR_UP	400	08TIE	Circuit Breaker	Open		
18:13:36,109	ALIGR_UP	220	04T1	Circuit Breaker	Open		
18:13:36,113	MURADNGR-1	400kV	F_03(PANK1)	Circuit Breaker	Open	Aligarh-Muradnagar opened from Muradnagar end	2555ms
18:13:36,130	ALIGR_UP	400	21T2	Circuit Breaker	Open	400/220kV ICT #2 at Aligarh tripped	2595ms
18:13:36,140	ALIGR_UP	400	20TIE	Circuit Breaker	Open		
18:13:36,152	ALIGR_UP	220	10T2	Circuit Breaker	Open		
18:13:36,447	MANP1_U	400	LIALGRH1	Protection Trip	App	Aligarh-Mainpuri-1 tripped from both ends	2980ms
18:13:36,479	MANP1_U	400	08ALMNP1	Circuit Breaker	Open		
18:13:36,480	ALIGR_UP	400	LIMANP71	Protection Trip	App		
18:13:36,481	MANP1_U	400	09ALIGRH	Circuit Breaker	Open		
18:13:36,519	ALIGR_UP	400	10MANP71	Circuit Breaker	Open		
18:13:36,541	ALIGR_UP	400	11TIE	Circuit Breaker	Open		
18:13:37,531	ALIGR_UP	400	LIMANP72	Protection Trip	App	Aligarh-Mainpuri-2 opened from Aliagarh end. Fault cleared as per PMU data.	3970ms
18:13:37,572	ALIGR_UP	400	07MANP72	Circuit Breaker	Open		
18:13:38,446	PANK1_UP	400kV	F_10(MUR1N)	Circuit Breaker	Open	Panki-Aligarh opened from Panki end	4885ms
18:13:38,521	SKNBD_UP	220kV	08SIKND1	Circuit Breaker	Open	Sikandrabad(400)-Sikandrabad D/C opened from sikandrabad end	4990ms
18:13:38,549	SKNBD_UP	220kV	09SIKND2	Circuit Breaker	Open		

Extract of report received from UPPTCL:

On 06.11.2018 at 18:13Hrs. 400KV ICT - I & II and 400KV lines tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	400KV Aligarh – Mainpuri Ckt. – I	06.11.18	20:31	
2.	400KV Aligarh – Mainpuri Ckt. – II	06.11.18	20:33	
3.	400KV Aligarh – Muradnagar	06.11.18	20:44	
4.	400KV Aligarh – Panki	06.11.18	20:49	
5.	400KV Sikandrabad – I	06.11.18	21:20	
6.	400KV Sikandrabad – II	0611.18	20:59	
7.	500MVA ICT I (400/220KV)	06.11.18	21:36	
8.	500MVA ICT II (400/220KV)	06.11.18	21:19	
9.	400KV Muradnagar – Atour	06.11.18	19:04	
10.	400KV Muradnagr – Aligarh	06.11.18	20:43	
11.	400KV Sikandrabad – Greater Noida – I	06.11.18	19:32	
12.	400KV Sikandrabad – Greater Noida – I	06.11.18	19:37	

Analysis report of the tripped elements, single line diagram, flags of the relevant portion of the grid is enclosed at annexure.

Analysis:-

As reported by UPPTCL line fault occurred on 400KV Aligarh – Muradnagar line, during fault Main & tie CBs were in service. Tie CB tripped but Main CB did not trip at 400KV Aligarh S/S. Due to defective Bus bar protection at Aligarh all lines tripped at other end. Causing delayed fault clearance of around 4000msec.

Remedial Measures taken/to be taken:-

Bus bar protection should be rectified at the earliest.
Thorough testing of 400/220KV Aligarh S/S is required.

U.P. POWER TRANSMISSION CORPORATION LIMITED

ELECTRICITY TEST & COMMISSIONING CIRCLE AGRA

FAULT ANALYSIS STATEMENT OF 400KV SUBSTATION ALIGARH (ET&C DIVISION ALIGARH)

Date 06/11/2018

S. No.	Tripping Date/Time	Closing Date/Time	Name of Substation	CB. No. With Direction	Type of Relay	Flags & Indication Observed	F/L Km	Analysis
1	2	3	4	5	6	7	8	
1	06.11.18 18:13	06.11.18 20:29	400KV Aligarh	Mainpuri-I	Micom/Siemens	DT Receive,	-	
			765KV Mainpuri	Aligarh-I	ABB/Micom	DT Receive	-	
2	06.11.18 18:13	06.11.18 20:32	400KV Aligarh	Mainpuri-II	Micom/Siemens	DT Receive	-	
			765 KV Mainpuri	Aligarh-II	ABB/Micom	DT Receive, Zone-3,	-	
3	06.11.18 CB not opened	06.11.18 20:49	400KV Aligarh	Panki	ZIV/Micom	No Flag, CB Not Open	-	
			400KV Panki	Aligarh	Siprotech	Y-N,Zone-3	Dist=498 Km	At 18.13hrs fault came on 400kv Aligarh-Muradnagar Line,but at Aligarh end,relay sensed,Tie CB opened but main CB not opened,due to which 400KV S/S Aligarh went into total darkness.This Substation has 1 and half breaker scheme. Bus Bar Protection system is kept out of service as it is defective.
4	06.11.18 CB not opened	06.11.18 20:43	400KV Aligarh	Muradnagar	ZIV/Micom	Y-N,Zone-1,2,3 Fault Current Ir=0.212A,Iy=2.877A,Ib=0.102A	Dist=70.99 Km	
			400KV Murad Nagar	Aligarh	ALSTOM	Zone-1 Phase B-N, Dist=92.58 Km	Dist=92.58 Km	
5	06.11.18 CB not opened	06.11.18 21:00	400 KV Aligarh	Sikandrabad-I	ZIV/Micom	No Flag,	-	
			400KV Sikandrabad	Aligarh-I	Micom/ABB	No Flag	-	
6	06.11.18 CB Not Opened	06.11.18 20:57	400KV S/S Aligarh	Sikandrabad-II	ZIV/Micom	No Flag	-	
			400KV Sikandrabad	Aligarh-II	Micom/ABB	No Flag	-	
7	06.11.18 18:13	06.11.18 21:26	400 KV S/S Aligarh	500 MVA T/F-I	ZIV/Micom	Tripped HV LV side CB	-	
8	06.11.18 18:13	06.11.18 21:19	400KV S/S Aligarh	500 MVA T/F-II	ZIV/Micom	O/C, E/F, Tripped HV LV side CB	-	

UPPTCL representative further informed that 400 kV bus bar protection at 400 kV Aligarh (UP) is defective. Issue has been taken up with OeM and would be resolved as soon as possible.

NRLDC representative further added that delayed clearance of fault of 4000ms as against the standard of 100ms is very alarming and it shows the failure of multiple layer of protection system. In this case if bus bar protection was not in service than reverse zone protection should have cleared the fault within 500ms or Z-2 from remote end should have cleared the fault. However, fault persisted for 4000ms and further resulted into tripping of 765/400 kV ICT at nearby station of Mainpuri (UP). 400 kV G.Noida-Sikandrabad ckt-1 & 2 also tripped during the fault on spurious DT signal received at Sikandrabad end. Signal was not generated at G. Noida end. It is also serious cause of concern and needs to be addressed immediately.

UP was requested to kindly look into the following:

- Exact reason and location of fault
- Delayed clearance of fault of around 4000ms
- Simultaneous tripping of multiple elements within 5 seconds of fault
- Status of tripping of 220kV feeders at Aligarh to be confirmed as per SCADA SLD, power flow is observed in the 220kV ckts
- Reason of outage of bus bar protection at Aligarh (UP) and remedial measures taken. (Intimation to RPC/ RLDC about outage of bus bar protection??)
- Non operation of reverse zone protection for outgoing lines from 400 kV Aligarh (UP) needs to be looked into.
- Reason for tripping of 400kV Sikandrabad(UP)-G.Noida(UP) ckts as well as all other elements
- Review of settings of ICTs at Aligarh and Mainpuri

- Explanation for sequential tripping of elements as tabulated in attached NRLDC SoE data
- DR/EL, Report along with remedial measures taken to be shared covering above points.

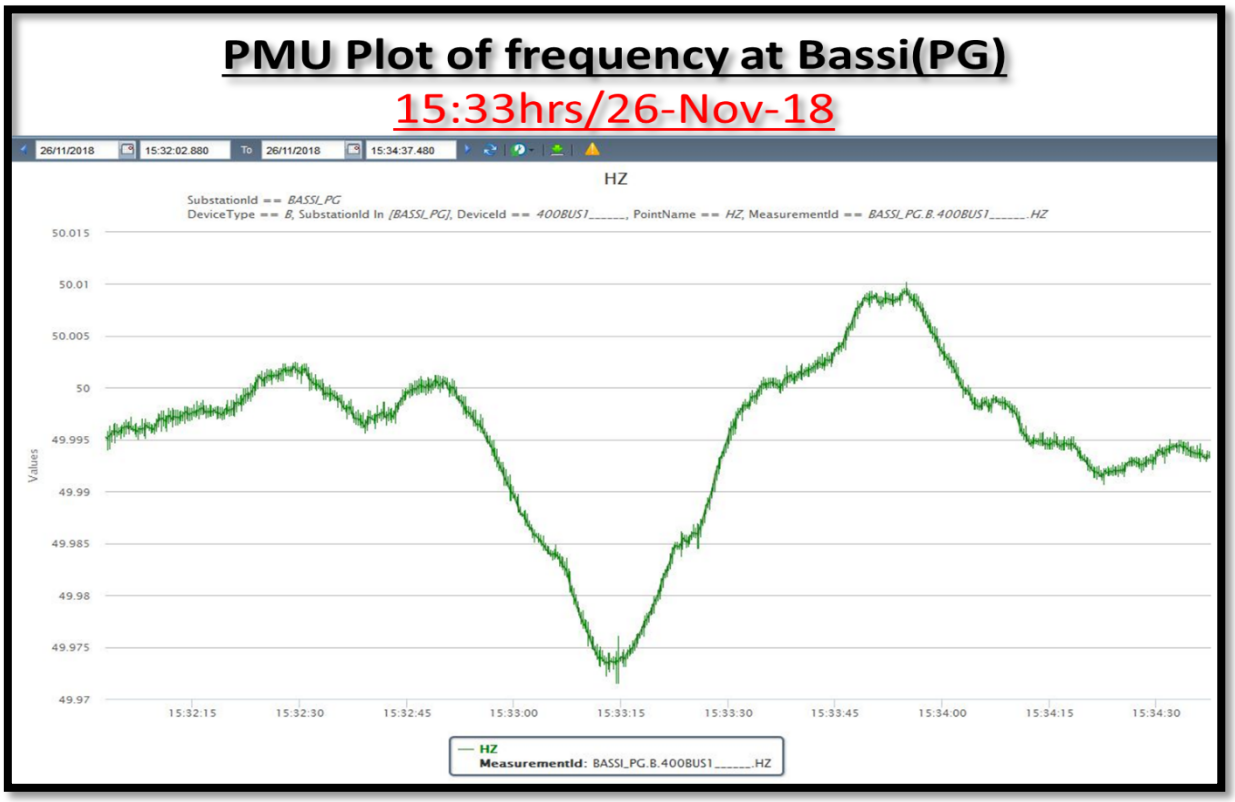
An event of such magnitude wherein forced outage of elements occurred at complete voltage level of a station may affect the safety and security of the grid. Further, delayed clearance of 4000ms as against the standard of 100ms is also very alarming and indicate towards an immediate and in depth analysis. **UP was requested to look into the event and send a report on above points, take remedial measures to avoid such incidents in future.**

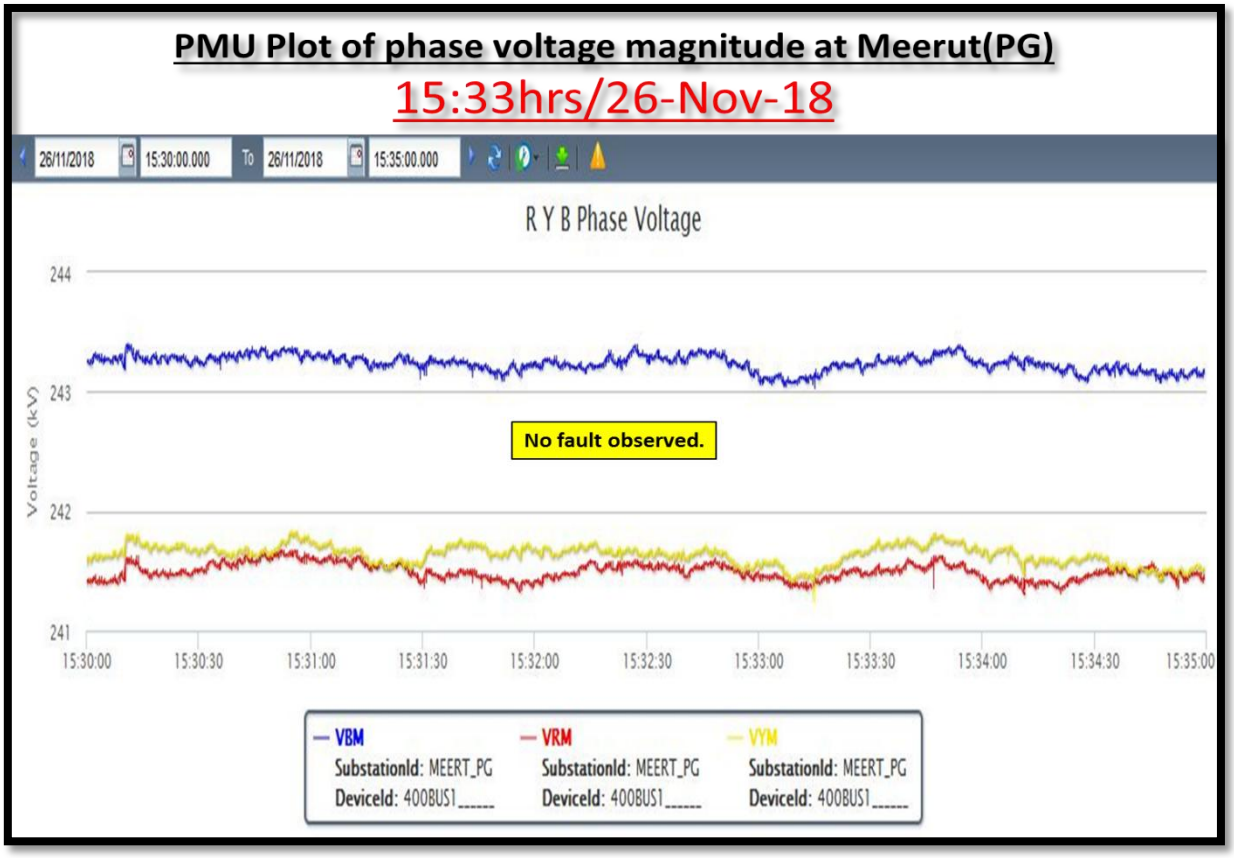
13. Multiple element tripping at 220 kV side of 400/220 kV Ataur (UP):

NRLDC representative stated the following as per gathered information:

- 400 kV Attaur (UP) is connected with Hapur D/C, Indirapuram D/C, Muzaffarnagar S/C, Muradnagar S/S and two 500MVA 400/220 kV ICT's. It has DMT scheme.
- 500MVA 400/220kV ICT 1 & ICT 2 at 400kV Ataur(UP) tripped due to Bus bar protection maloperation. As per PMU, No fault observed in the system. In antecedent conditions, 500MVA ICT 2 carrying 72 MW.
- 220 kV Mandola ckt-2, Morti ckt-1 and 500MVA ICT-1 was under outage (as per SCADA data)
- As per PMU data, there was no fault in the system.
- Preliminary Report, DR/EL and detailed report is still awaited from UP.

A preliminary report of the event has been issued from NRLDC. The PMU plot and NRLDC SCADA SoE are as follows:





UPPTCL representative informed that 220 kV bus bar protection at 400/220 kV Ataur (UP) station was mal-operated. Main-II bus bar protection was already under outage, so mal-operation of Main-I bus bar protection resulted into multiple element tripping at 220 kV Attaur (UP) along with 220 kV side of 400/220 kV 500MVA ICTs. ICT was not tripped on protection from ICT side however tripped on bus bar master trip relay operation. 220 kV bus bar protection (Areva make relay) has been replaced by the OeM and under observation.

NRLDC representative further requested to take the issue with OeM and share the finding in this case.

MS NRPC also expressed concerned about frequent mal-operation of protection system specially in state control area and requested all the NR utilities to kindly take remedial measures well advance to avoid any contingency in the grid.

Annex- IA

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LILO of Transmission Lines
(220kV- 4 ckt. km)

Annexure-2A&2B

S. No.	Name of element	Voltage Level (in kV)		Line Length (In kM)	Conductor Type	LILO Length (In Km)	Owner	Remarks	Actual date & time of charging (Synchronized)	
									Date	Time
1	220kV Jalandhar-Nehria-1 {LILO of 220kV DC Jalandhar-Hamirpur at Nehrian}	220	130	74.031	Single Zebra	1.097	HP(LILO portion only)		**22.11.2018**	**20:33**
2	220kV Jalandhar-Nehria-2 {LILO of 220kV DC Jalandhar-Hamirpur at Nehrian}	220	130	74.031	Single Zebra	1.097	HP(LILO portion only)		**24.11.2018**	**13:59**
3	220kV Hamipur-Nehria-1 {LILO of 220kV DC Jalandhar-Hamirpur at Nehrian}	220	130	56.306	Single Zebra	0.904	HP(LILO portion only)		**22.11.2018**	**19:51**
4	220kV Hamirpur-Nehria-2 {LILO of 220kV DC Jalandhar-Hamirpur at Nehrian}	220	130	56.306	Single Zebra	0.904	HP(LILO portion only)		**23.11.2018**	**11:18**

ICT
(Capacity Addition - 315 MVA)

S.No.	Name of element	Voltage Level	Transformation Capacity (in MVA)	New/replacement /augmentation	Agency/ Owner	Location	Actual date & time of charging (no load)		Actual date & time of charging (on load)	
							Date	Time	Remarks	Date
1	500 MVA ICT-3 at Tughlakabad	400	315	New (TBEA make)	PGCIL	Delhi	24.11.2018	16:06	**26.11.2018**	**12:15**

Bus Reactor

(Capacity Addition –Series Bus Reactor 150 MVAR AND Line Reactor 480 MVA)

S. No.	Name of element	Voltage Level (kV)	Transformation Capacity (in MVAr)	New/ replacement /augmentation	Make	Agency/ Owner	Remarks	Actual date & time of charging	
								Date	Time
1	12 ohm,75 MVAR/phase Series Bus Reactor along with associated bays no 416(main), 421 (main) at Ballabhgarh	400	75	New	Trench	PGCIL		29.11.2018	16:46
2	75 MVAr, 12 ohm Dadri series line reactor-2 at Mandola	400	75	New	Trench	PGCIL		02.11.2018	20:45
3	240 MVAR Switchable Line Reactor and associated bay no 707R of Banaskantha-1 at Chittorgarh	765	240	New	CGL	PGCIL		22.11.2018	16:39
4	240 MVAR Switchable Line Reactor and associated bay no 704R of Banaskantha-2 at Chittorgarh	765	240	New	CGL	PGCIL		22.11.2018	19:49

Outage details (Planned & Forced) : November-2018

Owner	Planned S/Ds	Force S/Ds		Total S/Ds		Force S/Ds		
		Emergency S/Ds(Nos)	Tripping (Nos)	Planned S/Ds(%)	Forced S/Ds(%)	Emergency S/Ds(%)	Tripping(%)	Total
PGCIL	479	67	51	68	32	57	43	364
UPPTCL	69	24	56	46	54	30	70	149
RRVPNL	48	14	17	61	39	45	55	79
DTL	21	13	4	55	45	76	24	38
UPCL	6	0	4	60	40	0	100	10
PSTCL	32	3	4	82	18	43	57	39
HVPNL	27	10	4	66	34	71	29	41
BBMB	30	2	3	86	14	0	0	35
NRSS29	0	0	4	0	100	0	100	4

Long Outages of Transmission Element (15 days) and Generating Units(30 days) as on 17.12.2018

SL. No	Element Name	Type	Voltage Level	Owner	Outage		Reason / Remarks
					Date	Time	
1	400kV Bamnauli(DTL)-Tughlakabad(PGCIL)-1	Line	400 kV	DTL	12/10/2018	8:15	SD taken by DTL for replacement of Tower No 173 by new Tower.
2	Amargarh 400(NRSS29)-URI I(NHPC) 2	Line	400 kV	PGCIL	29-10-2018	10:13	Replacement of complete Power cable and other maintenance work at Uri HEP.
3	Ballabgarh-Maharanibagh	Line	400 kV	PGCIL	21-11-2018	10:41	Shutdown For diversion work of line dueto DFCC, DFCCILwork.
4	400kV G.Noida(UP)-Nawada(HVPNL)	Line	400 kV	PGCIL	25-11-2018	0:00	For diversion work of line dueto DFCC, DFCCILwork by PGCIL
5	Azamgarh 315MVA ICT-1	ICT	400/220 kV	UPPTCL	20-11-2018	13:03	Increasing Capacity of 315 MVAT/F to 500M VA T/F (Repacement of 315 MVA, ICT-I by 500 MVA ICT)
6	Panki 240 MVA ICT 1	ICT	400/220 kV	UPPTCL	1/12/2018	13:00	Replacement of 240 MVA ICT-I by 315 MVA ICT for increasing capacity
7	Patiala(PG)-Patiala(PSEB) 2	Line	220 kV	PSTCL	28-10-2018	10:25	For replacement of conductor the line by PSTCL
8	FSC of Pampore-1 at Kishnpr	FSC	220 kV	PGCIL	30-10-2012	12:00	Line length has reduced after LILO work completion
9	FSC of Pampore-2 at Kishnpr	FSC	220 kV	PGCIL	30-10-2012	12:00	Line length has reduced after LILO work completion

SL. No	Element Name	Type	Voltage Level	Owner	Outage		Reason / Remarks
					Date	Time	
10	Vindhyachal HVDC BtB Block 2	HVDV Station	500 kV HVDC	PGCIL	26-11-2017	14:55	Differential protection operated.
11	Allahabad Rewa Road(400kV) - Obra	Line	400 kV	UPPTCL	14-10-2018	4:45	Tripped due to fire in cable gallery at Obra end
12	Akal 500 MVA ICT 4	ICT	400/220 kV	RRVPNL	5/8/2018	16:00	ICT burnt
13	Akal 315 MVA ICT 2	ICT	400/220 kV	RRVPNL	22-08-2018	22:55	ICT burnt.
14	FACT at BLB in Knp-BLB Line	FACTS	400 kV	PGCIL	2/7/2016	10:20	Y-Phase current imbalance
15	FSC (50%) of Koteshwar Pool -2 at Meerut (PG)	FSC	400 kV	PGCIL	14-07-2017	19:22	Fire in Y-ph unit
16	FSC of Balia-I at Lucknow	FSC	400 kV	PGCIL	29-11-2017	13:30	E/SD due to Hot Spot at Isolator
17	FSC (40%) of Fatehpur-II at MainpurI(PG)	FSC	400 kV	PGCIL	5/8/2018	0:10	Minimum oil protection operated. Presently out due to Low current.
18	Bairasuil(NHPC)-Pong(BBMB)	Line	220 kV	PGCIL	15-10-2018	10:50	for renovation & modernization. shutdown for 6 months
19	Bairasiul(NHPC)-Jassure(HPSEB)	Line	220 kV	PGCIL	15-10-2018	12:16	for renovation & modernization. shutdown for 6 months

Long Outage of Generating Units

SL. No	Station Name	Location	Owner	Unit No	Capacity	Reason	Outage		Remarks
							Date	Time	
1	Bairasiul HPS	HP	NHPC	3	60	For renovation and Modernisation of the plant	15-10-2018	9:11	
2	Bairasiul HPS	HP	NHPC	2	60	For renovation and Modernisation of the plant	15-10-2018	10:02	
3	Bairasiul HPS	HP	NHPC	1	60	For renovation and Modernisation of the plant	15-10-2018	10:14	
4	Chamera-III HPS	HP	NHPC	1	77	Annual maintenance	15-11-2018	14:00	
5	Chamera-II HPS	HP	NHPC	3	100	Annual maintenance	19-11-2018	9:35	
6	Obra TPS	UP	UPRVUNL	7	100	R & M work	1/7/2010	13:44	
7	Paricha TPS	UP	UPRVUNL	1	110	R & M Work	2/7/2016	17:30	
8	Pong HPS	HP	BBMB	2	66	Repair and Replacement of draft tube gates.	28-03-2018	16:20	
9	Auraiya GPS	UP	NTPC	5	109.3	Tripped during liquid firing test	5/12/2018	6:17	
10	Giral (IPP) LTPS	RAJASTHAN	RRVUNL	1	125	Bed materials leakage.	11/7/2014	8:20	
11	Giral (IPP) LTPS	RAJASTHAN	RRVUNL	2	125	Boiler tube leakage	27-01-2016	15:27	
12	Obra TPS	UP	UPRVUNL	13	200	R & M work	23-02-2018	7:00	
13	Bara PPGCL TPS	UP	Jaypee	2	660	Unit tripped due to emergency stop valve damaged.	15-09-2018	14:04	
14	Obra TPS	UP	UPRVUNL	12	200	Tripping details awaited.	24-09-2018	17:26	
15	Rajwest (IPP) LTPS	RAJASTHAN	RRVUNL	3	135	Boiler tube leakage	3/11/2018	16:57	

Central Sector reserve shutdown (1634 MW)

SL. No	Station Name	Location	Owner	Unit No	Capacity	Reason	Outage		Remarks
							Date	Time	
1	Faridabad GPS	HARYANA	NTPC	2	137.75	Reserve Shutdown	6/7/2018	22:51	
2	Dadri GPS	UP	NTPC	4	130.19	Reserve Shutdown	12/11/2018	23:06	
3	Auraiya GPS	UP	NTPC	1	111.19	Reserve Shutdown	13-11-2018	9:36	
4	Dadri GPS	UP	NTPC	6	154.51	Reserve Shutdown	13-11-2018	10:38	
5	Dadri GPS	UP	NTPC	3	130.19	Reserve Shutdown	13-11-2018	11:10	
6	Anta GPS	RAJASTHAN	NTPC	3	88.71	Reserve Shutdown	23-11-2018	21:43	
7	Dadri-I TPS	UP	NTPC	1	210	Reserve shutdown	29-11-2018	17:31	
8	Auraiya GPS	UP	NTPC	4	111.19	Reserve Shutdown Non-availibilty of gas	30-11-2018	5:33	
9	Auraiya GPS	UP	NTPC	6	109.3	Reserve Shutdown Non-availability of gas	30-11-2018	5:47	
10	Auraiya GPS	UP	NTPC	3	111.19	Reserve Shutdown Non-availability of gas	30-11-2018	5:57	
11	Dadri GPS	UP	NTPC	1	130.19	Reserved Shutdown due to Non-availability of cheap gas	2/12/2018	6:11	
12	Dadri-I TPS	UP	NTPC	3	210	Reserve shutdown.	5/12/2018	23:45	

State Sector reserve shutdown/Coal shortage (6915 MW)

SL. No	Station	Location	Owner	Unit No	Capacity	Reason(s)	Outage		Expected Revival Date
							Date	Time	
1	DCRTPP (Yamuna Nagar)	HARYANA	HPGCL	1	300	Reserve Shutdown	22-09-2018	4:51	
2	Guru Gobind Singh TPS (Ropar)	PUNJAB	PSEB	4	210	Reserve Shutdown	11/10/2018	13:10	
3	Lalitpur TPS	UP	LPGCL	2	660	Reserve Shutdown	7/11/2018	23:41	
4	Lalitpur TPS	UP	LPGCL	3	660	Reserve Shutdown	9/11/2018	8:01	
5	Lalitpur TPS	UP	LPGCL	1	660	Reserve Shutdown	13-11-2018	0:15	
6	Paricha TPS	UP	UPRVUNL	2	110	Reserve Shutdown	13-11-2018	21:00	
7	Harduaganj-C TPS	UP	UPRVUNL	7	105	Reserve Shutdown	13-11-2018	21:15	
8	Rosa TPS	UP	ROSA	3	300	Reserve Shutdown	13-11-2018	23:00	
9	Rosa TPS	UP	ROSA	4	300	Reserve Shutdown	13-11-2018	23:00	
10	Rosa TPS	UP	ROSA	2	300	Reserve Shutdown	15-11-2018	12:00	
11	Rosa TPS	UP	ROSA	1	300	Reserve Shutdown	15-11-2018	12:00	
12	Paricha TPS	UP	UPRVUNL	4	210	Reserve Shutdown	17-11-2018	20:13	
13	Suratgarh TPS	RAJASTHAN	RRVUNL	2	250	Reserve Shutdown	19-11-2018	12:33	
14	Guru Gobind Singh TPS (Ropar)	PUNJAB	PSEB	6	210	Reserve Shutdown	22-11-2018	22:40	
15	Paricha TPS	UP	UPRVUNL	6	250	Reserve Shutdown	26-11-2018	13:12	
16	Paricha TPS	UP	UPRVUNL	5	250	Reserve Shutdown	27-11-2018	19:23	
17	Panipat TPS	HARYANA	HPGCL	5	210	Reserve Shutdown	29-11-2018	22:01	
18	Guru Hargobind Singh TPS (Lehra Mohabbat)	PUNJAB	PSEB	1	210	Reserve Shutdown	3/12/2018	22:50	
19	Suratgarh TPS	RAJASTHAN	RRVUNL	3	250	Reserve Shutdown	4/12/2018	13:12	
20	Suratgarh TPS	RAJASTHAN	RRVUNL	5	250	Reserve Shutdown	5/12/2018	19:10	
21	Suratgarh TPS	RAJASTHAN	RRVUNL	4	250	Reserve Shutdown	7/12/2018	12:45	
22	Panipat TPS	HARYANA	HPGCL	7	250	Reserve Shutdown	13-12-2018	12:01	
23	Kota TPS	RAJASTHAN	RRVUNL	4	210	Reserve Shutdown	14-12-2018	12:24	
24	Guru Hargobind Singh TPS (Lehra Mohabbat)	PUNJAB	PSEB	2	210	Reserve Shutdown	15-12-2018	21:55	

Annexure-4

		MU	MW
State		Jan-19	Jan-19
Chandigarh	Availability	115	300
	Requirement	115	260
	Surplus/Shortfall (MU)	0	40
	Surplus/Shortfall (%)	0.0%	15.4%
Delhi	Availability	3540	5660
	Requirement	2150	4600
	Surplus/Shortfall (MU)	1390	1060
	Surplus/Shortfall (%)	64.7%	23.0%
Haryana	Availability	5450	8200
	Requirement	3800	7120
	Surplus/Shortfall (MU)	1650	1080
	Surplus/Shortfall (%)	43.4%	15.2%
Himachal Pradesh	Availability	836	1650
	Requirement	838	1640
	Surplus/Shortfall (MU)	-2	10
	Surplus/Shortfall (%)	-0.2%	0.6%
Jammu & Kashmir	Availability	760	1760
	Requirement	1710	2980
	Surplus/Shortfall (MU)	-950	-1220
	Surplus/Shortfall (%)	-55.6%	-40.9%
Punjab	Availability	4937	7549
	Requirement	3600	6760
	Surplus/Shortfall (MU)	1337	789
	Surplus/Shortfall (%)	37.2%	11.7%
Rajasthan	Availability	8553	11730
	Requirement	6963	12499
	Surplus/Shortfall (MU)	1589	-769
	Surplus/Shortfall (%)	22.8%	-6.2%

Uttar Pradesh	Availability	10605	16770
	Requirement	11160	17500
	Surplus/Shortfall (MU)	-555	-730
	Surplus/Shortfall (%)	-5.0%	-4.2%
Uttarakhand	Availability	1040	1970
	Requirement	1290	2180
	Surplus/Shortfall (MU)	-250	-210
	Surplus/Shortfall (%)	-19.4%	-9.6%
Total NR	Availability	35836	53618
	Requirement	31626	51400
	Surplus/Shortfall (MU)	4210	2218
	Surplus/Shortfall (%)	13.3%	4.3%

ANNEXURE - 6

Sub: Status of shunt Reactors as on 17.12.2018

S.No.	Bus Name	Voltage level (kV)	Reactor (MVAR)	Plg. Status
1	Peeragarhi	220	1x50	PR No 1100002017 Raised.
2	Mundka	400	1x125	Under finance vetting
		220	1x25	
3	Harsh Vihar	220	2x50	Under Finance vetting
4	Electric Lane	220	1x50	Site visit done, space is not feasible for installation. However, In OCC meeting , dt. 28.09.18, OCC was firm that 50MVAR reactor is required at Electric Lane, accordingly case file has been sent to SS&LM division for space markation and feasibility .
5	Bamnauli	220	2x25	Under cost estimation
6	Indraprastha	220	2x25	Under cost estimation
TOTAL			**450**	

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

उत्तरी क्षेत्र-1, मुख्यालय, बी-9, कुतुब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली-110016, दूरभाष: 26560112, 26560115, फैक्स: 011-26601081 तार 'नेटग्रिड'
Northern Region-1, Heaadquarters, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016 Tel.: 26560112, 26560115, Fax : 011-26601081 Gram: 'NETGRID'

संदर्भ संख्या / Ref. No. :

दिनांक / Dated :

Ref: NR-1/AM/NRPC/

Date :- 17th December'2018

ANNEXURE - 8

To,

The Member Secretary,
Northern Regional Power Committee,
18-A, Qutab Institutional Area,
Katwaria Sarai, New Delhi-110 016

Subject:- **Phase nomenclature mismatch issue with BBMB.**

Ref :- NRPC/Opr/106/01/2018/11740-41 dt. 06/10/2018

In subject reference the following technical infeasibility issues need to be addressed requiring materials, skilled gang and shutdowns.

a) Require de-stringing of the droppers from the last tower to gantry and then re-stringing in the correct phase. The terminations at Panipat (BBMB) are from Dadri-Panipat lines which are of single circuit design and are very old towers. The restringing of the last conductor spans can cause additional forces on the tower/ terminal equipment and which may be problematic in the future.

b) The de-stringing and then re-stringing at all these stations can cause clearance problems after work completion, which may lead to phase to phase and phase to earth faults.

c) Wave trap and LMU of one phase will have to be shifted with all pipe structure, etc. Earthing riser and flats also need to be changed.

d) There will be requirement of PLCC engineer for PLCC and LMU tuning with co-ordination at both ends.

e) A Full stringing gang with T&P is required to execute this work. However looking at the quantum of work finding a suitable party will be challenging.

f) At least 4-5 days of shutdown will be required at all sites along with financial implication for carrying out the above work.

In view of the above technical infeasibility and additional financial implication, it is proposed to enable the same with phase interchange at Dehar (BBMB) station itself in phased manner..

Thanking you.

Yours sincerely,

(Ravindra N. Gupta)
GM (AM, NR-1)

पंजीकृत कार्यालय : बी-9, कुतुब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली-110016
Regd. Office : B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016

आप हमसे हिन्दी में पत्र व्यवहार कर सकते हैं।

Encl :- As above

Copy :- i) Chief GM(AM), NR1

Possible Problems while changing phase conductors as per plan proposed by BBMB

The connections at Panchkula, Rajpura (PSTCL), Bhiwani (BBMB) and Panipat (BBMB) are to be interchanged as per BBMB plan which would require de-stringing of the droppers from the last tower to gantry and then re-stringing in the correct phase. However as per site visits the following technical problems are anticipated:

1. The terminations at Panipat (BBMB) are from Dadri-Panipat lines which are of single circuit design and are very old towers. The restringing of the last conductor spans can cause additional forces on the tower/ terminal equipment and which may be problematic in the future.
2. The de-stringing and then re-stringing at all these stations can cause clearance problems after work completion, which may lead to phase to phase and phase to earth faults.
3. Wave trap and LMU of one phase will have to be shifted with all pipe structure, etc. Earthing riser and flats also need to be changed.
4. There will be requirement of PLCC engineer for PLCC and LMU tuning with co-ordination at both ends.
5. A Full stringing gang with T&P is required to execute this work. However looking at the quantum of work finding a suitable party will be challenging.
6. At least 4-5 days of shutdown will be required at all sites along with financial implication for carrying out the above work.

In view of the above technical difficulties, outage requirement and the financial implications involved, it is proposed that some other possibilities be explored for resolving the phase nomenclature issue.

Follow up issues from previous OCCMs **ANNEXURE 9**

SNO	Description of Agenda point	Details	STATUS UPDATED
1	**Monitoring of schemes funded from PSDF (Agenda by NPC)**	The latest status of the schemes for which grant has been sanctioned from PSDF for the schemes in Northern Region. Utilities are requested to expedite implementation of the schemes and submit information of physical as well as financial progress in the prescribed format by first week of every month on regular basis to Member Convener, PSDF Project Monitoring Group (AGM, NLDC and POSOCO) with a copy to NPC Division	**The updated status available was attached as Annexure 9/1 of the Agenda of the 154th OCC meeting .All states were requested to update. PSTCL submitted the information**
2	**Sub-stations likely to be commissioned in next 6 months.**	All the concerned states were requested to submit the details of the downstream network associated SPECIFICALLY with THESE POWERGRID substations along with the action plan of their proposed/approved networks.	**The details of the substations of Power Grid and their required downstream network is enclosed *as* Annexure 9/2 of the Agenda of the 154th OCC meeting.** **All concerned were again requested to update regularly and ensure that the work is completed expeditiously.**
3	**Progress of installing new capacitors and repair of defective capacitors**	. The available up to date status of installation of new capacitors and revival of defective capacitor by the State constituents is enclosed as ***ANNEXURE 10/3OF THE AGENDA OF THE 146TH OCC MEETING.*** .	**All utilities were requested to update regularly. Information received from Rajasthan, Uttrakhand & Haryana placed at Annexure9/3**
4.	**Healthiness of defence mechanism: Self-**	Report of Mock exercise for healthiness of UFRs carried out by utilities themselves on quarterly basis is to be submitted to NRPC Secretariat and NRLDC. All utilities were advised to certify specifically, in the report that "***All the UFRs are checked and***	**Information from for period ending September 2018 has not been received from Punjab, Delhi, BBMB & Rajasthan.** **BBMB submitted the information. & others were**

	certification	***found functional"***. ***151st OCC meeting:*** **All utilities are requested to submit reports of testing in every quarter in soft copy. All the states were requested that the reports for period ending September 2018 by all the states should be submitted positively by First week of October.**	**requested to submit.**
5	**Strengthening of Intra-State transmission system**	Also all SLDCs are requested to give half yearly feedback ending 6/2018 in the month of 7/2018 to STU regarding bottlenecks, constraints and overloading in the State transmission network for proper transmission planning **153rd OCC meeting:** **PTCUL, Punjab ,Delhi & Rajasthan have submitted the information that send submitted to concerned office**	**HVPNL & UPPTCL were requested to submit the information.** **Also all SLDCs were requested to give half yearly feedback ending 12/2018 in the month of 1/2019 to STU regarding bottlenecks, constraints and overloading in the State transmission network for proper transmission planning**
6	**Mapping of Feeders in SCADA**	In the 141st OCC meeting members were informed about the "Compendium of SPS in NR" (*Annexure-_9 of the MOM_)* which was released in the 40th NRPC meeting. All the utilities were requested to go through the compendium and identify feeders concerning their state and map the same in SCADA. **150th OCC meeting:** MS NRRPC stated that as per the Compendium of SPS in NR" which was released in the 40th NRPC meeting. All the utilities are requested to go through the compendium and identify feeders concerning their state and map the same in SCADA. This document is available on NRLDC & NRPC website. NRLDC representative added that it is very important that the feeders should be mapped in SCADA. It was stated that this issue will be discussed in the Test committee meeting also. The matter under discussion in subsequent meetings but no further update	**All states except Punjab & Rajasthan were requested to update.**

Progress of Installation of HT Shunt Down Capacitor (rated 11 KV and above) in Haryana as on Oct-18

Name of Constituent / State	HT shunt Capacitors (rated 11 KV level and above) Installed up to 30.09.18	New Capacitor required during 2015-16 & 2016-17 & 2017-18 & 2018-19 (MVAR)	Capacitor Added during 10/2018 (MVAR)	Capacitor Added upto 10/2018 (MVAR)	Balance Capacitors to be added during 2015-16 & 2016-17 & 2017-18 & 2018-19 (MVAR)	Total Capacitors Installed in the state as on 31.10.18 (MVAR)
	A	B	C	D	B-D	A+C
PDC HSR	1350.972	198.68	79.2	577.483	-378.803	1430.172
PDC UH	835.15	208.03	19.25	104.6	103.43	854.4
TS PKL	2238.843	329.37	0	120.672	208.698	2238.843
TS HSR	1817.654	653.674	0	65.232	588.442	1817.654
Haryana as a whole	**6242.62**	**1389.75**	**98.45**	**867.99**	**521.77**	**6341.07**

Progress of revival of HT Shunt Down Capacitors (rated 11 KV and above) in Haryana during Oct-18

Name of Constituent / State	Defective Capacitors as on 30.09.18	Defective during 10/18 (MVAR)	Defective Capacitor as on 31.10.2018 (MVAR)	Capacitor revived during the 10/2018 (MVAR)	Net Defective Capacitors (need revival) (MVAR)
	A	B	C=A+B	D	C-D
PDC HSR	165.807	0	165.807	0	165.807
PDC UH	108.588	1.8	110.388	3.15	107.238
TS PKL	208.101	0	208.101	7.11	200.991
TS HSR	178.974	0	178.974	2	176.974
Haryana as a whole	**661.47**	**1.80**	**663.27**	**12.26**	**651.01**

Nov-18

Progress of Revival of defective HT Shunt Capacitors (Rated 11 KV and above) in Northern Region

ALL FIG. IN MVAR

Constituent	Defective Capacitors as on 31.10.2018	Defective during Nov-18	Defective Capacitors as on 30.11.2018	Defective Capacitors revived during Nov-18	Net Defective Capacitors need revival
	1	2	3=1+2	4	5=3-4
Rajasthan	328.53	18.58	347.10	35.295	311.81

Progress of revival of difective HT Shunt Capacitors (rated 11KV and above) in Northern Region					
Constituent	**Defective Capacitors as on 31.10.2018**	**Defective during November 2018**	**Defective Capacitor as on 30.11.2018**	**Defective Capacitors revived during November 2018**	**Net defective capaciors at the end of October 2018**
Uttarakhand	100.00	0.00	100.00	0.00	100.00

Progress of Installation of HT Shunt Capacitors (rated 11KV and above) in Northern Region As on						
State	**HT Shunt capacitors (rated 11KV level and above installed upto 31.03.2015**	**New Capacitors for FY 2015-16**	**Balance Backlog of capacitors to be added by end of FY 2015-16**	**Capacitors added during December 2015**	**Capacitors added in FY 2016-17**	**Total capacitors installed in the state as 28.02.2017**
Uttarakhand	325.00	600.00	275.00	0.00	10.00	335.00

AGENDA ITEM NO. 10
OCC - 154
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

S.No.	Attribute	Status
1.	Developer	UPRVUNL
2.	Name of Project	ANPARA 'D' TPS
3.	Sector (State / Central /Private)	State
4.	State	U.P.
5.	Region (NR, ER etc)	NR
6.	Unit No	6&7
7.	Unit Capacity (MW)	2x500 MW
8.	DT-of COMMISSIONING (DD/MM/YYYY)	Unit-6 – 08.06.2015 Unit-7 – 06.03.2016
9.	Age in years (Till 18.06.2018)	Unit-6 – 3 years Unit-7 – 2.25 years
10.	Whether FGD Installed (Y/N)	N
11.	Whether FGD space available (Y/N)	Y
12.	Whether FGD planned (Y/N)	Y
13.	Feasibility Study Started (Y/N)	Y
14.	Feasibility Study Completed (Y/N)	Y
15.	Tender Specifications Made (Y/N)	Y
16.	NIT Issued (Y/N)	Y
17.	Bids Opened (Y/N)	Y
18.	Bid Opening Date (DD/MM/YYYY)	Techno commercial bid-stage-I has been opened on 27.11.2018
19.	Bids Awarded (Y/N)	N
20.	Regulator Petition Cleared (Y/N)	N
21.	% Progress of FGD Installation	–
22.	FGD Commissioned (Y/N)	N
23.	FGD working satisfactorily (Y/N)	–
24.	FGD Phasing Plan for Implementation (DD/MM/YYYY)	Unit-6 – May-June-2021 Unit-7 – March-April-2021
25.	Current Status& remarks	Techno commercial bid are being evaluated by M/s NTPC.

AGENDA ITEM NO.
OCC -
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

S.No.	Attribute	Status
1.	Developer	UPRVUNL
2.	Name of Project	ParichhaTPS (2X210MW) & (2X250MW) Harduaganj TPS (2X250MW)
3.	Sector (State / Central /Private)	State
4.	State	U.P.
5.	Region (NR, ER etc)	NR
6.	Unit No	ParichhaTPS Unit no. 3,4 & 5, 6 Harduaganj TPS Unit no. 8 & 9
7.	Unit Capacity (MW)	(2X210MW) & (2X250MW) ParichhaTPS (2X250MW)Harduaganj TPS
8.	DT-of COMMISSIONING (DD/MM/YYYY)	ParichhaTPS Unit-3 – 29.03.2006 Unit-4 – 28.12.2006 Unit-5 – 24.05.2012 Unit-6– 11.03.2013 Harduaganj TPS Unit-8 – 27.09.2011 Unit-9 – 25.05.2012
9.	Age in years (Till 18.06.2018)	ParichhaTPS Unit-3 – 12.2 years Unit-4 – 11.5 years Unit-5 – 6 years Unit-6– 5.2 years Harduaganj TPS Unit-8 – 6.75 years Unit-9 – 6 years
10.	Whether FGD Installed (Y/N)	N
11.	Whether FGD space available (Y/N)	Y
12.	Whether FGD planned (Y/N)	Y
13.	Feasibility Study Started (Y/N)	Y
14.	Feasibility Study Completed (Y/N)	Y
15.	Tender Specifications Made (Y/N)	Y
16.	NIT Issued (Y/N)	Y
17.	Bids Opened (Y/N)	N
18.	Bid Opening Date (DD/MM/YYYY)	21/12/2018 (Techno commercial Bid stage-I)

AGENDA ITEM NO.
OCC -
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

19.	Bids Awarded (Y/N)	N
20.	Regulator Petition Cleared (Y/N)	–
21.	% Progress of FGD Installation	–
22.	FGD Commissioned (Y/N)	N
23.	FGD working satisfactorily (Y/N)	–
24.	FGD Phasing Plan for Implementation (DD/MM/YYYY)	ParichhaTPS Unit-3 – March-April- 2022 Unit-4 – March-April- 2022 Unit-5 – Jan.-Feb.-2022 Unit-6– Nov.-Dec.2022 Harduaganj TPS Unit-8 – 31.12.2019 Unit-9 – 31.12.2019
25.	Current Status& remarks	NIT has been published on 16.11.2018

AGENDA ITEM NO.
OCC -
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

S.No.	Attribute	Status
1.	Developer	UPRVUNL
2.	Name of Project	ANPARA 'A' & 'B' TPS
3.	Sector (State / Central /Private)	State
4.	State	U.P.
5.	Region (NR, ER etc)	NR
6.	Unit No	1,2,3 & 4,5
7.	Unit Capacity (MW)	3x210 MW & 2x500 MW
8.	DT-of COMMISSIONING (DD/MM/YYYY)	**Anpara A TPS** Unit-1 – 24.03.1986 Unit-2 – 28.02.1987 Unit-3 – 12.03.1988 **Anpara B TPS** Unit-4 – 19.07.1993 Unit-5 – 04.07.1994
9.	Age in years (Till 18.06.2018)	**Anpara A TPS** Unit-1 – 32 years Unit-2 – 31 years Unit-3 – 30 years **Anpara B TPS** Unit-4 – 25 years Unit-5 – 24 years
10.	Whether FGD Installed (Y/N)	N
11.	Whether FGD space available (Y/N)	Y
12.	Whether FGD planned (Y/N)	Y
13.	Feasibility Study Started (Y/N)	Y
14.	Feasibility Study Completed (Y/N)	Y
15.	Tender Specifications Made (Y/N)	N
16.	NIT Issued (Y/N)	N
17.	Bids Opened (Y/N)	N
18.	Bid Opening Date (DD/MM/YYYY)	–
19.	Bids Awarded (Y/N)	N
20.	Regulator Petition Cleared (Y/N)	N
21.	% Progress of FGD Installation	–
22.	FGD Commissioned (Y/N)	N

AGENDA ITEM NO.
OCC -
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

23.	FGD working satisfactorily (Y/N)	–
24.	FGD Phasing Plan for Implementation (DD/MM/YYYY)	**Anpara A TPS** Unit-1 – Sept-Oct 2022 Unit-2 – July- Aug 2022 Unit-3 – May-June 2022 **Anpara B TPS** Unit-4 – March-April 2022 Unit-5 – Jan-Feb 2022
25.	Current Status& remarks	An award for Pre award cosultancy services has been placed to M/s NTPC on 09.10.2018

AGENDA ITEM NO.
OCC -
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

S.No.	Attribute	Status
1.	Developer	UPRVUNL
2.	Name of Project	OBRA 'B' TPS
3.	Sector (State / Central /Private)	State
4.	State	U.P.
5.	Region (NR, ER etc)	NR
6.	Unit No	9,10,11,12 &13
7.	Unit Capacity (MW)	2x500 MW
8.	DT-of COMMISSIONING (DD/MM/YYYY)	Unit- 9 – 26.10.1980 Unit -10 – 14.01.1979 Unit- 11 – 31.12.1977 Unit- 12 – 28.03.1981 Unit- 13 – 21.07.1982
9.	Age in years (Till 18.06.2018)	Unit- 9 – 38 years Unit -10 – 39 years Unit- 11 – 41 years Unit- 12 – 37 years Unit- 13 – 36 years
10.	Whether FGD Installed (Y/N)	N
11.	Whether FGD space available (Y/N)	Y
12.	Whether FGD planned (Y/N)	Y
13.	Feasibility Study Started (Y/N)	Y
14.	Feasibility Study Completed (Y/N)	Y
15.	Tender Specifications Made (Y/N)	N
16.	NIT Issued (Y/N)	N
17.	Bids Opened (Y/N)	N
18.	Bid Opening Date (DD/MM/YYYY)	–
19.	Bids Awarded (Y/N)	N
20.	Regulator Petition Cleared (Y/N)	N
21.	% Progress of FGD Installation	–
22.	FGD Commissioned (Y/N)	N
23.	FGD working satisfactorily (Y/N)	–

AGENDA ITEM NO.
OCC -
STATUS OF FGD INSTALLATION VIS-À-VIS INSTALLATION PLAN AT IDENTIFIED TPS

24.	FGD Phasing Plan for Implementation (DD/MM/YYYY)	Unit-9 – July- Aug 2022 Unit-10 – Sept- Oct.2022 Unit-11 – Nov-Dec 2022 Unit-12 – May-June.2022 Unit-13 – March-April.2022
25.	Current Status& remarks	An award for Pre award cosultancy services has been placed to M/s Fichtner on 03.12.2018

RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD.
Corporate Identity Number (CIN) - U40102RJ2000SGC016484
Vidyut Bhawan, Jan path, Jaipur-302005
OFFICE OF THE ADDL. CHIEF ENGINEER (PPMC & IT)
Room No. 304, 3rd Floor, Jeevan Nidhi Bhawan-II,
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Telephone: 0141-2740989, Fax: 0141-2740006
email : pp.rvun@rgmail.com
web. : energy.rajasthan.gov.in/rvunl

150 YEARS OF CELEBRATING THE MAHATMA

No.RVUN /ACE (PPMC & IT)/SE(PP)/D. 1852 Dated: 17.12.18

The Superintending Engineer (Opr),
NRPC , 18-A,
Shaheed Jeet Singh Marg,
New Delhi –110016
E-mail:- seo-nrpc@nic.in

Sub: Status of FGD Installation.

On the subject cited above, please find enclosed here with status of FGD installation vis-à-vis installation plan of RRVUNL Power Project.

Enclosed: As above

17/12

Superintending Engineer (PP)
RVUNL, Jaipur

Copy forwarded to the following alongwith enclosures as above for information:

1. General Manager, Northern Region Load Despatch Centre, 18-A, Shaheed Jeet Singh Marg, Katwaria Sarai, New Delhi –110016
2. SE (SO&LD), RVPNL, Heerapura, Jaipur alongwith enclosures as above.

Superintending Engineer (PP)
RVUNL, Jaipur

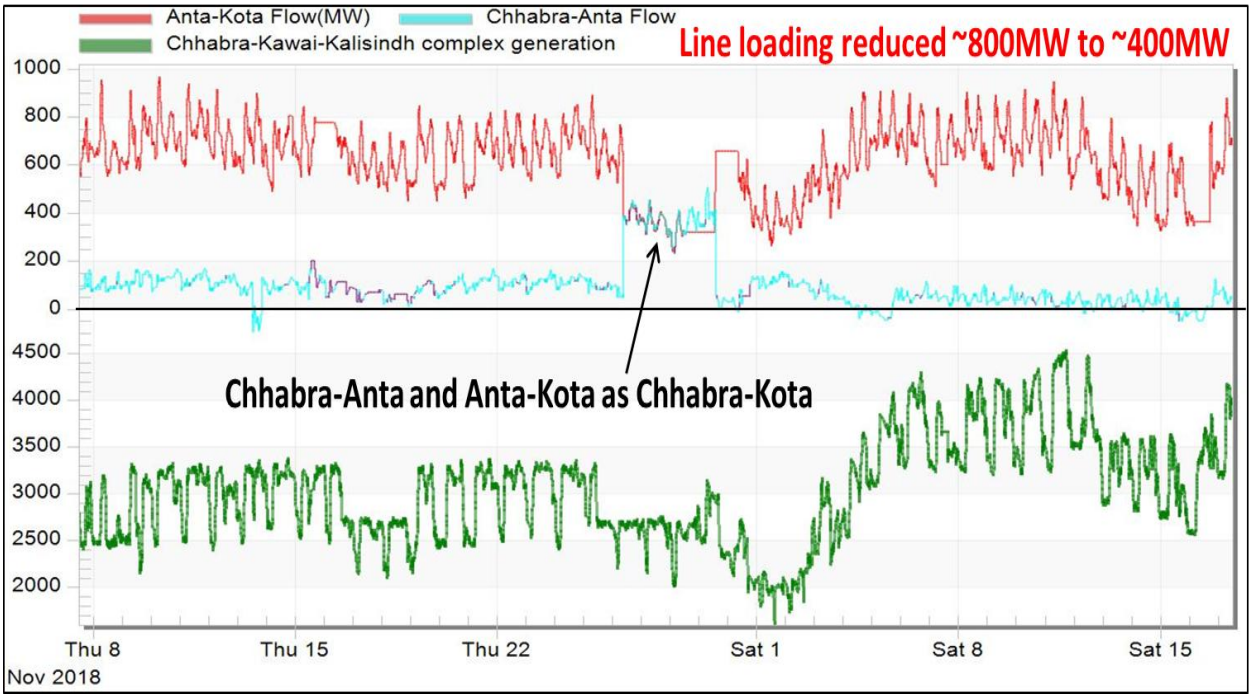
STATUS OF FGD INSTALLATION VIS - A VIS INSTALLATION PLAN AT IDENTIFIED TPS

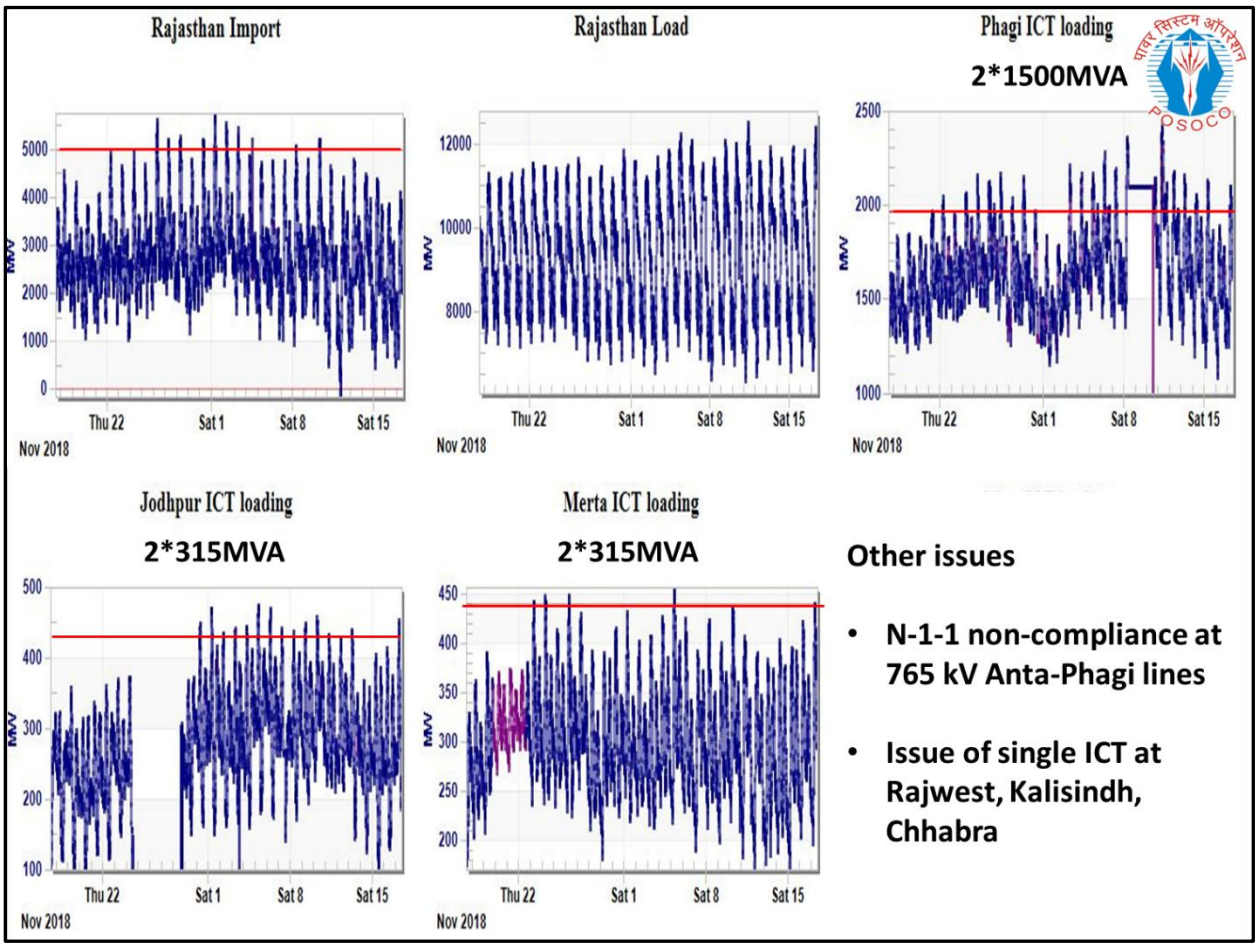
S. No.	Attribute	Status																					
		Kota Super Thermal Power Station (KSTPS)							Suratgarh Super Thermal Power Station (SSTPS)						Chhabra Thermal Power Project (CTPP)				Kalisindh Thermal Power Project (KaTPP)		Chhabra Super Critical Thermal Power Project (CSCTPP)		Suratgarh Super Critical Thermal Power Project (SSCTPP)
1	Developer	Rajasthan Rajya Vidyut Utpadan Nigam Ltd.																					
2	Name of Project	KSTPS							SSTPS						CTPP				KaTPP		CSCTPP		SSCTPP
3	Sector (State/Central /Private)	State																					
4	State	Rajasthan																					
5	Region (NR, ER etc)	NR																					
6	Unit No.	1	2	3	4	5	6	7	1	2	3	4	5	6	1	2	2	4	1	2	5	6	7 & 8
7	Unit Capacity (MW)	110	110	210	210	210	195	195	250	250	250	250	250	250	250	250	250	250	600	600	660	660	2x660 MW
8	Date of Commissioning (DD/MM/YYYY)	17.01.1983	13.07.1983	25.09.1988	01.05.1989	26.03.1994	30.07.2003	30.08.2009	10.05.1998	28.03.2000	29.10.2001	25.03.2002	30.06.2003	29.08.2009	30.10.2009	04.05.2010	14.09.2013	30.06.2014	02.05.2014	06.06.2015	04.04.2017	Under Commissioning	Under Commissioning
9	Age in years	35 yrs & 10 months	35yrs & 3 months	30yrs & 01 months	29yrs & 6 months	24 yrs & 7 months	15yrs & 03 months	9 yrs 02 months	20 yrs. & 5 month	18 yrs & 7 months	17yrs	16 yrs & 7 months	15 yrs & 4 months	9 yrs & 2 months	9 yrs	8 yrs & 5 months	5 yrs & 1 months	4 yrs & 4 months	4 yrs & 5 months	3 yrs & 4 months	1 yr & 6 months		
10	Whether FGD Installed (Y/N)	N	N	N	N	N			N						N				N		N		N
11	Whether FGD space available (Y/N)	Y	Y	Y	Y	Y			Y						Y				Y		Y		Y
12	Whether FGD planned (Y/N)	Feasibility Studies are under Process				Y			Y						Y				Y		Y		Y
13	Feasibility Study Started (Y/N)	Y				Y			Y						Y				Y		Y		Y
14	Feasibility Study Completed (Y/N)	N (under process)				Y			Y						Y				Y		Y		Y
15	Tender Specification Made (Y/N)	N	N	N	N	Y			Y						Y				Y		Y		Y
16	NIT Issued (Y/N)	N	N	N	N	N			N						N				N		N		N
17	Bids Opened (Y/N)	N	N	N	N	N			N						N				N		N		N
18	Bids Opening Date (DD/MM/YYYY)	N	N	N	N	N			N						N				N		N		N
19	Bids Awarded (Y/N)	N	N	N	N	N			N						N				N		N		N
20	Regulator Petition Cleared (Y/N)	N	N	N	N	N			N						N				N		N		N
21	% Progress of FGD Installation	-				-			-						-				-		-		-
22	FGD Commissioned (Y/N)	N	N	N	N	N			N						N				N		N		N
23	FGD working satisfactorily (Y/N)	NA	NA	NA	NA	NA			NA						NA				NA		NA		NA
24	FGD Phasing Plan for Implementation (DD/MM/YYYY)	31.12.20	31.12.20	31.12.20	31.12.20	31.12.22	31.12.22	31.10.22	31.12.22	31.10.22	31.08.22	30.06.22	30.04.22	28.02.22	31.12.21	31.10.21	31.08.21	31.08.21	30.06.21	30.04.21	30.04.20	-	-
25	Status	Feasibility Studies under process				1. Consultancy Services to assess the feasibility in commissioned/likely to be commissioned Units for implementation of revised emission norms in Power Stations of RVUN are being provided by M/s Fichtner Consulting Engineers (India) Pvt. Ltd., Chennai vide work order No. RVUN/CE(Civil-Environment)/D.581 dated 01.02.2018 2. Final DPR for implementation of revised emission norms in these Power Plants has been received. 3. Technical Specifications for FGD in SSCTPS Suratgarh, CSCTPP Chhabra, KaTPP Jhalawar, CTPP Chhabra, SSTPS Suratgarh & KSTPS, Kota has been received has been received. 4. Technical Specification & Bid Documents of FGD installation in SSCTPP Suratgarh, CSCTPP Chhabra & KaTPP Jhalawar have been finalized but due to model code of conduct in view of Assembly Election in Rajasthan, NIT shall be floated after waivel of model code of conduct in Rajasthan																				

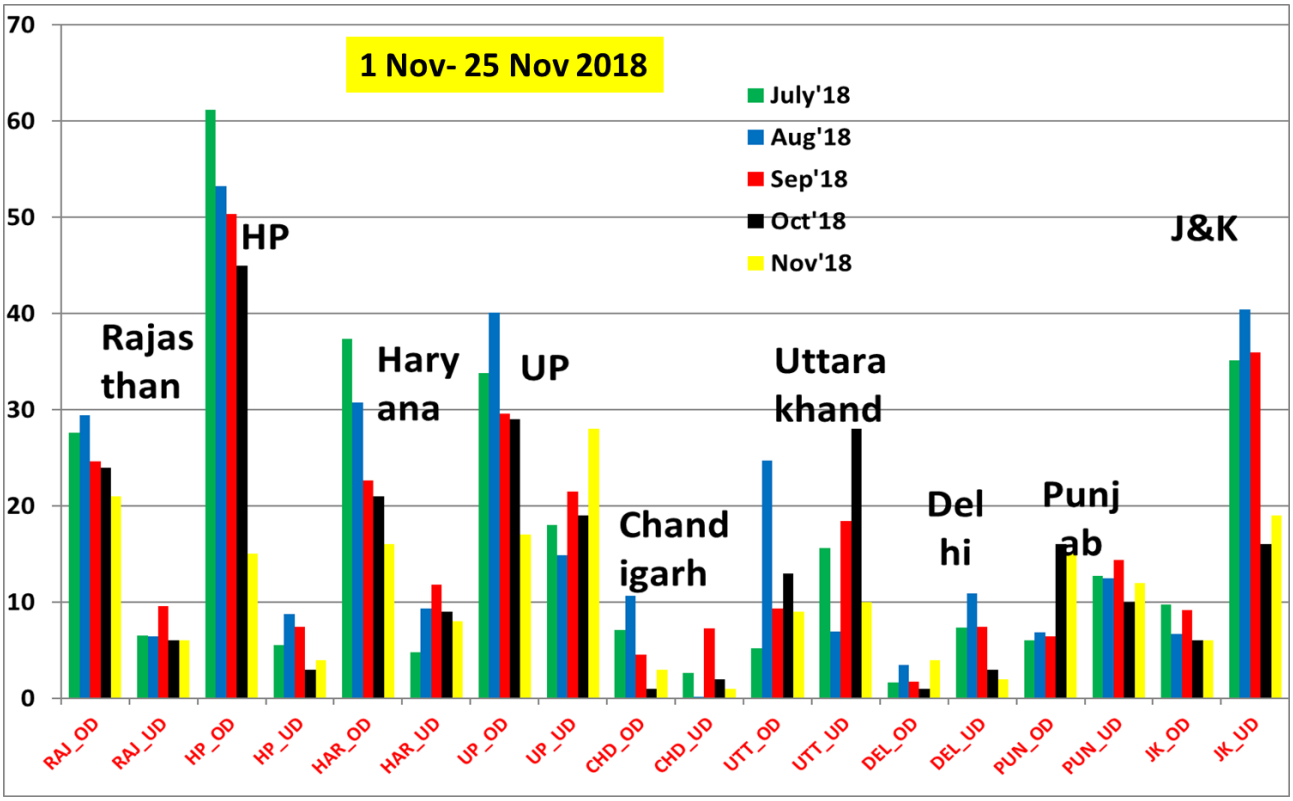
State-wise Emergency Restoration system in NR#				Annexure 15
Transmission Licensee	**Requirement of Total no of ERS in State**	**Number of ERS available in state**	**No of ERS to Be Procured**	**Remark if Any**
POWERGRID		2 set of 400 kV & 2 set 765 kV		
DTL		2 set		
PSTCL		2 set		
UPPTCL		2 set		
PTCUL			2 set	DPR under finalisation.
HVPN			2 set	BOQ under finalisation.
RRVPN			2 set	NIT would floated in 12/2018
HPPTCL			2 set	Matter under consideration regarding funds availability.
PDD J&K		2 set		
BBMB		0	0	153rd OCC : BBMB representative stated that the issue has been discussed in the Power Sub –Committee meeting of BBMB and it has been decided that the ERS will be obtained as and when required from the partner states only.
Sterlite*				

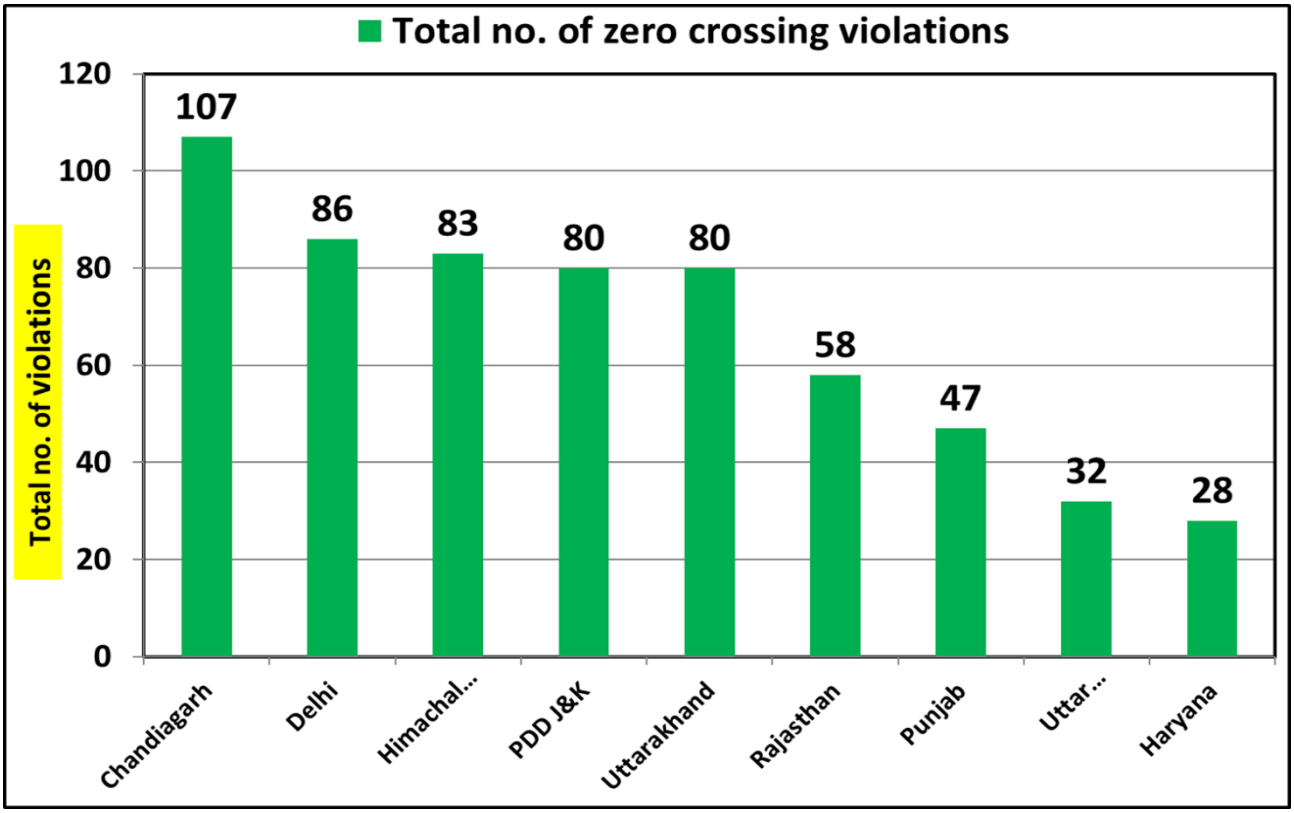
* Sterlite has an arrangement with M/s Supreme,Kolkota, to provide the ERS services as and when required and are in the process of procurement of their own.

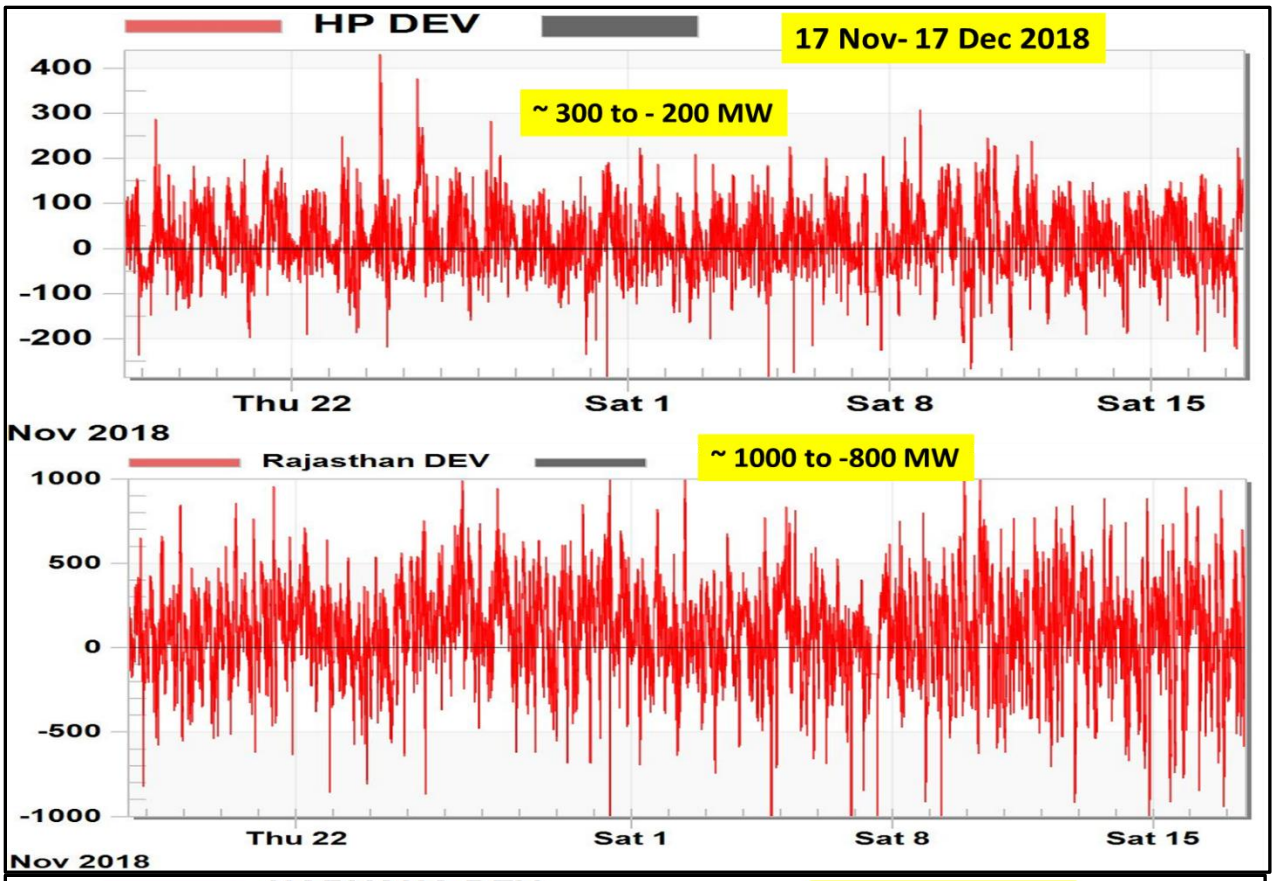
data as availbale with NRPC Sectt.

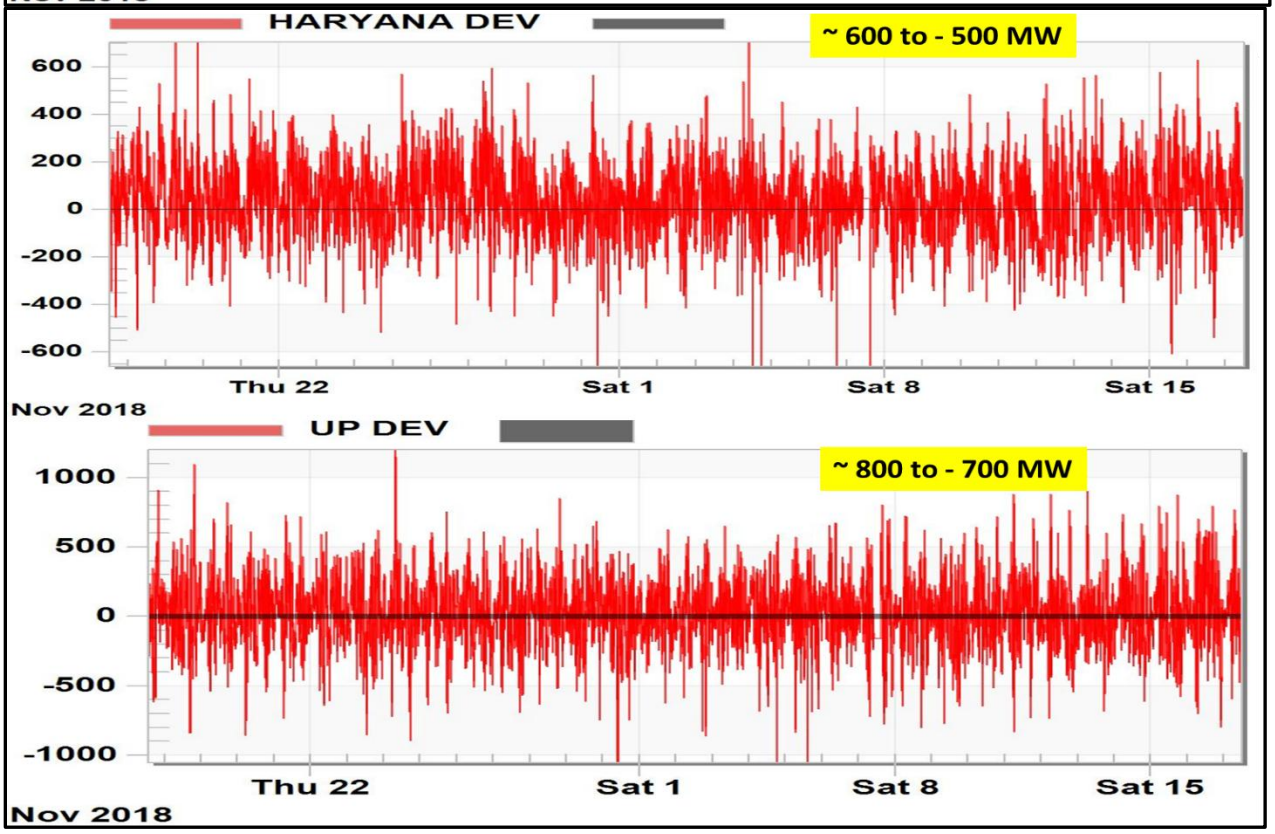

Anta-Kota Flow(MW)
Chhabra-Anta Flow
Chhabra-Kawai-Kalisindh complex generation
Line loading reduced ~800MW to ~400MW
Chhabra-Anta and Anta-Kota as Chhabra-Kota
Thu 8
Thu 15
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018

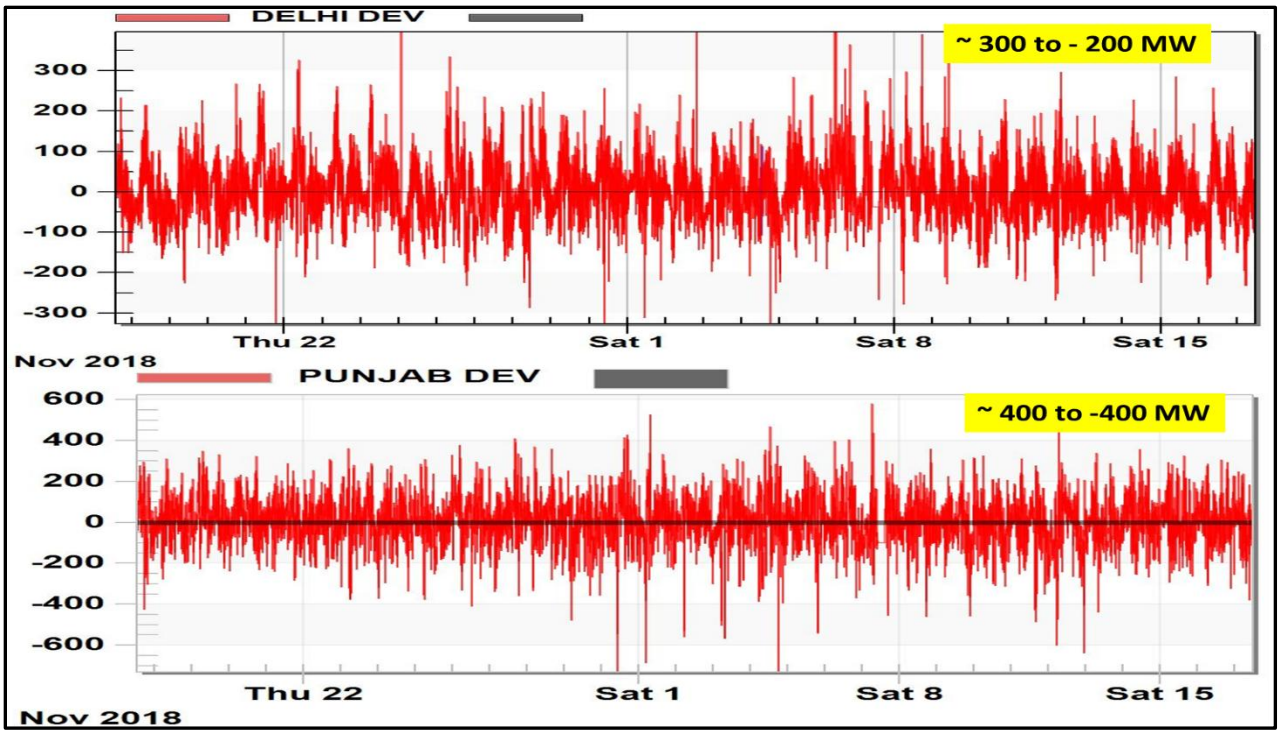

Rajasthan Import
Rajasthan Load
Phagi ICT loading
2*1500MVA
Jodhpur ICT loading
2*315MVA
Merta ICT loading
2*315MVA
POSOCO
Other issues
• N-1-1 non-compliance at 765 kV Anta-Phagi lines
• Issue of single ICT at Rajwest, Kalisindh, Chhabra

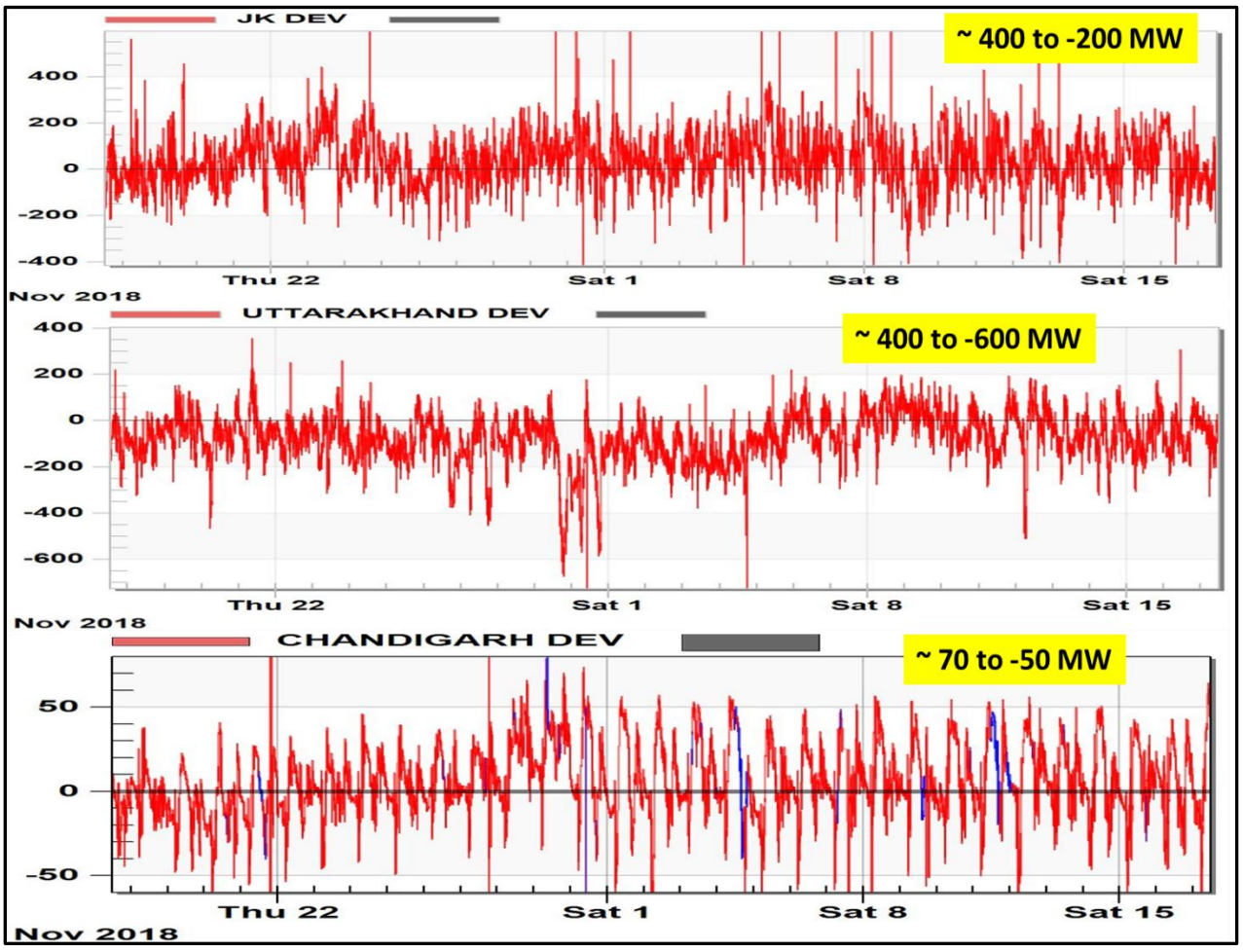

1 Nov- 25 Nov 2018
July'18
Aug'18
Sep'18
Oct'18
Nov'18
Rajas than
HP
Hary ana
UP
Chand igarh
Uttara khand
Del hi
Punj ab
J&K
70
60
50
40
30
20
10
0
RAJ_OD
RAJ_UD
HP_OD
HP_UD
HAR_OD
HAR_UD
UP_OD
UP_UD
CHD_OD
CHD_UD
UTT_OD
UTT_UD
DEL_OD
DEL_UD
PUN_OD
PUN_UD
JK_OD
JK_UD


Total no. of zero crossing violations
Total no. of violations
120
100
80
60
40
20
0
107
86
83
80
80
58
47
32
28
Chandiagarh
Delhi
Himachal...
PDD J&K
Uttarakhand
Rajasthan
Punjab
Uttar...
Haryana


HP DEV
17 Nov- 17 Dec 2018
~ 300 to - 200 MW
400
300
200
100
0
-100
-200
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018
Rajasthan DEV
~ 1000 to -800 MW
1000
500
0
-500
-1000
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018


HARYANA DEV
~ 600 to - 500 MW
600
400
200
0
-200
-400
-600
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018
UP DEV
~ 800 to - 700 MW
1000
500
0
-500
-1000
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018


DELHI DEV
~ 300 to - 200 MW
300
200
100
0
-100
-200
-300
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018
PUNJAB DEV
~ 400 to -400 MW
600
400
200
0
-200
-400
-600
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018


JK DEV
~ 400 to -200 MW
400
200
0
-200
-400
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018
UTTARAKHAND DEV
~ 400 to -600 MW
400
200
0
-200
-400
-600
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018
CHANDIGARH DEV
~ 70 to -50 MW
50
0
-50
Thu 22
Sat 1
Sat 8
Sat 15
Nov 2018

Annexure-3

For POSOCO to develop models of wind farms/ parks connected to Indian grid, the following information are required:

1. Electrical Single Line Diagram of Wind farm /park depicting :
    - For individual WTGs: Type, MW rating, MVAR capability, Manufacturer, Model no.
    - Reticulation system (MV system within the wind farm) : Length of individual branch / twig, Type of conductor, Electrical parameters (R, X, B)
    - Details of MV (690V/33kV) and HV (33kV/220kV) step-up transformers: Rating, Impedance, Tap changers (Type, Tap Steps, Max Ratio and Min Ratio in p.u.)
    - Aggregated steady state model (if available)
2. Encrypted model in PSS/E (*.dll files) for electromechanical transient simulation for components of WTGs / Wind farm
    - User guide for Encrypted models to be provided including instructions on how the model should be set-up
    - Corresponding transfer function block diagrams to be provided
    - Simulation results depicting validation of User-Defined models against actual measurement to be provided
    - The use of black-box type representation is not acceptable
3. Generic models of WTGs / Wind farms (in case of non-availability of item as per Sl.no.2 above).
    - Simulation results depicting validation of Generic models against User-Defined models or against actual measurement to be provided
4. Wind Turbine datasheet
5. Voltage/reactive control strategy of farm, reactive capability curves
6. Settings from a wind turbine (each model in the farm)
7. Settings from the Power plant controller
8. Disturbance recordings – of wind farm response to disturbance together with any associated information about the circumstances of the disturbance

3.1 Generic models in PSS/E for different technologies of Wind Turbines

Wind Turbine type	Technology	Generic model	Model Description
Type-1	Direct connected induction generator (SCIG) a) Fixed Speed Stall Control b) Fixed Speed Active Control	WT1G1	Generator model (conventional induction generator)
		WT2T1	Drive train model (two-mass drive train model)
		wt1p_b	Pitch controller *(Use only for Type 1 with active stall*)
Type-2	Wound rotor induction generator (WRIG) with a variable resistor in the rotor circuit, and typically employs pitch control	WT2G1	Generator model (induction generator with external rotor resistance
		WT2E1	External resistance controller
		WT12T1	Drive train model
		wt1p_b (no equivalent in PSS/E)	Pitch controller
Type-3	Doubly fed induction generator (DFIG) wind turbines ; Variable speed with rotor side converter	REGCA1	Renewable energy generator converter model
		REECA1	Renewable energy controls model
		WTDTA1	Drive train model
		WTARA	Wind turbine aerodynamic model
		WTPTA1	Simplified pitch controller model
		WTTQA1	Wind generator torque control
		REPCTA1	Renewable energy plant controller
Type-4	Full converter wind turbine Generator types: a) Synchronous b) Permanent Magnet type	REGCA1	Renewable energy generator converter model
		REECA1	Renewable energy controls model
		WTDTA1	Drive train model
		REPCA1	Renewable energy plant controller

Annexure: Formats for submission of modelling data for wind turbine generators / wind farms

Version History:

Version no.	Release Date	Prepared by*	Checked/Issued by*	Changes

***Mention Designation and Contact Details

Details submitted:

Details pending:

Details of models in PSS/E for modelling Wind plants / farms / parks:

Category	Parameter Description	Data
Generator Nameplate	Connection point voltage (kV)	
	Terminal voltage (kV)	
	Wind Farm - Rated active power (sent out) in MW	
	Turbine – Rated MVA	
	Turbine – Rated active power (PMAX) in MW	
	Number of wind turbines (Type wise)	
Reactive power capability	Capability chart at connection point [If not available, then for each individual wind turbine, and mode of operation of Power Plant Controller]	-
	QMAX	
	Qmin	
Single Line Diagram	Single line diagram of the wind farm showing number and location of turbines, cable run, transformers, feeders (including type of cables and electrical R,X,B parameters), and connection to transmission system Preferable : Electrical Single Line Diagram including details between individual WTGs and b/w WTGs and aggregation points	
Wind Turbine Details	Manufacturer and product details (include Year of Manufacture)	
	Year of commissioning	
	Fixed speed or variable speed	
	Type of turbine: stall control, pitch control, active stall control, limited variable speed, variable speed with partial or full-scale frequency converter	
	Hub height (in metre)	
	Rotor diameter (in metre)	
	Number of blades	
	Rotor speed (in rpm)	
	Gearbox ratio	
Generator	Type of generator: Type 1/ Type 2 / Type 3 / Type 4	
	Number of pole pairs	
	Stator resistance (in Ohms)	
	Rotor resistance (in Ohms)	
Speed control	Details of speed controller in wind turbine	
	Efficiency (Cp) curves	
	Cut-in wind speed	
	Wind speed at which full power is attained Cut-out wind speed	
	Pitch angle at low wind speed	

Category	Parameter Description	Data
Reticulation System	Voltage of the reticulation system	
	Number of feeders	
	Cable schedules (lengths, cable size, conductor material, rating info)	
Turbine Transformer	Details of the turbine transformer, including vector group, impedance, and number of taps, tap position, tap ratio	
	Nameplate details	
Wind-farm Step-up transformer	Details of the main wind farm step up transformer, including vector group, impedance, and tap position	
	Nameplate	
	OLTC?	
	Controlled bus	
	Voltage setpoint	
	Dead band	
	Number of taps	
	Tap ratio range	
Connection Details	Voltage influence (maximum change etc)	
	Short circuit ratio (SCR)	
	· Min	
	· Max	
	Harmonic filters	
	STATCOM	
	Synchronous condensers	
Power Plant Controller (PPC) Details	Does the wind farm have a PPC? If yes, whether PPC controls all or part of the WTGs in wind farm	
	What is the method of control – voltage regulation, power factor control, reactive power control?	
	Voltage control strategy (operating mode) - Controls MV Bus - Controls HV Bus - PF control - Q control - Voltage control	
	Is there a droop setting? - Voltage control - Frequency Control - Is there line drop compensation?	
	Is reactive power limited?	
	Temperature dependency	
	Active power ramp rate limiters	
	FRT protocols and setpoints - LVRT - HVRT	
	Provide settings from controller.	

3.3 Generic Models for Type-1 and Type-2 Wind turbine generators:

Category	Parameter Description	Data
GENERATOR model		
Generator : Type-1 (WT1G1)	Synchronous reactance (ohms or pu) Xs	
	Transient reactance (ohms or pu) X'	
	Wound rotor induction generator (WRIG) with a variable resistor in the rotor circuit, and typically employs pitch control	
	Leakage reactance, X_L	
	Saturation curve (E1, S(E1), E2, S(E2)	
Generator : Type-2 (WT2G1)	XA, stator reactance (pu)	
	Doubly fed induction generator (DFIG) wind turbines ; Variable speed with rotor side converter	
	X1 rotor reactance (put)	
	R_Rot_Mach, rotor resistance (pu)	
	R_Rot_Max (sum of R_Rot_Mach + total external resistance) in pu	
	Saturation curve (E1, S(E1), E2, S(E2)	
	Power – slip curve (Top 5 points in the T-s curve)	
Electrical Control model		
Rotor Resistance Control : Type-2 (WT2E1)	TsP, rotor speed filter time constant, sec.	
	Tpe, power filter time constant, sec.	
	Ti, PI-controller integrator time constant, sec.	
	Kp, PI-controller proportional gain, pu	
	ROTRV_MAX, Output MAX limit	
	ROTRV_MIN, Output MIN limit	
Drive Train model		
Two-Mass Turbine Model for Type 1 and Type 2 Wind Generators : (WT12T1)	H, Total inertia constant, sec	
	DAMP, Machine damping factor, pu P/pu speed	
	Htfrac, Turbine inertia fraction (Hturb/H)1	
	Freq1, First shaft torsional resonant frequency, Hz	
	Dshaft, Shaft damping factor (pu)	

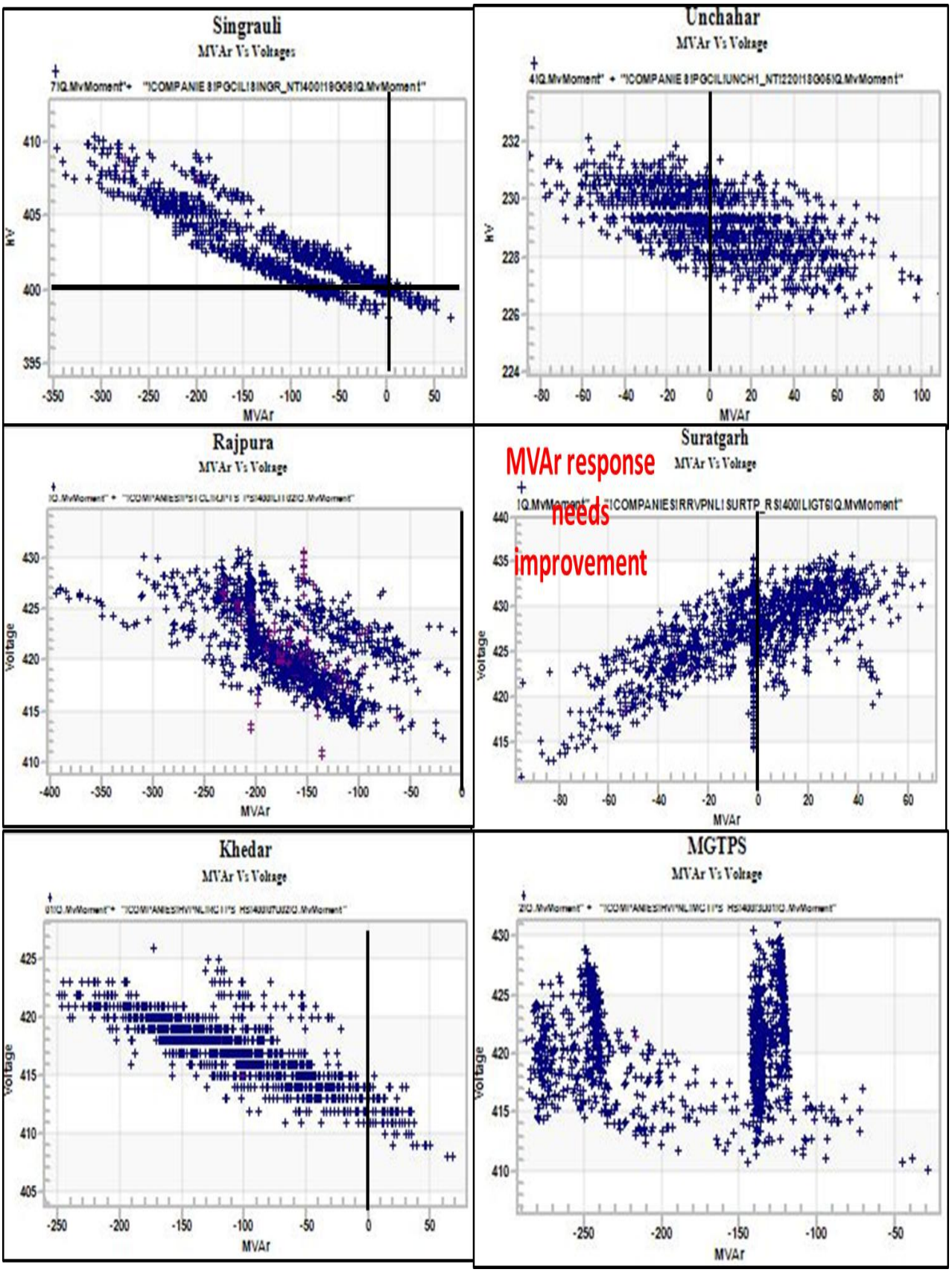
3.4 Generic Models for Type-3 and Type-4 Wind turbine generators:

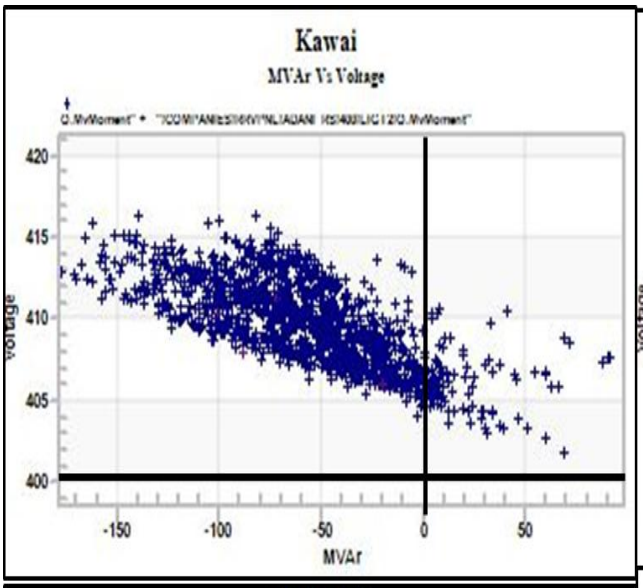
Category	Parameter Description	Data
GENERATOR model		
Type-3 or Type-4 (REGCA1)	Tg, Converter time constant (s)	
	Rrpwr, Low Voltage Power Logic (LVPL) ramp rate limit (pu/s)	
	Wound rotor induction generator (WRIG) with a variable resistor in the rotor circuit, and typically employs pitch control	
	Zerox, LVPL characteristic voltage 1 (pu)	
	Lvpl1, LVPL gain (pu)	
	Volim, Voltage limit (pu) for high voltage reactive current manage-	
	Doubly fed induction generator (DFIG) wind turbines ; Variable speed with rotor side converter	
	Lvpnt1, High voltage point for low voltage active current manage-	
	ment (pu)	
	Lvpnt0, Low voltage point for low voltage active current manage-	
	ment (pu)	
	Iolim, Current limit (pu) for high voltage reactive current manage-	
	ment (specified as a negative value)	
	Tfltr, Voltage filter time constant for low voltage active current man-	
	agement (s)	
	Khv, Overvoltage compensation gain used in the high voltage reac-	
	tive current management	
	Iqrmax, Upper limit on rate of change for reactive current (pu)	
	Iqrmin, Lower limit on rate of change for reactive current (pu)	
	Accel, acceleration factor (0 < Accel <= 1)	
Electrical Control model		
Type-3 and Type-4 Wind turbines : (REECA1) [Refer Block Diagrams]	Vdip (pu), low voltage threshold to activate reactive current injection logic	
	Vup (pu), Voltage above which reactive current injection logic is activated	
	Trv (s), Voltage filter time constant	
	dbd1 (pu), Voltage error dead band lower threshold (≤0)	
	dbd2 (pu), Voltage error dead band upper threshold (≥0)	
	Kqv (pu), Reactive current injection gain during over and undervoltage conditions	
	Iqh1 (pu), Upper limit on reactive current injection Iqinj	
	Iql1 (pu), Lower limit on reactive current injection Iqinj	
	Vref0 (pu), User defined reference (if 0, model initializes it to initial terminal voltage)	
	Iqfrz (pu), Value at which Iqinj is held for Thld seconds following a voltage dip if Thld > 0	
Category	**Parameter Description**	**Data**

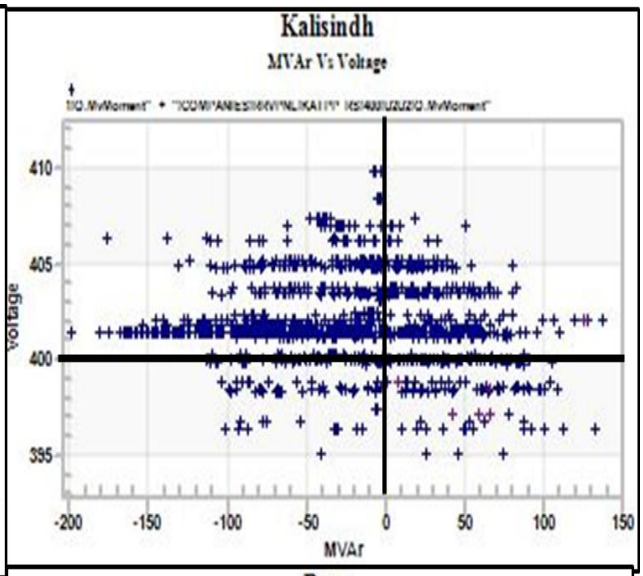
Electrical Control model		
Type-3 and Type-4 Wind turbines : (REECA1) [Refer Block Diagrams]	Thld (s), Time for which Iqinj is held at Iqfrz after voltage dip returns to zero (see Note 1)	
	Thld2 (s) (≥0), Time for which the active current limit (IPMAX) is held at the faulted value after voltage dip returns to zero	
	Tp (s), Filter time constant for electrical power	
	QMax (pu), limit for reactive power regulator	
	QMin (pu) limit for reactive power regulator	
	VMAX (pu), Max. limit for voltage control	
	VMIN (pu), Min. limit for voltage control	
	Kqp (pu), Reactive power regulator proportional gain	
	Kqi (pu), Reactive power regulator integral gain	
	Kvp (pu), Voltage regulator proportional gain	
	Kvi (pu), Voltage regulator integral gain	
	Vbias (pu), User-defined bias (normally 0)	
	Tiq (s), Time constant on delay s4	
	dPmax (pu/s) (>0) Power reference max. ramp rate	
	dPmin (pu/s) (<0) Power reference min. ramp rate	
	PMAX (pu), Max. power limit	
	PMIN (pu), Min. power limit	
	Imax (pu), Maximum limit on total converter current	
	Tpord (s), Power filter time constant	
	VQ-IQ characteristic (at least two pairs, up to 4 pairs of voltage and current in pu)	
	VP-IP characteristic (at least two pairs, up to 4 pairs, of voltage and current in pu)	[Refer Block Diagrams]
	Is turbine in PF control or Q control (including controlled by external signal)?	
	Is the turbine controlling voltage (directly, not than through PPC)?	
	If controlling voltage directly what bus does it control?	
	Is the turbine in P or Q priority mode?	
Drive Train model		
	H, Total inertia constant, sec	
	DAMP, Machine damping factor, pu P/pu speed	
	Htfrac, Turbine inertia fraction (Hturb/H)1	
	Freq1, First shaft torsional resonant frequency, Hz	
	Dshaft, Shaft damping factor (pu)	

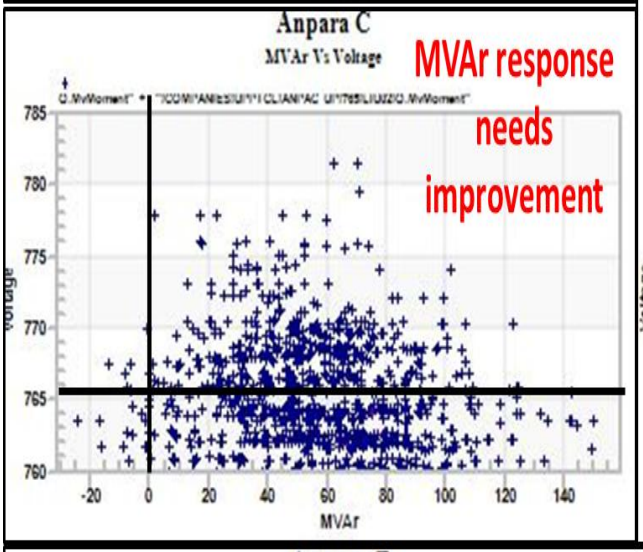
Category	Parameter Description	Data
Pitch Control model [for Type-3 only]		
Generic Pitch Control model for Type-3 : (WTPA1)	Kiw, Pitch-control Integral Gain (pu)	
	Kpw, Pitch-control proportional gain (pu)	
	Kic, Pitch-compensation integral gain (pu)	
	Kpc, Pitch-compensation proportional gain (pu)	
	Kcc, Gain (pu)	
	Tp, Blade response time constant (s)	
	TetaMax, Maximum pitch angle (degrees)	
	TetaMin, Minimum pitch angle (degrees)	
	RTetaMax, Maximum pitch angle rate (degrees/s)	
	RTetaMin, Minimum pitch angle rate (degrees/s) (< 0)	
Aerodynamic model [For Type-3 only]		
(WTARA1)	Ka, Aerodynamic gain factor (pu/degrees)	
	Theta 0 Initial pitch angle (degrees)	
Torque Controller model [For Type-3 only]		
Generic Torque Controller for Type-3 wind machines : (WTTQA1)	Kpp, Proportional gain in torque regulator (pu)	
	KIP, Integrator gain in torque regulator (pu)	
	Tp, Electrical power filter time constant (s)	
	Twref, Speed-reference time constant (s)	
	Temax, Max limit in torque regulator (pu)	
	Temin, Min limit in torque regulator (pu)	
	p1, power (pu)	
	spd1, shaft speed for power p1 (pu)	
	p2, power (pu)	
	spd2, shaft speed for power p2 (pu)	
	p3, power (pu)	
	spd3, shaft speed for power p3 (pu)	
	p4, power (pu)	
	spd4, shaft speed for power p3 (pu)	
	TRATE, Total turbine rating (MW)	

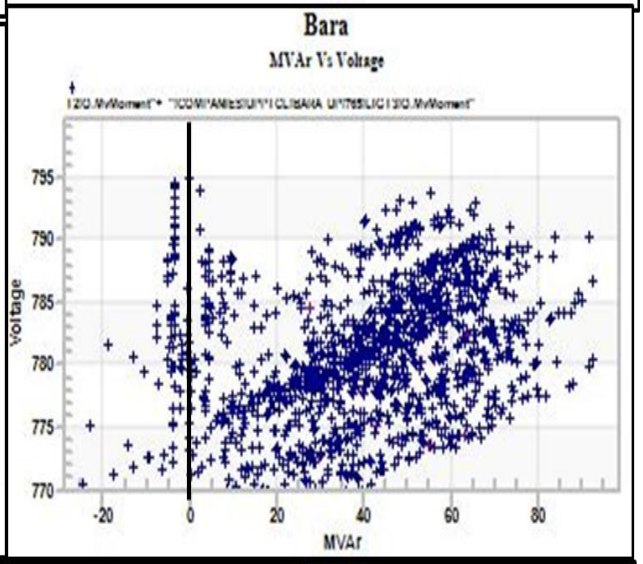
Category	Parameter Description	Data
Power Plant Controller (PPC) model		
Generic Power Plant Controller (PPC) model for Type-3 and Type-4 wind turbines : REPCTA1 for type 3, and REPCA1 for type 4 turbines	Tfltr, Voltage or reactive power measurement filter time constant (s)	
	Kp, Reactive power PI control proportional gain (pu)	
	Ki, Reactive power PI control integral gain (pu)	
	Tft, Lead time constant (s)	
	Tfv, Lag time constant (s)	
	Vfrz, Voltage below which State s2 is frozen (pu)	
	Rc, Line drop compensation resistance (pu)	
	Xc, Line drop compensation reactance (pu)	
	Kc, Reactive current compensation gain (pu)	
	emax, upper limit on deadband output (pu)	
	emin, lower limit on deadband output (pu)	
	dbd1, lower threshold for reactive power control deadband (<=0)	
	dbd2, upper threshold for reactive power control deadband (>=0)	
	Qmax, Upper limit on output of V/Q control (pu)	
	Qmin, Lower limit on output of V/Q control (pu)	
	Kpg, Proportional gain for power control (pu)	
	Kig, Proportional gain for power control (pu)	
	Tp, Real power measurement filter time constant (s)	
	fdbd1, Deadband for frequency control, lower threshold (<=0)	
	Fdbd2, Deadband for frequency control, upper threshold (>=0)	
	femax, frequency error upper limit (pu)	
	femin, frequency error lower limit (pu)	
	Pmax, upper limit on power reference (pu)	
	Pmin, lower limit on power reference (pu)	
	Tg, Power Controller lag time constant (s)	
	Ddn, droop for over-frequency conditions (pu)	
	Dup, droop for under-frequency conditions (pu)	


Singrauli
MVAr Vs Voltages
kV
MVAr
Unchahar
MVAr Vs Voltage
kV
MVAr
Rajpura
MVAr Vs Voltage
voltage
MVAr
Suratgarh
MVAr Vs Voltage
MVAr response needs improvement
voltage
MVAr
Khedar
MVAr Vs Voltage
voltage
MVAr
MGTPS
MVAr Vs Voltage
voltage
MVAr


Kawai
MVAr Vs Voltage
Voltage
MVAr


Kalisindh
MVAr Vs Voltage
Voltage
MVAr


Anpara C
MVAr Vs Voltage
MVAr response needs improvement
Voltage
MVAr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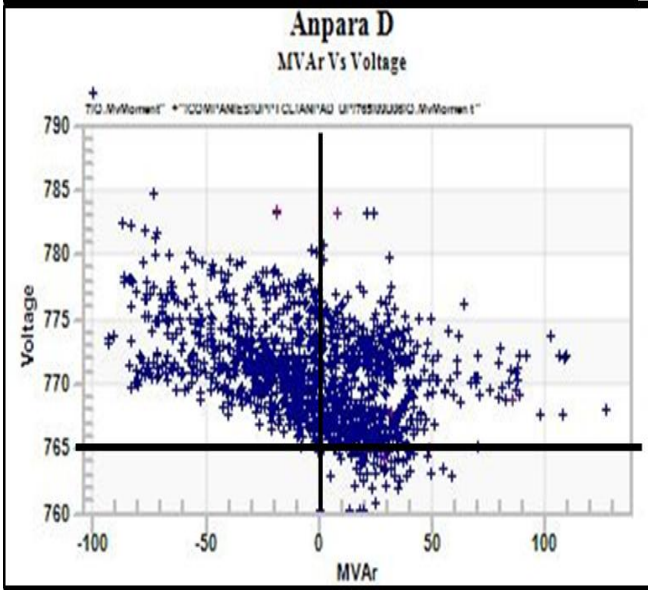
MVAr Vs Voltage
Voltage
MVAr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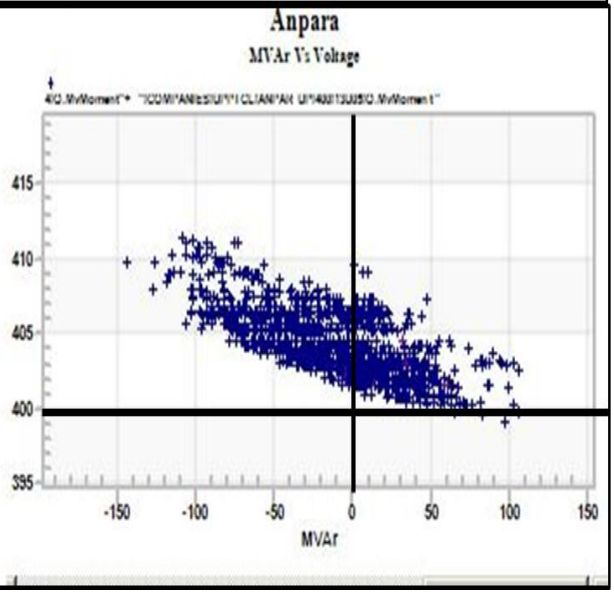
MVAr Vs Voltage
Voltage
MVAr


Anpara
MVAr Vs Voltage
MVAr

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