North Eastern Regional Power Committee

Agenda For

155th OCC Sub-Committee Meeting

Time of meeting : 10:00 Hrs.

Date of meeting : 10th April, 2019 (Wednesday)

Venue : "Hotel Nandan", Guwahati.

A. CONFIRMATION OF MINUTES

CONFIRMATION OF MINUTES OF 154th MEETING OF OPERATION SUB-COMMITTEE OF NERPC.

The minutes of 154th meeting of Operation Sub-committee held on 13th March, 2019 at Guwahati were circulated vide letter No. NERPC/SE (O)/OCC/2016/4556-4591 dated 25th March, 2019.

The Sub-committee may confirm the minutes of 154th OCCM of NERPC with the following amendments as no other comments/observations were received from the constituents.

ACTION TAKEN -ITEMS

B.1. ACTION TAKEN:

1. IMPLEMENTATION OF PROJECTS FUNDED FROM PSDF:

The status as informed in 154th OCC:

State	R&U scheme	ADMS	Capacitor Installation	SAMAST **	Line Differential Protection
Ar. Pradesh	Pkg-I: OBD completed. By Feb'19 LOA. Pkg-II: Tendering in process.	To submit comments to NIT by 18/02.	-	TESG queries submitted.	-
Nagaland	Pack-B: Dec'18 Pack-C: Dec'18	To submit comments to NIT by 18/02.	To re-submit proposal to NERPC for Study.	TESG queries **to be submitted**.	Lines identified. Under DPR preparation stage.
Mizoram	LOAs issued. Completion by Mar'19.	To submit comments to NIT by 18/02.	To re-submit proposal to NERPC for Study.	TESG queries submitted.	Lines not yet identified. To be taken up in Sub-group.
Manipur	LOAs issued. Completion by Nov'18.	To submit comments to NIT by 18/02.	Submitted to NERPC for Study before sending to NPC/NLDC.	TESG queries **to be submitted**.	Lines not yet identified. To be taken up in Sub-group.

Tripura	90% completed. Remaining by Feb'19	To submit comments to NIT by 18/02.	To submit proposal to NERPC for Study.	TESG queries submitted.	Lines not yet identified. To be taken up in Sub-group.
Assam	Substation auxiliary and diagnostics tools - Tendering in process. LOA by Dec'18.	To submit comments to NIT by 18/02.	-	TESG queries submitted.	Lines identified. Under DPR preparation stage.
Meghalaya	MePTCL LOA issued, 95%completed. Remaining LOAs by Feb'19. Commissioning works 60% completed, Total balance works by Jun'19. MePGCL – Erection complete by Mar'19	Revised DPR submitted. Query referred to DISCOM	-	TESG queries submitted.	DPR already submitted and awaited approval.

The entities may also be advised to furnish status as per format by first week of every month on regular basis to Member Convener, PSDF Project Monitoring Group (AGM, NLDC, POSOCO) with a copy to NPC & NERPC. The LOAs of R&M Scheme are to be furnished to NERLDC/NERPC regularly.

States may please intimate the latest status.

2. Long Outage of Important Grid Elements:

Name of the Element	Name of Utility	Status as informed in 154th OCC	Latest status
63MVAR Reactor at Byrnihat to replace with 80MVAR Reactor	MePTCL	NERPC will write to CEA for inclusion in NERSCT's MoM.	

Outage of 420kV 80MVAR L/R for 400kV Bongaigaon-NSLG-I at Bongaigaon - (out since *04.07.18*)	NERTS	By March, 2019	
132kV Dimapur - Imphal (*out since 25.07.18*)	NERTS	During 154th OCCM, Sr.GM (AM) NERTS informed that ROW issue for locations under Kohima District are yet to be resolved. In this regard, Power Commissioner of Nagaland has already made communication to Commissioner Home Nagaland on 11.03.19 for early resolution of the issue. Under such circumstances, Sr.GM (AM) informed the forum that the completion of job may scroll to June 2019 only if ROW issues are resolved within March 2019. The main reason of delay is ROW issue and thus extension of availability is due as per initial MOM.	
220kV Sonabil-Samaguri-I	AEGCL	LOA by March, 2019	
420kV 63 MVAR Line Reactor at 400 kV Bongaigaon S/S for 400kV Bongaigaon-Azara(out since Nov'18)	NERTS	By March, 2019 Subject to SD approval	

Utilities may please intimate the latest status.

3. <u>Submission of various data pertaining to reliable operation of the grid:</u>

Details of the data required	Name of Utility	Status of submission as per 154th OCC	Latest status
Primary response testing of generators: The make, vintage, kind of governor and whether facility for simulated signal input to governor is there or not	NTPC, NHPC	By Mar'19	
Data for Wind Turbine Generator	All SLDCs	By 30th April, 2019	

B.2. OPERATIONAL PERFORMANCE AND GRID DISCIPLINE DURING MARCH, 2019

As per the data made available by NERLDC, the grid performance parameters for March, 2019 are given below:

NER PERFORMANCE DURING MARCH, 2019

	Energy Met (MU)		w.r.t. Feb,19 % inc (+) /dec (-)	Energy Reqr. (MU)		w.r.t. Feb,19 % inc (+) /dec (-)	% inc (+) /dec (-) of energy reqr vs met. In Mar,19
States	**Mar-19**	**Feb-19**		**Mar-19**	**Feb-19**		
Ar. Pradesh	60.49	76.93	-21.37	60.87	77.28	-21.23	-0.62
Assam	656.48	621.73	5.59	679.52	635.00	7.01	-3.39
Manipur	67.51	94.74	-28.74	68.13	95.46	-28.63	-0.91
Meghalaya	172.78	188.34	-8.26	173.24	188.35	-8.02	-0.27
Mizoram	49.37	70.46	-29.93	49.80	70.98	-29.84	-0.86
Nagaland	57.29	77.40	-25.98	58.48	85.74	-31.79	-2.03
Tripura	89.94	147.46	-39.01	90.25	148.35	-39.16	-0.34
Region	**1153.87**	**1277.05**	**-9.65**	**1180.30**	**1301.15**	**-9.29**	**-2.24**

	Demand Met (MW)		w.r.t. Feb,19 % inc (+) /dec (-)	Demand in (MW)		w.r.t. Feb,19 % inc (+) /dec (-)	% inc (+) /dec (-) of energy reqr vs met. In Mar,19
States	**Mar-19**	**Feb-19**		**Mar-19**	**Feb-19**		
Ar. Pradesh	131	148	-11.49	133	138	-3.62	-1.50
Assam	1508	1440	4.72	1539	1417	8.61	-2.01
Manipur	199	194	2.58	204	192	6.25	-2.45
Meghalaya	357	356	0.28	357	355	0.56	0.00
Mizoram	105	109	-3.67	108	102	5.88	-2.78
Nagaland	125	132	-5.30	127	130	-2.31	-1.57
Tripura	249	231	7.79	249	231	7.79	0.00
Region	**2535**	**2514**	**0.84**	**2540**	**2480**	**2.42**	**-0.20**

REGIONAL GENERATION & INTER-REGIONAL EXCHANGE IN MU

Month---->	**Mar-19**	**Feb-19**
Total Generation in NER (Gross)	1240.164	1101.311
Total Central Sector Generation (Gross)	977.118	841.084
Total State Sector Generation (Gross)	263.046	260.227
Inter-Regional Energy Exchange		
(a) NER-ER	**312.59**	**184.75**
(b) ER-NER	**5.13**	**1.07**
(c)NER-NR	**0.00**	**4163.00**
(d)NR-NER	**381.85**	**45.83**
© Net Import	74.39	-4300.85

AVERAGE FREQUENCY (Hz)

Month---->	**Mar-19**	**Feb-19**
	% of Time	% of Time
Below 49.9 Hz	7.23	7.23
Between 49.9 to 50.05 Hz	70.92	70.92
Above 50.05 Hz	21.85	21.85
Average	50.00	50.00
Maximum	50.26	50.26
Minimum	49.68	49.68

C. ITEMS- STATUS REVIEW

1. Status of Generating Units, Transmission Lines in NER:

During 154th OCC meeting, the status as informed by different beneficiaries is as follows:

SN	Items	Status as given in 154th OCC Meeting		Status as given in 155th OCC Meeting	
		Timeline for completion	Timeline for completion	Timeline for completion	Furnishing of detail parameters
a. New Elements					
1	250 MW BgTPP Unit #III	By Mar'19	To be submitted to NERLDC.		
2	400/220kV, 315 MVA ICT-1 of NTPC at Bongaigaon	By Mar'19	To be submitted to NERLDC.		
3	Kameng HEP of NEEPCO two units (2 x 150 MW) Next two units (2x150 MW)	By July'19	Already submitted.		
4	132kV Monarchak – Surjamaninagar D/C of TSECL	by Jun'19	To be submitted to NERLDC.		
5	400/220 kV 315 MVA ICT-II at Bongaigaon	LV side (GIS) is expected to be completed by Apr'19.	LV side separate application to be submitted		
6	220/132 kV, 160MVA ICT-II at Balipara	Apr'19	To be submitted to NERLDC.		
7	220/132 kV, 1x160 MVA ICT with GIS Bay at Kopili	Apr'19	To be submitted to NERLDC.		
8	Dedicated 33kV feeder at Khliehriat Substation from Lumshnong.	To be taken up with MePDCL. SLDC to kindly mediate.	Not applicable.		

9	Replacement of 2x315 MVA ICTs with 2x500 MVA ICTs at Misa (PG)	• **ICT-I** Expected by March'19 without Tertiary connectivity of 4X25MVAR Tertiary Reactors and • **ICT-II** Expected by Jun'19	To be submitted to NERLDC.		
10	220kV Balipara-Sonabil-2	AEGCL will intimate the status in next OCC Meeting			
b. Elements under breakdown/upgradation					
11	Up-gradation of 132 kV Lumshnong-Panchgram line	DPR sent to NLDC/NPC	Not applicable.		
12	PLCC Panels at Loktak end of Loktak – Ningthoukhong 132 kV feeder and Loktak - Rengpang 132 kV feeder	May'19	Not applicable.		
13	Replacement of CTs and installation of Bus Bar Protection at 220 kV Misa	Expected Completion : Apr'19	Not applicable		
14	Upgradation of 132 kV Bus Bar at Umiam Stg-III to ACSR Zebra	DPR will be submitted soon.	Not applicable		
15	220/132 kV 30 MVA ICT at Mokokchung	Mar'19(LOA date) to be reviewed later on.	To be submitted to NERLDC		

Concerned constituents may kindly intimate the status.

C.2. Update on Real Time Energy Assessment for Effective Grid Management:

In 154th OCC meeting, the following were decided:

- CDAC to complete installation of TARA devices by 31.03.2019.
- Integration of WBES schedule & SMS alert app to be deployed by CDAC

NERTS has been advised to complete installation/replacement of SEMs as per list below –

SL NO	FEEDER NAME	STATUS	METER TO BE REPLACED/ INSTALLED BY PGCIL	Status
1	**SRIKONA END OF 132kV SILCHAR FDR -1**	REPLACE	1	To be done on 15th March'19
2	**SRIKONA END OF 132kV SILCHAR FDR -2**	REPLACE	1	
3	**MOKOK(S) END OF MOKOK-MOKOK-1**	REPLACE	1	To be completed by 25Th March'19
4	**MOKOK(S) END OF MOKOK-MOKOK-2**	REPLACE	1	
5	**KHUPI END OF 132 KV BALIPARA**	INSTALL	1	Khupi end requested to install the meter after 15th March because of non-availability of concerned person
6	**KHUPI END OF 132 KV KAMENG**	INSTALL	1	
7	**ZUANGTUI END OF MELRIAT**	INSTALL	1	Letter given to state for providing necessary permission for fitting of new meters. Reply awaiting
8	**LUANGMOL END OF AIZAWL**	INSTALL	1	

NERPC/CDAC may please update the status.

C.3. Ensuring proper functioning of Under Frequency Relays(UFR) & df/dt Relays:

In 7th NPC meeting held on 08.09.17 it was agreed that mock test is good enough to test the healthiness of the UFR & df/dt relays. The frequency of site inspection was proposed to be upto six months. RPC may carry out periodic inspection, in line with provisions of IEGC and furnish inspection reports to NPC.

Discussions as per previous meetings:-

- Inspection for Mawphlang completed.
- Inspection for Baghjap, Sankardevnagar and Sipajhar under Assam would be tentatively done by Apr'19.

NERPC may please intimate the latest status.

C.4. Extended C Band VSAT for power system communications in NER:

As per discussion in previous meetings:

- Leased Line Connectivity has been explored by NERTS for Roing, Tezu & Namsai with recurring expenditure amounting to INR 28 lakhs.
- VSAT Pilot project to be executed at Byrnihat station. The data would be transmitted from Byrnihat to KPTCL (via satellite) to SRLDC to NLDC to NERLDC. This would be kept in monitoring mode in the interim. Pilot project cost breakup for one year is to be put up for approval in the next TCC/RPC meeting. NERLDC has requested for finalisation of modality for VSAT pilot project. Order to be given to M/s KPTCL.
- NERPC to take up with proper authorities for funding of VSAT in NER from suitable sources.
- Financial impact for NER states i.r.o. VSAT for Roing, Tezu, Namsai by POWERGRID is to be explored (tentative cost is ▪ 54,653,880.00 for 5 years). matter has been referred to Corporate LD&C.
- Technical visit on 10.12.2018 concluded that VSAT for NER is technically feasible.

NERPC/NERLDC may please intimate the status.

C.5. DIMAPUR_PG Voice communication and telemetry out since Feb'18.

In 154th OCCM NERTS informed that as per 148Th OCC meeting the voice has already been restored on March'18. LOA has been placed to M/s GE which include both supply and installation. To be completed by June'19. However all the analog signals has been made through and also almost 80% digital signals are also reporting.

NERTS may please update the latest status.

C.6 Update on PDMS:

As per deliberation in the previous meeting(s) the following status/decisions:-

- Operational load flow has been completed and circulated to all constituents for comments. *SLDCs may please update the status.*
- Database building and network modelling for Assam has been completed.
- Server installation at NERPC to commence in March'19.
- Assam SAT w.e.f. 25.03.19 to 28.03.19. M/s PRDC to circulate the verifiable documents.
- Data collection for Meghalaya would commence in April'19.

- A technical committee would be formed with protection experts from various utilities.

NERPC/PRDC may please update the status.

C.7 Non-availability/ Non-functioning of synchronization facility at numerous stations

As per deliberations in the previous the following is the status for synchronization facility at stations of different utilities:

- NERTS – All stations synchronization facility available. The same is available at RTAMC. Sync check to be tested for 132kV AGTCCPP-Kumarghat on 16.02.19- To be tested again during the Black Start scheduled to be held in April, 2019.

- AEGCL – Sync check not available for 132kV stations. Procurement of synchronizing trolley and associated equipments(sockets etc.) to be completed. LOA date to be intimated by AEGCL. ***AEGCL may please update status.***
- DoP Ar.Pradesh – Sync check not available at Lekhi and Chimpu. Would be in place by Sep'19. ***DoP Ar. Pradesh may please update the status.***

NERLDC/NERTS/AEGCL/DoP Ar. Pradesh may please update the status

C.8 Phase shift errors in PMU:

In 153rd OCCM Sr.GM, NERTS informed that the 220kV of NER has phase matching with 220kV ER(Birpara). So, at present it is not recommended to change at primary as downstream will be affected. After detailed deliberations, the forum decided that wirings in the secondary may be changed. In this regard, a matrix is to be made for changing the connections. Since PMU is not installed in all ISTS elements, concerned utilities are requested to trigger DR output manually for all ISTS elements and submitted to NERPC/NERLDC for preparation of the matrix. It was decided that a team from NERPC (Sh Srijit Mukherjee), NERTS (Sh. Supriya Paul/Devaprasad Paul), NERLDC (Sh. Zerin Jacob) & AEGCL (Sh. Abhishek Kalita) will identify the exact problem at Silchar, Misa & Sarusajai by Feb'19.

In 154th OCCM it was agreed that the work would be completed by April'19.

NERPC may please update the status.

C.9 Compensation for Heat Rate degradation and Auxiliary Energy Consumption in case of gas based power plants:

In 154th OCCM it was decided that a Special Meeting would be convened prior to discuss the Heat Rate Degradation and Compensation Calculation for Thermal Power Plants.

NERPC may please intimate the status.

C.10 Operation of RHEP units in Synchronous condenser mode

In 153rd OCCM, Sr. Manager, NEEPCO informed that prima-facie it appears that Synchronous Condenser mode operation is not possible. However NEEPCO has written to BHEL(Bhopal) for solution. This item would be reviewed in the next meeting.

In 154th OCCM NEEPCO stated that as per communication from M/s BHEL the design of turbine and generator is such that, the generator can work in synchronous condenser mode. However the embedded pipe, air compressed system, DVR, protection logic etc. as per 2nd stage foundation drawing is not in place. This is in scope of NEEPCO. The matter has since been taken up with BHEL and the reply is awaited by mid April'19.

NEEPCO may please intimate the status.

C.11 Accurate Load forecasting by SLDCs as per IEGC c1.5.3 for better system operation

In 153rd OCCM NERLDC presented the RMSE for the month of Dec'18:

% Error with Actual Data (Forecasted by States)							
	Ar Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura
Median	16	6	7	10	32	12	8

Mizoram & Arunachal Pradesh SLDCs are requested to check the methodology for improving the load forecast.

In 154th OCCM, Mizoram informed that the issue will be intimated in the next OCC. Ar. Pradesh could not be updated due to absence of representative.

DoP Ar. Pradesh/P&ED Mizoram may please intimate the status.

C.12 Construction of Bay for 132kV Agia-Nongalbibra Line at 220kV Agia Sub Station, Agia, Assam

Stringing of 2nd Circuit 132kV Nongalbibra -Agia Line (SPA Scheme) Rs. 1.11 Cr Deposited by MePTCL by SBI Chq No. 511140 Dt. 15.03.2016 for the above work. Stringing of the Line Completed in 2018.

In 154th OCCM Meghalaya informed that stringing of line in their portion is almost completed.

AEGCL informed that C&R panels is yet to be installed. For this temporarily Non-SAS compatible panel would be diverted from other site. By Apr'19

AEGCL/MePTCL may please update the status.

C. 13 Tentative schedule for Black Start & Restoration Procedure Mock exercise in NER during the year 2019

In 154th OCCM the mock black start schedule was agreed as below:
AGTCCPP 09-04-19
LOKTAK 12-04-19

Khandong 06-06-19
KOPILI 07-05-19
RHEP 1st week of June'19
DOYANG 2nd week of June'19

NEEPCO/NHPC may please intimate the status.

C. 14 DVAR and PSS at AGTCCPP:

In 154th OCCM Sr. Manager, NEEPCO informed that the DVAR & PSS have already arrived at site and the same is to be commissioned now. AGTCCPP informed the FORUM that they changed the control system for Unit I. After the return of Unit 4, they will replace old AVR with DVAR along with PSS tentatively by April'19.

NEEPCO may please intimate the status.

C. 15 Bus Configuration issues for various sub-stations:

Distribution of 132 kV lines in both 132 kV Bus-1 & Bus-2 at Surajmaninagar for reliable operation. Action is to be taken by TSECL.

400kV Bus-A at Ranganadi & 132 kV Transfer Bus at Loktak are not commissioned as per the scheme since inception.

The 154th OCC forum requested TSECL for distribution of feeders in both the bus. It was also highlighted that in S.M. Nagar- phase sequence has to be ensured between Bus-2 and transfer Bus. TSECL mentioned that they would revert with timeline.

Regarding 400kV Bus-A at Ranganadi, NEEPCO requested NERPC to write to NEEPCO Management about the non-availability, as it is not proper to operate in single bus.

Regarding transfer bus at Loktak, NHPC informed that the same would be ready by Jun'19. In addition, NERPC informed that they will write a letter for both 400 Bus-A at Ranganadi and 132kV Transfer Bus at Loktak.

TSECL/ NEEPCO/NHPC/NERPC may please inform the status.

C. 16 Reactive power capability/injection of generating stations:

1. Tentative schedule for Reactive Power Capability testing of generating units- Tentative date for testing at Pare is 05.04.2019
2. Palatana units are not capable of regulating MVAR absorption/injection as the units are in AVR mode. Manual VAR regulation is not possible as informed by Palatana.

The 154th OCC forum requested all generators to strictly follow their capability curve.

NERLDC has informed that Palatana response not adequate as discussed in 154th meeting. (**Annexure-C.16**)

NERLDC/NEEPCO may please inform the status.

C. 17 Metering Status Review:

i. Procurement of additional 70 Laptops

ii. Non-receipt of SEM Time Drift Report **(Annexure-C.17)**

NERLDC/NERTS/All STUs may please intimate the status.

D. I T E M S FOR DISCUSSION

D.1 Generation Planning (ongoing and planned outages)

a. Present per day MU and projected number of days of operation.

Plants	Reservoirs level in meter	MU content	Present DC (in MU)	No of days as per current generation
Khandong + Kopili stg II			0.198	
Kopili			1.104	
Doyang			0.15275	
Loktak			1.097	

The outage of other generating stations may be approved considering the present water levels in reservoirs.

The Committee may discuss and approve the proposed shutdown by Generating Stations as given in Annexure – D.2 which is available in NERPC website.

D.2 Outage Planning Transmission elements

It was agreed in the 99th OCC meeting that shutdown will be availed only after approval is given by the OCC forum. It was also agreed that deferment/revision of outages elements other than already approved in OCC will be henceforth put/displayed in the website of NERPC (**under Operational Activities/OCC Approved shutdown**) as per CERC regulations/ CEA guidelines etc for ensuring smooth & secure grid operation.

Furnishing request of shut down of the element, which was approved by NERPC, by Indenting Agency (ISTS licensees/STUs/Generating Companies) to NERLDC: Planned shutdown approved by NERPC shall be considered for implementation by NERLDC on D-3 basis. If an outage is to be availed on say 10th of the month, the shutdown availing agency would reconfirm to NERLDC on 7th of the month by 10:00 Hr. This practice is necessary to ensure optimal capacity utilization and the time required for associated system study/coordination by/amongst RLDC/NLDC.

The sub-Committee may kindly discuss and approve the transmission line outages proposed by Constituents for April,2019 - May,2019 which is available in the website of NERPC.

D.3 Estimated Transmission Availability Certificate (TAC) for the month of December, 2018 - February, 2019:

NETC and POWERGRID have submitted the outage data for the month of December, 2018 - February, 2019. So the attributability of outage of the said elements may please be finalized.

Members may please discuss.

D.4 RGMO performance analysis of events

In 153rd OCCM, NERLDC presented a report on RGMO performance for an event on 05th Feb 2019 at 11:57 Hrs when load loss of aprrox. 869 MW occurred in Northern Region wherein the following generators have not given the desired response:

-Palatana GTG-I -BgTPP Unit – II

And the following generators have given negative response:

-Palatana GTG-II, STG-I/II -Kopili Unit#I

-BgTPP Unit #I

In 154th OCCM, OTPC informed that it operation of plant in RGMO is very difficult and the same has been informed in earlier OCC meeting also. Further, they stated that increasing generation in fraction of second is very difficult as corresponding amount of gas is not supplied automatically. ONGC is operating the pipeline manually and night time is even impossible.

NERLDC may please highlight the event dated 12.03.2019.

Members may please discuss.

D.5 Assessment of TTC, TRM & ATC by SLDC on respective Inter-State Transmission Corridor

The 154th OCC forum requested all the SLDCs to carry out the TTC/ATC calculations and decided that SLDC Ar. Pradesh would give presentation in the next OCC.

Members may please discuss.

D.6 Reliable power supply to Manipur system

For Ensuring reliable power supply to Manipur system, following actions were suggested by NERLDC:

a. 132 kV Jiribam – Jiribam (MA) – Rengpang – Loktak link to be kept in loop
b. Restoration of 132 kV Dimapur – Imphal line
c. Upgradation of 132 kV Kohima – Karong – Imphal (MSPCL) link

In 154th OCCM MSPCL informed the Forum that they would keep in 132 kV Jiribam – Jiribam (MA) – Rengpang – Loktak lin loop after checking the phase sequence. Powergrid informed 132kV Dimapur-Imphal will be restored after June 2019 and regarding Upgradation of 132 kV Kohima – Karong – Imphal (MSPCL) link no discussion due to the absence of Nagaland personnel.

Members may please discuss.

D. 7 Overloading of 132kV Pare-Lekhi line:

To limit the overloading of 132kV Pare-Lekhi line, 132kV Itanagar-Lekhi line has to be kept closed. As reported by SLDC Arunachal Pradesh during real time, they are unable to close the 132kV Itanagar-Lekhi line. Status review of CT ratio of 132kV Itanagar-Lekhi (Study results enclosed as Annexure-D.7)

NERLDC may please deliberate.

D.8 First time Charging of New Elements

Proposal for furnishing technical parameters required for dynamic modelling for start-up power and first-time synchronization of generators in standard formats.

In 154th OCCM NERLDC informed that draft standard format for furnishing technical parameters required for dynamic modelling for start-up power and first-time synchronization of generators was circulated to utilities vide email. It was requested to all utilities to give comments by 30th April'19, if any. Standard format for furnishing technical parameters required for dynamic modelling is attached as **Annexure-D.8**.

Members may please discuss.

AGENDA ITEMS FROM NERLDC:

D.9 Furnishing of breakup of STOA sold on contingency basis:

It has been observed that BgTPP, NTPC does not send breakup of STOA sold on contingency basis in real time. It is very important information for schedule preparation in real time. In absence of that BgTPP schedule become wrong in some day. It is requested to BgTPP to look into the matter.

NERLDC may please deliberate.

D.10 WhatsApp Group on "NER Grid Operation"

WhatsApp Group on "NER Grid Operation" has been created for exchange of information involving members from NER SLDCs, NERLDC, NERPC, POWERGRID, STU, ISGS etc. There are about 90 members in the group as on date. Active discussion in the group helps in coordination among utilities. NERPC may formalize.

NERLDC may please deliberate.

D.11 Reduction of NER-ER TTC

Reduction of NER-ER TTC for 26th Mar'19 for shutdown of 400 kV Misa-Balipara I was implemented as per D-3 confirmation. However, the shutdown was not availed in real time. NERTS may intimate the reason for deviation from the schedule after confirmation on D-3. Utilities are requested to strictly adhere to the approved shutdown schedule after confirmation on D-3.

NERLDC may please deliberate.

D.12 Updating the List of Important Grid Elements of NER.

All the Utilities are requested to update the excel file by 30th April'19 circulated vide email dated 06.02.19.

NERLDC may please deliberate.

D. 13 Spare of SEMs / DCDs:

Spare SEMs in stock are around 15 nos. and spare DCDs around 5 nos. as per latest information available. Considering the upcoming Transmission & Generation projects to be commissioned in next 2 years, 100 SEMs & 20 DCDs may be procured.

NERLDC may please deliberate.

D. 14 5 min metering:

CERC Order Dated: 16th of July, 2018, on Petition No. 07/SM/2018 (Suo-Motu) in the matter of - Pilot Project on 05-Minute Scheduling, Metering, Accounting and Settlement for Thermal/Hydro, and on Hydro as Fast Response Ancillary Services (FRAS). Following are the action points –

a. CTU to Install sixteen no. of 5-minute SEMs in NER- Eight nos. at Loktak HEP (4-main & 4-check) and Eight nos. at NTPC-BgTPP (4-main & 4-check).
b. All future procurements of Interface Energy Meters should ideally have recording at 5min interval and frequency resolution of 0.01 Hz. They should be capable of recording Voltage and Reactive Energy at every 5-min and should have feature of auto-time synchronization through GPS.
c. Accordingly, CTU shall facilitate the pilot project with installation of 5-minute meters at the pre-identified locations.

Accordingly CTU to arrange 16 no. of 5-Minute SEMs along with 2 no. of Compatible DCDs.

NERLDC may please deliberate.

AGENDA FROM NERTS:

D.15 Dismantling of 132kV S/C Dimapur-Imphal Transmission Line on account of highway construction by NHIDCL at Nagaland - outage thereof.

During the deliberation of special meeting held at Imphal on 25.09.2018 in connection with dismantling of 132KV Dimapur - Imphal S/C Transmission Line of POWERGRID to facilitate construction of Dimapur-Kohima 4-lane Highway, it was discussed and decided that POWERGRID would dismantle the line in various stretches involving 32 nos. of locations to clear the front to NHIDCL for construction of the Highway. Further, POWERGRID agreed to restore the line within 31.01.2019 subject to resolve of all RoW issues in time by Nagaland State Administration immediately on occurrence.

The foundation & erection works for diversion of the line has accordingly been taken up by POWERGRID with adequate mobilization. However, Right of Way issues along the new route involving 28 nos. of locations became deterrent to the progress as those are taking considerable time to get resolved. Further, with continuous persuasion with state administration only compensation for ROW of Dimapur portion involving 15 nos. of tower could be cleared on 08.03.2019. Subsequently, POWERGRID could expedite the progress in said 15 nos. of locations.

Now, so far as Kohima portion involving 13 nos. of tower is concerned, compensation for ROW of 9 locations has been finalised by the district Administration (Kohima) on 18.03.2019 and subsequently, POWERGRID has mobilised gangs in those locations.

Thus, as on date, following critical issues are pending with state administration:

a. Finalization of compensation of ROW for balance 4 locations in Kohoma District

b. Finalization of compensation for Surface damage for all the new spans in Kohima District

POWERGRID is pursuing continuously with the Administration to resolve above issue so that the construction activity can be taken up subsequently. In this regard, Commissioner (Power), Nagaland has expressed concerned on the issue and communicated Commissioner, Nagaland on 11.03.2019 to finalise the land compensation issue of Kohima portion to facilitate diversion of 132kV Dimapur – Imphal Line. The copy of the letter is enclosed for your ready reference.

Under such circumstances, considering lead time required for construction after resolving ROW issues, it is envisaged that the complete diversion work of 132kV Dimapur – Imphal Line would require another 3-4 months i.e., atleast till July 2019. However, possibility of further extension of completion period exists under following conditions:

1. Non-finalisation of balance compensation issues in Kohima District as stated above by Nagaland within March 2019.

2. Possible uncongenial weather condition in coming monsoon as the job already spilled over to monsoon period.

It is pertinent to mention here that considering the request of Nagaland Government, the concerned authority of the region allowed dismantling of 132kV Dimapur – Imphal Line to facilitate construction of Highway in Nagaland. However, as per practice, for any diversion work POWERGRID always first construct the diverted portion and then shifting is done to avoid outage. But, in this particular case the situation is otherwise.

Hence, considering all above stated facts, it is requested to consider the outage of 132kV Dimapur – Imphal Line under ***"Force Majeure Condition"*** till completion of restoration.

NERTS may please deliberate.

D.16 Acute Right Of Way constraints in execution of Railway diversion work of 132kV Nirjuli - Ranganadi TL

The issue of RoW constraints encountered by POWERGRID in Railways diversion work of 132KV Nirjuli -Ranganadi TL in Arunachal Pradesh was discussed in details during 19th TCC & NERPC meeting held at Guwahati on 27th & 28th Nov'2018.

As decided during the meeting, POWERGRID has already taken up the matter with Commissioner (Power), Govt. of Arunachal Pradesh & it is understood that necessary instruction has been passed on to the district Administration for early resolution of the RoW constraints.

It is pertinent to mention here that due to acute RoW issue the original route involving 3 locations was changed to another route involving 4 locations as per the advice of DC. However, as on date, POWERGRID is yet to receive clearance from AP Administration for RoW in the revised route which falls in Ambabasti village under Papumpare District. This is severely affecting the diversion work of the line as well as OPGW link establishment between Nirjuli, Lekhi (DoP, A.P.) & Ranganadi HEP under Microwave vacation project.

NERTS may please deliberate.

D.17 Acute Right Of Way constraints in in faced by POWERGRID in Assam for Maintenance of Transmission Lines:

During 19th NERPC Meeting held on 28th and 29th November 2019 at Guwahati, the issue of acute ROW problem faced by POWERGRID for maintaining 800 kV HVDC, BNC-AGRA Line, 400 kV D/C Bongaigaon – Balipara – III & IV, 400 kV D/C Silchar – PK Bari – I & II Line was discussed in details.

Till now, since then, there is no improvement in ROW issues. It is to be mentioned here that ± 800kV HVDC Line is passing through three region viz. NER, ER & NR and so, if any one Region takes shut down; other two Regions get opportunity shut down for maintenance of the line. Thus, there are many opportunity shut down available in this line but unfortunately, NER is not able to avail such opportunity shut down apart from its own approved shut down because of persisting ROW issues. The matter needs to be resolved on priority by escalating at highest administrative authority so that such important lines can be made defect free by carrying out regular maintenance by POWERGRID.

NERTS may please deliberate.

D.18 Circuit Breaker between Air Insulated Substation (AIS) and Gas Insulated Substation (GIS):

During 152nd OCCM (Refer MOM Item No. D.29), NERLDC proposed to install circuit breaker between AIS and GIS so that integration of GIS with AIS and maintenance of AIS bus could be done without taking the shutdown of the GIS and vice-versa in all the hybrid substations of NER.

Accordingly, the matter was referred to CTU for necessary review. After detail examination by CTU and POWERGRID, CC Engineering Department it was conveyed that construction of 400kV Bus Sectionalizer at this juncture is not possible due to severe space constrain and other technical issues. Further, it is suggested that for maintenance of AIS bus, jumpers interconnection between AIS & GIS may be removed.

NERTS may please deliberate.

D.19 Conversion of 132kV Badarpur, 132kV Khliehriat, 132/33kV Nirjuli and 132kV Imphal Station from Single Main Transfer Scheme to Double Main Transfer Scheme on GIS on completion of 25 years age:

During 16th NERPC and 6th SCM Meeting, approval was accorded for up-gradation of Bus Bar Scheme from Single Main Transfer to Double Main for 132kV Haflong, 132kV Jiribam, 132kV Kumarghat and 132kV Aizawl Sub Station on completion of 25 Years age considering the fact that Single Main and Transfer Scheme offers minimum reliability. Due to space constraint the conversion / up-gradation was approved on GIS from AIS.

Now the existing Bus Bar arrangement of 132kV Badarpur, 132kV Khliehriat, 132/33kV Nirjuli and 132kV Imphal Station is also Single Main and Transfer Scheme. These stations are going to complete 25 Years age during current tariff block 2019-24. Hence, in line with earlier approval of 132kV Haflong, 132kV Jiribam, 132kV Kumarghat and 132kV Aizawl Sub Station, it is proposed to convert the existing Single Main Transfer Scheme of 132kV Badarpur, 132kV Khliehriat 132/33kV Nirjuli and 132kV Imphal Station to Double Main and Transfer on completion of 25 Years. Further, here also there is a space constraint for which up-gradation is proposed on GIS from AIS. The tentative expenditure considering each station to be Rs. 30.00 Crores is Rs. 120.00 Crores.

NERTS may please deliberate.

Any other item:

Date and Venue of next OCC

It is proposed to hold the 156th OCC meeting of NERPC on second week of May, 2019. The date & exact venue will be intimated in due course.

*****

Annexure-C.16

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

उत्तर पुर्वी क्षेत्रीय भार प्रेषण केंन्द्र : लोअर नँगरा, लापालांग, शिलांग-793006, (मेघालय)
North Eastern Regional Load Despatch Centre: Lower Nongrah, Lapalang, Shillong - 793006, (Meghalaya)
Ph : 0364-2537470, 2537427, Fax - 2537486 Website : www.nerldc.org, Email - nerldc@posoco.in, CIN : U40105DL2009GOI188682

सदंर्भ/Ref: NERLDC/SO-I/OTPC/2019/ दिनांक/Date :01-04-2019

To,
The Head of the Project,
OTPC Power Plant
Udaipur-Kakraban Road, Palatana P.O.,
District Gomati, Tripura-799105

विषय/SUB: Non absorption of MVAR by all units of OTPC Palatana

Sir,

It has been observed that all the units of OTPC Palatana are unable to absorb MVAR and they have been observed to be in MVAR generation mode at almost all the times. Plots on MVAR generation/absorption of all the units pertaining to last one week along with the respective bus voltage have been attached as Annexure to this letter.
In this context, you are requested to kindly regulate the MVAR flow such that MVAR is absorbed by the units during high voltage condition in the Palatana Bus and MVAR id generated by the units during low voltage condition.

This is for further necessary action at your end please.

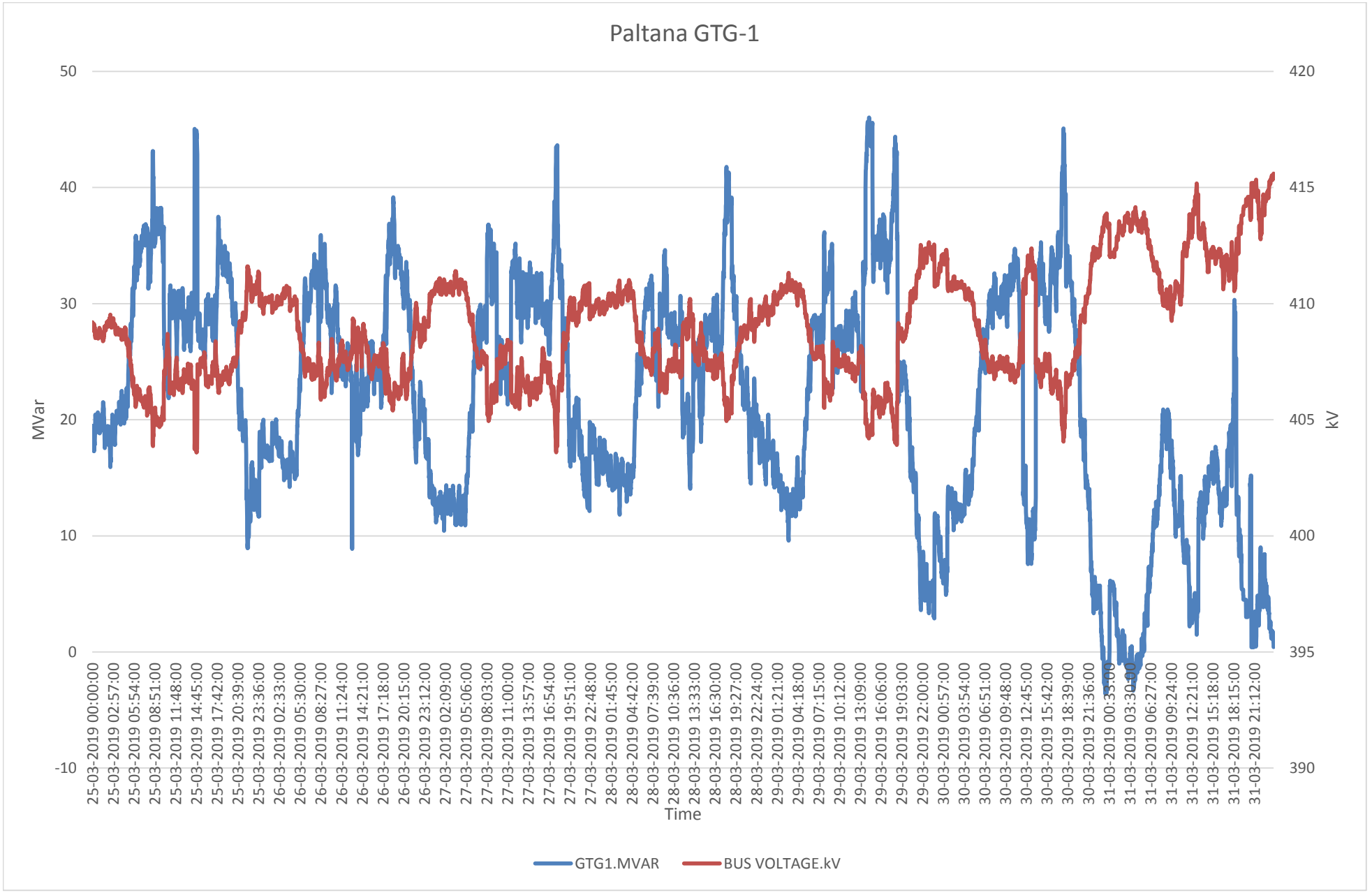
Yours sincerely,

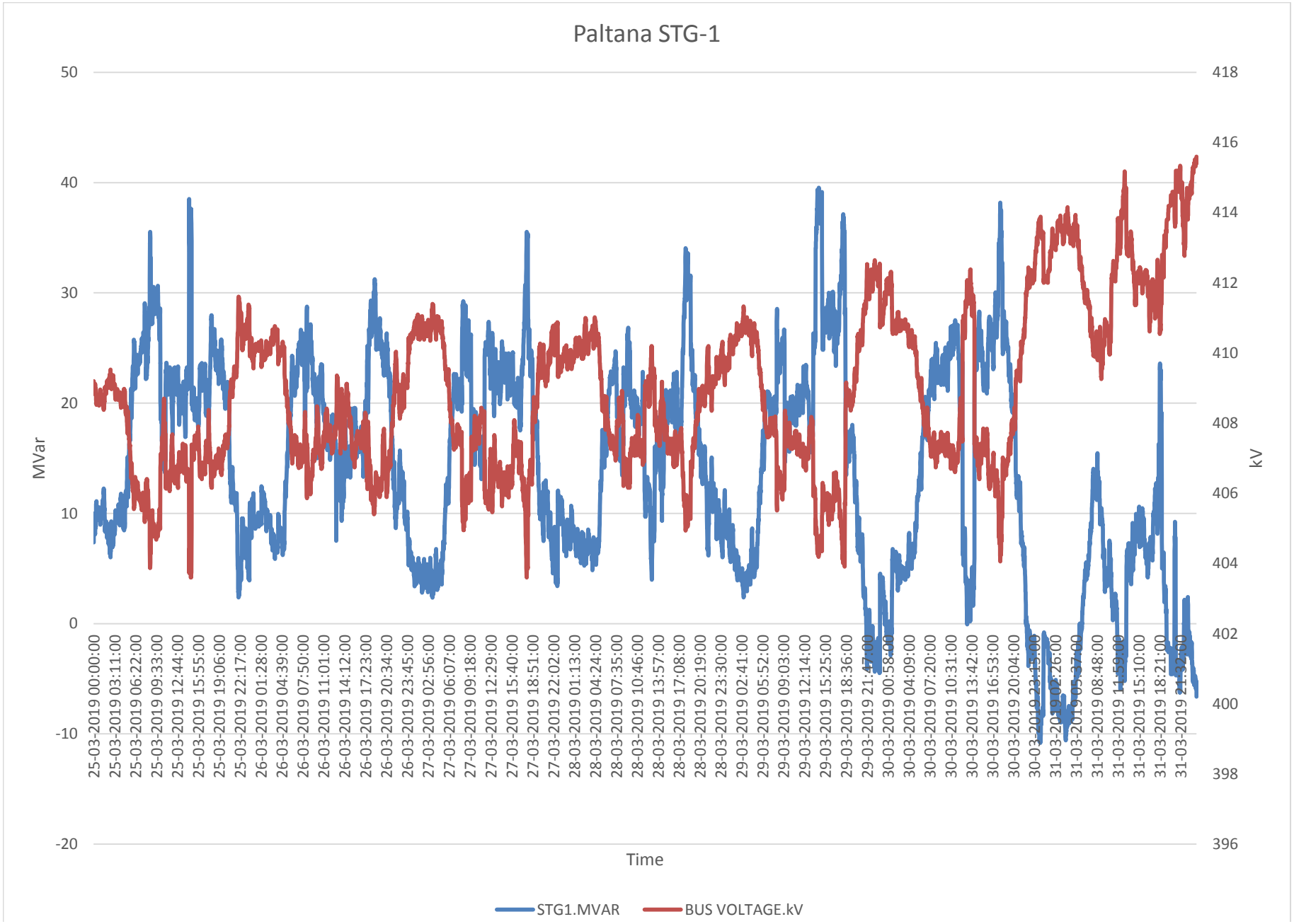
01/4/2019

(आर. सूत्रधार /R. Sutradhar)
व. महाप्रबंधक (एस.ओ-I)/Sr. GM (S.O-1)
उ.पू.क्षे.भा.प्रे.के/NERLDC.

Copy To:
1) सदस्य सचिव, उपूक्षेविस/ MS, NERPC

ANNEXURE

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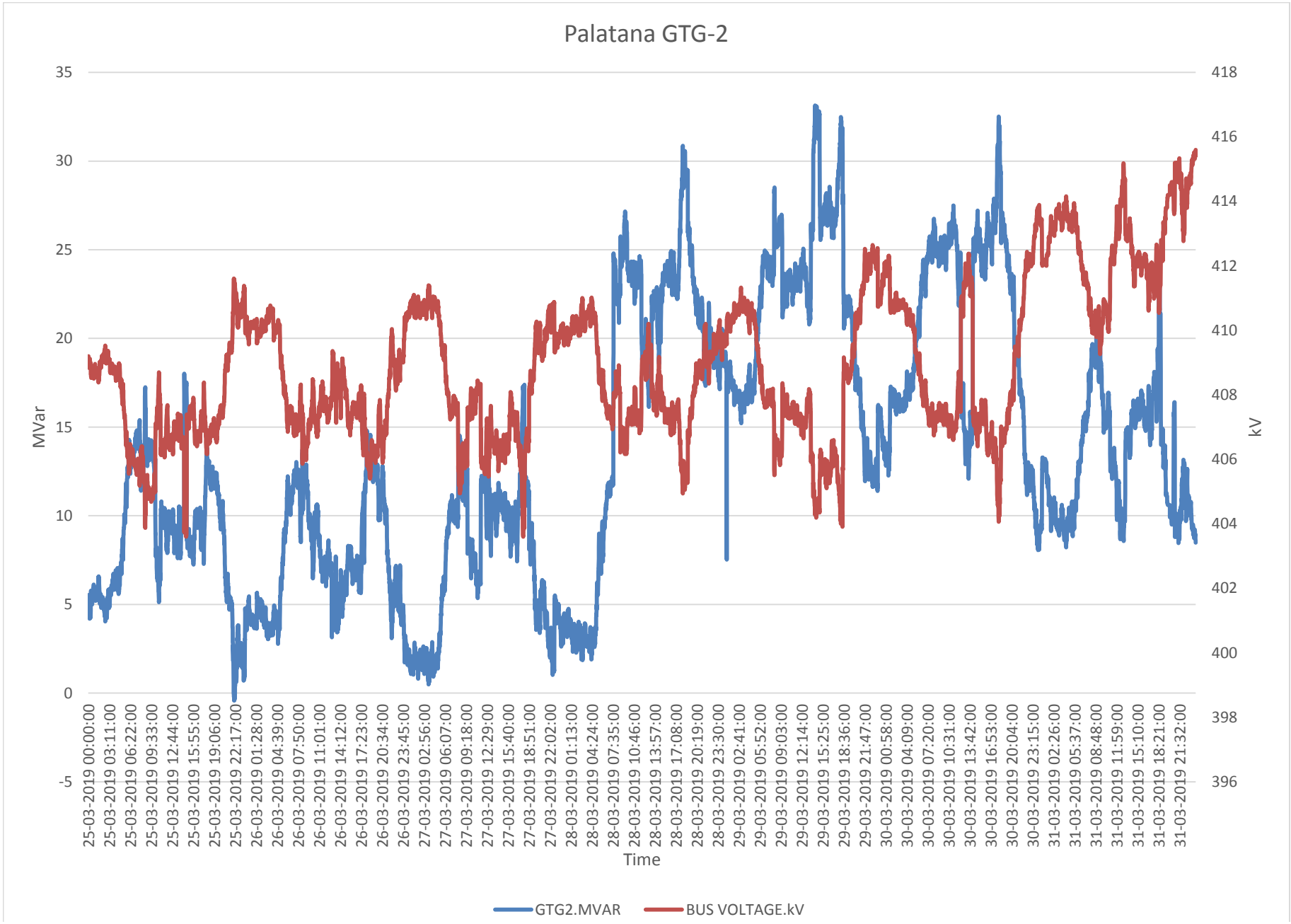
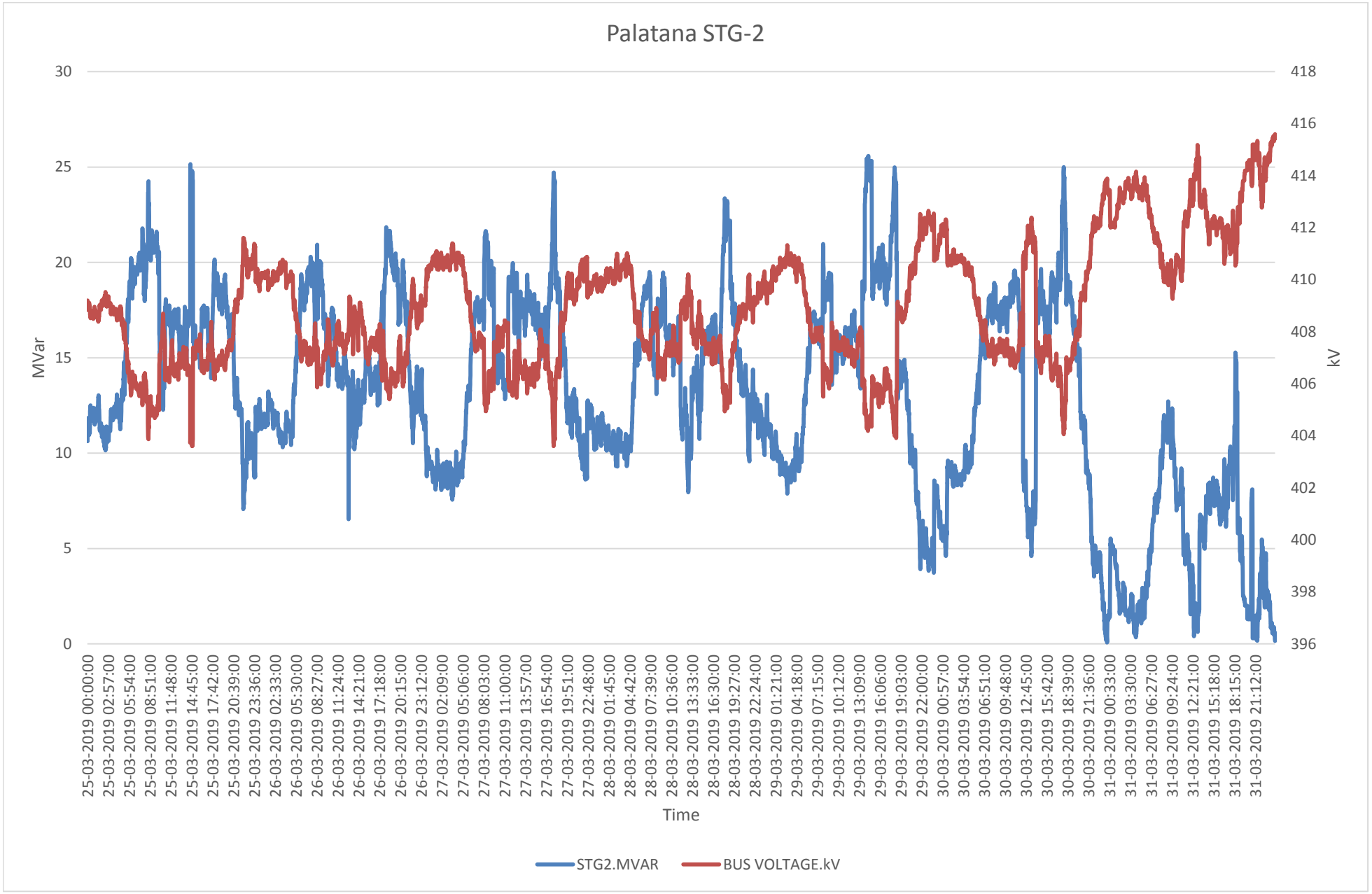
Time
STG1.MVAR
BUS VOLTAGE.kV


Palatana GTG-2
MVar
kV
Time
GTG2.MVAR
BUS VOLTAGE.kV


Palatana STG-2
MVar
kV
Time
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402
400
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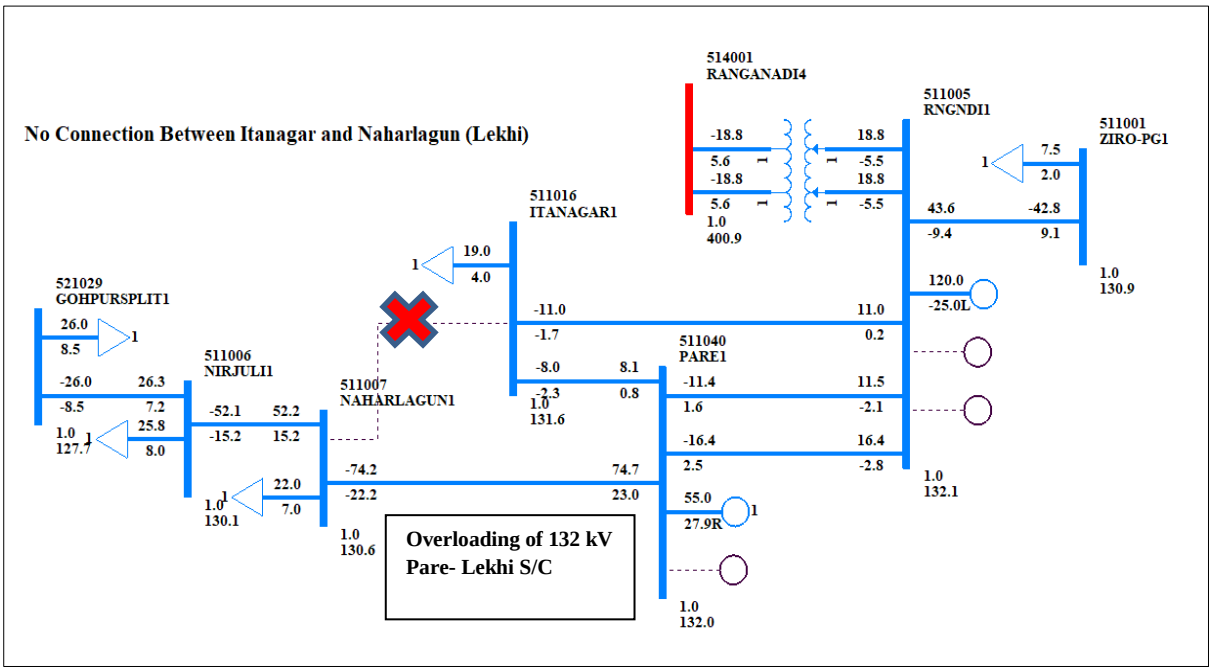
31-03-2019 21:12:00
STG2.MVAR
BUS VOLTAGE.kV

ANNEXURE- IV

SL.NO	PGCIL	STATUS
1	BNC (PG)	REPORT NOT RECEIVED
2	BADARPUR (PG)	REPORT NOT RECEIVED
3	Silchar(PG)	REPORT NOT RECEIVED
4	MARIANI (PG)	REPORT NOT RECEIVED
5	HAFLONG (PG)	REPORT NOT RECEIVED
6	Mokokchang(PG)	REPORT NOT RECEIVED
7	RANGIA (PG)	REPORT NOT RECEIVED
8	Melriat(pg)	REPORT NOT RECEIVED
9	Aizawl(pg)	REPORT NOT RECEIVED
10	Ziro(pg)	REPORT NOT RECEIVED
11	Misa(pg)	REPORT NOT RECEIVED
	ASSAM	
12	DULLAVCHERRA	REPORT NOT RECEIVED
13	SARUSAJAI	REPORT NOT RECEIVED
14	TINSHUKIA	REPORT NOT RECEIVED
15	**NAGALAND(S)**	REPORT NOT RECEIVED
16	**MIZORAM(S)**	REPORT NOT RECEIVED
	TRIPURA	
17	UDAIPUR	REPORT NOT RECEIVED
18	P.K BARI	REPORT NOT RECEIVED
19	79 TILLA	IRREGULAR
	MANIPUR	
20	NINGTHOKONG	REPORT NOT RECEIVED
21	RENGPANG	REPORT NOT RECEIVED
22	KARONG	REPORT NOT RECEIVED
23	YUREMBAM	REPORT NOT RECEIVED
	MEGHALAYA	
24	UMTRU	IRREGULAR
25	BYRNIHAT	REPORT NOT RECEIVED
	ARUNACHAL PRADESH	
26	CHIMPU	REPORT NOT RECEIVED
	GENERATION	
27	DOYANG	REPORT NOT RECEIVED
28	AGBPP	REPORT NOT RECEIVED
29	PARE	REPORT NOT RECEIVED
30	RHEP	REPORT NOT RECEIVED
31	PALATANA	IRREGULAR
32	KHANDONG	IRREGULAR

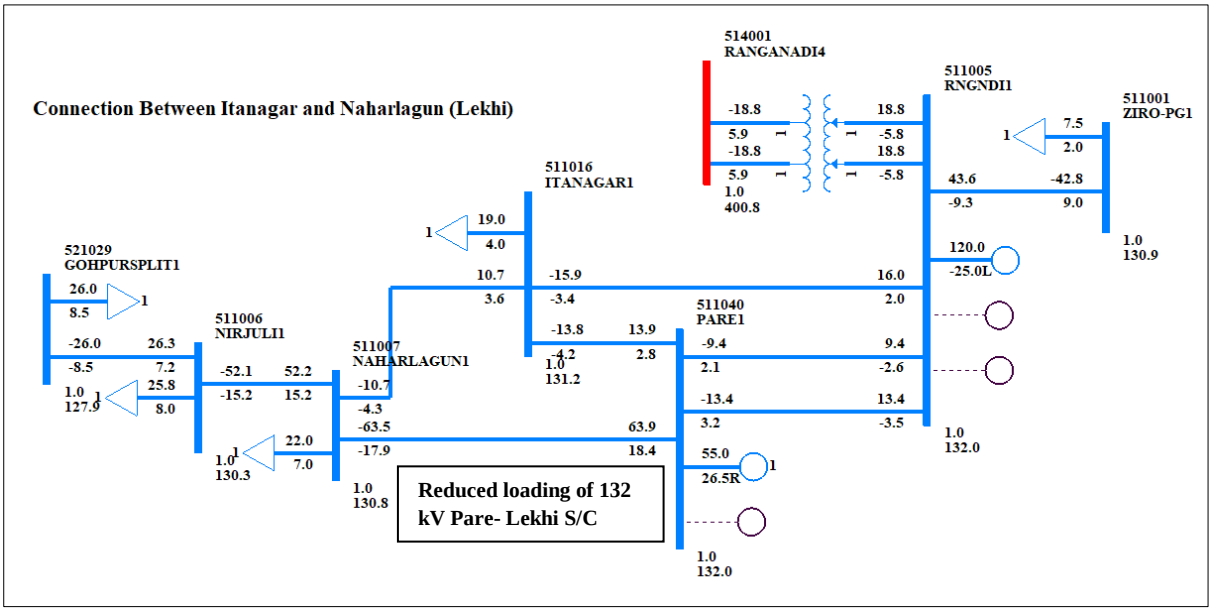
Study for Connection of 132 kV Itanagar – Lekhi (Naharlagun) S/C

132 kV Itanagar – Lekhi (Naharlagun) S/C is kept open which leads to overloading of 132 kV Pare- Lekhi S/C under various conditions.



Connecting 132 kV Itanagar – Lekhi (Naharlagun) S/C leads to decrease in loading of 132 kV Pare – Lekhi by about 11 MW, the same power being transferred from 132 kV Itanagar to 132 kV Lekhi.

Also, in case of tripping of 132 kV Pare – Lekhi S/C, 132 kV Itanagar – Lekhi will act as an alternate path for power supply to Lekhi Area of AP Power system, thereby increasing the reliability of the grid.



It is therefore desired to kept the link 132 kV Itanagar – Lekhi (Naharlagun) closed in all conditions

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Annexure-D.8

STANDARD FORMAT FOR

FURNISHING TECHNICAL PARAMETERS REQUIRED FOR DYNAMIC MODELLING FOR START-UP POWER AND FIRST TIME SYNCHRONIZATION OF GENERATORS

1. **Synchronous Machine Details**

Sl No.	ID	Information	Enter Values or use as Checklist (Yes/No/Submitted etc)
1	Generator Nameplate	Rated apparent Power in MVA	
		Rated terminal Voltage	
		Rated power factor	
		Rated speed (in RPM)	
		Rated excitation (in Amperes and Volts)	
2	Generator Datasheets	To be submitted	
3	Type of synchronous Machine	Round rotor or salient pole. Determines what type of synchronous machine model to use (for example GENROE is for a round rotor machine and GENSAL is for a salient pole machine)	
4	Generator capability curve	The generator capability curve shows the reactive capability of the machine and should include any restrictions on the real or reactive power range like under/over excitation limits, stability limits, etc.	
5	Generator Open Circuit and Short Circuit Characteristic	Graph of excitation current versus terminal voltage and stator current	
6	Generator vee-curves	Otherwise referred to as “V-curve”. The generating unit V-curve is a plot of the terminal (armature) current versus the generating unit field voltage.	
7	Unbalanced Load-Time Curve	To be submitted (if available)	

8	**Asynchronous Capability Curve**	To be submitted (if available)	
9	**Resistance values**	Resistance measurements of field winding and stator winding to a known temperature (Please mention value of T) [Used to derive per unit value for excitation voltage and stator resistance (Ra)]	
10	**Generator step up transformer (GSUT)**	**Nameplate** Rated primary and secondary voltages – Vector group – Impedance – Tap changer details-	
11	**Generator Transformer Data Sheet**	Datasheet is to be furnished. If not available, photograph of name plate is to be furnished	
12	**Auxiliary power (i.e. active and reactive auxiliary load)**	Value of auxiliary load (MW and Mvar) at rated power of the generating unit. Whether or not the load trips if the generating unit trips.	

2. Synchronous Machine Parameters

The parameters shown in this Table are used to represent and model a synchronous machine:

Sl No	Parameter	Description	Unit	Remark	Value
1	**Xd**	Direct axis synchronous reactance	**pu**	Unsaturated or saturated	
2	**Xd'**	Direct axis transient synchronous reactance	**pu**	Unsaturated or saturated	
3	**Xd''**	Direct axis sub-transient synchronous reactance	**pu**	Unsaturated or saturated	
4	**Xa**	Stator leakage reactance	**pu**	Unsaturated or saturated	
5	**Xq**	Quadrature axis synchronous reactance	**pu**	Unsaturated or saturated	
6	**Xq'**	Quadrature axis transient synchronous reactance	**pu**	Unsaturated or saturated	
7	**Xq''**	Quadrature axis sub-transient synchronous reactance	**pu**	Unsaturated or saturated	
8	**Tdo'**	Direct axis open circuit transient time constant	**s**		
9	**Tdo''**	Direct axis open circuit sub-transient time constant	**s**		
10	**Tqo'**	Quadrature axis open circuit transient time constant	**s**		
11	**Tqo''**	Quadrature axis open circuit sub-transient time constant	**s**		
12	**H**	Inertia Constant	**MW.s/ MVA**	Total rotating mass	
13	**S(1.0)**	Saturation Constant	**pu**	Can be calculated from OCC Curves	
14	**S(1.2)**	Saturation Constant	**pu**		

3. Site Load

Loads used for steady-state (i.e. load flow) simulations for representing the Power Station

	Low Output			High Output		
	kW	**kVAR**	**kVA**	**kW**	**kVAR**	**kVA**
Auxiliary						

4. Protection Systems

Sl No	Equipment Name	Information	Furnished (Yes/No)
1	**Generator**	Please furnish the list of Electrical and Mechanical Protection Functions (as per list in CEA Regulation) and settings in available format	
2	**Generator Transformer**		
3	**Unit Auxiliary Transformer**		
4	**Station Transformer**		

5. Excitation System Details

Sl No	ID	Information	Enter Values or use as Checklist (Yes/ No/ Submitted etc.)
1	**Type of Automatic Voltage Regulator (AVR)**	Manufacturer and product details (for example ABB UNITROL) Analogue or digital control system Year of commissioning Present settings (obtained either from HMI or downloaded from controller in digital systems)	
2	**Transfer Function of AVR**	IEEE Model with all parameters & Control Block Diagram to be submitted	
3	**Schematics of Excitation System and AVR Scheme**	Drawings of excitation system, typically prepared and supplied by the OEM Single line diagram (i.e. one-line diagram) for the excitation system	
4	**Operating Instructions of AVR**	Please furnish (if available)	
5	**Test Instruction and Test Report of AVR**	Please furnish (if available)	
6	**Type of excitation system**	Static excitation system OR Indirect excitation system (i.e. rotating exciter) – AC exciter, or – DC exciter	
7	**Details of AVR**	Rated excitation current (converter rating in	

	converter	Amperes) Six pulse thyristor bridge or PWM converter	
8	**Source of excitation supply**	Excitation transformer or auxiliary supply If excitation transformer, please furnish nameplate information and protection functions and settings	
9	**PSS**	Is the AVR equipped with a PSS? How many input Channels does the PSS have? If the PSS uses speed, is this a derived speed signal or measured directly? **PSS settings**	
10	**Schematic Diagram and Transfer Function of PSS**	If PSS is available, please furnish the schematic diagram and Transfer Function with control block of PSS along with all parameters	
11	**Excitation limiters**	What excitation limiters are commissioned? UEL OEL V/f limiter Stator current limiter Minimum excitation current limiter Others	

6. Turbine Governor Details – (For Thermal & Gas) Machines

Sl No	ID	Information	Enter Values or use as Checklist (Yes/No/Submitted etc)
1	**Turbine – Governor Transfer Function Model**	IEEE Model with all parameters & Control Block Diagram to be submitted	
2	**Turbine – Governor Schematic Diagram**	Schematic Diagram showing the installations and flow is to be submitted	
3	**Turbine- Governor Operation Manual**	Please furnish (if available)	
4	**Type of prime mover**	Mention the type of prime mover: Steam turbine Open cycle gas turbine Aero-derivative (twin shaft) gas turbine Combined cycle plant Other	
5	**Manufacturer of turbine**	Please include name of Manufacturer	
6	**Type of fuel**	Coal (brown or black) Gas Diesel (liquid fuel) Other	
7	**Governor**	Whether- Electro-mechanical governor Digital electric governor Any Other	
8	**Ramp rates**	How fast can the turbine increase and/or decrease load, specified in MW/min	
9	**RGMO/FGMO Settings**	Droop setting (% on machine base) Frequency influence limiters • Maximum frequency deviation limiter (eg +/-2 Hz) • Maximum influence limiter (eg 10% of rating) Ripple Factor Operating Frequency Range Under Frequency/Over Frequency Values Under Speed/ Over Speed Values	

10	**Dead-band**	Details of frequency dead-band (typically in Hz or RPM)	
11	**Technology**	Coal: • Sub-critical (Steam pressure = x MPa) • Super-critical (Steam pressure = x MPa) Gas/distillate: • Open cycle • Combined cycle • Engine Any other:-	
12	**Steam turbine**	Please mention which of the following are available:- **Tandem compound:** all sections on one shaft with a single generator **Cross compound:** consists of two shafts, each connected to a generator and driven by one or more turbine sections **Turbine sections:** High pressure (HP), intermediate pressure (IP) and low pressure (LP) **Reheat or non-reheat:** In a reheat, steam upon leaving HP section returns to boiler where it is passed through re-heater before entering IP section	
13	**Gas turbine**	Type of gas turbine: open cycle heavy duty, aero derivative twin shaft gas turbine Does turbine operate in dual fuel (gas and liquid fuel) Inlet guide vane characteristic Limit for exhaust gas temperature (EGT) Base load / frequency control	
14	**Combined cycle plant**	Details on heat recovery steam generator (HRSG) Size of steam turbine (MW) Frequency control of ST Time lag and relationship of GT and ST Is the combined cycle plant a single-shaft plant – i.e. the gas and steam turbine are on same shaft and drive same generator	

7. Turbine Governor Details – (For Hydro) Machines

Sl No	ID	Information	Enter Values or use as Checklist (Yes/No/Submitted etc)
1	**Turbine – Governor Transfer Function Model**	IEEE Model with all parameters & Control Block Diagram to be submitted	
2	**Turbine – Governor Schematic Diagram**	Schematic Diagram showing the installations and flow is to be submitted	
3	**Turbine- Governor Operation Manual**	Please furnish (if available)	
4	**Type of prime mover**	Hydro Electric Turbine Other (Pumped Storage)	
5	**Manufacturer of turbine**	Please include name of Manufacturer	
6	**Modes of operation**	Types of modes of operation capable: - Generator - Pump - Synchronous condenser -Any Other Modes	
7	**Governor**	-Electro-mechanical governor (including settings and drawings) -Digital electric governor (including settings and drawings) -PID governor details and settings -Transient droop (Dashpot) governor details and settings -Tacho- accelerometric governor details and settings Input transducer details	
8	**Ramp rates**	How fast can the turbine increase and/or decrease load, specified in MW/min	
9	**RGMO/FGMO Settings**	Droop setting (% on machine base) Frequency influence limiters • Maximum frequency deviation limiter (eg +/-2 Hz) • Maximum influence limiter (eg 10% of rating) Ripple Factor Operating Frequency Range	

		Under Frequency/Over Frequency Values Under Speed/ Over Speed Values	
10	**Dead-band**	Details of frequency dead-band (typically in Hz or RPM)	
11	**Hydro-electric turbine**	Type of hydro turbine -Impulse turbines – typical with high-head plants (Pelton wheel) -Reaction turbine – typical with low- and medium-head plants (such as Francis and Kaplan turbine) Water flow, velocity and pressure (e.g. intake and outtake/draft tube)	
12	**Penstock**	-Length (m) -Area (m2) -Internal penstock diameter -Pipe thickness, material or other characteristics (such as tapering) -Non-elastic or elastic -Linear or non-linear model (with or without relief valve) or Kaplan model -Flow of water through turbine (m3 /s) – with gates fully open -Number of penstocks supplied from common tunnel	
13	**Pressure relief valve**	Drawings/schematics Settings Operational descriptions	
14	**Pipe and Tunnel**	Diameter of pipe Thickness Material Length	

		Linear or non-linear model	
15	**Surge tank, reservoir and tail water (i.e. Head)**	Vertical distance between the upper reservoir and level of turbine (in meters) Head at turbine admission (lake head minus tailrace head) – (in meters) Head loss due to friction in conduit (in metres) Surge tank height, diameter and other characteristics (e.g. restricted inlet orifice)	
16	**Other**	Details of protection schemes that could influence dynamics (if any) Details of resonance chambers for pipes (if any) Temperature (e.g. water, ambient, unit)	

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