सत्यमेव जयते

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

No. उक्षेविस/प्रचालन/107/01/2019/3801-3839 दिनांक:25.04.2019

फैक्स संदेश / *FAX MESSAGE*

सेवा में : संरक्षण उप-समिति के सदस्य (सूची के अनुसार) ।
To: Members of Protection Sub-Committee (As per List)

विषय: संरक्षण उप-समिति की 37 वीं बैठक की कार्यसूची |
Subject: Minutes of 37th Protection Sub-Committee Meeting.

संरक्षण उप-समिति की 37वीं बैठक, 21.01.2019 को 10:30 बजे से से उ.क्षे.वि.स. सचिवालय, नई दिल्ली में आयोजित की गई थी | उक्त बैठक का कार्यवृत उत्तर क्षेत्रीय विद्युत् समिति की वेबसाइट (http://www.nrpc.gov.in) पर उपलब्ध है |

The 37th meeting of Protection Sub-Committee was held on **21st January, 2019** at **10:30 Hrs** at **NRPC Secretariat, New Delhi**. The minute of the meeting is available on NRPC website (http://www.nrpc.gov.in).

--Sd--
(Saumitra Mazumdar)
Superintending Engineer (O)

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List of Members of PSC

S.No.	Designation	Organization	Fax No.
1	Director (P&C)	BBMB	0172-2652054
2	General Manager (SLDC)	DTL	011-23236462
3	GM (O&M)	Delhi Transco Limited	011-23236462
4	GM (T)	IPGCL	23370247
5	Chief Engineer (TS)	HVPNL	0172-2591244
6	SE (M&P)	HVPNL	0172-2540014
7	SE (SO & SLDC)	HVPNL	0172-2560622
8	SE (SLDC)	PTCUL	0135-2763570/2451160
9	SE(T&C)	PTCUL	0135-2451826
10	Chief Engineer (SLDC)	UPPTCL	0522-2287880/2288736
11	SE(Tech)	HPGCL	0172-5022436
12	SE(O&M-VI)	HPGCL	0180-2566768
13	Chief Engineer (Transmission)	HPSEB	01972-223435
14	SE (PR& ALDC)	HPSEB	0177-2837143
15	Chief Engineer (C&S Wing)	PDD	0191-2474233
16	Chief Engineer (SLDC)	PSTCL	0175-2365340
17	Chief Engineer (P&M)	PSTCL	0161-2741280/2451491
18	CE (M&P)	RRVPNL	0141-2291891
19	SE (Electrical)	RRVUNL	01509-245299
20	Chief Engineer (LD)	RRVPNL	0141-2740920
21	SE (SO&LD)	RRVPNL	0141-2740920
22	Superintending Engineer (T&C)	UPPTCL	0121-2666062
23	Chief Engineer, (L-2)	UPRVUNL	0522-2287822/2287880
24	DGM (T&C)	PTCUL	0135-2760331
25	Chief Engineer (O&M)	NHPC	0129-2272413
26	GM (O&M) NR – I	PGCIL	011-26601079
27	GM (O&M), NR-II	PGCIL	01951-237186
28	Chief Manager (TS)	N.R.L.D.C	011-26852747
29	GM(OS-NR)	NTPC	0522-2305848
30	GM (OS)	NTPC Ltd	0120-2410082/2410068
31	DGM (Maintenance)	SJVNL	0177-2673283
32	DGM (O&M)	THDC India Ltd	01376-236305
33	Director (GM division)	CEA	011-26109750
34	General Manager	APCLP	01251-266326
35	Director	JPPVL	0120-4516201/4609464/4609496
36	Addl. CE(M&P-IT)	JVVNL	-
37	GM (Production)	Jhajjar Power Ltd	01251-270155
38	GM(P&M)	APL	7925557176
39	Sh. Raj Kumar Rastogi Add. GM	TPDDL	011-66039175
40	President (Power Systems)	LPGCL	+91-22- 22048681
41	Director (NPC)	CEA	
42	NPCIL		
	1.Maintenance Superintendent	NAPS	05734-222167
	2.Maintenance Superintendent	RAPS	01475-242060

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PART-A: NRPC

PART-B: NRLDC

Minutes of 37th meeting of Protection Sub-Committee (PSC) held on 21.01.2019 at 10:30 hrs. at NRPC Secretariat, New Delhi

PART-A: NRPC

37th meeting of Protection Sub- Committee (PSC) of NRPC was held on 21.01.2018 at NRPC Secretariat, New Delhi. The list of participants is enclosed at **Annex-I.**

A.1. Confirmation of minutes of 36th meeting of protection sub-committee

Minutes of 36th meeting of Protection Sub-committee were issued vide letter dated 29.11.2018. The Minutes are available on NRPC's website at http://www.nrpc.gov.in. No comments were received.

Sub-Committee confirmed the Minutes of 36th PSC meeting.

A.2. Implementation of Recommendations of Task Force

As a follow, up of one of the recommendations of Enquiry Committee headed by Chairperson, CEA on grid disturbances that took place on 30th and 31st July 2012, Ministry of Power had constituted a 'Task Force on Power System Analysis under Contingencies' in December 2012. The Task Force had submitted its report in August 2013. In a meeting taken by Secretary (Power), GoI on 11.03.2014, it was decided that the report be given wide circulation and its recommendations be implemented in a time bound manner. Some of the **issues** arising out of recommendations of the Task Force were as under:

A.2.1. Database of protection settings

Based on the recommendations of the Task Force, it was decided that data regarding settings of relays shall be compiled by the CTU and STUs in their respective network and furnished to RLDC and SLDC respectively with a copy to RPC for maintaining the database. The database was to be kept updated and verified during the audit. Regarding the protection coordination studies for proper Zone-III setting it was informed in 34th PSC meeting on 4th August, 2017 and 35th PSC meeting on 20th June, 2018 that these studies will be part of the project for maintaining database of protection setting database.

In 35th TCC/39th NRPC meeting approved the proposal for engaging a third party for Protection database was approved and NRPC sect. was authorised to take further necessary action in this regard. A format for submission of database was finalised in 30th PSC meeting.

Subsequently, approval of Chairperson, NRPC was obtained authorising Member Secretary, NRPC to carry out following activities:

i. Formation of group for finalization of detail scope of work of the Project.

ii. Submission of proposal for financing the Project through Power System Development fund (PSDF).
iii. Opening of a separate account in the name of 'NRPC Protection Database Fund' for receiving the grant from PSDF for the Project.
iv. Carry out e-tendering process including tender publication, opening, evaluation etc. for selecting contractor for implementing the scheme based on scope of work of the Project finalized by the group.

As approved, a core committee was formed to define the comprehensive Scope of the project comprising members from the utilities of NR. First meeting of the group for defining the scope of the project was held on 01.02.2018 and inputs were received from the members. Further, bid document including all the relevant suggestions/comments of the members was finalized.

Simultaneously, NRPC Secretariat also submitted the DPR of the project for PSDF funding based on the draft bidding document. The proposal of NRPC was scrutinized by the Techno-Economic Sub Group and further examined by Appraisal Committee and Monitoring Committee. Both Committees recommended the proposal for the grant from PSDF funding and also qualified proposal for 100% funding through PSDF.

In pursuance of the above, tender was published on Central Public Procurement (CPP) Portal of Govt. of India and NRPC website on 30.08.2018 and last date for receipt of bid was 15.10.2018 up to 14.00hrs. The technical bid was to be opened on 16.10.2018 at 15.00 hrs. However, only 2 bids were received at the time of bid opening. Hence, retendering for "Creation and Maintenance of Web Based Protection Database Management and Desktop Based Protection Setting Calculation Tool for Northern Region" was done. Subsequently after retendering, bid opening was held on 15.11.2018 at NRPC Secretariat, New Delhi. The total three no. of bids were received at the time of bid opening but only one bid was found responsive.

37th PSC meeting on 21st January, 2019 **- EE(O) informed that again retendering was carried out to ensure healthy competition. The last date for receipt of bid was 10.01.2019 up to 13.00hrs. The technical bid was opened on 11.01.2019 at 14.30 hrs wherein 2 bids were received. Both bids are being forwarded to Bid evaluation committee for further evaluation.**

A.2.2. Periodicity of Third-Party Protection Audit

The enquiry committee constituted by Govt of India to enquire into grid disturbances on 30th and 31st July, 2012 has recommended a thorough third-party protection audit need to be carried out in time bound manner as there is need to review the protection schemes.

In 18th PSC meeting on 03rd Sept, 2012, it was agreed that the exercise of protection audit should be carried out periodically and frequency of the same could be 2-3 years.

The following points are proposed to review the protection schemes periodically:

- Periodicity of Third-Party Audit from CPRI.
- Periodicity of Third-Party Audit from members of STUs nominated by NRPC Secretariat for Third Party Protection Audit of different STUs.
- The scope of Third-Party Protection audit of STUs.
- Any other Agency other than CPRI authorized to carry out Third Party Protection Audit.

In 35th PSC meeting held on 20th June, 2018 - The need of Protection audit was emphasized and members were requested to suggest suitable periodicity for the same. It was requested that periodicity should be decided uniformly at NPC level and each RPC should give them a suggestion. Members deliberated and recommended that the exercise of third party protection audit should be carried out periodically and frequency of the same should be 5 years.

It was also stated that Third Party Protection audit can be done any reputed agency working in the field of Power System protection other than CPRI. Members were requested to send the updated nominations of the protection engineers which would be carrying out the Third-Party Protection audit. The previous list was finalized in 24th PSC meeting which is attached as Annexure – II of the Minutes of 35th PSC meeting.

In 39th TCC/42nd NRPC meeting held on 27th and 28th June, 2018:- It was informed that issue of periodicity of third party protection audit was deliberated in 35th Protection Sub Committee where members recommended that Third Party Protection audit can be carried out periodically either by a team of Protection Engineers of the utilities as per the list finalized by the Protection Sub-Committee or by any reputed agency working in the field of Power System. The periodicity of the protection audit is to be 5 years as decided by 35th PSC held on 20.06.2018.

All the utilities were requested to share the feedback of the Protection audit carried out from other agencies so that agencies can be rated which will help other utilities to select the agencies for their Protection audit.

Committee was apprised that decisions of TCC/NRPC will be further communicated to NPC for the uniformity and finalization at National level. TCC recommended and NRPC further approved the periodicity of the protection audit to be 5yrs and same can be carried out by CPRI or by any other reputed agency also.

Further, agenda was submitted for deliberation in 8th NPC meeting held on 30.11.2018. The MoM are still awaited.

37th PSC meeting on 21st January, 2019 – SE(O) informed that issue was deliberated in 08th NPC meeting held on 30th November, 2018 wherein it was it was decided each RPC could have their own arrangements for carrying out the third-party protection audit.

All utilities (except DTL, BBMB, PSTCL and RRVPNL) were again requested to submit updated nominations of the protection engineers which would be carrying out the Third-Party Protection audit. The updated list is enclosed at Annexure – II.

A.2.2.1 Training Programme/Workshop on Protection Audit for Protection system Engineers

Protection is one of the key operational aspects of Power system. The revision in the protection settings/schemes after modification of network topologies is essential for reliable operations of the Grid. Hence, periodic audit of these protection schemes/settings/protection functions is essential for reliable and secure operation of the Grid.

Hence, it is important that Protection system engineers are well educated and trained to carry out the exercise of Protection Audit. Hence, it is proposed to organize Training Programme/Workshop on Protection Audit for Protection System Engineers.

Power System Division of Central Power Research Institute has submitted an offer for conducting 3 days Training Programme/Workshop on Protection Audit for Protection System Engineers which is enclosed as Annexure – II of 36th PSC agenda**.**

In 36th PSC meeting held on 19th September, 2018, agenda was deliberated in detail and PSC recommended that the training programme/workshop on Protection audit to be conducted by CPRI and approval of the same may be requested from NRPC.

In 40th TCC/43rd NRPC meeting held on 29th and 30th October, 2018, it was informed that a proposal from Power System Division of Central Power Research Institute for conducting 3 days Training Programme/Workshop at Bangalore on Protection Audit for Protection System Engineers has been received. It was told that training programme isn't residential and participants would be making their own arrangements and guest house accommodation could be provided at CPRI on twin sharing basis on chargeable basis, if available. The fee per participant for 3 days training is Rs. 10,500 exclusives of taxes. NRPC approved the proposal of carrying out 3 days Training programme on Protection audit at Bangalore through CPRI. Further, NRPC sect. has conveyed the acceptance to CPRI. Further, CPRI has proposed to organize training in 2 batches of 30 participants each in the month March and April, 2019.

37th PSC meeting on 21st January, 2019 – SE(O) informed that CPRI has been conveyed the acceptance for Training Programme/Workshop on Protection Audit for Protection system Engineers. CPRI was requested to conduct the training program in February. Due to some difficulties, CPRI has proposed to organize training in 2 batches of 30 participants each in the month March and April, 2019. He further informed that confirm dates for training program will be informed in due course of time.

Members were again requested to send the nominations for Training Programme/Workshop at Bangalore on Protection Audit for Protection System Engineers to be conducted by CPRI.

A.3 Violation of Protection standard in case of Inter-Regional lines of voltage 220kV and above

The section **3.e of Grid Standards Regulation of CEA, 2010** states that

"Provide standard protection systems having the reliability, speed, selectivity and sensitivity to isolate the faulty equipment and protect all components from any type of faults, within the specified fault clearance time and shall provide protection co-ordination as specified by the Regional Power Committee

Explanation: For purpose of this regulation "fault clearance time" means the maximum fault clearance time as specified below:

Sr. No.	*Nominal System Voltage (kV rms)*	*Maximum Time (in msec)*
1.	*765 and 400*	*100*
2.	*220 and 132*	*160*

Provided that in the event of non-clearance of the fault by a circuit breaker within the limit specified in Table, the breaker fail protection shall initiate tripping of all other breakers in the concerned bus section to clear the fault in the next 200 msec. "

Such delayed clearance of faults of Inter-regional lines may prove fatal to the security of the grid. Since, tripping of Inter Regional Lines of voltage 220kV and above are matter of concern to Grid security suitable action needs to be taken.

As per the IEGC clause 5.2.r and clause 15.3 of CEA grid standard, DR/EL of all the tripping of 220kV and above level shall be sent within 24 hours of NRLDC.

In 35th PSC meeting held on 20th June, 2018- It was stated that violation of Protection Standard should be avoided and DR/EL should be sent to NRPC/NRLDC within 24 hours as the tripping analysis for inter-regional lines is very important for safe and reliable operation of Grid. It was also informed that this was also followed up regularly in the OCC meetings.

In 36th PSC meeting held on 19th September, 2018- Representative of NRLDC informed that agenda pertains to violation of Protection standard such as delayed clearance of fault, spurious tripping, DR/EL submission within 24hrs and other events resulting into violation of Protection standard. A whatsapp group of PSC members was created in which information regarding tripping (name, date, time) and date & time at which details have been submitted could be shared. This would help in updating the database regularly and information could be shared amongst all.

In 40th TCC/43rd NRPC meeting held on 29th and 30th October, 2018- Representative of NRLDC informed that violation of protection standards was being highlighted regularly for inter-regional lines by circulating letter, but there were many single elements tripping violating protection standards which might result into multiple element tripping. Representative of NLDC emphasized on submission of DR/EL within 24 hrs as they were very important for further analysis. MS, NRPC told that utilities should submit the detailed report as well remedial measures taken for such events. He suggested utilities could make presentations in the PSC meetings explaining the tripping,

remedial measures taken and learning therefrom like practice being followed in PCM of WRPC.

37th PSC meeting on 21st January, 2019- Representative of NRLDC informed that monthly list of Grid incidences is being circulated where violation of Protection standards has been observed. Utilities were requested to avoid any violation of Protection standards

A.4 Grid disturbance at NAPS on 15.02.2018 due to Bus fault at 220kV Atrauli S/S (Agenda by NPCIL)

On 15.02.2018, NAPS both units were operating smoothly at full power, Grid parameters were also maintaining normal. All 220kV lines were in service. (Enclosed as Annexure-VI of 35th PSC agenda) At 19:17:10 Hrs, voltage dip from 220 kV up to 120 kV was observed at NAPS, however NAPS both units survived. 220kV Atrauli S/S is connected only with NAPS, Narora and Harduganj TPS, both are generating stations and hence an important element of grid network. At around 19.15hrs, normalization of one ICT was in progress at Atrauli S/S. During the process, its 220kV side circuit breaker developed fault causing flashover/ damage of the CB resulting into bus fault. Atrauli S/S does not have 220kV Bus differential protection scheme hence fault propagated into remote end 220kV S/S Narora and Harduganj.

In the 35th PSC meeting held on 20.06.2018 - Representative of NPCIL told that damage of the CB resulted into bus fault at 220kV side of Atruali S/s. He further told that Atrauli S/S does not have 220kV Bus differential protection scheme hence fault propagated into remote end 220kV S/S Narora and Harduganj, however distance relay of line protection operated and 220kV Atrauli-Narora, Atrauli - Harduaganj lines tripped in zone -4 at Atrauli end. The fault duration was 250 msec. It was informed that it is mandatory for all 220kV and above S/s to have bus differential protection as per the CEA regulations. He further told that lines were charged after the incidence without informing either Narora or Harduaganj end.

Representative of UPPTCL informed that bus differential protection at Atrauli s/s is to be commissioned by the end of July. He also informed that zone-4 setting has been changed to 160 msec. Representative of NPCIL also told that there is no bus differential scheme at 220kV Sambhal s/s and 220 kV Simbhaoli s/s. Representative of UPPTCL assured to look into matter and expedite the installation of bus differential scheme**.**

In 36th PSC meeting held on 19th September, 2018- Representative of UPPTCL stated that panels were delivered but installation and commissioning has not been completed. He further told that SEL has been awarded with the work.

37th PSC meeting on 21st January, 2019 - Representative of UPPTCL informed that bus bar protection relay has been installed and commissioned. He further told that Contact Multiplier Relay (CMR) is to be installed for phase wise LBB initiation as spare contacts were not available in old relay.

Representative of NRLDC highlighted that it is long pending issue and

compromising Grid security due to such a peity issue needs to be avoided.

A.5 Final report of the group to suggest measures for bringing improvement in the field of Power System Protection among the utilities in Northern Region

A group was constituted by Member Secretary, NRPC vide letter No. NRPC/OPR/107/06/ 2015/ dated: 26.08.2015 to suggest measures for bringing improvement in the field of Power System Protection among the utilities in Northern Region. The report was submitted in 34th TCC/38th NRPC meeting held on 24th /25th October, 2016 wherein the report was accepted for implementation. It was also agreed in the NRPC meeting that each utilities would immediately start working to develop training module for Basic Training on Protection System for Sub-Station Engineers (Level -1) and start training programs within 6 months. The issue was also discussed in 32nd PSC meeting wherein utilities were requested to organize Level-1 training and would submit the details.

BBMB, POWERGRID NR-I and PITCUL are conducting the training on Protection System (Level - I) at regular intervals.

First training programme of Level-2 was conducted successfully from 21st-25th November, 2016 for 25 nos. of participants through POWERGRID. 35th TCC/39th NRPC meeting held on 1st/2nd May, 2017 - Advised to conduct more such programmes including Level-3 for Protection System Engineers.

Protection training for level -3 was conducted successfully from 19th-23rd March, 2018 at Udaipur for 25 nos. of participants through POWERGRID.

In 35th PSC meeting held on 20.06.2018 - Members were informed that 1 batch of level - 2 and level – 3 training was completed and another batch for training is to be taken up shortly. Utilities were requested to share the details regarding content, no. of days of level-1 training arranged by them.

Representative of RRVPNL and DTL told that training is being arranged by them and details will be shared. Other utilities were also requested to share the details at the earliest.

In 39th TCC and 42nd NRPC meeting on 27th and 28th June, 2018 – It was told that NRPC Sectt has conducted Level-3 training for Protection System Engineers from 19th to 23rd March, 2018 with this the first batch for Level-2 and level-3 training has been successfully completed. It was also informed that NRPC Secretariat would be going for another batch of Protection System Engineers Level-2 and Level-3 training for which no. of participants might be increased from 25 to 50. Utilities were requested to preferably nominate the engineers working in the field of power system protection and make sure that nominated individual is available for entire duration of the training. It was stated that as the participants are being trained as trainer, they should further transfer the knowledge within their own utility so that additional trained manpower can be deployed.

In 36th PSC meeting held on 19th September, 2018 – It was informed that NRPC in its 42nd meeting has approved for 50 no. of participants for 2nd batch of Level-2 and Level-3 training of Protection System Engineers. It was proposed that training might be organized through any one of the OEM such as ABB, SIEMENS, GE etc. which would also include classroom training as well as hands on training on Relays.

In 40th TCC/43rd NRPC meeting held on 29th and 30th October, 2018- NRPC approved training to be organized through any one of the OEM such as ABB, SIEMENS,

GE etc. and authorized MS, NRPC to take necessary action in this regard.

37th PSC meeting on 21st January, 2019- Representative of Punjab informed that trainings were being conducted for operator level personnel in Punjab and its detail would be shared. Representative of Haryana, UP and POWERGRID also informed that Level-1 training programmes are being conducted regularly whose details would be shared.

A.6. Format for Detailed Analysis report

Members of the Protection sub-committee had raised the issue of devising a common format for submission of detailed analysis report of the tripping event. Accordingly, a format had been prepared and same is enclosed as Annex-VII of 35th PSC agenda**.** In the discussions held in 33rd PSC meeting, it was decided to align the format as per the SOPR. A committee to align the format as per SOPR is constituted and advised to submit the report by 04.08.2017.

In the 34th PSC as well as 35th meeting, it was decided to deliberate on format once the constituted committee submits its report. Members were requested to give the suggestions/comments about the format for Detailed Analysis Report. The POWERGRID, NR-I has suggested a format for the Detailed analysis report enclosed as Annex – III of 37th PSC agenda.

36th* PSC *meeting on 19th September, 2018- Representative of NRLDC informed that format was prepared in such a way that event could be concluded from submitted data and hardware database of DR/EL facility and Numerical relays would be created. The database of DR/EL facility and Numerical relays at substation would help in monitoring the compliance of different protection standards.

Representative of POWERGRID told that main objective of any protection engineers is to study/analyse cause of the tripping and suggest/take remedial measures to avoid such trippings in future. He told that detailed analysis report consisting of above is regularly submitted by POWERGRID. He further stated that excel file format attached is time consuming which will affect the main objective of analysis. He agreed that database is necessary for which data can be submitted once. He stressed that not only the format but also its compliance should also be discussed considering its complexity.

Representative of DTL stated that data in mentioned format can be submitted but stressed that focus should be on tripping analysis. Representative of Punjab told that it is difficult to submit the data in mentioned format as many times trippings weren't reported by field engineers. He was of the view that many columns in excel format were irrelevant Representative of UPPTCL stated that format is very long but they were submitting the data in mentioned data.

Representative of NRLDC emphasized that data in the mentioned format is as important as tripping analysis and both should be submitted. SE(O) highlighted that data could also be used for Transmission availability certification. He advised to begin the

data submission in mentioned format and considering the issues faced in implementation format would be simplified further, if required.

A.7. Persistent surge problem encountered by KWHEP since commissioning of

Kala Amb substation. (Agenda by Karcham Wangtoo HEP)

Background of problem:

KWHEP (4 x 250 MW) was connected to Abdullapur through double ckt line (212 km) since its commissioning in yr. 2011. This line is being maintained by Jaypee Power Grid Ltd. This line was working very well till Nov '2017 when Kala Amb substation was connected through LILO at about 175 km from KW. Ever since the introduction Kala Amb S/s, we are facing the problem of '**increase in LA counters'** located at Karcham Wangtoo Pothead yard. This increase is taking place in all the LAs of both ckt 1 and ckt 2 (Total six nos. LA).

Risk to KWHEP:

The counters have increased manifold (6-7 times) since introduction of Kala Amb and is still continuing to increase. Such high increase and further increasing trend pose risk to our LAs, power transmission and grid. Multiple attempts were taken from Kala Amb end to close their circuit breaker on 21st Nov' 17 and 5th Dec' 17 for back charging the line, as their relay tripped due to SOTF each time, they tried to close the CB, and the LA counters increased at Wangtoo end on all trials. The generating station are at the receiving end and bear the most of the risk posed to our equipment and generation loss.

Action till now:

The issue was discussed with our counterparts at Kala Amb several times telephonically and requested to solve the problem. As per their request, we rechecked all our setting and also sent our relay settings to them for review which was found ok. The mail was further forwarded to AM NR2 and several other people in PGCIL by Kala Amb team. On 5th April '18, we received a reply from Mr Atul Mathur (Asst. Chief Design engineer) in which he requested us to have our LAs tested and report be submitted for review to PGCIL. We immediately got all our LAs tested by PGCIL National Test Laboratory, Jalandhar on 12.4.16. All the LAs were found in excellent working condition and the test reports were submitted to PGCIL on 13.4.18 (Copy of mail and test reports attached as Annexure-IV of the 37th PSC agenda).

Present Status:

We have no feedback till now after submission of our reports despite several telephonic reminders. Despite our request to involve us also in solving the problem, we are completely unaware of further development.

Looking at the huge risk at our end, it is requested to take appropriate action immediately to solve this long persistent problem.

37th PSC meeting on 21st January, 2019- Representative of KWHEP told that LILO for 400kV D/C Abdullapur-KWHEP was done at 400kV Kala Amb substation in *Minutes of 37th Protection Sub-Committee (21st January, 2019)*

Nov, 2017. He informed when line is back charged from Kala amb s/s, it is observed that LA counters are increased at Kala amb s/s. He told that LAs were also tested at PGCIL National Test Laboratory which were found in order. He further informed that PIR aren't installed at CB in Kala amb s/s.

Representative of POWERGRID told that after LILO line length was decreased to 175 km and PIR aren't installed for the length less than 200km. He told that leakage current observed was also in the limits and the issue has already been taken up with the engineering department and it is also being followed up.

SE(O), NRPC asked POWERGRID to submit the report of Engineering department at the earliest. He suggested if issue isn't resolved, POWERGRID may appoint consultant to find out the solution.

A.8. Follow up action on outstanding issues from previous meetings:

A.8.1. Non- availability/defective PLCC link of STU Lines terminated at POWERGRID (NR-2) substations

22nd PSC meeting on 22nd July, 2013- POWERGIRD had submitted a list of its NR-2 sub-station in 22nd PSC meeting where PLCC was non-functional at other side.

36th* PSC *meeting on 19th September, 2018- Status of PLCC work in these sub-stations, as updated in the meeting is as under:

Sl. No.	Name of Substation	Name of Transmission Line	Availability of PLCC	Updated Status in 36th PSC	Present status
PLCC issues with PSTCL					
1	Amritsar	220 kV Verpal –I	Not installed	**Equipment has been installed at both the ends. End to end testing would be completed by 30.09.2018.**	**Representative of PSTCL informed that panels installed were being replaced and end to end testing would be completed by the end of the month.**

A.8.2. PLCC and Auto Re-closure issues related to UPPTCL

28th PSC meeting on 19th December, 2014 - POWERGRID had informed that there were various lines of UPPTCL wherein PLCC panels and auto re-closure schemes were not in working condition due to which frequent tripping of

lines on transient faults were taking place.

36th* PSC *meeting on 19th September, 2018- Status updated by UPPTCL and POWERGRID in the meeting was as under:

Sl. No.	Name of Transmission Line	Details of PLCC	Status
1.	220kV Allahabad-Rewa Road-I	PLCC link was through but failed frequently due to non-availability of wave trap at Rewa Road end.	**Representative of UPPTCL stated that relay panels were to be replaced. The shutdown was awaited. It was expected to be done by end of the month.**.
2.	220kV Allahabad-Rewa Road-II		
1.	220kV Kanpur-Mainpuri	PLCC panels not available	**PLCC panels were supplied but yet to be commissioned.**
1.	220kV Gorakhpur-Barhua	PLCC were not functional	**Relays were replaced with the Numerical relays and it would be function within one month**

A.8.3. Islanding scheme for Rajasthan and Punjab

A.8.3.1. Islanding scheme for Rajasthan

30th PSC meeting on 21st September, 2015 - RVPNL had stated that existing islanding scheme meant for RAPP-A and RAPP-B would change entirely if Mahi HPS is excluded from the scheme. Also, result of dynamic simulation studies had not yet been received from CPRI. RVPNL was requested to implement the scheme provisionally & necessary actions for procurement of relays etc. was to be initiated with completion target of one year. RRVPNL had agreed for the same.

31st PSC meeting on 7th June, 2016 - RVPNL stated that the procurement process for this islanding scheme was underway and the scheme, without considering Mahi, was expected to be functional by December, 2016.

32nd PSC meeting on 30th November, 2016 - RVPNL informed that the scheme excluding Mahi HPS would be implemented by June 2017.

33rd PSC meeting on 22nd February, 2017 - Status could not be confirmed as no representative of RVPNL attended the meeting.

34th PSC meeting on 4th August, 2017 - RVPNL intimated that relay purchase in process and the scheme is to be implemented by 31.01.2018.

35th PSC meeting on 20th June, 2018 – Representative RVPNL intimated that scheme has been approved but the purchase process was reverted back. He further told that re-tendering for relays is in process.

36th* PSC *meeting on 19th September, 2018- Representative of RVPNL stated that procurement has been completed and scheme would be implemented by Dec, 2018. He told that Mahi HPS has been permanently excluded from the scheme.

***37th* PSC *meeting on 21st January, 2019-* Representative of RVPNL informed that procurement is under process and expected to be completed by 30th June, 2019 MS, NRPC requested RRVPN to submit the complete islanding scheme for Rajasthan at the earliest.**

A.8.3.2. Islanding scheme for Punjab

A meeting was held on ***27th November, 2014 at NRPC Secretariat*** to review the islanding schemes for Punjab. In this meeting, it was decided that PSTCL would implement the scheme envisaged for Lehra Mohhabat TPS and Bhatinda TPS at first instance. Thereafter, based on the experience of such scheme, the islanding scheme meant for Ropar TPS would be implemented. PSTCL had informed that stability study for the scheme was being carried out by CPRI and report of the same would be available by ***31.12.2014***. Thereafter, procurement would start.

29th PSC meeting on 9th February, 2015 - PSTCL had informed that CPRI has submitted the dynamic study for islanding scheme for Bhantida TPS and PSTCL was under process of implementing the scheme. Procurement process was underway and the scheme would get implemented by ***30.11.2015***. PSTCL was requested to share the approved scheme with NRPC Sectt. and NRLDC. PSTCL had agreed for the same.

31st PSC meeting on 7th June, 2016 - PSTCL had informed that relays for islanding scheme of Bhatinda TPS had already been procured and installation of these relays was under process. He further stated that the scheme would be made functional by ***30.09.2016***.

32nd PSC meeting on 30th November, 2016 - PSTCL informed that Bhatinda, which is a part of the islanding scheme, would be in operation for a limited period during summer. In view of this, the scheme needs revision. Once the revised scheme is finalised it would be implemented. PSC advised PSTCL to finalise the scheme at the earliest and to share it with all the concerned including NRPC Sectt.

33rd PSC meeting on 22nd February, 2017 - PSTCL was requested to expedite the process and submit the information at the earliest.

34th PSC meeting on 4th August, 2017 – PSTCL was given approval to implement islanding scheme for only GHTP control area citing the plans of PSPCL to shut the GNDTP Bathinda plant by the year end. They were further requested to complete the same by 30.09.2017 and to submit the details of actual implemented schemes to NRLDC Secretariat and NRPC.

35th PSC meeting on 20th June, 2018- Representative of PSTCL stated that consent of PSPCL was received a one week before for the execution of Islanding scheme on only GHTP control area. It will be executed by 30.09.2018.

36th* PSC *meeting on 19th September, 2018- Representative of PSTCL stated that data was awaited from the PSPCL. He stated that PSPCL was requested to submit the data of the units which would be kept ON during peak/non-peak period. They have submitted the data stating that all the units would be kept ON but in actual scenario it has been observed that units for Lehra-Mohabbat TPS were off during winter and ran up to 50% in paddy seasons. He told that scheme would be implemented in a month after consultation with PSPCL.

37th* PSC *meeting on 21st January, 2019- **Representative of PSTCL informed that installation and commissioning is under progress and it will be completed by 31st March, 2019 and Bathinda was dropped from the scheme. He informed that currently, scheme for Lehra Mohabbat is being implemented. MS, NRPC asked PSTCL to share the islanding scheme for Lehra mohabbat at the earliest.**

A.8.4 Progress of rectification of deficiencies observed/improvements suggested in Basic Protection Audit.

The status of rectification of deficiencies observed in Basic Protection Audit carried out by POWERGRID & CPRI is to be submitted on monthly basis. The updated status in regard to expected completion time of rectification of protection related deficiencies as informed by utilities is enclosed as **Annexure-III.**

Utilities were requested to submit the updated status.

A.8.5. Third Party Protection Audit by the Protection Experts for intra-state system/ balance system not covered in Basic Protection Audit.

The status of TPPA as updated in the 34th PSC meeting is enclosed as Annex-VIII**.** In the 34th PSC meeting, PSC again stressed over non-rectification of deficiencies by most of the utilities. Utilities which have not submitted the action plan were requested to submit the same at the earliest. All the utilities were again requested to submit the action plan and to ensure expediting the process for rectification of discrepancies found in the audit. **Annexure-IV.**

Utilities were requested to submit the updated status.

A.8.6. Status of Bus Bar protection

As per the report of Basic Protection Audit carried out by CPRI and POWERGRID in 2012, non-availability/non-functionality of Bus Bar Protection at many of the S/S was one of the major observations.

19th PSC meeting on 21st November, 2012 - Action plan for rectification of deficiencies enumerated in the report was updated by the utilities during the meeting. This status has subsequently been revised based on information submitted by the utilities from time to time.

20th PSC meeting on 5th April, 2013 – As per the decision taken in 83rd OCC held on 17th January, 2013, it was agreed that each transmission and generation utility would nominate two protection experts and thereafter protection audit at intra-State sub-stations and generating stations can be carried out by a team drawn from these experts. List of nominations was prepared and updated subsequently.

21st PSC meeting on 25th June, 2013 – Bus Bar Protection Status as available with NRPC secretariat was discussed in the form of tabled agenda item and utilities were requested to update the same with 15 days.

22nd PSC meeting on 22nd July, 2013 – Information was not submitted by any of the utilities. Members were requested to update the status of Bus Bar Protection.

23rd PSC meeting on 9th September, 2013 – Only DTL, BBMB PSTCL, POWERGRID, NHPC and HPSEB Ltd. submitted the status. All other utilities were requested to update the status of Bus Bar Protection.

24th PSC meeting on 17th December, 2013 – Only DTL, BBMB PSTCL, POWERGRID, NHPC and HPSEB Ltd. had submitted the status. All other utilities were requested to update the status of Bus Bar Protection.

25th PSC meeting on 12th February, 2014 – **Immediate Alternative of Bus Bar Protection Scheme** - RVPNL stated that in the Sub stations, where Bus Bar Protection Scheme was currently not available, time setting of bus coupler connected in between main Buses may be reduced to 100 ms (operating time) and reverse reach of feeders may be reduced to 2 km and with time of operation as 160 ms. With above settings, in case of actual Bus fault, bus coupler operation will isolate the faulty buses from other main buses and feeders will also trip. This operation will reduce the fault duration and the healthy buses will remain intact.

PSC was of the view that scheme can be used purely as a temporary substitute till Bus Bar Protection is not installed. But at the same time, members expressed that endeavour should be made to operationalize Bus Bar Protection at the earliest.

28th PSC meeting on 19th December, 2014 – Utilities were requested to expedite the implementation of Bus Bar Protection and submit the information.

31st PSC meeting on 7th June, 2016 – PSC expressed concern of non-functioning of Bus Bar Protection at many sub-stations in the region. It was decided that efforts would be made to expedite implementation of Bus Bar protection and submit the information to NRPC Sectt with progressive commissioning of Bus Bar protection.

Attention of members was also drawn towards deliberations in the 25th meeting of PSC held in Feb, 2014, wherein it was decided that as an interim arrangement an alternative to Bus Bar protection can be implemented. In this arrangement time setting of Bus coupler connected in between main Buses may be reduced to 100 ms (operating time) and reverse reach of feeders may be reduced to 2 km and with time of operation as 160 ms. With above settings, in case of actual Bus fault, Bus coupler operation will isolate the faulty Buses from other main Buses and feeders will also trip. This operation will reduce the fault duration and the healthy Buses will remain intact.

32nd PSC meeting on 30th November, 2016 – UPPTCL stated that as agreed in 25th PSC meeting held in Feb, 2014, an interim arrangement alternative to Bus Bar protection has been implemented in some of their sub-stations. It was also informed that as normal operation has been reported, therefore, UP was planning to implement the same in other sub-stations. Delhi and Rajasthan also informed the similar action. It was felt that other states e.g. Haryana and Punjab may also implement the same as an interim measure till the bus -bar protection is installed. However, it was again emphasised that this would be a temporary arrangement only and must not be considered as an alternative to bus -bar protection.

33rd PSC meeting on 22nd February, 2017 – PSC advised all the concerned utilities to make interim arrangement as decided in 32nd PSC meeting, till the Bus bar protection is not installed.

34th PSC meeting on 4th August, 2017- PSC advised to remove the alternate arrangement wherever Bus bar protection has been installed. UP has installed alternative schemes in almost all of the substations where Bus bar protection is installed. Rajasthan will start procurement after finalizing contract for implementation of Bus bar protection.

35th PSC meeting on 20th June, 2018 - Representative of UPPTCL

informed that alternated arrangements were removed in all the substations wherever a bus bar protection was installed.

***37th* PSC *meeting on 21st January, 2019* -** Representative of Rajasthan informed that out of 74 locations where bus bar protection was to be installed 56 locations have been completed. He informed that installation at other locations is in process. **(Annexure - V)**

Utilities were requested to submit the updated status of Bus bar protection and the status of interim measures taken at their end.

A.8.7. CERC order on Petition No. 9/SM/2014 and 10/SM/2014

SE, NRPC stated that CERC in its order dated 14.06.2016 in Petition no. 9/SM/2014 for investigation of tower collapse and load crash in Northern Region on 30.5.2014 and Petition no. 10/SM/2014 for investigation of Line Outage due to Tower Collapse in Northern Region during April 2015 to June 2015 directed RPC Secretariat to examine the cases of delayed clearance of faults on transmission system during last two years and to submit an analysis report within six month from the date of issue of the order. The status of the delayed clearance of the fault from 01.04.2014 to 01.06.2015 was enclosed as Annex-VI of the agenda of 32nd PSC meeting. In the agenda following action was proposed:

- Utilities which had not submitted the detailed report along with the remedial measures taken/being taken were requested to submit the same.
- Utilities whosoever had submitted the report along with the measures to avoid the recurrences of these types of tripping were requested to submit the status of action suggested in report.

In the 32nd PSC meeting, members were requested to submit the reason for delayed clearance of faults and action taken to avoid recurrence, by 15th Dec, 2016 to NRPC Sectt.

Again in the 33rd PSC expressed concern over non-submission of data. Utilities were requested to furnish the information by 07.03.2017, so that the report may be submitted to CERC.

Subsequently, vide letter dated 10.07.2017, members of PSC were asked to submit the action taken on the recommendation of the discussions held in last 04 PSC meetings (30th, 31st, 32nd, 33rd) by 25.07.2017).

The issue was again flagged in 34th PSC meeting in which all the members agreed to submit the details as required. The status of details received is as given below:

Description	Information submitted by
Details regarding Event List as mentioned at	UPPTCL (Central and East North

Annex-VI to 34th PSC Minutes (Reasons /Action taken for Delayed Clearance of faults)	Zone), NJHPS, POWERGRID, NHPC, DTL, RRVPNL
Action taken status on the recommendation of the discussions held in last 04 PSC meetings (30th, 31st, 32nd, 33rd)	BBMB, NHPC, POWERGRID (NR-2) and NAPS

***36th* PSC *meeting on 19th September, 2018*--** Members were informed that list of events of delayed clearance of faults from 01.04.2014 to 01.06.2015 was already circulated but data has not been submitted by utilities. Utilities were requested to furnish the information as mentioned above at the earliest as the details need to be submitted to CERC.

In 40th TCC/43rd NRPC meeting held on 29th and 30th October, 2018- It was informed that list of delayed clearance fault was circulated again and again but data has been only received from the utilities mentioned above. He informed that partial information received till date was submitted to CERC as show cause notice was issued for non-submission of data in compliance of CERC order on Petition No. 9/SM/2014 and 10/SM/2014. He told that complete information would be submitted to CERC after receiving from utilities.

Utilities were requested to furnish the information as mentioned above at the earliest as the details need to be submitted to CERC.

A.8.8 General Recommendations/Best Practices in PSC meeting

In the 32nd PSC meeting it was deliberated that there is a need to keep the compilation of the general recommendations of the Protection Sub- Committee for reference. The compiled list of recommendations of PSC was circulated with the agenda of 33rd PSC meeting and also enclosed as Annexure – XII of 35th PSC agenda.

Members were requested to adhere to these general recommendations and follow the best practices as suggested by PSC. Members were also requested to forward best practices in their utility or any other utility which can be adopted to include in this compilation.

35th PSC meeting on 20th June, 2018 - It was informed that list of general recommendations was formed considering best practices as suggested by PSC but it has been observed that these practices were not being implemented. All the utilities were requested update the status regarding actions taken to adhere these general recommendations.

In 36th* PSC *meeting on 19th September, 2018 - Representative of NRLDC stated that during the deliberations in PSC meetings if any recommendation was recurring, then it was considered as general recommendation by PSC to be adhered by utilities. It has been observed that these recommendations were not followed by utilities and tripping due to same reason have been noticed. He insisted that utilities should adhere with these

recommendations. Utilities were also requested to share any frequent cause of tripping, maloperation observed due to particular setting or any input beneficial for other utilities so that these recommendations could be expanded.

In 40th TCC/43rd NRPC meeting held on 29th and 30th October, 2018- It was informed that compiled list of recommendations of PSC was circulated as General recommendations/Best Practices in PSC meetings. Utilities were requested to adhere to these general recommendations and to forward best practices in their utility which can be adopted to include in this compilation. It was informed that compendium of all the best practices would be made and same could be followed by the region as whole which might help in mitigating instances of mal-operation/mis-operation.

All the utilities were again requested to submit the updated status regarding actions taken to adhere these general recommendations.

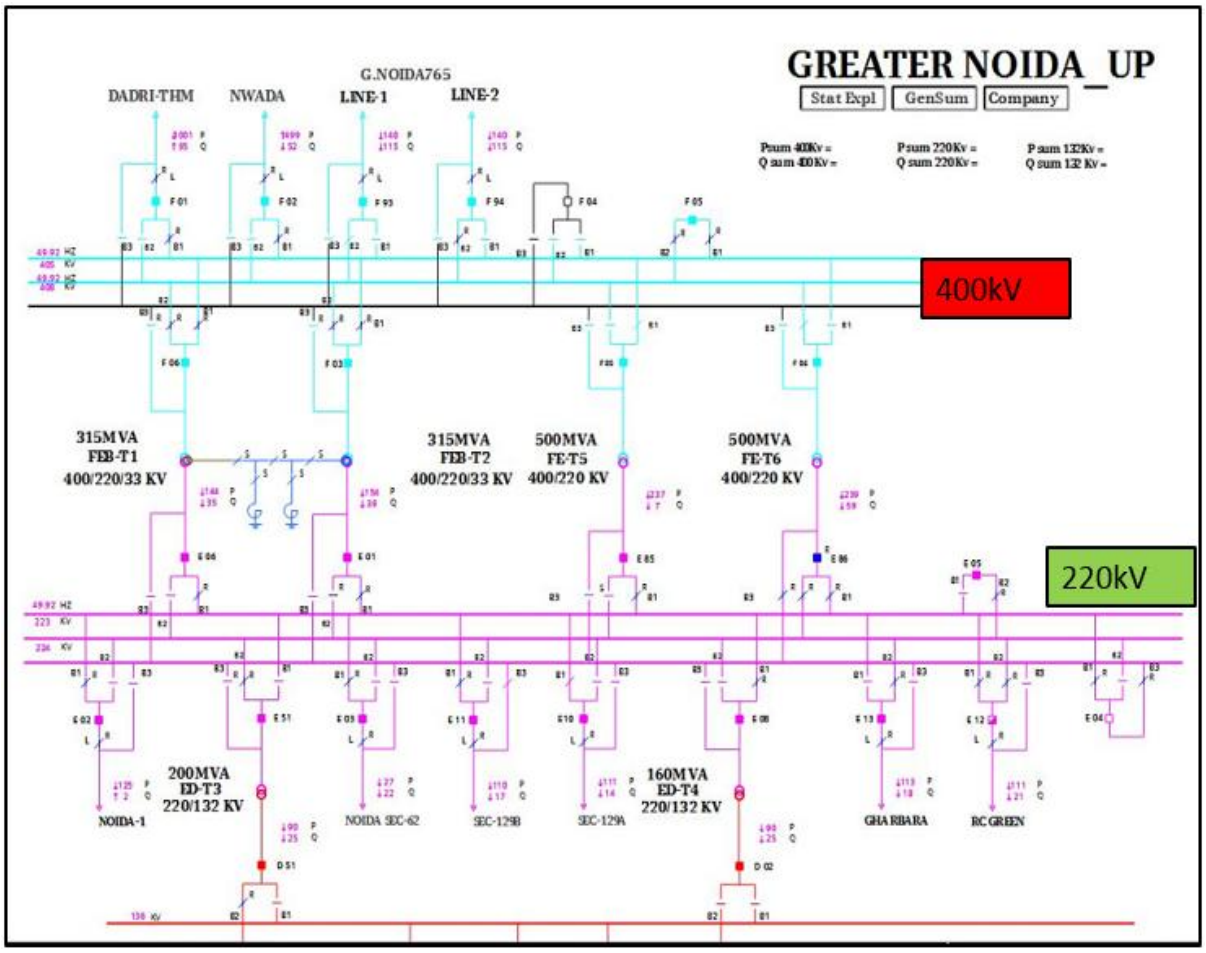
1. **Complete outage of 400/220 kV G. Noida (UP) on 06 Nov 2018 at 22:40hrs (Discussed in 151st OCC meeting):**

As reported by UP SLDC, conductor of R phase 400 kV Bus-A got broken at 400/220 kV G. Noida leading to 400 kV bus-bar fault at 400/220 kV G. Noida (UP). 400 kV bus bar protection did not operate at 400/220 kV G. Noida (UP). It was found that none of the breaker opened from 400 kV G. Noida (UP) end.

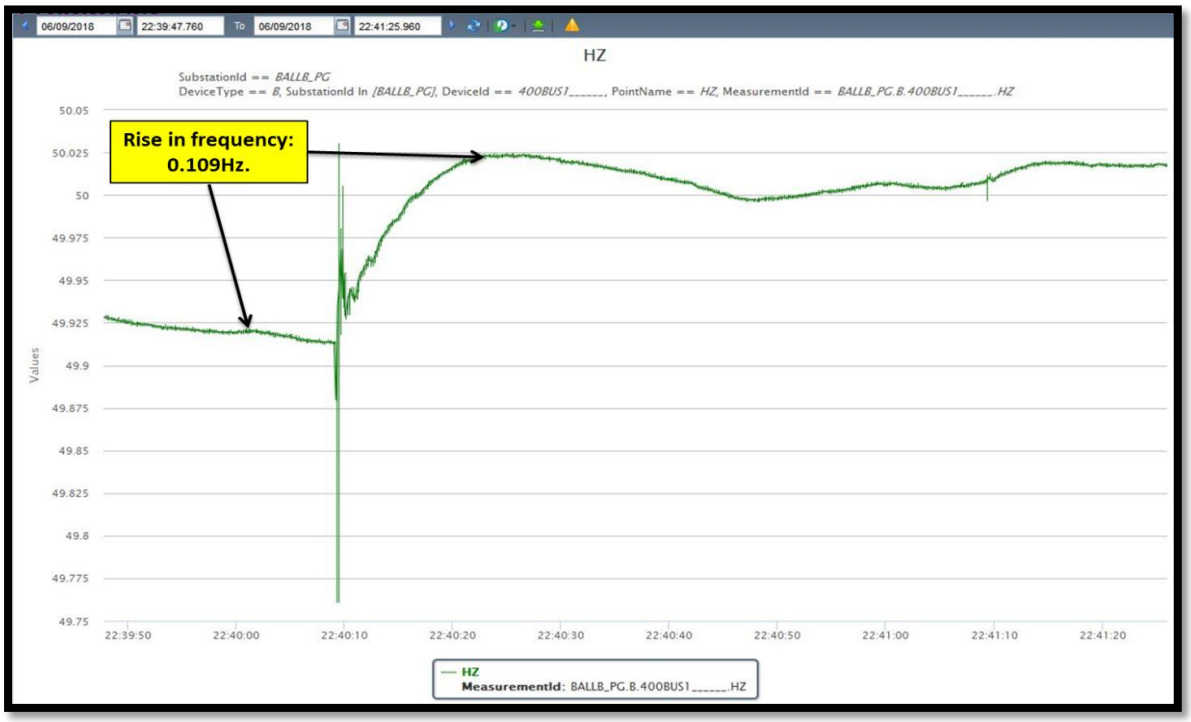
All the 400 kV connected lines from 400/220 kV G. Noida (UP) lines tripped from remote end. This resulted in loss of approx. 800-900 MW and frequency increasing from approx. 49.91 Hz to 50.12 Hz (thus a jump of approx. 0.11 Hz). After the tripping the line loading on remaining lines remained within limits.

As reported by NTPC Dadri, Vibration more 200 microns also sensed in Dadri stage-2 units.

400/220 kV G. Noida (UP) station is an important load feeding station in Delhi NCR with 1630MVA (2*315MVA+2*500MVA) capacity. Connectivity Diagram is as below:

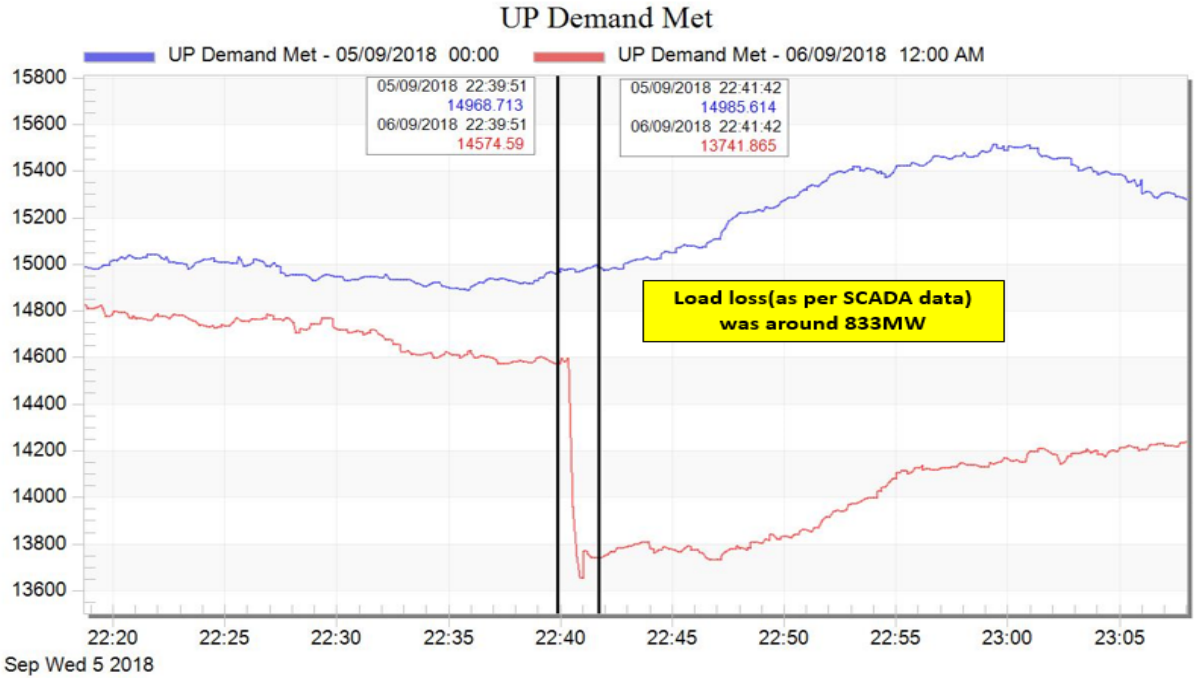


As per PMU data maximum dip in R-phase and fault clearance time was ~400ms. Delayed clearance of fault as per PMU data. PMU plot of phase voltages of Ballabhgarh (PG) is as below:



AS per PMU plot of frequency, it seems load loss occurred in the system.

As per SCADA data, load loss of around 830 MW observed in UP demand met. As informed by UP, Sector-62 Noida is further connected in the Grid through 400kV Indirapuram. All other 220 kV feeders and downward ICTs at 400/220kV G. Noida feed the radial load. SCADA data plot is as below:



As per SCADA SoE:

- 400 kV Dadri-G. Noida ckt tripped immediately from Dadri (NTPC) end. No breaker opened at 400/220 kV G. Noida end.
- Tripping also occurred at 400 kV G. Noida (765/400 kV)-G. Noida (400kV) ckt-1 & 2 from 400 kV G. Noida (765/400 kV) end. 765/400 kV 1500MVA ICT-1 also tripped at 765/400 kV G. Noida (UP).
- It seems time synchronization error in the reporting of SoE of 765/400 kV G. Noida (UP) and 400 kV Nawada (Haryana)

Time	S/S name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks	Comment
22:20:48,354	NAWADA	400kV	4GNODA1	Circuit Breaker	Open	Time Synch error	Main CB of 400kV Nawada(end)-Greater Noida opens
22:40:09,160	As per PMU data						
22:40:09,165	DADRI (Thermal)	400kV	20GN1MA2	Circuit Breaker	Open		Tie CB of 400kV Dadri(end)-Greater Noida & 400kV Dadri(end)-Mandola ckt-2 opens
22:40:09,212	DADRI (Thermal)	400kV	21GNODA1	Circuit Breaker	Open		Main CB of 400kV Dadri(end)-Greater Noida opens
22:40:37,000	GNOD7_U	400kV	403T1	Circuit Breaker	Open	Time Synch error	400kV side main CB of 1500 MVA ICT 1 765kV Greater Noida opens
22:40:37,000	GNOD7_U	765kV	701T1	Circuit Breaker	Open		765kV side main CB of 1500 MVA ICT 1 765kV Greater Noida opens
22:40:37,000	GNOD7_U	400kV	402T1T3	Circuit Breaker	Open		400kV side tie CB of 1500 MVA ICT 1 765kV Greater
22:40:37,000	GNOD7_U	765kV	702AGRT1	Circuit Breaker	Open		765kV side tie CB of 1500 MVA ICT 1 765kV Greater
22:40:37,000	GNOD7_U	400kV	415GNDA2	Circuit Breaker	Open		Main CB of 400kV Greater Noida(765kV)(end)-Greater noida(400kV) ckt-2 opens
22:40:37,000	GNOD7_U	400kV	418GNDA1	Circuit Breaker	Open		Main CB of 400kV Greater Noida(765kV)(end)-Greater noida(400kV) ckt-1 opens
22:40:37,000	GNOD7_U	400kV	414SPGD2	Circuit Breaker	Open		Tie CB of 400kV Greater Noida(765kV)(end)-Greater noida(400kV) ckt-2 opens
22:40:37,000	GNOD7_U	400kV	417SPGD1	Circuit Breaker	Open		Tie CB of 400kV Greater Noida(765kV)(end)-Greater noida(400kV) ckt-1 opens

UPPTCL representative informed that R-phase pantograph isolator assembly of 400 kV G. Noida (end)-Dadri ckt got snapped and fell down causing 400 kV bus fault at 400 kV G. Noida (UP) station. 400 kV bus

bar protection was not operated and all the 400 kV connected elements tripped from remote end in Z-2 distance protection operation. Further during investigation, it was found that only one source of 220 Volt DC was available for bus bar protection panel and positive fuse of this DCDB source-2 was found blown off resulting into 220V DC supply failure to 400 kV bus bar protection panel and 400 kV bus bar protection failed to operate.

Remedial Measures (As per UPPTCL report):

- In order to avoid any such incident in future both 400 kV and 220 kV bus bar protection relays have been fed with double DC source from DCDB independently along with DC supervision relay for both the DC supply of the bus bar protection relays. Both the DC supply to the bus bar protection relays and its DC supervision relays have been tested and found in order. Later bus bar protection put back into service.
- Testing of 400 kV bus bar protection at 400 kV G. Noida (UP) to be done.
- Testing of protection of 1500 MVA ICT-I at 765 kV G. Noida S/S.

NRLDC representative also raised the concern of outage of entire substation in 400 kV Delhi ring being a serious operational issue and any further tripping could result into disturbance propagating to larger area.

MS, NRPC also raised concern for non-operation of bus bar protection at important station of 400 kV G. Noida (UP) near Delhi control area and suggested for further detailed investigation of the incident and submit the report of the incident.

NRLDC representative informed that if there is time delay in fault clearance than there may be failure of primary protection, delay in protection operation or operation of secondary/back up protection. Intended function of protection system may not be operated. As per CEA Regulation fault clearance time is 100ms and 160ms for 400 kV & 220 kV system respectively.

UPPTCL representative informed that

- During the incident actual R-phase conductor got damage and snapped in the 400 kV switchyard resulted into bus fault at 400 kV G. Noida (UP) station.
- At the time of commissioning of SEL make bus bar protection, one DC supply source was provided as per approved drawing scheme of bus bar protection and this scheme is implemented at five 400 kV station in UP.
- Bus Bar Scheme (SEL make) with single DC source has been revised at 400 kV G. Noida (UP) and other four 400 kV station (Muzaffarnagar, Muradnagar). At present Bus Bar Protection has supply with double DC source.
- Only DC supply to the bus bar protection was under outage due to DC supply fuse failure. DC supervision relay was also found in damage condition. DC supervision relay has been restored and wired for alarm in the control room.
- Only One numerical bus bar differential protection implemented at all five 400 kV station. Redundancy is not available for bus bar differential protection.

NRLDC representative further suggested all the utilities to kindly make redundancy in bus bar protection at 400 kV voltage level.

POWERGRID and Punjab also informed that redundancy in bus bar protection is available at all 400 kV station.

Following points further agreed during PSC meeting:

- Remedial measures report considering the action points approved in OCC meeting to be submitted by UPPTCL/ Haryana/ NTPC. Action points are once again tabulated below:
    - Outage of entire substation in 400 kV Delhi ring is a serious operational issue and any further tripping could result into disturbance propagating to larger area and therefore, safeguards by way of protection system improvement need to be expedited.

- Healthiness of 400 kV Bus bar protection at 400/220 kV G. Noida (UP) station needs to be ensured. 400 kV bus bar protection shall be tested within 7days and submit the report to NRPC/ NRLDC. (**Action**: Uttar Pradesh; **Time Frame**: 7days)
- DC supply supervision relay and its alarm to be wired in control room and shall be visible to the control room operator. If DC supply failure alarm came into the system same needs to be attended on priority basis within 24hrs.
- Instantaneous tripping of 400 kV Dadri-G. Noida ckt from Dadri end needs to be looked into as fault was in Z-2 from Dadri end. (**Action**: NTPC; **Time Frame**: 7days)
- Tripping of 1500MVA 765/400 kV ICT-1 at 765/400 kV G. Noida (UP) needs to be checked and corrected. Protection Co-ordination of 1500MVA ICT with 400 kV G. Noida (765/400kV)-G. Noida (400/220kV) ckts also to be checked. (**Action**: Uttar Pradesh; **Time Frame**: 15days)
- Time synchronization of SCADA SoE of 765/400 kV G. Noida (UP) and Nawada (Haryana) to be checked and corrected. (**Action**: Haryana and UP; **Time Frame**: 15days)

- Redundant bus bar differential protection shall be provided at all 400 kV sub-station. (General Recommendation; **Action**: All NR constituents)
- Approved general recommendation of NRPC shall be strictly followed by all the NR constituents.

2. Tripping of all 400kV elements at 400/220kV Aligarh(UP) (Discussed in 153rd & 154th OCC meeting):

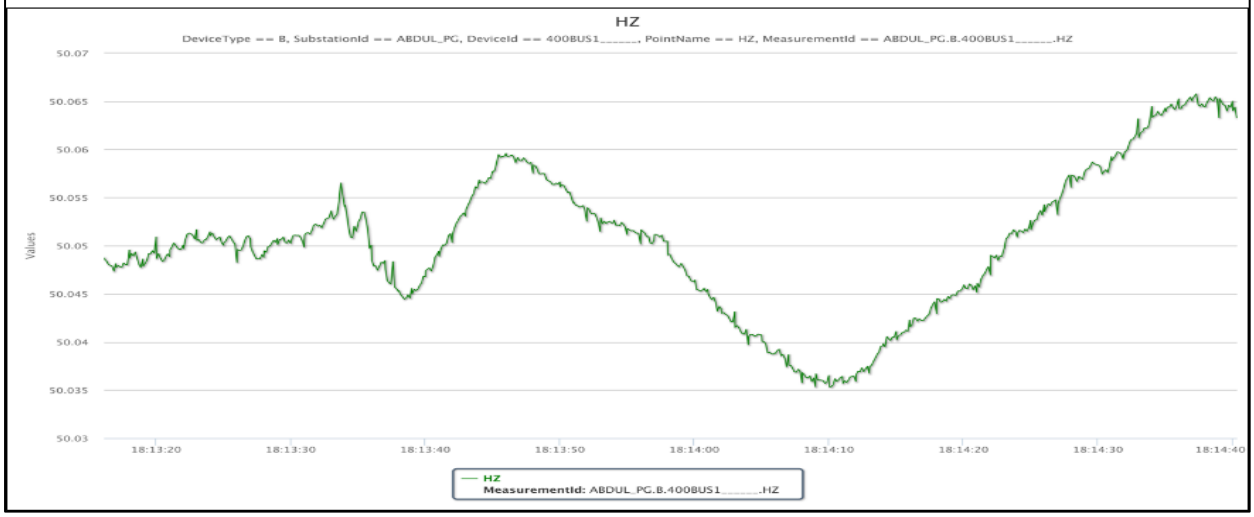
NRLDC representative stated the following as per gathered information:

- 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:

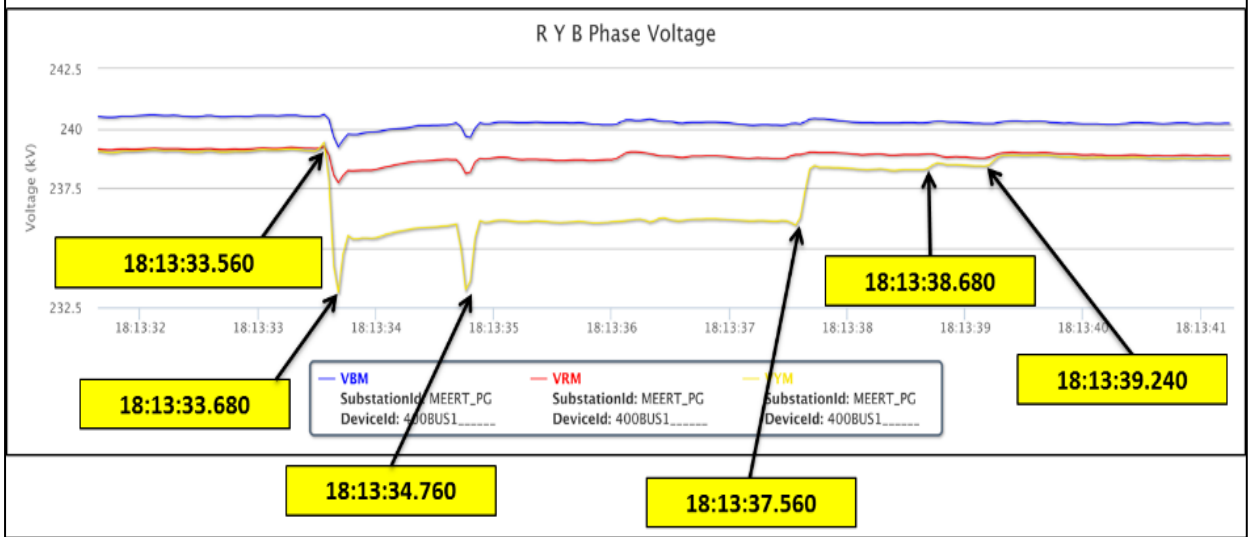
PMU Plot of frequency at Abdullapur(PG)

18:13hrs/06-Nov-18



PMU Plot of phase voltage magnitude at Meerut(PG)

18:13hrs/06-Nov-18



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-1	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.

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.

UPPTCL representative informed that

- Main CB of 400 kV Aligarh (end)-Muradnagar ckt was not opened due to breaker lockout. Breaker lockout position was due to less air pressure in the breaker and same was over looked by the operator.

- ZIV make LBB/ Bus Bar (distributed) Protection at Aligarh station was out of service. UPPTCL already contacted CGL twice but service engineer couldn't sort out the problem in the relay. Reverse zone setting at 400 kV Aligarh end revised to 100ms.
- ZIV make distributed bus bar protection is available at 400 kV Aligarh (UP). In case of communication issue with particular bay, bus bar protection blocked and send the tripping command to concerned bay (communication broke). This issue was still persisted thatswhy bus bar protection taken under outage. On this particular issue POWERGRID representative informed that it depends on configuration in the relay. In POWERGRID such type of configuration is not available.
- 400 kV Sikandrabad end didn't trip thatswhy lines tripped from 400 kV G.Noida end.

NRPC representative further suggested that revising the reverse zone setting is helpful for DMT scheme. It is not much useful in case of one an half breaker scheme.

NRLDC representative raised concern about following points:

- Mechanical problem in the main breaker of 400 kV Aligarh (end)-Muradnagar ckt. What is the status of breaker maintenance?
- Outage of LBB/ Bus Bar Protection at 400 kV Aligarh (UP) and restoration time for the same.
- Distance zone-2/zone-3 setting at remote end of 400 kV Aligarh (UP) to be checked and corrected.
- If fault current was very less, DEF (Directional earth fault) protection setting in the 400kV line needs to be checked and corrected.
- Protection Co-ordination of 765/400 kV ICT, 400/220 kV ICTs with respective transmission line.
- Delayed clearance of fault of 4000ms as against the standard clearance time of 100ms.

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. A further, delayed clearance of 4000ms as against the standard of 100ms is also very alarming and indicates towards an immediate and in depth analysis. But Detailed analysis is still pending from UPPTCL.

NRPC raised concern about non-submission of complete information about the incident and further remedial measures yet to be identified by UPPTCL. Internal Protection Audit for 400 kV Aligarh (UP), Sikandrabad (UP) and 765/400 kV Mainpuri (UP) was recommended by NRPC on 20-21st Feb 2019. UPPTCL shall share the report of the protection audit with NRPC/ NRLDC.

NRPC suggested UPPTCL to kindly also look into the following point during protection audit:

- 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.

Operator needs to be sensitized for alarm related to breaker lockout, any protection outage, DC supervision relay etc and same shall be reported to concerned engineer. (General Recommendation)

3. Multiple element tripping at 400 kV Dadri TPS and tripping of HVDC Rihand-Dadri Pole-2 (Discussed in 154th OCC meeting):

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.

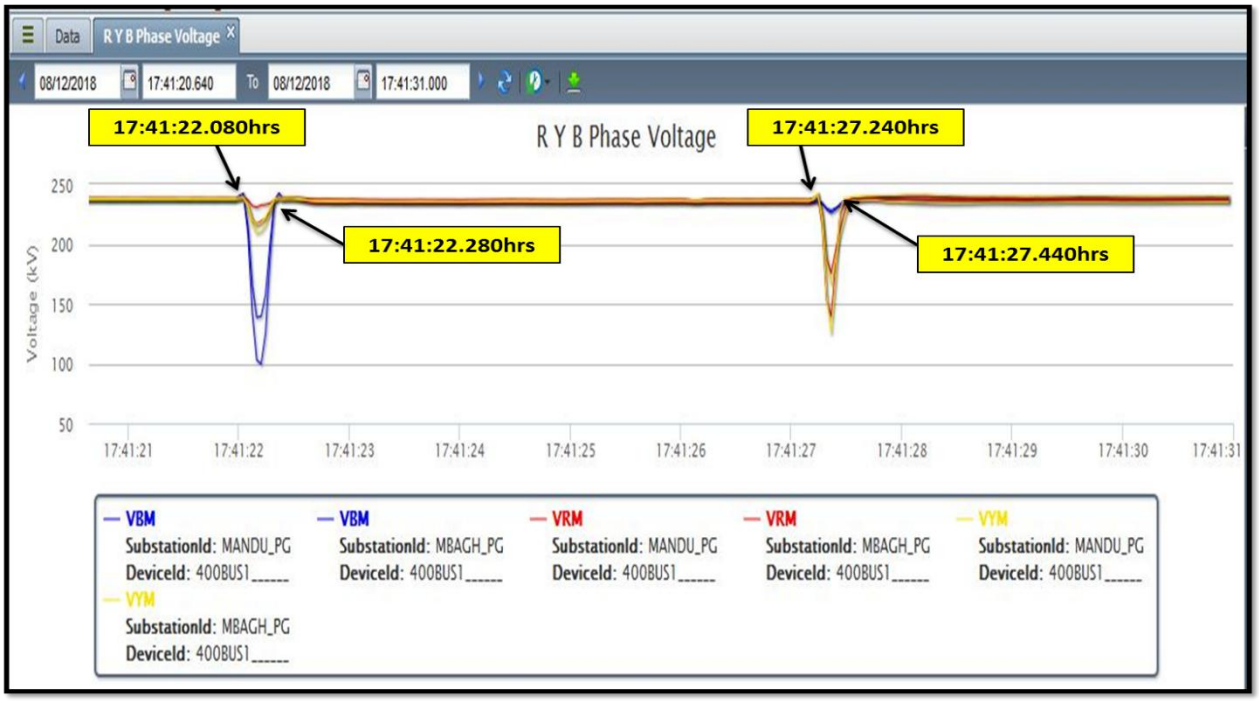
The PMU plot and NRLDC SCADA data and SoE are as follows:

PMU Plot of frequency at Mandaula(PG)

17:41hrs/08-Dec-18

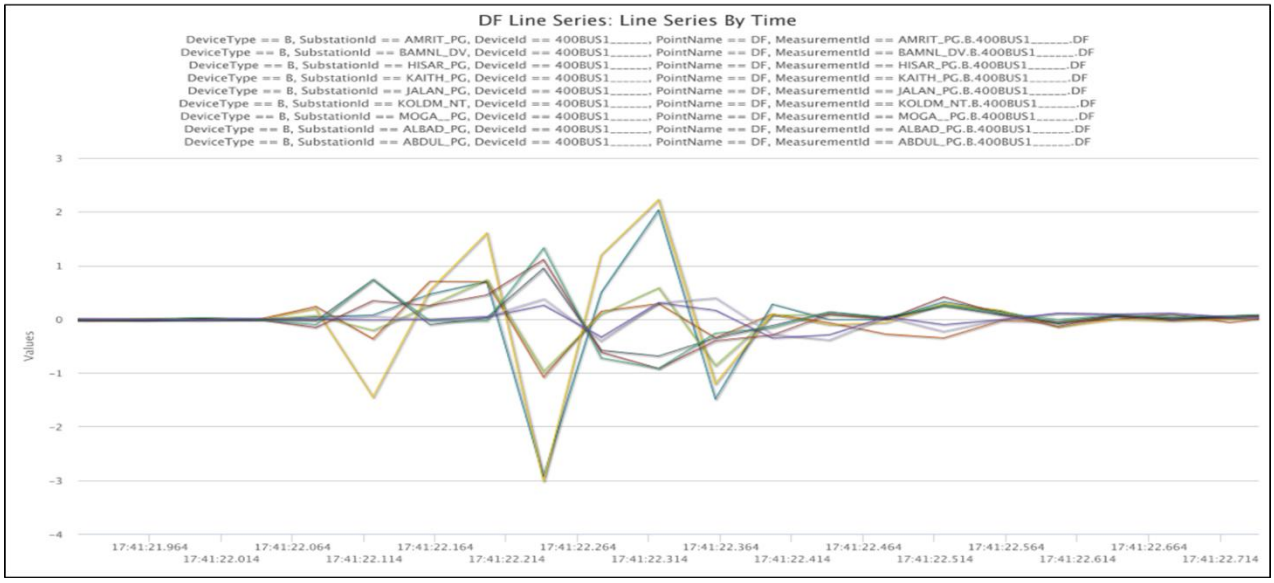
PMU Plot of phase voltage magnitude at Maharani Bagh(PG)

17:41hrs/08-Dec-18

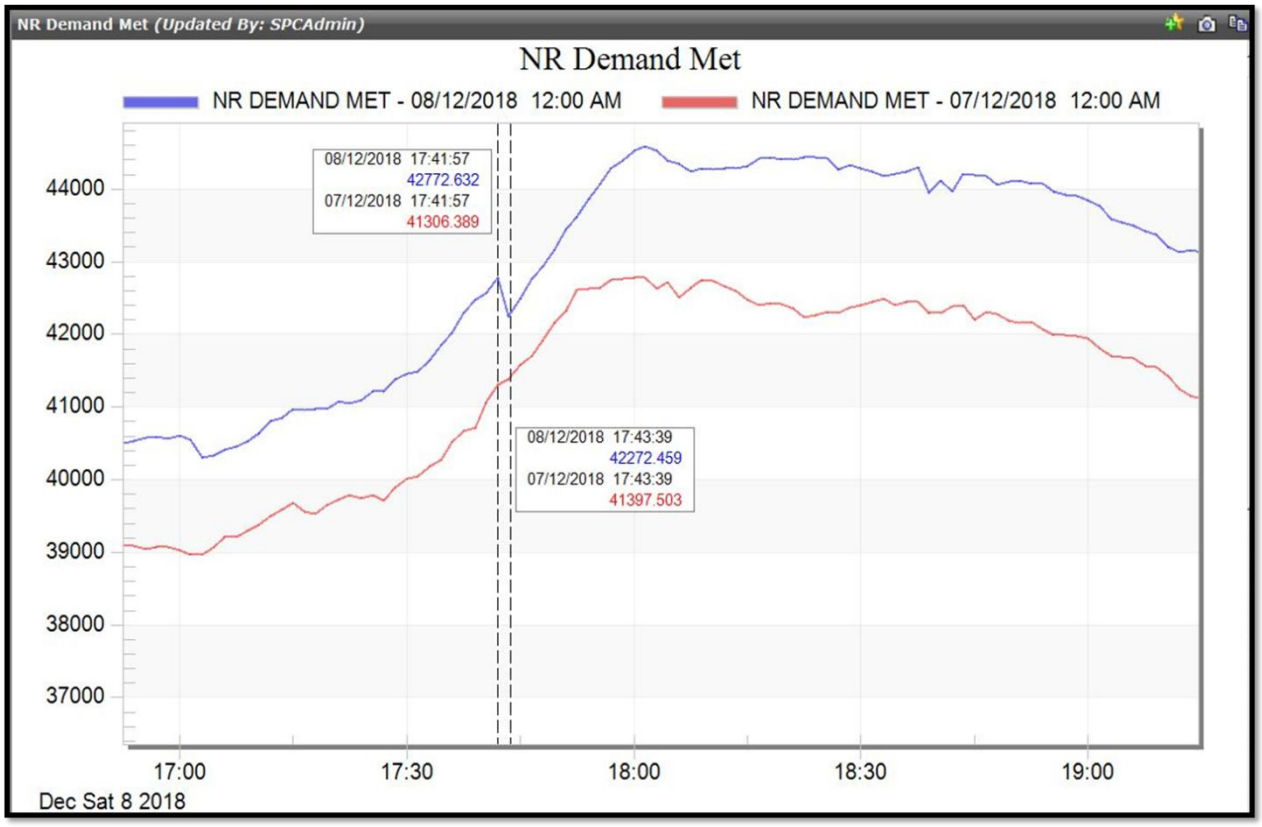


PMU Plot of df/dt

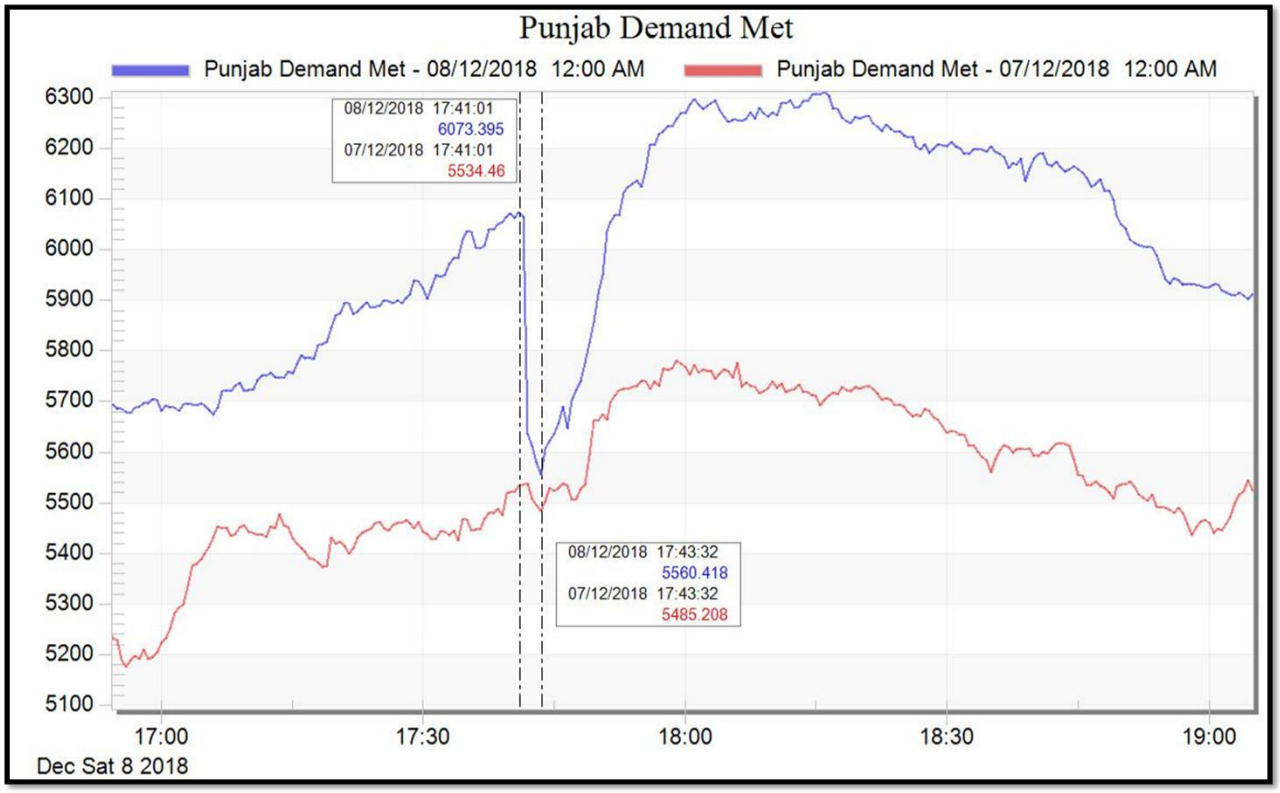
17:41hrs/08-Dec-18



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

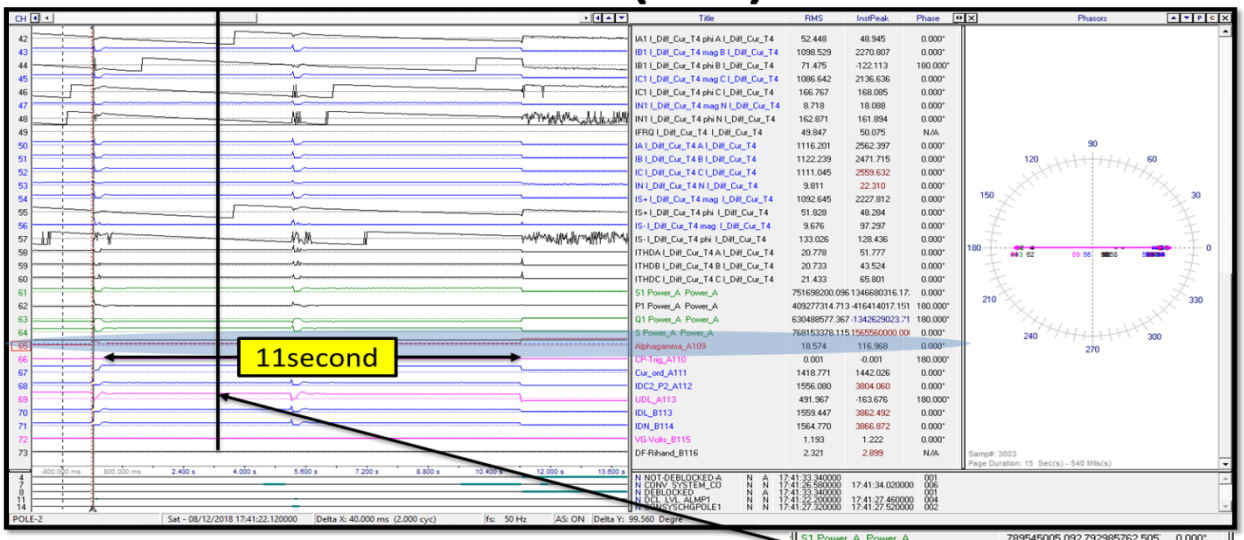
Constituent Details are as follows:

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.

Discussion in 37th PSC meeting:

POWERGRID representative informed following during the meeting:

- *Minimize tripping/ fault during OPGW installation*: Issue has been taken up with contractors through letters and verbal communication.
- *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*: 400 kV Ballabhgarh-Maharani Bagh ckt has been restored.
- *Unwanted tripping of 400 kV Delhi-Mandaula ckt-1 & 2 from Mandaula end and remedies taken:* After implementation of series line reactor of 12ohms, Line impedance setting in distance setting was revised with addition of 12 ohms in existing zone impedance setting. After addition of 12 ohms series impedance all distance zones overreached and it resulted into tripping of Dadri-Mandaula ckts in Z-1 instead of Z-2. As CVT location at Mandaula station is after series reactor so impedance had not added. Lateron 12 ohms impedance removed from Mandaula end zone impedance setting. At remote end of 400 kV Mandaula station this 12ohms impedance will be added in all distance zones (Z-2 & Z-3) for correct operation of the distance protection.
- *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):* Controller behavior at both Rihand and Dadri end is not in synch. Controller at Dadri end stabilizes the voltage but Rihand end couldn't stabilize and resulted into blocking at Rihand end. Controller in Rihand-Dadri HVDC is very old (more than 25 year old) and it is going to upgrade

- *SPS signal sending details from Rihand & Dadri and receipt of signal from remote end. (Time stamped signal of SPS)*: Yet to be done. POWERGRID will explore the possibility of logging of SPS signal.
- *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*: Issue has been checked and corrected at POWERGRID end
- *Detailed report of the incident covering all the aforesaid points shall be shared to NRPC/ NRLDC within 7days*: Share the details within 7days.

NTPC was requested to kindly look into the following:

- *Reason of tripping of three auxiliary bus at Dadri TPS*: Auxiliary buses tripped due to zero time delay in under voltage setting of auxiliary bus, it has been revised to 2second time delay with 80% of nominal voltage.
- Voltage drop relay setting for auxiliary bus contactor needs to be checked.

Punjab representative informed during the meeting:

- *Exact reason of operation of RoCoF relays in the region and remedial measures taken*: Punjab representative informed that time delay setting of rate of change of frequency (RoCoF(df/dt)) is 2 cycle instead of 7-8 cycle. Setting has been corrected at those locations.
- Co-ordinate with POWERGRID to check and correct the reason of non-tripping of feeders comes under SPS load group:
    - Cable was damaged at Laltokalan and it has been restored
    - Issue at Gobindgarh yet to be attended.
- Detailed report of the incident: Yet to be submitted, will share within 7days

NRLDC representative stated during the meeting:

- POWERGRID shall see the SPS signal scheme implemented at Mahendergarh end for Mundra-Mahendergarh scheme and implement the similar type of logging scheme for other SPS scheme implemented by POWERGRID.
- *Exact reason of operation of RoCoF relays in the region and remedial measures taken*: Punjab representative informed that time delay setting of rate of change of frequency (RoCoF(df/dt)) is 2 cycle instead of 7-8 cycle. Setting has been corrected at those locations.

Following are the action points decided during the meeting:

- POWERGRID shall see the SPS signal scheme implemented at Mahendergarh end for Mundra-Mahendergarh scheme and implement the similar type of logging scheme for other SPS scheme implemented by POWERGRID. In Mundra-Mahendergarh SPS scheme, logging of SPS signal and receipt to remote end has available in SCADA event log and Mahendergarh end. (**Time Frame**: 2months; **Utilitity**: POWERGRID)
- Receiving end of SPS signal for all existing SPS scheme needs to be wired in SCADA log/ event log. (**Time Frame**: 2months; **Utilitity**: Punjab, Rajasthan, Uttar Pradesh, Delhi, Haryana and other NR concerned utilities have SPS scheme)
- UFR and df/dt protection is last resort for prevention of any large grid disturbance. Setting of UFR and df/dt wrt to measurement cycle and absolute setting to be checked. (**Time Frame**: 15days; **Utilitity**: All concerned NR utilities)

- Staggering in under voltage setting for auxiliary buses at Dadri (NTPC) to be done and share the implemented setting. (**Time Frame**: 15days; **Utilitity**: NTPC)
- SPS signal issue for Gobindgarh feeder to be checked and corrected. End to end testing for Laltokalan and Gobindgarh shall also be done. (**Time Frame**: 7days; **Utilitity**: POWERGRID and Punjab)
- SPS signal related issues:
    - Tripping of Merta and Alwar end to be checked
    - Tripping at Samaypur (BBMB): only one ckt of 220 kV Samaypur-Palwal ckt tripped
    - Tripping at Modipuram to be checked
- Lower load relief/ non-tripping of feeder in C& D load group of SPS operation needs to be relooked by respective utilities (**Time Frame**: 7days; **Utilitity**: POWERGRID, Haryana, UP and Rajasthan)
- All the concerned utilities kindly share the detailed report considering the aforesaid points. (**Time Frame**: 15days; **Utilitity**: All NR constituents)

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.

A.1 Tripping Events:

The complete summary of the events along with the information reported, action taken by entities is attached at **Annexure-VI**.

The recommendations of PSC are as follows:

A. Multiple times bus bar protection operation at 400 kV Orai (UP) during line fault on any outgoing feeder:

1. In view of the lack of information and clarity about the events and no representative from UPPTCL (Orai zone) attended the meeting, the event would be included again for discussion in the next PSC meeting.
2. Bus Bar Protection at 400 kV Orai (UP) needs to be checked and corrected. Bus Bar Protection for 400 kV Bus-1 operated during A/R of the line. (**Action:** Uttar Pradesh**; Time:** Within 15days)
3. Operation of bus bar protection for 400 kV bus-2 within 100ms of fault occurrence needs to be looked into.
4. No representative from UPPTCL (Orai zone) presented during the meeting, It was informed to STU/SLDC-UP to collect the information (DR/EL, detailed report) and submit the details considering the points for discussion mentioned below: (**Action:** UPPTCL/ SLDC-UP, **Time:** Within 15days)
    a. Event of 16th Sep 2018
        i. Exact location of fault and nature of fault.
        ii. Sequence of tripping needs to be reported and explained.
        iii. Mal-operation of 400 kV Bus Bar Protection (400 kV Bus-1) at 400/220 kV Orai (UP) station during line fault in 400 kV Orai-Mainpuri ckt-1 needs to be looked into.
        iv. Similar incident happened multiple times. Operation of Bus Bar Protection in case of single phase to earth fault is serious cause of concern for grid security. UPPTCL is advised to look into the matter and take corrective action
        v. Detailed report, remedial measures report and supporting DR/EL needs to be submitted.
        vi. Operation of 400 kV bus bar protection at 400/220 kV Orai (UP) to be reviewed and corrected
    b. Event of 29th Nov 2018:
        i. Exact location of fault and nature of fault.
        ii. Sequence of tripping needs to be reported and explained.
        iii. Mal-operation of 400 kV Bus Bar Protection (400 kV Bus-2) at 400/220 kV Orai (UP) station during line fault in 400 kV Orai-Mainpuri ckt-2 needs to be looked into.
        iv. Similar incident happened multiple times. Operation of Bus Bar Protection in case of single phase to earth fault is serious cause of concern for grid security. UPPTCL is advised to look into the matter and take corrective action
        v. Detailed report remedial measures report and supporting DR/EL needs to be submitted.

B. Complete outage of 400/220 kV Gorakhpur (UP) at 16:56hrs of 17th Sep and 10:03hrs of 22nd Oct 2018

1. Operating procedure/checklist for maintenance or upgradation activity shall be followed religiously for prevention of any mal-operation/mis-operation. (**Action: General Recommendation**)
2. Bus Bar Protection of both side of 400/220 kV Gorakhpur (UP) needs to be thoroughly checked. (**Action:** Uttar Pradesh; **Time:** Within 7days)
3. Backup over current setting of 500MVA ICT-1 at Gorakhpur (UP) to be checked wrt sensitive setting as ICT tripped within 100ms. (**Action:** Uttar Pradesh; **Time:** Within 7days)
4. Tripping of 400 kV Gorakhpur (UP)- Gorakhpur (PG) ckt-1 from Gorakhpur (UP) end seems to be due to PLCC panel problem. UPPTCL shall kindly check the PLCC panel. (**Action:** Uttar Pradesh; **Time:** Within 7days)
5. Alstom make station event logger shall be kept in healthy condition. (**Action:** Uttar Pradesh; **Time:** Within 30days)
6. A detailed report covering the following points along with remaining DR, station EL shall be submitted: (**Action:** Uttar Pradesh; **Time:** Within 7days)
    a. Event on 17th Sep 2018:
        I. Sequence of tripping needs to be reported and explained
        II. Reason of delayed clearance of fault
        III. Operation of bus bar protection for both 400 kV buses at Gorakhpur (UP) needs to be relooked.
        IV. Delayed clearance of fault more than 400ms in case of operation of instantaneous bus bar protection operation also to be checked.
        V. Healthiness of both 400 kV & 220 kV bus bar protection of 400/220 kV Gorakhpur (UP) needs to be ensured.
        VI. Back up over current earth fault protection of 500MVA ICTs needs to be looked into.
        VII. Reason of tripping of 400 kV Gorakhpur (UP)-Gorakhpur (PG) ckt-1 from Gorakhpur (UP) end needs to be explained. (From PG end 400 kV Gorakhpur (UP)-Gorakhpur (PG) ckts tripped in Z-2)
        VIII. SCADA SoE (not received) of tripping of 400 kV Gorakhpur (UP) end-Azamgarh ckt.
        IX. Status of availability of DR/EL and extracting software needs to be shared.
        X. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL

    b. Event on 22nd Oct 2018:
        I. Sequence of tripping needs to be reported and explained.
        II. Reason of delayed clearance of fault.
        III. Operation of bus bar protection for both 220 kV buses at 400/220 kV Gorakhpur (UP) needs to be relooked.
        IV. Delayed clearance of fault more than 400ms in case of operation of instantaneous bus bar protection operation also to be checked.
        V. Healthiness of 220 kV bus bar protection of 400/220 kV Gorakhpur (UP) needs to be ensured.
        VI. Time synchronization of SCADA SoE to be checked and corrected.
        VII. Status of availability of DR/EL and extracting software needs to be shared.
        VIII. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL.

C. Multiple Element tripping at 400/220 kV Patran substation at 11:11 hrs of 18th Sep 2018

1. PTCL shall revise the scheme of 400 kV DC supply to GD for supply from both the DC source for better redundancy and reliability. Further tripping shall be done in case of actual gas leakage, otherwise alarm shall be taken in control room for DC supply failure. (**Action:** PTCL, **Time:** Within 60days)

D. Multiple element tripping at 400/220 kV Fatehpur (PG) at 12:17hrs of 29th Sep 2018

1. It was evident from DRs of the above trippings that the relays have functioned as per scheme and settings except LBB of the Tie CB. LBB relay (SIPROTECH- 7SS252) of 400KV Unchahar-2 – ICT-2 Tie was later found to be faulty when tested and same was replaced. All the major remedial measures have already been taken.
2. POWERGRID shall check and share the details for following points: (**Action:** UPPTCL/ SLDC-UP, **Time:** Within 15days)
    a. Reason of tripping of 220 kV Fatehpur (PG)-Fatehpur (UP) ckt-1.
    b. Digital data status needs to be checked for inter-tripping of 765/400 kV 1500MVA ICTs at Fatehpur (PG).
    c. Sequence of tripping in time stamped (ms) manner to be established.

E. Multiple Element tripping at 400/220kV Obra-B TPS at 04:37hrs of 14th Oct 2018

1. No representative from UPRVUNL presented during the meeting, It was informed to STU/SLDC-UP to collect the information (DR/EL, detailed report) and submit the details considering the points for discussion mentioned below: (**Action:** UPPTCL/ SLDC-UP, **Time:** Within 15days)
    a. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
    b. Exact location of fault and nature of fault.
    c. Sequence of tripping needs to be reported and explained.
    d. Reason of multiple element tripping without any fault in the system.
    e. Arrangement of station auxiliary supply and its back up at 400/220 kV Obra-B TPS to be shared. Also reason of tripping of all running units needs to be explained.
    f. Reason of tripping of 400 kV transmission line (400 kV Obra-Rewa Road and 400 kV Obra-Sultanpur ckt) needs to be reviewed.
    g. Availability of time synchronized SCADA SoE to be checked and corrected.
    h. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL

    A detailed report covering the aforesaid points along with remaining DR, station EL shall be submitted: (**Action:** UPPTCL/ SLDC-UP; **Time:** Within 15days)

F. Complete outage of 220 kV Kota TPS and Sakatpura (Raj) at 21:00hrs of 20th Oct and 14:26hrs of 13th Nov 2018

1. Time delay of Reverse zone setting at Kota TPS end is still 1000ms. Reverse zone (Z-4 setting) shall be coordinated with Z-2 timing (350/500ms) as per Rama Krishna committee report, same needs to be modified at Kota TPS. (time delay for reverse zone setting shall be 500ms) (**Action:** RRVUNL/ RRVPNL/ SLDC-Rajasthan, **Time:** Within 7days)
2. Back up earth fault setting of 220 kV Bus Couplers needs to be reviewed. (**Action:** RRVUNL, **Time:** Within 7days)

3. 220 kV bus bar protection at Sakatpura station shall be available within 30days. (**Action:** RRVPNL, **Time:** Within 30days)
4. Due to lack of information from RRVUNL complete tripping couldn't be analysed at the time of meeting. RRVUNL shall submit the detailed report considering the points for discussion mentioned below (**For the incident occurred at 21:00hrs of 20th Oct 2018**): (**Action:** RRVUNL/ RRVPNL/ SLDC-Rajasthan, **Time:** Within 15days)
    a. Reason of delayed clearance of fault.
    b. Failure of which primary and back up protection led to delayed clearance of fault.
    c. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
    d. Back up earth fault setting of 220 kV Bus Coupler-1 needs to be reviewed.
    e. Sequence of tripping needs to be reported and explained. (Time stamped data for the tripping didn't receive)
    f. Tripping of all station transformer (220/6.6kV) on back earth fault protection needs to be reviewed in accordance with current & time delay setting.
    g. Reason of tripping of unit-2 within 200ms of fault occurrence before tripping of all the lines from Kota TPS.
    h. Arrangement of station auxiliary supply and its back up at 220 kV Kota TPS to be shared. Also reason of tripping of all running units needs to be explained.
    i. Availability of time synchronized SCADA SoE to be checked and corrected.
        i. Tripping of units other than 2, 3 & 5
        ii. Tripping of 220 kV feeders from remote end of KTPS
        iii. Detailed report, remedial measures report and complete DR/EL (cfg, dat file) needs to be submitted by RRVPNL.

5. Reverse zone setting in all 220 kV feeders and bus coupler at 220 kV Sakatpura station needs to be checked and corrected. (As per details of 13th Nov 2018, only two feeders at 220 kV Sakatpura station tripped in reverse zone. Bus coupler also didn't trip in this incident). Bus coupler over current setting also needs to be revised for 100ms time delay. (**Action:** RRVPNL/ SLDC-Rajasthan, **Time:** Within 7days)
6. Due to lack of information from RRVPNL complete tripping couldn't be analysed at the time of meeting. RRVPNL shall submit the detailed report considering the points for discussion mentioned below: (**Action:** RRVPNL/ RRVUNL/ SLDC-Rajasthan, **Time:** Within 15days)
    a. Exact location of fault and nature of fault.
    b. Reason of delayed clearance of fault.
    c. Failure of which primary and back up protection led to delayed clearance of fault.
    d. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
    e. Status of availability of bus bar protection at 220kV Kota (Sakatpura) having four number of bus bars to be shared.
    f. As approved in 25th PSC meeting, temporary arrangement for bus bar protection, could be put in place till actual bus bar protection is available. Status of the same to be apprised. Reason of delayed clearance of fault if arrangement was there?
    g. Sensitive distance protection setting of 220 kV Morak (end)-KTPS ckt to be reviewed.
    h. Reverse zone (Z-4 setting) to be coordinated with Z-2 timing as per Rama Krishna committee report, same needs to be modified at Kota TPS.
    i. Rate of change of frequency protection at 220 kV Bhilwara (Raj) needs to be looked into.
    j. Availability of time synchronized SCADA SoE to be checked and corrected.
        i. Tripping of units other than 2, 3 & 5

ii. Tripping of 220 kV feeders from remote end of KTPS

k. Detailed report, remedial measures report and complete DR/EL (cfg, dat file) needs to be submitted by RRVPNL.

G. Multiple element tripping at 400/220 kV Kashipur at 13:28hrs of 25th Oct 2018

1. No representative from PTCUL presented during the meeting, PTCUL shall submit the information (DR/EL, detailed report) and the details considering the points for discussion mentioned below (**Action:** PTCUL/ SLDC-Uttarakhand, **Time:** Within 15days):
    a. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared
    b. Exact location of fault and nature of fault.
    c. Sequence of tripping needs to be reported and explained.
    d. Reason of delayed clearance of fault.
    e. Delayed clearance of fault in case of operation of bus bar protection for both 220 kV bus at 400/220 kV Kashipur (PTCUL) needs to be relooked.
    f. Delayed clearance of fault more than 1640ms in case of operation of instantaneous bus bar protection operation also to be checked.
    g. Healthiness of 220 kV bus bar protection of 400/220 kV Kashipur (PTCUL) needs to be ensured.
    h. Availability of time synchronized SCADA SoE to be checked and corrected.
    i. Reason of tripping of 400 kV Moradabad-Kashipur and Nehtaur-Kashipur ckts and its protection co-ordination with back up protection setting of 400/220 kV ICTs at Kashipur (PTCUL).
    j. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL

H. Multiple Element tripping at 400/220kV Bhiwadi Station at 08:14hrs of 24th Nov 2018

1. A/R in 220 kV Bhiwadi (PG)-Kushkhera ckt (both end) needs to be checked through end to end testing and put back in service. **(Action:** POWERGRID/ RRVPNL, **Time:** Within 7days**)**:
2. ABB make RADSS bus bar protection shall be replaced with new numerical bus bar protection at 220 kV Bhiwadi (PG) **(Action**: POWERGRID, **Time**: till March-2019**)**
3. At Bhiwadi(PG), time of opening of CB as captured from SCADA SoE is not consistent with PMU based fault timings. Time synchronization in view of above needs to be checked at Bhiwadi(PG). Time synchronization will be cross checked with RLDC SCADA SoE log at the time of next shutdown. **(Action**: POWERGRID**)**

I. Multiple Element tripping at 400/220kV Kirori (Haryana) on 20th Dec 2018 at 01:22hrs

1. In view of the lack of information and clarity about the events and no representative from HPGCL attended the meeting, the event would be included again for discussion in the next PSC meeting.
2. Issue needs to be discussed with HPGCL and share the detailed report considering the input from HPGCL. (**Action:** HVPNL; **Time:** Within 10days). If issue unsolved then kindly report to NRPC, NRPC will separately call a meeting for the same.
3. In 400 kV Khedar-Kirori ckt-1 at Kirori end, carrier was in unhealthy condition. NRPC suggested HVPNL to make it healthy. (**Action:** HVPNL. HPGCL; **Time:** Within 10days)

4. A detailed report covering the following points along with DR, station EL shall be submitted: (**Action:** HVPNL. HPGCL; **Time:** Within 10days)
    a. Exact location of fault and nature of fault for both the incident.
    b. Sequence of tripping needs to be reported and explained.
    c. Reason of delayed clearance of fault.
    d. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared
    e. Sensitive back up earth fault protection setting of 400 kV Khedar (end)-Kirori ckt-1 & 2 to be reviewed.
    f. 220 kV Kirori (end)-Bhuna ckt: Single phase (R-phase) tripping of line after 1000ms needs to be looked into? After 1200ms of opening of R-phase CB, Y&B-phase also tripped, reason of tripping?
    g. Tripping of Blue phase of 220 kV Kirori (end)-Masudpur ckt-2 during R-N fault to be checked? R-phase continuously fed the fault for another 900ms, reason to be looked into.
    h. R-phase of 220 kV Kirori (end)-Masudpur ckt-1 tripped and A/R after 1000ms. Y-N fault also reflected in the line and fault current was higher than R-N fault but line didn't trip, reason to be checked? R-phase voltage measurement in DR is not ok. (Low throughout DR capturing time). This R-phase voltage is from Bus PT so bus PT needs to be checked.
    i. Availability of time synchronized SCADA SoE to be looked into.
    j. Detailed report, remedial measures report and supporting DR/EL (only for 400 kV Khedar end) needs to be submitted by HVPNL.

J. Tripping other than to be discussed in 37th PSC meeting

For better reliability of power system each and every multiple element tripping should be analyzed properly and remedial measures to be taken by utilities. Total 78 multiple element tripping event reported by NRLDC to RPC and constituents for the month of Sep to Dec 2018.

Preliminary reports of all these trippings are available at NRLDC website and already send to concerned utilities within 24hrs of the incident.

Among 78 events, around 19 events would be discussed in 37th PSC meeting. For rest events, utilities may kindly submit the details (DR/EL and detailed report along with remedial measures) to NRLDC and NRPC at mail ID: nrldcso2@posoco.in, nrldcso2@gmail.com, seo-nrpc@nic.in and sep-nrpc@nic.in.

List of the all the multiple elements tripping event is available at NRPC website at following link: https://bit.ly/2LTT6tH

NRPC suggested all the concerned utility to kindly submit the detailed report in NRPC approved format. Member may kindly submit the details.

List of participants for 37th Protection Sub- Committee Meeting.

Date: 21.01.2019

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Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail
23	Kamal Kishore Kalra	ACE (MPTeS)	RVPN	9414061417	~~erkamal1961@gmail.com~~ ce.mps@rvpn.co.in
24	Sushil Kumar	AEN (MPTES)	RVPNL	9414061328	aen.prot.bharatpur@rvpn.co.in
25	Sachin Vyas	Dy Mgr. (C&M)	THDCIL	9760137888	sachinvyas01@gmail.com,
26	VIVEK KARTHIKEYAN	Dy Manager (Elec)	STERLITE POWER	8966903034	vivek.karthikeyan@sterlite.com
27	T. Thamarai Selvan	Sr. Engineer	WUPPTCL	7054205930	thamarai.wupptcl@gmail.com
28	Murali Krishna	Sr. Engineer	WUPPTCL	8500991911	murali.wupptcl@gmail.com
29	Tarun Tanwar	Sr. Engineer	JSWHEL	9816595557	tarun.tanwar@jsw.in.
30	Hunny Kalia	Sr. Engineer	JSWHEL	7018091548	hunny.kalia@jsw.in
31	S. C. Sharma	Sr. DGM	POWERGRID	9873918526	sc_sharma@powergridindia.com.
32	Shrey Kumar	AE	NRPC	8826648261	shrey.cea@gmail.com
33	Akshay Dubey	AEE	NRPC	9599179744	dubey.akshay@gov.in

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail
34	Amit Gupta	Manager	POSOCO	8800690954	amitgupta@posoco.in
35	Sanjay Kumar	STE(ERD)	NAPS	9412768003	sanjay_kumar@npcil.co.in
36	MAAZ	A.E (T&C)	UPPTCL	9412749844	setncmrt@gmail.com
37	Anuj pratap singh	EE (T&C)	UPPTCL	7290091978	eetncgtnoida@gmail.com
38	Kaushik Panditrao	AE	NRPC	9869081939	kaushik.panditrao@gov.in
39					
40					
41					
42					
43					
44					

Annexure - II

S.No	Constituent/ Utility	Nomination			
		Name	**Designation**	**Address**	**Ph. (O) /Mob. No.**
1.	SJVNL	1.Sh. Prakash Chand	Manager (E)	NJHPS, Jhakri,Distt-Shimla, HP	01782-275140
		2.Sh. Pintu Das	Dy.Manager (E)	NJHPS, Jhakri,Distt-Shimla, HP	01782-275140
2.	DTL (Updated)	1.Sh. Praveen Kumar	AM (T)		9999533903
		2.Smt. Ramneet Chanana	AM(T)		9999533730
		3.Sh.Avishek Malik	AM (T) Prot.		9999535139
3.	POWERGRID	1.Sh. Y.S. Rana	Sr. Engr.	POWERGRID, Moga	09501102085
		2.Sh. Subhas Kumar	Sr. Engr.	POWERGRID, Hisar	09729872353
		3. Sh. Ajay Gola	Sr. Engr.	NR-I HQ, New Delhi	09899555175
4.	NTPC	1.Sh. B.L.Yadav	AGM (OS)		09650993044
5.	PSTCL (Updated)_	Sh. Ranbir 1. Singh Walia	ASE	PSTCL, Ludhiana	9646118223
		2.Sh. Harvinder Singh	Sr EXN, Protection	PSTCL, Jalandhar	
		3. Sh Sanjeev Kumar	AEE	Protection Division, Mohali	
6.	HVPNL	1.Sh. Y.S. Gulia	Executive Engineer	HVPNL, M&P, Panipat	09354194830
7	RRVPNL (Updated)	1. Sh.Jyotirma Jaiminy	AEN-III (C&M)	400 kV GSS, Heerapura	09413382408
		2. Sh. Vijay Pal Yadav	AEN (Prot.)	RRVPNL, Alwar	09414061407
8	UPPTCL	1.Sh. D.K Acharya	Advisor to Director (Op) UPPTCL	Shakti Bhawan Extn (11th Floor) 14, Ashok Marg, Lucknow-226001	Ph.(O) –Director (Op) office 0522-2287833 Fax- 0522-2286476
		2.Sh. Kavindra Singh	Advisor to CE (TW), Meerut UPPTCL		
9	HPSEBL	1. Sh. Sat Pal Jamwal	Exe.Engg.	Protection & Testing Division, HPSEB Ltd. Kangra (HP)	09418122067 Telefax- 01892-264519
		2.Sh. Dharam Singh Rana	Asst. Engg.	Protection & Testing Division, HPSEB Ltd. Kangra (HP)	09418017213 Telefax- 01892-264519
10	PTCUL	1.Anupum Singh	Exe.Engg.	T&C	
		2. Asim Beg	Asst. Engg.	T&C	
11	NPCIL	1. Sh. N. K. Pushpakar	Maintenance Superintendent NAPS, or his nominee	Plant Site, Narora, Bulandshahar Distt. UP-202397	(5734) (O) 222167 (R) 222228 M-09412768002 e-mail-nkpushpakar@npcil.co

					.in
		2. Sh. Virender Yadav	RAPS-A	Rawatbhata Rajasthan Site, P.O. Anushakti, via: Kota, Rajasthan-323303	M- 09413358024
		3. Sh. Sanjay Jhamtani	RAPS-B	Rawatbhata Rajasthan Site, P.O. Anushakti, via: Kota, Rajasthan-323303	M- 09413356912
		4. Sh. Randhir Misra	RAPS-C	Rawatbhata Rajasthan Site, P.O. Anushakti, via: Kota, Rajasthan-323303	M- 09413358237
12	Rosa Power Supply Co. Ltd.	1. Sh. N. Kishore Kumar	DGM	Rosa Power Supply Co.Ltd., Hardoi Road, Service Building, Rosa Shahajahanpur-242406	05842-306675/09389495241
		2.Sh. Gaurav Gupta	Sr. Manager	Rosa Power Supply Co.Ltd., Hardoi Road, Service Building, Rosa Shahajahanpur-242407	05842306789/09369076402
13	NHPC	Sh. Amitabh Jha	Sr. Manager (E)	Uri Power Station, Baramullah, J&K	
		Sh. P. K. Das	Manager (E)	Baira Siul Power Station, Chamba, HP	
14	UJVN Limited	1. Sh. Manoj Rawat	A.E.	Dakpathar, Distt: Dehradun	09456590406
		2. Sh. Anoop Deepak	A.E.	Galogi, Distt: Dehradun	09456590173
15	BBMB (Updated)	Sh. Ranbir Singh Sharma	Assistant Director	P&T Cell BBMB Panipat	9466121202

Annex-III

Status of pending rectification of defects observed during BPA

Sl. No.	Utility	No. of sub-stations covered under BPA	Expected Completion	Remarks
1	UPPTCL	21	-	**Representative of UPPTCL informed that in 220 kV stations, PLCC panels were being procured from CGL and all major deficiencies have been rectified.**
2	UPRVUNL	4	-	**Obra 'A'** – including rectification of time synchronization & BBP, PLCC (to be installed by UPPTCL). To be completed by November, 2016. **Harduaganj** – to be completed by March, 2017 **Status could not be updated as there was no representation from UPRVUNL in the meetings.**
3	HPSEB Ltd.	1	October 2017	• Out of 12 deficiencies observed, 8 already rectified. • **1 no. deficiency to be rectified by March 2017 and** • **3 others by October 2017.**
4	UJVNL	1	December, 2016	Breaker for 220 kV Khodri-I &II needs to be replaced. Expected date as intimated by SLDC Uttarakhand in 127th OCC meeting was 31.12.2016. **Status could not be updated as there was no representation from UJVNL in the meetings.**
5	PDD, J&K	3	Status of progress is not submitted. Target completion not known.	As informed during 33rd NRPC meeting that deficiencies where procurement was not involved had been rectified and other works where procurement is involved are yet to be taken up. PDD J&K informed that they have submitted the proposal for

				PSDF funding and deficiencies will be rectified when fund will be disbursed from PSDF. As informed by PSTCL defects at 220kV Sarna-Udhampur line, pertains to PDD, J&K. **Status could not be updated as there was no representation from PDD J&K in the meetings.**

Annex-IV

Protection audit of intra-state system/balance system not covered in Basic Protection Audit

Utility	**Third party protection audit carried out by**	**No. of sub-stations covered/ expected to be covered**	**Status of Audit**	**Status of Report**	**Status of submission of action Plan for rectification of deficiencies**
RRVPNL, RRVUNL	CPRI	RRVPNL-39 RRVUNL-5	Completed	Submitted	**RRVPNL**- Lead Acid Batteries have been procured and installed. **RRVUNL**- Action Plan submitted.
BBMB	-do-	20	Completed	Submitted	The action to attend the deficiencies observed in the audit is underway.
PSTCL, PSPCL	-do-	PSTCL-22 PSPCL-3	Completed	Submitted	**Representative of PSTCL informed that Report on CPRI Audit already submitted and emailed.**
UPRVUNL	-do-	2	Completed	Submitted	**Parichha TPS and Panki TPS:** All the deficiencies are likely to be rectified by **March, 2018**
UPPTCL	-do-	41	Completed	Shall be submitted after	**Representative of UPPTCL**

Utility	**Third party protecti on audit carried out by**	**No. of sub-stations covered/ expected to be covered**	**Status of Audit**	**Status of Report**	**Status of submission of action Plan for rectification of deficiencies**
				receipt and examination of Report, same.	**informed that CPRI is working on this and detailed report will be submitted by June, 2019.**
Rosa Power	-do-	1	Completed	Submitted	Action Plan submitted and the deficiencies observed rectified.
UJVNL	-do-	2 (Chilla, Chhibra)	Completed	Submitted	Action Plan not submitted**. No representative was present.**
PDD J&K	-do-	3 (Janipur, Amargarh, Hiranagar)	Completed	Submitted	Action Plan for **Heeranagar** and **Amargarh** not submitted. **No representative was present.**
JSW	-do-	1	Completed	Submitted	Rectification of observation complied.
HPSEB Ltd.,	-do-	6 (Uprela Nangal, Giri 220 kV, Jassore 220 kV, Baddi, 220 kV Kangoo, 220 kV Kotla)	Completed	Submitted	Action Plan for **220 kV Kotla** not yet submitted. Rectification of observation partly complied. Rectification will be completed by October 2017

Utility	**Third party protection audit carried out by**	**No. of sub-stations covered/ expected to be covered**	**Status of Audit**	**Status of Report**	**Status of submission of action Plan for rectification of deficiencies**
UT Chandigarh	-do-	1 (Kishengarh)	Completed	Submitted	Not submitted. No representative was present.
Budhil Power	-do-	1	Completed	Submitted	Not submitted. No representative was present.
HVPNL	-do-	4 (Sector 72, Gurgaon ; Tepla; Bastara; A-5, Faridabad)	Completed	Submitted	To be rectified by December 2017
DTL	-do-	4 (Rohini; Mehrauli; Mundka; Shalimar Bagh)	Completed	Submitted	Action has already been taken. Report will be submitted.
PTCUL	-do-	4 (Pantnagar, Haridwar, Kashipur, Roorkee)	Completed	Submitted	Not submitted for **Haridwar, Roorkee** **Relays have been delivered at the site.** To be completed by 31st October, 2017

Annex-V

Status of Bus bar Protection for Northern Region Constituents

State/ Constituent	TRANSCO/GENCO	Total no. of S/S/ Sw. yards (220 kV and above)	No. of S/S/ Sw. yards where Bus bar protection is functioning	Remarks	Action Plan
Delhi	DTL	37	34	For 220 kV S/S namely, Gopalpur and Kanjhawala is being planned.(Lodi Road is GSS)	PO awarded to M/s GE T&D India Ltd. for the work of Supply and ETC of 26nos. Bus Bar Schemes in 400 and 220kV DTL substations on 06.04.18. Completion period is 9 months.
Haryana	HVPNL	63	48	12 out of which 5 in process ;7(date is yet to be decided); 3 not required	Tentative date of commissioning: 30.06.2019
	HPGCL	03	03		
Rajasthan	RVPNL	53	46 (7 defective)		74 nos. New Bus bar Protection scheme under commissioning. 10 Commissioned.
	RVUNL	05	05		

Himachal Pradesh	HPSEB	08	04	At one s/s it was working, 2 sub-station it was defective.	**04 nos. commissioned and for remaining 04 s/s to be done by Oct 2017.**
Punjab	PSTCL	98(5 no 400 kV s/s)	46(5 no. 400 kV s/s)		Work in progress for BBPS protection, 46/98 (220kV) 05/05 (400kV) completed. Till then reverse zone protection time set to 160 ms. For remaining substations, work has been undertaken by TS organization and will be completed by 31.12.19. by TS organization. Procurement process for BBPS delayed due to re-tendering twice by Finance wing of PSTCL. Re-tendered again last month and target date is 31-12-19 & PSDF funding available. PLCC work will also be completed by 31-3-19 as procurement process is underway.
	PSPCL	03	03		
J&K	PDD	06	-		**The status for the same could not be**

					ascertained as representative from PDD, J&K was not present in the meeting.
Uttarakhand	PTCUL	10	09		**Order placed for 01 defective. Would be completed by May 2017.**
	UJVNL	-	-		
BBMB	BBMB	23	20	Not required at Dhulkote and Jagadhari. also for Sangrur, Kurukshetra and Delhi as no. of feeders is less than five. PSC decided that it needs to be installed.	**Sangrur- commissioned 19.01.2016.** **For Kurukshetra and Delhi, LOI has been issued on 27.06.18 & material is likely to be received by March, 2019.** For Barnala it is to be provided by PSTCL as agreed in PSC. PSTCL were to commission it by 31.12.2016.
Uttar Pradesh	UPPTCL	99	10	04 no. are pending	Representative of UPPTCL informed that SEL panels are being procured and its installation would be completed within 6 months.
	UVUNL	05	-		
POWERGRID	PGCIL	55	55		
Central Generating	NTPC	11	11		
	NHPC	09	09		

Stations	NPCIL	02	02		
	THDC	02	02		
	SJVNL	02	02		

Annexure - VI

1. Tripping events

A. Multiple times bus bar protection operation at 400 kV Orai (UP) during line fault on any outgoing feeder.

Event category: GI-2

Generation loss: Nil
Loss of load: Nil
Energy Loss: Nil

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	100ms	
Phase of the fault	PMU data	Single phase to earth fault	In different phase for different dates

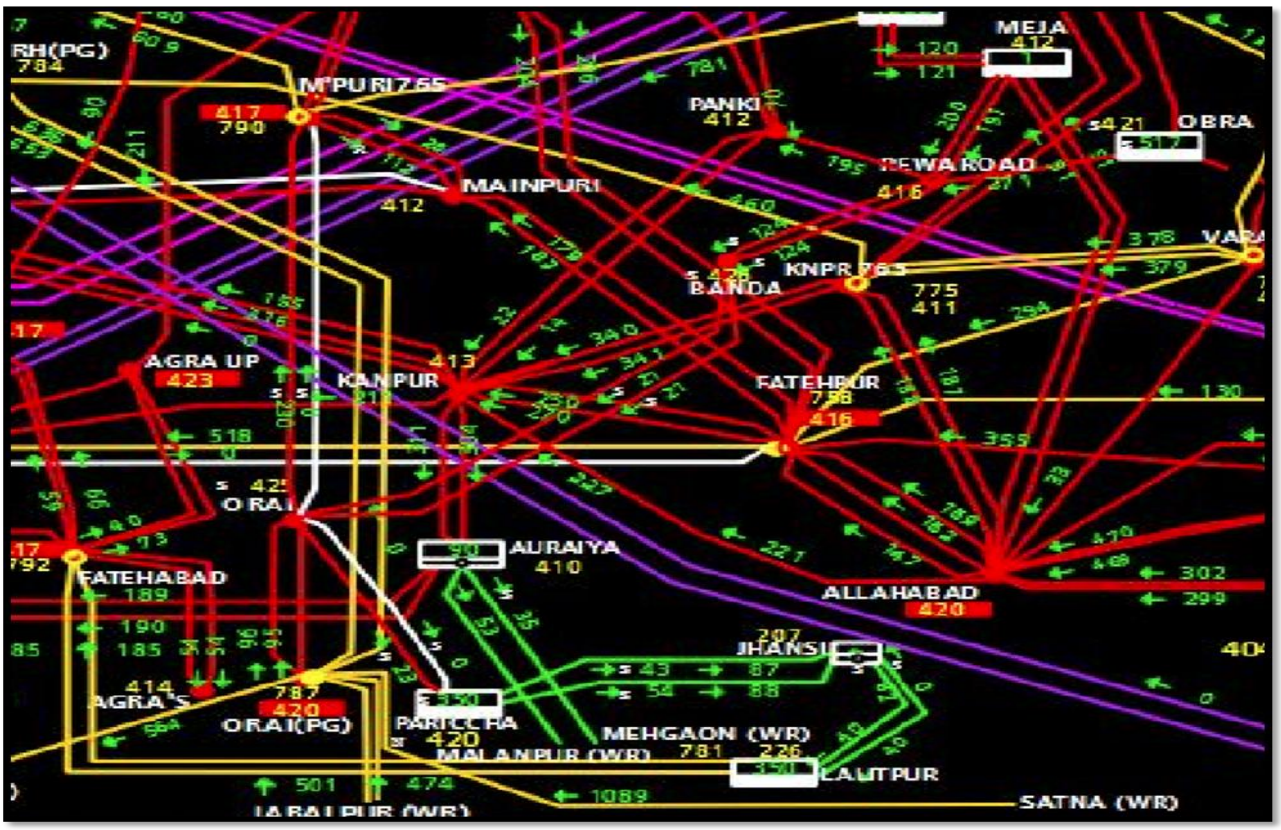
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	
DR/EL	Uttar Pradesh	Received (only DR)	For some of the tripping
Preliminary Report	Uttar Pradesh	Received	After 24hrs
Detailed Report	Uttar Pradesh	Not Received	

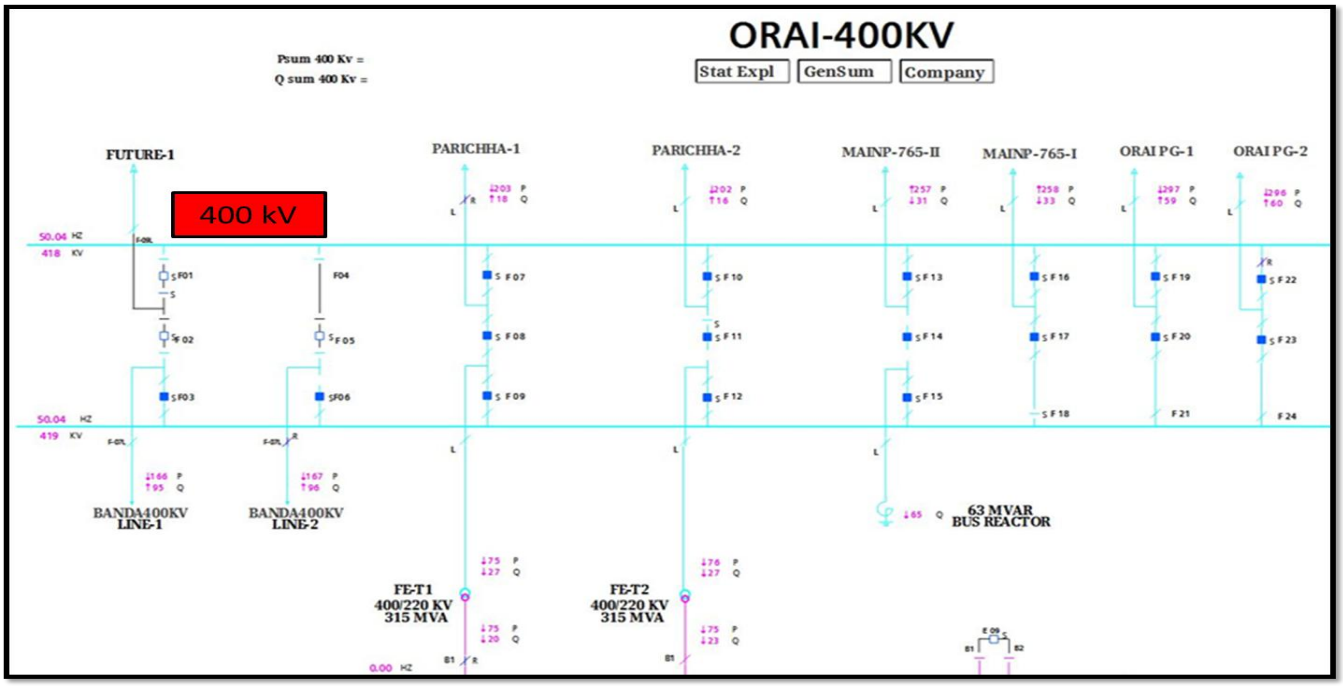
Description	Clauses	Utility	Remarks

Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	**Uttar Pradesh**	1. Detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

1. 400 kV Orai (UP) is connected with Orai (PG) D/C, Mainpuri (UP) D/C, Parichha (UP) D/C and Banda (UP) D/C. It also has two 315MVA 400/220 kV ICTs. It has one and half breaker scheme.
2. Connectivity and SLD of 400 kV Orai (UP):





3. *Event Description for 16th Sep 2018 event:*
    a. 400kV Mainpuri 765(UP)-Orai(UP) ckt-1 tripped on Y-N fault, 34.9Km from Mainpuri 765(UP) end. At the same time, 400 kV Bus 1 at 400kV Orai(UP) also tripped.
    b. In antecedent condition, 400kV Mainpuri 765(UP)-Orai(UP) ckt-1 carrying 258 MW.
    c. Name of the tripped element:
        - 400 kV Orai (UP)-Mainpuri ckt-1
        - 400 kV Bus-1 at Orai (UP)

    d. As per UP report: No report received

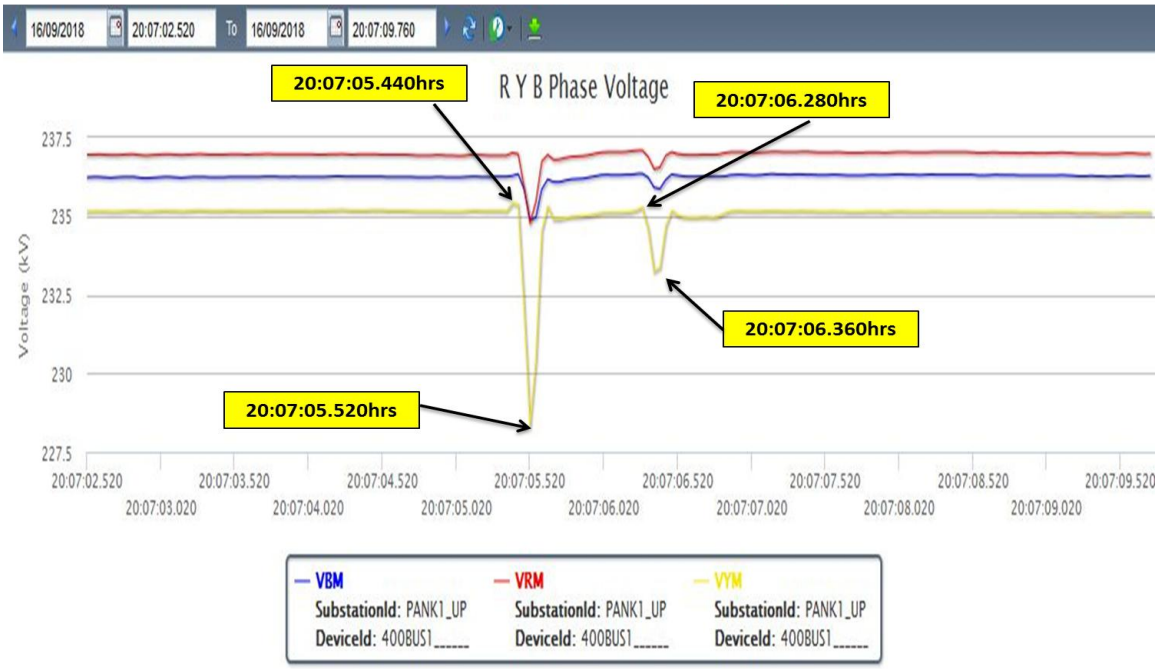
    e. PMU data of frequency and phase voltages:

PMU Plot of frequency at Panki(UP)

20:07hrs/16-Sep-18

PMU Plot of phase voltage magnitude at Panki(UP)

20:07hrs/16-Sep-18



f. SCADA SoE data:

Time	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
20:07:05:440	0ms	PMU data					Reference Time
20:07:05:553	115ms	ORAI1_U	400	16MANP1	CB	disturbe	
20:07:05:555	115ms	ORAI1_U	400	17MNPT3	CB	disturbe	
20:07:05:700	260ms	ORAI1_U	400	16MANP1	CB	Open	Main CB of 400 kv Orai-Mainpuri Ckt 1 opens
20:07:06:360	922ms	PMU data					It seems bus bar protection operated
20:07:06:363	925ms	ORAI1_U	400	16MANP1	CB	Close	
20:07:06:401	960ms	ORAI1_U	400	17MNPT3	CB	Open	Tie CB of 400 kv Orai-Mainpuri Ckt 1 opens
20:07:06:405	965ms	ORAI1_U	400	13MANPG2	CB	Open	Main CB of 400 kv Orai-Mainpuri Ckt 2 opens
20:07:06:406	965ms	ORAI1_U	400	07PRIC11	CB	Open	Main CB of 400 kv Orai-Paricha Ckt 1 opens
20:07:06:407	965ms	ORAI1_U	400	10PRIC11	CB	Open	Main CB of 400 kV Orai-Paricha Ckt 2 opens
20:07:06:408	970ms	ORAI1_U	400	16MANP1	CB	Open	Main CB of 400 kV Orai-Mainpuri Ckt 1 opens (400 kV Orai-Mainpuri Ckt 1 tripped}
20:07:06:408	970ms	ORAI1_U	400	22ORAPG2	CB	Open	Main CB of 400 kV Orai-Orai(PG) Ckt 2 opens
20:07:06:410	970ms	ORAI1_U	400	19ORAPG1	CB	Open	Main CB of 400 kV Orai-Orai(PG) Ckt 1 opens

g. As per PMU data:
   - As per PMU, maximum dip in Y-phase.
   - Fault Clearance time: **100ms**
   - SoE captured, it seems all the main CB connected to 400 kV Bus-1 of 400/220 kV Orai (UP) tripped after 900ms of fault occurrence

h. Preliminary report, DR/EL and detailed report is still awaited from UP.

4. *Event Description for 29th Nov 2018 event:*
   a. In antecedent condition 400 kV Orai-Parichha ckt-1 was under outage.
   b. In antecedent condition, 315 MVA ICT 1 carrying 123 MW and 400kV Banda(UP)-Orai(UP) ckt-1 carrying 75 MW.
   c. Y-N transient nature fault occurred in 400 kV Orai (UP)-Mainpuri ckt-2. Line auto reclosed successfully however during line fault, 400kV Banda(UP)-Orai(UP) ckt-1&2, 400 kV Orai (UP) Bus 2 and

315 MVA ICT 1 at 400/220kV Orai(UP) also tripped due to operation of 400 kV bus bar protection (bus-2) at 400 kV Orai (UP).

d. 400 kV Banda-Orai (UP) ckt-1&2 tripped as it was connected to only main Bus-2 at Orai (UP). Future bay yet to be commissioned.
e. 400/220 kV 315MVA ICT-1 tripped as tie CB was already under outage due to outage of 400 kV Orai (UP)-Parichha (UP) ckt-1
f. Following element connected to 220kV bus-2 of Orai (UP) tripped:
    - 400kV Banda(UP)-Orai(UP) ckt-1
    - 400kV Banda(UP)-Orai(UP) ckt-2
    - 315 MVA 400/220kV ICT 1 at Orai(UP)
    - 400 kV Bus 2 at 400/220kV Orai(UP)

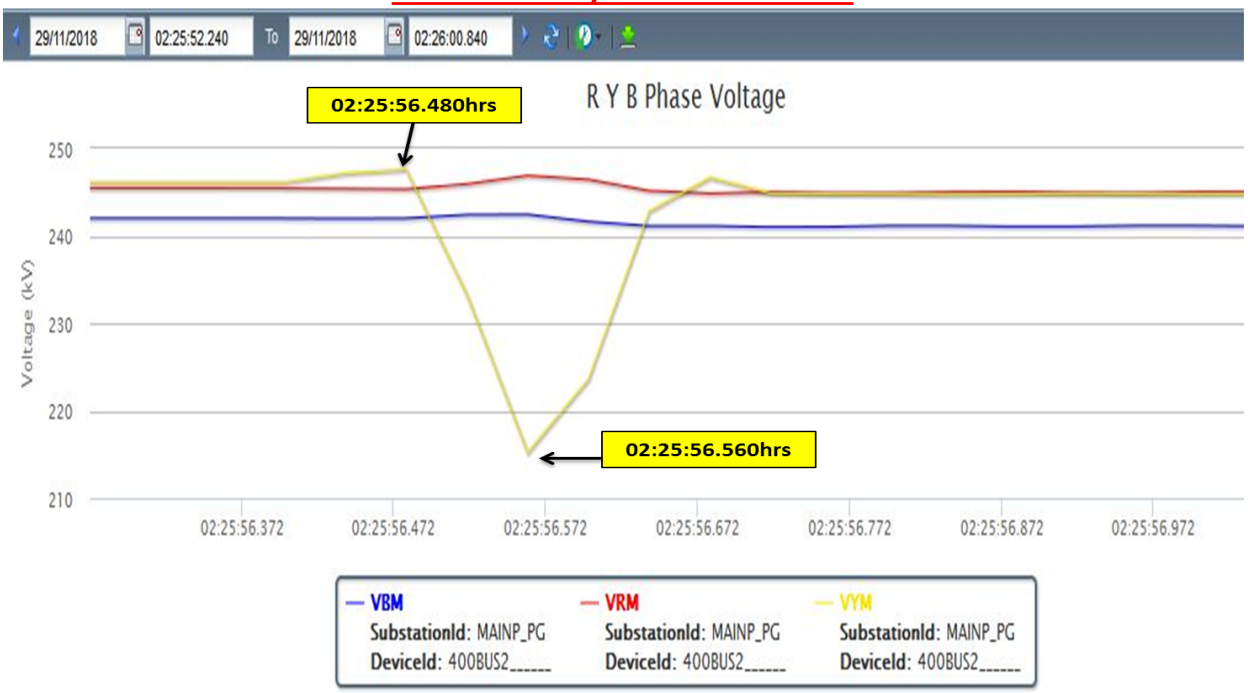
g. PMU plots of frequency, df/dt and phase voltage:

PMU Plot of frequency at Bassi(PG)

02:25hrs/29-Nov-18

PMU Plot of phase voltage magnitude at Mainpuri(PG)

02:25hrs/29-Nov-18



h. SCADA SoE data:

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
02:25:56,594	ORAI1_U	400	13MANPG2	Circuit Breaker	disturbe	
02:25:56,597	ORAI1_U	400	14BRMNPG	Circuit Breaker	disturbe	
02:25:56,607	MANP1_U	400	02T1ORI	Circuit Breaker	disturbe	
02:25:56,609	ORAI1_U	400	12T2	Circuit Breaker	disturbe	Main CB of 400kV side ICT 2 (disturb)
02:25:56,609	ORAI1_U	400	06BANDA2	Circuit Breaker	Open	Main CB of 400kV Orai-Banda ckt-2 opens
02:25:56,609	MANP1_U	400	01ORAI12	Circuit Breaker	disturbe	
02:25:56,610	ORAI1_U	400	17MNPT3	Circuit Breaker	Open	Tie CB of 400kV Orai-Mainpuri(765kV) ckt-1 opens
02:25:56,610	ORAI1_U	400	15BR	Circuit Breaker	Open	Main CB of 63 MVAR Bus reactor opens.
02:25:56,612	ORAI1_U	400	20SPORA1	Circuit Breaker	Open	Tie CB of 400kV Orai-Orai(PG) ckt-1 opens
02:25:56,612	ORAI1_U	400	09T1	Circuit Breaker	Open	Main CB of 400kV side ICT 1 opens.
02:25:56,613	ORAI1_U	400	23SPORA2	Circuit Breaker	Open	Tie CB of 400kV Orai-Orai(PG) ckt-2 opens
02:25:56,613	ORAI1_U	400	03BANDA1	Circuit Breaker	Open	Main CB of 400kV Orai-Banda ckt-1 opens
02:25:57,299	ORAI1_U	400	13MANPG2	Circuit Breaker	Close	
02:25:57,503	ORAI1_U	400	14BRMNPG	Circuit Breaker	Close	
02:25:57,653	MANP1_U	400	01ORAI12	Circuit Breaker	Close	
02:25:57,665	ORAI1_U	400	12T2	Circuit Breaker	Open	Main CB of 400kV side ICT 2 opens.

i. AS per UPPTCL details:

Sub: - Report on the Incident of Multiple Tripping at 400/220KV S/S Orai (UP).

Ref:- NRLDC letter No. NR_GD_GI/1408

On 29.11.2018 at 02:25Hrs. following elements tripped at 400/220KV S/S Orai (UP). Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	Bus bar – II	29.11.2018	04:26	Busbar protection
2.	400KV Orai – Mainpuri – II	29.11.2018 A/R	-	AR operated (GT, Z-1, Y- phase, dist.72.03km.)
3.	400KV Orai – Banda – I	29.11.2018	04:31	Busbar protection
4.	400KV Orai – Banda – II	29.11.2018	04:31	-do-
5.	315MVA ICT - I	29.11.2018	04:28	-do-
6.	315MVA ICT – II	29.11.2018	04:28	-do-

Generation Loss = **NIL**
Load Loss = **NIL**

As per the information provided by UPPTCL, fault was observed on 400KV Orai – Mainpuri – II line (Z-1, Y- phase, dist.72.03km.). Auto reclose of said line operated as the fault was of transient in nature. At the same time bus bar protection of main bus – II operated at 400KV Orai due to reflection of line fault on the bus, leading to tripping of all above mentioned elements connected to Main Bus – II at 400KV S/S Orai.

The detailed report along with flags, DR/ER and the reason shall be forwarded after receipt from the concerned authority.

(Zahir Ahmad)

j. As per PMU data:
   - As per PMU, maximum dip in Y-phase.
   - Fault Clearance time: **100ms**
   - SoE captured, it seems all the main CB connected to 400 kV Bus-2 of 400/220 kV Orai (UP) tripped within 100ms of fault occurrence

k. Preliminary report and DR/EL (partial) has been submitted however DR/EL and detailed report is still awaited from UPPTCL.

5. Multiple time 400 kV bus bar protection of 400 kV Orai (UP) operated during line fault on outgoing 400 kV feeders. Following are the details of the tripping:

Name of Elements (Tripped/Manually opened)	Owner / Agency	Outage		Event (As reported)	Category as per CEA Grid Standards
		Date	Time		
1) 400 kV Bus 1 at 400kV Orai(UP) 2) 400kV Mainpuri 765(UP)-Orai(UP) ckt-1	UP	16-Sep-18	20:07	400kV Mainpuri 765(UP)-Orai(UP) ckt-1 tripped on Y-N fault, 34.9Km from Mainpuri 765(UP) end. At the same time, 400 kV Bus 1 at 400kV Orai(UP) also tripped. In antecedent condition, 400kV Mainpuri 765(UP)-Orai(UP) ckt-1 carrying 258 MW. As per PMU, Y-N fault observed.	GI-2
1) 400kV Banda(UP)-Orai(UP) ckt-1 2) 315 MVA 400/220kV ICT 1 at Orai(UP) 3) 400 kV Bus 2 at 400/220kV Orai(UP)	UP	29-Nov-18	2:25	400kV Banda(UP)-Orai(UP) ckt-1 tripped on R-N fault. At the same time, 400 kV Bus 2 and 315 MVA ICT 1 at 400/220kV Orai(UP) also tripped. As per PMU, Y-N fault is observed. In antecedent condition, 315 MVA ICT 1 carrying 123 MW and 400kV Banda(UP)-Orai(UP) ckt-1 carrying 75 MW.	GI-2
1) 400kV Mainpuri 765(U)-Orai(UP) ckt-2 2) 400 kV Bus 1 at 400/220kV Orai(UP)	UP	3-Dec-18	2:18	400kV Mainpuri 765(UP)-Orai(UP) ckt-2 & 400 kV Bus 1 at 400/220kV Orai(UP) tripped on R-N fault. As per PMU, R-N fault is observed with unsuccessful autoreclosing attempt. In antecedent condition, 400kV Mainpuri 765(U)-Orai(UP) ckt-2 carrying 76 MW.	GI-2
1) 400kV Mainpuri 765(U)-Orai(UP) ckt-2 2) 400 kV Bus 1 at 400/220kV Orai(UP)	UP	9-Dec-18	4:25	400kV Mainpuri 765(UP)-Orai(UP) ckt-2 & 400 kV Bus 1 at 400/220kV Orai(UP) tripped on R-N fault. As per PMU, R-N fault is observed. In antecedent condition, 400kV Mainpuri 765(U)-Orai(UP) ckt-2 carrying 96 MW.	GI-2
1) 400kV Mainpuri 765(U)-Orai(UP) ckt-2 2) 400 kV Bus 1 at 400/220kV Orai(UP)	UP	10-Dec-18	20:35	As reported, 400kV Mainpuri 765(UP)-Orai(UP) ckt-2 & 400 kV Bus 1 at 400/220kV Orai(UP) tripped on R-N fault. As per PMU, R-N fault is observed. In antecedent condition, 400kV Mainpuri 765(U)-Orai(UP) ckt-2 carrying 135 MW.	GI-2
1) 400kV Orai(UP)-Paricha(UP)-2 2) 400kV Bus-1 at Orai(UP)	UP	25-Dec-18	2:34	R-N fault occurred in 400kV Orai(UP)-Paricha(UP)-2, 69km from Orai(UP). At Orai(UP), due to bus bar protection operation bus1 tripped. As per PMU data, R-N fault observed with unsuccessful auto-reclosing.	GI-2

Points for Discussion*:*

1. Event on 16th Sep 2018:
    a. Exact location of fault and nature of fault.
    b. Sequence of tripping needs to be reported and explained.
    c. Mal-operation of 400 kV Bus Bar Protection (400 kV Bus-1) at 400/220 kV Orai (UP) station during line fault in 400 kV Orai-Mainpuri ckt-1 needs to be looked into.
    d. Similar incident happened multiple times. Operation of Bus Bar Protection in case of single phase to earth fault is serious cause of concern for grid security. UPPTCL is advised to look into the matter and take corrective action
    e. Detailed report, remedial measures report and supporting DR/EL needs to be submitted.
    f. Operation of 400 kV bus bar protection at 400/220 kV Orai (UP) to be reviewed and corrected.

2. Event on 29th Nov 2018:
    a. Exact location of fault and nature of fault.
    b. Sequence of tripping needs to be reported and explained.

c. Mal-operation of 400 kV Bus Bar Protection (400 kV Bus-2) at 400/220 kV Orai (UP) station during line fault in 400 kV Orai-Mainpuri ckt-2 needs to be looked into.
d. Similar incident happened multiple times. Operation of Bus Bar Protection in case of single phase to earth fault is serious cause of concern for grid security. UPPTCL is advised to look into the matter and take corrective action
e. Detailed report remedial measures report and supporting DR/EL needs to be submitted.

3. Bus Bar Protection at 400 kV Orai (UP) needs to be thoroughly checked.
4. Remedial measures report for all the other tripping to be submitted.

No representative from UPPTCL (Orai zone) presented during the meeting.

POWERGRID representative informed that similar type of issue faced at 765 kV Phagi station where outage of faulted phase CT during auto reclosing of the line leads to differential current in bus bar differential protection (as that phase was already under outage and CT current was not came into picture, CT was not selected in bus bar protection). It further resulted into operation of bus bar differential protection. CT selection shall be taken from CB closing command.

NRPC raised concern for pending corrective action after multiple tripping at 400kV Orai (UP) and absence of concerned representative in the meeting. NRPC once again suggested all the NR utilities to make nodal officer for overall co-ordination for information and submission of the information (DR/EL, detailed report) and remedial measures report.

B. Complete outage of 400/220 kV Gorakhpur (UP) at 16:56hrs of 17th Sep and 10:03hrs of 22nd Oct 2018.

Event category: GD-1

Generation loss:

Nil (17.09.18)
Nil (22.10.18)

Loss of load:

225 MW (17.09.18)
180 MW (22.10.18)

Energy Loss: UP shall confirm about energy loss
0.36 MU (17.09.18)
0.15 MU (22.10.18)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	440ms & 440ms	17.09.2018
		440ms	22.10.2018
Phase of the fault	PMU data	R-N fault	17.09.2018
		R-N fault	22.10.2018

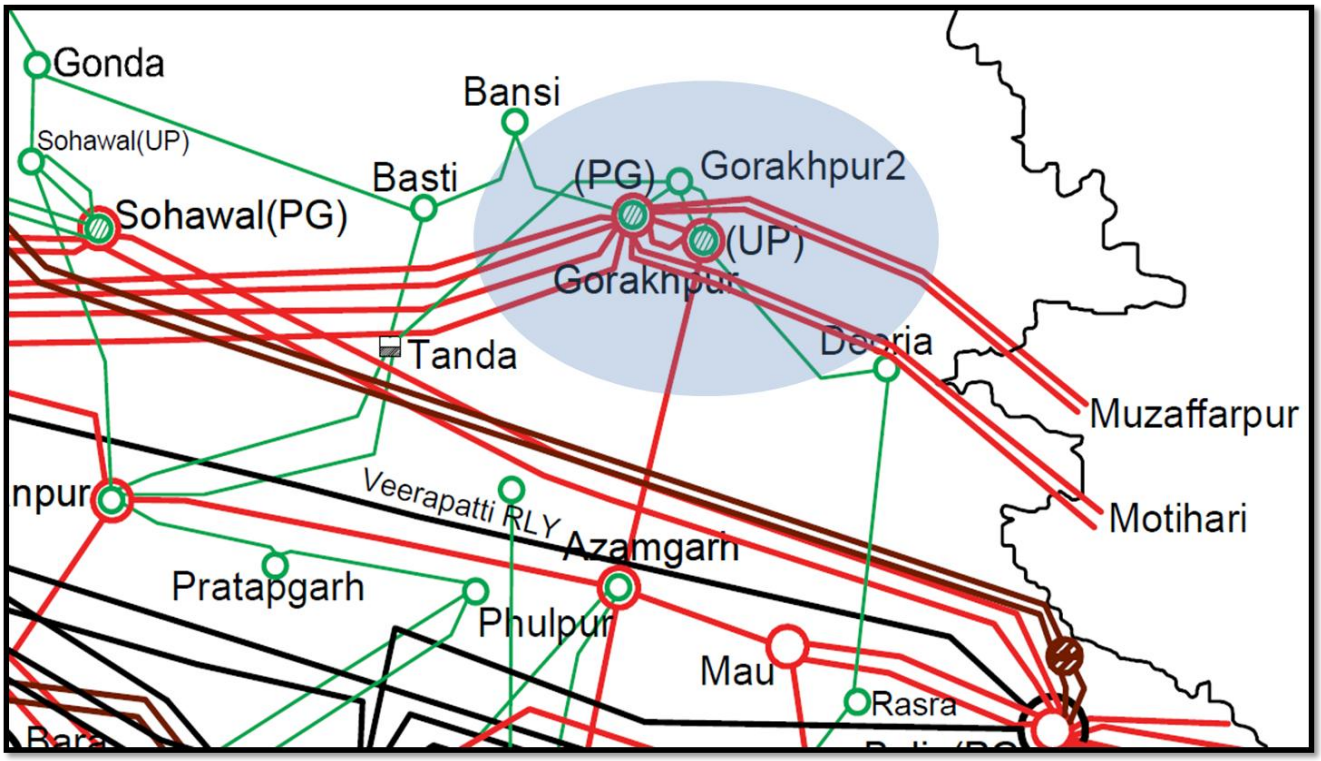
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	17.09.2018
			22.10.2018 (Time Synch error)
DR/ EL	Uttar Pradesh	Received (Only Flag details)	17.09.2018 (DR received from POWERGRID)
			22.10.2018
Preliminary Report	Uttar Pradesh	Received	17.09.2018
			22.10.2018
Detailed Report	Uttar Pradesh	Not Received	17.09.2018
			22.10.2018

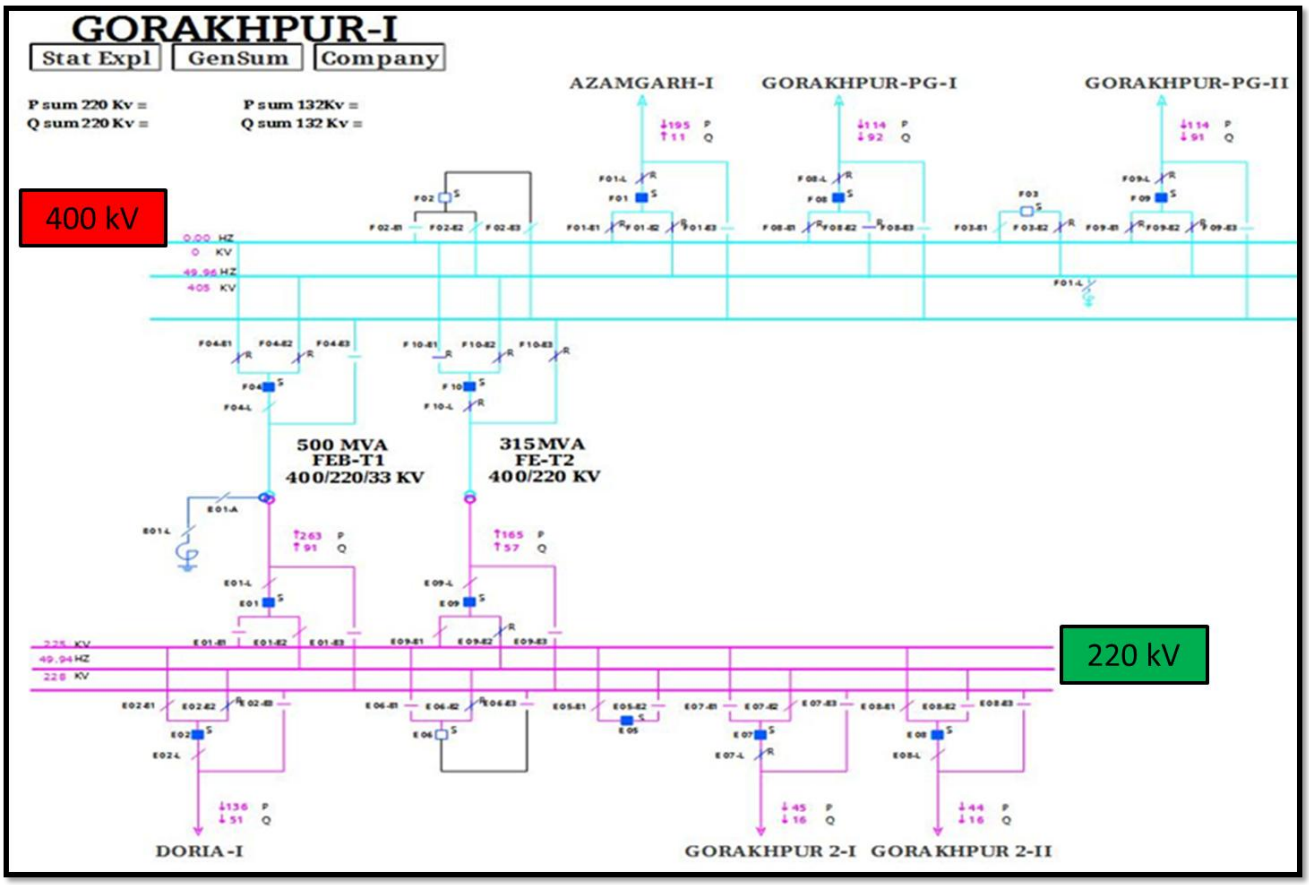
Description	Clauses	Utility	Remarks

Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2 4. CEA Grid Standard 3.1.e 5. CEA Transmission Planning Criteria	**Uttar Pradesh**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report 3. Correct operation of Protection System 4. Delayed Clearance of fault 5. Adequately Sectionalized and graded protective relaying system

Based on above information description of the events is:

1. 400 kV Gorakhpur (UP) is connected with Gorakhpur (PG) D/C, Azamgarh (UP) S/C. It also has 315MVA & 500MVA 400/220 kV ICT. It has DMT (double main transfer breaker) scheme. 220kV Gorakhpur 2 (UP) further connected with 220 kV Tanda (UP) S/C, Gorakhpur (PG) S/C and 400/220 kV Gorakhpur (UP) D/C.
2. Connectivity and SLD of 400/220 kV Gorakhpur (UP):


Gonda
Bansi
Sohawal(UP)
Basti
(PG)
Gorakhpur2
Sohawal(PG)
(UP)
Gorakhpur
Tanda
Deoria
Muzaffarpur
Veerapatti RLY
Azamgarh
Motihari
Pratapgarh
Phulpur
Mau
Rasra


GORAKHPUR-I
Stat Expl
GenSum
Company
P sum 220 Kv =
Q sum 220 Kv =
P sum 132Kv =
Q sum 132 Kv =
AZAMGARH-I
GORAKHPUR-PG-I
GORAKHPUR-PG-II
400 kV
500 MVA
FEB-T1
400/220/33 KV
315MVA
FE-T2
400/220 KV
220 kV
DORIA-I
GORAKHPUR 2-I
GORAKHPUR 2-II

3. *Event Description for 17th Sep 2018 event:*
    a. During charging of 400KV Gorakhpur(UP)-Gorakhpur(PG) ckt-II through 400 kV transfer bay, R-ph parallel disc insulator of 400 kV transfer bus got damaged causing tripping of all 400 kV feeders, 315MVA ICT-II, 500MVA ICT-I and 220 kV feeders on bus bar protection.
    b. After isolation of faulty bus section 400 kV feeders, ICTs, 220 kV feeders charged. Then after replacement of damaged disc insulators both 400 kV PGCIL ckts charged at 22:25 & 22:26 hrs respectively.
    c. Name of the tripped element:
        - 315 MVA ICT 2 at 400kV Gorakhpur(UP)
        - 500 MVA ICT 1 at 400kV Gorakhpur(UP)
        - 400 kV Gorakhpur(PG)-Gorakhpur(UP) ckt-1
        - 400 kV Gorakhpur(PG)-Gorakhpur(UP) ckt-2
        - 400 kV Azamgarh (UP)-Gorakhpur(UP)
        - 220 kV Gorakhpur (UP)-Gorakhpur 2 (UP) ckt-1 & 2
        - 220 kV Gorakhpur-Deoria ckt
        - 220 kV Gorakhpur-Hata ckt

    d. As per UP report:

Sub: - Report on the Incident of Simultaneous Tripping at 400KV S/S Gorakhpur.

On 17.09.2018 at 16:57Hrs. all ICTs and 400KV transmission lines connected with 400KV S/S Gorakhpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	500MVA ICT – I (400/220KV)	17.09.2018	18:41	-
2.	315MVA ICT – II (400/220KV)	17.09.2018	18:33	-
3.	400KV Gorakhpur-PG-I	17.09.2018	B/D	-
4.	400KV Gorakhpur-PG-II	17.09.2018	B/D	-
5.	400KV Azamgarh	17.09.2018	18:32	-

Generation Loss = **NIL**
Load Loss = 225 MW Approx.

It has been reported by site authorities that during shifting of 400KV Gorakhpur (PG) - II line on Transfer Bus, R-phase insulator string of TBC snapped causing Bus fault resulting in tripping of 400KV Gorakhpur (PG) I &II , 400KV Azamgarh and 315MVA ICT-2 and 500MVA ICT.

The detailed report along with flags, DR/ER and the reason shall be forwarded after receipt from the concerned authority.

Sub: - Report on the incident of simultaneous tripping of elements at 400kv Gorakhpur at 16:57Hrs. on dt. 17.09.2018 based on the information received from UPPTCL.

Ref:- NRLDC letter No. NR_GD_GI/1365

On 17.09.2018 at 16:57Hrs. all ICTs and 400KV transmission lines connected with 400KV S/S Gorakhpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	500MVA ICT – I (400/220KV)	17.09.2018	18:41	-
2.	315MVA ICT – II (400/220KV)	17.09.2018	18:33	-
3.	400KV Gorakhpur-PG-I	17.09.2018	22:25	-
4.	400KV Gorakhpur-PG-II	17.09.2018	22:26	-
5.	400KV Azamgarh	17.09.2018	18:32	-
6.	220KV Gorakhpur – I	17.09.2018	19:08	-
7.	220KV Gorakhpur – II	17.09.2018	18:57	
8.	220KV Deoria	17.09.2018	18:38	-
9.	220KV Hata - II	17.09.2018	19:11	-

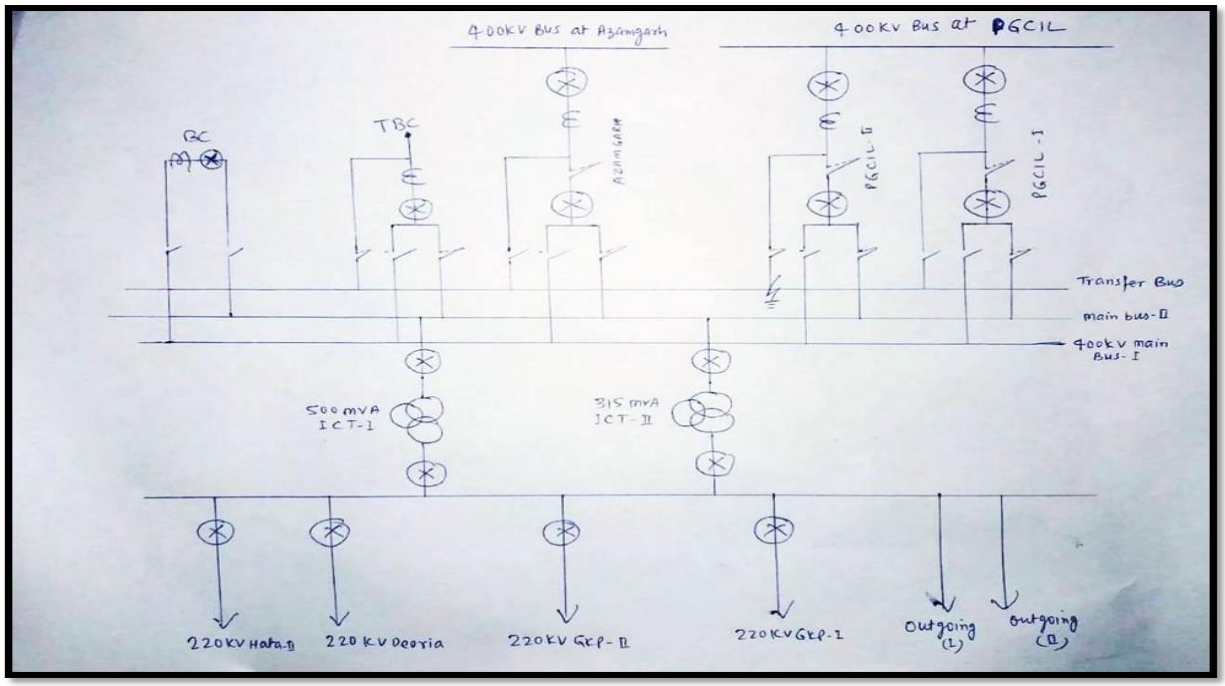
Analysis report of the tripped elements and single line diagram of the relevant portion of the grid is enclosed at annexure.

Analysis:-

During charging of 400KV Gorakhpur (PG) Ckt. – II through 400KV Transfer Bay due to S/D of main breaker of this line, R phase parallel disc insulator of 400KV Transfer Bus got damaged and fell on the ground causing bus fault. This led to tripping of all 400KV lines, ICTs and all 220KV feeders on bus bar protection.

Remedial Measures:-

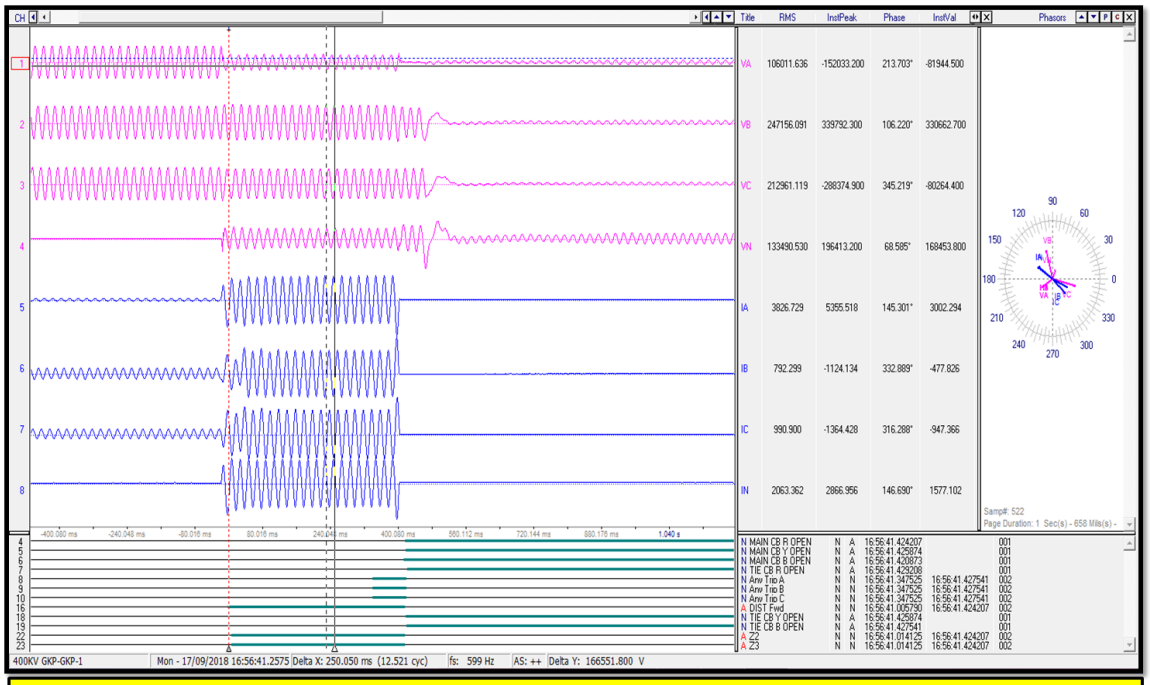
1. Cleaning of main and transfer bus disc insulators and also replacement of old disc insulators is required.
2. Thorough protection testing of 400/220KV system at Gorakhpur S/S is required.



5	**Antecedent conditions of load and generation , including frequency , voltage and the flows in the affected area at the time of tripping including weather condition prior to the event**	**1) 500 MVA ICT-I :-at 16.00 hrs.** i)Load: -199 MW, current: 527 Amp , Voltage: 227 KV.
		2) 315MVA ICT-II :-at 16.00 hrs. i)Load: -127MW, current: 336 Amp , Voltage: 229 KV.
		3) 400KV Azamgarh :-at 16.00 hrs. i)Load: -228MW, current: 318 Amp , Voltage: 412 KV.
		4) 400KV PGCIL-I :-at 16.00 hrs. i)Load: -47MW, current: 111Amp , Voltage: 408 KV.
		5) 400KV PGCIL-II :-at 16.00 hrs. i)Load: -47MW, current: 112Amp , Voltage: 408 KV.
		6) 220KV Deoria :-at 16.00 hrs. i)Load: +110 MW, current: 290 Amp , Voltage: 229 KV.
		7)220KV Gorakhpur-I :-at 16.00 hrs. i)Load: +16 MW, current: 53 Amp , Voltage: 227 KV.
		8)220KV Gorakhpur-II :-at 16.00 hrs. i)Load: +16 MW, current: 53Amp , Voltage: 228 KV.
		9) 220KV Out going-I :-at 16.00 hrs. i)Load: +71 MW, current: 195 Amp , Voltage: 228 KV.
		10) 220KV Out going-II :-at 16.00 hrs. i)Load: +75 MW, current: 195 Amp , Voltage: 228 KV.
		11) 220KV Hata-II :-at 16.00 hrs. i)Load: +00 MW, current: 10 Amp , Voltage: 225 KV.
		Weather condition: Clear
		Affected Area: Town supply of Deoria, Kushinagar, Maharjganj,partially tehsil & rural supply of Gorakhpur, Deroia, Kushinagar and Maharajganj districts.
6	**Duration of interruption and Demand and / or Generation (in MW and MWh) interrupted**	1) 500MVA - 01 hrs.45 minutes 2) 315MVA - 01 hrs 37 minutes 3) 400KV Azamgarh- 01 hr 35 minues 4) 400KV PGCIL Ckt-I- 05 hr 28minutes 5)400KV PGCIL Ckt-II- 05 hr 29 minutes 6) 220KV Deoria - 01 hrs 41 minutes 7) 220KV Gorakhpur-I - 02 hrs 11 minutes 8) 220KV Gorakhpur-II - 02 hrs 00minutes 9) 220KV Hata-II - 02 hrs 14 minutes 10) 220KV Outgoing-I - 01 hrs 41 minutes 11) 220KV outgoing-II - 01 hrs 41 minutes

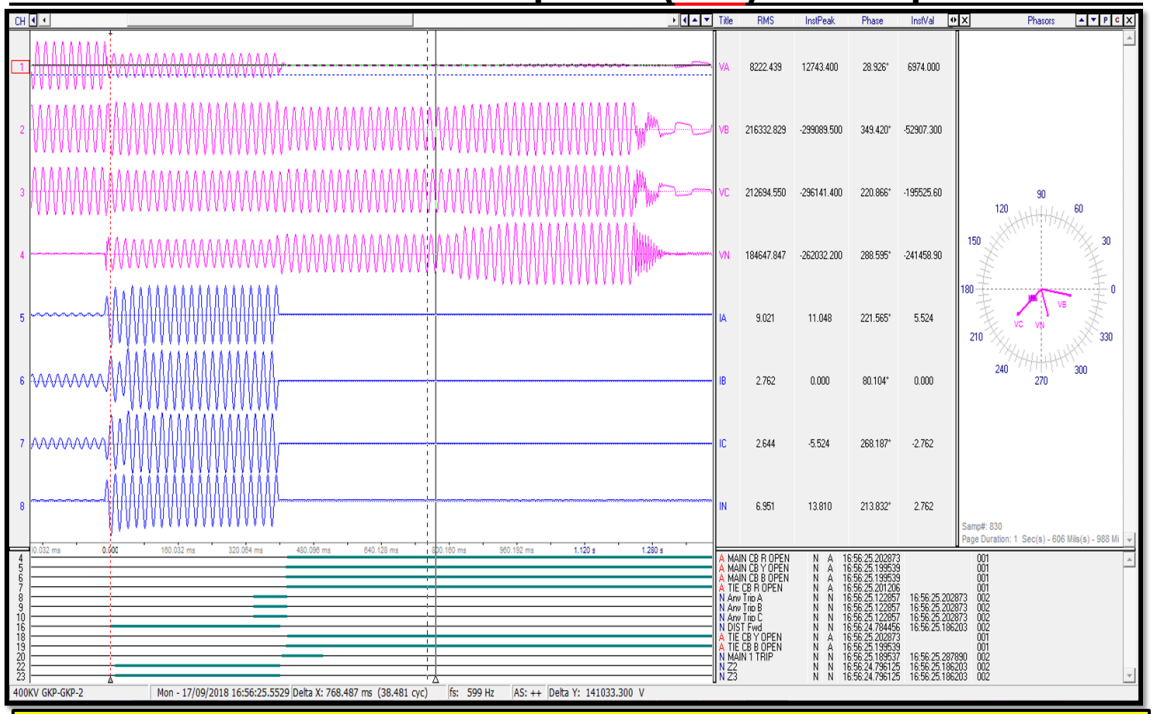
Sl.No.	Name of Feeder	Tripping Date & Time	Restoration date & Time	Details of Flag		Analysis	Remark
				Control Panel	Relay Panel		
1	500 MVA ICT-I	17.09.18 at 16.57 hrs	HV side- 18.41 hrs	**HV side:**		**At 400KV S/S UPPTCL Gorakhpur -** During charging of 400KV UPPTCL -PGCIL Gorakhpur ckt-II through 400KV transfer bay , R-ph parallel disc insulator of 400KV Transfer bus got damaged causing tripping of all 400KV feeders, 315MVA ICT-II, 500MVA ICT-I and 220KV feeders on bus bar protection. After isolation of faulty bus section 400KV feeders , ICTs, 220KV feeders charged. Then after replacement of damaged disc insulators both 400KV PGCIL ckts charged at 22:25 & 22:26 hrs. respectively.	
			LV Side- 18.42 hrs	VT fail,Directional O/C & E/F optd			
				Gr A trip relay optd	MTR -186,286		
				Gr B trip relay optd			
				LV side:			
				Gr B trip relay 86B	MTR -286		
2	315 MVA ICT-II		HV side- 18.33 hrs	**HV side:**			
			LV Side-	Gr A,B trip relay	86A1,86A2,86B1,86B2		
					Directional O/C &E/F with LBB pton INV HS E/F		
				LV side:			
				BB protn optd	96		
				master trip relay optd.	MTR 86		
3	400 kV Bus Bar Protn panel		18.32 hrs		BBR-87,Z2,		
4	400 kV Azamgarh		18.32 hrs	A/R block, BB optd	186A,186B,96		
5	400 kV PGCIL ckt-I		22.25 hrs	main-1/2 CR, Direct trip recive Ch-I/II, CB trouble alarm, CB auto trip,	RP1C- 79A/R block, bkr 50Z, 30KL, 52X1 A/B, RP1B- cont multi relay 30R2/F2,main-II distance protn relay -R,B-ph alarm 86B, 30P,30Q, RP1A- cont multi relay 30R1/F1, main-I distance relay -R,Y,B-ph -pick,E/F, Z1, CR,86A		
6	400 kV PGCIL ckt-I		22.26 hrs	CB trouble alarm, carrier channel alarm	RP2C- CB trouble protn realy 52X1 A/B, cont multi relay 30KL, RP2B- cont multi relay 30 R2/F2, 30MN, RP2A- cont multi relay 30R1/F1, main -I distannce protn relay- R,Y,B-ph E/F pick up,		
7	220 kV Bus Bar Protn panel		18.34 hrs.		BBR- 87, Z1		
8	220 kV Gorakhpur -I		19.08 hrs	BB protn optd	96 optd.		
				Auto reclose lock out optd.	186A,186B		
9	220 kV Gorakhpur -II		18.57 hrs	BB protn optd	BB relay 96, 67N/50LBB		
				Master trip relay			
10	220 kV Deoria		18.38 hrs	186 , 286optd., LBB optd	186,286		
11	220 kV Hata -II		19.11 hrs	96 optd, VT fail	VT fail		

DR details of 400 kV Gorakhpur PG(end)-Gorakhpur UP ckt-1



It seems line tripped from PG end in Z-2

DR details of 400 kV Gorakhpur PG(end)-Gorakhpur UP ckt-2



It seems line tripped from PG end in Z-2. Gorakhpur (UP) end connected for another 800ms as voltage persisted for that period.

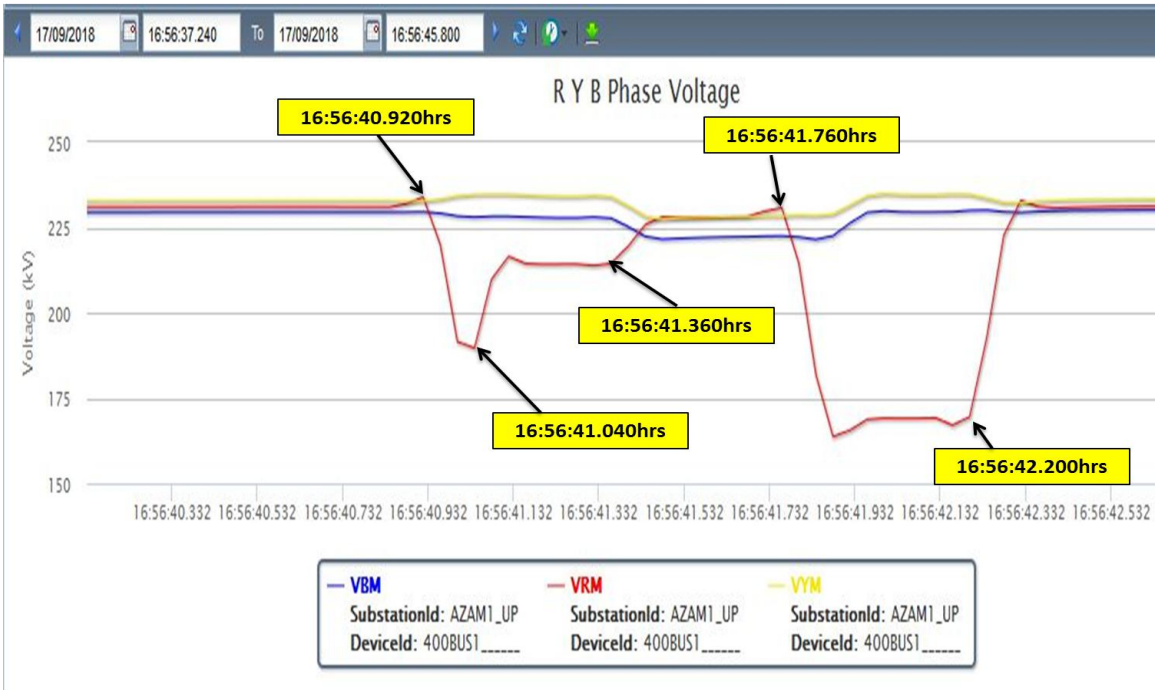
e. PMU data of frequency and phase voltages:

PMU Plot of frequency at Bassi(PG)

16:57hrs/17-Sep-18

PMU Plot of phase voltage magnitude at Azamgarh(UP)

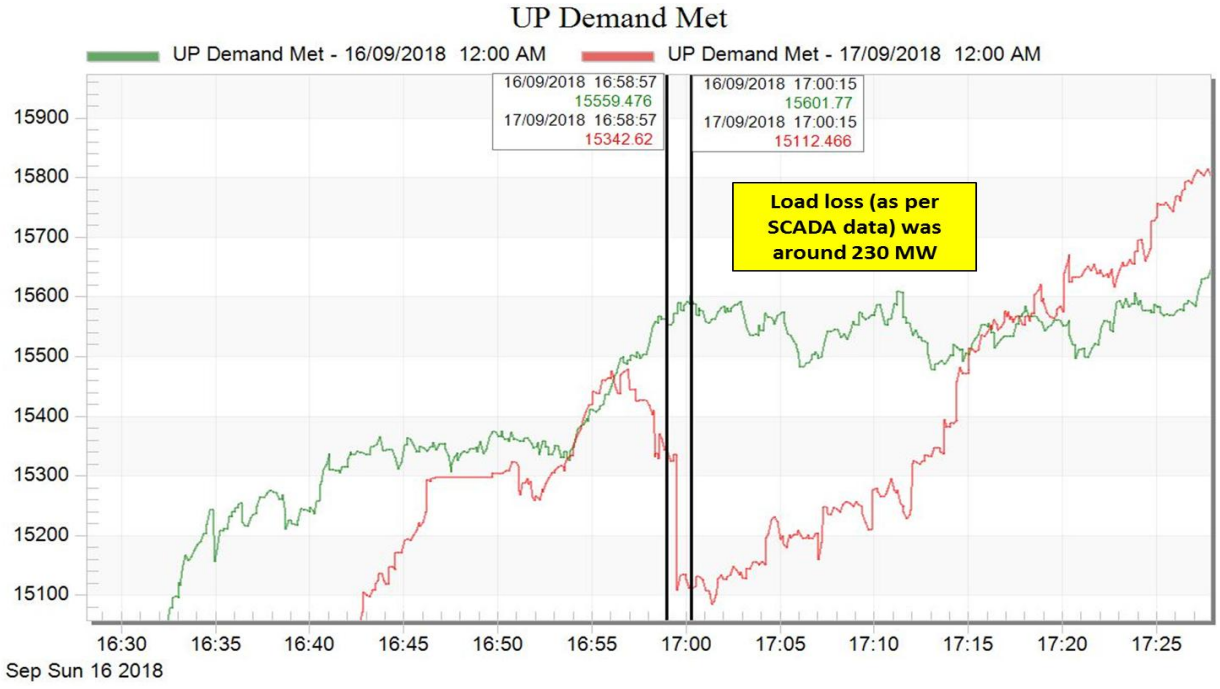
16:57hrs/17-Sep-18



f. SCADA SoE and Analog data:

Time	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
16:56:40:920	0ms	PMU data					Reference Time
16:56:40:575		GRK_1_UP	400kV	F_08(GRKPR-1)	Circuit Breaker	Open	Main CB of 400kV Gorakhpur(UP)-Gorakhpur(PG) Ckt-1 opens
16:56:40:993	70ms	GRK_1_UP	400kV	10T2	Circuit Breaker	Open	400kV Side Main CB of 315 MVA ICT 2 at Gorakhpur(UP) opens.
16:56:41:016	95ms	GRK_1_UP	220kV	E_02(DORIA)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Dorai(UP) opens
16:56:41:018	100ms	GRK_1_UP	220kV	09T2	Circuit Breaker	Open	220kV Side Main CB of 315 MVA ICT 2 at Gorakhpur(UP) opens.
16:56:41:022	100ms	GRK_1_UP	220kV	E_01(T1)	Circuit Breaker	Open	220kV Side Main CB of 500 MVA ICT 1 at Gorakhpur(UP) opens.
16:56:41:022	100ms	GRK_1_UP	220kV	E_07(GRK_2-1)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Gorakhpur2(UP) ckt-1 opens
16:56:41:025	105ms	GRK_1_UP	220kV	14HATA2	Circuit Breaker	Open	
16:56:41:027		GRK_1_UP	220kV	05MBC	Circuit Breaker	Open	220kV Side Bus coupler opens.
16:56:41:042	120ms	GRK_1_UP	220kV	E_08(GRK_2-2)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Gorakhpur2(UP) ckt-2 opens
16:56:41:760	840ms	PMU data					Again voltage dip
16:56:42:200	1280ms	PMU data					Voltage recovered
16:57:00:015	19 second	AZAM1_UP	400kV	16GRK1	Circuit Breaker	Open	Main CB of 400kV Azamgarh(UP)-Gorakhpur(UP) Ckt opens

UP Demand pattern during tripping



g. As per PMU data:
   - As per PMU, maximum dip in R-phase. Two voltage dip captured
   - Fault Clearance time: **440ms & 440ms**
   - SoE captured, it seems all the 400kV elements tripped within 100ms of fault occurrence except 400 kV Azamgarh-Gorakhpur ckt

h. As per DR and flag details:
   - 400 kV Gorakhpur PG (end)-Gorakhpur UP ckt-1 tripped in Z-2.
   - 400 kV Gorakhpur PG (end)-Gorakhpur UP ckt-2 tripped in Z-2 however Gorakhpur(UP) end tripped after 800ms of tripping from Gorakhpur PG end.
   - 500 MVA ICT at Gorakhpur (UP) tripped on back up protection within 100ms

i. Preliminary report and Flag details has been received but DR/EL and detailed investigation report along with remedial measures report is still awaited from UP.

4. *Event Description for 22nd Oct 2018 event:*
   a. 400 kV Gorakhpur (UP) is connected with Gorakhpur (PG) D/C, Azamgarh (UP) S/C. It also has 315MVA & 500MVA 400/220 kV ICT. It has DMT (double main transfer breaker) scheme. 220kV Gorakhpur 2 (UP) further connected with 220 kV Tanda (UP) S/C, Gorakhpur (PG) S/C and 400/220 kV Gorakhpur (UP) D/C.
   b. 220 kV Gorakhpur 2 (UP)-Tanda line tripped at 10:05hrs on 220 kV Gorakhpur 2 (UP) & at the same time 220 kV side bus bar protection operated at 400/220 kV Gorakhpur (UP) causing tripping of all connected 220 kV feeders,315MVA ICT-II and 500MVA ICT-I.
   c. During checking it was found that during normal condition bus bar protection CT core B-phase current is higher than twice times with respect to R&Y-phases current on 220 kV Gorakhpur-Gorakhpur ckt-I. Hence bus bar protection CT core cable for above feeder between CT JB (junction box) to bus bar protection panel replaced on dated 22.10.2018 and observed balance current for all three phases.
   d. Following element connected to 220kV bus of 400/220 kV Gorakhpur (UP) tripped:
      - 315 MVA ICT 2 at 400kV Gorakhpur(UP)
      - 500 MVA ICT 1 at 400kV Gorakhpur(UP)

- 220 kV Gorakhpur 2 (UP)-Tanda (UP)
- 220 kV Gorakhpur 2 (UP)-Gorakhpur (PG) ckt
- 220 kV Gorakhpur (UP)-Gorakhpur 2 (UP) ckt-1 & 2
- 220 kV Gorakhpur-Deoria ckt
- 220 kV Gorakhpur-Hata ckt

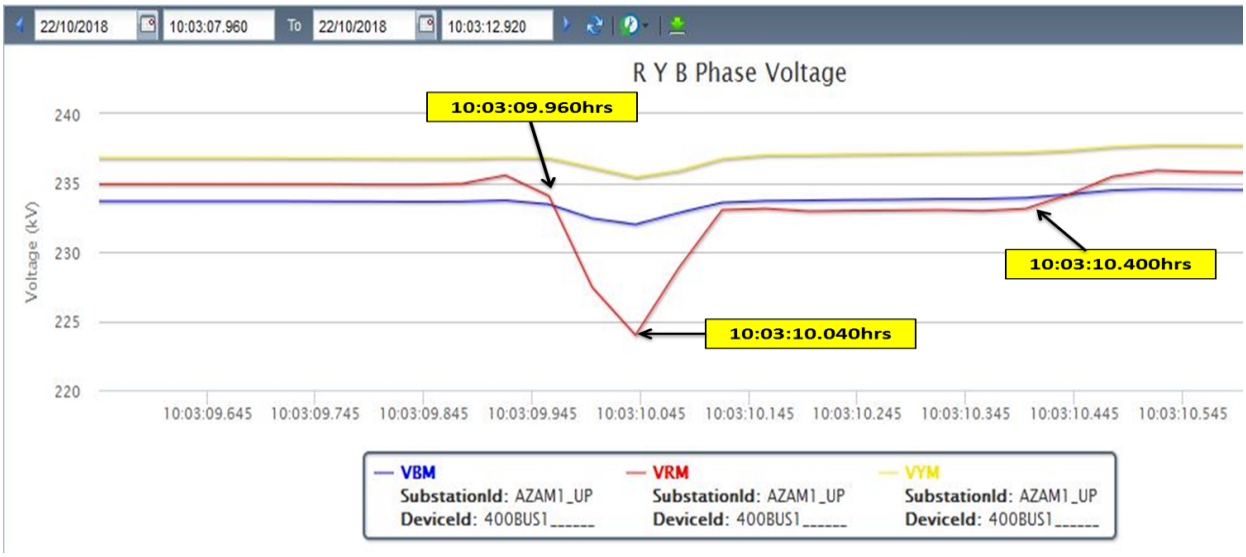
e. PMU plots of frequency and phase voltage:

PMU Plot of frequency at Bassi(PG)

10:03hrs/22-Oct-18

PMU Plot of phase voltage magnitude at Azamgarh(UP)

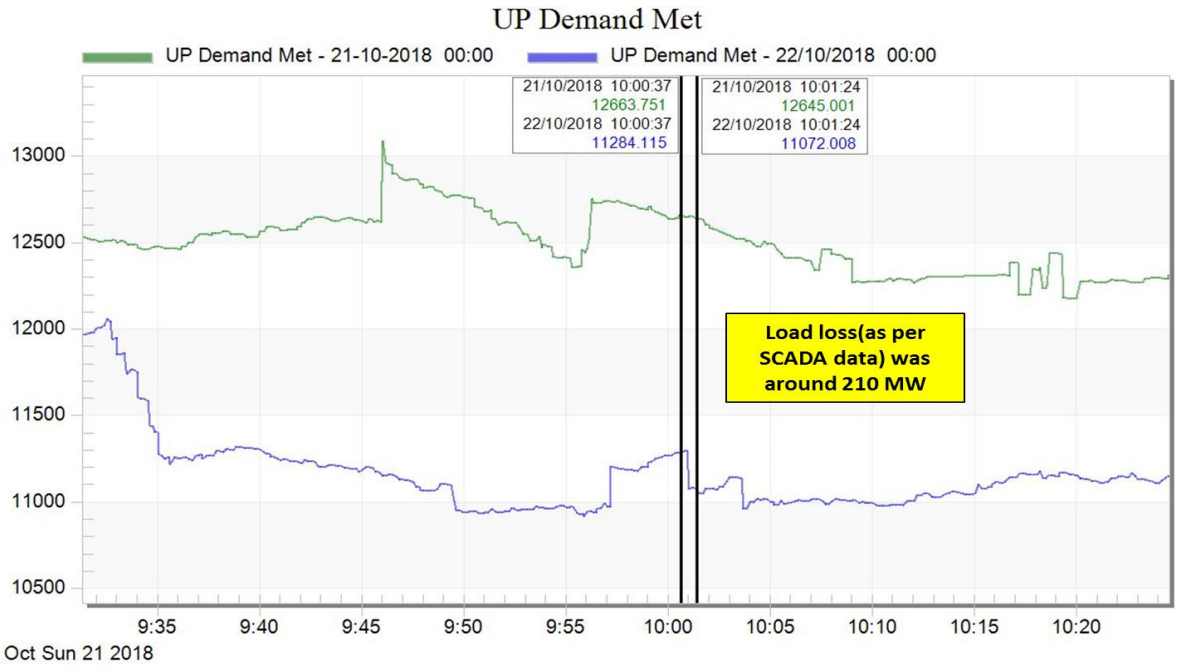
10:03hrs/22-Oct-18



f. SCADA SoE data:

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
10:03:09:199	GRK_1_UP	220kV	E_07(GRK_2-1)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Gorakhpur2(UP) ckt-1 opens
10:03:09:200	GRK_1_UP	220kV	05MBC	Circuit Breaker	Open	220kV Side Bus coupler opens.
10:03:09:200	GRK_1_UP	220kV	E_02(DORIA)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Dorai(UP) opens
10:03:09:201	GRK_1_UP	220kV	E_01(T1)	Circuit Breaker	Open	220kV Side Main CB of 500 MVA ICT 1 at Gorakhpur(UP) opens.
10:03:09:205	GRK_1_UP	220kV	14HATA2	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-HATA ckt opens
10:03:09:209	GRK2N_UP	220kV	E_03(EXTN1)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Gorakhpur New(UP)(end) ckt-1 opens
10:03:09:213	GRK2N_UP	220kV	E_04(EXTN2)	Circuit Breaker	disturbe	Main CB of 220kV Gorakhpur(UP)-Gorakhpur New(UP)(end) ckt-2 opens
10:03:09:217	GRK_1_UP	220kV	E_08(GRK_2-2)	Circuit Breaker	Open	Main CB of 220kV Gorakhpur(UP)-Gorakhpur2(UP) ckt-2 opens
10:03:09:218	GRK_1_UP	400kV	10T2	Circuit Breaker	Open	400kV Side Main CB of 315 MVA ICT 2 at Gorakhpur(UP) opens.
10:03:09:222	GRK_1_UP	220kV	09T2	Circuit Breaker	Open	220kV Side Main CB of 315 MVA ICT 2 at Gorakhpur(UP) opens.

UP Demand pattern during tripping



g. AS per UPPTCL details:

Sub: - Report on the Incident of Simultaneous Tripping at 400KV S/S Gorakhpur.

Ref:- NRLDC letter No. NR_GD_GI/1393

On 22.10.2018 at 10:05Hrs. all 400/220KV ICTs and 220KV transmission lines connected with 400KV S/S Gorakhpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	500MVAICT– I (400/220KV)	22.10.18	10:54	Bus bar protection operated
2.	315MVAICT–II (400/220KV)	22.10.18	10:47	-do-
3.	220KV Deoria line	22.10.18	10:54	-do-
4.	220KV Gorakhpur – I line	22.10.18	11:03	-do-
5.	220KV Gorakhpur – II line	22.10.18	11:04	-do-
6.	220KV Hata – II line	22.10.18	12:23	-do-

Generation Loss = **NIL**

Load Loss = 180 MW Approx.

It has been reported by site authorities that 220KV Gorakhpur – Tanda line tripped due to line fault caused by snapping of (Disc insulator) simultaneously 220KV bus bar protection also operated resulting into Blackout at 220KV Gorakhpur.

The detailed report along with flags, DR/ER and the reason shall be forwarded after receipt from the concerned authority.

Ref:- NRLDC letter No. NR_GD_GI/1393

On 22.10.2018 at 10:05Hrs. all 400/220KV ICTs and 220KV transmission lines connected with 400KV S/S Gorakhpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	500MVA ICT – I (400/220KV)	22.10.18	10:54	Bus bar protection operated
2.	315MVAICT – II (400/220KV)	22.10.18	10:47	-do-
3.	220KV Deoria line	22.10.18	10:54	-do-
4.	220KV Gorakhpur – I line	22.10.18	11:03	-do-
5.	220KV Gorakhpur – II line	22.10.18	11:04	-do-
6.	220KV Hata – II line	22.10.18	12:23	-do-
7.	220KV Bus coupler	22.10.18	10:48	-do-
8.	220KV outgoing – II	22.10.18	10:48	Isolator open
9.	220KV outgoing – I	22.10.18	10:48	-do-

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

Analysis:-

220KV Barahua Gorakhpur – Tanda line tripped at 10:05Hrs. on 220KV S/S Barahua Gorakhpur & at the same time 220KV side bus bar protection operated at 400KV S/S Gorakhpur causing tripping of all connected 220KV feeders, 500MVA ICT – I and 315MVA ICT – II.

During testing it was found that the protection cable between C.T Junction box to bus bar protection panel found defective due to which bus bar protection operated, Causing Blackout at 220KV Portion of 400/220KV S/S Gorakhpur.

Remedial Measures:-

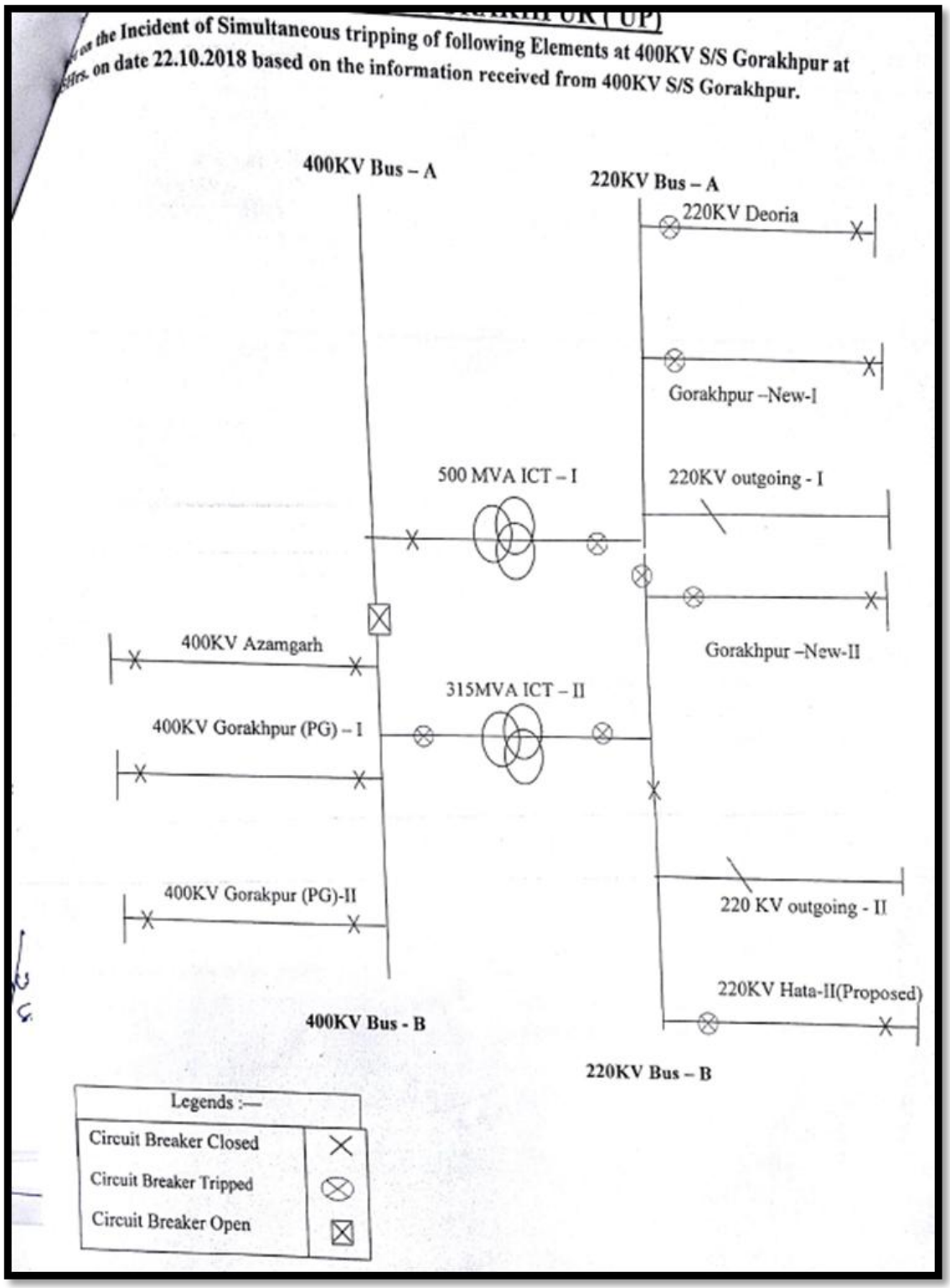
1. Bus bar protection C.T cable replaced from C.T Junction box to bus bar protection panel of 220KV Gorakhpur – Tanda Ckt. on 22.10.2018
2. Thorough testing of the protection system at 400KV S/S Gorakhpur is required.

5	**Antecedent conditions of load and generation , including frequency , voltage and the flows in the affected area at the time of tripping**	**1)500 MVA ICT-I :-at 10.00 hrs.** i)Load: - 127 MW, current: 322 Amp , Voltage: 230 KV.
		2)315MVA ICT-II :-at 10.00 hrs. i)Load: - 80 MW, current: 205 Amp , Voltage: 234 KV.
		3)220KV Deoria :-at 10.00 hrs. i)Load: - 100 MW, current: 302 Amp , Voltage: 230 KV.
		4)220KV Gorakhpur-I :-at 10.00 hrs. i)Load: 21 MW, current: 54 Amp , Voltage: 230KV.
		5)220KV Gorakhpur-II :-at 14.00 hrs. i)Load: 22 MW, current: 57 Amp , Voltage: 230 KV.
		6)220KV Out going-I :-at 10.00 hrs. i)Load:31 MW, current: 84 Amp , Voltage: 233 KV.
		7)220KV Out going-II :-at 10.00 hrs. i)Load: 35 MW, current: 90 Amp , Voltage: 230 KV.
		8)220KV Hata-II :-at 10.00 hrs. i)Load: - 00 MW, current: 10 Amp , Voltage: 231 KV.
		Affected Area: Partial Town & rural supply of Gorakhpur, town& rural supply of Deroia, Kushinagar and Maharajganj districts.
		Weather condition: Clear

Annexure-1

Details of Flags & tripping Analysis of 400KV Sub-Station , UPPTCL Gorakhpur on dated 22.10.2018

Sl.No.	Name of Feeder	Tripping Date & Time	Restoration date & Time	Details of Flag		Analysis	Remark
				Control Panel	Relay Panel		
1	500MVA ICT-I	22.10.18 at 10.05 hrs	LV Side-10.54 hrs	HV side:		220KV Barahua Gorakhpur- Tanda line tripped at 10.05 hrs on 220KV S/S Barahua Gorakhpur & at the same time 220KV side bus bar protection operated at 400KV S/S Gorakhpur causing tripping of all connected 220KV feeders , 500MVA ICT-I and 315MVA ICT-II.During checking it was found that during normal condition bus bar protection CT core B-ph current is higher than twice times with respect to R& Y-phases current on 220KV Gorakhpur-Gorakhpur Circuit-I. Hence Bus bar protection CT core cable for above feeder between CT JB to Bus Bar protection panel replaced on dated 22.10.2018 and observed balance current for all three phases.	
				LV side:			
				BB protn optd			
2	315 MVA ICT-II		HV side- 10.47 hrs	HV side:			
			LV Side-10.49 hrs	Gr A,B optd	86A1,86A2,86B1,86B2		
				LV side:			
				BB protn optd	96 optd.		
				master trip relay optd.	MTR 86		
3	220KV Gorakhpur -I		11.03 hrs	BB protn optd	96 optd.		
				Auto reclose lock out optd.	186A,186B		
4	220KV Gorakhpur -II		11.04 hrs	BB protn optd	---		
5	220KV Deoria		10.54 hrs	BB protn optd	---		
6	220KV Hata -II		12.23 hrs	96 optd	---		
7	220KV Bus Bar Protn panel		11.02 hrs taken in ckt.	----	BB- B phase -87, Z1 96TR1,96TR2, 96TR4,96TR5,96TR6, 96TR8,96TR9,96TR11		



h. As per PMU data:
   - As per PMU, maximum dip in R-phase.
   - Fault Clearance time: **440ms**

- SoE captured, it seems time synch error. (Tripping time captured in SCADA SoE is 800ms before the actual fault time (PMU reference time)

i. All 220kV elements connected to 400/220 kV Gorakhpur (UP) tripped.
j. Remedial Measures taken: Bus bar protection CT core cable for 220 kV Gorakhpur (UP)-Gorakhpur2 (UP) ckt-1 between CT JB (junction box) to bus bar protection panel replaced on dated 22.10.2018 and observed balance current for all three phases.
k. Preliminary report and flag details has been submitted however DR/EL and detailed report is still awaited from UPPTCL.

UP representative informed during the meeting:

1. Event on 17th Sep 2018:
    a. Exact location of fault and nature of fault: *Fault was on 400 kV transfer bus at 400/220 kV Gorakhpur (UP)*
    b. Sequence of tripping needs to be reported and explained.
    c. Reason of delayed clearance of fault: *Yet to be ascertained*
    d. Operation of bus bar protection for both 400 kV buses at Gorakhpur (UP) needs to be relooked: *400 kV Bus Bar Protection at 400/220 kV Gorakhpur (UP) was under outage*
    e. Delayed clearance of fault more than 400ms in case of operation of instantaneous bus bar protection operation also to be checked.
    f. Healthiness of bus bar protection of 400/220 kV Gorakhpur (UP) needs to be ensured: *Bus Bar Protection was healthy but under outage due to mistake of commissioning engineer during upgradation of ICT at Gorakhpur (UP)*
    g. Back up over current earth fault protection of 500MVA ICTs needs to be looked into: *ICT tripped on backup over current earth fault protection.*
    h. Reason of tripping of 400 kV Gorakhpur (UP)-Gorakhpur (PG) ckts needs to be explained. (From PG end these ckts tripped in Z-2): *To be looked into*
    i. SCADA SoE (not received) of tripping of 400 kV Gorakhpur (UP) end-Azamgarh ckt.
    j. Status of availability of DR/EL and extracting software needs to be shared: *Alstom make event logger (EL) was not in service*

k. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL

l. Apart from aforesaid points following are the useful information relayed to the tripping
   - 500MVA ICT was newly commissioned at 400/220 kV Gorakhpur (UP). For connection of bus bar protection for 500MVA ICT, bus bar protection was taken under test mode (one day before) and it was inadvertently remain in test mode.
   - At the time of incident, 400 kV bus bar protection at 400/220 kV Gorakhpur (UP) was not operated.
   - Alstom make event logger (EL) was not in service.
   - Manual error during upgradation work. Operating procedure/ check list for upgradation work at 400 kV Gorakhpur (UP) didn't follow.
   - Operation of SEL make 220 kV bus bar protection at 400/220 kV Gorakhpur (UP) end needs to be checked.

2. Event on 22nd Oct 2018:
   a. Exact location of fault and nature of fault: *Fault was in 220 kV Gorakhpur 2-Tanda (UP) ckt.*
   b. Sequence of tripping needs to be reported and explained.
   c. Reason of delayed clearance of fault.
   d. Operation of 220 kV bus bar protection during fault in outgoing line (220kV Gorakhpur-Tanda ckt) from adjacent 220 kV Gorakhpur 2 (UP) needs to be looked into: *One of the cable from CT JB to bus bar protection found earthed and B-phase current reading was double than normal current. It may be the reason of operation of 220 kV Bus Bar Protection during through fault condition. Damaged cable has been already replaced and after replacement no bus bar protection operated for through fault condition.*
   e. Operation of bus bar protection for both 220 kV buses at 400/220 kV Gorakhpur (UP) needs to be relooked.
   f. Delayed clearance of fault more than 400ms in case of operation of instantaneous bus bar protection operation also to be checked.
   g. Healthiness of 220 kV bus bar protection of 400/220 kV Gorakhpur (UP) needs to be ensured.
   h. Time synchronization of SCADA SoE to be checked and corrected.
   i. Status of availability of DR/EL and extracting software needs to be shared.

j. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL.

3. Bus Bar Protection of both side of 400/220 kV Gorakhpur (UP) needs to be thoroughly checked.

UPPTCL submit the detailed report and remedial measures report.

C. Multiple Element tripping at 400/220 kV Patran substation at 11:11 hrs of 18th Sep 2018.

Event category: GI-2
Generation loss: Nil
Loss of load: Nil
Energy Loss: Nil

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	As per PMU data	**No fault**	No fault in the system
Phase of the fault	As per PMU data	**NA**	

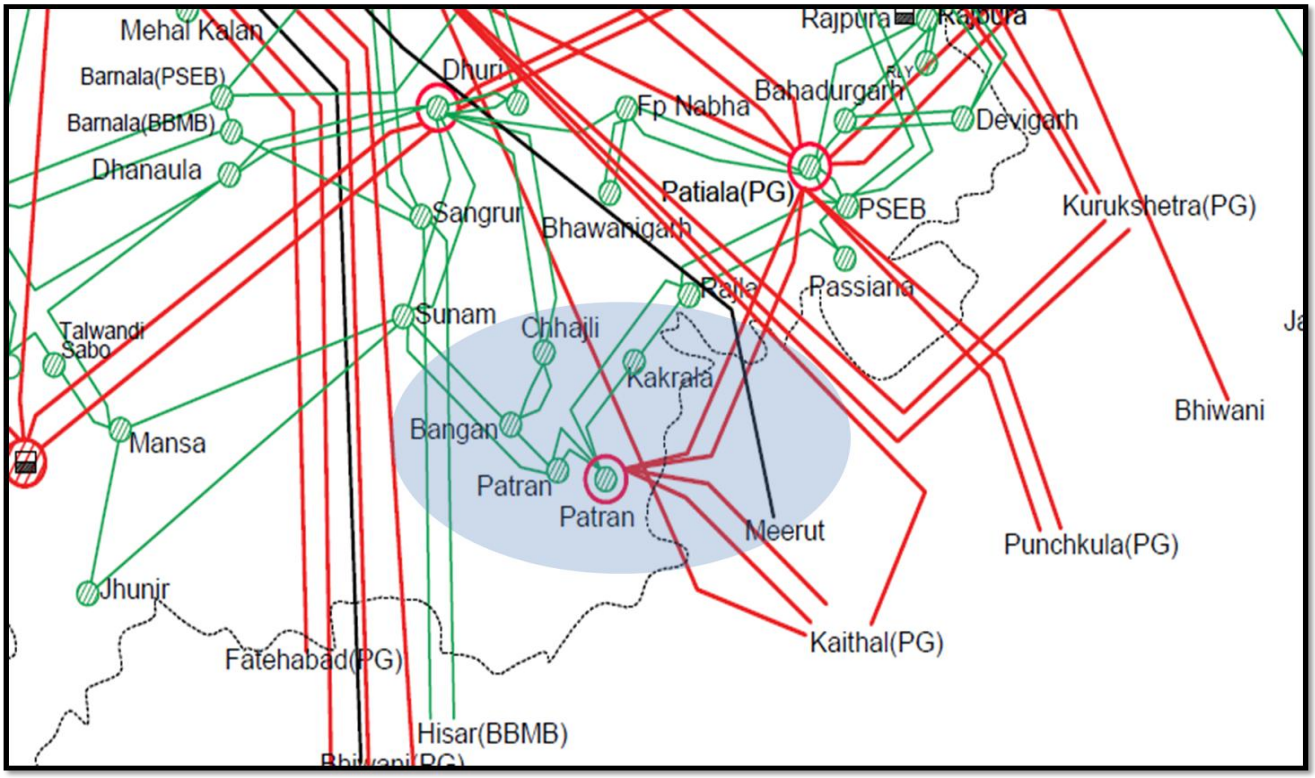
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)	NR	Available	
DR/ EL	PTCL	Received	
	Punjab	NA	
	POWERGRID	Received	
Preliminary Report	PTCL	Received	
	Punjab	Not Received	
	POWERGRID	Received	
Detailed Report	PTCL	Not Received	
	Punjab	Not Received	

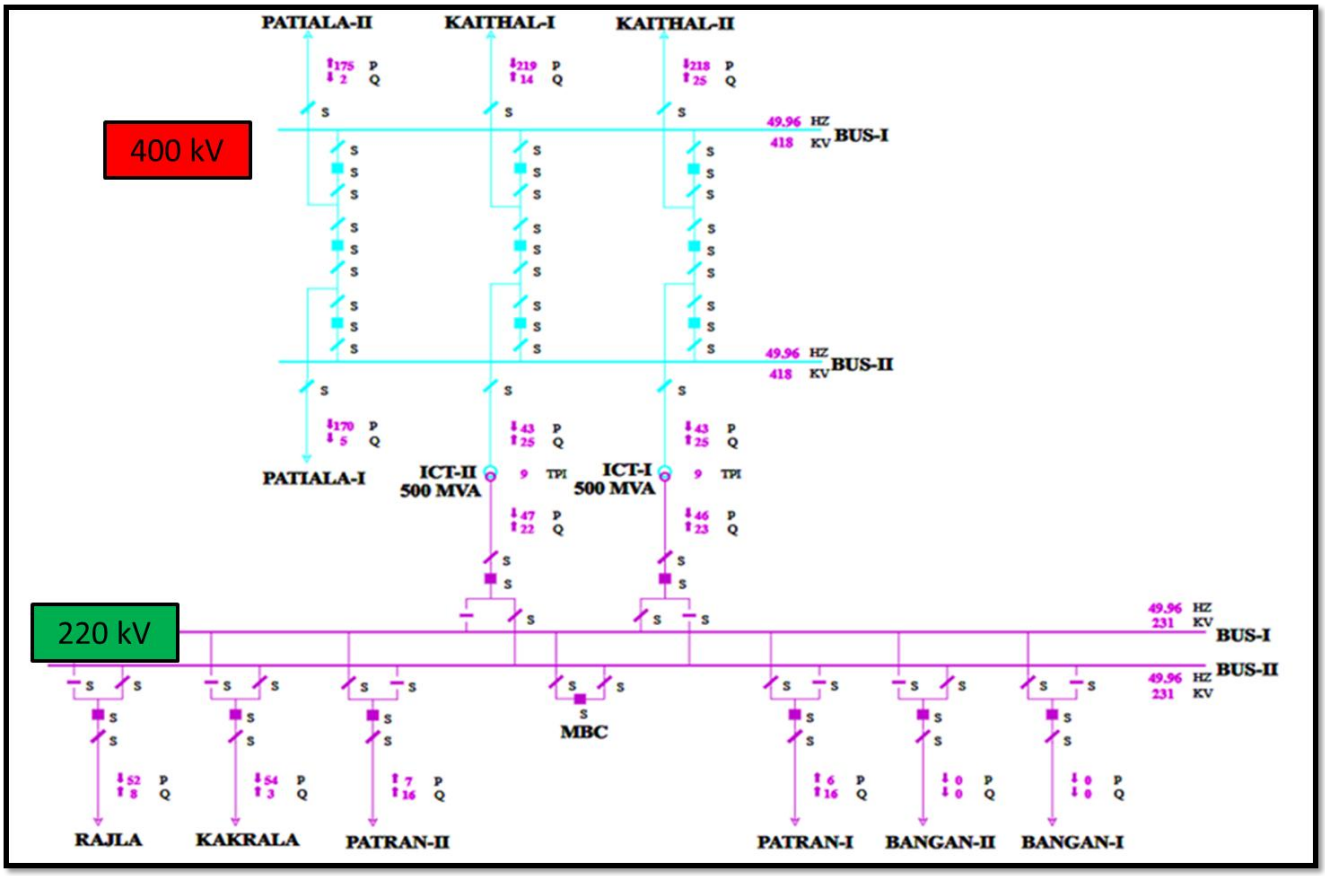
Description	Clauses	Utility	Remarks

Violation of Clauses	1. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 2. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) 3. CEA Grid Standard 3.1.e 4. CEA Transmission Planning Criteria	**PTCL**	1. Detailed Report didn't provide 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system
	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**Punjab**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report not received

Based on above information description of the events is:

1. Connectivity Diagram of 400/220 KV Patran substation:





2. 400 kV Patran s/s is connected with 400 KV Patiala D/C, 400 KV Kaithal D/C and has two 500MVA 400/220 kV ICT's. It has one and half breaker scheme at 400 kV level and DM (double main) scheme at 220 kV level.
3. At 11:11:57 all 400 lines and both 500 MVA ICTs at 400/220 kV Patran station tripped.
4. The DR and event loggers are showing DC supply fail signal only with no tripping signal issued.

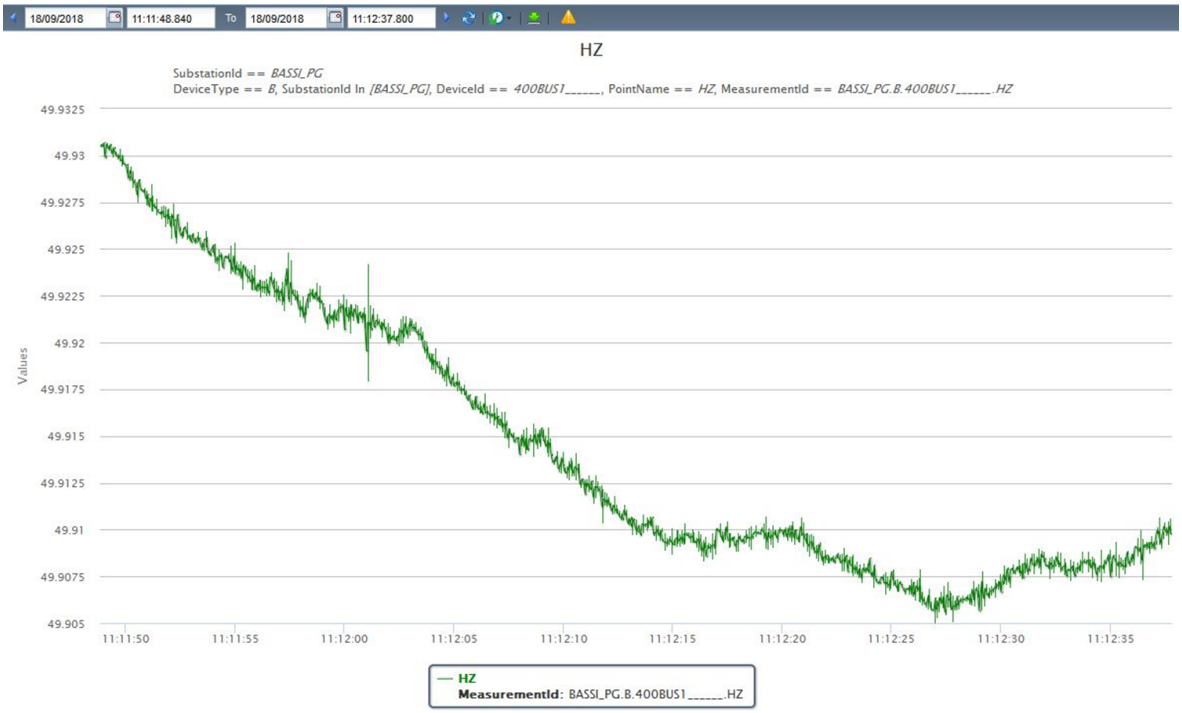
5. Antecedent Condition:
    - 400 kV Patran-Kaithal ckts were carrying 139 MW each.
    - 400 kV Patran-Patiala ckts were carrying 68 MW each.

6. Name of the tripped elements are as below:
    - 400 kV Patran - Kaithal ckt-1 & 2
    - 400 kV Patran - Patiala ckt-1 & 2
    - 500 MVA 400/220 kV ICT – 1 & 2

7. PMU plot of frequency and phase voltages:

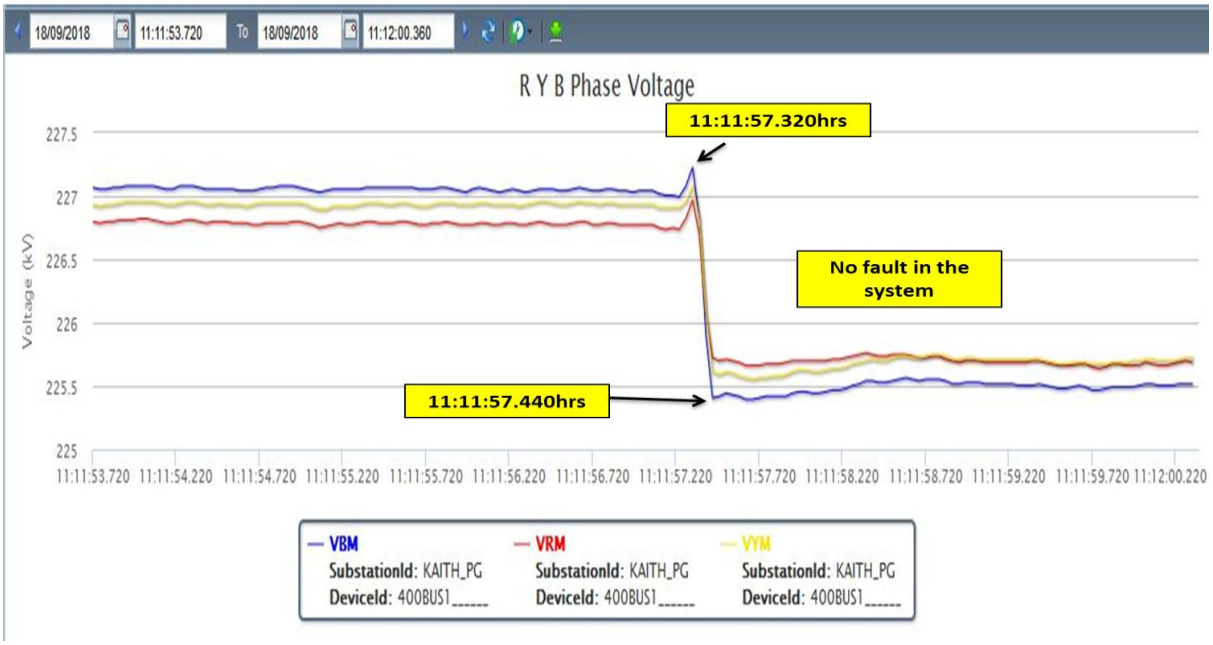
PMU Plot of frequency at Bassi(PG)

11:12hrs/18-Sep-18



PMU Plot of phase voltage magnitude at Kaithal(PG)

11:12hrs/18-Sep-18



8. As per SCADA SoE:

Time	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
11:11:57:320	0ms	PMU data					Reference Time
11:11:57:345	25ms	PATRN_P	220	07T2	Circuit Breaker	Open	220kV side Main CB of 500MVA ICT2 at Patran opens
11:11:57:345	25ms	PATRN_P	220	07T2	Circuit Breaker	Disp	
11:11:57:346	25ms	PATRN_P	400	04KATHL1	Circuit Breaker	Open	Main CB of 400kV Patran(end)-Kaithal ckt-1 opens
11:11:57:346	25ms	PATRN_P	400	04KATHL1	Circuit Breaker	Disp	
11:11:57:349	30ms	PATIALA	400kV	14PA2LD2	Circuit Breaker	Open	Tie CB of 400kV Patiala(end)-Patran ckt-2 & 400kV Patiala(end)-Ludhiana ckt-2 opens
11:11:57:350	30ms	PATRN_P	400	09T1	Circuit Breaker	Open	400kV side Main CB of 500MVA ICT1 at Patran opens
11:11:57:350	30ms	PATRN_P	400	09T1	Circuit Breaker	Disp	
11:11:57:351	30ms	KAITHAL	400kV	11PA1BG2	Circuit Breaker	Open	Tie CB of 400kV Kaithal(end)-Patran ckt-1 & 400kV Kaithal(end)-Baghpat ckt-2 opens
11:11:57:351	30ms	PATRN_P	400	08KAT2T1	Circuit Breaker	Open	Tie CB of 400kV Patran(end)-Kaithal ckt-2 & 500MVA ICT1 opens
11:11:57:351	30ms	PATRN_P	400	08KAT2T1	Circuit Breaker	Disp	
11:11:57:352	30ms	PATIALA	400kV	13PATRN2	Circuit Breaker	Open	Main CB of 400kV Patiala(end)-Patran ckt-2 opens
11:11:57:352	30ms	KAITHAL	400kV	10PATRN1	Circuit Breaker	Open	Main CB of 400kV Kaithal(end)-Patran ckt-1 opens
11:11:57:360	40ms	PATIALA	400kV	2PA1MLE	Circuit Breaker	Open	Tie CB of 400kV Patiala(end)-Patran ckt-1 & 400kV Patiala(end)-Malerkotla opens
11:11:57:362	40ms	PATIALA	400kV	1PATRN1	Circuit Breaker	Open	Main CB of 400kV Patiala(end)-Patran ckt-1 opens
11:11:59:902	2580ms	PATRN_P	400	06T2	Circuit Breaker	disturbe	
11:11:59:902	2580ms	PATRN_P	400	06T2	Circuit Breaker	Disp	
11:12:00:079	2760ms	PATRN_P	400	02PAT12	Circuit Breaker	Open	Tie CB of 400kV Patran(end)-Patiala ckt-1 & 400kV Patran(end)-Patiala ckt-2 opens
11:12:00:079	2760ms	PATRN_P	400	02PAT12	Circuit Breaker	Disp	
11:12:00:081	2760ms	PATRN_P	400	06T2	Circuit Breaker	Open	400kV side Main CB of 500MVA ICT2 at Patran opens
11:12:00:084	2765ms	PATRN_P	220	04T1	Circuit Breaker	Open	220kV side Main CB of 500MVA ICT1 at Patran opens
11:12:00:084	2765ms	PATRN_P	220	04T1	Circuit Breaker	Disp	
11:12:00:086	2765ms	PATRN_P	400	05KAT1T2	Circuit Breaker	Open	Tie CB of 400kV Patran(end)-Kaithal ckt-1 & 500MVA ICT2 opens
11:12:00:086	2765ms	PATRN_P	400	05KAT1T2	Circuit Breaker	Disp	
11:12:00:090	2770ms	PATRN_P	220	10RJLA	Circuit Breaker	Disp	
11:12:00:094	2775ms	PATRN_P	400	03PATIA1	Circuit Breaker	Open	Main CB of 400kV Patran(end)-Patiala ckt-1 opens
11:12:00:094	2775ms	PATRN_P	400	03PATIA1	Circuit Breaker	Disp	
11:12:00:095	2775ms	PATRN_P	400	07KATHL2	Circuit Breaker	Open	Main CB of 400kV Patran(end)-Kaithal ckt-2 opens
11:12:00:095	2775ms	PATRN_P	400	07KATHL2	Circuit Breaker	Disp	
11:12:00:098	2780ms	PATRN_P	400	01PATIA2	Circuit Breaker	Open	Main CB of 400kV Patran(end)-Patiala ckt-2 opens

9. As per PMU data:
    - No fault in the system

10. Patran SoE data:

#	Activation time (YT+YM)	Station	Bay	Device	Object Text	Status
131	2018-09-18 11:12:00.068	PATRAN	SUX	BCU	48V battery charger1 float on	Alarm
132	2018-09-18 11:12:00.080	PATRAN	404	BCU	Drive remote control	Alarm
133	2018-09-18 11:12:00.159	PATRAN	406	BCU	Line PT reset	Alarm
134	2018-09-18 11:12:18.652	PATRAN	403	BCU	Drive remote control	Alarm
135	2018-09-18 11:12:18.653	PATRAN	406	BCU	Drive remote control	Alarm
136	2018-09-18 11:12:00.090	PATRAN	407	PLCC	Direct Trip Send Channel-1	Normal
137	2018-09-18 11:12:00.134	PATRAN	204	BCU	Bph Trip coil-1 faulty	Normal
138	2018-09-18 11:12:00.138	PATRAN	207	BCU	Rph Trip coil-1 faulty	Normal
139	2018-09-18 11:12:00.176	PATRAN	206	BCU	DC1 fail	Normal
140	2018-09-18 11:12:00.163	PATRAN	206	BCU	Rph Trip coil-1 faulty	Normal
141	2018-09-18 11:12:00.135	PATRAN	207	BCU	Yph Trip coil-1 faulty	Normal
142	2018-09-18 11:12:00.166	PATRAN	2BB1	REB1	DC-1 Supply fail	Normal
143	2018-09-18 11:12:00.187	PATRAN	404	BCU	DC 1/2 supply fail	Normal
144	2018-09-18 11:12:18.676	PATRAN	SUX	BCU	48V battery charger2 float on	Alarm
145	2018-09-18 11:12:18.676	PATRAN	SUX	BCU	220V battery charger1 float on	Alarm
146	2018-09-18 11:12:18.676	PATRAN	SUX	BCU	220V battery charger2 float on	Alarm
147	2018-09-18 11:12:00.140	PATRAN	202	BCU	Bph Trip coil-1 faulty	Normal
148	2018-09-18 11:12:00.154	PATRAN	208	BCU	Yph Trip coil-1 faulty	Normal
149	2018-09-18 11:12:00.135	PATRAN	204	BCU	Yph Trip coil-1 faulty	Normal
150	2018-09-18 11:12:00.084	PATRAN	201	BCU	Yph Trip coil-1 faulty	Normal
151	2018-09-18 11:12:00.084	PATRAN	201	BCU	Bph Trip coil-1 faulty	Normal
152	2018-09-18 11:12:00.081	PATRAN	207	BCU	Bph Trip coil-1 faulty	Normal
153	2018-09-18 11:12:00.125	PATRAN	204	BCU	Rph Trip coil-1 faulty	Normal
154	2018-09-18 11:12:18.688	PATRAN	401	BCU	Drive remote control	Alarm
155	2018-09-18 11:12:18.688	PATRAN	203	BCU	CB Spring charged	Alarm
156	2018-09-18 11:12:18.688	PATRAN	203	BCU	LCC AC MCB trip	Alarm
157	2018-09-18 11:12:18.688	PATRAN	208	BCU	LCC AC MCB trip	Alarm
158	2018-09-18 11:12:18.689	PATRAN	405	BCU	Drive remote control	Alarm
159	2018-09-18 11:12:18.691	PATRAN	202	BCU	CB Spring charged	Alarm
160	2018-09-18 11:12:18.691	PATRAN	202	BCU	LCC AC MCB trip	Alarm
161	2018-09-18 11:12:00.188	PATRAN	208	BCU	Rph Trip coil-1 faulty	Normal
162	2018-09-18 11:12:00.169	PATRAN	208	BCU	Bph Trip coil-1 faulty	Normal
163	2018-09-18 11:12:18.691	PATRAN	408	BCU	Drive remote control	Alarm
164	2018-09-18 11:12:18.692	PATRAN	402	BCU	Drive remote control	Alarm
165	2018-09-18 11:12:18.692	PATRAN	204	BCU	CB Spring charged	Alarm
166	2018-09-18 11:12:18.693	PATRAN	409	BCU	Drive remote control	Alarm
167	2018-09-18 11:12:00.085	PATRAN	206	BCU	Bph Trip coil-1 faulty	Normal
168	2018-09-18 11:12:00.077	PATRAN	202	BCU	Yph Trip coil-1 faulty	Normal
169	2018-09-18 11:12:00.085	PATRAN	206	BCU	Yph Trip coil-1 faulty	Normal
170	2018-09-18 11:12:18.681	PATRAN	404	BCU	CB not ready	Normal

11. As per POWERGRID details:

- **Tripping time**:
  - 400 kV Kaithal Patran I & II : 18.09.2018 at 1111 Hrs
  - 400 kV Patiala Patran I & II : 18.09.2018 at 1111 Hrs

- **Restoration**:
  - 400 kV Kaithal Patran I: 1200 Hrs, 18.09.2018
  - 400 kV Kaithal Patran II: 1208 Hrs, 18.09.2018
  - 400 kV Patiala Patran I: 12:25 Hrs, 18.09.2018
  - 400 kV Patiala Patran II: 1226 Hrs, 18.09.2018

12. As per POWERGRID report, 400 kV Kaithal Patran I & II and Patiala Patran I & II tripped due to DT received at Patiala and Kaithal End. DT received due to blackout of Patran substations.
13. POWERGRID & PTCL details received within 24hrs

PTCL representative informed during the meeting:

1. Exact reason of tripping of elements: *400 kV Patran station is GIS station. DC supply for DC source-1 was inadvertently off during maintenance work.*
2. Failure of both DC sources simultaneously: *Only DC source-1 failed and Gas Density (GD) monitor installed at 400 kV GIS have only one DC supply.*
3. Whether DC supply failed or it was a case of DC source mixing and earth fault: *DC supply for DC source-1 was inadvertently off during maintenance work. It was a human error.*
4. Whether 220 kV Lines tripped or not: *220 kV lines didn't trip. At 220 kV side GD monitor have supply from two DC source with changeover scheme.*
5. DRs needs to be sent in CFG format: *Later on DR in .cfg format sent separately*
6. Detailed report, remedial measures report needs to be submitted by PTCL.

PTCL representative further informed that SF-6 Gas Density (GD) monitor installed in 400 kV side (ABB make) of 400/220 kV Patran (GIS) station have only one DC source supply and that is also failed due to manual error. DC source supply fed to GD through Nc (Normally closed) signal and it send tripping command to all the breaker in case of opening of Nc contact or DC supply failure. Issue has been taken up with OeM for providing two DC source supply to Gas Density monitor for increased redundancy and reliability.

POWERGRID representative suggested that in case of failure of both DC supply to the GD, bus bar protection/tripping should not extend to the breaker. Substation should not trip in case of failure of both DC supply to the GD. In GIS, all of the sudden pressure will not go down upto lockout level, first it will send alarm for low gas pressure so in case of failure of both DC supply to GD, DC supervision relay send the alarm to the operator for further action and it should not trip the breakers. Scheme should be self-supervisory in nature and tripping contact should be picked up only in case of actual tripping condition. In POWERGRID, for the alarm purpose Nc (Normally closed) contact and for tripping purpose No (Normally open) contact shall be used in the scheme.

PTCL may further discuss with OeM and explore the possibility. PTCL shall share the information to NRPC/ NRLDC.

NRLDC representative also raised concern about complete outage of 400 kV station due to DC supply failure and supported the view of POWERGRID. In case of tripping on low gas pressure in GIS chamber if leakage is after the breaker than scheme shall send the tripping command to remote end of the GIS station.

D. Multiple element tripping at 400/220 kV Fatehpur (PG) at 12:17hrs of 29th Sep 2018

Event category: GD-1
Generation loss: Nil (UP may confirm)
Loss of load: 220 MW (UP may confirm)
Energy Loss: 0.077MU (UP may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	560ms	
Phase of the fault	PMU data	Y-N fault	

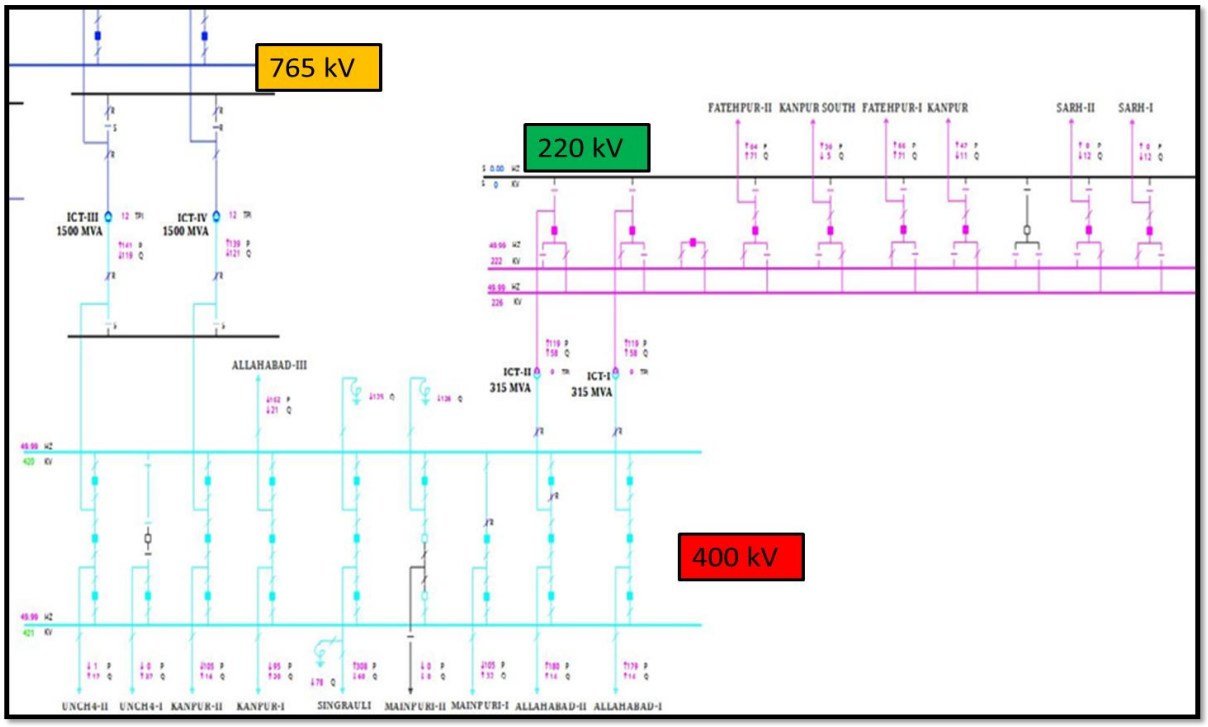
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	POWERGRID	Available	
DR/EL	POWERGRID	Not Received	
Preliminary Report	POWERGRID	Not Received	
Detailed Report	POWERGRID	Not Received	

Description	Clauses	Utility	Remarks

Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	**POWERGRID**	1. Preliminary Report, DR/EL and detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

1. Single Line Diagram of 400/220 kV Fatehpur (PG):



2. 400 kV Fatehpur (PG) is connected with Allahabad (PG) triple ckt, Kanpur D/C, Unchahar D/C, Mainpuri PG D/C and Singrauli S/C. It also has two 315MVA 400/220 kV & two 1500MVA 765/400 kV ICT. It has one and half breaker scheme at 400 kV & 765 kV voltage level.
3. It seems there was fault in 220 kV downward network at 400/220 kV Fatehpur (PG)

4. 315 MVA ICT 1 & ICT 2 at 765kV/400/220kV Fatehpur(PG) tripped due to operation of directional earth fault.
5. At the same time other 400kV lines and 1500 MVA ICT 3 & ICT 4 also tripped.
6. In antecedent conditions, 1500 MVA ICT 3 & ICT 4 carrying 141 MW & 139 MW respectively.
7. Name of the tripped elements are as below:
    - 400 kV Allahabad(PG)-Fatehpur(PG) ckt-1
    - 400 kV Allahabad(PG)-Fatehpur(PG) ckt-2
    - 400 kV Allahabad(PG)-Fatehpur(PG) ckt-3
    - 400 kV Fatehpur(PG)-Mainpuri(PG) ckt-1
    - 400 kV Fatehpur(PG)-Singrauli(PG)
    - 315 MVA ICT 1 & ICT 2 at 765kV/400kV Fatehpur(PG)
    - 1500 MVA ICT 3 & ICT 4 at 765kV/400kV Fatehpur(PG)
    - 220 kV Fatehpur(PG)-Fatehpur(UP) ckt-1

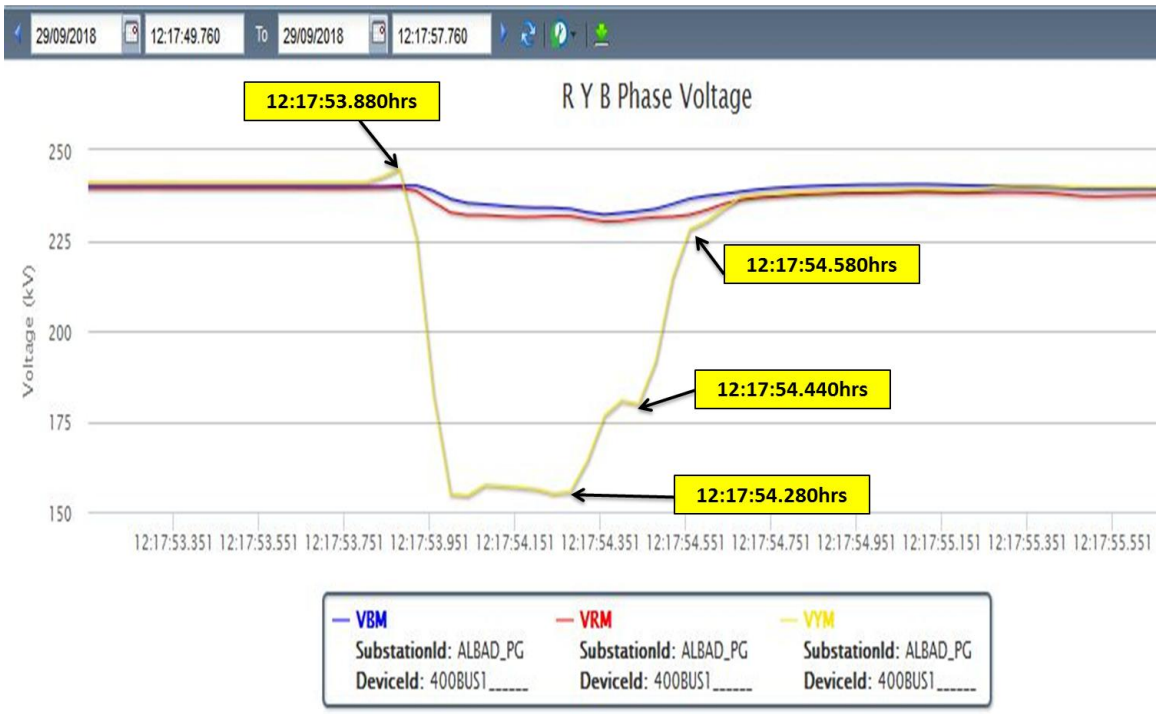
8. PMU plots:

PMU Plot of frequency at Bassi(PG)

12:18hrs/29-Sep-18

PMU Plot of phase voltage magnitude at Allahabad(PG)

12:18hrs/29-Sep-18

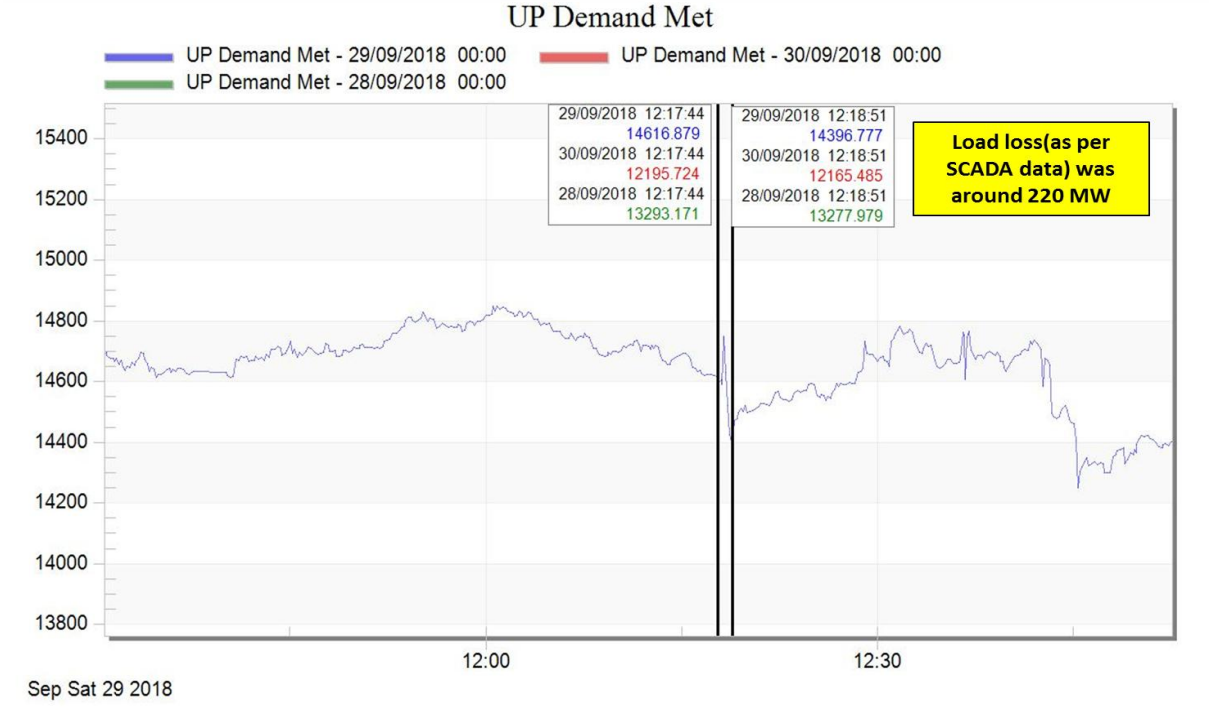


9. As per SCADA data:

Time	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
12:17:53:880	**0ms**	**PMU data**					**Reference Time**
12:17:54:016	135ms	FATEHPUR	400kV	32T4TIE	Circuit Breaker	disturbe	
12:17:54:022	140ms	FATEHPUR	400kV	32T4TIE	Circuit Breaker	Open	400kV side Tie CB of 1500MVA ICT 4 opens.
12:17:54:487	605ms	MAINPURI	400kV	9FATPR1	Circuit Breaker	Open	
12:17:54:496	615ms	FATEHPUR	400kV	21SINGR	Circuit Breaker	disturbe	
12:17:54:503	625ms	FATEHPUR	400kV	20R2SIN	Circuit Breaker	Open	Tie CB of 400kV Fatehpur(end)-Singrauli & Reactor opens.
12:17:54:504	625ms	FATEHPUR	400kV	15MAINP1	Circuit Breaker	disturbe	
12:17:54:506	625ms	FATEHPUR	400kV	15MAINP1	Circuit Breaker	Open	Main CB of 400kV Fatehpur(end)-Mainpuri ckt-1 opens
12:17:54:507	625ms	FATEHPUR	400kV	14MAINP1	Circuit Breaker	Open	Tie CB of 400kV Fatehpur(end)-Mainpuri ckt-1 opens
12:17:54:508	630ms	FATEHPUR	400kV	21SINGR	Circuit Breaker	Open	Main CB of 400kV Fatehpur(end)-Singrauli opens.
12:17:54:510	630ms	FATEHPUR	400kV	11T2AL2	Circuit Breaker	disturbe	
12:17:54:513	635ms	FATEHPUR	400kV	8T1AL1	Circuit Breaker	Open	Tie CB of 315 MVA ICT 1 & 400kV Fatehpur(end)-Allahabad ckt-1 opens.
12:17:54:513	635ms	FATEHPUR	400kV	8T1AL1	Circuit Breaker	disturbe	
12:17:54:513	635ms	FATEHPUR	400kV	9ALBAD1	Circuit Breaker	disturbe	
12:17:54:515	635ms	FATEHPUR	400kV	9ALBAD1	Circuit Breaker	Open	Main CB of 400kV Fatehpur(end)-Allahabad ckt-1 opens.

Time	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
12:17:54:520	640ms	FATEHPUR	400kV	11T2AL2	Circuit Breaker	Open	Tie CB of 315 MVA ICT 2 & 400kV Fatehpur(end)-Allahabad ckt-2 opens.
12:17:54:574	695ms	MAINPURI	400kV	8T1FA1	Circuit Breaker	Open	
12:17:54:588	710ms	FATEHPUR	765kV	5T4GA2	Circuit Breaker	Open	765kV side Tie CB of 1500MVA ICT 4 opens.
12:17:54:611	730ms	FATEHPUR	400kV	25T3	Circuit Breaker	disturbe	
12:17:54:615	735ms	FATEHPUR	765kV	3T3	Circuit Breaker	disturbe	
12:17:54:624	745ms	FATEHPUR	400kV	26T3KA2	Circuit Breaker	disturbe	
12:17:54:629	750ms	FATEHPUR	765kV	3T3	Circuit Breaker	Open	765kV side Main CB of 1500MVA ICT 3 opens.
12:17:54:631	750ms	FATEHPUR	400kV	25T3	Circuit Breaker	Open	400kV side Main CB of 1500MVA ICT 3 opens.
12:17:54:634	755ms	FATEHPUR	400kV	26T3KA2	Circuit Breaker	Open	400kV side Tie CB of 1500MVA ICT 3 opens.
12:17:54:760	880ms	FATEHPUR	765kV	2T3GA1	Circuit Breaker	Open	765kV side Tie CB of 1500MVA ICT 3 opens.
12:17:54:996	1115ms	FATEHPUR	400kV	12ALBAD2	Circuit Breaker	Open	Main CB of 400kV Fatehpur(end)-Allahabad ckt-2 opens.
12:17:55:469	1590ms	FATEHPUR	220kV	9KANPS	Circuit Breaker	Open	

UP Demand pattern during tripping

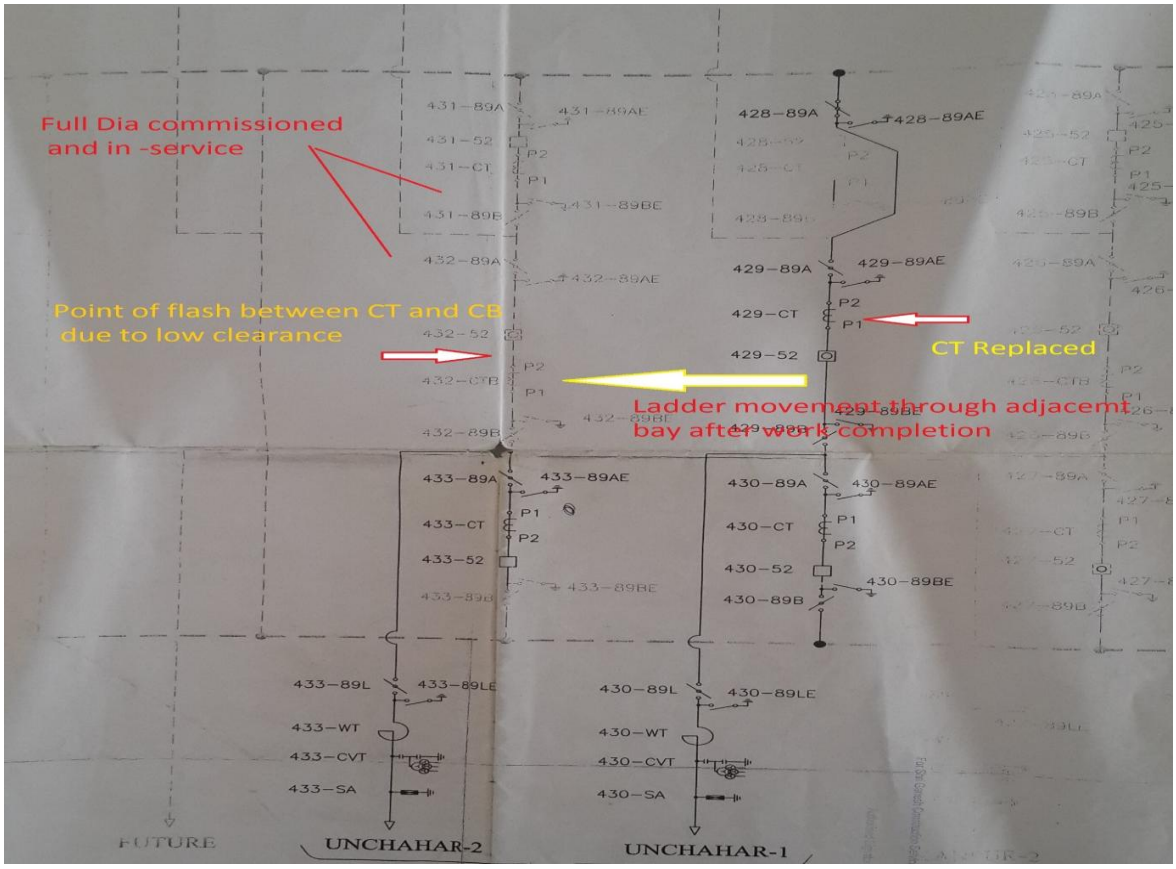


10. As per PMU & SCADA data:
    - As per PMU, maximum dip in Y-phase.
    - Fault Clearance time: **520ms**
    - SoE captured, it seems all the 400kV elements tripped with some time interval.
    - 765/400 kV ICT tripped after fault clearance

11. Preliminary Report, DR/EL and detailed report is still awaited from POWERGRID.

POWERGRID representative informed during the meeting:

1. Exact location of fault and nature of fault: *The work of replacement of CTs was being carried out in 400 kV Unchahar-1 – Future Tie bay, which is adjacent to 400KV Unchahar-2 – ICT-2 Tie bay in which fault has occurred. Erection of CTs was completed and manpower and T&P was being removed from the site. An Extendable Aluminium Ladder was used during erection of CTs and the same was also being shifted to one side by hired Maintenance Assistance Fitter. The Fitter was instructed to pull the ladder from Gravelled area to Road. However, as informed by Fitter, he misunderstood the instruction and thought that he has to shift the Ladder outside the Switchyard and started moving the Ladder towards 400KV Unchahar-2 – ICT-2 Tie bay and reached near to middle phase before anybody from POWERGRID could react.*



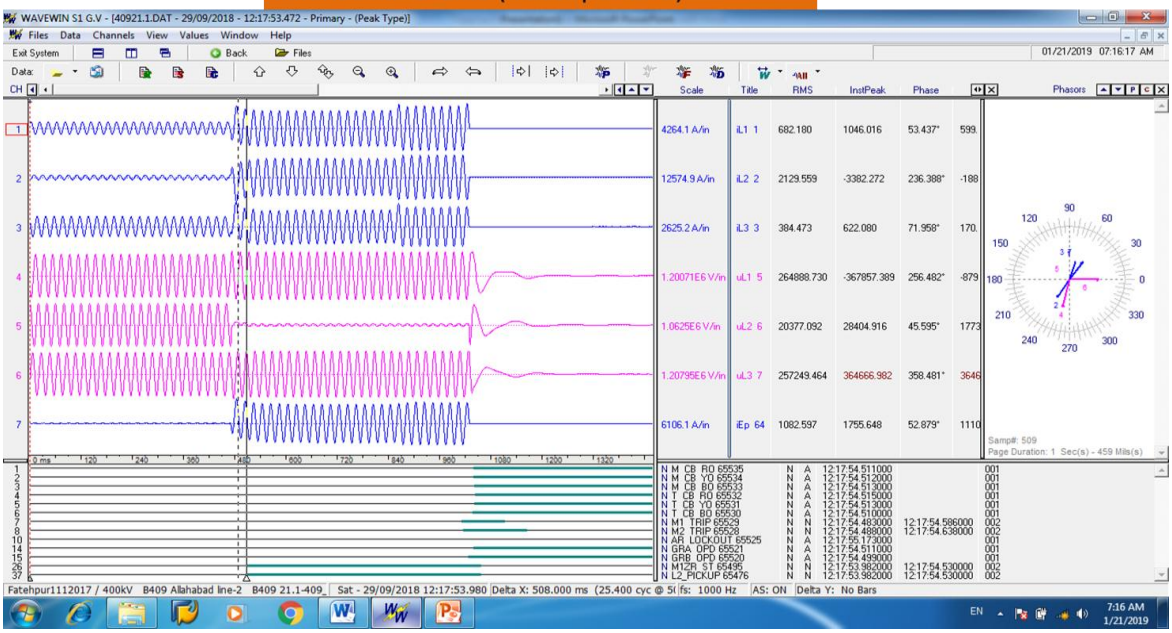
Location of fault given at picture-1 and physical measurement of incident occurred depicted at picture-2

2. Sequence of tripping needs to be reported and explained.
3. Reason of delayed clearance of fault: *As it is seen from the picture-1 that the fault was occurred in the vicinity of the charged Y phase of above 400KV Unchahar-2 – ICT-2 Tie bay, therefore the ICT-2 tripped on Teed Differential. However, the Unchahar Line not tripped as no fault current fed from Unchahar Substation because the line was charged in radial mode. Main CB of Unchahar-2 Line not tripped on Reverse Zone since no fault current fed from line. Therefore, the fault current sustained till isolation of fault approximately for 500ms. However, the LBB of Tie CB must have operated to trip the Main CB of Unchahar-2 to isolate the faulty section.*
4. Reason of multiple elements tripping at Fatehpur (PG): *As LBB protection was not operated for tie CB, all the elements tripped in reverse zone/Z-2 except 765/400 kV ICT-1 at Fatehpur (PG).*
5. Reason of tripping of 765/400 kV ICTs at Fatehpur (PG). ICTs tripped after fault clearance: *765/400 kV ICT-2 tripped on instantaneous*

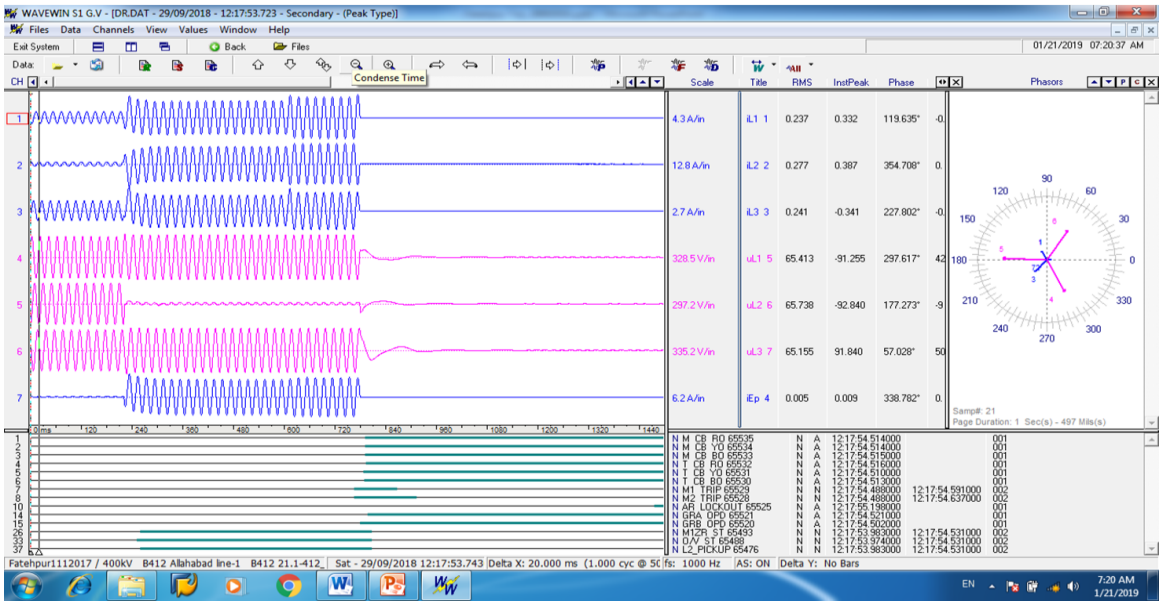
differential protection. 765/400 kV ICT-1 at Fatehpur (PG) tripped on back up over current earth fault protection

6. Protection co-ordination for 400/220 kV ICTs and 400 kV transmission elements: *Protection co-ordination is checked and found ok.*
7. Protection co-ordination of 765/400 kV ICTs at Fatehpur (PG): *Protection co-ordination is checked and found ok.*
8. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by POWERGRID: *Extract of DR/EL is as below-*

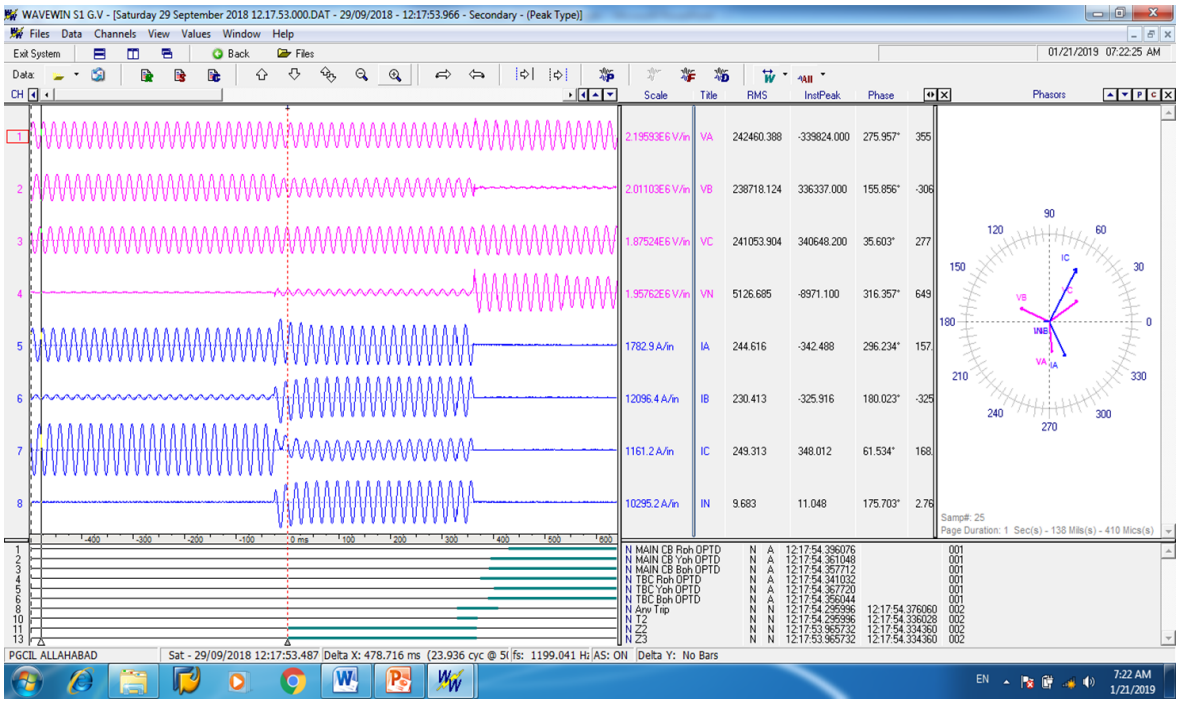
Allahabad -1 Line (Fatehpur End)



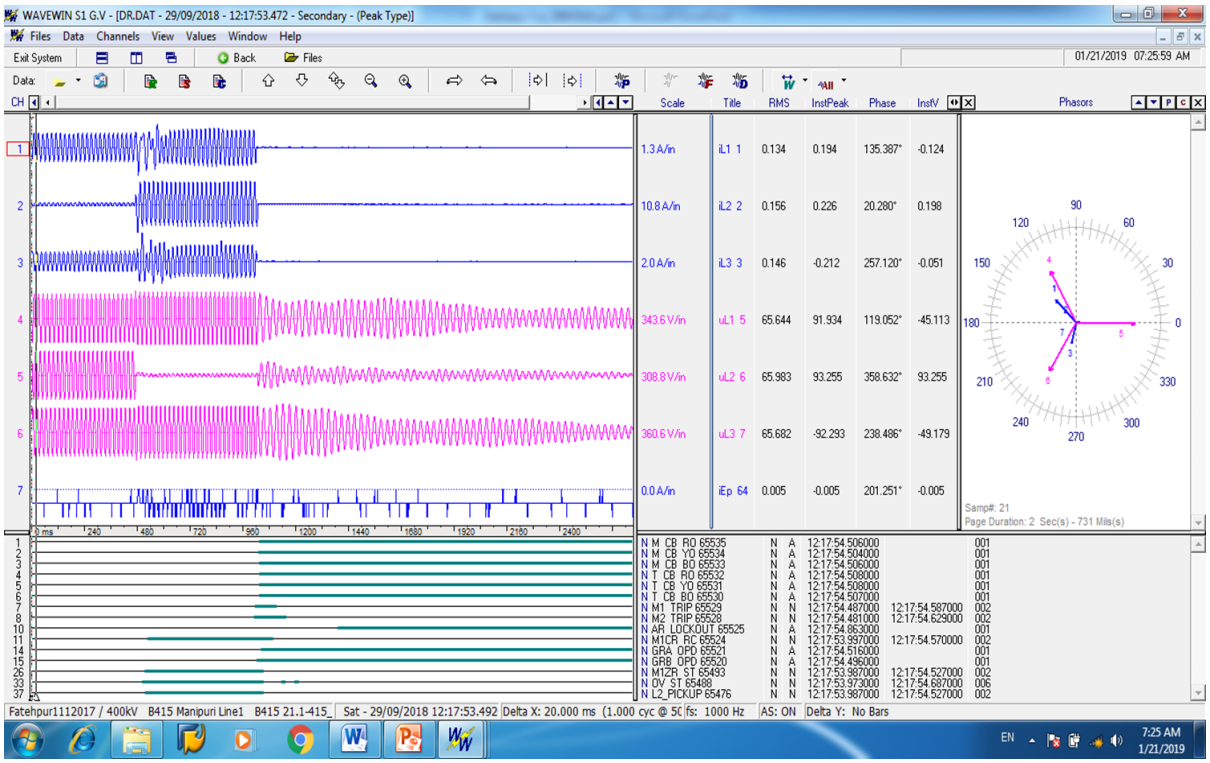
Allahabad -2 Line (Fatehpur End)



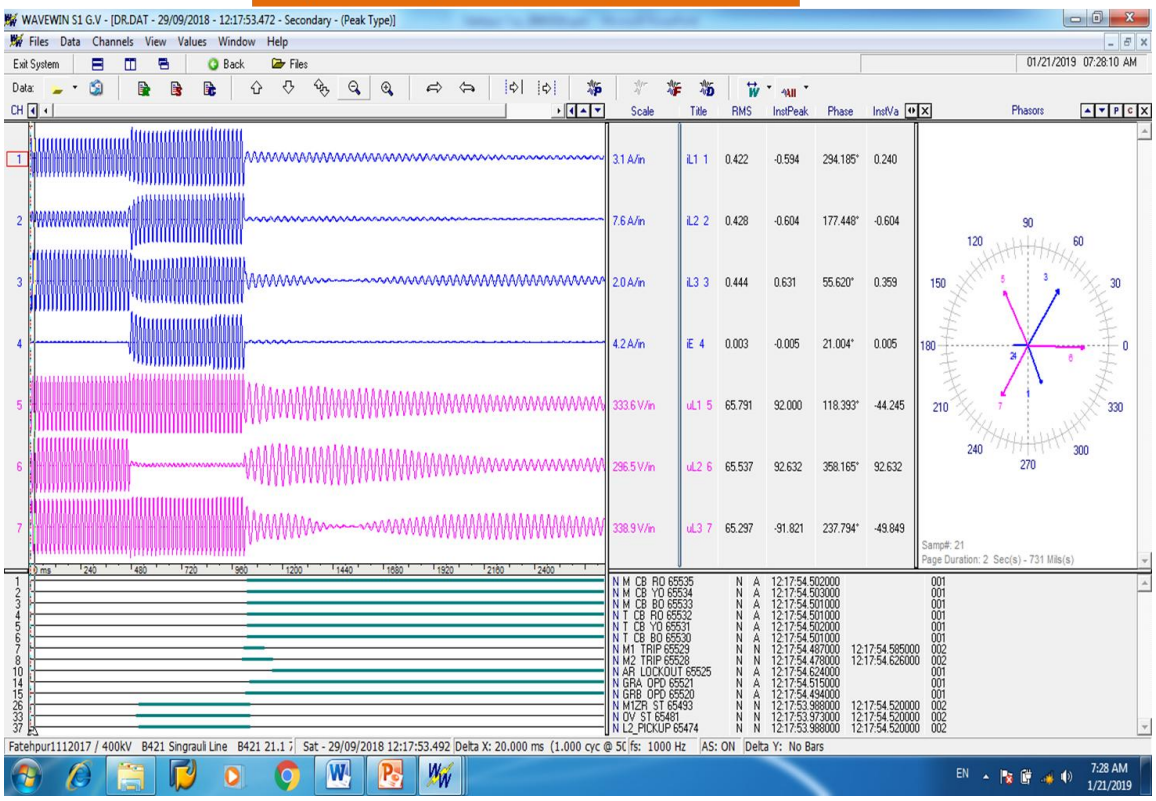
Allahabad -3 Line (Allahabad End)



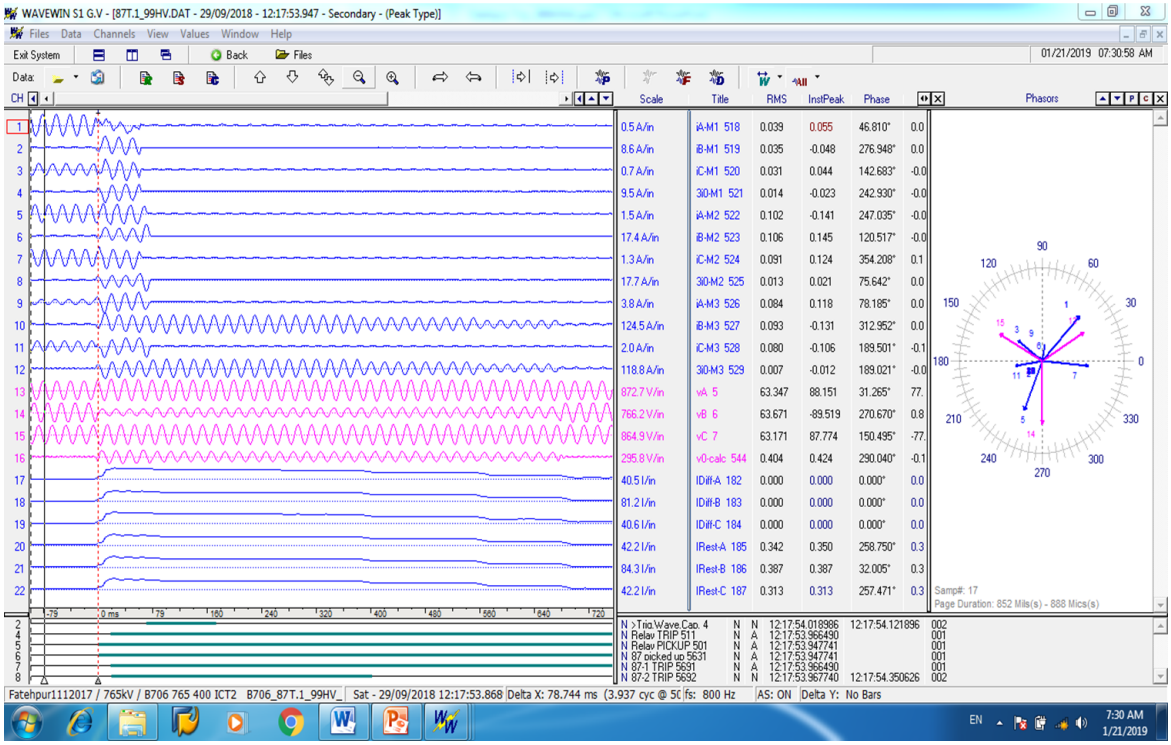
Mainpuri-1 Line (Fatehpur End)



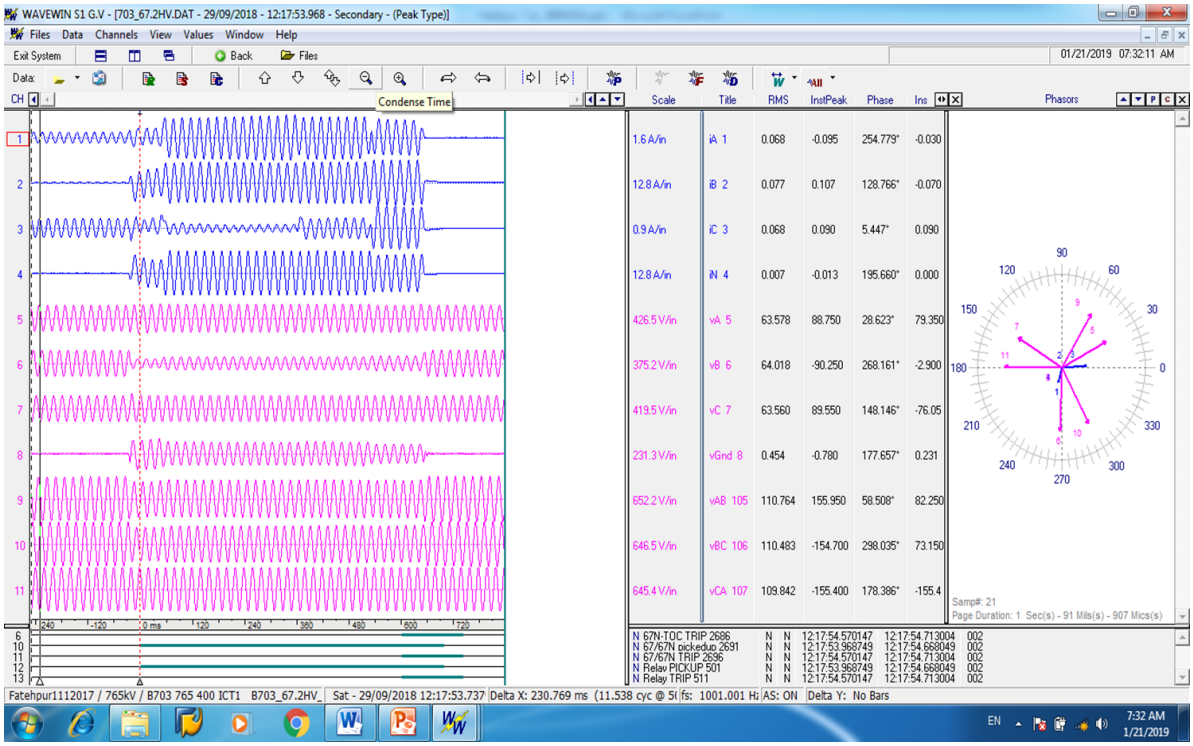
Singrauli Line (Fatehpur End)



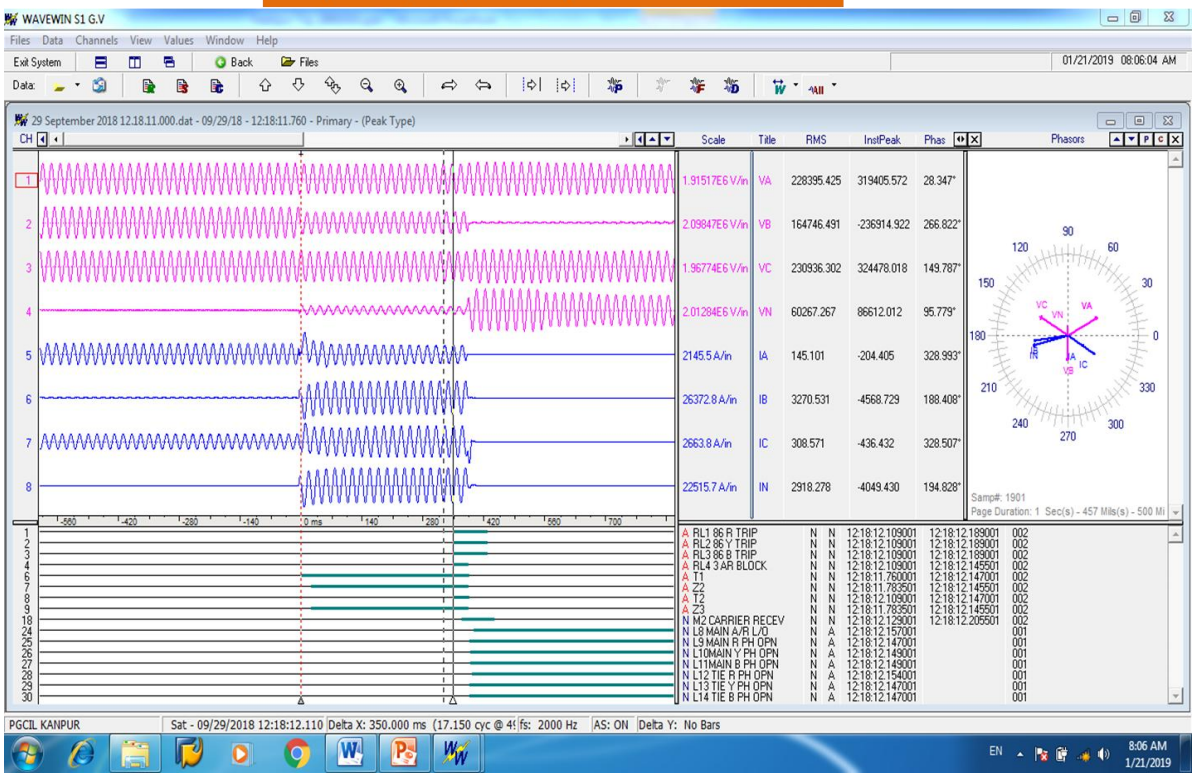
765/400kV ICT-2 (Fatehpur End): Instantaneous tripping on differential protection



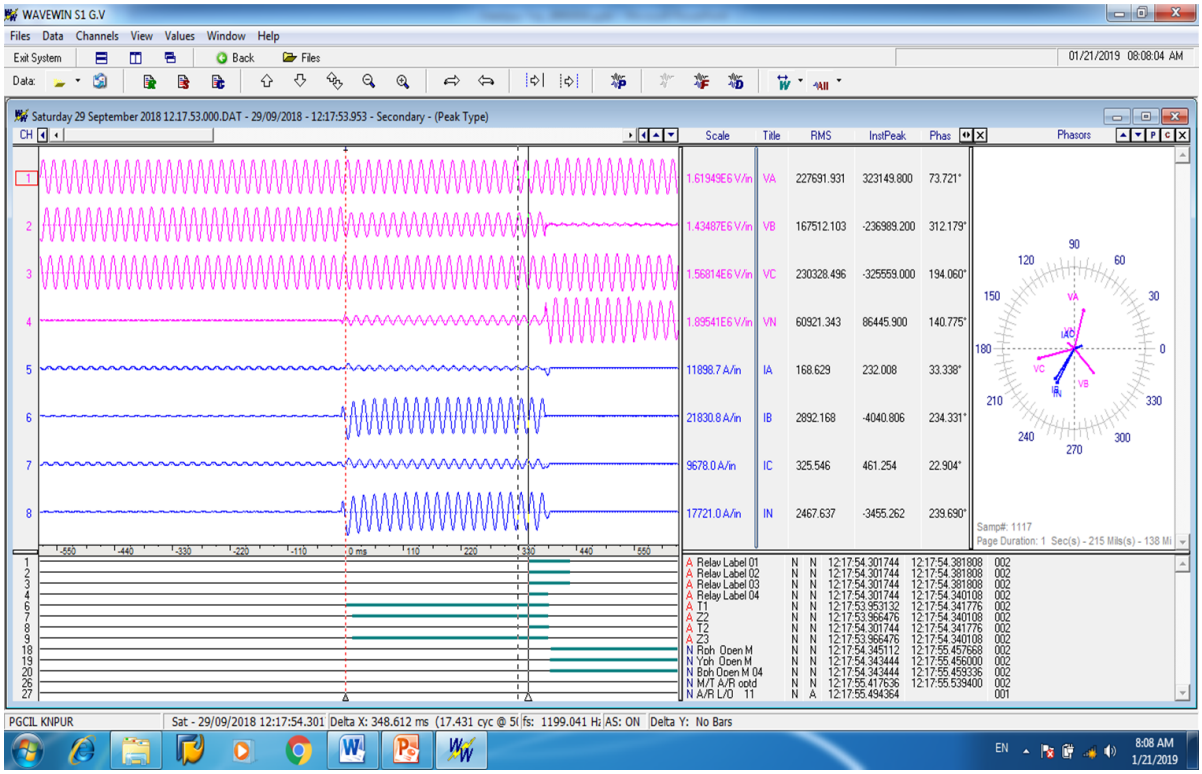
765/400kV ICT-1 (Fatehpur End): Tripped on back up earth fault protection



Kanpur-2 (Kanpur End)



Kanpur-1 (Kanpur End)



Multiple Element Tripping at POWERGRID Fatehpur Substation on 29.09.2018

Brief History of Events:

On Date 29.09.2018, 12:17 hrs. Following Lines and ICTs tripped at Fatehpur 765/400/220KV Substation:

Tripped from Fatehpur (PG) End:

400KV Fatehpur – Allahabad – 1
400KV Fatehpur – Allahabad – 2
400KV Fatehpur – Mainpuri – 1
400KV Fatehpur-Singrauli
765/400KV ICT-1
765/400KV ICT-2

Tripped from Remote Ends Only:

400KV Fatehpur – Allahabad – 3
400KV Fatehpur – Kanpur – 1
400KV Fatehpur – Kanpur – 2

Element Out of Service in Precedent Condition:

400KV Fatehpur – Mainpuri – 2 on Over-Voltage Regulation

Action Taken by POWERGRID:

- It was evident from DRs of the above trippings that the relays have functioned as per scheme and settings except LBB of the Tie CB.
- LBB relay (SIPROTECH- 7SS252) of 400KV Unchahar-2 – ICT-2 Tie was later found to be faulty when tested and same was replaced.

E. Multiple Element tripping at 400/220kV Obra-B TPS at 04:37hrs of 14th Oct 2018

Event category: GD-1
Generation loss: 400MW (As per UP report)
Loss of load: 160MW (As per UP report)
Energy Loss: 0.22 MU

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	No fault	
Phase of the fault	PMU data	NA	

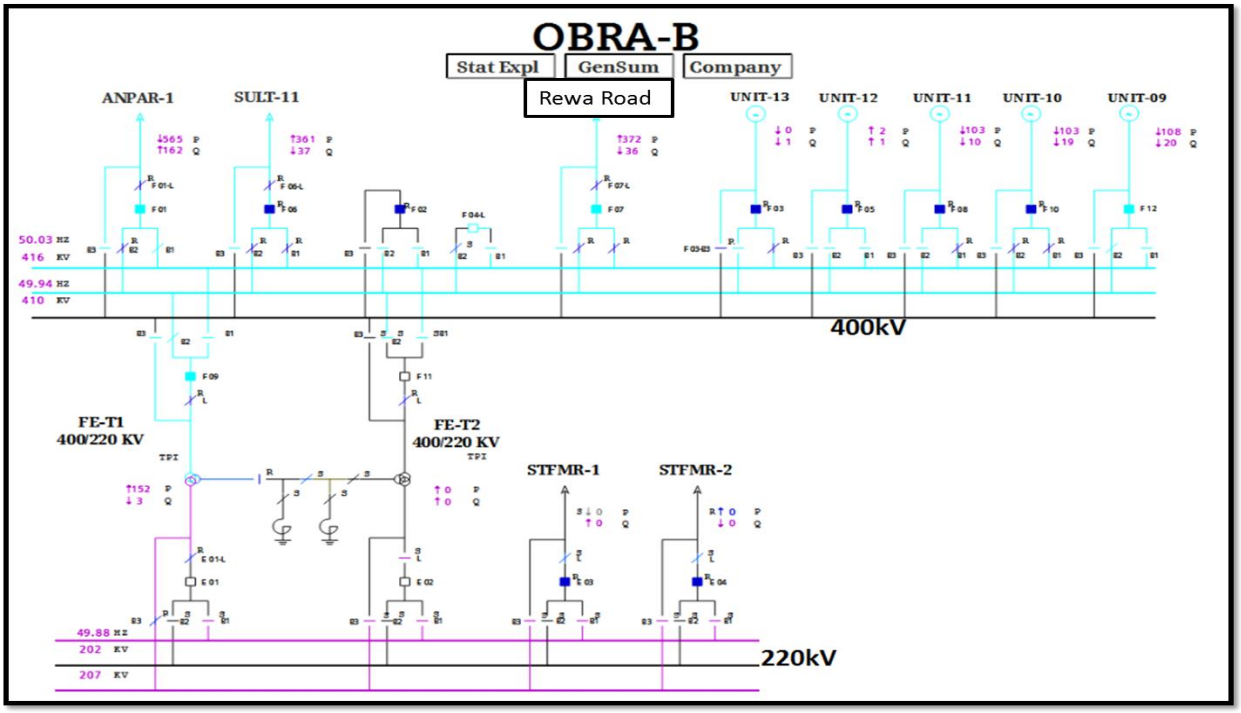
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	
DR/EL	Uttar Pradesh	Not Received	
Preliminary Report	Uttar Pradesh	Received	Within 24hrs
Detailed Report	Uttar Pradesh	Not Received	

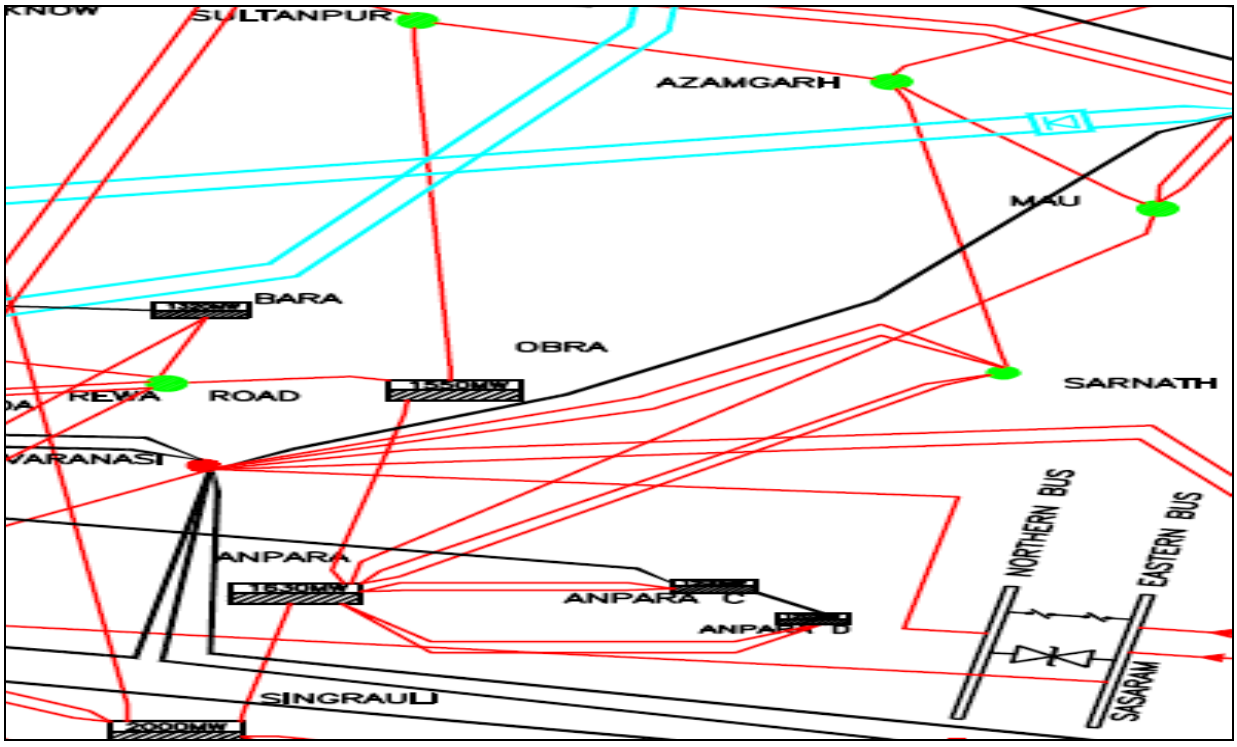
Description	Clauses	Utility	Remarks

Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA Grid Standard 15.3 3. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 4. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) 5. CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	**Uttar Pradesh**	1. Detailed Report yet to be received 2. DR/EL yet to be received 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

1. Single Line Diagram of Obra-B TPS:





2. 400 kV Obra-B TPS is connected with Anpara TPS S/C, Rewa Road S/C and Sultanpur S/C. It also has five units of 200MW and two 400/220kV 240MVA ICTs. It has DMT (double main transfer breaker) bus bar scheme.
3. At 04:37hrs of 14th Oct 2018, 220/6.6 kV 30MVA station Transformer-I&II tripped on fault due to fire in cable gallery. It further resulted into running unit number 9,10,11 & 12 each of 200MW.
4. Fault was not captured in PMU at the time of multiple element tripping.
5. 400/220 kV 315MVA ICT-I&II, 400 kV Obra-Sultanpur & 400 kV Obra-Rewa Road ckt also tripped at the same time.
6. 400 kV Obra-Anpara ckt also manually opened at 04:43hrs.
7. Name of the tripped elements are as below:
    - 400 kV Obra-B(UP)-Rewa road(UP)
    - 400 kV Obra-B(UP)-Sultanpur(UP)
    - 315 MVA ICT-1 at 400/220kV Obra-B(UP)
    - 315 MVA ICT-2 at 400/220kV Obra-B(UP)
    - Unit -9 (200 MW) at 400/220kV Obra-B(UP)
    - Unit -10 (200 MW) at 400/220kV Obra-B(UP)
    - Unit -11 (200 MW) at 400/220kV Obra-B(UP)
    - 220 kV/ 6.6 kV, 30 MVA Station transformer at 400/220kV Obra-B(UP)

8. In antecedent condition:
    - 400/220 kV 240MVA ICT-2 of Obra-B TPS was already under outage
    - 220/132 kV 100MVA ICT-3 at Obra A TPS was already under outage

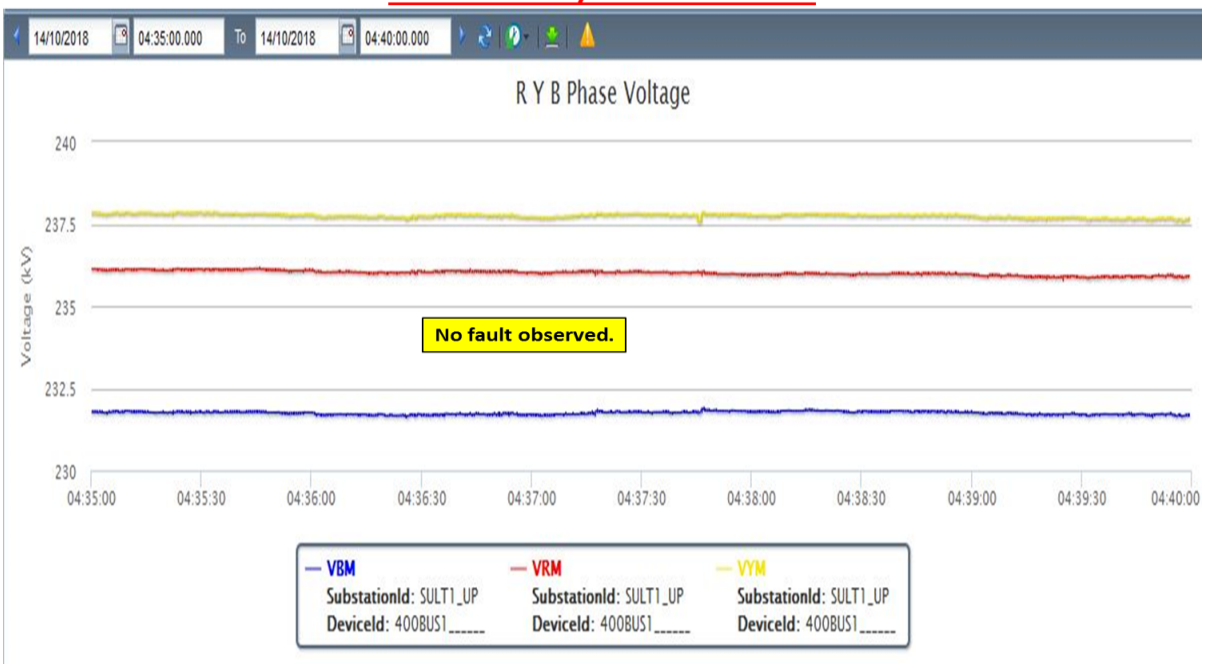
9. PMU plots:

PMU Plot of frequency at Bassi(PG)

04:37hrs/14-Oct-18

PMU Plot of phase voltage magnitude at Sultanpur(UP)

04:37hrs/14-Oct-18



PMU Plot of phase voltage magnitude at Obra B TPS (UP)

04:37hrs/14-Oct-18

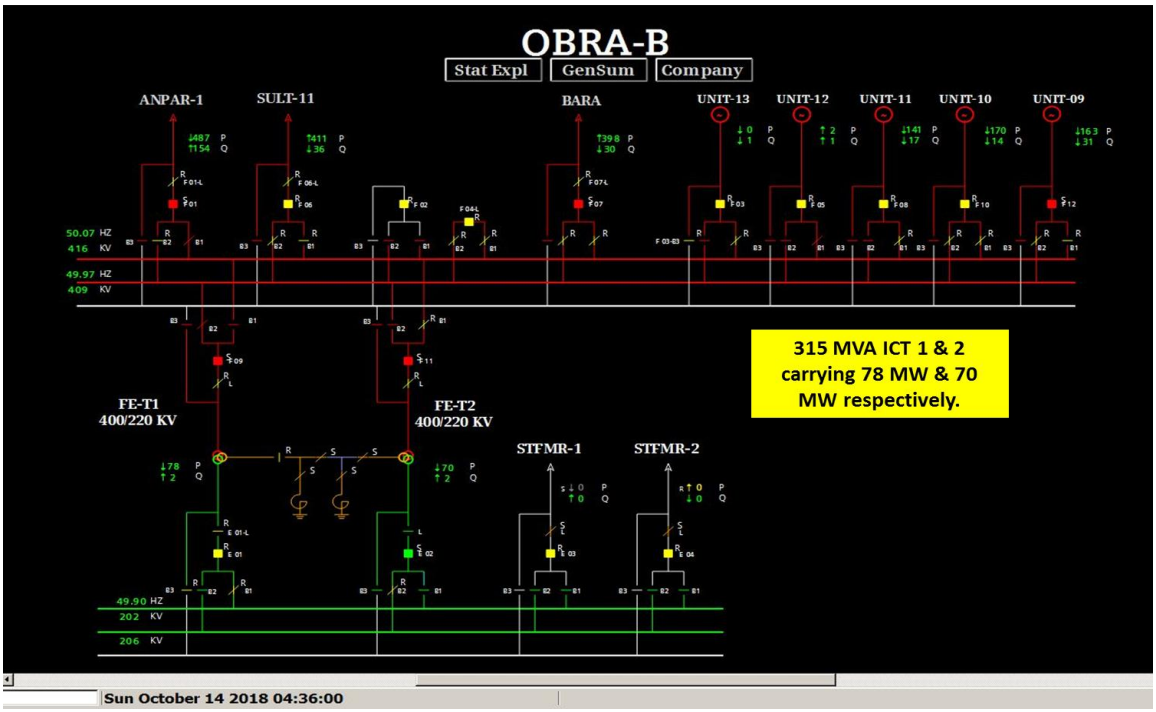
PMU Plot of phase voltage magnitude at Obra B TPS (UP)

04:43hrs/14-Oct-18

10. As per SCADA data:

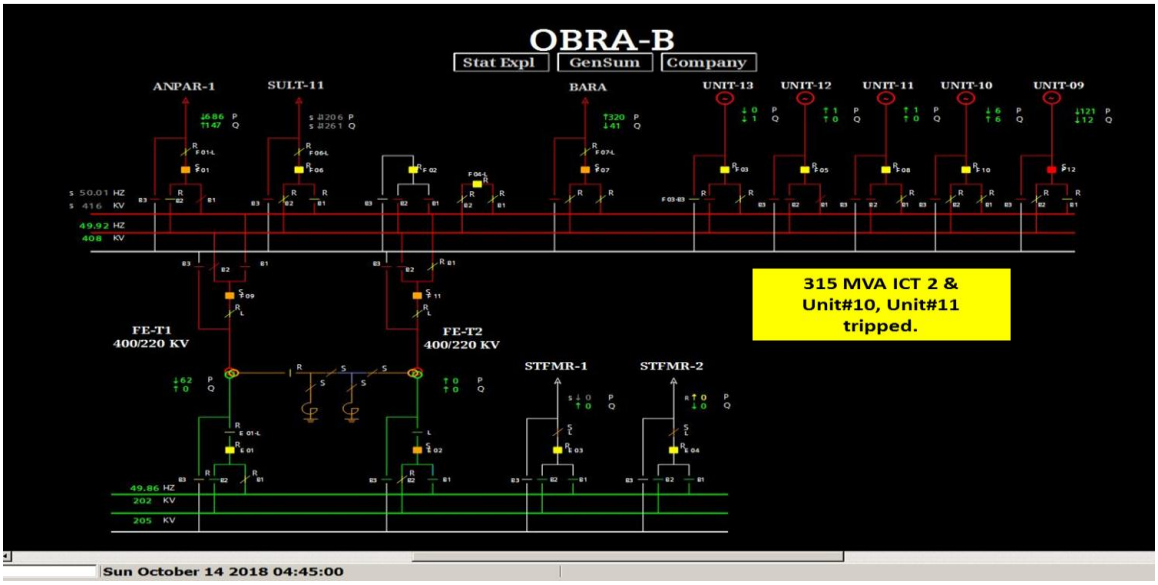
SLD of 400/220kV Obra(UP) before the incident

04:36hrs/14-Oct-18



SLD of 400/220kV Obra(UP) after the incident

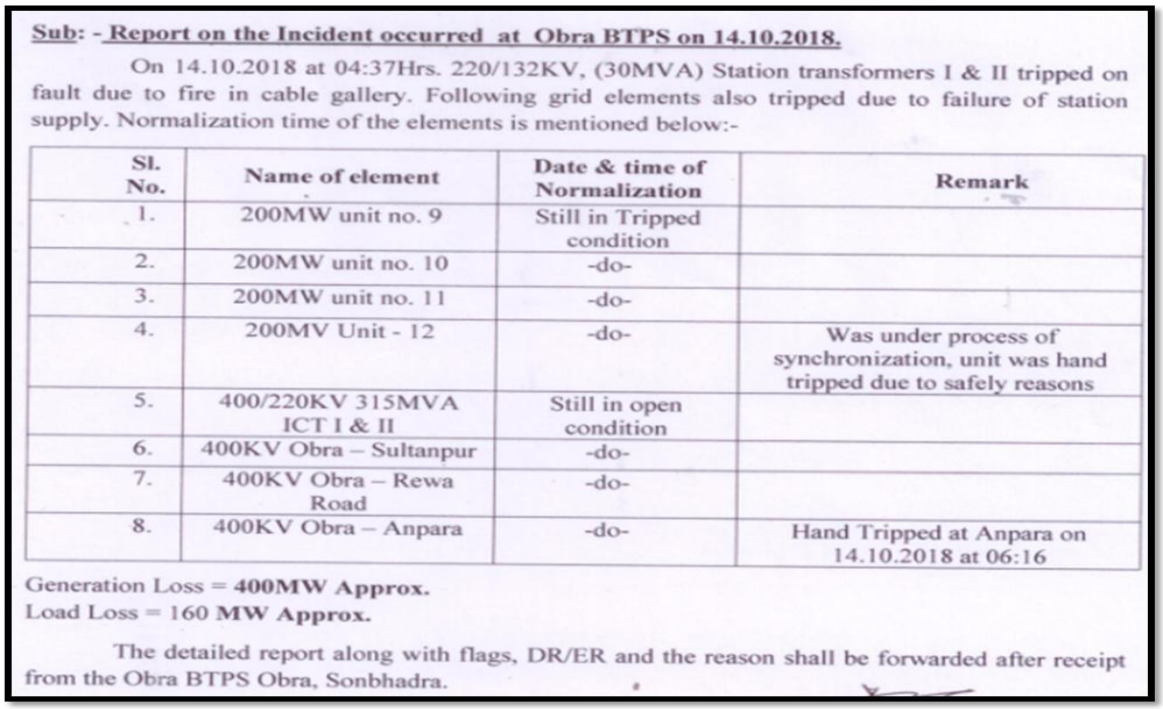
04:45hrs/14-Oct-18



11. As per PMU and SCADA data:
    - As per PMU, no fault in the system.
    - Fault Clearance time: **Not Applicable**

- No SoE captured

12. As per UP Report:



Sub: - Report on the Incident occurred at Obra BTPS on 14.10.2018.

On 14.10.2018 at 04:37Hrs. 220/132KV, (30MVA) Station transformers I & II tripped on fault due to fire in cable gallery. Following grid elements also tripped due to failure of station supply. Normalization time of the elements is mentioned below:-

Sl. No.	Name of element	Date & time of Normalization	Remark
1.	200MW unit no. 9	Still in Tripped condition	
2.	200MW unit no. 10	-do-	
3.	200MW unit no. 11	-do-	
4.	200MV Unit - 12	-do-	Was under process of synchronization, unit was hand tripped due to safely reasons
5.	400/220KV 315MVA ICT I & II	Still in open condition	
6.	400KV Obra – Sultanpur	-do-	
7.	400KV Obra – Rewa Road	-do-	
8.	400KV Obra – Anpara	-do-	Hand Tripped at Anpara on 14.10.2018 at 06:16

Generation Loss = **400MW Approx.**
Load Loss = 160 **MW Approx.**

The detailed report along with flags, DR/ER and the reason shall be forwarded after receipt from the Obra BTPS Obra, Sonbhadra.

13. Multiple element tripping without any fault in the system is serious cause of concern and it shall be prevented for reliable and secure grid operation.
14. Preliminary Report has been received but DR/EL, detailed report and remedial measures report is still awaited from UPPTCL.

Points for Discussion:

1. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
2. Exact location of fault and nature of fault.
3. Sequence of tripping needs to be reported and explained.
4. Reason of multiple element tripping without any fault in the system.
5. Arrangement of station auxiliary supply and its back up at 400/220 kV Obra-B TPS to be shared. Also reason of tripping of all running units needs to be explained.
6. Reason of tripping of 400 kV transmission line (400 kV Obra-Rewa Road and 400 kV Obra-Sultanpur ckt) needs to be reviewed.
7. Availability of time synchronized SCADA SoE to be checked and corrected.
8. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL.

No representative from UPRVUNL presented during the meeting.

NRPC raised concern about absence of concerned person from constituents specially from generation side and requested all the STU/SLDC to share the feedback with generators.

NRPC would also write letter to all the heads of state generating companies for presence in the various RPC meeting.

F. Complete outage of 220 kV Kota TPS and Sakatpura (Raj) at 21:00hrs of 20th Oct and 14:26hrs of 13th Nov 2018.

Event category: GD-1

Generation loss:
850 MW (20.10.18)
700 MW (13.11.18)

Loss of load:
150 MW (20.10.18)
250 MW (13.11.18)

Energy Loss: Rajasthan may confirm about energy loss
Nil MU (20.10.18)
Nil MU (13.11.18)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	840ms	20.10.2018
		1160ms	13.11.2018
Phase of the fault	PMU data	R&B-phase to earth fault	20.10.2018
		Three phase fault	13.11.2018

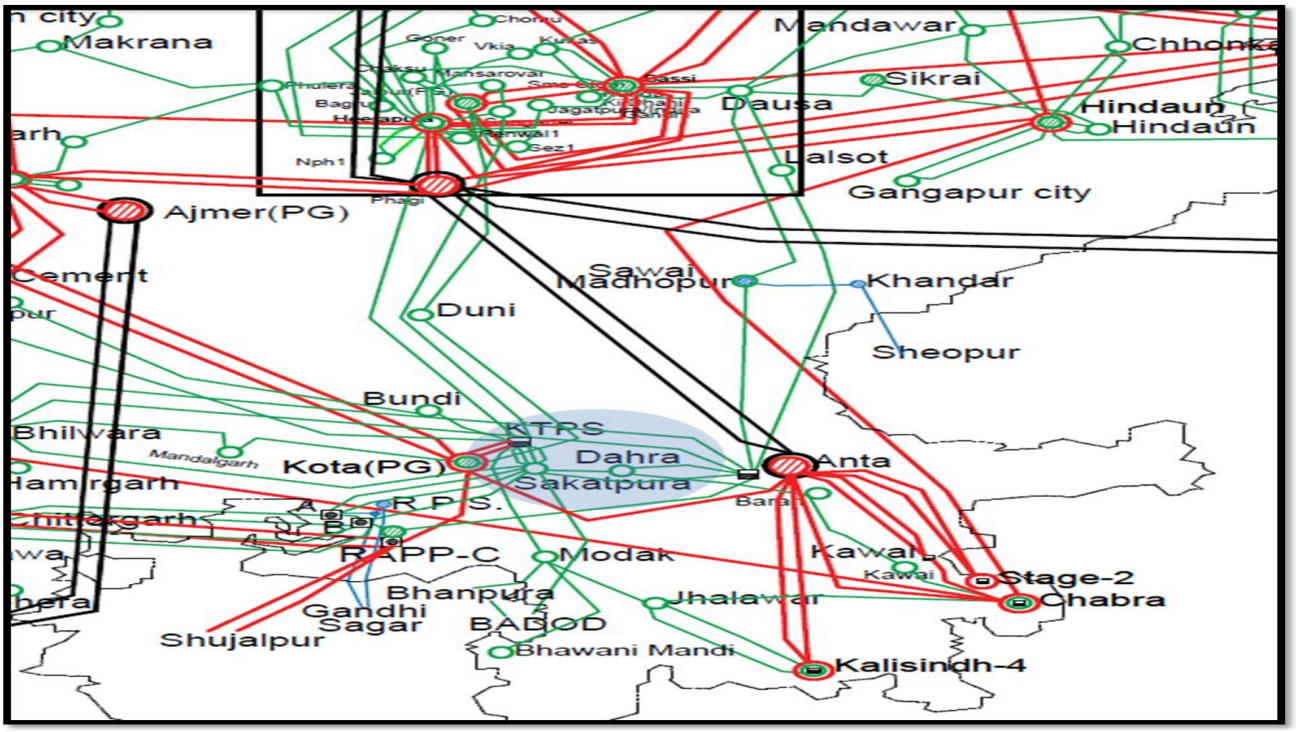
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Available (Partial)	20.10.2018
			13.11.2018

DR/ EL	Rajasthan	Received (Partial)	20.10.2018
			13.11.2018
Preliminary Report	Rajasthan	Received	20.10.2018
			13.11.2018
Detailed Report	Rajasthan	Not Received	20.10.2018
			13.11.2018

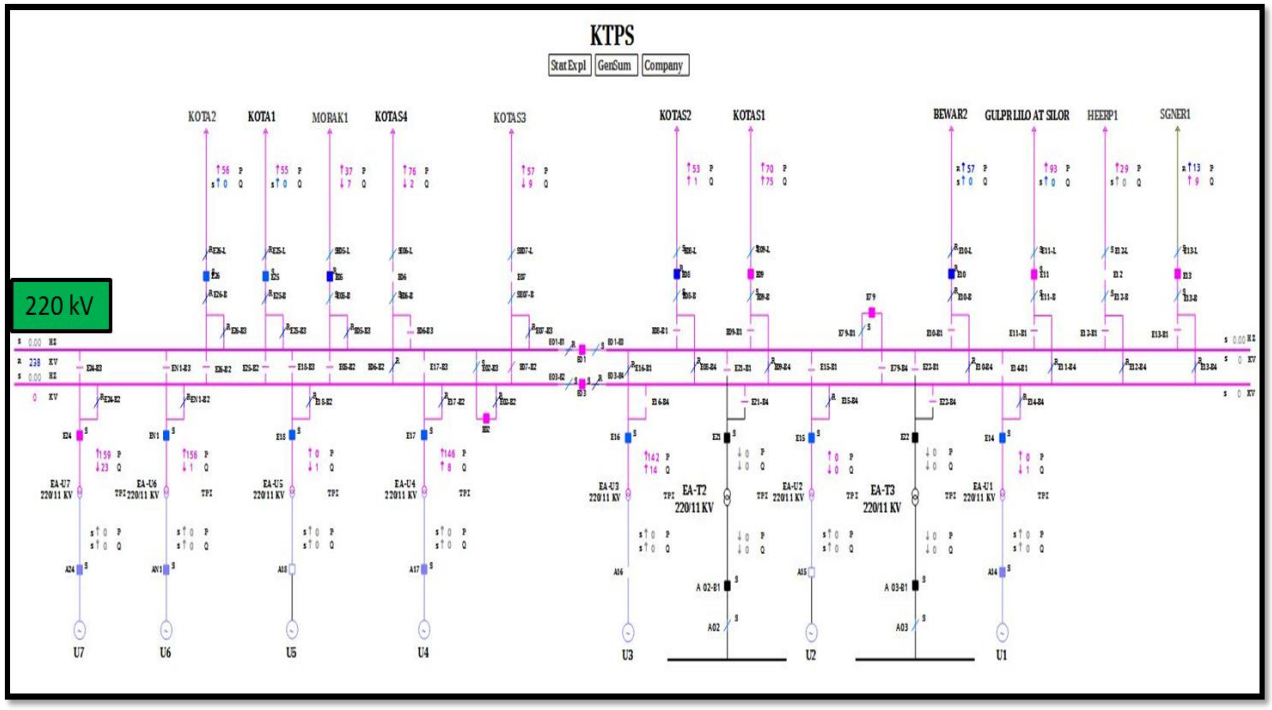
Description	**Clauses**	**Utility**	**Remarks**
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A, 43.4.C.4 & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2 4. CEA Grid Standard 3.1.e 5. CEA Transmission Planning Criteria	**Rajasthan**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report yet to be received 3. Non-Availability of Numerical Bus Bar/LBB Protection at 220 kV and above S/s 4. Correct operation of Protection System 5. Delayed Clearance of fault 6. Adequately Sectionalized and graded protective relaying system

Based on above information description of the events is:

1. 220 kV Kota TPS is connected with Sakatpura four ckt, Kota (PG) D/C, Heerapura S/C, Vatika S/C, Bundi S/C, Beawar S/C, and Morak S/C. Kota TPS has total seven units (capacity of 2x110+3x210+2x195 MW). It has DM (double main single breaker) bus bar scheme. 220 kV buses are sectionalised in total five parts.
2. Connectivity and SLD of 220 kV Kota TPS and 220 kV Sakatpura (Raj):



Single Line Diagram: Kota TPS (220kV)



Single Line Diagram: 220 kV Sakatpura

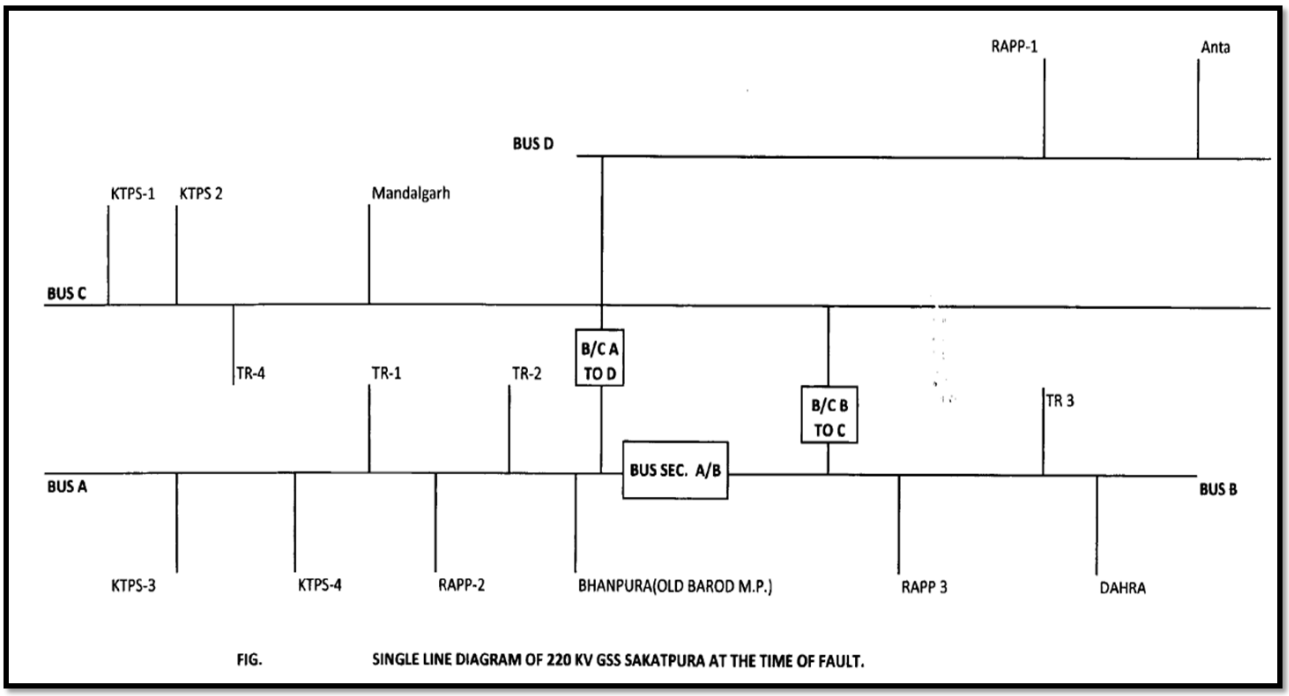


FIG. SINGLE LINE DIAGRAM OF 220 KV GSS SAKATPURA AT THE TIME OF FAULT.

3. *Event Description for 20th Oct 2018 event:*
   a. In antecedent condition unit-1 of 110MW was under planned outage. 220 kV KTPS-Kota (PG) ckt-1 & 2 was also under shutdown along with 220 kV bus section-3 & 5.
   b. At 220kV KTPS (Raj) switchyard heavy arcing occurred at 220kV Kota Th(Raj)-Morak(Raj) feeder during restoration activity of 220kV Bus 3 & 5, due to this Bus coupler 1 tripped on earth fault and various emanating feeders tripped resulting in tripping of all the running units. As per PMU, Voltage dip in all the three phases is observed and dip in frequency of around 0.052Hz is observed.
   c. Name of the tripped element:
      - 220kV Kota Th(Raj) –Sakatpura(Raj) ckt 1,2,3,4
      - 220kV Kota Th(Raj)- Morak(Raj)
      - 220kV Kota Th(Raj)-Kota(PG) D/c
      - 220kV Kota Th(Raj)-Vatika(Raj)
      - 220kV Kota Th(Raj)-Beawar(Raj)
      - 220kV Kota Th(Raj)-Heerapura(Raj)
      - 220kV Kota Th(Raj)-Silor(Raj)
      - 220kV Kota Th(Raj) Unit#2,3 4, 5, 6,7
      - 220kV Sakatpura(Raj)- RAPP A ckt 1,3

- 220kV Sakatpura(Raj)- RAPP B ckt 2
- 100MVA ICT 2 & 3, 160MVA ICT 1 & 4 at 220kV Sakatpura(Raj)

d. As per RRVUNL report:

Preliminary Report

Date & Time of event : 20.10.2018 & 21:00 Hrs.
Introduction of Event : Tripping of various elements at KTPS due to fault at 220 KV KTPS- Modak.

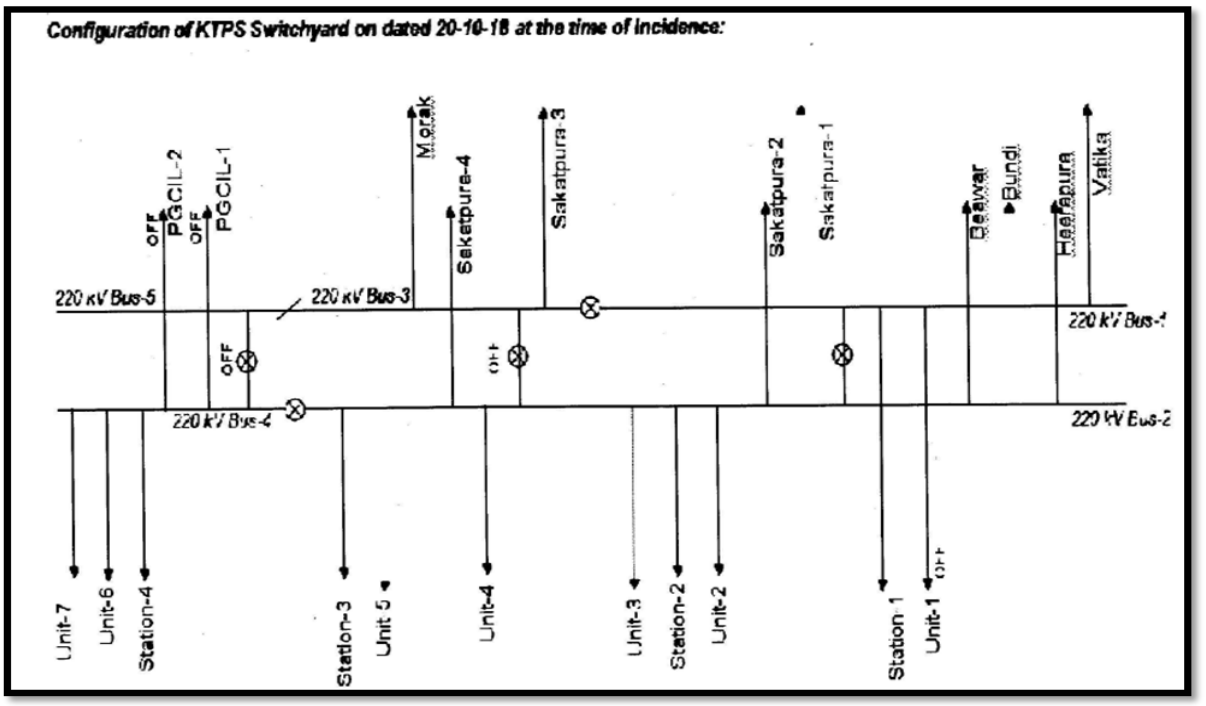
Total Loss of Generation : 1130 MW (D.C. 1026 MW)

Total Loss of Load: :

Triggering Incident:. : At KTPS end switch yard heavy arcing occurred at 220kV KTPS –Morak feeder during restoration activity of 220kV Bus 3 & 5 and due to this the B/C -1 tripped on E/F and various emanating feeders tripped resulting in tripping of all the running units.

S.NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1.	KTPS Unit No.2	20.10.2018	21.00 Hrs.	21.10.2018	5.57 Hrs.		Grid Station failure at KTPS. At KTPS end switch yard heavy arcing occurred at 220kV KTPS –Morak feeder during restoration activity of 220kV Bus 3 & 5 and due to this the B/C -1 tripped on E/F and various emanating feeders tripped resulting in tripping of all the running units.
2.	KTPS Unit No.3	20.10.2018	21.00 Hrs.	21.10.2018	7.49 Hrs.		
3.	KTPS Unit No.4	20.10.2018	21.00 Hrs.	21.10.2018	11.22 Hrs.		
4.	KTPS Unit No.5	20.10.2018	21.00 Hrs.	21.10.2018	12.32 Hrs.		
5.	KTPS Unit No.6	20.10.2018	21.00 Hrs.	20.10.2018	21:44 Hrs	SAKATPURA END:- CARRIER RECEVIED ,NO TRIPPING;M/T	
6.	KTPS Unit No.7	20.10.2018	21.00 Hrs.	20.10.2018	21:50 Hrs	SAKATPURA END:-:- M/T RAPP B End:- Z-2, Phase "A" &"C" Dist. 80 Km	

Configuration of KTPS Switchyard on dated 20-10-18 at the time of incidence:



1. Name of Equipment : Tripping of KSTPS Unit-2,3,4,5,6,& 7

2. Date of Tripping : **20-10-2018**

3. Time of Tripping : **21:00 Hrs**

4. Incidence :

Prior to tripping all the KSTPS Units (except Unit-1) were running normal and all the 220 kV feeders were connected (except 220 kV KTPS-PGCIL-1 & 2). At 220 kV KTPS Switch Yard, the 220 kV Bus-3 & 5 were under shutdown and process of charging the Buses and normalization was under progress. Due to fault at Isolator of 220 kV KTPS - Morak feeder all the running units along with various 220 kV feeders tripped and total black out was observed at KTPS, Kota. The details of tripping of various Units and 220 kV Feeders are as follows:

S.No	Unit/Feeder	Breaker opening Time	Remarks
1	Unit-2	20-10-18 ; 21:00	Operation of Lock out relay
2	Unit-3	20-10-18 ; 20:59:30	Loss of all fuel
3	Unit-4	20-10-18 ; 20:59:30	Loss of all fuel
4	Unit-5	20-10-18 ; 21:02:46	Loss of all fuel
5	Unit-6	20-10-18 ; 21:00:05	Generator O/V protection
6	Unit-7	20-10-18 ; 21:00:49	Operation of Lock out relay
7	Station Trafo-1	20-10-18 ; 21:01:12	Tripped on Earth Fault protection
8	Station Trafo-2	20-10-18 ; 21:01:14	Tripped on Earth Fault protection
9	Station Trafo-3	20-10-18 ; 21:00	Tripped on Earth Fault protection
10	Station Trafo-4	20-10-18 ; 21:00	Tripped on Earth Fault protection
11	KTPS-Heerapura	-no tripping at KTPS end-	Tripped on Distance protection Zone-1 at Heerapura end
12	KTPS-Vatika	-no tripping at KTPS end-	Tripped on Zone-3 at far end
13	KTPS-Bundi	-no tripping at KTPS end-	Tripped on O/C & E/F at Bundi end.
14	KTPS-Beawar	20-10-18 ; 20:57:37	Tripped on Z-1 at KTPS end.
15	KTPS-Morak	-no tripping at KTPS end-	Tripped manually at KTPS end.
16	KTPS-PGCIL-1	Under Shut down	-
17	KTPS-PGCIL-2	Under Shut down	-
18	KTPS-Sakatpura-1	no tripping at KTPS end	Tripped on Dir E/F protection at Sakatpura end.
19	KTPS-Sakatpura-2	no tripping at KTPS end	Tripped on Dir E/F protection at Sakatpura end.

20	KTPS-Sakatpura-3	no tripping at KTPS end	Tripped on Dir E/F protection at Sakatpura end.
21	KTPS-Sakatpura-4	-no tripping at KTPS end-	Tripped on Dir E/F protection at Sakatpura end.

5. Investigation:

On investigation it was revealed that at 220 kV KTPS Switch Yard, the 220 kV Bus-3 & 5 were under shutdown and process of charging the Buses and normalization was under progress which was started around 17:00 hrs.

The charging of Bus-3 & 5 was done by closing of Bus-Coupler-2 , Bus-Coupler-3 & Bus Sectionalizer-1. After charging the Bus -3 & 5 , the 220 kV KTPS-Sakatpura-3 has been shifted to Bus-3 and changeover of 220 kV KTPS-Morak feeder was under process. The Bus-3 Isolator of Morak feeder has been closed and as soon as opening of Isolator of Bus -2, some arcing was observed at the Isolators of Bus-Coupler-2 and it tripped on Earth Fault protection while Bus Coupler-3 was tripped manually as a sparking was also observed at Isolators.

Due to this happening, the Morak feeder was again shifted to Bus-2 in order to check the problem of B/C-2. After closing of Bus-2 Isolator of Morak feeder and before opening of Isolator of Bus-3 , suddenly a flash over occurred on Bus-2 Isolator of Morak feeder and at the same time tripping of Bus Coupler-1 on Earth fault protection was there. The Morak feeder started acting as a Bus Coupler and all the current now started flowing through the Isolators of Morak feeder causing heavy arcing which ultimately damage the Isolator. All the Station Transformers were tripped on Earth Fault Protection .The 220 kV emanating feeders were tripped at far end except Beawar feeder while Morak feeder was tripped manually. As no corridor was available at KTPS, a complete black out occurred .

6. **Restoration :**

The start up supply was taken from 220 kV KTPS-Sakatpura-1 feeder at 22:44:01 Hrs as directed by LD. Rest of the feeders and Generating Units were restored as follows:

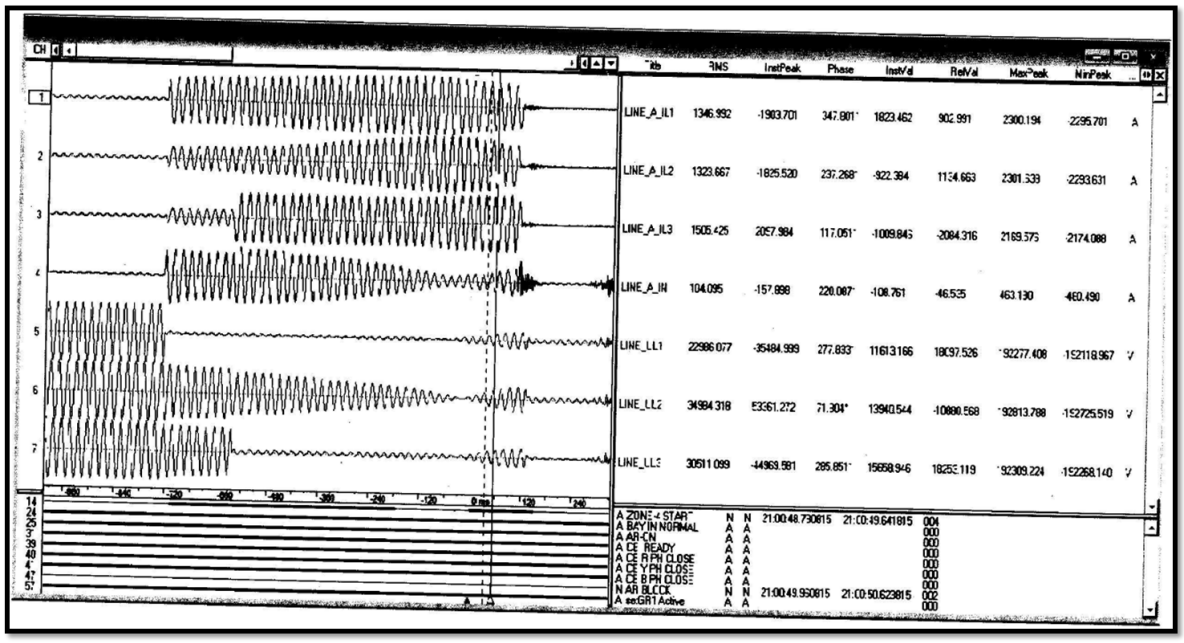
S.No	Unit/Feeder	Restoration Time
1	Unit-2	21-10-18 ; 05:57 hrs
2	Unit-3	21-10-18 ; 07:48 hrs
3	Unit-4	21-10-18 ; 11:21 hrs
4	Unit-5	21-10-18 ; 12:32 hrs
5	Unit-6	22-10-18 ; 17:52 hrs

6	Unit-7	22-10-18 ; 19:24 hrs
7	KTPS-Vatika	21-10-18 ; 05:52 hrs
8	KTPS-Bundi	21-10-18 ; 05:51 hrs
9	KTPS-Beawar	21-10-18 ; 06:03 hrs
10	KTPS-Sakatpura-1	20-10-18 ; 22:44 hrs
11	KTPS-Sakatpura-2	21-10-18 ; 01:17 hrs
12	KTPS-Sakatpura-3	21-10-18 ; 07:40 hrs
13	KTPS-Sakatpura-4	21-10-18 ; 07:44 hrs

7. Analysis :

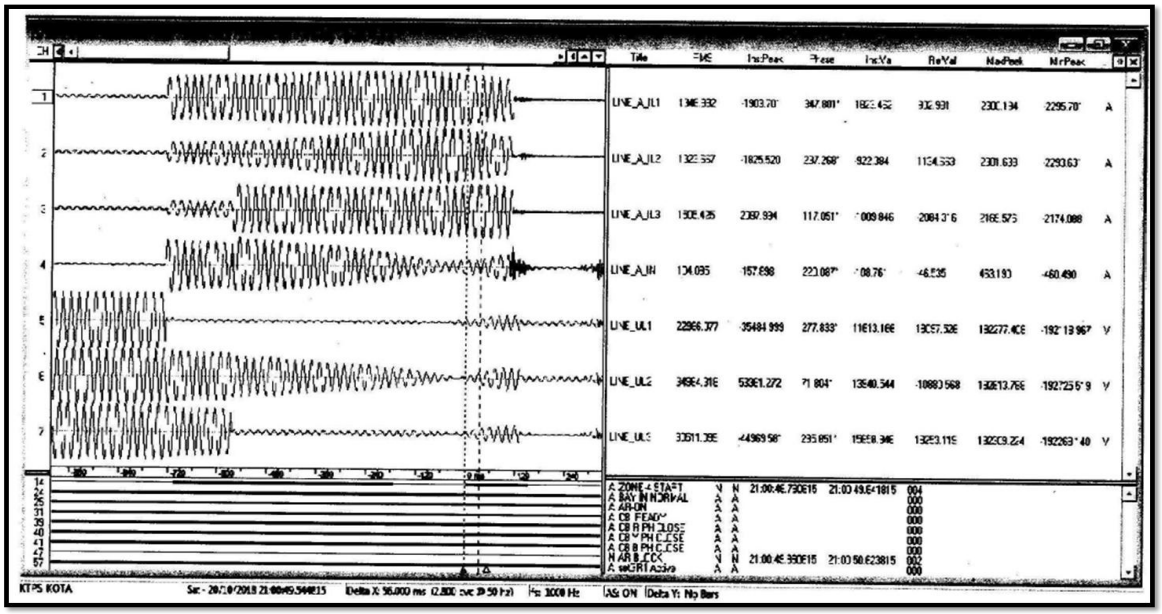
The tripping of Bus-Coupler-1 is the main cause of this incidence. Due to the tripping of B/C-1, the Morak feeder becomes a B/C and the current which was flowing through B/C-1, started flowing through the Morak feeder Isolators. This high current caused heavy arcing and resulting in damaging of Bus-2 Isolator of Morak feeder. The tripping of Station Transformers and other outgoing feeders resulting in tripping of Generating Units.

DR of 220kV KTPS (end)-Vatika



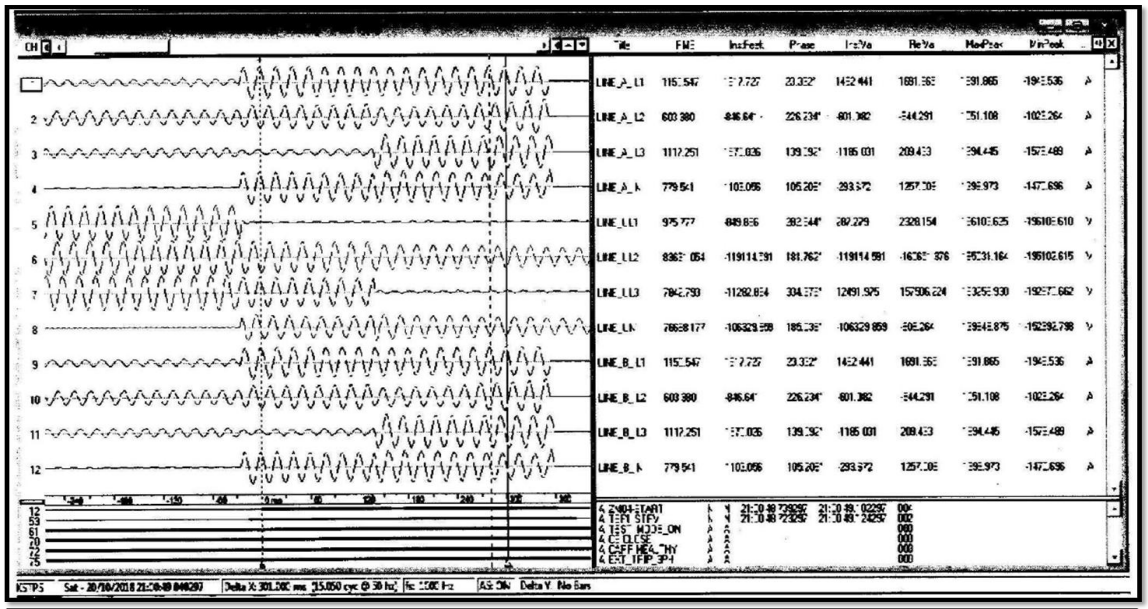
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
Line tripped from Heerapura end on distance protection Z-3.

DR of 220kV KTPS (end)-Heerapura



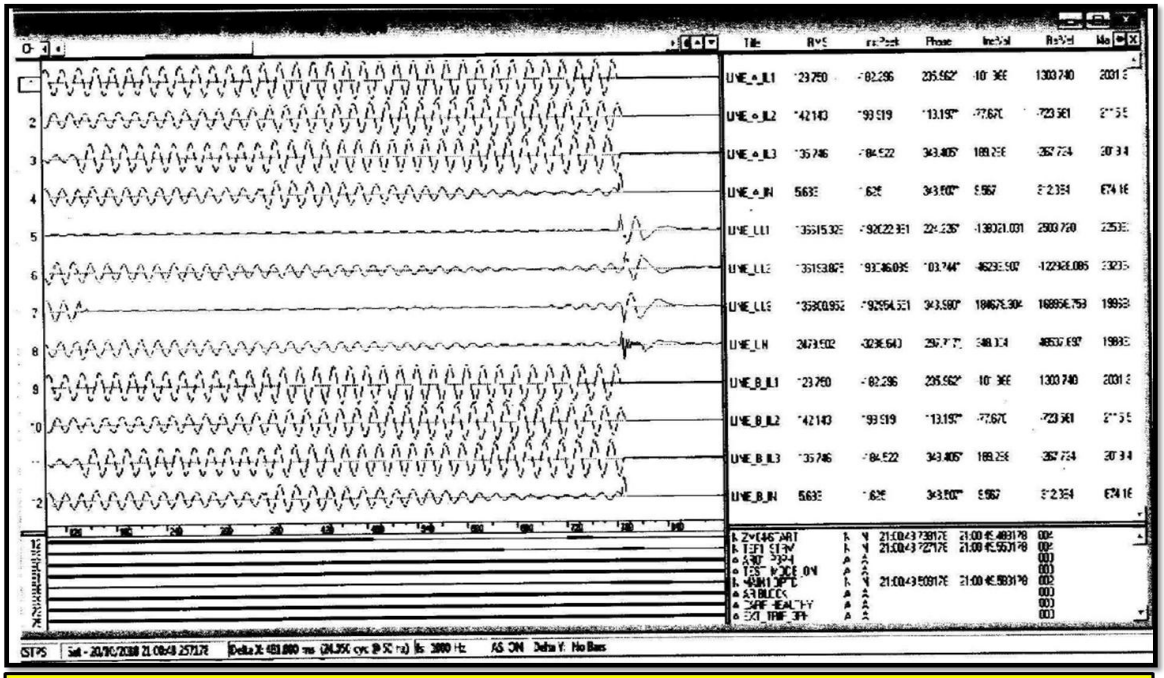
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
Line tripped from Heerapura end on DP Z-1. (it seems line tripped after 1000ms)

DR of 220kV KTPS (end)-Bundi



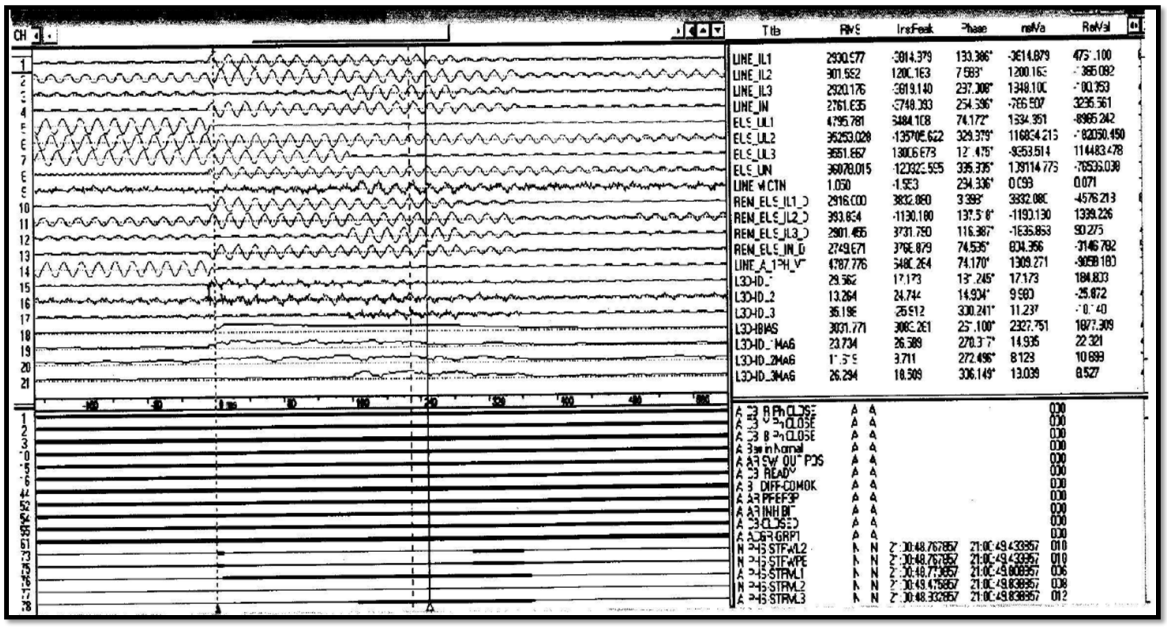
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
Line tripped from Bundi end on backup O/C earth fault protection.

DR of 220kV KTPS (end)-Beawar



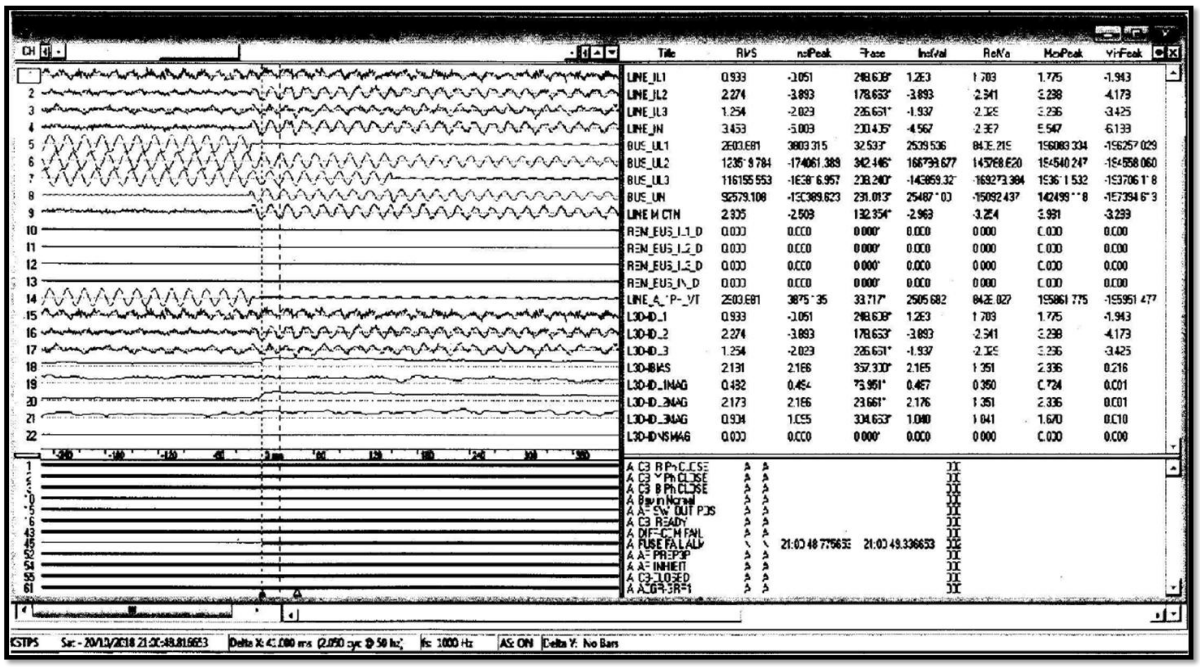
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)

DR of 220kV KTPS (end)-Sakatpura ckt-1



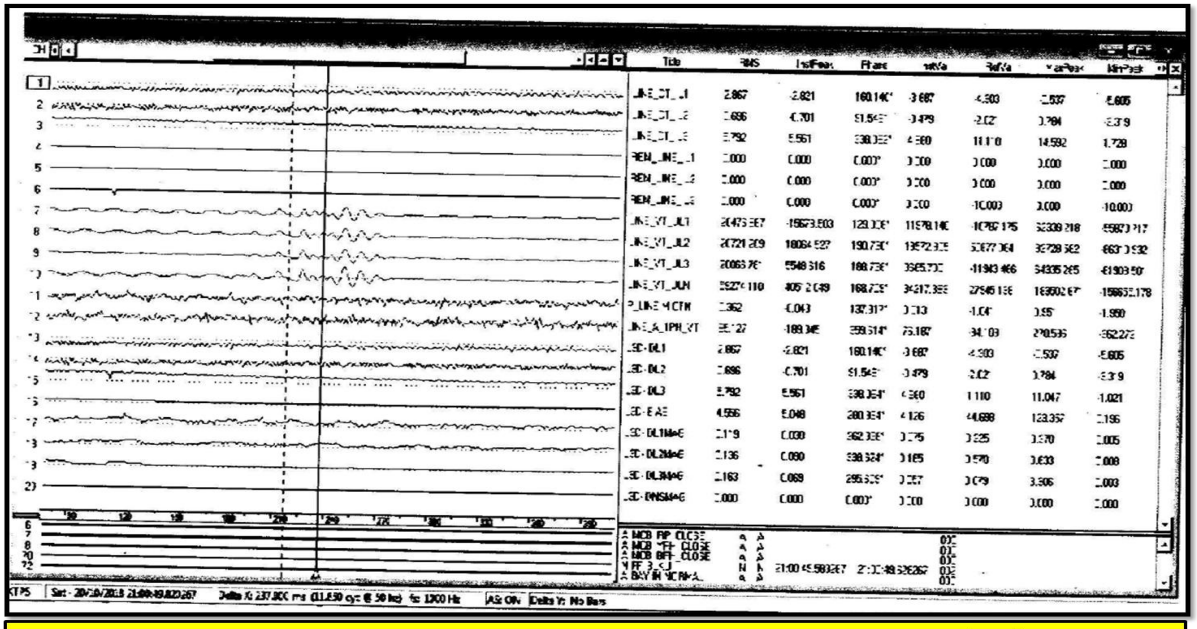
Differential protection didn't operate. Line tripped from Sakatpura end on O/C E/F protection

DR of 220kV KTPS (end)-Sakatpura ckt-2



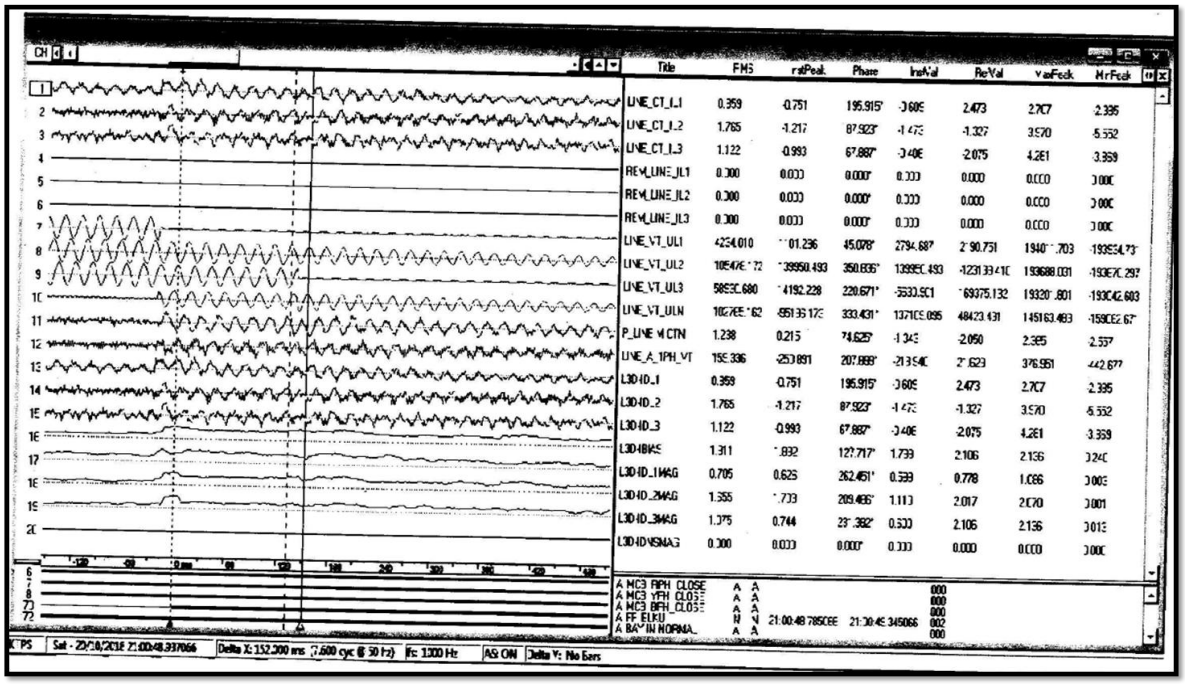
Differential protection didn't operate. Line tripped from Sakatpura end on O/C E/F protection

DR of 220kV KTPS (end)-Sakatpura ckt-3



Differential protection didn't operate. Line tripped from Sakatpura end on O/C E/F protection

DR of 220kV KTPS (end)-Sakatpura ckt-4



Differential protection didn't operate. Line tripped from Sakatpura end on O/C E/F protection

e. As per RRVUNL report:

Preliminary Report

Date & Time of event : 20.10.2018 & 21:05 Hrs.

Introduction of Event : Multiple Tripping at 220 KV GSS SAKATPURA Kota

Total Loss of Generation : 1065 MW

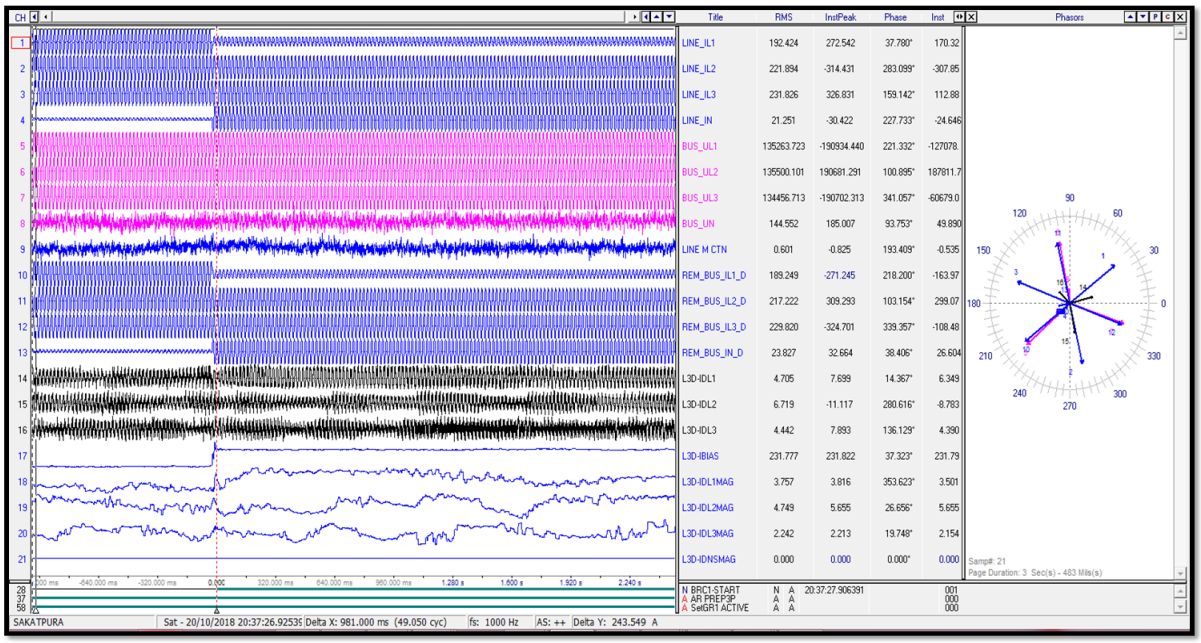
Total Loss of Load: : -

Triggering Incident:.

S.NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1.	220KV SAKATPURA-KTPS CKT NO-1	20.10.2018	21:05 Hrs	20.10.2018	22:47 Hrs.	M/T	Close after Clearance from KTPS & LD
2.	220KV SAKATPURA-KTPS CKT NO-2	20.10.2018	21:05 Hrs	21.10.2018	01.18 Hrs.	SAKATPURA END:-:- 64NX,86	
3.	220KV SAKATPURA-KTPS CKT NO-3	20.10.2018	21:05 Hrs	21.10.2018	07.40 Hrs.	SAKATPURA END:-:- 64NX,86	
4.	220KV SAKATPURA-KTPS CKT NO-4	20.10.2018	21:05 Hrs	21.10.2018	0741 Hrs.	SAKATPURA END:-:- 64NX,86	
5.	220KV SAKATPURA-RAPP(A) NO-1	20.10.2018	21:05 Hrs	20.10.2018	21:44 Hrs	SAKATPURA END:- CARRIER RECEVIED ,NO TRIPPING;M/T	
6.	220KV SAKATPURA-RAPP(B) NO-2	20.10.2018	21:05 Hrs	20.10.2018	21:50 Hrs	SAKATPURA END:-:- M/T RAPP B End:- Z-2, Phase "A" &"C" Dist. 80 Km	
7.	220KV SAKATPURA-RAPP(A) NO-3	20.10.2018	21:05 Hrs	20.10.2018	21:45 Hrs	SAKATPURA END:- CARRIER RECEVIED ,NO TRIPPING;M/T	
8.	220KV SAKATPURA-ANTA	NO TRIPPING					ALREADY OPEN AT ANTA END on dated 20.10.2018 AT 19:43Hrs. LD APPROVEL NO LD 367 & NRLD 1493

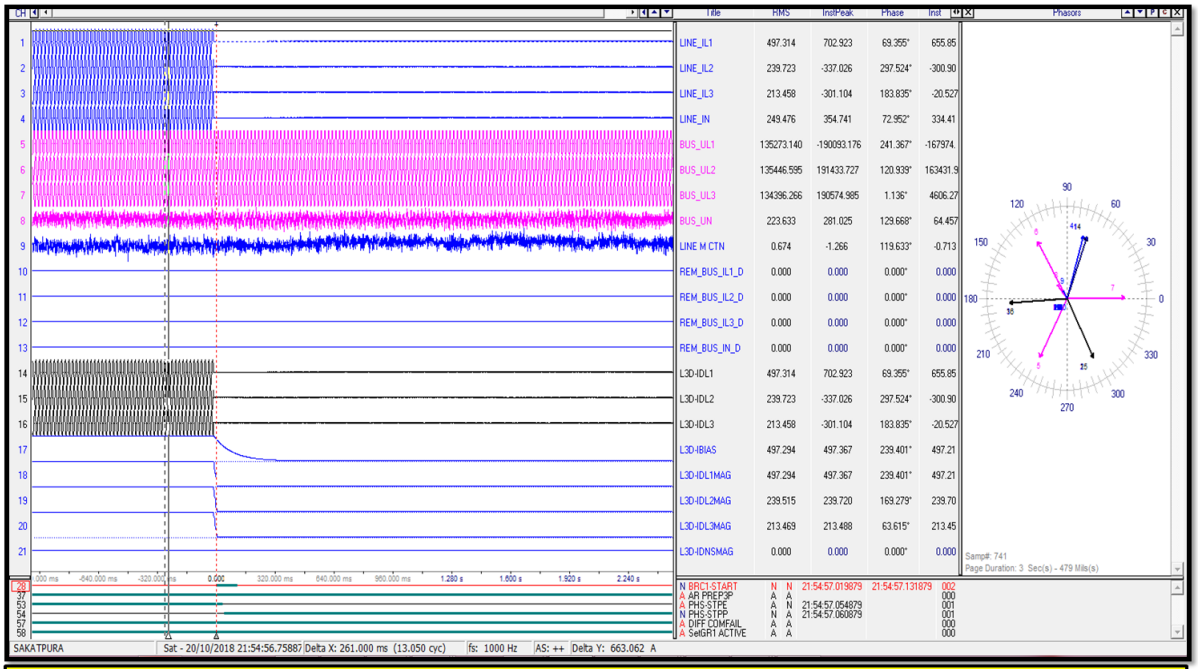
9.	220KV SAKATPURA-MANDALGARH	20.10.2018	21:05 Hrs	20.10.2018	21:35 Hrs	NO TRIPPING	Before supply failure load of Mandalgarh was being supplied. After incidante the supply at GSS taken from Bhilwara through Bhilwara- Mangalgarh-Kota(s) line.
10.	220KV SAKATPURA-DAHRA	20.10.2018	21:05 Hrs	20.10.2018	22:10 Hrs	**SAKATPURA END:-** M/T **DAHRA END:-**Z2 ,A- PHASE	
11.	220KV SAKATPURA-BHANPURA(M.P.)	20.10.2018	M/T AT 21:10 Hrs	20.10.2018	22:50 Hrs	**SAKATPURA END:-** M/T AT 21:10 Hrs **BHANPURA(M.P.)END:-** Z2,R,Y& B PHASE,DIST =81.5 Km TRIPPED AT 21:05Hrs	
12.	220/132KV 100MVA Tr-4	20.10.2018	21:05 Hrs	20.10.2018	21:44Hrs	**SAKATPURA END:-** 220KV SIDE 64NX,86; 132KV SIDE INTER TRIP	
13.	220/132KV 160MVA Tr-1	20.10.2018	21:05 Hrs	20.10.2018	21:35Hrs	**SAKATPURA END:-** M/T 132KV SIDE AT 21:10 Hrs DUE TO SUPPLY FAIL	
14.	220/132KV 100MVA Tr-2	20.10.2018	21:05 Hrs	20.10.2018	21:36 Hrs	**SAKATPURA END:-** M/T 132KV SIDE AT 21:10 Hrs DUE TO SUPPLY FAIL	
15.	220/132KV 100MVA Tr-3	20.10.2018	21:05 Hrs	20.10.2018	21:42 Hrs	**SAKATPURA END:-** M/T 132KV SIDE AT 21:10 Hrs DUE TO SUPPLY FAIL	
16.	220KV B/C B TO C	20.10.2018	21:05 Hrs	20.10.2018	21:36Hrs	**SAKATPURA END:-** 64NX,86	
17.	132 KV SAKATPURA-RLY 1 & 2	20.10.2019	21:05 Hrs	20.10.2018	21:35 Hrs	**SAKATPURA END:-** NO TRIPPING, NO INDICATION BOTH END	

DR of 220kV Sakatpura (end)-KTPS 1



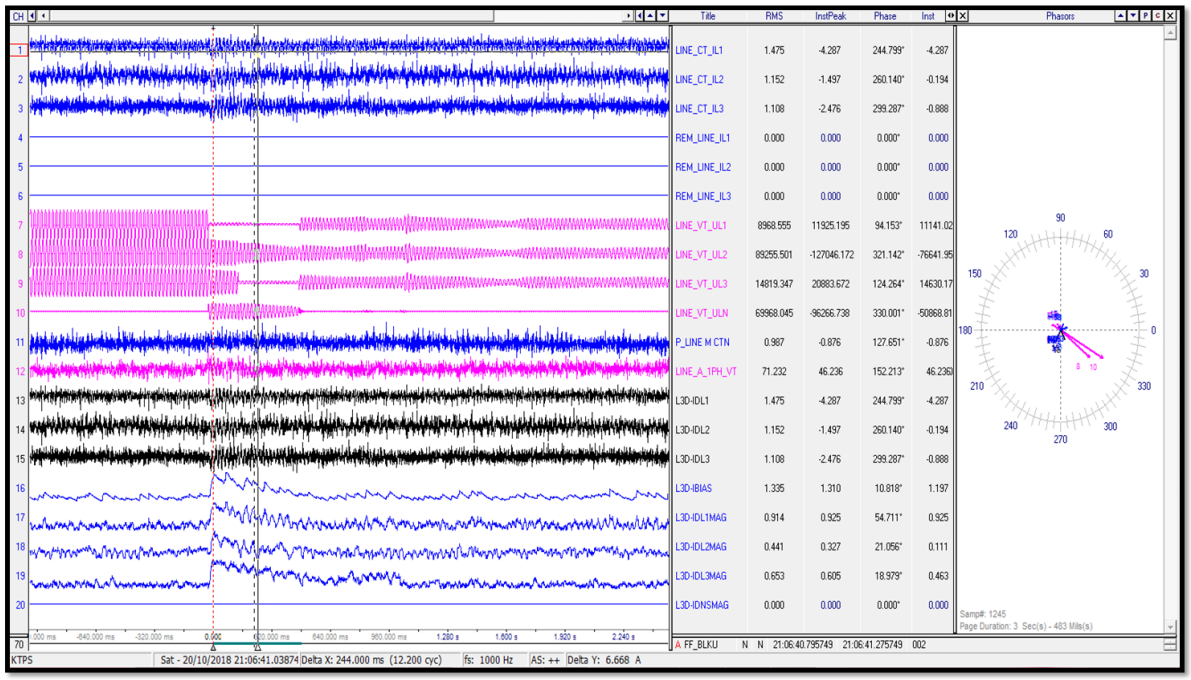
Time Synch error, as DR triggering time is different from actual fault time

DR of 220kV Sakatpura (end)-KTPS 2



Time Synch error, as DR triggering time is different from actual fault time

DR of 220kV Sakatpura (end)-KTPS 4



Time Synch error, as DR triggering time is different from actual fault time

Name of Element	Date and time of tripping	Date and time of closing
220 KV KTPS-1	20.10.2018/ 21:05 Hrs (M/T)	20.10.2018/ 22:47 Hrs
220 KV KTPS-2	20.10.2018/ 21:05 Hrs	21.10.2018/ 01:18 Hrs
220 KV KTPS-3	20.10.2018/ 21:05 Hrs	21.10.2018/ 07:42 Hrs
220 KV KTPS-4	20.10.2018/ 21:05 Hrs	21.10.2018/ 07:44 Hrs
220KV RAPP(A) NO-1	20.10.2018/ 21:05 Hrs (M/T)	20.10.2018/ 21:44 Hrs
220KV RAPP(B) NO-2	20.10.2018/ 21:05 Hrs (M/T)	20.10.2018/ 21:50 Hrs
220KV RAPP(A) NO-3	20.10.2018/ 21:05 Hrs (M/T)	20.10.2018/ 21:45 Hrs
220KV MANDALGARH	20.10.2018/ 21:05 Hrs (M/T)	20.10.2018/ 21:35 Hrs
220KV DAHARA	20.10.2018/ 21:05 Hrs (M/T)	20.10.2018/ 22:10 Hrs
220KV BHANPURA(M.P.)	20.10.2018/ 21:10 Hrs (M/T)	21.10.2018/ 00:22 Hrs

On dated 20.10.2018 at 21:05 Hrs, a Blast has been observed with highly flash over in the 220 kV Yard of KTPS simultaneously All 220 kV feeders emanating from 220 kV KTPS yard tripped in Z2 or E/F from local/remote end. Supply of Sakatpura sub-station fail in the same time due to following feeders tripped from local/remote end :-

1. 220kV Sakatpura-KTPS-3 tripped on E/F from local end
2. 220kV Sakatpura-KTPS-4 tripped on E/F from local end
3. 220kV Sakatpura-RAPP-2 tripped in Z-2 from remote end
4. 220kV Sakatpura-Bhanpura(M.P) tripped in Z-2 from remote end

   Above 220kV feeders are running on Bus-A and distance protection scheme not commissioned on KTPS-3&4 due to short line length 900 meter only.
5. 220kV Sakatpura-RAPP-3 tripped on Z-1 from remote end
6. 220kV Sakatpura-Dahra tripped on Z-2 from remote end
7. 220kV Bus Coupler (B-C) tripped on E/F from local end

   Above 220kV feeders are running on Bus-B
8. 220kV Sakatpura-KTPS-1 Not tripped
9. 220kV Sakatpura-KTPS-2 tripped on E/F from local end
10. 220kV Sakatpura-Mandalgarh Not tripped(radial feeder)

    Above 220kV feeders are running on Bus-C and distance protection scheme not commissioned on KTPS-1&2 due to short line length 900 meter only.
11. 220kV Sakatpura-RAPP-1 tripped on Z-1 from remote end
12. 220kV Sakatpura-Anta(GTPS) Not tripped(already open at Anta)

    Above 220kV feeders are running on Bus-D.

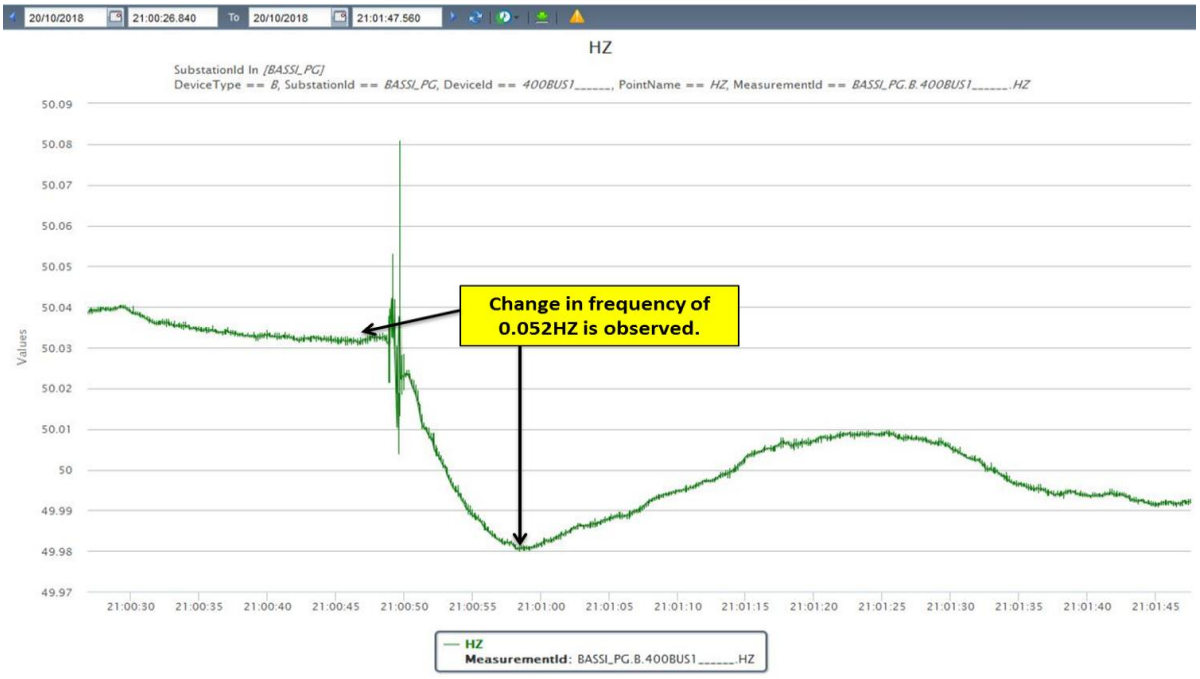
Complete supply of 220kV Sakatpura isolated from all 220 kV feeding sources.

- On 20.10.2018 at 21:05 Hrs, a Blast has been observed with highly flash over in the 220 kV Yard of KTPS simultaneously All 220 kV Ckt from 220 kV KTPS Supply to Sakatpura fail in the same time other source of 220 kV i.e. 220 kV RAPP No. 1, 2, 3 and Bhanpura (M.P.) tripped from other end and it has been observed that supply of 220 kV Sakatpura isolated from all 220 kV feeding sources

f. PMU data of frequency and phase voltages:

PMU Plot of frequency at Bassi(PG)

21:00hrs/20-Oct-18



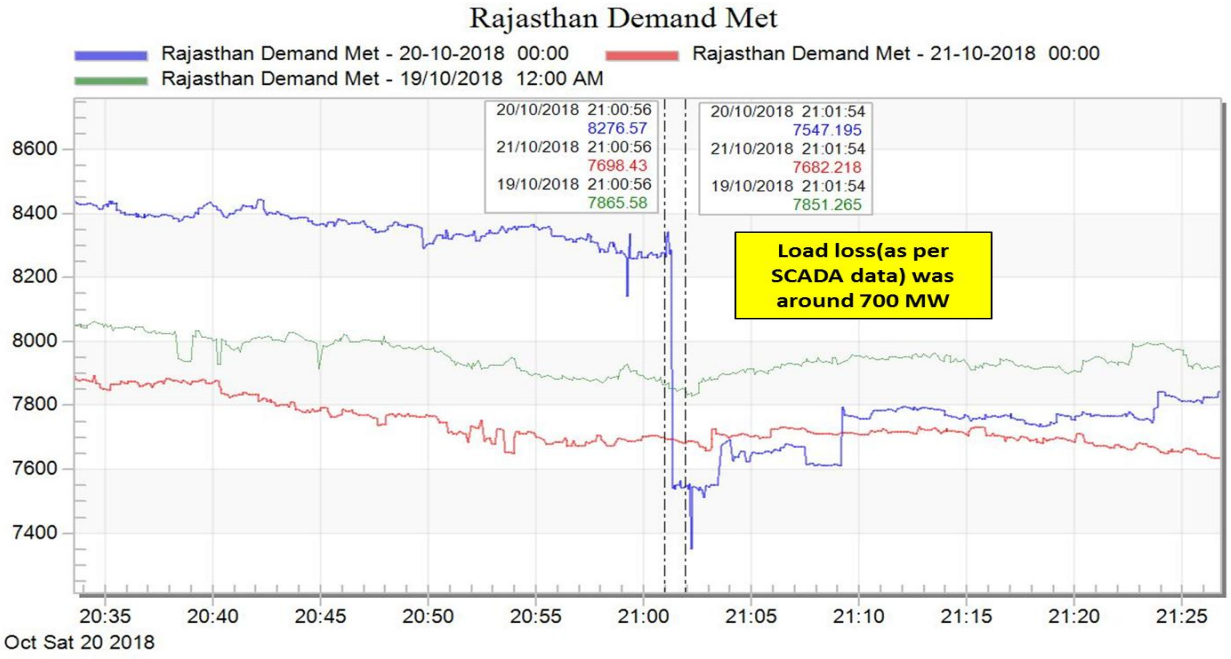
PMU Plot of phase voltage magnitude at Kota(PG)

21:00hrs/20-Oct-18

g. SCADA SoE and Analog data:

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
20:58:05:081	KOTA	220kV	E_02(KTPS_-2)	Circuit Breaker	Open	Main CB of 220kV Kota(Raj) – Sakatpura(Raj)(end) ckt-2 opens
20:58:07:238	KOTA	220kV	E_06(KTPS_-4)	Circuit Breaker	Open	Main CB of 220kV Kota(Raj) – Sakatpura(Raj)(end) ckt-4 opens
21:00:48:011	MANDL_R	220	02KOTAPG	Circuit Breaker	Open	
21:00:48:150	DYRA	220kV	E_01(KOTAS-1)	Circuit Breaker	Open	
21:00:48:162	KOTA	220kV	16MBC	Circuit Breaker	Open	Bus coupler opens
21:00:48:209	KOTA	220kV	E_XX(RAPPB)	Circuit Breaker	Close	
21:00:48:299	KOTA	220kV	E_03(KTPS_-3)	Circuit Breaker	Open	Main CB of 220kV Kota(Raj) – Sakatpura(Raj)(end) ckt-3 opens
21:00:48:654	VATIK_R	220	04KTPS	Circuit Breaker	Open	
21:00:48:860	KOTA	220kV	E_23(T4)	Circuit Breaker	Open	220kV side Main CB of 220/132kV ICT 4 at Sakatpura(Raj)(end) opens
21:00:48:866	KOTA	132kV	D_46(T4)	Circuit Breaker	disturbe	
21:00:48:984	KTPS	11kV	E_15_G(U2)	Circuit Breaker	Open	Main CB of Unit 2 at Kota(Raj) opens
21:00:49:580	KTPS	220kV	E_10(BEWAR-2)	Circuit Breaker	Open	Main CB of 220kV Kota(Raj) –Beawar(Raj)(end) opens
21:00:49:775	KTPS	11kV	E_18_G(U5)	Circuit Breaker	Open	Main CB of Unit 5 at Kota(Raj) opens
21:00:49:789	KTPS	11kV	E_16_G(U3)	Circuit Breaker	Open	Main CB of Unit 3 at Kota(Raj) opens

Rajasthan Demand pattern during tripping



h. As per PMU data:

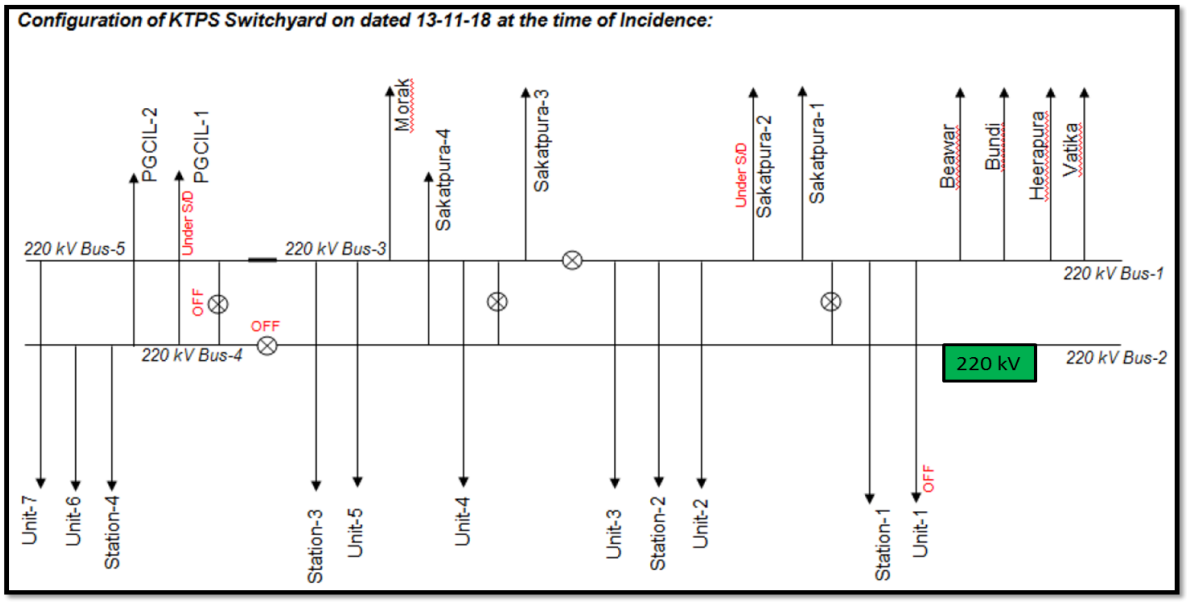
- As per PMU, Maximum dip in R&B-phase.
- Fault Clearance time: **840ms**

- SoE captured, Unit-2 tripped before tripping of all the lines, reason of the same needs to be ascertained

i. As per DR and flag details:
   - As per KTPS DR, Z-4 (reverse zone) started in all the 220 kV feeders but line didn't trip in 500ms.

j. Preliminary Report received within 24hrs. DR/EL received for some of the tripped elements. Detailed report is still awaited from RRVPNL.

4. *Event Description for 13th Nov 2018 event:*



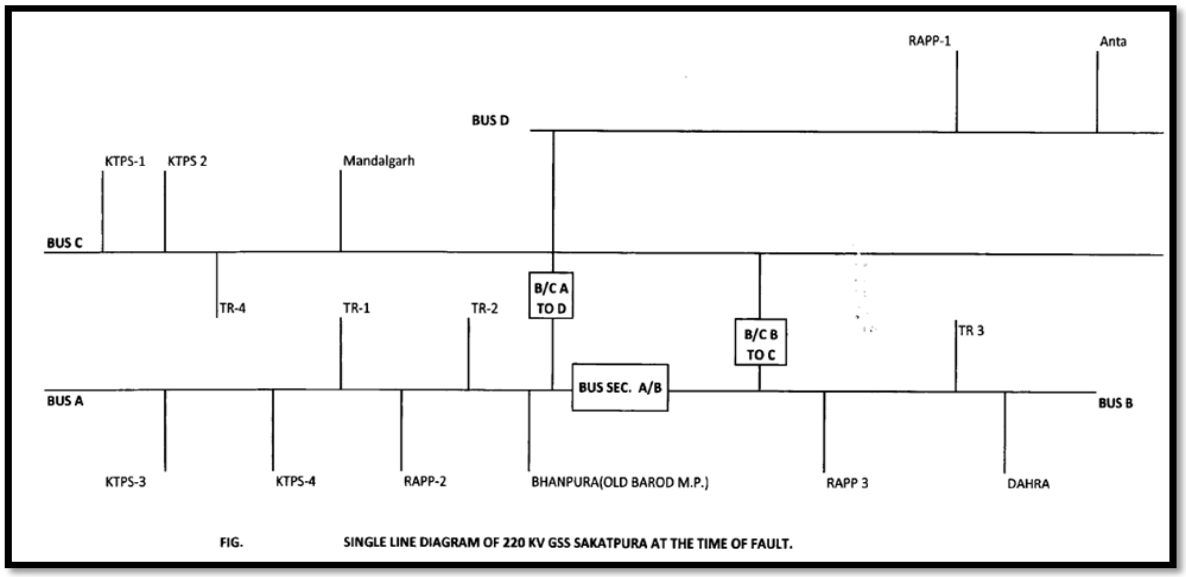


FIG. SINGLE LINE DIAGRAM OF 220 KV GSS SAKATPURA AT THE TIME OF FAULT.

a. In antecedent condition:
   - 110 MW unit-1 of KTPS was under shutdown.
   - 220 kV Kota TPS-Sakatpura ckt-2 was under shutdown
   - 220 kV Kota TPS-Kota (PG) ckt-1 was under shutdown

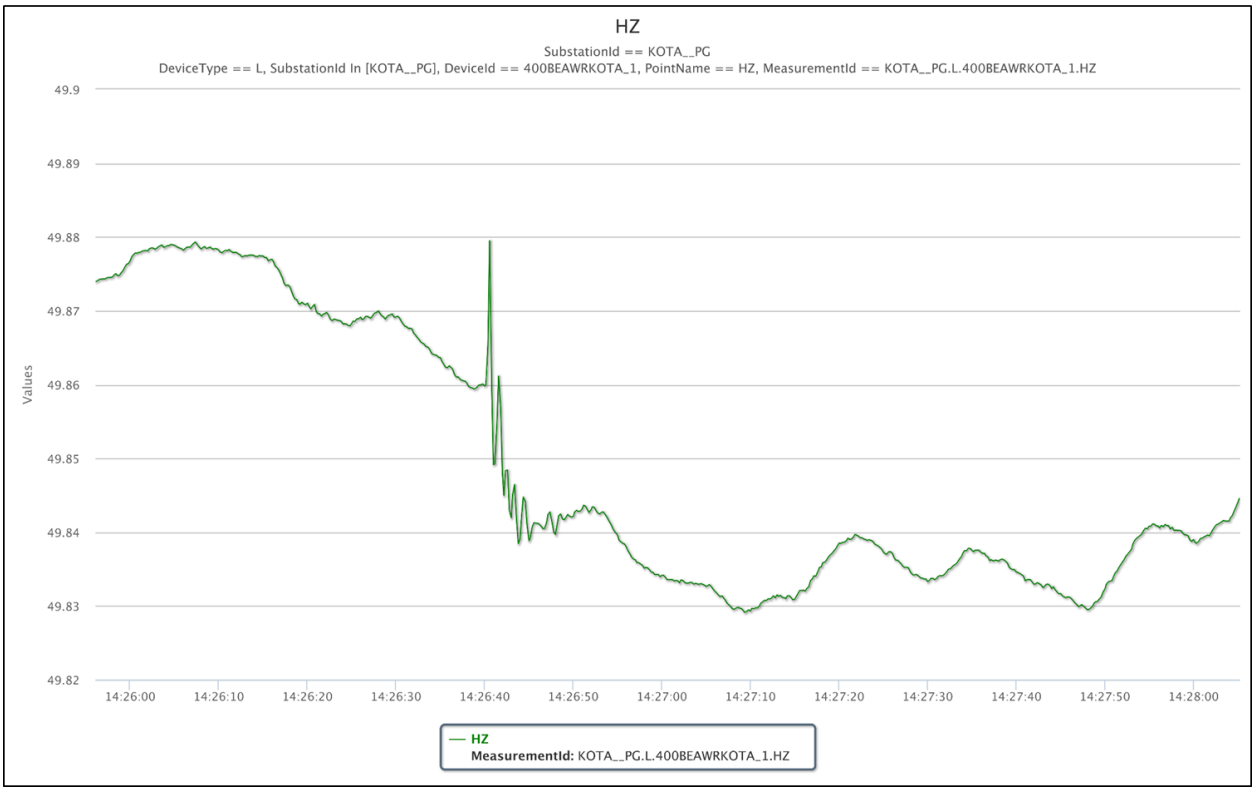
b. Following element connected to 220kV bus of 400/220 kV Gorakhpur (UP) tripped:
   - 220kV Sakatpura(RVPNL)-Dyra(RVPNL)
   - 220kV Sakatpura(RVPNL)-Anta(NTPC)
   - 220kV Sakatpura(RVPNL)-RAPS-1
   - 220kV Sakatpura(RVPNL)-RAPS-2
   - 220kV Sakatpura(RVPNL)-RAPS-3
   - 220kV Sakatpura(RVPNL)-Bhanpura(MPPTCL)
   - 220kV Sakatpura(RVPNL)-KTPS(RRVUNL)-1
   - 220kV Sakatpura(RVPNL)-KTPS(RRVUNL)-3
   - 220kV Sakatpura(RVPNL)-KTPS(RRVUNL)-4
   - 220kV KTPS(RRVUNL)-KOTA(PG)-1
   - 220kV KTPS(RRVUNL)-Morak
   - 220kV KTPS(RRVUNL)-Heerapura(RVPNL)
   - 220kV KTPS(RRVUNL)-Bundi(RVPNL)
   - 220kV Sakatpura(RRVPNL)-Mandalgarh(RRVPNL)
   - 220 kV Unit #2,3,4,5 &7 at KTPS

c. Due to bus fault at 220kV Sakatpura and delayed clearance of fault, multiple element tripping occurred at 220kV KTPS and further cascade tripping occurred at 220kV Dyra and Rana Pratap Sagar.
d. All running units viz. Unit #2, #3, #4, #5 & #7 also tripped at KTPS except unit-6 which was on separate bus with one ckt og Kota (PG). RPS (Rana Pratap Sagar) units also tripped at the same time.
e. Rate of change of frequency protection also operated at 220 kV Bhilwara (Raj)

f. PMU plots of frequency and phase voltage:

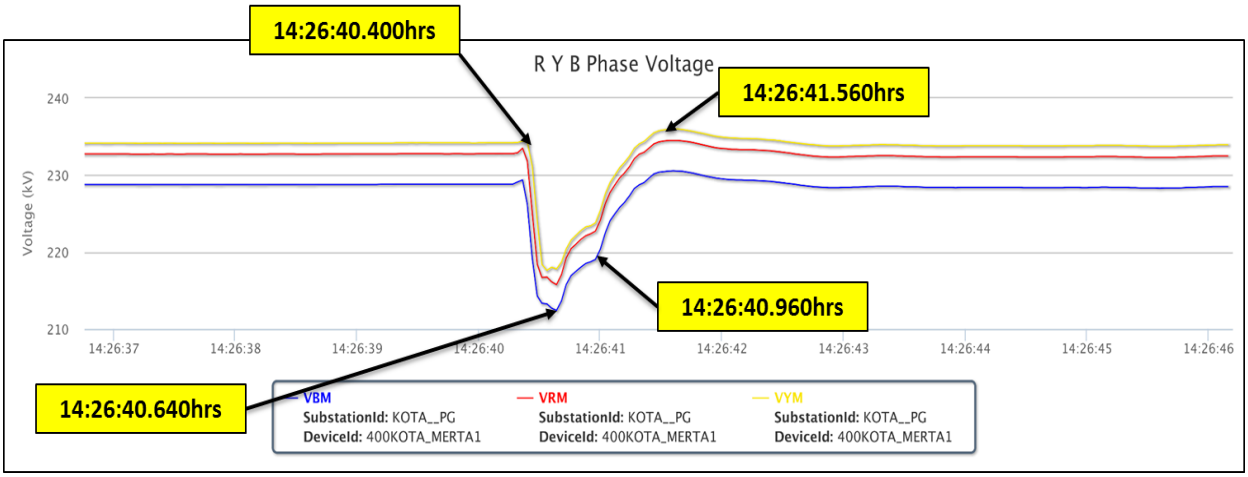
PMU Plot of frequency at Kota(PG)

14:26hrs/13-Nov-18



PMU Plot of phase voltage magnitude at Kota(PG)

14:26hrs/13-Nov-18



g. SCADA SoE data:

Time (hrs)	Station	kV	Element	Device	Status	Remarks
14:26:39,461	KOTA	220	14RAPP3	CB	disturbe	
14:26:39,482	MANDL_R	220	02KOTAPG	CB	Open	
14:26:39,547	MORAK	220	E_01(KTPS_-1)	CB	Open	Modak-KTPS opened from Modak end
14:26:39,713	KOTA	220	13BS	CB	Open	Bus sectionaliser at Sakatpura opened
14:26:39,725	KOTA	220	18ANTA	CB	Open	Sakatpura (end)-Anta opened
14:26:39,728	KOTA	220	12RAPP2	CB	Open	Sakatpura (end)-RAPS-2 opened
14:26:39,760	MORAK	220	E_13(T2)	CB	Close	ICT at Morak tripped
14:26:40,089	RPS	132	08KOTAS	CB	Open	RPS-Sakatpura opened from RPS end
14:26:40,111	RPS	132	07JS	CB	Open	RPS-Jawahar Sagar opened from RPS end
14:26:40,297	VATIK_R	220	04KTPS	CB	Open	Vatika-KTPS opened from Vatika end
14:26:40,435	RPS	132	01KOTAIA	CB	Open	
14:26:41,294	KTPS	220	17KOTAS4	CB	Open	KTPS-Sakatpura-4 opened from KTPS end
14:26:41,592	KTPS	11	19U5	CB	Open	Unit #5 at KTPS tripped
14:26:42,048	RPS	132	05U2	CB	Open	Unit #1, #2, #3 & #4 at RPS tripped
14:26:42,123	RPS	132	04U1	CB	Open	
14:26:42,166	RPS	132	10U4	CB	Open	
14:26:42,336	RPS	132	09U3	CB	Open	
14:26:42,526	KTPS	11	10U2	CB	Open	Unit #2 at KTPS tripped
14:26:43,043	KTPS	11	12U3	CB	Open	Unit #3 at KTPS tripped
14:26:47,643	KOTA	220	14RAPP3	CB	Close	Sakatpura (end)-RAPS-3 opened

h. AS per RRVUNL details:

Tripping Report

1. Name of Equipment : Tripping of KSTPS Unit-2,3,4,5& 7 on grid disturbance

2. Date of Tripping : **13-11-2018**

3. Time of Tripping : **14:26 Hrs**

4. Substation affected : **220 kV KTPS, Kota**

5. Incidence :

At 14:26 Hrs on dated 13-11-18 , when all the KSTPS Units (except Unit-1) were running normal , suddenly Unit No.-2,3,4,5 & 7 along with various 220 kV feeders tripped and total black out was observed at KTPS, Kota.

6. **Brief Summary of Event:**

On investigation it was revealed that there is some fault at 220 kV Sakatpura GSS. This Bus fault was not cleared instantaneously as the Bus Bar protection provided at 220 kV GSS Sakatpura is out of service.

As the 220 kV Sakatpura GSS is situated at a very near to KTPS switchyard (approximate 400 Mtr) it behaves like a extended bus for 220 KV KTPS Switchyard. All the 220KV feeders from KTPS were tripped at far end except 220 kV KTPS-Sakatpura-4 which was tripped on Backup O/C protection. Due to delayed fault clearance most of the outgoing feeders were tripped on Zone-2 or Zone-3 at far end. As most of the feeders in vicinity of KTPS, Kota and 220 kV Sakatpura GSS were tripped either at KTPS end or far end on distance protection, no corridor was left behind to evacuate the power generation in the tune of 800 MW and therefore Unit-2,3 & 4 were tripped on over speed protection of Turbine due to sudden load throw off and Unit 5 was tripped on Dead machine, while Unit-7 was tripped on Generator Backup protection during this disturbance.

Unit # 6 was not effected during this incident as same was connected to Bus # 4 which was connected to PGCIL Feeder's independently.

S. No.	Name of Element	Tripping Date	Tripping Time	Closing Date	Closing Time	Indication, KTPS end	Remark
1	110 MW ,Unit-2	13-11-18	14:26	13-11-18	19:33	Turbine Trip	
2	210 MW, Unit-3	13-11-18	14:26	13-11-18	22:10	Turbine Trip	
3	210 MW, Unit-4	13-11-18	14:26	13-11-18	19:40	Turbine Trip	
4	210 MW, Unit-5	13-11-18	14:26	13-11-18	19:46	Dead Machine	
5	195 MW, Unit-7	13-11-18	14:26	13-11-18	17:33	Back Up Impedance	
6	195 MW, Unit-6	No tripping running continuous and feeding power to PGCIL # 2					
7	220 kV KTPS-Heerpura	13-11-18	No tripping at KTPS end	13-11-18	15:05	Tripped Manually	Tripped on Z-2, at Heerapura end
8	220 kV KTPS-Vatika	13-11-18	No tripping at KTPS end	13-11-18	16:34	Tripped Manually	Tripped on Z-3, at Vatika end
9	220 kV KTPS-Bundi	13-11-18	No tripping at KTPS end	13-11-18	20:03	Tripped Manually	Tripped on Z-3, at Bundi end
10	220 kV KTPS-Beawar	13-11-18	No tripping at KTPS end	13-11-18	19:56	Tripped Manually	Tripped on Z-2, at Bundi end
11	220 kV KTPS-Sakatpura-1	13-11-18	No tripping at KTPS end	13-11-18	15:31	Tripped Manually	No tripping at Sakatpura end
12	220 kV KTPS-Sakatpura-2	Feeder was under Shut down , taken by 220 kV Sakatpura GSS.					
13	220 kV KTPS-Sakatpura-3	13-11-18	No tripping at KTPS end	13-11-18	20:12	Tripped Manually	No tripping at Sakatpura end
14	220 kV KTPS-Sakatpura-4	13-11-18	14:26	13-11-18	16:29	Backup O/C , Phase-C	No tripping at Sakatpura end
15	220 kV KTPS-Morak	13-11-18	No tripping at KTPS end	13-11-18	20:11	Tripped Manually	Tripped on Z-1, at Morak end
16	220 kV KTPS-PGCIL-1	Feeder was under Shut down , taken by 400KV PGCIL GSS.					
17	220 kV KTPS-PGCIL-2	No Tripping					

8. **Restoration:**

The startup supply was taken from 220 kV KTPS-Heerapura feeder at 15:05 Hrs as directed by LD. After getting startup supply, all the Station Transformers were charged and Unit light up activities initiated.

9. **Analysis:**

The delayed fault clearance at 220 kV Sakatpura GSS resulted in tripping of various 220 kV feeders emanating from KTPS, Kota on Zone-2 or Zone-3 distance protection at far end stations. The lack of Bus Bar protection at 220 kV Sakatpura GSS cause of this incidence in which loss of Generation in the tune of almost 800 MW.

11. **Remedial Measures:**

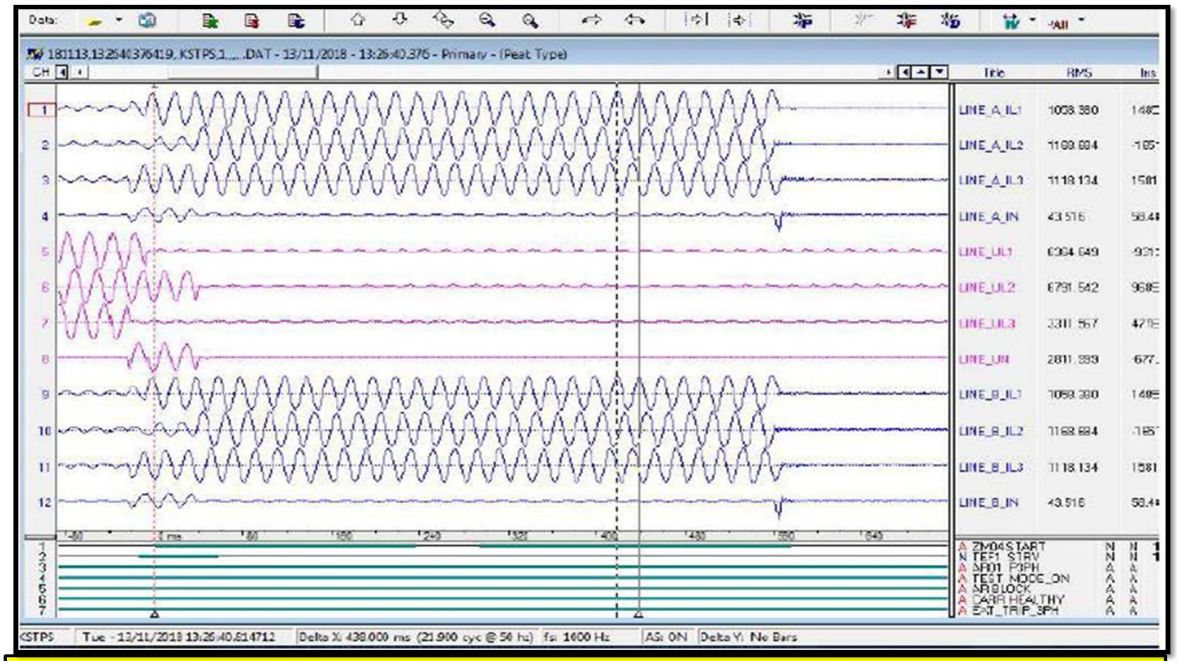
(a) Unit # 6 was connected to PGCIL feeder's on dated 27/10/2018 same was survived during this event.

(b) Now Unit # 7 also connected to PGCIL feeder's on dated 13/11/2018.

(c) Relay setting of KSTPS-Sakatpura Feeder No. 1 to 4 setting also reduced at KSTPS end. Over current TMS change from 0.1 to 0.05 and for earthfault TMS reduced to 0.15 to 0.05.

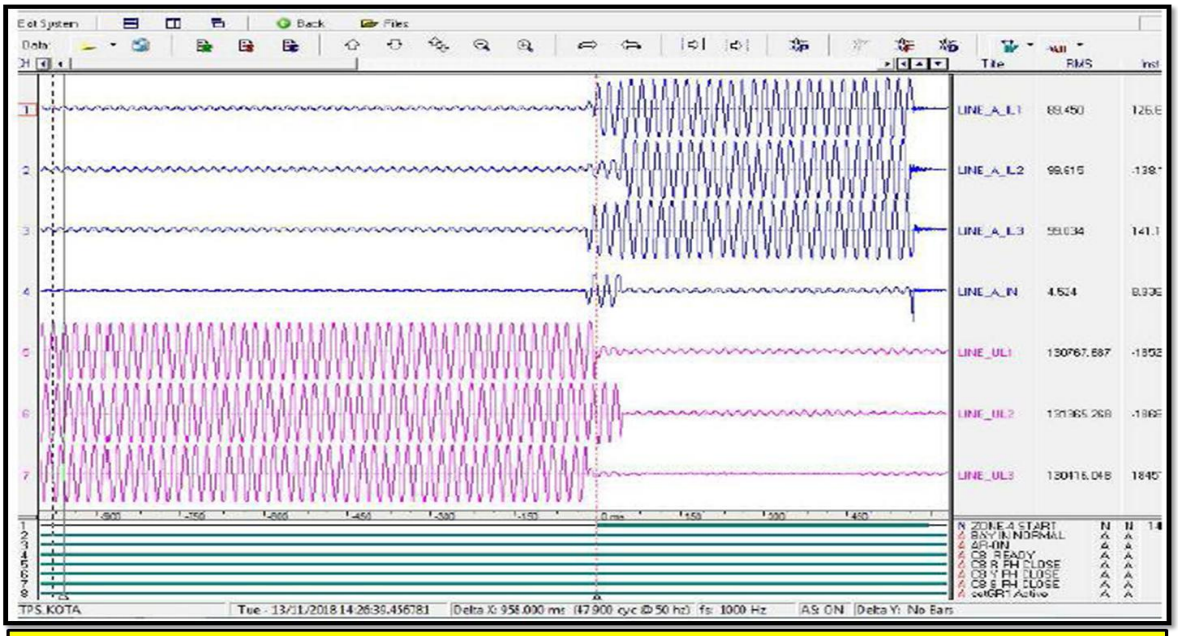
(d) The provision of Bus Bar relay at 220 kV Sakatpura GSS is the utmost requirement and this will save the Generation at KTPS, Kota in case of Bus Faults occurred.

DR of 220kV KTPS (end)-Beawar



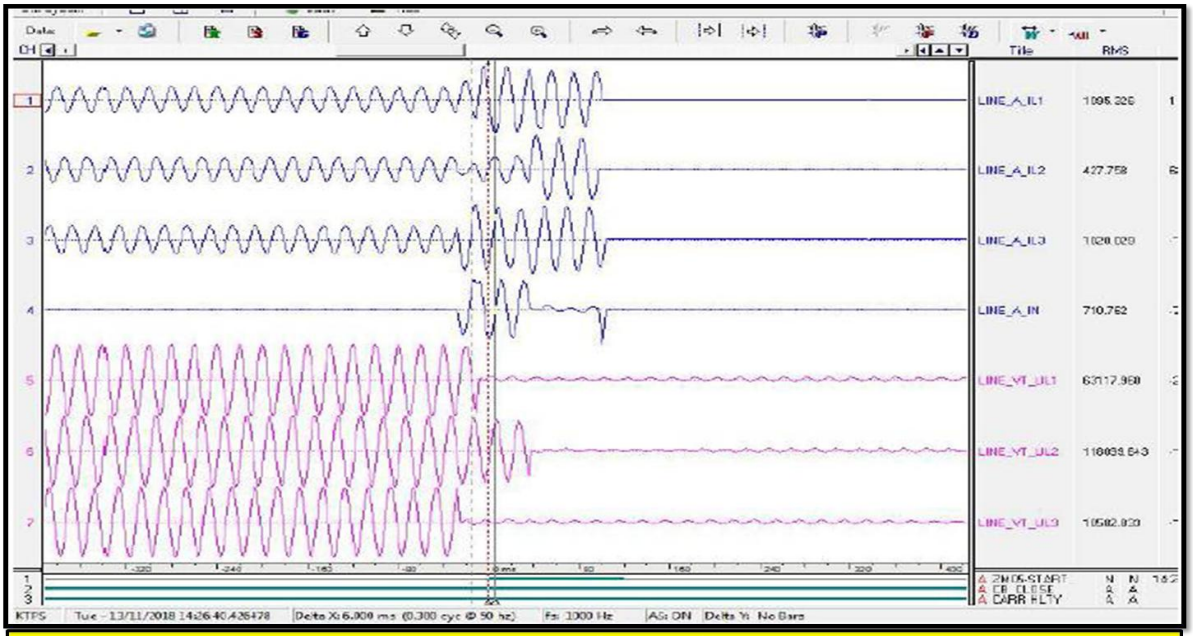
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
It seems line tripped from Beawar end in Z-2 time (500ms)

DR of 220kV KTPS (end)-Heerapura



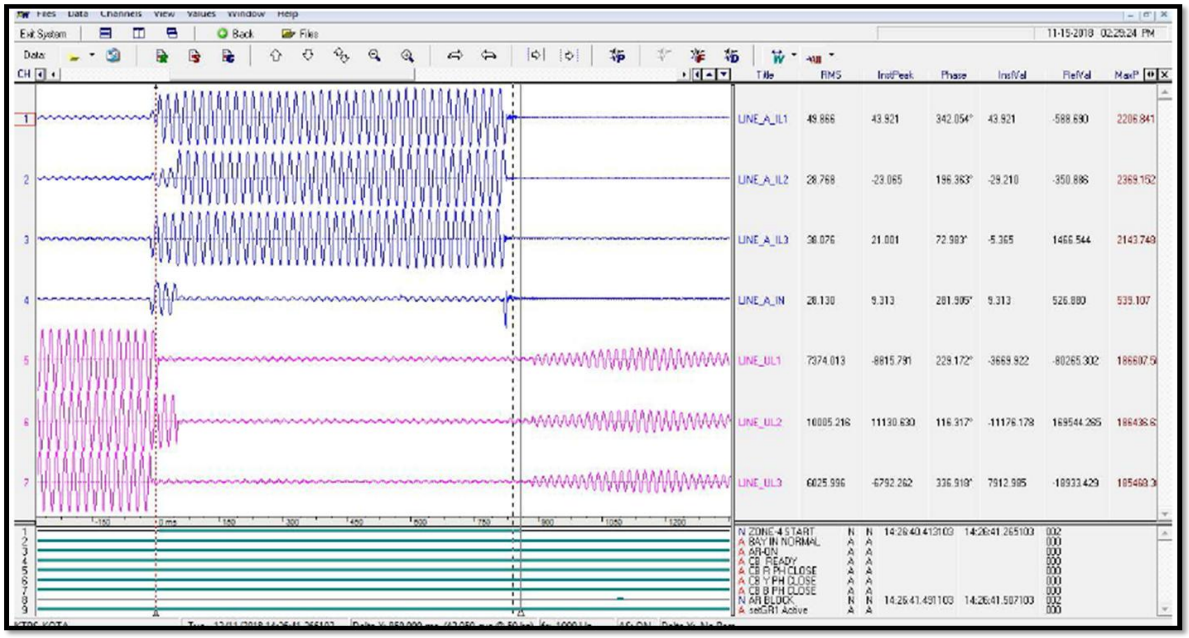
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
It seems line tripped from Heerapura end in Z-2 time (500ms)

DR of 220kV KTPS (end)-Morak



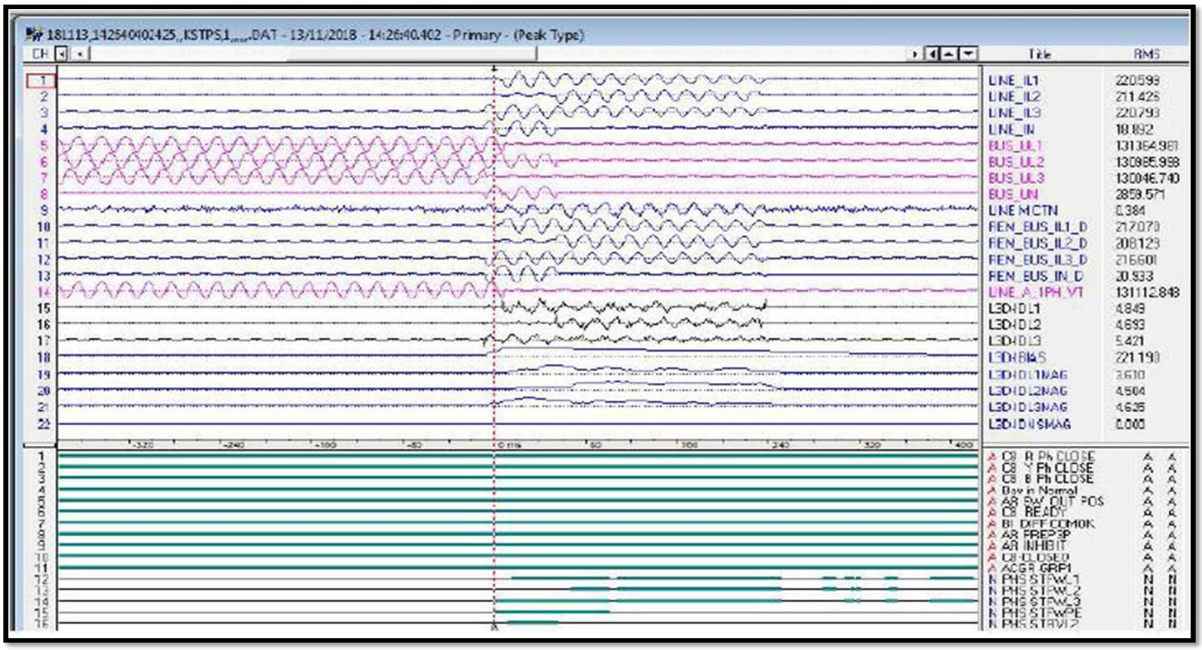
Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
It seems line tripped from Morak end in Z-1 time (100ms)

DR of 220kV KTPS (end)-Vatika



Reverse zone setting needs to be looked into (It should be co-ordinated with Z-2 timing)
It seems line tripped from Vatika end in Z-2 time (500ms)

DR of 220kV KTPS (end)-Sakatpura 1



Differential protection didn't operate. Line tripped from Sakatpura end on O/C E/F protection

i. AS per RRVPNL details:

Preliminary Report

Date & Time of event: - : **13.11.2018 at 14.24 Hrs**
Introduction of Event: - : **Multiple trippings at 220 KV GSS Kota &Dyra**
Total Loss of Load: - : **NA**
Weather :

Supply of 220 KV GSS, 220 Kv Dyra & KTPS disturbed at 14.24 Hrs on dated 13.11.2018 due to cascade tripping at 220 KV GSS Kota (S) i.e. 220 KV Kota (S)- RAPPA Ckt I & III , 220 Kv Kota(S) – Badod , 220 KV Kota(S) – Anta , 220 Kv Kota(S) – RAPPB , 220 Kota(S)- Mandalgarh . Tripping details awaited.

Supply of 220 Kv Kota(S) & Dyra restored at 14.44 Hrs from 220 Kv Kota (S) –Mandalgarh & 220 Kv Kota(S) –RAPPA I.

Due to this tripping KTPS unit No. 2,3,4,5,6,7 tripped at 14.24 Hrs/13.11.2018

13.11.2018

Preliminary Report

Date & Time of event: - : **13.11.2018 at 14.24 Hrs**
Introduction of Event: - : **Multiple trippings at 220 KV GSS Kota**
Total Loss of Load: - : **250MW**
Generation Load : **620MW**
Weather :

Supply of 220 KV GSS Kota(S) & Generation at KTPS disturbed at 14.24 Hrs on dated 13.11.2018 due to cascade tripping at 220 KV GSS Kota (S) as follows.

Name of GSS	Name of Line	Date	Tripping Time Hrs.	Closing Time Hrs.	Relay Indication		Remark
					At Sakatpura end	At Other end	
220 kv Gss sakatpura kota	220KV SAKATPURA-ANTA (NTPC)	13.11.2018	14:24Hrs dt.13.11.2018	15:46 Hrs dt.13.11.2018	Main 1-zone4,dist - 1.7 km ,-186 A 186 B ,R,Y,B phase	phase A,Zone2,dist.59.1 3km	CLOSE AFTER CLEARANCE BY 220 KV GSS Anta & , Charging code NR-1235
	220 KV SAKATPURA-RAPP(A) CIRCUIT NO.2	13.11.2018	14:24Hrs dt.13.11.2018	15:11 HRS dt.13.11.2018	Main 1-zone4,dist - 1.7 km ,-Main-2 186 A 186 B ,R,Y,B phase	M/T ,NO Tripping , No indication	CLOSE AFTER CLEARANCE BY RAPP Charging code NR-1239
	220 KV SAKATPURA-RAPP(A) CIRCUIT NO.1	13.11.2018	14:24Hrs dt.13.11.2018	14:44rs dt.13.11.2018	NO Tripping , No indication	CB Tripped with carear trouble	
	220 KV SAKATPURA-RAPP(A) CIRCUIT NO.3	13.11.2018	14:24Hrs dt.13.11.2018	14:57Hrs dt.13.11.2018	NO Tripping , No indication	CB Tripped with carear trouble	
	220 KV SAKATPURA-Bhanpura	13.11.2018	14:24Hrs dt.13.11.2018		NO Tripping , No indication	Phase zone,2 fault loc.81.2km	Charging code NR-1237,,NL526,WR1 069 closed from bhanpura end only at 16:11 Hrs

Name of GSS	Name of Line	Date	Tripping Time Hrs.	Closing Time Hrs.	Relay Indication		Remark
220 kv Gss sakatpura kota	220 KV SAKATPURA-Mandalgad	13.11.2018	14:24Hrs dt.13.11.2018	14:40Hrs dt.13.11.2018	NO Tripping , No indication	A,B,C Phase zone,2 fault loc.86.2km	
	220KV SAKATPURA-KTPS NO1	13.11.2018	14:24Hrs dt.13.11.2018	15:30Hrs dt.13.11.2018	NO Tripping , No indication		
	220KV SAKATPURA-KTPS NO3	13.11.2018	14:24Hrs dt.13.11.2018	15:32Hrs dt.13.11.2018	NO Tripping , No indication		
	220KV SAKATPURA-KTPS NO4	13.11.2018	14:24Hrs dt.13.11.2018	15:40Hrs dt.13.11.2018	NO Tripping , No indication		
	220/132 KV ,160 MVA TR1	13.11.2018	14:24Hrs dt.13.11.2018	14:59Hrs dt.13.11.2018	NO Tripping , No indication		
	100 MVA TR2	13.11.2018	14:24Hrs dt.13.11.2018	14:49Hrs dt.13.11.2018	NO Tripping , No indication		
	100 MVA TR3	13.11.2018	14:24Hrs dt.13.11.2018	14:59Hrs dt.13.11.2018	NO Tripping , No indication		
	100 MVA TR4	13.11.2018	14:24Hrs dt.13.11.2018	14:49Hrs dt.13.11.2018	NO Tripping , No indication		
	All, 132 KV feeders, Supply restored	13.11.2018		14:49Hrs dt.13.11.2018	NO Tripping , No indication		

Supply of 220 Kv Kota(S)-& Dyra restored at 14.44 Hrs from 220 Kv Kota (S) –Mandalgarh & 220 Kv Kota(S) –RAPPA I.

Due to these trippings at 220 kv Gss sakatpura kota, the KTPS unit No. 2,3,4,5 & 7 tripped at 14.24 Hrs/13.11.2018. Unit No.6 is running and unit No.1 is under shutdown.

S. No.	Name of Sub-Station	Name of Feeder	Modal & make of relay	Frequency setting of relay (HZ)	Date of operation of relay	Exact time of operation of Relay	Approved load relief (MW) from the feeder	Actual Load relief (MW) obtained from the feeder	Total Load Relief at any particular instant (in MW)	Affected Area	Whether power flow it was monitored in SLDC through SCADA	If yes, time of tripping in SCADA SOE	Total impact at state level in SCADA (MW change in drawl of the state)
							MW	MW			Yes/No	Yes/No	MW
1	220 KV GSS, Bhilwara	132KV GSS Devgarh + Karera	MICOM P941	F = 49.80 Hz Df/dt .212.7 m Hz/sec	13.11. 2018	14:27	26	26	49	Karera, Devgarh	No	No	
		132KV GSS Gangapur+ Raipur					23	23		Gangapur & Raipur	No	No	

Rate of Change of Frequency (RoCoF) operation at 220 kV Bhilwara station

j. As per PMU & DR data:
   - As per PMU, maximum dip in all three phase.
   - Fault Clearance time: **1160ms**

- 220 kV Morak-KTPS ckt tripped in Z-1 from Morak end.
- 220 kV Heerapura-KTPS, Vatika-KTPS and Bundi-KTPS ckt tripped in Z-2 from remote end of KTPS.
- As per KTPS DR, Z-4 (reverse zone) started in all the 220 kV feeders but line didn't trip in 500ms

k. Preliminary Report received within 24hrs. DR/EL received for some of the tripped elements. Detailed report is still awaited from RRVPNL.

Points for Discussion*:*

1. Event on 20th Oct 2018:
    a. Exact location of fault and nature of fault.
    b. Reason of delayed clearance of fault.
    c. Failure of which primary and back up protection led to delayed clearance of fault.
    d. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
    e. Back up earth fault setting of 220 kV Bus Coupler-1 needs to be reviewed.
    f. Sequence of tripping needs to be reported and explained. (Time stamped data for the tripping didn't receive)
    g. Tripping of all station transformer (220/6.6kV) on back earth fault protection needs to be reviewed in accordance with current & time delay setting.
    h. Reason of tripping of unit-2 within 200ms of fault occurrence before tripping of all the lines from Kota TPS.
    i. Reverse zone (Z-4 setting) to be co-ordinated with Z-2 timing as per Rama Krishna committee report, same needs to be modified at Kota TPS.
    j. Arrangement of station auxiliary supply and its back up at 220 kV Kota TPS to be shared. Also reason of tripping of all running units needs to be explained.
    k. Availability of time synchronized SCADA SoE to be checked and corrected.
        i. Tripping of units other than 2, 3 & 5
        ii. Tripping of 220 kV feeders from remote end of KTPS

l. Detailed report, remedial measures report and complete DR/EL (cfg, dat file) needs to be submitted by RRVPNL.

2. Event on 13th Nov 2018:
    a. Exact location of fault and nature of fault.
    b. Reason of delayed clearance of fault.
    c. Failure of which primary and back up protection led to delayed clearance of fault.
    d. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
    e. Status of availability of bus bar protection at 220kV Kota (Sakatpura) having four number of bus bars to be shared.
    f. As approved in 25th PSC meeting, temporary arrangement for bus bar protection, could be put in place till actual bus bar protection is available. Status of the same to be apprised. Reason of delayed clearance of fault if arrangement was there?
    g. Sensitive distance protection setting of 220 kV Morak (end)-KTPS ckt to be reviewed.
    h. Reverse zone (Z-4 setting) to be co-ordinated with Z-2 timing as per Rama Krishna committee report, same needs to be modified at Kota TPS.
    i. Rate of change of frequency protection at 220 kV Bhilwara (Raj) needs to be looked into.
    j. Availability of time synchronized SCADA SoE to be checked and corrected.
        i. Tripping of units other than 2, 3 & 5
        ii. Tripping of 220 kV feeders from remote end of KTPS
    k. Detailed report, remedial measures report and complete DR/EL (cfg, dat file) needs to be submitted by RRVPNL.

Discussion during the meeting for 20th Oct 2018 event:

- Rajasthan representative informed about the tripping, after completing the work on 220 kV Bus-3 & 5, RRVUNL was in process of restoring these buses through bus coupler-2 & 3, section-1 was already charged after closing of bus coupler.220 kV Sakatpura ckt-3 was taken on bus-3. When 220 kV Kota TPS-Morak ckt was discharged from 220 kV Bus-2 after charging from 220 kV bus-3, bus coupler-2 tripped on back up earth fault protection and bus coupler-3 also tripped due to flashover on one of the isolator. To attend the flashover of bus isolator when 220kV Kota TPS-Morak ckt again taken on bus coupler-2 and connection on bus coupler-3

was taken out, heavy spark occurred on the bus isolator connected to bus-2 and created bus fault. At the same time 220 kV bus coupler-1 tripped and all the station transformer also tripped. Bus isolator fault occurred only in case of switching of 220 kV Kota TPS-Morak ckt from one bus to other bus. RRVUNL decided to do bus switching for 220 kV Kota TPS-Morak ckt in offline mode only.

- 220 kV bus bar protection was out of service during changeover of feeder from one bus to other bus (general practice in Kota TPS). At the time of incident 220 kV bus bar protection was manually taken out of service.
- Rajasthan representative further informed that at that moment what current flow through the bus coupler is not known due to conventional relays for bus coupler.
- Rajasthan representative informed that, some of the auxiliary supply fed through UAT and some through station auxiliary transformer. Redundancy is not available for station auxiliary transformer.
- NRLDC suggested RRVUNL to check the station event logger details and prepare the complete sequence of event in time stamped (in ms) manner.
- Delhi representative informed that in DTL also such type of isolator failure observed during switching of the feeder from one bus to other bus (for example at Mandola station). Failure occurs due to unbalance current flowing and delay in closing/ opening of the isolator phases and it further resulted into tripping of bus coupler on backup earth fault protection. Due to increased load on the station, current flow through bus coupler reached more than 20A which is higher than the setting value of backup earth fault setting. Relay pickup setting shall be increased from exiting current setting.
- UPPTCL representative also informed that bus bar protection was manually taken out of service at selected location where bus bar protection operated due to auxiliary contact issue. (For example at Bareilly (UP))
- NRLDC raised concern about outage of bus bar protection during changeover of feeder from one bus to other bus. Issue needs to be catered instead of outage of bus bar protection

Discussion during the meeting for 13th Nov 2018 event:

- NRLDC raised concern about complete outage of Kota TPS and Sakatpura station due to non-healthy bus bar protection at 220 kV Sakatpura station and suggested RRVPNL to ensure the healthiness of bus bar protection as soon as possible.

- RRVUNL representative informed that proposal was sent to RRVPNL to reduce the TMS setting of backup over current earth fault and distance protection may be implemented along with differential protection in 220 kV Kota TPS-Sakatpura ckt-1,2,3&4. Distance protection setting may be 5kM distance with 160ms time delay for zone-1.
- RRVPNL representative informed that these four ckts are very important for load management. If there is any delay in fault clearance from Kota TPS end resulted into tripping of all four ckts from Kota TPS to Sakatpura and it further resulted into load load in Sakatpura area.
- RRVUNL representative further informed that, at present two units are radially fed supply towards 400/220 kV Kota (PG) so power flow on 220 kV Kota TPS-Sakatpura lines are almost 100Ampere per ckt. In case of tripping of 220 kV Kota TPS-Sakatpura ckts, Kota TPS generation and Sakatpura load shall not be disturbed.
- NRPC suggested RRVPNL to discuss the remedial measures of implementing distance zone setting (Z-1 setting with 5kM distance and 160ms time delay) in 220 kV Kota TPS-Sakatpura ckts along with differential protection till the time of implementation healthy bus bar protection at 220 kV Sakatpura station.
- Reverse zone setting in all 220 kV feeders at 220 kV Sakatpura station is 160ms and bus coupler setting is 100ms. Bus coupler earth fault setting time delay is 100ms but time delay for back up over current setting is 500ms. In this case as three phase balanced fault so earth fault protection was not picked up and resulted into delayed operation of bus coupler after 500ms on back up over current setting.

G. Multiple element tripping at 400/220 kV Kashipur at 13:28hrs of 25th Oct 2018

Event category: GD-1
Generation loss: 180 MW (As per PTCUL report)
Loss of load: 225 MW (As per PTCUL report)
Energy Unserved: 0.22 MU (PTCUL may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	1640ms	
Phase of the fault	PMU data	Y B-N fault	

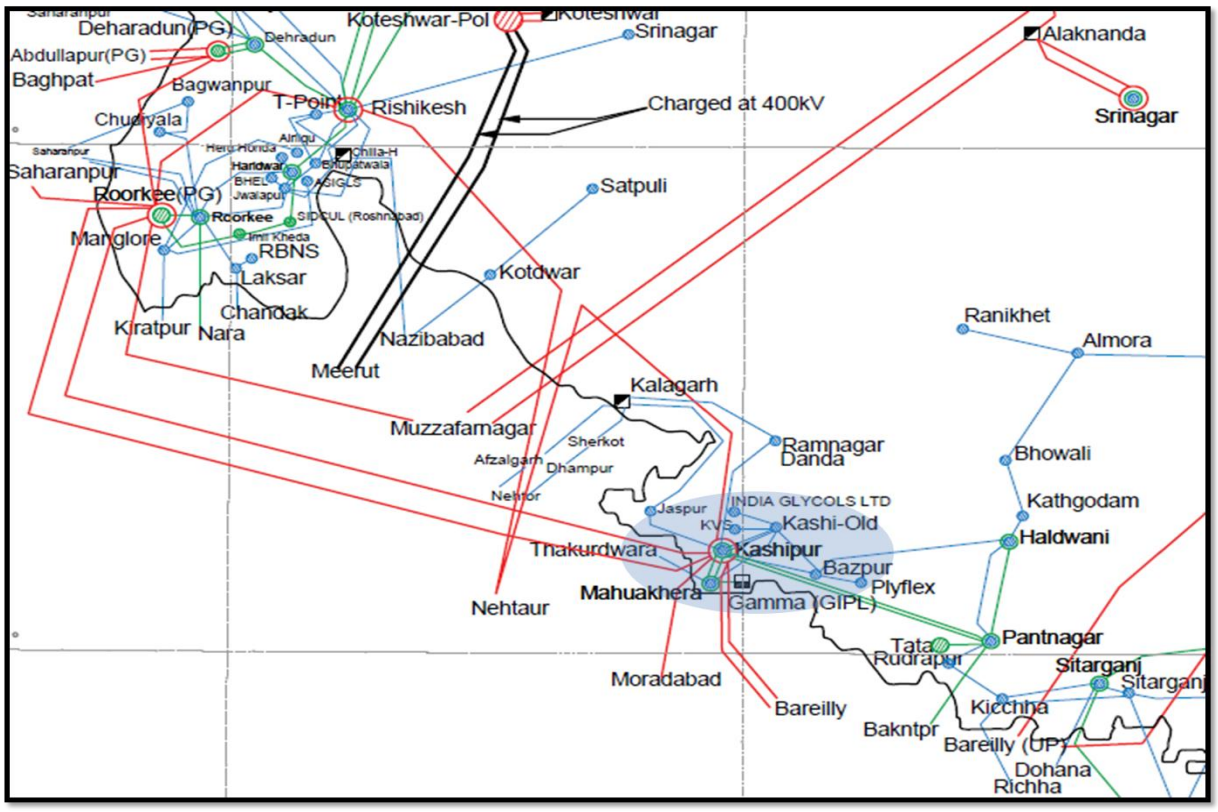
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttarakhand	Not Available	
	Uttar Pradesh	Available (Partial)	
DR/EL	Uttarakhand	Received	After 24hrs
	Uttar Pradesh	Not Received	
Preliminary Report	Uttarakhand	Received	Within 24hrs
	Uttar Pradesh	Not Received	
Detailed Report	Uttarakhand	Not Received	

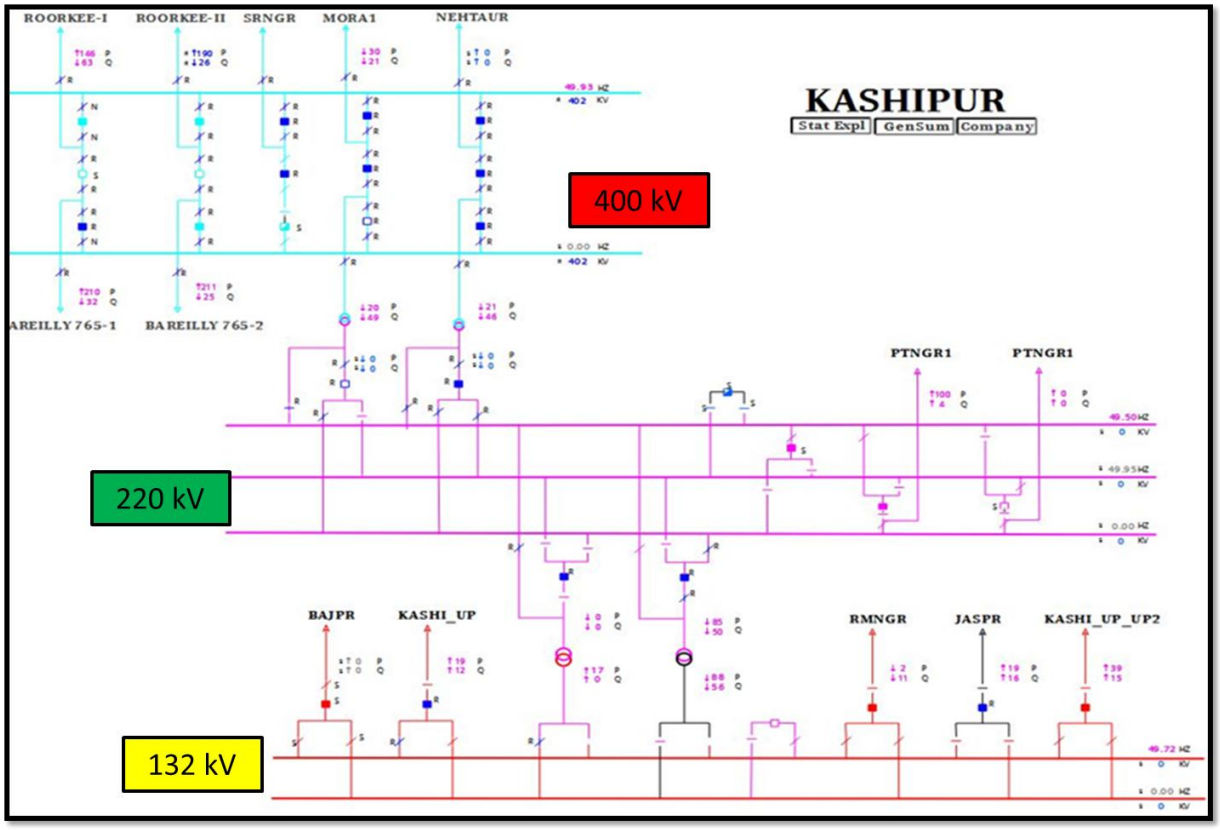
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2 4. CEA GRid Standard 2010-3.e & CEA Transmission Planning Criteria	**Uttarakhand**	1. Detailed Report yet to be received 2.DR/EL received after 24hrs 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system 5. Delayed Clearance of Fault

Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	**Uttar Pradesh**	1. Preliminary Report, DR/EL and detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

1. Connectivity Diagram and SLD of 400 kV Kashipur:





2. 400 kV Kashipur (PTCUL) is connected with Roorkee (PG) D/C, Bareilly (PG) D/C, Moradabad S/C and Nehtaur S/C. It also has two 315MVA 400/220 kV ICT. It has one and half breaker scheme at 400 kV level and DMT (double main transfer breaker) scheme at 220kV level.
3. 220 kV Main Bus-1 and 160MVA transformer-1 was in shut down for maintenance.
4. At 14:28hrs isolator 201-89B (160MVA T/F-1 Main Bus-2 isolator) try to close for returning the shutdown of 160MVA T/F-1 but Y&B phases isolators got stuck mechanically and created a spark on the jaw blades of Y&B phase which results in completely burn of mentioned isolator phases and earthed 220kV Main Bus-2 through insulators which creates a Bus fault at 220 kV side. This resulted into tripping of both 315MVA T/F-1&2, 160MVA T/F-2, All 220 kV feeders and also 400 kV Nehtaur and Moradabad lines.
5. This resulted into total blackout at 132 kV S/S Kashipur, Bazpur, Jaspur, Ramgnagar and 220 kV Mahuakheraganj station.
6. Name of the tripped elements are as below:
    - 400kV Kashipur (UTT)-Nehtaur 400 (UP)
    - 400kV Kashipur(UTT)-Moradabad(UP)
    - 315 MVA ICT 1 at 400/220kV Kashipur(UTT)

- 315 MVA ICT 2 at 400/220kV Kashipur(UTT)
- 160 MVA ICT 2 at 220/132kV Kashipur(UTT)
- 400kV Kashipur (UTT)-Pantnagar(UTT) ckt-1
- 400kV Kashipur (UTT)-Pantnagar(UTT) ckt-2

7. As per PTCUL Report:

Time and date of event- 25-10-2018 at 13:28Hrs (as per GPS time)

Location- 400KV Substation Kashipur.

Description and cause of event- 220kV Main Bus-1 and 160MVA T/F-1 was in shut down for maintenance. At 14:28Hrs Isolator 201-89B (160MVA T/F-1 Main Bus-2 Isolator) try to close for returning the shutdown of 160MVA T/F-1 but Y and B Phases of isolators got stuck mechanically and created a spark on the jaw blades of Y and B Phase which results in completely burn of mentioned isolator phases and earthed 220kV Main Bus-2 through insulators which creates a Bus fault at 220kV side. This resulted into tripping of Both 315MVA T/F-1&2, 160MVA T/F-2, All 220kV feeders and also 400kV Nehtaur and Moradabad Lines.

Generation Loss- 182 MW (As per Previous Hour reading)

Loss of load- 225 MW (As per Previous Hour reading)

Analysis-

1- At 13:28Hrs, During the closing of isolator, Y and B Phases of isolator got stuck and created a spark between the blades of isolator.
2- This result into failure of insulator of isolator and earthed 220kV Main Bus-2 through Bus Post Insulators. This resulted into a 220kV Bus Fault.
3- This fault current was fed through all Transformers, all 220kV and 400kV Lines, Which results into tripping of the following feeders and Transformers :-
   a) 400kV Moradabad Line at Moradabad end
   b) 400kV Nehtaur Line at both ends
   c) Both 315MVA T/F-1&2
   d) Both 160MVA T/F-2
   e) 220kV SEPL, Mahuakheraganj, Pantnagar-1&2 Circuits, all tripped at other ends.
4- This results into total blackout at 132kV Substation Kashipur, Bazpur, Jaspur, Ramnagar and 220kV S/S Mahuakheraganj.

Action Taken-

1-220kV Main Bus-2 shutdown taken for replacing burnt isolator and all the 220kV Supply was resumed through 220kV Main Bus-1.

2-At 14:25Hrs Both 315MVA T/F-1&2 charged.

3-220kV Pantnagar closed at 14:44Hrs, 220kV Pantnagar closed at 14:45Hrs,220kV Mahuakheraganj closed at 14:46HRs and 220kV SEPL closed at 14:51HRs.

4-160MVA T/F-2 charged at 14:53HRs.

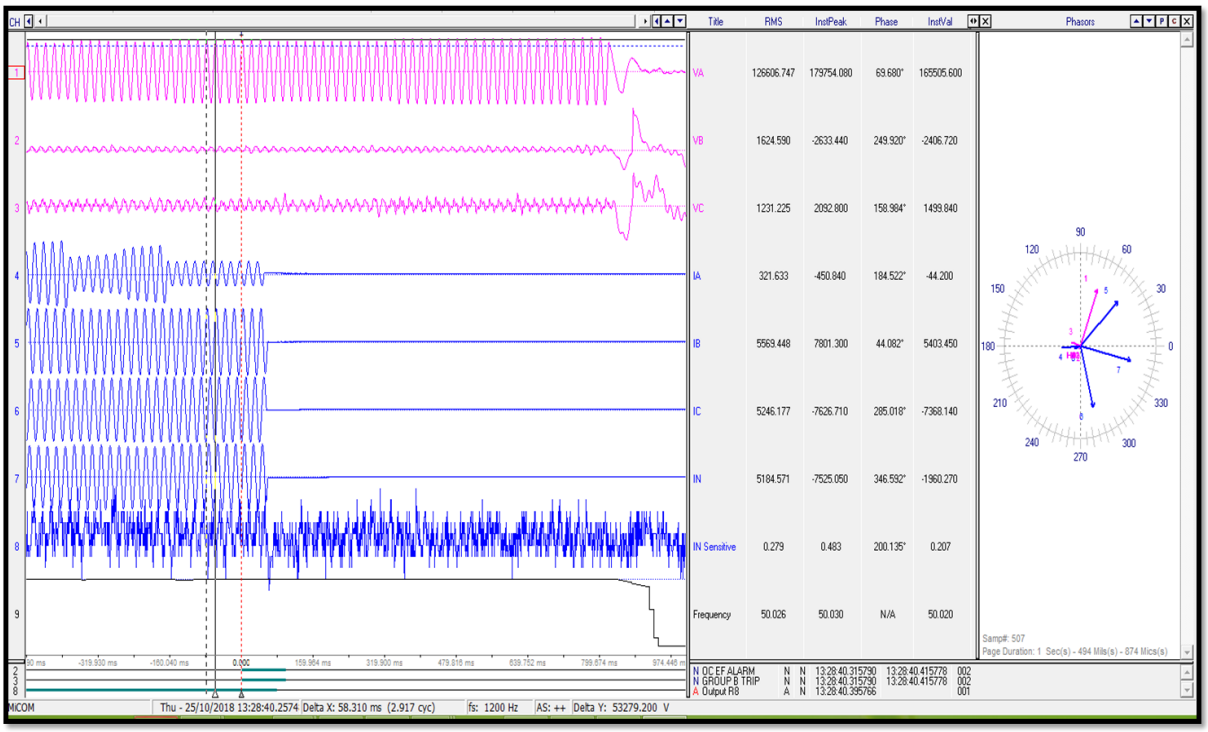
5-All 132kV feeders was closed one by one at 15:01HRs.

6-160MVA T/F-1 was closed through 220kV TBC at 15:54HRS.

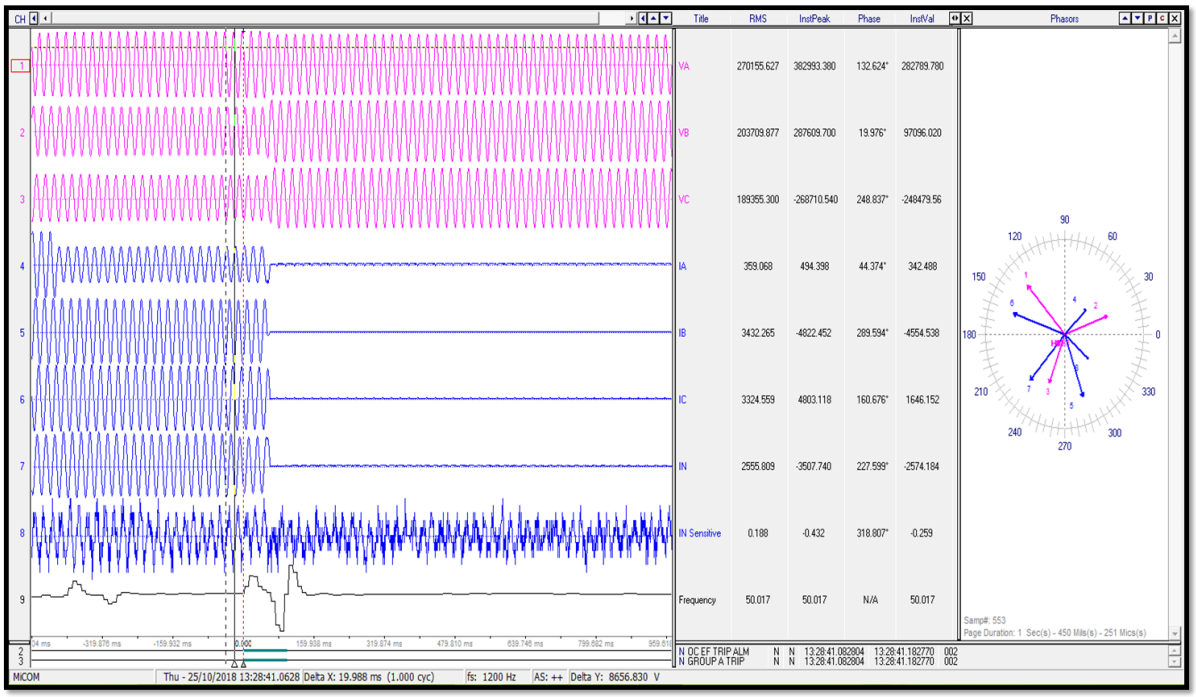
- W.

8. As per DR details:

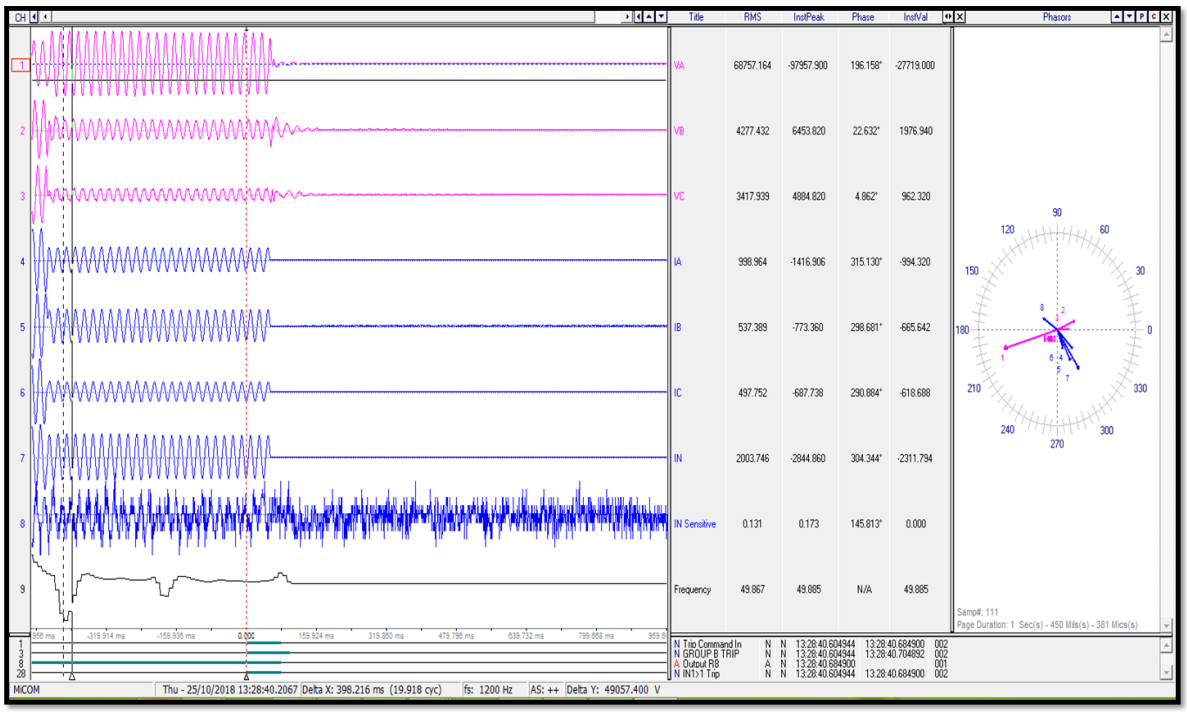
DR of 315MVA ICT-1 (LV) at Kashipur (Uttarakhand)



DR of 315MVA ICT-2 (HV) at Kashipur (Uttarakhand)



DR of 160MVA ICT-2 at Kashipur (Uttarakhand)



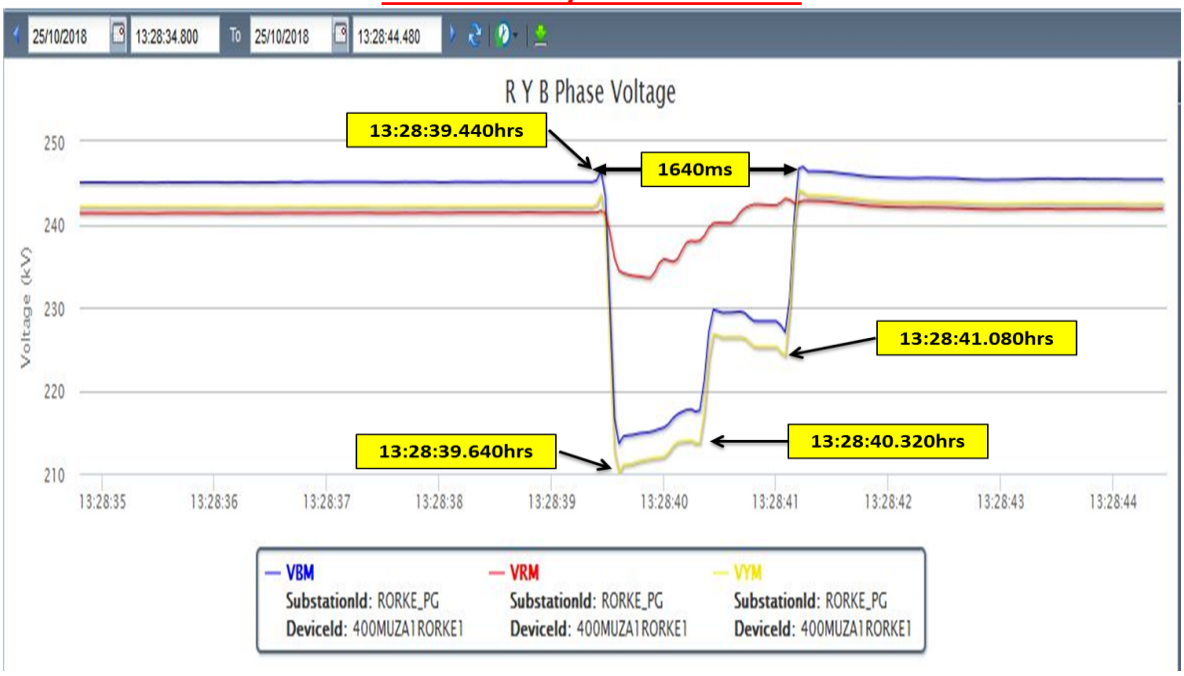
9. PMU plots:

PMU Plot of frequency at Bassi(PG)

13:28hrs/25-Oct-18

PMU Plot of phase voltage magnitude at Roorkee(PG)

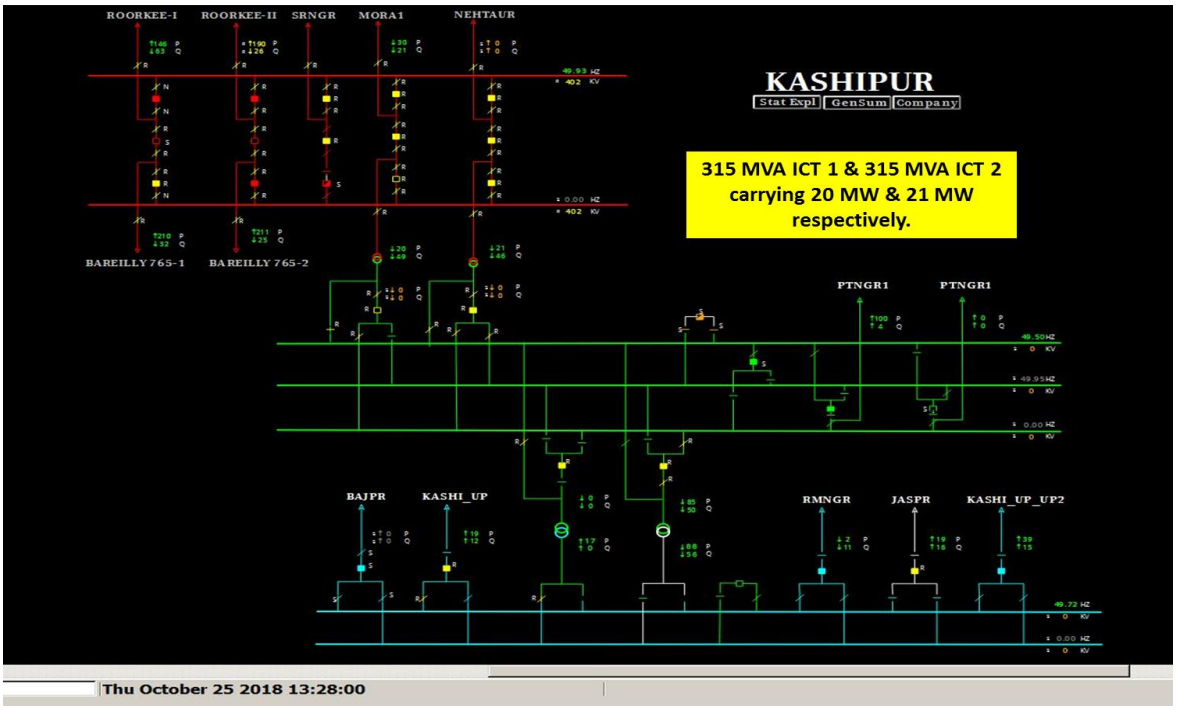
13:28hrs/25-Oct-18



10. As per SCADA SLD:

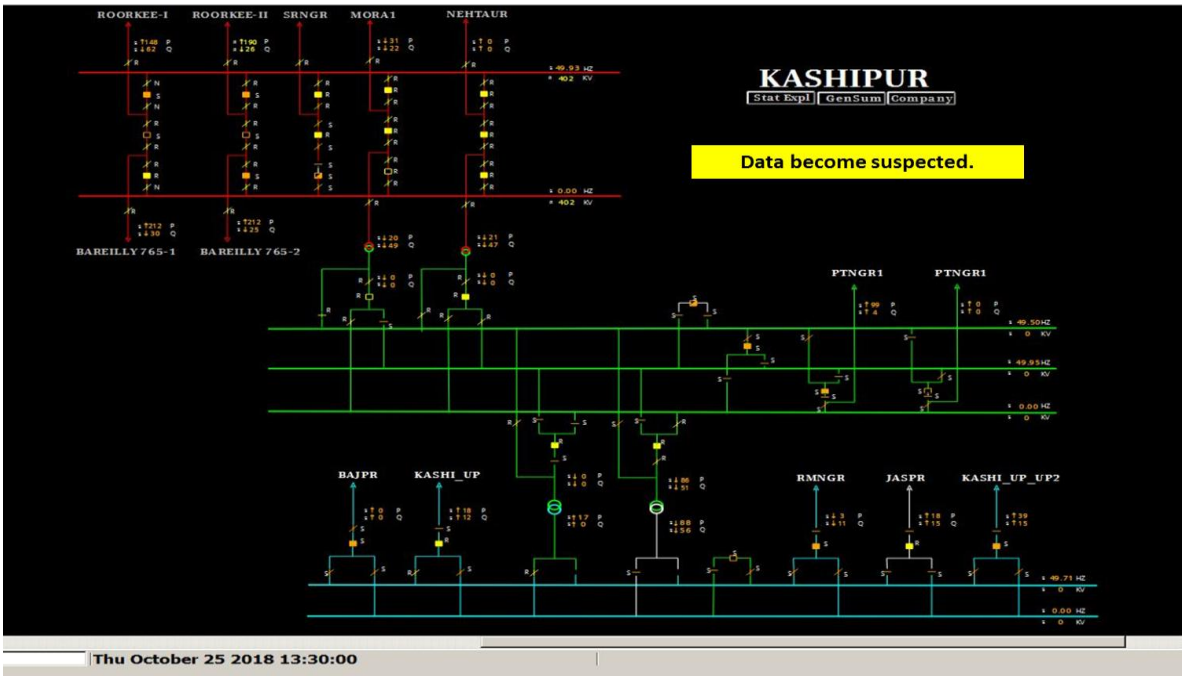
SLD of 400/220kV Kashipur(UTT) before the incident

13:28hrs/25-Oct-18



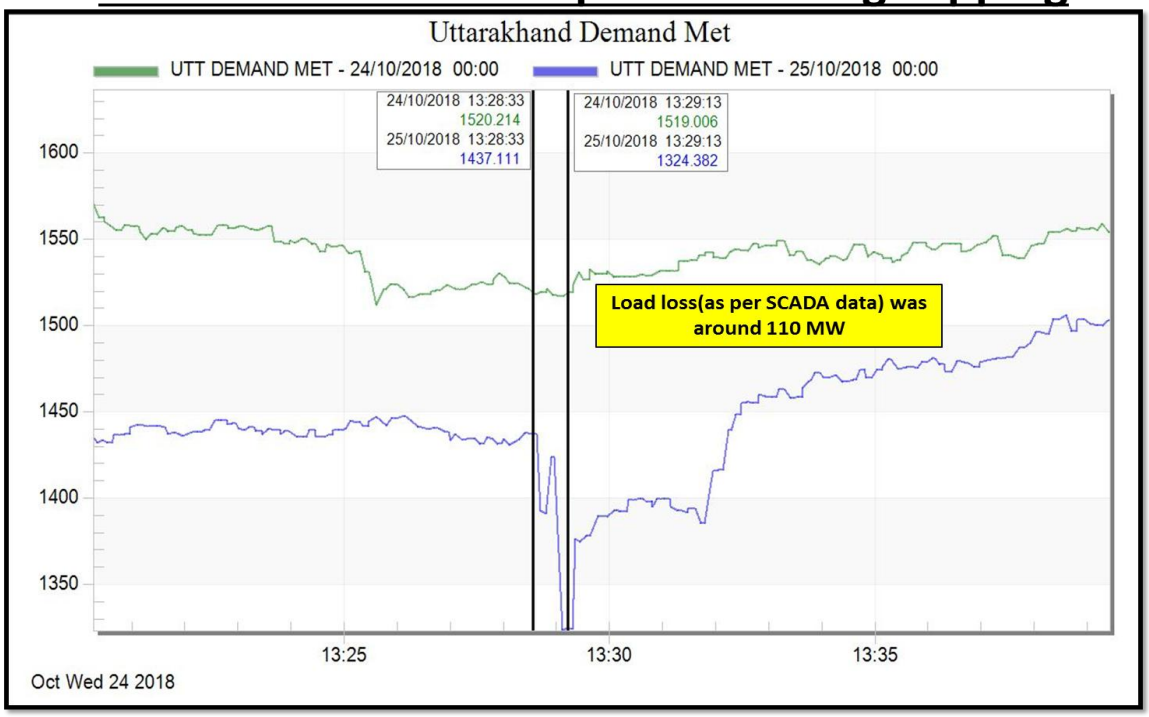
SLD of 400/220kV Kashipur(UTT) after the incident

13:30hrs/25-Oct-18



11. As per SCADA data plot:

Uttarakhand Demand pattern during tripping



12. As per SCADA SoE:

Time (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status
13:28:40,503	MORA1_UP	400kV	F_02(KASHI)	CB	Open
13:29:58,453	NHTR1_U	400kV	09KASHI	CB	Open
13:29:58,453	NHTR1_U	400kV	08T2KSHI	CB	Open

13. As per PMU, SCADA & DR data:
    - As per PMU, maximum dip in Y&B-phase.
    - Fault Clearance time: **1640ms**
    - SoE captured, it seems time synch error. (Tripping time captured in SCADA SoE is 800ms before the actual fault time (PMU reference time)
    - It seems 400/220 kV ICTs (ICT-1 & 2) of Kashipur tripped on back up protection

14. Preliminary Report, DR/EL has been received from Uttarakhand but detailed report is still awaited.
15. Preliminary Report, DR/EL is still awaited from UPPTCL.

Points for Discussion*:*

1. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared
2. Exact location of fault and nature of fault.
3. Sequence of tripping needs to be reported and explained.
4. Reason of delayed clearance of fault.
5. Delayed clearance of fault in case of operation of bus bar protection for both 220 kV bus at 400/220 kV Kashipur (PTCUL) needs to be relooked.
6. Delayed clearance of fault more than 1640ms in case of operation of instantaneous bus bar protection operation also to be checked.
7. Healthiness of 220 kV bus bar protection of 400/220 kV Kashipur (PTCUL) needs to be ensured.
8. Availability of time synchronized SCADA SoE to be checked and corrected.
9. Reason of tripping of 400 kV Moradabad-Kashipur and Nehtaur-Kashipur ckts and its protection co-ordination with back up protection setting of 400/220 kV ICTs at Kashipur (PTCUL).
10. Detailed report, remedial measures report and supporting DR/EL needs to be submitted by UPPTCL.

NRPC raised concern about absence of concerned person from constituents and requested all the STU/SLDC to share the feedback with concerned utilities.

H. Multiple Element tripping at 400/220kV Bhiwadi Station at 08:14hrs of 24th Nov 2018

Event category: GI-2
Generation loss: Nil MW (Rajasthan may confirm)
Loss of load: Nil MW (Rajasthan may confirm)
Energy load: Nil MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks

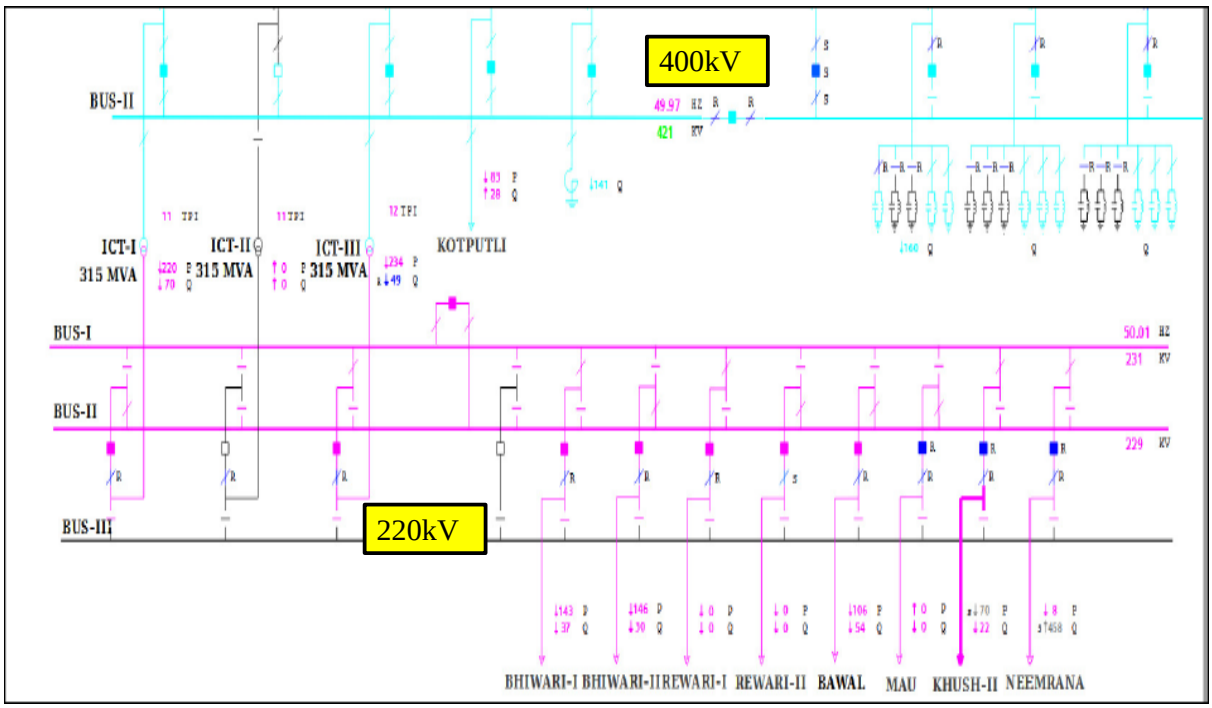
Fault Clearance Time		**120ms**	As per PMU data
Phase of the fault		Maximum dip in Blue-phase	As per PMU data

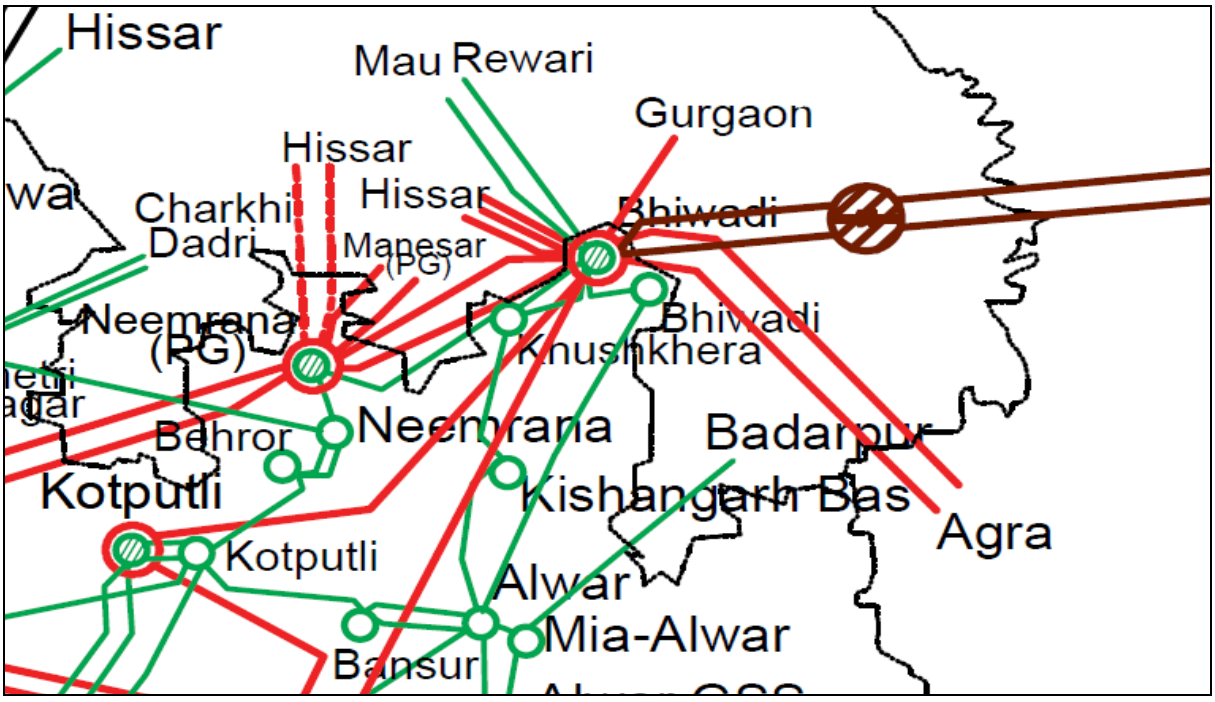
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)		Partially Received	Time Synch error
DR/ EL	POWERGRID	Received	
	Rajasthan	Not received	
Preliminary Report	POWERGRID	Received	
	Rajasthan	Not received	
Detailed Report	POWERGRID	Not received	

Description	**Clauses**	**Utility**	**Remarks**
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3 3. CEA (Technical standards for connectivity to the Grid) Regulation, 2007-6. 4.d 4. 43.4.A of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; 5. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)	**POWERGRID**	1. Detailed rpeort yet to be received 2. Adequately Sectionalized and graded protective relaying system
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**Rajasthan**	1. Preliminary Report, DR/EL yet to be received

Based on above information description of the events is:

1. Single Line Diagram and connectivity diagram of Bhiwadi (PG):





2. 220kV Bhiwadi (PG) is connected with Rewari D/C, Bhiwadi (Raj) D/C, Mau S/C, Kushkhera S/C, Bawal S/C and Neemrana S/C. It also has three 315MVA 400/220 kV ICTs. It has DMT (double main transfer) scheme at 220kV and one and half breaker scheme at 400 kV level.

3. B-N fault occurred in 220kV Bhiwadi(PG)-Kushkhera ckt. This ckt tripped without A/R at both end.
4. At the same time 220 kV bus bar protection for 220 kV bus-2 of Bhiwadi (PG) operated.
5. It resulted into multiple element tripping in the system and all the 220 kV feeders connected to 220 kV bus-2 of Bhiwadi (PG) tripped along with 400/220 kV 315MVA ICT-1 & 3.
6. DR details of different element tripping has been received but DR details of 220 kV bus bar protection is still awaited
7. Name of the tripped element:
    - 220kV Bhiwadi(PG)-Kushkhera(RVPNL) ckt-2
    - 220kV Bhiwadi(PG)-Bhiwadi(RVPNL) ckt-2
    - 220kV Bhiwadi(PG)-Mau(HVPNL)
    - 315 MVA ICT 1 at 400/220kV Bhiwadi(PG)
    - 315 MVA ICT 3 at 400/220kV Bhiwadi(PG)
    - 220kV Bhiwadi(PG)-Rewari(HVPNL) ckt-1
    - 220kV Bhiwadi(PG)-Rewari(HVPNL) ckt-2
    - 220kV Bus 2 at 400/220kV Bhiwadi(PG)

8. It seems, in antecedent condition 220 kV Bhiwadi-Mau ckt & Bhiwadi-Rewari ckt-2 was under outage from remote end of Bhiwadi (PG).

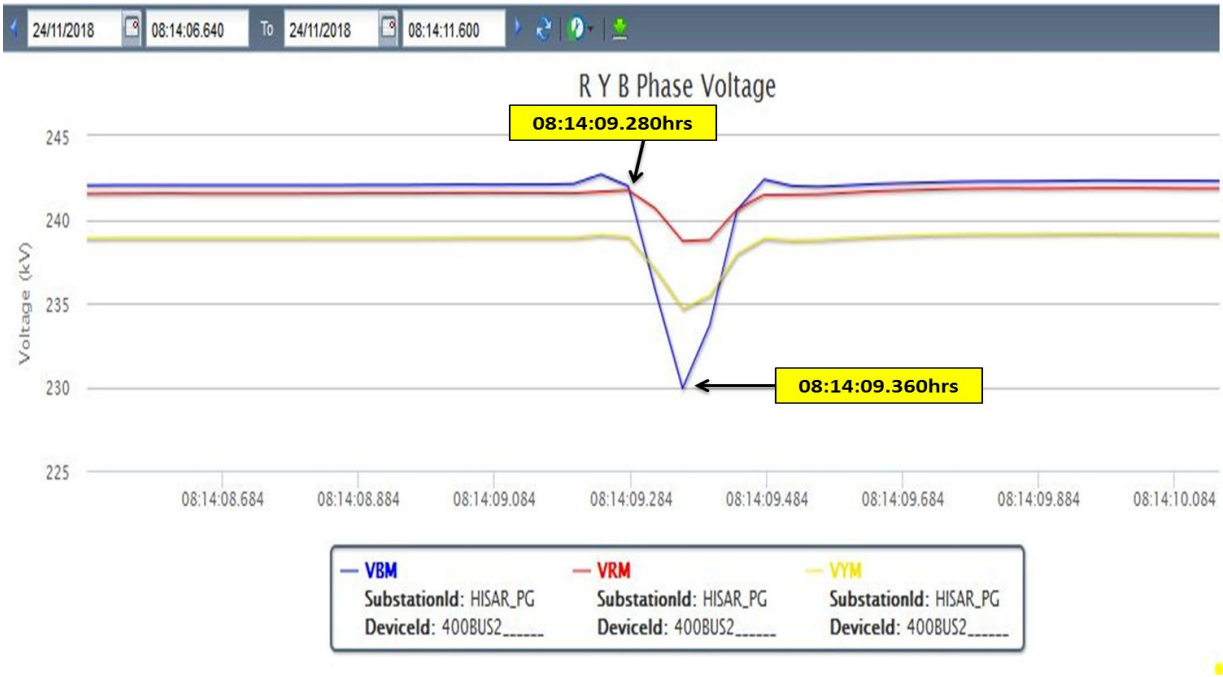
9. PMU plots:

PMU Plot of frequency at Bassi(PG)

08:14hrs/24-Nov-18

PMU Plot of phase voltage magnitude at Hisar(PG)

08:14hrs/24-Nov-18



10. As per PMU data:
    - B-N fault occurred at 08:14:09.280hrs and cleared in **120ms**.

11. SCADA data and SoE:

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
08:14:09:423	KHUSHKEDA	220kV	E_02(BHIWA-2)	Circuit Breaker	disturbe	
08:14:09:423	KHUSHKEDA	220kV	E_02(BHIWA-2)	Circuit Breaker	Open	Main CB of 220kV Bhiwadi(PG)-Kushkhera(RVPNL) ckt-2 opens.
08:14:09:405	BHIWADI	220kV	03T3	Circuit Breaker	Open	220kV Side Main CB of 315 MVA ICT 3 at Bhiwadi(PG) opens.
08:14:10:358	BHIWADI	400kV	3T1	Circuit Breaker	Open	400kV Side Main CB of 315 MVA ICT 1 at Bhiwadi(PG) opens.
08:14:10:359	BHIWADI	220kV	01T1	Circuit Breaker	Open	220kV Side Main CB of 315 MVA ICT 1 at Bhiwadi(PG) opens.
08:14:10:359	BHIWADI	400kV	2T1AG1	Circuit Breaker	Open	400kV Side Tie CB of 315 MVA ICT 1 at Bhiwadi(PG) opens.
08:14:10:359	BHIWADI	220kV	09RWARI2	Circuit Breaker	Open	Main CB of 220kV Bhiwadi(PG)-Rewari(HVPNL) ckt-2 opens.
08:14:10:360	BHIWADI	220kV	07BHIWR2	Circuit Breaker	Open	Main CB of 220kV Bhiwadi(PG)-Bhiwadi(RVPNL) ckt-2 opens.
08:14:10:654	BHIWADI	220kV	04MBC	Circuit Breaker	Open	220kV Side Bus coupler opens.

12. As per SCADA SoE:
    a. As per SCADA SoE, feeders at Bhiwadi tripped at different timings (SCADA SoE time needs to be checked).

13. As per POWERGRID details:

220kV Bhiwadi(PG)-Khushkhera(R) tripped at 08:14:09 Hrs in Zone-1 from Bhiwandi(PG) end on B -N fault(Jumper snap at location no. 20 of 220kV PG Bhiwadi- Khuskhera line as reported by RVPNL person). During fault detected in 220kV Bhiwadi(PG)-Khushkhera(R), Bus Bar-2 Protection operated and following feeders connected to Bus-2 along with Bus Coupler tripped immediately .

a) 220KV ICT-1

b) 220KV ICT-3 (220kV side CB)

c) 220KV Bhiwadi-2

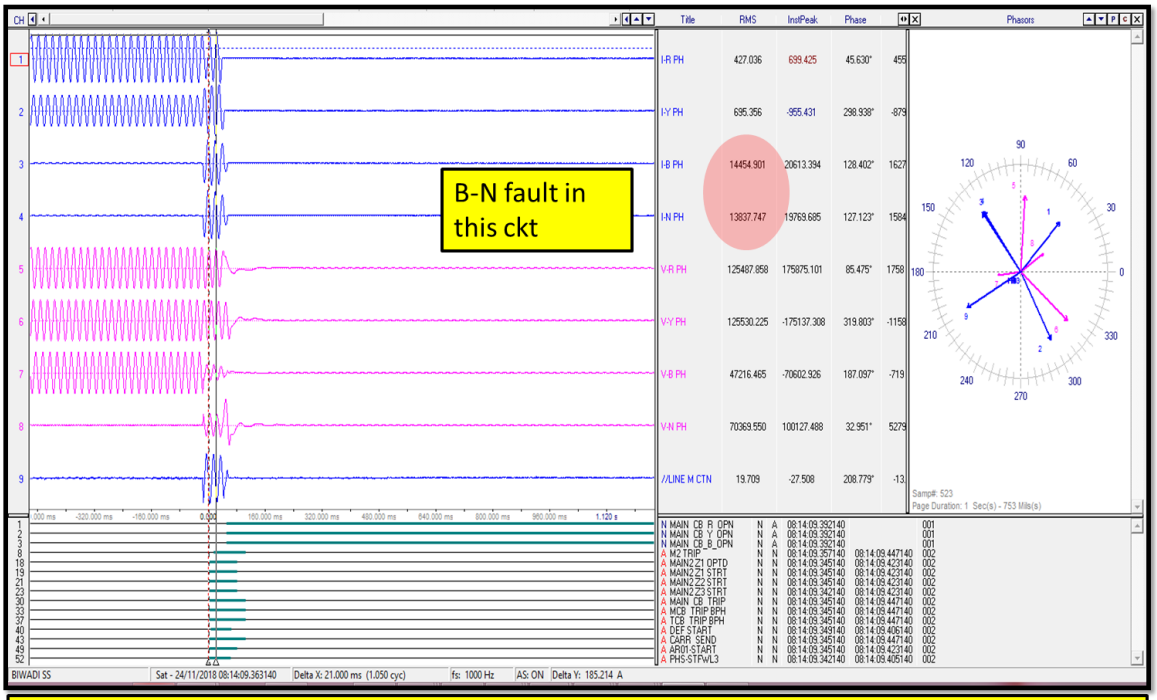
d) 220KV Rewari-2

e) 220KV Mau

Charging Sequence:

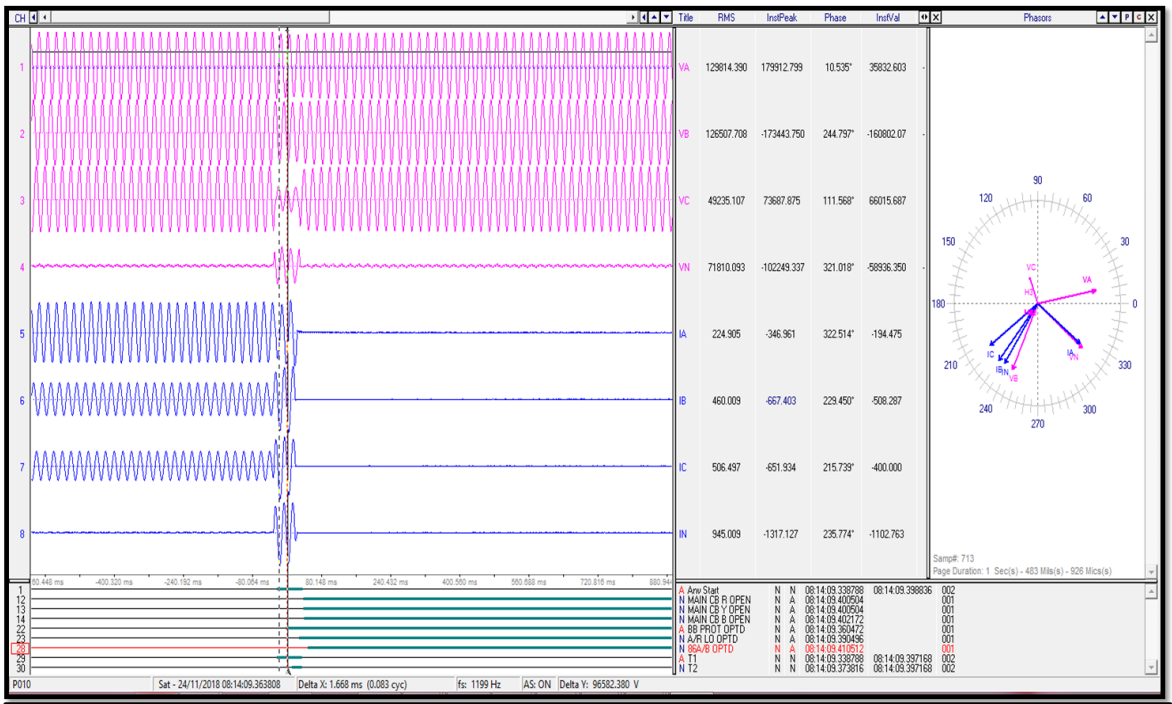
1. 220KV Bus-2 & Bus coupler	Restored at 09:18 Hrs
2. 315MVA ICT-1	Restored at 09:18 Hrs
3. 315MVA ICT-3	Restored at 09:43 Hrs
4. 220KV Rewari-2	Restored at 09:45 Hrs
5. 220KV Mau line	Restored at 10:00 Hrs
6. 220KV Bhiwadi-2 line	Restored at 09:55 Hrs
7. 220KV Khushkhera line	Under shutdown by RVPNL

DR of 220 kV Bhiwadi (PG) (end)-Kushkhera



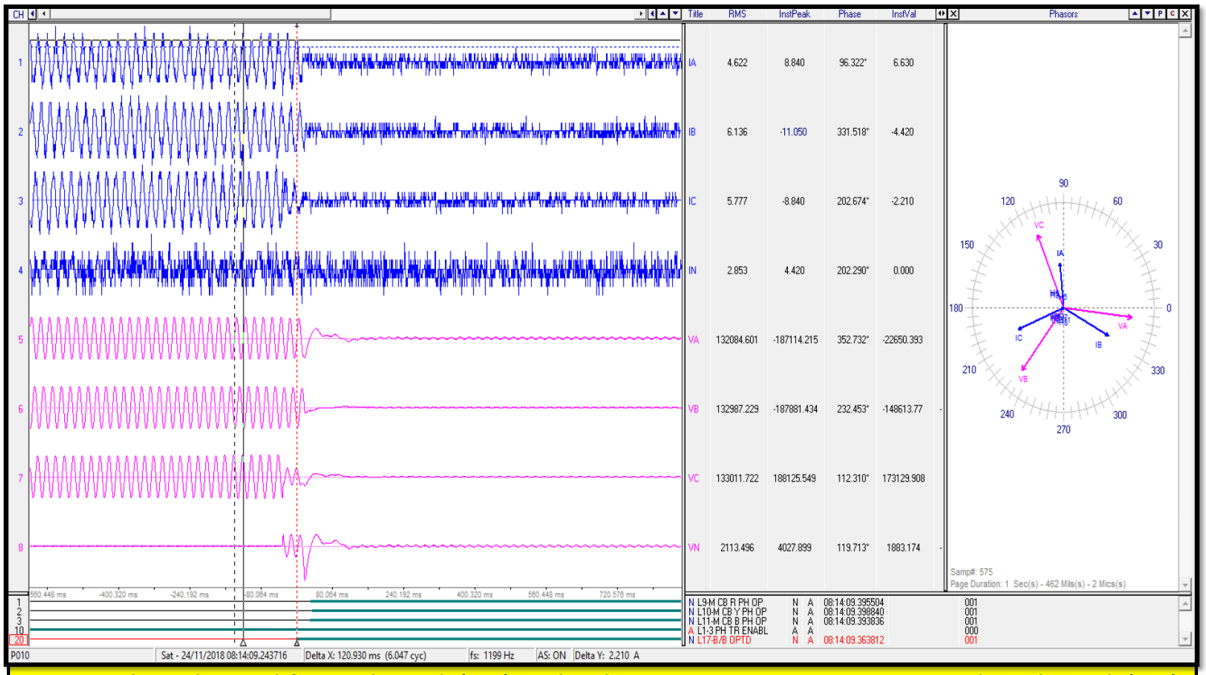
All three phase of the line tripped from both end without any auto reclosure operation on B-N (Blue phase) fault. A/R needs to be checked and put in service at both end.

DR of 220 kV Bhiwadi (PG) (end)-Bhiwadi (Raj) ckt-2



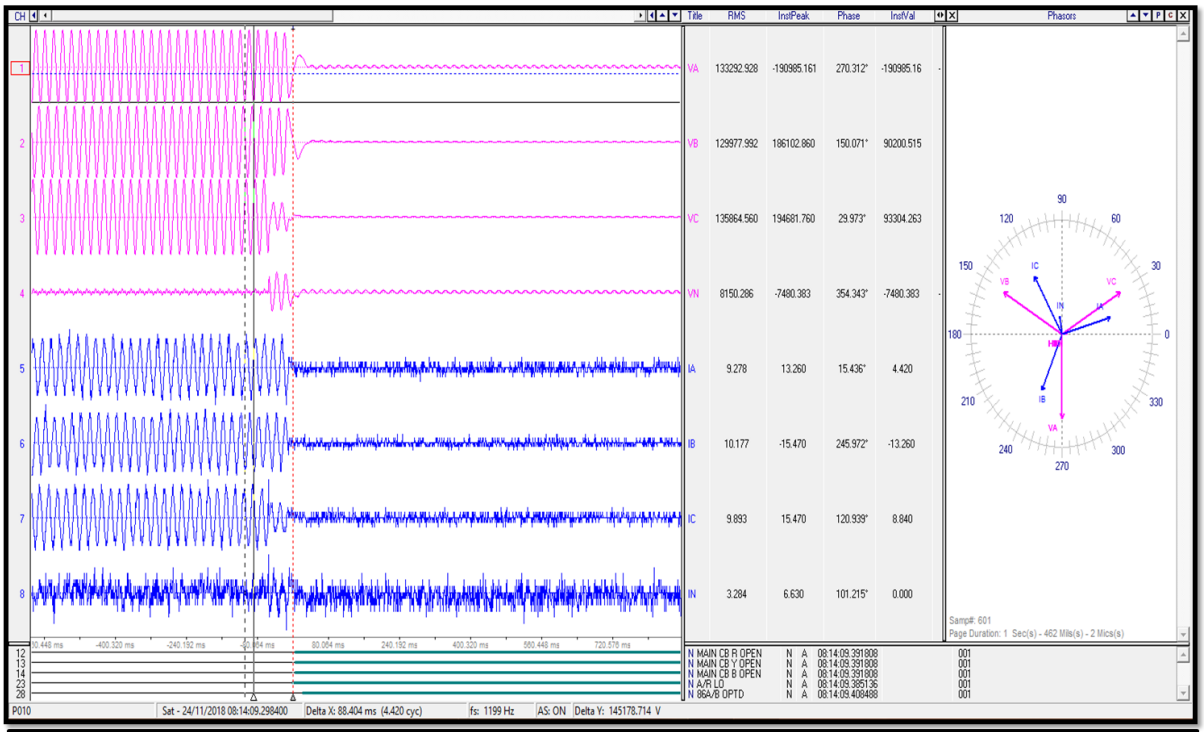
Tripped on master trip relay operation

DR of 220 kV Bhiwadi (PG) (end)-Mau



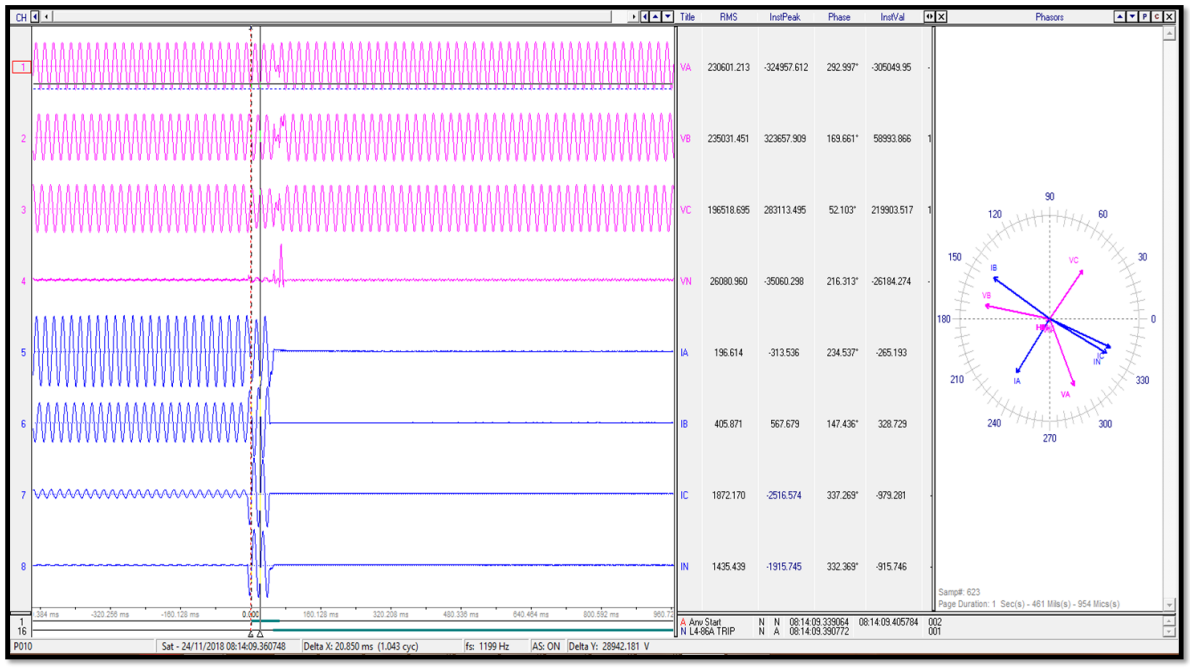
It seems line charged from Bhiwadi (PG) end only. Bus Bar protection operated at Bhiwadi (PG)

DR of 220 kV Bhiwadi (PG) (end)-Rewari ckt-2



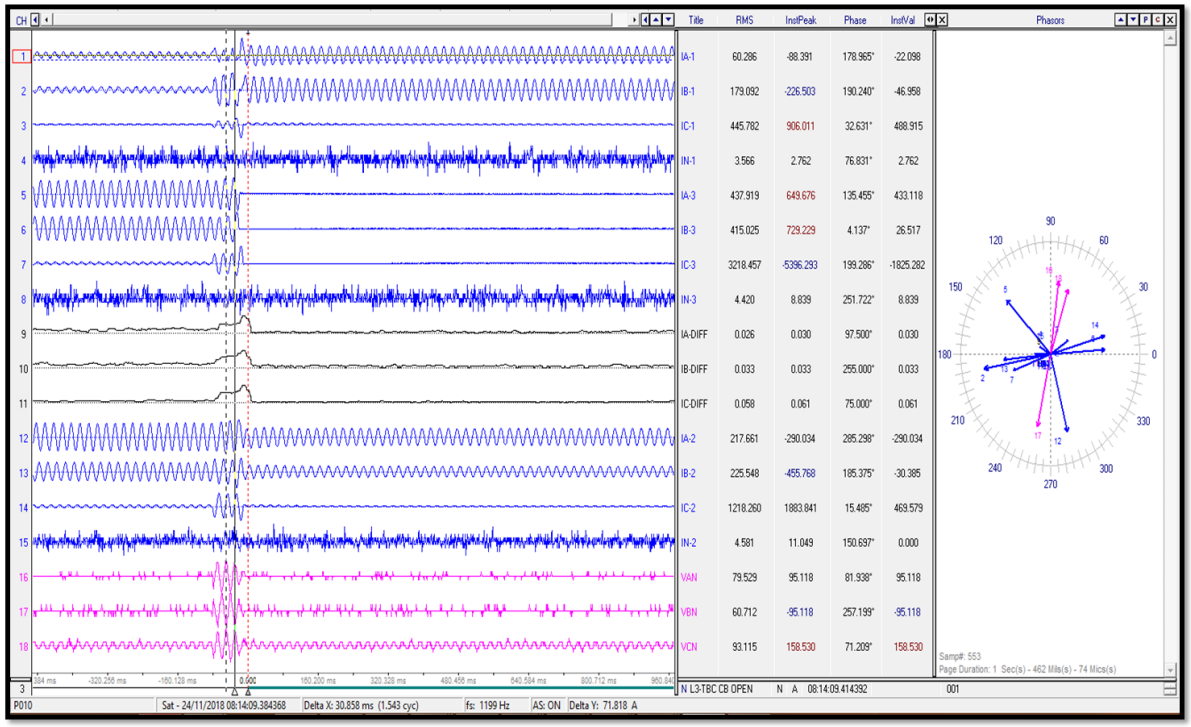
It seems line charged from Bhiwadi (PG) end only. Bus Bar protection operated at Bhiwadi (PG)

DR of 315MVA 400/220 kV ICT-1 at Bhiwadi (PG)



Inter tripping not observed for ICT-1?

DR of 315MVA 400/220 kV ICT-3 at Bhiwadi (PG)



14. Preliminary Report, DR/EL has been received from POWERGRID but detailed report is still awaited.
15. Details are still awaited from Rajasthan.

POWERGRID representative informed during the meeting:

1. A/R in 220 kV Bhiwadi (PG)-Kushkhera ckt (both end) needs to be checked and put in service: *Non-auto mode as auto reclosure is not working at Kushkhera end.*
2. Reason of operation of bus bar protection at 220kV Bhiwadi (PG) during through fault needs to be relooked: *Exact reason couldn't identify however relay replacement to be done.*
3. Operation of bus bar protection during through fault also observed in past on 22nd Jan 2018 & 26th July 2018. Remedial measures taken by POWERGRID for earlier incident: *Bus Bar Protection was under observation after operation of bus bar protection. Once relay module got damage and same was replaced. CT associated with faulted phase was also checked for earlier incident to rule out CT saturation. CT saturation was also not found. Now this ABB make RADSS bus bar protection relay is going to be replaced.*
4. Status of ABB make RADSS bus bar protection replacement with new numerical bus bar protection at 220 kV Bhiwadi (PG): *It shall be completed by March-2019*
5. Why 220 kV Mau & Rewari ckt-2 was already under tripped condition from remote end of Bhiwadi (PG): *These ckts was under outage from remote end. Haryana may confirm the further details.*
6. At Bhiwadi(PG), time of opening of CB as captured from SCADA SoE is not consistent with PMU based fault timings. Time synchronization in view of above needs to be checked at Bhiwadi(PG): *Time synchronization will be cross checked with RLDC SCADA SoE log at the time of next shutdown*.
7. Delayed tripping of bus coupler also to be checked: *It may be due to time synch error otherwise other connected elements may have tripped in Z-2. Delayed clearance had also captured in PMU data.*

Rajasthan representative informed that auto reclosure in 220 kV Bhiwadi (PG)-Kushkhera ckt is in healthy condition and also in enable condition. End to end testing can be done.

NRPC suggested all the NR utilities to kindly put auto reclosure in service for all 220 kV and above transmission lines.

I. Multiple Element tripping at 400/220kV Kirori (Haryana) on 20th Dec 2018 at 01:22hrs

Event category: GI-2
Generation loss: Nil (As per Haryana Report)
Loss of load: Nil (As per Haryana Report)
Energy Loss: Nil MU (As per Haryana Report)

Data Summary received at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	1280ms	
Phase of the fault	PMU data	R-N fault followed by Y-N fault	

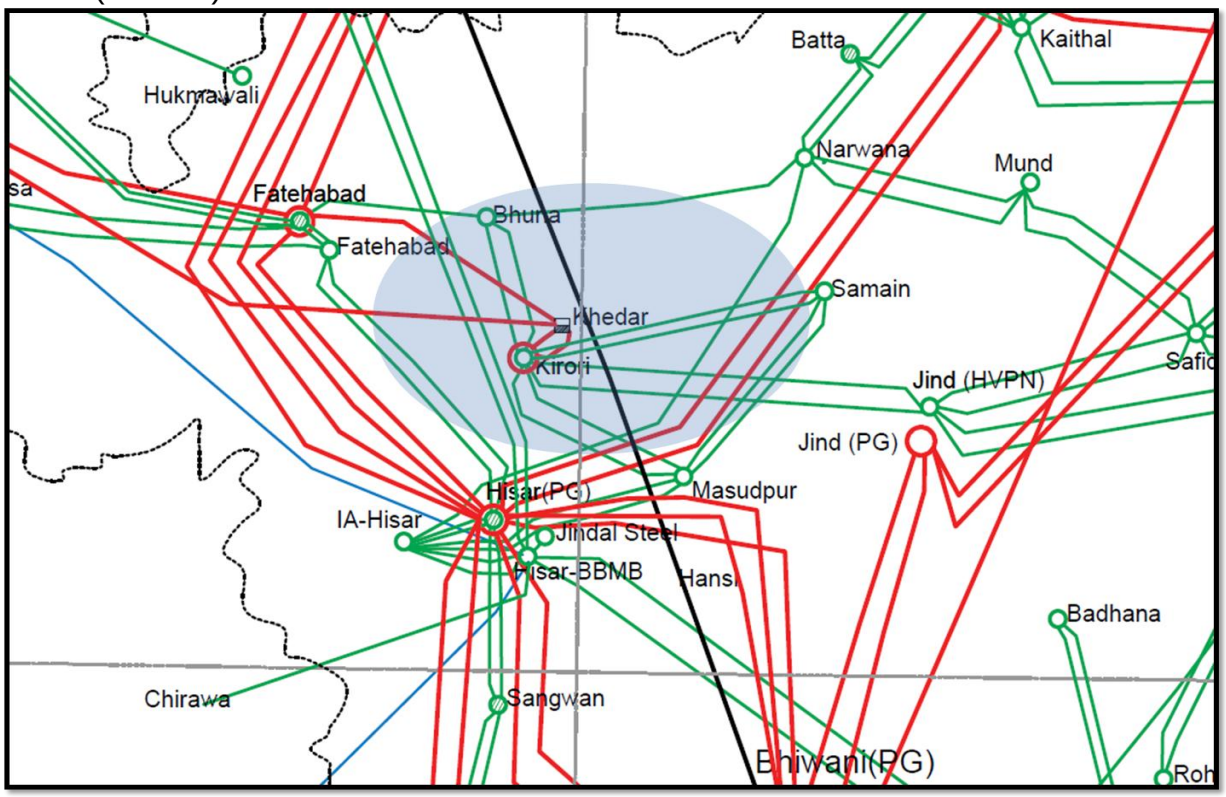
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Haryana	Not Availble	
DR/EL	Haryana	Received	DR/EL of Khedar end not received
Preliminary Report	Haryana	Received	
Detailed Report	Haryana	Not Received	

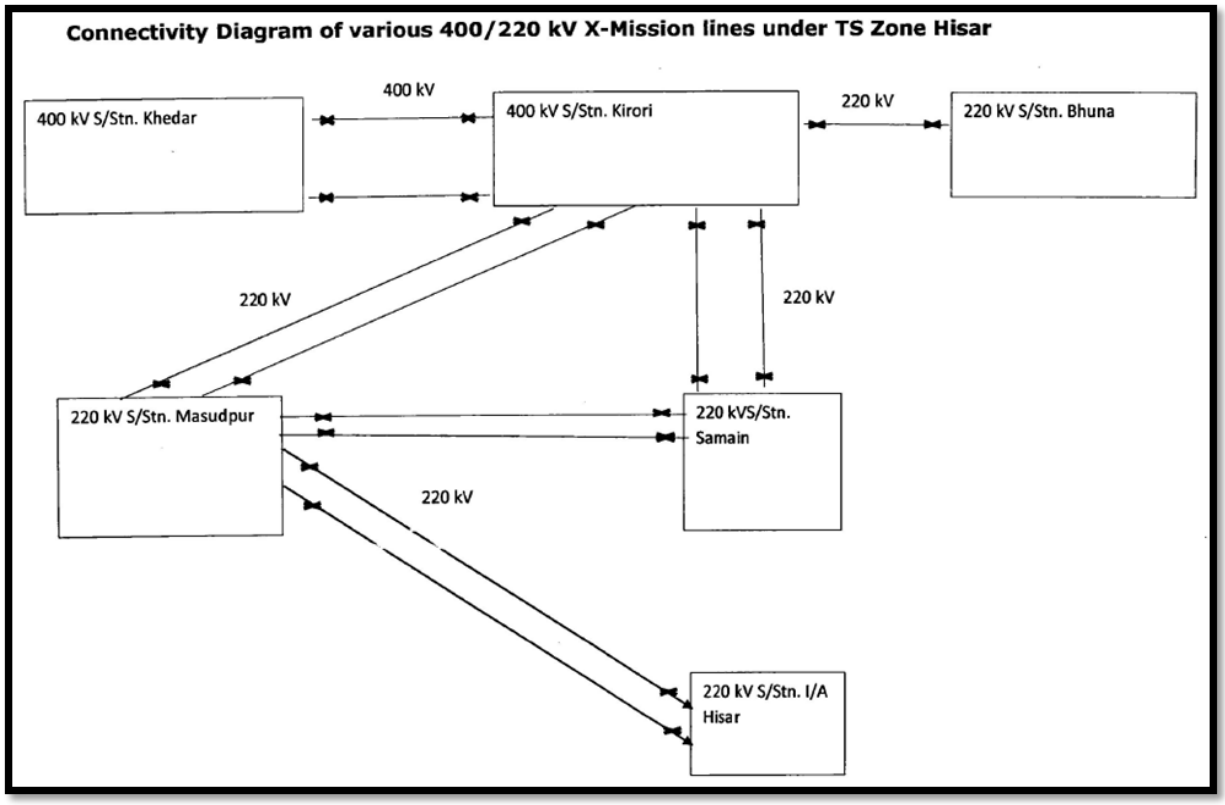
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013),	**Haryana**	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system

	part-II, B2		

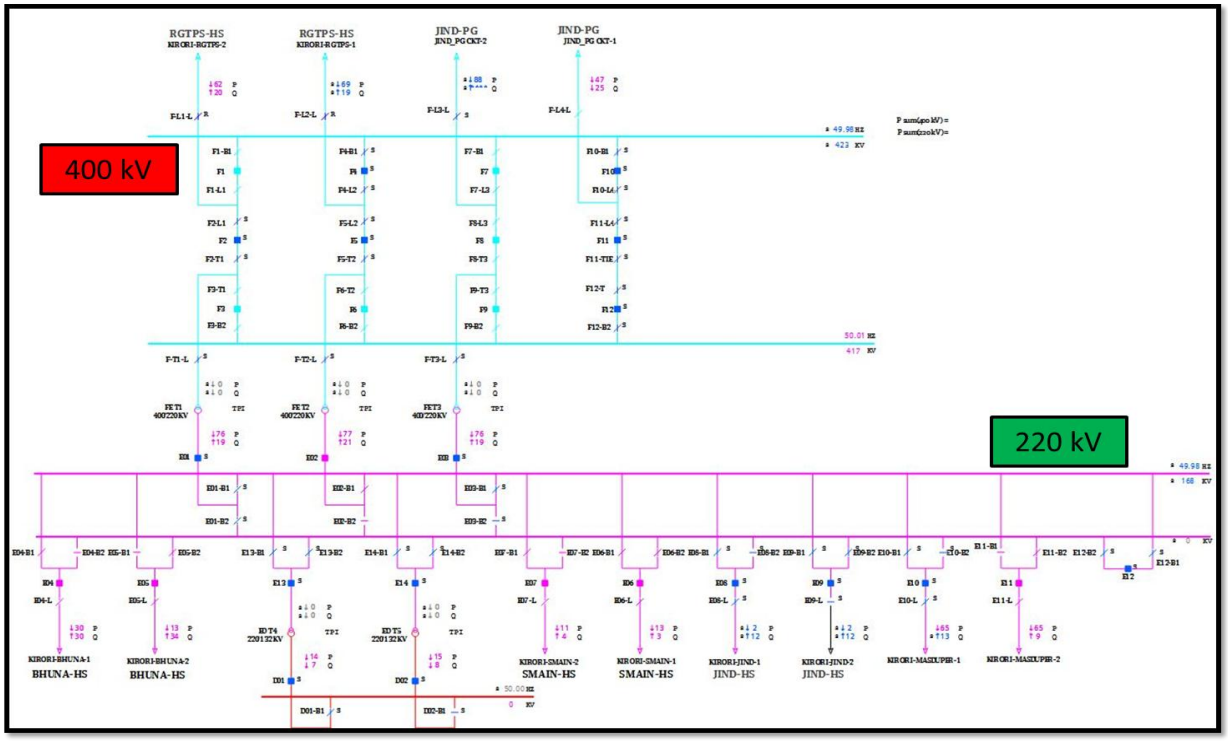
Based on above information description of the events is:

1. Connectivity Diagram & Single Line diagram of 400/220 kV Kirori (HVPNL):





SLD of 400/220 kV Kirori (HVPNL)



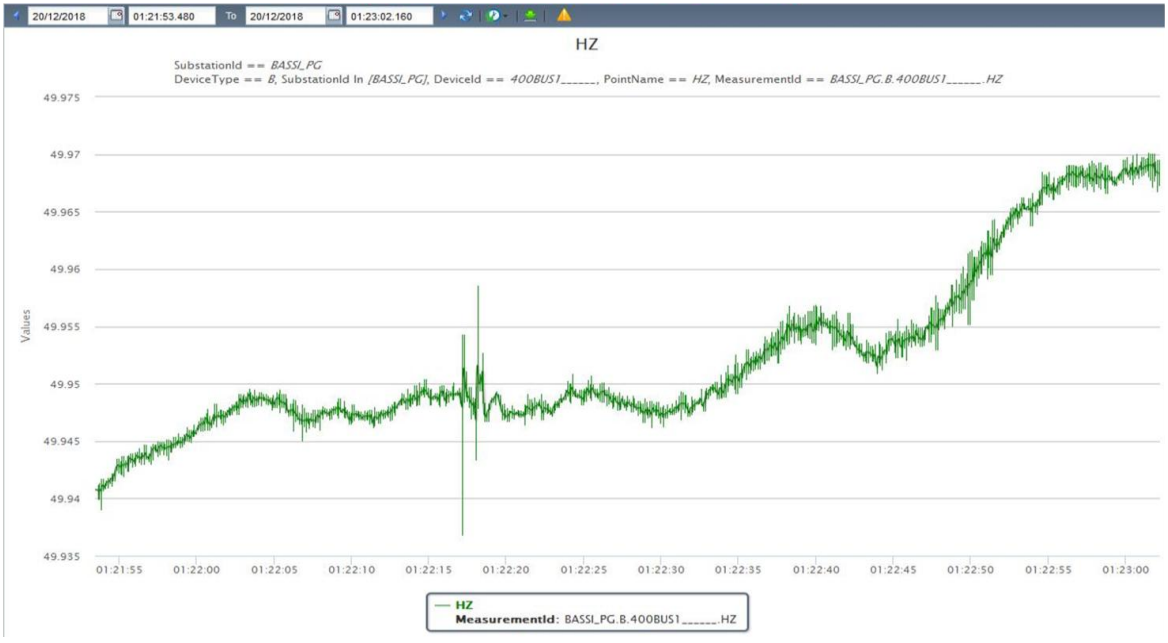
2. 400/220 kV Kirori (HVPNL) is connected with Khedar D/C, Jind D/C. It also has three 315MVA 400/220 kV ICTs. It has one and half breaker scheme at 400kV voltage level and DM (double main) bus scheme at 220 kV level. 220kV Kirori (HVPNL) further connected with 220 kV Samain D/C, Masudpur D/C and 220 kV Bhuna S/C.
3. As per the analysis of SoE, it is observed that fault may have occurred at 220 kV Khedar-Samain ckt-2.
4. As the fault was of temporary nature, the current may have been flown through the earth fault which was virtually created through the insulator disc of the line towers. The healthiness of insulator disc should be got checked from testing lab. The earth fault may have been created through the insulator disc. May be due to foggy weather.
5. 400 kV Khedar-Kirori ckt-1 &2 tripped on back earth fault protection (Sensitive setting at 400 kV Khedar end).

6. Name of the tripped elements:
    - 400kV Khedar(HVPNL)-Kirori(HVPNL) ckt-1
    - 400kV Khedar(HVPNL)-Kirori(HVPNL) ckt-2
    - 220 kV Kirori(HVPNL)-Smain ckt-1
    - 220 kV Kirori(HVPNL)-Smain ckt-2
    - 220 kV Kirori(HVPNL)-Masudpur ckt

7. PMU plot of frequency and phase voltages:

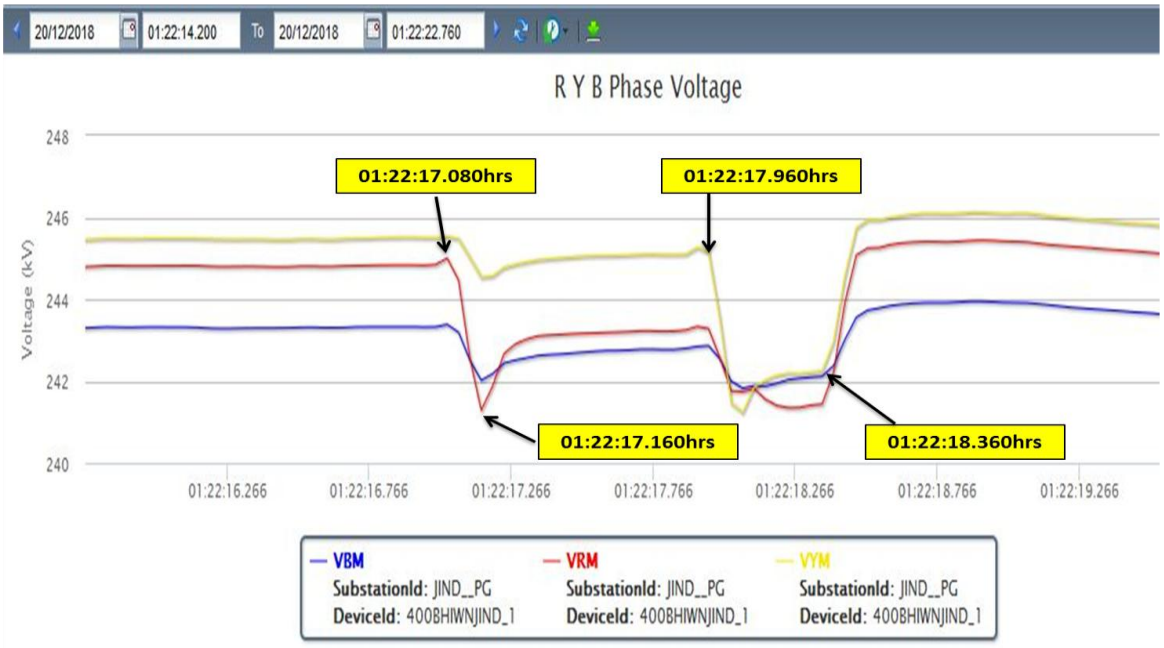
PMU Plot of frequency at Bassi(PG)

01:22hrs/20-Dec-18



PMU Plot of phase voltage magnitude at Jind(PG)

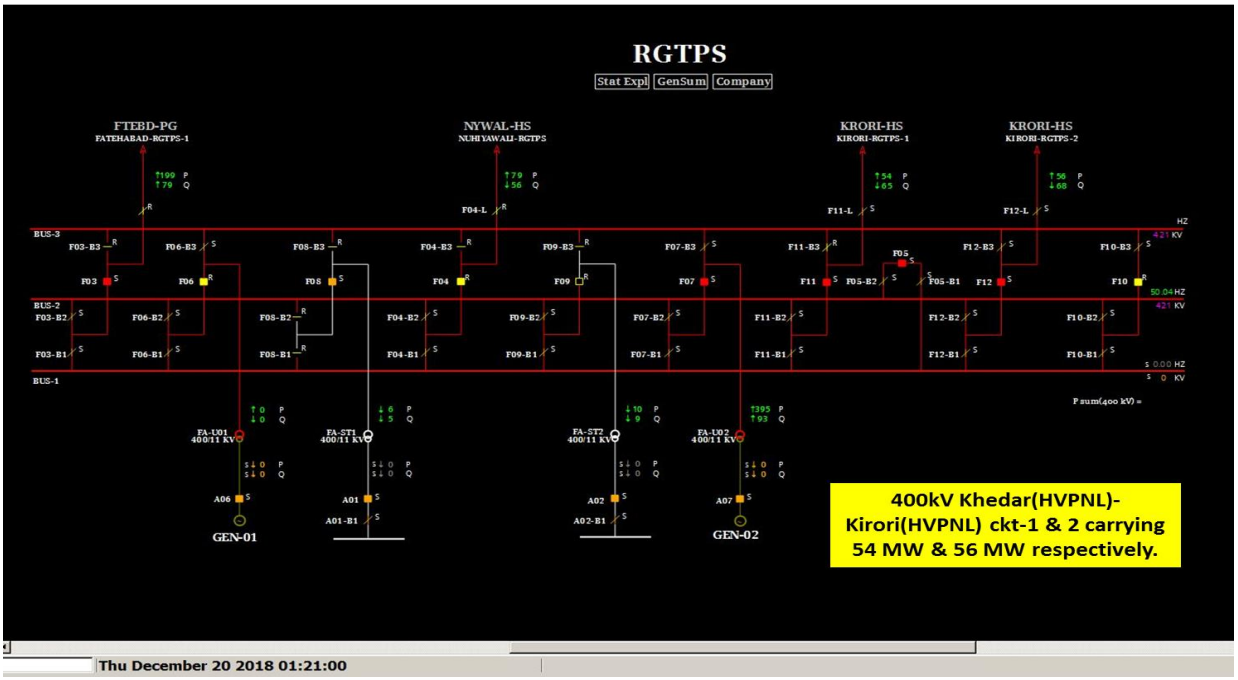
01:22hrs/20-Dec-18



8. As per PMU and SCADA data:
    - As per PMU, maximum dip in R-phase followed by Y-phase.
    - Fault Clearance time: **1280ms**
9. SCADA MW flows:

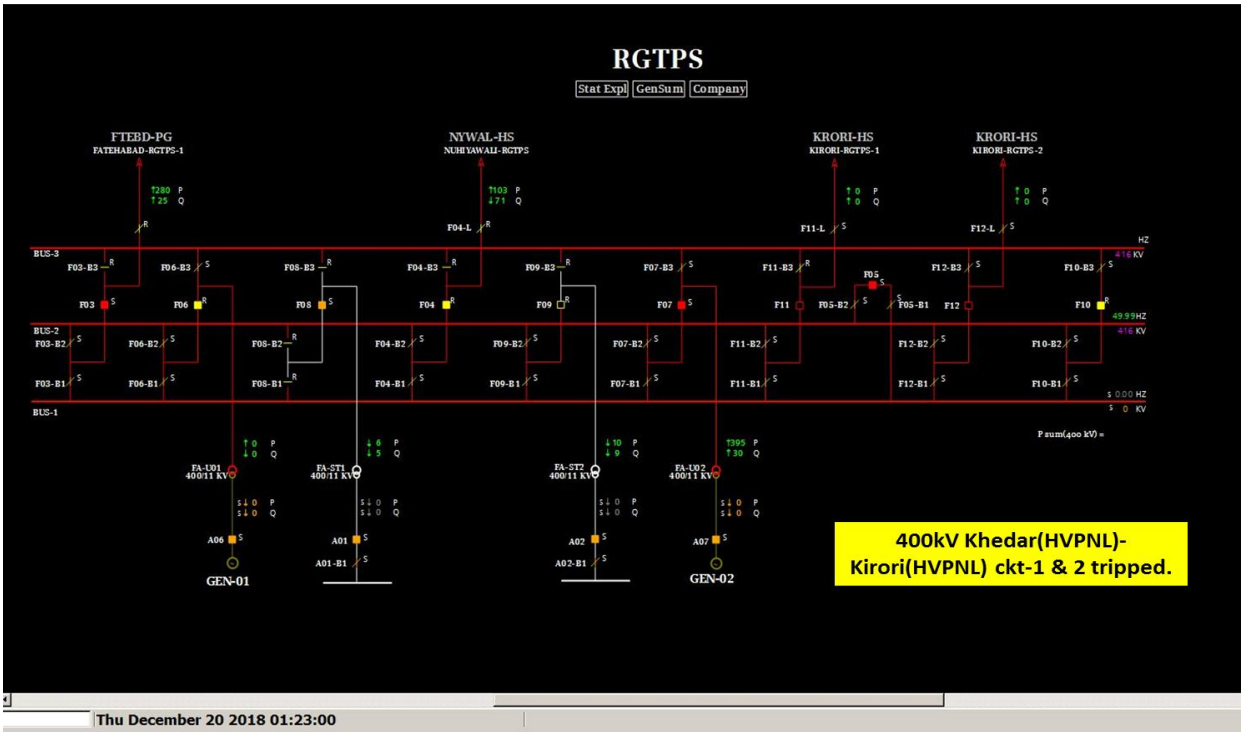
SLD of 400kV Khedar(HVPNL) before the incident

01:21hrs/20-Dec-18



SLD of 400kV Khedar(HVPNL) after the incident

01:23hrs/20-Dec-18



10. SCADA SoE:

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
01:27:17:403	KIRORI	400kV	KIRORI-RGTPS2	Circuit Breaker	Open	Main CB of 400kV Khedar-Kirori ckt-2 opens

11. As per Haryana report:

Line /Equipment	Duration		Relay Operated This End	Relay Operated Other end	Reason/ Fault Found	Normal Time for restoration
	From	To				
400 kV Khedar - kirori Ckt 2	01:22 Hrs	03:17 Hrs	Kirori End: Active Group 1, Start Phase C, Aux Direct Trip	Khedar End: Directional E/F, R Phase	Transient fault	02:05 Hrs
400 kV Khedar - kirori Ckt 1	01:22 Hrs	02:28 Hrs	Kirori End: Not Tripped	Khedar End: Directional E/F, R Phase	Transient fault	01:06 Hrs
220 kV Kirori- Bhuna Ckt 1	01:22 Hrs	03:47 Hrs	Kirori End: Start Phase A-N, Tripped A Fault Duration: 42.37ms Relay Trip Time: 79.85ms Fault Location XY 6927: m IA: 571.4 A IB: 934.6 A IC: 222.7 A VAN: 19.70kV VBN: 93.50kV VCN: 127.3kV Fault Resistance XY -24.78: Ohm Fault in Zone (Zone: 1)	Bhuna End: Not tripped	Transient fault	02:25 Hrs
220 kV Kirori- Samain Ckt 1	01:22 Hrs	04:12 Hrs	Kirori End: Start Phase B-N, tripped ABC, Fault Duration: 48.38ms Relay Trip Time: 106.7ms Fault Location XY: 24.18km IA: 0 A IB: 4218 A IC: 215.2 A VAN: 98.01kV VBN: 71.61kV VCN: 129.8kV Fault Resistance XY: 811.3mOhm Fault in Zone (Zone: 1)	Samain : Not Tripped	Transient fault	02:50 Hrs

Line /Equipment	Duration		Relay Operated This End	Relay Operated Other end	Reason/ Fault Found	Normal Time for restoration
	From	To				
400 kV Khedar - kirori Ckt 2	01:22 Hrs	03:17 Hrs	Kirori End: Active Group 1, Start Phase C, Aux Direct Trip	Khedar End: Directional E/F, R Phase	Transient fault	02:05 Hrs
400 kV Khedar - kirori Ckt 1	01:22 Hrs	02:28 Hrs	Kirori End: Not Tripped	Khedar End: Directional E/F, R Phase	Transient fault	01:06 Hrs
220 kV Kirori- Bhuna Ckt 1	01:22 Hrs	03:47 Hrs	Kirori End: Start Phase A-N, Tripped A Fault Duration: 42.37ms Relay Trip Time: 79.85ms Fault Location XY 6927: m IA: 571.4 A IB: 934.6 A IC: 222.7 A VAN: 19.70kV VBN: 93.50kV VCN: 127.3kV Fault Resistance XY -24.78: Ohm Fault in Zone (Zone: 1)	Bhuna End: Not tripped	Transient fault	02:25 Hrs
220 kV Kirori- Samain Ckt 1	01:22 Hrs	04:12 Hrs	Kirori End: Start Phase B-N, tripped ABC, Fault Duration: 48.38ms Relay Trip Time: 106.7ms Fault Location XY: 24.18km IA: 0 A IB: 4218 A IC: 215.2 A VAN: 98.01kV VBN: 71.61kV VCN: 129.8kV Fault Resistance XY: 811.3mOhm Fault in Zone (Zone: 1)	Samain : Not Tripped	Transient fault	02:50 Hrs

Event Log (Khedar end)

Events 20-12-2018 15:23:16

#		Time (ET+EM)	Station	Bay	Device	Object Text	State Text	Event Text
1	*	20-12-18 01:22:17.118	HISAR	KIRORI-2	21L1	Directional E/F start	Alarm	Alarm
2	*	20-12-18 01:22:17.119	HISAR	KIRORI-1	21L1	Directional E/F start	Alarm	Alarm
3	*	20-12-18 01:22:17.126	HISAR	FATEHABAD-1	21L2	Directional E/F start	Alarm	Alarm
4	*	20-12-18 01:22:17.150	HISAR	KIRORI-2	21L1	Directional E/F start	Alarm	Alarm
5	*	20-12-18 01:22:17.150	HISAR	KIRORI-1	21L1	Directional E/F start	Alarm	Alarm
6		20-12-18 01:22:17.299	HISAR	FATEHABAD-1	21L2	Directional E/F start	Normal	Normal
7	*	20-12-18 01:22:18.013	HISAR	FATEHABAD-1	21L2	Directional E/F start	Alarm	Alarm
8		20-12-18 01:22:18.017	HISAR	FATEHABAD-1	21L2	Directional E/F start	Normal	Normal
9	*	20-12-18 01:22:18.020	HISAR	FATEHABAD-1	21L2	Directional E/F start	Alarm	Alarm
10	*	20-12-18 01:22:18.022	HISAR	FATEHABAD-1	21L1	Directional E/F start	Alarm	Alarm
11		20-12-18 01:22:18.052	HISAR	FATEHABAD-1	21L1	Directional E/F start	Normal	Normal
12		20-12-18 01:22:18.117	HISAR	FATEHABAD-1	21L2	Directional E/F start	Normal	Normal
13	*	20-12-18 01:22:18.130	HISAR	FATEHABAD-1	21L2	Directional E/F start	Alarm	Alarm
14		20-12-18 01:22:18.184	HISAR	FATEHABAD-1	21L2	Directional E/F start	Normal	Normal
15	*	20-12-18 01:22:18.265	HISAR	KIRORI-2	21L1	Directional E/F operated	Alarm	Alarm
16	*	20-12-18 01:22:18.269	HISAR	KIRORI-2	21L1	Trip R phase	Alarm	Alarm
17	*	20-12-18 01:22:18.269	HISAR	KIRORI-2	21L1	Trip Y phase	Alarm	Alarm
18	*	20-12-18 01:22:18.269	HISAR	KIRORI-2	21L1	Trip B phase	Alarm	Alarm
19	*	20-12-18 01:22:18.269	HISAR	KIRORI-2	21L1	DT send channel-1	Alarm	Alarm
20	*	20-12-18 01:22:18.269	HISAR	KIRORI-2	21L1	Main-1 A/R inhibit	Alarm	Alarm
21	*	20-12-18 01:22:18.269	HISAR	KIRORI-2	21L1	Main-1 relay general trip	Alarm	Alarm
22	*	20-12-18 01:22:18.274	HISAR	KIRORI-2	21L1	Main-1 prepare 3-ph trip	Alarm	Alarm
23	*	20-12-18 01:22:18.287	HISAR	KIRORI-1	21L1	Directional E/F operated	Alarm	Alarm
24	*	20-12-18 01:22:18.289	HISAR	KIRORI-1	21L1	Main-1 relay general trip	Alarm	Alarm
25	*	20-12-18 01:22:18.289	HISAR	KIRORI-1	21L1	Trip R phase	Alarm	Alarm
26	*	20-12-18 01:22:18.289	HISAR	KIRORI-1	21L1	Trip Y phase	Alarm	Alarm
27	*	20-12-18 01:22:18.289	HISAR	KIRORI-1	21L1	Trip B phase	Alarm	Alarm
28	*	20-12-18 01:22:18.289	HISAR	KIRORI-1	21L1	DT send channel-1	Alarm	Alarm
29	*	20-12-18 01:22:18.296	HISAR	KIRORI-2	Q52PH	Breaker position indication Y phase	Intermediate	Intermediate
30	*	20-12-18 01:22:18.297	HISAR	KIRORI-2	Q52PH	Breaker position indication R phase	Intermediate	Intermediate
31	*	20-12-18 01:22:18.297	HISAR	KIRORI-2	Q52PH	Breaker position indication B phase	Intermediate	Intermediate
32		20-12-18 01:22:18.305	HISAR	KIRORI-2	Q52PH	Breaker position indication Y phase	Open	Open
33	*	20-12-18 01:22:18.307	HISAR	KIRORI-2	Q52PH	Breaker position indication R phase	Faulty	Faulty
34	*	20-12-18 01:22:18.307	HISAR	KIRORI-2	Q52PH	Breaker position indication B phase	Faulty	Faulty
35		20-12-18 01:22:18.311	HISAR	KIRORI-2	Q52	Breaker position indication	Open	Open
36		20-12-18 01:22:18.311	HISAR	KIRORI-2	Q52PH	Breaker position indication R phase	Open	Open
37		20-12-18 01:22:18.311	HISAR	KIRORI-2	Q52PH	Breaker position indication B phase	Open	Open
38	*	20-12-18 01:22:18.316	HISAR	KIRORI-1	Q52PH	Breaker position indication R phase	Intermediate	Intermediate
39	*	20-12-18 01:22:18.316	HISAR	KIRORI-1	Q52PH	Breaker position indication Y phase	Intermediate	Intermediate
40	*	20-12-18 01:22:18.317	HISAR	KIRORI-1	Q52PH	Breaker position indication B phase	Intermediate	Intermediate
41		20-12-18 01:22:18.320	HISAR	KIRORI-2	21L1	Directional E/F start	Normal	Normal
42		20-12-18 01:22:18.325	HISAR	KIRORI-1	Q52PH	Breaker position indication Y phase	Open	Open
43		20-12-18 01:22:18.326	HISAR	KIRORI-1	Q52PH	Breaker position indication R phase	Open	Open
44		20-12-18 01:22:18.326	HISAR	KIRORI-1	Q52	Breaker position indication	Open	Open
45		20-12-18 01:22:18.326	HISAR	KIRORI-1	Q52PH	Breaker position indication B phase	Open	Open
46		20-12-18 01:22:18.331	HISAR	KIRORI-2	21L1	Directional E/F operated	Normal	Normal
47		20-12-18 01:22:18.336	HISAR	KIRORI-2	21L1	DT send channel-1	Normal	Normal

Event Log (Khedar end)

Events 20-12-2018 15:26:15

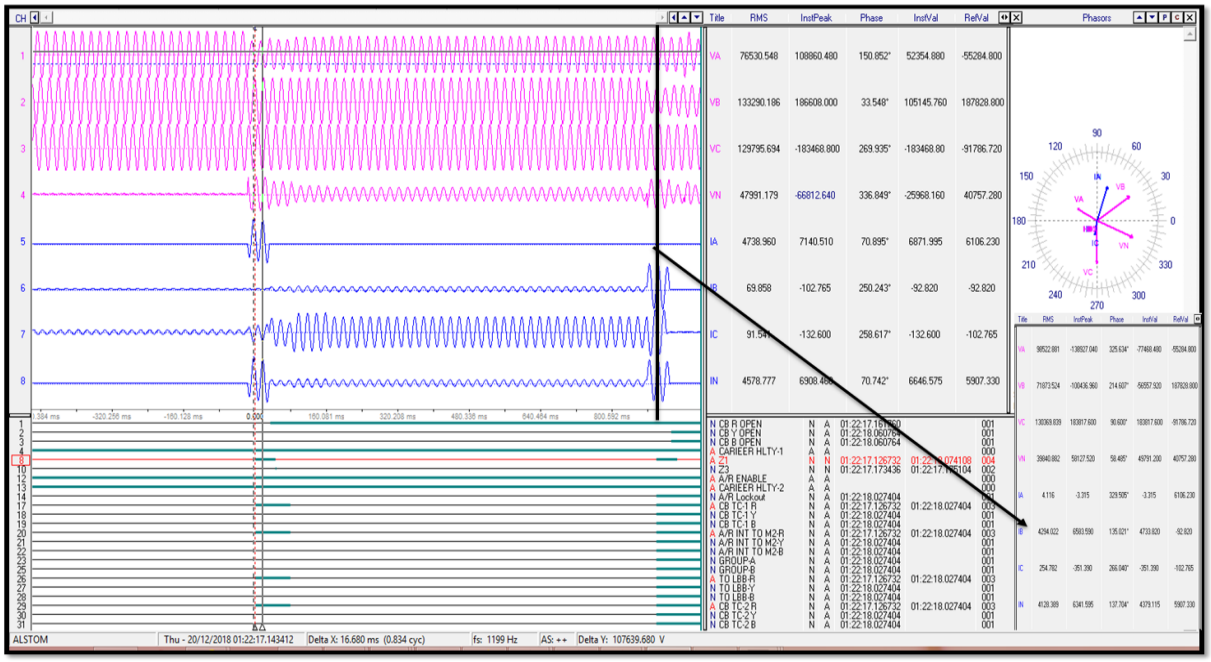
#		Time (ET+EM)	Station	Bay	Device	Object Text	State Text	Event Text
1		20-12-18 01:22:18.336	HISAR	KIRORI-2	21L1	Main-1 A/R inhibit	Normal	Normal
2		20-12-18 01:22:18.340	HISAR	KIRORI-1	21L1	Directional E/F start	Normal	Normal
3		20-12-18 01:22:18.348	HISAR	KIRORI-1	21L1	Directional E/F operated	Normal	Normal
4		20-12-18 01:22:18.352	HISAR	KIRORI-1	21L1	DT send channel-1	Normal	Normal
5		20-12-18 01:22:18.438	HISAR	KIRORI-2	Q52	Breaker open interlocked	On	On
6		20-12-18 01:22:18.438	HISAR	KIRORI-2	89A	Disconn. open interlocked	Off	Off
7		20-12-18 01:22:18.438	HISAR	KIRORI-2	89D	Disconn. open interlocked	Off	Off
8		20-12-18 01:22:18.438	HISAR	KIRORI-2	89L	Disconn. open interlocked	Off	Off
9		20-12-18 01:22:18.470	HISAR	KIRORI-2	21L1	Trip R phase	Normal	Normal
10		20-12-18 01:22:18.470	HISAR	KIRORI-2	21L1	Trip Y phase	Normal	Normal
11		20-12-18 01:22:18.470	HISAR	KIRORI-2	21L1	Trip B phase	Normal	Normal
12		20-12-18 01:22:18.470	HISAR	KIRORI-2	21L1	Main-1 relay general trip	Normal	Normal
13		20-12-18 01:22:18.476	HISAR	KIRORI-1	Q52	Breaker open interlocked	On	On
14		20-12-18 01:22:18.476	HISAR	KIRORI-1	89B	Disconn. open interlocked	Off	Off
15		20-12-18 01:22:18.476	HISAR	KIRORI-1	89D	Disconn. open interlocked	Off	Off
16		20-12-18 01:22:18.476	HISAR	KIRORI-1	89L	Disconn. open interlocked	Off	Off
17		20-12-18 01:22:18.490	HISAR	KIRORI-1	21L1	Main-1 relay general trip	Normal	Normal
18		20-12-18 01:22:18.490	HISAR	KIRORI-1	21L1	Trip R phase	Normal	Normal
19		20-12-18 01:22:18.490	HISAR	KIRORI-1	21L1	Trip Y phase	Normal	Normal
20		20-12-18 01:22:18.490	HISAR	KIRORI-1	21L1	Trip B phase	Normal	Normal
21		20-12-18 01:22:18.492	HISAR	KIRORI-1	21L1	Directional E/F start	Normal	Normal
22		20-12-18 01:22:18.541	HISAR	KIRORI-2	21L1	Directional E/F start	Normal	Normal
23		20-12-18 01:22:18.580	HISAR	KIRORI-1	21L1	Carrier channel-1 fail	Normal	Normal
24		20-12-18 01:22:18.583	HISAR	KIRORI-1	21L1	Main-1 A/R inhibit	Normal	Normal
25	*	20-12-18 01:22:23.710	HISAR	KIRORI-1	21L1	Carrier channel-1 fail	Alarm	Alarm
26	*	20-12-18 01:22:23.713	HISAR	KIRORI-1	21L1	Main-1 A/R inhibit	Alarm	Alarm
27		20-12-18 02:16:33.236	HISAR	KIRORI-1	86A	General trip relay reset cmd	Execute	Execute
28		20-12-18 02:16:33.427	HISAR	KIRORI-1	Q52	Breaker close interlocked	Off	Off
29		20-12-18 02:16:33.580	HISAR	KIRORI-1	86A	General trip relay reset cmd		
30		20-12-18 02:21:38.235	HISAR	SAS1		User: OPERATOR3	Login	Login
31		20-12-18 02:28:55.437	HISAR	KIRORI-1	Q52	Breaker close select command	Selected	Selected
32		20-12-18 02:28:56.265	HISAR	KIRORI-1	Q52	Breaker close execute command	Executed	Executed
33		20-12-18 02:28:56.266	HISAR	SAS1		User: OPERATOR3	Operation performed	Operation performed
34	*	20-12-18 02:28:56.434	HISAR	KIRORI-1	Q52PH	Breaker position indication B phase	Intermediate	Intermediate
35	*	20-12-18 02:28:56.436	HISAR	KIRORI-1	Q52PH	Breaker position indication R phase	Intermediate	Intermediate
36	*	20-12-18 02:28:56.436	HISAR	KIRORI-1	Q52PH	Breaker position indication Y phase	Intermediate	Intermediate
37		20-12-18 02:28:56.453	HISAR	KIRORI-1	Q52PH	Breaker position indication B phase	Closed	Closed
38		20-12-18 02:28:56.455	HISAR	KIRORI-1	21L1	CB spring charged	Normal	Normal
39		20-12-18 02:28:56.456	HISAR	KIRORI-1	Q52PH	Breaker position indication Y phase	Closed	Closed
40		20-12-18 02:28:56.457	HISAR	KIRORI-1	Q52PH	Breaker position indication R phase	Closed	Closed
41		20-12-18 02:28:56.457	HISAR	KIRORI-1	Q52	Breaker position indication	Closed	Closed
42		20-12-18 02:28:56.628	HISAR	KIRORI-1	Q52	Breaker open interlocked	Off	Off
43		20-12-18 02:28:56.628	HISAR	KIRORI-1	Q52	Breaker close interlocked	On	On
44		20-12-18 02:28:56.628	HISAR	KIRORI-1	89B	Disconn. open interlocked	On	On
45		20-12-18 02:28:56.628	HISAR	KIRORI-1	89D	Disconn. open interlocked	On	On
46		20-12-18 02:28:56.628	HISAR	KIRORI-1	89L	Disconn. open interlocked	On	On
47	*	20-12-18 02:28:59.929	HISAR	KIRORI-1	21L1	CB spring charged	Alarm	Alarm

Prescribed Format For Daily Tripping and breakdown

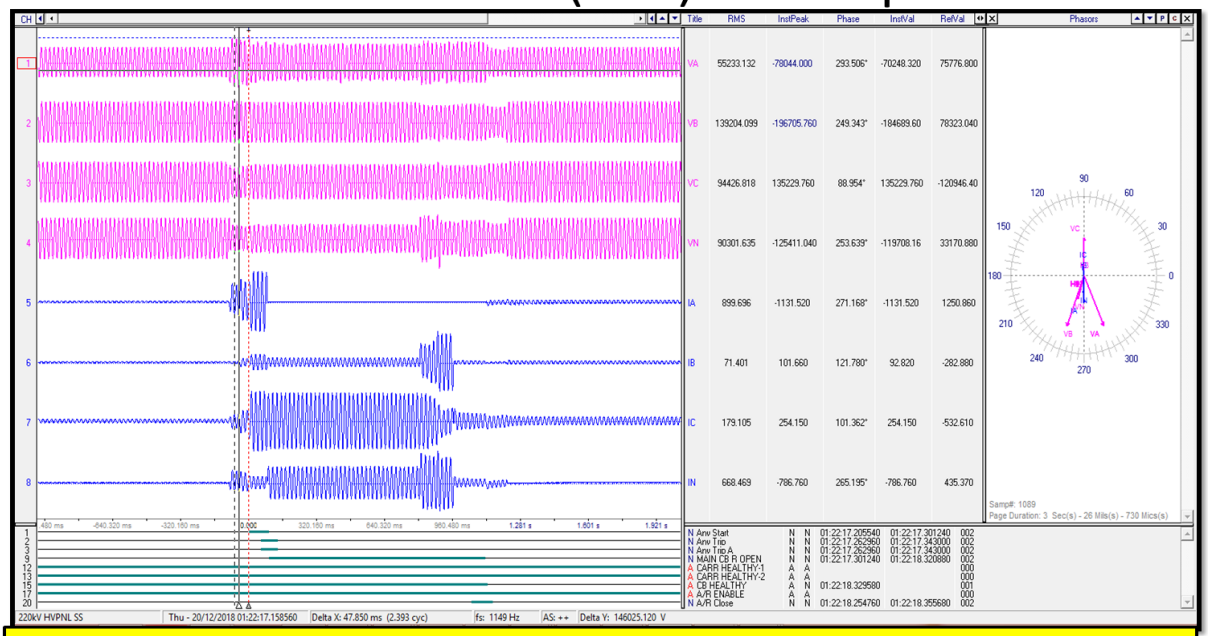
Sl. No.	Date	Name of TS Division	S/Stn	Line /Equipment	Duration		Relay Operated This End	Relay Operated Other end	Reason/ Fault Found	Normal Time for restoration
					From	To				
1	20.12.2018	400 kV Kirori	400 kV Kirori	400 kV Khedar - kirori Ckt 2	01:22 Hrs	03:17 Hrs	Kirori End: Active Group 1, Start Phase C,	Khedar End: Directional E/F, R Phase	Transient fault	02:05 Hrs
2	20.12.2018	400 kV Kirori	400 kV Kirori	400 kV Khedar - kirori Ckt 1	01:22 Hrs	02:28 Hrs	Kirori End: Not Tripped	Khedar End: Directional E/F, R Phase	Transient fault	01:06 Hrs
3	20.12.2018	400 kV Kirori	400 kV Kirori	220 kV Kirori- Bhuna Ckt 1	01:22 Hrs	03:47 Hrs	Kirori End: Start Phase A-N, Zone 1 Disatnce 6.927 KM,IA=571.1 A, IB=934.6, IC =222.7 A	Bhuna End: Not tripped	Transient fault	02:25 Hrs
4	20.12.2018	400 kV Kirori	400 kV Kirori	220 kV Kirori- Samain Ckt 1	01:22 Hrs	04:12 Hrs	Kirori End: Start Phase B-N, tripped ABC, Zone 1 Disatnce 24.18 KM,IA=0 A, IB=4.281 kA, IC =215.2 A	Samain : Not Tripped	Transient fault	02:50 Hrs
5	20.12.2018	400 kV Kirori	400 kV Kirori	220 kV Kirori- Samain Ckt 2	01:22 Hrs	04:13 Hrs	Kirori End: Start ABC, ZONE 2, distance 39.06 km, IA=4.162 kA, IB=3.920 kA, IC=505.5A	Samain : Not Tripped	Transient fault	02:49 Hrs
6	20.12.2018	400 kV Kirori	400 kV Kirori	220 kV Kirori- Masudpur Ckt 1	01:22 Hrs	Auto Reclose at 01: 22 Hrs	Kirori End: DPS opearted in Zone 1, Start Phase A-N, Tripped A, distance 21.29 km, IA=1.785 A, IB= 551.1 A, IC=814.9 A, A/R opearted	Samain : Not Tripped	Transient fault	NA
7	20.12.2018	400 kV Kirori	400 kV Kirori	220 kV Kirori- Masudpur Ckt 2	01:22 Hrs	03:00 Hrs	Kirori End: DPS opearted in Zone 1, Start Phase A B-N, Tripped ABC, distance 26.37 km, IA=2.590 A, IB= 1.104 A, IC=6.398 A,	Samain : Not Tripped	Transient fault	1:38 Hrs
8	20.12.2018	XEN TS Hisar	220 kV Masudpur	220 kVMasudpur- Samian ckt.-1	1.22 hrs	03:25 Hrs	Masudpur end: DPS opereted in Zone-3 Y-phase fault current 0 amp.	Samain : Not Tripped	Transient fault	2.03 Hrs
9	20.12.2018	XEN TS Hisar	220 kV Masudpur	220 kVMasudpur- Samian ckt.-2	1.22 hrs	03:25 Hrs	Masudpur end: DPS opereted in Zone-3 R-phase fault current 1083 amp.	Samain : Not Tripped	Transient fault	2.03 Hrs

Data of EL and DR of Kirori End is attached.
EL at Khedar end is also attached.

DR of 220 kV Kirori (end)-Samain ckt-1

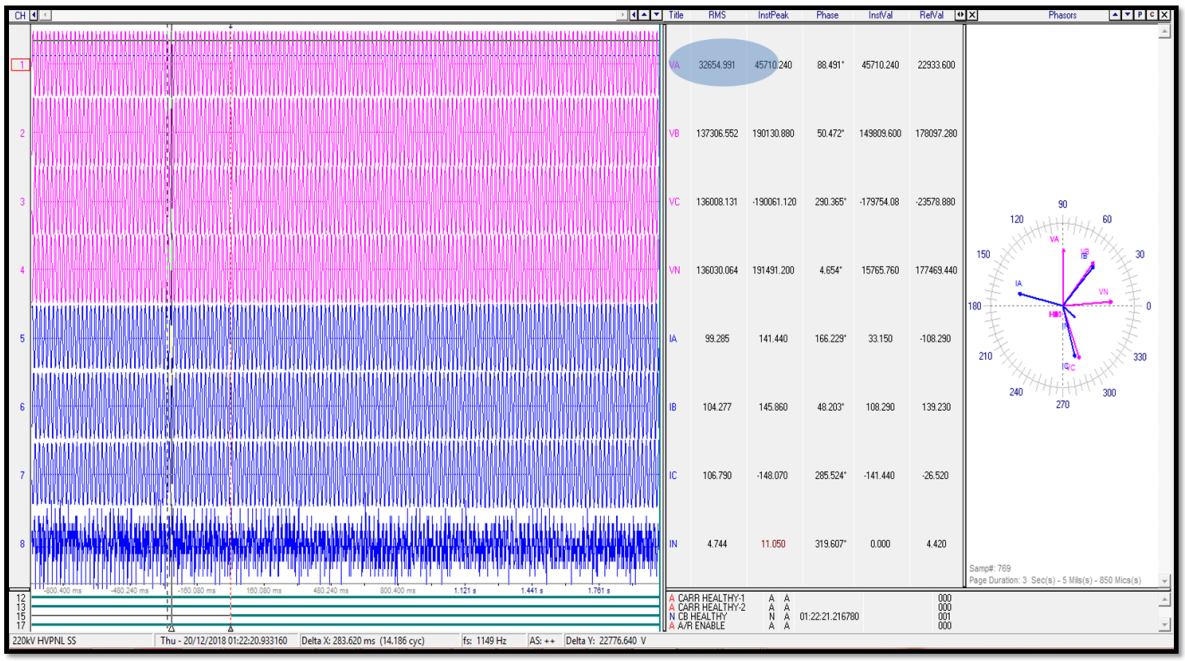


DR of 220 kV Kirori (end)-Masudpur ckt-1



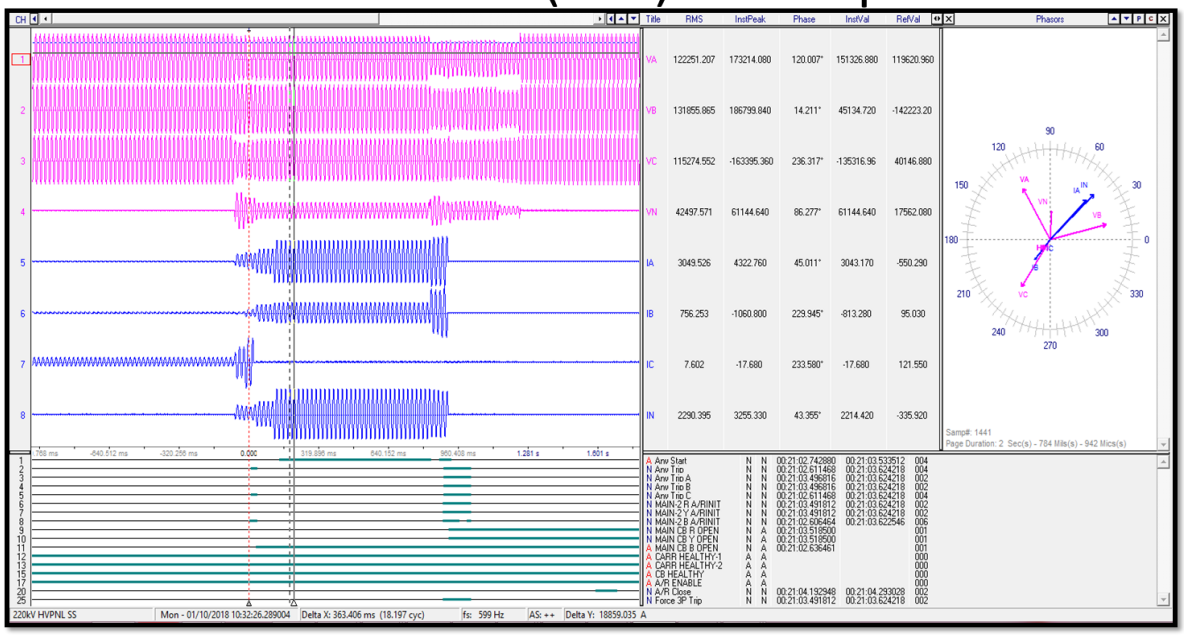
R-phase of the line tripped and A/R after 1000ms. Y-N fault also reflected in the line and fault current was higher than R-N fault but line didn't trip.
R-phase voltage measurement in DR is not ok. (low throughout DR time)

DR of 220 kV Kirori (end)-Masudpur ckt-1



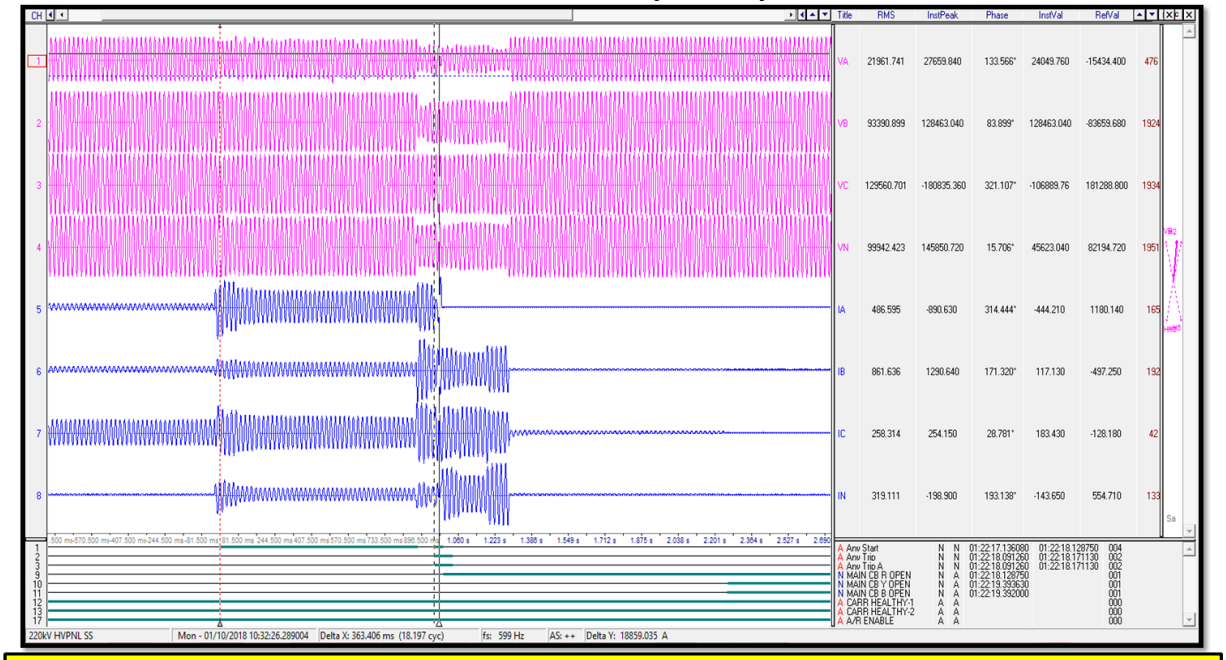
Line didn't trip during fault

DR of 220 kV Kirori (end)-Masudpur ckt-2



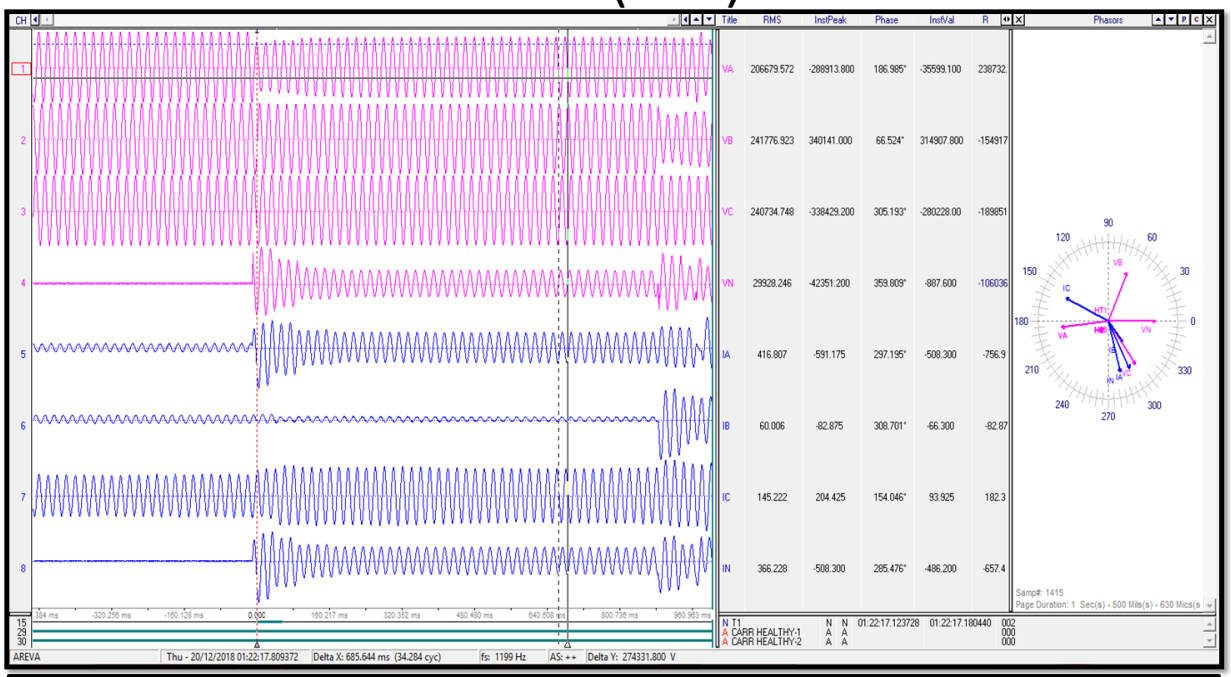
R-N fault than why Blue phase of the line tripped. (R-phase continuously fed the fault) reason?
After 900ms, on occurrence of Y-N fault, all three phase of the line tripped

DR of 220 kV Kirori (end)-Bhuna ckt



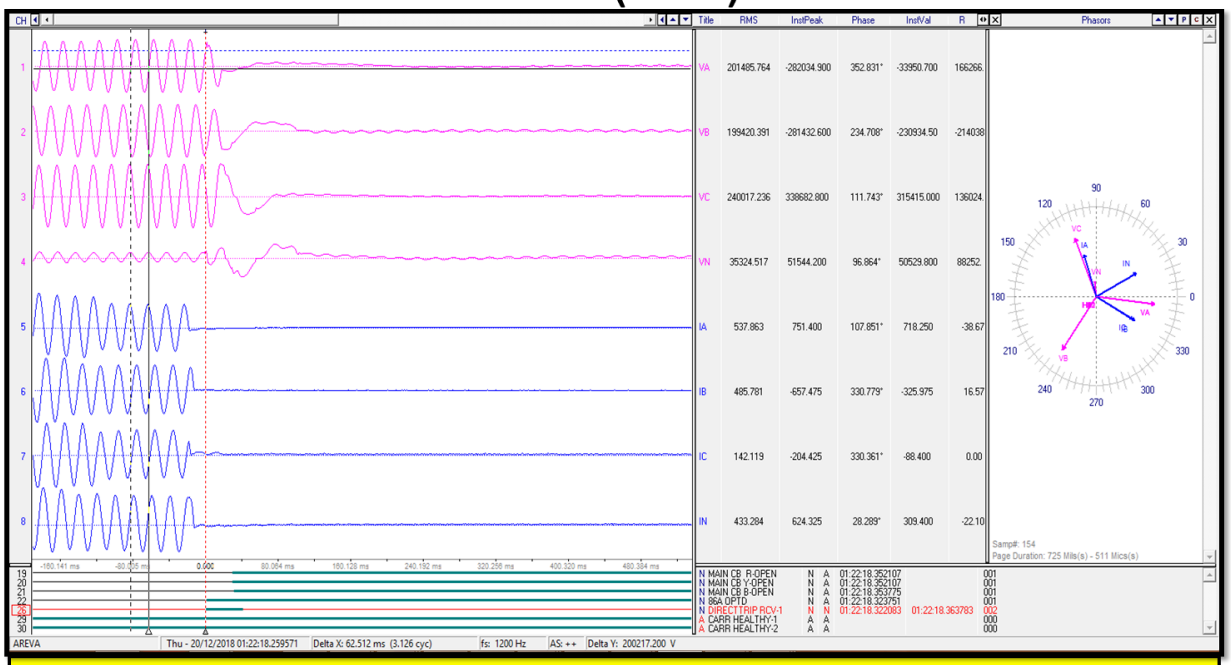
R-N fault line tripped after 1000ms probably on Z-3/reverse zone protection. (Why only single phase tripping occurred?)
After 1200ms of opening of R-phase CB, Y&B-phase also tripped probably on PD (Pole discrepancy)

DR of 400 kV Kirori (end)-Khedar ckt-2



It seems line didn't trip from Kirori end however as per SCADA SoE line tripped within 320ms from Kirori end.

DR of 400 kV Kirori (end)-Khedar ckt-2



It seems line didn't trip from Kirori end however as per SCADA SoE line tripped within 320ms from Kirori end.
Line finally tripped at 01:22:18:320hrs from Kirori end on DT received from remote end.

Extract of Haryana Report

Observation and Suggestion:

- The fault occurred in the system was temporary in nature
- No visible fault was observed in any of the tripped elements
- As per the analysis of SoE, it is observed that fault may have occurred at 220 kV Khedar-Samain ckt-2.
- As the fault was of temporary nature, the current may have been flown through the earth fault which was virtually created through the insulator disc of the line towers. The healthiness of insulator disc should be got checked from testing lab.
- The earth fault may have been created through the insulator disc. May be due to foggy weather.
- The numerical relays, should be time synchronized with GPS server at all 220 kV S/S, which will help in analysis of faults.
- The earth fault setting at 400 kV Khedar is 0.120second in Micom relay. The setting is very much low as compared to norms of NRPC.

12. Consolidated SoE:

Time	Time Chronology	Voltage Level (in kV)	Element Name	Element Type	Status	Source	Remarks
01:22:17:080	0ms					PMU data	R-N fault
01:22:17:161	80ms	220 kV	Kirori-Smain ckt-1 (fault current: 4.3kA)	R-phase CB	Open	DR data	R-N fault
01:22:17:262	420ms	220 kV	Kirori-Masudpur ckt-1 (fault current: 1.7kA)	R-phase CB	Open	DR data	R-N fault
01:27:17:403	320ms	400kV	Kirori-Khedar (RGTPS) ckt-2	CB (All three phase CB)	Open	SCADA SoE	Main CB of 400kV Khedar-Kirori opens
01:22:17:960	880ms					PMU data	Y-N fault
01:22:18:060	980ms	220 kV	Kirori-Smain ckt-1 (fault current: 4.2kA)	All three phase CB	Open	DR data	Y-N fault (All three phase of the line tripped before line A/R)
01:22:18:091	1010ms	220 kV	Kirori-Bhuna ckt (fault current: 1kA)	R-phase CB	Open	DR data	Other two phase of the line tripped after 1200ms of R-phase tripping
01:22:18:254	1175ms	220 kV	Kirori-Masudpur ckt-1 (fault current: 1.7kA)	R-phase CB	A/R	DR data	R-phase voltage was low before fault and after fault clearance
01:22:18:322	1240ms	400kV	Kirori-Khedar (RGTPS) ckt-2	CB (All three phase CB)	Open	DR data	
01:22:18:360	1280ms					PMU data	Fault cleared

13. As per DR details:
    - 400 kV Kirori-Khedar ckt-2 didn't trip from Kirori end however as per SCADA SoE line tripped within 320ms from Kirori end. Line finally tripped at 01:22:18:320hrs from Kirori end on DT received from remote end.
    - 220 kV Kirori (end)-Bhuna ckt tripped on R-N fault, line tripped after 1000ms probably on Z-3/reverse zone protection. (Why only single phase tripping occurred?) After 1200ms of opening of R-phase CB, Y&B-phase also tripped probably on PD (Pole discrepancy).
    - Blue phase of 220 kV Kirori (end)-Masudpur ckt-2 tripped during R-N fault. Why Blue phase of the line tripped. (R-phase continuously fed the fault) reason? After 900ms, on occurrence of Y-N fault, all three phase of the line tripped
    - R-phase of 220 kV Kirori (end)-Masudpur ckt-1 tripped and A/R after 1000ms. Y-N fault also reflected in the line and fault current was higher than R-N fault but line didn't trip. R-phase voltage measurement in DR is not ok. (low throughout DR time)

14. Preliminary Report, DR/EL has been received from Haryana but detailed report is still awaited from Haryana.

HVPNL representative informed during the meeting:

1. Exact location of fault and nature of fault: ***Fault was in 220 kV Kirori-Smain ckt-1. Distance protection at 220 kV Kirori end operated in Z-1 but Smain end distance protection was not in service due to unavailability of bus PT. 220 kV Kirori-Smain ckt-2 tripped in Z-2 from Kirori end.***
2. Sequence of tripping needs to be reported and explained: *To be reported*.
3. Reason of delayed clearance of fault: ***Fault was in 220 kV Kirori-Smain ckt-1. Distance protection at 220 kV Kirori end operated in Z-1 but Smain end distance protection was not in service due to unavailability of bus PT. It resulted into delayed clearance of fault.***
4. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared: ***To be reported***
5. Sensitive back up earth fault protection setting of 400 kV Khedar (end)-Kirori ckt-1 & 2 to be reviewed: ***TMS setting for DEF protection at Khedar end is 0.120 however at Kirori end it is 0.480. Sensitive DEF setting at Kirori end resulted into tripping of the line in 100ms***.
6. 220 kV Kirori (end)-Bhuna ckt: Single phase (R-phase) tripping of line after 1000ms needs to be looked into? After 1200ms of opening of R-phase CB, Y&B-phase also tripped, reason of tripping? *:* ***NRLDC representative informed that negative resistance value sensed by the relay which mean relay sensed the fault in reverse direction. Haryana representative agreed to recheck the Protection setting for 220 kV Kirori (end)-Bhuna ckt***.
7. Tripping of Blue phase of 220 kV Kirori (end)-Masudpur ckt-2 during R-N fault to be checked? R-phase continuously fed the fault for another 900ms, reason to be looked into: ***Time synch error in the relay, other points to be checked and reported later on***.
8. R-phase of 220 kV Kirori (end)-Masudpur ckt-1 tripped and A/R after 1000ms. Y-N fault also reflected in the line and fault current was higher than R-N fault but line didn't trip, reason to be checked? R-phase voltage measurement in DR is not ok. (Low throughout DR capturing time): ***Voltage measurement has taken from bus PT so bus PT shall be checked. Other points to be checked and reported later on***.
9. Availability of time synchronized SCADA SoE to be looked into.
10. Detailed report, remedial measures report and supporting DR/EL (only for 400 kV Khedar end) needs to be submitted by HVPNL: ***Detailed report to be shared within 10days***

NRLDC representative raised concern about non-submission of information wrt tripping agenda (points for discussion).

NRPC suggested HVPNL to discuss the issue with HPGCL wrt sensitive DEF setting in 400 kV Khedar-Kirori ckt-1 & 2 and share the detailed report within

10days. If there is any issue in discussion than separate meeting shall be called at NRPC.

J. Tripping other than to be discussed in 37th PSC meeting:

For better reliability of power system each and every multiple element tripping should be analyzed properly and remedial measures to be taken by utilities. Total 78 multiple element tripping event reported by NRLDC to RPC and constituents for the month of Sep to Dec 2018.

Preliminary reports of all these trippings are available at NRLDC website and already send to concerned utilities within 24hrs of the incident.

Among 78 events, around 19 events would be discussed in 37th PSC meeting. For rest events, utilities may kindly submit the details (DR/EL and detailed report along with remedial measures) to NRLDC and NRPC at mail ID: nrldcso2@posoco.in, nrldcso2@gmail.com, seo-nrpc@nic.in and sep-nrpc@nic.in.

List of the all the multiple elements tripping event is available at NRPC website at following link:

Member may kindly submit the details.