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

No. उक्षेविस/प्रचालन/107/01/2018/10839-10877 दिनांक: 17.09.2018

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 36 वीं बैठक की संशोधित कार्यसूची |
Subject: Revised Agenda for 36th Protection Sub-Committee Meeting.

संरक्षण उप-समिति की 36वीं बैठक, 19.09.2018 को 10:30 बजे से उ.क्षे.वि.स. सचिवालय, नई दिल्ली में आयोजित की जाएगी | उक्त बैठक की कार्यसूची उत्तर क्षेत्रीय विद्युत् समिति की वेबसाइट (http://www.nrpc.gov.in) पर उपलब्ध है |

The 36th meeting of Protection Sub-Committee is scheduled to be held on **19th September, 2018** at **10:30 Hrs** at **NRPC Secretariat, New Delhi**. The agenda for the meeting is available on NRPC website and same can be downloaded from http://www.nrpc.gov.in .

--Sd--
(Upendra Kumar)
Superintending Engineer (P)

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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)	Common Services 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)	UPPCL	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	Assistant Vice President	BRPL	39996055/39999765
37	GM (Production)	Jhajjar Power Ltd	01251-270155
38	GM(P&M)	APL	7925557176
39	Sh. Umesh Gupta, AsVP	BRPL	011-26419833
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

Agenda for
36th Meeting of Protection Sub-committee of Northern Regional Power Committee

Time of meeting	**:**	**10.30 Hrs.**
Date of meeting	**:**	**19th September, 2018**
Venue	**:**	**NRPC Secretariat, New Delhi**

A.1. Confirmation of minutes of 35th meeting of protection sub-committee

Minutes of 35th meeting of Protection Sub-committee were issued vide letter dated 10.08.2018. The Minutes are available on NRPC's website at http://www.nrpc.gov.in. No comment has been received.

Sub-Committee may confirm the Minutes.

A.2. Implementation of Recommendations of Task Force

As a followup 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.

A format for submission of database was finalised in 30th PSC meeting.

The issue was deliberated in 34th TCC/38th NRPC meeting held on 24th/25th October, 2016 wherein it was decided that protection setting data would be provided by all the utilities within 02 months for 400 kV and 220 kV S/S.

33rd PSC meeting on 22nd February, 2017 – During 33rd PSC meeting, it was noted that only few utilities had submitted the data. PSC advised all the utilities to submit the data in prescribed format by March,2017. It was also opined that if data were not submitted by utilities then engagement of third party in line with ERPC and SRPC may be considered.

The issue was discussed in the 35th TCC/39th NRPC meeting held on 1st/2nd May,

2017 in which TCC expressed their concern over the non-submission of protection database by the utilities. In the meeting, it was also informed that a project of Protection Database Management System is being implemented by ERPC and SRPC by engaging 3rd party with funding through PSDF. TCC recommended and NRPC thereafter approved the proposal for engaging a third party for Protection database and authorised NRPC sectt. to take further action.

34th PSC meeting on 4th August, 2017—During the meeting, M/s PRDC gave presentation about the various provisions included in the project being implemented by them in ER. Citing the concerns of utilities, it was proposed to form a core committee to define the comprehensive Scope of the project comprising members from NRPC secretariat, NRLDC, and all the utilities of NR.

Approval of Chairperson, NRPC has been 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.

Nominations for the committee for finalisation of detailed scope of work of the project were sought from the utilities and based on the nomination received a committee has been formed. The first meeting of the committee was held on 1st February 2018 at NRPC Secretariat, New Delhi. Based on the inputs received from the members, Bidding Document shall be modified and circulated for the approval of the committee in its next meeting.

NRPC Secretariat has submitted the DPR of the project for PSDF funding.

Tender shall be floated after the finalization of the Bidding Document by the committee.

38th TCC and 41st NRPC meeting on 27th and 28th February, 2018- Based on the discussions held in 34th PSC meeting, a core committee has been 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 based on the inputs received from the members, Draft Bidding Document has been prepared by the NRPC Secretariat

The Draft Bidding document incorporating all the inputs given by members in the meeting was further circulated for suggestions/comments, if any. The Bid document including all the relevant suggestions/comments of the members has been finalized.

NRPC Secretariat has 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.

Appraisal Committee has recommended the proposal for the grant from PSDF funding and also qualified proposal for 100% funding through PSDF. The e-tendering Creation and maintenance of web based Protection Database Management and PC based Protection setting calculation tool for Northern Region Power System Network will be initiated on the receipt of MoM of Monitoring Committee.

35th PSC meeting on 20th June 2018, it was told that the Draft Bidding document incorporating all the inputs given by members in the meeting was further circulated for suggestions/comments, if any. The Bid document including all the relevant suggestions/comments of the members has been finalized.

NRPC Secretariat has 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.

Appraisal Committee has recommended the proposal for the grant from PSDF funding and also qualified proposal for 100% funding through PSDF. The e-tendering Creation and maintenance of web based Protection Database Management and PC based Protection setting calculation tool for Northern Region Power System Network will be initiated on the receipt of MoM of Monitoring Committee.

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.

39th TCC and 42nd NRPC meeting on 27th and 28th June, 2018, it was informed that Monitoring Committee has approved the Protection Database Management System proposal and e-tendering process will be initiated on the receipt of MoM of Monitoring Committee. The project timeline is of 18 months with 5 year support period preceded with one year defect liability period. It was also told that modelling and data collection would be done up to 132 kV level for Uttarakhand, Himachal Pradesh and Jammu and Kashmir and up to 220 kV level for all other states of the region. Utilities will be provided with licenses so that studies can be carried out by them.

In pursuance of the above, the bid document has been finalized incorporating comments/suggestions given by the committee. Further, the tender has been published on 30th August and the Last date for the receipt of the bid is 15th October,2018. The technical bid shall be opened on 16th October, 2018. The Bid evaluation committee has been formulated comprising members from NRPC secretariat and NRPC constituents.

Members may take a note of the same.

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.

Members may take note of the information. Members are also requested to update nominations of the protection engineers which would be carrying out the Third Party Protection audit. The list is enclosed at Annexure – I as finalized in 24th PSC.

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.**

Members may deliberate about the Training Programme/Workshop on Protection Audit.

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. "

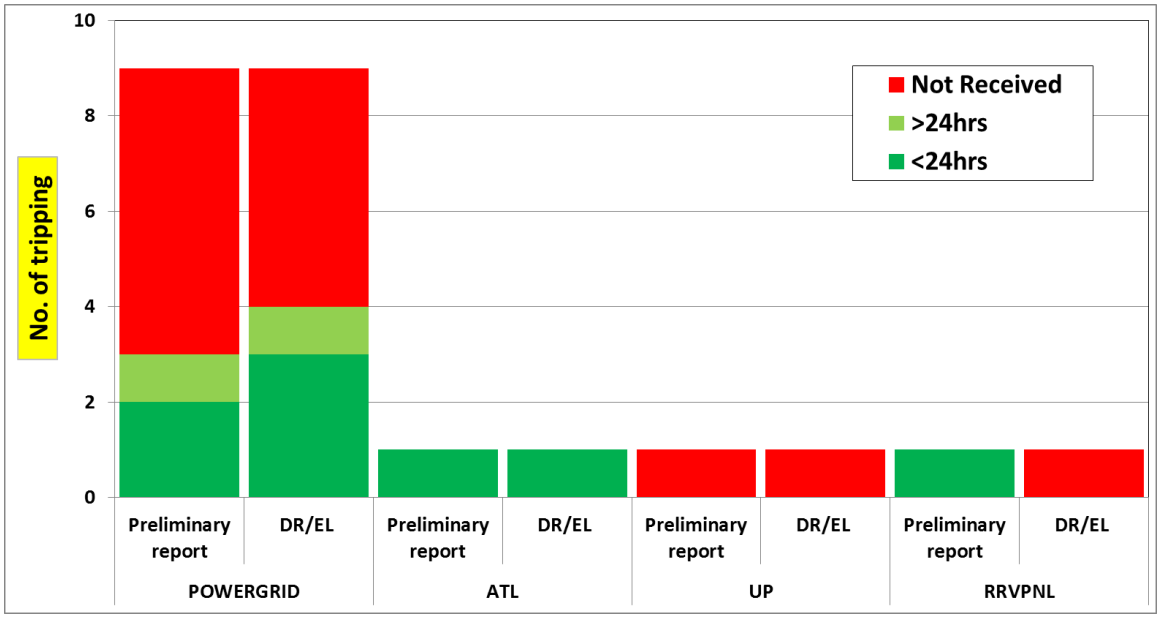
Such delayed clearance of faults of Inter-regional lines may prove fatal to the security of the grid. Since, tripping of Inter Regional Lines of voltage 220kV and above are matter of concern to Grid security suitable action needs to be taken. The list of inter-regional lines where delayed clearance was observed is attached as **Annexure-III.**

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.

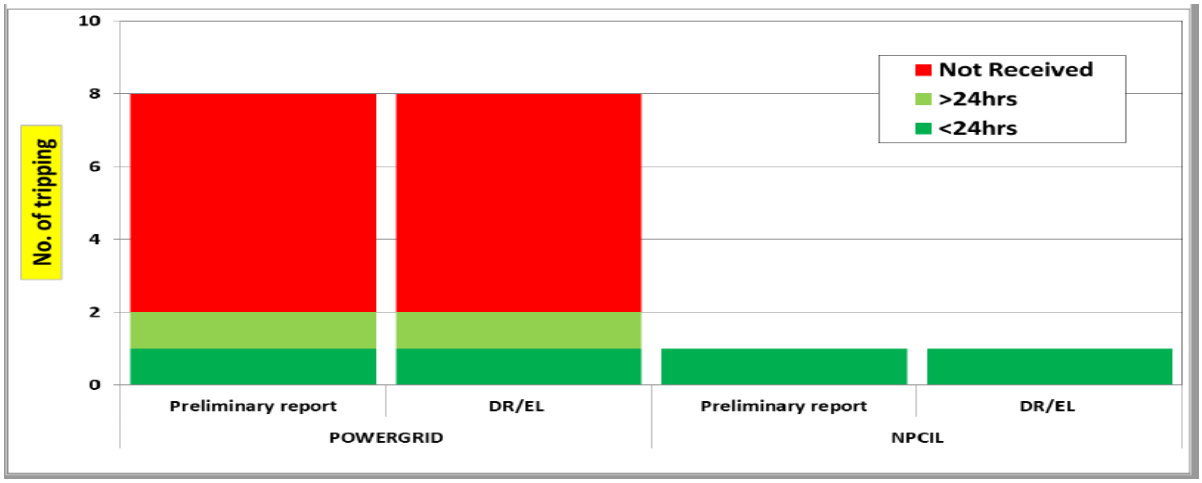
In 35th PSC meeting held on 20th June, 2018- It was stated that violation of Protection Standard should be avoided and DR/EL should be sent to NRPC/NRLDC within 24 hours as the tripping analysis for inter-regional lines is very important for safe and reliable operation of Grid. It was also informed that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

Utilities were requested to submit the DR/EL of all the tripping of 220 kV and above level within 24 hours to NRLDC. However, most of the utilities are not submitting the DR/EL of the trippings within 24 hours. The details of the same for the months of June, Jul and Aug, 2018 are highlighted below:

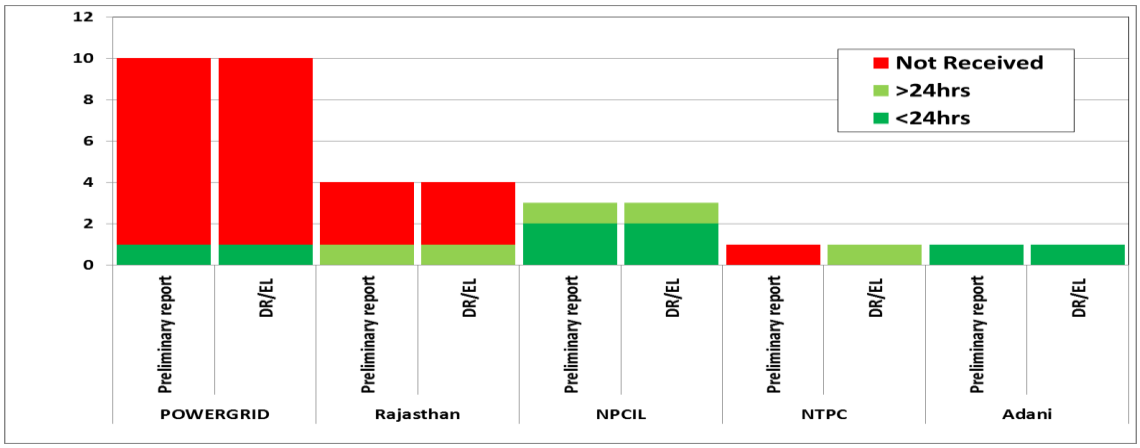
IR trippings: Details received status for August, 2018 as per 151th OCC



IR trippings: Details received status for July, 2018 as per 150th OCC



IR trippings: Details received status for June, 2018 as per 149th OCC



Utilities may also apprise the committee about the reasons for the delayed clearance of the faults and remedial actions taken to avoid such trippings in future.

Members may deliberate.

A.4 Actions taken on the outcome of the meeting of Protection Analysis Sub Group (PSAG)

It was deliberated in the 31st PSC meeting to create a Protection Analysis Sub-Group (PSAG) for conducting a detailed discussion of grid events of greater importance requiring immediate attention on regular basis as the discussion of a large number of grid events are not possible in the regular PSC meeting.

Subsequently, in the 32nd PSC meeting the members of group were decided. The 10th PSAG meeting was held on 18.04.2018 and minutes of the same was issued vide letter dated 27.07.2018. The following trippings were discussed in the meeting. **(Minutes attached as Annexure - IV)**

Sr No	Incident Discussed	PSAG meeting held on	Utility concerned
1.	Blackout of 400kV Kishenpur substation on 12.02.2018 at 11:24hrs and 12:07hrs and 400kV GSS Wagoora substation on 10.03.2018 at 09:51hrs	18.04.2018	PGCIL, NHPC, PDD J&K

PGCIL (NR-2) has submitted the compliance report (attached as Annexure-V) on the issues raised during 10th PSAG meeting along with DEF settings at Kishenpur.

The NHPC, PDD J&K are requested to submit the remedial actions taken at their end as per the findings of the meeting.

Members may take note of the same.

A.5 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**.**

UPPTCL may update the status.

A.6 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 utility 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.

Rajasthan has submitted the details of the level – I training.

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.

The Level-2 training for 2nd batch is tentatively scheduled during November–December, 2018.

Utilities are also requested to share the details of Level -I training at the earliest.

Members may deliberate about the second batch for Level-2 and level-3 training.

A.7. 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 (33 PSC Agenda Annex-IX) 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 & 35th PSC meeting, it was decided to deliberate on format once the constituted committee submits its report.

The Committee met to align the format as per SOPR but no consensus was reached among the members of the Committee. However, POWERGRID, NR-I has suggested a format for the Detailed analysis report which is enclosed as **Annex – VI.**

Members may deliberate on the proposed format(s) for Detailed Analysis report. (Annex. VII of 35th PSC agenda)

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.

35th* PSC *meeting on 20th June, 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 35th PSC	Present status
PLCC issues with PSTCL					
1	Amritsar	220 kV Verpal –I	Not installed	**PLCC Panels are installed on both end & wiring has been completed on PSTCL end & wiring on PGCIL end will be done with co-ordination of PLCC team of PSTCL by PGCIL. End to end testing will be completed by 30.09.2018**	

PSTCL may update the status.

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.

35th PSC meeting on 20th June, 2018- Status updated by UPPTCL and POWERGRID in the meeting was as under:

Sl. No.	Name of Transmission Line	Details of PLCC	Status as updated in 35th PSC	Present status
Allahabad S/S				
1.	220kV Allahabad-Rewa Road-I	PLCC link was through but failed frequently due to non availability of wave trap at Rewa Road end.	PLCC commissioned but not functional as end to end testing was pending.	
2.	220kV Allahabad-Rewa Road-II			
Kanpur S/S				
1.	220kV Kanpur-Mainpuri	PLCC panels not available	-	
Gorakhpur S/S				
1.	220kV Gorakhpur-Barhua	PLCC were not functional	PLCC has been commissioned but available relays do not have carrier feature which were to be replaced in 1 month.	
2.	220kV Gorakhpur-Basti	PLCC panels were not available	PLCC allotment was expected in August 2017.	

UPPTCL/POWERGRID may update the status.

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.

RVPNL may update the status.

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.

PSTCL may update the status.
Other utilities may update the status of islanding schemes in their respective state.

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-VII.**

Utilities are requested to update the latest 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-VIII.**

Utilities are requested to update the latest 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.

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 - IX)**

Utilities may update the 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/2015

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 Annex-VI to 34th PSC Minutes (Reasons /Action taken for Delayed Clearance of faults)	UPPTCL and NJHPS
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

Utilities are requested to furnish the information as mentioned above at the earliest as the details need to be submitted to CERC. However, if no further information is received, CERC will be intimated accordingly.

A.8.8. Submission of information in compliance to Hon'ble CERC Standards of Performance of inter-state transmission licensees Regulations, 2012:

In 32nd PSC meeting it was intimated that the Hon'ble **CERC SOPR-2012** regulation mandates inter-State Transmission Licensees to furnish the protection system reliability indices on monthly basis as attached at Annexure-I of the additional agenda of 32nd PSC. It had been observed that presently no such information was being received from the ISTS licensees.

It was requested that ISTS licensees submit such information on monthly basis to NRLDC.

Utilities were requested to share the DR/EL of the single element tripping and details of the tripping in desired format attached as Annexure-2 of the additional agenda of 32nd PSC.

PGCIL has submitted the details. Other utilities are requested to send the data from September 2016 onwards at the earliest.

A.8.9 Creation of Protection Analysis Sub-Group (PSAG):

SE, NRPC informed that in 31st PSC meeting it was deliberated that owing to the large number of grid events in the region and the intervening period between two successive PSC meetings, a detailed discussion of such large events during the limited time frame of the meeting becomes difficult. Further, it has been observed that several events in the grid require immediate analysis and rectification of defects.

He added that considering the above, it was proposed that a Protection Analysis Sub-Group (PSAG) would be formed to discuss and analyse major grid events, which require immediate attention. The subgroup would suggest specific corrective actions required by respective entity. The entities would submit the status of compliance of these recommendations in a stipulated time frame.

SE, NRPC further informed that PSC had decided to constitute a Protection Analysis Sub-Group with members from NRPC Secretariat, NRLDC and POWERGRID as permanent members. Further, all other utilities of Northern Region would provide one nomination each. The nominee from the utilities would be called when the tripping related to that utility is to be discussed. The group shall conduct its business on monthly basis and submit its report to PSC. In 32nd PSC meeting, members of the group were decided.

In 35th PSC held on 20th June,2018: Representative of NRLDC emphasized that remedial actions as recommended by PSAG and PSC should be compiled in tabular form with the time frame by utility and submitted to NRPC/NRLDC. He also stated that PSAG

group is to be expanded with more than one nomination from the utilities which might be sent for the physical audit in case of important multiple element tripping. MS, NRPC stated that expanding the group shall also help in manpower development as it is a learning exercise for Protection Engineers. Members were requested to send the additional nominations for the PSAG group.

Updated list of members of PSAG attached as Annexure-X. BBMB has submitted the additional nominations for PSAG. Other utilities are requested to submit the additional nominations for PSAG at the earliest.

A.8.10 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.

Utilities may update the status regarding actions taken to adhere these general recommendations.

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Northern Regional Load Despatch Centre

Agenda for 36th PSC meeting

19/09/2018

NOTE: All the utilities are requested to submit DR/EL and other tripping related data to NRPC/NRLDC and bring the same in the 36th PSC meeting to be held on 19th September, 2018.

1. Tripping events

A. Multiple Element tripping at 765/400kV Anta (Raj) at 14:40hrs of 02nd May 2018

Event category: GD-1
Generation loss: 1315 MW (As per Rajasthan report)
Loss of load: Nil (As per Rajasthan report)
Energy Loss: Nil (As per Rajasthan Report)

Data Summary received/available at NRLDC:

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

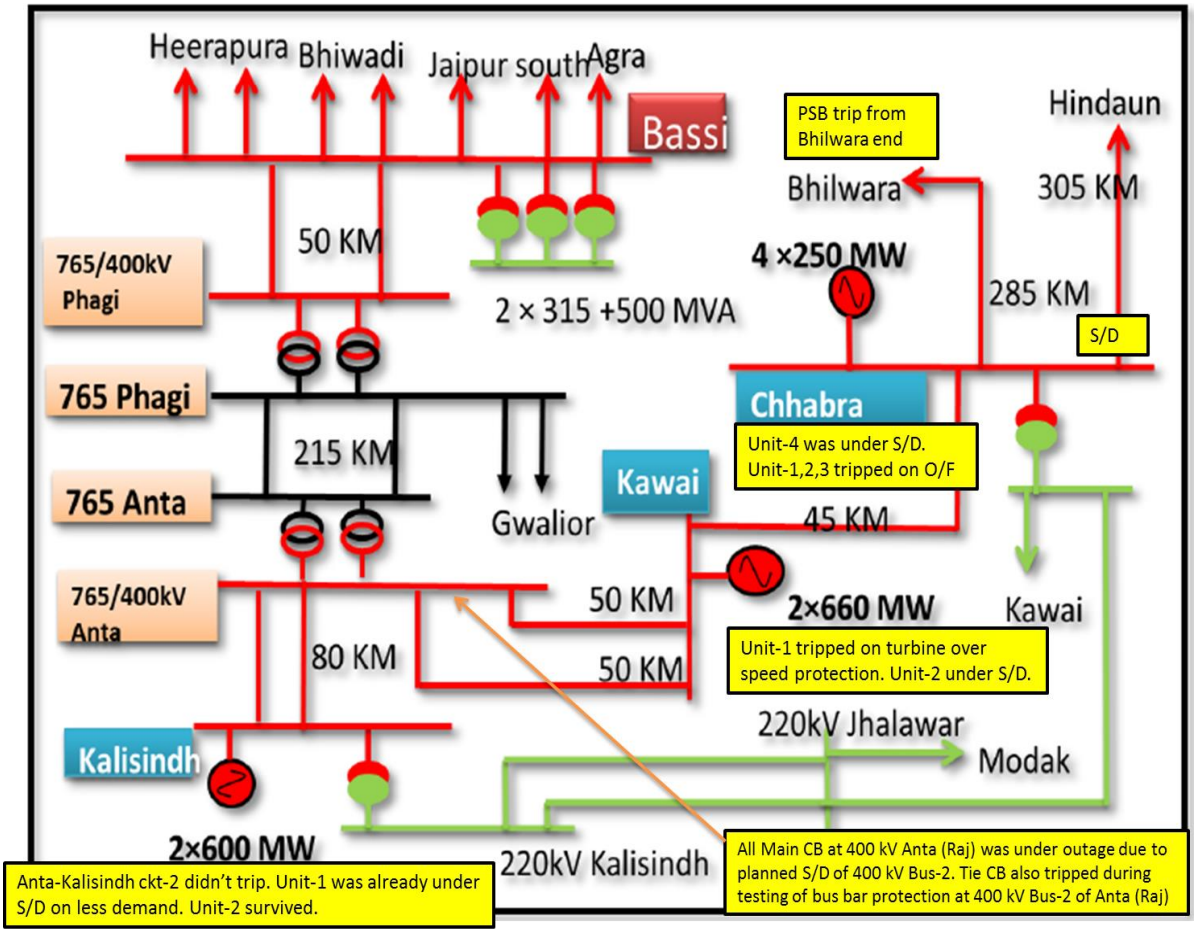
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received	Within 24hrs
Preliminary Report	Rajasthan	Received	Within 24hrs
Detailed Report	Rajasthan	Not Received	Remedial action report pending

Description	Clauses	Utility	Remarks

Violation of Clauses	1. 43.4.A of CEA Technical Standard for Construction of Electrical Plants and Electric Lines 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3) 3. CEA Grid Standard 3.1.e 4. CEA Transmission Planning Criteria	**Rajasthan**	1. Detailed Report didn't provide 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 of Chhabra/ Kawai/Kalisindh complex:



2. 400 kV Anta (Raj) is connected with Kawai D/C, Kalisindh D/C, Chhabra SCTPS D/C, Deedwana S/C and three 3*500MVA 765/400 kV ICT's. It has one and half breaker scheme.

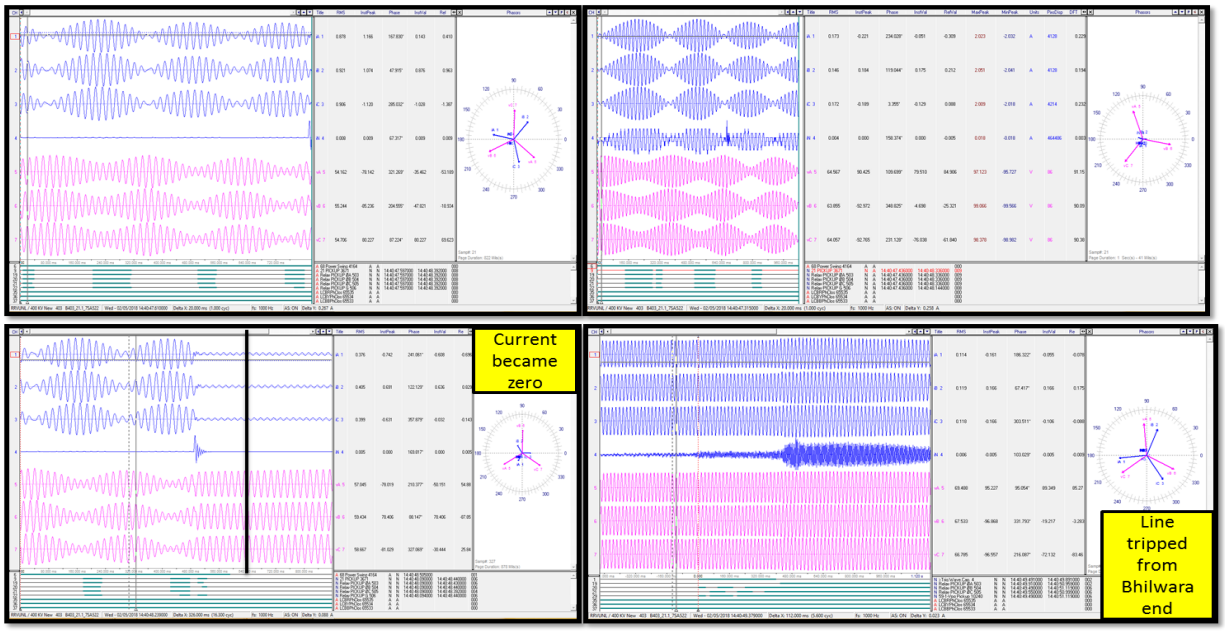
3. 400 kV Bus-2 of Anta (Raj) was already under planned shutdown for testing of bus bar protection.
4. During testing all tie CB except tie CB for 400 kV Kalisindh ckt-2 tripped at 400 kV side of 765/400 kV Anta (Raj). No power system fault occurred in the system.
5. After tripping of all main and tie CB at 400 kV Anta (Raj), 400 kV Kalisindh ckt-1, Kawai D/C, Chhabra SCTPS D/C tripped.
6. After tripping of 400 kV Kawai-Anta(Raj) D/C, Kawai generation pushed towards Chhabra TPS. As 400 kV Chhabra-Hindaun ckt was already under planned outage, 400 kV Chhabra-Bhilwara ckt loaded in the range 1100-1200MW.
7. Sudden shifting of power and constraint in transmission network resulted into oscillation in the system.
8. 400 kV Chhabra-Bhilwara ckt also tripped on power swing.
9. After tripping of all outgoing transmission line from Chhabra-Kawai complex resulted into outage of units (three units at Chhabra TPS, one unit at Kawai SCTPS) on over speed/ over frequency protection.
10. As 400 kV Anta-Kalisindh ckt-2 remain connected in the system resulted into survival of only running unit (unit-2) of 400 kV Kalisindh TPS.
11. SPS didn't operate at 400 kV Kawai SCTP.

12. Antecedent Condition:
    - 400 kV Chhabra-Hindaun ckt was already under planned shut down.
    - 660MW Unit-2 of Kawai SCTPS was already under planned outage.
    - Unit-1 of Kalisindh TPS was also under planned shutdown on less demand
    - Unit-4 of Chhabra TPS was under planned shutdown.
    - Power flow on different feeders:

S. No.	Name of Element	Load before the incident
1	400 kV CTPP-Bhilwara line	400 MW
2	400 kV CTPP-Hindaun line	0 MW
3	400 kV CTPP-Adani line	135 MW
4	ICT	185 MW
5	Unit#1	250 MW
6	Unit#2	250MW
7	Unit#3	250 MW
8	Unit#4	0 MW

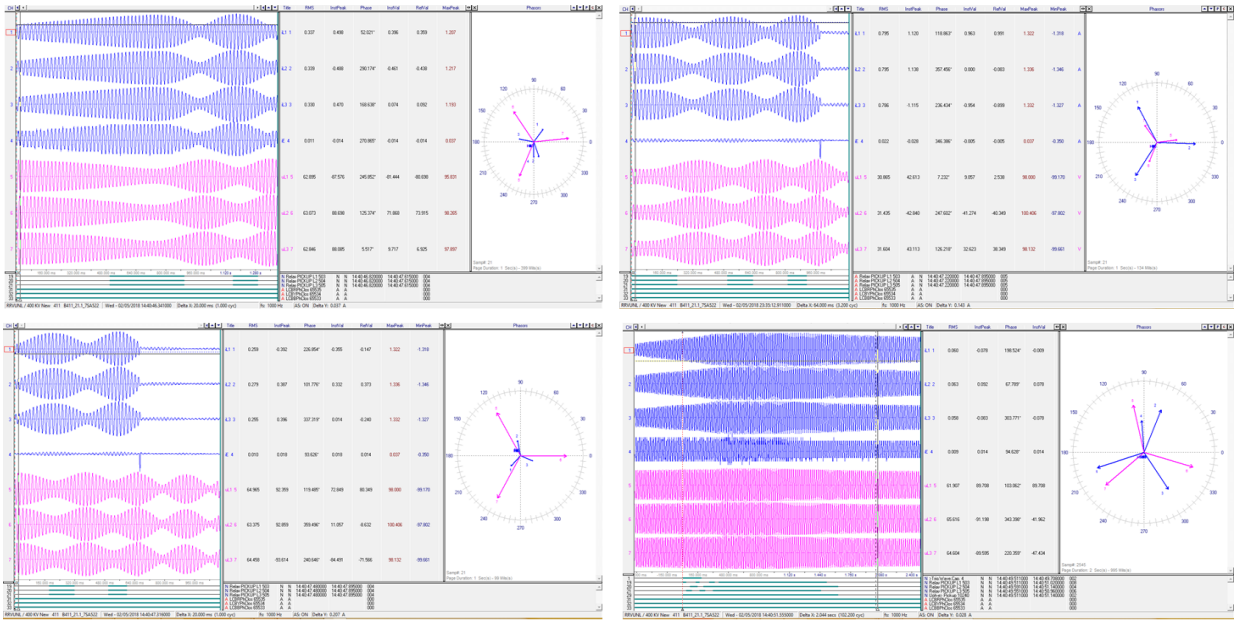
13. Name of the tripped elements are as below:
    - 400 kV Anta-Kawai ckt-1 & 2
    - 400 kV Anta-Kalisindh ckt-1
    - 400 kV Anta-Chhabra ckt-1
    - 400 kV Chhabra-Bhilwara ckt
    - 400 kV 250MW Unit-1,2,3 of Chhabra TPS.
    - 400 kV 660MW Unit-1 of Kawai SCTPS
14. DR plots:

DR -400 kV Chhabra(end) –Bhilwara ckt



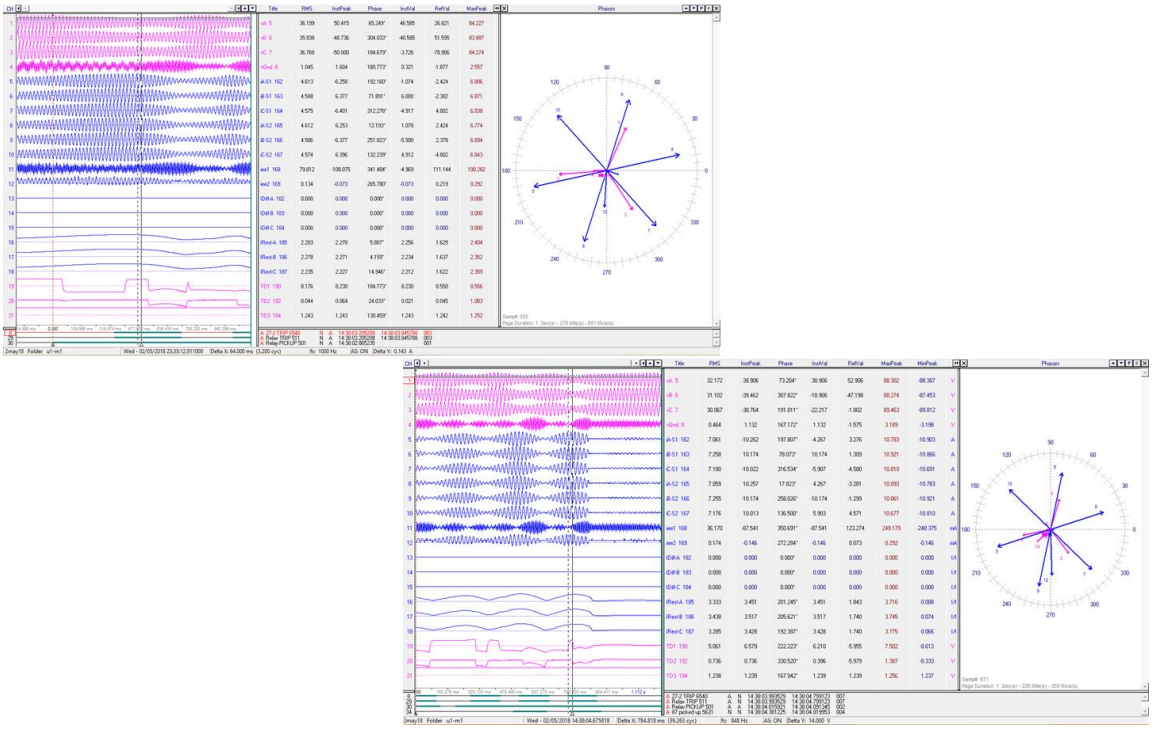
Continuous oscillation in observed in the line.
It seems DR capturing time is 1000ms instead of 2500ms (decided in PSC meeting)

DR -400 kV Chhabra(end) –Kawai ckt

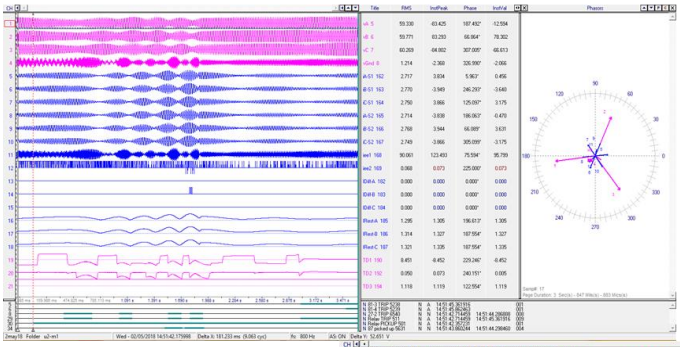


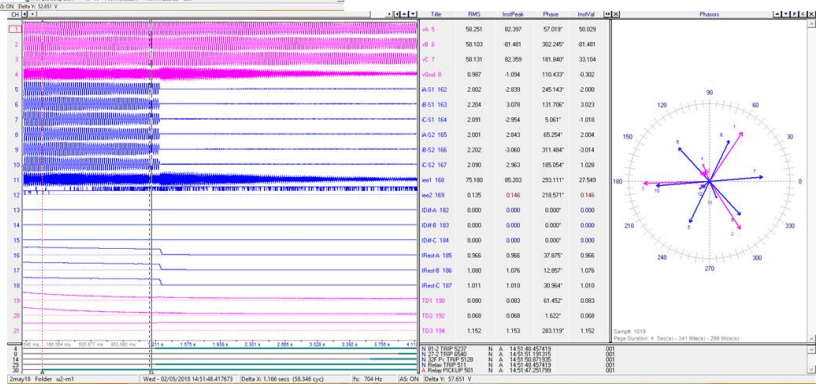
Continuous oscillation in observed in the line.
It seems DR capturing time is less than 2500ms as decided in PSC meeting

DR -400 kV Chhabra(end) Unit-1

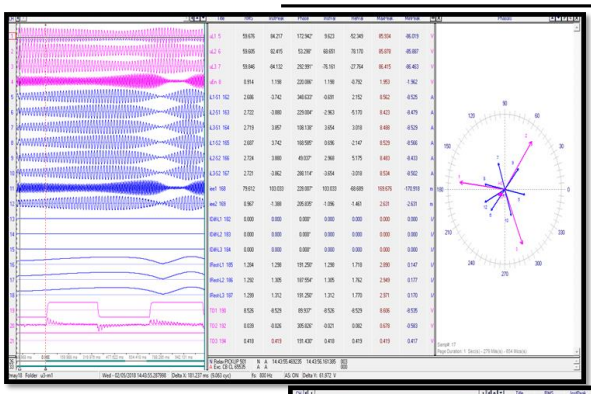


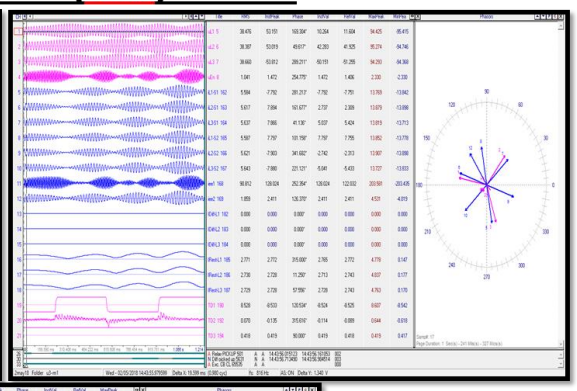
DR -400 kV Chhabra(end) Unit-2

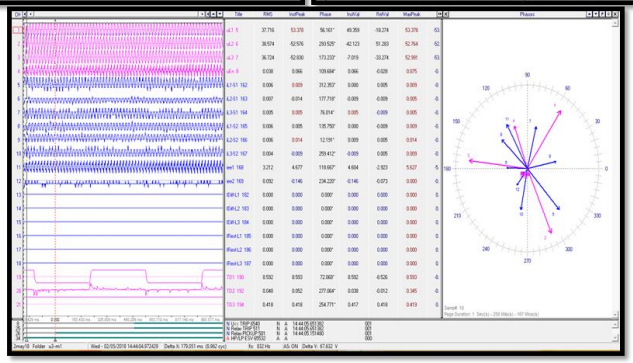




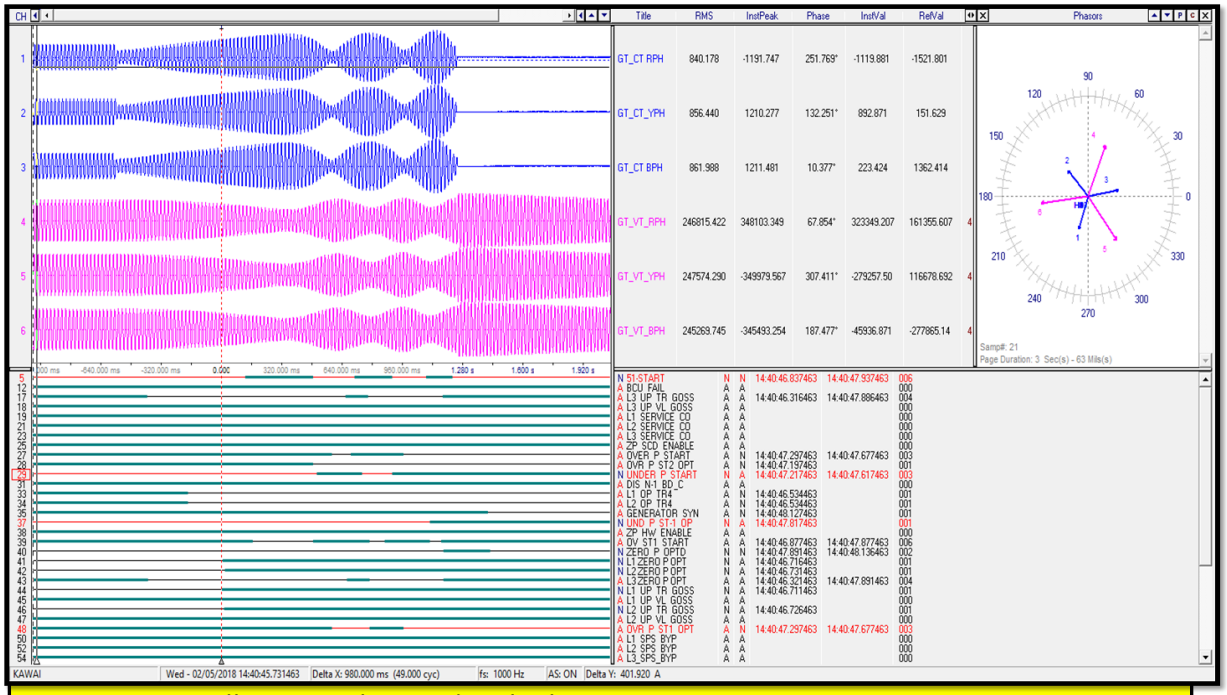
DR -400 kV Chhabra(end) Unit-3





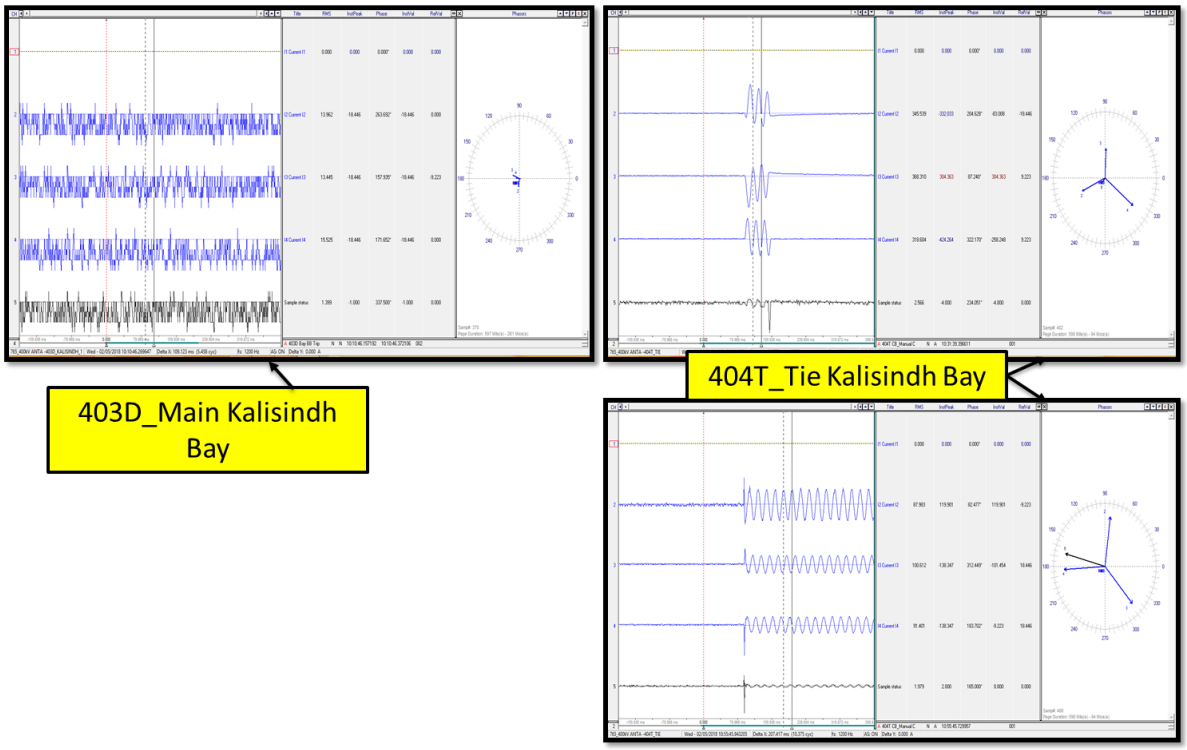


DR -400 kV Kawai(end) Unit-1



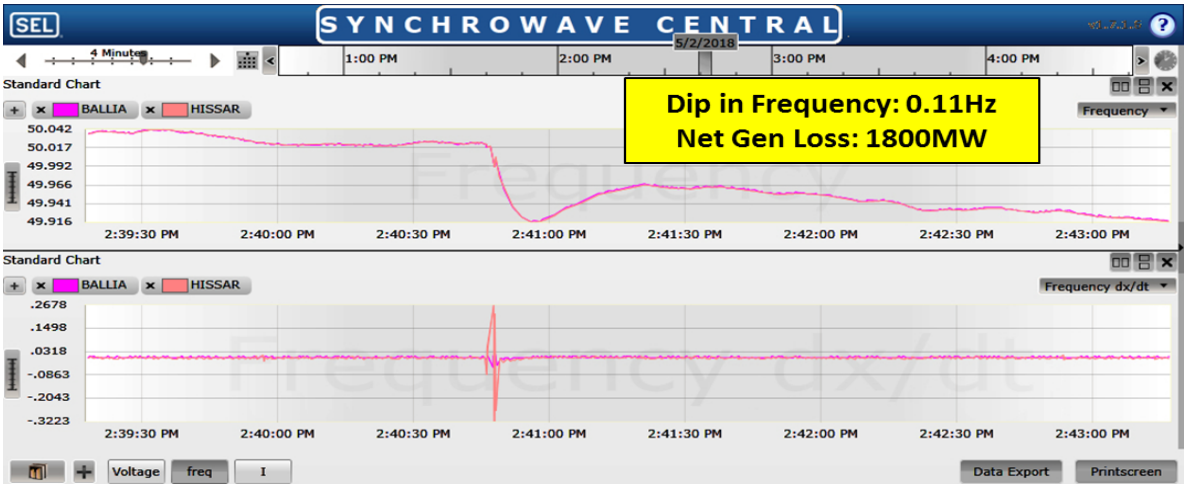
Continuous oscillation in observed in the line.
Unit tripped on turbine over speed

DR -400 kV Anta (end) Bus Bar

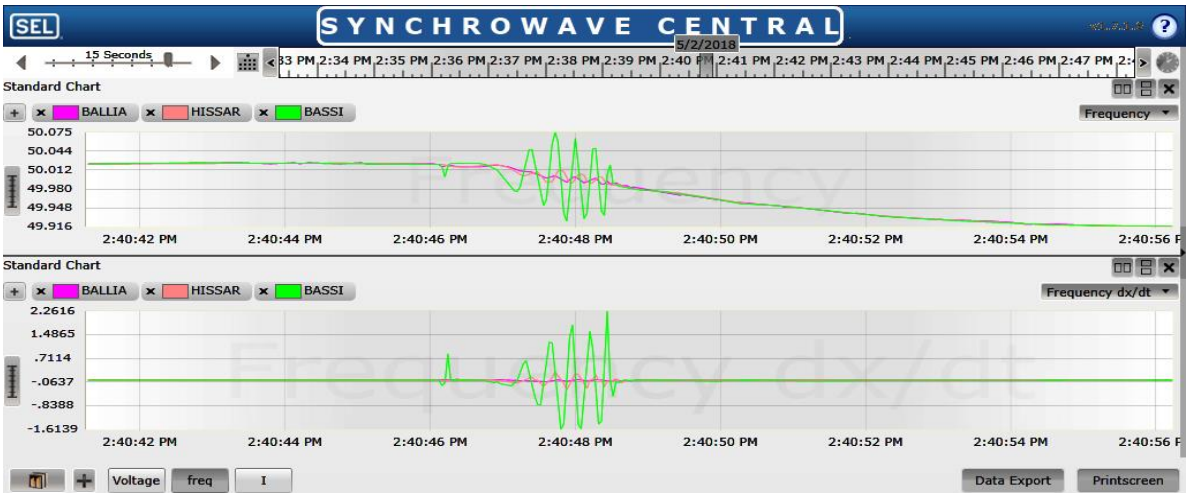


Time Synchronisation Error

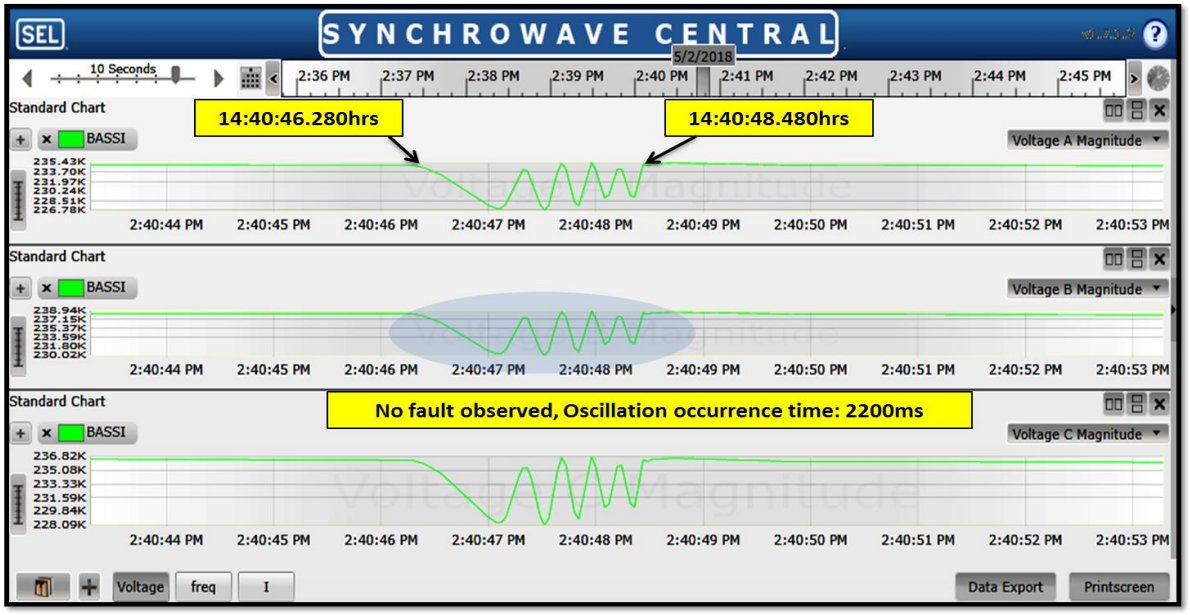
15. PMU plots:



PMU plot of frequency of different station



PMU plot of frequency of different station showing oscillation at Bassi (PG)



PMU plot of phase voltages of Bassi (PG)

16. As per PMU data:
    - No fault in the system
    - Oscillation occurred for **2200ms** in the system
17. As per Kawai (Adani) Report:
    - It was communicated from Anta end that Bus-bar protection was operated at their substation which caused isolation of 400kV Kawai-Anta Line-1 & 2 from grid. Load through-off at Line-1 & 2 caused transfer 600Mw power flow to 400kV Adani, Kawai-Chhabra line.
    - As per information received from Chhabra TPP, one of the 400kv O/G line was under shutdown at CTPP while three units were in running

condition there. Transfer of 600MW on available out going 400kV line at Chhabra caused overloading of lines. Therefore outgoing line of Chhabra tripped from remote end (May be due to over voltage) and complete black-out happened for Chhabra-Kawai complex.

- 400KV Adani, Chhabra-Kawai Line tripped from Chhabra end manually but no DT received at Kawai end.

Preliminary Report

Date & Time of event: - : **02/05/2018**
Introduction of Event: - : **Tripping of Unit-1 & Black-out at 400kV switchyard of 2X660MW KAWAI TPP.**
Total Loss of Generation : **650MW**
Total Loss of Load: - : **625MW**
Weather : **42°C (Normal wind speed)**
Triggering Incident:-

Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1.	660MW UNIT-1	02/05/2018	14:40:46Hrs	03/05/2018	01.32 Hrs.	Over-speed & SPS - Zero Power protection operated	
2.	400kv Kawai Anta Line-1	02/05/2018	14:40:46Hrs	02/05/2018	15:02:25Hrs	Line Voltage became zero Line Under power detected	
3.	400kv Kawai Anta Line-2	02/05/2018	14:40:46Hrs	02/05/2018	15:02:25Hrs	Line Voltage became zero Line Under power detected	
4.	400kv Adani, Kawai – Chhabra Line-3	02/05/2018	14:40:46Hrs	02/05/2018	15:02:25Hrs	Line Voltage became zero Line Under power detected Zone-3 Protection Started	

18. As per Chhabra TPS Report:

S. No.	Name of Element	Tripping		Closing Date	Closing Time (in hrs)	Remarks
		Date	Time (in hrs)			
1	UNIT-1	2/5/2018	14:40	2/5/2018	20:41	Over Frequency trip
2	UNIT-2	2/5/2018	14:40	2/5/2018	21:50	Over Frequency trip
3	UNIT-3	2/5/2018	14:40	2/5/2018	23:23	Over Frequency trip
4	UNIT-4	2/5/2018	14:40	2/5/2018	-	Under annual shutdown from 11/04/2018
5	400 kV Chhabra-Kawai	2/5/2018	14:47:11 Hrs. (Manually open)	2/5/2018	18:39	
6	400 kV CTPP-Hindaun	2/5/2018	-.	2/5/2018	21:23	Under planned shutdown from 01-05-2018
7	400 kV CTPP-Bhilwara	2/5/2018	14:47:44 Hrs. (Manually open)	2/5/2018	22:54	
8	220 kV CTPP- Kawai Line	2/5/2018	14:47:40 Hrs. (Manually open)	2/5/2018	18:33	
9	220 kV CTPP-Jhalawar Line	2/5/2018	14:47:37 Hrs. (Manually open)	2/5/2018	15:33	

19. Extract of Rajasthan report:

Preliminary Report

Date & Time of event: - : 02.05.2018 at 14.40 Hrs
Introduction of Event: - : Multiple trippings at 765 KV GSS at Anta
Total Loss of Generation : Nil
Total Loss of Load: - :
Weather :

Triggering Incident:-

Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400 KV Anta _ Kalasindh	02.05.2018	14.40	02.05.2018	15.26	Bus Bar Protection Main I unit	
2	400 KV Anta- Chabra Ck I	02.05.2018	14.40	02.05.2018	15.25	Bus Bar Protection Main I unit	
3	400 KV Anta – Kawai I	02.05.2018	14.40	02.05.2018	15.02	Bus Bar Protection Main I unit	
4	400 KV Anta _ Kawai II	02.05.2018	14.40	02.05.2018	15.03	Bus Bar Protection Main I unit	
5	400 KV Anta _ Kawai Spare Line	02.05.2018	14.40	02.05.2018	15.28	Bus Bar Protection Main I unit	

DETAILED ANALYSIS REPORT FOR TRIPPING AT 765 kV GSS ANTA

A. INTRODUCTION

1. Time & Date of Event: May 2, 2018 at 14:40 Hours
2. Substation affected along with voltage level: 400/765 kV GSS ANTA.
3. Brief event summary: *400 kV Tie Breakers tripped causing interruption on 400 kV Lines to KAWAI (APRL), CSCTPS & KALISINDH SCTPS*

B. ANTECEDENT CONDITION

1. Weather Information: - Hot Summer Afternoon with high Velocity Winds
2. Additional relevant Information: -

C. EVENT DATA

1. Change in Frequency:
2. Generation Loss: None
3. Single Line Diagram of affected area:

4. Name and time of the tripped elements in the time chronology: 1. *400 kV KAWAI Circuit 1&2, 400 kV CHHABRA Circuit # 1 & 400 kV KALI SINDH Circuit# 1*

5. Location and type of fault: Tripping caused during testing of Bus Bar Protection Relay at Anta 400 kV Bus End.
6. Flag Detail, DR and EL for each affected element: *Bus Bar Protection Relay Main 1 operated.*
7. Appropriate Graphical plot.
8. Equipment Failure: -

D. Event Description /Analysis of the event

9. Description: -

E. RESTORATION

10. Restoration Time of Tripped elements in time chronology:

ANTA-> KAWAI Circuit # 1 & 2	15:02 Hours & 15:03 Hours respectively
CHHABRA Circuit # 1	15:25 Hours
KALISINDH Circuit # 1	15:26 Hours

11. Special finding/issues identified during restoration: - NA

F. REMEDIAL ACTION

12. Remedial action taken: The Relay Programmed Logic corrected.
13. Remedial action to be taken along with the frame: Relay tested ok

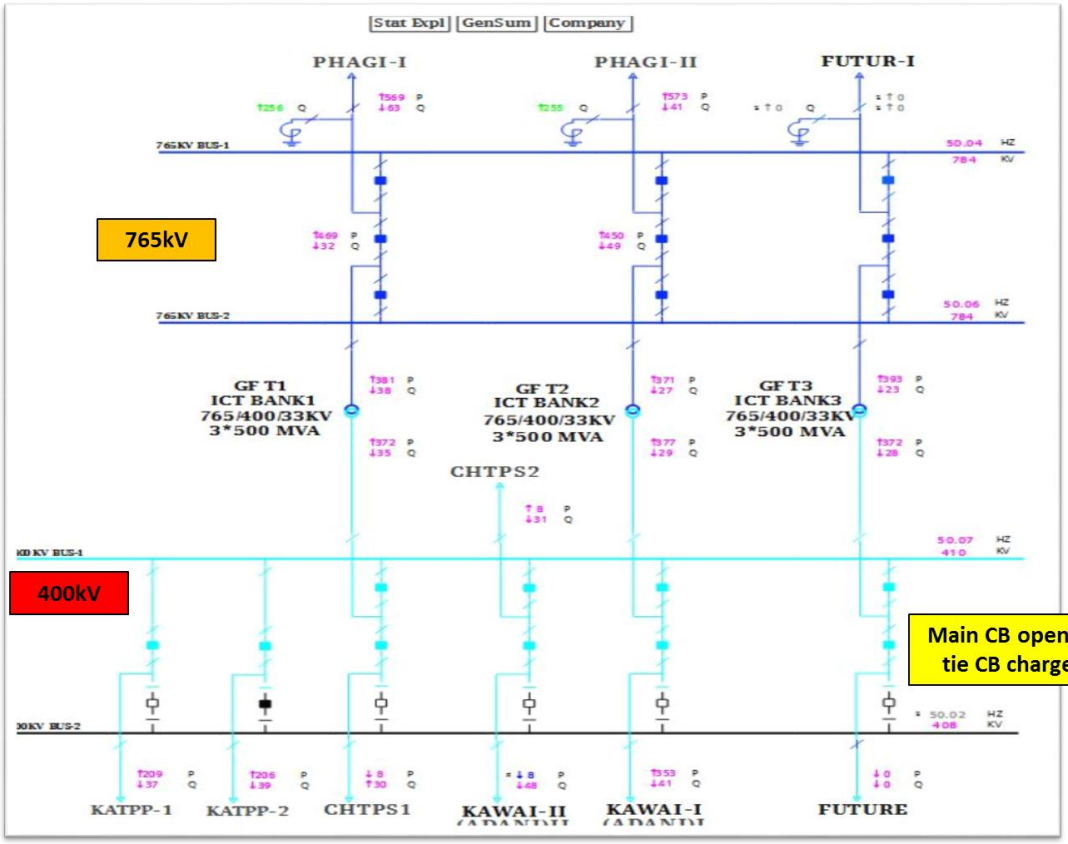
G. Lesson Learnt : More care & check Next time

H. Any other Information: - NA

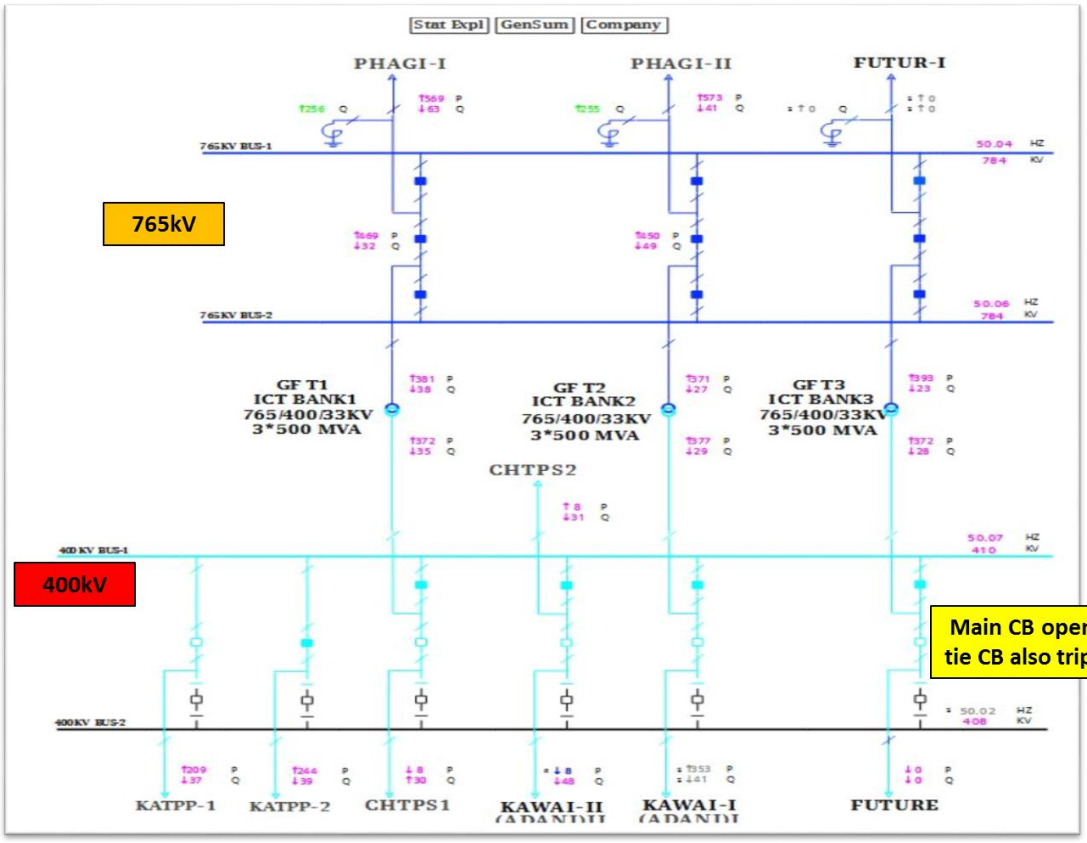
20. SCADA Analog data and SoE:

No SCADA SoE available in NR SCADA

SLD of 765/400 kV Anta (Raj) before the incident



SLD of 765/400 kV Anta (Raj) after the incident



21. Preliminary Report, DR/EL and detailed report has been received from Rajasthan. However, remedial measures report is still awaited from Rajasthan.

Points for Discussion:

1. Reason of tripping of all tie CB at 400 kV Anta (Raj).
2. Reason of non-tripping of tie CB of 400 kV Anta (end)-Kalisindh ckt-2.
3. 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.
4. SPS non-operation details needs to be looked into.
5. Detailed report and supporting DR/EL needs to be submitted
6. Time synchronization of DR to be checked and corrected

Rajasthan may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

B. Multiple element tripping at 400/220kV Ajmer (Raj) at 16:55hrs of 24th May 2018 and 17:55hrs of 06th Jun 2018

Event category: GD-1
Generation loss:

Nil	(24.05.2018, As per Rajasthan Report)
Nil	(06.06.2018, As per Rajasthan Report)

Loss of load:

Nil	(24.05.2018, Rajasthan may confirm)
110MW	(06.06.2018, Rajasthan may confirm)

Energy Loss:

Nil MU	(24.05.2018, Rajasthan may confirm)
__ MU	(06.06.2018, Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	100ms	24.05.2018
		1000ms	06.06.2018
Phase of the fault	PMU data	Y-N fault followed by B-N fault	24.05.2018
		B-N fault	06.06.2018

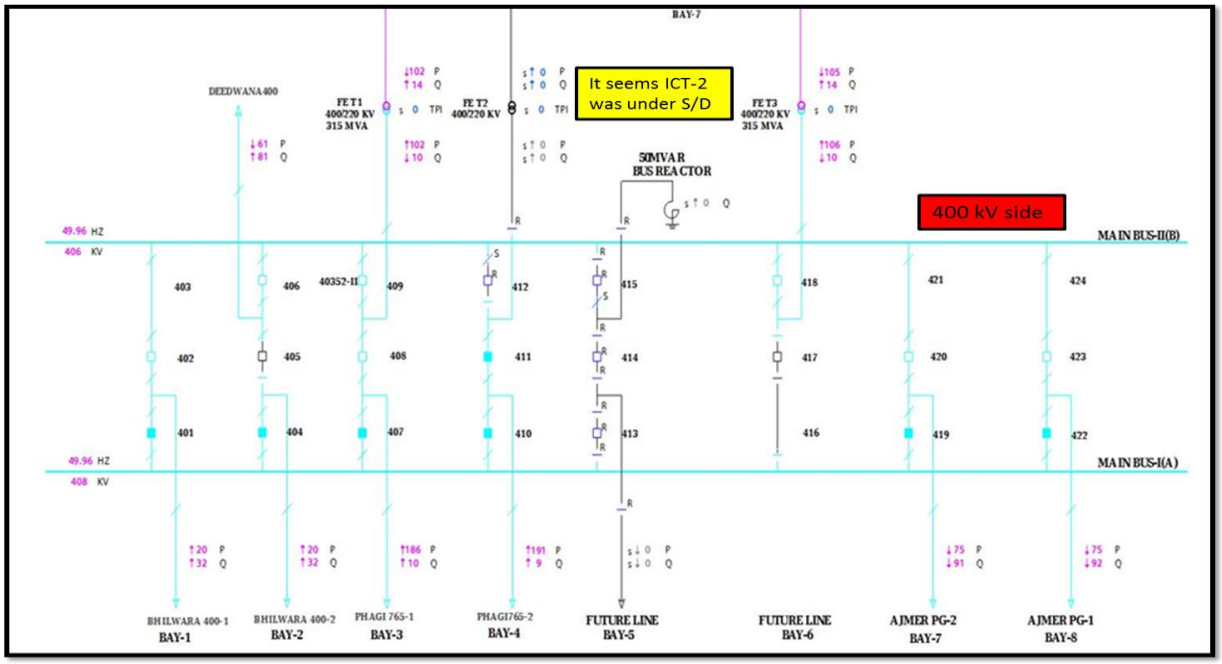
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	24.05.2018
			06.06.2018
DR/ EL	Rajasthan	Received (Partial)	24.05.2018 (Not received)
			06.06.2018 (After 24hrs)
Preliminary Report	Rajasthan	Received	24.05.2018 (Within 24hrs)
			06.06.2018 (After 24hrs)
Detailed Report	Rajasthan	Not Received	24.05.2018
			06.06.2018

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	**Rajasthan**	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 Ajmer (Raj) is connected with D/C Ajmer7 (PG), Bhilwara D/C, Phagi D/C, Deedwana S/C and three 315MVA 400/220 kV ICT's. It has one and half breaker scheme.
2. 220 kV Ajmer 4 (Raj) connected with 220 kV Ajmer S/C, 220 kV Beawar, 220 kV Jethana D/C. At 220 kV side DMT (double main transfer breaker) scheme.
3. *Event Description for 24th May 2018 event:*
    a. SLD of 400 kV Ajmer (Raj):



b. Bus Bar Protection operated for 400 kV Bus-2 Ajmer (Raj).

c. Name of the tripped element:
   - 400 kV Ajmer-Deedwana
   - 400/220 kV 315MVA ICT-1 & 3 at Ajmer (Raj)
   - 400 kV Bus Bar-2 at Ajmer (Rajasthan)

d. As per Rajasthan report:

Preliminary Report

Date & Time of event: - : **24.05.2018 at 16.55**
Introduction of Event: - : **400 KV Ajmer - Deedwana**
Total Loss of Generation : **Nil**
Total Loss of Load: - : **NA**
Weather :

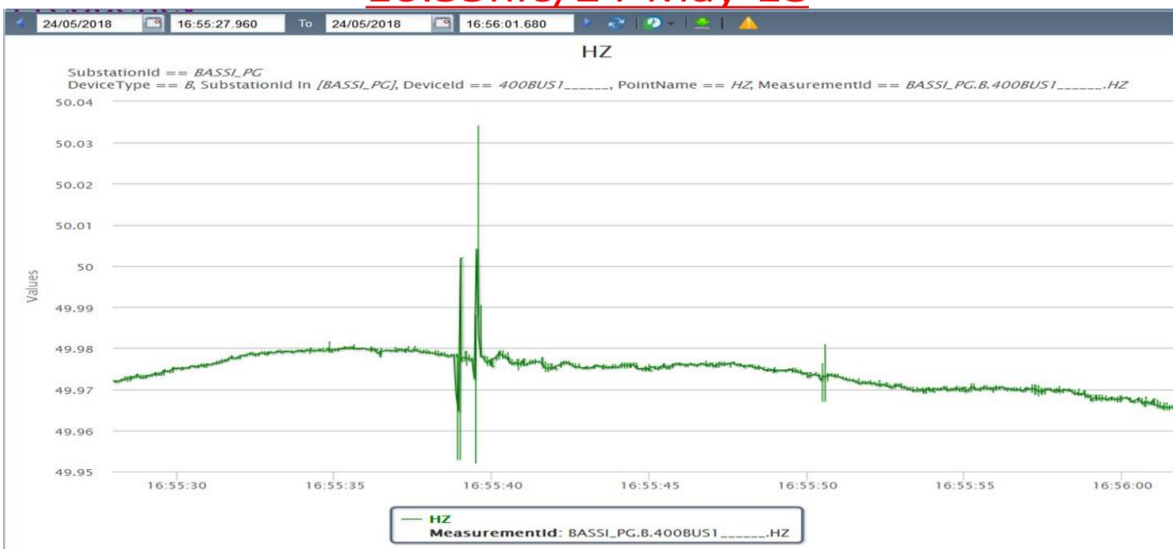
Triggering Incident:-

Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400 KV Ajmer - Deedwana	24.05.2018	16.55	24.05.2018	17.32	Bus – Bar Protection operated	
2	400 KV ICT-1at 400 KV GSS Ajmer	24.05.2018	16.55	24.05.2018	17.38		
3	400 KV ICT 3 at 400 KV GSS Ajmer	24.05.2018	16.55	24.05.2018	17.36		

e. PMU data of frequency and phase voltages:

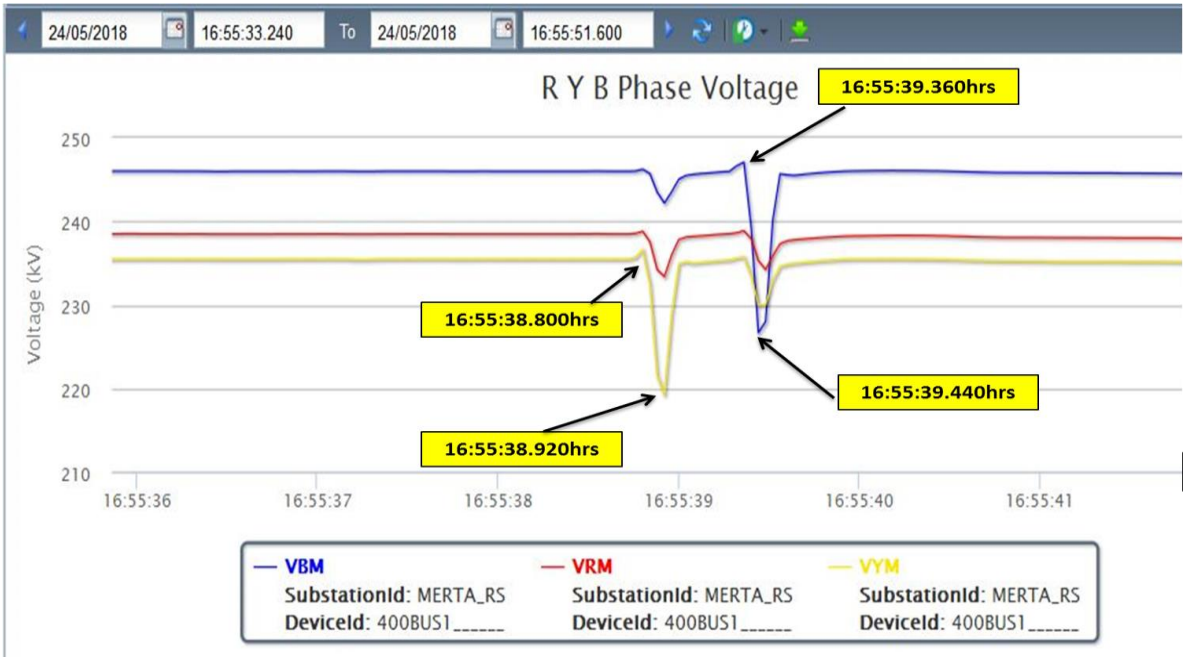
PMU Plot of frequency at Bassi(PG)

16:55hrs/24-May-18



PMU Plot of phase voltage magnitude at Merta(Raj)

16:55hrs/24-May-18



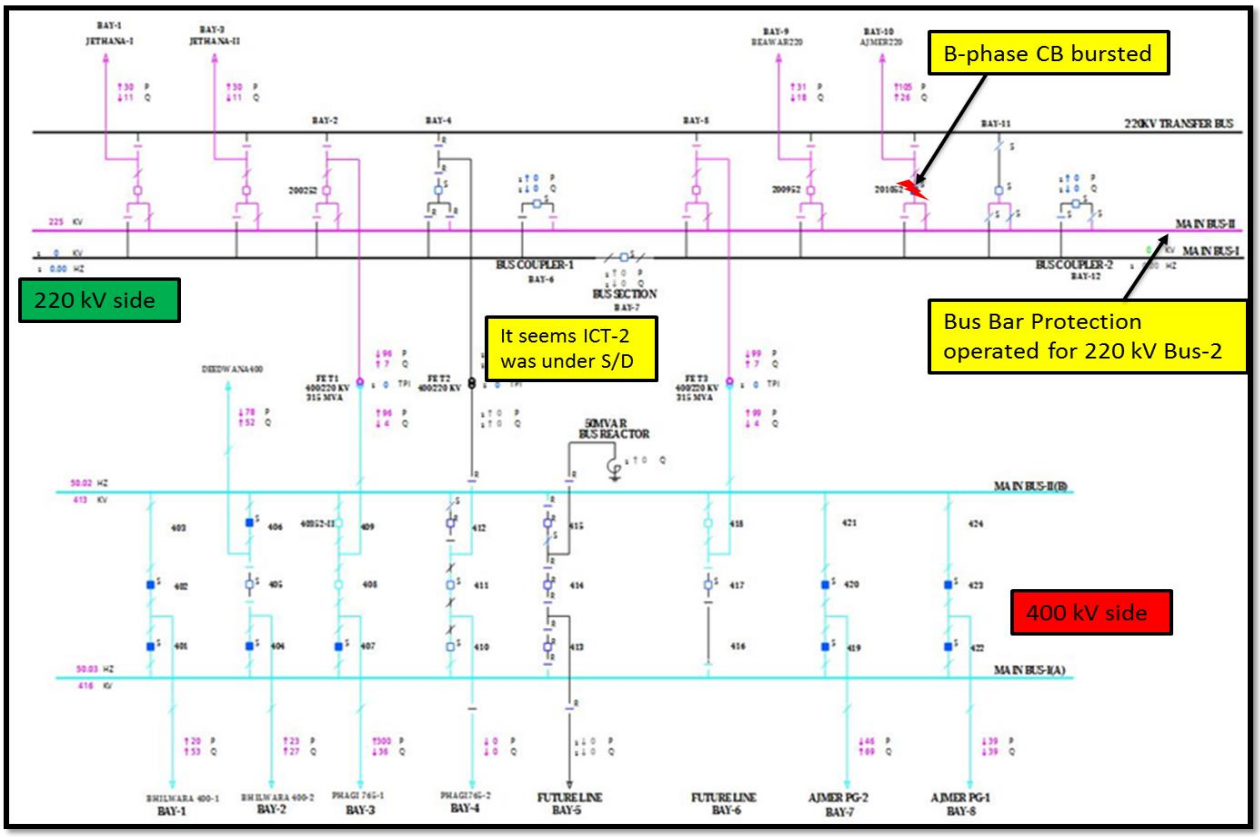
f. SCADA SoE data: No SoE reported

g. As per PMU data:
   - Y-N fault followed by B-N fault observed at 16:55:38.800hrs and 16:55:39.360hrs respectively.
   - Fault clearance time in less than 100ms for both the incident

h. As per SCADA data:
   - 400 kV Ajmer-Deedwana, 315 MVA ICT 1 & 3 tripped.
   - Bus 2 voltage was not became zero after tripping of 400 kV Bus-2

i. Preliminary report has been submitted however DR/EL and detailed report is still awaited from Rajasthan.

4. *Event Description for 06th Jun 2018 event:*
   a. In antecedent condition, 220 kV Bus-1 of 400/220kV Ajmer (Raj) was already under outage
   b. SLD of 400/220 kV Ajmer (Raj):

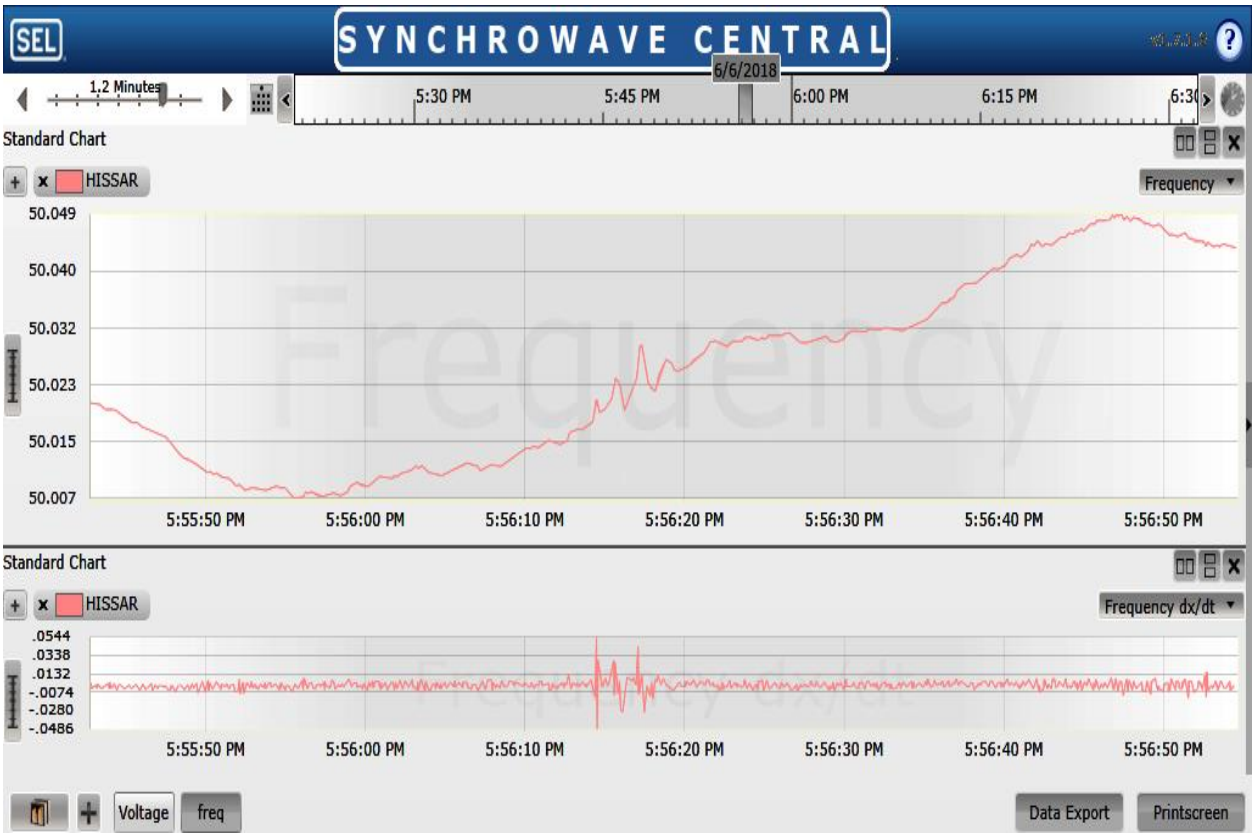


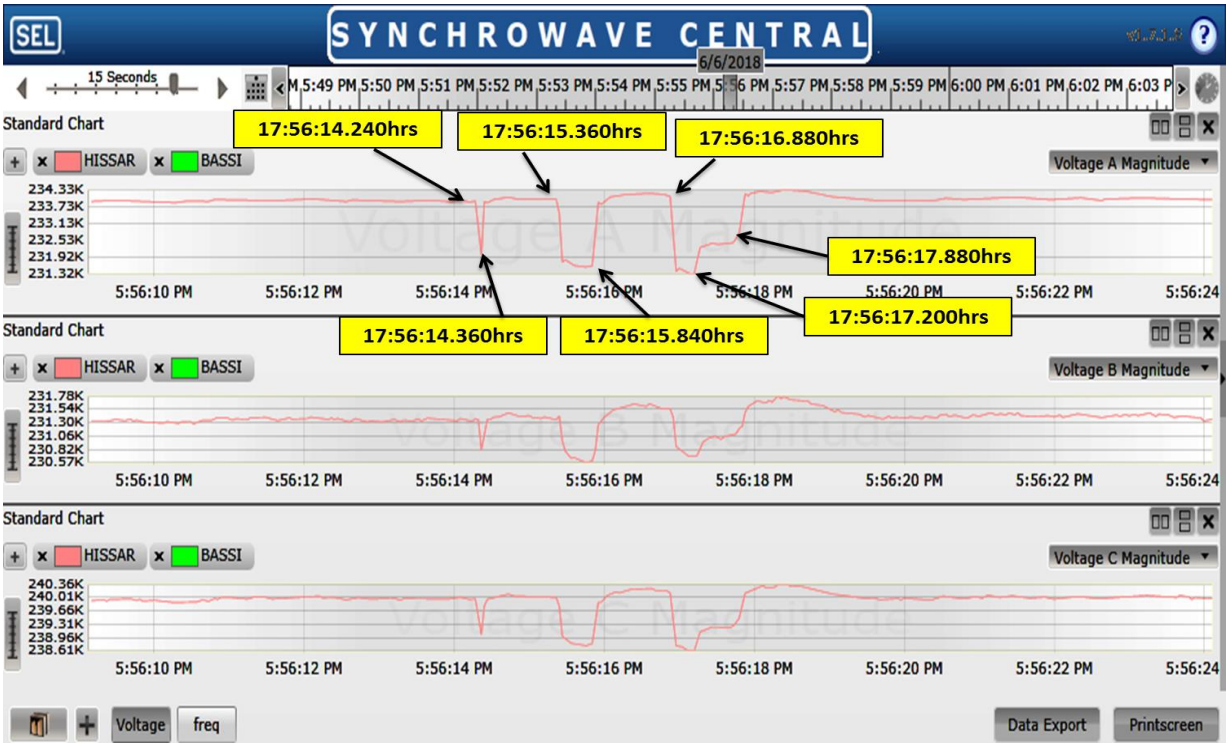
c. B-phase CB of 220 kV Ajmer (400kV)-Ajmer (220kV) line was bursted at 400/220 kV Ajmer (Raj). It resulted into operation of bus bar protection for 220 kV Main Bus-II.

d. Following element connected to 220kV bus-2 0f Ajmer (Raj) tripped:

- 220 kV Ajmer-Jethana ckt-1 & 2
- 220 kV Ajmer-Beawar ckt
- 220 kV Ajmer-Ajmer(220kV) ckt
- 400/220 kV 315MVA ICT-1 & 3 at Ajmer (Raj)
- 220 kV Bus Bar-II at 400/220 kV Ajmer (Raj)

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

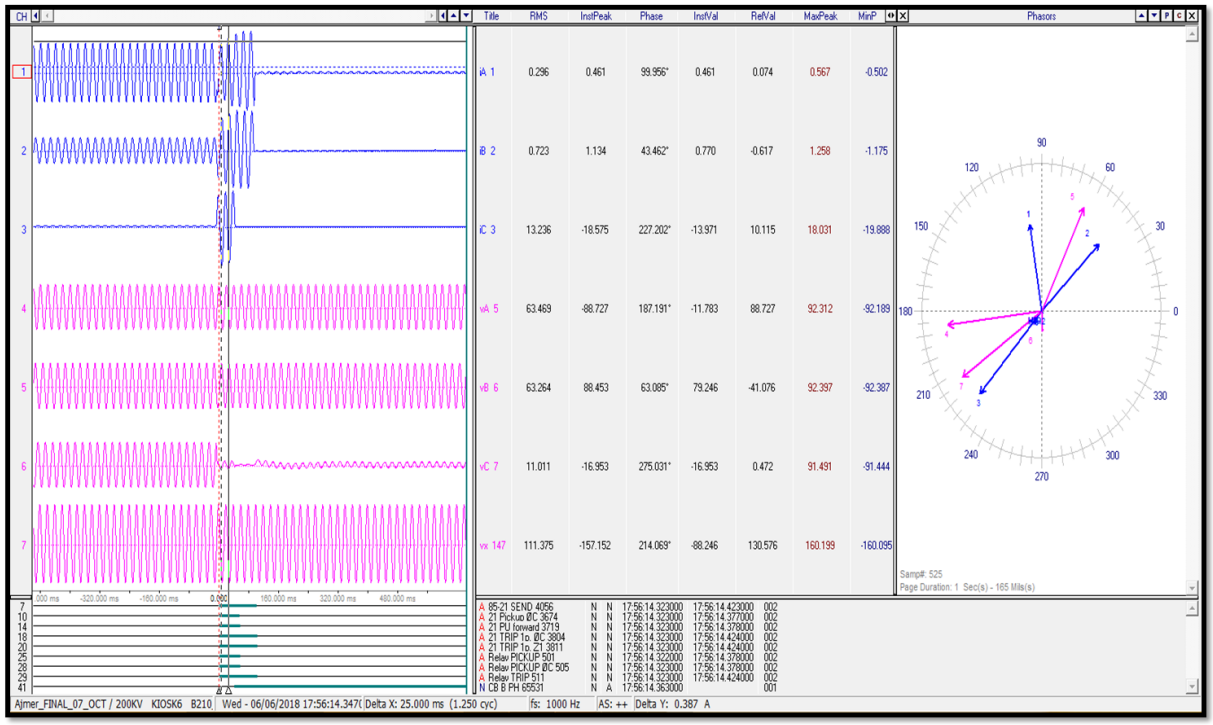




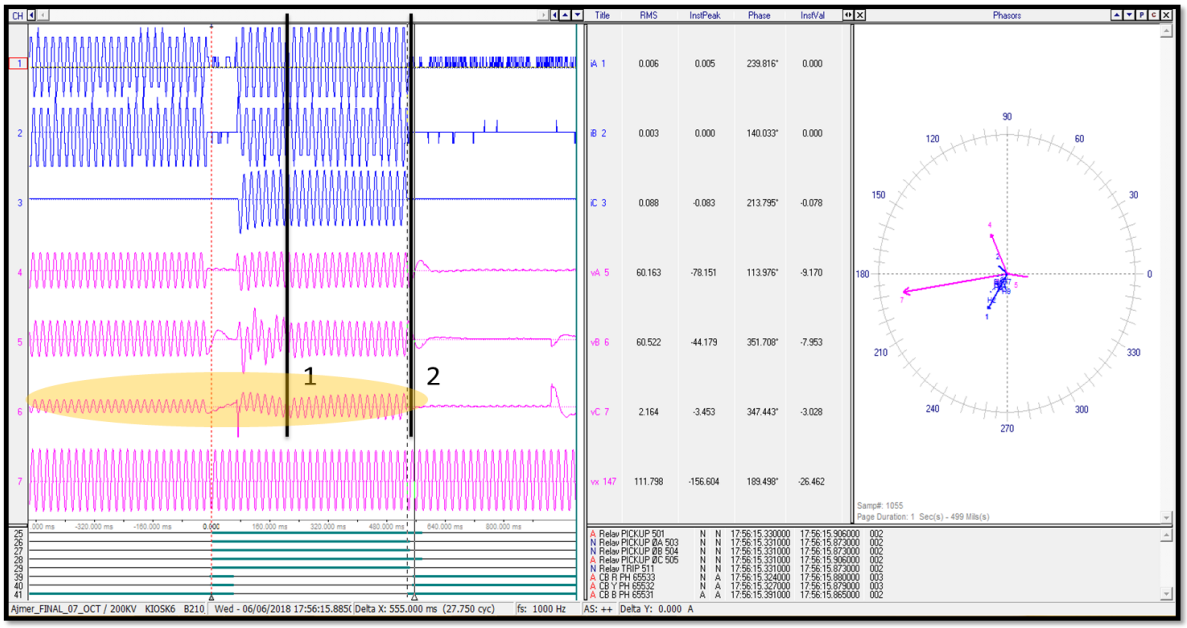
f. SCADA SoE data: No SoE reported

g. AS per DR details:

DR of 220 kV Ajmer4 (end)-Ajmer line

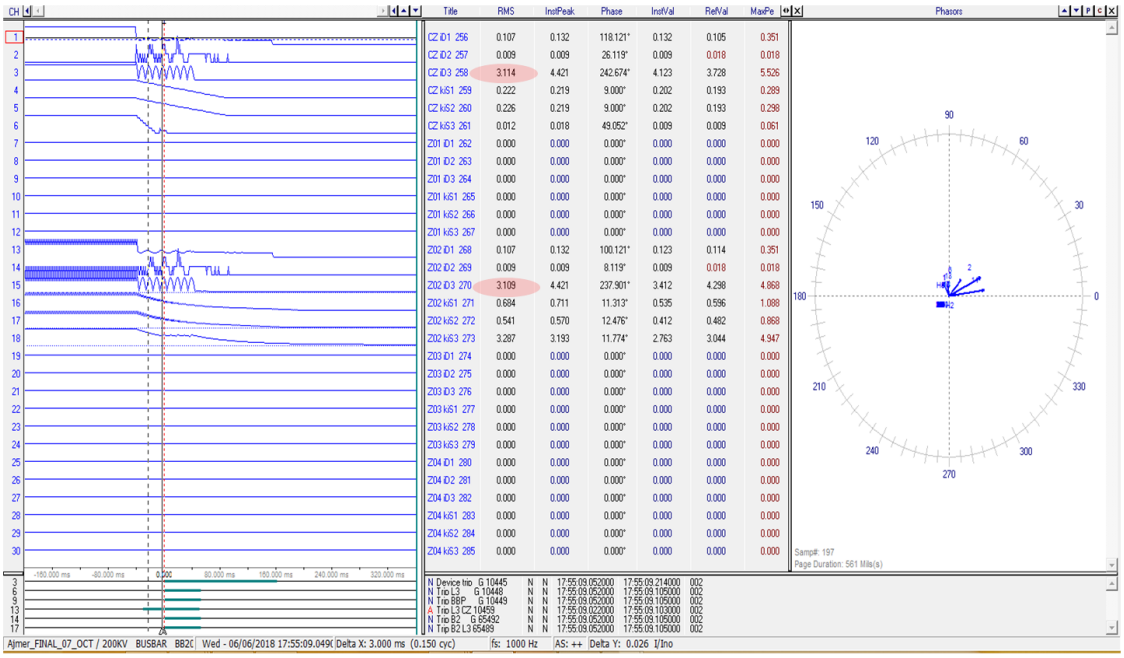


DR of 220 kV Ajmer4 (end)-Ajmer line

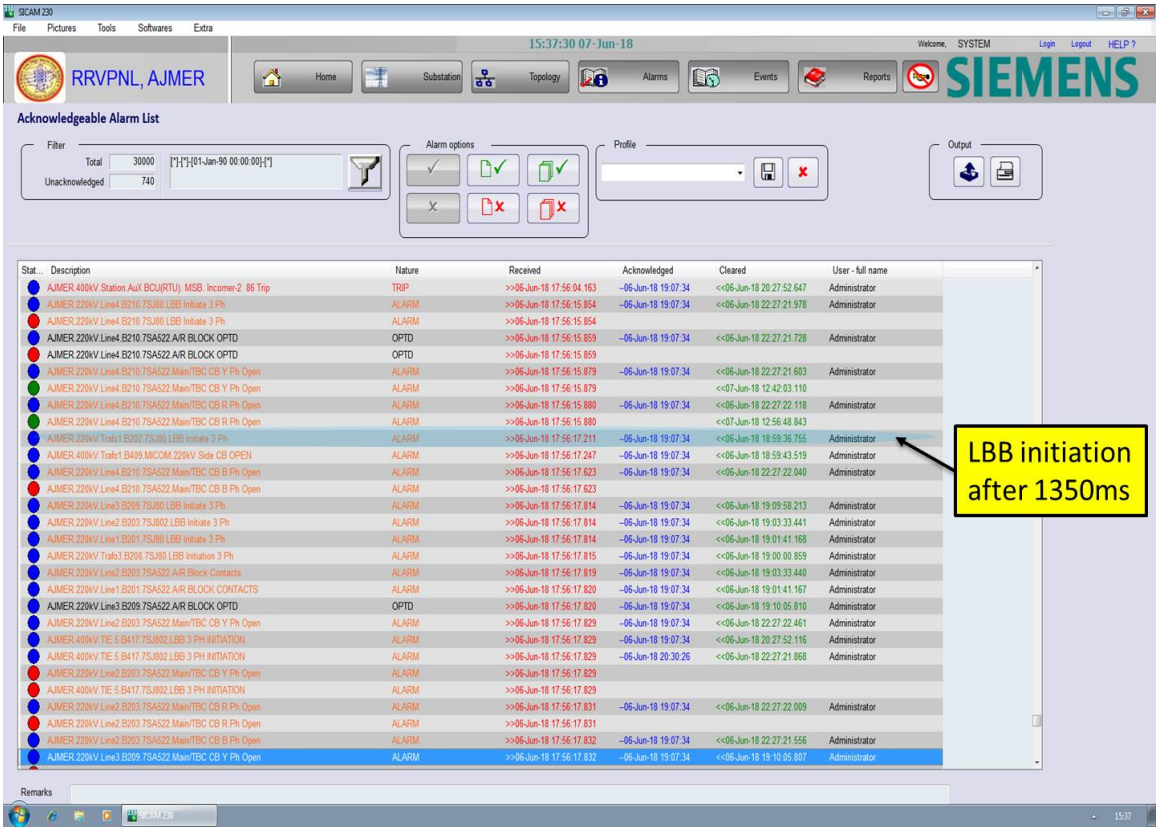


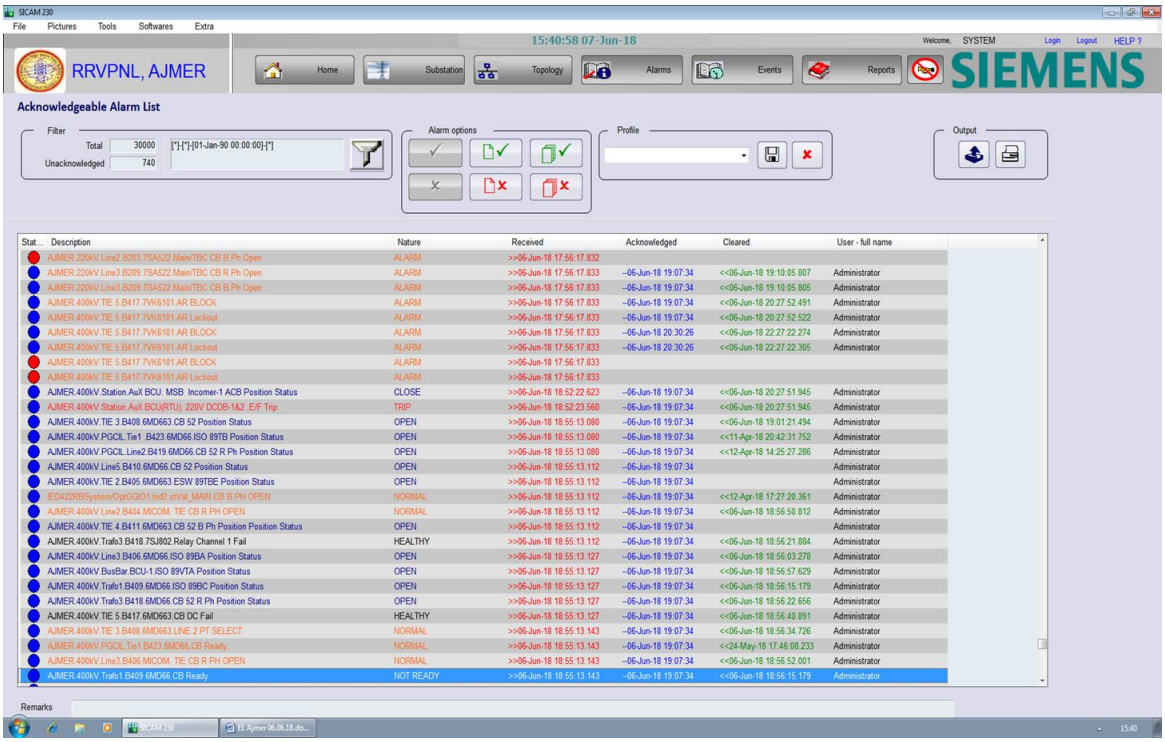
Point 1. Only B-phase was under open condition (from the start of the captured DR)
Point 2. All three phase of the line tripped

DR of 220 kV Ajmer4 (end)-Ajmer line



Time synch error or check the PMU plot at 17:55 hrs





h. As per PMU data:
   - B-N fault observed at 17:56:15.360hrs & 17:56:16.880hrs
   - Slight voltage dip observed in all three phase.
   - Fault clearance time more than 1000ms for two incident of fault

i. As per Rajasthan details:

Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
	220 kV Ajmer S/C Line	06.06.2018	17:55 Hrs	06.06.2018	19:24 Hrs	400 kV GSS Ajmer End- Main-2 Zone-1 optd, B-phase Dist. Protection 2.45kms, Main-1 Zone 1 optd, B phase DT Send, carrier send CH1 CH2. 220 kV GSS Ajmer end- 85x2, 86T, 86 AR, 86 BR, 86 CR	220 KV Bus bar operated
	400/220 kV, 315 MVA ICT-I	06.06.2018	17:55 Hrs	06.06.2018	18:56 Hrs	LBB initiation 86.1, 86.2 optd	Tripped due to 220 kV Main I Bus Bar Operated
	400/220 kV, 315 MVA ICT-III	06.06.2018	17:55 Hrs	06.06.2018	18:54 Hrs	LBB initiation 86.1, 86.2 optd	Tripped due to 220 kV Main I Bus Bar Operated
	220KV Ajmer-Jethana ckt-I	06.06.2018	17:55 Hrs	06.06.2018	19:01 Hrs	400 kV Ajmer end: LBB initiation 86.1, 86.2 optd 220 kV Jethana End: Main I, Main II Distance protection operated, Zone III, A ph. optd , 81.5 km	Tripped due to 220 kV Main I Bus Bar Operated
	220 kV Ajmer-Jethana ckt-II	06.06.2018	17:55 Hrs	06.06.2018	19:24 Hrs	400 KV Ajmer end: LBB initiation 86.1,86.2 optd 220 kV Jethana End: Main I, Main II Distance protection operated, Zone III, A ph. optd , 81.6 km	Tripped due to 220 kV Main I Bus Bar Operated
	220 kV Beawar line	06.06.2018	17:55 Hrs	06.06.2018	19:09 Hrs	400 kV Ajmer end: LBB initiation 86.1,86.2 optd 220 kV Beawar end: Main I: A ph. optd. Zone II Distance 77.9 km Main II: A ph. optd. Zone II Distance 78.2 km 86.A, 86.B operated	Tripped due to 220 kV Main I Bus Bar Operated

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

Points for Discussion*:*

1. Event on 24th May 2018:
    a. Multiple element tripping in case of operation of 400 kV bus bar protection at 400/220 kV Ajmer (Raj) as it has one and half breaker scheme.
    b. Operation of bus bar protection for 400 kV Bus-2 Ajmer (Raj) needs to be looked into.
    c. Why bus voltage didn't become zero at 400 kV Ajmer (Raj)
    d. In case of line fault, A/R status for 400 kV Ajmer-Deedwana line needs to be looked into.
    e. In case of operation of bus bar protection, tripping of elements needs to be looked into. (As elements would be connected to other bus via tie breaker)
    f. Detailed report and supporting DR/EL needs to be submitted.
    g. Operation of 400 kV bus bar protection operation at 400/220 kV Ajmer (Raj) to be reviewed and corrected.

2. Event on 06th Jun 2018:
    a. In case of operation of distance protection, as Z-1 initiated in flag details, breaker should have operated and cleared the fault.
    b. In case of operation of LBB protection, delayed operation of LBB protection (fault duration more than 1000ms), same has been checked through station EL details?
    c. Exact location of fault to be reported.
    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. Detailed report and supporting DR/EL needs to be submitted
    f. Operation of 220 kV bus bar protection/ LBB operation at 400/220kV Ajmer (Raj) to be reviewed and corrected.
    g. Time synchronization of DR to be checked and corrected

Rajasthan may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

C. Multiple element tripping at Uri-II HEP at 13:55hrs of 26th May 2018

Event category: GD-1
Generation loss: 240MW (NHPC may confirm)
Loss of load: Nil (J&K may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	240ms	As per PMU data
Phase of the fault	PMU data	R-N fault	As per PMU data

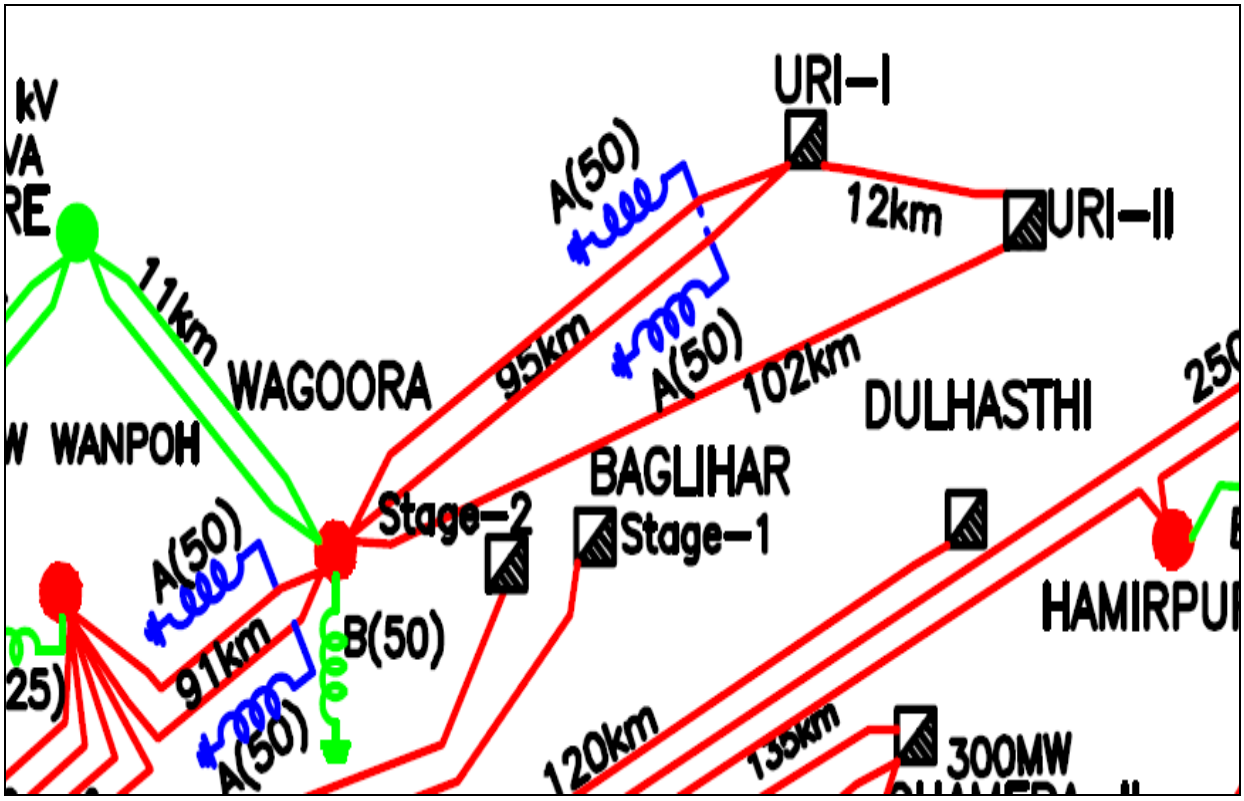
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)		Available	
DR/EL	NHPC	Received	Within 24hrs
Preliminary Report	NHPC	Received	Within 24hrs
Detailed Report	NHPC	Received	Not in proper format

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; 3. CEA Grid Standard 3.1.e 4. CEA Transmission Planning Criteria	**NHPC**	1. Correct operation of Protection System 2. Delayed Clearance of fault 3. Adequately Sectionalized and graded protective relaying system

Based on above information description of the events is:

1. Connectivity Diagram:



2. R-N fault occurred in 400kV Uri-II-Uri-I ckt. R-phase opened at both ends.
3. At the time of auto-reclosing, R-phase CB closed from Uri-I end but failed to close from Uri-II end resulting in tripping of other two poles on pole discrepancy.

4. At the time of opening of R-phase CB from Uri-I end, 400kV Uri-II-Wagoora ckt sensed fault in Z-1 from Uri-II end resulting in tripping of R-phase.
5. Units at Uri-II tripped at the time of opening of R-phase of both lines from Uri-II.
6. At Uri-I, in 400kV Uri-II-Uri-I ckt, R-phase fault occurred again after 245ms of closing of R-phase. Thus, 3-phase trip occurred due to fault in reclaim time. However, after 100ms, Y & B phases again got closed at Uri-I.
7. Name of the tripped elements are as below:
    - Unit #2, #3, #5 & #6 at Uri-II
    - 400kV Uri-II – Uri-I
8. As per NHPC Report and DR details:

NHPC Report, Uri-II

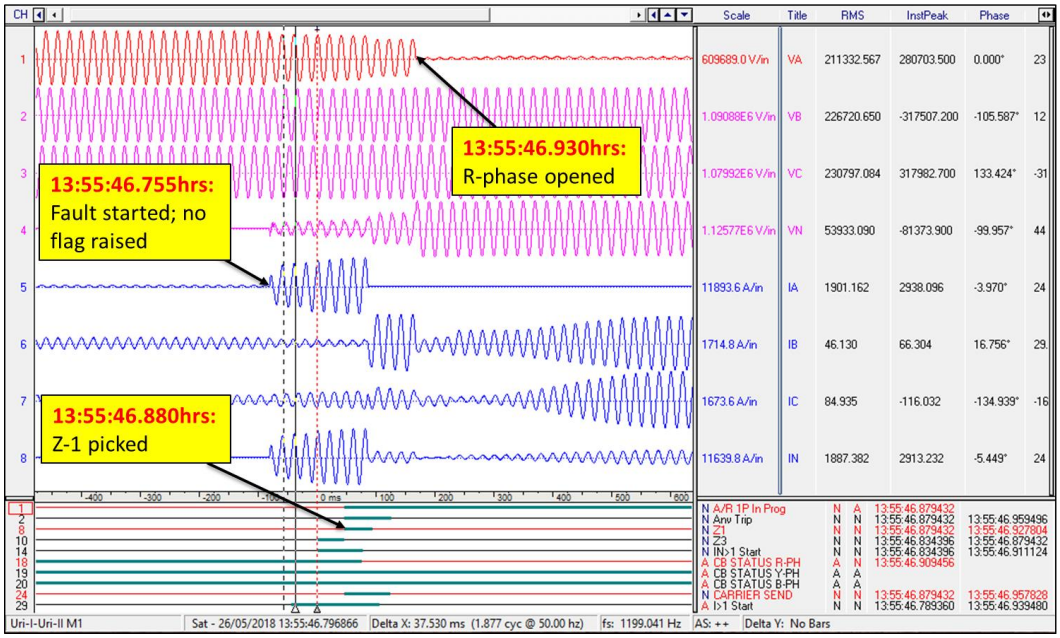
1. **Date & Time of Event:**	**On 26/05/2018 at 13:55 hrs.**
2. **Substation Name:**	**Uri-II पावर स्टेशन**
3. **Antecedent Condition:**	1.Four Units were running. 2. Two Lines were in operation.
4. **Change in Frequency:**	N.A.
5. **Generation Loss/Load Loss:**	NIL.
6. **Name of Tripped Elements & Time of tripped Elements:**	Uri-I Line at 13:55 hrs. on 26-May-2018 Unit-1 at 13:55 hrs. on 26-May-2018 Unit-2 at 13:55 hrs. on 26-May-2018 Unit-3 at 13:55 hrs. on 26-May-2018 Unit-4 at 13:55 hrs. on 26-May-2018
7. **Single Line Diagram of affected Area:**	NA
8. **Triggering Incident:**	Uri-I Line at 13:55 hrs.
9. **Flag Details, DR/EL:**	DR/EL already sent.
10. **Event Description:**	1. Uri-I Lines: From the DR of the line protection relay it is evident that maximum dip in voltage and increase in current was in R-phase. Accordingly distance protection relay sensed the fault in Zone-I and tripped the faulty phase. However, the faulty phase did not reclose after 1 Sec dead time and other two phases ultimately opened on pole discrepancy, as evident from the EL. This indicates that the auto reclose relay has not operated correctly. The reason for non-operation of auto-reclose relay needs to be investigated. 2. Wagoora Line: The distance protection relay of wagoora line initially sensed the fault in Zone-4 (reverse) as the fault was in Uri-II to Uri-I line. At the time of opening of faulty phase of Uri-II to Uri-I line, the distance protection relay of wagoora line sensed the fault in Zone-I and opened the R-phase circuit breaker which ultimately successfully auto-reclosed at 1 sec dead time. However, as the fault was on Uri-II to Uri-I line and no fault was on wagoora line, the activation of Zone-I in Wagoora line needs to be investigated. The distance protection relay of wagoora line needs to be tested for any mal-operation during current reversal as happened during the above event.

	3. Units: It is evident from the DR of Line and generator protection relay that all the four running units got tripped at the time of opening of R-phase breaker of both the lines. The reason for tripping of all the units has neither been recorded in DR/EL of the generator protection relay nor in the station EL. Therefore, Power Station needs to investigate the reason for tripping of units in the instant case.
11. **Appropriate Graphical Plot if any:**	NA
12. **Restoration Time:**	Uri-I Line at 16:00 hrs. on 26-May-2018 Unit-1 at 15:17 hrs. on 26-May-2018 Unit-2 at 15:33 hrs. on 26-May-2018 Unit-3 at 15:27 hrs. on 26-May-2018 Unit-4 at 15:43 hrs. on 26-May-2018
13. **Remedial Action Taken:**	NIL
14. **Remedial Action to Be Taken**:	Power Station shall investigate the reason for tripping of units, in the instant case and shall take remedial action as required

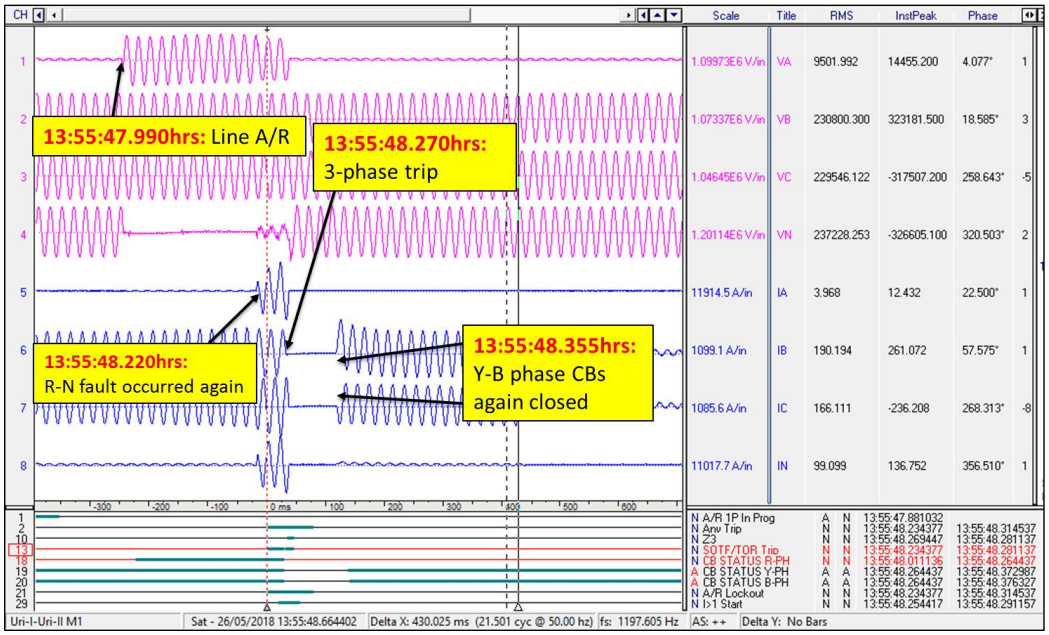
NHPC Report, Uri-I

1. **Date & Time of Event:**	**On 26/05/2018 at 13:55 hrs.**
2. **Substation Name:**	**Uri पावर स्टेशन**
3. **Antecedent Condition:**	1.Four Units were running. 2. All three Lines were in operation.
4. **Change in Frequency:**	N.A.
5. **Generation Loss/Load Loss:**	NIL.
6. **Name of Tripped Elements & Time of tripped Elements:**	Uri-II Line at 13:55 hrs. on 26-May-2018
7. **Single Line Diagram of affected Area:**	NA
8. **Triggering Incident:**	Uri-II Line at 13:55 hrs.
9. **Flag Details, DR/EL:**	DR/EL already sent.
10. **Event Description:**	1. Lines: From the DR of the line protection relay it is evident that maximum dip in voltage and increase in current was in R-phase. Accordingly distance protection relay sensed the fault in Zone-I at 12.38 km and tripped the faulty phase. The faulty phase reclosed after 1 Sec dead time and after 245 ms of closing of breaker, a fault again occurred on R-phase. As the fault occurred within 500 ms window, SOTF/TOR function got activated and issued three phase trip command. Accordingly, all three phase breaker got opened but after 100 ms, Y and B-phase breaker got closed but R-phase circuit breaker was in open condition. Immediately after operation of SOTF/TOR function, closing command is being issued to the circuit breaker of healthy phases. The reason for successive closing of two pole has not been recorded in the EL of the relay. Therefore, the reason for closing of circuit breaker, in the instant case, needs to be investigated.
11. **Appropriate Graphical Plot if any:**	NA
12. **Restoration Time:**	Uri-II Line at 16:01 hrs. on 26-May-2018
13. **Remedial Action Taken:**	NIL
14. **Remedial Action to Be Taken**:	Power Station has been requested to perform the test on auto-reclose along with SOTF/TOR function to find out the source of closing command to the breaker e.g. from auto-reclose & check sync relay, any other signal from GIS controller etc to ensure complete three phase tripping (without reclosing) in case of unsuccessful single phase, single shot auto reclose.

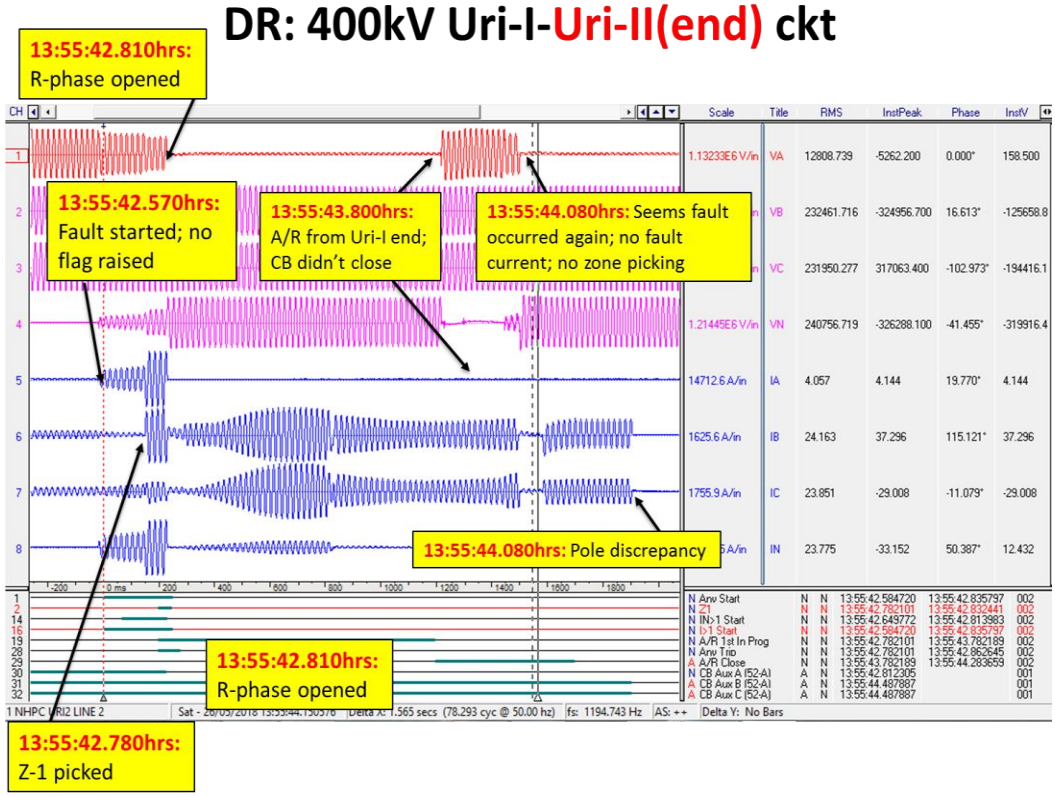
DR: 400kV Uri-I(end)-Uri-II ckt



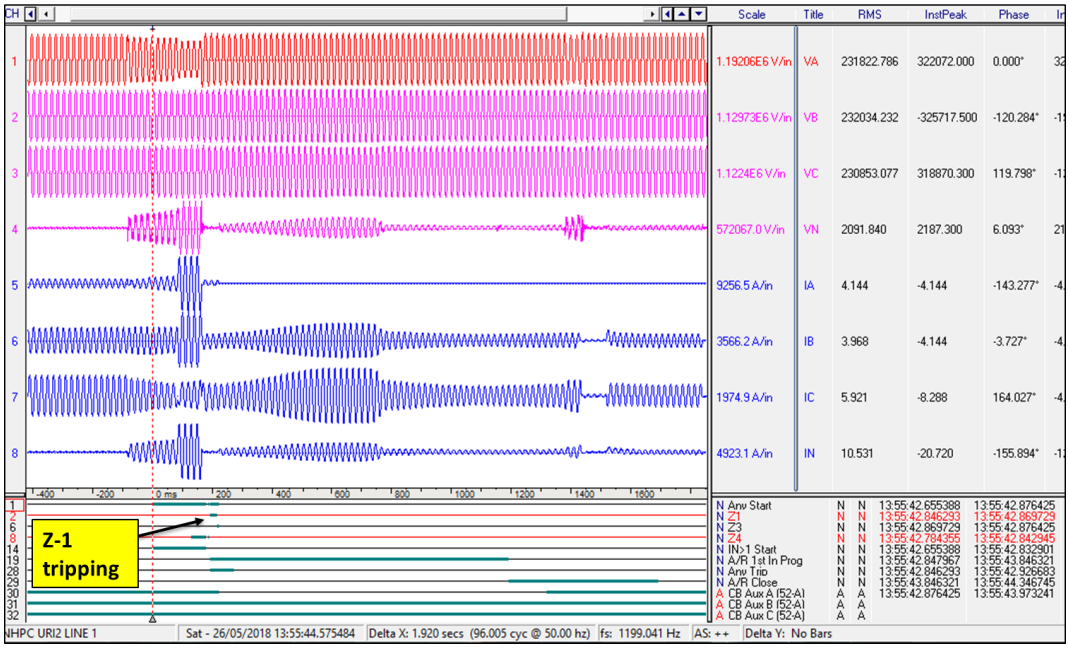
DR: 400kV Uri-I(end)-Uri-II ckt



DR: 400kV Uri-I-Uri-II(end) ckt



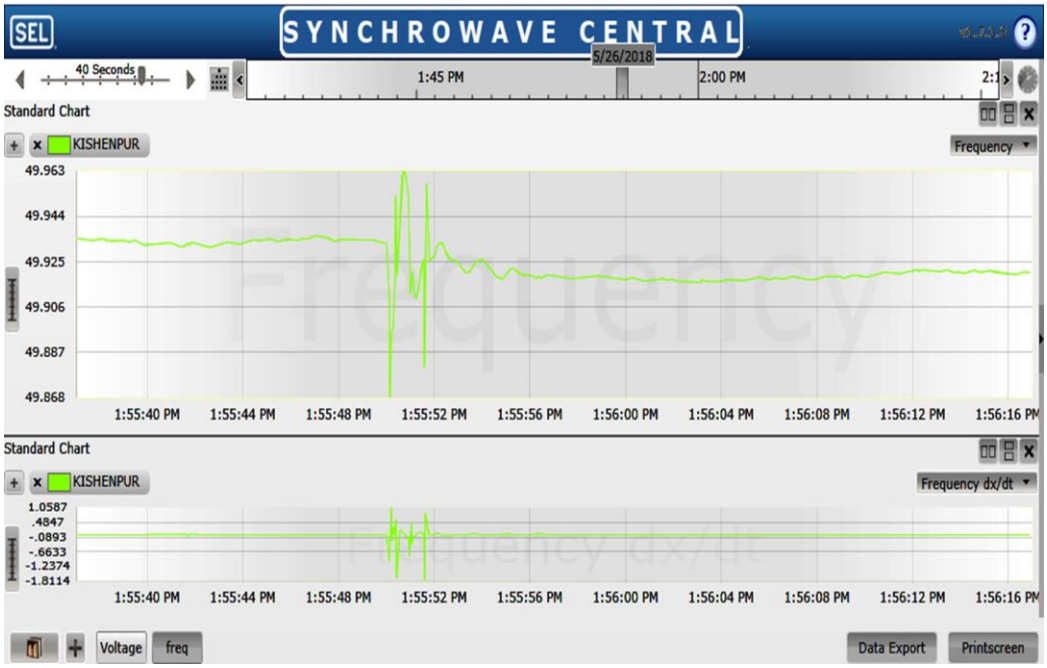
DR: 400kV Wagoora-Uri-II(end) ckt



9. PMU plots:

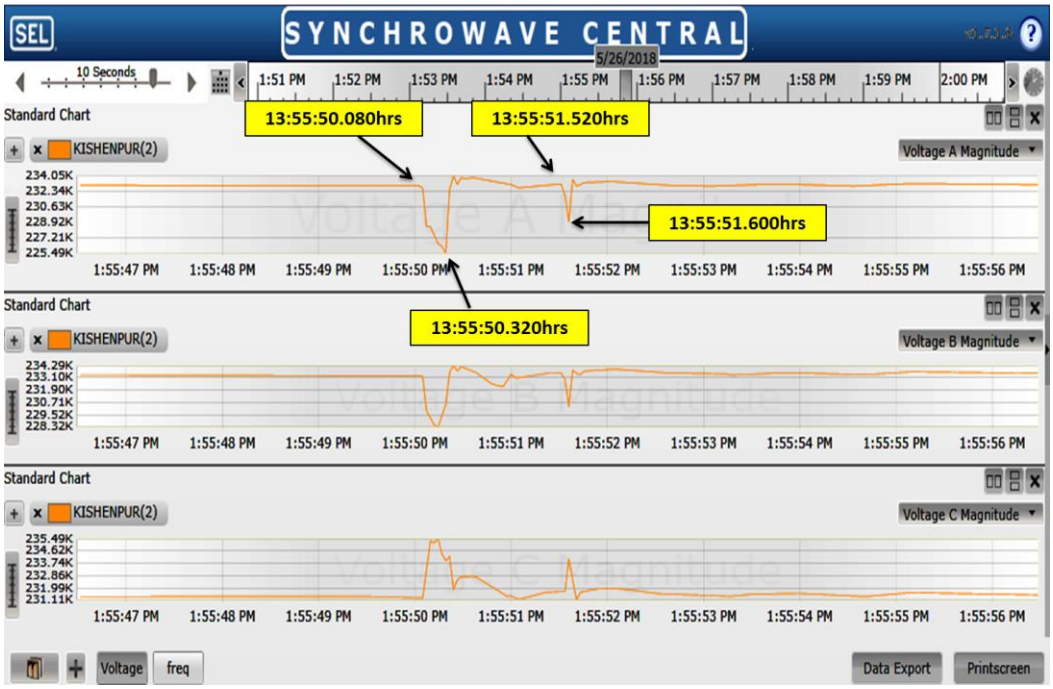
PMU Plot of frequency at Kishenpur(PG)

13:55hrs/26-May-18



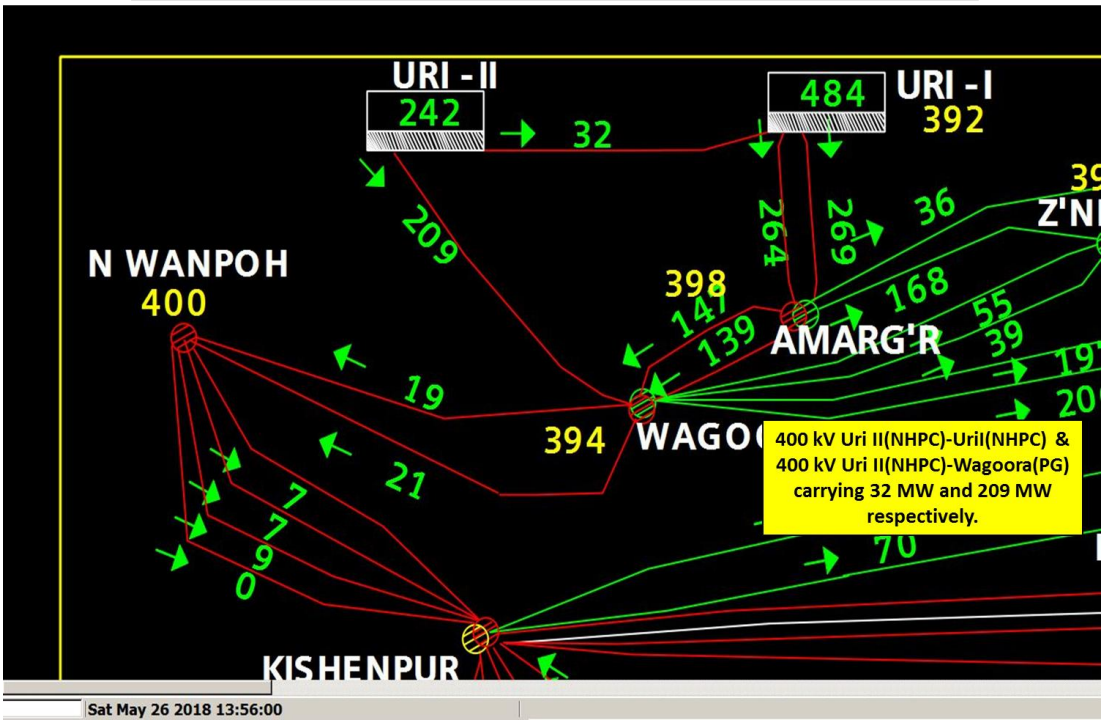
PMU Plot of phase voltage magnitude at Kishenpur (PG)

13:55hrs/26-May-18

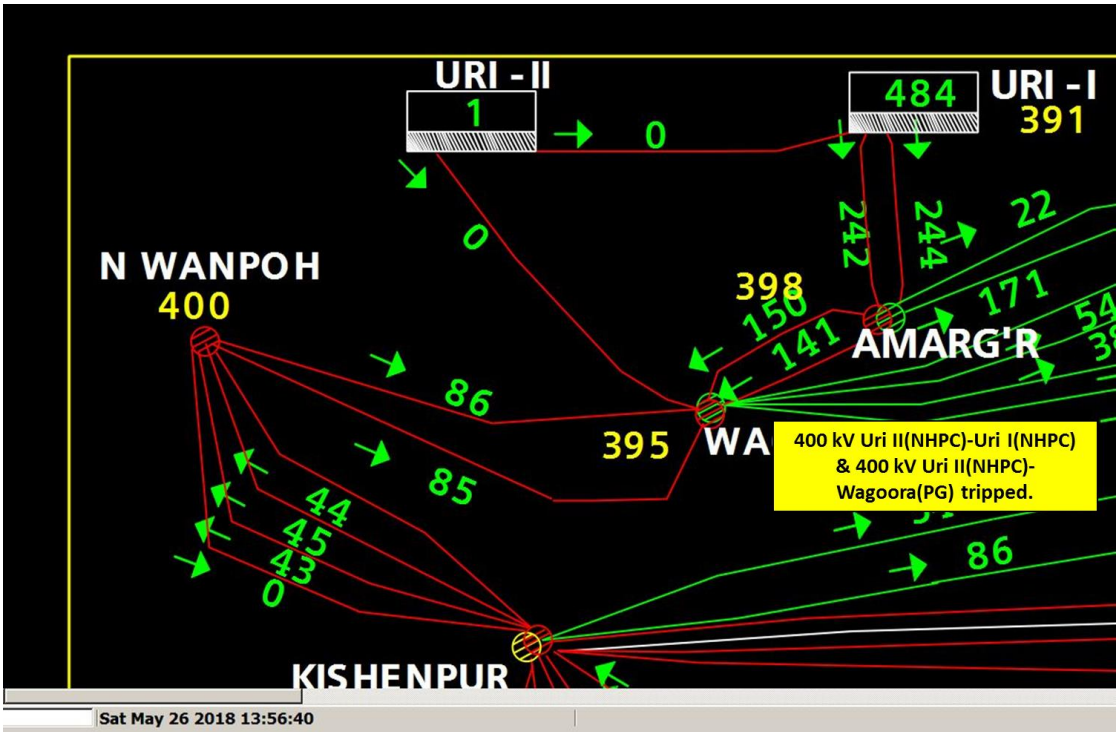


10. As per SCADA data:

Snapshot of Power Network before the incident



Snapshot of Power Network after the incident



11. As per PMU & SCADA data:

- R-N fault occurred at 13:55:50.080hrs and cleared in 240ms.
- R-N fault again occurred at 13:55:51.520hrs and cleared timely.
- All units at Uri-II tripped within 20ms starting at 13:55:44.320hrs.
- 400kV Uri-II-Uri-I tripped at 13:55:45.415hrs (~1100ms after units tripping) from Uri-II end.

12. Preliminary Report, DR/EL and Detailed Report received from NHPC but investigation report as mentioned in the detailed report report is yet to be received.

Action Points*:*

1. Reason for delayed fault clearance of around 250ms to be shared.
2. No auto-reclosing in case of single L-G fault at Uri-II end to be investigated corrected and findings to be shared.
3. Reason for closing of Y&B phases at Uri-I without any indication to be shared.
4. Reason for tripping of R-phase of Wagoora ckt at Uri-II in zone-1 to be shared.
5. As per PMU, fault occurred at 13:55:50hrs; As per SoE, units opened at 13:55:45hrs; As per DR, fault occurred at 13:55:55hrs. It seems all three sources of information are not in time synchronization. The same needs to be checked.

Discussion Points*:*

1. It seems pole discrepancy timing at Uri-II for Uri-I feeder is around 1.5sec.

NHPC may elaborate the incident, submit the required details and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

D. Complete outage of 400kV Paricha TPS(UP) at 21:56hrs of 27th May 2018

Event category: GD-1
Generation loss: 700MW (UP may confirm)
Loss of load: Nil (UP may confirm)
Energy Loss: __ MU (UP may confirm)

Data Summary received/available at NRLDC:

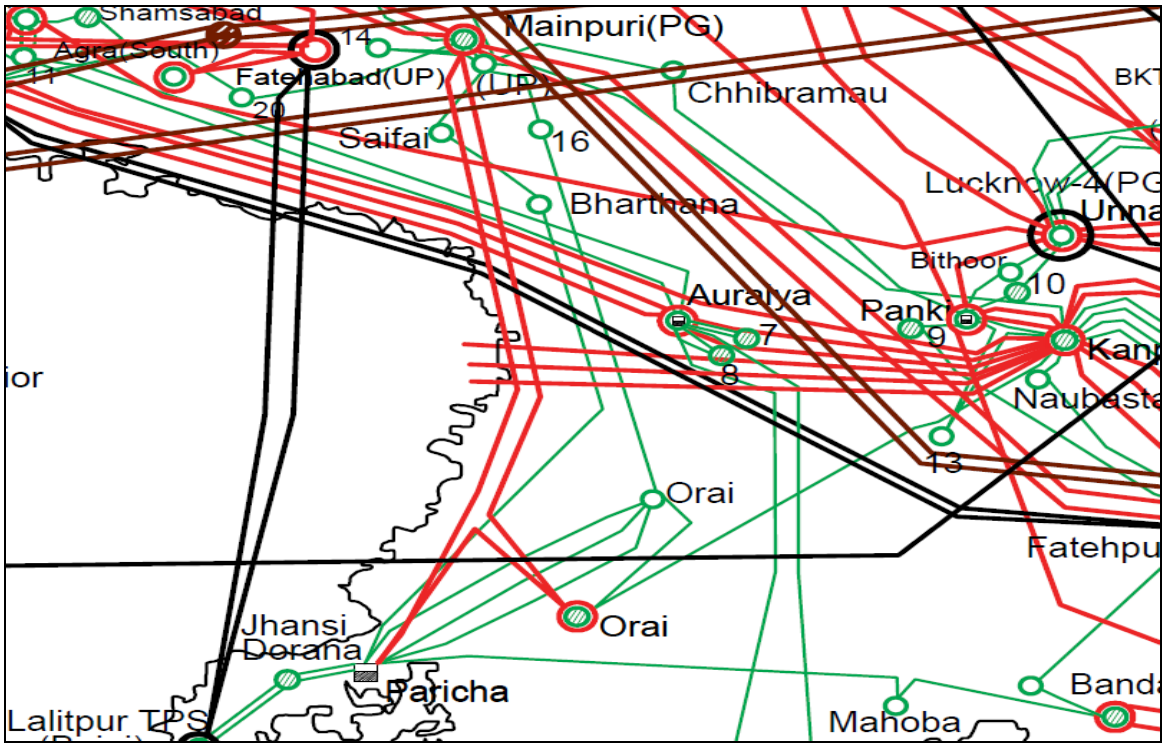
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	880ms	As per PMU data
Phase of the fault	PMU data	B-N fault	As per PMU data

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

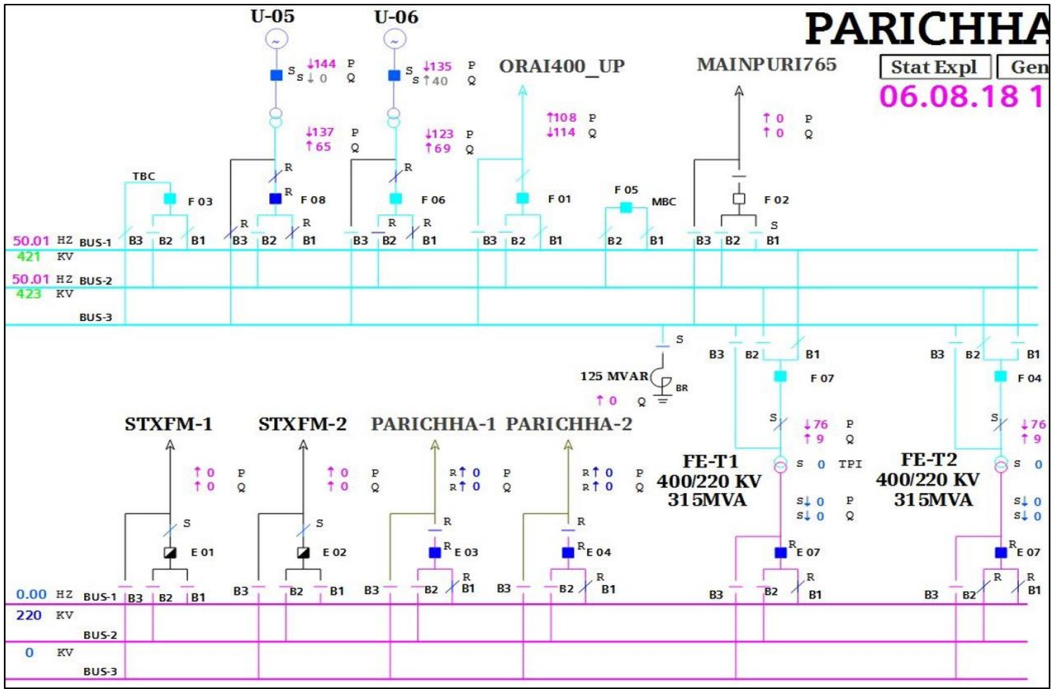
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3) 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:

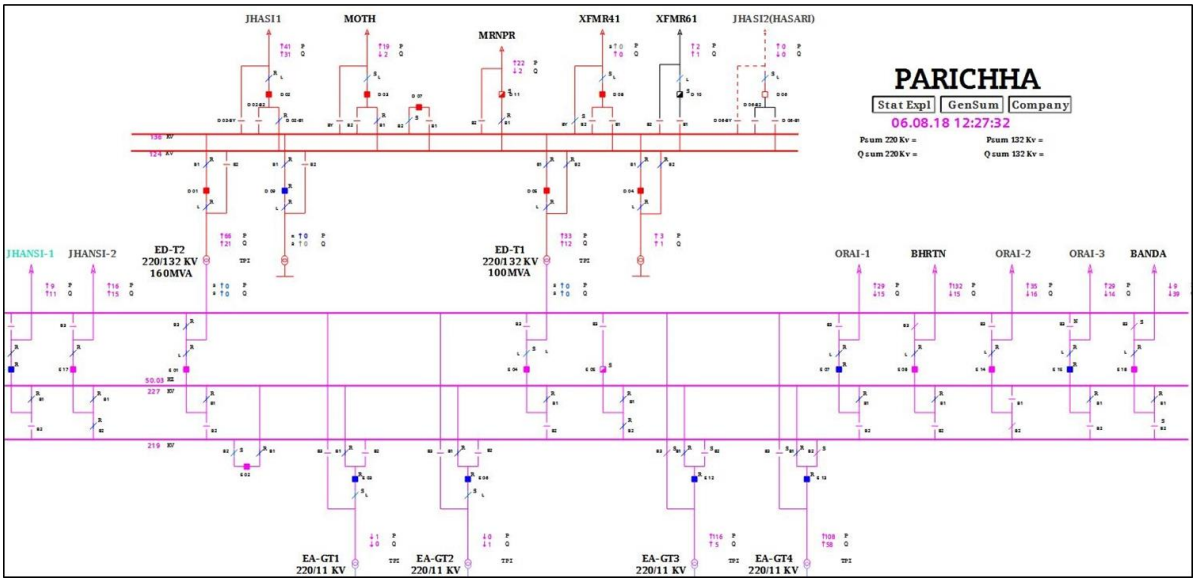
1. Connectivity Diagram:



Single Line Diagram: Paricha TPS (400kV)



Single Line Diagram: Paricha TPS (220kV)



2. Paricha TPS is having following elements at 220kV: Bhartna S/C, Orai T/C, Jhansi Dorana D/C, Mahoba S/C, 220/132kV 100MVA and 160MVA ICTs, 400/220kV 315MVA ICT #1 & #2. Paricha has 2x110+2x210+2x250MW generation capacity. It has DMT (double main transfer breaker) scheme.
3. Antecedent condition:
   Unit #1 at Paricha TPS under planned S/D for R&M work since 02-Jul-16
4. B-phase CT of 220kV bus-A of bus coupler get damaged.
5. This resulted in complete outage of Paricha TPS.
6. Name of the tripped elements are as below:
   - Unit #2, #3, #5 & #6
   - 220kV Paricha-Orai-1, 2&3
   - 220kV Paricha-Mahoba
   - 220kV Paricha-Jhansi Dorana D/C
   - 220kV Paricha-Bharthna
   - 220/132kV 100MVA & 160MVA ICTs
   - 400/220kV 315MVA ICT #1 & #2
7. As per UP Report:

Sub: - Report on the Incident of tripping of elements at Parichha TPS based of the information received from Parichha TPS Jhansi.

Dear Sir,

On 27.05.2018 at 21:56 hrs, all transmission lines, ICTs and Units connected with Parichha TPS tripped. Normalization time of the elements is mentioned below:-

S. No.	Name of element	Date & time of normalization		Remarks
1.	110MW Unit – II	28.05.2018	07:35	
2.	210MW Unit – III	28.05.2018	05:10	
3.	250MW Unit – V	28.05.2018	02:20	
4.	250MW Unit – VI	28.05.2018	03:21	
5.	220KV Parichha – Bharthana	27.05.2018	23:49	
6.	220KV Parichha – Orai – I	28.05.2018	02:17	
7.	220KV Parichha - Orai – II	28.05.2018	04:42	
8.	220KV Parichha – Orai – III	28.05.2018	04:42	
9.	220KV Parichha – Dunara – I	28.05.2018	00:45	
10.	220KV Parichha – Dunara – II	28.05.2018	00:45	
11.	220KV Parichha – Mahoba	28.05.2018	04:35	
12.	220KV Bus 'B'	27.05.2018	23:10	
13.	100MVA ICT	31.05.2018	21:00	
14.	160MVA ICT	27.05.2018	23:06	
15.	315MVA ICT – I	27.05.2018	23:05	
16.	315MVA ICT – II	27.05.2018	23:05	

Flags of the elements which tripped and single line diagram of the relevant portion of the grid are enclosed at annexure.

Analysis–At 21:56 hrs on27.05.2018, B phase CT of Bus 'A' of 220KV Bus coupler damaged. Due to damaged of CT all 220KV lines ICTs tripped. Due to failure of station supply unit 2, 3, 5 and 6 also got tripped on (class A and class B), HV back up earth fault, Flame failure and both ID fans trip respectively.

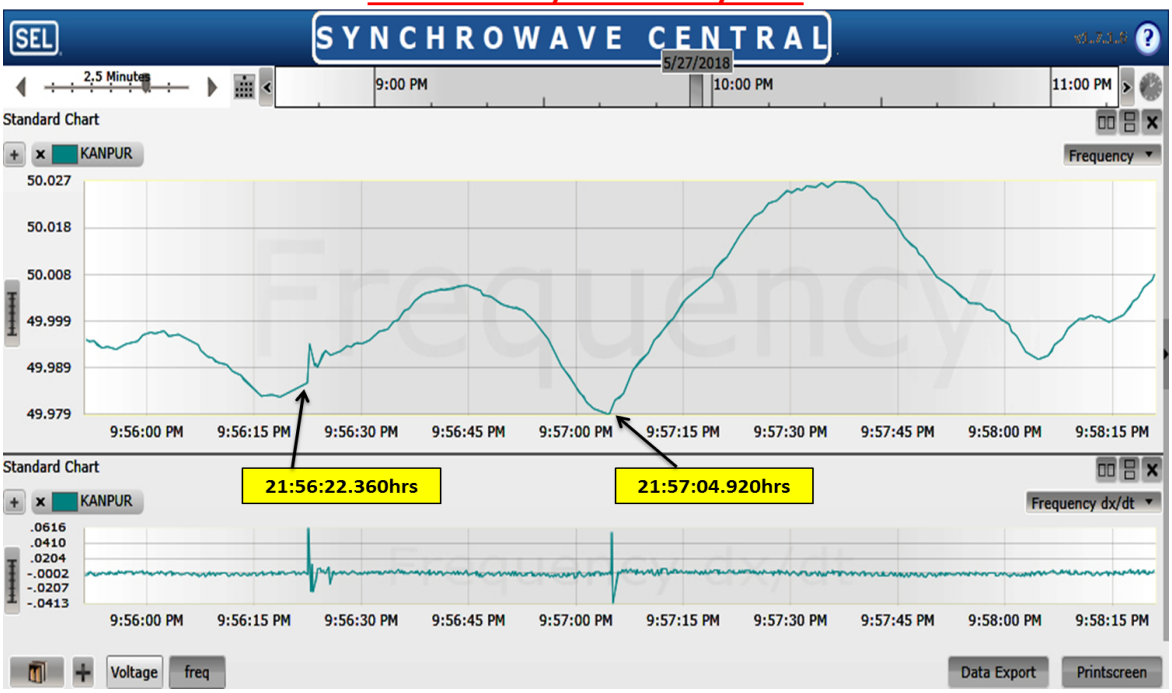
Remedial Measures:-

1. Testing of station protection system is required.

8. PMU plots:

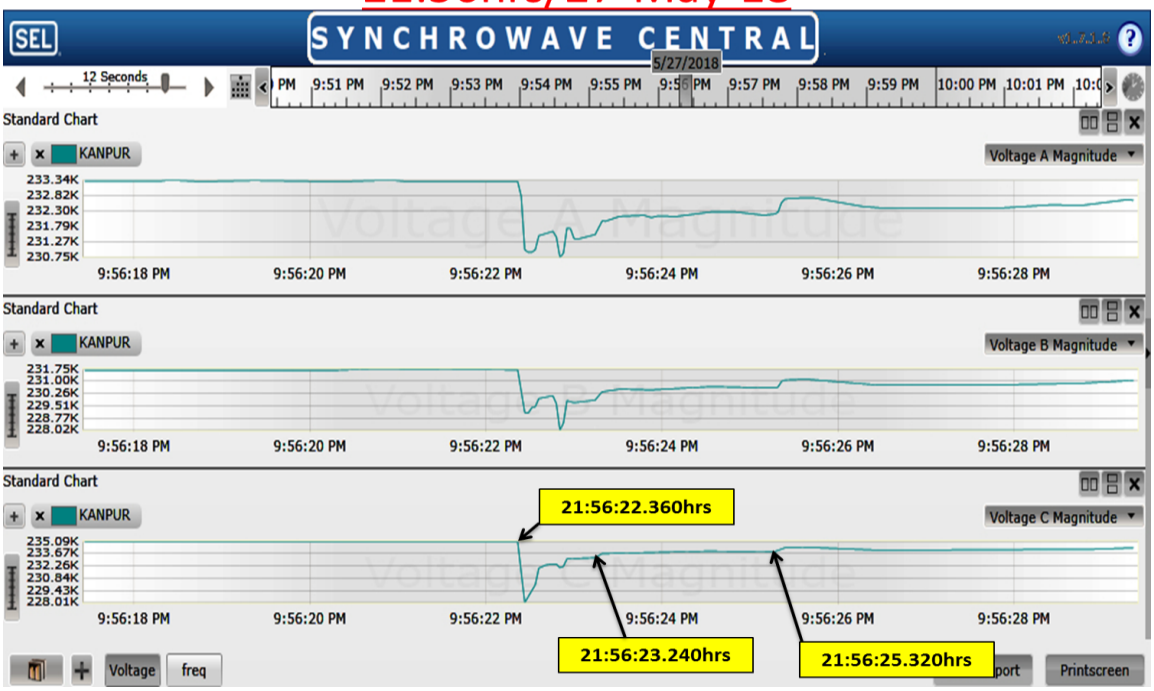
PMU Plot of frequency at Kanpur(PG)

21:56hrs/27-May-18



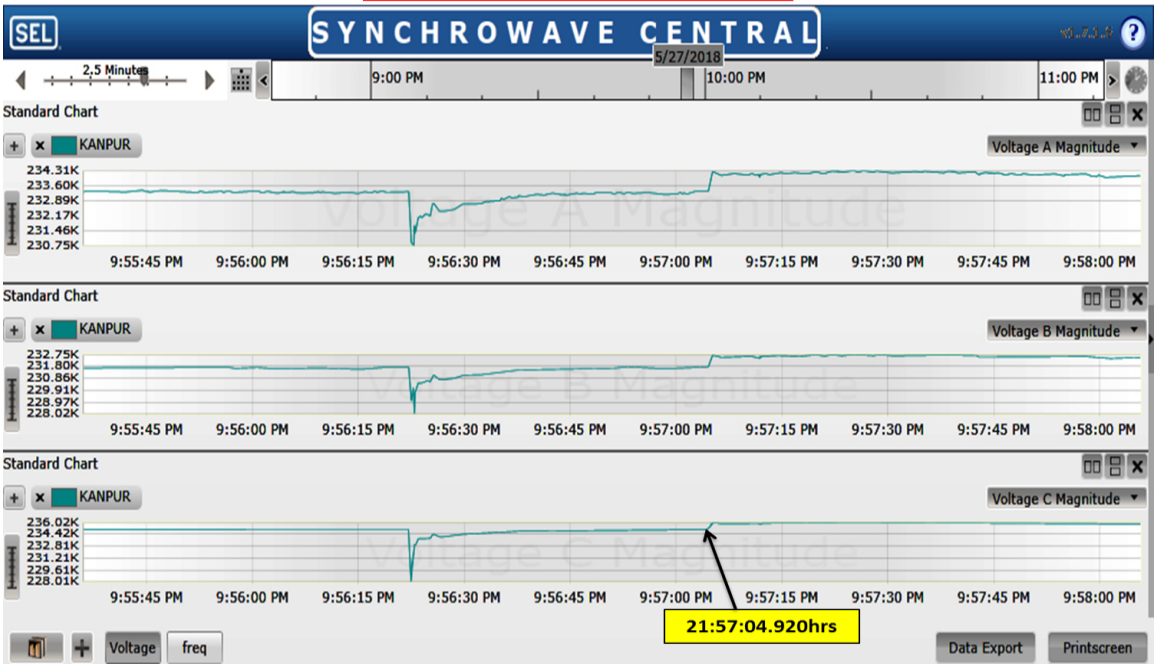
PMU Plot of phase voltage magnitude at Kanpur(PG)

21:56hrs/27-May-18



PMU Plot of phase voltage magnitude at Kanpur(PG)

21:56hrs/27-May-18



9. Probable sequence of events:

Probable sequence of event

Based on UP SCADA SoE and PMU data

Time (in hrs)	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
21:56:22,360	0ms	PMU data					Reference Time
21:56:22:575	215ms	ORAI1_U	220	01T1	CB	Open	Main CB of 220 kV Orai(end)-Parichha Ckt 1 opens
21:56:22:625	265ms	MHOBA_U	220	01PRINC	CB	Open	Main CB of 220 kV MAHOBA(end)-Parichha opens
21:56:23:255	895ms	BHRTN_UP	220kV	E_03(PRINC)	CB	Open	Main CB of 220 kV Bharthna(end)-Parichha opens; Fault clears

10. As per PMU & SCADA data:
    - B-N fault occurred at 21:56:22.360hrs and cleared with delay of 880ms at 21:56:23.240hrs.
    - A rise in 3-phase voltage also observed at 21:57:04.920hrs.
    - 220kV Orai-Paricha-1 and 220kV Mahoba-Paricha ckt tripped after ~250ms of fault.
    - 220kV Bharthna-Paricha tripped at the time of clearing of fault after ~ 900ms.
11. Preliminary Report and Detailed Report received from UP but DR/EL are still awaited from UP. Remedial measures report is also awaited from UPPTCL.

Action Points*:*

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. Availability and healthiness of bus bar protection at Paricha TPS at the time of tripping to be shared.
3. Reason for delayed clearance of around a second fault to be shared.
4. In view of all tripped elements not captured in SCADA SoE data, digital SCADA data reporting from Paricha TPS to be checked, rectified and ensured in future.

UP may elaborate the incident, submit the required details and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

E. Multiple Element tripping at 400/132kV Anpara-ATPS and 400/220k V Obra-B TPS at 22:25hrs of 28th May 2018

Event category: GD-1
Generation loss: 850MW (As per NTPC report)
Loss of load: 250MW (UP may confirm)
Energy Loss: ___ MU (UP may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	2minute	As per PMU data

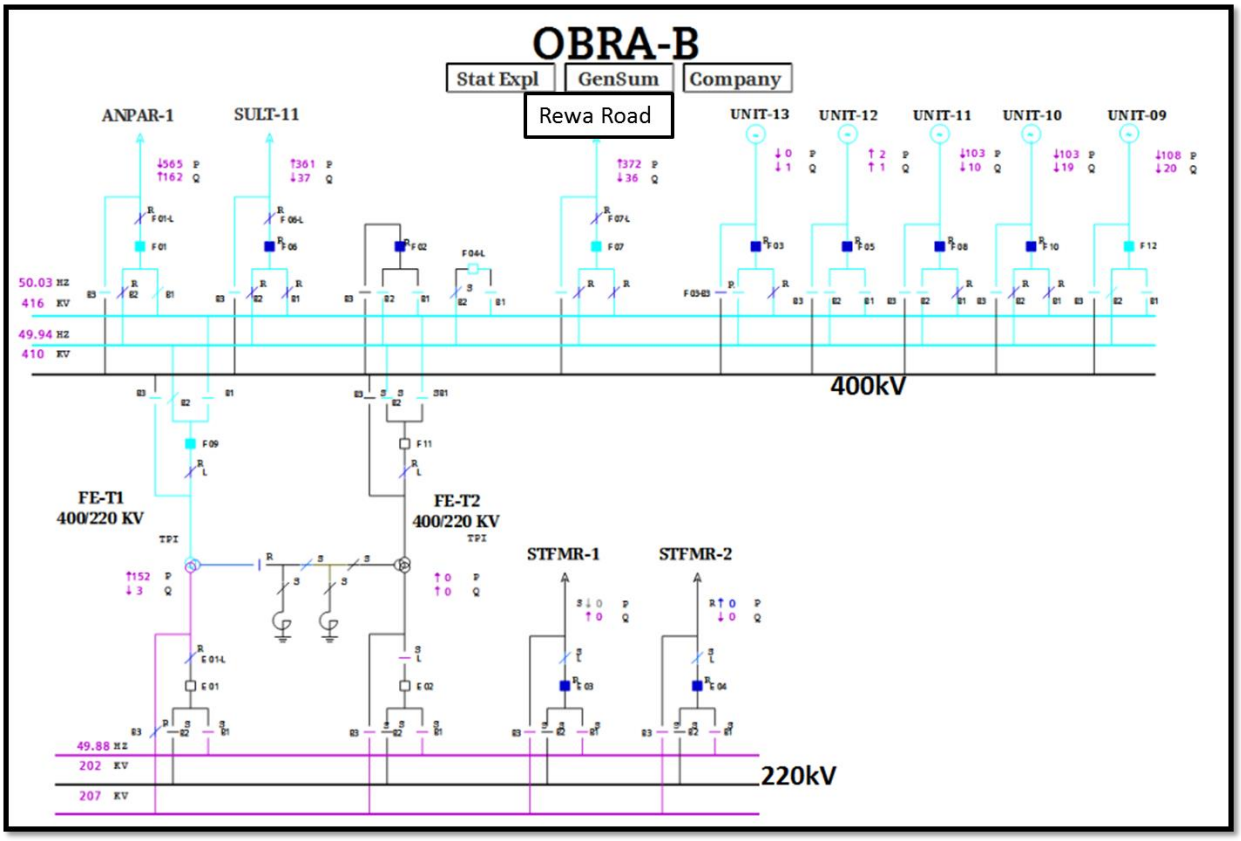
Phase of the fault	PMU data	Y-B phase to phase to earth fault	As per PMU data

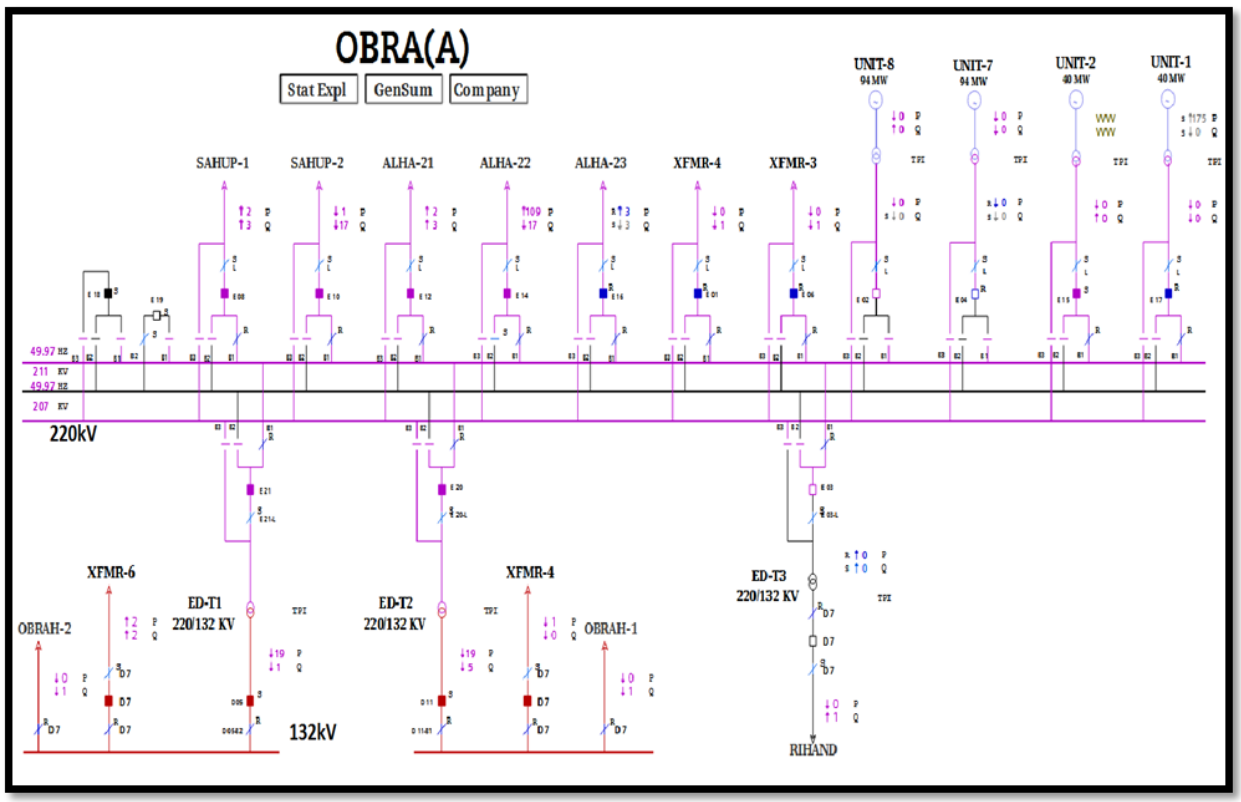
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available (Partial)	
DR/EL	Uttar Pradesh	Not Received	
Preliminary Report	Uttar Pradesh	Received	After 24hrs
Detailed Report	Uttar Pradesh	Not Received	

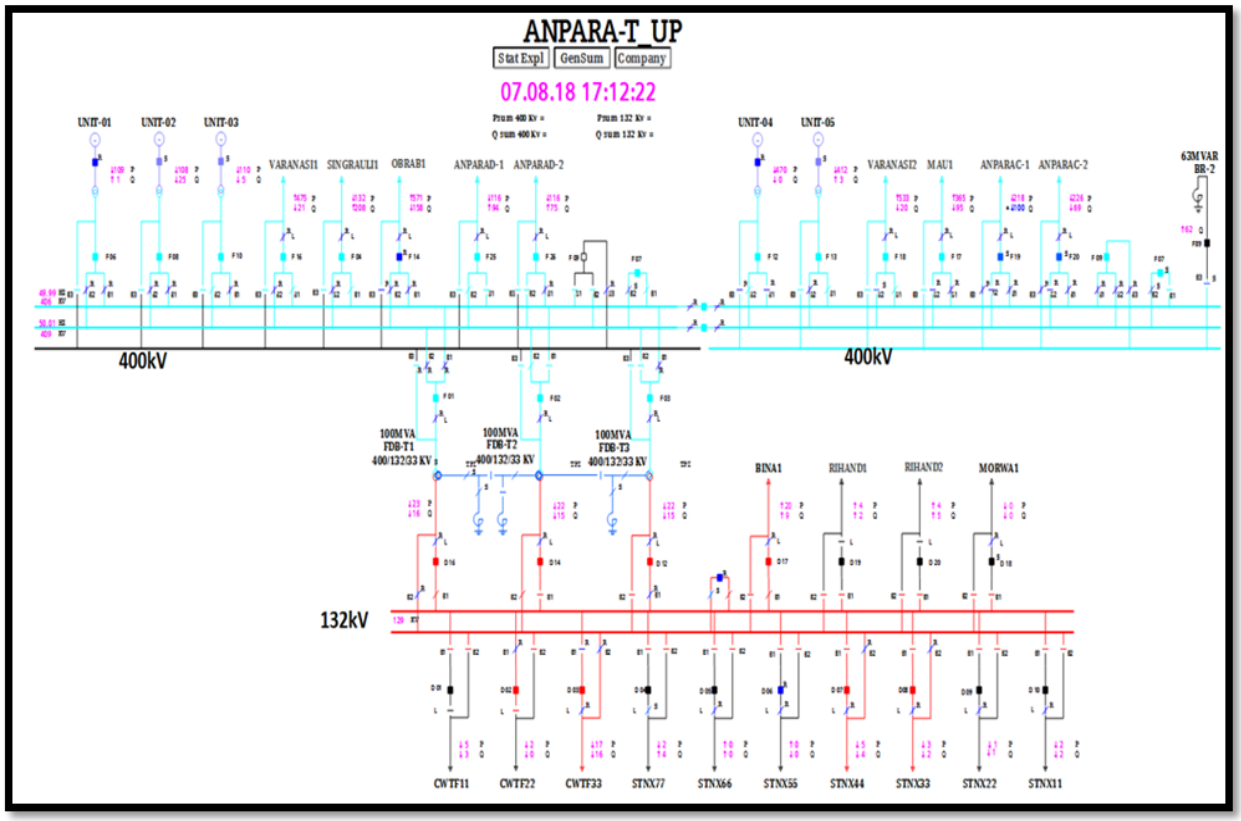
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3) 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

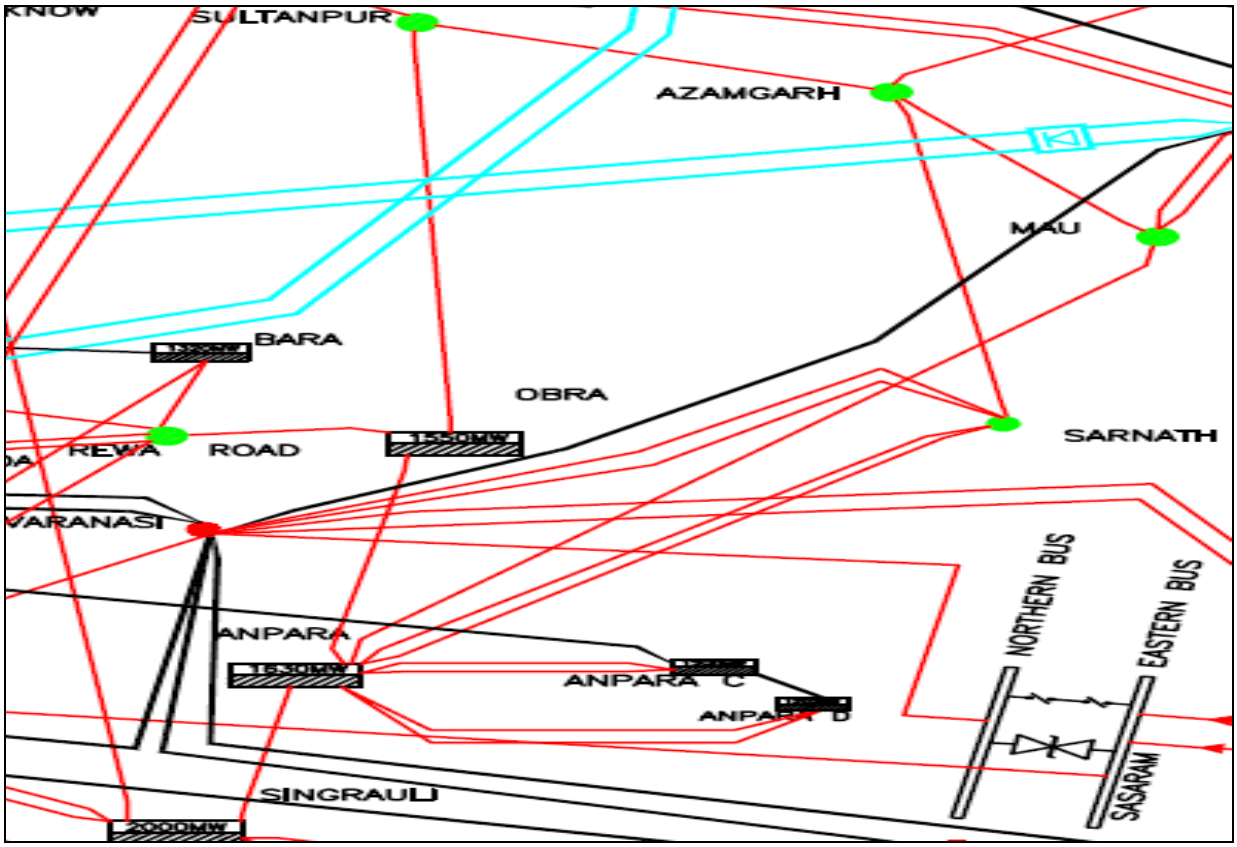
Based on above information description of the events is:

1. Single Line Diagram of Obra-A, B TPS and Anpara-A TPS:


OBRA-B
Stat Expl
GenSum
Company
Rewa Road
ANPAR-1
SULT-11
UNIT-13
UNIT-12
UNIT-11
UNIT-10
UNIT-09
50.03 HZ
416 KV
49.94 HZ
410 KV
400kV
FE-T1
400/220 KV
FE-T2
400/220 KV
STFMR-1
STFMR-2
49.88 HZ
202 KV
207 KV
220kV


OBRA(A)
Stat Expl
GenSum
Company
UNIT-8
94 MW
UNIT-7
94 MW
UNIT-2
40 MW
UNIT-1
40 MW
SAHUP-1
SAHUP-2
ALHA-21
ALHA-22
ALHA-23
XFMR-4
XFMR-3
49.97 HZ
211 KV
49.97 HZ
207 KV
220kV
XFMR-6
OBRAH-2
ED-T1
220/132 KV
ED-T2
220/132 KV
XFMR-4
OBRAH-1
ED-T3
220/132 KV
132kV
RIHAND


ANPARA-T_UP
Stat Expl
GenSum
Company
07.08.18 17:12:22
UNIT-01
UNIT-02
UNIT-03
UNIT-04
UNIT-05
VARANASI1
SINGRAULI1
OBRAB1
ANPARAD-1
ANPARAD-2
VARANASI2
MAU1
ANPARAC-1
ANPARAC-2
63MVAR BR-2
400kV
400kV
100MVA FDB-T1 400/132/33 KV
100MVA FDB-T2 400/132/33 KV
100MVA FDB-T3 400/132/33 KV
BINA1
RIHAND1
RIHAND2
MORWA1
132kV
CWTF11
CWTF22
CWTF33
STNX77
STNX66
STNX55
STNX44
STNX33
STNX22
STNX11

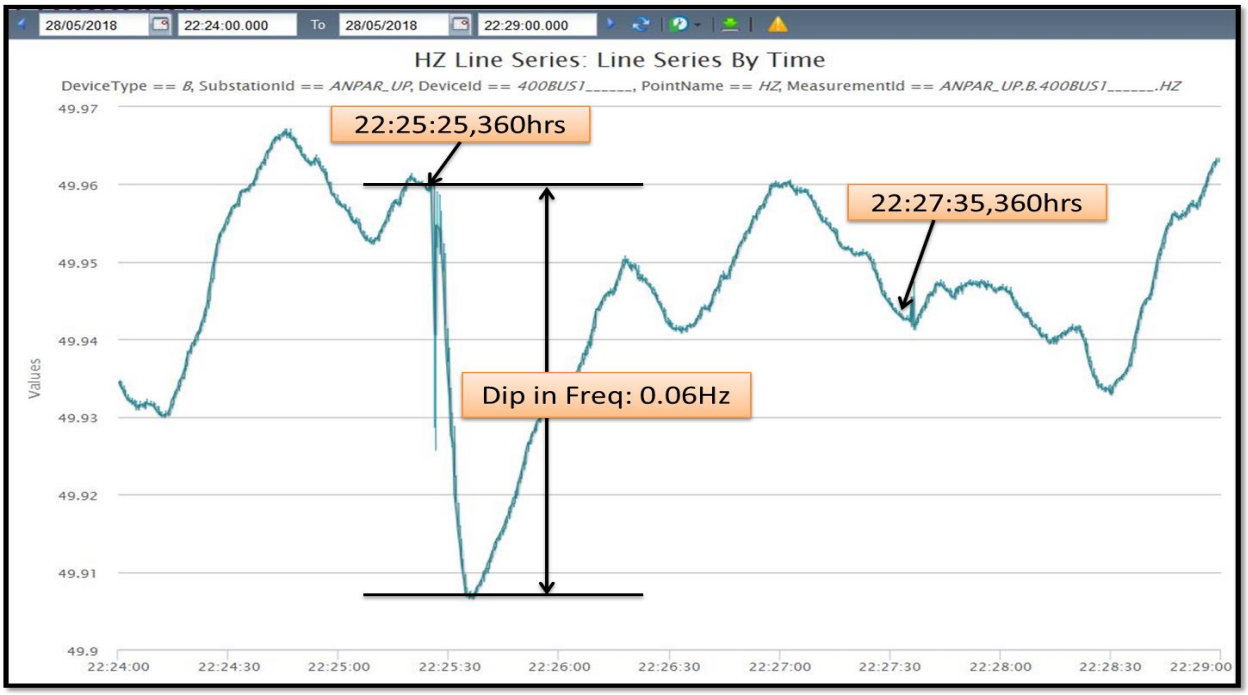

SULTANPUR
AZAMGARH
MAU
BARA
OBRA
REWA
ROAD
SARNATH
VARANASI
ANPARA
ANPARA C
SINGRAULI
NORTHERN BUS
EASTERN BUS
SASARAM

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 bus bar scheme.
3. On 28th May 2018 at 21:28hrs 400 kV Anpara-Obra line tripped on R-phase to earth fault. All three phase of the line tripped from Anpara end however Y&B-phase stucked at Obra end.
4. As informed by Anpara TPS, written instruction for opening of line side isolator and closing of earth switch was received from Obra TPS.
5. At 22:25hrs, on the instruction of Obra end, Anpara end isolator for 400kV Anpara-Obra line opened and earth switch closed manually. It resulted into Y&B-phase to earth fault and dead short ckt at Anpara TPS as Y&B-phase of the line was already stucked at Obra-B TPS.
6. It resulted into widespread fire in 400kV Bay of Anpara-Obra line at Anpara end and operation of bus bar protection for 400kV Bus-2 of Anpara-A TPS.
7. Breaker at Obra end didn't open during the incident and fault persisted in the system for more than **2minutes**.
8. Finally at Obra end also all the connected 400kV elements tripped along with running units of Obra TPS.
9. Name of the tripped elements are as below:
    - 400 kV Anpara-Obra B ckt
    - 400 kV Obra B-Sultanpur (UP)
    - 400 kV Obra B-Rewa Road (UP) ckt
    - Unit 1 & 3 of 200MW at Anpara TPS
    - Unit 9, 10 & 11 of 200MW at Obra-B TPS
    - 400 kV Bus-B of Anpara TPS.
    - 400/132 kV 100MVA ICT-2 at Anpara TPS
    - 400/220 kV 240MVA ICT-1 at Obra B TPS
    - 220/132 kV ICT-1 & 2 at Obra A TPS
    - Station Transformer-4 & 6 of Obra-A TPS

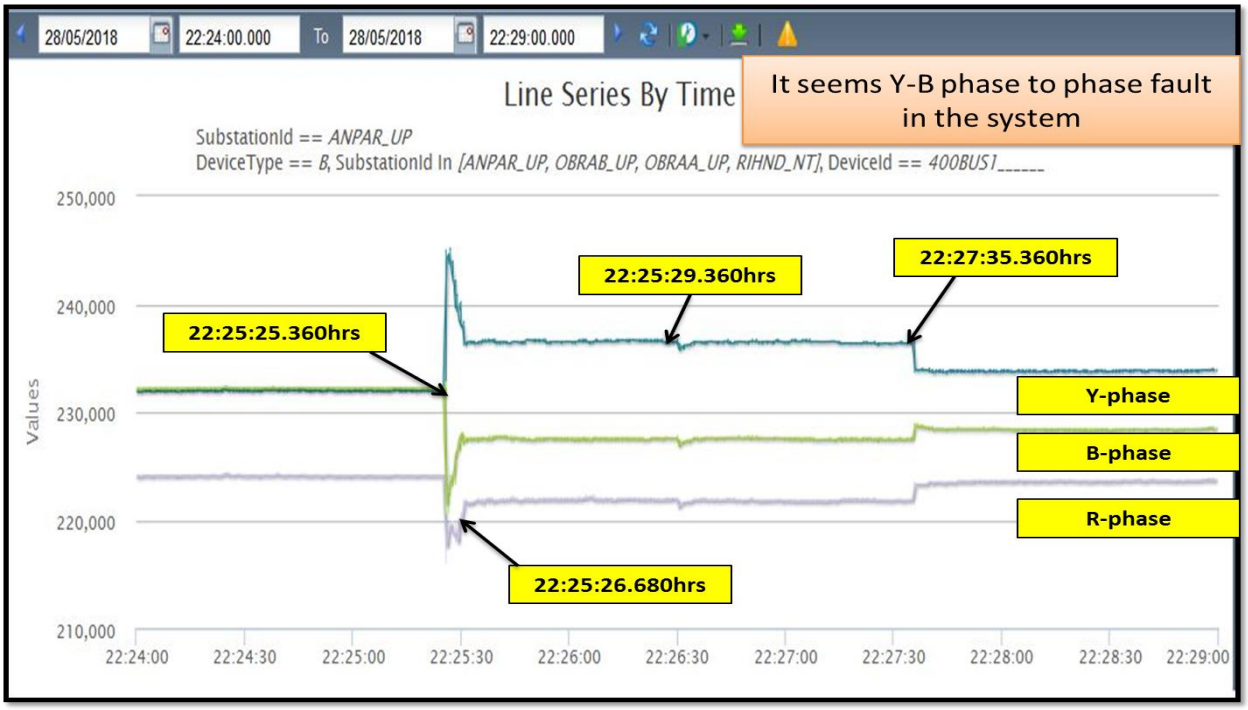
10. In antecedent condition:
    - 400/220 kV 240MVA ICT-2 of Obra-B TPS was already under outage
    - 220/132 kV 100MVA ICT-3 at Obra A TPS was already under outage

11. PMU plots:

PMU data of Anpara Bus Frequency

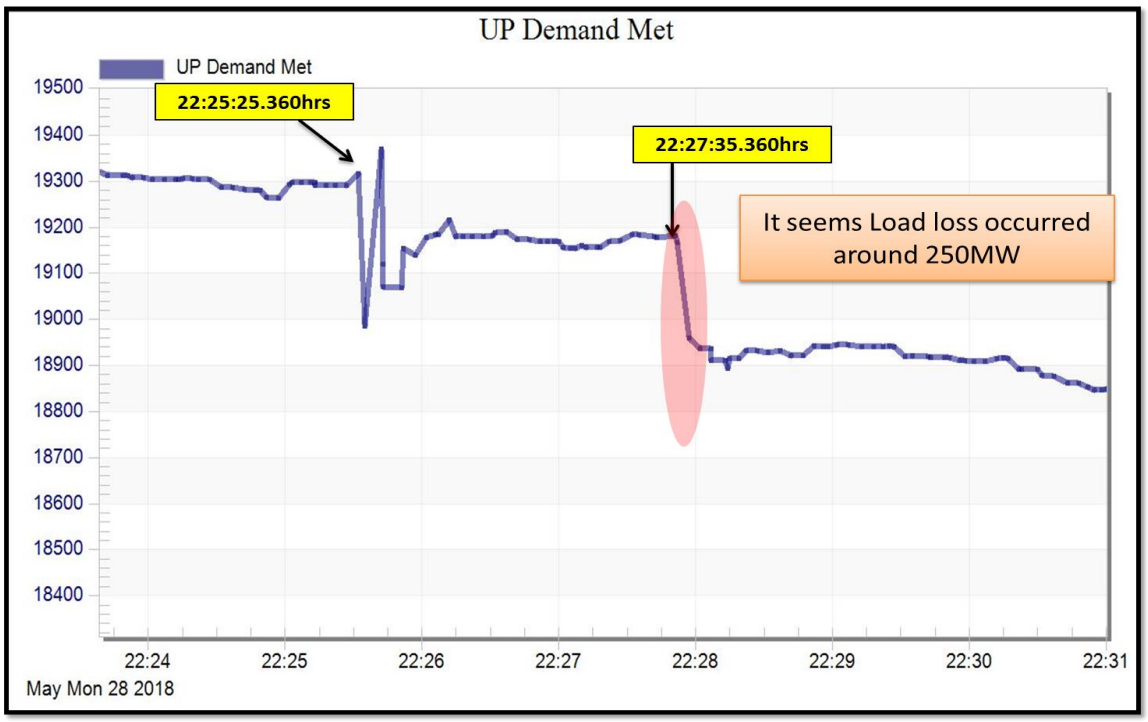


PMU Plot of phase voltages of Anpara



12. As per SCADA data:

UP Demand Pattern



Time (in ms)	Station Name	Voltage Level (in kV)	Element Name	Element Type	Status
22:25:27,437	*ALHA1_U*	*400kV*	*14OBRAB*	*CB (Circuit Breaker)*	*Open*
22:25:27,532	**ANPAR_UP**	**400kV**	**F_10(U03)**	**CB**	**Open**
22:25:27,532	ANPAR_UP	132kV	D_14(T2)	CB	Open
22:25:27,532	ANPAR_UP	400kV	F_02(T2)	CB	Open
22:25:27,532	ANPAR_UP	400kV	23BS	CB	Open
22:25:27,532	ANPAR_UP	400kV	07MBC	CB	Open
22:25:28,090	OBRA(A)	132kV	D_07(XFMR6)	CB	Open
22:25:28,090	OBRA(A)	220kV	E_20(T2)	CB	Open
22:25:28,510	OBRA(A)	132kV	D_03(XFMR4)	CB	Open
22:25:28,510	OBRA(A)	220kV	E_21(T1)	CB	Open
22:25:28,891	OBRA(A)	132kV	D_01(RIHAN)	CB	Open
22:25:28,891	OBRA(A)	220kV	E_03(T3)	CB	Open
22:25:29,350	ANPAR_UP	132kV	D_19(RIHAN-1)	CB	Open
22:25:29,350	ANPAR_UP	132kV	D_20(RIHAN-2)	CB	Open
22:27:36,365	**OBRAB_UP**	**400kV**	**F_12(U09)**	**CB**	**Open**
22:27:43,925	*OBRAB_UP*	*400kV*	*F_07(PANK1)*	*CB*	*Open*
22:29:40,419	RIHAN_UP	132kV	D_20(SONE_-2)	CB	Open
22:29:44,179	RIHAN_UP	132kV	D_13(ALFAC-2)	CB	Open
22:29:46,279	RIHAN_UP	132kV	D_15(ALFAC-1)	CB	Open

13. As per PMU data:
    - Y-B LLG fault occurred at **22:25:25.360hrs** and cleared with delay of 1320ms at **22:25:26.680hrs**.
    - A dip in 3-phase voltage also observed at **22:27:35.360hrs**.
    - Bus Bar Protection at Anpara- A TPS operated after 2300ms of fault occurrence.
    - Unit-9 of Obra B TPS tripped after 2 minutes of fault occurrence.
    - 400 kV Obra B-Panki ckt also tripped after 2 minutes of fault occurrence.
    - 400 kV Rewa Road-Panki ckt tripped within 2300ms of fault occurrence.
    - Station transformer and 100MVA 220/132 kV ICTs tripped after 2600ms of fault occurrence.

14. As per UP Report:

Sub: - Flash Report on the Incident of Simultaneous tripping at Obra TPS and Anpara TPS.

On 28.0518 at 22:25 Hrs. 200MW unit 9,10,and 11 and 400KV Obra – Sultanpur line and Obra – Rewa Road line at Obra TPS and 210MW unit I & III and 100MVA ICT – II tripped at Anpara TPS on Bus Bar protection. Normalization time of the elements is mentioned below:-

Sl. No.	Name of element	Date & time of Normalization		Remark
1.	200MW unit – 9 (Obra TPS)	29.05.2018	02:18	
2.	200MW unit – 10 (Obra TPS)	Shut Down		
3.	200MW unit – 11 (Obra TPS)	29.05.2018	05:28	
4.	400KV Obra – Sultanpur	29.05.2018	00:20	
5.	400KV Obra – Rewa Road	29.05.2018	01:36	
6.	210MW unit – I (Anpara TPS)	29.05.2018	00:16	
7.	210MW unit – III (Anpara TPS)	29.05.2018	00:38	
8.	100MVA T/F – II (Anpara TPS)	28.05.2018	23:05	

Generation Loss =850 MW, (At Obra - 500MW, At Anpara - 350MW
Load Loss = 304MW

It has been reported by site authorities that 400KV Obra – Anpra line Tripped at 21:28 hrs on distance protection. At 22:25 hrs during closing of earth switch after opening the isolators at Anpara TPS as required by maintenance people at Obra TPS heavy flash over occurred at Anpara TPS and bus bar protection operated at Anpara and Obra causing black out at Obra TPS and Bus – II at Anpara – A got isolated. B phase CT, isolator and Bus bay also got damaged at Anpara end. On inspection it was found that only one Pole of Ckt breaker at Obra end of 400KV Anpara – Obra line was open and other two poles were in closed position. 210MW unit No I & III and 100MVA ICT – II were on Bus – II at Anpara. Detailed report will be sent after receipt of data event logger and other information from Anpara TPS and Obra TPS.

15. As per Anpara A TPS Report:

Report on tripping of Units and 400 KV Lines at Anpara TPS on 28.05.2018

Status of various elements just prior to incident was as under:-

400KV BUS I of ATPS G-2, ICT-1,ICT-3, L-1 L-3

400KV BUS II of ATPS - G1, G3, ICT-2, L-2

400KV BTPS- G4, L-6, L-9

400KV BTPS- G5 L-5, L-8

BUS coupler – Both the Buses were coupled through Bus coupler at both ATPS & BTPS S/Y.

BUS SECTION- (I) Main Bus-I &II of ATPS and Main Bus-I &II of BTPS connected through Bus section.

(II) Main Bus-I &II of BTPS and Main Bus-I &II of CTPS connected through Bus section.

Description of tripping of lines with cause.

- **Anpara-Obra Line (L-2)** Tripping Time: 21:28:49Hrs.

Tripped on distance protection Zone-2 (R phase)

Fault current Ia=8.54 KA, Fault distance=37 KM from Anpara end.

Trip relay 86.1 & 86.2 operated, breaker of all three phase opened on protection.

- At about 22:10 Hrs MCB, OBRA TPS verbally instructed to MCB ATP, Anpara TPS for opening of line Isolator and closing of earth switch of obra line at Anpara end because of fire in Obra switchyard. MCB, Anpara TPS refused to execute any operation on verbal instruction and requested to send written message through proper code for any operation. Thereafter following message received By AE (O), MCB Anpara from MCB operation OBRA TPS at 22:12Hrs vide massage code no.OB/05/4896 as detailed below:-

आप को अवगत कराना है कि 400 के0वी0 ओबरा–अनपरा एल–2 लाईन का अनपरा छोर पर एल0एस0आई0 खुलवाकर एवं अर्थ ब्लेड लगा कर सूचित करें । (Copy of massage register of AE Operation enclosed)

- Thereafter at about 22:25Hrs MCB operation Staff of Anpara TPS opened all the three phase line isolators of OBRA line and started to close B phase earth switch incompliance of above message at 400KV 'A'TPS, Anpara Switchyard end. Suddenly flashover occurred and fire initiated on same earth switch. Consequent upon Bus Bar protection of 400KV ATPS Bus-II operated and following elements tripped.

1. 210MW Unit-1
   96 bus bar protection operated.
2. 210 MW Unit-3
   96 bus bar protection operated.
3. Bus coupler ATPS Switchyard.
   96 bus bar protection operated.
4. Bus Section-II
   96 bus bar protection operated.
5. 400/132/33KV, 100MVA ICT-II
   96 bus bar protections operated.
   Following equipments found damaged after incident.
   B-phase line side isolator including earth switch, 4" IPS tube approximate length 20 meters, B-phase transfer Bus pantograph isolator including support insulator, B-phase CT & 4" IPS tube support insulator.

Normalization-

Date	Time	Description of Normalization
28.05.2018	22:58	400KV Bus-Section-II charged.
28.05.2018	23:00	400KV Bus-Coupler ATPS charged.
28.05.2018	23:02	400KV ICT-2 charged.
29.05.2018	00:16	210MW Unit# 1 charged.
29.05.2018	00:38	210MW Unit# 3 charged.

Analysis-

At 21:28:49Hrs on 28.05.2018 400KV Anpara-Obra Line (L-2) tripped on R phase zone-2 fault and breaker of all three phases opened on protection. In compliance of written message of MCB OBRA TPS received at 22:12Hrs MCB operation of Anpara TPS opened all three phases of line isolators of OBRA line at about 22:25Hrs.Whereas as per normal practice MCB, Obra TPS should not send massage to open line isolators without confirmation of properly isolation of connected systems at Obra end. When B phase earth switch of OBRA line closed heavy flashover on earth switch occurred due to OBRA line was in charged condition from OBRA end, as OBRA end breaker of R & B phase reportedly was not opened. Simultaneously Bus Bar differential protection 87B of 400KV Bus-II of 'A'TPS switchyard operated and this bus was isolated after tripping of all elements (G-1,G-3,ICT-2,Bus coupler, Bus section-II).

16. Such delayed clearance of fault near generating complex may have resulted into major catastrophe in the grid and it shall be prevented for reliable and secure grid operation.
17. 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. Availability and healthiness of bus bar protection at Obra-B TPS at the time of tripping to be shared.
3. Is Pole discrepancy protection operated at 400 kV Obra-B TPS of 400kV Obra B TPS-Anpara TPS ckt?
4. Reason for delayed clearance of fault to be shared.
5. Reason of delayed bus bar protection operation at Anpara A TPS? (2.3second after fault occurrence time)
6. There is a significant difference between tripping of elements at 400kV Obra B TPS and Anpara TPS. Exact sequence of event needs to be checked and reported.

7. Reason of tripping of units at Obra-B TPS? What protection operated for Obra-B TPS units?
8. Reason of station transformer and 220/132kV ICT tripping at Obra-A TPS?
9. Reason of immediate tripping of Rewa Road-Obra B TPS from Rewa Road end?
10. Reason delayed tripping of 400 kV Obra B TPS-Panki from Obra B end?
11. Such delayed clearance of fault near generating complex may have resulted into major catastrophe in the grid and it shall be prevented for reliable and secure grid operation
12. Points raised in 148th OCC Meeting:
    a. Operational issue at Obra-B TPS. If Y&B-phase breaker stucked than that bus should vacate by opening of all the connected line from remote end.
    b. Communication issue between Anpara-A TPS and Obra-B TPS
    c. Operational issue as before opening of line side isolator and closing of earth switch O&M staff should check the line voltage in Y&B-phase.
    d. Origin of fault.
    e. Reason of fire in Obra-B TPS switchyard.
    f. Reason of breaker stuck at Obra-B TPS and remedial measures

13. DR/EL and detailed report considering remedial measures is still awaited from UPPTCL.

UPPTCL may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

F. Complete outage of Tehri-Koteshwar HEP complex at 21:56hrs of 30th May 2018

Event category: GD-1
Generation loss: 600MW (THDC may confirm)
Loss of load: Nil
Energy Unserved: Nil

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks

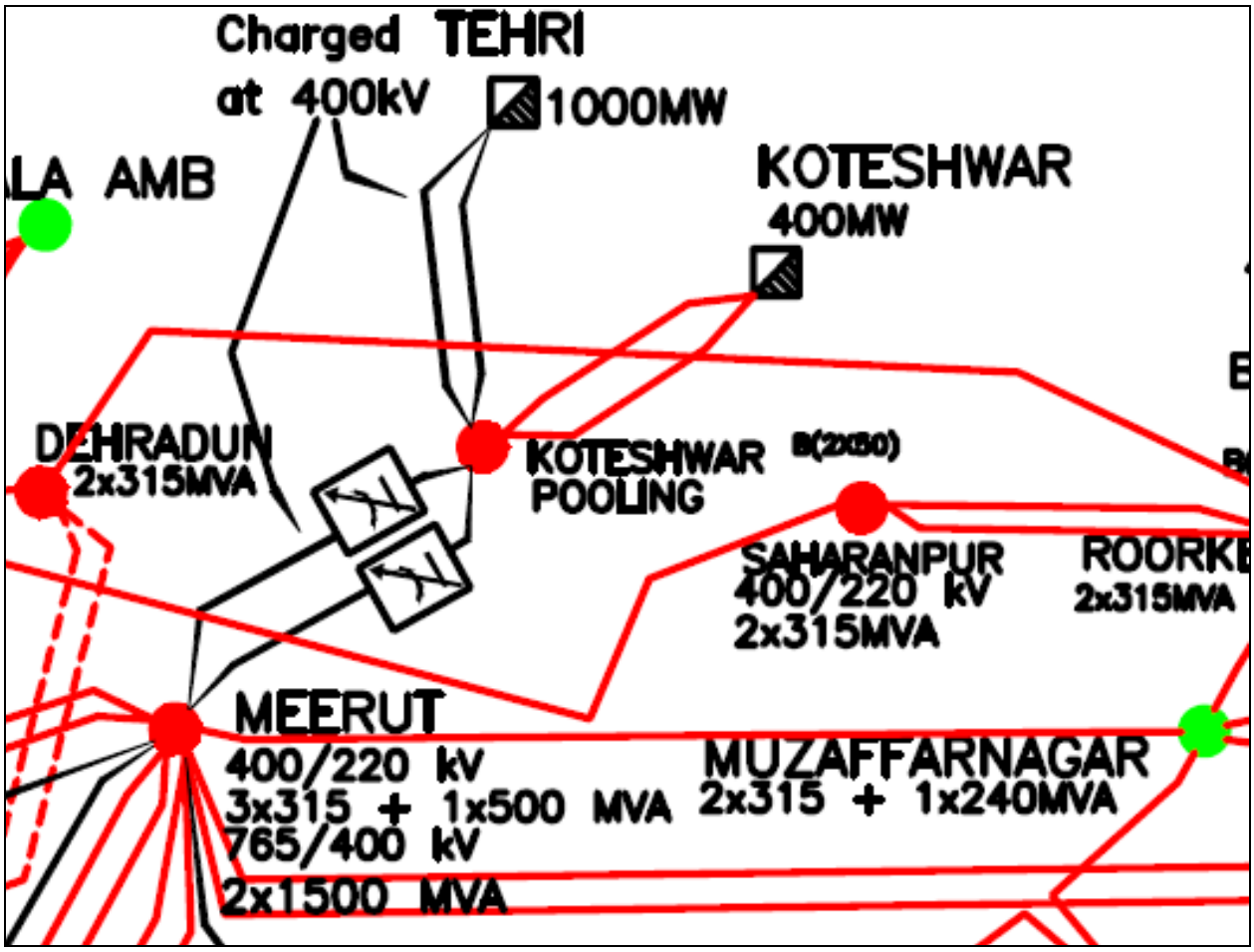
Fault Clearance Time		**100ms & 2360ms**	As per PMU data
Phase of the fault		B-N fault	As per PMU data

Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)	THDC & POWERGRID	Available	
DR/ EL	THDC	Received	After 24hrs
	POWERGRID	Not Received	
Preliminary Report	THDC	Received	After 24hrs
	POWERGRID	Not Received	
Detailed Report	THDC	Not Received	
	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) 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	**THDC & POWERGRID**	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. Connectivity Diagram and SLD of 400/220 kV Agra (UP):

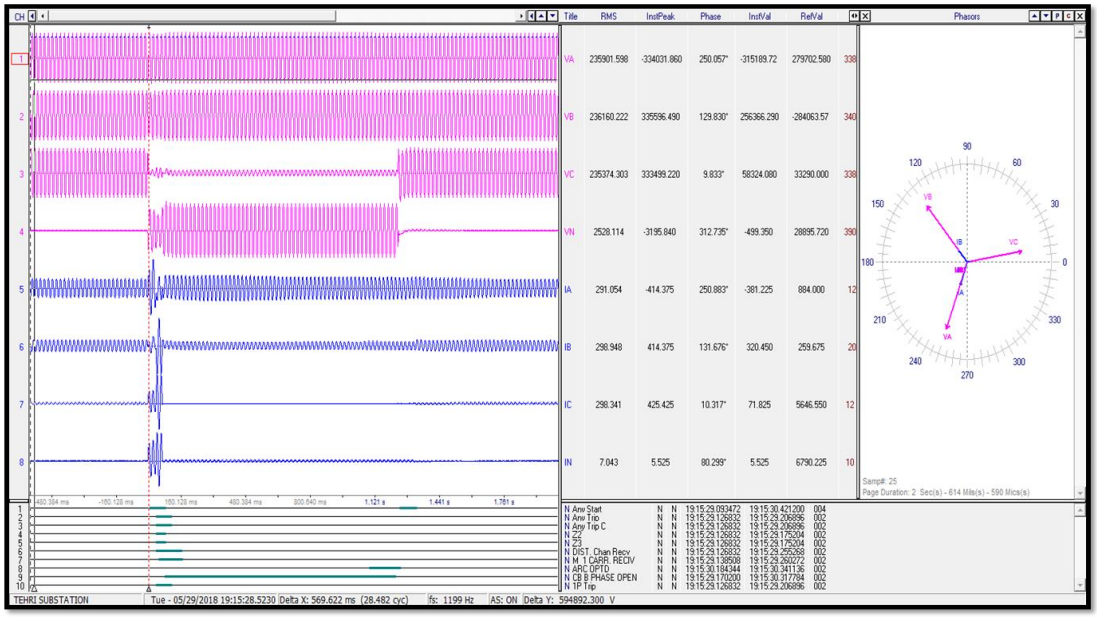


2. 400kV Tehri HEP and Koteshwar HEP are connected to 400kV Koteshwar(PG) S/S through 400kV D/C lines each. 400kV Koteshwar(PG) is further connected to 400kV Meerut(PG) through a 400kD/C having FSC on both circuits. Tehri and Koteshwar HEP have 4x250MW and 4x100MW of generation capacity respectively.
3. Antecedent Condition:
   - 400kV Koteshwar(THDC)-Koteshwar(PG)-2 and suspected to be under outage (THDC may confirm)
   - Unit #1, #2 & #4 running at Tehri HEP
   - Unit #1 & #3 running at Koteshwar HEP
   - FSC of 400kV Koteshwar(PG)-Meerut(PG)-2 out
4. At 19:15hrs, B-N fault occurred. All elements at Koteshwar HEP tripped.
5. At 19:18hrs, B-N fault occurred. It seems fault was in 400kV Meerut-Koteshwar (PG) ckt-2 and didn't clear timely.
6. Due to this, units at Tehri tripped on 51NGT protection stage-1 & 2 after 1.2sec & 1.6sec.

7. Name of the tripped elements are as below:
    - At 19:15hrs: Koteshwar HEP complete outage
        i. 400kV Koteshwar(THDC)-Koteshwar(PG)-1 at 19:15hrs
        ii. Unit #1 & #3 at Koteshwar HEP
    - At 19:18hrs: Tehri HEP complete outage
        i. Unit #1, #2 & #4 at Tehri HEP
        ii. 400kV Koteshwar(PG)-Meerut(PG)-2
8. As per THDC Report:
    - Tehri HEP was running with 3-Units at total stn load of 399MW as per the schedule.
    - At 19:15hrs., Zone-2 distance protection operated in Line-1 and subsequently A/R operated in B-phase. As per the DR, A/R operating cycle was approx. 1.1 second. Fault location recorded by protection relay was about 12.57Km from Tehri end.
    - After 3 min at 19:18hrs, again disturbance in both the lines was reported and the duration was quite large resulting in tripping of bus coupler and CBs of all the generating Units of Tehri HEP on operation of 51NGT(earth fault at 400kV side) stage-1 and Stage-2 after the pre-set delay of 1.2 & 1.6 sec. respectively.
    - On analyzing the fault, it indicates that fault existed at 400kV KPS-Meerut section, which was not cleared at KPS end. Hence, delay in clearing the fault reflected at Generator end causing unbalance in the system resulting in operation of 51NGT.
    - DR of Main-2 relay of both the Tehri-KPS lines are attached. DR PC installed at Tehri by PGCIL is unable to download the disturbance from the Main-1 relays of both the lines as it is not communicating and the same needs to be rectified on priority.
    - Further, It is pertinent to mention here that this was the 5^{th} incident in the current month w.r.t. fault in Tehri-KPS Lines. Other incidents which had occurred on 30.04.18, 02.05.18, 09.05.19&13.05.18 have been appraised to PGCIL vide letter no. THDCIL/Tehri/DGM(O&M)/F-88/73 dated 16.05.18(attached) for taking necessary action to avoid any unanticipated tripping of lines & units of Tehri HEP in future. The DR of all the incidents is being attached herewith for ready reference.

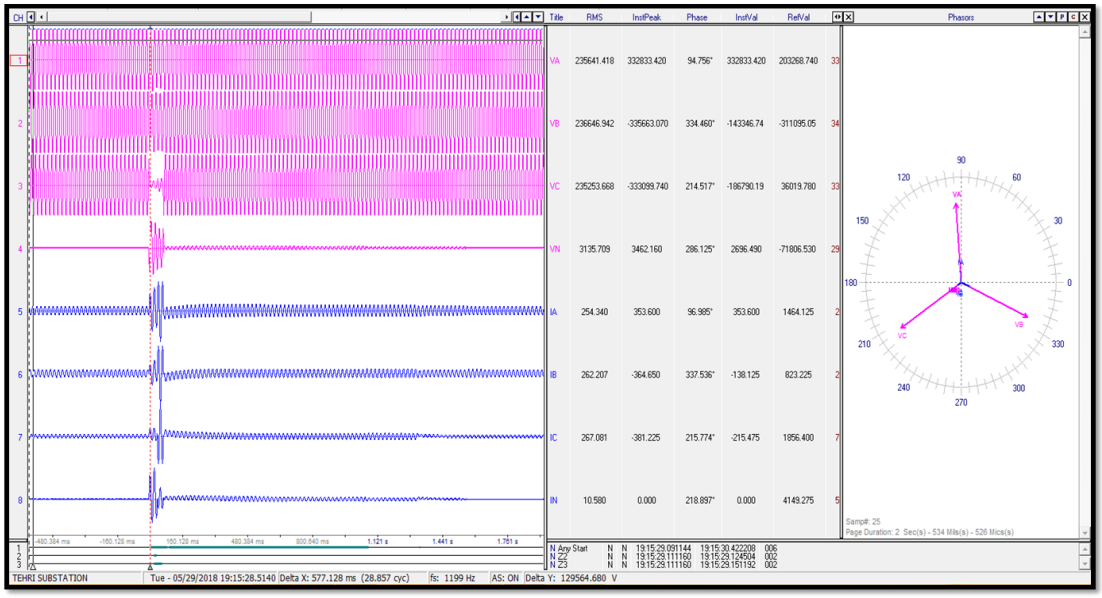
9. As per DR details:

DR of 400kV Tehri (**end**)-Koteshwar ckt-1 (*19:15hrs*)



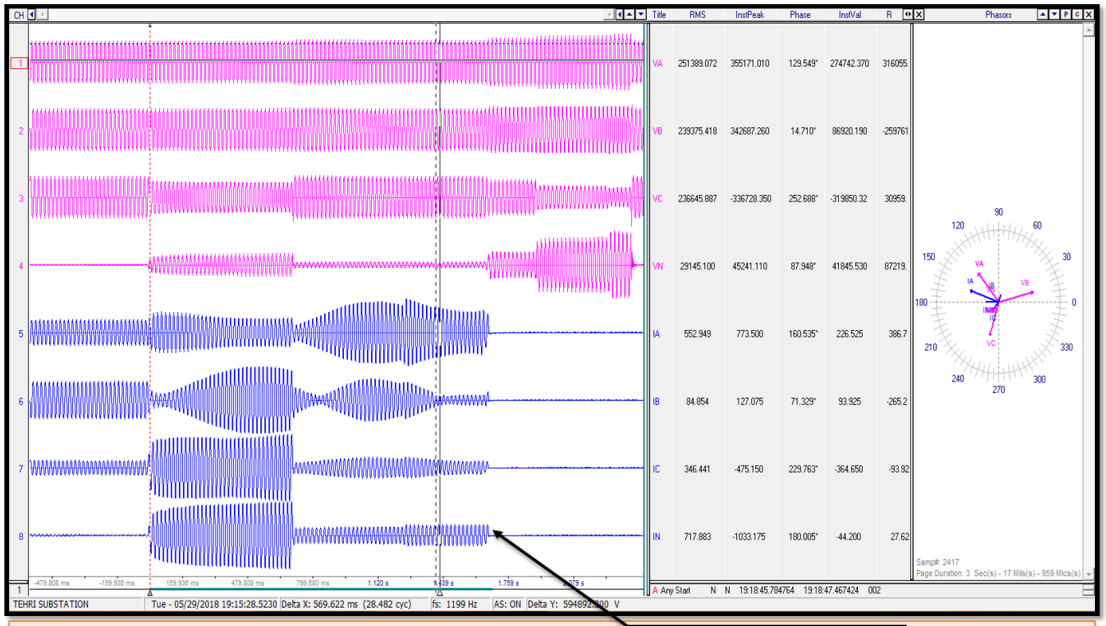
- B-N fault. Z-2 from Tehri end.
- B-phase tripped within 100ms due to carrier received from remote end.
- Successful A/R.

DR of 400kV Tehri (**end**)-Koteshwar ckt-2 (*19:15hrs*)



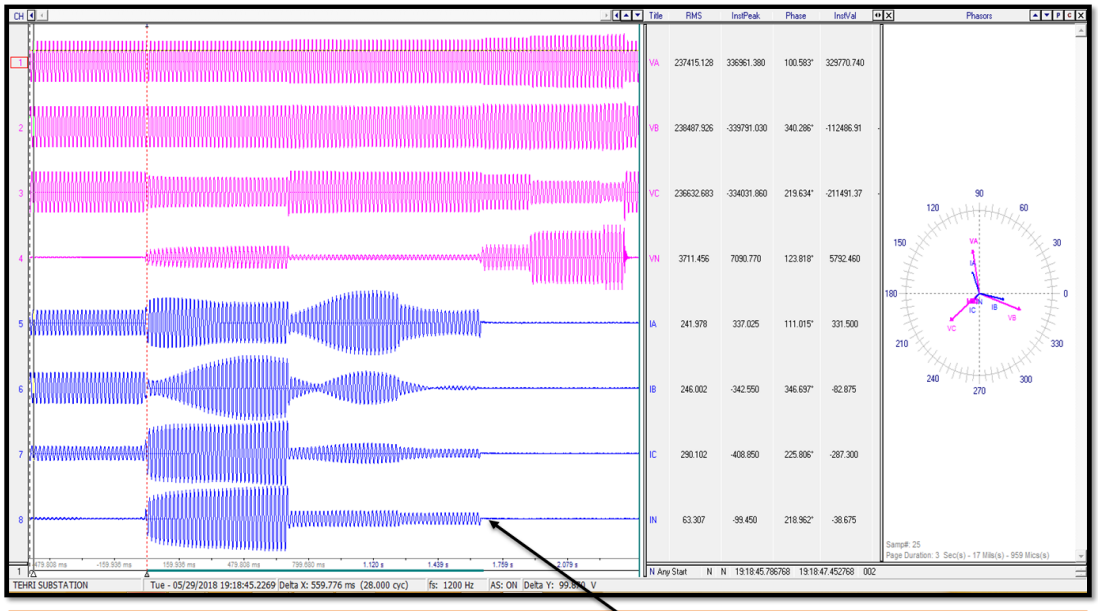
- B-N fault. Z-2 from Tehri end.
- Z-2 start, no tripping as fault was in ckt-1 and cleared timely

DR of 400kV Tehri (**end**)-Koteshwar ckt-1 (*19:18hrs*)



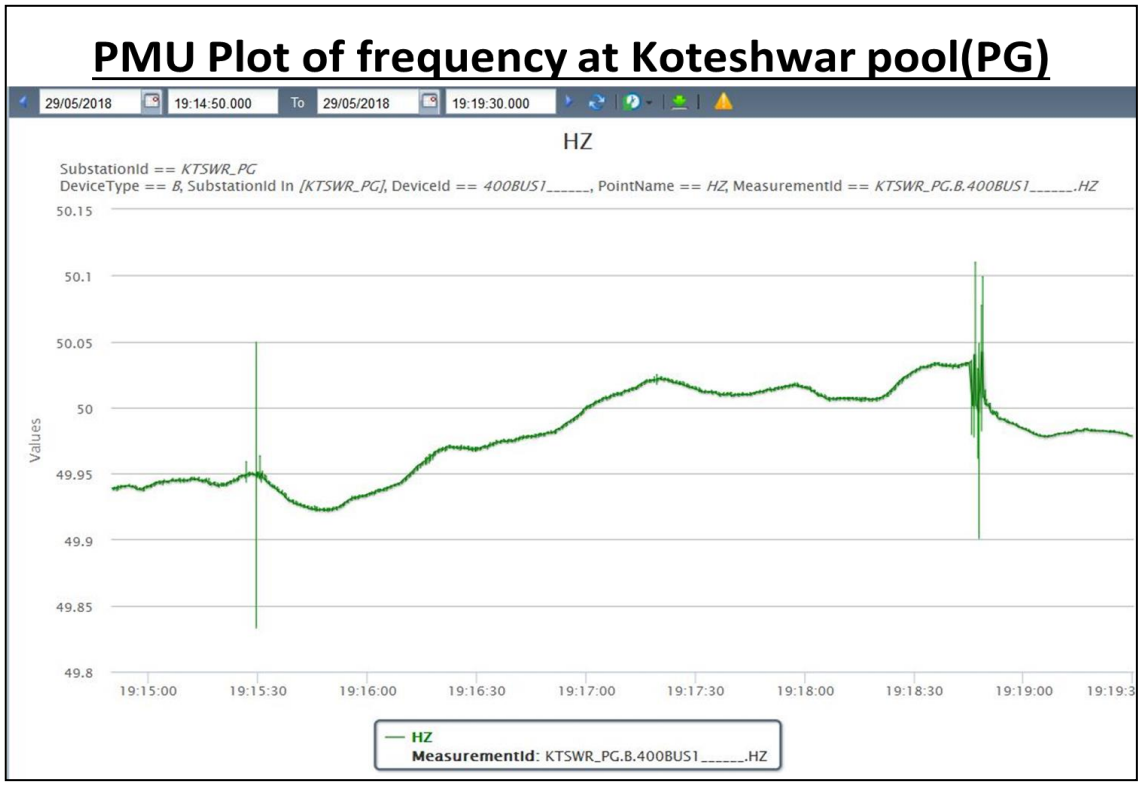
- Fault was not in the line.
- Delayed clearance of fault
- Oscillation also observed in the system

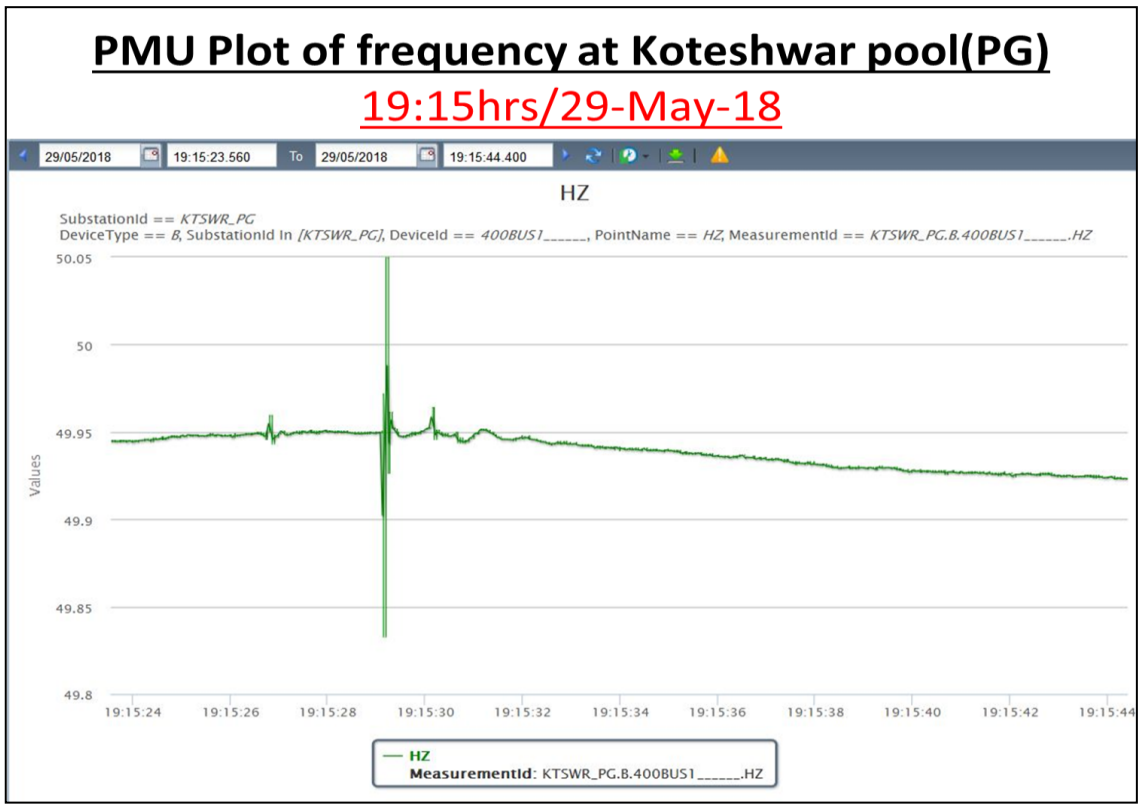
DR of 400kV Tehri (**end**)-Koteshwar ckt-2 (*19:18hrs*)



- Fault was not in the line.
- Delayed clearance of fault
- Oscillation also observed in the system

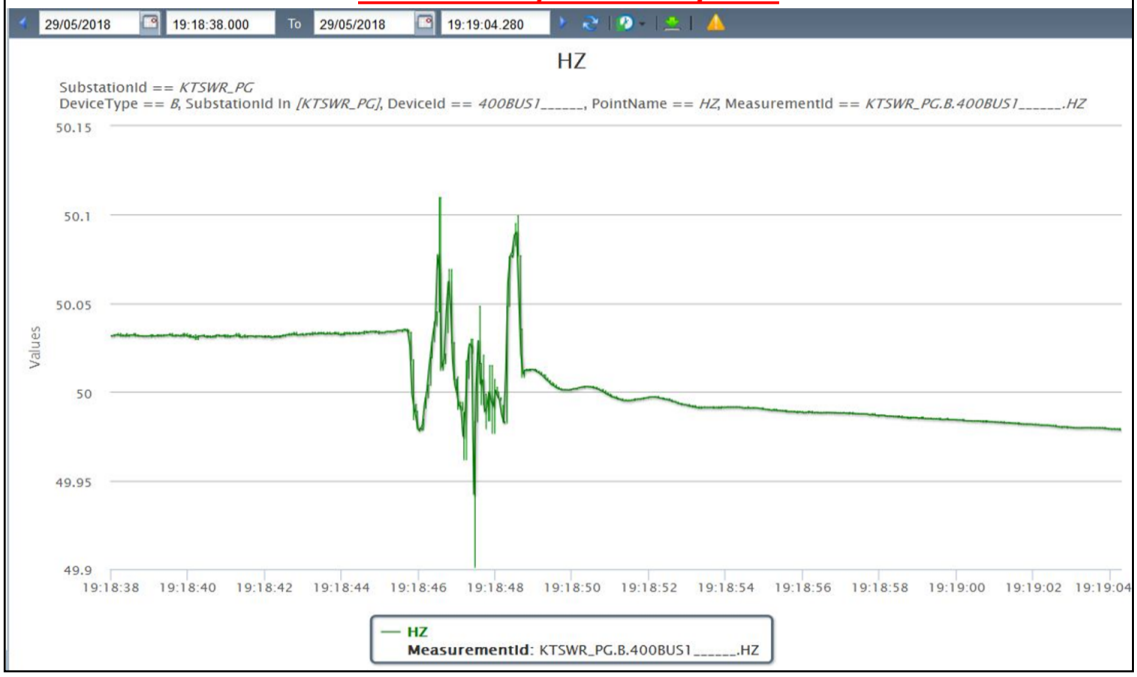
10. PMU plots:


PMU Plot of frequency at Koteshwar pool(PG)
29/05/2018
19:14:50.000
To
29/05/2018
19:19:30.000
HZ
SubstationId == KTSWR_PG
DeviceType == B, SubstationId In [KTSWR_PG], DeviceId == 400BUS1_____, PointName == HZ, MeasurementId == KTSWR_PG.B.400BUS1_____.HZ
50.15
50.1
50.05
50
49.95
49.9
49.85
49.8
Values
19:15:00
19:15:30
19:16:00
19:16:30
19:17:00
19:17:30
19:18:00
19:18:30
19:19:00
HZ
MeasurementId: KTSWR_PG.B.400BUS1_____.HZ

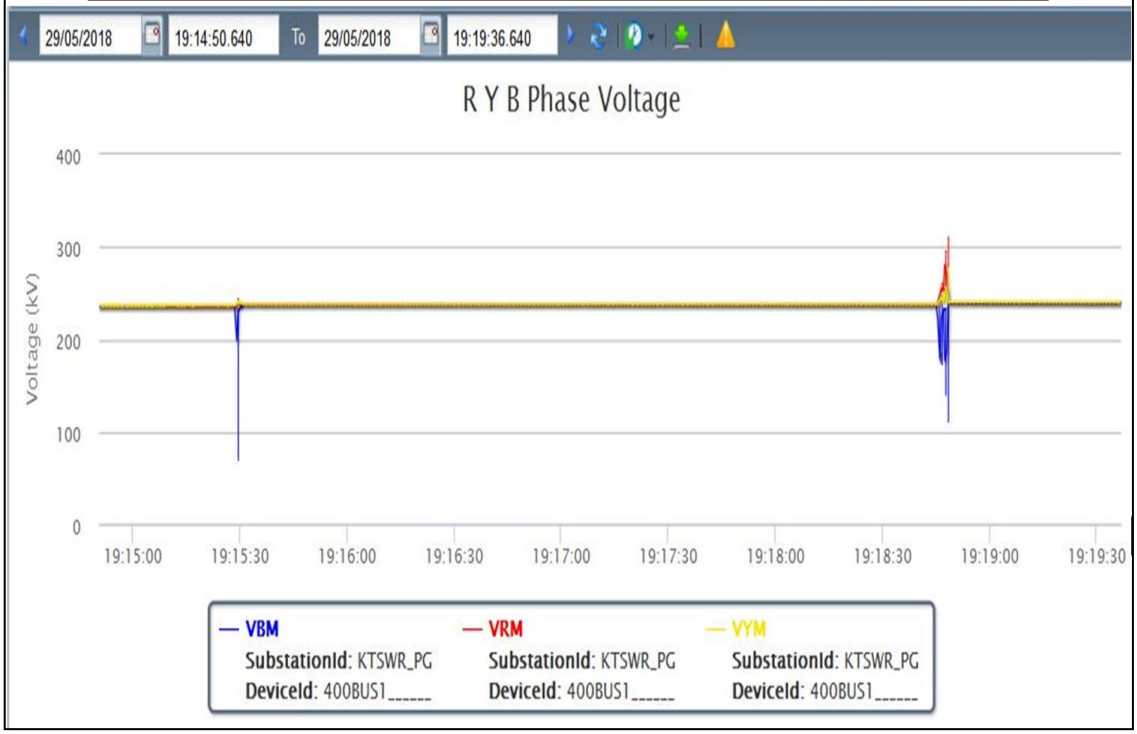

PMU Plot of frequency at Koteshwar pool(PG)
19:15hrs/29-May-18
29/05/2018
19:15:23.560
To
29/05/2018
19:15:44.400
HZ
SubstationId == KTSWR_PG
DeviceType == B, SubstationId In [KTSWR_PG], DeviceId == 400BUS1_____, PointName == HZ, MeasurementId == KTSWR_PG.B.400BUS1_____.HZ
50.05
50
49.95
49.9
49.85
49.8
Values
19:15:24
19:15:26
19:15:28
19:15:30
19:15:32
19:15:34
19:15:36
19:15:38
19:15:40
19:15:42
HZ
MeasurementId: KTSWR_PG.B.400BUS1_____.HZ

PMU Plot of frequency at Koteshwar pool(PG)

19:18hrs/29-May-18

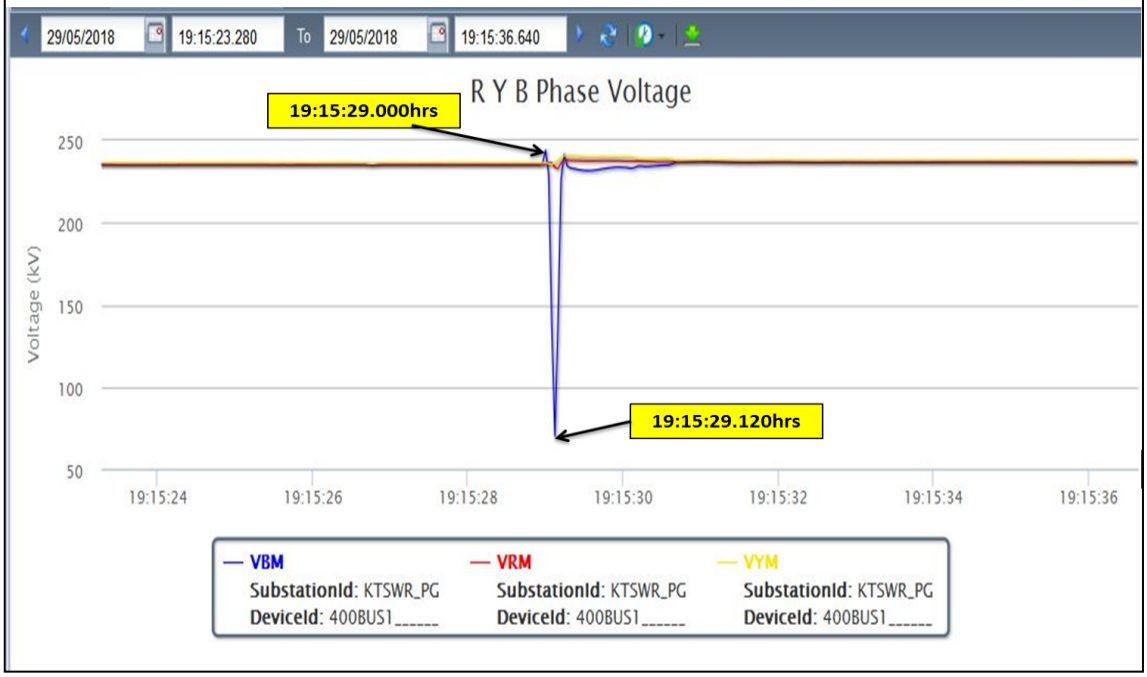


PMU Plot of phase voltage magnitude at Koteshwar pool (PG)



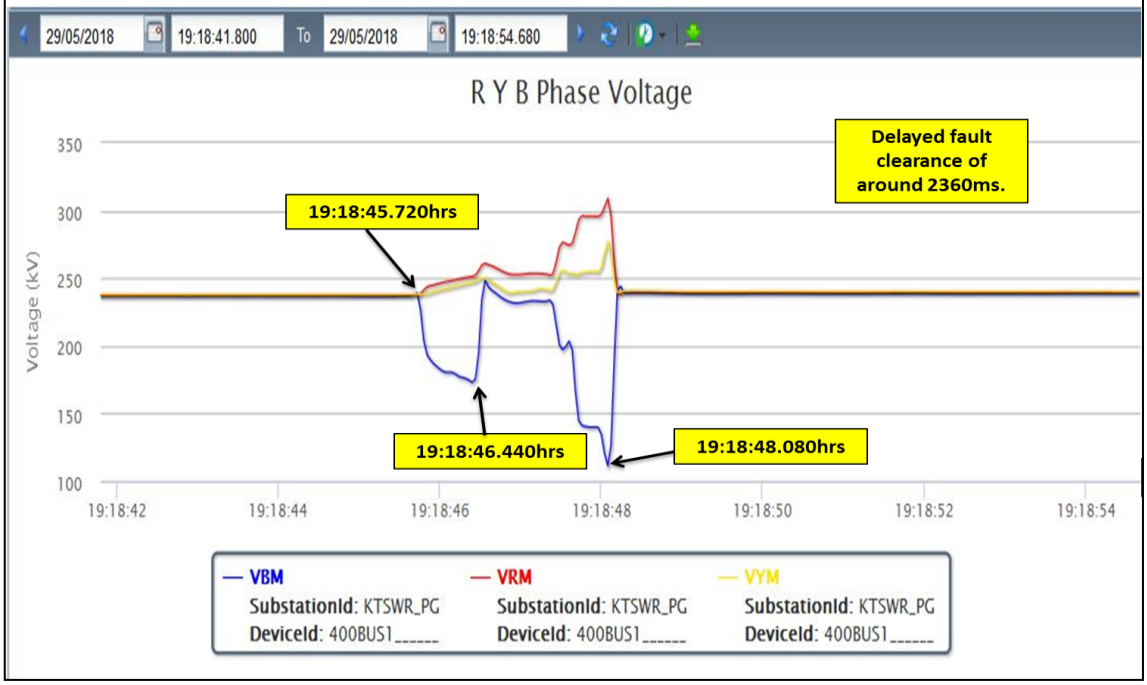
PMU Plot of phase voltage magnitude at Koteshwar pool (PG)

19:15hrs/29-May-18



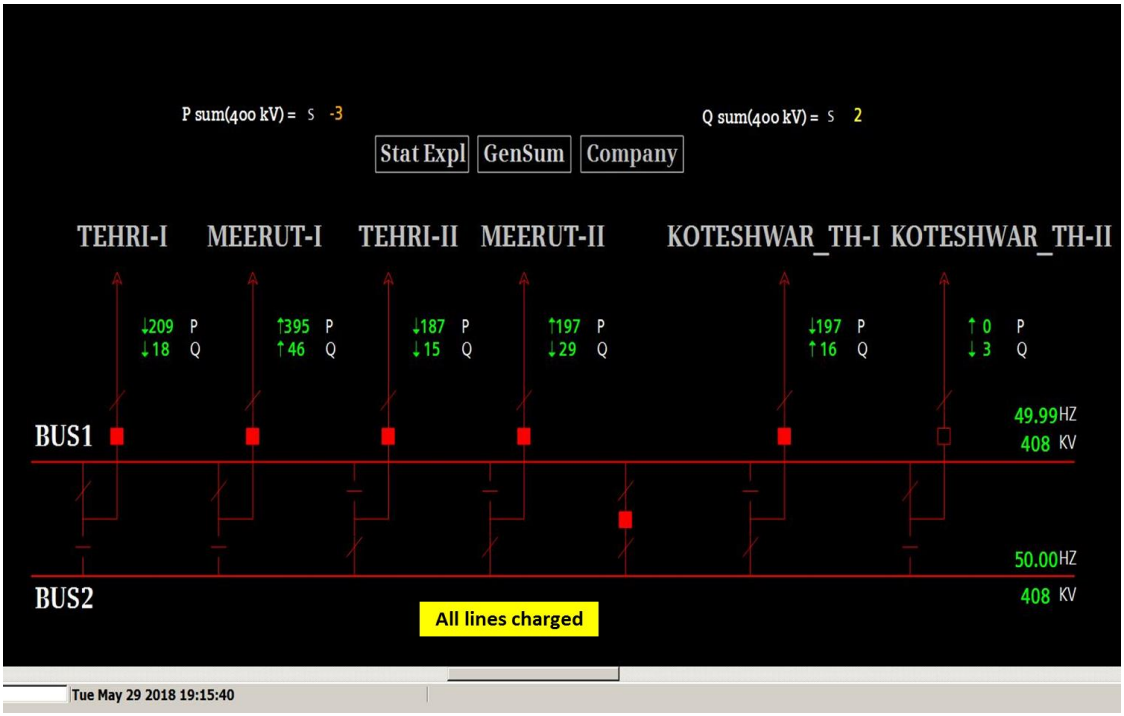
PMU Plot of phase voltage magnitude at Koteshwar pool (PG)

19:18hrs/29-May-18

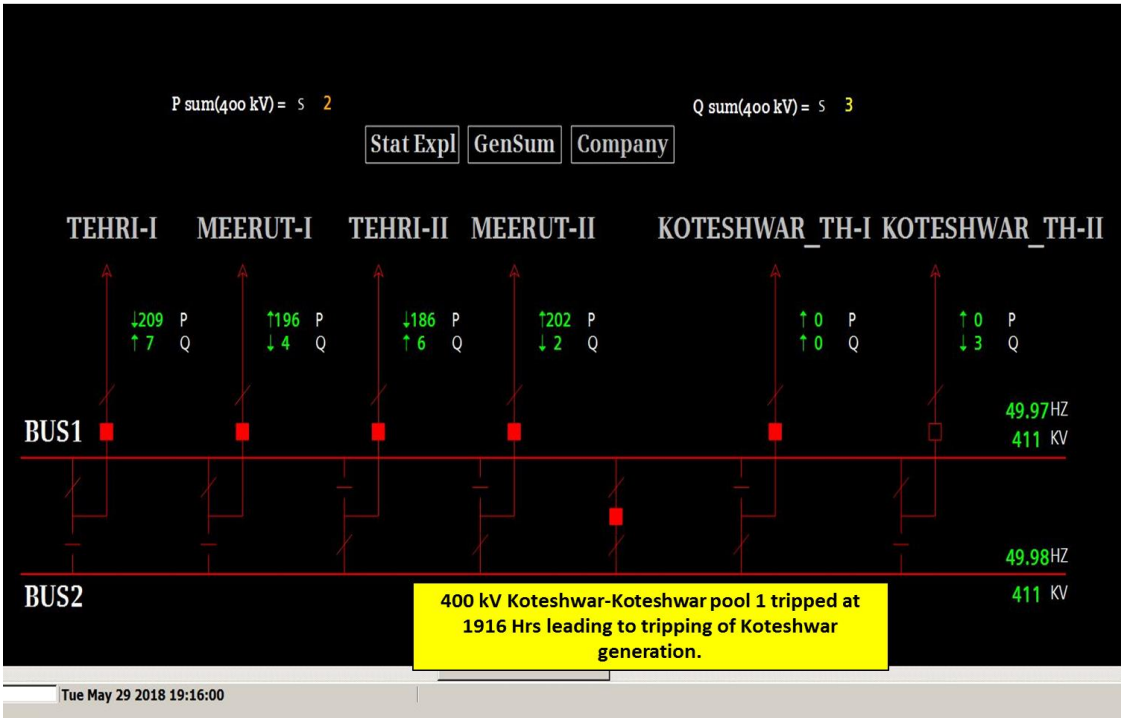


11. As per SCADA SLD:

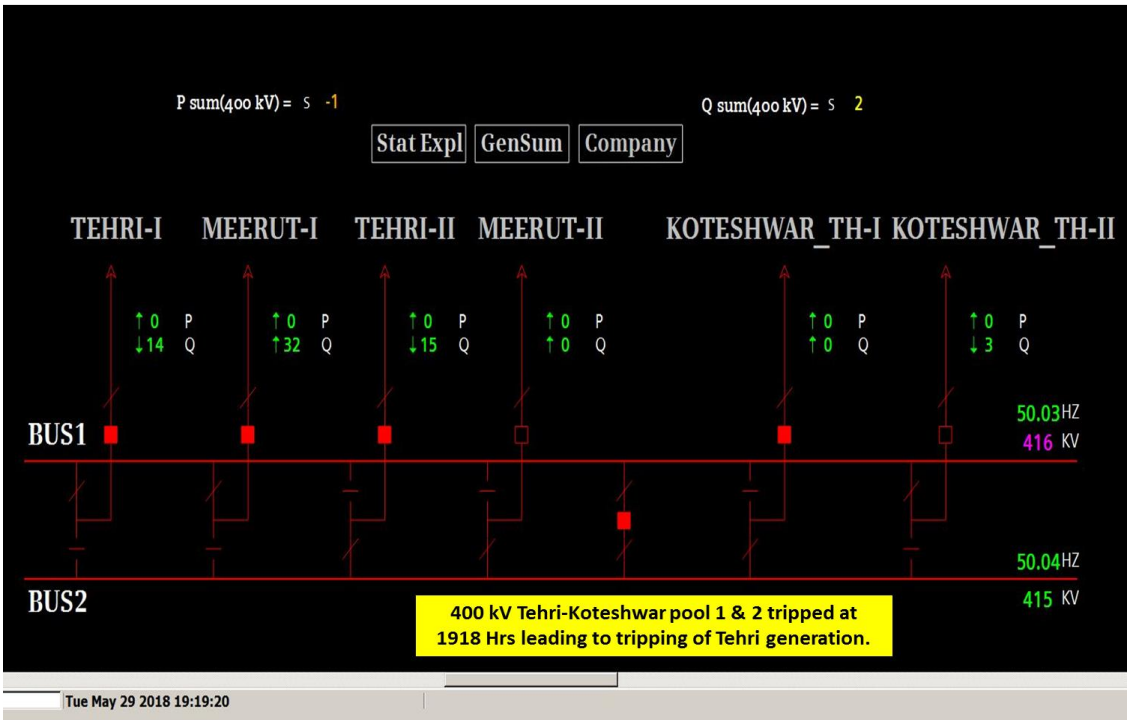
SLD of 400 kV Koteshwar pool (PG) before the incident



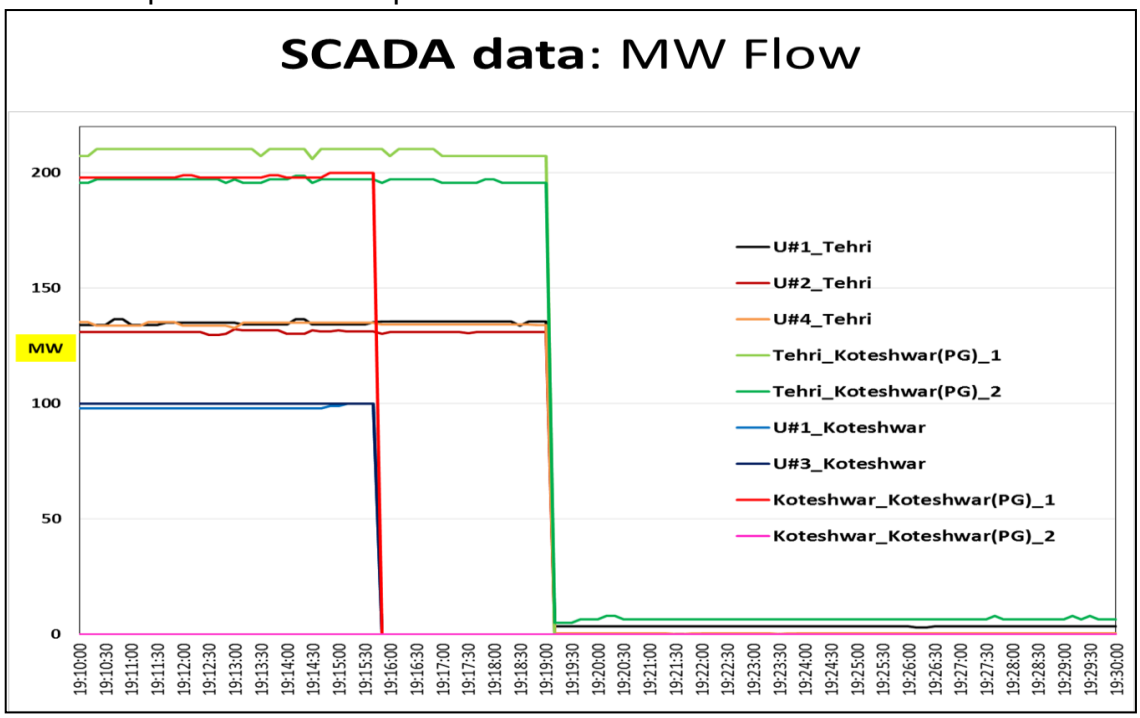
SLD of 400 kV Koteshwar pool (PG) after the incident



SLD of 400 kV Koteshwar pool (PG) after the incident



12. As per SCADA data plot:



13. As per SCADA SoE:

Time (hrs)	Substation	Voltage (kV)	Element	Device	Status	Remarks
19:15:29,096	KOTESHWAR	400kV	01TEHRI1	Protection Trip	App	400kV KoteshwarPG(end)-Tehri-1 A/R
19:15:29,123	KOTESHWAR	400kV	01TEHRI1	Circuit Breaker	disturbe	
19:15:29,197	KOTESHWAR	400kV	01TEHRI1	Protection Trip	Disp	
19:15:30,432	KOTESHWAR	400kV	01TEHRI1	Circuit Breaker	Close	
19:15:32,447	KOTESHWAR	400kV	07TH2	Protection Trip	App	400kV KoteshwarPG(end)-KoteshwarTH-1 tripped
19:15:32,474	KOTESHWAR	400kV	07TH2	Circuit Breaker	disturbe	
19:15:32,489	KOTESHWAR	400kV	07TH2	Circuit Breaker	Open	
19:15:32,587	KOTESHWAR	400kV	07TH2	Protection Trip	Disp	
19:18:46,456	KOTESHWAR	400kV	04MEERT2	Protection Trip	App	
19:18:46,483	KOTESHWAR	400kV	04MEERT2	Circuit Breaker	disturbe	
19:18:46,559	KOTESHWAR	400kV	04MEERT2	Protection Trip	Disp	
19:18:47,694	KOTESHWAR	400kV	04MEERT2	Circuit Breaker	Close	
19:18:48,142	KOTESHWAR	400kV	04MEERT2	Circuit Breaker	disturbe	
19:18:48,161	KOTESHWAR	400kV	04MEERT2	Circuit Breaker	Open	400kV KoteshwarPG(end)-Meerut-2 tripped
19:18:48,360	KOTESHWAR	400kV	04MEERT2	Protection Trip	App	
19:18:48,490	KOTESHWAR	400kV	04MEERT2	Protection Trip	Disp	
19:18:48,594	TEHRI	400kV	11H04	Circuit Breaker	Open	Running units at Tehri tripped
19:18:50,597	TEHRI	400kV	02H01	Circuit Breaker	Open	
19:18:50,598	TEHRI	400kV	06H02	Circuit Breaker	Open	

14. As per PMU & SCADA data:
    - B-N fault occurred at 19:15:29.000hrs and cleared in ~100ms.
    - After 3 min, a B-N fault again occurred at 19:18:45.720hrs and cleared with delay of 2360ms at 19:18:48.080hrs.
    - 400kV KoteshwarPG(end)-KoteshwarTH-1 tripped at 19:15:32.490hrs i.e. after ~3.5sec of fault.
    - 400kV KoteshwarPG(end)-Meerut-2 tripped at 19:18:48.160hrs i.e. after ~2.5sec of second fault.
    - Unit #4 at Tehri tripped at 19:18:48.600hrs i.e. after ~3sec of fault whereas Unit #1 & #2 tripped after ~5sec of fault.

15. Preliminary Report, DR/EL and Detailed report has been received from Tehri HEP end but still awaited from Koteshwar HEP end.

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. Reason for delayed clearance of fault to be Reason for tripping of 400kV Koteshwar (PG) end-Koteshwar (TDC)-1 at 19:15:32.490hrs i.e. after ~3.5sec of fault to be shared.
3. Reason for tripping of 400kV Koteshwar (PG) end-Meerut ckt-2 at 19:15:32.490hrs i.e. after ~3.5sec of fault to be shared.
4. Reason for staggered tripping of units at Tehri in ~3sec and ~5sec of fault occurrence to be looked into and shared.
5. In view of all tripped elements not captured in SCADA SoE data, digital SCADA data reporting from Koteshwar HEP to be checked, rectified and ensured in future.

Action Points*:*

1. Non-tripping of 400kV Tehri-Koteshwar (PG) D/C from Tehri end in Z-2/Z-3 before tripping of units.
2. 51NGT stage-1, 2 settings of units at Tehri HEP having time delay of 1.2sec & 1.6sec.

THDC may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

G. Multiple Element tripping at 220kV Sarna (Punjab) on 01st Jun 2018 at 15:50hrs

Event category: GD-1
Generation loss: Nil (Punjab may confirm)
Loss of load: 220MW (Punjab may confirm)
Energy Loss: ___MU (Punjab may confirm)

Data Summary received at NRLDC:

Description		**Fault Info**	**Remarks**
Fault Clearance Time		**580ms**	As per PMU data
Phase of the fault		Maximum dip in B-phase	As per PMU data

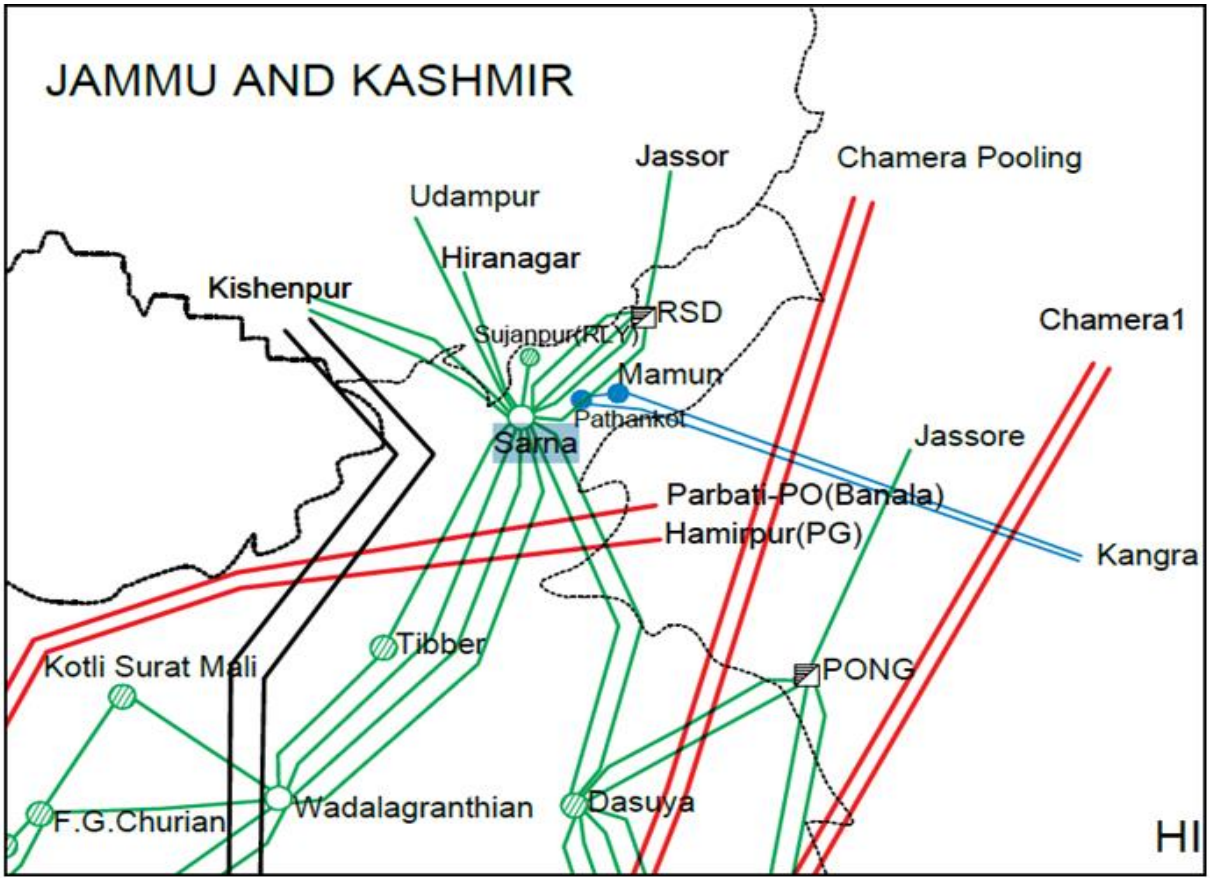
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)	Punjab	Available	
DR/ EL	Punjab	Not Received	

	POWERGRID	Not Received	
	J&K	Not Received	
Preliminary Report	Punjab	Not Received	
	POWERGRID	Not Received	
	J&K	Not Received	
Detailed Report	Punjab	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)	**Punjab**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report 3. Adequately Sectionalized and graded protective relaying system
	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**POWERGRID, J&K**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report

Based on above information description of the events is:

1. Connectivity Diagram:



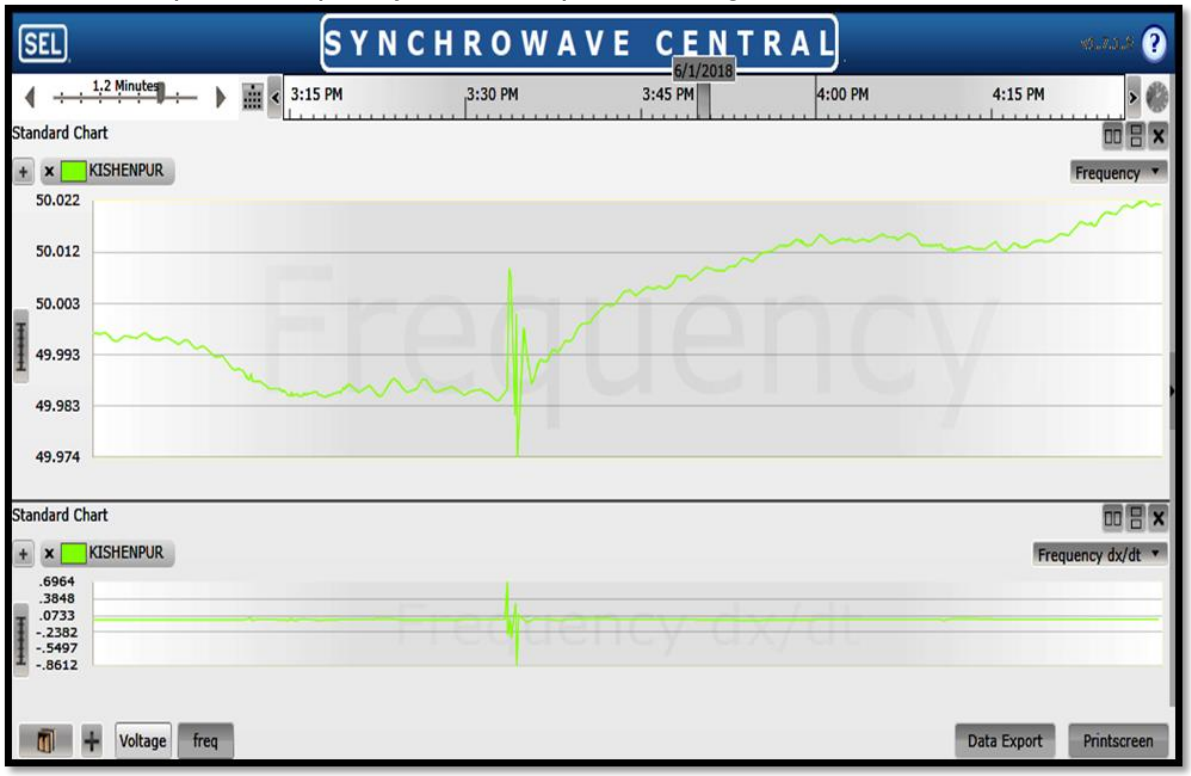
2. 220 kV Sarna HEP connected with Wadala Granthian four ckt (one ckt LILOed at Tibber), RSD (Ranjit Sagar Dam) four ckt, Kishenpur D/C, Dasuya D/C, Sujanpur Railway D/C, Hiranagar S/C, Udhampur S/C, one ICT of 220/132kV & one ICT of 220/66kV.
3. Bus scheme is double bus single breaker scheme at 220kV Sarna stations.
4. In antecedent condition:
    - As per SCADA data, it seems 220 kV Bus-2 of Sarna (Punjab) was already under outage
    - 220 kV Sarna-Wadala granthian ckt-1 & 2, 220 kV Sarna-RSD ckt-3 & 4 was also under outage

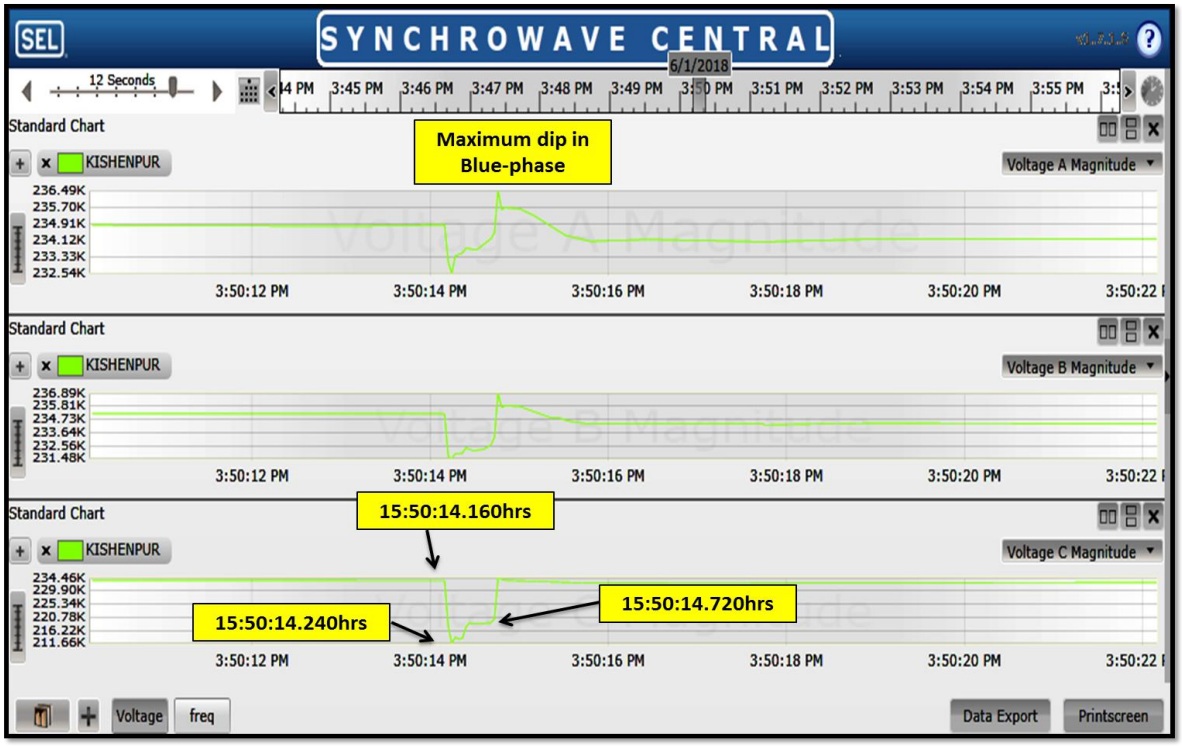
5. CT (Current Transformer) of 220 kV Sarna (end)-Wadala granthian ckt-4 bursted and resulted into bus fault for 220 kV Sarna (Punjab).

6. Name of the tripped elements:
    - 220 kV Kishenpur-Sarna ckt-1 &2
    - 220 kV Sarna-Wadala ckt-IV
    - 220 kV Sarna-Timber ckt
    - 220 kV Sarna-Dasuya ckt
    - 220 kV Sarna-Hiranagar (J&K) ckt

- 220 kV Sarna-Udhampur ckt
- 220 kV Sarna-RSD ckt-1 & 2

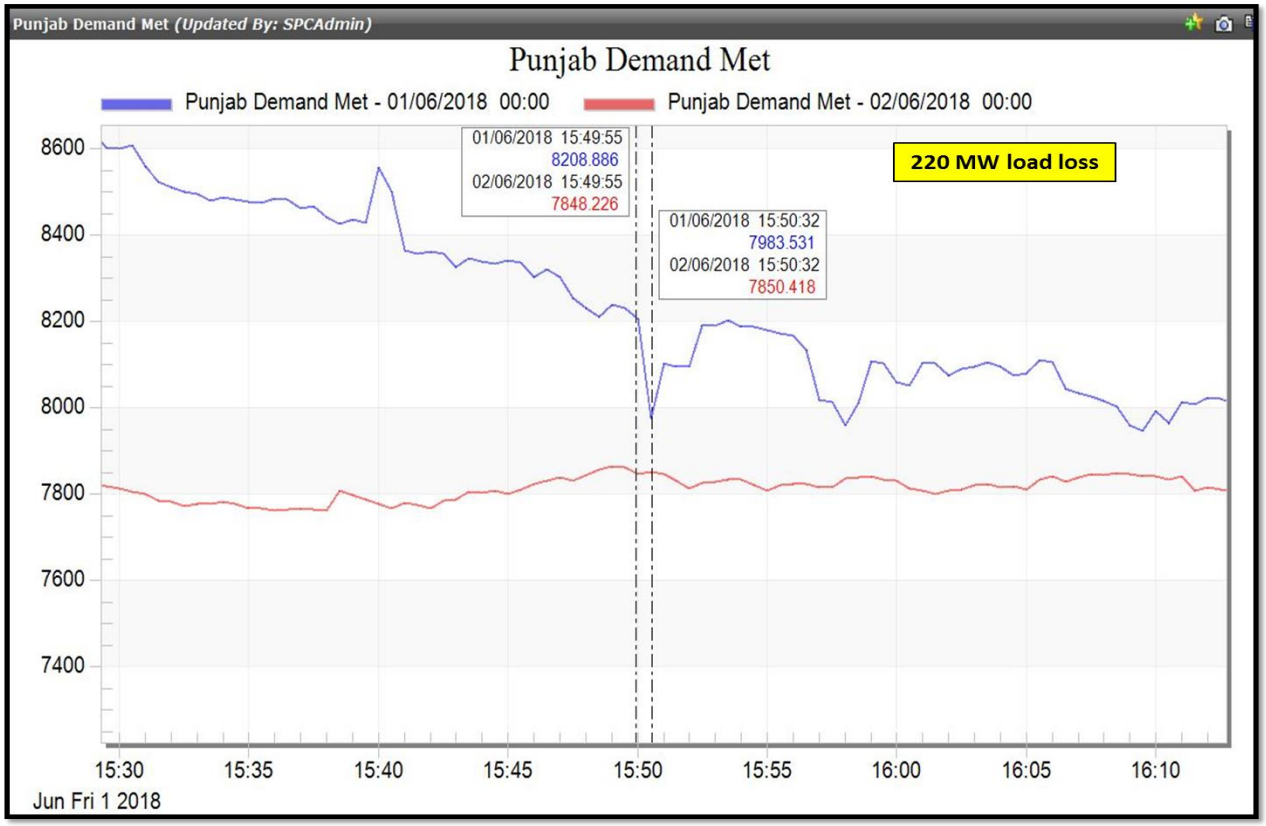
7. PMU plot of frequency, df/dt and phase voltages:





8. As per PMU and SCADA data:
    - B-N fault observed at 15:50:14.160hrs
    - Voltage dip observed in Blue phase.
    - Fault clearance time 580ms.

- SCADA MW flows:



- SCADA SoE:

Time (in ms)	Reference Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
15:50:14,160	**0ms**						PMU data (Fault started)
15:50:14,300	**140ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	disturbe	
15:50:14,301	**140ms**	SARNA	220kV	E_10(TIBBER)	Circuit Breaker	Open	
15:50:14,307	**145ms**	SARNA	220kV	E_3(UDHAM)	Circuit Breaker	Open	
15:50:14,310	**150ms**	SARNA	220kV	E_12(RSDPH-2)	Circuit Breaker	Open	
15:50:14,313	**155ms**	SARNA	220kV	E_13(RSDPH-1)	Circuit Breaker	Open	
15:50:14,506	**345ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	Close	
15:50:14,511	**350ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	disturbe	
15:50:14,637	**475ms**	SARNA	220kV	E_7(DASYA-2)	Circuit Breaker	disturbe	
15:50:14,645	**485ms**	SARNA	220kV	E_5(HRNGR)	Circuit Breaker	disturbe	
15:50:14,662	**500ms**	SARNA	220kV	E_8(KISHN-1)	Circuit Breaker	Open	
15:50:14,664	**505ms**	SARNA	220kV	E_7(DASYA-2)	Line Isolator	Open	
15:50:14,664	**505ms**	SARNA	220kV	E_7(DASYA-2)	BusBar Isolator 2	Open	
15:50:14,664	**505ms**	SARNA	220kV	E_9(KISHN-2)	Circuit Breaker	Open	
15:50:14,687	**525ms**	SARNA	220kV	E_7(DASYA-2)	BusBar Isolator 1	Open	
15:50:14,720	**560ms**						PMU data (Fault cleared)
15:50:15,293	**1135ms**	SARNA	220kV	E_16(T1)	Circuit Breaker	disturbe	
15:50:17,492	**3330ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	Open	
15:50:17,645	**3485ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	disturbe	
15:50:20,524	**6365ms**	SARNA	220kV	E_16(T1)	Circuit Breaker	Close	
15:50:20,587	**6425ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	Open	
15:50:20,741	**6580ms**	SARNA	220kV	E_11(WDALA-4)	Circuit Breaker	disturbe	
15:58:53,805		SARNA	220kV	E_17(T2)	Circuit Breaker	Close	
15:58:53,821		SARNA	220kV	E_17(T2)	Circuit Breaker	Open	
15:58:53,823		SARNA	220kV	E_17(T2)	Circuit Breaker	disturbe	

9. Preliminary Report, DR/EL and detailed report are still awaited from Punjab. It was observed that Punjab is continuously violating the IEGC clause 5.2.r which states that *"All the Users, STU/SLDC and CTU shall send information/ data including disturbance recorder/sequential event recorder output to RLDC within 24 hours for purpose of analysis of any grid disturbance/event. No User, SLDC/STU or CTU shall block any data/information required by the RLDC and RPC for maintaining reliability and security of the grid and for analysis of an event"*

Points for Discussion:

1. Reason of outage of 220 kV Bus-2 at Sarna (Punjab).
2. If 220 kV bus-2 was not under planned outage, reason of tripping of complete station to be looked into.
3. Exact location of fault to be reported.
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.

5. Reason of delayed clearance of fault.
6. Delayed clearance of fault in case of operation of bus bar protection at 220 kV Sarna (Punjab) needs to be looked into.
7. Detailed report and supporting DR/EL needs to be submitted
8. Status of bus bar protection at 220kV Sarna (during incident of 19.02.2016, it was out of service)
9. 220 kV Bus Bar Protection at Sarna (Punjab) needs to be checked and corrected.

Punjab may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

H. Complete outage of 400kV Rosa TPS(UP) at 23:58hrs of 01st June 2018

Event category: GD-1
Generation loss: 440MW (As per UP report)
Loss of load: Nil (As per UP report)
Energy Loss: ___ MU (UP may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	1760ms	As per PMU data
Phase of the fault	PMU data	Y-N fault	As per PMU data

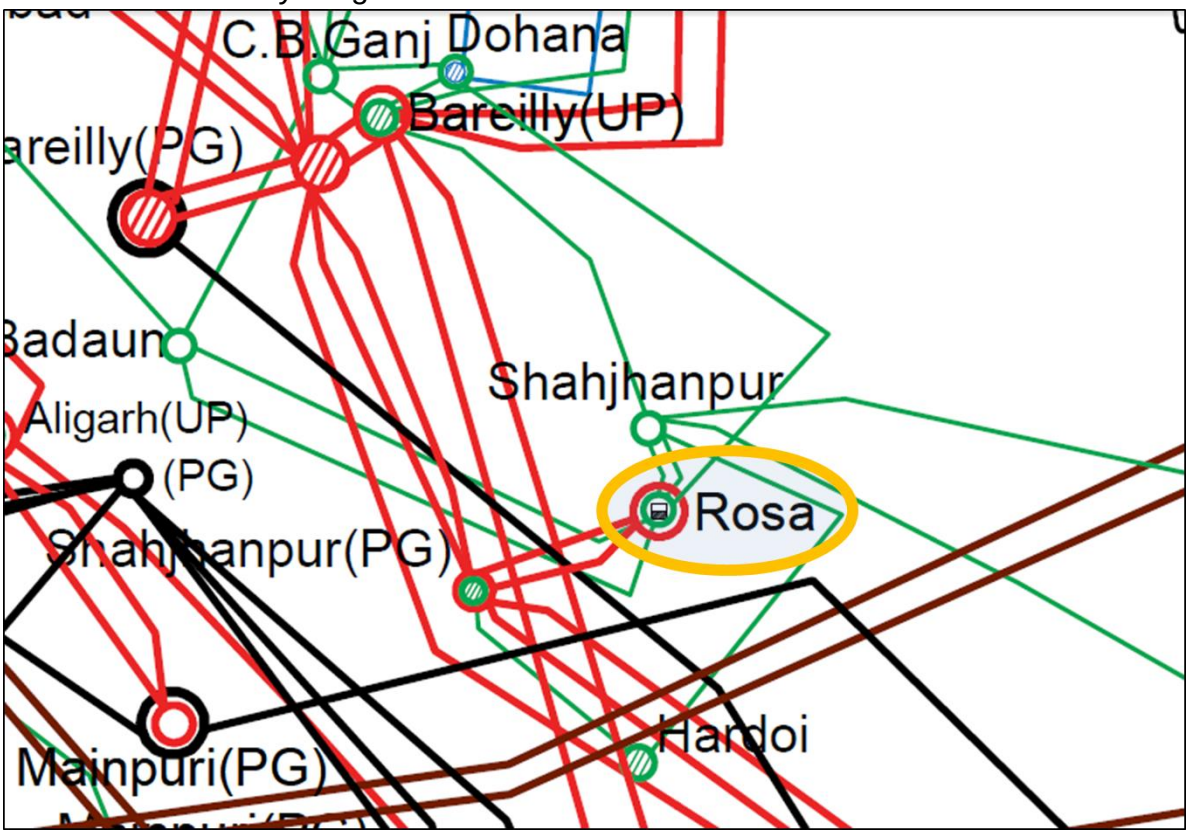
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available (Partial)	
DR/EL	Uttar Pradesh	Not Received	
Preliminary Report	Uttar Pradesh	Received	Within 24hrs
Detailed Report	Uttar Pradesh	Not Received	

Description	Clauses	Utility	Remarks

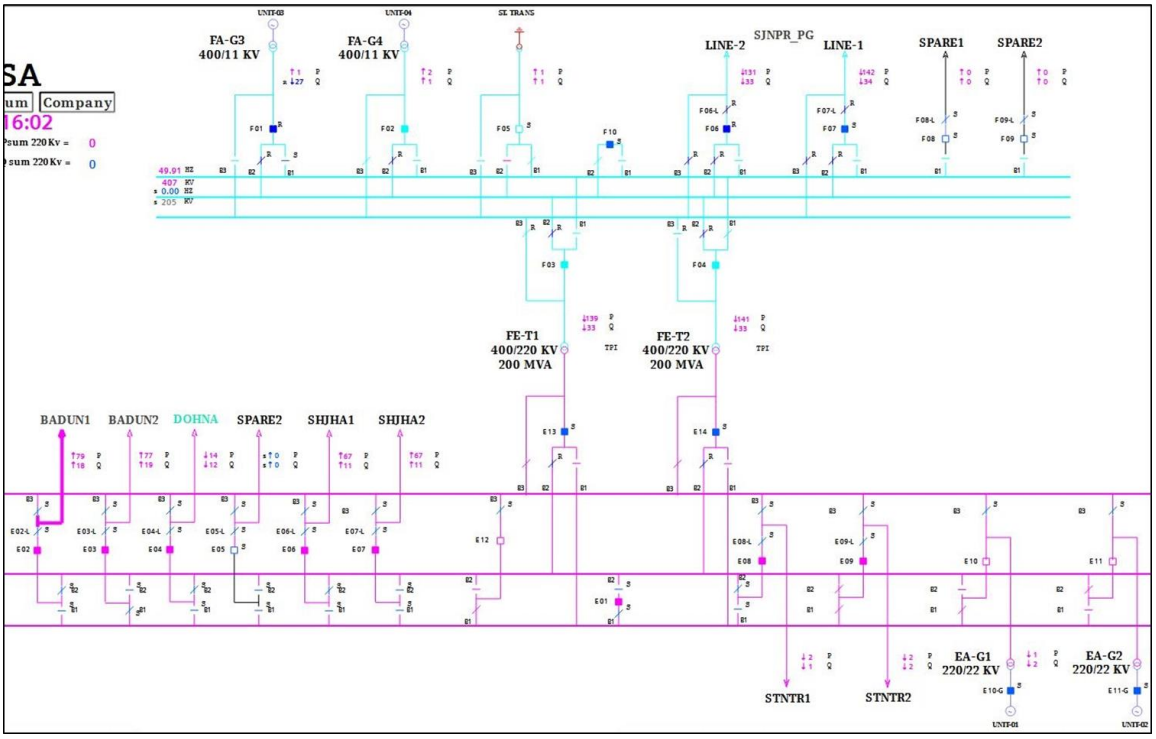
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to 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. Connectivity Diagram:



Single Line Diagram: Rosa TPS



2. Rosa TPS has following elements at 220kV: Badaun D/C, Shahjahanpur(UP) D/C, Dohana S/C, Unit #1, #2; At 400kV: 400kV Shahjahanpur(PG) D/C and Unit #3, #4; Rosa TPS has 4x300MW capacity.
3. Antecedent condition and tripped elements as per UP report:

S. No.	Name of element	Date & time of normalization		Remarks
1.	300MW Unit – I	03.06.2018	17:02	Hand tripped at 23:56:18
2.	300MW Unit – II	03.06.2018	19:31	Hand tripped at 23:56:22
3.	300MW Unit – III	03.06.2018	17:17	Tripped on generator protection V/F at 23:58:04
4.	300MW Unit – IV	03.06.2018	17:53	Hand tripped at 23:02:10
5.	400KV (PG) line – I	02.06.2018	00:11	Tripped at 23:03
6.	400KV (PG) line – II	02.06.2018	05:12	Tripped at 23:03
7.	220KV Shahjahanpur – I	02.06.2018	02:18	Hand tripped at 00:05:13
8.	220KV Shahjahanpur – II	02.06.2018	01:33	Hand tripped at 00:05:45
9.	220KV Badaun – I	02.06.2018	00:43	Hand tripped at 00:04:49
10.	220KV Badaun – II	02.06.2018	02:06	Hand tripped at 00:04:29
11.	220KV Dohna	10.06.2018	18:27	Already tripped at 21:53:52 hrs

4. At 22:58hrs, 400kV Rosa-Shajahanpur-2 tripped on Z-1 from Rosa end and 400/220kV ICT-1 at Rosa tripped on differential protection.

5. At 23:01hrs, 400kV Rosa-Shajahanpur-1 also tripped on Z-1 from Rosa end.
6. Due to tripping of both 400kV Shajahanpur(PG) ckts, loading on 220kV Shajahanpur(UP) ckts increased to ~300MW each ckt. To reduce it, unit #4 hand tripped.
7. At 23:52hrs due to heavy system jerk, unit #1 excitation system came to manual mode. There were heavy disturbance in generator terminal voltage and reactive power in all three running units which came on house load due to load thrown off and OPC acted several times in all units.
8. 220kV line CBs were closed at Rosa TPS but none of them were taking load.
9. Unit #1, #2 were hand tripped whereas unit #3 tripped on generator protection at 23:58:04hrs.
10. As per UP Report:

Flash Report

No: 1663 /SE(R&A)/EE-II /Report Dated: 02/06/2018

General Manager, NRLDC
18-A, SJSS Marg, KatwariaSarai,
New Delhi – 110016

Sub: - Flash Report on the Incident of Simultaneous tripping at Rosa TPS Rosa Shajahanpur .

On 01.06.2018 at 23:58 hrs. 300MW Units and 220KV Ckt tripped simultaneously. Normalization time of the elements is mentioned below:-

Sl. No.	Name of element	Date & time of Normalization		Remark
1.	315MW Unit – I	-	-	
2.	315MW Unit – II	-	-	
3.	315MW Unit – III	-	-	
4.	220KV Rosa – Shajahanpur – I	02.06.2018	02:18	
5.	220KV Rosa – Shajahanpur – II	02.06.2018	01:33	
6.	220KV Rosa – Badaun – I	02.06.2018	00:43	
7.	220KV Rosa – Badaun – II	02.06.2018	02:06	
8.	220KV Rosa – Dohna	Shut down		
9.	400KV Rosa – PGCIL – I	02.06.2018	00.:11	
10.	400KV Rosa – PG – II	02.06.2018	05:12	
11	300MW Unit - IV	-	-	

Generation Loss =**440MW**
Load Loss = **NIL**

It has been reported by site authorities that 220KV Y phase lighting arrester damaged of 220KV Badaun – Rosa Ckt at 220KV S/S Badaun. All 220KV Ckts 300MW Unit I, II, & III simultaneously tripped 300MW Unit 4th all ready open because 400KV Rosa PGCIL – I & II tripped on line fault at 23:03hrs on 01.06.2018.

Detailed report will be sent after receipt of data event logger and other information from Rosa TPS.

No: 1971 CE(C&S)/SE(R&A)/EE-II/Report Dated: 3/6/2018

General Manager, NRLDC
18-A, SJSS Marg, KatwariaSarai,
New Delhi - 110016

Sub: - Report on the Incident of tripping/hand tripping of elements at Rosa TPS based on the information received from Rosa TPS.

Dear Sir,

On 01.06.2018 at 23:58 hrs, all transmission lines, Units connected with Rosa TPS tripped/ hand tripped. Normalization time of the elements is mentioned below:-

S. No.	Name of element	Date & time of normalization		Remarks
1.	300MW Unit – I	03.06.2018	17:02	Hand tripped at 23:56:18
2.	300MW Unit – II	03.06.2018	19:31	Hand tripped at 23:56:22
3.	300MW Unit – III	03.06.2018	17:17	Tripped on generator protection V/F at 23:58:04
4.	300MW Unit – IV	03.06.2018	17:53	Hand tripped at 23:02:10
5.	400KV (PG) line – I	02.06.2018	00:11	Tripped at 23:03
6.	400KV (PG) line – II	02.06.2018	05:12	Tripped at 23:03
7.	220KV Shahjahanpur – I	02.06.2018	02:18	Hand tripped at 00:05:13
8.	220KV Shahjahanpur – II	02.06.2018	01:33	Hand tripped at 00:05:45
9.	220KV Badaun – I	02.06.2018	00:43	Hand tripped at 00:04:49
10.	220KV Badaun – II	02.06.2018	02:06	Hand tripped at 00:04:29
11.	220KV Dohna	10.06.2018	18:27	Already tripped at 21:53:52 hrs

Analysis report of the elements which tripped/hand tripped and single line diagram of the relevant portion of the grid are enclosed at annexure.

Analysis– At 22:58:17 hrs on 01.06.2018, 400/220KV ICT – I (200MVA) tripped due to differential protection, 400KV (PG) – II tripped at 22:58:17 hrs on Zone – I protection and 400KV (PG) – I also tripped at 23:01:25 hrs on Zone – I protection. Due to tripping of 400KV lines loading on 220KV Shahjahanpur – I and – II lines raised to more than 300MW on each line. To reduce overloading of these lines unit – 4 was hand tripped.

At 23:52:46 hrs due to heavy system jerk, unit – I excitation system came in manual mode. There was heavy disturbance in generator terminal voltage and reactive power in all three running units. All three running generators 1, 2, 3 at Rosa came house load due to load throw off and OPC acted several times in all units. 220KV lines breaker were closed at Rosa TPS but none of them were taking load units – I, II were hand tripped and unit – III tripped on generator protection at 23:58:04 hrs.

Due to above incidence complete black out occurred at Rosa TPS.

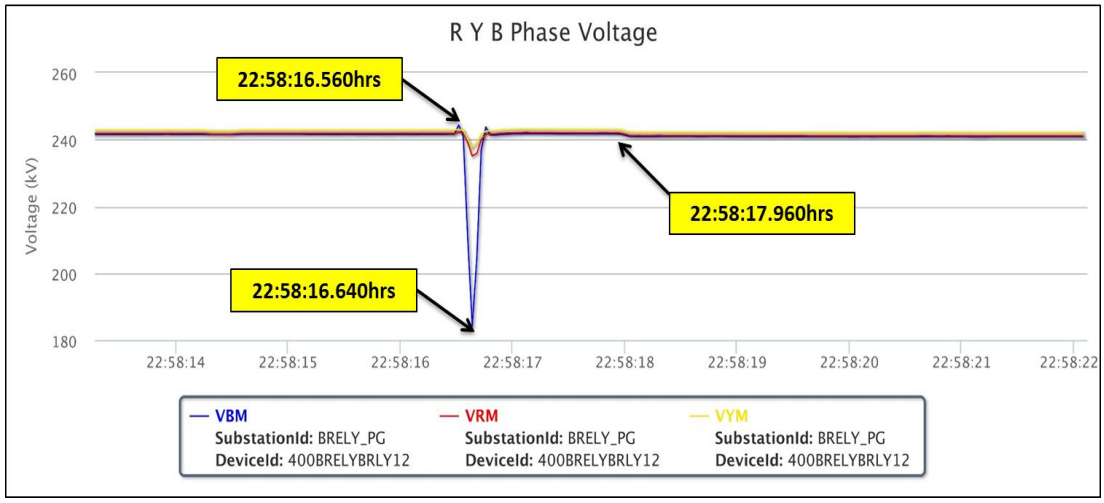
11. PMU plots:

PMU Plot of frequency at Lucknow(PG)

23:56hrs/01-June-18

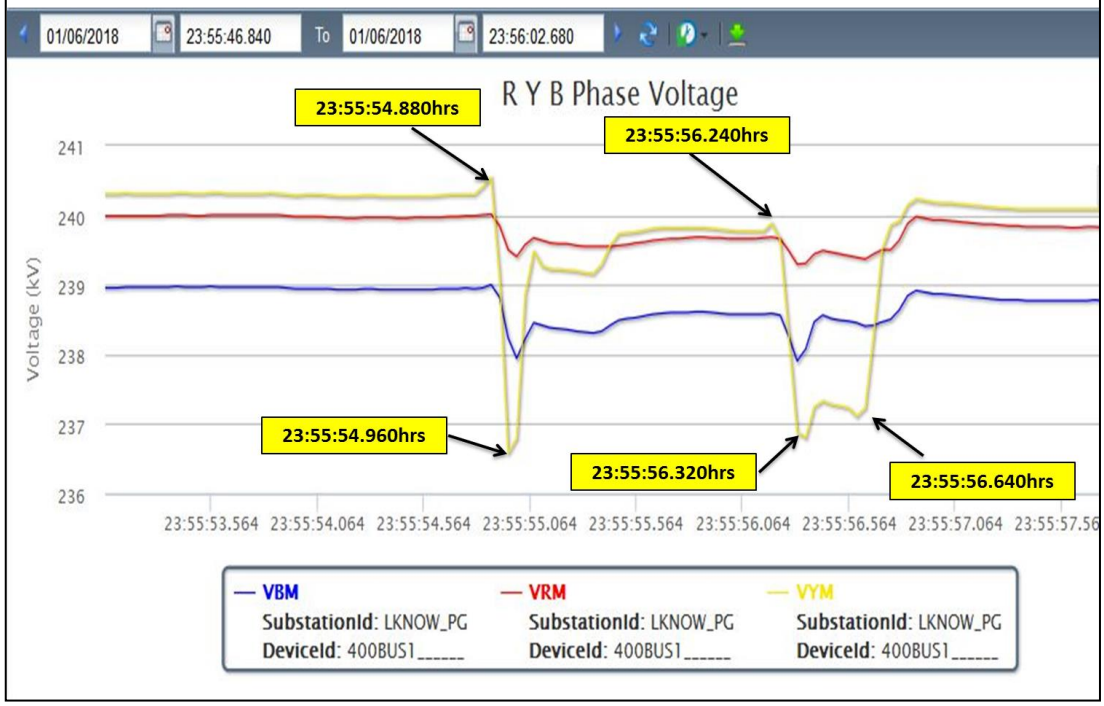
PMU Plot of phase voltage magnitude at Bareilly

22:58hrs/01-June-18



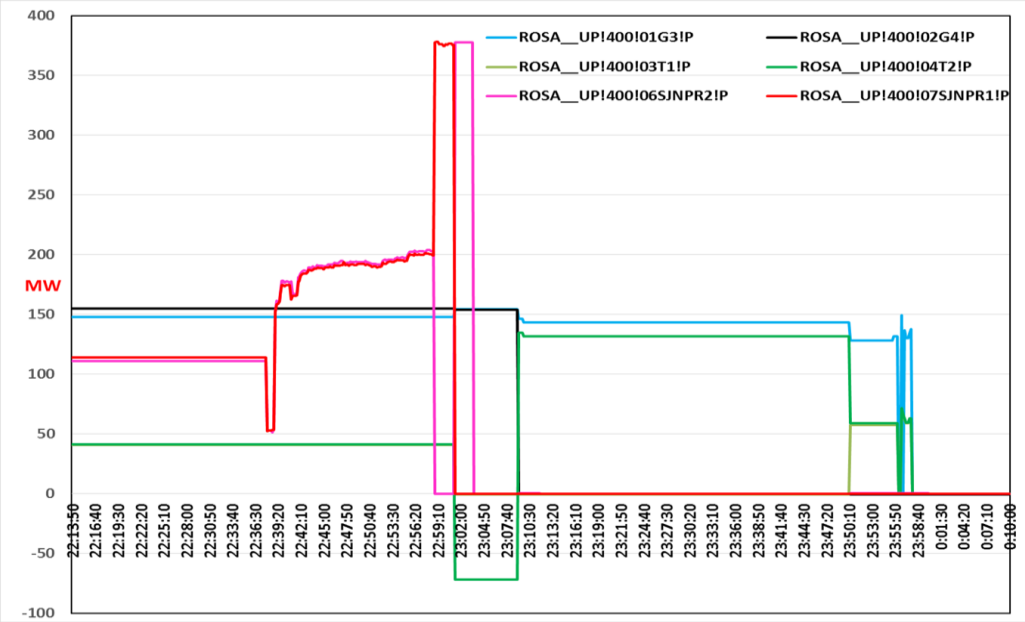
PMU Plot of phase voltage magnitude at Lucknow(PG)

23:56hrs/01-June-18

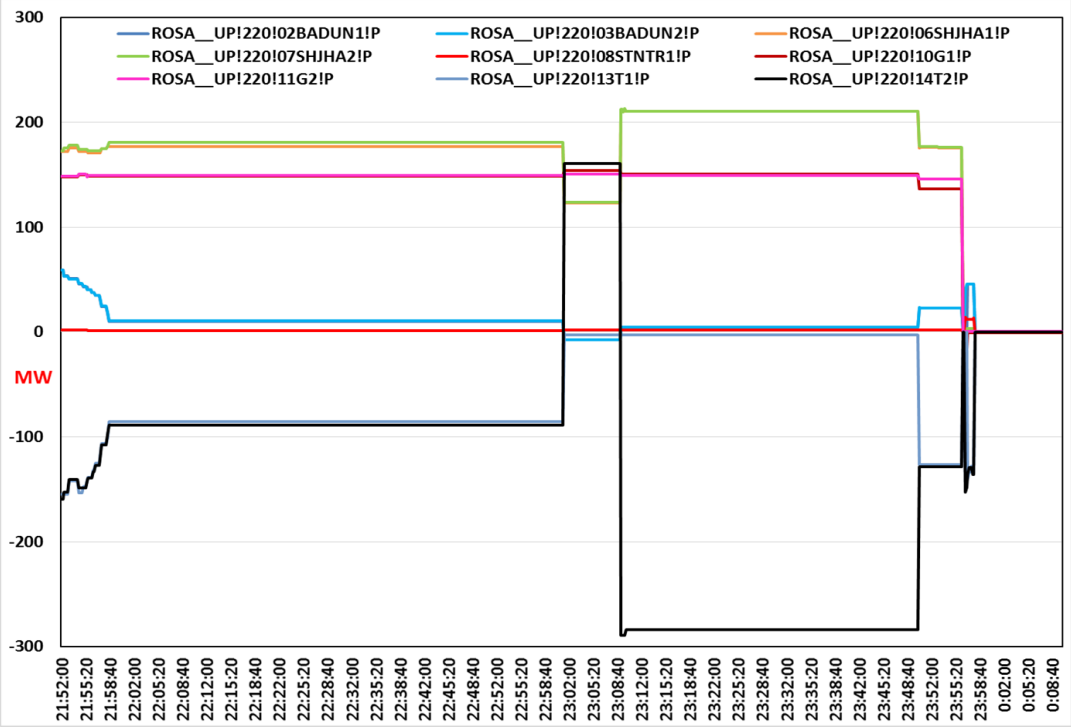


12. As per SCADA data:

400kV connected elements MW flow: Rosa TPS



220kV connected elements MW flow: Rosa TPS



Uttar Pradesh/PG SoE

Time (in hrs)	Station	Voltage	Element	Device	Status	Remarks
21:53:52,467	ROSA_UP	220kV	E_04(DOHNA)	CB	Open	220kV Rosa-Dohna ckt tripped
22:04:02,170	DOHNA_UP	220kV	E_02(CBGA2)	CB	Open	
22:34:18,920	ROSA_UP	400kV	F_03(T1)	CB	Close	
22:34:39,882	ROSA_UP	220kV	E_13(T1)	CB	Close	
22:58:16,661	SJNPR_PG	400kV	16ROS2	CB	disturbe	400kV Shajahanpur-Rosa-2 tripped in Z-1
22:58:16,662	SJNPR_PG	400kV	17TIE	CB	disturbe	
22:58:16,685	ROSA_UP	400kV	F_07(BRELY-1)	CB	Open	
22:58:16,721	ROSA_UP	400kV	F_03(T1)	CB	Open	400/220kV ICT-1 at Rosa tripped on differential protection
22:58:16,722	ROSA_UP	220kV	E_13(T1)	CB	Open	
22:58:18,753	SJNPR_PG	400kV	17TIE	CB	Close	
22:58:19,283	SJNPR_PG	400kV	16ROS2	CB	Open	
23:01:23,793	SJNPR_PG	400kV	17TIE	CB	disturbe	400kV Shajahanpur-Rosa-2 tripped in Z-1
23:01:23,804	ROSA_UP	400kV	F_06(LKNOW-1)	CB	disturbe	
23:01:24,807	ROSA_UP	400kV	F_06(LKNOW-1)	CB	Open	
23:01:24,876	SJNPR_PG	400kV	17TIE	CB	Close	
23:01:53,853	SJNPR_PG	400kV	17TIE	CB	disturbe	
23:01:54,915	SJNPR_PG	400kV	17TIE	CB	Close	
23:02:08,688	SJNPR_PG	400kV	17TIE	CB	Open	

Uttar Pradesh/PG SoE

Time (in hrs)	Station	Voltage	Element	Device	Status	Remarks
23:02:10,055	ROSA_UP	400kV	F_02(G4)	CB	Open	Unit #4 at Rosa hand tripped
23:07:14,934	DOHNA_UP	220kV	E_02(CBGA2)	CB	Close	
23:27:26,245	ROSA_UP	400kV	F_03(T1)	CB	Close	
23:27:37,733	ROSA_UP	220kV	E_13(T1)	CB	Close	
23:55:55,308	SHJHA_UP	220kV	E_01(SITPR)	CB	Open	
23:55:56,237	SHJHA_UP	220kV	E_06(CBGA1-1)	CB	Open	
23:56:25,097	ROSA_UP	220kV	E_11(G2)	CB	Open	Unit #2 at Rosa hand tripped
23:56:38,732	SHJHA_UP	220kV	E_02(T1)	CB	Open	
23:56:51,367	ROSA_UP	220kV	E_10(G1)	CB	Open	Unit #1 at Rosa hand tripped
23:57:57,212	ROSA_UP	400kV	F_01(G3)	CB	Open	Unit #1 at Rosa tripped on generator protection V/f
23:58:03,807	BADUN_UP	220kV	E_03(T1)	CB	disturbe	

13. As per PMU & SCADA data:
    - B-N fault occurred at 22:58:16.560hrs and cleared timely.
    - Two successive Y-N faults occurred at 23:55:54.880hrs and 23:55:56.240hrs with delayed clearance of fault.
    - Tripping / Manual opening of multiple elements captured in SCADA SoE.
14. Preliminary Report, Detailed Report is received form UP. DR/EL along with remedial measures report is still awaited from UP.

Action Points*:*

1. At 22:58hrs, 400kV Rosa-Shajahanpur-2 tripped on Z-1, fault cleared timely as seen from PMU. However, 400/220kV ICT-1 also tripped on differential protection. Reason for tripping of ICT, setting of differential protection, coordination between ICT protection and line protection to be looked into and shared.
2. Reason for tripping of Unit #3 at Rosa on V/f protection, setting of V/f protection to be looked into and shared.
3. Reason for fluctuation in V, Q of three running units, relevant plots showing such variation to be looked into and shared.
4. At 23:55hrs, reason for delayed clearance of fault to be looked into and shared.
5. At 23:55hrs, sequence of event of tripping of elements around Rosa area to be ascertained and shared.

UP may elaborate the incident, submit the required details and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

I. Multiple Element tripping at 400kV Singrauli (NTPC) & Anpara (UP) Station at 15:24hrs of 02nd Jun 2018

Event category: GD-1
Generation loss: 1100MW (NTPC and UP may report)
Loss of load: Nil (UP may confirm)
Energy Loss: ___MU (UP may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks

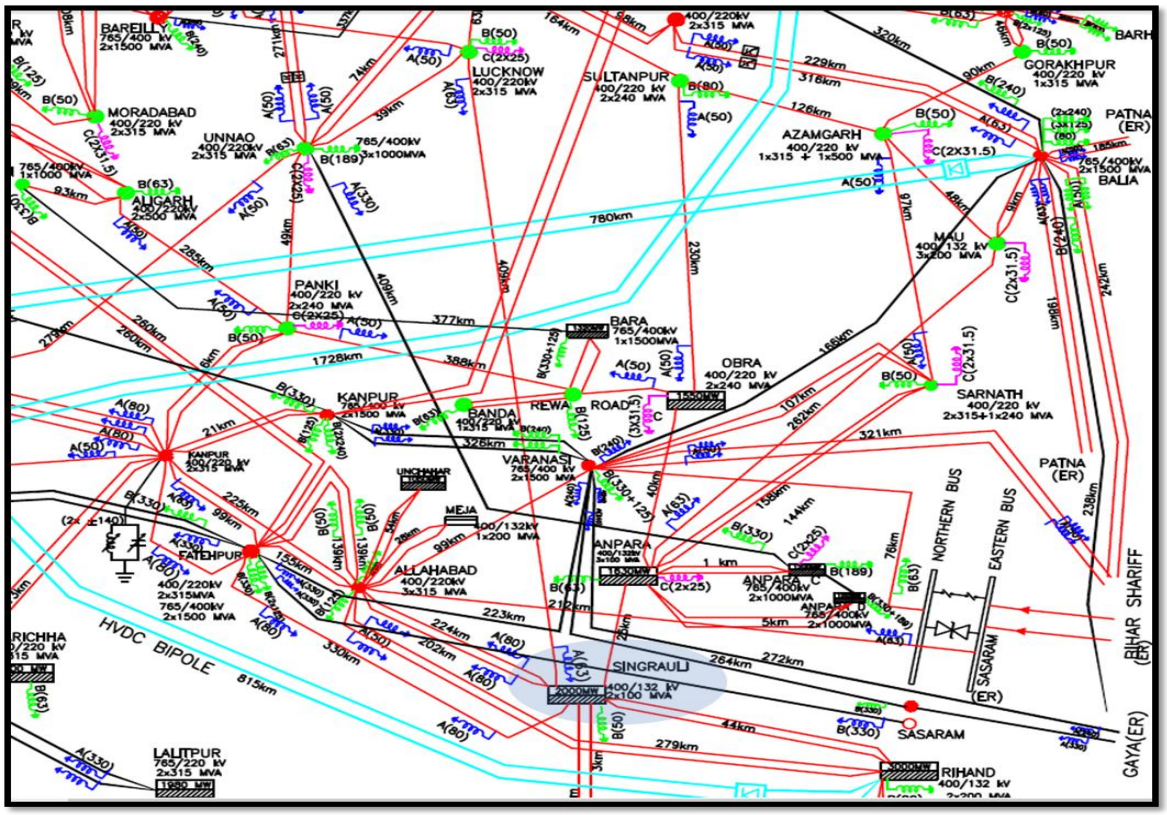
Fault Clearance Time		**100ms**	As per PMU data
Phase of the fault		Multiple fault	As per PMU data

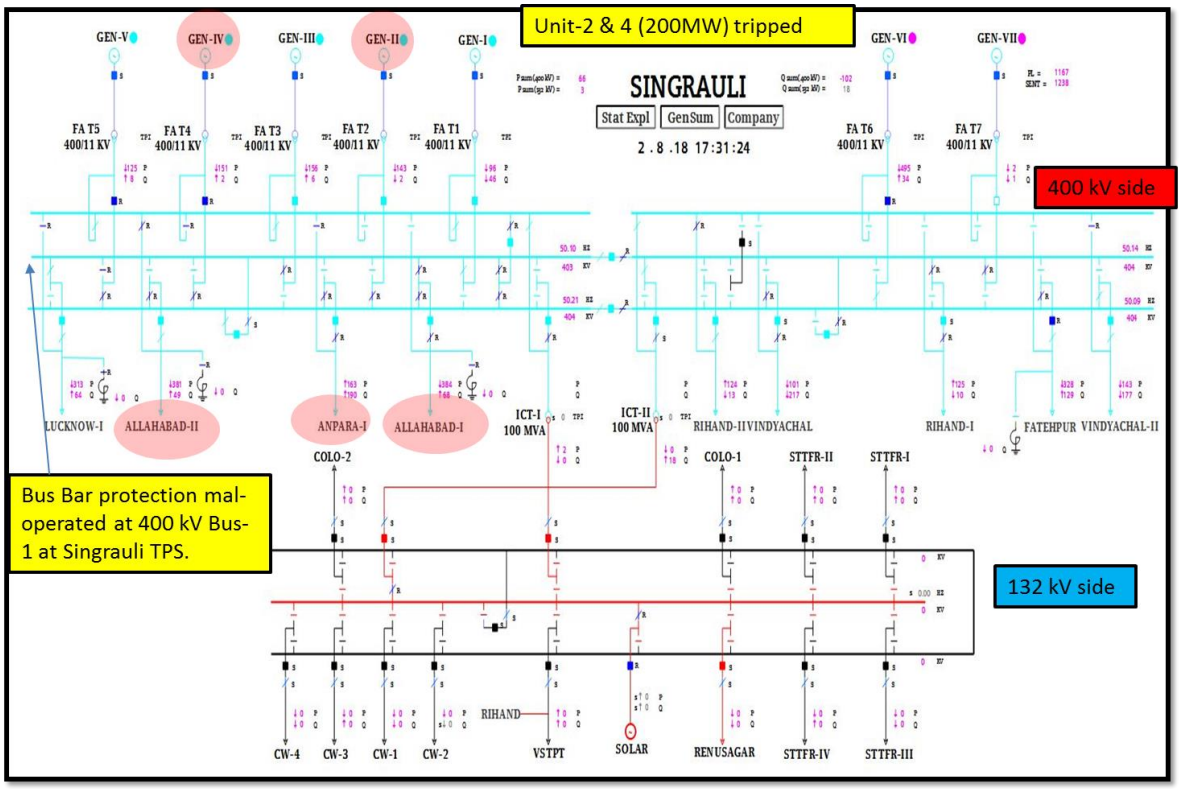
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)	NR and UP	Available	
DR/ EL	NTPC	Not Received	
	UP	Not Received	
	POWERGRID	Received (Partial)	After 24hrs
Preliminary Report	NTPC	Not Received	
	UP	Not Received	
	POWERGRID	Received (Partial)	After 24hrs
Detailed Report	NTPC	Not Received	
	UP	Not Received	

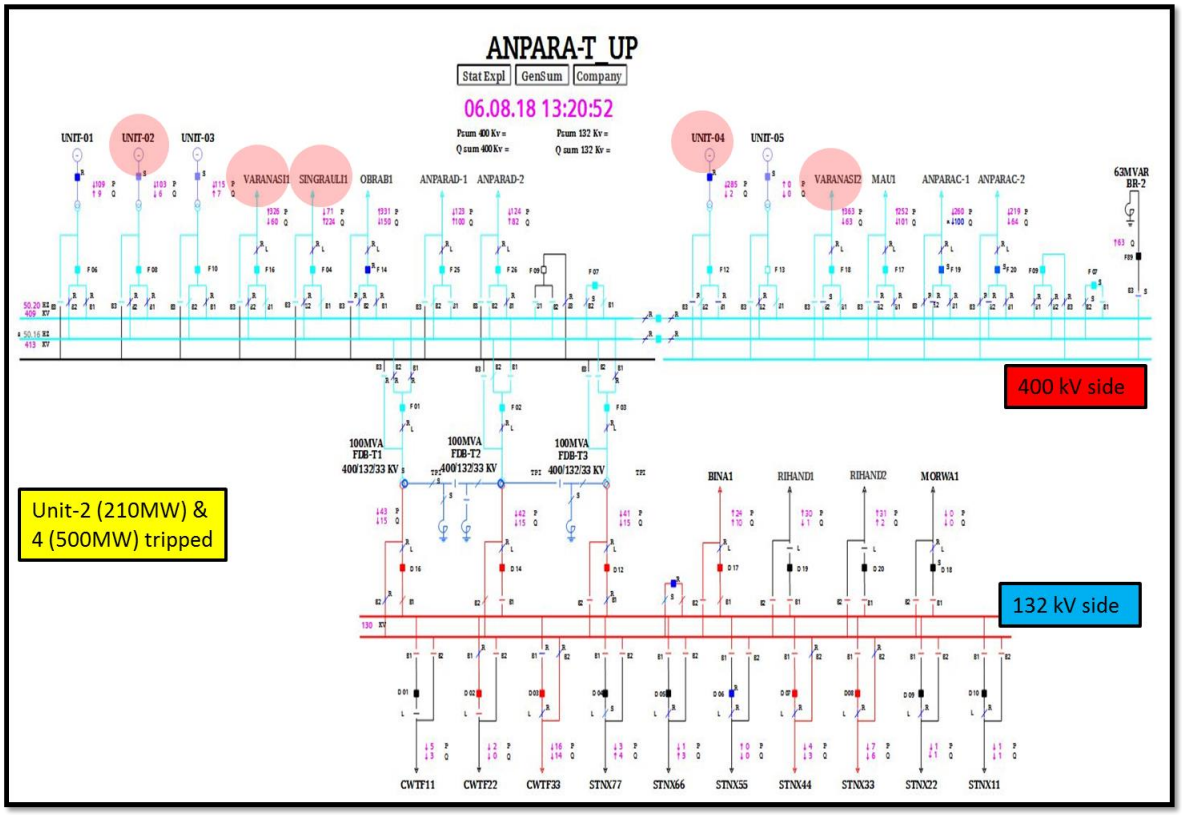
Description	**Clauses**	**Utility**	**Remarks**
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3 3. CEA (Technical standards for connectivity to the Grid) Regulation, 2007-6. 4.d 4. 43.4.A of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; 5. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)	**NTPC & Uttar Pradesh**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report 3. Adequately Sectionalized and graded protective relaying system
	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**POWERGRID**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report

Based on above information description of the events is:

1. Connectivity Diagram & SLD of Singrauli and Anpara TPS:


BAREILLY
765/400 kV
2x1500 MVA
MORADABAD
400/220 kV
2x315 MVA
UNNAO
400/220kV
2x315 MVA
765/400kV
3x1000MVA
ALIGARH
400/220kV
2x500 MVA
PANKI
400/220 kV
2x240 MVA
LUCKNOW
400/220kV
2x315 MVA
SULTANPUR
400/220 kV
2x240 MVA
400/220kV
2x315 MVA
GORAKHPUR
400/220 kV
1x315 MVA
AZAMGARH
400/220 kV
1x315 + 1x500 MVA
MAU
400/132 kV
3x200 MVA
PATNA
(ER)
BALIA
765/400kV
2x1500 MVA
BARA
765/400kV
1x1500MVA
OBRA
400/220 kV
2x240 MVA
SARNATH
400/220 kV
2x315+1x240 MVA
KANPUR
765/400 kV
2x1500 MVA
BANDA
400/220 kV
1x315 MVA
REWA ROAD
VARANASI
765/400 kV
2x1500 MVA
MEJA
400/132kV
1x200 MVA
ANPARA
400/132kV
3x150 MVA
ANPARA C
765/400kV
2x1000MVA
ANPARA D
765/400kV
2x1000MVA
NORTHERN BUS
EASTERN BUS
SASARAM
(ER)
FATEHPUR
400/220kV
2x315MVA
765/400kV
2x1500 MVA
ALLAHABAD
400/220kV
3x315 MVA
HVDC BIPOLE
815km
SINGRAULI
400/132 kV
2x100 MVA
2000MW
SASARAM
RIHAND
400/132 kV
LALITPUR
765/220 kV
2x315 MVA
1680 MW
RICHHA
GAYA(ER)
BIHAR SHARIFF
(ER)


Unit-2 & 4 (200MW) tripped
SINGRAULI
Stat Expl
GenSum
Company
2 . 8 .18 17:31:24
GEN-V
GEN-IV
GEN-III
GEN-II
GEN-I
GEN-VI
GEN-VII
FA T5 400/11 KV
FA T4 400/11 KV
FA T3 400/11 KV
FA T2 400/11 KV
FA T1 400/11 KV
FA T6 400/11 KV
FA T7 400/11 KV
400 kV side
LUCKNOW-I
ALLAHABAD-II
ANPARA-I
ALLAHABAD-I
ICT-I 100 MVA
ICT-II 100 MVA
RIHAND-II
VINDYACHAL
RIHAND-I
FATEHPUR
VINDYACHAL-II
COLO-2
COLO-1
STTFR-II
STTFR-I
Bus Bar protection mal-operated at 400 kV Bus-1 at Singrauli TPS.
132 kV side
CW-4
CW-3
CW-1
CW-2
RIHAND
VSTPT
SOLAR
RENUSAGAR
STTFR-IV
STTFR-III



2. In antecedent condition, weather was stormy.
3. Name of the tripped element:
    - 400 kV Singrauli NTPC-Anpara (UP) ckt
    - 400 kV Singrauli NTPC-Allahabad (PG) ckt-1 & 2
    - HVDC Vindhyachal BtB block-1
    - 200MW Unit-2 & 4 of 400 kV Singrauli NTPC
    - 400 kV Anpara-C to Anpara-D ckt
    - 765/400 kV 1000MVA ICT-II of Anpara TPS
    - Unit-2 (210MW) & 4 (500MW) of 400 kV Anpara (UP) TPS

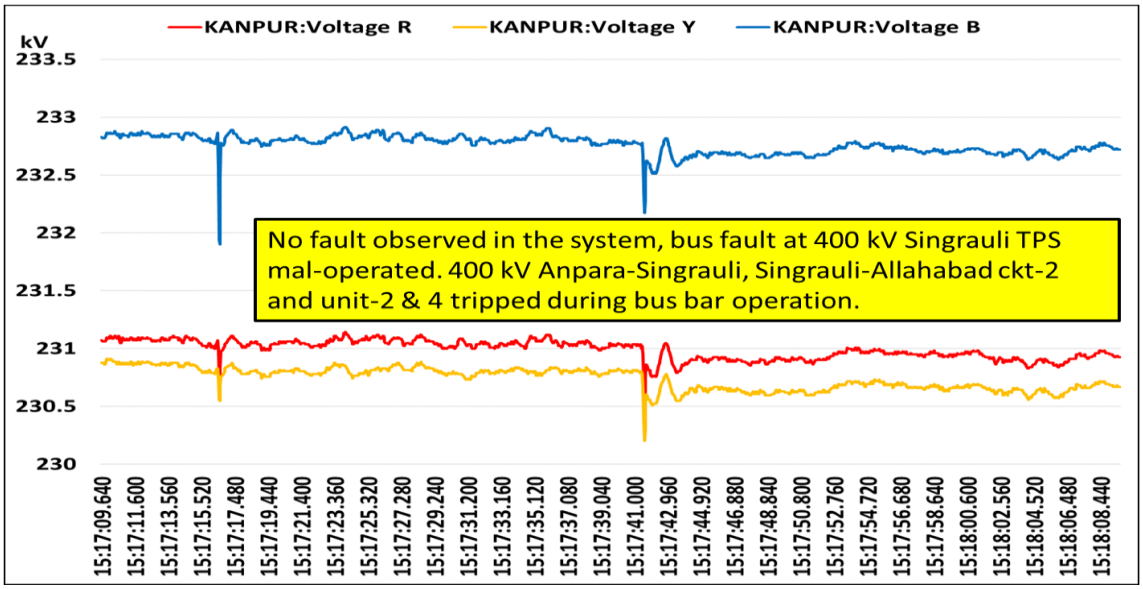
4. 400 kV Singrauli TPS is connected with Allahabad (PG) D/C, Rihand D/C, Vindhyachal D/C, Fatehpur (PG) S/C, Anpara S/C, Lucknow S/C. It also have 5 units of 200MW and two units of 500MW, two 100MVA 400/132kV ICT. 400/132kV Singrauli station have DMT (double main transfer breaker) scheme, both 400 kV buses have with sectionaliser.
5. Weather was stormy on 02nd June 2018.
6. On 02nd June 2018, at 15:18 hrs 400 kV Singrauli-Anpara & 400 kV Singrauli-Allahabad ckt-II tripped. Due to breaking of R-Phase CT jumper of 400 kV Anpara-Singrauli ckt led to Bus bar protection operation of 400

kV BUS-I at Singrauli TPS. At the same time 200MW unit#2 & unit#4 at 400 kV Singrauli TPS also tripped.

7. At 15:22 hrs, 765 kV Anpara D-Anpara C tripped. After this at 15:24 hrs 400 kV Singrauli-Allahabad ckt-I & HVDC Vindhyachal pole-I tripped.
8. At 15:26 hrs , 765/400 kV 1000MVA ICT- II at Anpara C tripped due to differential protection operation due to breakage of its Clamp on R and Y Phases & at the same time Unit 2 (210MW) & 4 (500MW) tripped at Anpara TPS.
9. PMU plots:

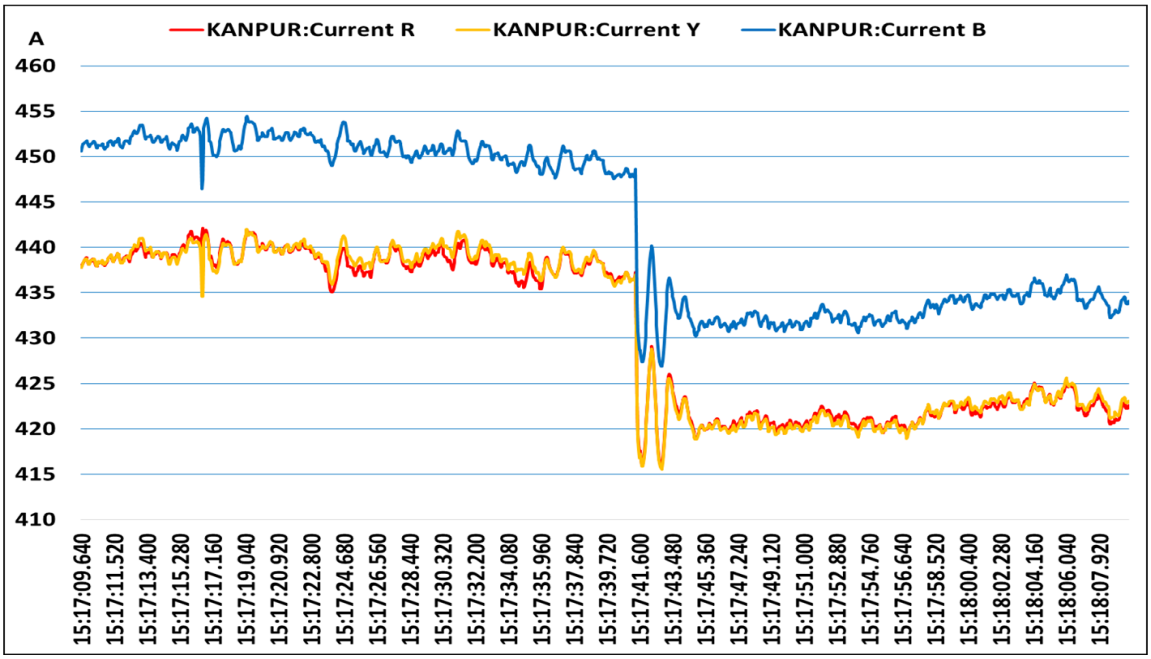
PMU Plot of phase voltage magnitude at Kanpur (PG)

15:17hrs/02-June-18



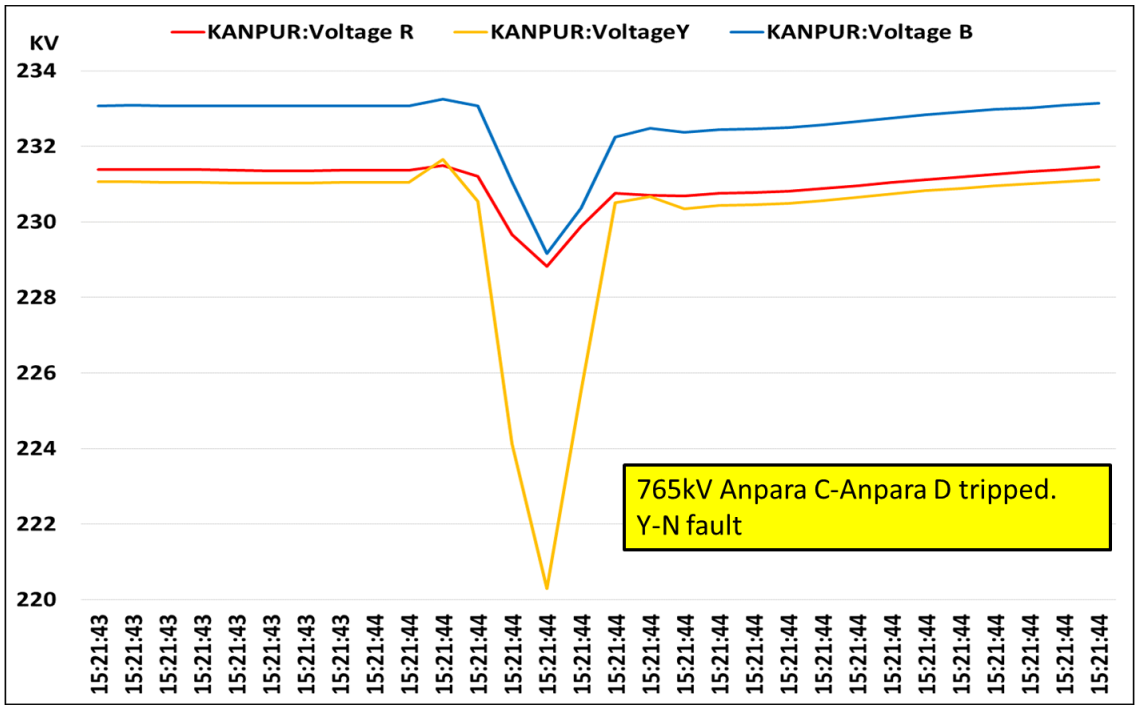
PMU Plot of phase current magnitude at Kanpur (PG)

15:17hrs/02-June-18



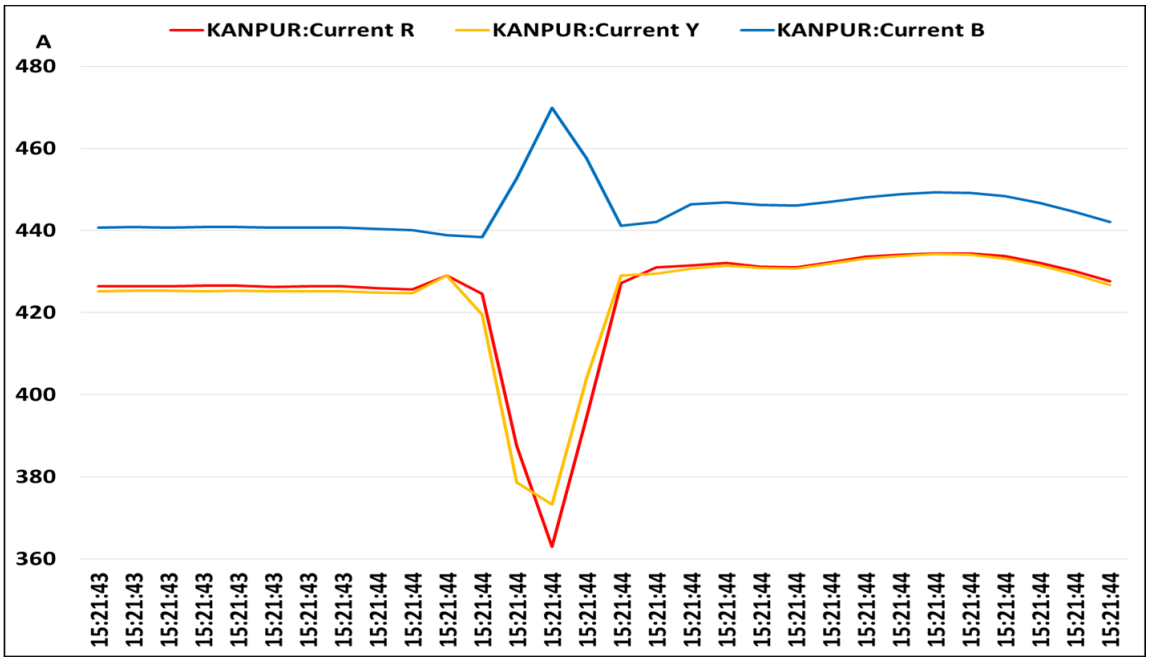
PMU Plot of phase voltage magnitude at Kanpur (PG)

15:21hrs/02-June-18



PMU Plot of phase current magnitude at Kanpur (PG)

15:21hrs/02-June-18

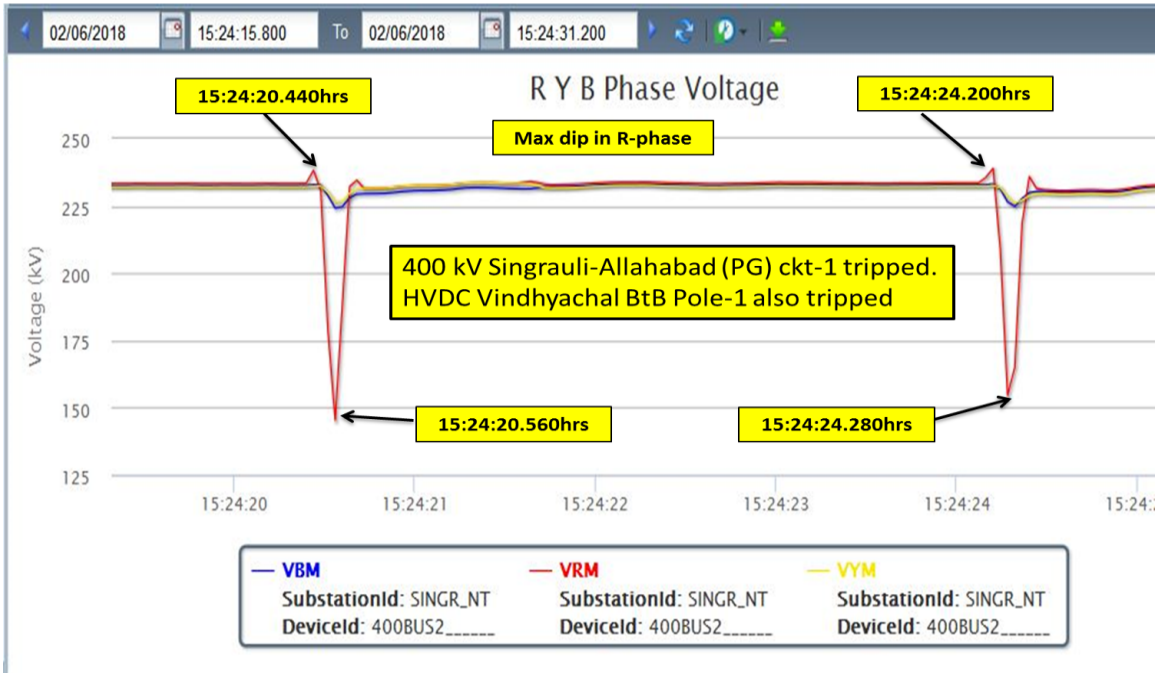


PMU Plot of frequency at Singrauli (NTPC)

15:24hrs/02-June-18

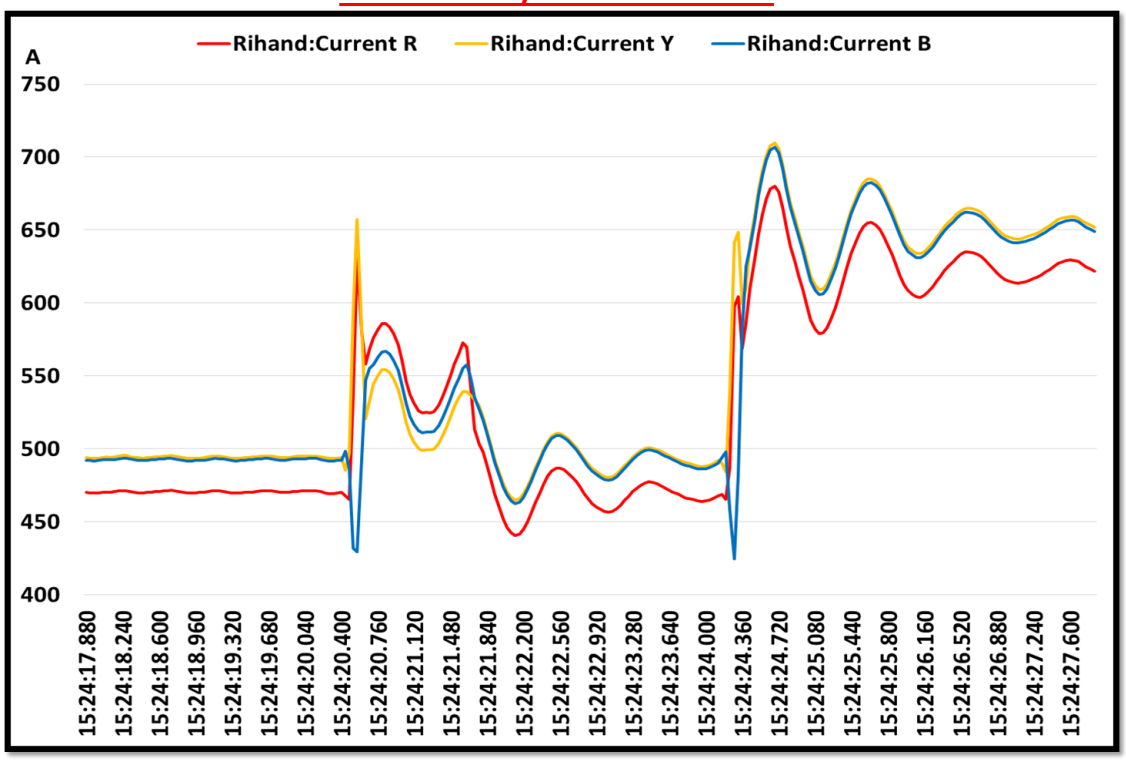
PMU Plot of phase voltage magnitude at Singrauli (NTPC)

15:24hrs/02-June-18



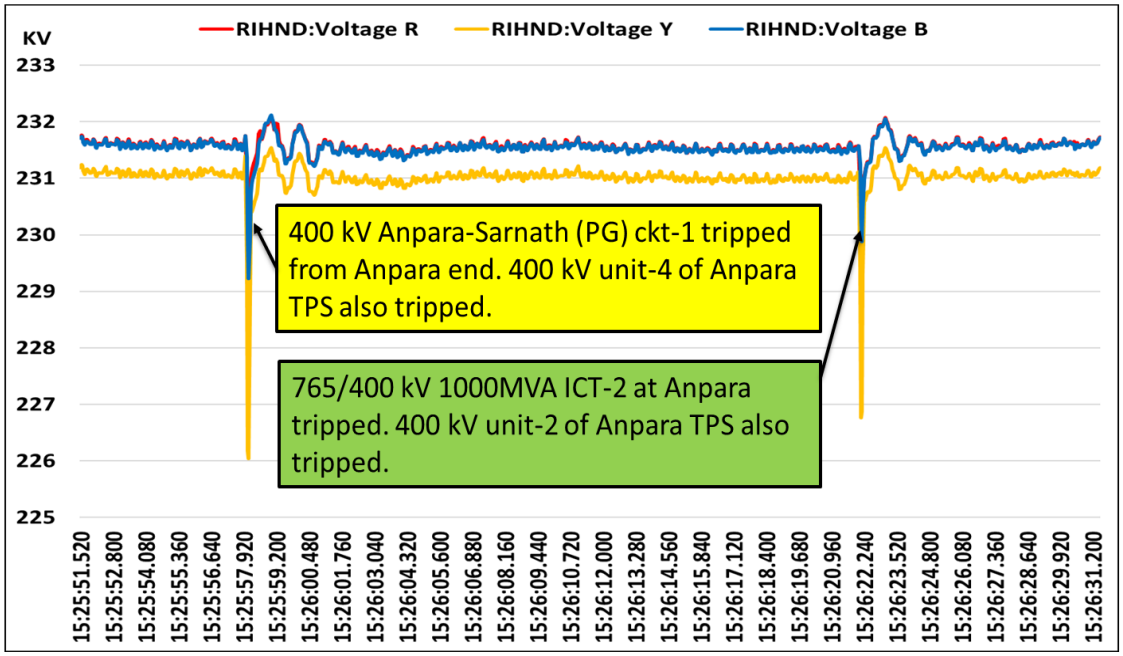
PMU Plot of phase current magnitude at Rihand (NTPC)

15:24hrs/02-June-18



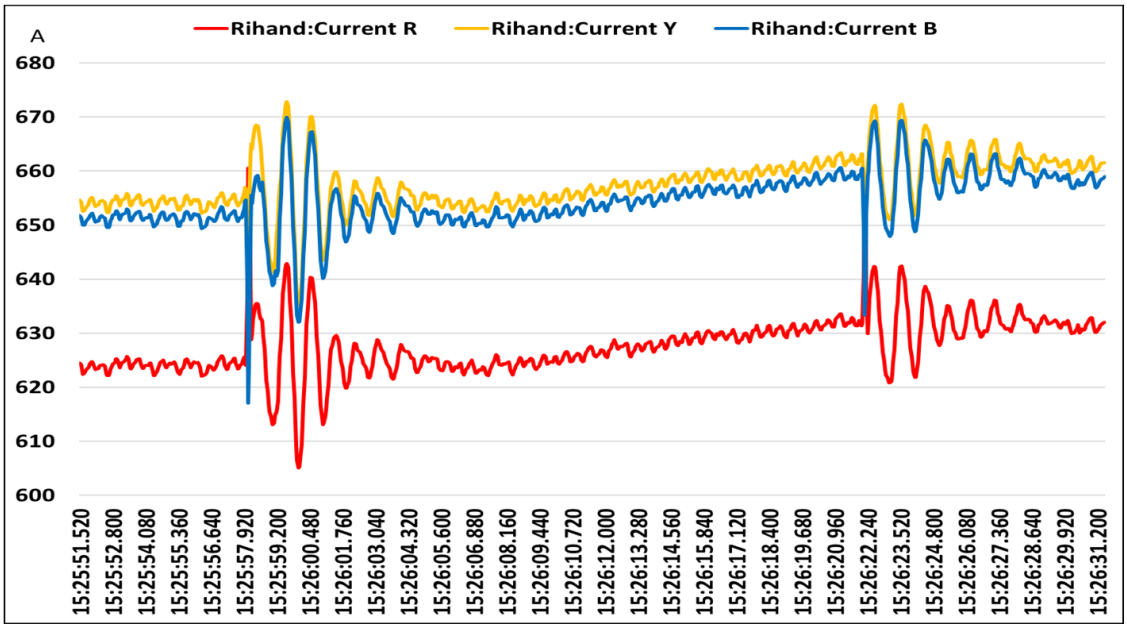
PMU Plot of phase voltage magnitude at Rihand

15:26hrs/02-June-18

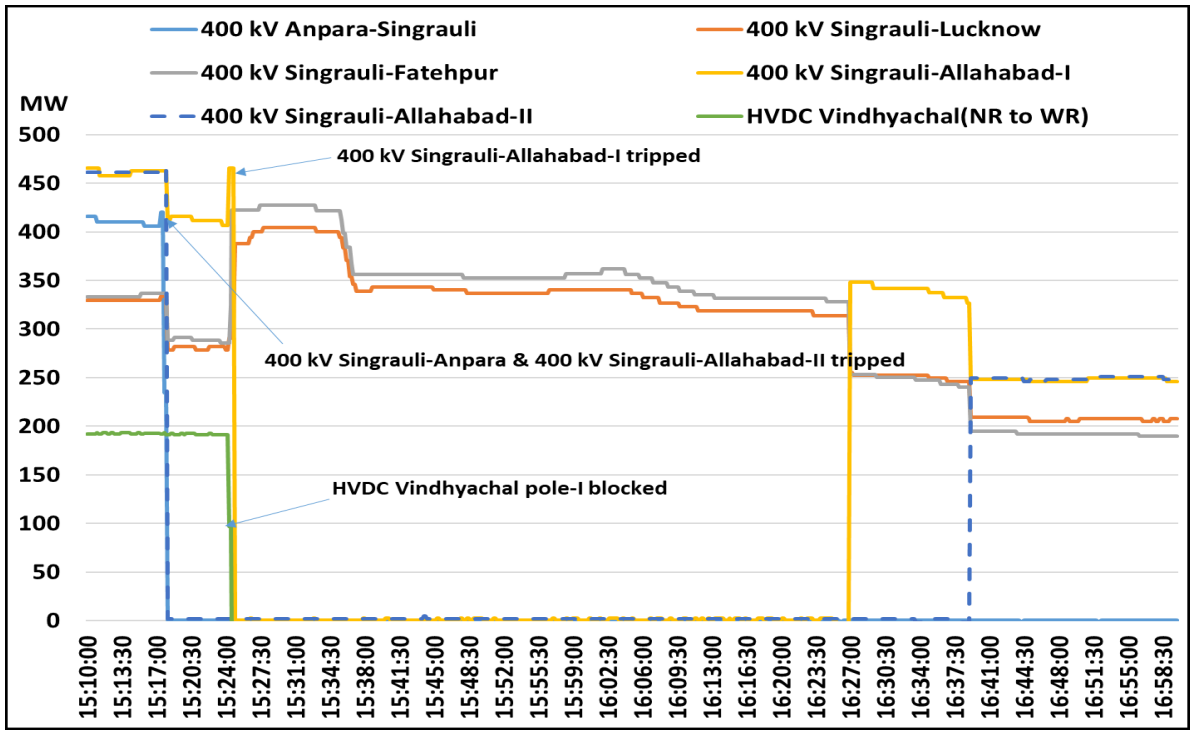


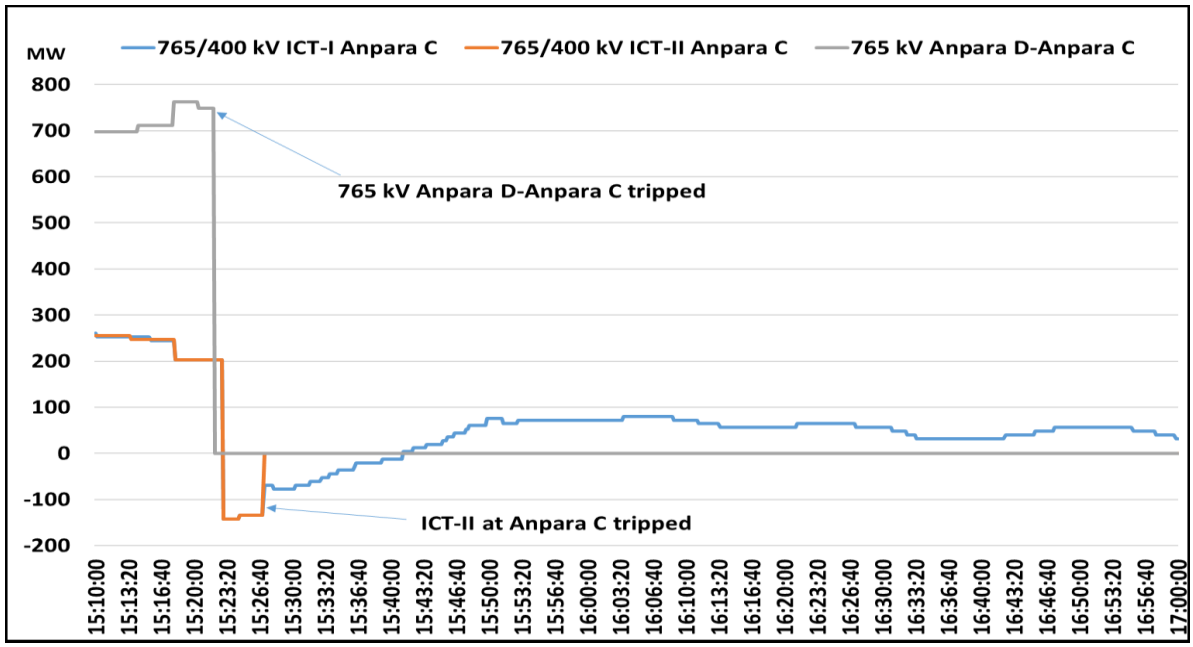
PMU Plot of phase current magnitude at Rihand

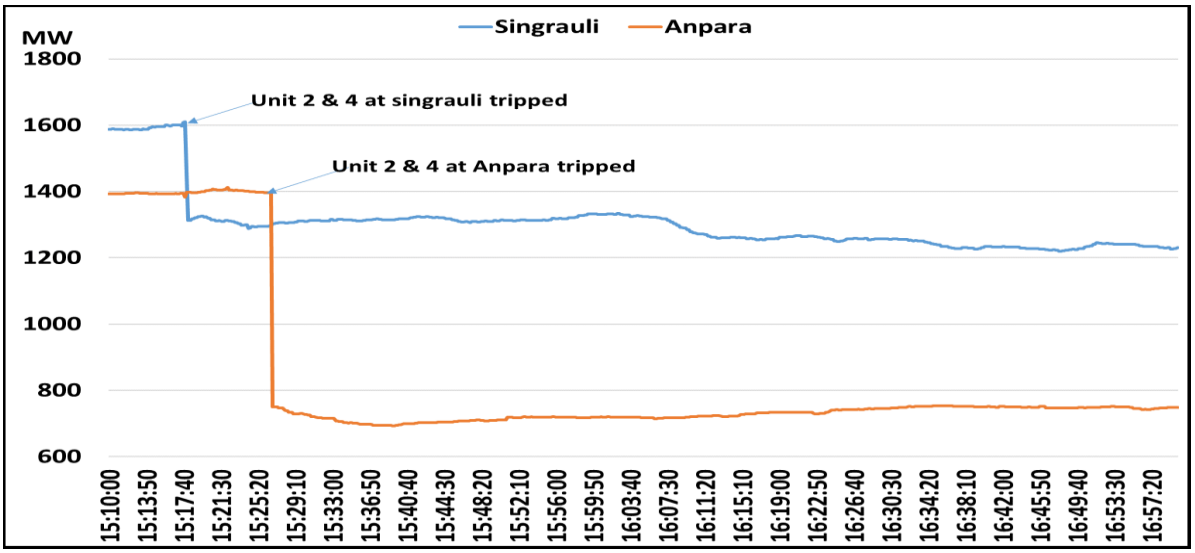
15:26hrs/02-June-18

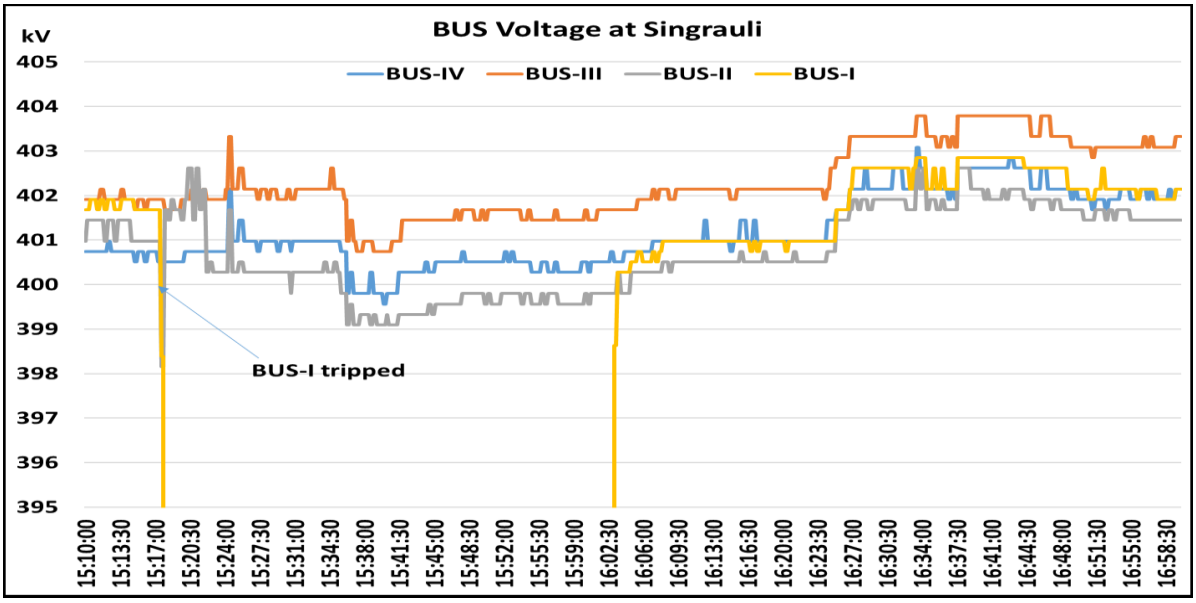


10. SCADA Analog data and SoE:






Singrauli
Anpara
MW
1800
1600
1400
1200
1000
800
600
Unit 2 & 4 at singrauli tripped
Unit 2 & 4 at Anpara tripped
15:10:00
15:13:50
15:17:40
15:21:30
15:25:20
15:29:10
15:33:00
15:36:50
15:40:40
15:44:30
15:48:20
15:52:10
15:56:00
15:59:50
16:03:40
16:07:30
16:11:20
16:15:10
16:19:00
16:22:50
16:26:40
16:30:30
16:34:20
16:38:10
16:42:00
16:45:50
16:49:40
16:53:30
16:57:20


BUS Voltage at Singrauli
kV
BUS-IV
BUS-III
BUS-II
BUS-I
405
404
403
402
401
400
399
398
397
396
395
BUS-I tripped
15:10:00
15:13:30
15:17:00
15:20:30
15:24:00
15:27:30
15:31:00
15:34:30
15:38:00
15:41:30
15:45:00
15:48:30
15:52:00
15:55:30
15:59:00
16:02:30
16:06:00
16:09:30
16:13:00
16:16:30
16:20:00
16:23:30
16:27:00
16:30:30
16:34:00
16:37:30
16:41:00
16:44:30
16:48:00
16:51:30
16:55:00
16:58:30

Time (in ms)	S/S Name	Voltage (in kV)	Element Name	Element Type	Status	Remarks
15:17:41,415	SINGRAULI	400kV	08G02	Circuit Breaker	Open	400 kV Singrauli unit-2 tripped
15:17:41,416	SINGRAULI	400kV	07ANPAR1	Circuit Breaker	Open	400 kV Singrauli-Anpara ckt tripped from Singrauli end
15:17:41,420	SINGRAULI	400kV	24BS	Circuit Breaker	Open	400 kV Bus Sectionaliser between 400 kV Bus-2A & 2B
15:24:24,319	SINGRAULI	400kV	09ALBAD1	Circuit Breaker	Open	400 kV Singrauli-Allahabad (PG) ckt-1 tripped from Singrauli end
15:25:58,069	ANPAR_UP	400kV	F_16(VRNSI-1)	Circuit Breaker	Open	400 kV Anpara-Sarnath (PG) ckt-1 tripped from Anpara end
15:25:58,090	ANPAR_UP	400kV	F_12(U04)	Circuit Breaker	Open	400 kV Anpara unit-4 tripped
15:25:59,192	ANPAR_UP	400kV	F_16(VRNSI-1)	Circuit Breaker	Close	400 kV Anpara-Sarnath (PG) ckt-1 closed from Anpara end
15:26:22,164	ANPAC_UP	400kV	F_21(T2)	Circuit Breaker	Open	765/400 kV ICT-2 tripped at Anpara(UP) end (400kV end)
15:26:22,169	ANPAC_UP	765kV	G_13(T2)	Circuit Breaker	Open	765/400 kV ICT-2 tripped at Anpara(UP) end (765kV end)
15:26:22,187	ANPAR_UP	400kV	F_08(U02)	Circuit Breaker	Open	400 kV Anpara unit-2 tripped

11. As per PMU data and SCADA data:
    - At 15:18hrs, there is only 0.5 kV dip in all phases of Kanpur PMU. (Rihand PMU was not available). It seems there was no bus fault. Bus bar protection mal-operated.
    - At 15:22hrs, 765 kV Anpara D-Anpara C tripped. Observation on Kanpur PMU, there is 11 kV dip in Y-phase & fault clearing time is less than 100ms.
    - At 15:24hrs, 400 kV Singrauli-Allahabad ckt-I & HVDC Vindhyachal pole-I tripped. Observation based on Singrauli and Rihand PMU, maximum dip in R-phase & fault clearing time is less than 100ms.
    - At 15:26hrs, 765/400 kV 1000MVA ICT- II at Anpara C tripped due to differential protection operation due to breakage of its Clamp on R and Y Phases. At the same time, Unit 2 (210 MW) & 4 (500 MW) tripped at Anpara tripped. Observation based on Rihand PMU, there is 6kV dip in Y-phase & fault clearing time is less than 100ms. The oscillations were also observed at the time event

12. Preliminary Report, DR/EL is still awaited from NTPC and UPPTCL. Partial details has been received from POWERGRID.

Points for Discussion:

1. Bus configuration in antecedent condition at 400 kV Singrauli and Anpara TPS needs to be looked into.
2. Reason of multiple element tripping at 400/132kV Singrauli TPS.
3. Reason of tripping of unit-2 & 4 at Singrauli TPS still awaited.
4. As per SCADA SoE, reason of opening of bus sectionaliser of Bus-2A and Bus-2B needs to be looked into (as bus bar operation at 400 kV Bus-1 operated).
5. At 15:17hrs during operation of bus bar protection at 400 kV Singrauli TPS, exact location of fault to be reported.
6. 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.
7. Reason of multiple element tripping at 400kV Anpara TPS.
8. Reason of tripping of unit-2 & 4 at Anpara TPS still awaited.
9. Protection co-ordination of unit protection with line distance protection needs to be looked into at 400 Singrauli and Anpara TPS.
10. At 15:26 hrs, from SOE it can be gathered that 400 kV Anpara-Sarnath ckt-I successfully reclosed from Anpara end after 1000ms. Details needs to be looked into.
11. Tripping of Vindhyachal BtB during fault in AC system needs to be looked into.
12. Why all three phase main CB opened at Allahabad (PG) end of 400 kV Allahabad-Singrauli ckt-1 in antecedent condition?
13. Detailed report and supporting DR/EL needs to be submitted by NTPC and UPPTCL.
14. 400 kV Bus Bar Protection mal operation at 400kV Singrauli station needs to be checked and corrected.

NTPC/ UPPTCL/ POWERGRID may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

J. Multiple Element tripping at 400kV Singrauli (NTPC) Station at 15:05hrs of 10nd Jun 2018

Event category: GD-1
Generation loss: 1100MW (NTPC and UP may report)
Loss of load: Nil (UP may confirm)

Energy Loss: ___MU (UP may confirm)

Data Summary received/available at NRLDC:

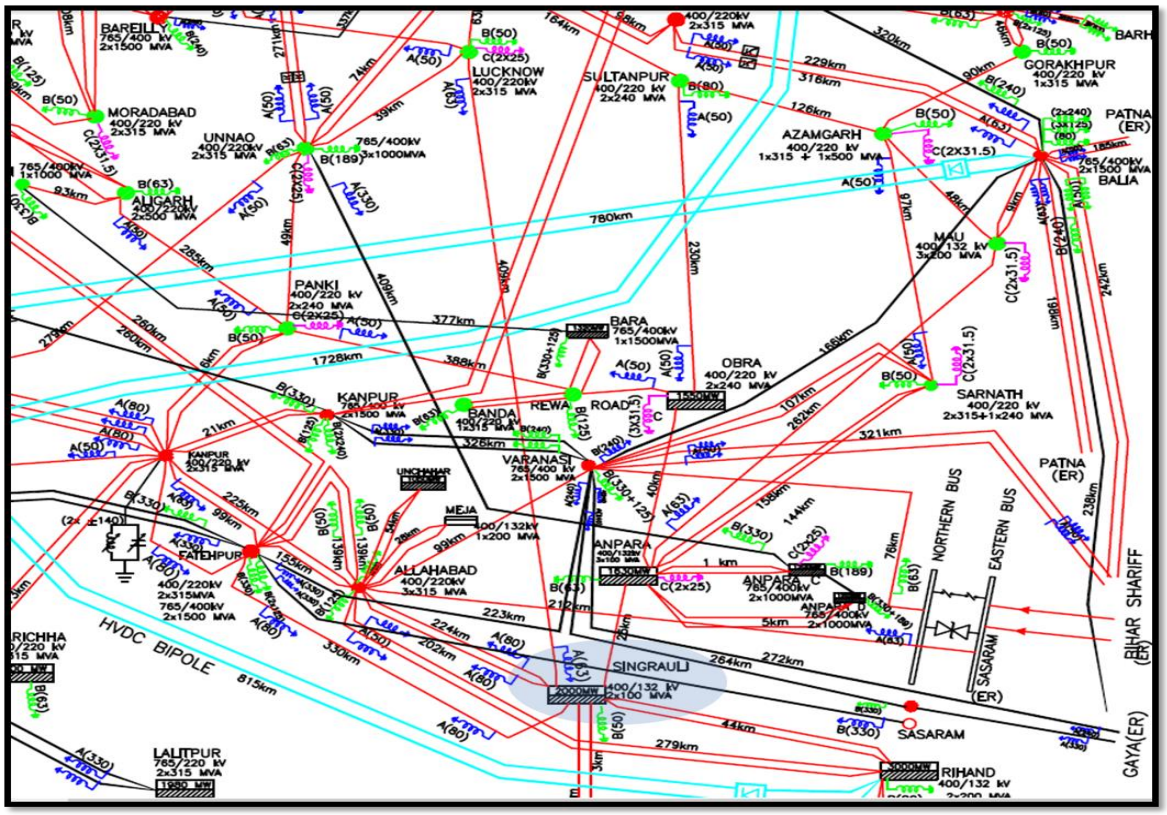
Description		**Fault Info**	**Remarks**
Fault Clearance Time		**100ms**	As per PMU data
Phase of the fault		Y-N fault	As per PMU data

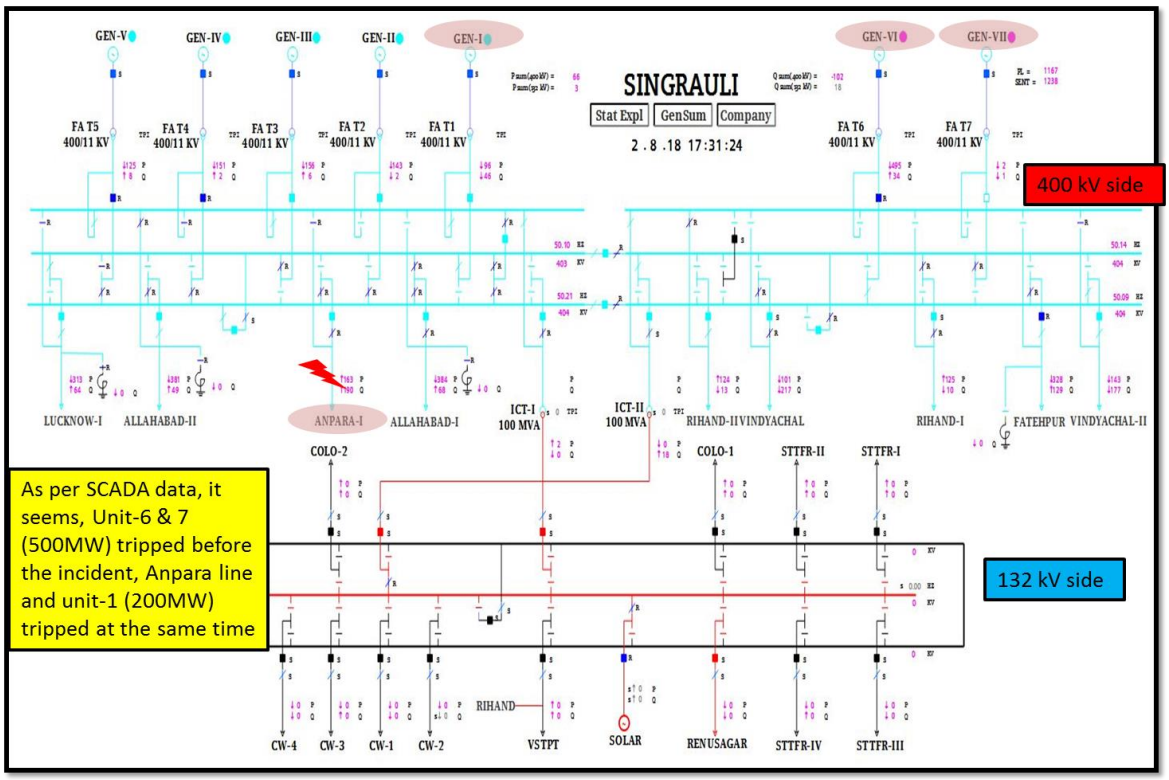
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)	NTPC	Available (Partial)	
DR/ EL	NTPC	Not Received	
	UP	Not Received	
Preliminary Report	NTPC	Not Received	
	UP	Not Received	
Detailed Report	NTPC	Not Received	
	UP	Not Received	

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)	**NTPC & Uttar Pradesh**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report 3. Adequately Sectionalized and graded protective relaying system

Based on above information description of the events is:

1. Connectivity Diagram & SLD of Singrauli TPS:





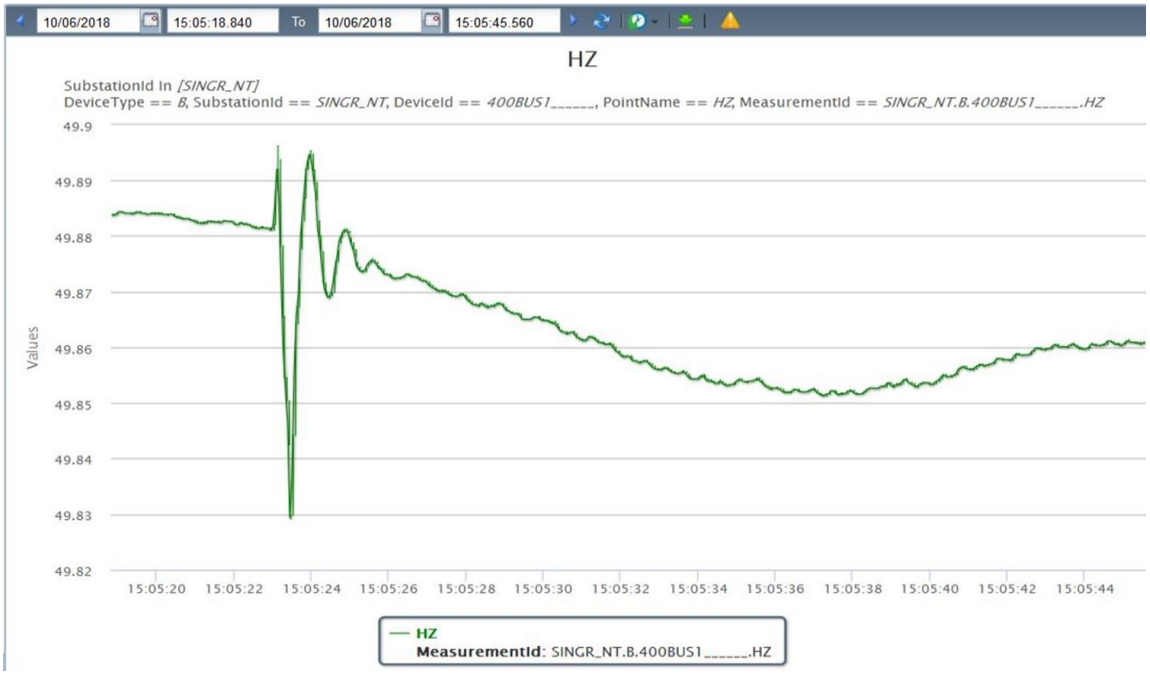
2. In antecedent condition, weather was stormy.

3. Name of the tripped element:
    - 400 kV Singrauli-Anpara ckt
    - 200MW Unit-1 of 400 kV Singrauli TPS
    - 500MW Unit-6 of 400 kV Singrauli TPS
    - 500MW Unit-7 of 400 kV Singrauli TPS

4. 400 kV Singrauli TPS is connected with Allahabad (PG) D/C, Rihand D/C, Vindhyachal D/C, Fatehpur (PG) S/C, Anpara S/C, Lucknow S/C. It also have 5 units of 200MW and two units of 500MW, two 100MVA 400/132kV ICT. 400/132kV Singrauli station have DMT (double main transfer breaker) scheme, both 400 kV buses have with sectionaliser.
5. At 15:05hrs, 400 kV Singrauli-Anpara ckt tripped. 400 kV unit-1, 6 & 7 also tripped.
6. PMU plots:

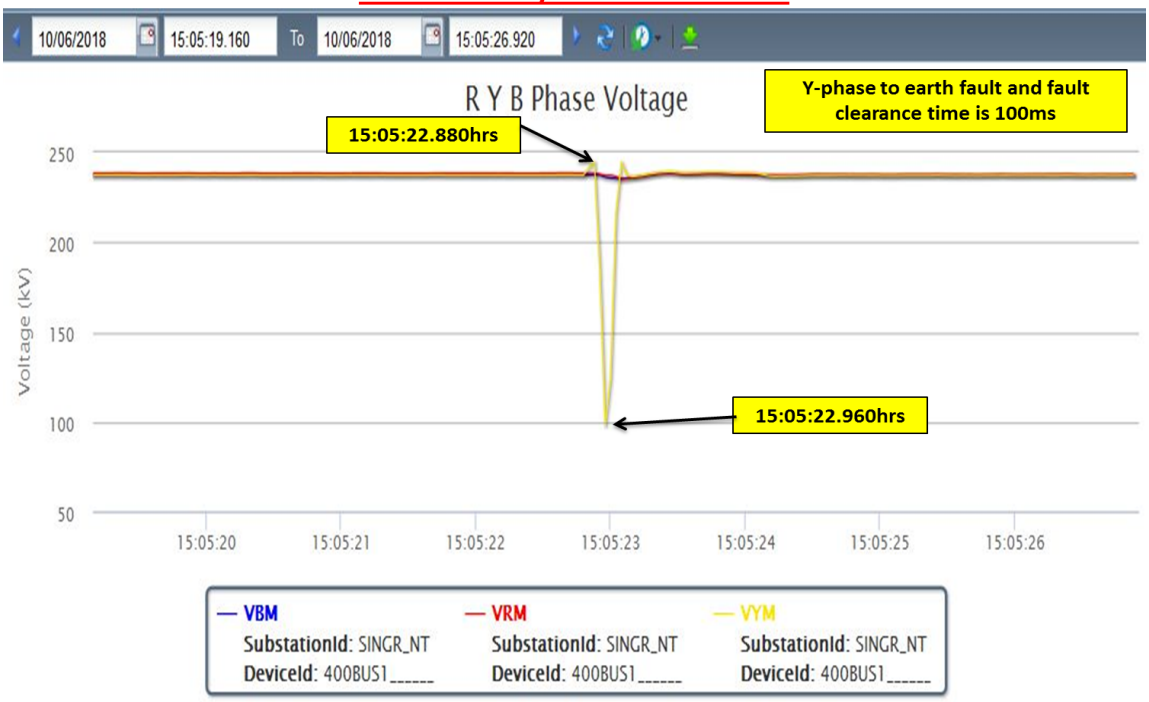
PMU Plot of frequency at Singrauli(NTPC)

15:05hrs/10-June-18

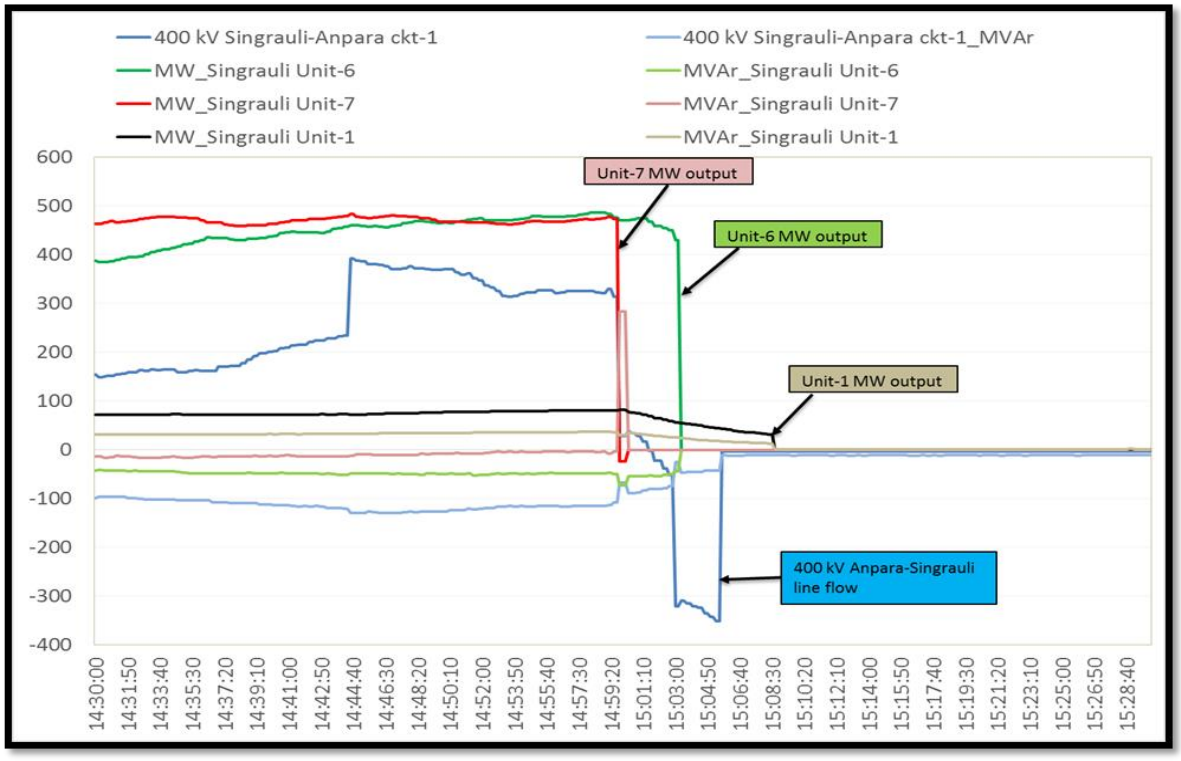


PMU Plot of phase voltage magnitude at Singrauli (NTPC)

15:05hrs/10-June-18



7. SCADA Analog data and SoE:



Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status
15:05:23,937	SINGRAULI	400kV	07ANPAR1	Circuit Breaker	Close

Unit tripping details not captured in SCADA SoE

8. As per PMU data and SCADA data:
   - Y-N fault observed at 15:05:22.880hrs
   - Voltage dip observed in Yellow phase.
   - Fault clearance time 100ms
   - Unit tripping details not captured in SCADA SoE.

9. Preliminary Report, DR/EL and detail report is still awaited from NTPC and UPPTCL.

Points for Discussion*:*

1. Reason of multiple element tripping at 400/132kV Singrauli TPS.
2. Exact location of fault to be reported.
3. 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.
4. Detailed report and supporting DR/EL needs to be submitted

NTPC/ UPPTCL may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

K. Complete outage of 400kV Merta(RRVPNL) at 16:22hrs of 19th June 2018

Event category: GD-1
Generation loss: Nil (Rajasthan may confirm)
Loss of load: Nil (Rajasthan may confirm)
Energy Loss: __ MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

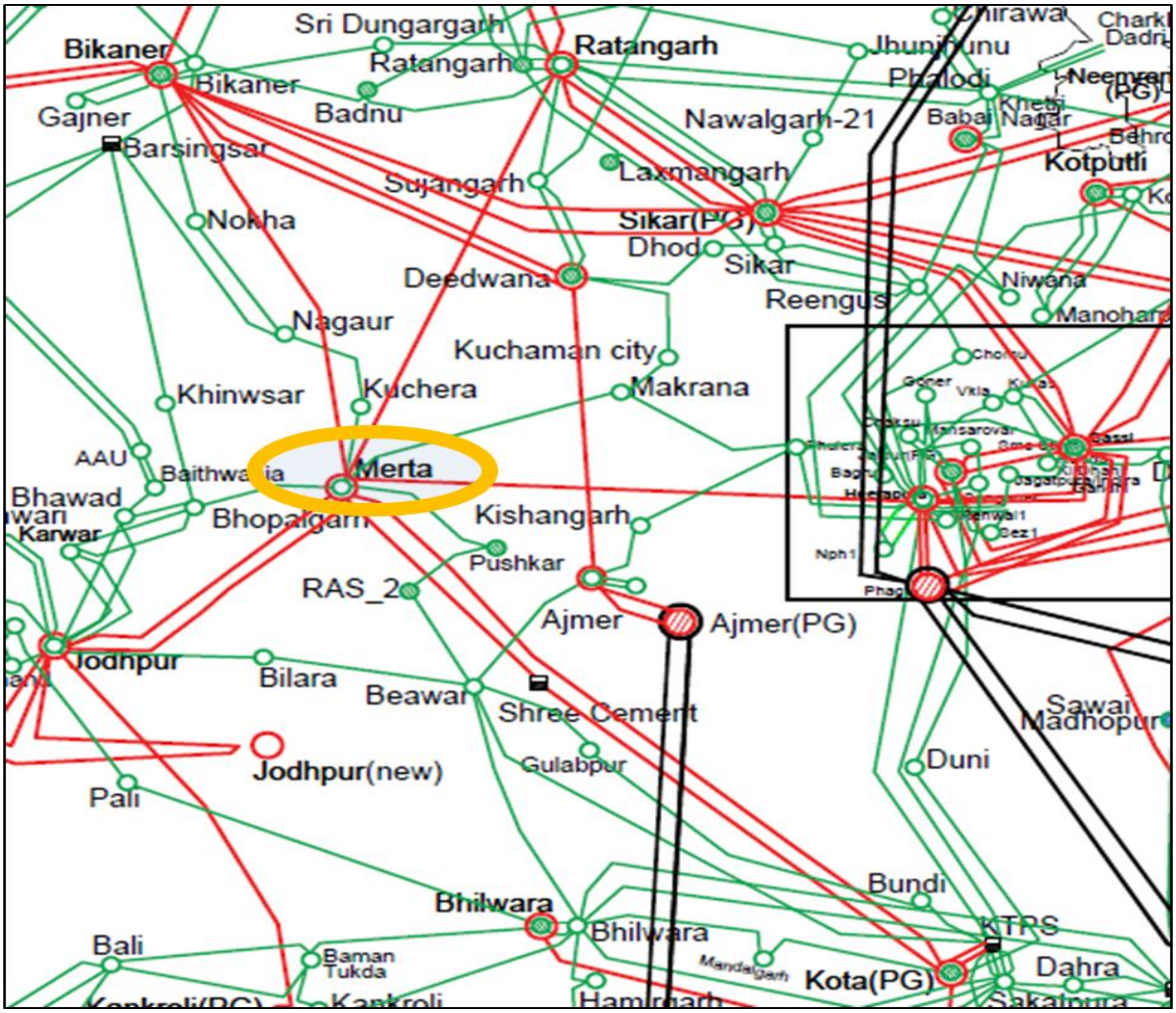
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	400ms	As per PMU data
Phase of the fault	PMU data	R-N fault	As per PMU data

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

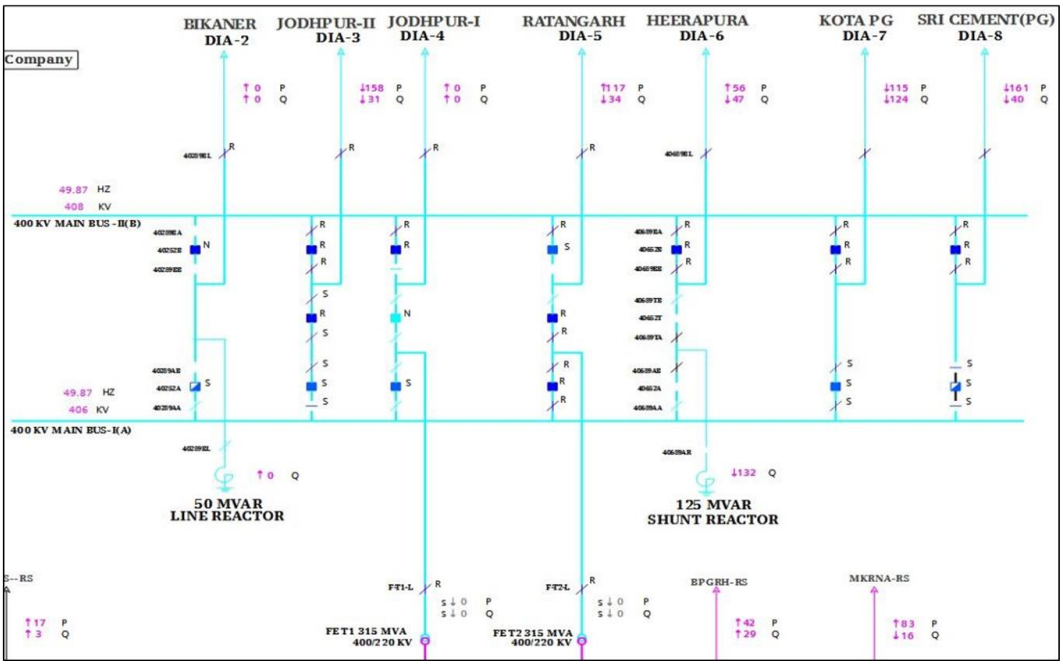
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3) 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 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. Connectivity Diagram:


Bikaner
Bikaner
Gajner
Barsingsar
Nokha
Sri Dungargarh
Ratangarh
Ratangarh
Badnu
Sujangarh
Laxmangarh
Nawalgarh-21
Sikar(PG)
Dhod
Sikar
Reengus
Deedwana
Nagaur
Kuchaman city
Makrana
Khinwsar
Kuchera
AAU
Baithwasia
Merta
Bhawad
Karwar
Bhopalgarh
Kishangarh
Pushkar
RAS_2
Ajmer
Ajmer(PG)
Jodhpur
Bilara
Beawar
Shree Cement
Jodhpur(new)
Gulabpur
Pali
Bhilwara
Bhilwara
Bali
Baman Tukda
Mandalgarh
Kota(PG)
Bundi
KTPS
Dahra
Duni
Sawai Madhopur
Chirawa
Jhunjhunu
Phalodi
Babai
Kotputli
Niwana
Chomu
Phag
Nph1

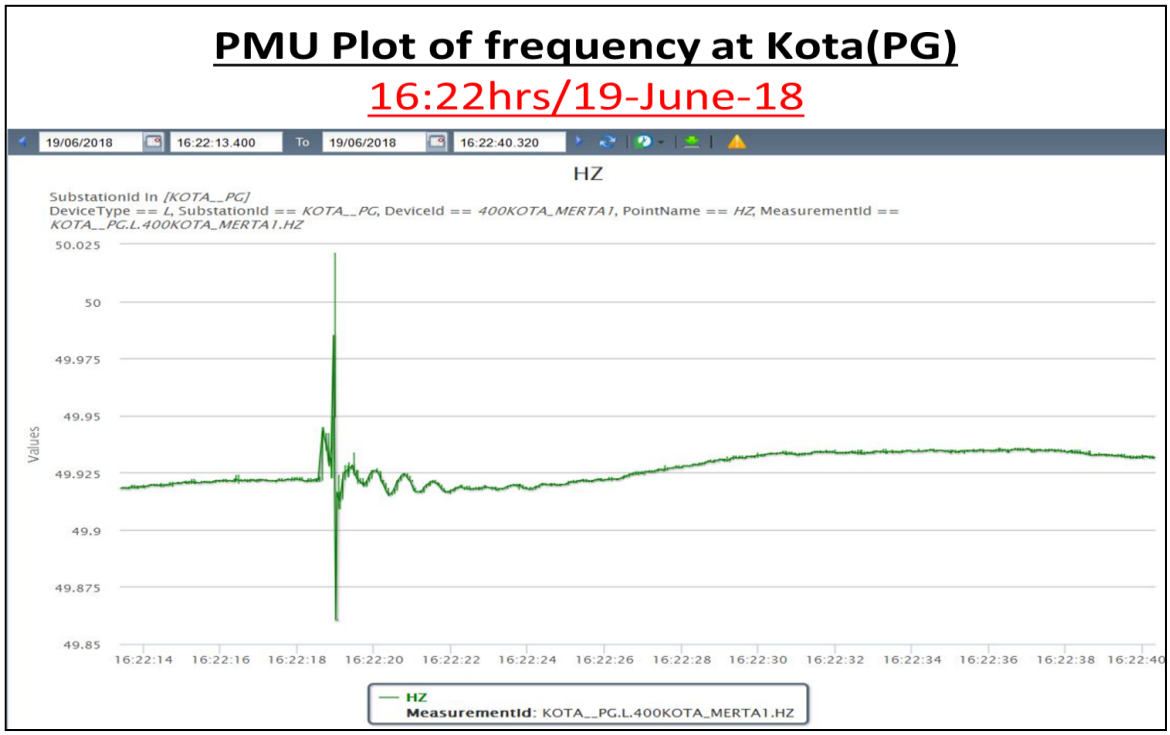
Single Line Diagram: Merta(RRVPNL), 400kV side

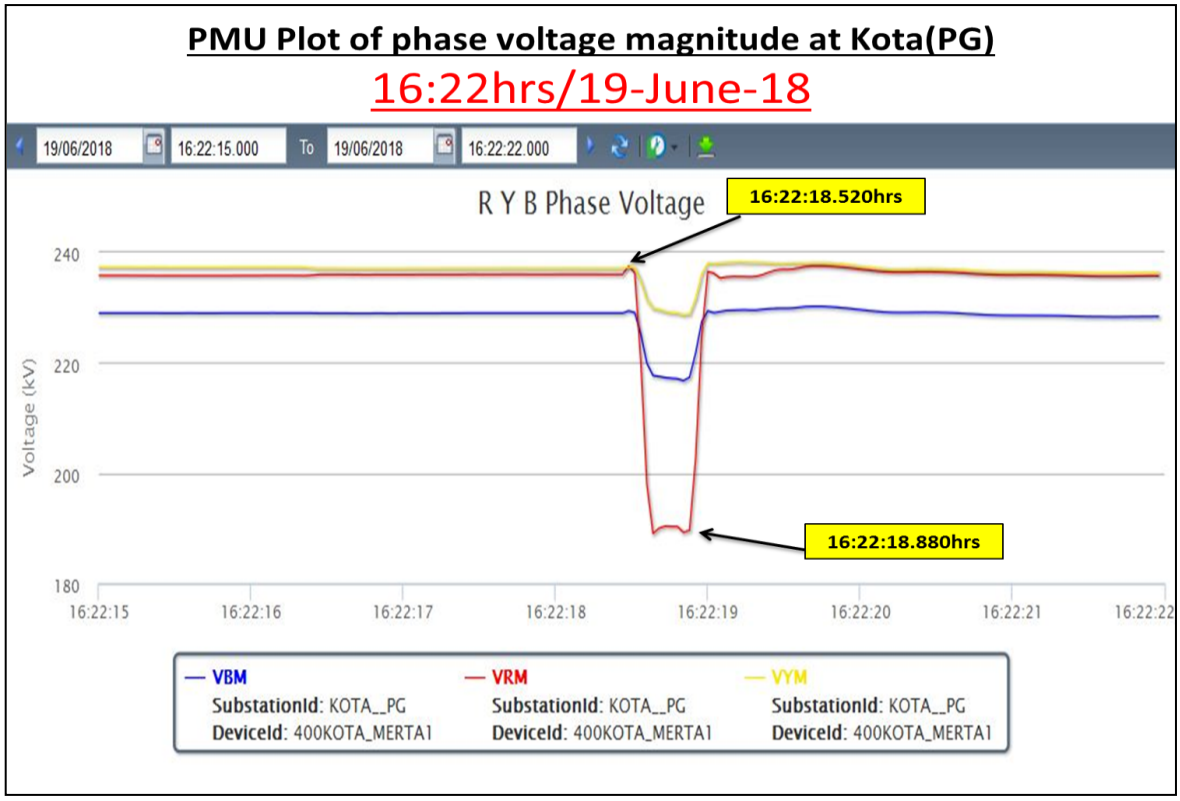


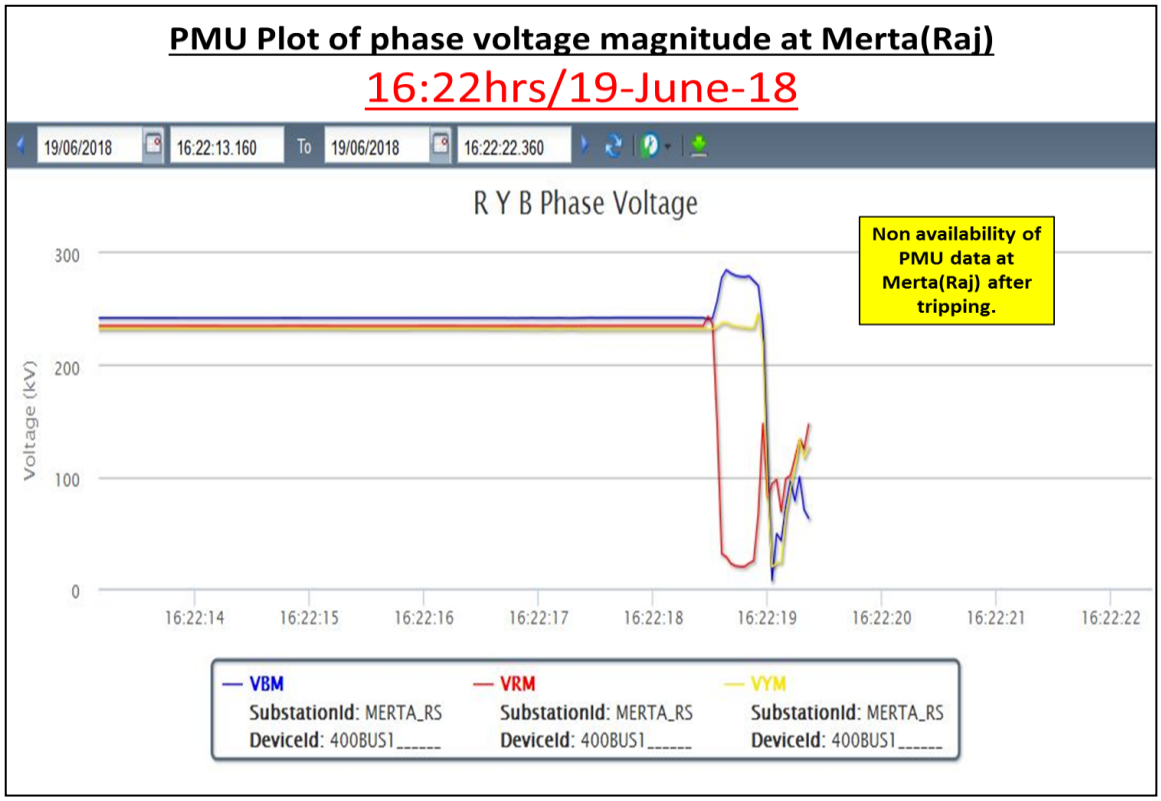
2. Merta has following elements at 400kV: Kota-Merta S/C, Sh. Cement-Merta S/C, Jodhpur-Merta D/C, Heerapura-Merta S/C, Ratangarh-Merta S/C, Bikaner-Merta S/C, 400/220kV 315MVA ICT #1 and #2; At 220kV four S/C to Kuchera, Bhopalgarh, Pushkar and Makrana are present.
3. Busbar protection operated at 400/220kV Merta(RVPNL) due to blast in R-Phase main breaker of 400/220kV ICT-2.
4. It further led to tripping of all 400kV lines and 315 MVA ICT 1 & ICT 2 at 400/220kV Merta(RVPNL).
5. At Jodhpur, 400kV Jodhpur-Merta D/C tripped in Z-2 distance protection.
6. As per jodhpur, Rajasthan Report:

S.N	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400kV Surpura-Merta-I CKT	19.06.2018	16:15 Hrs			At Jodhpur end:- Dist. Protection Optd, Z2, R,Y,B PHASE trip	
2	400kV Surpura-Merta-II CKT	19.06.2018	16:25 Hrs			Main-I :- Distance Prot. optd. Z2, R,Y,B phase trip, Relay 186A Main II:- Dist. Prot.optd Z2, R,Y,B phase trip, Relay 186B Dist. 105.2 km	

7. PMU plots:


PMU Plot of frequency at Kota(PG)
16:22hrs/19-June-18
19/06/2018
16:22:13.400
To
19/06/2018
16:22:40.320
HZ
SubstationId In [KOTA__PG]
DeviceType == L, SubstationId == KOTA__PG, DeviceId == 400KOTA_MERTA1, PointName == HZ, MeasurementId == KOTA__PG.L.400KOTA_MERTA1.HZ
Values
50.025
50
49.975
49.95
49.925
49.9
49.875
49.85
16:22:14
16:22:16
16:22:18
16:22:20
16:22:22
16:22:24
16:22:26
16:22:28
16:22:30
16:22:32
16:22:34
16:22:36
16:22:38
16:22:40
HZ
MeasurementId: KOTA__PG.L.400KOTA_MERTA1.HZ


PMU Plot of phase voltage magnitude at Kota(PG)
16:22hrs/19-June-18
19/06/2018
16:22:15.000
To
19/06/2018
16:22:22.000
R Y B Phase Voltage
16:22:18.520hrs
16:22:18.880hrs
Voltage (kV)
240
220
200
180
16:22:15
16:22:16
16:22:17
16:22:18
16:22:19
16:22:20
16:22:21
16:22:22
VBM
SubstationId: KOTA__PG
DeviceId: 400KOTA_MERTA1
VRM
SubstationId: KOTA__PG
DeviceId: 400KOTA_MERTA1
VYM
SubstationId: KOTA__PG
DeviceId: 400KOTA_MERTA1



8. As per SCADA data:

Rajasthan/PG SoE

Time (in hrs)	Station	Voltage	Element	Device	Status
16:22:18,899	MAKRANA	220kV	E_05(MERTA-1)	CB	Open
16:22:18,984	KOTA	400kV	2MER1SCM	CB	Open
16:22:18,985	KOTA	400kV	3MERTA1	CB	Open
16:22:31,269	SHREE CEMENT	400kV	1MERTA	CB	Open
16:22:31,491	SHREE CEMENT	400kV	2G1MER	CB	Open

9. As per PMU & SCADA data:
   - R-N fault occurred at 16:22:18.520hrs and cleared with delay in 400ms.

- 220kV Makrana-Merta, 400kV Kota-Merta D/C tripped from remote end with a delay of ~350ms & ~450ms from time of fault (as observed from PMU) respectively.

10. Preliminary Report is received from Jodhpur(RRVPNL) end but Merta end report is still awaited. DR/EL, Detailed Report along with remedial measures report is still awaited from Rajasthan.

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. Reason for complete outage of 400/220kV Merta(RRVPNL) and tripping of both 400kV buses.
3. Reason for delayed clearance of fault to be shared.
4. Reason for tripping of 400kV Kota-Merta D/C, 400kV Jodhpur-Merta D/C and 220kV Merta-Makhrana from remote end to be shared.

Rajasthan may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

L. Multiple element tripping at 400/220kV Agra (UP) Station at 15:13hrs of 21st Jun 2018

Event category: GD-1
Generation loss: Nil
Loss of load: 550MW (UP may confirm about load loss)
Energy Loss: _____MU (UP may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		NA	As per PMU data
Phase of the fault		NA	As per PMU data

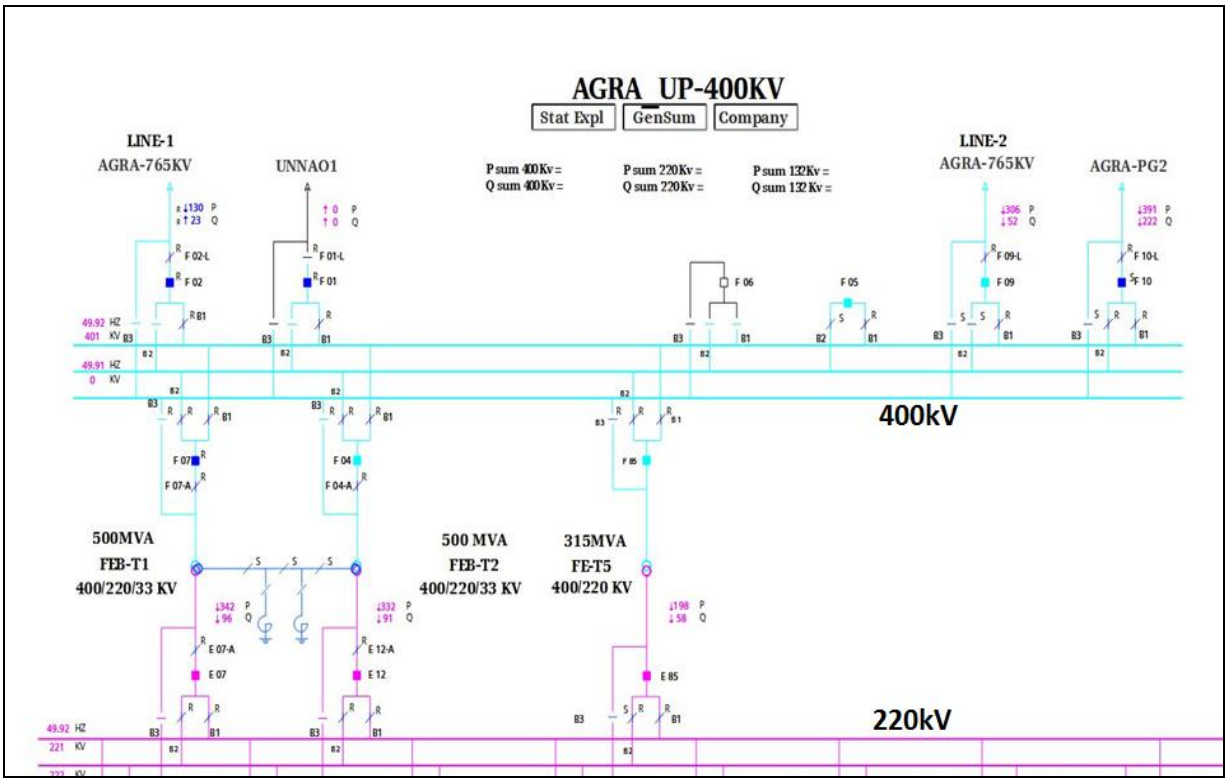
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available (Partial)	
DR/ EL	Uttar Pradesh	Received	After 24hrs
	POWERGRID	Not Received	

Preliminary Report	Uttar Pradesh	Not Received	After 24hrs
	POWERGRID	Not Received	
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) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	**Uttar Pradesh & POWERGRID**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report 3. Correct operation of Protection System 4. Adequately Sectionalized and graded protective relaying system 5. Incorrect/ mis-operation / unwanted operation of Protection system

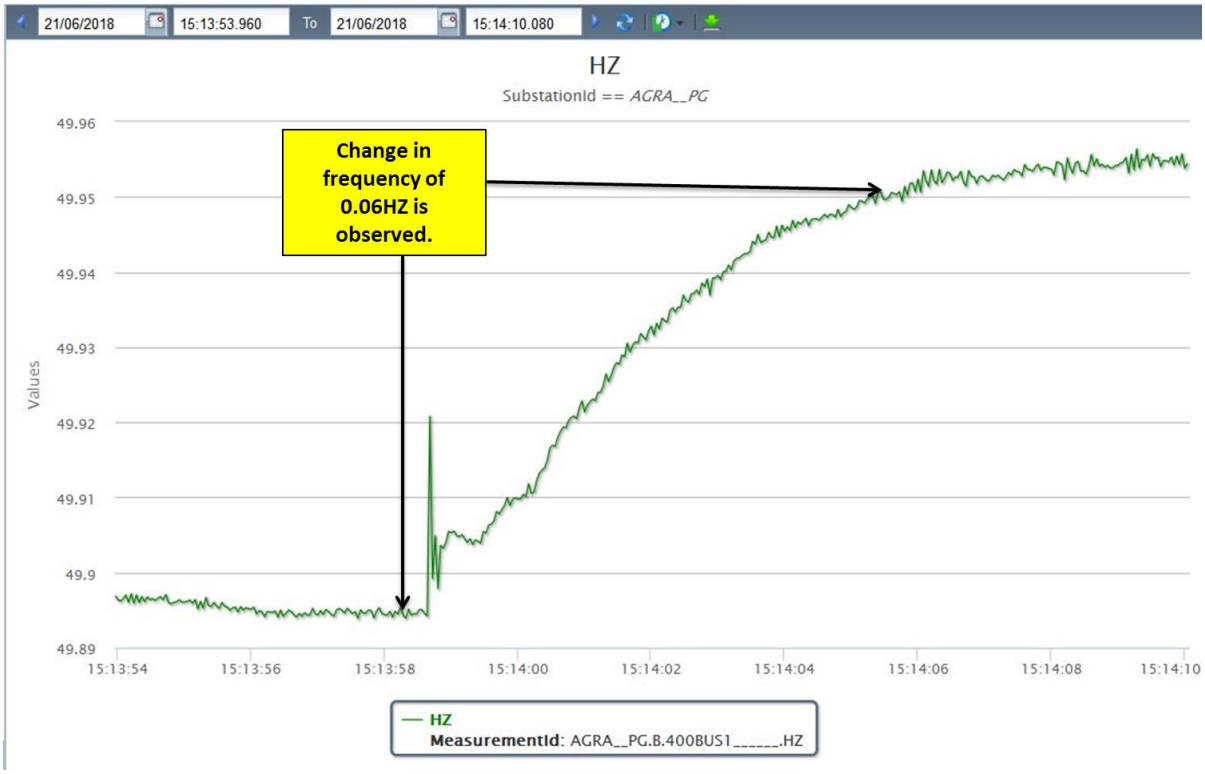
Based on above information description of the events is:

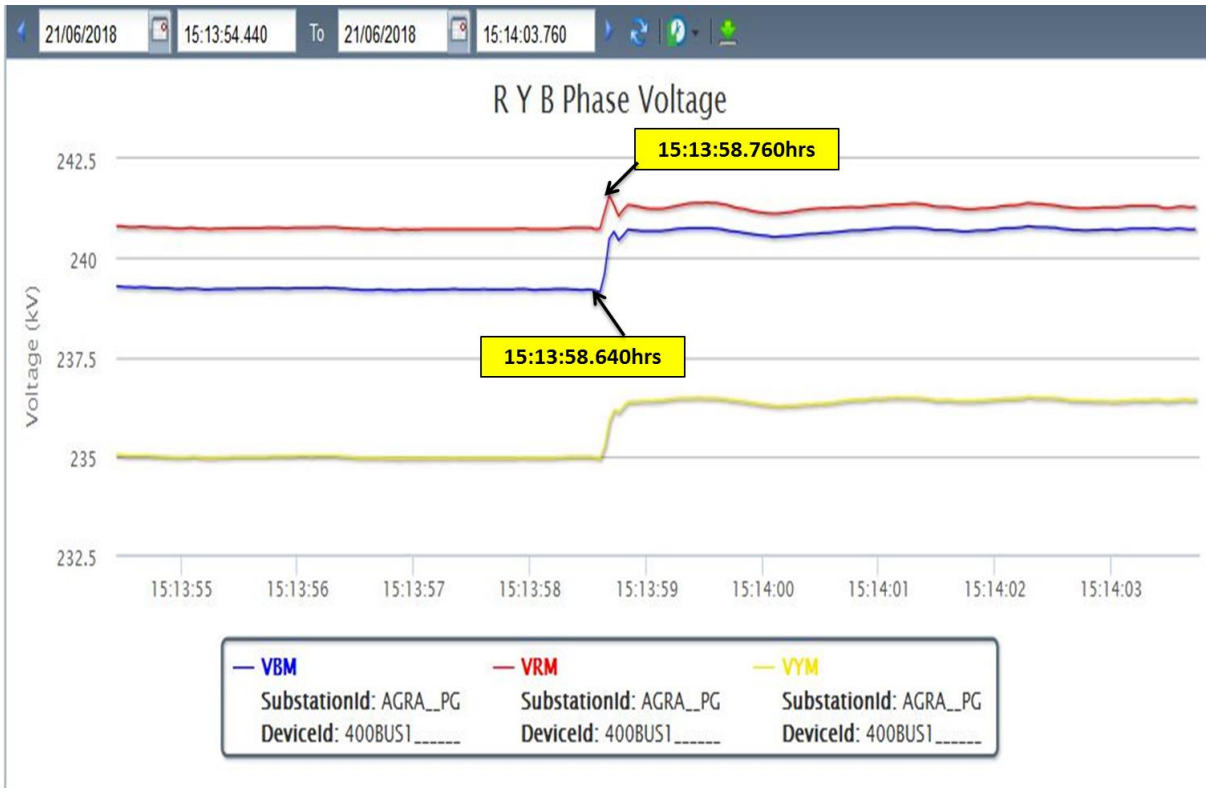
1. Single Line Diagram of 400 kV Agra (UP):



2. 400 kV Agra (UP) is connected with Fatehabad (UP) D/C, Agra (PG) S/C and Unnao S/C. It also have three 400/220 kV ICTs (2*500MVA+1*315MVA).
3. 400 kV Agra (UP) has double main and transfer scheme.
4. 400kV Agra(UP)-Unnao(UP) under planned S/D from 29-Apr-18 to 22-Jun-18 for Diversion of line (Tower no 591 - 596) due to Firozabad bypass Road of NHAI.
5. As reported, bus bar protection mal-operated at 400kV Agra (UP). All 400kV connected elements tripped.
6. Tripped elements:
    - 400kV Agra(UP)-Fatehabad(UP) D/C
    - 400kV Agra(UP)-Agra(PG)
    - 400kV/220kV 500MVA ICT #1, #2 at Agra(UP)
    - 400kV/220kV 315MVA ICT #3 at Agra(UP)

7. PMU plots:

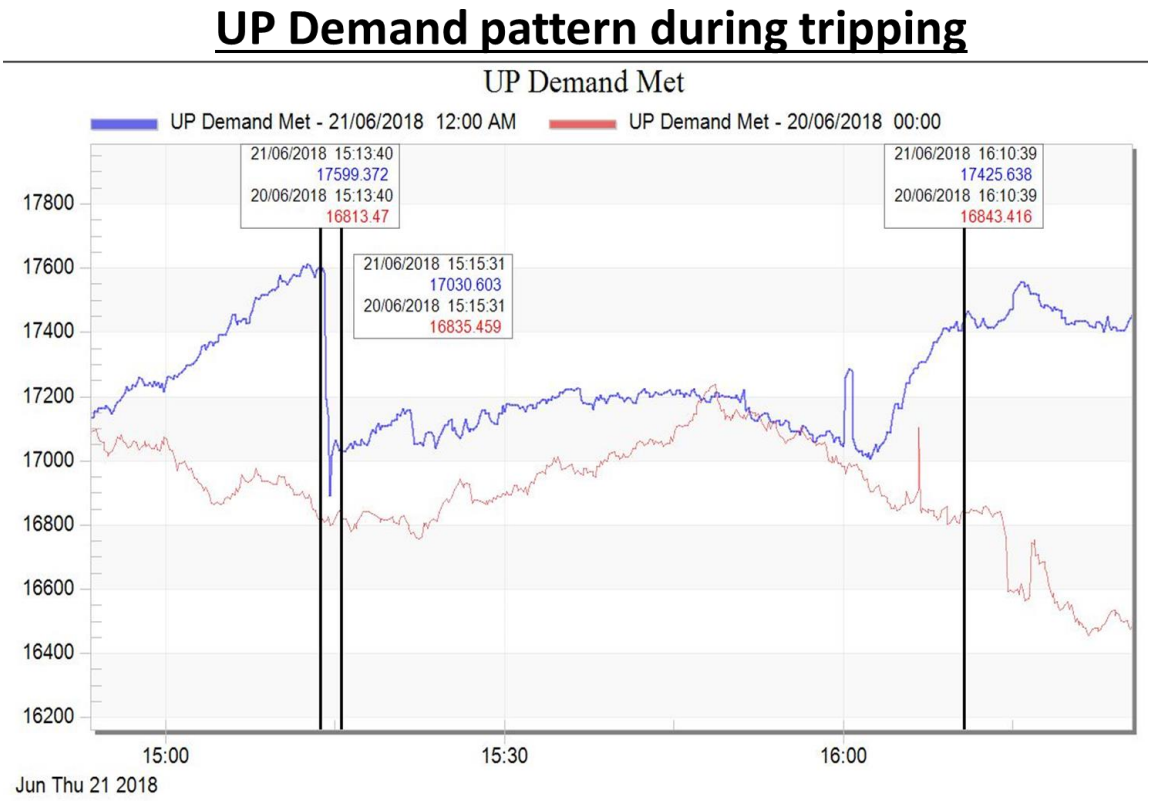

21/06/2018
15:13:53.960
To
21/06/2018
15:14:10.080
HZ
SubstationId == AGRA__PG
Change in frequency of 0.06HZ is observed.
Values
49.96
49.95
49.94
49.93
49.92
49.91
49.9
49.89
15:13:54
15:13:56
15:13:58
15:14:00
15:14:02
15:14:04
15:14:06
15:14:08
15:14:10
HZ
MeasurementId: AGRA__PG.B.400BUS1_____.HZ


21/06/2018
15:13:54.440
To
21/06/2018
15:14:03.760
R Y B Phase Voltage
15:13:58.760hrs
15:13:58.640hrs
Voltage (kV)
242.5
240
237.5
235
232.5
15:13:55
15:13:56
15:13:57
15:13:58
15:13:59
15:14:00
15:14:01
15:14:02
15:14:03
VBM
SubstationId: AGRA__PG
DeviceId: 400BUS1_____
VRM
SubstationId: AGRA__PG
DeviceId: 400BUS1_____
VYM
SubstationId: AGRA__PG
DeviceId: 400BUS1_____

8. SCADA SoE:

Time (in hrs)	Station	Voltage	Element	Device	Status
15:13:33,405	AGRA1_UP	400kV	F_85(T5)	CB	Open
15:13:33,405	AGRA1_UP	220kV	E_85(T5)	CB	Open
15:13:57,874	AGRA1_UP	400kV	F_04(T2)	CB	Open
15:13:57,875	AGRA1_UP	400kV	F_09(AGRA_-1)	CB	disturbe

9. SCADA Analog data of UP demand met:



10. As per PMU data and SCADA SoE:
    - No fault observed.
    - Rise in 400kV voltage at Agra(UP) observed at 15:13:58.640hrs. Rise in voltage was due to load loss in the system

- 400/220kV 315MVA ICT #3 tripped at 15:13:33.405hrs whereas 500MVA ICT #2 tripped after 24sec at 15:13:57.874hrs.
- No other element tripping captured in SCADA SoE

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

Points for Discussion*:*

1. Reason for mis-operation of bus bar protection at 400 kV Agra (UP) to be shared.
2. Healthiness of bus bar protection at 400 kV Agra (UP) to be checked and corrected.
3. Reason for tripping of all elements at 400 kV Agra (UP) to be shared.
4. As per SCADA SoE, difference of around 24 seconds observed between tripping of 400/220kV ICT #2 and #3. Reason for the same to be shared.
5. As per PMU, Rise in 3-pase voltage occurred at 15:13:58.640hrs whereas tripping of relevant elements in SCADA SoE occurred at 15:13:33.405hrs and 15:13:57.874hrs. Time synchronization of digital SCADA status at 400kV Agra (UP) to be looked into.
6. 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.
7. Preliminary Report, DR/EL and detailed report is still awaited from UPPTCL.

UP may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

M. Multiple element tripping at 400/220 kV Panki (UP) at 20:45hrs of 08th July 2018

Event category: GD-1
Generation loss: Nil (UP may confirm)
Loss of load: 338MW (UP may confirm)
Energy Loss: __ MU (UP may confirm)

Data Summary received/available at NRLDC:

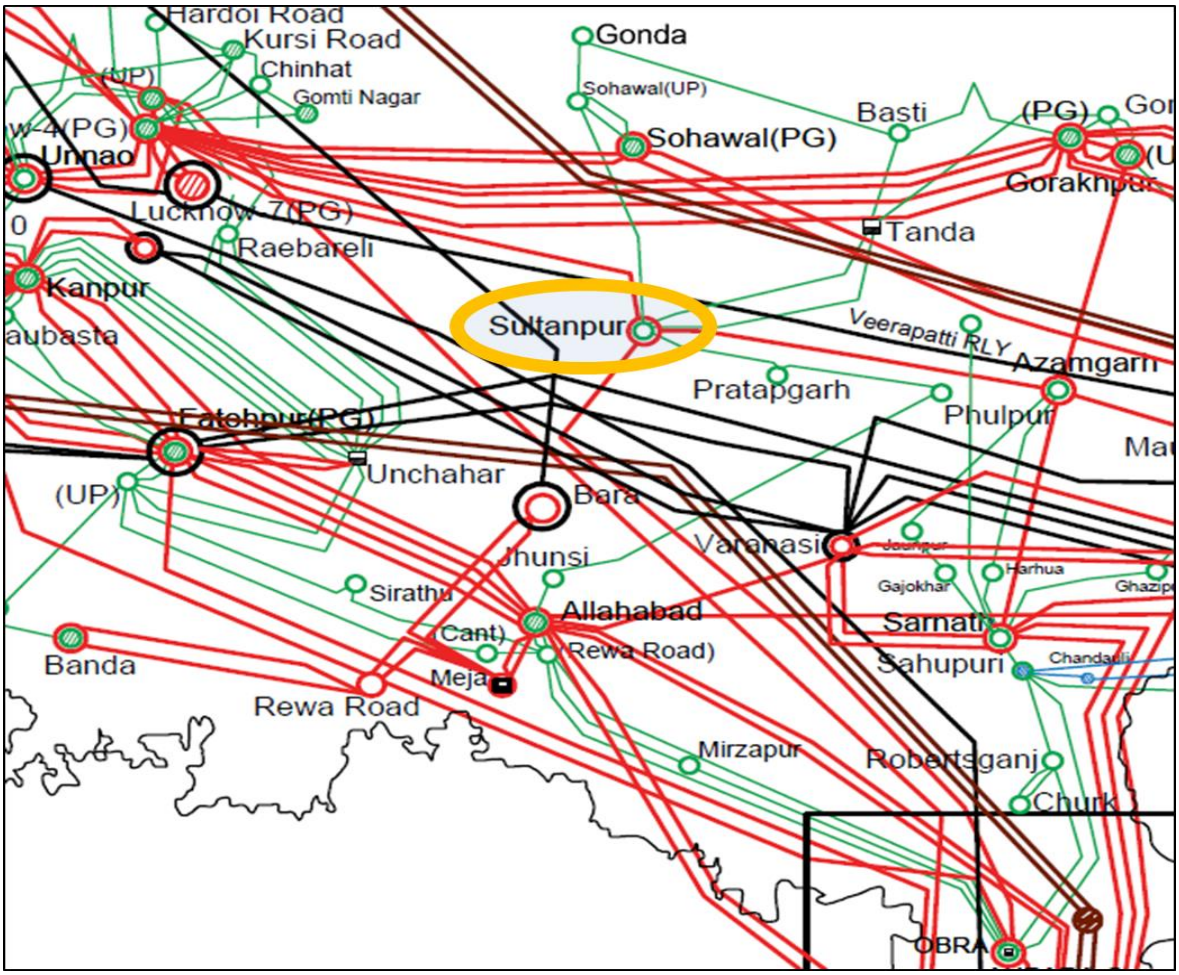
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	2040ms	
Phase of the fault	PMU data	Y-B phase to earth fault	

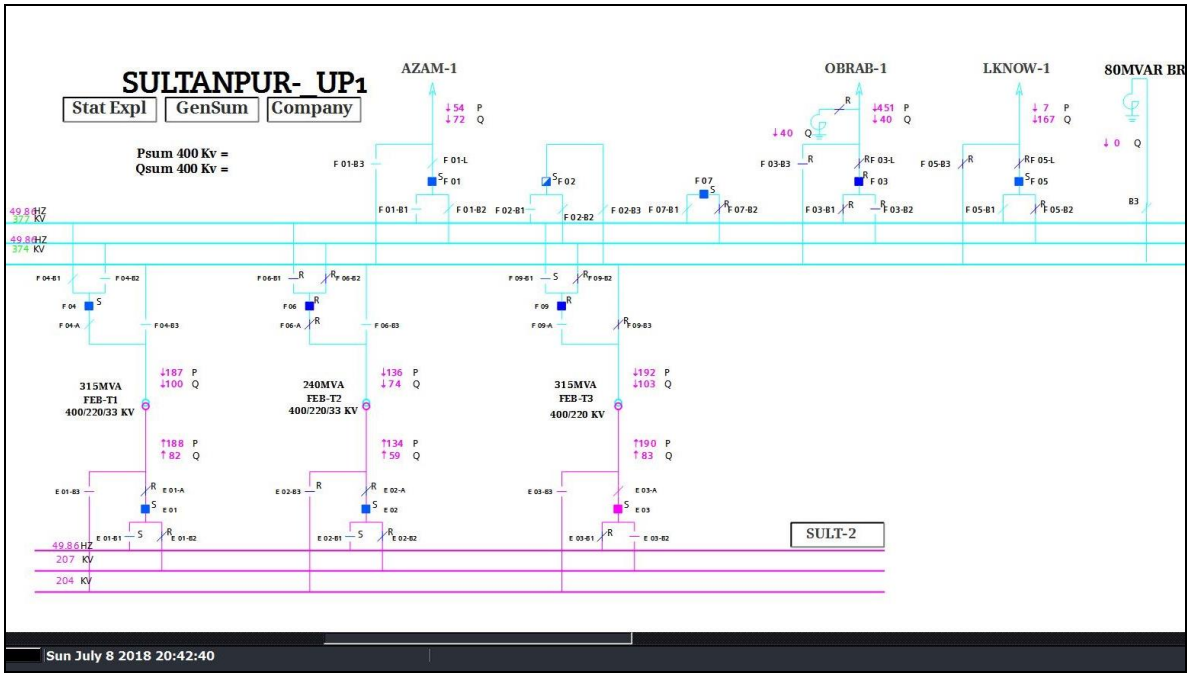
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available (Partial)	
DR/ EL	Uttar Pradesh	Not Received	Submitted Flag details
	POWERGRID	Not Received	
Preliminary Report	Uttar Pradesh	Received	Within 24hrs
	POWERGRID	Not Received	
Detailed Report	Uttar Pradesh	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)	**Uttar Pradesh & POWERGRID**	1. DR/EL, Preliminary report within 24hrs 2. Correct operation of Protection System 3. Adequately Sectionalized and graded protective relaying system

Based on above information description of the events is:

1. Connectivity Diagram:


Hardoi Road
Kursi Road
Chinhat
Gomti Nagar
Gonda
Sohawal(UP)
Sohawal(PG)
Basti
(PG)
Gorakhpur
Unnao
Lucknow-7(PG)
Raebareli
Tanda
Kanpur
Sultanpur
Veerapatti RLY
Azamgarh
Pratapgarh
Phulpur
Fatehpur(PG)
Unchahar
Bara
Varanasi
Jhunsi
Harhua
Gajokhar
Sirathu
Allahabad
Sarnath
Banda
(Cant)
Rewa Road)
Sahupuri
Chandauli
Meja
Rewa Road
Mirzapur
Robertsganj
Churk
OBRA

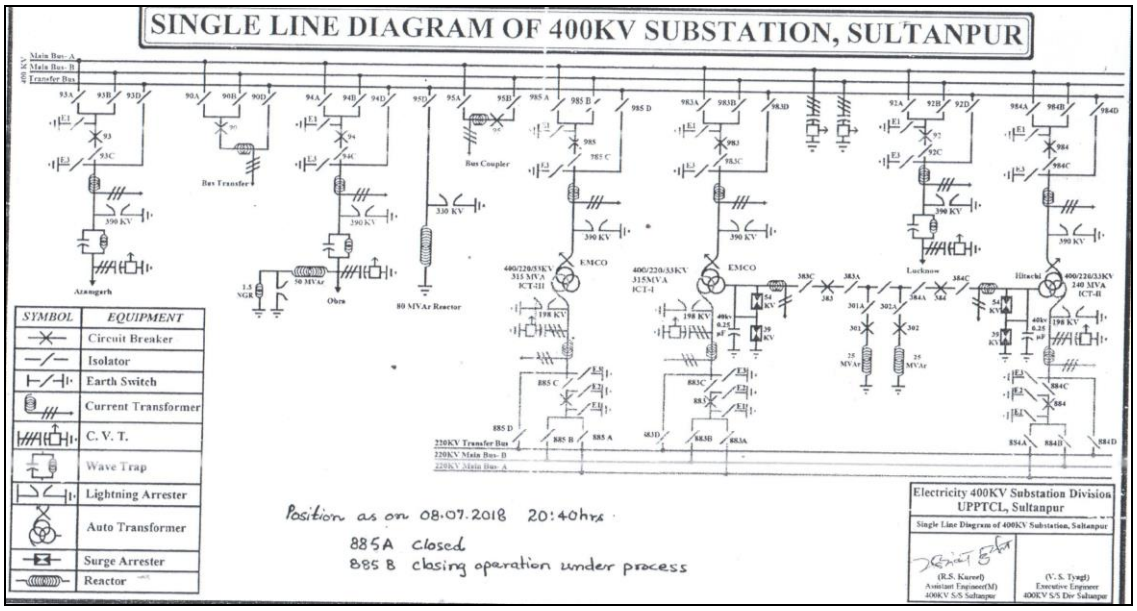

SULTANPUR-_UP1
Stat Expl
GenSum
Company
Psum 400 Kv =
Qsum 400 Kv =
AZAM-1
OBRAB-1
LKNOW-1
80MVAR BR
315MVA
FEB-T1
400/220/33 KV
240MVA
FEB-T2
400/220/33 KV
315MVA
FEB-T3
400/220 KV
SULT-2
Sun July 8 2018 20:42:40

2. 400 kV Sultanpur (UP) is connected with Azamgarh (UP) S/C, Lucknow (PG) S/C, Obra (UP) S/C and it also have three ICTs (2*315MVA+1*240MVA). 220 kV Sultanpur (UP) is connected with 220 kV Tanda S/C, 220 kV New Tanda S/C, 220 kV Pratapgarh S/C and 220kV Sohawal (UP) S/C. 220 kV Sultanpur (UP) also have two ICTs (1*200MVA+1*160MVA).
3. 400/220 kV Sultanpur (UP) have DMT (double main transfer breaker) scheme.
4. At 220kV substation Sultanpur (UP), main bus B was under shutdown.
5. After returning the shutdown at 20:16hrs, both 200MVA and 160MVA, 220/132kV transformers were taken on 220kV bus B and then 220kV side of 315MVA ICT- 3 was being transferred to 220kV bus B with closing of bus side isolator manually.
6. During the closing of isolator, flashing occurred between isolator contacts which increased further. Upon seeing heavy flashing, operator moved away from the site of isolator and informed control room.
7. After checking, it was found that during closing of isolator, high flashing occurred between jaws and operator stopped further operation of isolator. Intensity of flashing increased further after opening of 220kV bus coupler at 220kV substation Sultanpur which completely damaged the jaws and molten metal touched the structure which created fault. Spots were observed on isolator structures of Y & B phases. Fault current were also found in Y & B phases. This resulted into tripping of all 3 lines from other end in zone-3. 400/220kV ICTs did not trip. It was analysed that in such magnitude of fault current, operating time of IDMT relay for backup protection could have been more than zone-3 operating time.
8. At 220kV substation, all charged 220kV lines and transformers were tripped manually

9. Name of the tripped elements are as below:
    - 400 kV Sultanpur (UP)-Obra (UP)
    - 400 kV Sultanpur (UP)-Lucknow (PG)
    - 400 kV Sultanpur (UP)-Azamgarh (UP)
    - 400/220 kV three ICTs (2*315MVA+1*240MVA)
    - 220 kV Sultanpur (UP)-Tanda
    - 220 kV Sultanpur (UP)-New Tanda
    - 220 kV Sultanpur (UP)-Sohawal (UP)
    - 220 kV Sultanpur (UP)-Pratapgarh (UP)

10. As per UP report:

Sl. No.	Name of element	Date & time of Normalization		Remark
1.	400KV Obra line	09.07.2018	00:10	Protection tripping
2.	400KV Azamgarh line	08.07.2018	22:35	Tripped at 400KV Azamgarh end Zone-III Protection
3.	400KV PGCIL Lucknow	08.07.2018	21:58	Tripped at 400KV PGCIL end Zone-III Protection
4.	315MVA ICT-I	08.07.2018	23:27	Hand tripped
5.	240MVA ICT-II	08.07.2018	23:06	Hand tripped
6.	315MVA ICT-III	09.07.2018	00:31	Hand tripped
7.	220KV Sohawal	08.07.2018	21:32	Hand tripped
8.	220KV New Tanda	08.07.2018	22:32	Hand tripped
9.	220KV Pratapgarh	08.07.2018	21:54	Hand tripped
10.	220KV Tanda TPS	08.07.2018	23:43	Under s/d from 06.07.2018 at 12:02



A. Introduction

1. Time & Date of Event: 20:45 hrs on 08.07.2018
2. Substation(s) affected along with voltage level: 400kV substation, Sultanpur and 220kV substation Sultanpur
3. Brief Event Summary: At 220kV substation Sultanpur, main bus B was under shutdown. After returning the shutdown at 20:16hrs, both 200MVA and 160MVA, 220/132kV transformers were taken on 220kV bus B and then 220kV side of 315MVA ICT- 3 was being transferred to 220kV bus B with closing of bus side isolator manually. During the closing of isolator, flashing occurred between isolator contacts which increased further. Upon seeing heavy flashing, operator moved away from the site of isolator and informed control room. At the occurrence of flashing, all 3numbers 400kV line at 400kV substation tripped from other end and 3 numbers 400/220kV ICTs were tripped manually. At 220kV substation, all charged 220kV lines and transformers were tripped manually. Which caused total outage of both substations.

B. Antecedent Conditions

1. Weather Information: Clear.
2. Additional relevant information viz. power flow, shutdowns etc: 220kV Main bus-B and 220kV Tanda Thermal line were under shutdown.

C. Event data

1. Change in Frequency. Not known.

2. Generation Loss/Load Loss: Total 338MW export on 220kV and 132kV lines and 132/33kV transformers.

3. Single Line Diagram (SLD) of affected Area: SLD depicting bus scheme/configuration of all the affected stations along with digital open/close status of all CB/Isolator of affected voltage level buses indicating availability of various elements viz. Buses, Lines, ICT, Reactor etc. enclosed.

4. Name and time of the tripped elements in time chronology: Based upon time stamped event log, DR etc.:

Time of tripping 20:45hrs
At 400kV substation Sultanpur:
(i) 400kV PGCIL Lucknow line
(ii)400kV Obra line
(iii)400kV Azamgarh line
(iv) 400/220kV 315MVA ICT-1 (Manually opened)
(v) 400/220kV 240MVA ICT-2 (Manually opened)
(vi) 400/220kV 315MVA ICT-3 (Manually opened)

At 220kV substation Sultanpur: Manually opened:
(i)220kV Pratapgarh
(ii)220kV New Tanda
(iii)220kV Tanda Thermal
(iv)220kV Sohawal
(v)220kV Bus Coupler
(vi) 160MVA 132/33kV Transformer
(vii) 200MVA 132/33kV Transformer
And all 132kV lines(6nos.) and 132/33kV Transformers(3nos.)

5. Location and type of fault: Location of fault was on 220kV bus side isolator of 315MVA 400/220kV ICT-3.

6. Flag Details, DR and EL for each affected element: Flag details enclosed. DR not triggerred due to no tripping of lines and ICTs at 400kV substation Sultanpur. Only Reactor of 400kV Obra line tripped which sent direct trip to Obra. Static relay is installed for Reactor protection. DR snapshot obtained from PG Lucknow is enclosed. EL shows no event.

7. Appropriate Graphical Plot: Including SCADA data/ print out of DR and EL details. It may be separately annexed:

D. Event Description/ Analysis of the Event

9. Description: Detailed description including the reference of DR/EL and explanation based on ***pt. C. Event data***.: After checking, it was found that during closing of isolator, high flashing occurred between jaws and operator stopped further operation of isolator. Intensity of flashing increased further after opening of 220kV bus coupler at 220kV substation Sultanpur which completely damaged the jaws and molten metal touched the structure which created fault. Spots were observed on isolator structures of Y and B phase. Fault current were also found in Y and B phase. This resulted into tripping of all three lines at other end in zone-3. 400/220kV ICTs did not trip. It was analysed that in such magnitude of fault current, operating time of IDMT relay for backup protection could have been more than zone-3 operating time.

E. Restoration

10. Restoration time of tripped elements in time chronology.

At 400kV substation Sultanpur:

1. 400 KV Sultanpur – PG Lucknow line at 21:58 hrs
2. 400 KV Sultanpur – Azamgarh line at 22:35 hrs
3. 400/220kV 240 MVA T/F –2 at 23:06 hrs
4. 400/220kV 315 MVA T/F –II at 23:27 hrs through transfer bus.
5. 400kV Sultanpur – Obra line at 00:10hrs (on 09.07.2018)
6. 400/220kV 315 MVA T/F –II at 00:31hrs (on 09.07.2018

At 220kV substation Sultanpur:

1. 220kV Sultanpur – Sohawal line at 21:32 hrs
2. 220/132kV 200MVA T/f at 21:32 hrs
3. 220/132kV 160MVA T/f at 21:32 hrs
4. 220kV Sultanpur - Pratapgarh at 21:54 hrs
5. 220kV Sultanpur – New Tanda at 22:14 hrs
6. 220kV Sultanpur – Tanda Thermal at 23:43 hrs

F. Remedial Action

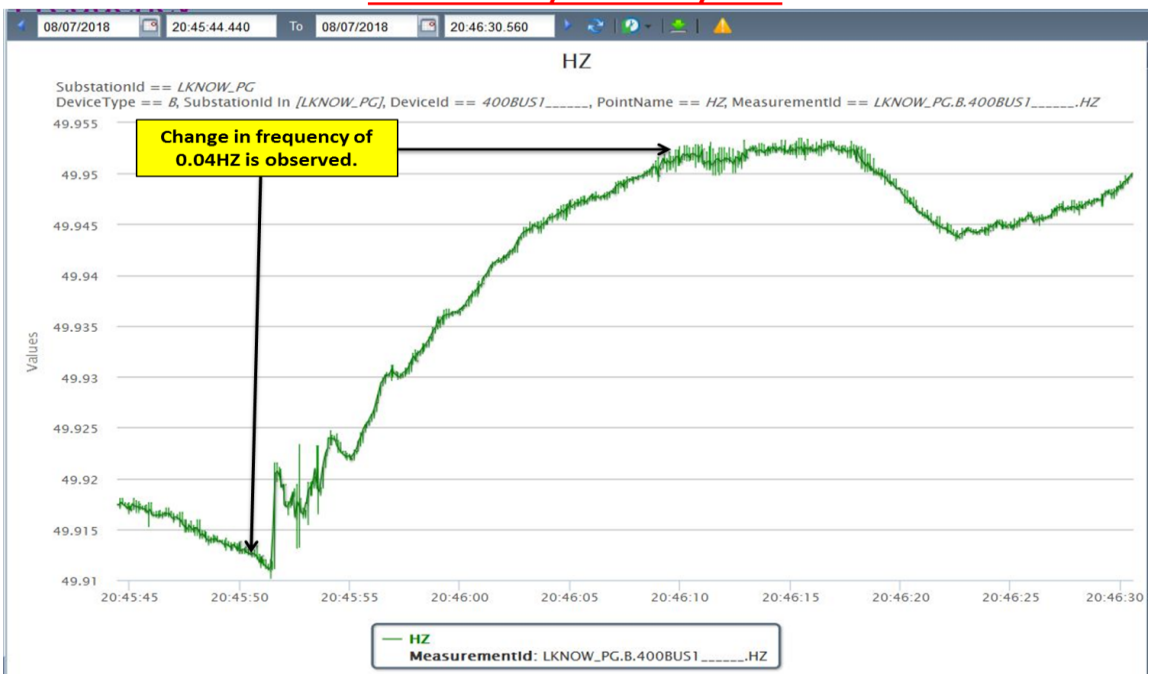
- Remedial Action Taken: Isolator is being replaced.
- Remedial Action to be taken along with time frame.

G. Lesson Learnt: In this case stucking of isolator during closing operation and increase in severity of fault with the opening of 220kV Bus coupler at 220kV substation caused total outage at 400kV and 220kV substations. Motorised operation of isolator has been recommended.

11. PMU plots:

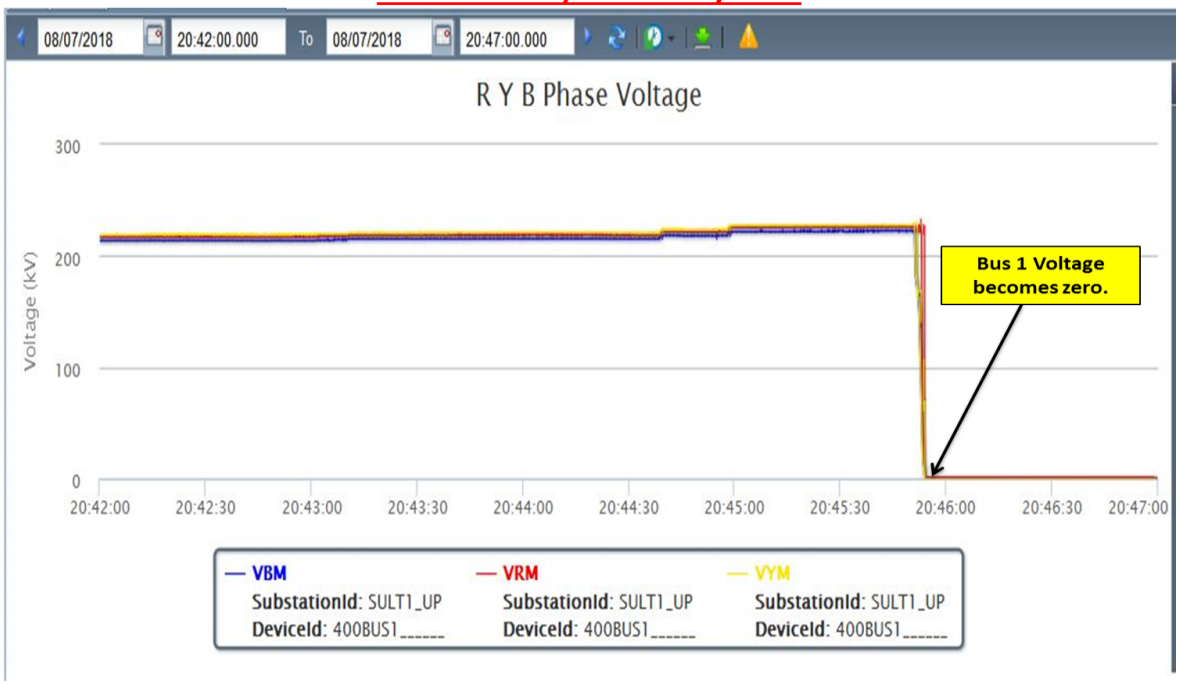
PMU Plot of frequency at Lucknow(PG)

20:45hrs/08-July-18



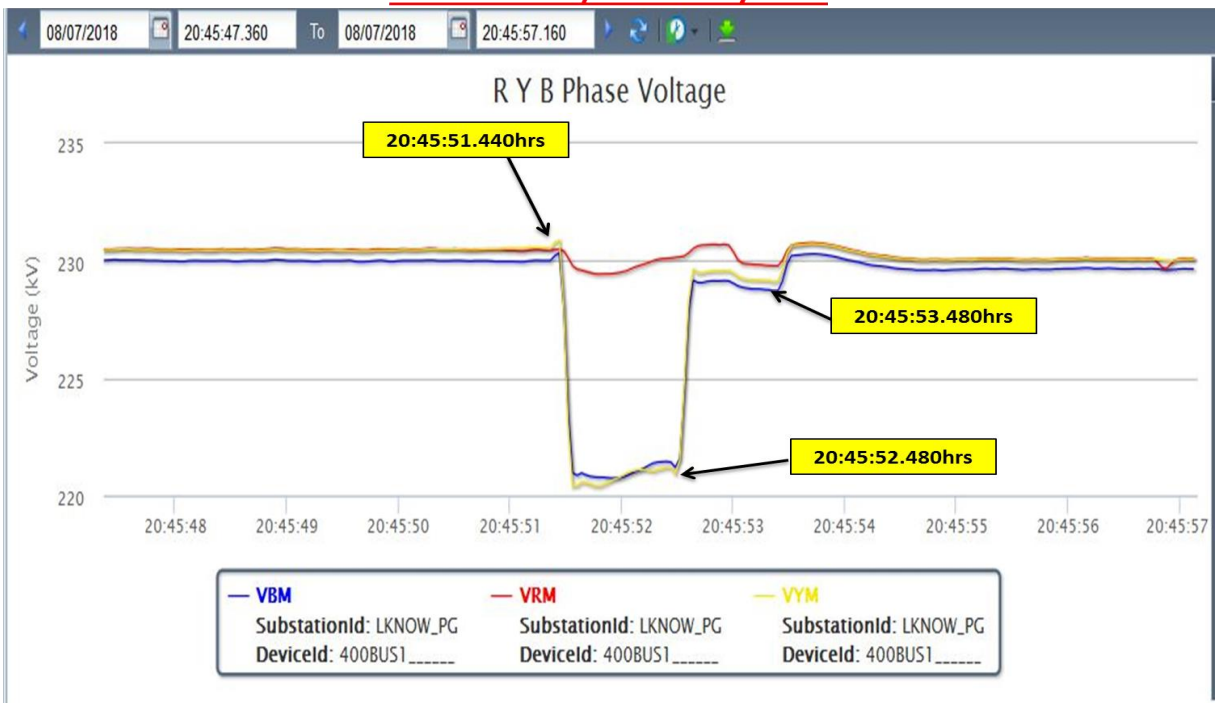
PMU Plot of phase voltage magnitude at Sultanpur(UP)

20:45hrs/08-July-18

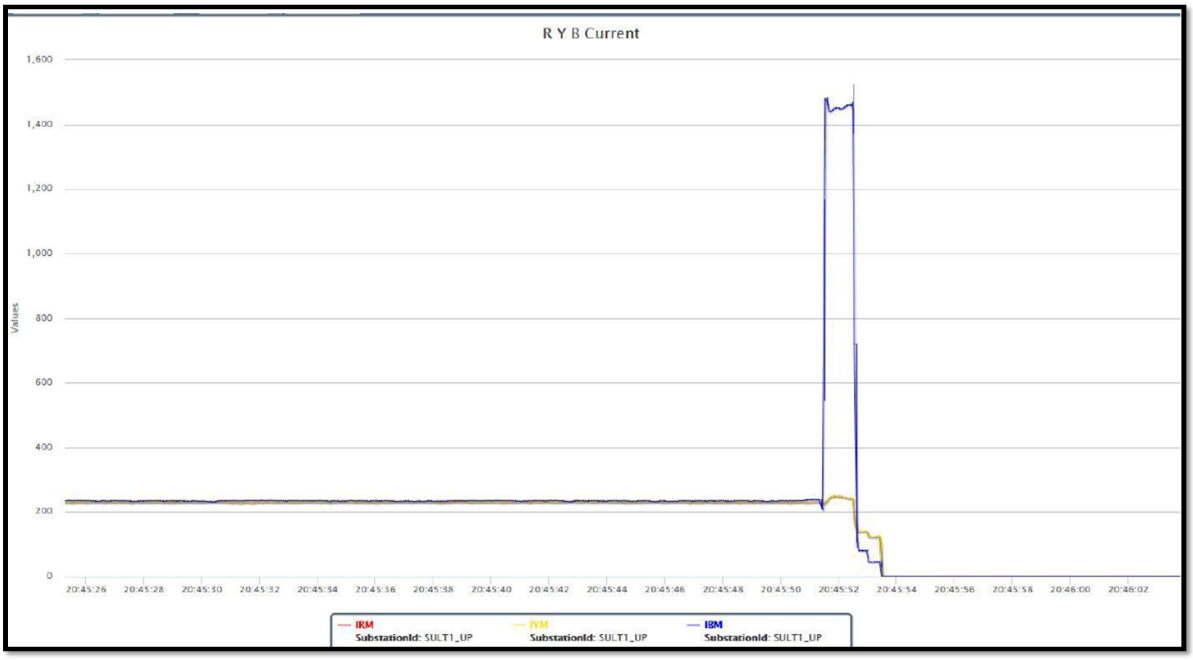


PMU Plot of phase voltage magnitude at Lucknow(PG)

20:45hrs/08-July-18



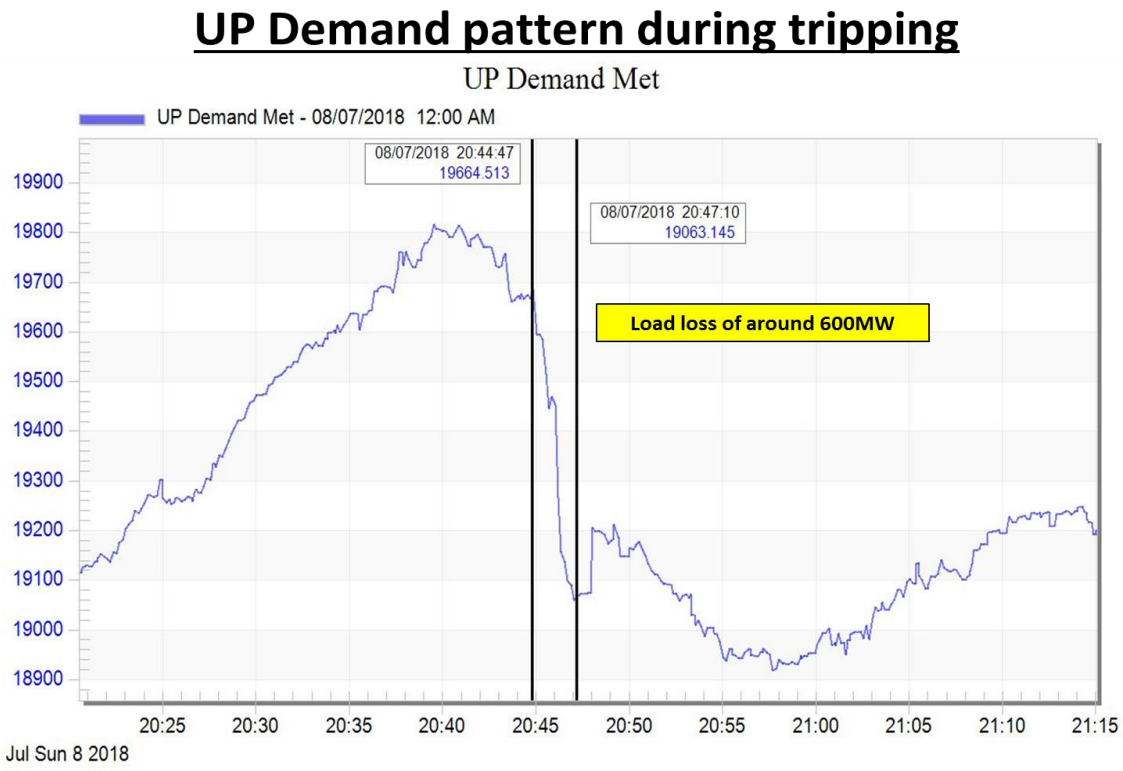
400 kV Sultanpur (UP)-Lucknow (PG) fault current



12. Flag details received from UP:

Sl.no.	Name of transmission line	Time of tripping	Time of closing	Line length	Flags detail	
					At Sultanpur end	At other end
1	400kV Sultanpur - PGCIL, Lucknow	20:45hrs	21:58hrs	163.6km	no flag	Main protection trip, A/R unsuccessful,CB trip. Zone-III, B phase, distance 464km,Fault current= 1.332kA
2	400kV Sultanpur - Azamgarh	20:45hrs	22:35hrs	123.2km	no flag	Gen trip, Y-ph pickup, B-pickup, Zone-III,86 Main & I/C breaker, over voltage alarm, Fault current= 1.14kA, IL3= 1.33kA
3	400kV Sultanpur - Obra	20:45hrs	00:31hrs (09.07.2018)	230km	no flag on line protection. Reactor protection operated 86R.	Main I&II Definitive trip, A/R block, L2-E ON, L3-E ON,Dist loop L2-3f, Dist 139.1%, IL1= 0.53kA IL2= 1.69kA IL3 = 1.54kA

13. As per SCADA Analog data:



14. Sequence of events (As per SCADA data):

Time (in hrs)	Station	Voltage	Element	Device	Status
20:46:09.026	AZAM1_UP	400kV	5T2SU1	CB	Open
20:46:16.944	AZAM1_UP	400kV	4GRK1SU1	CB	Open

15. As per PMU & SCADA data:
    - Y-B fault occurred at 20:45:51.440hrs and cleared at 20:45:53.480hrs. Hence. Delayed clearance of fault in 2040ms observed.
    - Opening of both Sultanpur CBs (Azamgarh station has ring main bus scheme) from Azamgarh is observed at 20:46:09.026hrs and 20:46:16.944hrs.
    - No other tripping captured in SoE.

16. Preliminary Report DR/EL and Detailed Report received from UPPTCL.

Discussion Points*:*

1. The fault seems to be a bus fault. Hence, availability of bus bar protection at 220kV Sultanpur (UP) and its operation at the time of tripping to be confirmed.
2. Setting of backup overcurrent protection of 400/220kV ICTs at Sultanpur to be shared. The setting needs to be revised and coordinated with distance protection of 400kV lines.
3. Non-tripping of 220kV lines in Z-2/3, Reverse zone to be looked into.
4. Reason for fault clearance if all the 400/220kV ICTs and 220kV lines were manually opened to be shared.
5. 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.
6. Availability of DR/EL and extracting software at 400/220 kV Sultanpur(UP) needs to be looked into.

Uttar Pradesh may elaborate the incident, submit the required details and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

N. Multiple Element tripping at 400kV Rajpura (Punjab) on 23rd July 2018 at 03:15hrs

Event category: GD-1
Generation loss: 650MW (Punjab may confirm)
Loss of load: Mil (As per Punjab Report)
Energy Loss: Nil MU (As per Punjab Report)

Data Summary received at NRLDC:

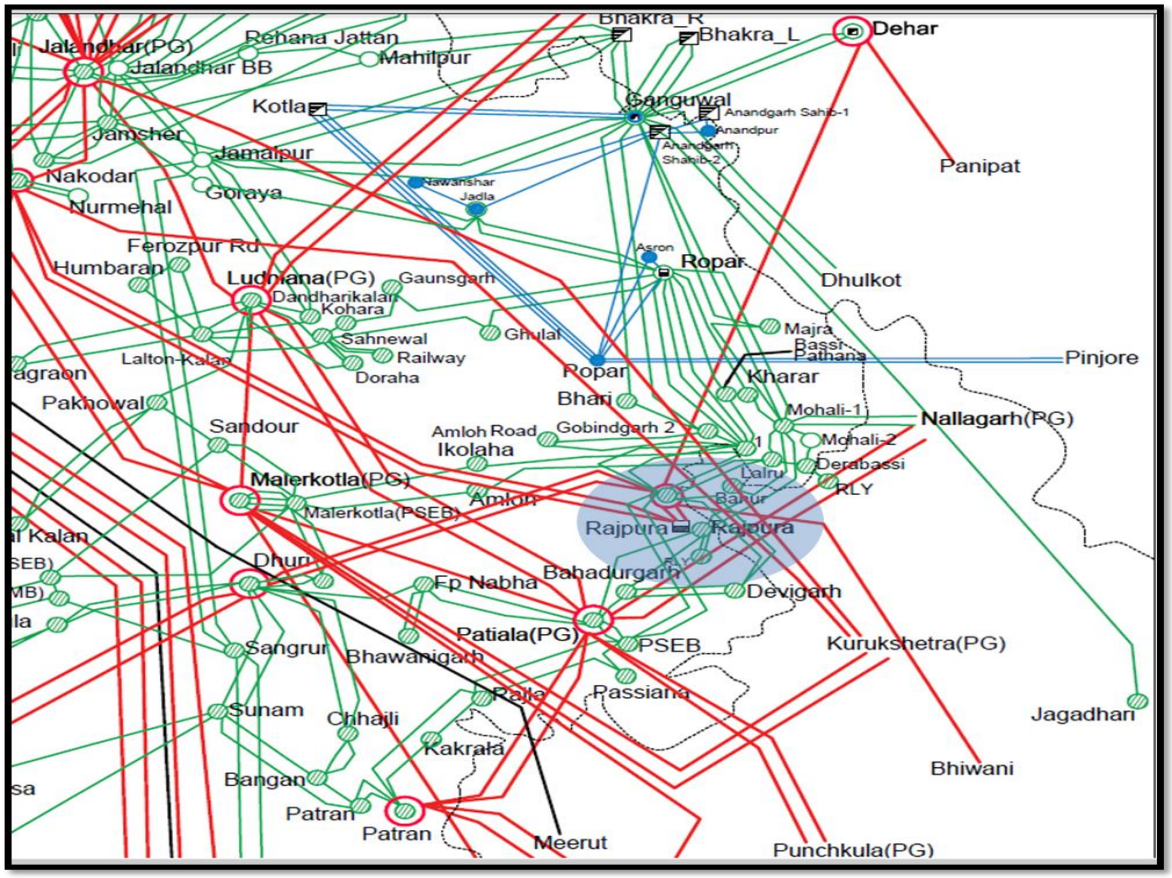
Description	Reference	Fault Info	Remarks
Fault Clearance Time	As per PMU data	**100ms**	
Phase of the fault	As per PMU data	Dip in all three phase	Bus Fault

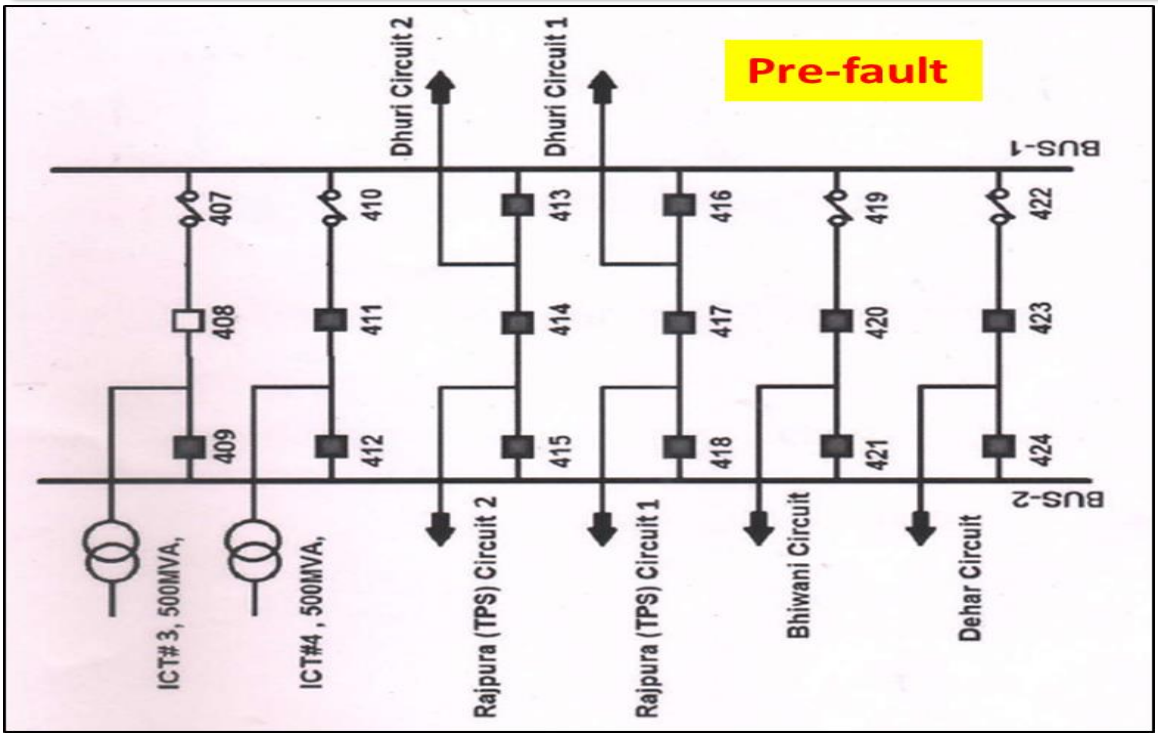
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)	Punjab	Available	
DR/ EL	Punjab	Received	After 24hrs (some DR pending)
	BBMB	Not Received	
Preliminary Report	Punjab	Received	After 24hrs
	BBMB	Not Received	
Detailed Report	Punjab	Received	

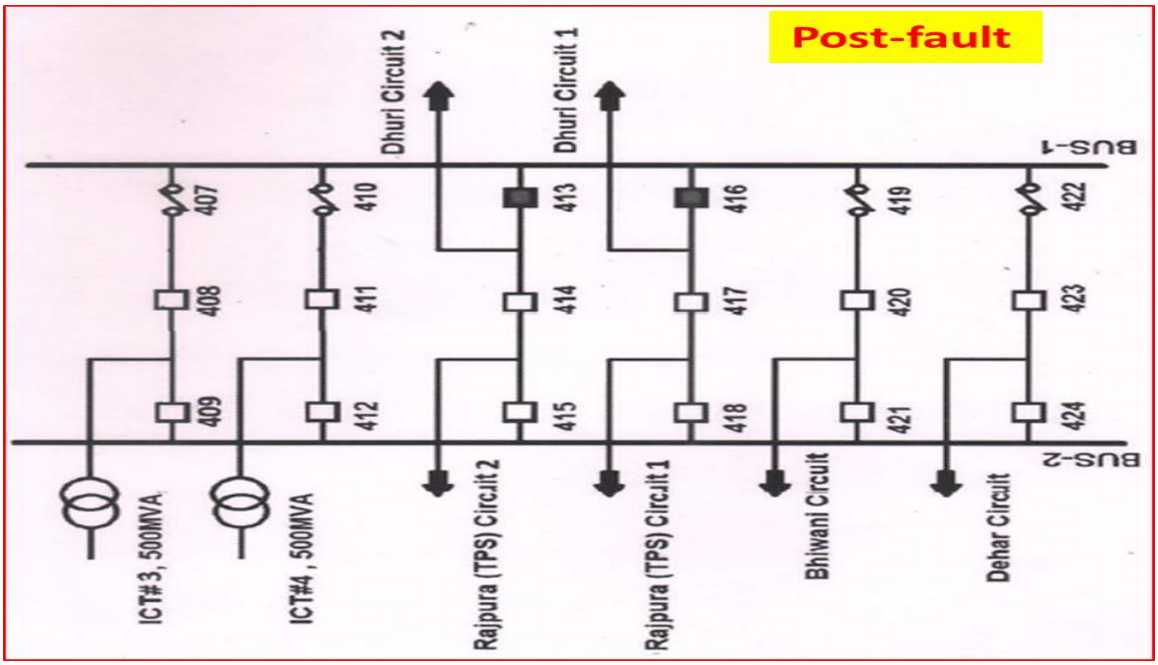
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)	**Punjab**	1. DR/EL, Preliminary report within 24hrs 2. Correct operation of Protection System 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system
	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**BBMB**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report

Based on above information description of the events is:

10. Connectivity Diagram:


Bhakra_R
Bhakra_L
Dehar
Jalandhar(PG)
Rehana Jattan
Jalandhar BB
Mahilpur
Kotla
Jamsher
Jamalpur
Nakodar
Goraya
Nurmehal
Ferozpur Rd
Humbaran
Ludhiana(PG)
Dandharikalan
Kohara
Gaunsgarh
Sahnewal
Railway
Doraha
Lalton-Kalan
Pakhowal
Sandour
Malerkotla(PG)
Malerkotla(PSEB)
Dhuri
Sangrur
Bhawanigarh
Sunam
Chhajli
Bangan
Patran
Patran
Meerut
Nawanshar
Jadla
Ganguwal
Anandgarh Sahib-1
Anandpur
Anandgarh Sahib-2
Panipat
Asron
Ropar
Dhulkot
Majra
Bassi Pathana
Pinjore
Kharar
Ghulal
Ropar
Bhari
Mohali-1
Nallagarh(PG)
Mohali-2
Derabassi
RLY
Lalru
Banur
Amloh Road
Gobindgarh 2
Ikolaha
Amloh
Rajpura
Rajpura
Bahadurgarh
Devigarh
Fp Nabha
Patiala(PG)
PSEB
Kurukshetra(PG)
Passiana
Kakrala
Jagadhari
Bhiwani
Punchkula(PG)

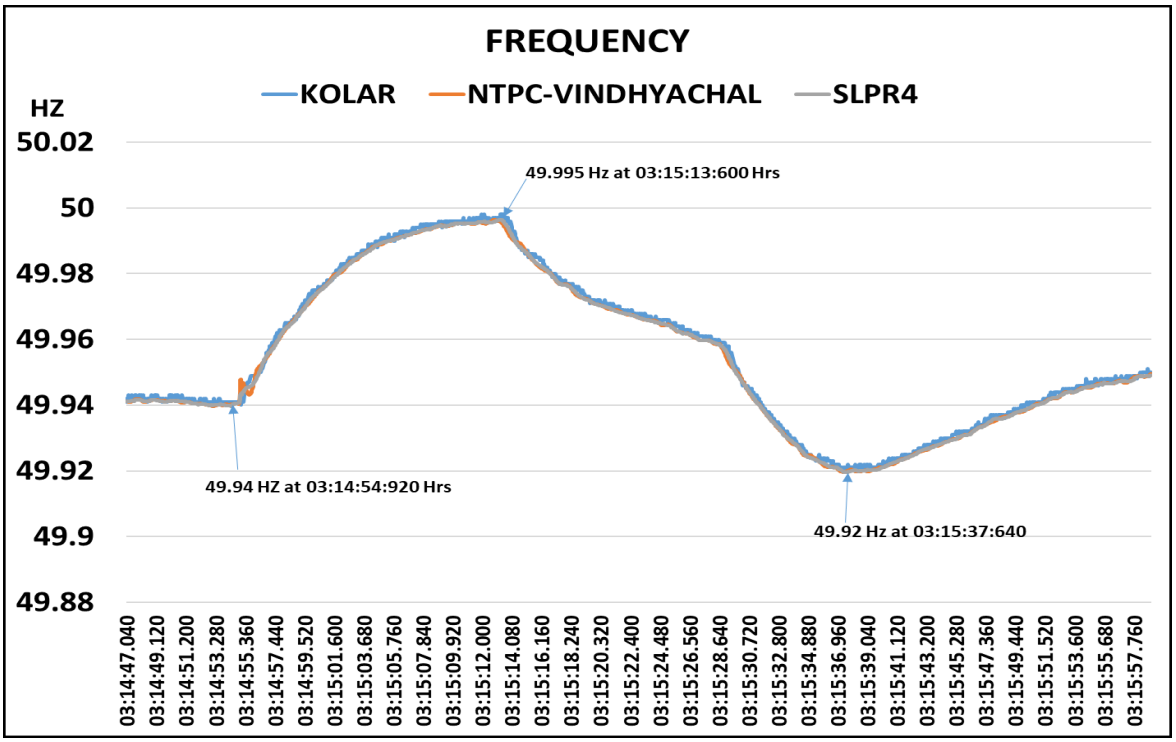

Pre-fault
Dhuri Circuit 2
Dhuri Circuit 1
BUS-1
BUS-2
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
ICT# 3, 500MVA,
ICT#4 , 500MVA,
Rajpura (TPS) Circuit 2
Rajpura (TPS) Circuit 1
Bhiwani Circuit
Dehar Circuit



11. At Rajpura (PSTCL), optical cable wire broke and fell on 400kV bus-2 at 400/220 kV Rajpura (PSTCL).
12. This resulted in operation of bus bar protection for 400 kV bus-2 and all CBs connected to 400 kV Rajpura (PSTCL) bus-2 tripped.
13. At the same time, tie CBs of feeders also tripped mainly due to wrong mapping of function in relay. The same has been reportedly corrected.
14. In antecedent condition:
    - Tie CB of 400/220kV ICT #3 already open (Dia not completed as future bay.

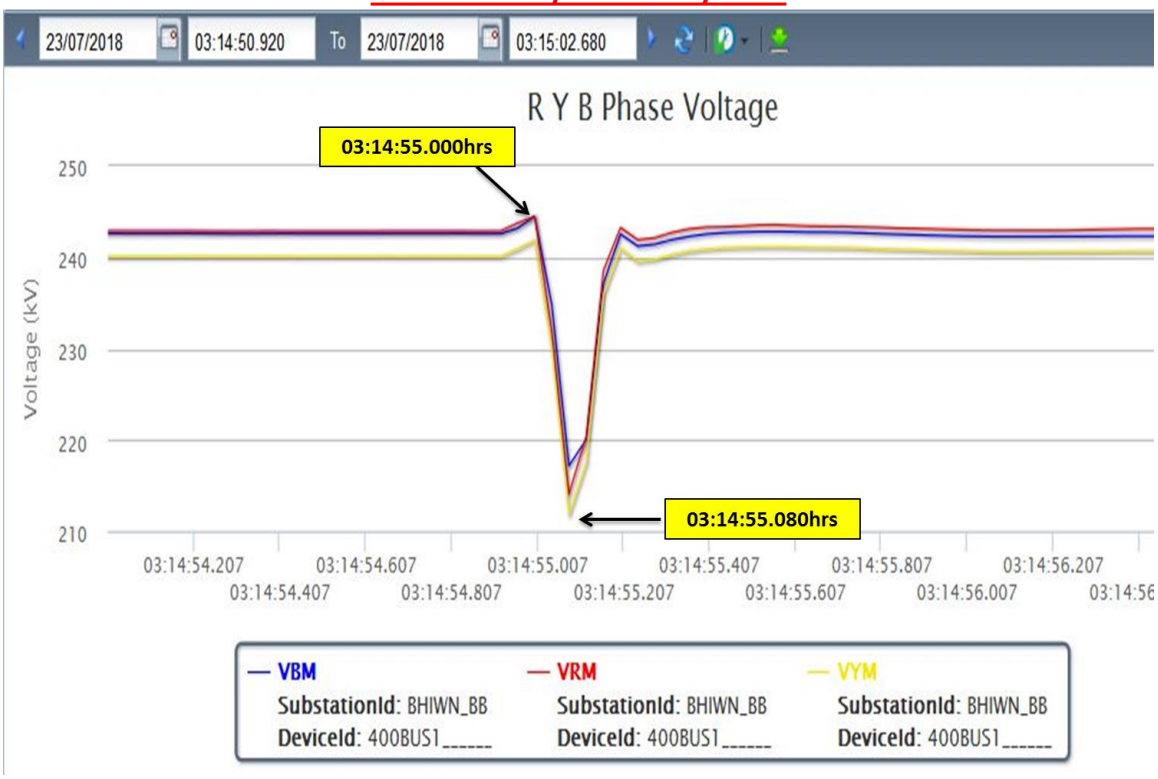
15. Name of the tripped elements:
    - Unit 1 and 2 at Rajpura Thermal
    - 400kV Rajpura-Rajpura Thermal D/C
    - 400kV Rajpura-Bhiwani
    - 400kV Rajpura-Dehar
    - 500MVA ICT 3&4 at Rajpura

16. PMU plot of frequency, df/dt and phase voltages:



PMU Plot of phase voltage magnitude at Bhiwani(BBMB)

03:15hrs/23-July-18



17. As per SCADA SoE:

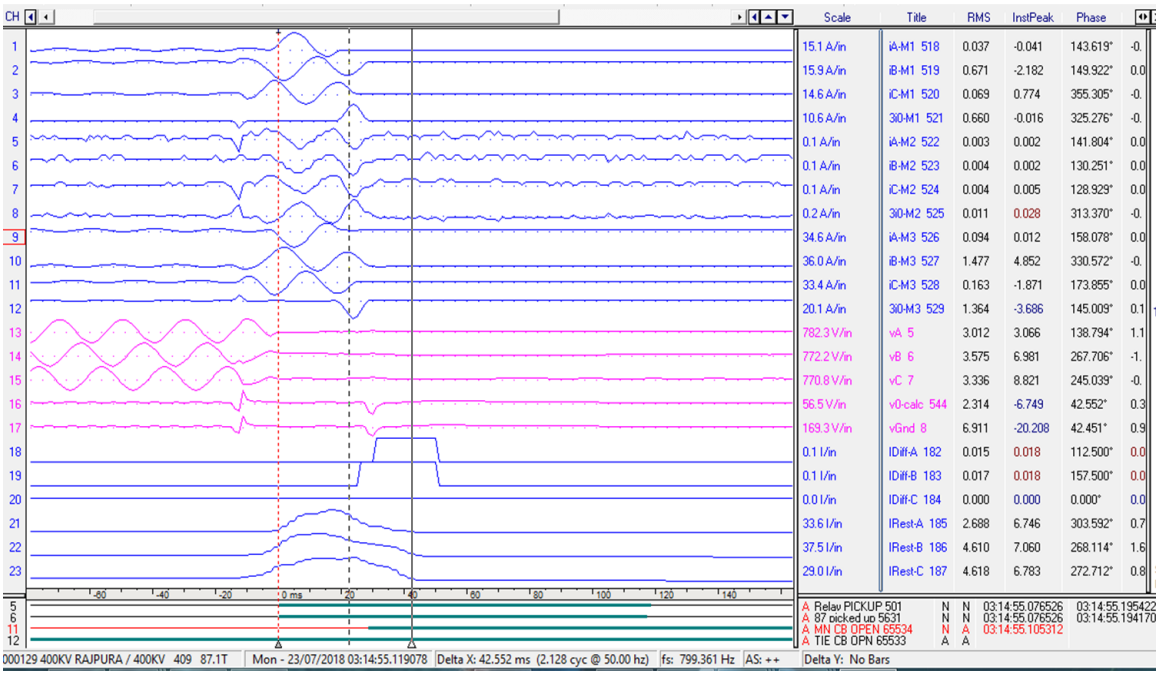
Time	Time Duration (in ms)	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
03:14:55:000	0ms	PMU data					Reference Time
03:14:55:085	85ms	RAJPURA	400kV	21BHIWNI	Circuit Breaker	disturbe	
03:14:55:088	90ms	RAJPURA	400kV	24DEHAR	Circuit Breaker	disturbe	
03:14:55:097	95ms	RAJPURA	400kV	21BHIWNI	Circuit Breaker	Open	Main CB of 400 kV Rajpura(end)-Bhiwani opens
03:14:55:098	100ms	RAJPURA	400kV	24DEHAR	Circuit Breaker	Open	Main CB of 400 kV Rajpura(end)-Dehar opens
03:14:55:104	105ms	RAJPURA	400kV	20LI1BWN	Circuit Breaker	disturbe	
03:14:55:108	110ms	RAJPURA	400kV	23LI2DHR	Circuit Breaker	disturbe	
03:14:55:115	115ms	RAJPURA	400kV	20LI1BWN	Circuit Breaker	Open	Tie CB of 400 kV Rajpura(end)-Bhiwani opens { 400 kV Rajpura(end)-Bhiwani opens}
03:14:55:120	120ms	RAJPURA	400kV	23LI2DHR	Circuit Breaker	Open	Tie CB of 400 kV Rajpura(end)-Dehar opens { 400 kV Rajpura(end)-Dehar opens}
03:14:55:140	140ms	RAJPURA	400kV	F_6 (BUS	Circuit Breaker	disturbe	
03:14:55:143	145ms	RAJPURA	400kV	F_6 (BUS	Circuit Breaker	disturbe	
03:14:55:146	145ms	RAJPURA	400kV	F_6 (BUS	Circuit Breaker	Open	
03:14:55:148	150ms	RAJPURA	400kV	F_6 (BUS	Circuit Breaker	Open	
03:14:55:248	250ms	RAJPURA	400kV	18RAJPR1	Circuit Breaker	Open	Main CB of 400 kV Rajpura(end)-Rajpura(TH) Ckt-1 opens
03:14:55:333	335ms	RAJPURA	400kV	14DHRJP2	Circuit Breaker	Open	Tie CB of 400 kV Rajpura(end)-Rajpura(TH) Ckt-2 opens
03:14:55:370	370ms	RAJPURA	400kV	15RAJPR2	Circuit Breaker	Open	Main CB of 400 kV Rajpura(end)-Rajpura(TH) Ckt-2 opens { 400 kV Rajpura(end)-Rajpura(TH) Ckt-2 opens}
03:14:55:666	665ms	RAJPURA	400kV	17DHRJP1	Circuit Breaker	Open	Tie CB of 400 kV Rajpura(end)-Rajpura(TH) Ckt-1 opens { 400 kV Rajpura(end)-Rajpura(TH) Ckt-1 opens}
03:14:57:137	2135ms	RAJPURA	220	5T3	Circuit Breaker	disturbe	
03:14:57:138	2140ms	RAJPURA	400kV	F_5 (K'D	Circuit Breaker	disturbe	
03:14:57:139	2140ms	RAJPURA	400kV	F_5 (K'D	Circuit Breaker	Open	
03:14:57:143	2145ms	RAJPURA	220	5T3	Circuit Breaker	Open	Main CB of 220kV Side of 500MVA ICT3 opens
03:14:57:145	2145ms	RAJPURA	220	6T4	Circuit Breaker	disturbe	
03:14:57:146	2145ms	RAJPURA	220	6T4	Circuit Breaker	Open	Main CB of 220kV Side of 500MVA ICT4 opens

18. As per PMU and SCADA data:

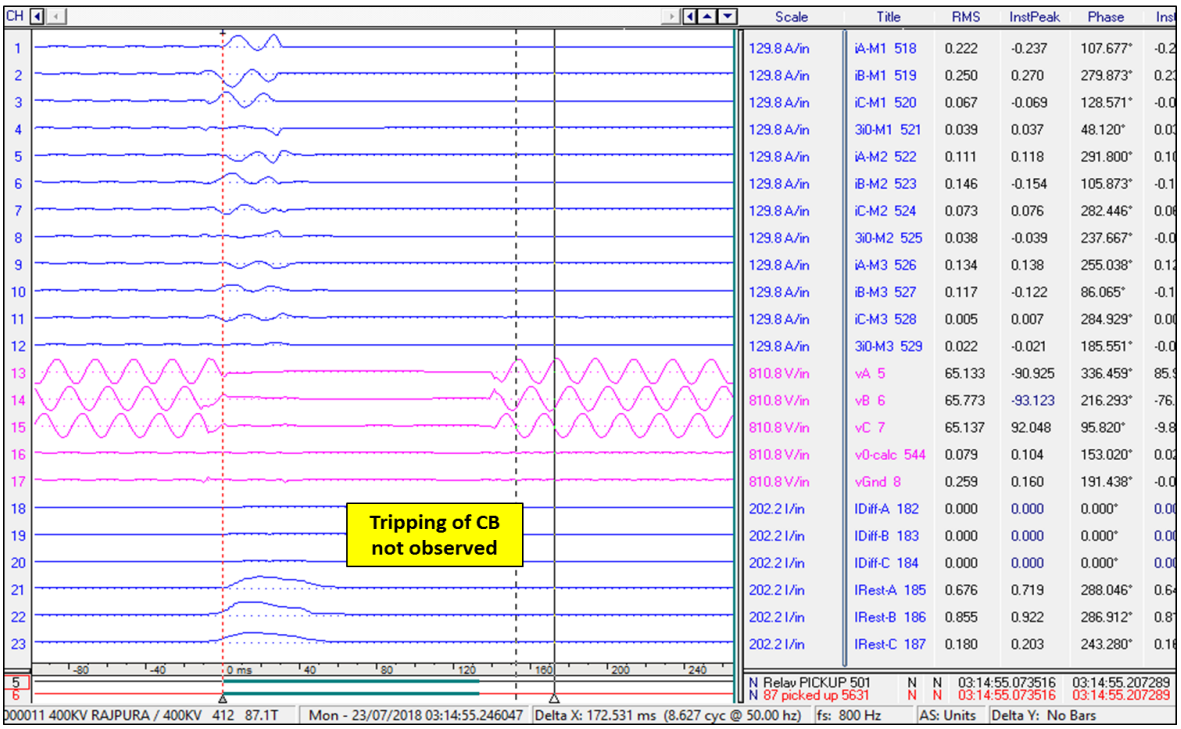
- 3-phase fault observed at 03:14:55.000hrs and got timely cleared.
- Tripping of main Tie CBs of all tripped ckts captured in SoE except 400kV side CBs of ICTs.
- It seems CB of bay 414, 415, 417 & 418 opened with time delay

19. As per DR details:

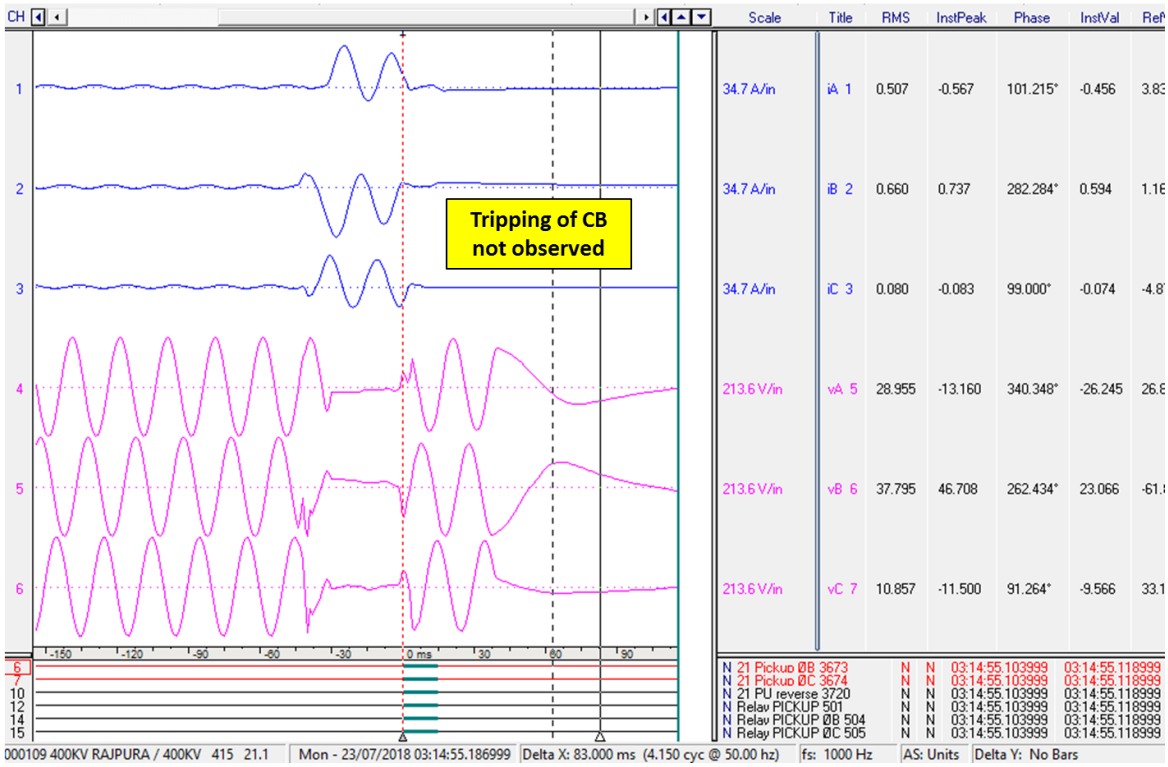
DR: 400/220kV ICT #3 at Rajpura (PSTCL)



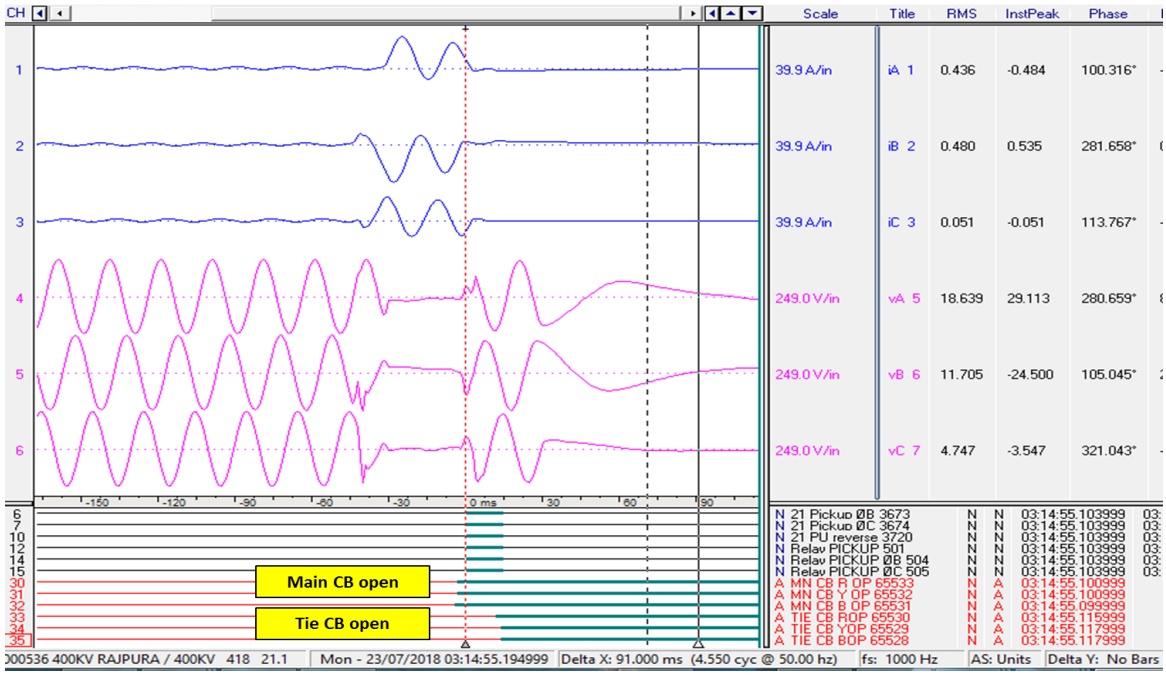
DR: 400/220kV ICT #4 at Rajpura



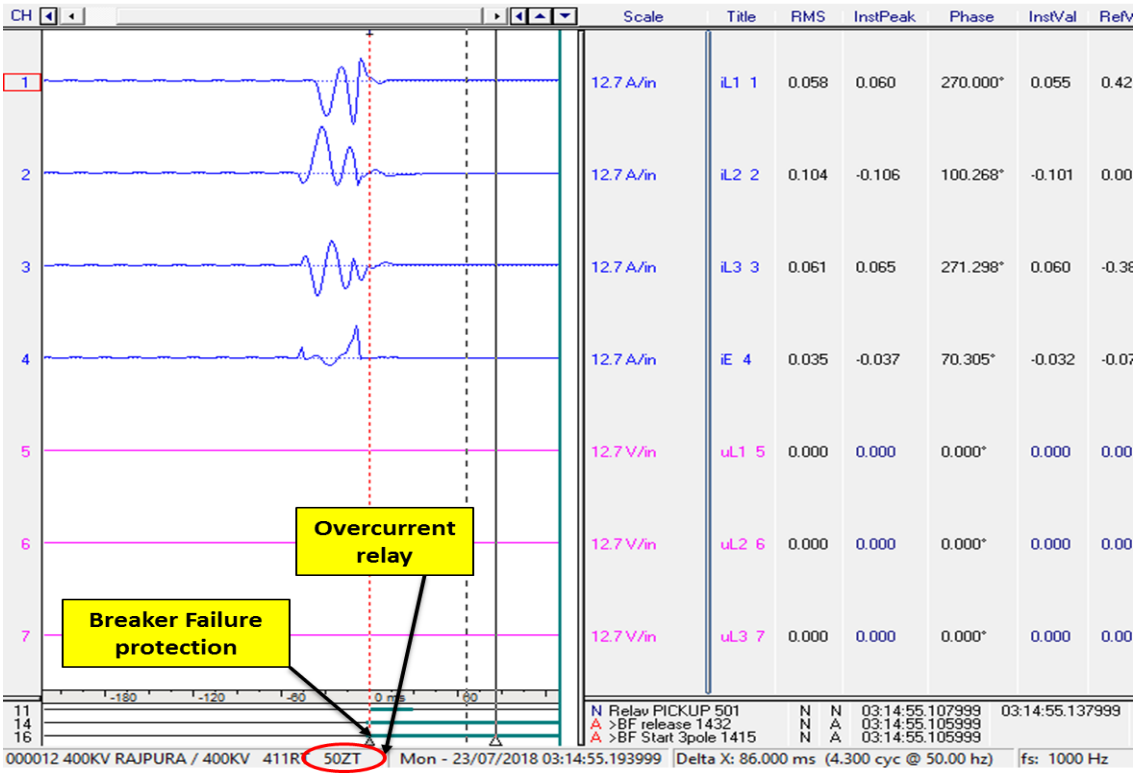
DR: 400kV Rajpura(end)-Rajpura TPS-1



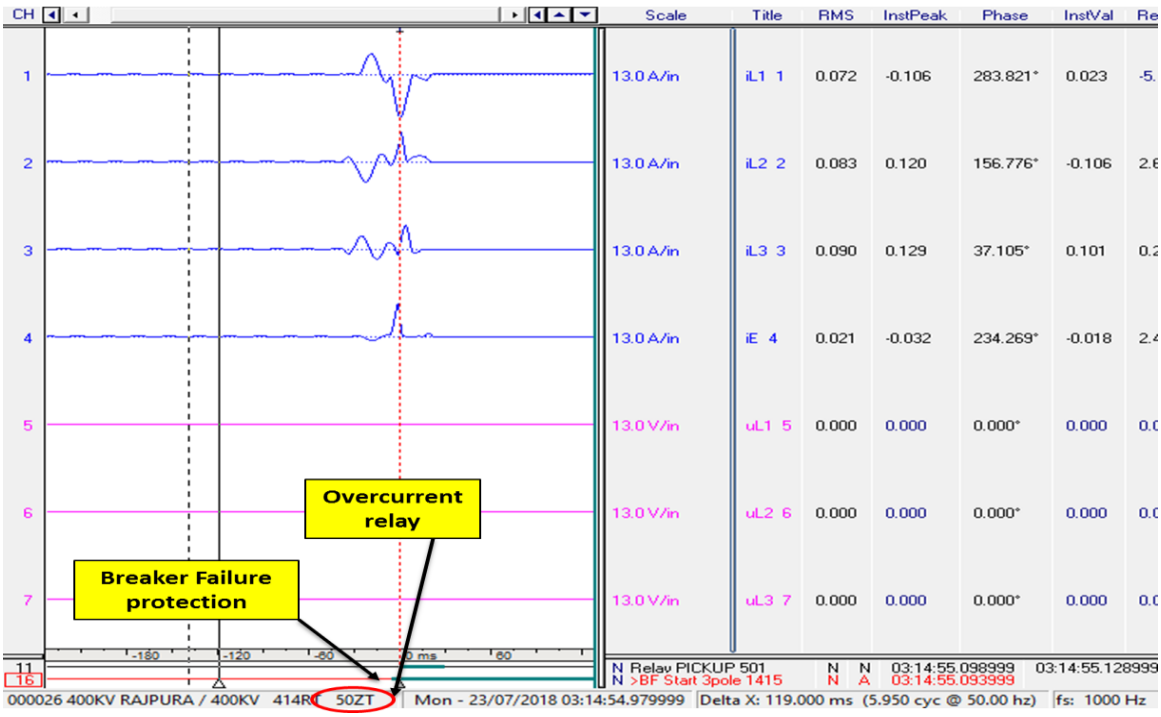
DR: 400kV Rajpura(end)-Rajpura TPS-2



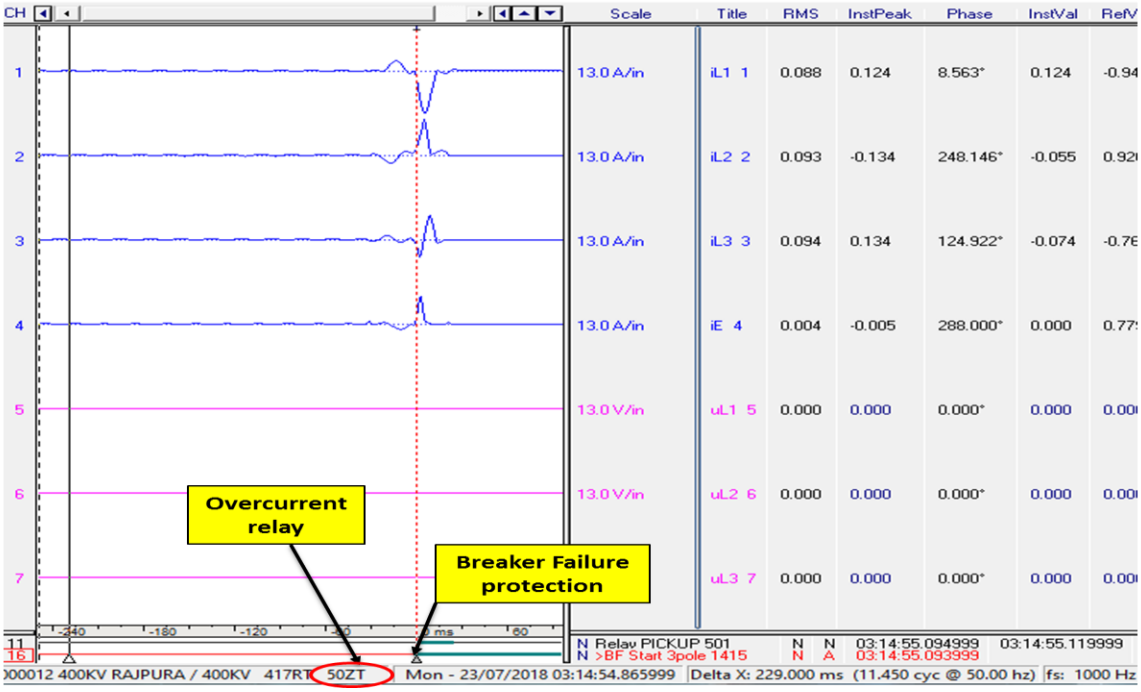
DR: bay 411 (Tie CB of ICT #4) at Rajpura



DR: bay 414 (Tie of Rajpura TPS-2 & Dhuri-2) at Rajpura



DR: bay 417 (Tie of Rajpura TPS-1 & Dhuri-1) at Rajpura



Event Log: Bay 415 (Rajpura TPS-2, main)

CB open indication at 03:14:55.370hrs

Individual phases opened at 03:14:55.105hrs

Event Log - 23-07-18 - 400KV RAJPURA / 400KV / 415 / BCU_415/6MD663 V04.83.03(3)

Number	Indication	Value	Date and time	Cause	State
170.0065.01	25 voltage V1 too low	ON	23.07.2018 06:33:48.937	Spontaneous Com.Issued=AutoLocal	
170.0043.01	>25 funct.group 1 measurement only	ON	23.07.2018 06:33:48.932	Spontaneous Com.Issued=AutoLocal	
	52 CB	CLOSE	23.07.2018 06:33:39.295	Select before Operate Positiv Command Issued=SICAM	
	52 CLIL	ON	23.07.2018 05:37:12.492	Spontaneous Com.Issued=AutoLocal	
	86.2 Optd	OFF	23.07.2018 05:37:12.456	Spontaneous	
	86.1 Optd	OFF	23.07.2018 05:37:11.008	Spontaneous	
	89B OprCnt	62	23.07.2018 05:31:40.185	Spontaneous Com.Issued=AutoLocal	
	89B ISO	CLOSE	23.07.2018 05:31:40.177	Spontaneous	
	89B ISO	Intermediate Position	23.07.2018 05:31:37.717	Spontaneous	
	89B OprCnt	61	23.07.2018 05:06:42.735	Spontaneous Com.Issued=AutoLocal	
	89B ISO	OPEN	23.07.2018 05:06:42.735	Spontaneous	
	89B ISO	Intermediate Position	23.07.2018 05:06:38.951	Spontaneous	
	CB OprCnt	169	23.07.2018 03:14:55.375	Spontaneous Com.Issued=AutoLocal	
	89B CLIL	ON	23.07.2018 03:14:55.371	Spontaneous Com.Issued=AutoLocal	
	89B OPIL	ON	23.07.2018 03:14:55.371	Spontaneous Com.Issued=AutoLocal	
	89A OPIL	ON	23.07.2018 03:14:55.371	Spontaneous Com.Issued=AutoLocal	
	89A CLIL	ON	23.07.2018 03:14:55.371	Spontaneous Com.Issued=AutoLocal	
	52 CLIL	OFF	23.07.2018 03:14:55.370	Spontaneous Com.Issued=AutoLocal	
	52 CB	OPEN	23.07.2018 03:14:55.370	Spontaneous Com.Issued=AutoLocal	

Event Log - 23-07-18 - 400KV RAJPURA / 400KV / 415 / BCU_415/6MD663 V04.83.03(4)

Number	Indication	Value	Date and time	Cause
02703	>BLOCK 79	ON	23.07.2018 03:14:55.369	Spontaneous Com.Issued=AutoLocal
02783	79: Auto recloser is blocked	ON	23.07.2018 03:14:55.370	Spontaneous Com.Issued=AutoLocal
	CB Y OprCnt	176	23.07.2018 03:14:55.115	Spontaneous Com.Issued=AutoLocal
	52 CB YPH	OPEN	23.07.2018 03:14:55.106	Spontaneous
	CB B OprCnt	182	23.07.2018 03:14:55.105	Spontaneous Com.Issued=AutoLocal
	CB R OprCnt	182	23.07.2018 03:14:55.105	Spontaneous Com.Issued=AutoLocal
	86.1 Optd	ON	23.07.2018 03:14:55.105	Spontaneous
	86.2 Optd	ON	23.07.2018 03:14:55.103	Spontaneous
	52 CB BPH	OPEN	23.07.2018 03:14:55.103	Spontaneous
	52 CB RPH	OPEN	23.07.2018 03:14:55.103	Spontaneous

Event Log: Bay 418 (Rajpura TPS-1, main)

Event Log - 23-07-18 - 400KV RAJPURA / 400KV / 418 / BCU_418/6MD663 V04.83.03(8)

Number	Indication	Value	Date and time	Cause	State
	CBLWOILAL	OFF	23.07.2018 03:14:57.046	Spontaneous	
	CBLWOILAL	ON	23.07.2018 03:14:57.028	Spontaneous	
	CBLWOILAL	OFF	23.07.2018 03:14:56.974	Spontaneous	
	CBLWOILAL	ON	23.07.2018 03:14:56.957	Spontaneous	
	CBLWOILAL	OFF	23.07.2018 03:14:56.822	Spontaneous	
	CBLWOILAL	ON	23.07.2018 03:14:56.814	Spontaneous	
	CBLWOILAL	OFF	23.07.2018 03:14:56.752	Spontaneous	
	CBLWOILAL	ON	23.07.2018 03:14:56.736	Spontaneous	
	CBLWOILAL	OFF	23.07.2018 03:14:56.602	Spontaneous	
	CBLWOILAL	ON	23.07.2018 03:14:56.588	Spontaneous	
	CBLWOILAL	OFF	23.07.2018 03:14:56.530	Spontaneous	
	CBLWOILAL	ON	23.07.2018 03:14:56.517	Spontaneous	
	416 LCVT SEL	OFF	23.07.2018 03:14:56.193	Spontaneous Com.Issued=AutoLocal	
	89L OPIL	ON	23.07.2018 03:14:56.192	Spontaneous Com.Issued=AutoLocal	
	89L CLIL	ON	23.07.2018 03:14:56.192	Spontaneous Com.Issued=AutoLocal	
	.417 CB	OPEN	23.07.2018 03:14:55.668	Spontaneous Com.Issued=AutoLocal	

Tie CB (417) opened at 03:14:55.680hrs

20. As per Punjab Report:

Element Tripped: - Rajpura (400 kV) – Rajpura (NPL) circuit 1 & 2, Rajpura (400 kV) - 400kV Bhiwani ckt, Rajpura (400 kV) – 400kV Dehar ckt, 400kV Bus-Bar 2 and ICT 3 & 4 tripped at 400 kV Rajpura Sub-Station PSTCL

Ref : Preliminary Report No: NR_GD_GI/1314 Dated 23.07.2018

1.	Confirm the actual load loss.	NIL MW
2.	Reason of bus fault.	-
3.	Action being taken to prevent such incident in future.	-
4.	Reason of delayed clearance of fault as per IEGC.	-

5	Detailed Report	
a.	Time and date of event (GPS Sync time)	**23.July.18 03:15:00 Hrs**
b.	Location.	Rajpura (Punjab)
c.	Plant and/or Equipment directly involved.	**Rajpura Thermal circuit 1 & 2, 400kV Bhiwani ckt, 400kV Dehar ckt, 400kV Bus-Bar 2 and I CT 3&4 at Rajpura, PSTCL**
d.	Single line diagram showing the connection (isolators) of various 220 KV lines, bus coupler, ICT's etc	-
e.	Description and cause of event.	Optical cable broke and fallen on Bus-Bar 2
f.	Antecedent conditions of load and generation, including frequency, voltage and the flows in the affected area.	Generation Loss- Load Loss- NIL MW Frequency – 50.02 Hz Voltage – 415 kV
g.	Time duration of tripping including Weather Condition prior to the event.	Weather Condition - Cloudy
h.	Duration of interruption and Demand and/or Generation (in MW and MWh) interrupted.	Nil
i.	All Relevant system data including copies of records of all recording instruments including Disturbance Recorder, Event Logger, DAS etc of DPR's of affected lines.	Attached
j.	Sequence of tripping with time.	#
k.	Details of Relay Flags.	
l.	Remedial measures.	--

Description and cause of event.	Optical cable broke and fallen on Bus-Bar 2

❖ **400/220kV ICT-3 (Bay 409)**

- Bus-Bar Differential Relay 87BB sensed the fault and picked up at 03:14:55:076 Hrs
- 87BB issued the Trip command instantaneously
- Tie CBs of Bay 408 was already in open state and Main CBs open detected after 48 msec.

❖ **400/220kV ICT-4 (Bay 412)**

- Disturbance was observed at 03:14:55:064 Hrs
- Bus-Bar Differential Protection Relay picked up at 03:14:55:076 Hrs
- 87BB picked up the fault at 03:14:55:076 and issued the Trip command instantaneously
- Main CBs was opened at 03:14:55:105 Hrs and thus clear the Fault at 03:14:55:124 Hrs
- Tie CBs also got opened at 03:14:55:129 Hrs and it was found that the address #6201 having function 'Configuration of Signal Relay' was wrongly set to Function No. 7631 'Busbar Protection: Trip in phase L123' which lead to tripping signal being issued to Tie CBs. It is now corrected to Function No. 7639 'Busbar Protection: Intertrip'.

❖ **400kV Rajpura Thermal (NPL) ckt-2 (Bay 415)**

- Disturbance was recorded in Distance Protection Relay at 03:14:55:062 Hrs and got picked up for reverse fault of phase Yellow and Blue phase at 03:14:55:104 Hrs
- 87BB picked up the fault at 03:14:55:079 and issued the Trip command instantaneously to three phases
- Main CBs open detected at 03:14:55:114 Hrs
- LBB Relay was operated and Direct Trip was sent to other end due to the wrong addressing of #6201 to Function No. 7631 'Busbar Protection: Trip in phase L123' .This also lead to tripping signal being issued to Tie CBs and opened the Tie CBs at 03:14:55:119 Hrs. It is now corrected to Function No. 7639 'Busbar Protection: Intertrip'.

❖ **400kV Rajpura Thermal (NPL) ckt-1 (Bay 418)**

- Disturbance was recorded in Distance Protection Relay at 03:14:55:064 Hrs and got picked up for reverse fault of phase Yellow and Blue phase at 03:14:55:104 Hrs
- 87BB picked up the fault at 03:14:55:074 and issued the Trip command instantaneously to three phases
- Main CBs open detected at 03:14:55:101 Hrs
- LBB Relay was operated and Direct Trip was sent to other end due to the wrong addressing of #6201 to Function No. 7631 'Busbar Protection: Trip in phase L123' .This also lead to tripping signal being issued to Tie CBs and opened the Tie CBs at 03:14:55:116 Hrs. It is now corrected to Function No. 7639 'Busbar Protection: Intertrip'.

❖ **400kV Bhiwani (Bay 421)**

- Distance Protection Relay (Main-2) picked the fault in reverse zone at 03:14:55:081 Hrs
- Fault current entered in 87BB at 03:14:55:064 Hrs and it got picked after 14 msec and instantly issued the trip command to three phases
- Main CBs were detected open at 03:14:55:111 Hrs
- Tie CB B phase open detected at 03:14:55:129 Hrs. Tie CB tripped due to the reason mentioned in the above circuits and wrong addressing of #6201 to Function No. 7631 'Busbar Protection: Trip in phase L123' now corrected to Function No. 7639 'Busbar Protection: Intertrip'.

❖ **400 kV Dehar (Bay 424)**

- Distance Protection Relay (Main-2) pick the fault in reverse zone at 03:14:55:089 Hrs and 86 Master operated after 5 msec
- Main CBs were open detected within 5msec from 03:14:55:111 Hrs
- Tie CB B phase open detected at 03:14:55:129 Hrs. It is assumed that Tie CB tripped due to the reason mentioned in the above circuits but no 'LBB relay operated' or 'Direct trip send' signal was found in the Event log. The current setting of 87BB is now corrected to Function No. 7639 'Busbar Protection: Intertrip'.

❖ **Tie Bay 411**

- Fault current entered at 03:14:55:059 Hrs as LBB Relay recorded and picked up at 03:14:55:108 Hrs
- TCB of R-Y-B phases opened at 03:14:55:132 due to the LBB protection because Local Trip Time was found 0 msec instead of 200 msec. Now it is corrected.

❖ **Tie Bay 414 & 417**

- After fault detected in 87BB of NPL Bays, issued the trip command to Main CBs and due to the wrong setting parameter of of #6201 to Function No. 7631 'Busbar Protection: Trip in phase L123', M1 contact was operated thus issued DT send to remote end and also Trip TCBs of Bay. This opened the Tie CBs. The setting is now corrected to Function No. 7639 'Busbar Protection: Intertrip'.

❖ **Tie Bay 420 & 423**

- 87BB of Main Bay(421,424) issued the trip command to Main CBs and due to the wrong setting parameter of of #6201 to Function No. 7631 'Busbar Protection: Trip in phase L123', M1 contact was operated thus issued DT send to remote end and also Trip TCBs of Bay 420 & 423. It is corrected now.

21. Preliminary Report, DR/EL and detailed report has been received from Punjab.

Action Points:

10. DR of 421 (Bhiwani) and 424 (Dehar) bay are yet to be received. The same needs to be provided.
11. Post fault time in DR of few bays are very less (~100ms only). The same needs to be extended for better analysis of event. (-500ms and +2000ms)
12. Reason for tripping of units at Rajpura TPS to be ascertained and shared.
13. Reason for initiation of LBB protection in few of the Tie bays at Rajpura to be shared.

Points for Discussion:

1. It seems from SCADA SoE and BCU Event Log data that CB of 415 and 417 bay opened after 350ms and 680ms of fault occurrence. However, fault got cleared within 100ms.
2. Reason of rise in frequency first than dip in frequency to be explained.

Punjab may elaborate the incident and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

O. Multiple element tripping at 400/220 kV Panki (UP) at 02:38hrs of 26th July 2018

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

Data Summary received/available at NRLDC:

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

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

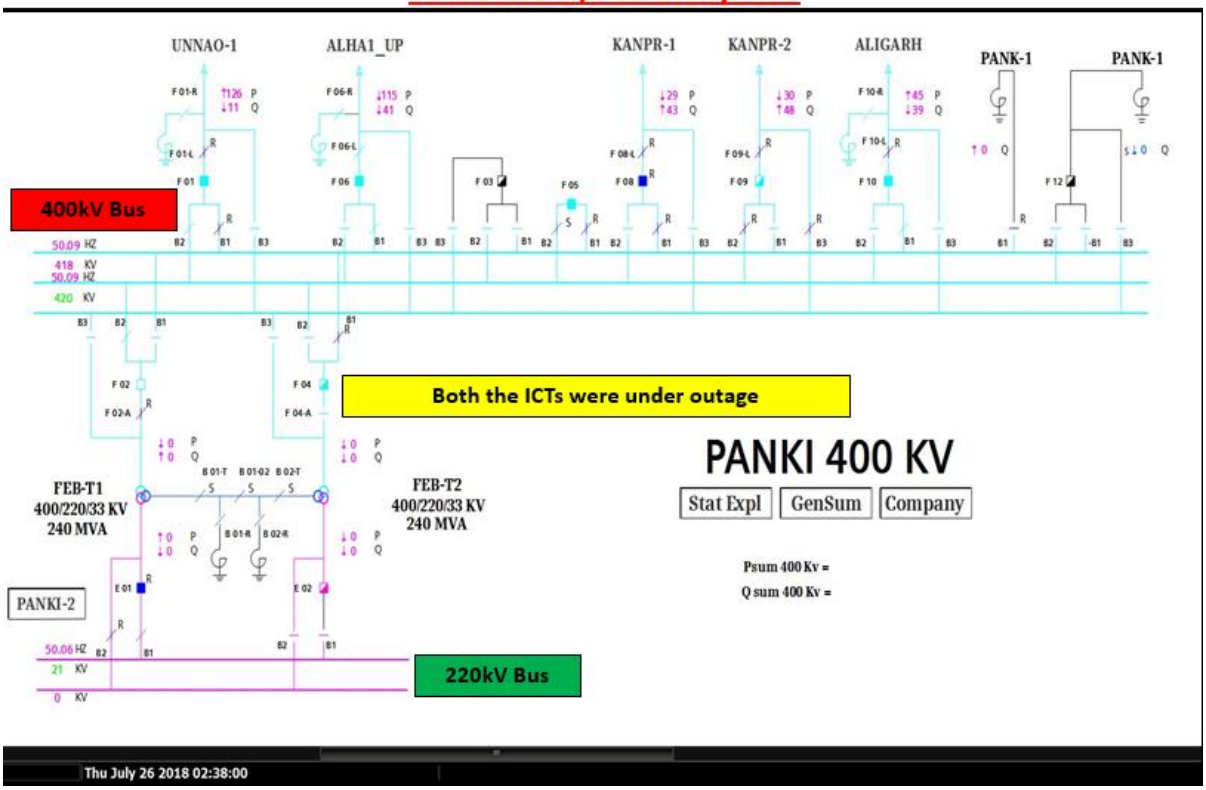
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	**Uttar Pradesh & POWERGRID**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report not received 3. Correct operation of Protection System 4. Adequately Sectionalized and graded protective relaying system 5. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

12. Single Line Diagram:

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

02:38hrs/26-July-18

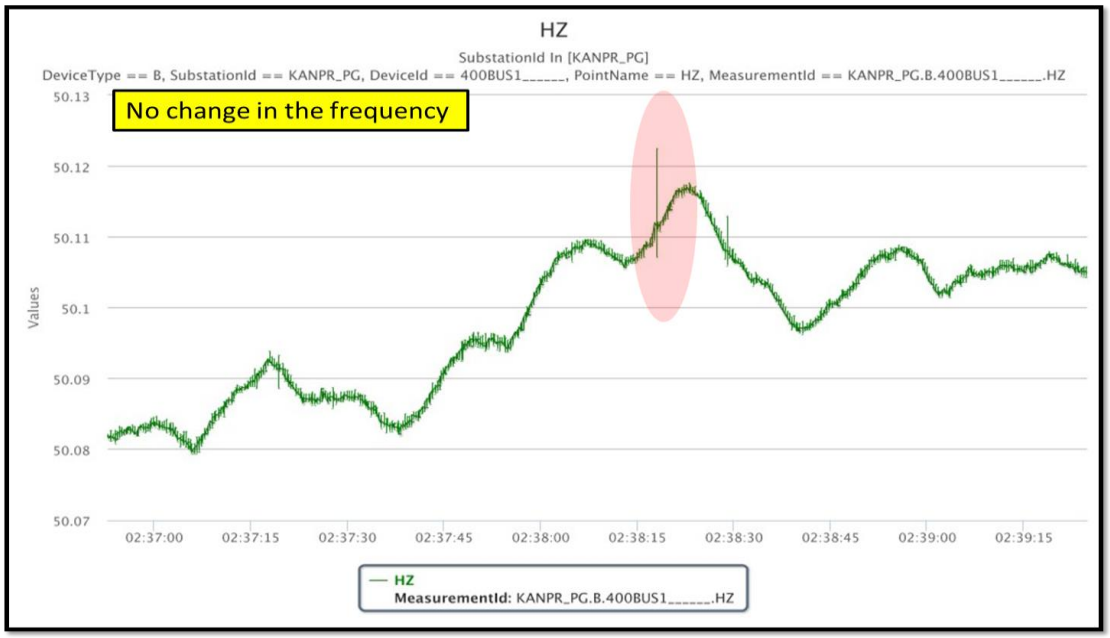


13. 400 kV Panki (UP) is connected with Kanpur (PG) D/C, Unnao (UP) S/C, Aligarh (UP) S/C, Allahabad (UP) S/C. It also have two 400/220 kV ICTs (1*315MVA+1*240MVA).
14. 400 kV Panki (UP) has Double Main Transfer Breaker scheme.
15. 400/220 kV ICT-2 at Panki (UP) was already under long outage from 17.06.2018 due to blast in the ICT-2.
16. 400/220 kV ICT-1 also tripped at 01:35hrs of 26th July 2018.
17. At 02:38hrs, all 400 kV lines from 400 kV Panki (UP) tripped due to DC earth fault at the station.
18. Name of the tripped elements are as below:
    - 400 kV Panki-Kanpur (PG) ckt-1 & 2
    - 400 kV Panki-Unnao (UP) ckt
    - 400 kV Panki-Aligarh (UP) ckt
    - 400 kV Panki-Allahabad (UP) ckt
19. No report received from UPPTCL.

20. PMU plots:

PMU Plot of frequency of Kanpur (PG) station

02:38hrs/26-July-18

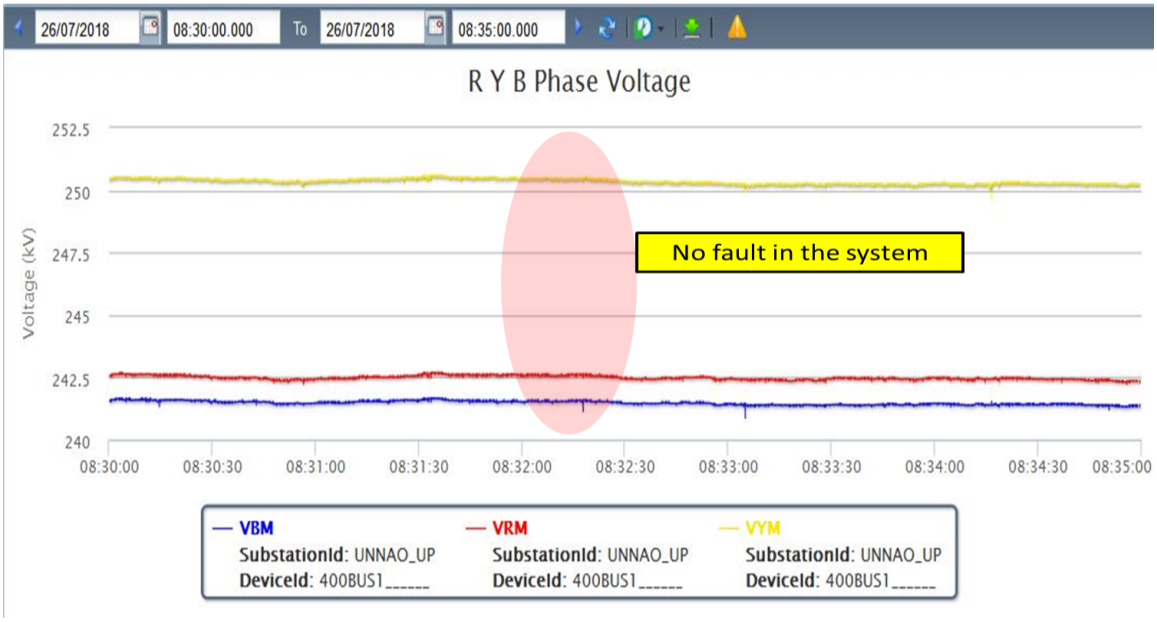


PMU Plot of phase voltage of Kanpur (PG) Bus

02:38hrs/26-July-18

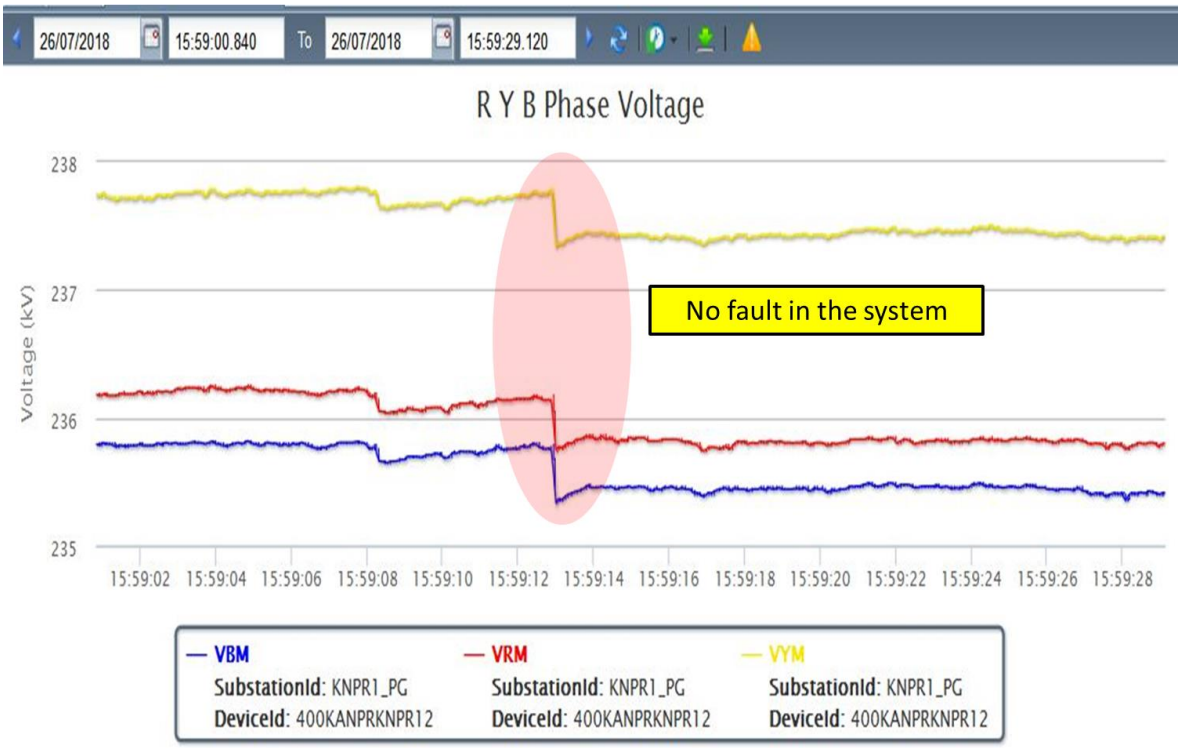
PMU Plot of phase voltage of Unnao(UP) Bus

08:32hrs/26-July-18



PMU Plot of phase voltage of Kanpur(PG)

15:59hrs/26-July-18



21. Sequence of events (As per SCADA data):

Time	S/S Name	Voltage (in kV)	Element Name	Element type	Status	Remarks
02:38:16,385	UNNAO_UP	400kV	F_05(PANK1-1)	Circuit Breaker	Open	UP SoE
02:38:17,397	PANK1_UP	400kV	F_06(OBRAB)	Circuit Breaker	disturbe	UP SoE
02:38:17,434	PANK1_UP	400kV	05MBC	Circuit Breaker	disturbe	UP SoE
02:38:17,437	PANK1_UP	400kV	F_09(KANPR-2)	Circuit Breaker	Open	UP SoE
02:38:17,464	PANK1_UP	400kV	F_01(UNNAO-1)	Circuit Breaker	Open	UP SoE
02:38:17,465	PANK1_UP	400kV	F_10(MUR1N)	Circuit Breaker	Open	UP SoE
02:38:17 ***	KANPUR	400kV	5PAN2FA2	Circuit Breaker	Open	NR SoE
02:38:17,488	PANK1_UP	400kV	F_09(KANPR-1)	Circuit Breaker	Open	UP SoE
02:38:17,748	ALIGR_UP	400	LIPANK1	Protection Trip	App	UP SoE
02:38:17,790	ALIGR_UP	400	04PANK1	Circuit Breaker	Open	UP SoE
02:38:17,792	ALIGR_UP	400	05TIE	Circuit Breaker	Open	UP SoE

Time (in ms)	S/S Name	Voltage (in kV)	Element Name	Element Type	Status	Remarks
08:32:19,988	PANK1_UP	400	F_08(KANPR-1)	Circuit Breaker	Open	UP SoE
08:32:20,251	PANK1_UP	400	F_02(T1)	Circuit Breaker	Open	UP SoE
15:59:06,236	PANK1_UP	400	F_06(OBRAB)	Circuit Breaker	disturbe	UP SoE
15:59:06,238	PANK1_UP	400	F_10(MUR1N)	Circuit Breaker	Open	UP SoE
15:59:06,241	PANK1_UP	400	F_06(OBRAB)	Line Isolator	Open	UP SoE
15:59:06,241	PANK1_UP	400	F_06(OBRAB)	BusBar Isolator 1	Open	UP SoE
15:59:08,246	ALIGR_UP	400	LIPANK1	Protection Trip	App	UP SoE
15:59:08,277	ALIGR_UP	400	05TIE	Circuit Breaker	Open	UP SoE
15:59:08,280	ALIGR_UP	400	04PANK1	Circuit Breaker	Open	UP SoE

22. As per PMU & SCADA data:
    - No fault in the system all the time.

- It seems all the connected elements tripped within 100ms from Panki (UP) end.
- It seems all 400 kV connected elements also tripped from remote end of 400 kV Panki (UP).

23. Preliminary Report DR/EL and Detailed Report is still awaited from UPPTCL.

Discussion Points:

5. Complete station outage due to DC earth fault is serious cause of concern and same needs to be explained.
6. Reason of tripping of connected 400 kV elements from remote end of 400 kV Panki (UP).
7. Exact reason of complete station outage and sequence of tripping needs to be submitted with supporting details from the station end.
8. Remedial measures taken report to be shared.
9. Availability and healthiness of bus bar protection at 400 kV Panki (UP) at the time of tripping to be shared.

UP may elaborate the incident, submit the required details and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

P. Multiple element tripping at 400/220 kV Suratgarh STPS (Raj) at 12:08hrs of 01st Aug 2018

Event category: GD-1
Generation loss: 380 MW (Rajasthan may confirm)
Loss of load: Nil (Rajasthan may confirm)
Energy Loss: Nil (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	100ms	
Phase of the fault	PMU data	Y-N fault	

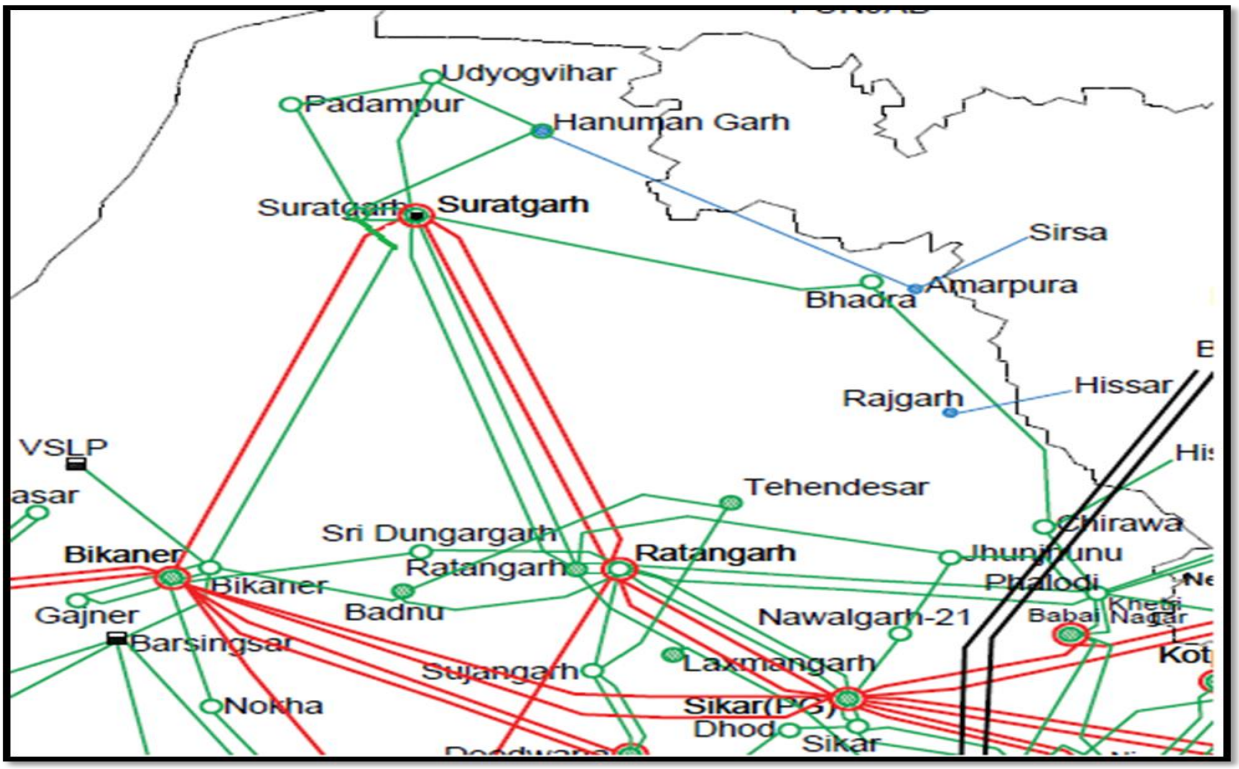
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Available	Time Synch Error

DR/EL	Rajasthan	Received (only Event Logger)	Numerical protection was not available
Preliminary Report	Rajasthan	Received	After 24hrs
Detailed Report	Rajasthan	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	**Rajasthan**	1. Detailed Report didn't provide 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system 4. Non-availability of numerical bus bar protection at 220kV and above station 5. Non availability of DR for 400/220 kV ICTs

Based on above information description of the events is:

22. Connectivity Diagram of 400/220 kV Suratgarh TPS:

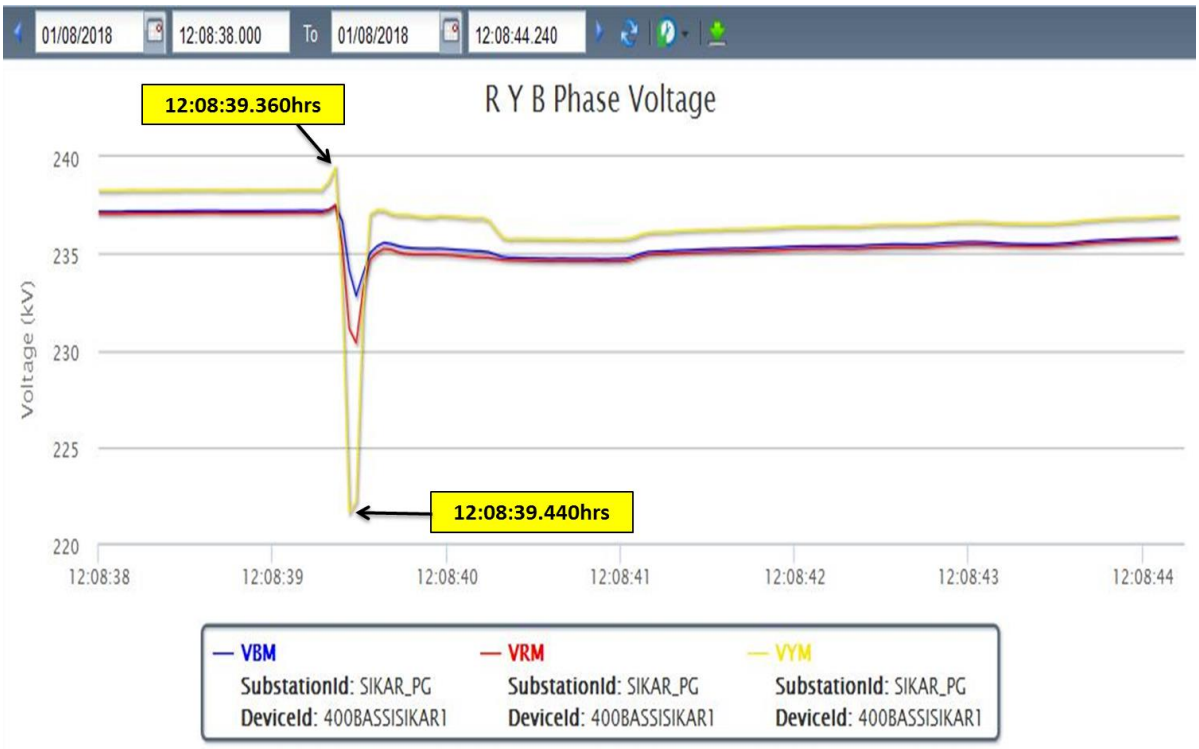


23. 220 kV Suratgarh TPS is connected with Ratangarh D/C, Suratgarh(Raj) D/C, Sriganganagar S/C and Bhadra S/C. It also have two 400/220kV ICTs (2*315MVA). Unit-1&2 (250MW) connected at 220 kV station and Unit-3,4,5&6 (250MW) connected at 400 kV Suratgarh TPS. 400kV Suratgarh TPS is further connected with Ratangarh S/C, Bikaner S/C, Suratgarh SCTPS D/C.
24. 400 kV Suratgarh TPS has one an half breaker scheme and 220 kV Suratgarh TPS has DMT (double main transfer breaker) scheme.
25. Antecedent Condition:
    - 400kV Suratgarh TPS unit-3 & 4 (250MW) was running at 190MW. Unit-5 & 6 (250MW) was under shutdown
    - 400 kV and 220 kV all the buses were under charged condition at 400/220 kV Suratgarh TPS
26. Name of the tripped elements are as below:
    - 220 kV Suratgarh TPS-Ratangarh ckt-2
    - 220 kV Suratgarh TPS-Suratgarh ckt-2
    - 220 kV Suratgarh TPS- Bhadra ckt
    - 400/220 kV 315MVA ILT-1 &2
    - 220 kV Station Transformer-4
    - 250MW Unit-3 & 4

27. At 12:08hrs, Y-phase CT of 220 kV Suratgarh TPS (end)-Ratangarh ckt-2 bursted and resulted into bus fault for 220 kV Bus-2 of Suratgarh TPS. Feeders/ Transformers connected to faulted bus immediately tripped due to operation of bus bar protection.

28. PMU plots:

PMU plot of frequency of Sikar (PG)



PMU plot of phase voltages of Sikar (PG)

29. As per PMU data:
    - Y-phase to earth fault. Fault started at **12:08:39.360hrs**
    - Fault clearance time: within **100ms**

30. As per Rajasthan Report:

- At 12:08hrs, Y-phase CT of 220 kV Suratgarh TPS (end)-Ratangarh ckt-2 bursted and resulted into bus fault for 220 kV Bus-2 of Suratgarh TPS. Feeders/ Transformers connected to faulted bus immediately tripped due to operation of bus bar protection.
- After detailed checking, it was found that B-phase CT of 220 kV Suratgarh TPS-Ratangarh ckt-2 was bursted and caught fire. Fire was immediately controlled with the help of water spraying/ foam jets through fire tender after isolation the feeder from STPS & Remote end.
- It was found that B-phase CT of 220 kV was bursted. Due to bursting of B-phase CT of 220 kV Suratgarh TPS-Ratangarh ckt-2, the splinters of this also damaged Y-phase CT and adjoining isolator 89-C & 89-D of same feeder, which resulted into the bus fault and caused the bus bar protection operation for 220 kV Bus-2.

- The backup earth fault protection of 220 kV side of 400/220 kV ICT-1 was also operated and tripped the ICT-1 immediately. 400 kV side breaker also tripped on inter tripping.
- CDD-31 type Alstom make earth fault protection relay is installed on ILT# 1&2.
- RADSS type ABB make Bus Bar protection relay is installed at 220 KV buses. No facility for DR/ EL is available in these CDD-31 & RADSS relays.
- At STPS, 6 nos. 220/6.6 KV station transformers are installed to fed the auxiliary power to all 6 nos. 250MW units. Each unit has independent 220/6.6 KV station transformer to fed auxiliary power to respective unit like ST#3 for unit#3, ST#4 for unit#4 etc. All the station transformers are connected with 220 KV switchyard. GT#1&2 are connected with 220 kV switchyard & GT#3, 4, 5 & 6 are connected with 400 kV switchyard and 220 kV & 400 kV switchyards are connected through ILT#1&2.
- Due to the operation of Bus bar protection of 220 kV bus-2, the connected station transformer#4 was tripped on bus bar protection. Station Transformer#3 was not tripped as this was connected with 220 KV Bus-1B.
- The auxiliary supply failure of unit#4 was due to tripping of ST#4 resulted in tripping of unit#4. And auxiliaries of unit#3 were tripped due to heavy dip in 220 KV system voltage resulted in tripping of unit#3.
- For Unit#3, heavy voltage dip occurred in 220 KV system voltage and 415 V emergency bus tripped & hence LOPs of main unit auxiliaries (i.e. ID, FD, Mill, PA etc.) tripped which resulted in “boiler trip on all ID fans off”, consequently turbine tripped on MFR & finally Generator tripped on turbine trip.
- For Unit#4, tripping of Station Transformer# 4 occurred due to operation of Bus Bar protection of 220 KV Bus-2, all unit auxiliaries like ID, FD, Mill, PA, BFP, CEP etc. tripped & boiler tripped on “loss of all fuel” resulted in turbine trip on MFR & finally Generator tripped on turbine trip.
- Arrangement of Auxiliary supply:
    a. In Unit# 3, no UATs are installed. This unit# 3 has independent 50 MVA, 220/6.9 KV station transformer to fed auxiliary power to 6.6 KV unit Buses 3SA& 3SB through 6.6 KV station Bus OSC.
    b. During running condition of unit, 6.6 KV auxiliary supply fed to 6.6 KV CW switchgear & 6.6 KV/ 415 V compressor transformer from 6.6 KV station Bus OSC only. Hence, on tripping of station transformer# 3, no 6.6 KV supply shall be available to CWP/ ACWP & compressors as per SLD enclosed even though unit buses 3SA & 3SB fed from respective UATs

31. Extract of Rajasthan report

On dated 01.08.2018, STPS Unit # 3 & 4 were running on approximate 190 MW load on each unit & Unit# 1, 2, 5 & 6 were in de-synchronized condition and connected feeders on 220 kV Buses were as follows:-

Bus-1A:
220 kV STPS-Suratgarh-1
220 kV STPS-Sriganganagar
220 kV STPS-Ratangarh-1
Station Transformer-1

Bus-1B
220 kV side of ILT-1
Station Transformer-3
Station Transformer -5&6

Bus-2
220 kV STPS-Suratgarh-2
220 kV STPS-Ratangarh-2
220 kV STPS-Bhadra
ILT-2
Station Transformer-4

The Bus Coupler Breaker between 220 KV Bus-1A & 220 KV Bus-2 was closed & the Sectionaliser breaker between 220 KV Bus-1A & 220 KV Bus-1B was also closed.

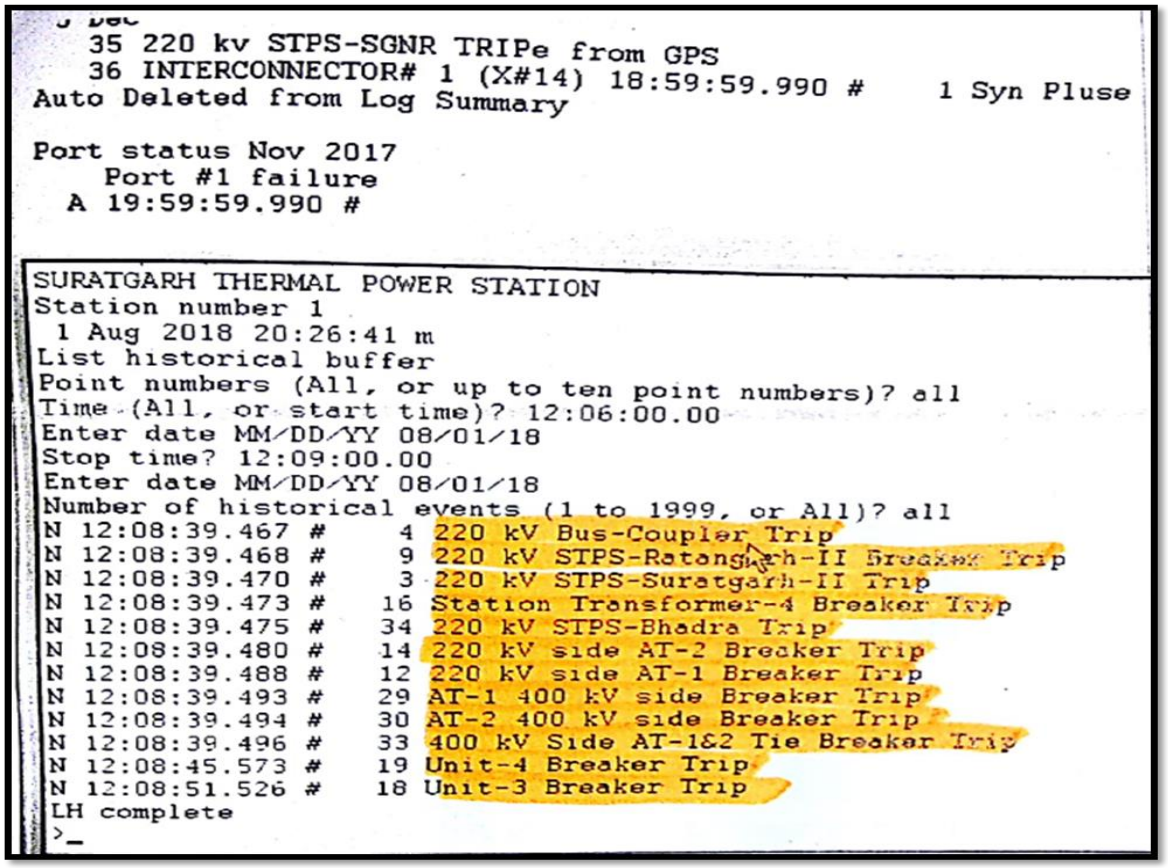
Suddenly at 12:08 hrs on dated 01.08.2018, failure/ bursting of B- phase CT occurred on 220 KV STPS-Ratangarh-2, and further converted into Bus fault. As this feeder was connected on 220 kV Bus-2, all the feeders/transformers connected to this bus immediately tripped due to operation of bus bar protection. The E/F protection of 220 kV side of Interlinking Transformer -1 was operated and this caused the tripping of 400 kV side breaker of Interlinking Transformer -1 on inter tripping.

The details of tripping are as under:-

S. No.	Unit/ Feeder	Time of Tripping	Cause of Tripping
1.	220 KV Bus Coupler	12:08:39.467 hrs	Bus-2 Bus Bar Protection operated
2.	220 KV STPS- Ratangarh-2	12:08:39.468 hrs	Bus-2 Bus Bar Protection operated
3.	220 KV STPS- Suratgarh-2	12:08:39.470 hrs	Bus-2 Bus Bar Protection operated
4.	Station Transformer-4	12:08:39.473 hrs	Bus-2 Bus Bar Protection operated
5.	220 KV STPS- Bhadra	12:08:39.475 hrs	Bus-2 Bus Bar Protection operated
6.	ILT-2 (220 KV side)	12:08:39.480 hrs	Bus-2 Bus Bar Protection operated & Earth Fault Protection Operated
7.	ILT-1 (220 KV side)	12:08:39.488 hrs	Earth Fault Protection Operated
8.	ILT-1 (400 KV side)	12:08:39.493 hrs	Inter Tripping with 220 KV side breaker
9.	ILT-2 (400 KV side)	12:08:39.494 hrs	Inter Tripping with 220 KV side breaker
10.	400 KV side ILT-1 & 2 Tie	12:08:39.496 hrs	Inter Tripping with 400 KV side main breaker of ILT-1 or ILT-2
11.	Unit# 3	12:08:45.573 hrs	Disturbance in auxiliary supply due to tripping of Station Transformer#4
12.	Unit# 4	12:08:51.526 hrs	Aux. power supply failure

Note: - All outgoing feeders connected at 220 KV Bus-1A, 220 KV Bus-1B & 400 KV Bus-1 & 2 were healthy.

SoE as per Rajasthan report:



32. SCADA Analog data and SoE:

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status
12:08:38,427	SURAT_THER	220kV	03MBC	Circuit Breaker	disturbe
12:08:38,427	SURAT_THER	220kV	E_13_B2(BHDRA-1)	Circuit Breaker	disturbe
12:08:38,449	SURAT_THER	220kV	E_01_B1(SURAT-2)	Circuit Breaker	disturbe
12:08:38,453	SURAT_THER	220kV	E_07_B2(RATAN-2)	Circuit Breaker	Close
12:08:38,453	SURAT_THER	220kV	E_07_B2(RATAN-2)	Circuit Breaker	disturbe
12:08:38,456	SURAT_THER	220kV	03MBC	Circuit Breaker	Close
12:08:38,456	SURAT_THER	220kV	E_13_B2(BHDRA-1)	Circuit Breaker	Close
12:08:38,456	SURAT_THER	220kV	17ST4	Circuit Breaker	disturbe
12:08:38,479	SURAT_THER	400kV	17TIE	Circuit Breaker	disturbe
12:08:38,480	SURAT_THER	400kV	16AT1	Circuit Breaker	disturbe
12:08:38,482	SURAT_THER	400kV	17TIE	Circuit Breaker	Close
12:08:38,484	SURAT_THER	400kV	F_02_C(U4)	Circuit Breaker	disturbe
12:08:38,451	SURAT_THER	400kV	F_02_C(U4)	Circuit Breaker	Close
12:08:38,885	SURAT_THER	400kV	16AT1	Circuit Breaker	Close
12:08:38,970	SURAT_THER	220kV	17ST4	Circuit Breaker	Close
12:08:39,270	SURATGARH	220kV	E_20(SURTP-1)	Circuit Breaker	disturbe
12:08:39,280	SURATGARH	220kV	E_02(SURTP-2)	Circuit Breaker	Open
12:08:40,072	SURATGARH	220kV	E_20(SURTP-1)	Circuit Breaker	Close
12:08:41,006	SRIGANGAGR	132kV	D_01(SGNGR-1)	Circuit Breaker	disturbe
12:08:44,567	SURAT_THER	400kV	F_02_C(U4)	Circuit Breaker	disturbe
12:08:44,578	SURAT_THER	400kV	F_02_C(U4)	Circuit Breaker	Close

Time Synch error in SCADA SoE

33. As per Remedial Measures Report of Rajasthan:
    a. Setting of back up earth fault protection for ILT#1 & ILT#2 has been checked and revised as suggested by "sub-committee on relay/protection under task force for power system analysis under contingencies" of NRPC.

Name of protection	**Earlier setting**	**Existing setting**
Back up earth fault protection (High set) for 400 KV side	2.4 Amp	3.64 Amp
Back up earth fault protection (High set) for 220 KV side	3.6 Amp	6.6 Amp

    b. Tan Delta test of all CTs will be carried out during annual shut down to ascertain their healthiness.

34. Preliminary Report, DR/EL (only event logger details, DR not available as numerical bus bar/ back up earth fault protection is not available) and detailed report has been received from Rajasthan.

Action Points*:*

7. Reason of non-availability of UAT (unit auxiliary transformer) needs to be looked into.
8. Setting correction in back up earth fault protection of 400/220 kV ICT-1 & 2 needs to be shared along with time delay setting.
9. Time synchronization & status of SCADA SoE needs to be checked and corrected.
10. Phase Sequence error at 220 kV Suratgarh TPS needs to be checked as fault was in Yellow-phase (as per PMU data) but in Rajasthan report it was reported as Blue-phase to earth fault?
11. DR/EL should be available for event analysis, numerical protection to be implemented at 220 kV Suratgarh TPS (Bus Bar and ICT protection).

Rajasthan may elaborate the incident, submit the detailed report and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

Q. Multiple element tripping and SPS operation at Jhakri/Rampur/Karcham complex at 04:02hrs of 29th Aug 2018

Event category: GD-1
Generation loss: 1230 MW (NJPC/ JSW may confirm)
Loss of load: Nil

Data Summary received/available at NRLDC:

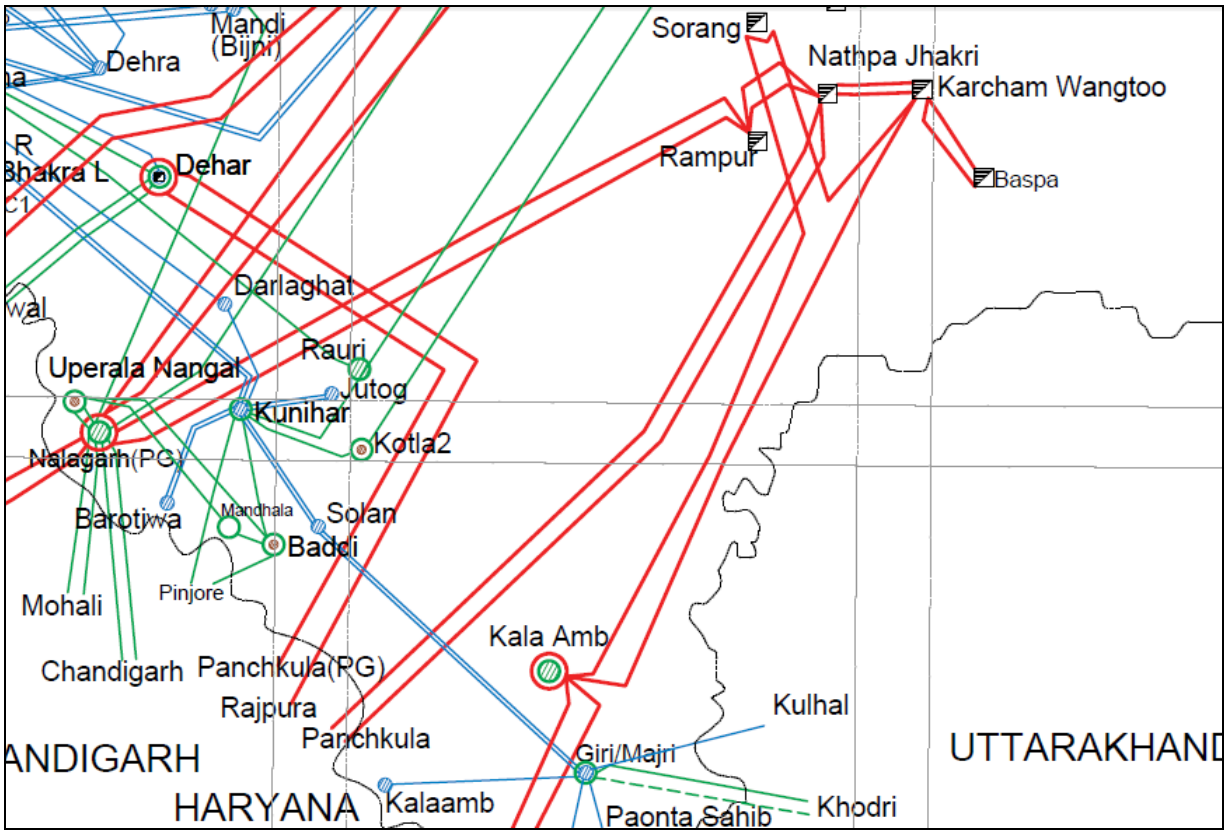
Description	Reference	Fault Info	Remarks
Fault Clearance Time	As per PMU data	**100ms**	
Phase of the fault	As per PMU data	B-N fault	

Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)	NR and UP	Available	
DR/ EL	NJPC	Received	Not received from Jhakri
	JSW	Not Received	
	POWERGRID	Received	
Preliminary Report	NJPC	Received	Not received from Jhakri
	JSW	Not Received	
	POWERGRID	Received	
Detailed Report	NJPC	Not Received	
	JSW	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)	**NJPC**	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	**JSW**	1. DR/EL, Preliminary report within 24hrs 2. Detailed Report not received

Based on above information description of the events is:

13. Connectivity Diagram:



14. 400 kV Rampur is connected with Jhakri D/C, Nalagarh D/C. 400 kV Rampur have six unit of 68.67 MW capacity. 400 kV Jhakri is connected with Rampur D/C, Panchkula D/C and Karcham D/C. 400 kV Jhakri have six unit of 250 MW and 400 kV Karcham have four units of 250MW.
15. At 04:02hrs of 29-Aug-18, B-N fault (94km from Rampur end) occurred in both 400kV Rampur–Nalagarh ckts.
16. 400kV Rampur–Nalagarh ckt-1 was successfully auto reclosed at both ends. However, 400kV Rampur–Nalagarh ckt-2 was auto reclosed successfully at Nalagarh (PG) but CB failed to close at Rampur end resulting in tripping of all CBs at Rampur on pole discrepancy.
17. Due to the above incident, SPS operated at Nathpa Jhakri and Rampur causing tripping of 2 units each at Rampur & Nathpa Jhakri hydro station.
18. Due to SPS operation at Karcham, units-2 & 4 went into NLNE mode (No load Not Excited).

19. Name of the tripped elements are as below:
    - 400 kV Rampur(NJPC)–Nalagarh(PG) ckt-2
    - Unit#5 at 400kV Nathpa-Jhakri(NJPC)
    - Unit#6 at 400kV Nathpa-Jhakri(NJPC)
    - Unit#1 at 400kV Rampur(NJPC)

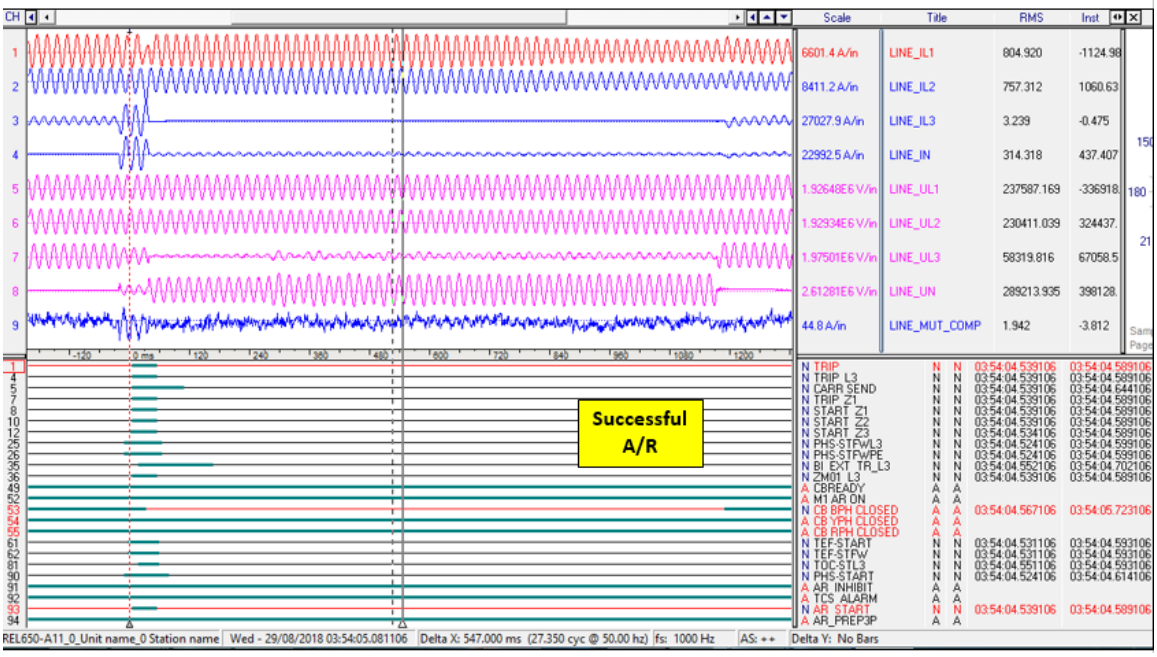
- Unit#2 at 400kV Rampur(NJPC)
- Unit#2 at 400kV Karcham Wangtoo (NLNE mode)
- Unit#4 at 400kV Karcham Wangtoo (NLNE mode)

20. SPS logic for generation (Jhakri/Karcham/Rampur) complex:

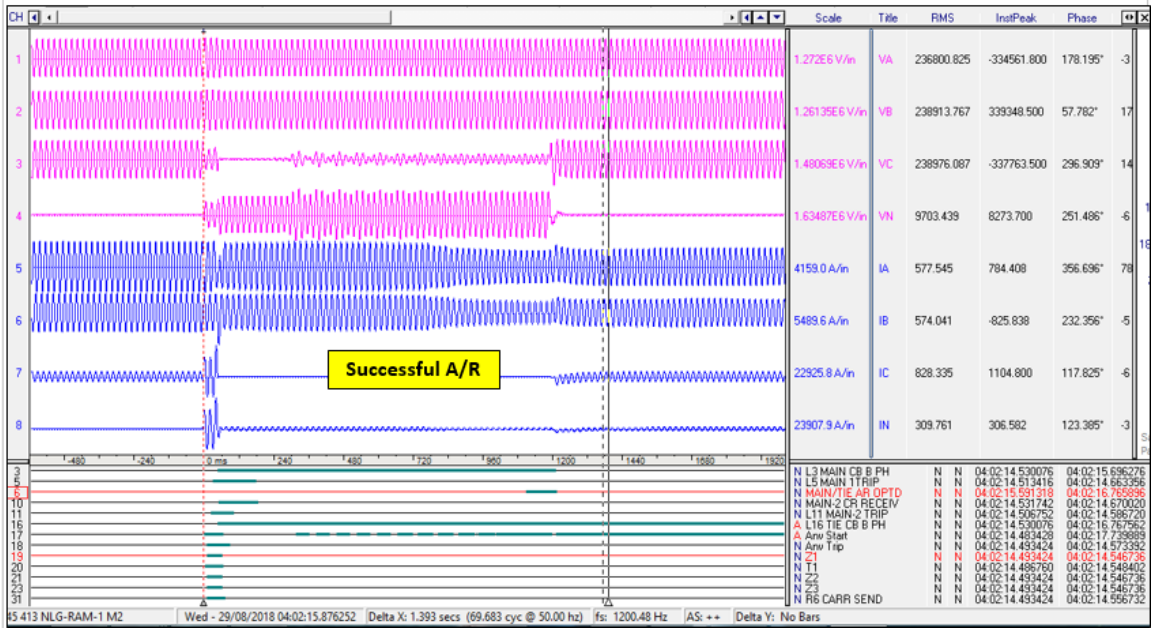
Case	Contingency	Action
Case-1	Load on any of the lines at Jhakri or Rampur towards Nalagarh exceeds 850 MW	Trip 1 unit of Wangtoo HPS, 1 unit of Jhakri HEP & 1unit of Rampur HEP
Case-2	400 kV bus voltage at Wangtoo drops below 395 kV	Trip 2 units of Wangtoo HPS
Case-3	Any two lines of Jhakri or Rampur HPS trip	Trip 2 units of Jhakri, 2 units of Rampur HPS and 2 units of Wangtoo HPS
Case-4	Both 400 kV Wangtoo-Abdullapur lines at Wangtoo trip	Trip 2 units of Wangtoo HPS
Case-5	Power Flow of any outgoing line of Rampur or Jhakri exceed by 800MW	Initiate the Alarm to the operators at Jhakri, Rampur & Karcham

21. As per NJPC Report and DR details:

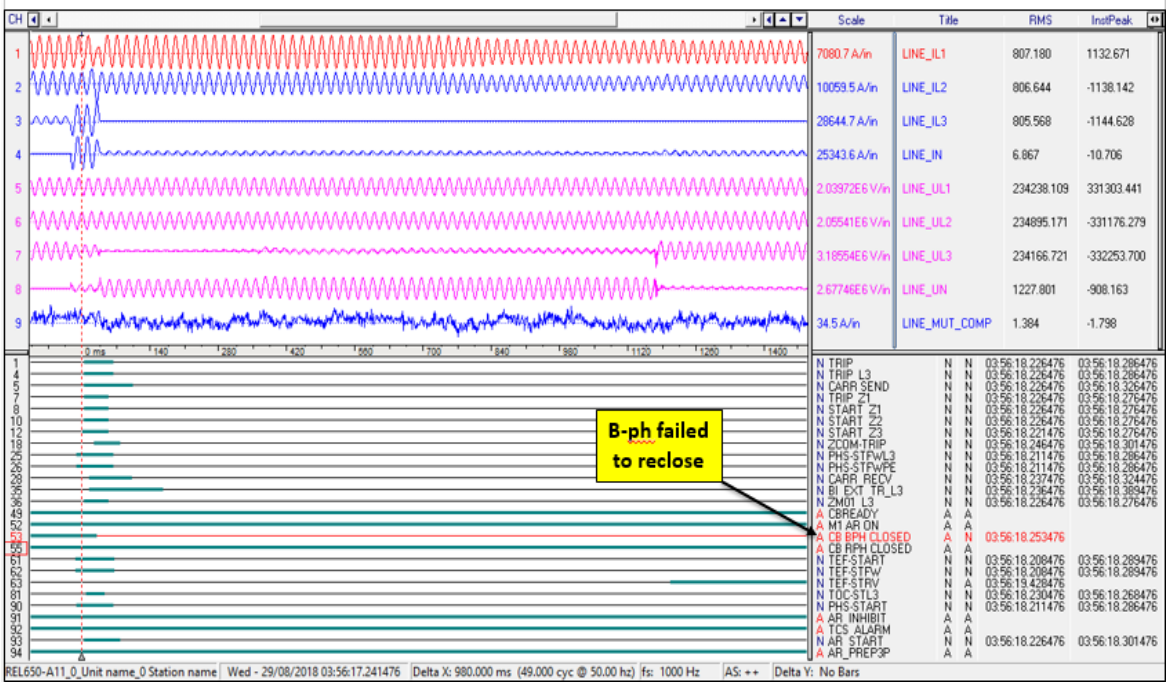
DR: 400kV Rampur(end)-Nallagarh-1



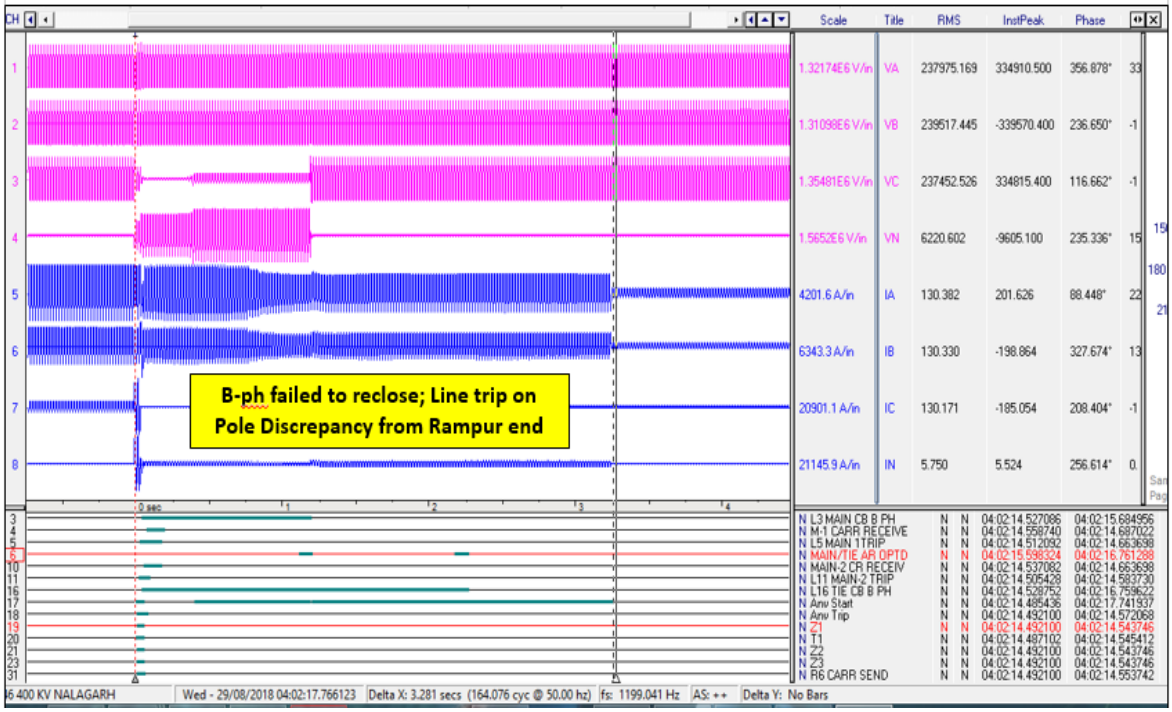
DR: 400kV Rampur-Nalagarh(end)-1



DR: 400kV Rampur(end)-Nalagarh-2



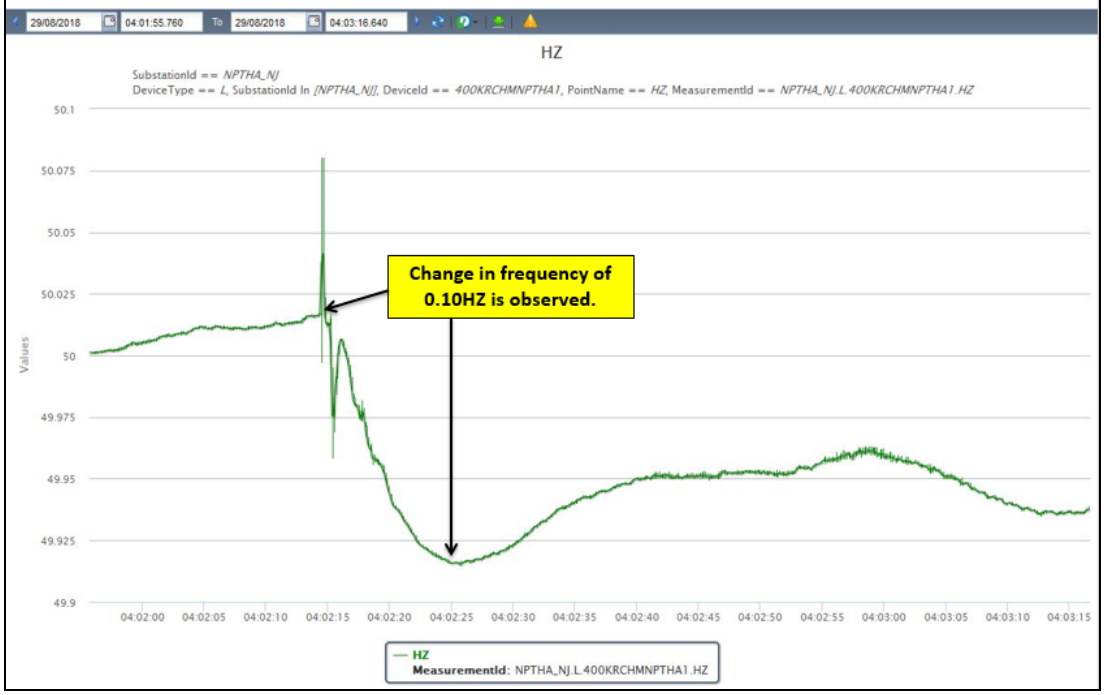
DR: 400kV Rampur-Nalagarh(end)-2



22. PMU plots:

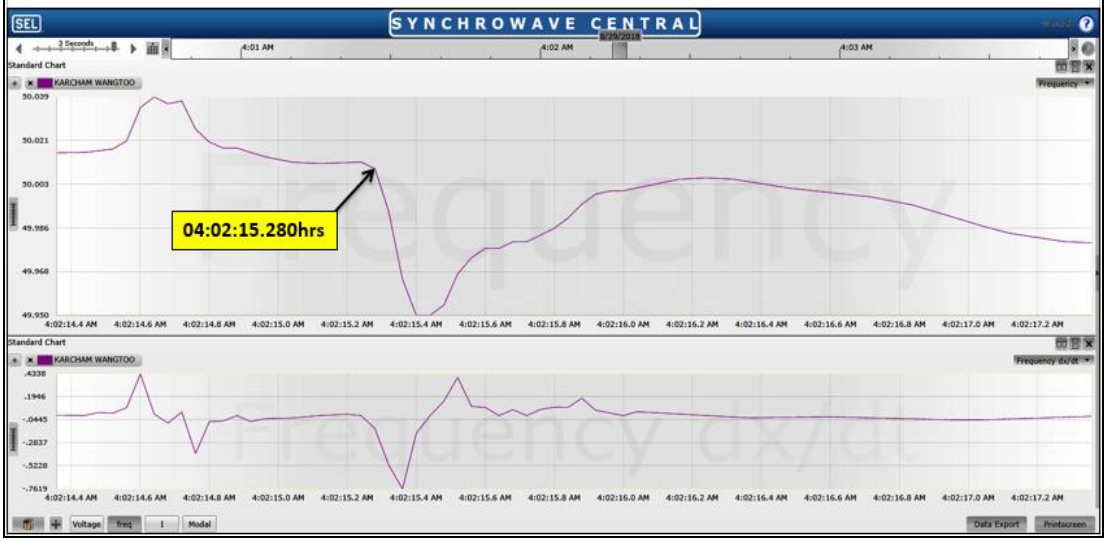
PMU Plot of frequency at Nathpa Jhakri(NJPC)

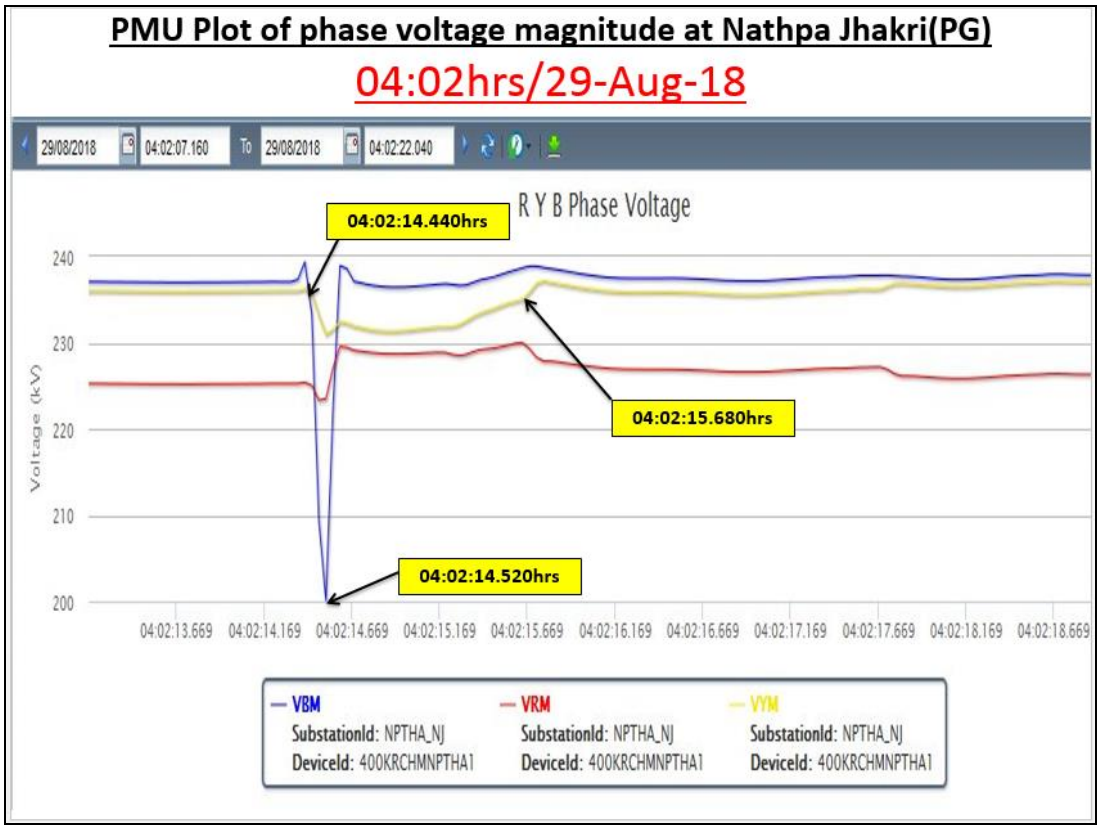
04:02hrs/29-Aug-18



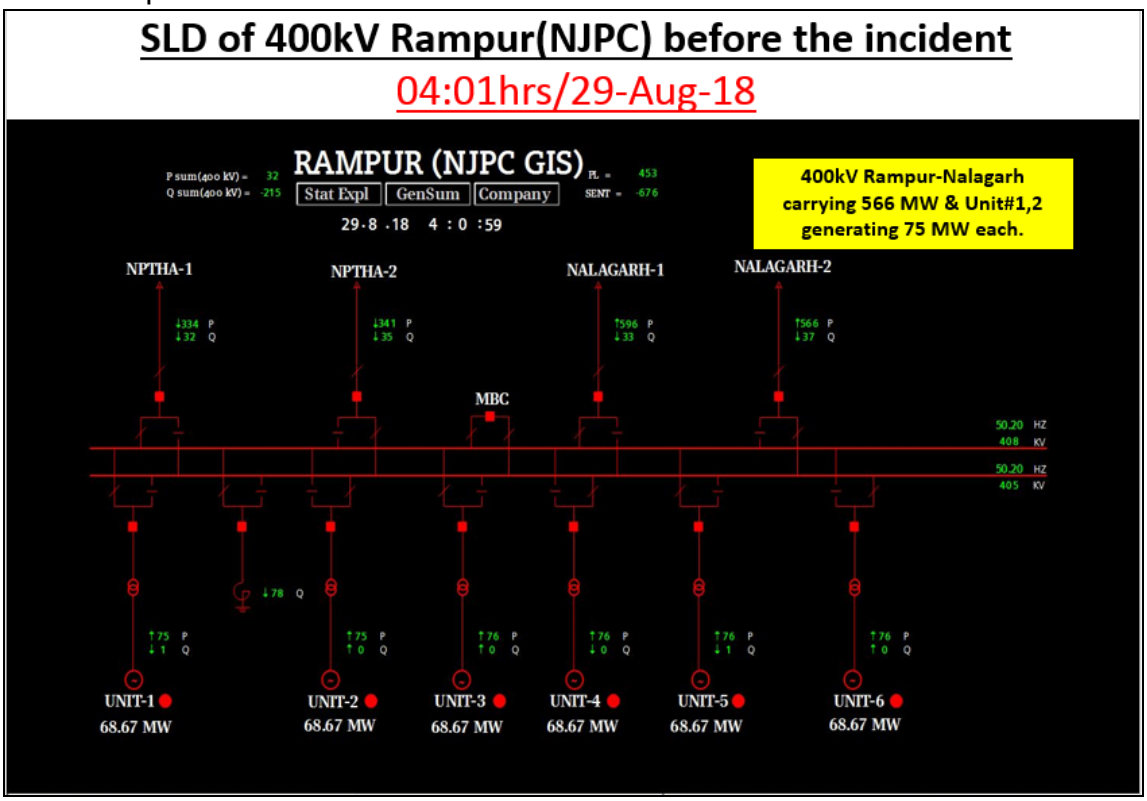
PMU Plot of frequency at Karcham

04:02hrs/29-Aug-18



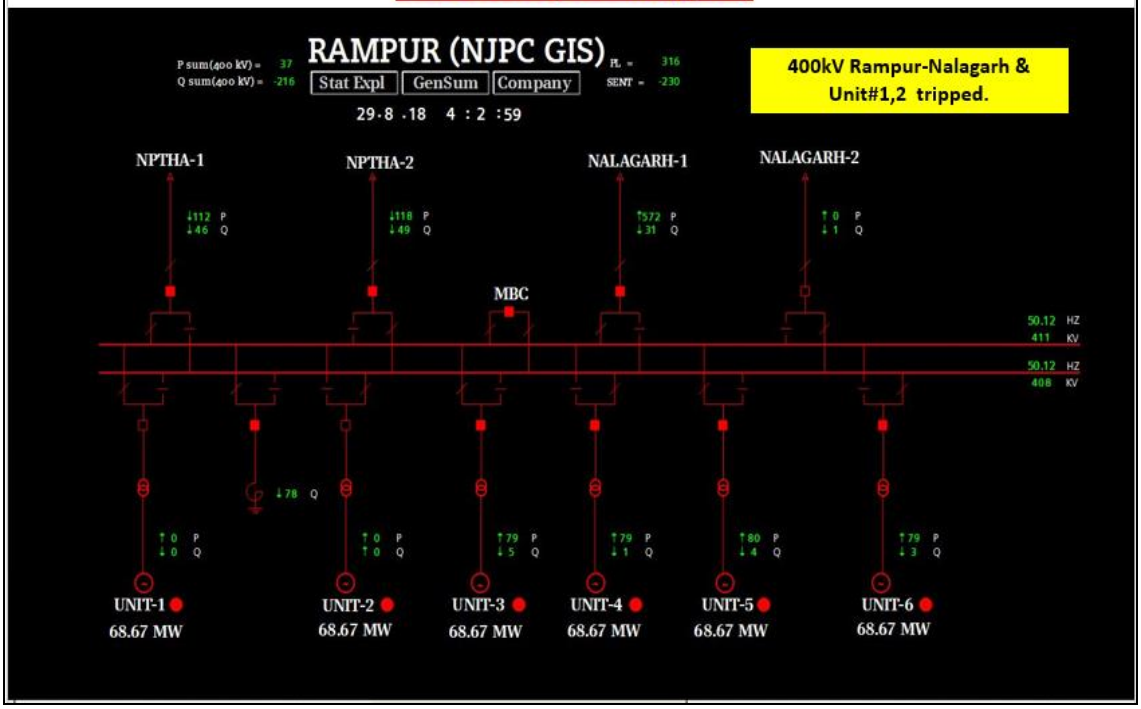


23. As per SCADA data:



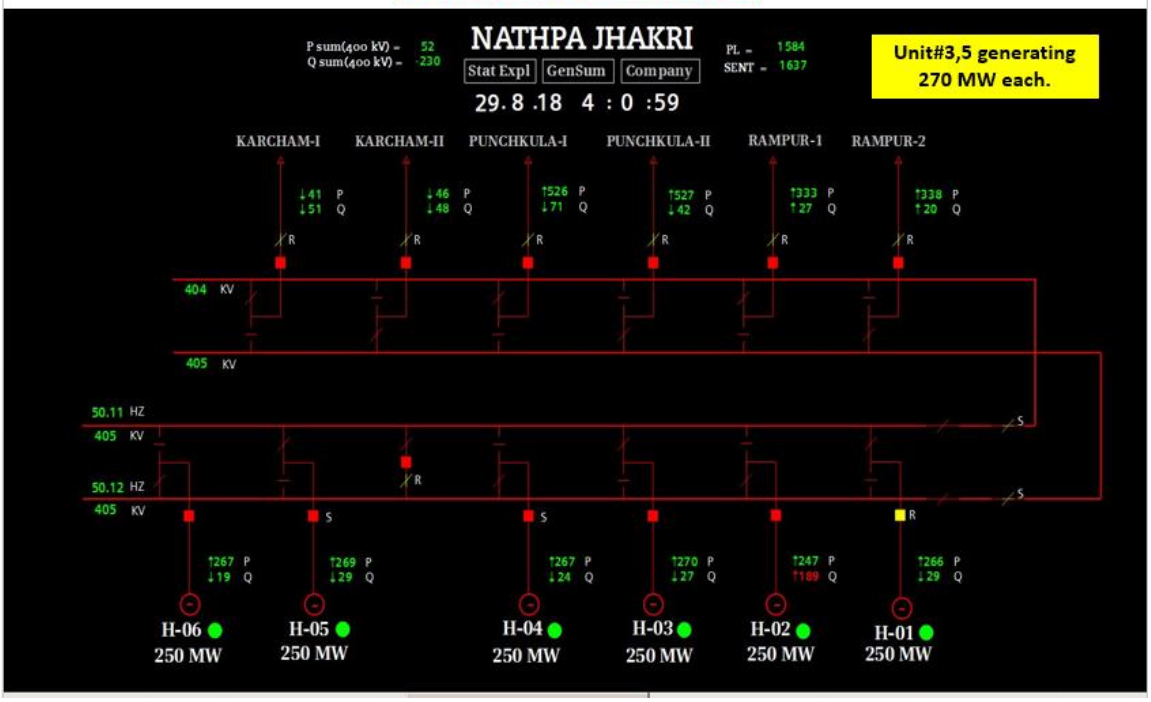
SLD of 400kV Rampur(NJPC) after the incident

04:03hrs/29-Aug-18



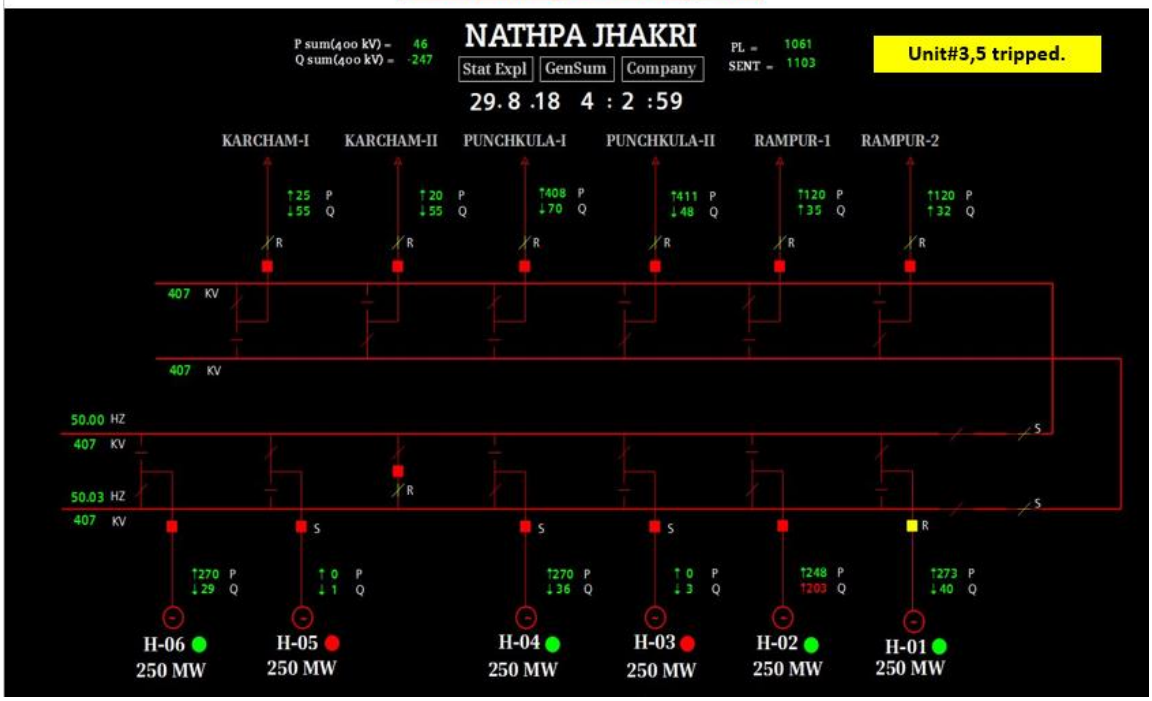
SLD of 400kV Nathpa Jhakri(NJPC) before the incident

04:01hrs/29-Aug-18



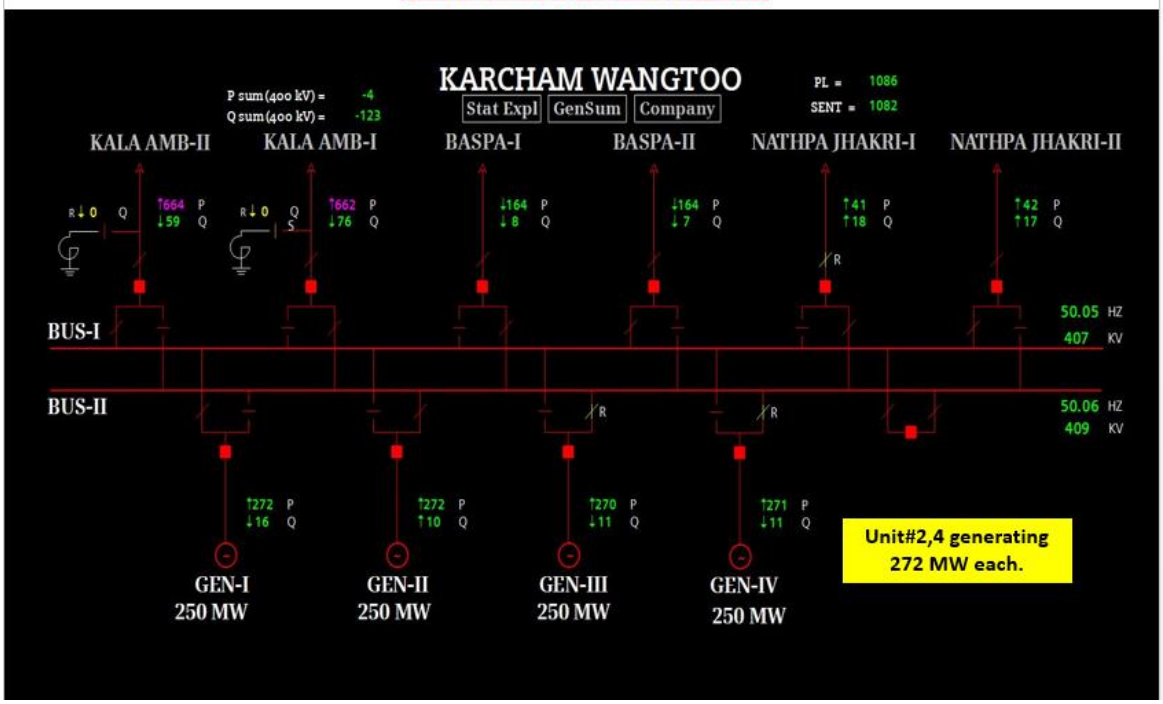
SLD of 400kV Nathpa Jhakri(NJPC) after the incident

04:03hrs/29-Aug-18



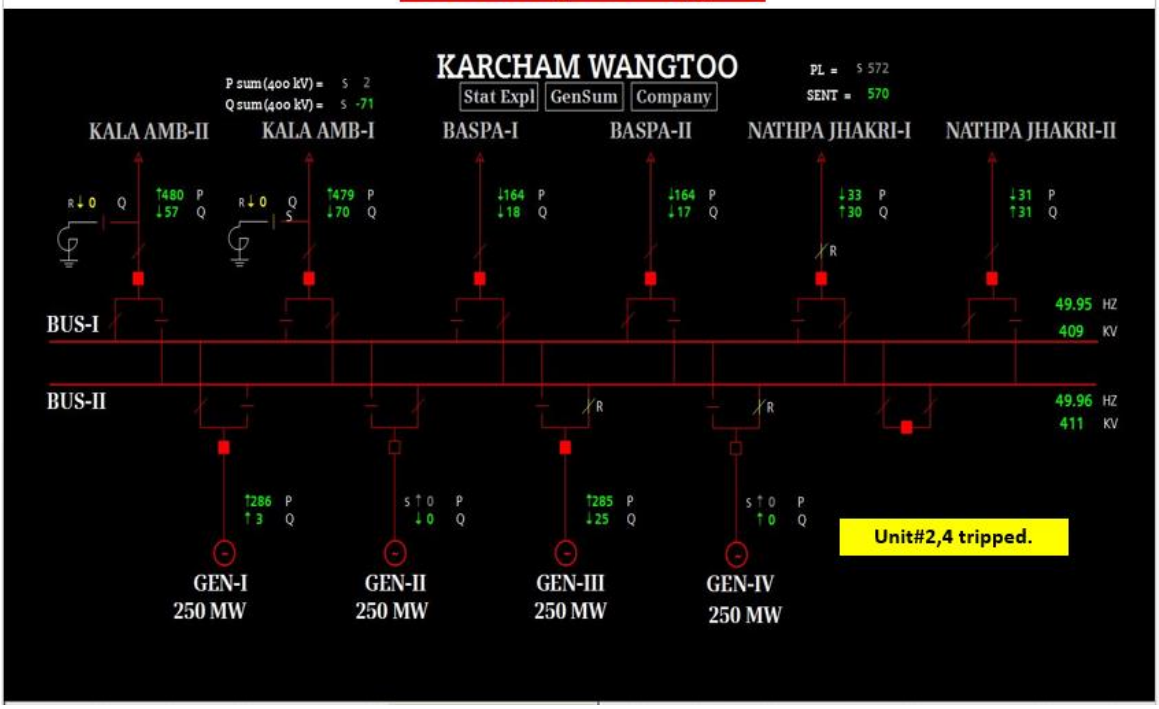
SLD of 400kV Karcham(JSW) before the incident

04:01hrs/29-Aug-18



SLD of 400kV Karcham (JSW) after the incident

04:04hrs/29-Aug-18



24. As per SCADA SoE:

Time	Station	Voltage	Element	Device	Status
04:00:00,000	KARCHAM	400kV	G2H02	Circuit Breaker	Open
04:00:00,000	KARCHAM	400kV	G4H04	Circuit Breaker	Open
04:00:00,000	KARCHAM	400kV	G2H02	Circuit Breaker	Close
04:00:00,000	KARCHAM	400kV	G4H04	Circuit Breaker	Close
04:01:41,743	RAMPUR	400kV	02G2	Protection Trip	App
04:06:43,652	RAMPUR	400kV	01G1	Protection Trip	App
04:08:49,863	RAMPUR	400kV	01G1	Protection Trip	Disp
04:09:12,782	RAMPUR	400kV	02G2	Protection Trip	Disp

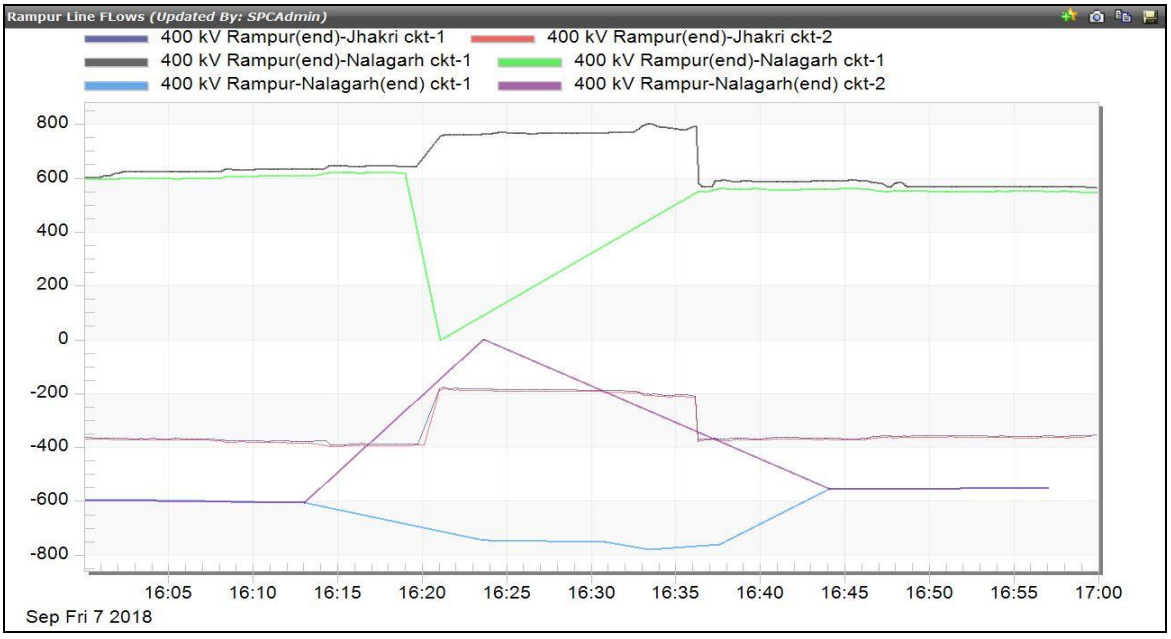
25. As per PMU & SCADA data:
    - B-N fault occurred at 04:02:14.440hrs and cleared in 80ms.
    - Dip in frequency of around 0.1Hz is observed.

- A sharp dip in frequency observed at 04:02:15.280hrs, indicating tripping of units before auto-reclosure attempt of faulted ckts

26. Preliminary Report, DR/EL has been received from Rampur and POWERGRID within 24hrs however detailed report is still awaited from Rampur. Preliminary Report, DR/EL and detailed report is still awaited from Jhakri and JSW.

Points for Discussion:

6. Non closing of B-phase CB of 400kV Nalagarh-Rampur-2 at Rampur end to be looked into.
7. Tripping of two units each at Karcham, Jhakri and Rampur is as per the case-2 of SPS logic i.e. tripping of any two lines from Jhakri or Rampur. However, only one ckt (400kV Rampur-Nallagarh-2) tripped. Therefore, SPS logic needs to be checked.
8. It seems from PMU frequency data that generating units tripped before auto-reclosing attempt of lines. The following needs to be shared w.r.t. SPS:
    - *Logic calculation time.*
    - *Time in which tripping command sent to units after meeting the condition for SPS.*
    - *Logic for various SPS conditions checking.*
9. On 07th Sep 2018 at 16:20hrs, 400 kV Rampur-Nalagarh ckt-2 tripped on transient nature of fault. At that time also SPS of Jhakri/Karcham/Rampur complex operated (Case-1 operation) although line MW was not beyond 850MW. SCADA data plot is as below:



10. The reporting of SCADA SoE at NRLDC and its time synchronization to be looked into and resolved

NJPC/ JSW may elaborate the incident, submit the required details and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

R. Tripping other than to be discussed in 36th 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 126 multiple element tripping event reported by NRLDC to RPC and constituents.

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

Among 126 events, around 18 events would be discussed in 36th 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.

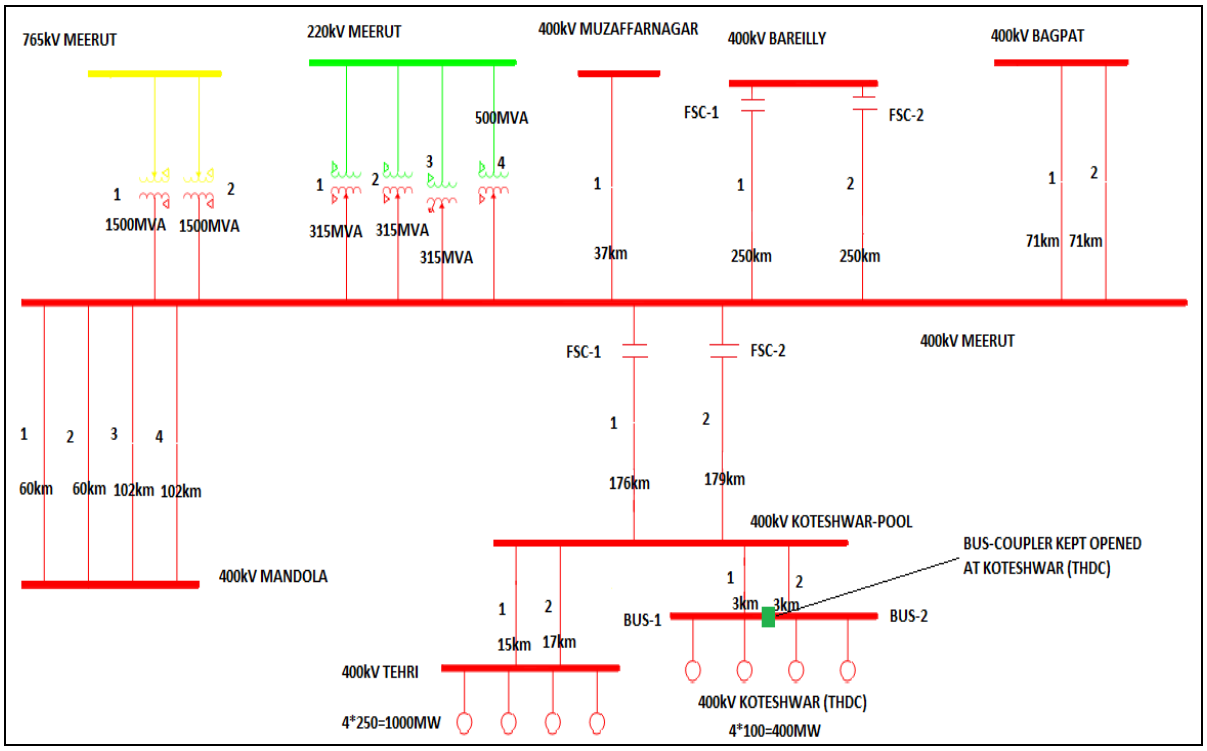
List of the all the multiple elements tripping event is available at NRPC website at following link: http://www.nrpc.gov.in/meetings/prsub.html (Grid incident)

Member may kindly submit the details.

2. Oscillation and SPS related Agenda points

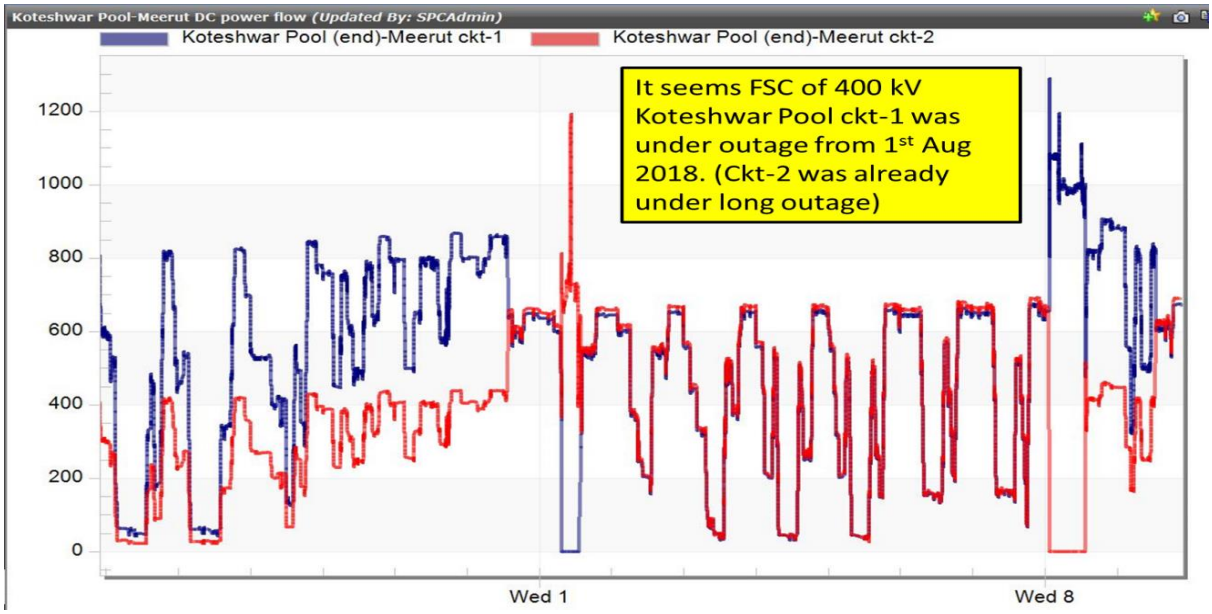
A. Observance of Oscillations in the grid on 08th Aug 2018 due to tripping of one of the evacuation line from 400kV Tehri-Koteshwar complex (N-1 contingency of line outage:

Tehri HEP is the major hydro generating station with 1000MW (4*250MW) capacity and in its downtail Koteshwar (THDC) HEP with capacity of 400MW (4* 100MW). The main evacuation line from the Tehri-Koteshwar HEP complex is 176 kM long 400 kV Koteshwar Pool to Meerut D/C line with 50% series compensation of each circuit at Meerut end. Connectivity Diagram is as below:



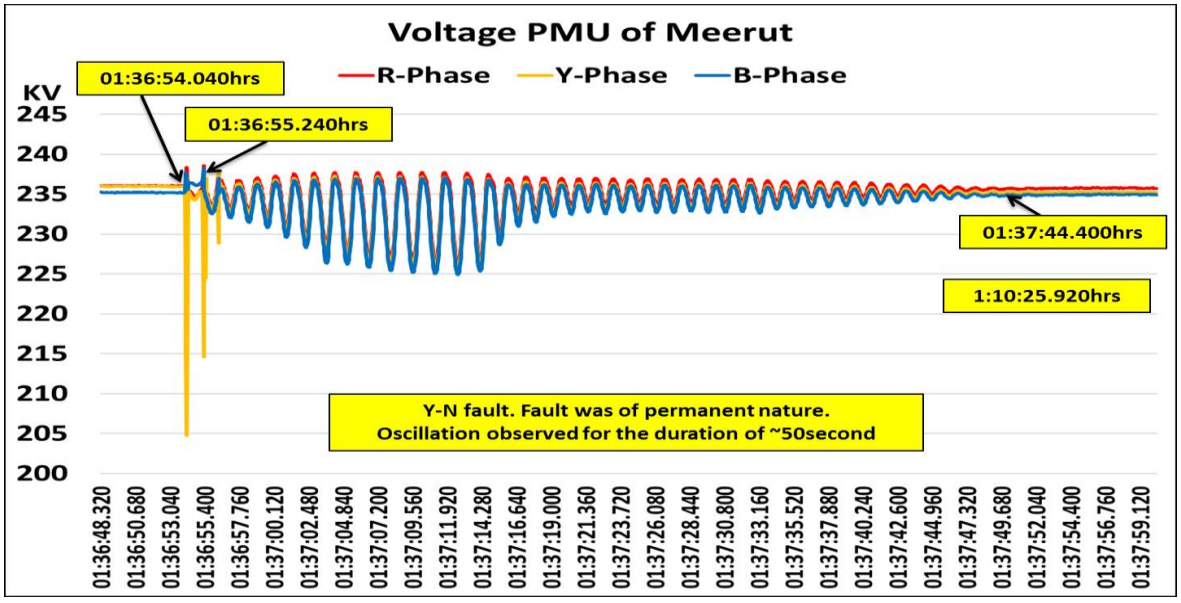
The antecedent generation of 1000 MW from Tehri HEP and 360 MW from Koteshwar HEP was being evacuated through on 400 kV Koteshwar Pool -Meerut ckt-1 & 2.

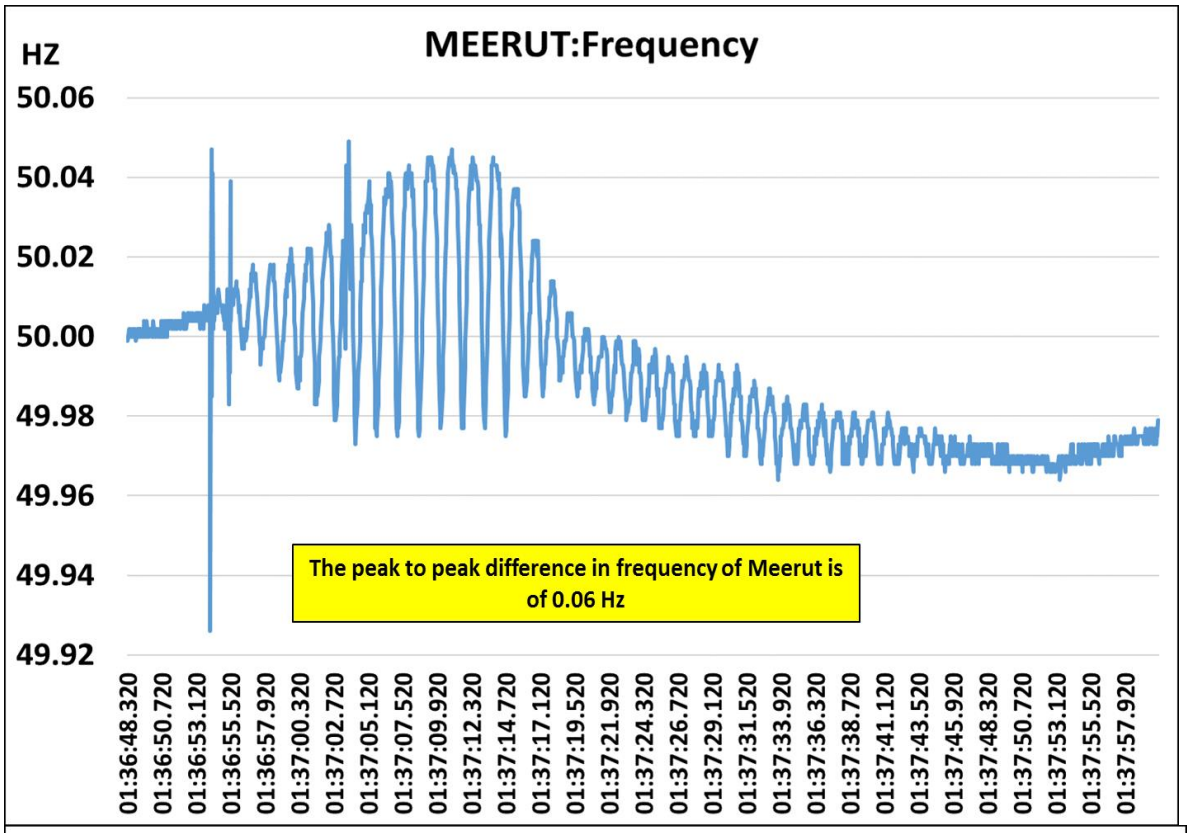
Fixed Series Compensation (FSC) of 400 kV Koteshwar Pool- Meerut- ckt-2 is out of service since 16th July 2015 except for brief period during July 2017 (01-13 Jul 2017). FSC of 400kV Koteshwar Pool -Meerut ckt-1 also went under outage on 1st Aug 2018. Thus at the incident time both the FSCs were out of service. SCADA plot of power flow of 400 kV Koteshwar Pool-Meerut ckt-1 & 2 is as below:

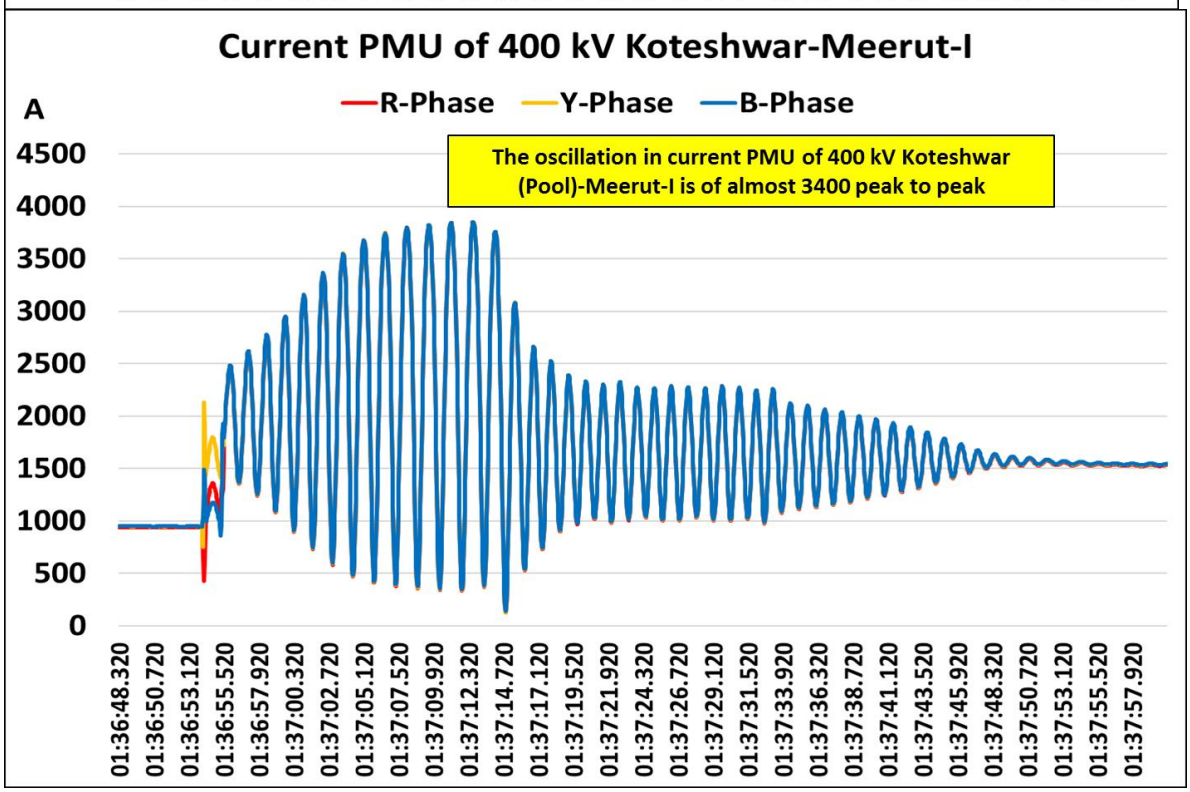


At 01:36hrs, 400 kV Koteshwar Pool –Meerut ckt-2 tripped on Y-N fault after unsuccessful auto reclosing. Line tripped on permanent nature of fault after auto reclosing of the line. After tripping of 400 kV Meerut-Koteshwar Pool ckt-2, power flow on ckt-1 reached more than 1200MW.

The outage of 400 kV Tehri-Koteshwar (Pool) ckt-2 caused severe oscillations of growing nature in the grid. The voltage & Frequency of Meerut PMU is given below:







The oscillations seems to damp only after tripping of one unit at Tehri HEP after 21 second on some protection.

The modal analysis carried out on few of the frequency signal from PMUs of Northern Region stations indicate negative damping for dominant mode of **0.675Hz**.

Although SPS was implemented at Koteshwar (Pool) with following logic:
"*If any one of the 400 kV Koteshwar-Meerut circuit trips and sum of antecedent power flow on both the circuit is more than 1200MW, one unit of 250 MW of Tehri HPS should be tripped instantaneously*"

However, during this event this SPS did not operate despite conditions for operation of SPS being prevalent.

In 141th OCC meeting, after incident of 09th Nov 2017 in which widespread oscillation observed for 50 second, it was decided to change the setting of 1200MW to 1100MW in SPS logic of Tehri Koteshwar complex.

Oscillations were very severe and can have impact on safety and security of grid as well as that of units.

This Agenda point was again discussed in 151st OCC meeting, in which oscillation details were shown and discussed. Following points were discussed during the meeting:

- At Tehri HEP, the setting of unit #1 dead fault to be checked. Further, the sensitivity of Unit #1 as compared to other units also needs to be checked: ***THDC informed that AVR setting of unit-1 would checked in Nov-2018 and report would be submitted***.
- Full SPS including the functional logic needs to be checked at Koteshwar (PG)/ Tehri HEP: *POWERGRID shall kindly update*
- In SPS logic, tripping of two units at Tehri HEP could also be thought of: ***Tripping of one unit at Tehri and one unit at Koteshwar HEP was approved. THDC shall kindly implement the tripping signal at Koteshwar HEP in co-ordination with POWERGRID.***
- In view of several fault incidents in recent past, strengthening of 400kV Tehri-Koteshwar-Meerut transmission lines to be looked into: ***Line maintenance needs to be checked and reported by POWERGRID.***
- Setting of df/dt relay operated in Punjab to be checked and shared: ***Punjab informed that df/dt setting checked at S/S and all the setting are as per NRPC recommended setting.***
- Any UFR, df/dt relay operation in any other state to be checked and confirmed: ***Details are awaited from the other utilities. Other state utilities kindly inform about operation/ non-operation of df/dt relay in its control area.***
- Long outage of FSC of 400 kV Meerut-Koteshwar ckt-2 to be looked into and revival of FSC shall be expedited: ***POWERGRID shall inform.***
- AVR/ PSS tuning needs to be looked into for better tuning at Tehri and Koteshwar HEP*:* ***Last PSS tuning was conducted in Dec. 2015 and to comply the guidelines issued in 34th NRPC and 30th TCC, the process for engaging M/s BHEL expert for PSS Tuning/Step response test of Excitation Systems (4 X***

250MW) of Tehri HPP has already been initiated and the work shall be completed tentatively by Nov'18.

- Reason of outage of FSC of 400 kV Meerut-Koteshwar ckt-1 (01 Aug to 08 Aug 2018) without informing to NRLDC, to be informed and such future cases to be avoided: ***POWERGRID shall inform.***
- Auto reclosure issue of tie CB of 400 kV Meerut (end)-Koteshwar Pool ckt-2 to be checked and corrected: ***POWERGRID shall inform.***

POWERGRID/ THDC may kindly inform about the status of SPS testing.

Other utility may also inform the status of action points already taken or to be taken with time frame.

B. Oscillations observed in the grid on 25th & 29th July 2018 due to tripping of one of the evacuation line from 220 kV Dhauliganga HEP:

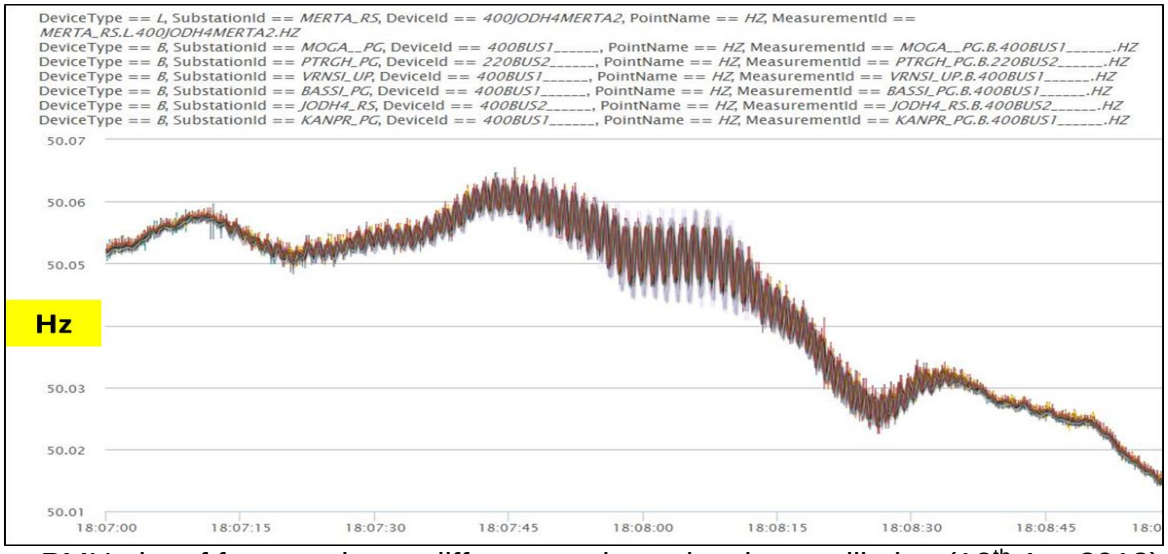
220 kV Dhauliganga station is connected with 220 kV Bareilly (UP) through two twin moose (400 kV charged at 220 kV) D/C line, in which one circuit has LILOed at 220 kV Pithoragarh (PG) (59km from Dhauliganga).

In last three months, three incident of growing nature of oscillations have been observed in the grid. Consolidated summary of these incident of growing nature of oscillation is tabulated below:

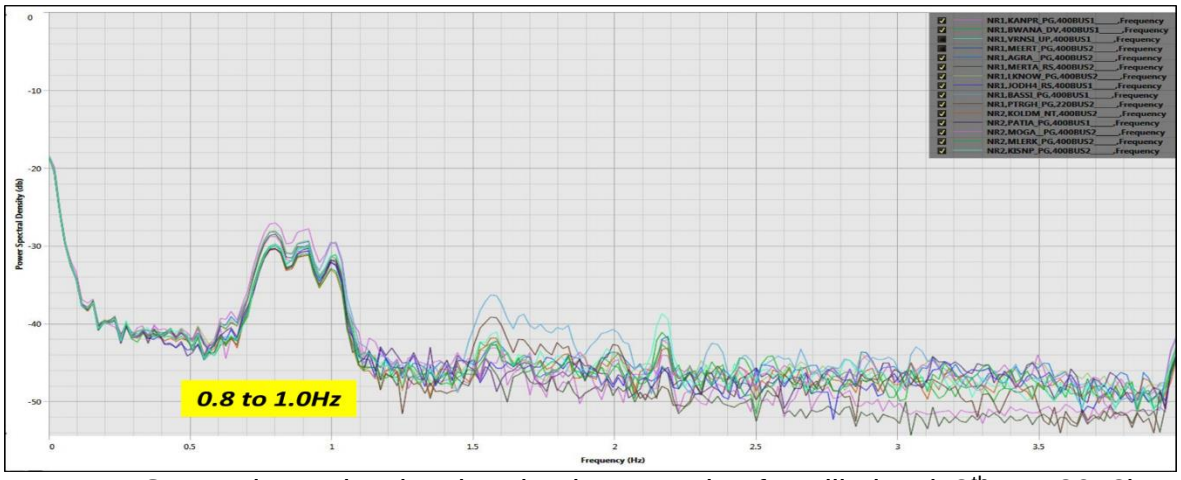
Particulars	**Event at 18:07hrs of 18.04.2018**	**Event at 14:49 hrs of 25.07.2018**	**Event at 16:56 hrs of 29.07.2018**
Antecedent Generation at Dhauliganga HEP	280MW	285MW	285MW
Event Brief	At Dhauliganga HEP, testing was underway from 17:00hrs of 18-Apr-18 to address the issue of oscillation observed at Dhauliganga HEP in the past. During this, as reported, full generation (280MW) at Dhauliganga was made to evacuate through one 220kV Pithoragarh ckt only. The testing also included different scenarios of PSS ON and OFF on different number of units (two units PSS ON and two units PSS off). Initiation of	Tripping of 220 kV Dhauliganga-Pithoragarh ckt on B-N fault resulted into 285MW loading on Bareilly ckt. It further initiated the growing nature of oscillation in the system	Tripping of 220 kV Dhauliganga-Pithoragarh ckt on R-N fault resulted into 285MW loading on Bareilly ckt. It further initiated the growing nature of oscillation in the system

	oscillations in the grid and resulted in tripping of unit number-1 at Dhauliganga. Immediate backing down (10MW from 70MW) was done at other units which resulted in damping of oscillations		
Faulted phase and duration	No fault, testing was underway	B-N fault & 100ms	R-N fault & 100ms
Dominant mode of oscillation (in Hz)	0.8Hz	0.8Hz	0.87Hz
Damping	Negative	Negative	Negative
Duration of Oscillation	2 minutes	24 second	13 second
Generation Loss (in MW)	70	285	285
Oscillation continued till	Tripping of one unit and manual generation backing down (how much MW)	Tripping of remaining circuit (220 kV Dhauliganga-Bareilly (UP)) in Z-1 and all the running units of Dhauliganga HEP	Tripping of remaining circuit (220 kV Dhauliganga-Bareilly (UP)) on out of step (OOS) protection and all the running units of Dhauliganga HEP

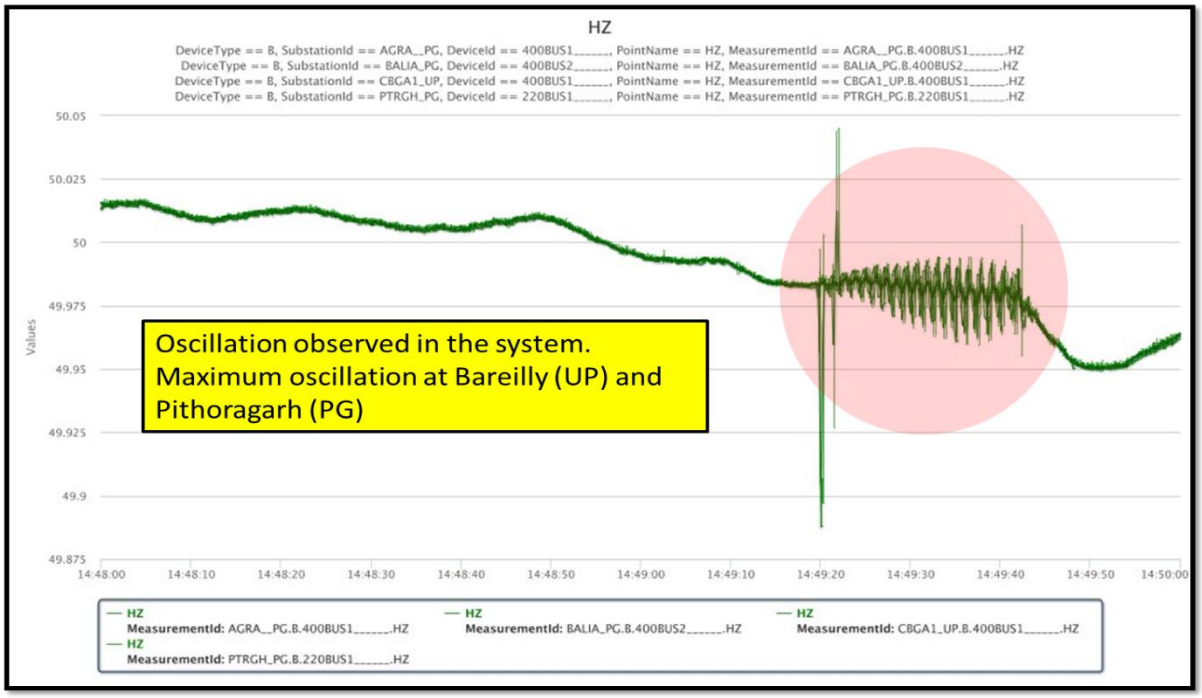
The impact of oscillation was widespread in the grid and oscillation also observed on Inter Regional lines from NR. PMU plot of frequency and voltage during oscillation is given below:



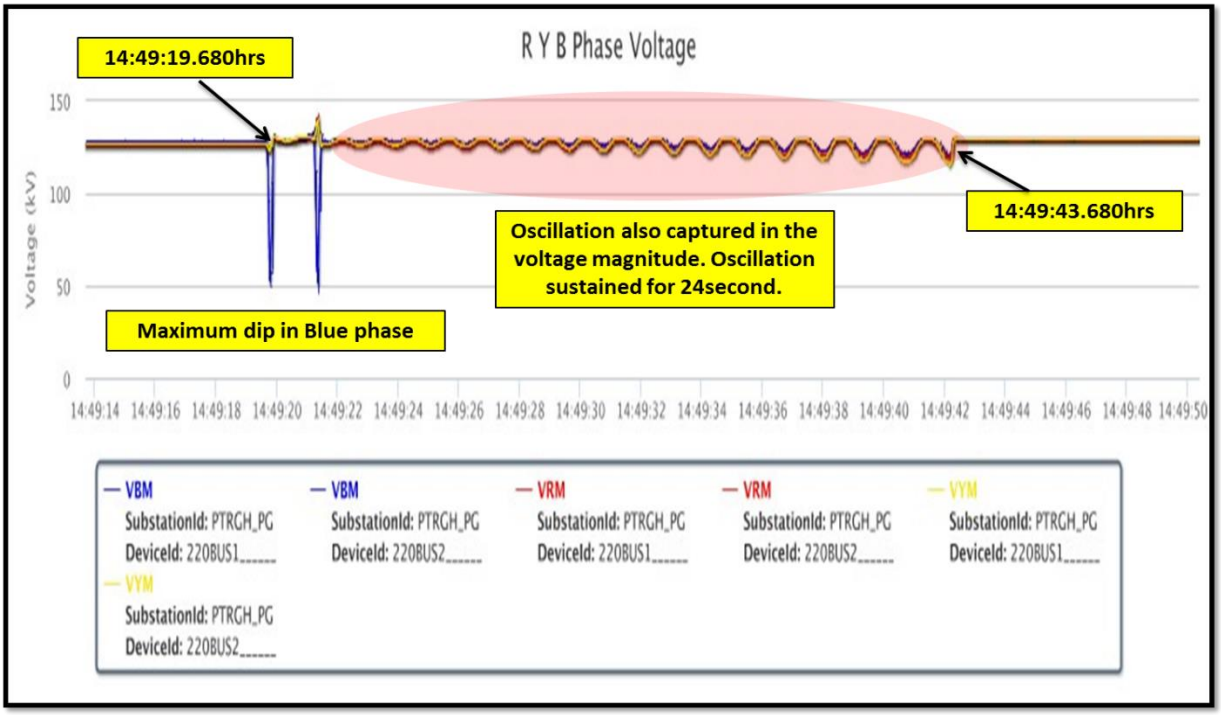
PMU plot of frequencies at different stations showing oscillation (18th Apr 2018)



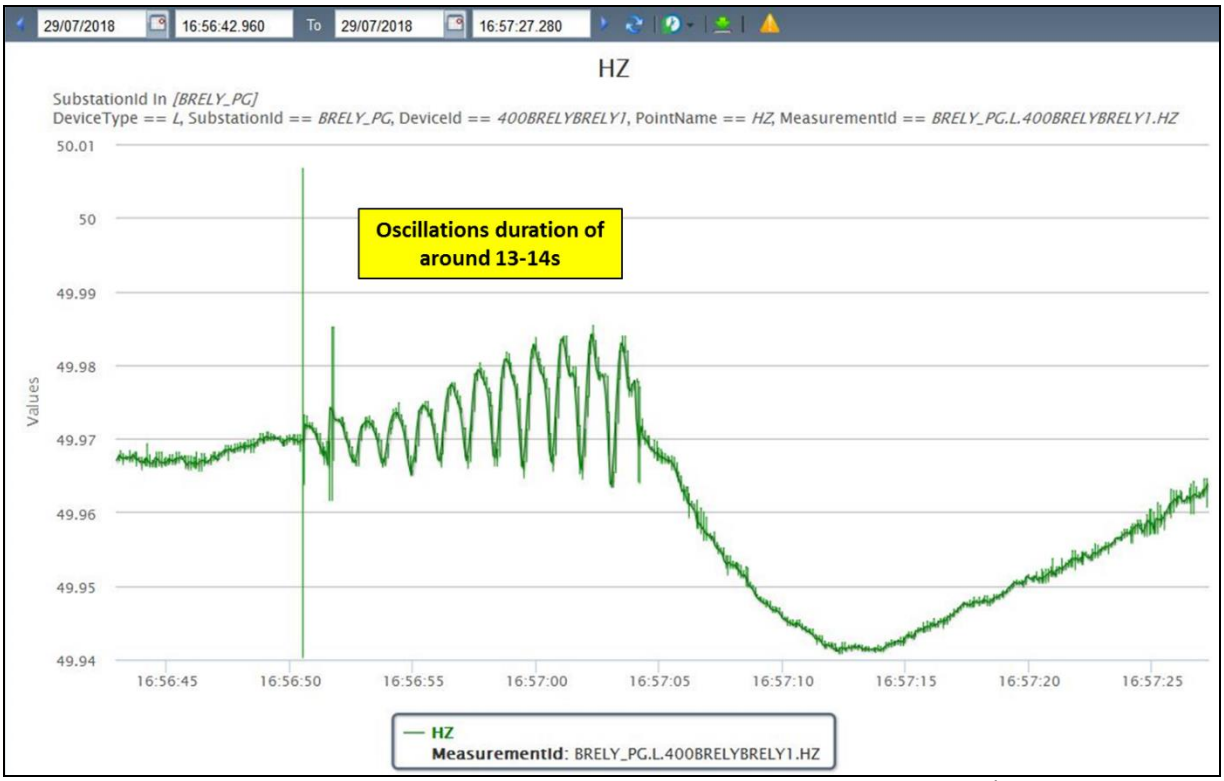
Power Spectral Density showing dominant mode of oscillation (18th Apr 2018)



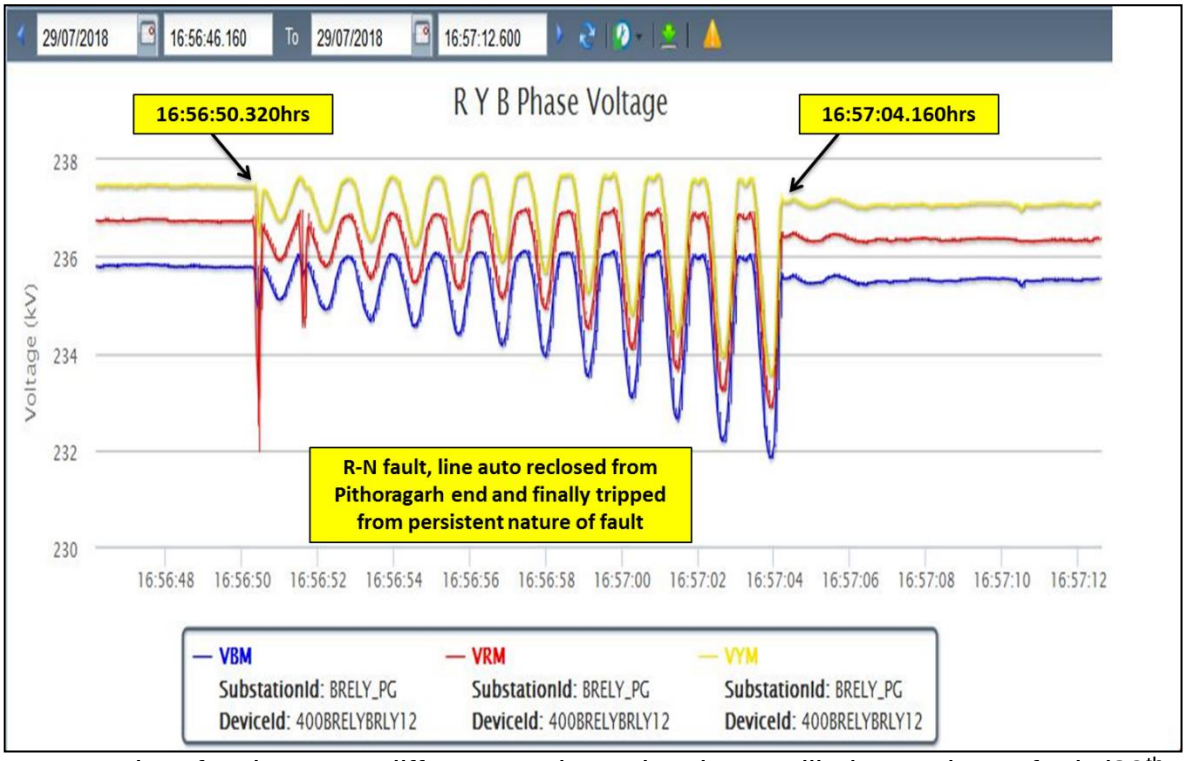
PMU plot of frequencies at different stations showing oscillation (25th July 2018)



PMU plot of Voltages at different stations showing oscillation and B-N fault (25th July 2018)



PMU plot of frequencies at different stations showing oscillation (29th July 2018)



PMU plot of Voltages at different stations showing oscillation and R-N fault (29th July 2018)

This Agenda point was already discussed in 150th OCC meeting, in which oscillation details were shown and discussed. Following points were suggested to NHPC:

- Proper tuning/ retuning of PSS/AVR of the units at 220 kV Dhauliganga HEP
- SPS (System Protection scheme). With the following logic shall be implemented at 220 kV Dhauliganga HEP.
    - Probable logic of SPS could be: *Trip two units at Dhauliganga HEP in case of tripping of one of the 220 kV outgoing lines from Dhauliganga HEP or power flow on any of the outgoing line become zero*

Decision in 150th OCC meeting:

- NHPC representative stated that SPS logic has been prepared on the basis of power flow on lines and would be shared and approved in upcoming OCC/PSC meeting.
- NRLDC representative requested that PSS tuning shall be extensively carried out and report to be shared. Further, the dynamic machine parameters are important to assess the dynamic behaviour of the system and shall be shared by NHPC and other constituents as well.
- OCC requested constituents to provide the respective details.

NHPC and other constituents may please provide the details. NHPC may please submit the SPS logic for approval of NRPC.

Members may like to discuss.

Annexure - I

~~Annexure-IV~~

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	1.Sh.Samba Siva Rao	GM (T)	220 kV Grid S/stn Bldg., Park Street, Delhi-1	011-23369008
		2.Sh.Gaurav Gangawar	AM (T) Prot.	220 kV Grid S/stn Bldg., Park Street, Delhi-1	011-23369008
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	1.Sh. Sandeep Verma	Sr. XEN, Protection	PSTCL, Patiala	09646118375
		2.Sh. Shiv Kumar	Asst. EXN, Protection	PSTCL, Jalandhar	09646118315
6.	HVPNL	1.Sh. Y.S. Gulia	Executive Engineer	HVPNL, M&P, Panipat	09354194830
7	RRVPNL	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	RRVPNL	1. Sh. Jyotimay Jaiminy	AEn-III (O&M)	400 kV GSS Heerapura, Jaipur	09413382408
		2. Vijay Pal Yadav	AEn(Prot.)	RRVPNL, Alwar	09414061407
13	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
14	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	
15	UJVN Limited	1. Sh. Manoj Rawat	A.E.	Dakpathar, Distt: Dehradun	09456590406
		2. Sh. Anoop Deepak	A.E.	Galogi, Distt: Dehradun	09456590173

केन्द्रीय विद्युत अनुसंधान संस्थान
(भारत सरकार की सोसाइटी, विद्युत मंत्रालय)
प्रो सर सी. वी. रामन रोड़, सदाशिवनगर डाक घर, पो. बा. सं. 8066, बेंगलूर - 560 080
CENTRAL POWER RESEARCH INSTITUTE
(A Govt of India Society under Min. of Power)
Prof. Sir C.V. Raman Road, Sadashivanagar P.O., P.B. No. 8066, Bangalore - 560 080, India
वेबसाइट/website : http://www.cpri.in

No.

04. Sept., 2018

To,
Member Secretary
Northern Regional Power Committee,
Central Electricity Authority,
18-A, Shaheed Jeet Singh Marg,
Katwaria Sari,
Delhi -110016

Dear Sir,

Sub: Protection Audit-Workshop/Training Programme.

Drawing your kind attention on the discussion held in Power Systems Division on 24 August 2018 at CPRI regarding organsing the Protection Audit training programme for the Utilities under NRPC at Bangalore.

First of all we are thankful for your interest in this training programme & we are hereby pleased to submit the offer for same.

1.0 INTRODUCTION:

Government of India has established the Northern Regional Power Committee (NRPC) Comprising of power systems and generating units of union territory of Chandigarh, states of Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttarapardesh, Uttrakhand and Delhi. To facilitate the stability and smooth operation of the integrated grid and economy & efficiency in the operation of power system in the Northern region, NRPC is involved by undertaking regional level operation analysis for improving grid performance,

facilitating inter-state/inter-regional transfer of power, and planning for maintaining proper voltages through reactive compensation studies for the states coming in Northern region.

Protection is one of the key operational aspect of power systems operation. The revision in protection setting /schemes for modification in network topologies is essential for reliable operation of power systems. The NPRC coordinates with all transmission utilities of Northern Grid for any revision in Protection schemes/setting and auxiliary protection function. Therefore periodic audit of these protection sachems/setting/protection functions and auxiliary protection is an healthy practice for enhancing the protection reliability.

In the recent past, CPRI carried out protection audit for RVPNL, BBMB, UPPTCL, PSTCL, Power grid western region, Goa Electricity Board NHPC, Torrent Power, Essar Power, Nellore Power Plant, Indrasagar, Rosa Power, Panki Power etc.

In this context, *Power Systems Division of Central Power Research Institute* (CPRI) is pleased to submit an offer for conducting a protection audit programme for Power Utilities under NRPC.

2.0 Topics to be covered.

The topics to be covered in brief during the three (03) days training programme are as under:

Day1- Protection Audit of main Protection for Power Transformer, Lines, Bus bars, reactors & Short circuit Studies.

Day-2: Protection Audit of main Protection for Alternators

Day-3: Protection Audit of Backup Protections & Auxiliary Protection functions Demonstration of Protection in Lab. & Lab. visits

The actual daily schedule may change as per the availability of Experts.

3.0- Training Fee

Training Fee for Central /State Govt. Power Utilities/ Electricity Boards Personnel is as under:

Fee Per Day/Participant Rs.	Days	Total Without GST Rs.	Total with GST@18% Rs.
3,500	3	10,500	12,390

The fee is to be paid in favour of "CPRI, through online transaction mode as per following details:

Name of beneficiary-Central Power Research Institute
Branch SBI, CPRI
IFSC Code: SBIN0010370
Account No: 10356553310.

4.0: Travel and Accommodation

- Bengaluru is well connected by Road, Rail and Air
- Participants have to make their own travel arrangements
- Guest house accommodation on twin sharing basis can be provided on chargeable basis subject to availability
- CPRI is situated in between Mekhri Circle and Yeshwanthpur.
  Near Indian Institute of Science (commonly known as Tata Institute)

5.0 Venue:

CCAR Auditorium, Central Power Research Institute
Prof. Sir. C V Raman Road,
Sadashivanagar P O,
Bengaluru 560 012

I hope the above, training offer meets the protection audit requirement of NRPC, if any additional requirement are there, and same may be communicated to CPRI

Thank you

Yours sincerely,

04th Sept 18

(K. S. Meera)
Additional Director, Power Systems Division

Northern Regional inter regional lines tripping for Aug-18

Annexure -III ----~~Annexure-I~~---

S. No.	Name of Transmission Element Tripped	Owner/ Utility	Outage		Load Loss/ Gen. Loss	Brief Reason (As reported)	Category as per CEA Grid standards	Restoration		# Fault Clearance Time (>100 ms for 400 kV and 160 ms for 220 kV)	*FIR Furnished (YES/NO)	DR/EL provided in 24 hrs (YES/NO)	Other Protection Issues and Non Compliance (inference from PMU, utility details)	Remedial Action	Remarks
			Date	Time				Date	Time						
1	500kV HVDC Mundra-Mohindergarh-1	ATL	9-Aug-18	5:39	Nil	DC Earth fault resulted in busbar protection operation at Mundra.	NA	9-Aug-18	14:24	NA	YES	YES			Information received from NR end. From PMU, no fault observed.
2	800kV HVDC Champa(PG)-Kurukshetra(PG)-1	POWERGRID	10-Aug-18	16:16	Nil	Converter differential alarm received at Kurukshetra	NA	15-Aug-18	13:56	NO	NO	NO	Pole tripping on suspected AC system fault.	Protection needs to be checked and rectified.	From PMU, B-N fault observed in AC system.
3	800kV HVDC Champa(PG)-Kurukshetra(PG)-2	POWERGRID	11-Aug-18	12:33	Nil	Tripped due to common neutral protection operated at champa end.	NA	11-Aug-18	14:45	NA	NO	NO		Details of tripping yet to be received.	From PMU, no fault observed.
4	800kV HVDC Champa(PG)-Kurukshetra(PG)-1	POWERGRID	17-Aug-18	16:39	Nil	R-B fault in 765kV Jhatikara-Bhiwani occurred resulted in commutation failure. The delay in inhibit DC line protection command resulted in outage of both poles on DC line fault protection.	GI-2	17-Aug-18	18:12	NA	YES	YES	Inhibit DC line protection command delayed. Only one restart attempt in place of designed 3 attempts.	Protection needs to be checked and rectified.	Information received from NR end. From PMU, R-B fault observed in AC system.
5	800kV HVDC Champa(PG)-Kurukshetra(PG)-2	POWERGRID	17-Aug-18	16:39	Nil	R-B fault in 765kV Jhatikara-Bhiwani occurred resulted in commutation failure. The delay in inhibit DC line protection command resulted in outage of both poles on DC line fault protection.	GI-2	17-Aug-18	17:47	NA	YES	YES		Reason for DT sent from Zerda end to be ascertained and problem to be rectified.	Information received from NR end. From PMU, no fault observed.
6	220kV Auraiya(NTPC)-Mehgaon(MPPTCL)	POWERGRID/ MPPTCL	18-Aug-18	16:49	Nil	CT blast at Mehgaon end resulted in bus bar protection. Line manually opened at Auraiya end.	NA	18-Aug-18	18:46	320ms	YES (After 24hrs)	YES (After 24hrs)			Information received from NR end. From PMU, B-N fault observed.
7	765kV Gwalior(PG)-Phagi(RRVPNL)-2	POWERGRID/ RRVPNL	19-Aug-18	22:35	Nil	Y-Ph LA blasted at Phagi end resulted in tripping of line in Z-1.	NA	20-Aug-18	18:41	NO	YES	NO			Information received from NR end. From PMU, Y-N fault observed.
8	220kV Pusauli(PG)-Sahupuri(UP)	UPPTCL/ POWERGRID	25-Aug-18	11:01	Nil	Tripped due to damage in the cables of relay panel at Sahupuri end.	NA	25-Aug-18	12:43	NA	NO	NO		Suspected mis-operation of protection. Protection needs to be checked and rectified.	From PMU, no fault observed.
9	800kV HVDC Agra(PG)-BNC(PG)-1	POWERGRID	27-Aug-18	0:23	Nil	DC Line fault. 202km from Agra end.	NA	27-Aug-18	15:28	NA	NO	NO		Details of tripping yet to be received.	From PMU, no fault observed.
10	800kV HVDC Champa(PG)-Kurukshetra(PG)-1	POWERGRID	28-Aug-18	4:45	Nil	DC line fault	NA	28-Aug-18	6:38	NA	NO	YES		Suspected tripping of pole on temporary AC system fault. Protection needs to be checked and rectified.	Information received from NR end. From PMU, Y-N fault observed in AC system.
11	800kV HVDC Agra(PG)-BNC(PG)-1	POWERGRID	29-Aug-18	9:22	Nil	During Metallic return mode, HVDC pole & line tripped on ground fault protection operated at Agra end.	NA	29-Aug-18	10:25	NA	NO	NO		Reason for DT sent from Motihati end to be ascertained and problem to be rectified.	From PMU, spiked increase in voltage is observed.
12	Vindhyachal HVDC BtB Block 1	POWERGRID	29-Aug-18	20:43	Nil	DC Over current protection trip	NA	30-Aug-18	6:55	NA	NO	NO		Details of tripping yet to be received.	From PMU,No fault observed.

 # Fault Clearance time has been computed using PMU Data from nearest node available and/or DR provided by respective utilities (*Annexure-* ***II)***

****Yes, if written Preliminary report furnished by constituent(s)***

R-Y-B phase sequencing (Red, Yellow, Blue) is used in the list content.All information is as per Northern Region unless specified.

Reporting of Violation of Regulation for various issues for above tripping

1	Fault Clearance time(>100ms for 400kV and >160ms for 220kV)	1. CEA Grid Standard-3.e 2. CEA Transmission Planning Criteria
2	DR/EL Not provided in 24hrs	1. IEGC 5.2(r) 2. CEA Grid Standard 15.3
3	FIR Not Furnished	1. IEGC 5.9.6.a 2. CEA Grid Standard 12.2 (Applicable for SLDC, ALDC only)
4	Protection System Mal/Non Operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.A 2. CEA (Technical Standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)
5	A/R not operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.C 2. CEA Technical Planning Criteria

Northern Regional inter regional lines tripping for Jul-18

Annexure-I

S. No.	Name of Transmission Element Tripped	Owner/ Utility	Outage		Load Loss/ Gen. Loss	Brief Reason (As reported)	Category as per CEA Grid standards	Restoration		# Fault Clearance Time (>100 ms for 400 kV and 160 ms for 220 kV)	*FIR Furnished (YES/NO)	DR/EL provided in 24 hrs (YES/NO)	Other Protection Issues and Non Compliance (inference from PMU, utility details)	Remedial Action	Remarks
			Date	Time				Date	Time						
1	800kV HVDC Champa(PG)-Kurukshetra(PG)-1	POWERGRID	3-Jul-18	12:46	Nil	Converter Differential Latch blocked from Champa end	NA	3-Jul-18	14:06	NA	NO	NO	wrong operation of protection suspected.	Protection needs to be checked and rectified.	From PMU, no fault observed.
2	400kV Goraphpur(PG)-Motihari(DMTCL)-1	POWERGRID/ DMTCL	4-Jul-18	10:52	Nil	DT received at Gorakhpur, reported problem in Gas chamber at Motihari	NA	4-Jul-18	11:40	NA	NO	NO	From PMU, R-phase voltage of 400kV Lucknow(end)-Gorakhpur-1 is around 15kV less than other phases.	Suspected CVT error 400kV Lucknow-Gorakhpur-1 at Lucknow end to be checked and rectified.	Information received from ER end. From PMU, no fault observed.
3	400kV RAPS C(NPC)-Shujalpur(PG)-1	NPCIL/ POWERGRID	6-Jul-18	14:02	Nil	DT Received at RAPS-C.	NA	6-Jul-18	14:44	NA	YES	YES			Information received from NR end. The protectection channels viz. distance zone, Over voltage, Auto-recloasing etc. are not configured in DR (RAPS end). Same needs to be incorporated.
4	400kV Bhinmal(PG)-Zerda(PG)	POWERGRID	9-Jul-18	11:46	Nil	DT received at Bhinmal end.	NA	9-Jul-18	14:22	NA	YES	YES		Reason for DT sent from Zerda end to be ascertained and problem to be rectified.	Information received from NR end. From PMU, no fault observed.
5	HVDC Vindhyachal HVDC BtB Block 1	POWERGRID	11-Jul-18	12:54	Nil	DC Overcurrent protection operated	NA	11-Jul-18	23:13	NA	NO	NO	Sensitive Protection setting of DC over current.	Protection needs to be checked and rectified.	From PMU, no fault observed.
6	400kV Bhinmal(PG)-Zerda(PG)	POWERGRID	14-Jul-18	22:09	Nil	Tripped due to bus bar protection operated at Zerda end.	NA	15-Jul-18	2:26	YES (150ms)	YES (After 24hrs)	YES (After 24hrs)	Delayed fault clerance from Zerda end suspected.		Information received from NR end. From PMU, R-N fault observed.
7	400kV Gorakhpur(PG)-Muzaffarpur(PG)-1	POWERGRID	18-Jul-18	15:23	Nil	Line trip command during Permanent Bypass Operation of TCSC System in which Bypass Breaker Failed to close. DT Send from Gorakpur end.	NA	18-Jul-18	17:03	NA	NO	NO	From PMU, R-phase voltage of 400kV Lucknow(end)-Gorakhpur-1 is around 15kV less than other phases.	Suspected CVT error 400kV Lucknow-Gorakhpur-1 at Lucknow end to be checked and rectified.	From PMU, no fault observed.
8	400kV Goraphpur(PG)-Motihari(DMTCL)-1	POWERGRID/ DMTCL	21-Jul-18	7:11	Nil	DT received at Gorakhpur end.	NA	21-Jul-18	8:53	NA	NO	NO		Reason for DT sent from Motihati end to be ascertained and problem to be rectified.	From PMU, no fault observed.
9	HVDC Vindhyachal HVDC BtB Block 1	POWERGRID	23-Jul-18	19:57	Nil	DC Overcurrent protection operated	NA	24-Jul-18	13:11	NA	NO	NO	Sensitive Protection setting of DC over current.	Protection needs to be checked and rectified.	From PMU, R-N fault observed.

 # Fault Clearance time has been computed using PMU Data from nearest node available and/or DR provided by respective utilities (*Annexure-* ***II)***

****Yes, if written Preliminary report furnished by constituent(s)***

R-Y-B phase sequencing (Red, Yellow, Blue) is used in the list content.All information is as per Northern Region unless specified.

Reporting of Violation of Regulation for various issues for above tripping

1	Fault Clearance time(>100ms for 400kV and >160ms for 220kV)	1. CEA Grid Standard-3.e 2. CEA Transmission Planning Criteria
2	DR/EL Not provided in 24hrs	1. IEGC 5.2(r) 2. CEA Grid Standard 15.3
3	FIR Not Furnished	1. IEGC 5.9.6.a 2. CEA Grid Standard 12.2 (Applicable for SLDC, ALDC only)
4	Protection System Mal/Non Operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.A 2. CEA (Technical Standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)
5	A/R not operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.C 2. CEA Technical Planning Criteria

Northern Regional inter regional lines tripping for Jun-18

Annexure-I

S. No.	Name of Transmission Element Tripped	Owner/ Utility	Outage		Load Loss/ Gen. Loss	Brief Reason (As reported)	Category as per CEA Grid standards	Restoration		# Fault Clearance Time (>100 ms for 400 kV and 160 ms for 220 kV)	*FIR Furnished (YES/NO)	DR/EL provided in 24 hrs (YES/NO)	Other Protection Issues and Non Compliance (inference from PMU, utility details)	Remedial Action	Remarks
			Date	Time				Date	Time						
1	400kV RAPS C(NPC)-Shujalpur(PG)-1	NPCIL/ POWERGRID	1-Jun-18	15:52	Nil	R-N fault.		1-Jun-18	18:08	NA	YES (After 24hrs)	YES (After 24hrs)			Information received from NR end. The protectection channels viz. distance zone, Over voltage, Auto-recloasing etc. are not configured in DR (RAPS end). Same needs to be incorporated.
2	HVDC Vindhyachal HVDC BtB Block 1	POWERGRID	2-Jun-18	15:24	Nil	DC overcurrent protection operated.		2-Jun-18	17:30	NA			Sensitive Protection setting of DC over current.	Protection needs to be checked and rectified.	From PMU, R-N fault observed.
3	800kV HVDC Champa(PG) - Kurukshetra(PG)-1	POWERGRID	3-Jun-18	10:59	Nil	Tripped without any alarm.		3-Jun-18	12:08	NA			wrong operation of protection suspected.	Protection needs to be checked and rectified.	From PMU, no fault observed.
4	220kV Sakatpura(RRVPNL)-Badod(MPPTCL)	RRVPNL/ MPPTCL	6-Jun-18	4:18	Nil	B-N fault.		6-Jun-18	20:32	370ms		YES (After 24hrs)	Delayed clerance of fault in Z-2 from Sakatpura end.	Non-tripping of line in Z-1 from Badod to be checked and rectified.	Information received from NR end.
5	220kV Auraiya(NTPC)-Malanpur(MPPTCL)	NTPC/ MPPTCL	7-Jun-18	6:21	Nil	R-N fault.		7-Jun-18	7:09	NA		YES (After 24hrs)	No Auto reclosure observed; Time sychronization mismatch (~46sec) between DR and PMU timings observed.	Auto reclosing issue at Auraiya to be resolved; Time synchronization in DR to be checked and rectified.	Information received from NR end.
6	800kV HVDC Champa(PG) - Kurukshetra(PG)-1	POWERGRID	8-Jun-18	3:07	Nil	Tripped due to External Block Received at Champa End.		8-Jun-18	3:37	NA			wrong operation of protection suspected.	Protection needs to be checked and rectified.	From PMU, no fault observed.
7	765kV Gwalior (PG) - Phagi (RRVPNL)-1	RRVPNL/ POWERGRID	8-Jun-18	16:02	Nil	R-N fault at 86.18 km from Phagi.		8-Jun-18	18:20	NA				Line	From PMU, unsuccessful auto-reclosing observed.
8	400kV RAPS C(NPC)-Shujalpur(PG)-1	NPCIL/ POWERGRID	9-Jun-18	16:38	Nil	Y-N fault		9-Jun-18	19:50	NA	YES	YES	No Auto reclosure observed.	Auto reclosing issue at RAPS to be resolved	Information received from NR end.
9	765kV Gwalior (PG) - Phagi (RRVPNL)-2	RRVPNL/ POWERGRID	9-Jun-18	19:19	Nil	B-N fault.		9-Jun-18	20:12	NA					From PMU, multiple faults observed.
10	765kV Agra(PG)-Gwalior(PG)-2	POWERGRID	9-Jun-18	21:12	Nil	R-B fault.129 km from Gwalior,fault current 23 kA at Agra.		10-Jun-18	1:27	NA					
11	220kV Sakatpura(RRVPNL)-Badod(MPPTCL)	RRVPNL/ MPPTCL	11-Jun-18	16:18	Nil	Broken conductor at Kota end		11-Jun-18	19:01	NA	YES (After 24hrs)		As per protection philosophy, alarm is set in case of Broken conductor in place of tripping	Broken conductor settings to be shared. Alarm amy be adopted in place of tripping.	Information received from NR end. From PMU, no fault observed.
12	HVDC Vindhyachal HVDC BtB Block 1	POWERGRID	12-Jun-18	20:00	Nil	DC overcurrent protection operated.		12-Jun-18	22:03	NA			Sensitive Protection setting of DC over current.	Protection needs to be checked and rectified.	From PMU, R-Y fault observed in AC system.
13	800kV HVDC Champa(PG) - Kurukshetra(PG)-1	POWERGRID	15-Jun-18	14:15	Nil	Due to filter power limit alarm.		15-Jun-18	14:57	NA			wrong operation of protection suspected.	Protection needs to be checked and rectified.	From PMU, no fault observed.
14	400kV Balia(PG)-Patna(PG)-2	POWERGRID	16-Jun-18	20:21	Nil	R-B fault. 146.9 kms from Balia.		16-Jun-18	21:34	NA					From PMU, B-N fault observed.
15	765kV Fatehpur(PG)-Sasaram(PG)	POWERGRID	17-Jun-18	17:37	Nil	Tripped on R-N fault, 254.5km from Fatehpur end.		17-Jun-18	19:14	NA					From PMU, R-N fault observed followed by Y-N fault in reclaim time.
16	800kV HVDC Champa(PG) - Kurukshetra(PG)-1	POWERGRID	21-Jun-18	0:55	Nil	DC valve bushing failure.		30-Jun-18	20:11	NA			wrong operation of protection suspected.	Protection needs to be checked and rectified.	From PMU, no fault observed.
17	400kV RAPS C(NPC)-Shujalpur(PG)-1	NPCIL/ POWERGRID	25-Jun-18	13:43	Nil	R-Y fault, 13.62km from RAPP C end.		25-Jun-18	16:03	NA	YES	YES	Time sychronization mismatch (~15sec) between DR and PMU timings observed.	Time synchronization in DR to be checked and rectified.	Information received from NR end.
18	400kV Bhinmal(PG)-Zerda(PG)	POWERGRID	27-Jun-18	7:32	Nil	Y-B Fault , 105km from Bhinmal end.		27-Jun-18	21:32	NA	YES	YES			Information received from NR end.
19	500kV HVDC Mohindergarh(APL)-Mundra(APL)-2	APL/ATL	30-Jun-18	0:08	Nil	DC Line fault		30-Jun-18	4:07	NA					From PMU, no fault observed.

 # Fault Clearance time has been computed using PMU Data from nearest node available and/or DR provided by respective utilities (*Annexure-* ***II)***

****Yes, if written Preliminary report furnished by constituent(s)***

R-Y-B phase sequencing (Red, Yellow, Blue) is used in the list content.

Reporting of Violation of Regulation for various issues for above tripping

1	Fault Clearance time(>100ms for 400kV and >160ms for 220kV)	1. CEA Grid Standard-3.e 2. CEA Transmission Planning Criteria
2	DR/EL Not provided in 24hrs	1. IEGC 5.2(r) 2. CEA Grid Standard 15.3
3	FIR Not Furnished	1. IEGC 5.9.6.a 2. CEA Grid Standard 12.2 (Applicable for SLDC, ALDC only)
4	Protection System Mal/Non Operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.A 2. CEA (Technical Standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)
5	A/R not operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.C 2. CEA Technical Planning Criteria

Minutes of the 10th Protection Analysis Sub Group (PSAG) meeting held on 18th April, 2018 at NRPC, New Delhi

A meeting was held on 18.04.2018 at NRPC Secretariat, New Delhi to discuss the Kashmir Valley trippings of complete blackout of 400kV Kishenpur substation on 12.02.2018 and 400kV GSS Wagoora substation on 10.03.2018. List of participants is attached as **Annexure-I.**

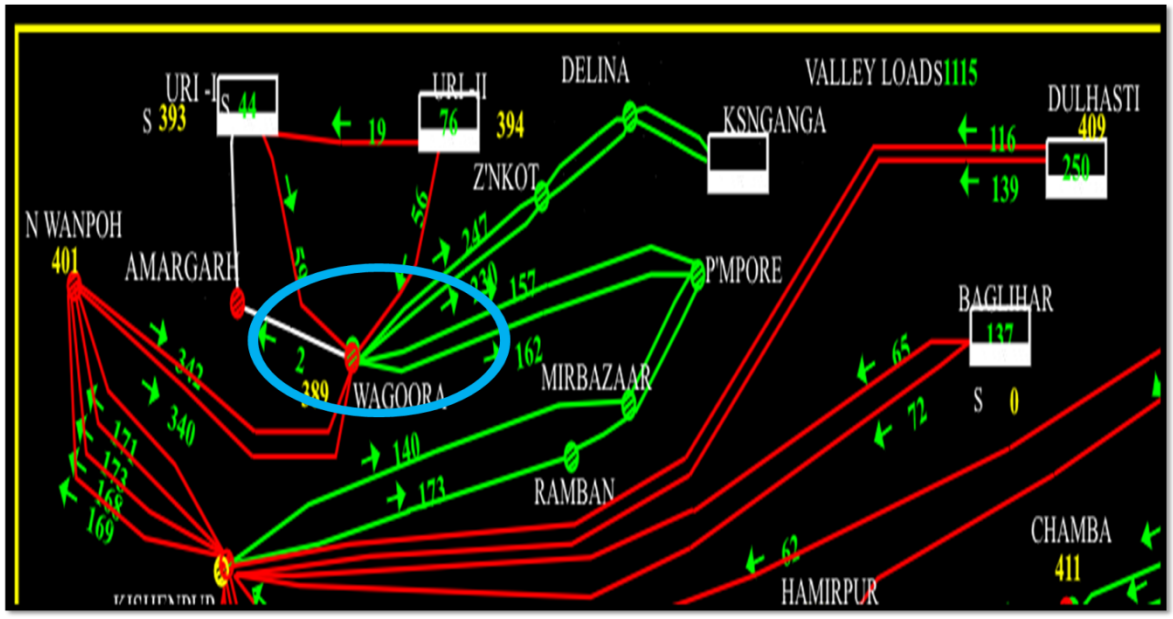
Deliberations:

SE(O) welcomed all the participants and briefed about the tripping incidents that happened on 12.02.2018 and 10.03.2018. He further requested NRLDC representative to brief the antecedent conditions and events happened on those days.

1. **Collapse of Kashmir valley due to multiple element tripping at Kishenpur(PG) on 12th Feb, 2018 at 11:24hrs and 12:07hrs:**

Representative of NRLDC briefed about the connectivity of Kashmri valley with the grid (Presentation attached as **Annexure - II**). He stated that the connectivity of Kashmir valley to the Grid is through following four interconnections:

1. 400kV New Wanpoh-Wagoora ckt-1
2. 400kV New Wanpoh-Wagoora ckt-2
3. 220kV Kishenpur-Ramban-Mirbazar-Pampore
4. 220kV Kishenpur-Mirbazar-Pampore



The antecedent Conditions at Kishenpur S/S were as following:

a) 400 kV New Wanpoh I, II & III were in service.
b) 400 kV Samba –I & II were in service
c) 400 kV Moga-I & II were in service
d) 400 kV Chamera were in Service
e) 400 kV Baglihar -II were in service
f) 400 kV Dulhasti –II were in service
g) All three ICT-I, II & III were in service
h) All 220 kV feeders were in service
i) 400 kV Kishenpur- New Wanpoh IV out on Overvoltage.
j) 400 kV Kishenpur- BagliharCkt I out on Overvoltage.
k) 400 kV Kishenpur- DulhastiCkt I out on Overvoltage
l) Elements on 400 kV Bus I: 400 kV New Wanpoh I, II & III & IV, 400 kV Baglihar I & II, 400 kV Dulhasti I & II, ICT III.
m) Elements on 400 kV Bus II: 400 kV ICT I & II, 400 kV Samba I & II, 400 kV Moga I & II & 400 kV Chamera.
n) Unit #1 & #2 not running at Uri-1
o) Unit #1 & #2 not running at Uri-2

He also briefed about the elements tripped at 11.24 hrs which are as following:

a) 400kV Kishenpur-Wanpoh-1, 2, 3
b) 400kV Kishenpur-Samba D/C
c) 400kV Kishenpur-Baglihar-2
d) 400kV Kishenpur-Chamera II ckt
e) 400/220kV ICT-1, 3 at Kishenpur
f) 400kV Kishenpur-Moga D/C
g) Collapse of Kashmir Valley resulting in complete outage of Wagoora, Uri-1, Uri-2 and other stations in the valley

He informed that in the last year 5 such incidents happened where Kashmir valley collapsed.

PCE-II, CEA queried whether any SPS for load shedding was not designed in case of contingency in the Kashmir valley. He said that if not then SPS should be designed for the Kashmir valley for load shedding. He further asked about the power flow on D/C 220kV Wagoora – Ziankote, D/C 220kV Wagoora-Pampore. PCE II was informed that SPS was designed for the Kashmir valley but it has not been implemented yet.

Representative of POWERGRID stated that usually power flow of around 450 MW and 400 MW takes place on D/C 220kV Wagoora – Ziankote and D/c 220kV

Wagoora-Pampore lines respectively. PCE- II, CEA queried about the the generation at the Uri I and II.

Representative of NHPC stated that there are 120*4 units at Uri –I and 60*4 units at Uri –II. He stated that usually in lean period during off peak hours around 180 MW and during peak hours around 360 MW is generated at Uri I and II. PCE- II, CEA stated that considering the power flow in the valley, load of around 400 MW shall be shed in case of tripping of 400 kV New Wanpoh-Wagoora D/C. He further asked about the sequence of events on the tripping day.

Representative of POWERGRID told that 400 kV Kishenpur-New Wanpoh-3 ckt tripped on persistent R-N fault due to snapping of earth wire during the snowfall. He further informed that main protection from New Wanpoh end operated correctly and opened the line. It also sent the permissive carrier to the Kishenpur end but fault was not picked up from Kishenpur end as mutual compensation wiring was done in the relays of circuit 3 & 4 with neutral wiring of relays were interchanged. Hence, relay of circuit 3 sensed the neutral current of circuit 4 which was already out due to which earth fault of ckt # 3 was not picked up. He also informed that distance relays don't send DT and give trip command if carrier from other end is received and its own starter is picked up. (Presentation attached as **Annexure - III**)

Further, he told that snapped conductor came in contact with another conductor which led to phase to phase fault and it was picked up by relay in zone-2 and circuit was opened at Kishenpur end after 9 secs. He stated as the fault current was less and fed together by all other circuits at Kishenpur end, it was not picked up in zone-3 by other circuits connected at Kishenpur end. He further told that remaining 2 circuits of 400kV New Wanphoh-Kishenpur and 400 kV Samba-I & II from Samba end tripped on DEF protection.

PCE-II, CEA queried about the tripping of 220kV feeder from Kishenpur end. It was informed that 220 kV feeder at Kishenpur end were not tripped but New Wanpoh and Wagoora were completely out. Representative of POWERGRID stated that bus voltage at Wagoora substation was zero. Representative of NRLDC stated that Kashmir valley was considered to be collapsed as the load shown for valley was zero in SCADA. It was also informed that 220 kV Wagoora-Pampore circuits were tripped from Pampore end.

Upon queried about the Uri I & II, representative of NHPC stated that unit 3&4 of Uri – I were tripped on excitation equipment failure and unit 3&4 of Uri -II were tripped on under frequency and shaft current protection respectively. It was also informed that GPS was not functioning properly at Uri substation. He also told that

transducers at Uri station were replaced to avoid excitation equipment failure and it has performed satisfactorily thereafter.

After asking about the incident at 12:07 hrs, representative of POWERGRID stated that restoration was under process and power flow around 150 MW was started. He stated that code for ckt 1 and 2 was received from NRLDC and same was instructed at station. After restoring circuit 1 and 2, the circuit 3 was also tried to restore by operator assuming that same code was applicable for circuit 3. It was also clarified that no code was issued from NRLDC for circuit 3. He further agreed that it was due to miscommunication which should be avoided in future.

PCE- II, CEA told that the entire analysis of the event could not be done, due to unavailability of complete data, hence it was not possible to arrive at any conclusion. He emphasized upon the implementation of SPS for load shedding at the earliest in the Kashmir valley. He further advised for the special meeting to be held with entire data available and insisted upon the presence of representatives from PDD Jammu & Kashmir for complete analysis of the event.

The following points were discussed and necessary actions were recommended:

- The actual collapse of Kashmir valley needs to be established as even after loss of connectivity from Grid at 400kV level (through N. Wanpoh), the grid was connected through 220kV ckts from Kishenpur. Same needs to be confirmed.

- SPS (Special Protection Scheme) needs to be reviewed for Kashmir valley **(Annexure - IV)** wherein in case of loss of few of the interconnections of valley from grid, load shedding should be done to avoid any overloading of remaining interconnections. It was also advised that SPS should be implemented for Kashmir valley at the earliest.

- As per DR (11:24hrs) of 400kV Kishenpur-Wanpoh(end)-3, DEF operated for 15ms and DT command was sent. However, no DT was received at Kishenpur end. POWERGRID representative agreed to check the same and revert.

- Reasons for tripping of 400/220kV ICT-1 at Kishenpur needs to be ascertained. POWERGRID representative stated that it was tripped on over flux agreed to check and share the setting.

- Setting of DEF (Residual polarizing voltage, current values etc.) for all the lines emanating from Kishenpur (both ends) to be shared. POWERGRID representative agreed to check the same and revert.

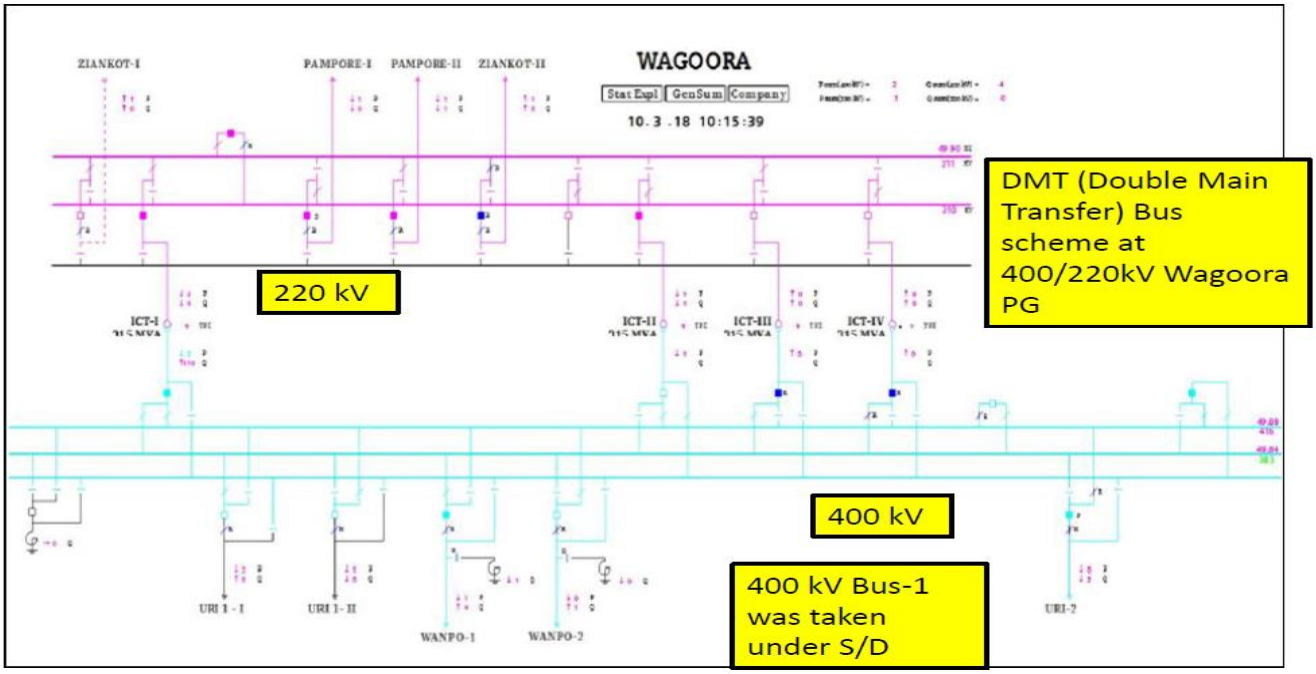
- Charging of 400kV Kishenpur-Wanpoh-3 without consent/code of NRLDC was deliberated. Further, it was stated if attempt were to be taken, it could have been

taken from Wanpoh end in place of Kishenpur end wherein problem was suspected due to multiple element tripping. POWERGRID representative agreed to the human error happened in this case wherein ckt-3 was also closed by mistake, though code for only ckt-1&2 closing was given.

- In case of tripping of 400kV Kishenpur-Samba-1&2on DEF, DT was not sent to Kishenpur end. POWERGRID representative agreed to check the same and revert.
- Same unit (#2 at Uri-II) tripped at different time as per DR of main-1,2 of Unit #2 at Uri-II. Further, Event log of Unit #1 showed tripping of unit around 15 sec prior to fault starting time. In this respect, time synchronization at Uri-II needs to be checked. NHPC representative agreed to the above error in time. He explained that the GPS at the plant should be replaced.
- Reason and setting of Excitation equipment failure at Uri-1 to be shared. NHPC representative agreed to check the same and revert.
- Reason and setting of Shaft current Protection at Uri-2 to be shared. NHPC representative agreed to check the same and revert.

2. Collapse of Kashmir valley due to complete outage of 400kV Wagoora(PG) on 10th Mar 2018 at 09:51hrs:

Representative of NRLDC briefed about the connectivity of 400kV Wagoora with the grid (Presentation attached as **Annexure - V**). He stated that 400kV Wagoora substation has DMT scheme with following connections:



He further briefed about the antecedent Condition at Wagoora SS and told the status as following:

a) 400kV Uri-1-Wagoora ckt-2 was under planned outage
b) Unit-2 of Uri-1 HEP was under outage and Unit-1 of Uri-2 HEP was under outage.
c) Elements on 400 kV Bus I of Wagoora (PG): ICT-I, ICT-III, 400 kV Uri I, 400 kV New Wanpoh I,
d) Elements on 400 kV Bus II of Wagoora (PG): ICT-II, ICT-IV, 400 kV Uri I (Amargarh II), 400 kV New Wanpoh II, 400 kV Uri Stage II

He also briefed about the elements tripped at 09.51 hrs on 10.03.2018 at Wagoora which are as following:

a) 400kV Kishenpur-Wanpoh-1, 2, 3
b) 400kV Kishenpur-Samba D/C
c) 400kV Kishenpur-Baglihar-2
d) 400/220kV ICT-1 at Kishenpur
e) Collapse of Kashmir Valley resulting in complete outage of Wagoora, Uri-1, Uri-2 and other stations in the valley

Representative of POWERGRID stated that there was planned outage of Bus - 1 on that day. He informed that it was observed that whenever shutdown is availed on one circuit of 400 kV Wagoora – Uri D/C line, supervision unit of Check zone gets operated due to earthing of induced voltage through line CT which blocks the operation of Check Zone and results in non-operation of bus bar protection in case of any bus fault.

Hence, this problem was being analyzed on 10.03.2018 by checking the settings of Check Zone supervision unit. During checking the supervision relay, for exploring the possibility of increasing the setting, the relay was removed from its rack and Check Zone Switch was put in OUT position. This makes the trip command direct.

He informed that during switching of a feeder from Bus-1 to Bus-2, due to improper switching of CT selection relay caused by isolator limit/ auxiliary contacts problem, Zone-A and Zone-B operated. As at this time the Check Zone switch was already in OUT position, tripping command was directly issued to both the buses and all elements on both the buses tripped.

The following points were discussed and necessary actions were recommended:

- Co-ordination between Operation staff and Protection staff:
    - Check zone was made OUT (tripping direct from bus zones), before switching of feeders from bus-1 to 2 would lead to tripping of buses on bus bar protection during shifting of feeders among buses.

Representative of POWERGRID stated that such error in coordination should be avoided. PCE-II, CEA suggested to include the sequence of operation to be followed in case of shutdown in the procedure at site so that such type of events would not occur again.

- No information at NRLDC was there about blocking of bus bar protection due to supervision unit at Wagoora. POWERGRID representative informed that the bus bar scheme would also be replaced to avoid any future tripping on above.
- High Impedance bus bar protection pickup setting and supervision unit pick up setting at Wagoora needs to be shared.

PCE – II, CEA also told that such problems with GE relays should be rectified in co-ordination with representative of GE as in most of the states DMT schemes were implemented with these GE relays.

The meeting ended with Vote of Thanks to the chair.

Annexure-I

List of Participants for the PSAG meeting held on 18.04.2018 at NRPC, New Delhi to the Kashmir Valley trippings of 12.02.2018 and 10.03.2018

Sr. No.	Name	Designation	Organization	Phone/Mobile	e-mail ID
1.	B.K. Sharma	PCE-II	CEA	-	bks59@nic.in
2.	M. A. K. P. Singh	MS	NRPC	-	ms-nrpc@nic.in
3.	Upendra Kumar	SE	NRPC	9910180485	seo-nrpc@nic.in
4.	Bhanwar Singh Meena	EE	NRPC	8750251805	bhanwarmeenamop@gmail.com
5.	Swarup Kumar Das	Manager (E)	NHPC	9717786721	sdas_nhpc@yahoo.co.in
6.	Praveen Kumar	Manager	PG, NR-II	9419245474	mr.praveenkumar@powergridindia.com
7.	Ankit Gupta	Sr. Engineer	NRLDC	9560770520	ankit.gupta@posoco.in
8.	Shashank Tyagi	Dy. Mgr	NRLDC	-	-
9.	Kaushik Panditrao	AE	NRPC	9869081939	kaushik.panditrao@gov.in
10.	Akshay Dubey	AEE	NRPC	9599179744	dubey.akshay@gov.in
11.	Anil Kumar Gautam	AEE	NRPC	7065203211	akgautam.cea@gov.in

Compliance for the issues raised during 10th PSAG meeting held on 18.04.18 on collapse of Kashmir Valley on 12.02.18

Sl. No.	Issue Raised	Reply
1	As per DR (11:24hrs) of 400kV Kishenpur-Wanpoh(end)-3, DEF operated for 15ms and DT command was sent. However, no DT was received at Kishenpur end. POWERGRID representative agreed to check the same and revert.	The same has been check for DT command, it is working fine. No solid reason is found for said non receipt of DT at Ksihenpur. At the time of tripping the pulse of DEF and DT seen the DR for 10- 14 mSec., may be the short duration of pulse is the reason for non-transmission of DT to Kishenpur.
2	Reasons for tripping of 400/220kV ICT-1 at Kishenpur needs to be ascertained. POWERGRID representative stated that it was tripped on over flux agreed to check and share the setting.	From the BCU event, ICT tripping on Over Flux was observed. However, no other flag of any was found dropped except Master trip relay. The Over flux setting of ICT-1 at Kishenpur is 2.42 with IDMT Characteristics.
3	Setting of DEF (Residual polarizing voltage, current values etc.) for all the lines emanating from Kishenpur (both ends) to be shared. POWERGRID representative agreed to check the same and revert.	Separate Excel sheet is enclosed.
4	In case of tripping of 400kV Kishenpur-Samba-1&2on DEF, DT was not sent to Kishenpur end. POWERGRID representative agreed to check the same and revert.	As per the schematic of the said lines, DT was not configured with DEF tripping. On checking it is found that th DT send on DEF operation vary from scheme to scheme. Now, it has been decided to remove the DT send signal on DEF operation.
5	Non-operation of Z-3 protection of lines emanating from Kishenpur to be looked into.	The amount of current fed to the fault was not very high. It was around 2.7 kAmp. This current was distributed in all the connected feeders and voltage drop was not that much high for Z-3 operation.

6	Non-operation of DEF protection of 400kV Kishenpur-Wanpoh-1&2 from Kishenpur end to be checked as fault seems to be nearer for forward directional looking DEF protection at Kishenpur end than Wanpoh end (Line tripped on DEF from Wanpoh end).	CB of Wanpoh -3 was not tripped and fault was fed from Wanpoh to fault point through Kishenpur that's why DEF operated at Wanpoh seeing the current in neutral. But, for the same case as CB was already tripped from Wanpoh end and there was no direct fault feeding from Kishepur through any of ckt-1 &2 toward Wanpoh side. That's why DEF did not operate at Kishenpur.

Setting adopted for Bus bar protection at Wagoora:

Diff 87A			
Zone A	**Zone B**	**Zone C**	**Check Zone**
275 V	275 V	275 V	275 V
Supervision Relay 95A			
10 V, 3 Sec	14 V, 3 Sec	10 V, 3 Sec	14 V, 3 Sec

Detailed Analysis Report_Format

A. Pre Fault Condition:

1. Time & Date of Event.
2. Element already out of service prior to incident
3. Element tripped
4. Brief Event Summary.

B. Fault details

1. Element tripped: Name
   Time
   Relay Flag details i.e. Phase, Fault current, Fault Location, Zone information (in case of line), Diff/REF (in case of ICT/Reactor)
2. Equipment failure (if any): If any equipment failed during fault incident, or any equipment failure caused multiple element tripping, details of equipment failed i.e. Make, Model, Probable/ascertained reason of failure may be incorporated

C. Fault Analysis

1. Analysis of Fault – if protection did not operated as per desired condition, corrective measures (if already taken).

D. Restoration Sequence

1. Restoration time of tripped elements

E. Lesson Learnt

F. Any other Information

Enclosure: DR/EL of

Annex-VII

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, auto recloser deficiency due to PLCC issue is remaining rest all have been rectified. Order has been placed for PLCC and deficiency will be rectified once the equipments are supplied.**
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 last 03 (33rd PSC, 34th PSC and 35th PSC) 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.	As informed during 33rd NRPC meeting that deficiencies where procurement was not involved had been rectified and other

			Target completion not known.	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-VIII

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	Not 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 receipt and examination of Report, same.	Action plan to be submitted by **11.08.2017**.

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**
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
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.

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
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-IX

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	56	39	17 nos. defective	1 done; next 14 by June ,17 and other 2 in 2017-18, as control cable was not available.
	HPGCL	03	03		
Rajasthan	RVPNL	133	46 (7 defective)		74 nos. Bus bar Protection scheme under commissioning.
	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	For the remaining stationed procurement action has been initiated.
	UVUNL	05	-		
POWERGRID	PGCIL	55	55		
Central Generating Stations	NTPC	11	11		
	NHPC	09	09		
	NPCIL	02	02		
	THDC	02	02		
	SJVNL	02	02		

Annex-X

List of members of Protection Analysis Sub-Group (PSAG)

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21.	UPRVUNL	Mr. Shekh Salim	9415900086 se.omc_3.parichha@uprvunl.org
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Annexure - XI

DRAFT

Implementation of Special Protection Scheme (SPS) at Dhauliganaga Power Station

Dhauliganga Power Station has four generating units of 70 MW each with two 220 kV lines (twin moose conductor). The line length of Pithoragarh Line is 59 kM and that of Bareilly line is 235 kM.

It has been observed earlier on many occasions that in case of tripping of one line the second line is not capable of transmitting the full generating capacity i.e. 280 MW and severe power swing introduced in the surviving line with PSS of all the four units "ON". Further it has been noticed that the power flow above 185 MW on single line (in case tripping of other line) causes the oscillation on the surviving line and ultimately tripped on out of step/Zone-1. Power Station has performed the test on functionality of PSS on all the four units (by the OEM) on 20/04/2018 to ensure its proper operation. It has been concluded in the report that:

1. Based on step response test PSS behaviour is normal and is damping the disturbance (+2% variation in stator voltage).
2. When total load for one line goes above 185 MW with PSS on then overall system become unstable.
3. During line fault conditions fluctuations are undamped in nature and it become so large that in the end it may trip all the running machines.

Further, NRLDC vide its letter no. NRLDC/TS-15 dated 24/04/2018 has emphasized that the augmentation of transmission lines is required to ensure reliable evacuation of total power (280MW) of Dhauliganga Power Station through individual line. However, till the time such augmentation is done, it is proposed to implement an SPS at Dhauliganga Power Station to avoid oscillation in the system & successive complete outage of Power Station. NRLDC in its grid incident report no- NRLDC\TS-15, dt-24.04.2018 has also requested to implement SPS at Dhauliganga Power Station.
Keeping in view of above, the following SPS is proposed to be implemented at Dhauliganga Power Station:

Objective of the Proposed Scheme

Two units and one line shall be kept on one bus and other two units and second line shall be kept on second bus. If power flow of any one of the transmission Line exceeds 180 MW, the Bus Coupler Circuit Breaker would be opened to isolate Bus-1 & Bus-2. So two units and one healthy line connected to one bus will survive and continue to operate. Rest two/One unit(s) connected to other bus will trip on over frequency/speed if the faulty line trips.

Logic to be Implemented

1. The over current Stage-I of Line protection relays of both lines shall be configured corresponding to 180 MW i.e. 525A with time delay zero.
2. If current flow in all phases of any one of the 220 KV lines exceeds 525 Amp, it will give trip command to **only** Bus Coupler Circuit breaker.
3. An Alarm/event namely "SPS Operated" would be created in Plant SCADA.
4. The "SPS OFF" shall also be configured in SCADA by taking feedback from manual switch.

Modification to be carried Out at DGPS

1. Configure Back up I>1 as Enable in Protection Group-1 in Relay.
2. Assign a new Output contact in Line #1 & 2 Micom P442& P443 relay with Digital Input I>1 (Setting as 525 A Primary Value). **I>1 shall be realised in the PSL based on over current activation in all the three phases (i.e. I>1 = AND (IA>1, IB>1, IC>1), as shown in the diagram enclosed as Annexure-I.** It must be ensured that the configured input contact (I>1) has not been used any other purpose (trip) in relay PSL. Assign an output contact among the available spare contacts.
3. A Selector Switch (ON/OFF) having minimum 02 NO & 02 NC contacts and a 220V DC Pick up relay R1 having minimum 02 NO contact has to be installed in the convenient place.
4. The output contact of both line protection relay as mentioned at sl.no.2 of both Lines should be used to pick up the newly installed relay R1. Both the NO contacts of R1 to be wired as per the drawing attached.
5. One NC contact of selector switch will be hardwired by 24 V DC to Digital Input of GIS Controller for showing " SPS OFF" in DCS.

Operating Condition

1. When Four units are running, two units & one 220 KV line should be kept on one bus and other two units & other 220 KV line should be kept on other bus.
2. When three units are running, two units and Bareilly line (preferably) should be kept on one bus and other unit and Pithoragarh line should be kept on other bus.
3. Auto-reclose function on both 220 KV lines should be kept "ON" with SOTF/TOR in Operation.
4. SPS must be kept in service i.e. "ON" in all normal operating condition.
5. AVR of all units must be kept in auto mode with "PSS ON" in all running units.

Test before Implementation

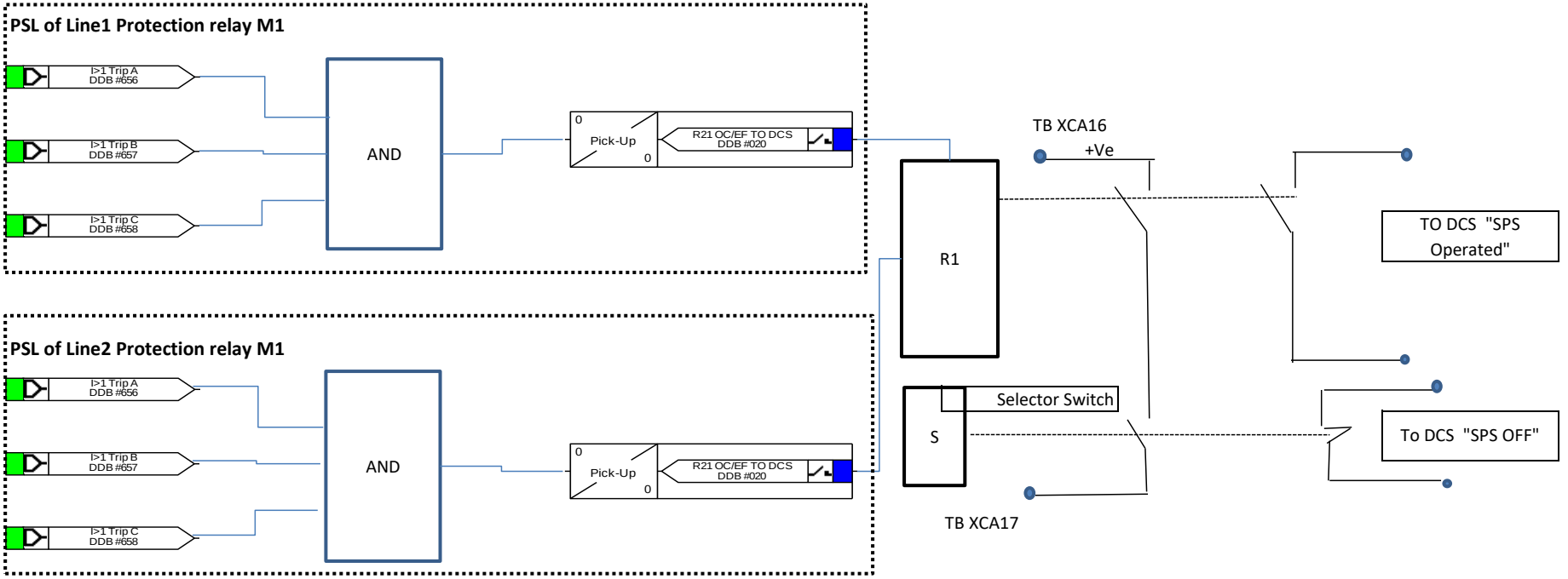
1. The completeness of the control circuit of the new scheme must be ensured.
2. After connecting the trip contact to TB XCA 16 & XCA17, secondary injection test has to be carried out in Distance relays of both 220 KV Lines.
    i. Over current stage-1 must issue trip command only to B/C CB.
    ii. Check Alarm to SCADA for “SPS operated” and “ SPS OFF”.

Restoration after tripping

It is considered that one line with two units on one bus will survive, in case of one line tripping. Other line & two units on other bus will be OFF.

1. Now first close B/C breaker. Then second bus will be charged.
2. Get the line voltage (earlier dead) from remote end.
3. Synchronize the line breaker (on second bus).
4. Restore remaining two units on second bus.
5. Normal operation restored.

SPS scheme for Dhauliganga Power Station



R1- 220 V DC pickup relay (to be installed)

S- Sector switch having 2 NO potentio free contact.

Note: 1. Over current Stage-I protection must be exclussively used for this scheme. This O/C protection must not be used for line protection.

2. DC supply to the potentio free contact of Line protection relays (Line-1 & 2) must be from a single source.