



भारत सरकार

Government of India

विद्युत मंत्रालय

Ministry of Power

उत्तर क्षेत्रीय विद्युत समिति

Northern Regional Power Committee

No. उ.क्षे.वि.स./प्रचालन/107/01/2019/7742-80

दिनांक: 26.07.2019

सेवा में : संरक्षण उप-समिति के सदस्य (सूची के अनुसार) ।

To: Members of Protection Sub-Committee (As per List)

विषय: संरक्षण उप-समिति की 38 वीं बैठक की कार्यसूची ।

Subject: Agenda for 38th Protection Sub-Committee Meeting.

संरक्षण उप-समिति की 38^{वीं} बैठक का आयोजन दिनांक 01.08.2019 और 02.08.2019 को 10:30 बजे से उ.क्षे.वि.स. सचिवालय, नई दिल्ली में की जाएगी । उक्त बैठक की कार्यसूची उत्तर क्षेत्रीय विद्युत समिति की वेबसाइट (<http://www.nrpc.gov.in>) पर उपलब्ध है ।

The 38th meeting of Protection Sub-Committee is scheduled to be held on **01.08.2019 and 02.08.2019 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> .

(सौमित्र मजूमदार)

अधीक्षण अभियंता (प्रचालन)

List of Members of PSC

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

Agenda for
38th Meeting of Protection Sub-committee of
Northern Regional Power Committee

Time of meeting : 10.30 Hrs.
Date of meeting : 01.08.2019 and 02.08.2019
Venue : NRPC Secretariat, New Delhi

A.1. Confirmation of minutes of 37th meeting of protection sub-committee

Minutes of 37th meeting of Protection Sub-committee were issued vide letter dated 25.04.2019. 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 follow up of one of the recommendations of Enquiry Committee headed by the 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 Union Power Secretary 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

In 37th PSC meeting on 21st January 2019, it was informed that retendering has been carried out second time to ensure healthy competition. Technical bids were opened on 11.01.2019, wherein 2 bids were received. Both bids were forwarded to Bid Evaluation Committee for further evaluation.

In 42nd TCC/45th NRPC meetings held on 07th and 08th June 2019, it was informed that no suitable bidder was found due to lack of competition, even after two re-tendering processes. It was stated that in the 8th NPC meeting held on 30.11.2018, the efforts of WRPC for in-house development of the database was appreciated and NRPC was suggested to seek assistance of WRPC in case no bidder comes up after retendering. In view of the above, two options were discussed:

First option: All STUs shall submit protection setting data in a time bound manner so as to comply with the recommendations of 'Task Force on

Power System Analysis under Contingencies'. For this option, all the states were requested to appoint nodal officers (SE level or above) for facilitating the collection of protection setting data. To facilitate manpower, it was also proposed that the States may depute their one or two officers in NRPC for some period on rotation basis.

Second option: Approach any central agency like CPRI without any change in scope of work as already approved under PSDF scheme so that the approved PSDF funding could also be utilized. It was also clarified that NRPC so far has not discussed the matter with CPRI.

TCC was of the view that the Protection setting are already available with the substation personnel and any third party engaged would also require the help of the substation personnel for extracting the settings from the relay. Also, in case of some changes in the setting, the substation personnel shall have the responsibility of reflecting the changes accordingly in the centralized database and for that he should be well aware of how to extract the settings and getting it reflected in the centralized database. They also opined that a portal may also be made on which the changes made in the protection settings could be updated in real time.

In view of the above TCC decided to initially go for the first option and advised utilities to nominate the nodal officers at the earliest so that the database could be operationalized as soon as possible. TCC opined that matter may also be discussed with CPRI and its outcome may be informed in the next meeting.

In the meetings, all utilities were advised to go forward with the collection of the data and appointment of nodal officers and by that time the possibility of CPRI collecting the data shall also be explored.

Members may deliberate regarding submission of the data for Protection settings.

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 had recommended for carrying out thorough third-party protection audit in time bound manner as there is need to review the protection schemes.

The matter related to periodicity of third-party protection audit was deliberated in the 35th Protection Sub-Committee meeting, 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. Further, it was decided in the 35th PSC that periodicity of the protection audit can be 5 years

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.

It was decided in the **39th TCC & 42nd NRPC meeting** that periodicity of protection audit can be 5 years and same can be carried out by CPRI or any other reputed agency.

In 08th NPC meeting held on 30.11.2018, it was decided that each RPC could have their own arrangements for carrying out the third-party protection audit. They may use the audit format template in the reports of Consultant M/s Tractebel Engineering S.A., Romania. (Enclosed as **Annexure-I**)

In 37th PSC meeting held on 21.01.2019, it was decided that each RPC could have their own arrangements for carrying out the third-party protection audit in every 5 years.

Members may update the status on following points:

- **Total number of sub-stations.**
- **Number of sub-stations where third-party protection audit has been conducted in last 5 years.**

A.2.3. Training Programme/Workshop on Protection Audit for Protection system Engineers

In 36th PSC meeting held on 19.09.2018, a proposal from Power System Division of Central Power Research Institute for conducting 3 days Training Programme/Workshop at Bengaluru on Protection Audit for Protection System Engineers was discussed. CPRI had proposed training cost @ Rs.10,500 per participant (exclusive of taxes) and excluding boarding & lodging arrangement cost. PSC recommended the training programme to be organized by CPRI.

Based on the recommendation of PSC, the matter was deliberated in 40th TCC/43rd NRPC meeting held on 29th / 30th October 2018, wherein NRPC approved the proposal of carrying out 3 days Training programme on Protection audit at Bengaluru through CPRI for 60 Nos. of participants from utilities of NR. It was decided to book the expenditure on training in NRPC fund.

Subsequently, CPRI proposed to organize training in 2 batches of 30 participants each. Accordingly, training programme for 1st batch of participants has been conducted successfully from 27th to 29th March 2019 at CPRI, Bengaluru.

Based on the confirmation from CPRI, the training of 2nd batch is scheduled to be held from 21st August to 23rd August 2019 at CPRI, Bengaluru. The status of nominations received / yet to receive is as under:

Nominations already received	Nominations to be received
PSTCL (3)	UPPTCL
UPRVUNL (2)	Adani Power
UPSLDC (3)	NHPC (1)
BBMB (2)	SJVNL
POWERGRID NR-I (1)	CLP Jhajjar

Nominations already received	Nominations to be received
Talwandi Saboo (2)	NPCIL
Uttarakhand (2)	NTPC

Members are requested to send maximum 2 Nos. of nominations for the 2nd batch of Training Programme/Workshop at CPRI, Bengaluru on Protection Audit for Protection System Engineers, latest by 08.08.2019.

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 as under:

“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 the 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-II**.

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 to NRLDC.

In 35th PSC meeting held on 20.06.2018, it was stated that violation of Protection Standard should be avoided and DR/EL should be sent to NRPC/NRLDC within 24 hours as the tripping analysis for inter-regional lines is very important for safe and reliable operation of Grid. It was also informed that this was also followed up regularly in the OCC meetings.

In 36th PSC meeting held on 19.09.2018, representative of NRLDC informed that agenda pertains to violation of Protection standard such as delayed clearance of fault, spurious tripping, DR/EL submission within 24hrs and other events resulting into violation of Protection standard. A Whatsapp group of PSC

members was created in which information regarding tripping (name, date, time) and date & time at which details have been submitted could be shared.

In 40th TCC/43rd NRPC meeting held on 29.10.2018 & 30.10.2018, representative of NRLDC informed that violation of protection standards was being highlighted regularly for inter-regional lines by circulating letter, but there were many single elements tripping violating protection standards which might result into multiple element tripping. Representative of NLDC emphasized on submission of DR/EL within 24 hrs. as they were very important for further analysis. MS, NRPC told that utilities should submit the detailed report as well remedial measures taken for such events.

In the 37th PSC meeting held on 21.01.2019, representative of NRLDC informed that monthly list of Grid incidences is being circulated where violation of Protection standards has been observed. Utilities were requested to avoid any violation of Protection standards.

Members are requested to avoid violation of Protection standard.

A.4. Final report of the Committee to suggest measures for bringing improvement in the field of Power System Protection among the utilities in Northern Region

The report, submitted by the duly constituted committee, was accepted for implementation in the 34th TCC/38th NRPC meeting held on 24th/25th October, 2016. 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 submit the details.

BBMB, POWERGRID NR-I and PITCUL have been conducting 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. In the 35th TCC/39th NRPC meeting held on 1st/2nd May 2017, it was decided 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 39th TCC and 42nd NRPC meeting on 27th and 28th June 2018, it was informed that NRPC Sectt. can plan for another batch of Protection System Engineers Level-2 and Level-3 trainings for which no. of participants might be increased from 25 to 50. Utilities were requested to preferably nominate the engineers working in the field of power system protection and make sure that nominated individual is available for entire duration of the training. It was stated that as the participants are being trained as trainer, they should further transfer

the knowledge within their own utility so that additional trained manpower can be deployed.

In 36th PSC meeting held on 19.09.2018, it was informed that NRPC in its 42nd meeting has approved for **50 no. of participants for 2nd batch of Level-2 and Level-3 training of Protection System Engineers**. It was proposed that training might be organized through any one of the OEM such as ABB, SIEMENS, GE etc. which would also include classroom training as well as hands on training.

In 40th TCC/43rd NRPC meeting held on 29th and 30th October 2018, NRPC approved training to be organized through any one of the OEM such as ABB, SIEMENS, GE etc. and authorized MS, NRPC to take necessary action in this regard.

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

All utilities (except DTL, RRVPNL, BBMB) are requested to share the details of Level-I training (training module, periodicity of training and number of participants covered in the training) at the earliest.

A.5. Persistent surge problem encountered by KWHEP since commissioning of Kala Amb substation (Agenda by Karcham Wangtoo HEP)

Background of problem

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

Risk to KWHEP

The counters have increased manifold (6-7 times) since introduction of Kala Amb and is still continuing to increase. Such high increase and further increasing trend pose risk to the LAs, power transmission and grid. Multiple attempts were taken from Kala Amb end to close their circuit breaker on 21.11.2017 and 05.12.2017 for back charging the line, as their relay tripped due to SOFT each time, they tried to close the CB, and the LA counters increased at Wangtoo end on all trials. The generating station are at the receiving end and bear the most of the risk posed to the equipment and generation loss.

Action till now

The issue was discussed with the officials at Kala Amb several times telephonically with the request to solve the problem. As per their request, KWHEP rechecked all settings and also sent relay settings to them for review which was found ok. The mail was further forwarded to AM NR-2 and several other officials in POWERGRID by Kala Amb team. On 05.04.2018, KWHEP received a reply from Mr. Atul Mathur (Asst. Chief Design Engineer) in which he requested to have the LAs tested and report be submitted for review to POWERGRID. KWHEP immediately got its LAs tested by PGCIL National Test Laboratory, Jalandhar on 12.04.2018. All the LAs were found in excellent working condition and the test reports were submitted to POWERGRID on 13.04.2018 (*Copy of mail and test reports attached as Annexure-IV of 37th PSC agenda*).

Present Status

There is no feedback till now after the submission of reports despite several telephonic reminders. Despite the request to involve KWHEP also in solving the problem, KWHEP is completely unaware of further development. Looking at the huge risk at KWHEP end, appropriate action needs to be taken immediately to solve this long persistent problem.

In 37th PSC meeting on 21.01.2019, representative of KWHEP intimated that PIR aren't installed at CB in Kala amb s/s. Representative of POWERGRID told that after LILO line length was decreased to 175 km and PIR aren't installed for the length less than 200km. He told that leakage current observed was also in the limits and the issue has already been taken up with the engineering department and it is also being followed up. POWERGRID was requested to submit the report of Engineering department at the earliest. It was also suggested that POWERGRID may appoint consultant to find out the solution if issue isn't resolved.

POWERGRID may update.

A.6. Oil leakage and High current/Overheating in Line reactor NGR (Agenda by NPCIL)

Event Description

At RAPP-7 & 8 400kV switchyard on 07.05.2019 about 0900 hrs., oil leakage was observed from 25 NB pipe to conservator of 63 MVAR, 400 kV RAPP-Jaipur Line reactor. Subsequently, at 0934 hrs., 400kV Bus-II side CB (513-CB-5B) was manually opened (centre breaker (513-CB-5C) was already open) to isolate Jaipur Line Reactor. Excessive humming sound was observed from NGR and approximately 25 A was observed to be flowing in NGR of line reactor. The NGR temperature was increasing continuously and had reached to 75°C at 1145 hrs.

At 1220 hrs., RAPP-Kota line opened. Kota-Jaipur remained charged, which led to slight reduction in Voltage and Current in all three phases. Since the NGR temperature was increasing continuously and had reached to 85°C at around 1230 hrs., NGR deluge was manually operated to cool down the NGR and line isolator was opened at RAPP end, leading to zero current and approximately 3 kV voltage. Line was taken in service next day (08.05.2019 at 1505 hrs.) without the Line Reactor.

Observations/Analysis

- a) **Oil leakage from equalizing/vent pipe header of line reactor:** During visual inspection it is found that there is a crack developed in the pipe line to conservator. Further investigation is in progress to check whether the crack in the pipe is due to material defect or due to consequential effect of the vibration of reactor tank.
- b) **While isolating the Jaipur Line Reactor:** Subsequent to isolation of RAPP-Jaipur line at both ends, voltages in all three phases of the line as recorded by line distance protection relay 21-1 & back up impedance protection relay 21-R of line reactor at RAPP end were observed to be in the range of 96 kV to 105 kV. The phase currents were in the range of 22 A to 25 A and they were almost in phase. This resulted in flow of about 71A in the NGR of line reactor which in turn caused increase in temperature of NGR.

RAPP-Jaipur line and RAPP-Kota line with LILO at Kota to Jaipur are forming the double circuit lines on common towers. After opening RAPP-Kota line, slight reduction in voltages and currents in RAPP-Jaipur line are observed which were in the range of 83kV to 102kV and 15A to 19A. After opening of line isolator of RAPP-Jaipur line at RAPP end, the currents reduced to zero and voltages came down to 3kV.

It is opined that voltages are expected to be induced in a line adjacent to live line due to mutual coupling between the lines. However, the induced voltages in adjacent line should be nearly symmetrical if the live line voltages are symmetrical. Hence there would not be flow of high current through NGR of line reactor. This is further corroborated by the data recorded during isolation of one of the circuits of RAPP-Shujalpur DC line, where in no such high currents were observed. Also, the simulation studies were made which indicate no such zero-sequence induction if the lines are properly transposed.

Since the zero sequence induced voltages and currents were observed in RAPP-Jaipur line during the present incident, there must be some zero sequence currents in nearby lines, possibly due to uncleared arcing ground faults somewhere in the grid. DR data of RAPP-Kota line which was carrying a current of about 80A, indicate some zero-sequence current of the order of about 25A. As the data of Kota-Jaipur line is not available with NPCIL, it could not be checked whether zero sequence currents were existing in that line during the subject event.

Members may deliberate regarding following:

- a) It is requested to further analyse and suggest on this event to avoid such high currents/overheating in line reactor NGR.
- b) RAPP Site has indicated that since remote end i.e. Jaipur end NGR did not experience humming noise and overheating problem as it has been provided with bypass arrangement. As per telephonic discussion with design engineer of POWERGRID, bypass scheme is adopted where line reactor is required to be used as bus reactor. However, Jaipur substation engineers have indicated that auto bypass scheme is adopted at Jaipur and NGR gets bypassed when current through exceeds the set threshold. NRPC may suggest about the intent of NGR bypass scheme.

A.7. Regarding SPS scheme implemented at Tehri HPP (4x250MW) and Koteshwar HEP (4x100MW) (Agenda by THDC)

This has the reference to MoM of 151st OCC meeting dated 13.09.2018. In compliance, SPS scheme was implemented by THDCIL at Tehri HPP (4x250MW) and Koteshwar HEP (4x100MW) in co-ordination with POWERGRID.

Initially the SPS scheme was implemented at 1250 MW for tripping of one Unit at Tehri (250 MW) in case of outage of one line. This was further modified at 1150 MW due to observance of oscillations in line and tripping of one Unit of Koteshwar (100 MW) was added with Tripping of Unit at Tehri (250 MW).

It is learnt that FSC on both the circuits of 400 kV Koteshwar Pooling-Meerut D/C Line have been resumed to service by POWERGRID. Since FSC retrieval must have resulted in strengthening of aforementioned D/C Line and thus, it is proposed to discuss and review the SPS scheme implemented at Tehri HPP and Koteshwar HEP for necessary modifications to avoid commercial losses to THDCIL.

Accordingly, necessary mandate may be given for POWERGRID to disable the SPS at their end while FSC is in service to avoid undesirable tripping of operational units.

Members may deliberate.

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 22.07.2013 - POWERGIRD had submitted a list of its NR-2 sub-station where PLCC was non-functional at other side.

37^h PSC meeting on 21.01.2019 - 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	Status
PLCC issues with PSTCL				
1	Amritsar	220 kV Verpal –I	Not installed	Representative of PSTCL informed that panels installed were being replaced and end to end testing would be completed by the end of the month.

PSTCL may update the status.

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

28th PSC meeting on 19.12.2014 - POWERGRID 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.

37^h PSC meeting on 21.01.2019 - Status updated by UPPTCL and POWERGRID in the meeting was as under:

Sl. No.	Name of Transmission Line	Details of PLCC	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.	Representative of UPPTCL stated that relay panels were to be replaced. The shutdown was awaited. It was expected to be done by end of the month.
2.	220kV Allahabad-Rewa Road-II		
Kanpur S/S			
1.	220kV Kanpur-Mainpuri	PLCC panels not available	PLCC panels were supplied but yet to be commissioned.
Gorakhpur S/S			
1.	220kV Gorakhpur-Barhua	PLCC were not functional	Relays were replaced with the Numerical relays and it would be functional within one month.

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 held on 21.09.2015 - RVPNL 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 held on 07.06.2016 - 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 held on 30.11.2016 - RVPNL informed that the scheme excluding Mahi HPS would be implemented by June 2017.

34th PSC meeting held on 04.08.2017 - RVPNL intimated that relay purchase is in process and the scheme is to be implemented by 31.01.2018.

35th PSC meeting held on 20.06.2018 – Representative of RVPNL intimated that scheme has been approved but the procurement process was reverted back. It was further told that re-tendering for relays is in process.

36th PSC meeting held on 19.09.2018 - Representative of RVPNL stated that procurement has been completed and scheme would be implemented by Dec 2018. It was also mentioned that Mahi HPS has been permanently excluded from the scheme.

37th PSC meeting held on 21.01.2019 - Representative of RVPNL informed that procurement is under process and expected to be completed by 30.06.2019. MS, NRPC requested RRVPNL to submit the complete islanding scheme for Rajasthan at the earliest.

RVPNL may update the status.

A.8.3.2. Islanding scheme for Punjab

A meeting was held on 27.11.2014 at NRPC Sectt. 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 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** and thereafter, procurement would start.

29th PSC meeting held on 09.02.2015 - PSTCL informed that CPRI has submitted the dynamic study for islanding scheme for Bhatinda 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 held on 07.06.2016 - PSTCL informed that relays for islanding scheme of Bhatinda TPS had already been procured and installation of these relays was under process. Further, it was stated that the scheme would be made functional by **30.09.2016**.

32nd PSC meeting held on 30.11.2016 - 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 held on 22.02.2017 - PSTCL was requested to expedite the process and submit the information at the earliest.

34th PSC meeting held on 04.08.2017 - 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 and NRPC Secretariat.

35th PSC meeting held on 20.06.2018 - 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 and it would be executed by 30.09.2018.

36th PSC meeting held on 19.09.2018 - Representative of PSTCL stated that data was awaited from the PSPCL. He stated that PSPCL was requested to submit the data of the units which would be kept ON during peak/non-peak period. They have submitted the data stating that all the units would be kept ON but in actual scenario it has been observed that units for Lehra-Mohabbat TPS were off during winter and ran up to 50% in paddy seasons. He told that scheme would be implemented in a month after consultation with PSPCL.

37th PSC meeting on 21.01.2019 - Representative of PSTCL informed that installation and commissioning is under progress and it will be completed by **31st March 2019** and Bathinda was dropped from the scheme. He informed that currently, scheme for Lehra-Mohabbat is being implemented. PSTCL was requested to share the islanding scheme for Lehra-Mohabbat at the earliest.

PSTCL may update the status.

Haryana, UP and other states are also requested to update the status of islanding schemes in their respective states.

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

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

Utilities 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.

In the 34th PSC meeting, stress was given over non-rectification of deficiencies found in the audit by most of the utilities. Utilities which have not submitted the action plan were requested to submit the same at the earliest. Status of actions taken on Third Party Protection Audit is enclosed as **Annexure-IV**.

All the utilities are requested to submit the updated status and ensure expediting the process for rectification of discrepancies found in the audit.

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.

23rd PSC meeting held on 09.09.2013 – Only DTL, BBMB PSTCL, POWERGRID, NHPC and HPSEB Ltd. submitted the status of Bus Bar protection.

25th PSC meeting held on 12.02.2014 - RVPNL stated that in the substations 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 the 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 can reduce the fault duration and the healthy buses can 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.

32nd PSC meeting held on 30.11.2016 - UPPTCL stated that as agreed in 25th PSC meeting, 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.

34th PSC meeting held on 04.08.2017 - UPPTCL informed that alternative schemes had been installed in almost all the substations where Bus bar protection was not installed. PSC advised to remove the alternate arrangement wherever Bus bar protection has been installed. RVPNL intimated that contract was under finalization stage and procurement would start after the same.

35th PSC meeting held on 20.06.2018 - Representative of UPPTCL informed that alternated arrangements were removed in all the substations wherever bus bar protection was installed.

37th PSC meeting on 21st January, 2019 - Representative of Rajasthan informed that bus bar protection work was completed in 56 out of 74 locations and installation at other locations is in process.

Status of Bus bar protection for NR is enclosed as **Annexure-V**.

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/2014

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 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 four PSC meetings (30th, 31st, 32nd and 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 34 th PSC Minutes (Reasons /Action taken for Delayed Clearance of faults)	UPPTCL (Central and East North Zone), NJHPS, POWERGRID, NHPC, DTL, RRVNL
Action taken status on the recommendation of the discussions held in 30 th , 31 st , 32 nd , 33 rd PSC meetings	BBMB, NHPC, POWERGRID (NR-2) and NAPS

36th PSC meeting held on 19.09.2018 - Members were informed that list of events of delayed clearance of faults from 01.04.2014 to 01.06.2015 was already circulated but data has not been submitted by utilities.

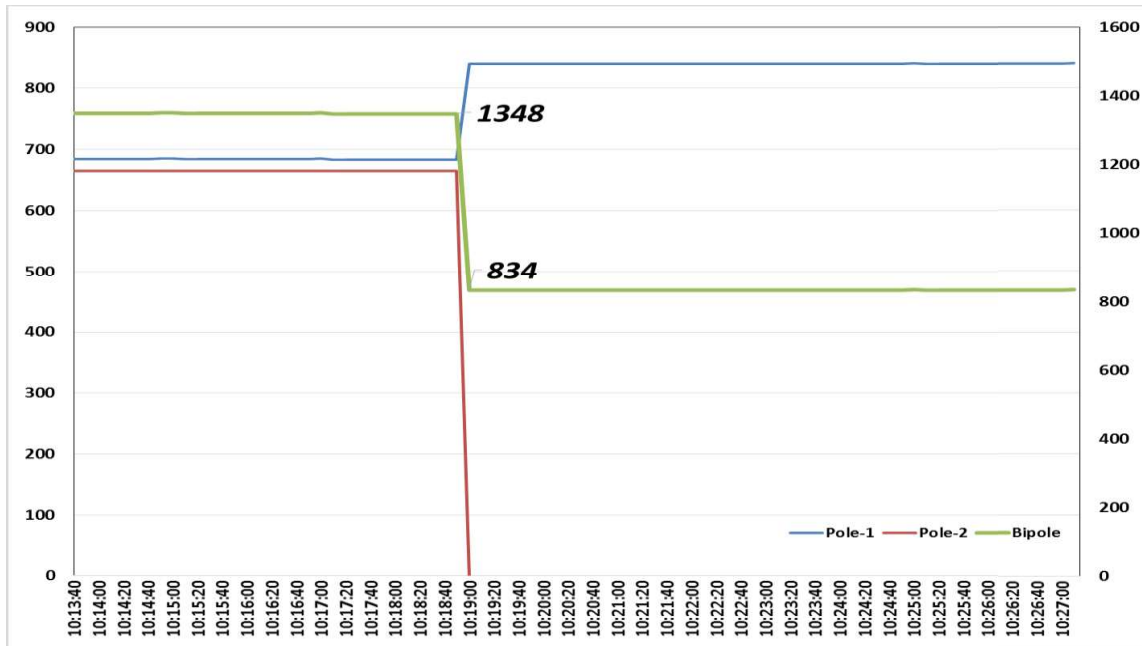
In 40th TCC/43rd NRPC meeting held on 29th and 30th October 2018 - It was informed that list of delayed clearance fault was circulated again and again but data has been only received from the utilities mentioned above. He informed that partial information received till date was submitted to CERC as show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

Utilities are requested to furnish the information as mentioned above without any further delay as the details need to be submitted to CERC.

A.9. Tripping discussions in monthly OCC meetings

A.9.1. HVDC Rihand-Dadri Pole-2 tripping and subsequent operation of SPS on 25th Mar-2019 (158th OCC meeting)

HVDC Rihand-Dadri Pole-1 & 2 were running with HVDC line in service and power flow of the order of 1350MW. At 10:27hrs of 25th Mar 2019, HVDC Rihand-Dadri Pole-2 tripped on VESDA. Tripping of Pole-2 resulted into power order reduction from 1350MW to 840MW. SCADA data of MW power flow of HVDC Pole-1 & 2 is graphically shown below:



It seems from SCADA data, case-1 operated (bipole reduction by more than 750MW). However, in actual case-2 would have been operated as reduction of only ~515MW occurred as per SCADA data.

State	Actual Load Relief obtained from SCADA	Planned Load Relief	% relief *
Punjab	80	196	41%
Haryana	120	190	63%
Rajasthan	40	170	24%
UP	Nil	200	0%
Delhi	150	350	43%

*: Considering load shedding in group A, B, C & D

Further feeder wise SCADA details is tabulated below:

Load Group A&B-

	Group-A				Group-B			
	Scheduled	SCADA	CB STATUS	Scheduled	SCADA	CB STATUS		
Delhi	220kV Mandola-Narela -I	150	-23	■	220kV Mandola-Gopalpur -I	200	88	■
	220kV Mandola-Narela -II		0	■	220kV Mandola-Gopalpur -II		64	■
UP	Feeders from 220/132 kV Muradnagar Old	100						
Rajasthan	220 kV Alwar-GSS Mandawar	25	22	■	220/132 kV Ratangarh-132 KV Sardar Sahar	26	0	■ S
Haryana					220/33 kV, 100 MVA Panipat (BBMB) ICT	50	38	■
Punjab	220 kV Malerkotla-66 kV Malerkotla	35	13	■ S				
	220 kV Malerkotla-66 kV Naudhrani		0	□				
Total		310	12			276	189	

(Before the incident)

	Group-A			Group-B				
	Scheduled	SCADA	CB STATUS	Scheduled	SCADA	CB STATUS		
Delhi	220kV Mandola-Narela -I	150	-23	<input type="checkbox"/>	220kV Mandola-Gopalpur -I	200	1	<input checked="" type="checkbox"/> S
	220kV Mandola-Narela -II		1	<input type="checkbox"/>	220kV Mandola-Gopalpur -II		0	<input checked="" type="checkbox"/> S
UP	Feeders from 220/132 kV Muradnagar Old	100						
Rajasthan	220 kV Alwar-GSS Mandawar	25	27	<input checked="" type="checkbox"/>	220/132 kV Ratangarh-132 KV Sardar Sahar	26	0	<input checked="" type="checkbox"/> S
Haryana					220/33 kV, 100 MVA Paripat (BBMB) ICT	50	37	<input checked="" type="checkbox"/>
Punjab	220 kV Malerkotla-66 kV Malerkotla	35	0	<input checked="" type="checkbox"/> S				
	220 kV Malerkotla-66 kV Naudhrani		0	<input type="checkbox"/>				
Total		310	5			276	39	

(After the incident)

Load Group C&D -

Group-C				Group-D			
	Scheduled	SCADA	CB STATUS		Scheduled	SCADA	CB STATUS
220/132 kV, 63 MVA Modipuram ICT -II	100	12	<input checked="" type="checkbox"/>				
220/132 kV, 40 MVA Modipuram ICT -III		7	<input checked="" type="checkbox"/>				
132 kV Modipuram-Mawana		0	<input type="checkbox"/>				
132 kV Modipuram-Sardhana		6	<input checked="" type="checkbox"/>				
132 kV Modipuram-Kankerkhara		28	<input checked="" type="checkbox"/>				
132 kV Kota-Talera	60	11	<input checked="" type="checkbox"/> S	132 kV Alwar-Bansoor	59	0	<input checked="" type="checkbox"/>
132 kV Merta-Roon		7	<input checked="" type="checkbox"/>	132 kV Alwar-Malakhera		33	<input checked="" type="checkbox"/>
132 kV Merta-Merta Road		16	<input type="checkbox"/> S				
220kV Samaypur-Palwal -I	140	50	<input checked="" type="checkbox"/>				
220kV Samaypur-Palwal -II		68	<input checked="" type="checkbox"/>				
66 kV Gobindgarh-Focal Point	71			66 kV Laltokalan-Gill Road -I	90	30	<input checked="" type="checkbox"/> S
66 kV Gobindgarh-Talwara -D/C				66 kV Laltokalan-Gill Road -II		30	<input checked="" type="checkbox"/> S
66 kV Gobindgarh-Chourwala D/C				66 kV Laltokalan-Ferozpur Road		10	<input checked="" type="checkbox"/> S
	371	203			149	103	

(Before the incident)

Group-C				Group-D			
	Scheduled	SCADA	CB STATUS		Scheduled	SCADA	CB STATUS
220/132 kV, 63 MVA Modipuram ICT -II	100	12	<input checked="" type="checkbox"/>				
220/132 kV, 40 MVA Modipuram ICT -III		7	<input checked="" type="checkbox"/>				
132 kV Modipuram-Mawana		-0	<input type="checkbox"/>				
132 kV Modipuram-Sardhana		6	<input checked="" type="checkbox"/>				
132 kV Modipuram-Kankerkhara		27	<input checked="" type="checkbox"/>				
132 kV Kota-Talera	60	11	<input checked="" type="checkbox"/> S	132 kV Alwar-Bansoor	59	0	<input type="checkbox"/>
132 kV Merta-Roon		0	<input checked="" type="checkbox"/>	132 kV Alwar-Malakhera		0	<input type="checkbox"/>
132 kV Merta-Merta Road		17	<input type="checkbox"/> S				
220kV Samaypur-Palwal -I	140	0	<input type="checkbox"/>				
220kV Samaypur-Palwal -II		-0	<input checked="" type="checkbox"/> S				
66 kV Gobindgarh-Focal Point	71			66 kV Laltokalan-Gill Road -I	90	0	<input type="checkbox"/>
66 kV Gobindgarh-Talwara -D/C				66 kV Laltokalan-Gill Road -II		0	<input type="checkbox"/>
66 kV Gobindgarh-Chourwala D/C				66 kV Laltokalan-Ferozpur Road		0	<input type="checkbox"/>
	371	81			149	0	

(After the incident)

Following are the discussion points:

- Reason of operation of Case-2 instead of Case-1 needs to be looked into. (POWERGRID)
- Lower load relief in case of operation of SPS (Respective states)
- Non-tripping of feeders come under SPS operation (Respective states)
 - Non tripping at Modipuram in UP
 - Non tripping at Mandola-Narela ckts in Delhi
 - Non tripping of Gobindgarh in Punjab
- Antecedent power flow became zero or very less in some of the feeders.
- Telemetry of some of the feeders in SCADA.
- Data telemetry of SPS signal wiring in the SCADA to be expedited. (POWERGRID and respective utilities)
- Reporting of the SPS operation from Punjab, Delhi and NTPC is still awaited.

Details received from UP, Rajasthan and Haryana:

Name of substation : 220 KV Substation Muradnagar						
Sl. No.	Date and Time of Tripping	Counter reading of Digital Tele Protection coupler		Name of Feeder/ Transformer which tripped	Total load shed due to tripping of Feeder/ Transformer as per hourly loading (MW)	Date and time of Normalization
		Before receipt of command	After receipt of command			
1	25.03.19 10:20	35	36	Following 132KV Feeders : 132 KV Morla (CB no 77) 132 KV Dasna (CB no 73)	24	Date :- 25.03.19 CB no-77 at 10:45 CB no-73 at 10:50
2	<p>220 KV S/S Modipuram (UPPTCL)- No tripping observed of SPS digital tele protection system installed at 220 KV S/S Modipuram since dt.- 06.10.17 and synchronization fail LED glowing continuously on the card of SPS cabinet, for which same has been intimated to PGCIL vide letter no.- 673/ETCC/MT dt.- 16.11.18 & NRPC in OCC & PSC meetings, you are therefore requested to coordinate with NRPC to get it set right. This matter was also discussed on dt.- 05.03.19 in blackout /protection meeting held at SLDC Lucknow.</p>					

Regarding the trailing mail, as per SCADA the instantaneous loading on various points in Haryana before tripping:

Samaypur-Palwal ckt-1	51MW
Samaypur-Palwal ckt-2	64MW
220/33kV 60MVA t/f at BBMB Panipat	26MW

The same may be confirmed by SCADA data. Kindly update the load relief of Haryana to 141MW.

Northern Regional Grid Operation Monitoring Format- 2

1. Date and time of the triggered control operation: 10.15 Hrs. on dated 25/03/2019
2. SPS initiated control received (Yes / No)

Sr. No.	Location	Control Received (Y/N)
1	Alwar (Rajasthan))	Y
2	Merta (Rajasthan)	Y

2.1. Load Shedding:

Sr. No	Name of GSS	Name of Feeder	Tripped (Y/N)	Load relief (MW)	Total Load Relief (MW)
1.	220 KV GSS Alwar	132 KV Alwar- Malakhera	Y	35	35
2.	220 KV GSS Alwar	132 KV Alwar- Bansur	Y	0	
3.	400 KV GSS Merta	132 KV Merta- Roon	Y	36	45
4.	400 KV GSS Merta	132 KV Merta- Merta Road	Y	9	
TOTAL RELIEF :					90 MW

Apart from above SPS operation, Haryana representative also reported the tripping of 220 kV Samaypur-Palwal ckt-1 & 2 on 19th Mar 2019 at 16:13hrs. At the time of tripping of these feeders, SPS condition was not fulfilled. It needs to be relooked by POWERGRID and Haryana.

POWERGRID representative informed that SPS logic operated at HVDC Rihand end is correct as Rihand end PLC logic sense the 770MW, hence Case-1 operated. SPS

NRLDC representative informed that there may be issue with the SPS logic or measurement equipment. It seems there is difference between SCADA data and site reported data. He further informed that load shedding figures are very poor compare to planned load shedding figures. Total average response of the total load group is around 35-40%. Further details have already been tabulated above. He raised concern about poor response from the utilities and undesired operation case other than planned case. SPS are the safety net for power system and safety net should be ensured each and every time in the grid.

Member Secretary, NRPC raised serious concern about poor load relief and reporting from the constituents and progress on earlier OCC/ TCC recommendations. He further suggested NRPC secretariat to write the letter to all Managing Director of STU/SLDC and concerned utilities for poor load shedding response on account of SPS operation. He also suggested to all the concerned officer to ensure the proper load shedding in case of SPS operation.

UPPTCL representative informed that there was an issue in DTPC of Modipuram and Nara. Modipuram DTPC has been corrected by POWERGRID but Nara DTPC issue is still pending. Lower load relief observed at 220 kV Muradnagar (24MW against 100MW planned relief), it was due to shifting of 100MVA Dasna load at 765 kV Hapur station. Now two new feeders with 140MVA load has been connected at 220 kV Muradnagar station.

Haryana representative informed that Panipat TPS also tripped and shed 26MW load. However, SCADA data was showing nil relief. NRLDC representative clarified that this load shedding data in SCADA is also coming from Haryana so it may be checked and corrected by Haryana.

Delhi representative informed that 220 kV Mandola-Narela D/C fed either from Mandola end or DSIDC Bawana end. Some maintenance activity was running at 220 kV Mandola so this load was shifted towards Bawana.

Following action points were decided during the meeting:

- HVDC Rihand-Dadri SPS logic needs to be checked and corrected in view of error in SPS logic or measurement equipment. (Action: POWERGRID; Time Frame: 15days)
- Load needs to be ensured according to planned load in the SPS so that desired relief to be available at the time of actual requirement in the system. (Action: Punjab, Rajasthan, Uttar Pradesh, Haryana and Delhi; Time Frame: 15days)
- Difference in SLDC reporting and SCADA data of Panipat TPS needs to be looked into. (Action: Haryana; Time Frame: 15days)
- Difference in SLDC reporting and SCADA data of Alwar and Merta needs to be looked into. (Action: Rajasthan; Time Frame: 15days)
- Uttar Pradesh please share the details of additional feeders wired at 220 kV Muradnagar (UP) (Action: Uttar Pradesh; Time Frame: 7days)
- POWERGRID shall check the reason of sending the SPS signal at 220 kV Samaypur-Palwal ckt-1 & 2 on 19th Mar 2019 at 16:13hrs. (Action: POWERGRID; Time Frame: 7days)

All the concerned utilities may update the status on above action points.

A.9.2. Repeated observance of low frequency oscillation in the Indian Grid due to controller interaction at HVDC Agra end (158th OCC meeting)

Repeated operations of HVDC controller at Agra end of +/- 800 kV HVDC Agra-Alipurduar-Biswanath Chariali observed in the month of Feb - March. The recent such observance of oscillations in the grid due to HVDC controller interactions at Agra are tabulated as under:

Date	Time	Oscillation in the Region	Reason	Remarks
21st Feb 2019	03:46:28 to 03:47:15hrs	NR, NER and ER	Controller operation at HVDC Agra end of HVDC Agra-APD-BNC	Fault in 400 kV Agra-Sikar ckt-1 which cleared within 100ms
23rd Feb 2019	00:23:04 to 00:23:11 hrs	NR, NER and ER	Controller operation at HVDC Agra end of HVDC Agra-APD-BNC	Manual opening of 765kV Lalitpur-Fatehabad-1 to avoid over voltage tripping
14th Mar 2019	09:05:15 to 09:05:21hrs	NR, NER and ER	Controller action at Agra end. HVDC Agra-BNC Pole-1 also tripped due to reverse power direction trip.	Blue phase to earth fault in 400 kV Bongaigaon-Balipara ckt-2. At the same time HVDC Agra-BNC pole-1 also tripped
03rd Apr 2019	10:49-10:50hrs	NR, NER and ER	Controller operation at HVDC Agra end of HVDC Agra-APD-BNC	Fault signature was not captured in PMU plot of phase voltages of NR stations. It seems mal-operation of any HVDC controller

Some of these controller interactions seems to have been triggered during AC system fault in the vicinity of converter/inverter stations. However, there are incidents wherein the controller interactions have been triggered due to nearby AC transmission line switching operation and sometimes without observance of either any switching operation or any fault in the system. Such as, on 03rd Apr 2019, though oscillations have been captured through PMU phase voltages and frequency but without any fault in the system. It is also pertinent to mention that during one of the such incident on 14th March 2019, the HVDC Agra-BNC pole-1 tripped as well.

Most of the oscillation captured having frequency of 2-4 Hz, it comes under the category of local area mode which generally occurs due to malfunction of excitation control and DC circuit control.

NRLDC has already written a letter (dated 05th Apr 2019) to POWERGRID for analyzing the issue, taking corrective action and reporting the entire issue to NRPC/ NRLDC

POWERGRID representative informed that issue has been found during reverse power direction from Agra to BNC. Issue has been referred to ABB from POWERGRID corporate centre and still under discussion. Any finding will be share with NRPC/ NRLDC.

NRLDC representative informed that bidirectional power flow on HVDC Agra-BNC was already approved and it was not a new thing so this issue should be taken care at the time of commissioning itself. MS, NRPC suggested POWERGRID to kindly expedite the action and share the detailed report on the findings.

POWERGRID may update the status.

A.9.3. Load Crash in Northern Region on 12th June 2019

Sudden thunder storm/rainfall during summer/monsoon in NR is probable phenomenon and subsequent load crash in range of 7-15 GW in region as a whole. Such fast reduction of large load causes frequency/voltage excursions, line loading etc. There have been number of instances of tower collapse & damage also in the past during such thunder storms which resulted in constraints in supply power for extended duration of time. Apart from EHV line outage on tower collapse, line faults, nearly 30-40 lines used to be opened manually to control high voltage.

Recently on 12th June 2019, load crash of 11.6GW occurred in Northern Grid on account of dust storm/ thunderstorm within 2hrs 30minutes time span.

Punjab, Haryana, Rajasthan, Uttar Pradesh, Uttrakhand, Chandigarh & Delhi were the major affected state control area during load crash. Demand crash in Punjab started first at 16:00hrs itself followed by Rajasthan & Haryana at 16:10hrs and 17:30hrs respectively. Delhi demand started decreasing at 18:30hrs. Uttar Pradesh demand was already 2000MW lesser than previous day on account of pleasant weather in central area of Uttar Pradesh, its demand started decreasing at 18:50hrs. Uttrakhand demand started decreasing at 19:00hrs, Chandigarh started decreasing after 19:30hrs of 12th Jun 2019. Maximum demand crash of Northern Region was 12405MW at 19:26hrs of 12th Jun 2019 as compared to previous day. Maximum load crash of affected state control area is tabulated below:

State Control Area	Demand Met (MW) at 19:26hrs of 11th June'19	Demand Met (MW) at 19:26hrs of 12th June'19	Demand Reduction (in MW)	Minimum Demand Met (in MW)	Load Crash Amount (in MW) and duration
Punjab	8102	4981	3121	4904 (18:53hrs)	4400MW in 03:00hrs (Started in 15:53hrs of 12th June)
Haryana	8087	4149	3938	3801 (19:59hrs)	4450MW in 02:30hrs (Started in 17:29hrs of 12th June)
Rajasthan	9656	8738	918	8414 (18:09hrs)	2750MW in 02:00hrs (Started in 16:10hrs of 12th June)
Uttar Pradesh	20619	17021	3598	17021 (19:26hrs)	1300MW in 00:35hrs (Started in 18:50hrs of 12th June)
Delhi	5423	4671	752	4667 (19:13hrs)	1000 MW in 00:42hrs (Started in 18:31hrs of 12th June)

Chandigarh	317	310	7	106 (20:08hrs)	200 MW in 00:30hrs (Started in 19:36hrs of 12th June)
J&K	2149	2257	-108		
Uttarakhand	1812	1735	77	1492 (22:02hrs)	400 MW in 01:00hrs (started at 19:02hrs of 17th May)
Himachal Pradesh	1120	1022	98	837 (21:00hrs)	
Northern Region	57241	44836	12405	44836 (19:26hrs)	11600MW in 02:30hrs (started at 16:50hrs of 12th June)

Total 22 number of 400 and above voltage level lines/elements tripped on phase to earth fault during thunderstorm.

NRLDC representative informed following during the meeting:

- NRLDC representative presented the behaviour of different state control area during load crash. He also emphasized about the importance of weather monitoring during load crash. He requested all the SLDCs to put separate screen dedicated for real time weather monitoring.
- 3000MW Central generation backing down occurred in Northern Region and ~4000MW backing down occurred in other region.
- Most of the State thermal generation backing down was not upto technical minimum (55%).
- Delayed backing down response observed in Rajasthan state thermal generation.
- Tower collapsed occurred in 400 kV Agra-Sikar ckt-1 & 2.
- It has been observed from the previous thunderstorm incidents that utilities are manually shutting down their feeders during the storm to avoid collateral damage. It was decided in summer preparedness meeting in year 2016 (23.06.2016), taken by Joint Secretary (Trans), MoP that the states shall categorize all the feeders in two lists, one which do not require manual opening (in view of safety requirements), and the other with safety concern. The list with safety concern shall be progressively reduced.
- This aspect has been discussed during different meetings at TCC/NRPC level as well. However, the list from the states is yet to be received

Action points decided during the meeting:

- NRPC suggested to all the state load despatch centre to put separate screen dedicated for weather monitoring and use this information in real time grid operation.

- States shall categorize all the feeders in two lists as per decision in meeting date 23.06.2016 and submit the details to NRPC/ NRLDC before 30th June 2019.
- Utilities shall submit the detailed report on load crash before 30th June 2019 considering the following points:
 - Load Crash (in MW) in the State
 - Analysis of Thermal Generation backing down in the state (till technical minimum or not, if not than reason of the same needs to be discussed)
 - Analysis of fast ramping down of state generation during reduction in demand met.
 - Reason of large deviation from the schedule
 - Line tripping & tower collapse (132 kV and above)
 - Line manually opened on high voltage in state Grid
 - Future remedial measures (Improvement in action taken for future)
 - Weather monitoring and warning/alerts issued or not?

All the concerned utilities may update the status on above action points.

A.10. Tripping events

NOTE: All the utilities are requested to submit DR/EL and other tripping related data to NRPC/NRLDC and bring the same in the 38th PSC meeting scheduled to be held on 01st and 02nd, August 2019.

They are also requested to make presentation highlighting cause of the event, actions taken and remedial measure to be taken in future for avoidance of similar instances.

A. Multiple Element tripping at 400/220kV Bhadla (Raj) Station at 12:26hrs of 16th Jan 2019

Event category: GD-1

Generation loss: 1400 MW (Rajasthan may confirm)

Loss of load: Nil MW (Rajasthan may confirm)

Energy load: Nil MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance	PMU data	1080ms	

Time			
Phase of the fault	PMU data	Y&B phase to phase to earth fault	

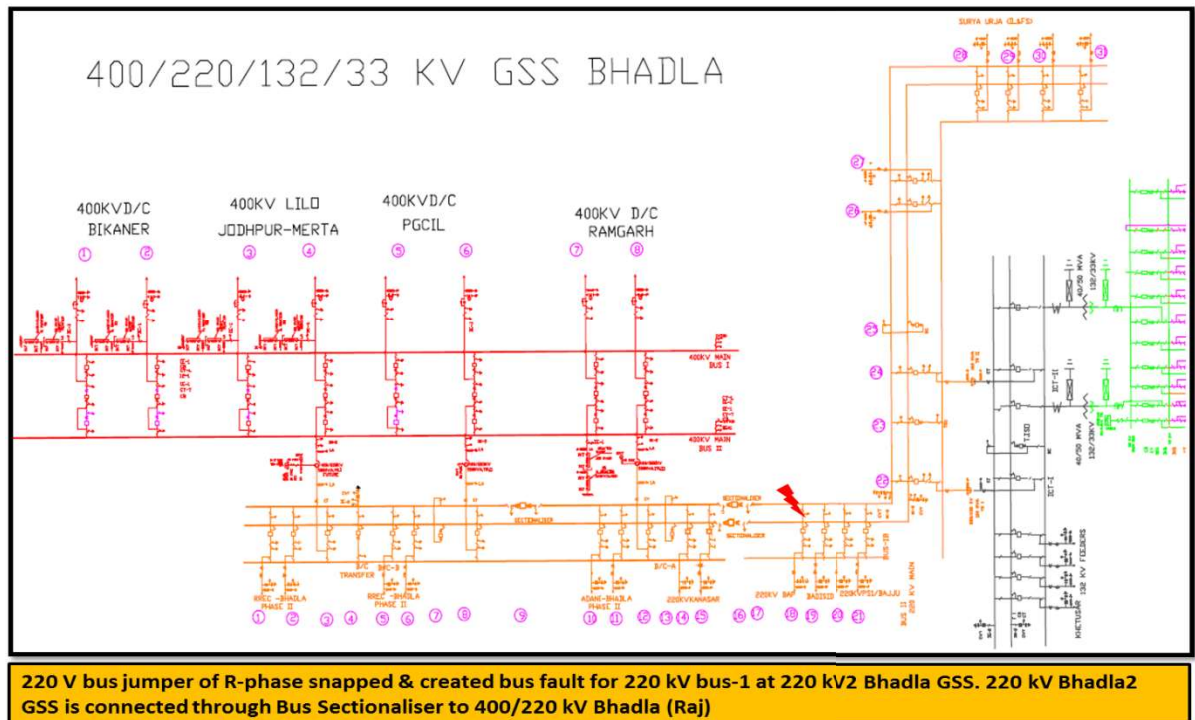
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received (after 24hrs)	DR/EL received partially
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

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, 6.4) CEA (Technical standard for connectivity to the	Rajasthan	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system 4. Delayed clearance of Fault

	Grid, Amendment Regulation 2013), part-II, B2 4. CEA GRid Standard 2010-3.e & CEA Transmission Planning Criteria	
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Based on above information description of the events is:

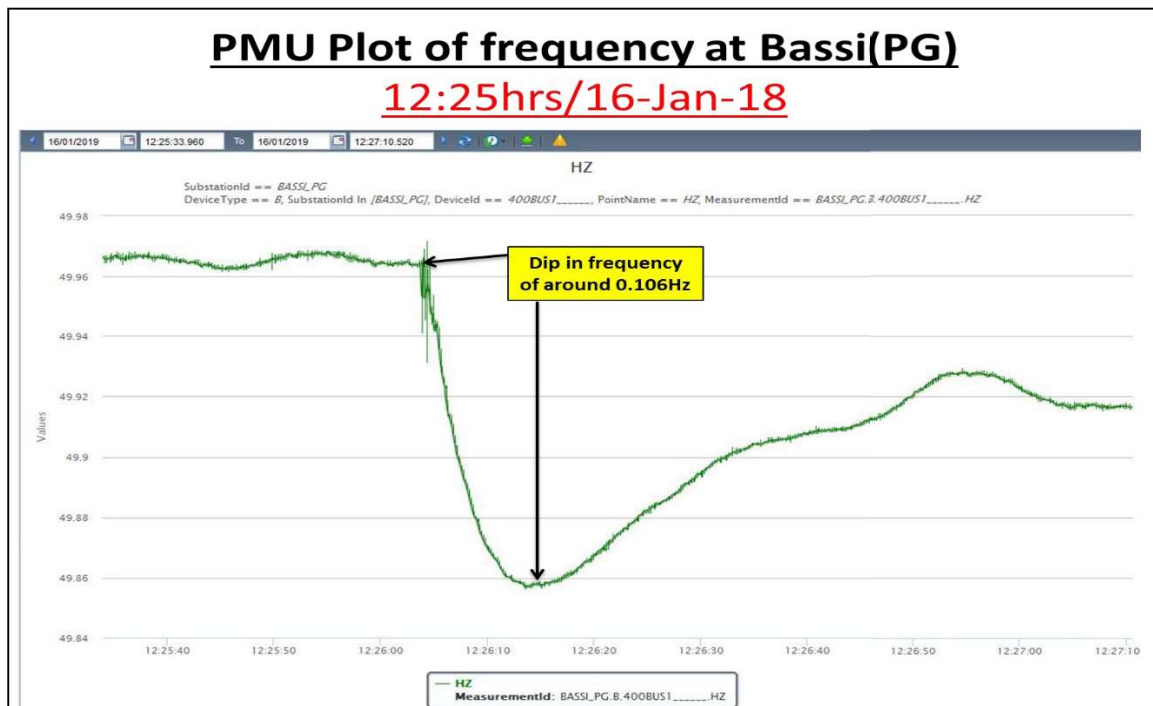
1. Connectivity diagram of 400/220 kV Bhadla (Raj):

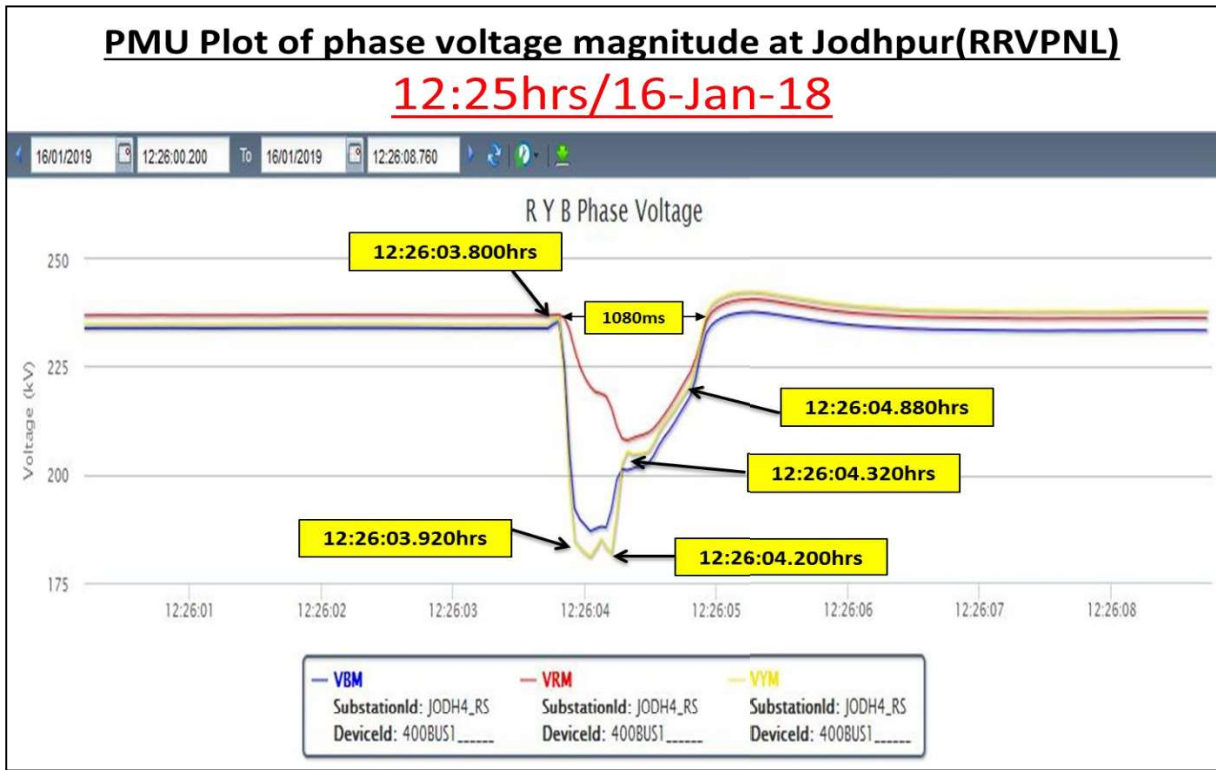


- 400/220 kV Bhadla (Raj) station has one and half breaker scheme. It is connected through Bikaner D/C, Ramgarh D/C, Bhadla (PG) D/C, Jodhpur S/C and Merta S/C. It also has three 500 MVA 400/220 kV ICTs. At 220 kV side of 400/220 kV Bhadla (Raj), it is connected with 220 kV RSDCL D/C, 220 kV ARERPL, 220 kV Kanasar ckt and 220 kV Bhadla2 GSS through 220 kV Bus Sectionalisher. 220 kV Bhadla2 GSS further connected with Bap S/C, Badisid S/C and Surya Urja D/C. Bhadla station is connected to solar park.
- In antecedent conditions, 400kV Bhadla(RRVPNL)-Bikaner(RRVPNL) ckt-1 & 2, 400kV Bhadla(RRVPNL)-Merta(RRVPNL) carrying 301 MW, 303 MW & 188 MW respectively.
- 220 kV R-phase bus jumper snapped and resulted into bus fault at 220 kV Bhadla GSS. 220 kV Bus sectionaliser didn't trip during fault resulted into delayed clearance of fault and further tripping of 220 kV elements at 400/220 kV Bhadla station along with multiple 400 kV lines in Z-2.
- 400 kV outgoing lines tripped from remote end of Bhadla station except

Bikaner ckt-2.

6. Station event logger is not working at 400/220 kV Bhadla station.
7. Preliminary Report received & DR/EL details of 220 kV tripped elements received however detailed report & remedial measures report is still awaited from Rajasthan.
8. Time synch error found in many of the DR submitted.
9. Name of the tripped element:
 - 400kV Bhadla(RRVPNL)-Bikaner(RRVPNL) ckt-1
 - 400kV Bhadla(RRVPNL)-Bikaner(RRVPNL) ckt-2
 - 400kV Bhadla(RRVPNL)-Jodhpur(RRVPNL)
 - 400kV Bhadla(RRVPNL)-Merta(RRVPNL)
 - 220 kV Bhadla (400/220 kV)-RSDCL ckt-1 & 2
 - 220 kV Bhadla (400/220 kV)-AREPRL ckt-1 & 2
 - 220 kV Bhadla (400/220 kV)-Kanasar ckt-2
 - 220 kV Bhadla (400/220 kV)-Bhadla GSS Bus Sectionaliser
 - 220 kV Bhadla2 GSS-Bap
 - 220 kV Bhadla2 GSS-Badisid
 - 220 kV Bhadla2 GSS-Sourya Urja ckt-1 & 2
10. PMU plots:

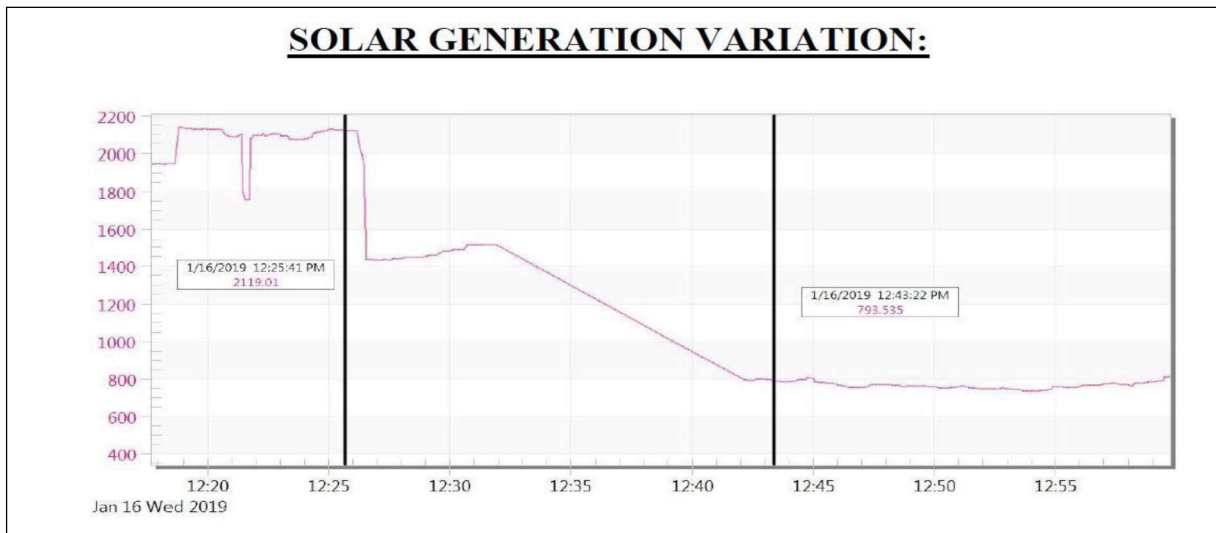




11. As per PMU data:

- Y-B phase to phase to earth fault occurred at 12:26:03.800hrs and cleared in **1080ms**.

12. SCADA data and SoE: Analog data was suspected and SoE didn't capture in NR SCADA. Solar generation loss of `1400MW was captured.



13. As per Rajasthan details:

Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400 KV Bikaner – Bhadla I	16.01.2019	12.24	16.01.2019	13.26	Bikaner _ DPS, 189.1Km	
2	400 KV Bikaner – Bhadla II	16.01.2019	12.24	16.01.2019	13.27	Bikaner - DT Send	
Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400 KV GSS Merta– Bhadla	16.01.2019	12.28	16.01.2019	14.05	Merta - 331.7Km , DPS, Y ph, ; Bhadla- No Indication	
Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400 KV GSS Jodhpur – Bhadla	16.01.2019	12.25	16.01.2019	14.01	Jodhpur - Z2, 354.8Km , B & C Ph	

**Preliminary Report on System Disturbance occurred at 400/220 KV
GSS Bhadla on 16/01/2019**

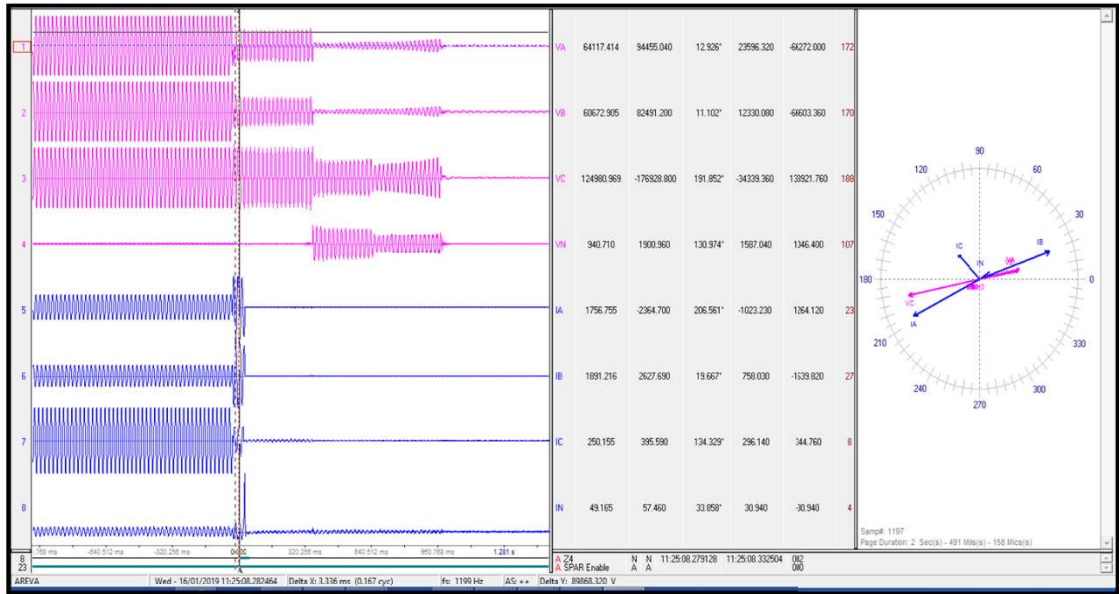
Date and time of event	1/16/2019	12:25:00 PM
Date time of restoration	1/16/2019	01:26:00 PM
Duration	1H 1 Min	
Introduction of event	Multiple element tripping at 400/220KV Bhadla (RRVPNL)	
Loss of Gen (MW)	1400	
Area Affected	Rajasthan	
Substations Affected	400/220 KV Bhadla (RRVPN)	
Triggering Incident:	As report, Flashover occurred at 220 KV main Bus Jumper (Dropper) at 220KV Bhadla GSS Leading to tripping of 8 Nos. 400KVLines associated with 400/220KV Bhadla (RRVPN)	
Category:	GD-1	
Description	<p>As reported,400KV Bhadla (RRVPN)-Bikaner ckt-1 tripped on RN fault, 189.1Km from Bikaner end, 400KV Bhadla (RVPNL) Bikaner ckt-2 tripped due to DT received at Bikaner end, 400KV Bhadla(RVPNL)-Jodhpur(RVPNL) trip due to Y-B fault, 254.4 KM from Jodhpur end and 400 KV Bhadla (RVPNL)-Merta (RVPNL) trip due to Y-B fault, 333.17 KM from Merta end.</p> <p>There was burning of Jumper of R phase at 220KV GSS Bhadla on 220 KV Bus. The bus was connected to 220 KV Bus of 400 KV GSS Bhadla through Sectionalizer. After isolation of faulty section, the system of 400 KV GSS Bhadla was restored at 13.26 hours and generation of 900 MW restored.</p> <p>After replacement of burnt Jumper, system of 220 KV GSS Bhadla and remaining 500 MW generation restored at 16.35 hours.</p>	
Name of the Tripped Elements	: 1. 400KV Bhadla (RRVPN)-Bikaner ckt-1 2. 400KV Bhadla (RRVPN)-Bikaner ckt-2 3. 400KV Bhadla (RRVPN)-Jodhpur 4. 400KV Bhadla (RRVPN)-Merta 5. 220 KV Bhadla – RSDCL-I Line-1 6. 220 KV Bhadla – RSDCL-I Line-2 7. 220 KV Bhadla – AREPRL Line-1 8. 220 KV Bhadla – BAP Line 9. 220 KV Bhadla – Badisid Line	

Changshya



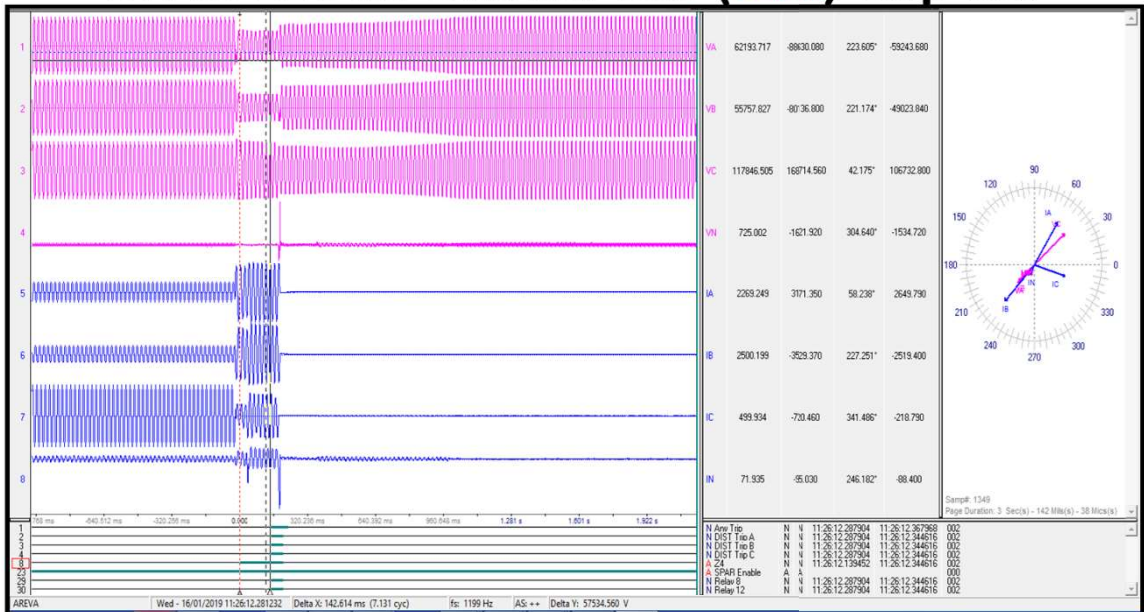
Name of GSS	Name of Line / Equipment	Date of Tripping	Time in Hours		Relay indication				Remarks
			Tripping	Closing	BHADLA END		Other END		
					Annuciation	Relay indication	Annuciation	Relay indication	
400KV GSS BHADLA	400KV Bhadla-Bikaner Line-1	16.01.2019	12:24	13:26		No Trip		Dist. Relay M-2 (189.1KM) in Zone-2 in Y and B phase	R-phase dropper Jumper of 220 kv main bus was broken
	400KV Bhadla- Bikaner Line-2	16.01.2019	12:24	13:27		Backup impedance(21R)-127KM, 86A & 86B, DT send		DT received	
	400KV LILO Merta Line	16.01.2019	12:24	14:05		No Trip		Dist. Relay M-1(331.7KM) & M-2(327.7KM) in Zone-2 in Y and B phase	
	400KV LILO Jodhpur Line	16.01.2019	12:24	14:01		No Trip		Dist. Relay M-1(354.8KM) & M-2(354.8KM) in Zone-2 in A and B phase	
	220KV BHADLA-RSDCL GSS-1 LINE-1	16.01.2019	12:24	13:31		No Trip		O/C inst. Feature optd.	
	220KV BHADLA-RSDCL GSS-1 LINE-2	16.01.2019	12:24	13:32		No Trip		Z- 2 Trip , 8.6km	
	220KV BHADLA-AREPRL LINE-1	16.01.2019	12:24	13:32		No Trip		U/V Trip	
	220KV BHADLA-AREPRL LINE-2	16.01.2019	No Trip	No Trip		No Trip		U/V Trip	
	220KV BHADLA-KANASAR LINE-2	16.01.2019	No Trip	No Trip		No Trip		Z- 2 Trip , 9.6km	
	220KV SECTIONALIZER-2	16.01.2019	12:43			Manually Triped		Manually Triped	
220 KV GSS BHADLA	220 KV Bhadla-Bap	16.01.2019	12:25	16:45	Distance. Protection Operated	Distance relay operated zone-4 distance -650.1 meter(M-I) & -276.6 meter(M-2)	NIL	No Tripping(manual trip)	R-phase dropper Jumper of 220 kv main bus was broken
	220 KV Bhadla-Badisdid	16.01.2019	12:25	16:50	NIL	No Tripping (manual trip)	Distance. Protection Operated	Distance relay operated zone-2 distance 56.31 km	
	220 KV Bhadla-Sourya Urja-I	16.01.2019	14:45	16:50	NIL	No Tripping (manual trip)	DT received	U/V Trip,DT send	
	221 KV Bhadla-Sourya Urja-II	16.01.2019	14:45	16:45	NIL	No Tripping (manual trip)	DT received	U/V Trip,DT send	

DR of 220 kV Bhadla GSS (end)-Badisid ckt



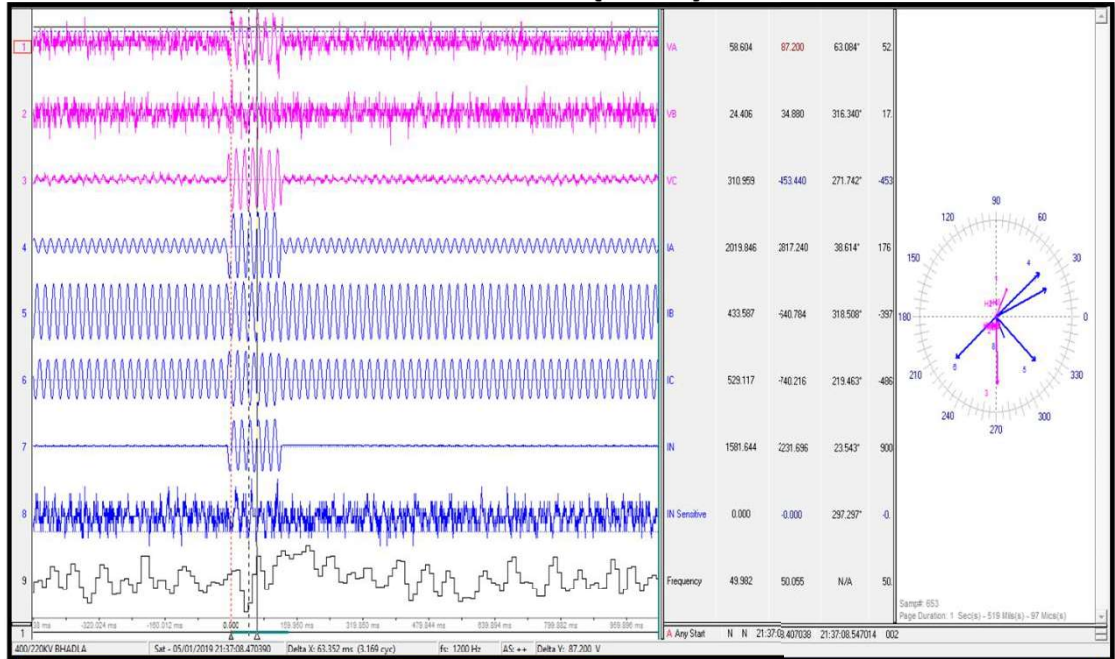
Maximum fault current in R&Y-phase
Time Synchron error

DR of 220 kV Bhadla GSS (end)-Bap ckt



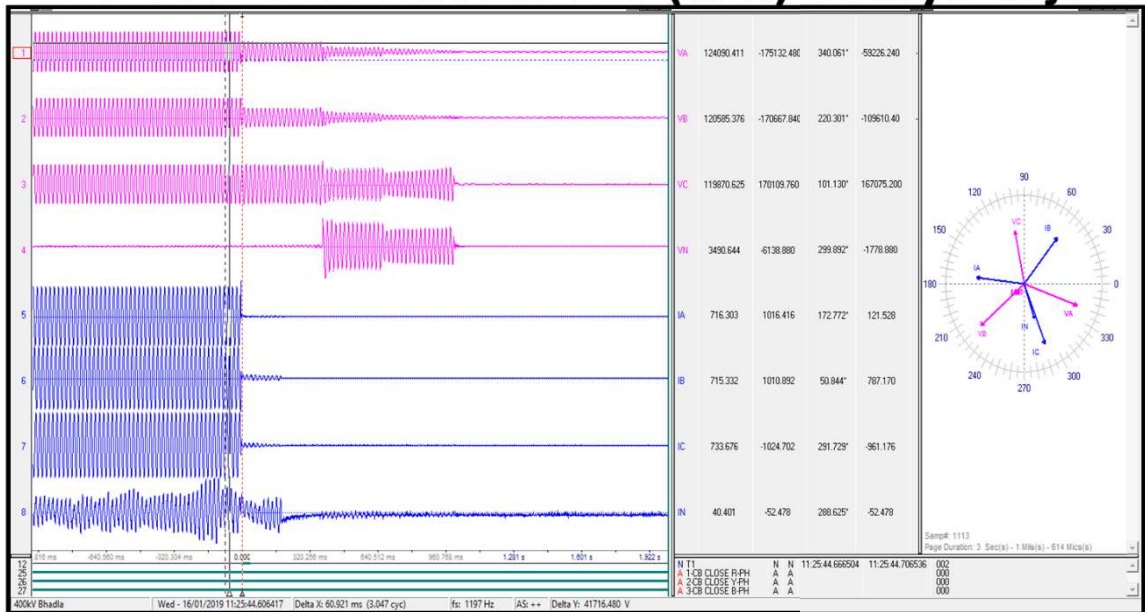
Maximum fault current in R&Y-phase
Time Synchron error

DR of 220 kV Bhadla GSS (end) Bus Sectionaliser



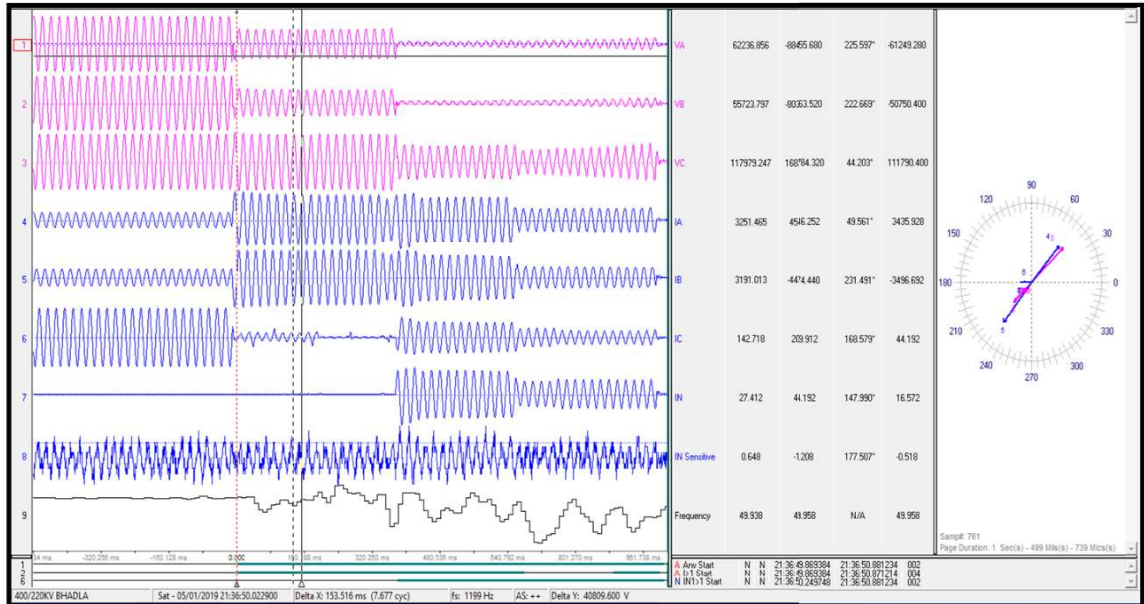
Maximum fault current in R-phase
Time Synchron error

DR of 220 kV Bhadla GSS (end)-Sourya Urja



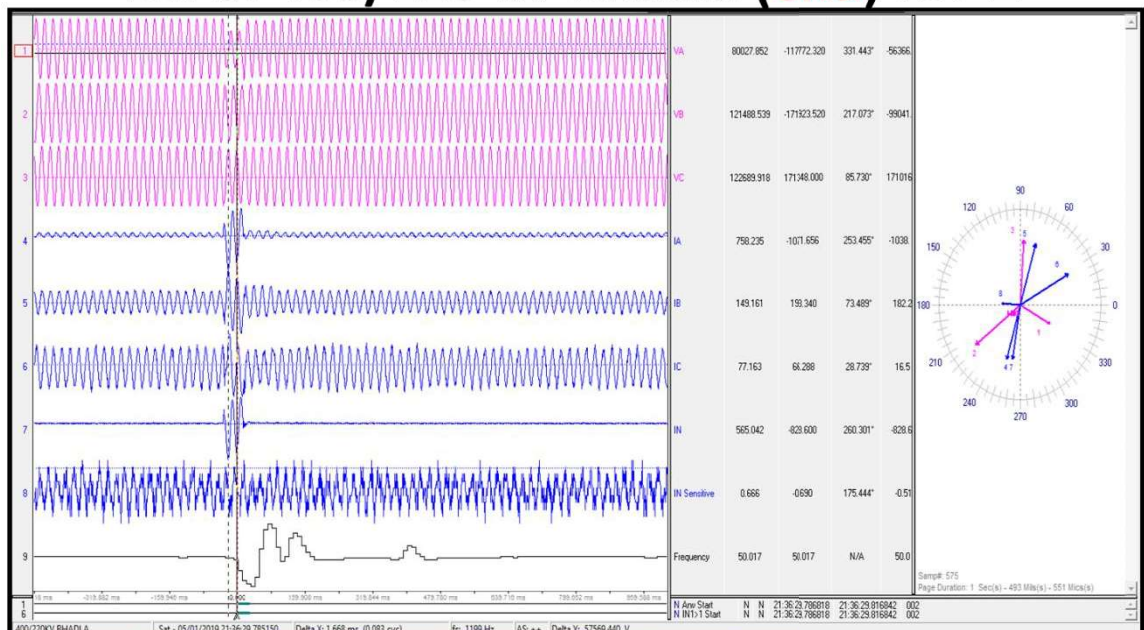
Solar generation tipped immediately, may be due to absence of LVRT
Time Synchron error

DR of 400/220 kV Bhadla (end) ICT-1



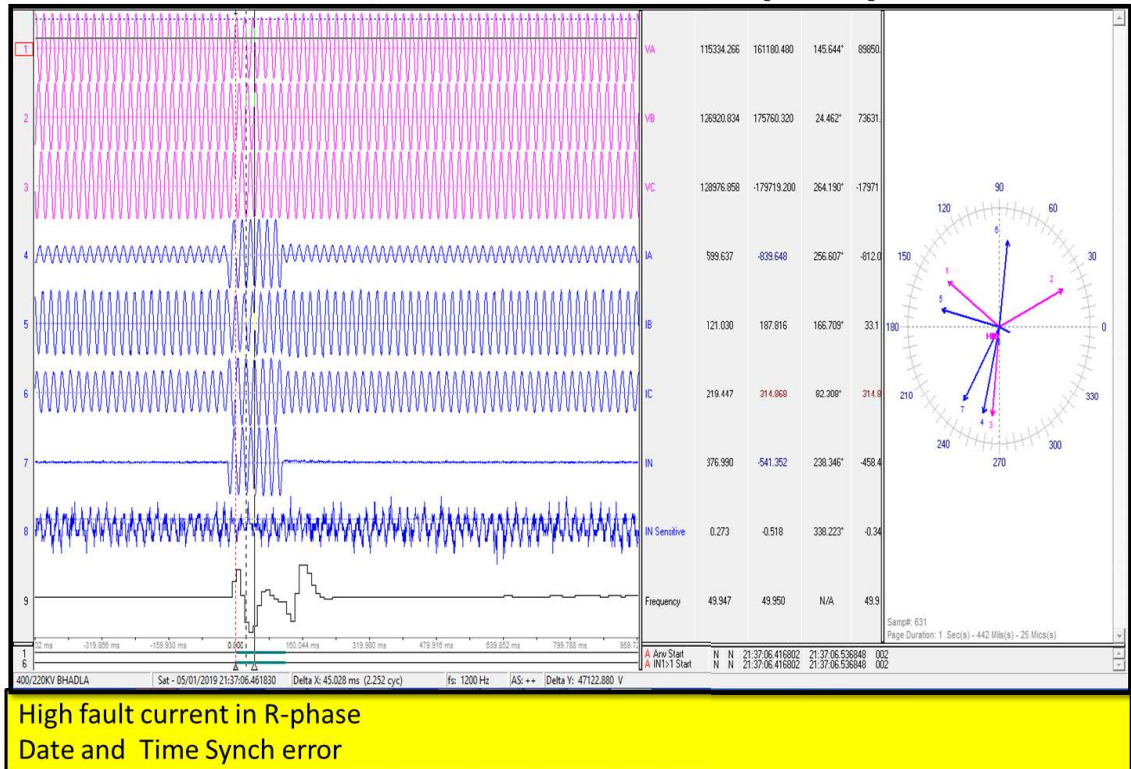
High fault current in R&Y-phase
Date and Time Synch error

DR of 400/220 kV Bhadla (end) ICT-2



High fault current in R-phase
Date and Time Synch error

DR of 400/220 kV Bhadla (end) ICT-3



1. Remedial Measures taken as per Rajasthan report:
 - TMS (Time Multiplier setting) of back up O/C & E/F protection of 220 kV bus sectionaliser between 400/220 kV Bhadla (Raj) and 220 kV Bhadla GSS has already been revised.
2. Preliminary Report & partial DR details received but detailed report in desired format is still awaited from Rajasthan. Station EL detail is also not submitted.

Cause of Concern:

- Non-operation of bus bar protection and backup over current & earth fault protection of 220 kV Bus sectionaliser resulted into delayed clearance of fault
- Fault was at 220 kV Bus of Bhadla2 GSS and 220 kV bus bar protection was not operated.
- Further 220 kV bus sectionaliser didn't trip on back up over current earth fault protection.
- 400/220 kV ICTs at Bhadla (Raj) didn't trip on back up O/C & E/F protection for bus fault or if all 400 kV lines tripped before tripping of ICTs than issue of protection co-ordination between 400/220 kV ICTs and remote end of 400 kV outgoing lines from 400/220 kV Bhadla station.
- DR details of 400 kV tripped elements is yet to be received from Rajasthan.
- Suspected SCADA Analog data of 400/220 kV Bhadla (Raj) station, it hampers the analysis of the tripping.

- SCADA digital stats for 400/220 kV Bhadla (Raj) & 220 kV Bhadla GSS was not available in Rajasthan SoE.
- Station event logger is not working at 400/220 kV Bhadla station.
- DR of 220 kV Bhadla GSS & 400/220 kV Bhadla station was not time synchronized.

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. Non-operation of bus bar protection at 220 kV Bhadla GSS needs to be looked into.
3. Bus bar protection at 400/220 kV Bhadla (Raj) and 220 kV Bhadla GSS need to be thoroughly checked.
4. Old setting and revised setting of O/C & E/F protection of 220 kV bus sectionaliser between 220 kV Bhadla GSS and 400/220 kV Bhadla station needs to be again checked and shared.
5. Protection Co-ordination between back up protection of 400/220 kV ICTs and main distance protection of 400 kV outgoing lines from 400/220 kV Bhadla (Raj) station needs to be looked into.
6. Tripping of Solar generation in view of LVRT operation/ non-operation needs to be thoroughly checked and informed.
7. DR details of 400 kV tripped elements needs to be checked and submitted.
8. Healthiness of station event logger to be ensured.
9. Time Synchronization of DR of all the elements of 400/220 kV Bhadla (Raj) and 220 kV Bhadla GSS needs to be corrected.
10. Availability of digital and analog data of 400/220 kV Bhadla (Raj) and 220 kV Bhadla GSS to be ensured.
11. Detailed Report and Remedial measures report is still awaited from Rajasthan

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 220kV Shahjahanpur (UP) Station at 01:29hrs of 22nd Jan 2019

Event category: GD-1

Generation loss: 150 MW (As per UP report)

Loss of load: Nil MW (As per UP report)

Energy load: Nil MU (As per UP report)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	9320ms	
Phase of the fault	PMU data	Y-phase to earth fault followed by Y-B double phase to earth fault	

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

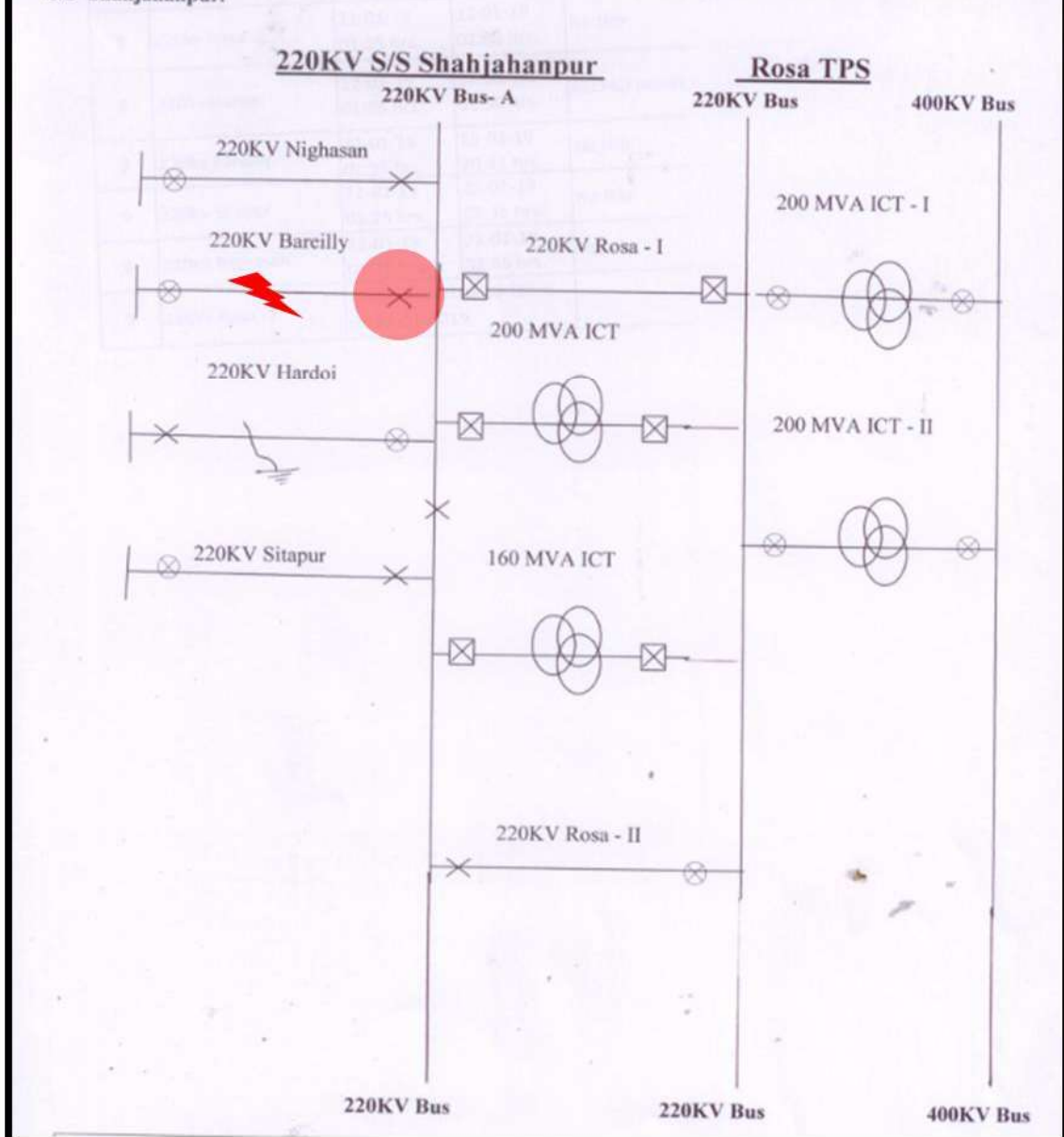
Description	Clauses	Utility	Remarks
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<p>Violation of Clauses</p>	<p>1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for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

1. Connectivity diagram of 220 kV Shahjahanpur (UP):

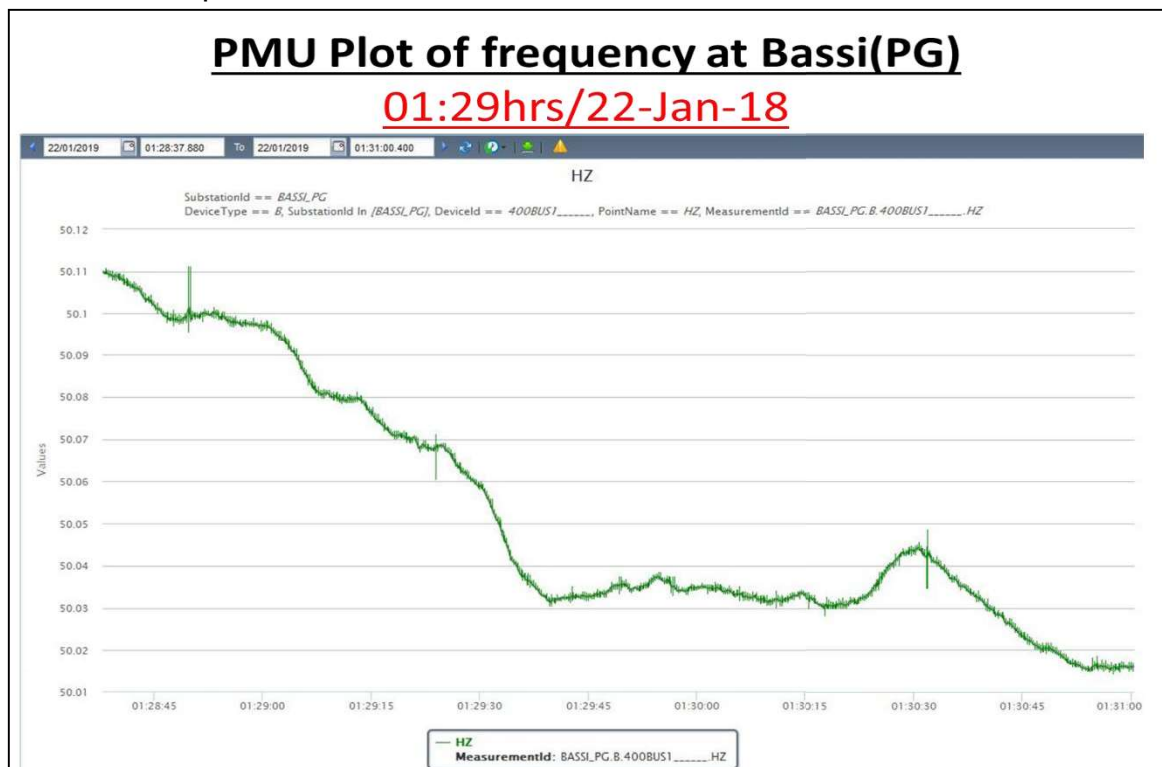
Report on the Incident of Simultaneous tripping of following Elements at Rosa TPS and 220KV S/S Shahjahanpur at 01:25 Hrs. on date 22.01.2019 based on the information received from Rosa TPS and 220KV S/S Shahjahanpur.

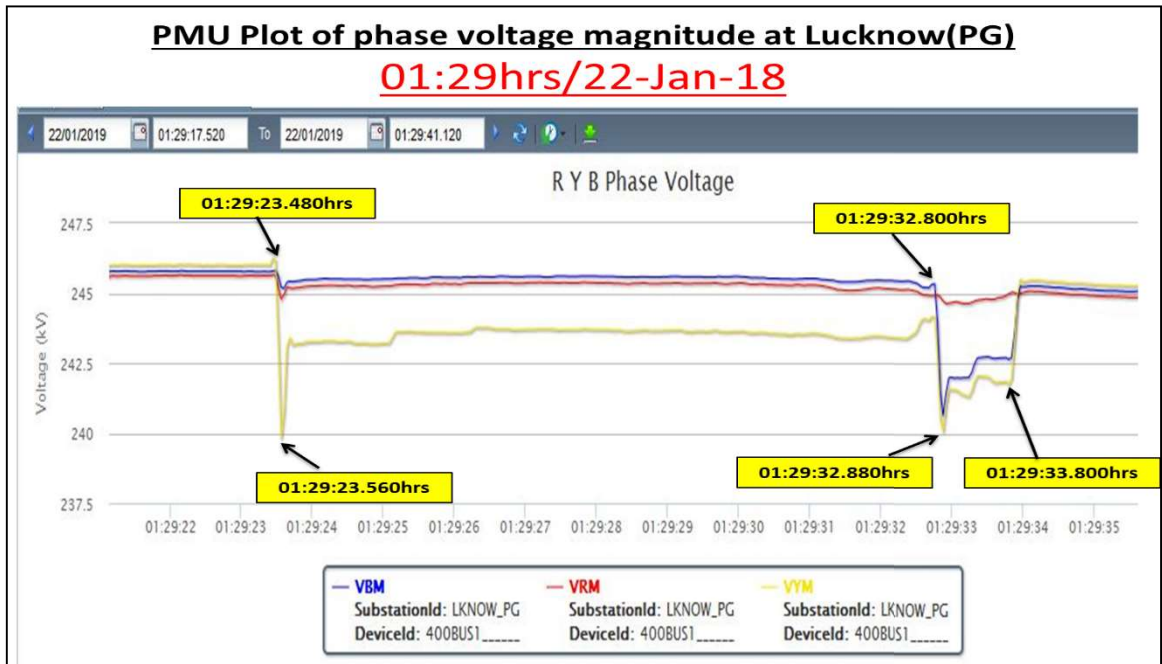


2. 220 kV Shahjahanpur station has double main transfer breaker scheme. It is connected through Rosa D/C, Bareilly S/C, Nighasen S/C, Hardoi S/C and Sitapur S/C. It also have two 160 MVA 220/132 kV ICTs.
3. In antecedent conditions, 200 MVA ICT 1 & 2 at 400/220kV Rosa(UP) carrying 14 MW & 16 MW respectively. 220 kV LBB/ Bus Bar Protection was out of service at 220 kV Shahjahanpur station.
4. R-phase jumper of 220 kV Shahjahanpur-Bareilly ckt snapped and touched to Y-phase and then grounded. It resulted into R-Y double phase to earth fault in the system.
5. Breaker at Shahjahanpur end didn't trip. LBB protection was also not in service and all the 220 kV lines tripped from remote end except 220 kV Shahjahanpur-Hardoi ckt.

6. 220 kV Shahjahanpur-Hardoi ckt tripped from Shahjahanpur end.
7. 200MVA 400/220 kV ICT-1 & 2 of Rosa TPS also tripped at the time of fault in the system.
8. Unit-2 of Rosa TPS also tripped on earth fault protection.
9. Name of the tripped element:
 - 220kV Shahjahanpur(UP)-Bareilly(UP)
 - 220kV Shahjahanpur(UP)-Sitapur(UP)
 - 220kV Shahjahanpur(UP)-Nighasan(UP)
 - 220kV Shahjahanpur(UP)-Hardoi(UP)
 - 220kV Rosa(UP)-Shahjahanpur(UP) ckt-1
 - 220kV Rosa(UP)-Shahjahanpur(UP) ckt-2
 - 200 MVA ICT 1 at 400/220kV Rosa(UP)
 - 200 MVA ICT 2 at 400/220kV Rosa(UP)
 - 300 MW Unit#2 at 400/220kV Rosa(UP)

10. PMU plots:





11. As per PMU data:

- Y-phase to earth fault followed by Y-B double phase to earth fault
- Fault clearance time: **9320ms**.

12. SCADA data and SoE: Digital status captured in NR SoE is given below:

Time	Ref time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
01:29:23.480	0ms						PMU ref time
01:29:24:972	1490ms	SHJHA_UP	132kV	D_01(T1)	Circuit Breaker	Open	132kV side CB of 220/132kV ICT 1 at 220kV Shahjahanpur(UP) opens.
01:29:24:972	1490ms	SHJHA_UP	220kV	E_02(T1)	Circuit Breaker	Open	220kV side CB of 220/132kV ICT 1 at 220kV Shahjahanpur(UP) opens.
01:29:32:686	9205ms	ROSA_UP	400kV	F_06(LKNOW-1)	Circuit Breaker	Open	400 kV Rosa-Lucknow (UP) ckt tripped at Rosa end
01:29:32:798	9320ms	ROSA_UP	400kV	F_02(G4)	Circuit Breaker	Open	CB of Unit#4 at Rosa(UP) opens
01:29:32:800	9320ms						Voltage dip in Y&B-phase (PMU)
01:29:32:932	9450ms	ROSA_UP	220kV	E_11(G2)	Protection Trip	Disp	Unit-2 of Rosa TPS tripped
01:29:33:150	9570ms	ROSA_UP	220kV	E_07(SHJHA-2)	Circuit Breaker	Open	CB of 220kV Rosa(UP)-Shahjahanpur(UP) ckt-2 opens.
01:29:33:800	10220ms						Fault finally cleared

13. As per UPPTCL details:

Sub: - Report on the Incident of Simultaneous Tripping at 400/220KV S/S Rosa TPS and 220KV S/S Shahjahanpur.

On 22.01.2019 at 01:29Hrs. following elements at 400/220KV S/S Rosa TPS and 220KV S/S Shahjahanpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	220KV Rosa-Shahjahanpur -I			Under S/D since 21.01.19
2.	220KV Rosa-Shahjahanpur -II	22.01.19	02:38	Tripped at Rosa end (Z-2)
3.	220KV Shahjahanpur - Sitapur	22.01.19	02:35	Tripped at Sitapur end
4.	220KV Shahjahanpur - Nighasan	22.01.19	02:35	Tripped at Nighasan end
5.	220KV Shahjahanpur - Hardoi	22.01.19	02:50	O/C and E/F protection
6.	220KV Shahjahanpur - Bareilly	Under S/D		Tripped at Bareilly end
7.	200MVA ICT-I at Rosa TPS	22.01.19	02:17	Differential protection
8.	200MVA ICT-II at Rosa TPS	22.01.19	02:17	-do-
9.	Unit -II at Rosa TPS	22.01.19	04:39	E/F

Generation Loss = 150MW Approx.

Load Loss = NIL

It has been reported by site authorities that fault occurred in 220KV Shahjahanpur- Bareilly line. The breaker at Bareilly end tripped on distance protection (GT, Y- phase, Z-1, dist. 23.29km.) but the breaker at Shahjahanpur did not trip. In the absence of LBB protection system at 220KV Shahjahanpur, the fault was sensed by the relays at other end of the lines emanating from 220KV Shahjahanpur, causing tripping of lines at other end on distance protection (Z-2/Z-3).

200 MVA ICT- I and ICT -II at 400 KV Rosa TPS tripped on differential protection due to mismatch of CT current on either side of ICTs. Unit- II at Rosa TPS also tripped as it sensed earth fault occurred in 220KV Shahjahanpur – Bareilly line as intimated by Rosa TPS.

Sub: - Report on the Incident of Simultaneous Tripping at 400/220KV S/S Rosa TPS and 220KV S/S Shahjahanpur.

On 22.01.2019 at 01:29Hrs. following elements at 400/220KV S/S Rosa TPS and 220KV S/S Shahjahanpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	220KV Rosa-Shahjahanpur -I	22.01.19	15:41	
2.	220KV Rosa-Shahjahanpur -II	22.01.19	02:38	Tripped at Rosa end (Z-2)
3.	220KV Shahjahanpur - Sitapur	22.01.19	02:35	Tripped at Sitapur end
4.	220KV Shahjahanpur - Nighasan	22.01.19	02:35	Tripped at Nighasan end
5.	220KV Shahjahanpur - Hardoi	22.01.19	02:50	O/C and E/F protection
6.	220KV Shahjahanpur - Bareilly	23.01.19	20:41	Tripped at Bareilly end
7.	200MVA ICT-I at Rosa TPS	22.01.19	02:17	Differential protection
8.	200MVA ICT-II at Rosa TPS	22.01.19	02:17	-do-
9.	Unit - II at Rosa TPS	22.01.19	04:39	E/F

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

Analysis:-

On 220KV Shahjahanpur - Bareilly line, between tower number 22 and 23, R- phase jumper snapped and touched Y- phase and then grounded which created earth fault. This caused blackout at 220KV substation Shahjahanpur due to tripping of other 220KV lines from other end except 220KV Hardoi which tripped at Shahjahanpur end. This caused blackout at 220KV substation Shahjahanpur. 220KV Shahjahanpur I, II lines and 200MVA ICT I & II tripped at Rosa TPS.

14. Discussion in monthly OCC meeting of UPPTCL:

6. In the matter of the issues related to tripping of ICTs on differential protection at Rosa TPS representative of Rosa TPS intimated that the said issue has been resolved. However, Rosa TPS has been advised to disable 5th Harmonic content relay and to do earthing of equipments such as CT/CVT at junction box instead of control panel. Also, representative of Rosa TPS has been asked to share drawing of the substation with Er. Kavindra Singh, advisor, UPPTCL for examination.
8. Various issues related to Blackout at Shahjahanpur on 22.01.2019 were also discussed. Analysis of the said blackout revealed that various mal-operation/non-operation of protection system led to the blackout at 220kV S/S Shahjahanpur. It was advised to concerned authority to carry out testing of protection system and set right the setting of relays, if any.
As a general instruction it was directed that following testing should be carried out:-
 - a) Yearly testing of protection system.
 - b) Quarterly checking of battery.
 - c) To carry out Mock test to ensure tripping of breaker at 70% DC voltage.

15. Remedial Measures taken/ to be taken as per UPPTCL report:

- Relay panel on 220 kV Bareilly line at Shahjahanpur end is old has static PYTS relays and backup relay is also defective. Back up protection relay has been replaced with another healthy relay and lower TMS 0.1 has been set

- Distance panel for 220 kV Bareilly-Shahjahanpur line is being arranged and will be replaced in 7-10days
- Thorough protection testing at Rosa TPS is required

16. Preliminary Report received within 24hrs but DR/EL & detailed report in desired format 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. Reason of outage of LBB protection at 220 kV Shahjahanpur station and remedial measures taken in this regard?
3. Healthiness of 220 kV LBB/ bus bar protection at 220 kV Shahjahanpur station needs to be ensured.
4. Delayed clearance of fault (more than 10 second)? Such large fault clearance time may have resulted into tripping of multiple units in near vicinity.
5. Reason of delayed tripping of 220 kV Rosa (end)-Shahjahanpur ckts.
6. Protection co-ordination between 220 kV Rosa-Shahjahanpur ckts and 400/220 kV ICTs at Rosa TPS.
7. Protection setting of 220 kV and 400 kV units of Rosa TPS needs to be thoroughly checked.
8. Reason of tripping of 400 kV Rosa-Lucknow (UP) ckt at Rosa end?
9. Protection Audit for 220 kV Shahjahanpur and Rosa TPS to be done.
10. DR/EL, Detailed Report and Remedial measures report 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.

C. Multiple Element tripping at 400kV Jhakri (SJVNL) Station at 06:37hrs of 23rd Jan 2019

Event category: GD-1

Generation loss: 925 MW (NJPC may confirm)

Loss of load: Nil

Energy load: Nil

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		80ms	As per PMU data
Phase of the fault		Y-B phase to phase fault	As per PMU data

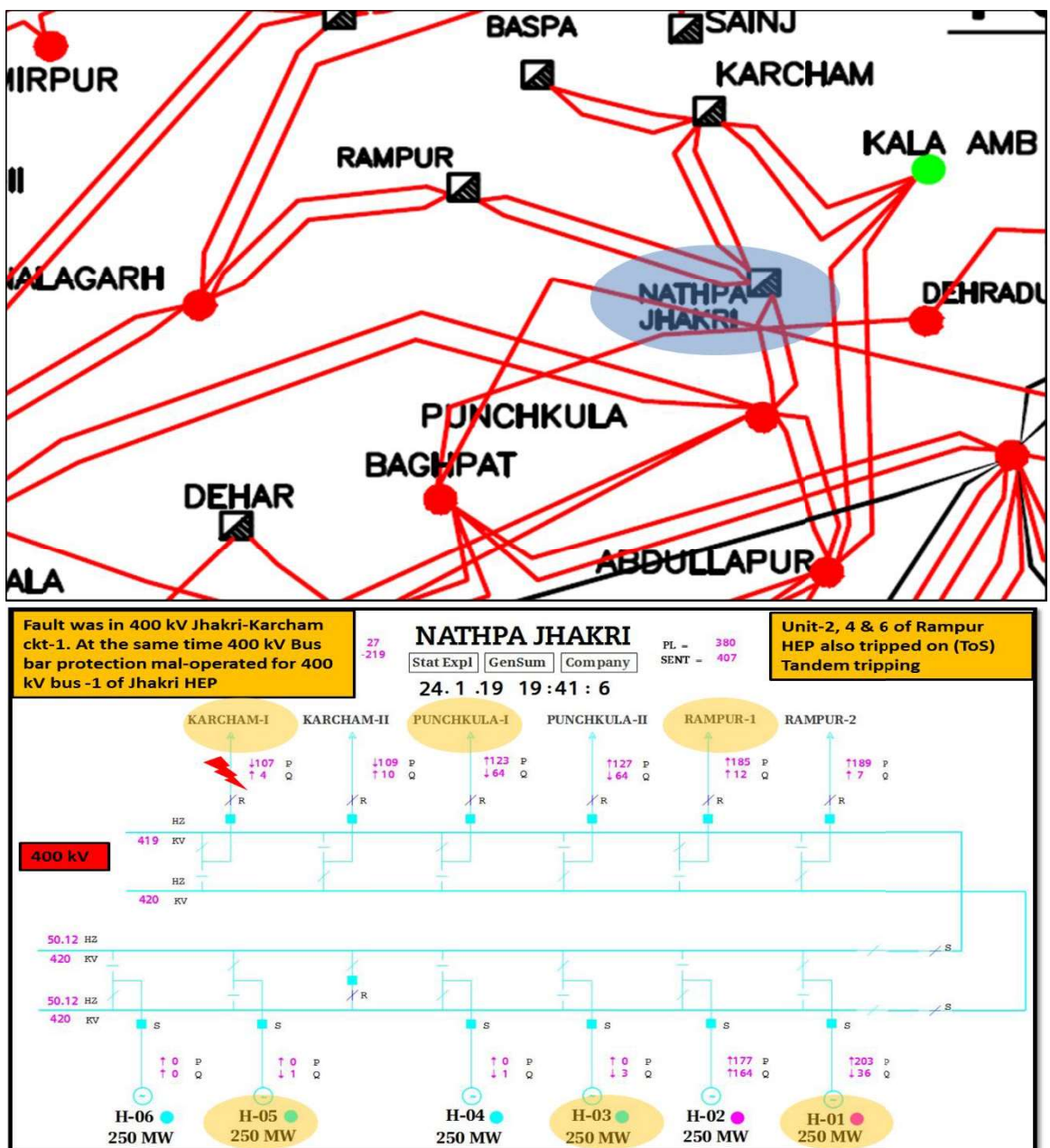
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Received	Time Synch error
DR/ EL	NJPC	Received	Within 24hrs
	POWERGRID	Not received	
Preliminary Report	NJPC	Received	
	POWERGRID	Not received	
Detailed Report	NJPC	Not received	

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,	NJPC	1. Detailed report yet to be received 2. Adequately Sectionalized and graded protective relaying system

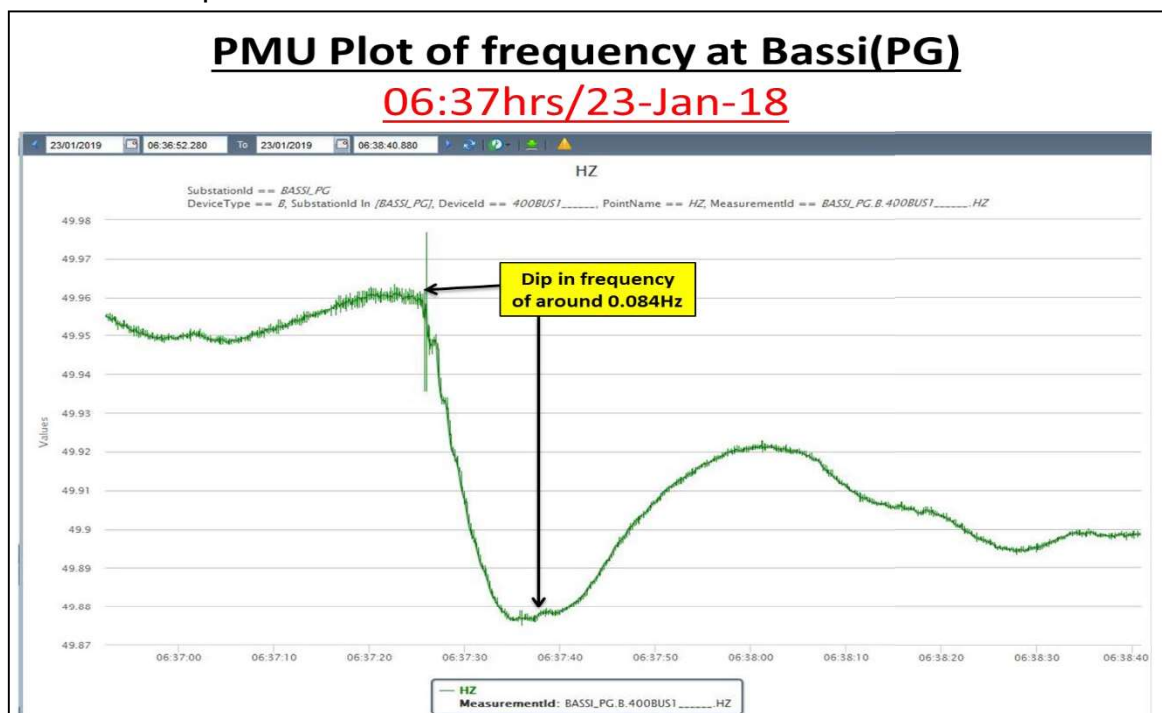
	2007: Schedule Part 1. (6.1, 6.2, 6.3)		
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	POWERGRID	1. Preliminary Report, DR/EL yet to be received

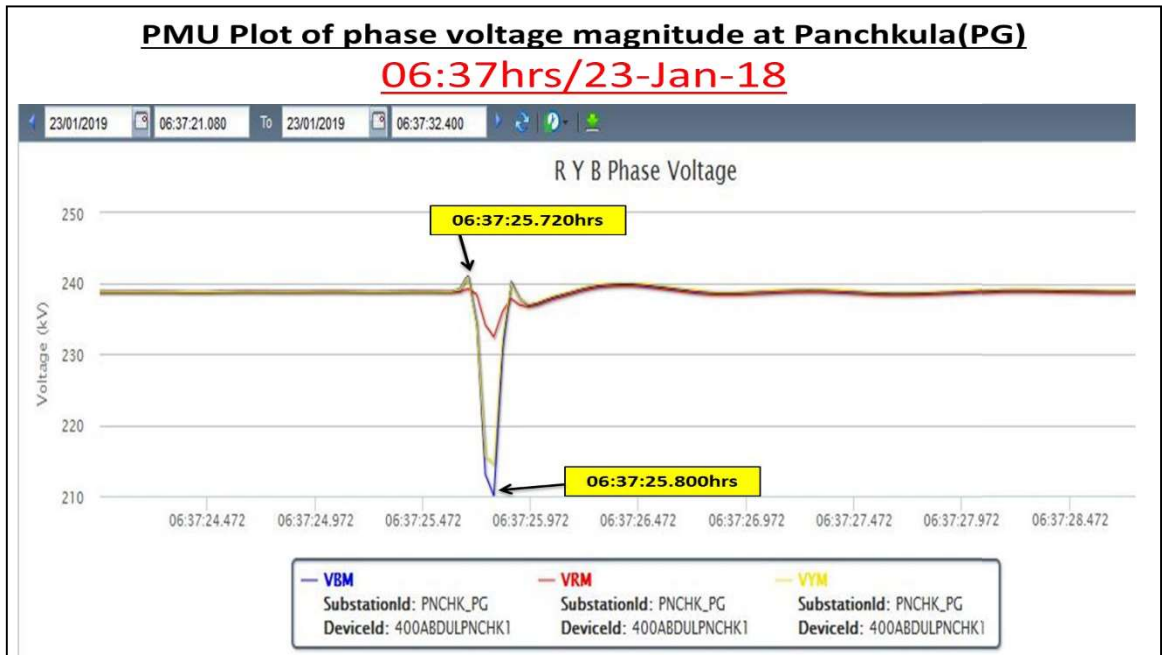
Based on above information description of the events is:

1. Connectivity diagram of 400 kV Jhakri HEP:



2. 400 kV Jhakri HEP station has double main single breaker bus scheme. It is connected through Karcham D/C, Rampur D/C and Panchkula D/C. It also has six units of 250MW.
3. In antecedent conditions, 400kV Jhakri(SJVNL)-Panchkula(PG) ckt-1 & 400kV Jhakri(SJVNL)-Rampur(SJVNL) ckt-1 carrying 607 MW & 416 MW respectively
4. 400kV Jhakri(SJVNL)-Karcham Wangtoo(JSW) ckt-1 tripped on Y-B phase to phase fault within 100ms.
5. At the time of phase to phase fault in the line, High Impedance based Bus Bar differential protection of 400 kV Bus-1 at Jhakri HEP operated and tripped all elements associated with 400 kV Bus-1 (Unit #1,3,5, 400kV Jhakri(SJVNL)-Panchkula(PG) ckt-1 & 400kV Jhakri(SJVNL)-Rampur(SJVNL) ckt-1). As per PMU, Y-B fault is observed.
6. High Impedance based Bus Bar differential protection of 400 kV Bus-1 at Jhakri HEP mal-operated.
7. Station event logger details yet to be furnished.
8. Name of the tripped element:
 - 400kV Jhakri(SJVNL)-Karcham Wangtoo(JSW) ckt-1
 - 400kV Jhakri(SJVNL)-Rampur(SJVNL) ckt-1
 - 400kV Jhakri(SJVNL)-Panchkula(PG) ckt-1
 - 250 MW Unit#1,3,5 at 400kV Jhakri(SJVNL).
 - 68 MW Unit#2,3,4 at 400kV Rampur(SJVNL)
9. PMU plots:





10. As per PMU data:

- Y-B phase to phase fault occurred at 06:37:25.720hrs and cleared in **80ms**.

11. SCADA data and SoE: Analog data was suspected and SoE captured for some of the tripped elements.

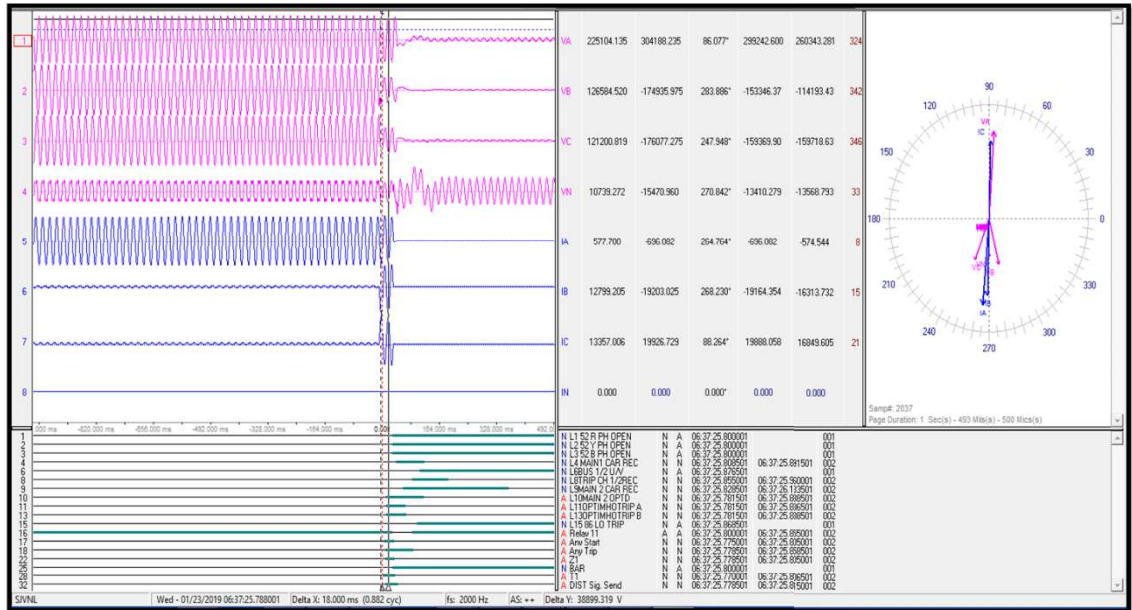
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
06:37:24:***	NAPTHA	400kV	L5KRCHM1	Circuit Breaker	Open	Main CB of 400kV Jhakri(SJVNL)-Karchamwangtoo(JSW) ckt-1 opens.
06:37:24:***	NAPTHA	400kV	LIRAMPR1	Circuit Breaker	Open	Main CB of 400kV Jhakri(SJVNL)-Rampur-(SJVNL) ckt-1 opens.
06:37:24:***	NAPTHA	400kV	L4PNCHK1	Circuit Breaker	Open	Main CB of 400kV Jhakri(SJVNL)-Panchkula(PG) ckt-1 opens.
06:37:25:831	PUNCHKULA	400kV	L1NPHTA1	Protection Trip	App	
06:37:25:858	PUNCHKULA	400kV	17T2NP21	Circuit Breaker	Open	Tie CB of 315 MVA ICT 2 at 400kV Panchkula(PG) & 400kV Jhakri(SJVNL)-Panchkula(PG){end} ckt-1 opens.
06:37:25:861	PUNCHKULA	400kV	16NPHTA1	Circuit Breaker	Open	Main CB of 400kV Jhakri(SJVNL)-Panchkula(PG){end} ckt-1 opens.

12. As per NJPC details:

Preliminary Report Format (To be furnished by Utilities within 24hrs)

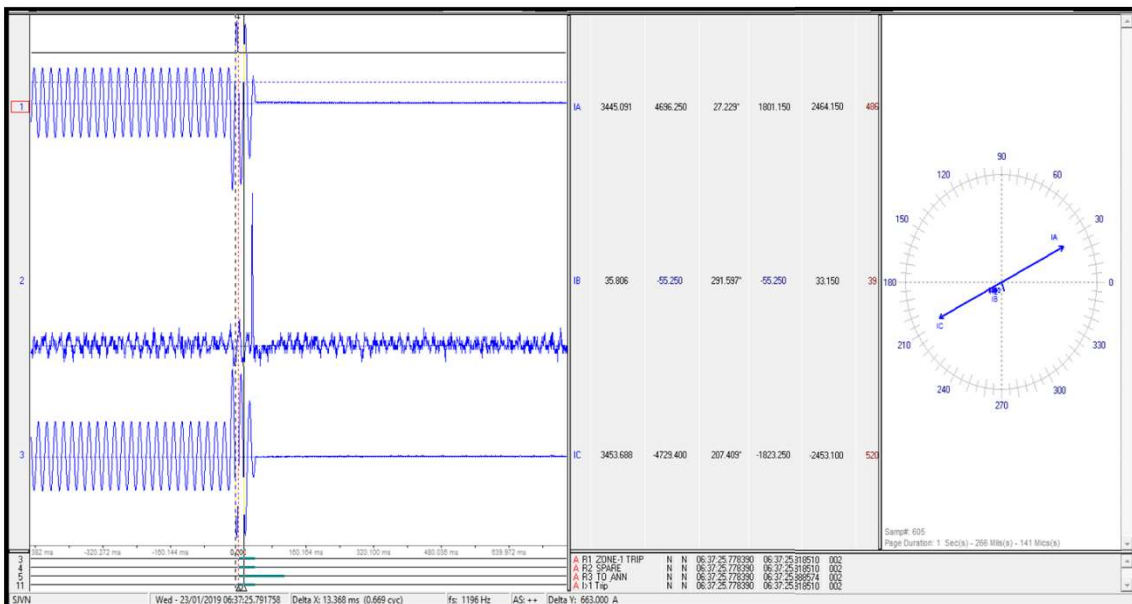
1. Time & Date of Event: 06:37:25:800 Hrs dated 23.01.2019
2. Substation Name: NJHPS Jhakri
3. Antecedent Condition: Generating Units (1 to 5) were running as per schedule & evacuating the power to GRID through 06 Nos Line Feeders (NJ-Panchkula-I &II, NJ- Rampur-I &II & NJ- KW-1 &II).
4. Generation Loss/Load Loss: - There is no generation loss as there is no spillage of water.
5. Name of the tripped elements & time of tripped elements:
U#1, 06:37:25:630
U#3, 06:37:25:627
U#5, 06:37:25:627
NJ-Panchkula-1, 06:37:25:800
NJ-Rampur-1, 06:37:25:800
NJ-KW-1, 06:37:25:800
6. Primary Cause of tripping (Triggering Incident): Maximum fault current observed in NJ-KW-1 under Phase to Phase fault (Y&B Phase) of approx. 15KA magnitude at 06:37:25:768 Hrs (Copy of DR attached) & thereafter NJ-KW-1 tripped on Phase to Phase fault (Between Y&B Phase) at 06:37:25:800 Hrs (Copy of DR attached).
As soon as NJ-KW-1 tripped which is on Bus bar-1, the Bus Coupler, Unit # 1, 3, 5 & Panchkula-I & Rampur-I also got tripped. There is no tripping on the elements associated with Bus Bar-II.
7. Flag Details, DR/EL: Along with DR/EL Attached, .cfg, .dat file format.
Event Description: As soon as NJ-KW-1 tripped which is on Bus bar-1, the Bus Coupler, Unit # 1, 3, 5 & Panchkula-I & Rampur-I also got tripped. There is no tripping on the elements associated with Bus Bar-II.
8. Restoration Time: NJ-Pkl-1 restored at 07:40 Hrs.
NJ-Rampur-1 restored at 08:21 Hrs.
NJ-KW-1 restored at 17:04 Hrs due to problem at Karcham Wangtoo end.
9. Remarks (If any): After initial investigation, it appears Mal operation of High Impedance based Bus Bar Differential relay & reason for malfunctioning is still under investigation with us.
The matter has been also discussed with OEM of Bus Bar Relay (M/s GE T&D India Ltd) for Maloperation of bus bar relay based on high impedance principle as line faults should not operate Bus Bar relay. We are planning to depute their engineers to site as soon as we will get the complete Shutdown on double bus system from NRPC to make the high impedance scheme working as per protection philosophy.

DR details of 400 kV Jhakri (end)-Karcham-1



Y-B phase to phase fault in 400 kV Jhakri-Karcham ckt-1

DR details of 400 kV Bus-1 of Jhakri HEP



In antecedent, current was around 1400-1500 Ampere
Issue of Phase mapping in DR

13. Preliminary Report and DR/EL details received but detailed report along with remedial measures is still awaited from NJPC.

Points for Discussion:

1. Mal-operation of high impedance bus bar protection at 400 kV Jhakri HEP needs to be looked into.

2. Availability of SCADA analog and digital data of Jhakri HEP needs to be ensured.
3. Detailed Report and Remedial measures report is still awaited from Jhakri

NJPC 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.

D. Multiple Element tripping at 400/220kV Muradnagar (UP) Station at 12:49hrs of 07th Feb 2019

Event category: GD-1

Generation loss: Nil (As per UP report)

Loss of load: 375 MW (As per UP report)

Energy load: 0.468 MU (UP may confirm)

Data Summary received/available at NRLDC:

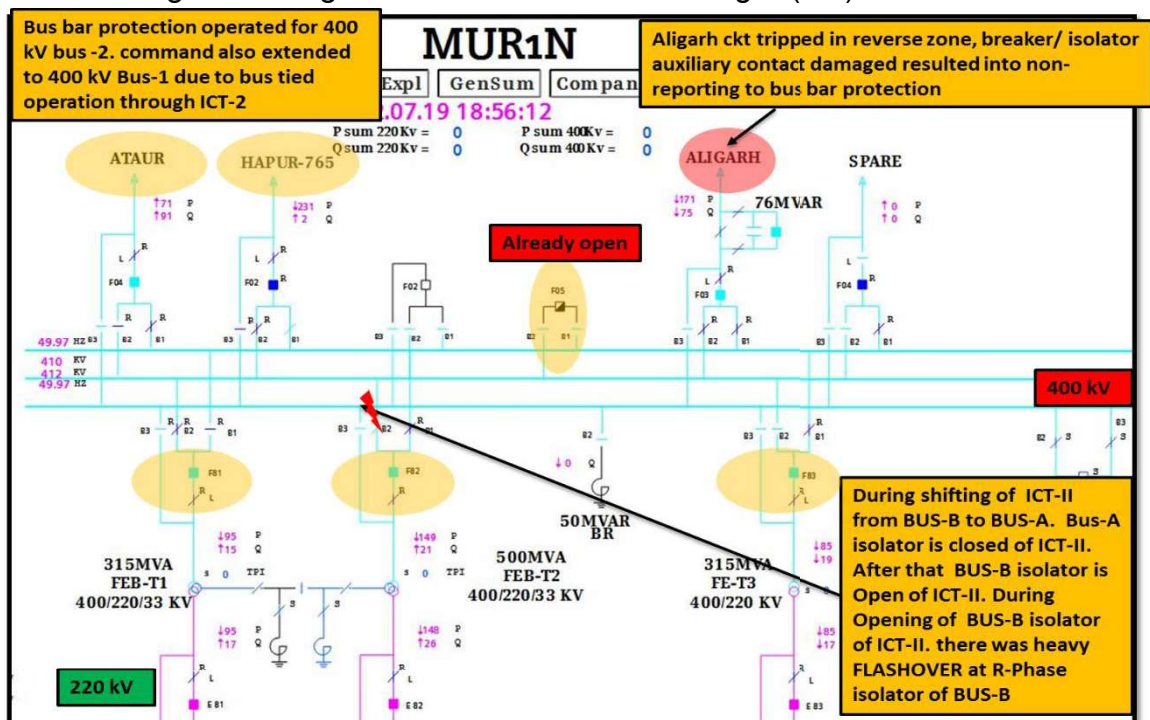
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	480ms	
Phase of the fault	PMU data	R-phase to earth fault	

Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	
DR/EL	Uttar Pradesh	Received	After 24hrs
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, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2 4. CEA Grid Standard 2010-3.e & CEA Transmission Planning Criteria	Uttar Pradesh	1. DR/EL within 24hrs 2. Detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system 4. Delayed clearance of Fault

Based on above information description of the events is:

1. Single line diagram of 400/220 kV Muradnagar (UP):



2. 400/220 kV Muradnagar (UP) station has DMT (double main transfer breaker) scheme. It is connected through Ataur S/C, Aligarh S/C and Hapur S/C. It also has two 315 MVA & one 500MVA 400/220 kV ICTs.
3. 400 kV Aligarh and ICT-II was connected through 400 kV BUS-B & 400 kV Ataur, Hapur, 400/220 kV ICT-I and ICT-III was connected through 400 kV BUS-A of 400/220 kV Muradnagar1 (UP). 400 kV Bus coupler was also under shutdown.
4. During shifting of ICT-II from BUS-B to BUS-A. Bus-A isolator is closed of ICT-II. After that BUS-B isolator is open of ICT-II. During Opening of BUS-B isolator of ICT-II. there was heavy FLASHOVER at R-Phase isolator of BUS-B.
5. Due to FLASHOVER at BUS-B of R-Phase, bus bar protection operated for 400 kV Bus-B of 400 kV Muradnagar 1 (UP) station.
6. Tripping command also extended to all the element connected on Bus-A due to bus tied operation. It further resulted into complete station outage of 400 kV Muradnagar 1 (UP) except 400 kV Muradnagar1-Aligarh ckt.
7. Status (Isolator and breaker) of Aligarh bay not shown on Bus bar relay, due to Bus bar relay contact burnt. 400 kV Muradnagar1 (UP)-Aligarh ckt didn't trip on bus bar protection operation and finally tripped on reverse zone from Muradnagar1 (UP) after 500ms.
8. Non-tripping of 400 kV Muradnagar1 (UP)-Aligarh ckt on bus bar protection resulted into delayed clearance of fault.
9. Fault finally get cleared in 500ms after tripping of 400 kV Muradnagar1 (UP)-Aligarh ckt.
10. Name of the tripped element:
 - 400 kV Bus A & B at 400/220kV Muradnagar 1 (UP)
 - 400 kV Muradnagar 1 (UP)-Hapur (UP)
 - 400 kV Muradnagar 1 (UP)-Ataur (UP)
 - 315 MVA ICT 1 & 3 at 400/220kV Muradnagar 1 (UP)
 - 500 MVA ICT 2 at 400/220kV Muradnagar 1 (UP)
 - 220kV Muradnagar(UP)-Muradnagar II(UP) ckt 1 & 2
 - 220kV Muradnagar(UP)-Sahibabad(UP) ckt 1 & 2
 - 220kV Muradnagar(UP)-Loni(UP)
 - 220kV Muradnagar(UP)-Faridnagar(UP)

11. PMU plots:

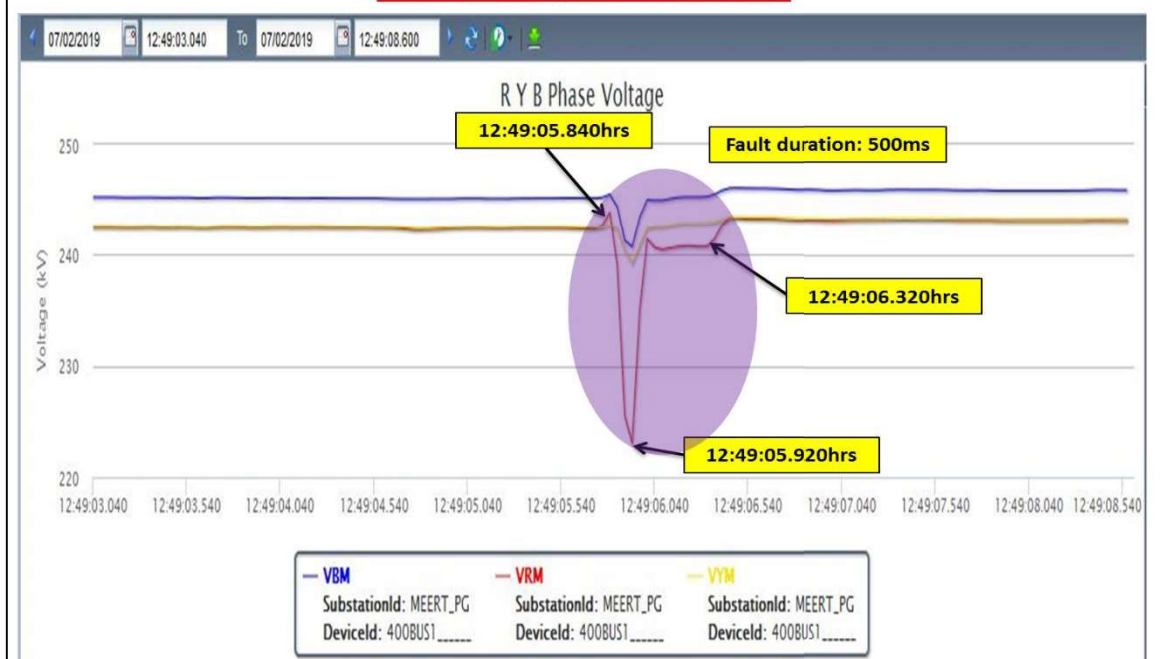
PMU Plot of frequency at Bassi(PG)

12:49hrs/07-Feb-19



PMU Plot of phase voltage magnitude at Meerut(PG)

12:49hrs/07-Feb-19



12. As per PMU data:

- R phase to phase fault occurred at 12:49:05.840hrs and cleared in **480ms**.

13. SCADA data and SoE: SoE captured for all the tripped elements.

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
12:49:05:707	MURADNGR-1	400kV	F_02(MORA1-1)	Circuit Breaker	Open	CB of 400kV Hapur 765(UP)-Muradnagar(UP) opens.
12:49:05:711	MURADNGR-1	400kV	F_81(T1)	Circuit Breaker	Open	400kV side CB of 315 MVA ICT 1 at 400/220kV Muradnagar(UP) opens.
12:49:05:713	MURADNGR-1	400kV	F_83(T3)	Circuit Breaker	Open	400kV side CB of 315 MVA ICT 3 at 400/220kV Muradnagar(UP) opens.
12:49:05:715	MURADNGR-1	400kV	F_82(T2)	Circuit Breaker	Open	400kV side CB of 500 MVA ICT 2 at 400/220kV Muradnagar(UP) opens.
12:49:05:724	MURADNGR-1	220kV	E_82(T2)	Circuit Breaker	Open	220kV side CB of 500 MVA ICT 2 at 400/220kV Muradnagar(UP) opens.
12:49:05:724	MURADNGR-1	400kV	F_01(MUZA1)	Circuit Breaker	disturbe	
12:49:05:732	MURADNGR-1	220kV	E_83(T3)	Circuit Breaker	Open	220kV side CB of 315 MVA ICT 3 at 400/220kV Muradnagar(UP) opens.
12:49:05:737	MURADNGR-1	220kV	E_81(T1)	Circuit Breaker	Open	220kV side CB of 315 MVA ICT 1 at 400/220kV Muradnagar(UP) opens.
12:49:06:173	MURADNGR-1	400kV	F_03(PANK1)	Circuit Breaker	Open	CB of 400kV Aligarh(UP)-Muradnagar(UP) opens.

14. As per UPPTCL details:

Sub: - Report on the Incident of Multiple Tripping at 400 KV S/S Muradnagar.

On 07.02.2019 at 12:49Hrs. following elements tripped at 400KV S/S Muradnagar. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	400KV Muradnagar- Aligarh	07.02.19	Not Charged	G.T,A-N,Z-3,dist.-1.08km., 86A, 86B
2.	400KV Muradnagar- Hapur	07.02.19	14:04	86A, 86B
3.	400KV Muradnagar- Aaur	07.02.19	14:21	A,N, Carrier received
4.	315MVA ICT – I (400/220KV)	07.02.19	15:00	Busbar protection
5.	315MVA ICT – III(400/220KV)	07.02.19	14:32	-do
6.	500MVA ICT - II(400/220KV)	07.02.19	Not Charged	-do-

Generation Loss = NIL
Load Loss = 375MW Approx.

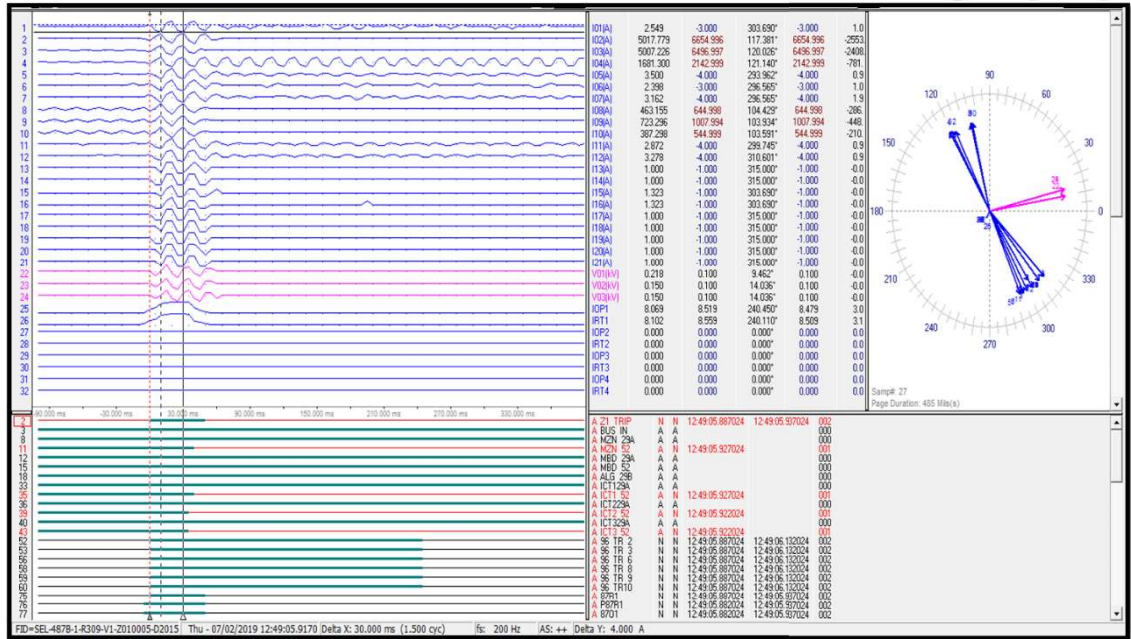
As per the information provided by UPPTCL, while working on 400KV bus coupler at 400KV S/S Muradnagar, 400KV busbar protection operated. It led to the tripping of above mentioned 400KV lines and ICTs (400/220KV).

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

S. NO.	Tripping Date/Time	Closing Date/Time	Name of Substation	C.B. No. with Direction (Code)	Type of Relay Scheme	Flags & Indications Observed	F/L (KM)	Analysis
1	2	3	4	5	6	7	8	9
1	07.02.2019 shut down	07.02.2019 shut down	400 KV MDR-I	T-95 400KV BUS- COUPLER. 12:49:05 (Bus bar operated)	SEL-487 BUS-BAR (R- PHASE)	12:49:05 (Bus bar operated). CP:-Bus-Bar Zone-1 optd Bus Tied. RP:-Trip, 87 (Diff. R Phase), 87 BTR, Zone-1, 96TR2 = Ataur Close at 14:21 96TR3 = Hapur Close at 14:04 96TR6 = 400 kV Bus Coupler Shut down 96TR8 = 400KV ICT-I Close at 15:00 96TR9 = 400KV ICT-II Close at 16:43 96TR10 = 400KV ICT-III Close at 14:32		1. 400 kV Aligarh and ICT-II was feed through 400 kV BUS -B. 2. 400 kV Ataur, Hapur, ICT-I and ICT-III was feed through 400 kV BUS -A. 3-CB-95 (bus coupler) was in shutdown. 4.Status(Isolator and breaker) of Aligarh bay not shown on Bus bar relay, due to Bus bar relay contact burnt. 5. During shifting of ICT-II from BUS-B to BUS-A. Bus-A isolator is closed of ICT-II. After that BUS-B isolator is Open of ICT-II. 6. During Opening of BUS-B isolator of ICT-II. there was heavy FLASHOVER at R-Phase isolator of BUS-B. 7-Due to FLASHOVER at BUS-B, Aligarh bay distance relay Tripped in ZONE-4. 8-Due to FLASHOVER at BUS-B of R-Phase, bus bar operated at differential protection.

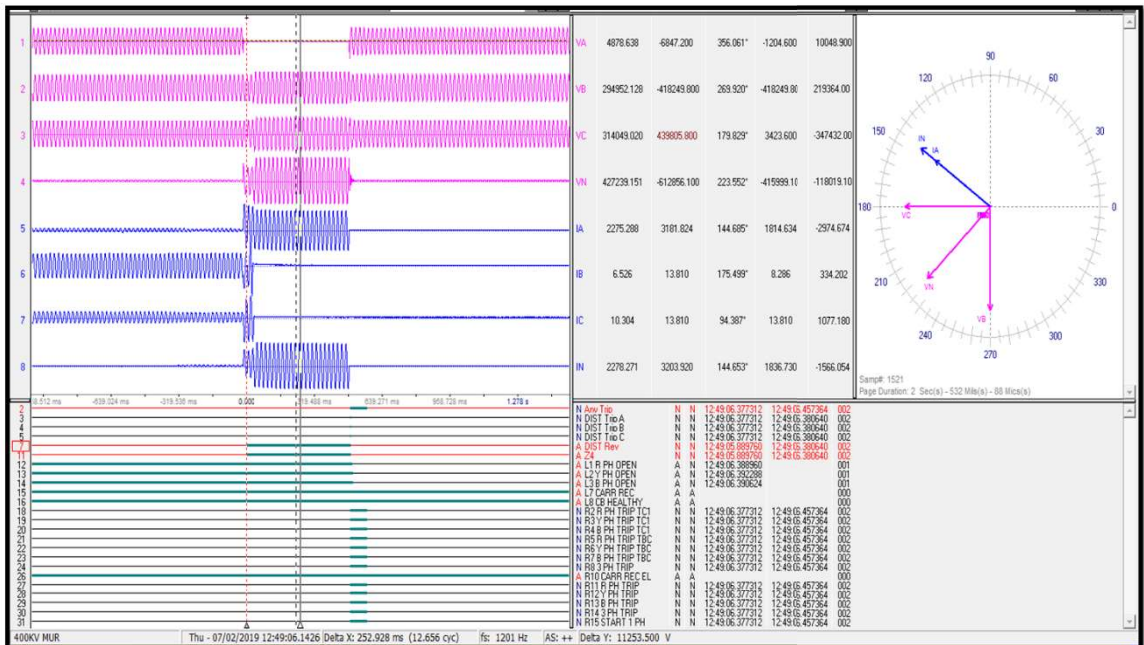
S. NO.	Tripping Date/Time	Closing Date/Time	Name of Substation	C.B. No. with Direction (Code)	Type of Relay Scheme	Flags & Indications Observed	F/L (KM)	Analysis
1	2	3	4	5	6	7	8	9
2	07.02.2019 12:49:05	07.02.2019 14:04	400 KV MURAD NAGAR-I	T-92 HAPUR	MICOM REL-670	CP:- NIL RP: MI=86A MII=86B A/R Panel=Aux BB (Bus-Bar Relay)		
3	07.02.2019 12:49:05	07.02.2019 16:41	400 KV MDR-I	T-93 ALIGARH	SEL-421 MICOM	CP : NILL RP: M1:Trip, A Phase, Ground, Zone-3 (Reverse), 86A, 86B, 86C, 86T, 86T1 IA=2268A, IB=2A, IC=2A, IG=2270A VA=4KV, VB=294KV, VC=313KV Main-2:Trip, A-Phase trip, Zone-4, 86A, 86B, 86C, ARLO VA=12.55KV, VB=242.2KV, VC=250.9 KV IA=2.43KA, IB=315.6A, IC=847.1A	-1.08 -6.697	

DR of 400 kV Bus Bar Protection at Muradnagar (UP)



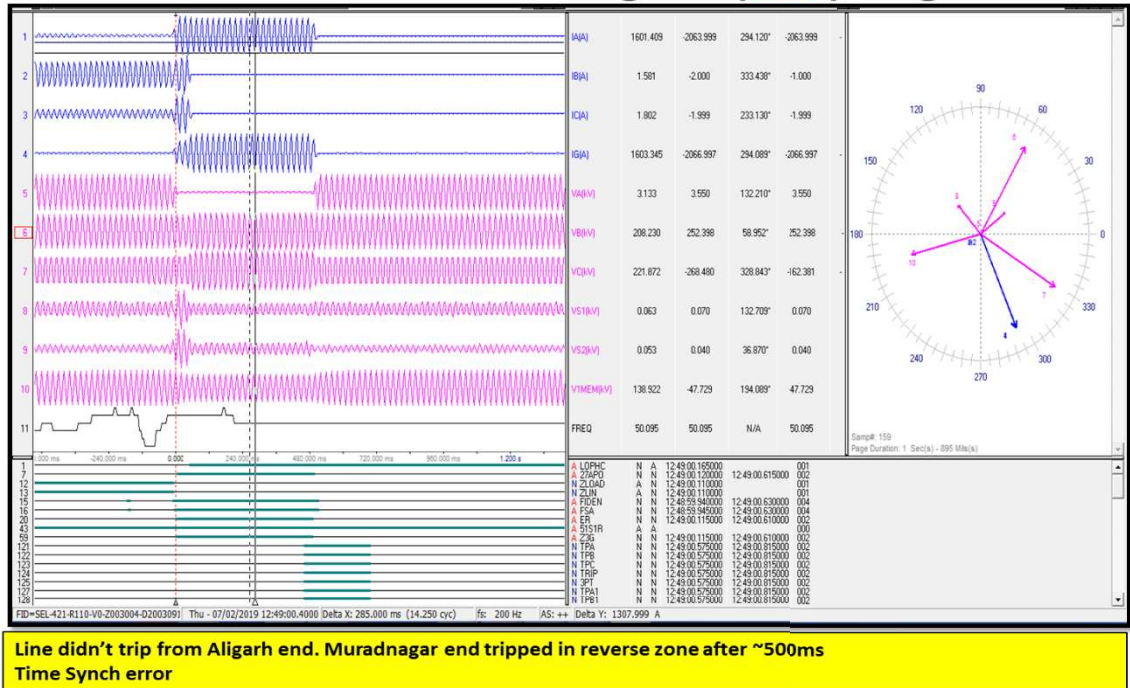
- 400 kV Bus Bar Protection operated for 400 kV Bus-B
- 400 kV Bus-A also operated due to bus tied operation

M1 DR of 400 kV Muradnagar 1 (end)-Aligarh ckt



- Line didn't trip from Aligarh end. Muradnagar end tripped in reverse zone after ~500ms

M2 DR of 400 kV Muradnagar 1 (red)-Aligarh ckt



15. Preliminary Report, DR/EL details received but detailed report along with remedial measures report is still awaited from UPPTCL.

Points for Discussion:

1. Reason of delayed clearance of fault needs to be looked into.
2. 400 kV Bus tied operation at the time of bus fault needs to be looked into.
3. Isolator/ breaker auxiliary contacts to be replaced for 400 kV Aligarh at 400 kV Muradnagar1 (UP)
4. Status of 220 kV elements connected at 400/220 kV Muradnagar1 (UP), is it radially connected if not than reason of zero power flow/ tripping of all the 220 kV connected lines from 400/220 kV Muradnagar1 (UP).
5. Maintenance Procedures need to be followed at the time of maintenance activity at any 400 kV station.
6. Detailed Report and Remedial measures report 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.

E. Multiple element tripping at 400/220kV Rosa TPS (UP) on LBB operation at 21:41hrs on 07-Feb-19

Event category: GD-1

Generation loss: Nil (UP may confirm)

Loss of load: 125MW (UP may confirm)

Energy load: 0.22 MU (UP may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	480ms	
Phase of the fault	PMU data	Blue phase to earth fault	

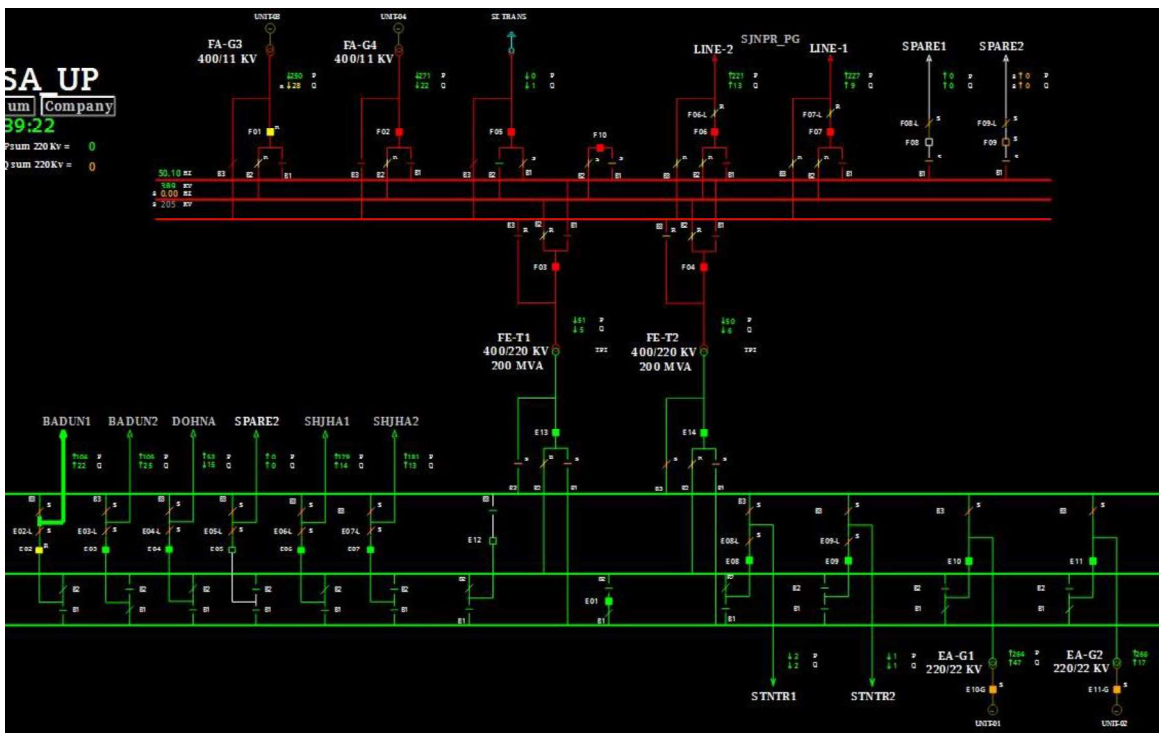
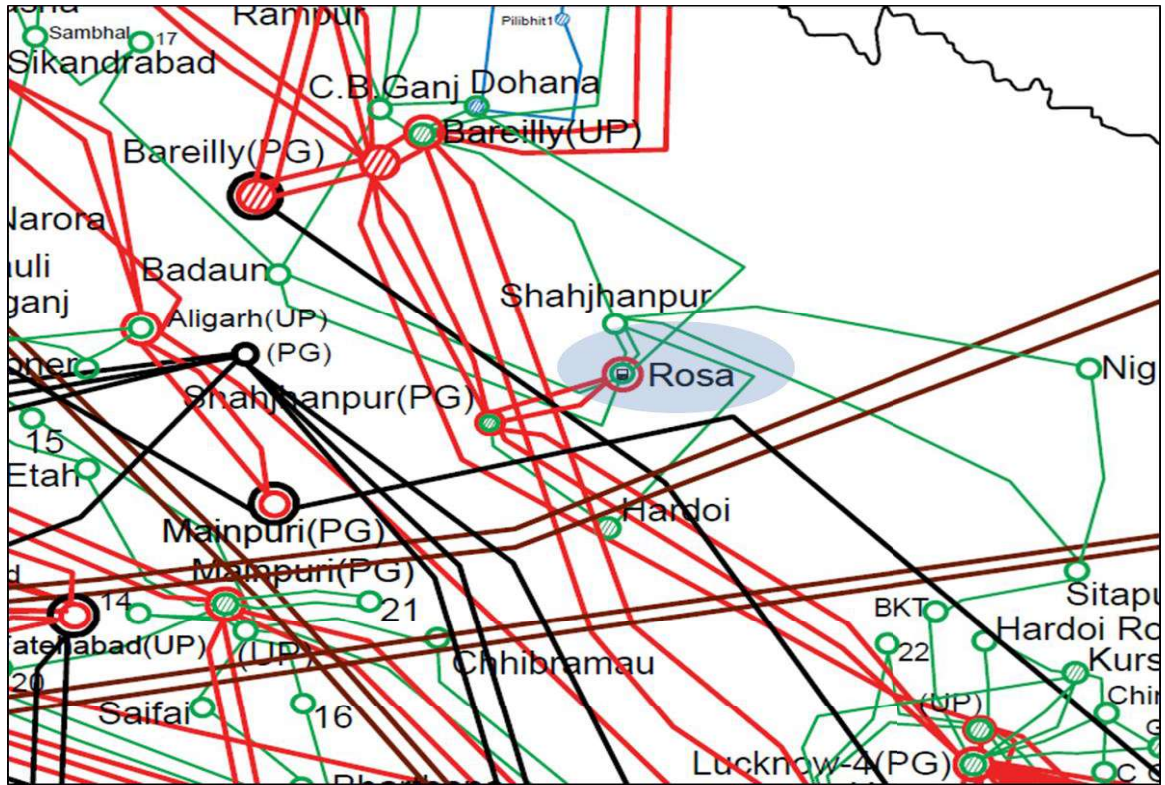
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Not Available	Available only for 220 kV Rosa-Dohna ckt
DR/EL	Uttar Pradesh	Not Received	Only EL details received after 24hrs
Preliminary Report	Uttar Pradesh	Received	Within 24hrs
Detailed Report	Uttar Pradesh	Not Received	

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

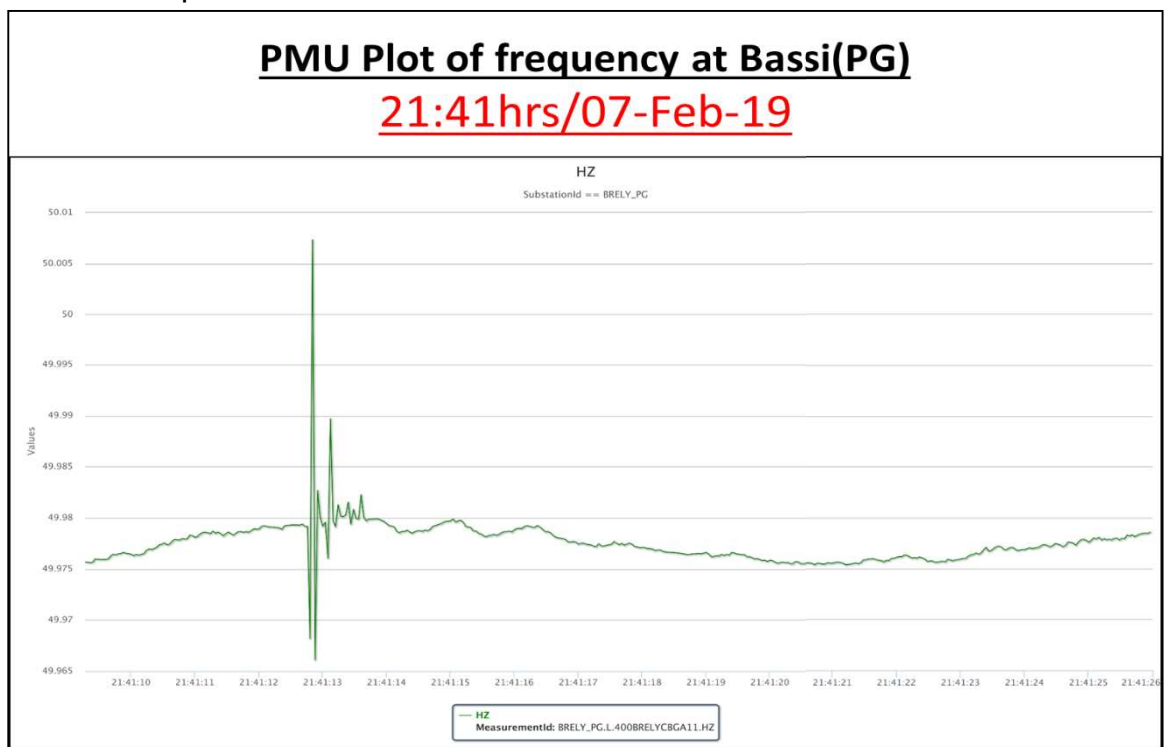
1. Connectivity diagram of 400/220 kV Rosa TPS:



2. In antecedent condition, All the four unit of Rosa were in shutdown condition at the time of fault.
3. At 21:41hrs on 07-Feb-19, B-N fault occurred in 220kV Rosa-Dohna ckt.
4. The CB of aforesaid line failed to open resulted in LBB protection operation.
5. All 220kV connected elements tripped on LBB protection operation.
6. Name of the tripped element and time of normalization is as under:

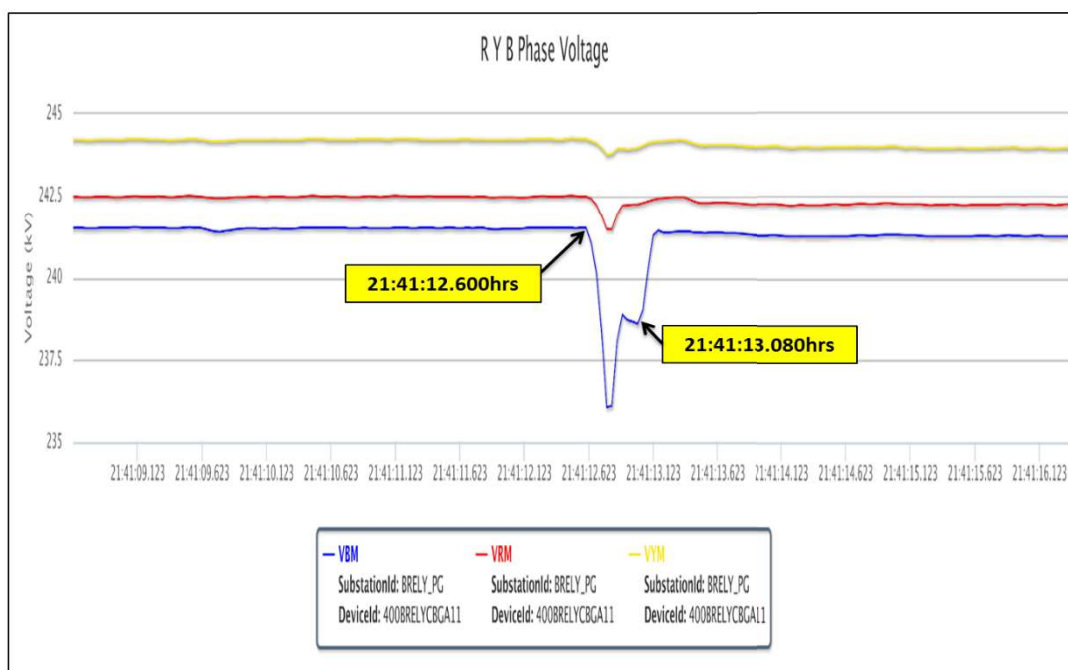
Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	220KV Rosa-Dohna	09.02.19	19:21	B, N, Z-2,;dist.92.99km.
2.	220KV Rosa-Shahjahanpur-I	07.02.19	23:40	220KV Busbar protection operated
3.	220KV Rosa- Shahjahanpur- II	07.02.19	23:39	-do-
4.	220KV Rosa- Badaun – I	07.02.19	23:43	-do-
5.	220KV Rosa- Badaun – II	07.02.19	23:43	-do-
6.	200MVA ICT – I	08.02.19	01:30	-do-
7.	200MVA ICT – II	08.02.19	00:08	-do-

7. PMU plots:



PMU Plot of phase voltage magnitude at Lucknow(PG)

21:41hrs/07-Feb-19



8. SCADA data and SoE:

Time (in hrs)	Station	Voltage (in kV)	Element	Type	Status
21:41:12.918	DOHNA_UP	220	06ROSA	CB	Open

9. As per UP details:

Analysis:-

It has been reported by Rosa TPS that phase to earth fault occurred in 220KV Rosa- Dohna line. Breaker at Rosa TPS did not trip, causing operation of LBB protection of 220 KV bus at Rosa TPS. This led to the tripping of all 220KV lines and 200MVA ICT -I & II on 220KV LBB protection.

Remedial Measures taken/to be taken:-

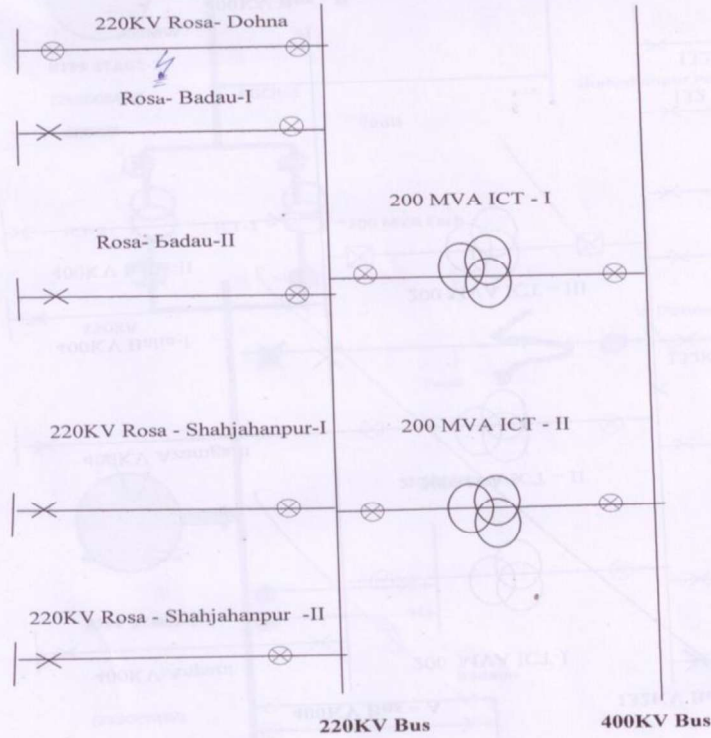
1. Faulty relay of 220KV Dohna feeder at Rosa TPS has been replaced.
2. Relays of other feeder emanating from Rosa TPS may also be checked thoroughly at Rosa TPS.

Report on the Incident of Simultaneous tripping of following Elements at Rosa TPS at 21:45Hrs. on dated 2. 2019 based on the information received from Rosa TPS

Rosa TPS

220KV Bus

400KV Bus



Legends :—

Circuit Breaker Closed	⊗
Circuit Breaker Tripped	⊗
Circuit Breaker Open	⊠

Station Event log: Rosa end

Badaun-1

07/02/19 21:41:13.102	LINE - 2	/CB 2-52	B PH POSITION	OPEN
07/02/19 21:41:13.103	LINE - 2	/CB 2-52	R PH POSITION	OPEN
07/02/19 21:41:13.103	LINE - 2	/CB 2-52	Y PH POSITION	OPEN

Badaun-2

07/02/19 21:41:13.102	LINE - 1	/CB 1-52	Y PH POSITION	OPEN
07/02/19 21:41:13.102	LINE - 1	/CB 1-52	B PH POSITION	OPEN
07/02/19 21:41:13.107	LINE - 1	/CB 1-52	R PH POSITION	OPEN

Shahjahanpur-1

07/02/19 21:41:13.102	LINE - 5	/CB 8-52	R PH POSITION	OPEN
07/02/19 21:41:13.103	LINE - 5	/CB 8-52	B PH POSITION	OPEN
07/02/19 21:41:13.104	LINE - 5	/CB 8-52	Y PH POSITION	OPEN

Shahjahanpur-2

07/02/19 21:41:13.102	LINE - 6	/CB 10-52	B PH POSITION	OPEN
07/02/19 21:41:13.103	LINE - 6	/CB 10-52	Y PH POSITION	OPEN
07/02/19 21:41:13.107	LINE - 6	/CB 10-52	R PH POSITION	OPEN

ICT-1 LV 220KV

19/02/07 21:41:13.106	220kV ICT-1	/CB 212-52	Y PH POSITION	OPEN
19/02/07 21:41:13.107	220kV ICT-1	/CB 212-52	R PH POSITION	OPEN
19/02/07 21:41:13.107	220kV ICT-1	/CB 212-52	B PH POSITION	OPEN

ICT-2 LV 220KV

19/02/07 21:41:13.109	220kV ICT-2	/CB 214-52	R PH POSITION	OPEN
19/02/07 21:41:13.109	220kV ICT-2	/CB 214-52	Y PH POSITION	OPEN
19/02/07 21:41:13.109	220kV ICT-2	/CB 214-52	B PH POSITION	OPEN

10. As per PMU, SCADA SoE and Station EL data:

- a. As per PMU, B-N fault observed at 21:41:12.600hrs.
- b. Fault Clearance time: **480ms**
- c. As per SoE, 220kV Rosa-Dohna tripped from Dohna end at 21:41:12.918hrs.
- d. As per Station EL, all elements tripped around 21:41:13.100hrs.

11. Preliminary Report received within 24hrs from UP. EL and detailed report received after 24hrs from UP. DR still awaited from UP.

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 even surpassing LBB time of 200ms needs to be looked into.
3. Antecedent configuration of feeders on 220kV buses i.e. which feeder/ICT was on which bus to be shared.
4. LBB protection would have tripped elements connected to one bus.

The following may be confirmed:

- a. *Were all 220kV elements connected to one bus only?*
- b. *If not, why elements connected to both buses tripped?*

5. As per SCADA SoE and PMU data, it appears fault cleared from Dohna end after 320ms of occurrence or clock at Dohna end is not time synchronized. In case of former, delayed clearance of fault from Dohna end to be looked into whereas in case of latter, time synchronized SCADA SoE data from Dohna end to be checked and corrected.
6. Availability of time synchronized SCADA SoE from Rosa to be checked and corrected.
7. DR needs to be submitted by UPPTCL.

UP may elaborate the incident in line with above points, present and submit the DR of the tripped elements and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

F. Multiple Element tripping at 400 kV Dadri (NTPC) Station at 09:03hrs of 14th Feb 2019

Event category: GI-2

Generation loss: Nil

Loss of load: Nil (Planned load relief due to SPS operation)

Energy load: Nil

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		80ms	As per PMU data
Phase of the fault		Red phase to earth fault	As per PMU data

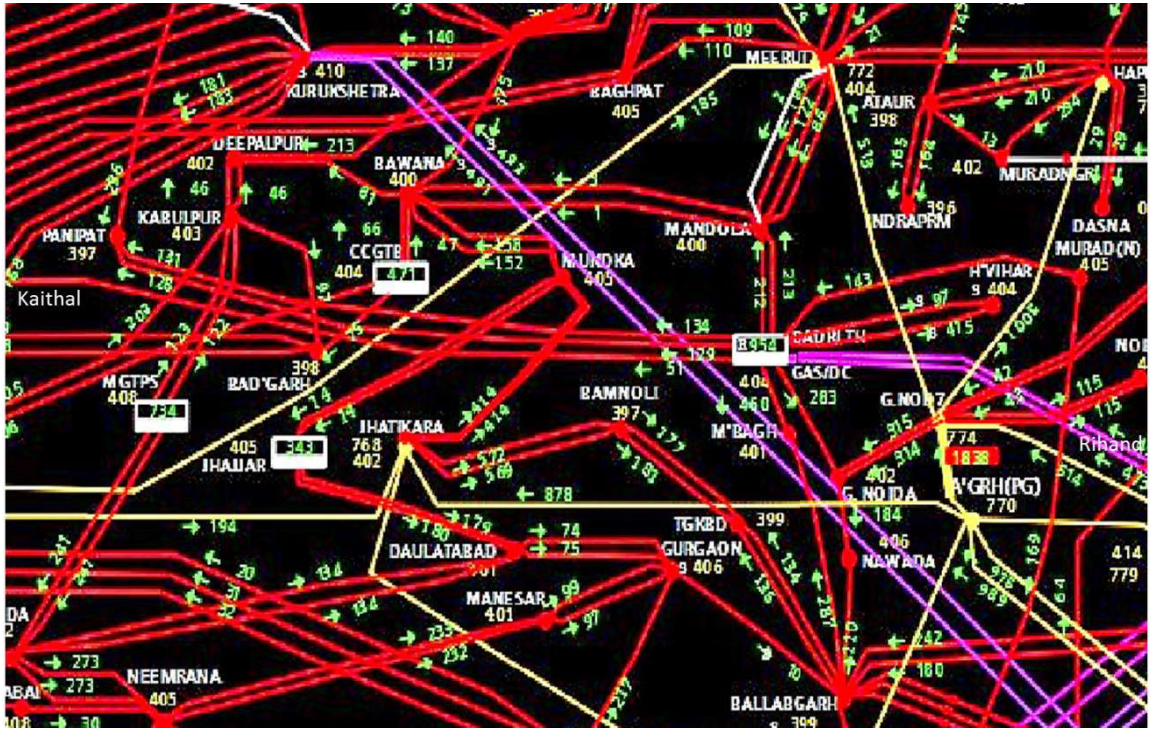
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Received	
DR/ EL	POWERGRID	Partially Received	Within 24hrs
	Delhi	Received	After 24hrs

	NTPC	Not received	
Preliminary Report	POWERGRID	Received	Within 24hrs
	Delhi	Not received	After 24hrs
	NTPC	Not received	
Detailed Report	POWERGRID & NTPC	Not received	

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

Based on above information description of the events is:

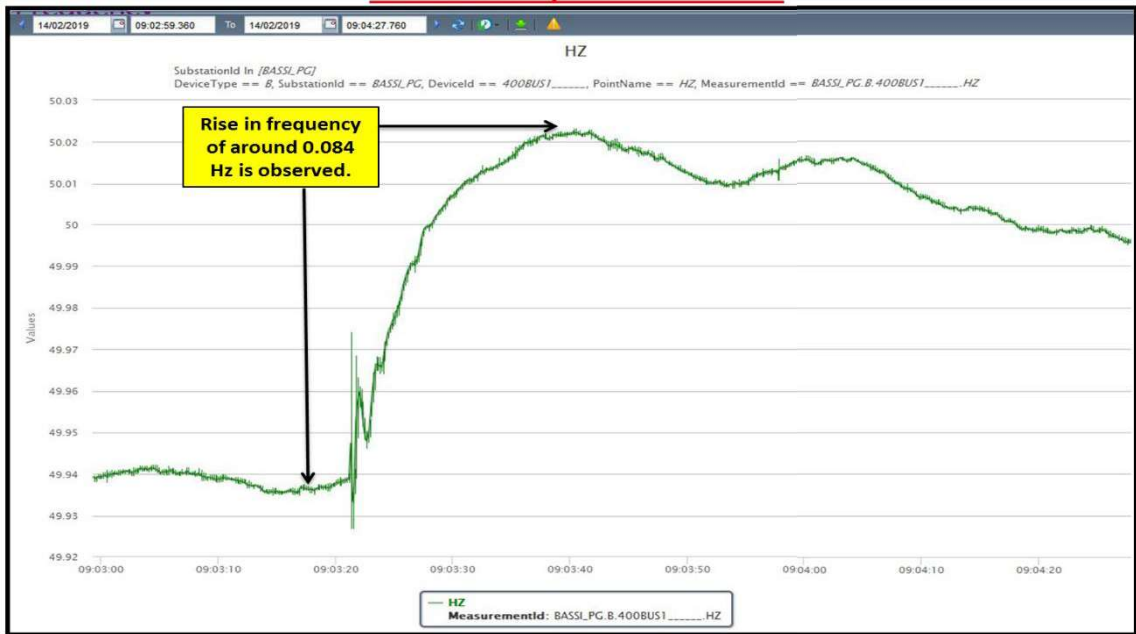
1. Connectivity Diagram of 400 kV Dadri station:



2. 400 kV Dadri station has connectivity through 400 kV Panipat (BBMB) D/C, Harsh Vihar D/C, Mandola D/C, Kaithal S/C, Muradnagar New S/C, Maharani Bagh S/C & G. Noida S/C. It also have one and half breaker scheme.
3. At 09:03hrs, R-N fault occurred in the system. 400 kV Harsh Vihar-Dadri ckt-1 tripped on phase to earth fault without A/R attempt and convertor transformer of HVDC Rihand-Dadri Pole-1 tripped on transformer differential protection and resulted into blocking of HVDC Rihand-Dadri Pole-1.
4. After blocking of Pole-1 power order reduction on HVDC was more than 500MW and less than 750 MW. SPS case-2 of HVDC Rihand-Dadri should have operated and send tripping command to load group A & B
5. As per Rihand end EL (event logger) details, it seems SPS case-1 operated and send the tripping command to all four load group A, B, C & D.
6. Name of the tripped element:
 - 500kV HVDC Rihand-Dadri Pole 1
 - 400kV Dadri(NTPC)-Harsh Vihar(DTL) ckt-1
 - 220kV Palwal(HVPNL)-Samaypur(BBMB) ckt-1 & 2
 - 220kV Gopalpur(DTL)-Mandola(PG) ckt-1 & 2
 - 220kV Mandola(PG)-Narela(DTL) ckt-1 & 2
7. In antecedent conditions, 500kV HVDC Rihand-Dadri Pole 1 carrying 700 MW.
8. PMU plots:

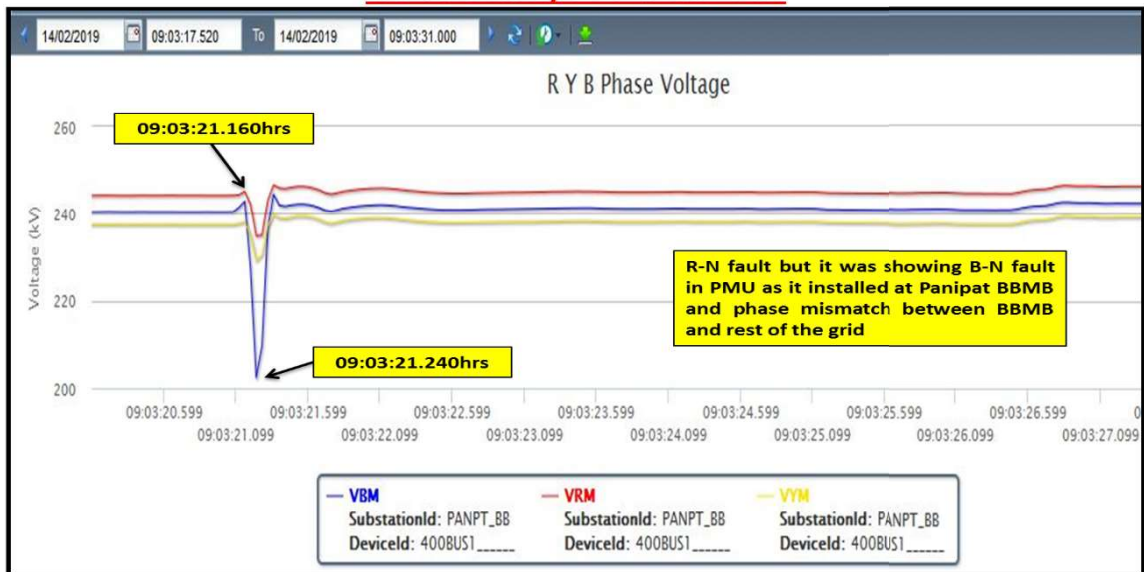
PMU Plot of frequency at Bassi(PG)

09:03hrs/14-Feb-19



PMU Plot of phase voltage magnitude at Panipat (BBMB)

09:03hrs/14-Feb-19



9. As per PMU data:

- R-N fault occurred at 09:03:21.160hrs and cleared in **80ms**.

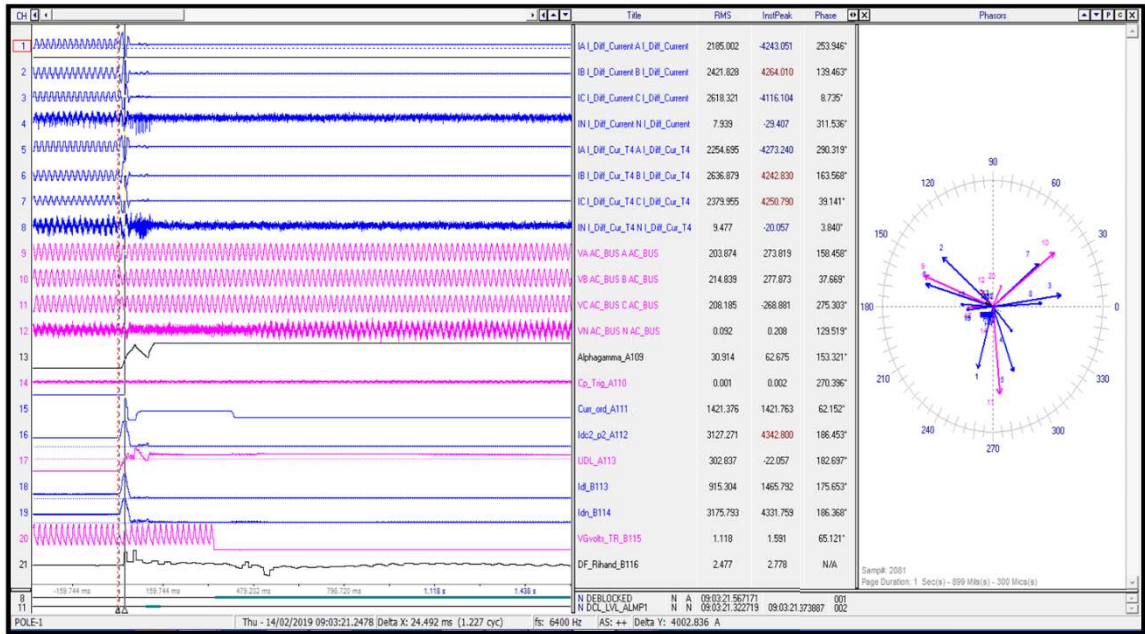
10. SCADA data and SoE: SoE captured in NR SCADA SoE for some of the tripped elements

Time	S/S Name	Reference time	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
09:03:21:160		0ms					PMU reference time
09:03:21:162	HARSH VIHAR	2ms	400kV	F_02(D_THM-1)	CB	disturbe	
09:03:21:214	HARSH VIHAR	55ms	400kV	F_02(D_THM-1)	CB	Open	Main CB of 400kV Dadri-Harsh Vihar ckt-1 opens
		80ms					PMU reference time
09:03:21:280	DADRI HVDC	120ms	400kV	6RHNVH1	CB	Open	Main CB of 500kV HVDC Rihand-Dadri pole I opens.
09:03:21:305	DADRI HVDC	145ms	400kV	5RH1CP2	CB	Open	Tie CB of 500kV HVDC Rihand-Dadri pole I opens.
09:05:47:468	GOPALPUR		33kV	05MBC	CB	Close	
09:06:53:471	NARELA		220kV	E_13(MANDU-2)	CB	Open	
09:07:03:953	NARELA		66kV	C_10(TII)	CB	Close	
09:07:03:956	NARELA		220kV	E_03(DSIDC-1)	CB	Close	
09:07:03:960	NARELA		66kV	C_02(DSIDC-2)	CB	Close	
09:07:03:962	NARELA		66kV	C_04(T4)	CB	Open	
09:07:03:962	NARELA		66kV	C_05(T1)	CB	Close	
09:07:03:962	NARELA		66kV	C_13(T3)	CB	Close	
09:07:03:962	NARELA		66kV	C_01(DSIDC-1)	CB	Close	
09:07:03:962	NARELA		66kV	C_14(JHANG-1)	CB	Close	
09:07:03:962	NARELA		66kV	C_15(JHANG-2)	CB	Close	
09:07:03:963	NARELA		66kV	C_08(T2)	CB	Close	
09:07:03:963	NARELA		66kV	C_09(TI)	CB	Close	
09:07:03:963	NARELA		66kV	C_06(BADLI-1)	CB	Close	
09:07:05:833	NARELA		220kV	E_16(DSIDC-2)	CB	Close	
09:08:58:767	GOPALPUR		66kV	04DMRCL	CB	Open	
09:09:01:664	GOPALPUR		66kV	C_02(JHANG-2)	CB	Close	
09:09:01:665	GOPALPUR		33kV	05MBC	CB	Close	
09:09:01:665	GOPALPUR		66kV	C_03(JHANG-1)	CB	Close	
09:09:01:665	GOPALPUR		33kV	B_09(CIVIL-1)	CB	Close	
09:09:01:666	GOPALPUR		33kV	B_10(DIFR_)	CB	Open	
09:09:01:666	GOPALPUR		33kV	B_02(AZADP-2)	CB	Close	
09:09:01:666	GOPALPUR		33kV	B_03(AZADP-1)	CB	Close	
09:09:01:667	GOPALPUR		33kV	B_04(T5)	CB	Close	
09:09:01:667	GOPALPUR		33kV	B_12(INDRA-1)	CB	Close	
09:09:01:668	GOPALPUR		33kV	B_06(T4)	CB	Close	
09:09:01:670	GOPALPUR		33kV	B_07(INDRA-2)	CB	Close	
09:09:01:716	GOPALPUR		33kV	B_10(DIFR_)	CB	Close	

11. As per POWERGRID details:

1	Date and Time of Occurrence	14.02.2019	09:03:21 hrs
2	Date and Time of Restoration	14.02.2019	12:20:32 hrs
3	Outage Duration	03:17:11 hrs mts sec	
4	Particulars of Tripping: (Relay flags as per Annexure -I and PLCC Counter readings as per Annexure-II)	POLE-1 tripped at 09:03:21 hrs. on 14.02.19 on PROTECTION BLOCK OPERATED FROM DADRI END.	
5	Connection of line/ICT before Occurrence(indicate line/ICT connected to which Bus i.e Bus No.1,2 or Transfer Bus)	Both Pole-1 & Pole-2 were in service at a BPF of 1400 MW in JNT/PWR/SYNC/100% mode. Both 400 kV Bus-A & Bus-B were in service	
6	System Condition immediately before occurrence a. Frequency b. Voltage c. Load MW & MVAR(On each line/ICT) 1 POLE-1 2 POLE-2 d. Whether any line/equipment was under maintenance. e. Whether any protection was bypassed/ not available.	49.95 400 700MW 700MW	No No
7	Tripping sequence(Indicate time of tripping of each feeder)	POLE 1 PROTECTION BLOCK FROM OTHS	
8	Equipment damage, if any	Nil	
9	Sequence of normalization	Normalized from Dadri end.	
10	Reasons for unsuccessful auto-reclosure or auto restart.	NA	
11	Analysis a. Cause of occurrence b. suggestion for improvement	Protection Trip issued from Dadri end.	
12	Any other information	NA	
13	Review of Protection by T&C Engineer	System is in normal condition.	

DR of HVDC Rihand (end)-Dadri Pole-1



EL of HVDC Rihand (end)-Dadri Pole-1

TIME	EVENT	STATUS
14-02-2019 09:03:21.266	20.025 KPP.21, P2 PC, POLE POWER CONTROL ALARM (MONITOR-3)	9475/9507 -MINOR ON
14-02-2019 09:03:21.277	10.104 KPP.11, P1 PC, PPC CURRENT ORDER LIMITED	-MINOR ON
14-02-2019 09:03:21.281	20.104 KPP.21, P2 PC, PPC CURRENT ORDER LIMITED	-MINOR ON
14-02-2019 09:03:21.318	21.016 KPB.21, P2 CC-A CP-A, DC LINE PROT, LEVEL ALARM	10174/10212 -MINOR ON
14-02-2019 09:03:21.319	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910 -MINOR ON
14-02-2019 09:03:21.319	22.016 KPB.24, P2 CC-B CP-A, DC LINE PROT, LEVEL ALARM	10374/10412 -MINOR ON
14-02-2019 09:03:21.325	11.016 KPB.11, P1 CC-A CP-A, DC LINE PROT, LEVEL ALARM	6174/6212 -MINOR ON
14-02-2019 09:03:21.325	12.016 KPB.14, P1 CC-B CP-A, DC LINE PROT, LEVEL ALARM	6374/6412 -MINOR ON
14-02-2019 09:03:21.348	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR OFF
14-02-2019 09:03:21.369	21.016 KPB.21, P2 CC-A CP-A, DC LINE PROT, LEVEL ALARM	10174/10212 -MINOR OFF
14-02-2019 09:03:21.370	22.016 KPB.24, P2 CC-B CP-A, DC LINE PROT, LEVEL ALARM	10374/10412 -MINOR OFF
14-02-2019 09:03:21.375	11.016 KPB.11, P1 CC-A CP-A, DC LINE PROT, LEVEL ALARM	6174/6212 -MINOR OFF
14-02-2019 09:03:21.375	12.016 KPB.14, P1 CC-B CP-A, DC LINE PROT, LEVEL ALARM	6374/6412 -MINOR OFF
14-02-2019 09:03:21.399	20.025 KPP.21, P2 PC, POLE POWER CONTROL ALARM (MONITOR-3)	9475/9507 -MINOR OFF
14-02-2019 09:03:21.458	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910 -MINOR ON
14-02-2019 09:03:21.515	10.090 KPP.11, POLE 1 PROT BLOCK FROM OTHS	5490/5562 -EMERGN ON
14-02-2019 09:03:21.569	41.141 BLOCK INDICATION POLE-1	-EMERGN ON
14-02-2019 09:03:21.570	41.142 DEBLOCK INDICATION POLE-1	-RESET
14-02-2019 09:03:21.603	10.090 KPP.11, POLE 1 PROT BLOCK FROM OTHS	5490/5562 -EMERGN OFF
14-02-2019 09:03:21.655	30.054 KB.12, BC-A, MINIMUM FILTER ALARM	4512.6/3432 -MINOR OFF
14-02-2019 09:03:21.697	31.047 NR GRID SPECIAL PROTECTION SCHEME CASE-1 EXECUTED	-EMERGN ON
14-02-2019 09:03:21.750	30.066 KB.13, BC-B, MINIMUM FILTER ALARM	4512.8/3532 -MINOR OFF
14-02-2019 09:03:22.317	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910 -MINOR OFF
14-02-2019 09:03:22.389	20.025 KPP.21, P2 PC, POLE POWER CONTROL ALARM (MONITOR-3)	9475/9507 -MINOR ON
14-02-2019 09:03:22.445	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910 -MINOR OFF
14-02-2019 09:03:22.688	31.047 NR GRID SPECIAL PROTECTION SCHEME CASE-1 EXECUTED	-EMERGN OFF
14-02-2019 09:03:23.278	41.093 P1.WL1.D POLE BUS DISCONNECTOR CLOSED	-RESET
14-02-2019 09:03:24.284	20.081 KPP.21, P2 PC, IO PPC IS NOT EQUAL TO IO COM	9487/9506 -MINOR ON
14-02-2019 09:03:25.267	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR ON
14-02-2019 09:03:25.269	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR OFF
14-02-2019 09:03:25.270	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR ON
14-02-2019 09:03:25.271	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR OFF
14-02-2019 09:03:25.273	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR ON
14-02-2019 09:03:25.274	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933 -MINOR OFF

EL of HVDC Rihand (end)-Dadri Pole-1

TIME	EVENT		
14-02-2019 09:03:25.275	52.038 RAA.21, ACFP, A.Z22 UNBAL PROT, START DELAY TRIP	2064/1933	-MINOR ON
14-02-2019 09:03:28.789	41.094 P1.WL1.D POLE BUS DISCONNECTOR OPENED		-SET
14-02-2019 09:03:28.825	20.048 RPB.21, P2 OSR, SMOOTHING REACTOR COOLER GROUP FAILURE	9480/12356	-MINOR ON
14-02-2019 09:03:28.834	20.048 RPB.21, P2 OSR, SMOOTHING REACTOR COOLER GROUP FAILURE	9480/12356	-MINOR OFF
14-02-2019 09:03:28.908	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910	-MINOR ON
14-02-2019 09:03:28.929	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR ON
14-02-2019 09:03:29.300	20.081 KPP.21, P2 PC, IO PPC IS NOT EQUAL TO IO COM	9487/9506	-MINOR OFF
14-02-2019 09:03:29.907	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910	-MINOR OFF
14-02-2019 09:03:29.917	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR OFF
14-02-2019 09:03:34.024	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR ON
14-02-2019 09:03:35.330	20.085 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA21 MINOR ALARM	9490/9910	-MINOR ON
14-02-2019 09:03:36.352	20.085 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA21 MINOR ALARM	9490/9910	-MINOR OFF
14-02-2019 09:03:37.377	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR OFF
14-02-2019 09:03:41.422	10.025 KPP.11, P1 PC, POLE POWER CONTROL ALARM (MONITOR-3)	5475/5507	-MINOR ON
14-02-2019 09:03:44.656	10.085 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA11 MINOR ALARM	5490/5910	-MINOR ON
14-02-2019 09:03:45.635	10.085 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA11 MINOR ALARM	5490/5910	-MINOR OFF
14-02-2019 09:03:51.615	10.104 KPP.11, P1 PC, PPC CURRENT ORDER LIMITED		-MINOR OFF
14-02-2019 09:04:04.631	41.075 P1.WL2.Q NEUTRAL BUS BREAKER CLOSED		-RESET
14-02-2019 09:04:04.675	41.076 P1.WL2.Q NEUTRAL BUS BREAKER OPENED		-SET
14-02-2019 09:04:04.882	10.062 KPD.11, MCI, P1.WL2.Q BREAKER ALARM	5486/6620	-MINOR ON
14-02-2019 09:04:09.889	41.079 P1.WL2.D2 METALLIC RETURN SWITCH CLOSED		-RESET
14-02-2019 09:04:12.763	41.080 P1.WL2.D2 METALLIC RETURN SWITCH OPENED		-SET
14-02-2019 09:04:15.110	10.062 KPD.11, MCI, P1.WL2.Q BREAKER ALARM	5486/6620	-MINOR OFF
14-02-2019 09:04:19.813	41.077 P1.WL2.D1 GROUND RETURN SWITCH CLOSED		-RESET
14-02-2019 09:04:22.711	41.078 P1.WL2.D1 GROUND RETURN SWITCH OPENED		-SET
14-02-2019 09:04:40.092	30.066 KB.13, BC-B, MINIMUM FILTER ALARM	4512.8/3532	-MINOR OFF -Ack
14-02-2019 09:04:40.092	30.054 KB.12, BC-A, MINIMUM FILTER ALARM	4512.6/3432	-MINOR OFF -Ack
14-02-2019 09:04:40.092	41.141 BLOCK INDICATION POLE-1		-EMERGN ON -Ack
14-02-2019 09:04:40.092	10.025 KPP.11, P1 PC, POLE POWER CONTROL ALARM (MONITOR-3)	5475/5507	-MINOR ON -Ack
14-02-2019 09:04:40.092	20.104 KPP.21, P2 PC, PPC CURRENT ORDER LIMITED		-MINOR ON -Ack
14-02-2019 09:04:40.467	10.087 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA.11 TRIGGERED	5487/5910	-MINOR OFF -Ack
14-02-2019 09:04:40.467	10.104 KPP.11, P1 PC, PPC CURRENT ORDER LIMITED		-MINOR OFF -Ack
14-02-2019 09:04:40.467	10.085 MA.11, P1 TFR, TRANSIENT FAULT RECORDER MA11 MINOR ALARM	5490/5910	-MINOR OFF -Ack
14-02-2019 09:04:40.467	20.087 MA.21, P2 TFR, TRANSIENT FAULT RECORDER MA.21 TRIGGERED	9490/9910	-MINOR OFF -Ack

12.Planned SPs information:

Ref No: SPS/NR/LINE/04

SPS for 1500 MW HVDC Rihand-Dadri bipole related contingency

The 1500 MW HVDC Rihand-Dadri Bipole is the major high capacity link between the pit head generating stations in south – east part of northern region (NR) and the load centres in the central and western part of NR. Outage of this high capacity link results in overloading of the parallel AC network. In order to take care of any contingency due to outage of this high capacity link, scheme has been developed to carry out the automatic backing down of generation at the sending end and load shedding at the receiving end. For the purpose of load shedding the loads have been distributed in different groups say group- A, B, C & D.

Details of the corrective action logic for different cases are as explained below.

SPS Scheme logic:

Case-1

Contingency: Tripping of any or both poles resulting in power order reduction by 750 MW and above.

Action 1: Immediately Shed Loads in Groups A, B, C & D. (Fig 1 Load Details)

And

Action 2: Reduce generation at Singrauli/Rihand by 500 MW in the fastest possible time

And

Action 3: Ramp down the power flow from West to North by 100 MW (variable) at Vindhyachal HVDC station at the maximum ramp rate possible (300MW/Sec)

Case-2

Contingency: Tripping of any or both poles resulting in power order reduction above 500MW but less than 750MW

Action 1: Immediately Shed Loads in Groups C & D. (Fig 1 Load Details)

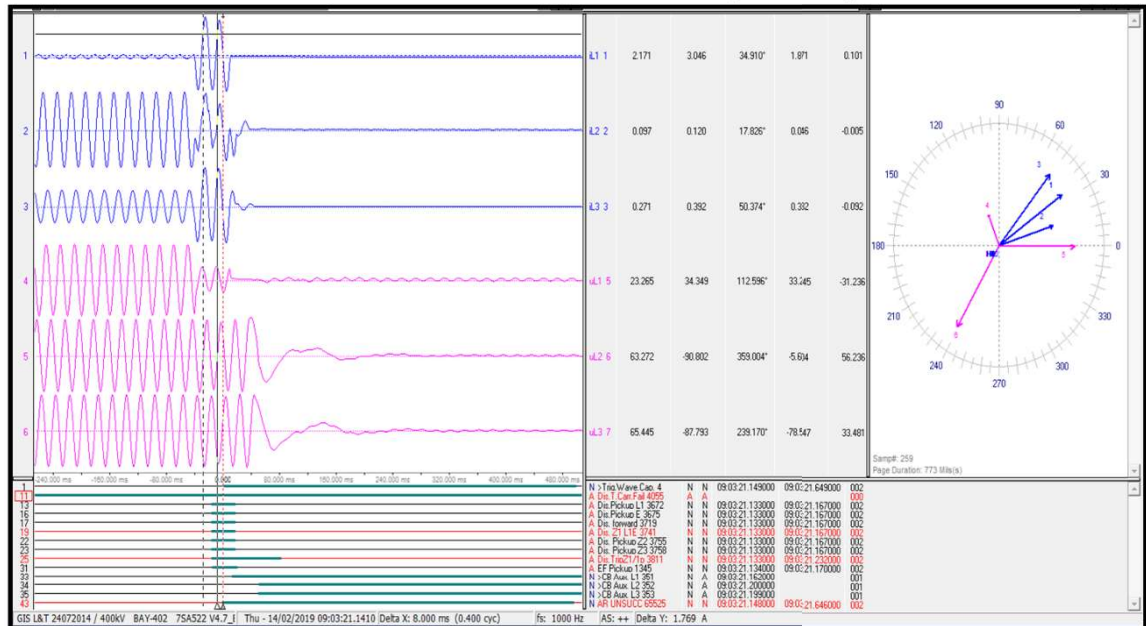
And

Action 2: Ramp down the power flow from West to North by 100 MW (variable) to Northern Region through HVDC back-to-back stations at Vindhyachal at the maximum ramp rate possible (300 MW/Sec).

Load Shedding shall be achieved within 500ms, including all signal propagation/breaker opening time delay

13. As per Delhi details:

DR of 400 kV Harsh Vihar (end)-Dadri ckt



- Line tripped in Z-1 without A/R attempt
- Communication channel failed

14. Preliminary Report received from PG-NR3, fault was at Dadri end however details are still awaited from PG-NR1.
15. DR details received from Harsh vihar end but details are still awaited.

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. Is it actual fault in HVDC convertor transformer or mal-operation of differential protection during line fault in 400 kV Dadri-Harsh Vihar ckt-1. (POWERGRID kindly check)
3. In case of actual fault in convertor transformer, reason of tripping of 400 kV Dadri-Harsh Vihar (end) ckt-1 in distance Z-1 protection. (Delhi kindly check)
4. Non auto-reclosing of 400 kV Dadri-Harsh Vihar (end) ckt-1 needs to be looked into.
5. Reason of operation of Case-1 of HVDC Rihand-Dadri SPS instead of Case-2 needs to be checked and corrected
6. Detailed Report and Remedial measures report is still awaited from POWERGRID & NTPC.

POWERGRID/ NTPC 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. 400kV Bus-3 tripping at 400/220kV Ballabgarh(PG) at 10:03hrs of 25-Feb-2019

Event category: GI-2

Generation loss: Nil

Loss of load: Nil

Energy load: Nil

Data Summary received/available at NRLDC:

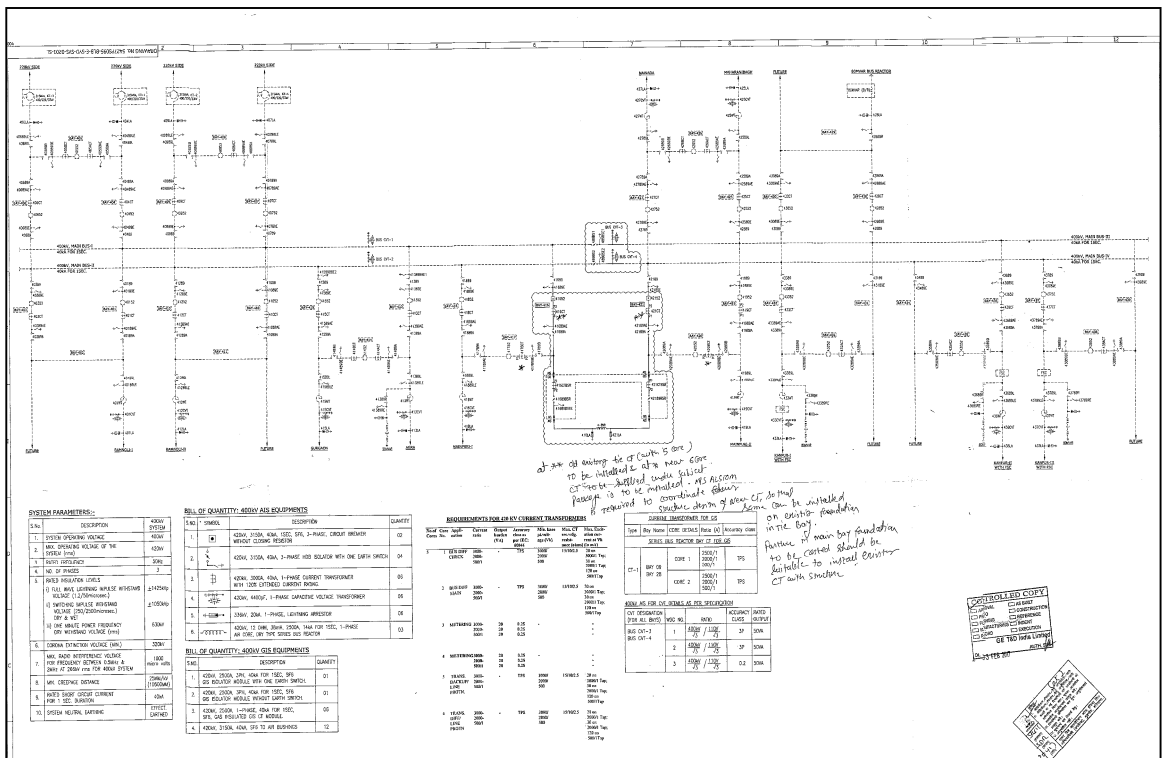
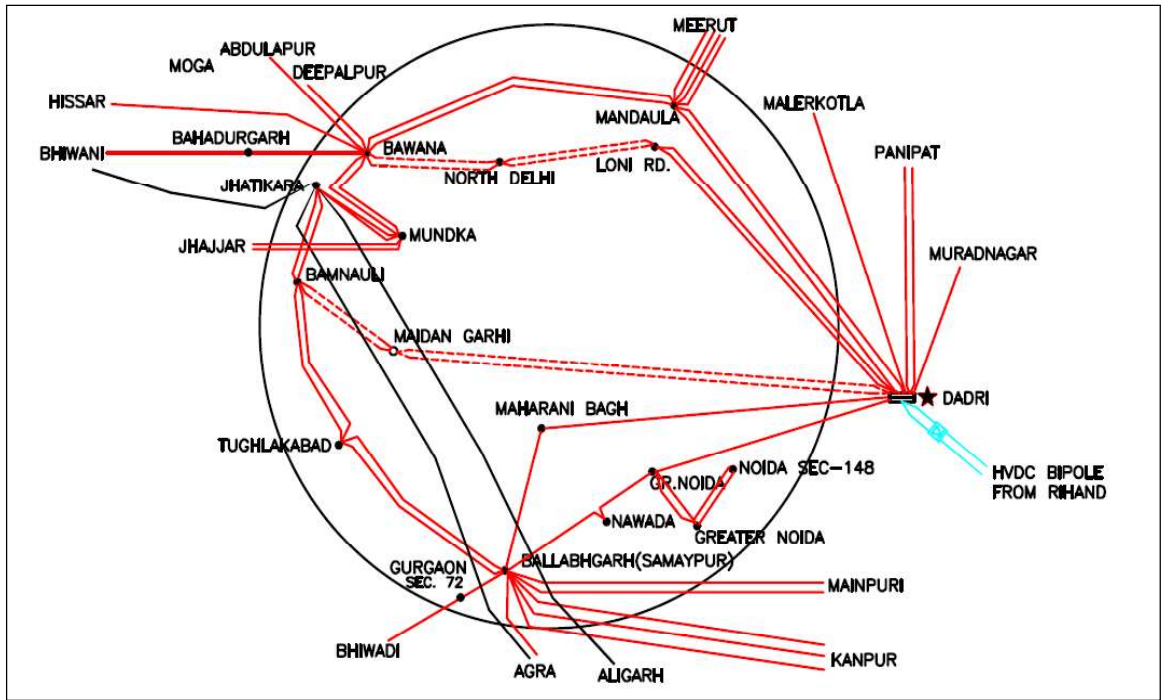
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	80ms	As per PMU data
Phase of the fault	PMU data	R-N fault	As per PMU data

Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	POWERGRID	Available	Partial data
DR/EL	POWERGRID	Received (after 24hrs)	DR/EL received partially
Preliminary Report	POWERGRID	Received (after 24hrs)	
Detailed Report	POWERGRID	Not Received	

Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	POWERGRID	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received

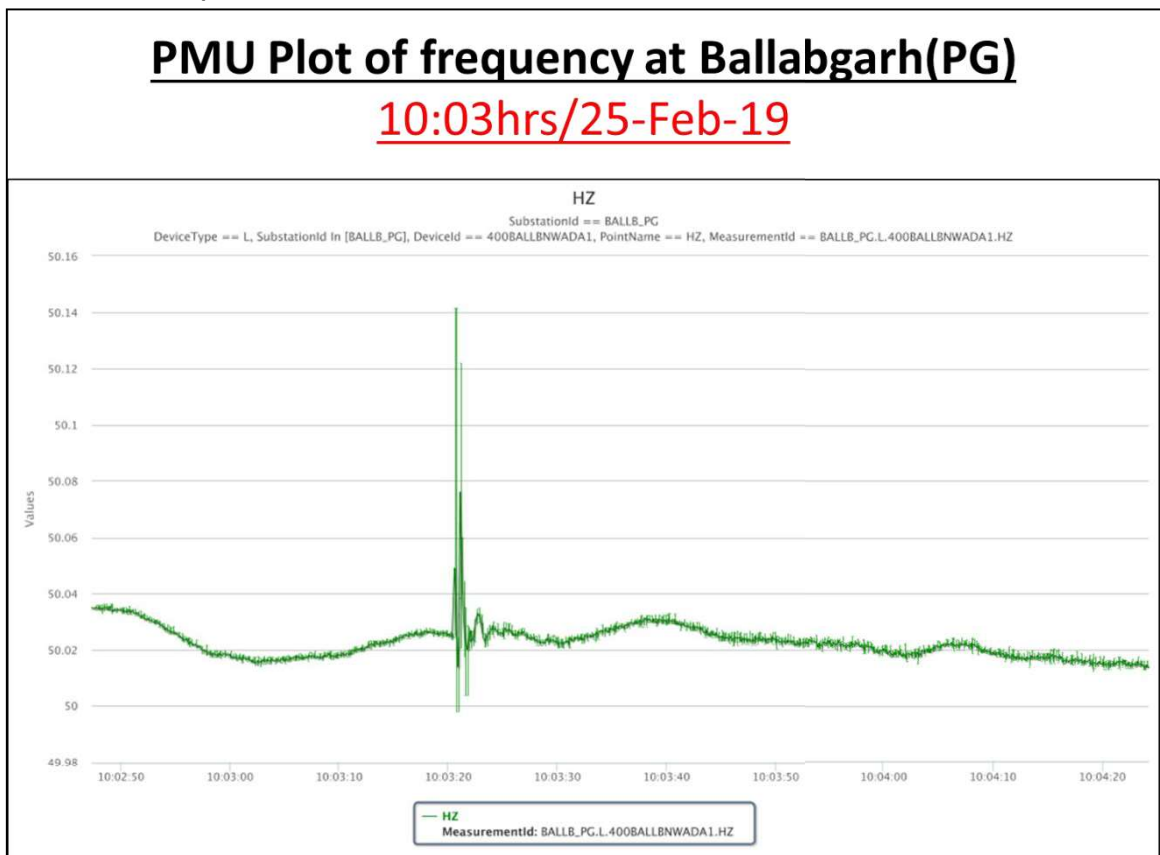
Based on above information description of the events is:

17. Connectivity diagram of Ballabgarh(PG):



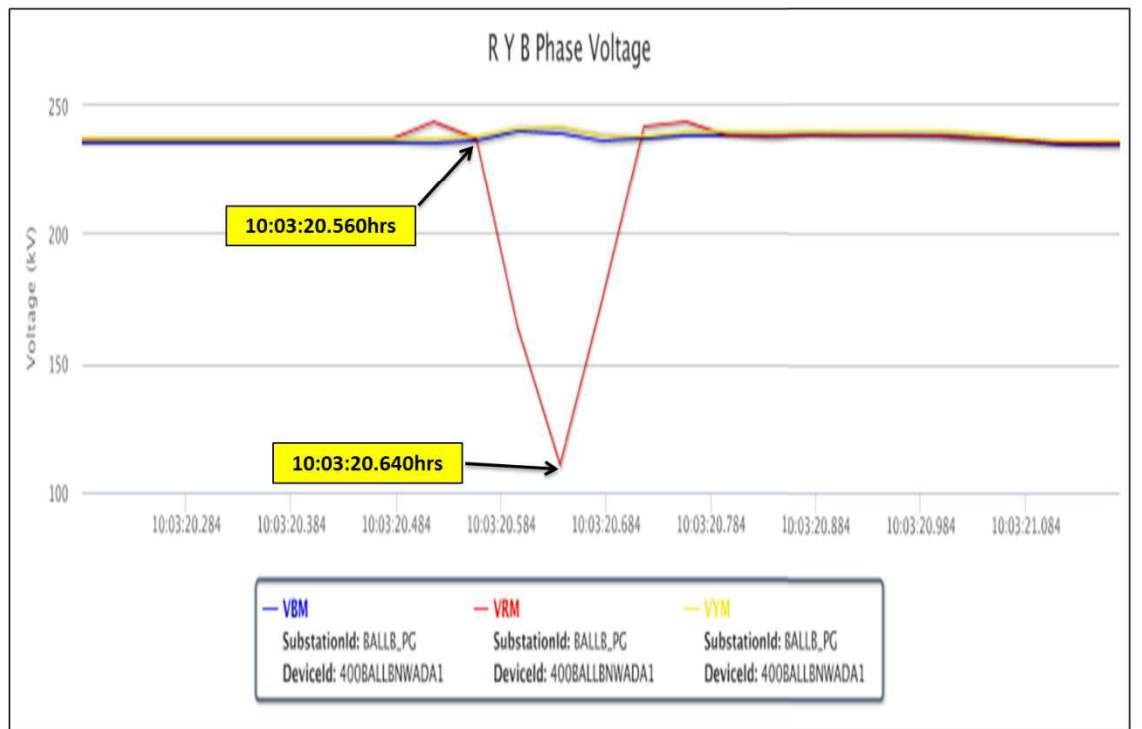
18.400/220kV Ballabghar(PG) is connected at 400kV through Kanpur(PG) 3 ckts (with FSC), Maharani Bagh(PG), Nawada(HVPNL), Mainpuri(PG) D/C, Agra(PG), Gurgaon(PG) and Tughlaqabad(PG) D/C. It has one and a half breaker bus bar scheme. Recently, a series reactor has also been installed between bus-1 and bus-4. There are a total of 4 buses wherein two have sectionaliser isolator which is kept open during normal operation.

19. In antecedent conditions, Shutdown for 400kV Bus-4 was scheduled at Ballabgarh sub-station for RTV coating work on Bus BPIs & insulator replacement work.
20. After opening of all breakers & bus isolators pertaining to Bus-4, Bus earth switch was to be closed for further maintenance. In an inadvertent error, operator closed BUS-3 (in service) instead of BUS-4. The Bus-3 being charged in condition resulted in live bus fault bus bar operation resulting in isolation of Bus-3 and Bus-1 (coupled by series reactor) as per scheme.
21. Name of the tripped element:
- 400kV Ballabgarh-Kanpur 3 ckts
 - 400kV Ballabgarh-Mainpuri-2
 - 80MVAR bus reactor
22. PMU plots:



PMU Plot of voltage magnitude at Ballabgarh(PG)

10:03hrs/25-Feb-19



23. NR SCADA SoE:

Time	Station	Voltage	Element	Device	Status	Remarks
10:03:20,644	KANPUR	400kV	17BALLB1	CB	Open	Main CB of Ballabgarh-1
10:03:20,672	KANPUR	400kV	13AU2BA2	CB	Open	Tie CB of Ballabagarh-2 /Auraiya-2
10:03:20,916	MAINPURI	400kV	13BALLB2	CB	Open	Main CB of Ballabgarh-2
10:03:20,917	MAINPURI	400kV	14BL2TIE	CB	Open	Tie CB of Ballabagarh-2

24. As per POWERGRID details:

POWERGRID Detailed Report

1. Shutdown for 400kV Bus-4 was scheduled at Ballabgarh sub-station for RTV coating work on Bus BPIs & insulator replacement work. Shutdown was taken as per following sequence:

Sl No.	Time stamp	Event
1	09:34:59.378	Series Reactor CB # 42152 opened manually
2	09:35:18.583	Nawada CB # 42752 opened manually
3	09:35:56.891	BR Tie CB # 42952 opened manually
4	09:36:52.351	Kanpur-1 CB # 43352 opened manually
5	09:37:16.441	Kanpur-2 CB # 43652 opened manually
6	09:37:48.989	Kanpur-3 CB # 43752 opened manually
7	09:39:45.584	Mainpuri-2 – Series Reactor isolator # 42189 opened
8	09:39:48.166	Series Reactor Bay Isolator 42189 opened
9	09:41:00.081	Kanpur-3 Bay Isolator 89 opened
10	09:42:16.294	Kanpur-2 Bay Isolator 89 opened
11	09:43:56.306	Nawada Bay Isolator 89 opened
12	09:48:51.042	Future Isolator 43089 opened
13	09:51:31.001	Kanpur-1 Isolator 89 opened
15		Bus-3 sectionalizer ES closed
17	10:03:23.358	BusBar protection BB-1/3 zone-1 operated

2. After opening of all breakers & bus isolators pertaining to Bus-4, Bus earth switch was to be closed for further maintenance. In an inadvertent error, operator closed **BUS-3 (in service) instead of BUS-4**. The Bus-3 being charged in condition resulted in live bus fault and correct bus bar operation resulting in isolation of Bus-3 and Bus-1 (coupled by series reactor) as per scheme.

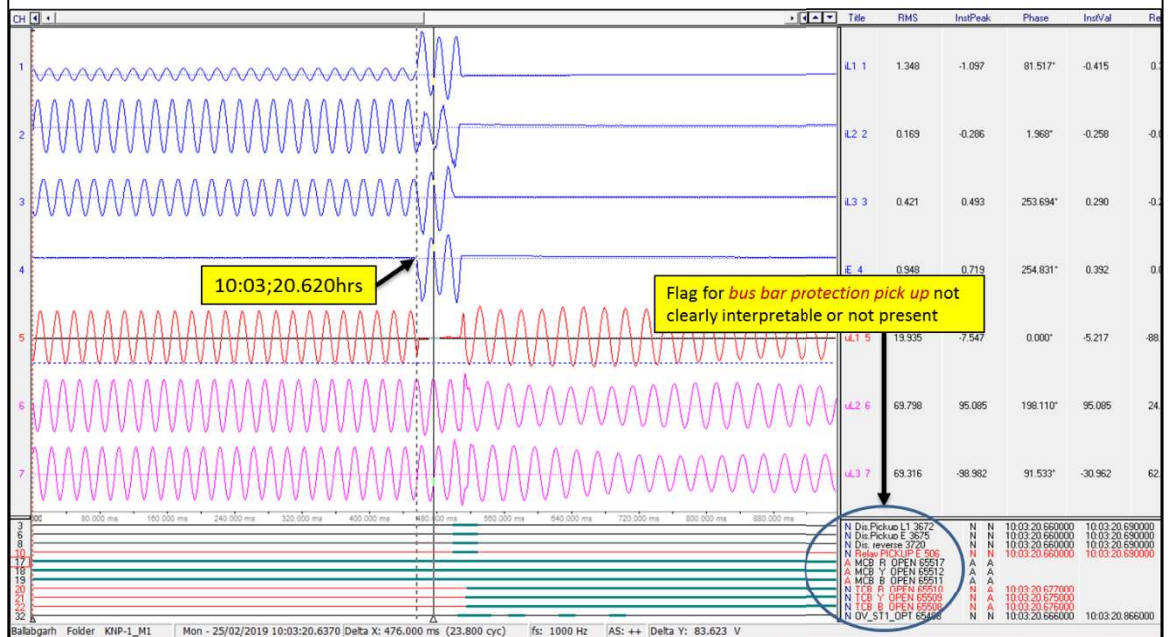
3. Outage of following transmission elements resulted during above incident:

-400kV Ballabgarh-Kanpur Ckt-1, Ckt-2 & Ckt-3, Mainpuri-2

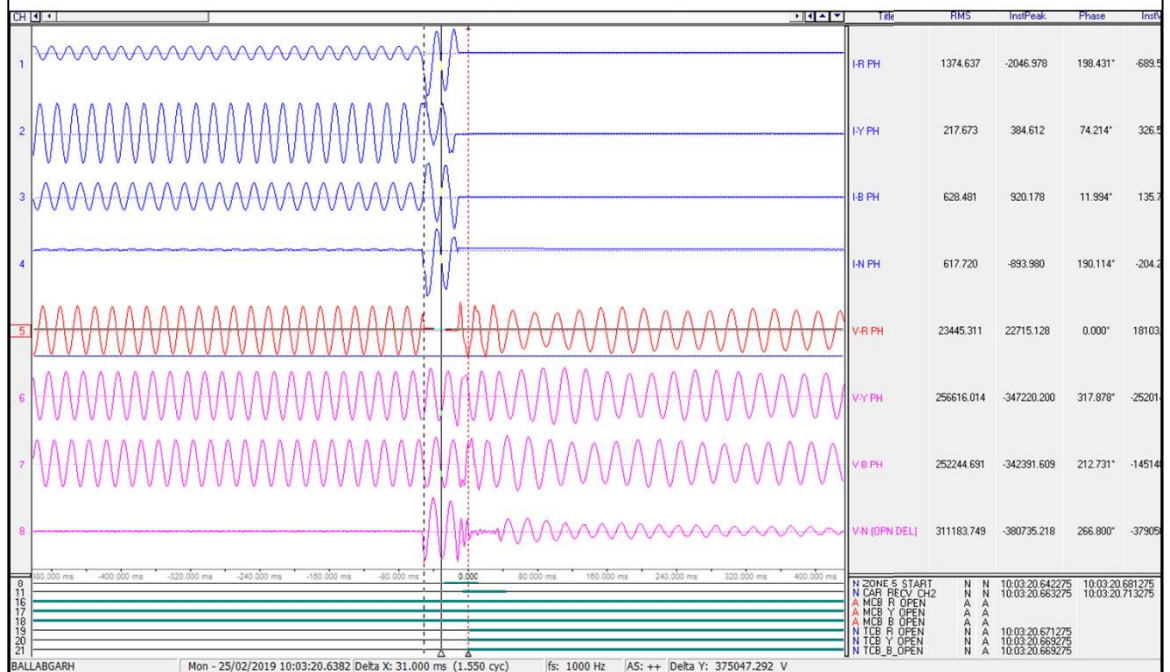
-80MVAr Bus Reactor

All above transmission elements were taken in service & system was normalized by 11:45 hrs.

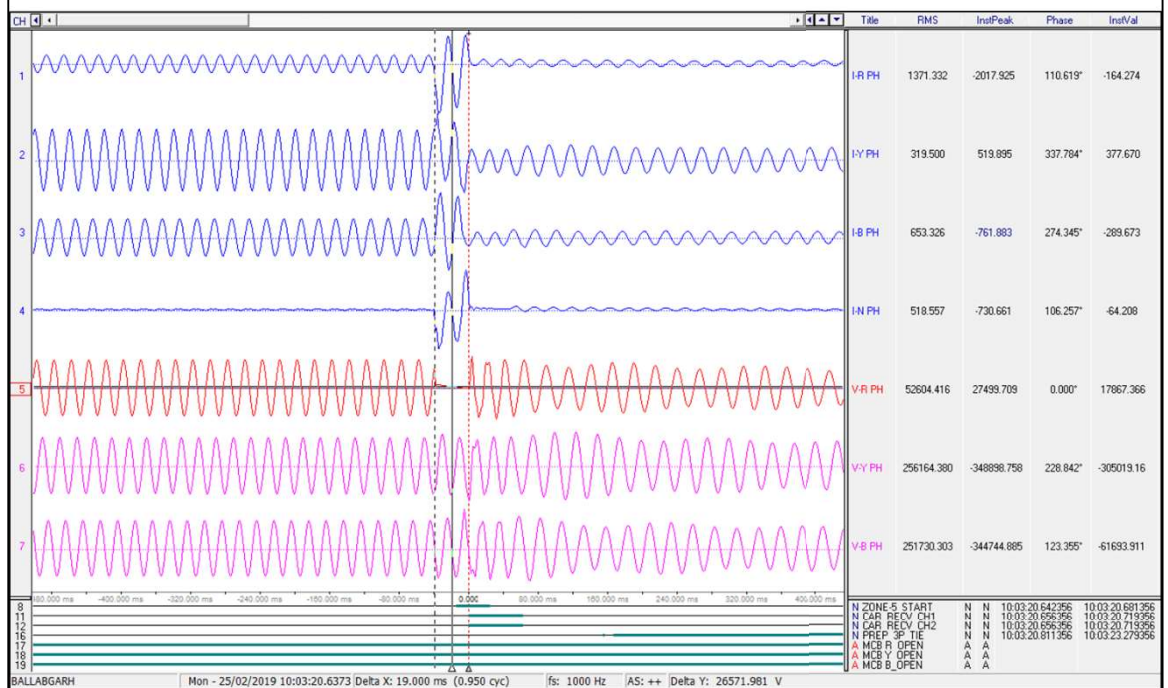
DR: 400kV Ballabgarh(end)-Kanpur-1



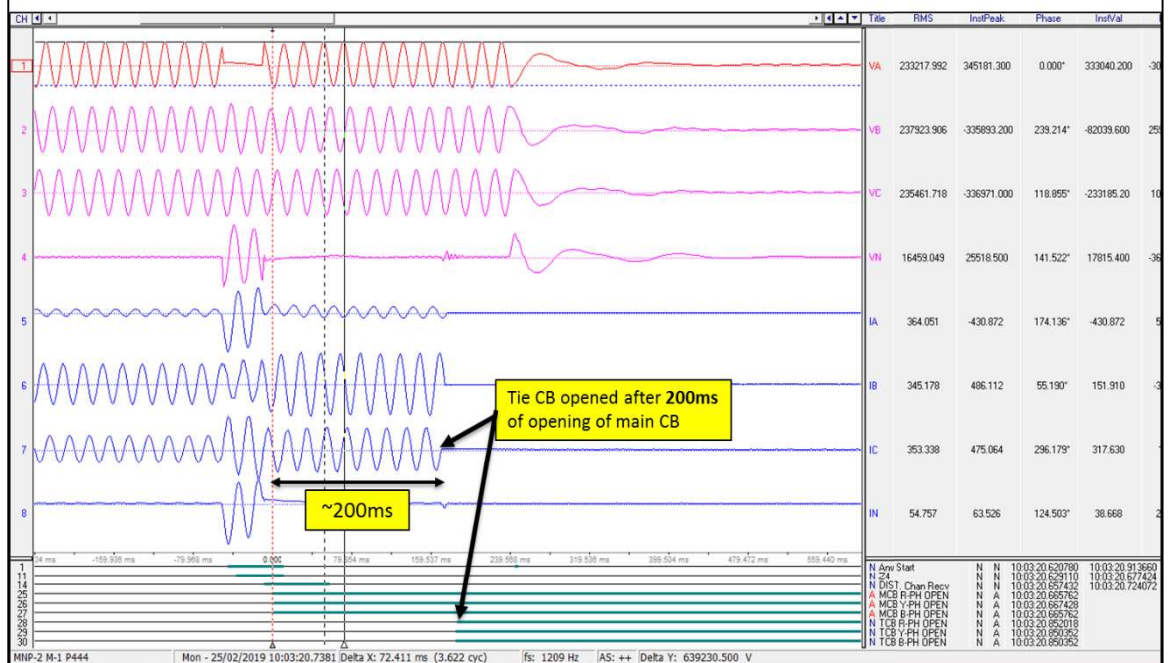
DR: 400kV Ballabgarh(end)-Kanpur-2



DR: 400kV Ballabgarh(end)-Kanpur-3



DR: 400kV Ballabgarh(end)-Mainpiri-2



25. As per PMU, SCADA SoE, DR data:

- As per PMU, DR and SCADA SoE, R-phase fault occurred at 10:03:20.600hrs.
- Fault Clearance time: 80ms

- c. As per DR, Kanpur-1, 2, 3 tripped at the time of fault. Mainpuri-2 tie CB tripped after around 200ms of opening of main CB.

26. DR, Detailed Report received after 24hrs from POWERGRID.

Points for Discussion:

1. Reason for opening of Series Reactor Bay Isolator 42189 to facilitate shutdown of bus-4 to be shared. It may have remained charged through tie CB of Mainpuri-2 ckt.
2. Reason for opening of Kanpur-2 main CB # 43652 which was connected to bus-3 to facilitate shutdown of bus-4 to be shared.
3. Reason for opening of tie CB of series reactor and Mainpuri-2 after ~200ms of opening of Mainpuri-2 main CB to be shared.
4. Outage of whole bus on account of human error is a serious concern and needs to be avoided in future.
5. As per SCADA SoE data, CB status from Ballabgarh not reflected in SoE. Further, reporting from Kanpur(PG) end was also partial. The reporting of above digital SCADA status signals to be looked into and rectified.
6. POWERGRID shall submit the detailed report in desired format along with remedial measures taken report considering the aforesaid points.

POWERGRID may elaborate the incident in line with above points, present and submit the EL (Event Log) of the tripped elements and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events

H. Multiple Element tripping at 400/220kV Bhadla (Raj) Station at 10:58hrs of 06th Mar 2019

Event category: GD-1

Generation loss: 1100 MW (Rajasthan may confirm)

Loss of load: Nil MW (Rajasthan may confirm)

Energy load: Nil MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	200ms	

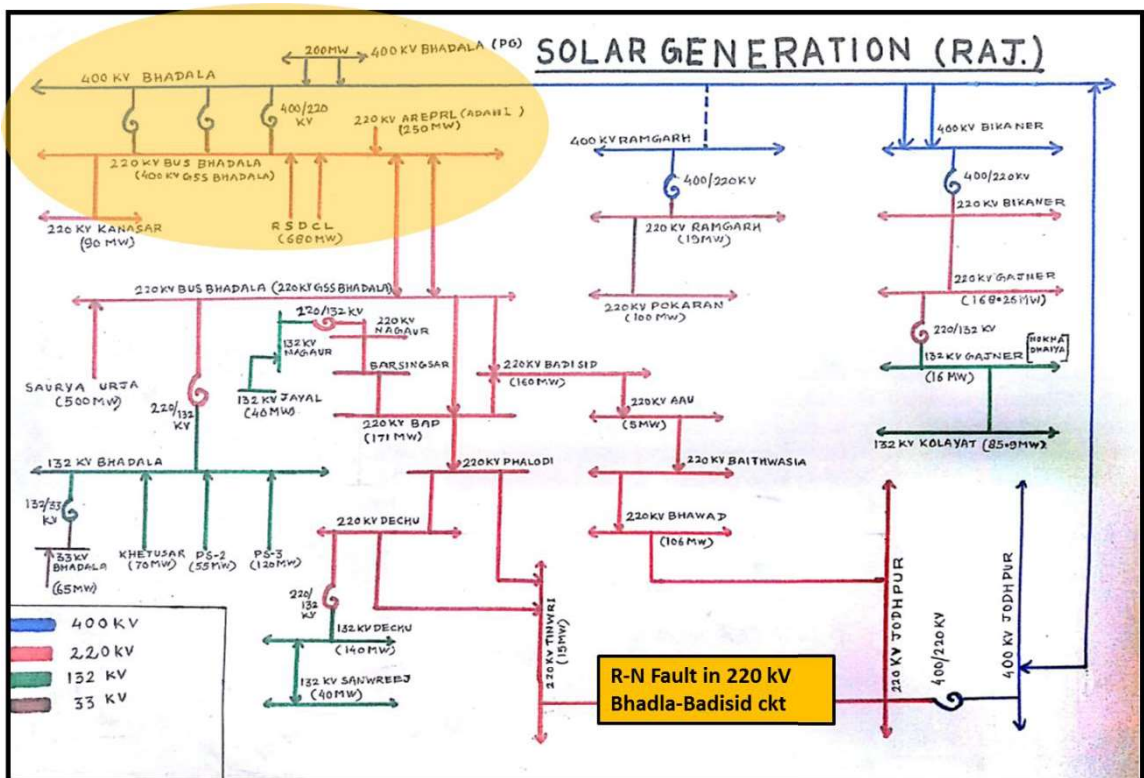
Phase of the fault	PMU data	R-N fault	
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Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received (after 24hrs)	DR/EL received partially
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

Description	Clauses	Utility	Remarks
Violation of Clauses	<p>1. IEGC 5.2.r & 5.9.6.c (VI)</p> <p>2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2)</p> <p>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)</p> <p>CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013),</p>	Rajasthan	<p>1. Preliminary Report, DR/EL within 24hrs</p> <p>2. Detailed Report yet to be received</p> <p>2. Adequately Sectionalized and graded protective relaying system</p> <p>3. Incorrect/ mis-operation / unwanted operation of Protection system</p>

Based on above information description of the events is:

1. Connectivity diagram of 400/220 kV Bhadla (Raj):



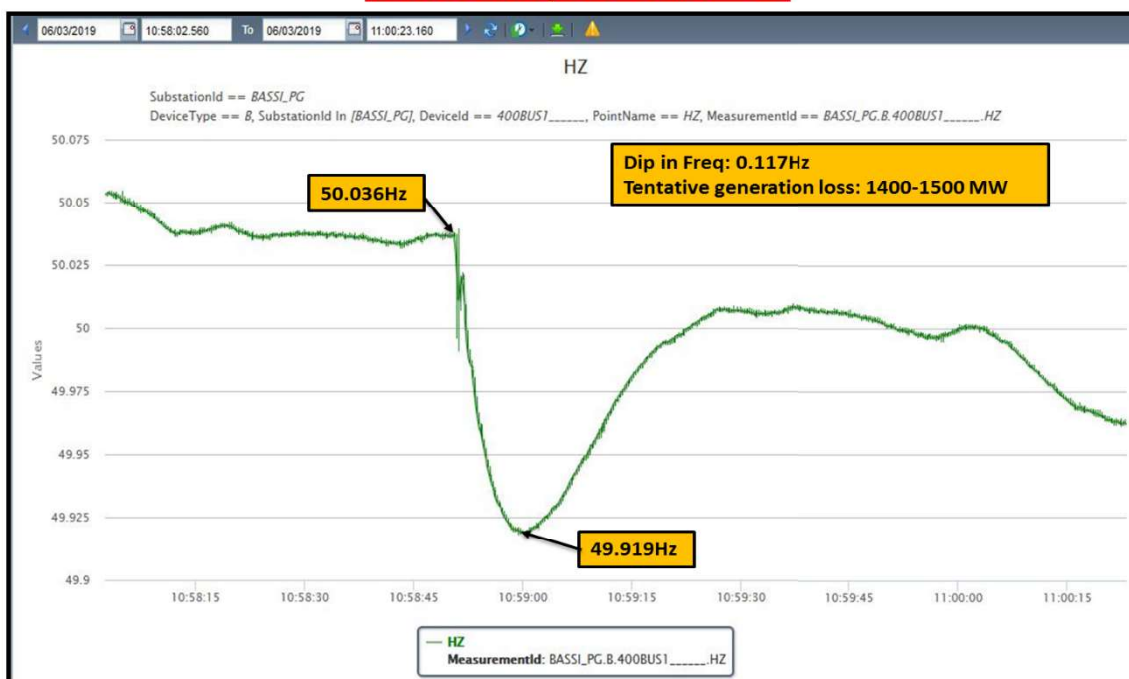
2. 400/220 kV Bhadla (Raj) station has one and half breaker scheme. It is connected through Bikaner D/C, Ramgarh D/C, Bhadla (PG) D/C, Jodhpur S/C and Merta S/C. It also has three 500 MVA

400/220 kV ICTs. At 220 kV side of 400/220 kV Bhadla (Raj), it is connected with 220 kV RSDCL D/C, 220 kV ARERPL, 220 kV Kanasar ckt and 220 kV Bhadla2 GSS through 220 kV Bus Sectionalizer. 220 kV Bhadla2 GSS further connected with Bap S/C, Badisid S/C and Sourya Urja D/C. Bhadla station is connected to solar park.

3. R-N fault occurred in 220 kV Bhadla2-Badisid ckt on account of snapping of jumper in the line. At the same time 220 kV Bhadla2-Bap ckt tripped in Reverse zone. 220 kV Bhadla-RSDCL D/C also tripped instantaneously on back up O/C protection.
4. 220 kV Bhadla- Kanasar line tripped in Z1 from Kanasar end and 220/132 kV 160MVA transformer also tripped on O/F (over flux protection) instantaneous feature.
5. 220 kV bus sectionaliser at 220 kV Bhadla2 (Raj) also tripped on earth fault.
6. Preliminary Report & partial DR/EL details received but detailed report in desired format is still awaited from Rajasthan.
7. Name of the tripped element:
 - 220kV Bhadla(RRVPNL)-Badisid (RRVPNL) ckt-1
 - 220kV Bhadla(RRVPNL)-RSDCL(RRVPNL) ckt-1
 - 220kV Bhadla(RRVPNL)-RSDCL(RRVPNL) ckt-2
 - 220kV Bhadla(RRVPNL)-RSDCL(RRVPNL) ckt-3
 - 220kV Bhadla(RRVPNL)-RSDCL(RRVPNL) ckt-4
 - 220kV Bhadla(RRVPNL)-Saurya Urja(RRVPNL) ckt-1
 - 220kV Bhadla(RRVPNL)-Saurya Urja(RRVPNL) ckt-2
8. In antecedent conditions, 220kV Bhadla(RRVPNL)-Saurya Urja(RRVPNL) ckt-1 & 2 carrying 254 MW each.
9. PMU plots:

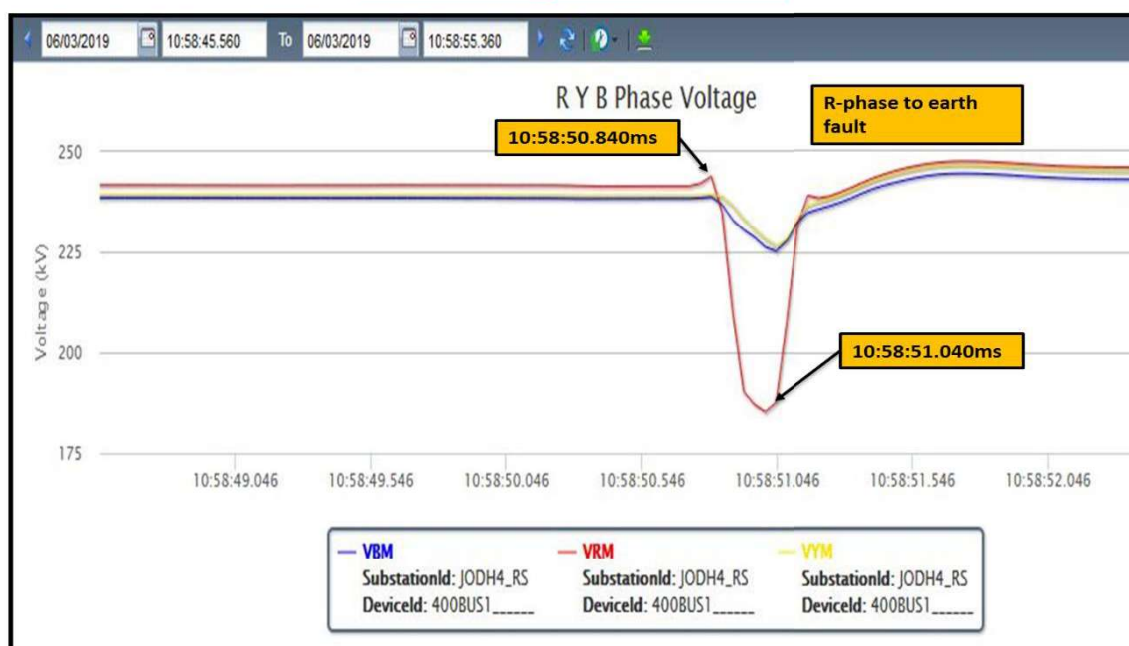
PMU Plot of frequency at Bassi(PG)

10:58hrs/06-Mar-19



PMU Plot of phase voltage magnitude at Jodhpur(Raj)

10:58hrs/06-Mar-19

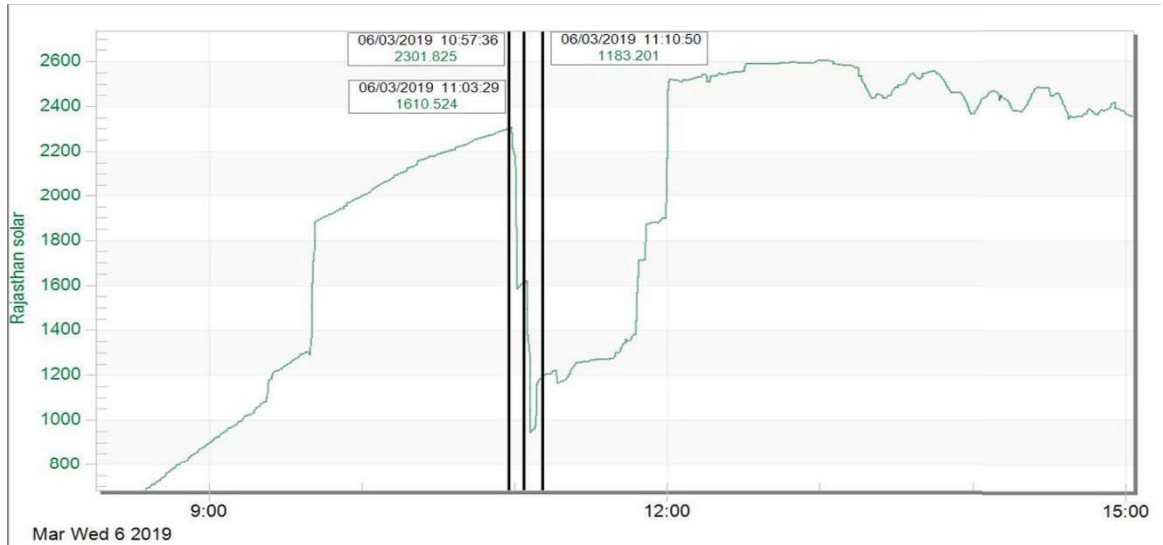


10. As per PMU data:

- R-N fault occurred at 10:58:50.840hrs and cleared in **200ms**.

11. SCADA data and SoE: Analog data was suspected and SoE didn't capture in NR SCADA. Solar generation loss of `1100MW was captured.

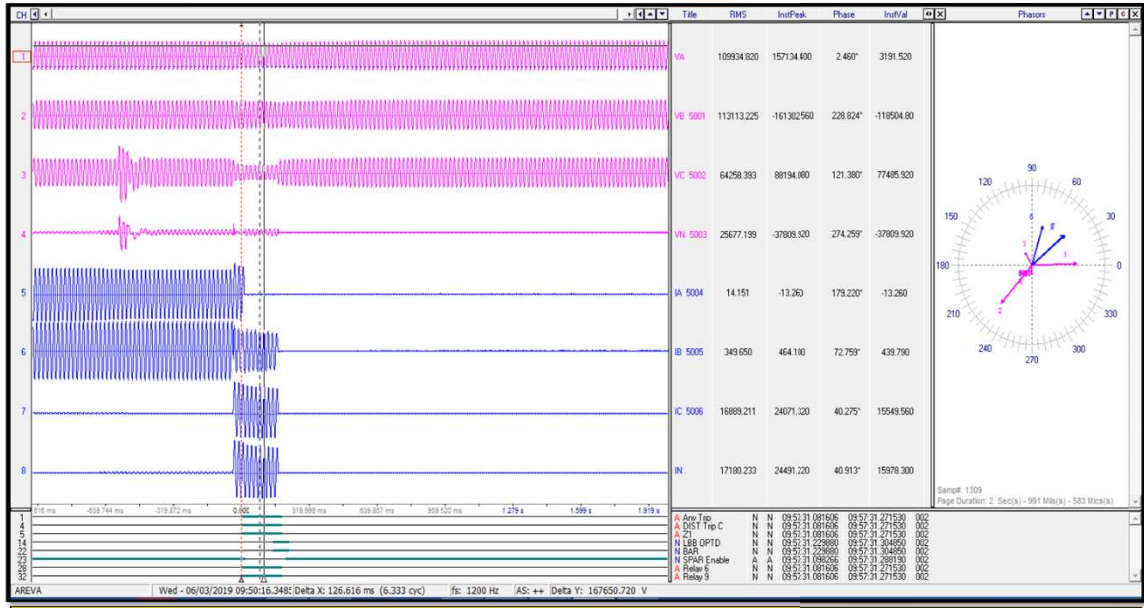
Rajasthan Solar Generation pattern during tripping



12. As per Rajasthan details:

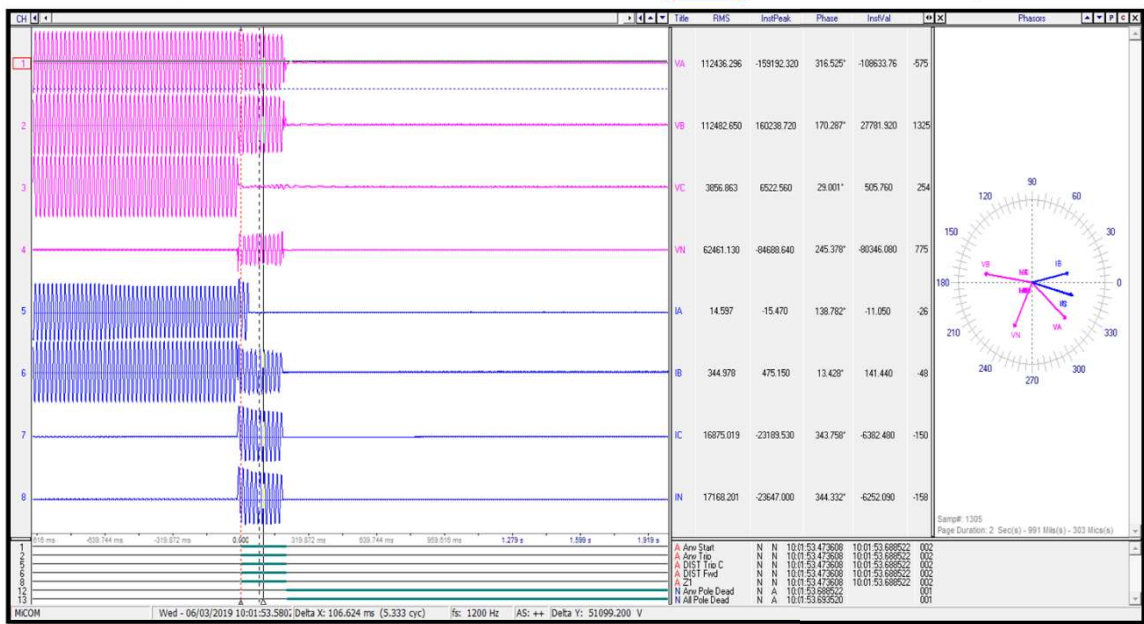
Preliminary Report							
<u>Date & Time of event:-</u>		: 06.03.2019 at 11.00 Hrs.					
<u>Introduction of Event:-</u>		: Multiples tripping at 220 KV GSS Bhadla					
<u>Total Loss of Generation</u>		: 445 MW					
<u>Total Loss of Load:-</u>		: NIL					
<u>Triggering Incident:-</u>							
Total Generation loss~ 1100MW (as per SCADA) however reported as 445 MW							
Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	220 KV Bhadla- Badisidh	06.03.2019	11.00	06.03.2019	23.20	Bhala- C Ph, 5.824Km , Z1	R Ph wave trap Jumper broken at Bhadla
2	220 KV Baap – Badla	06.03.2019	11.00	06.03.2019	11.43	Bhadla- M1, DPS, 1.01Km , Z4	

M-1 DR of 220 kV Bhadla (end) -Badisid ckt



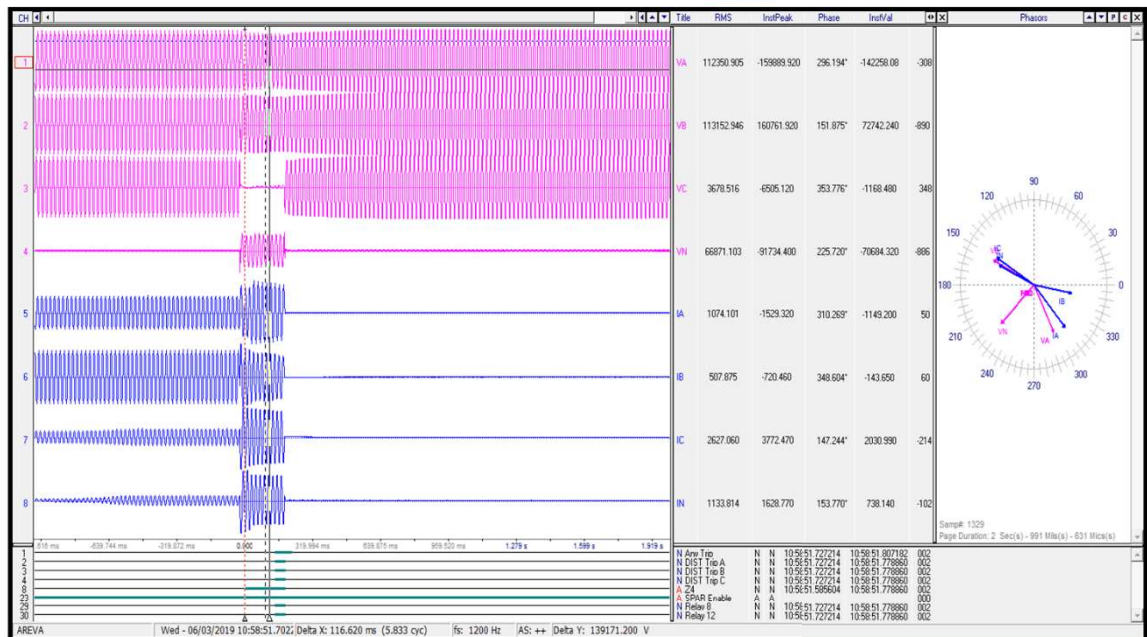
- DR of different time or time sync error?
- Distance Z-1 fault in the line. Fault in Blue phase, LBB operated within 150ms

M-2 DR of 220 kV Bhadla (end) -Badisid ckt



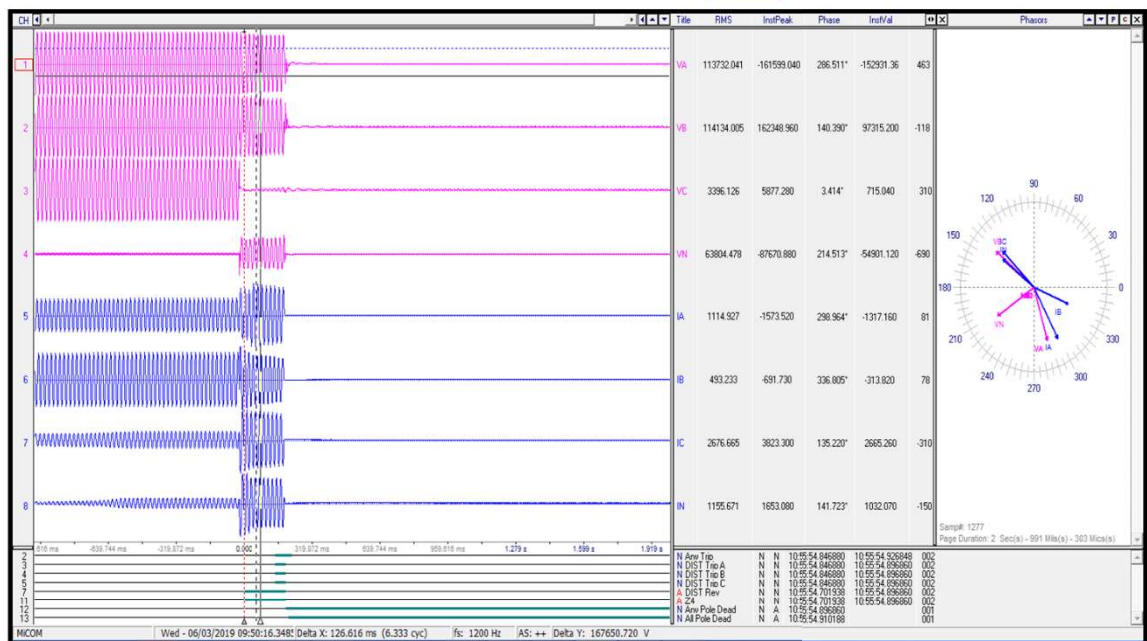
- DR of different time or time sync error?
- Fault in Blue phase, All pole tripped within 220ms of fault occurrence

M-1 DR of 220 kV Bhadla (end) –Bap ckt



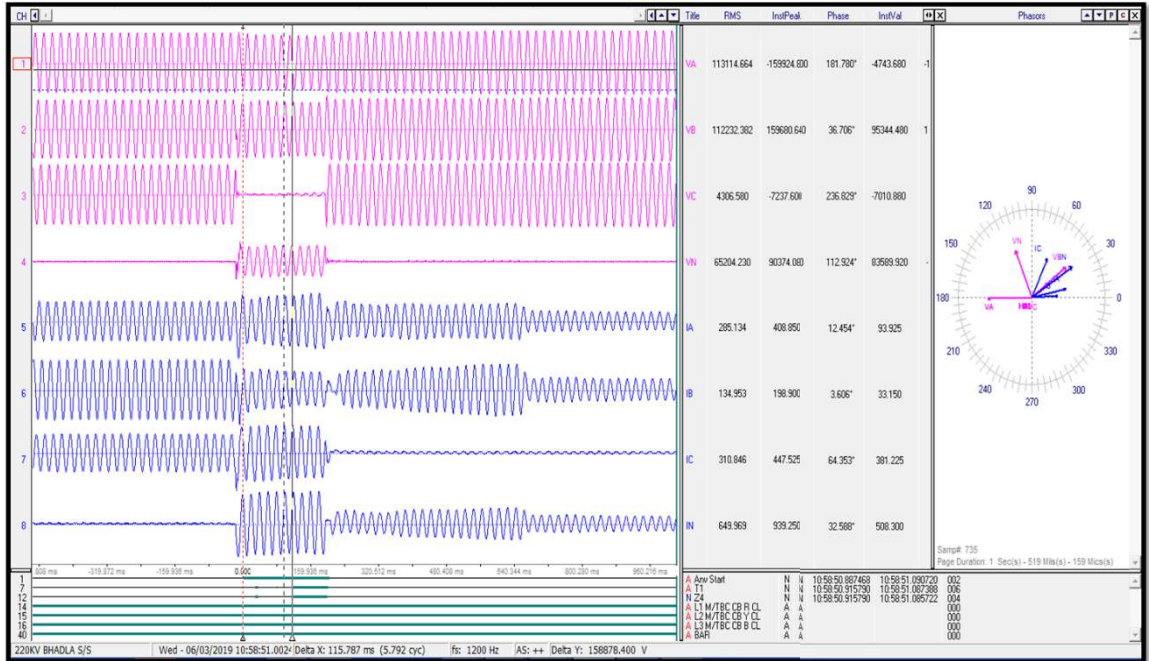
- **Fault in Blue phase, line tripped in reverse zone in 150ms**

M-2 DR of 220 kV Bhadla (end) –Bap ckt



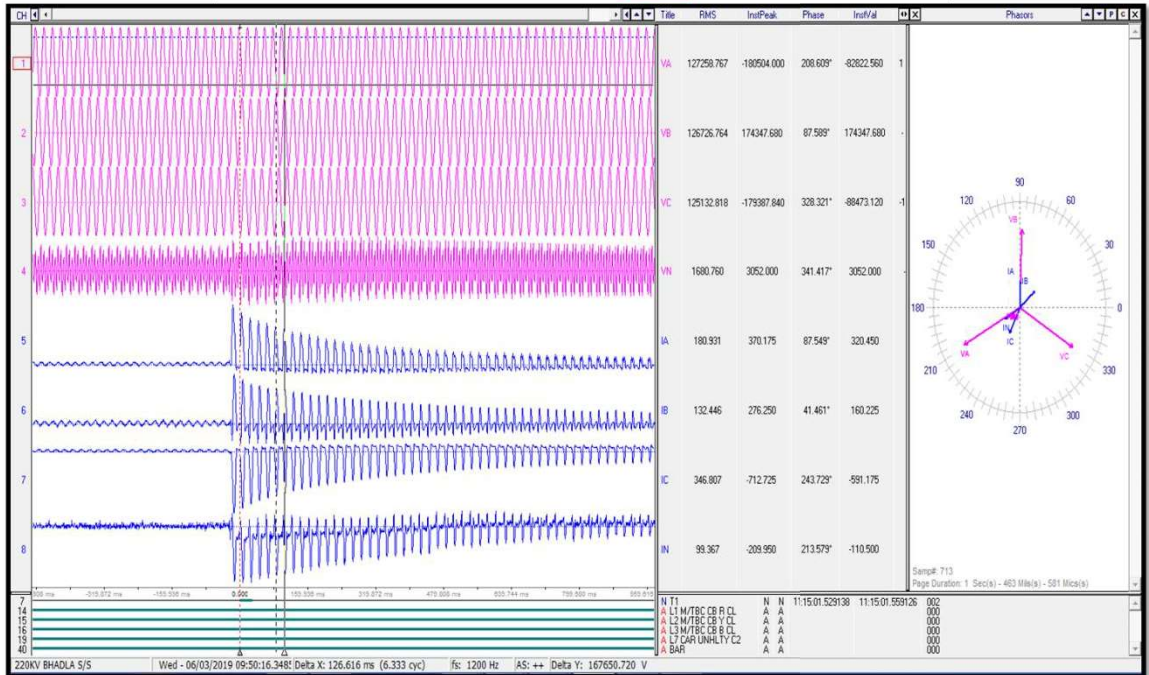
- **Time synch error?**
- **Fault in Blue phase, line tripped in reverse zone**

DR of 220 kV Bhadla (end) –Kansar ckt

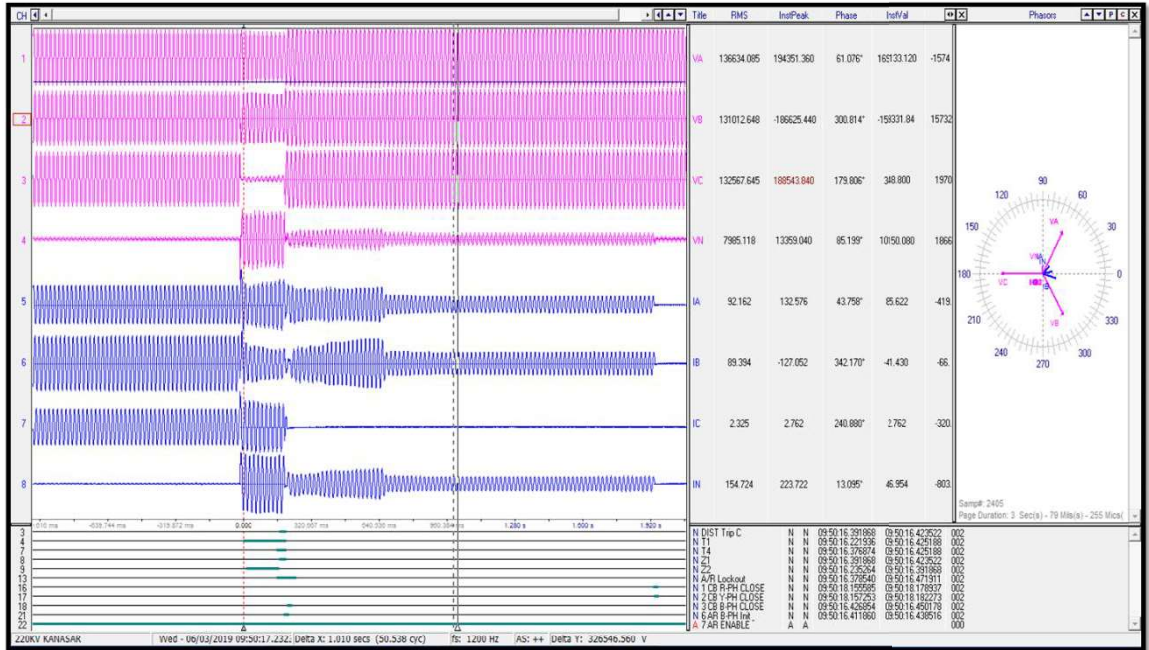


• **Fault in Blue phase, line tripped in reverse zone**

DR of 220 kV Bhadla (end) –Kansar ckt

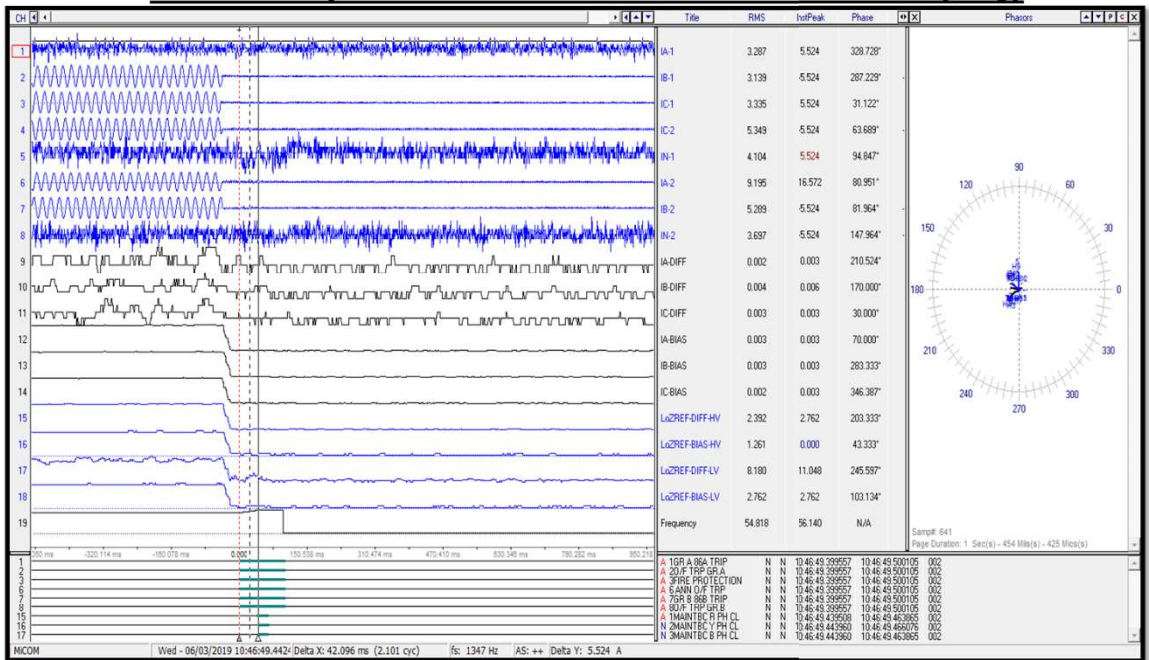


DR of 220 kV Kanasar (end) –Bhadla ckt



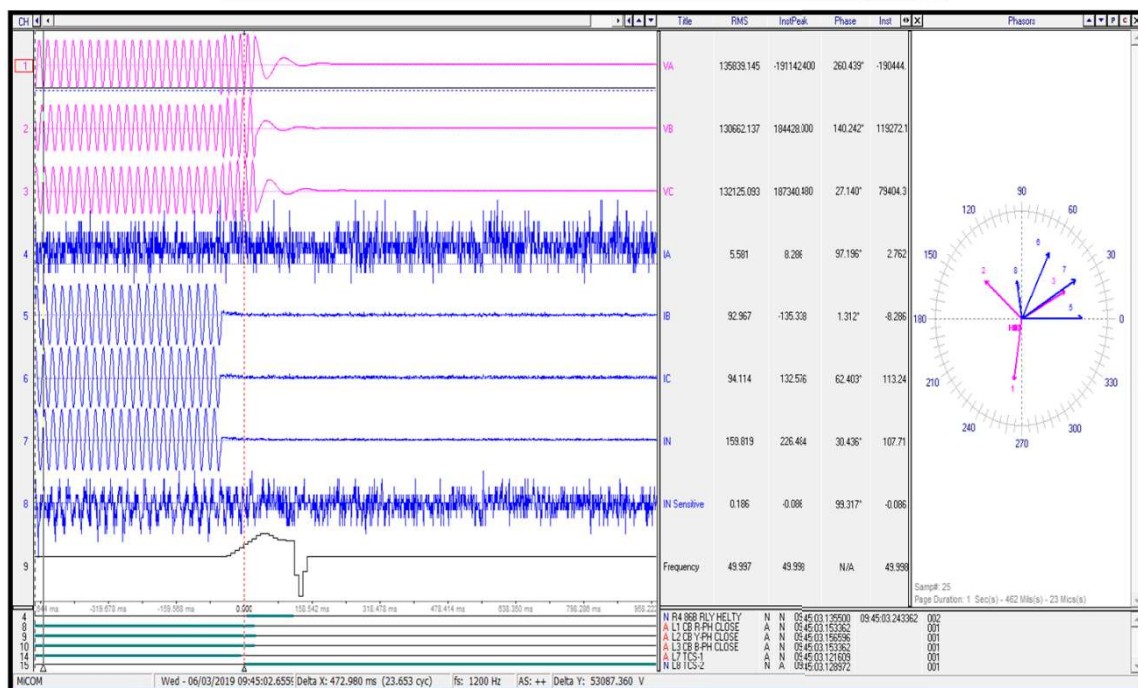
- Time sync error?
- Line tripped in Z-1

DR of 220/132 kV 160 MVA ICT at Kanasar (Raj)



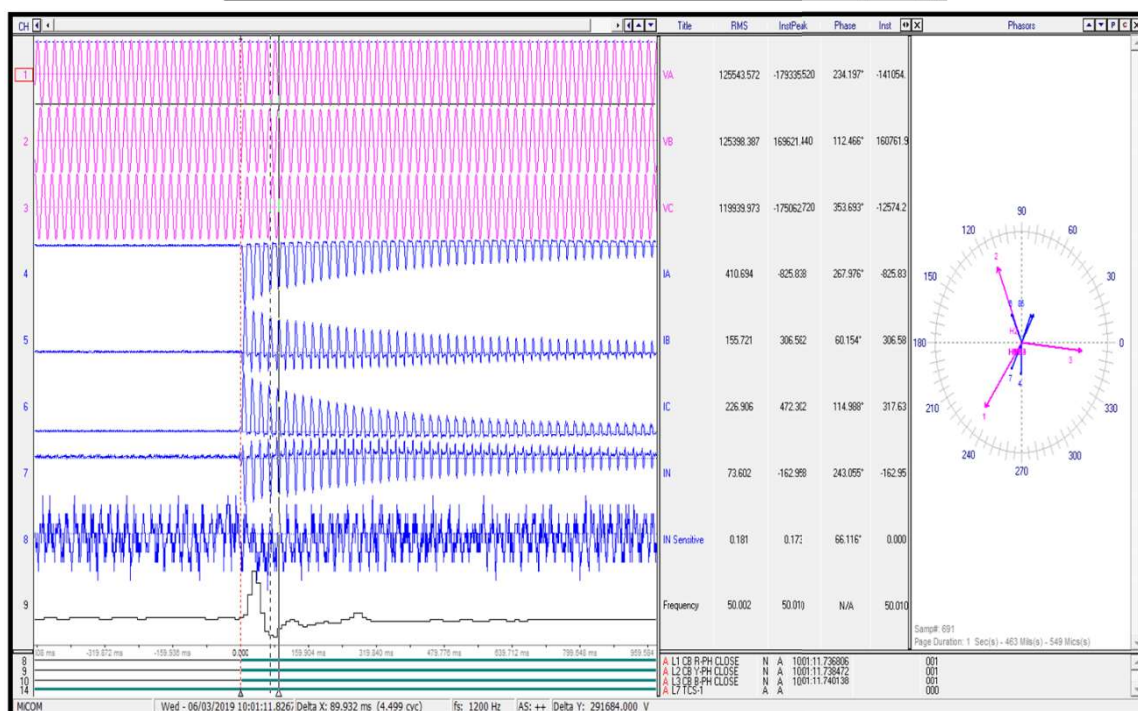
DR of different time or time sync error?

DR of Bus Sectionaliser at Bhadla (Raj)



- DR of different time or time synchrony error?

DR of Bus Sectionaliser at Bhadla (Raj)



- DR of different time or time synchrony error?

- It seems fault was in 220 kV Bhadla-Badisid ckt.
- Time synchrony error in almost all the DR.
- 220 kV Bhadla – Bap line tripped from Bhadla end in reverse zone (Z4)
- 220 kV Bhadla- Kanasar line tripped in Z1 from Kanasar end.

- 220/132 kV 160MVA transformer also tripped instantaneously on over flux protection.
- 220 kV bus sectionaliser also tripped on back up earth fault.

13. As per Rajasthan Report:

- 220 kV Bhadla – Badisid line tripped on actual fault from Bhadla end due to jumper open at Bhadla end.
- 220 kV Bhadla – Bap line tripped from Bhadla end in Z4.
- 220 kV Bhadla – RSDCL -1 line-1 tripped on O/C instantaneous feature from RSDCL-1 side.
- 220 kV Bhadla – RSDCL -1 line-2 tripped on O/C instantaneous feature from RSDCL-1 side.
- 220 kV Bhadla- Kanasar line tripped in Z1 from Kanasar end and 220/132 kV 160MVA transformer also tripped on O/F (over flux protection) instantaneous feature.
- 220 kV bus sectionaliser tripped on earth fault

14. Remedial Measures taken as per Rajasthan report:

- 220 kV Bhadla – RSDCL 1 – 1 & 2 Ckt O/C setting at RSDCL-1 side revised.
- 220/132 kV, 160 MVA transformer O/F (over flux protection) setting revised at 220 kV Kanasar GSS end

15. Preliminary Report & partial DR details received but detailed report in desired format is still awaited from Rajasthan. Station EL detail is also not submitted.

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 of operation of LBB protection within 150ms of fault occurrence?
3. Healthiness of bus bar protection/ LBB needs to be ensured.
4. In this event, why reverse zone protection operated?
5. W.r.t. the Solar generation tripping, the aspect of tripping of Solar generation from angle of the absence Fault Ride Through (FRT) or Low Voltage Ride Through (LVRT) has asked from Rajasthan. No information in this regard received at NRLDC/ NRPC.
6. Detailed of Generation/ Load loss needs to be checked and reported.
7. Phase nomenclature mismatch observed at 400/220 kV Bhadla station (As per PMU data fault is in R-phase however as per DR details: Blue phase)
8. Changes in the settings (over current, over flux etc) needs to be shared with NRLDC/ NRPC.

9. Availability of SCADA Analog data and Digital data needs to be ensured.
10. Availability & Healthiness of station event logger needs to be ensured.
11. Time synchronization of DR/EL needs to be looked into.
12. Detailed Report and Remedial measures report is still awaited from Rajasthan

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.

I. Multiple element tripping at 400/220 kV Gorakhpur(UP) at 19:12hrs of 12-Mar-19

Event category: GD-1

Generation loss: Nil (As per UP report)

Loss of load: Nil (As per UP report, 200MW as per SCADA/PMU data)

Energy load: 0.22 MU (UP may confirm)

Data Summary received/available at NRLDC:

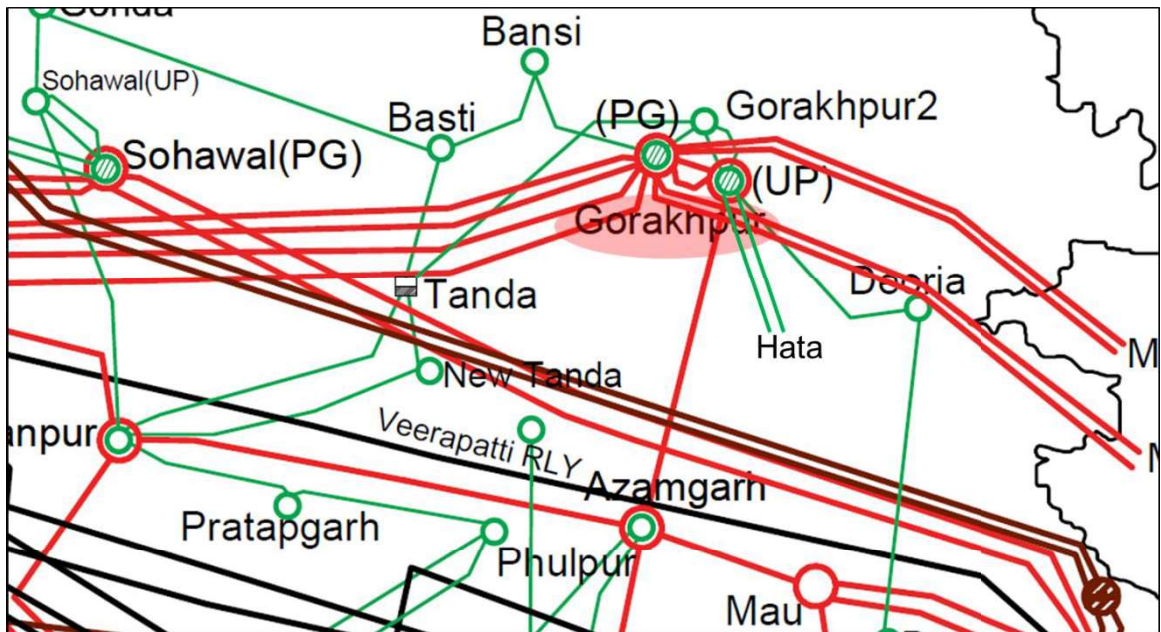
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	80ms	
Phase of the fault	PMU data	Blue phase to earth fault	

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

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

Based on above information description of the events is:

1. Connectivity diagram of 400/220kV Gorakhpur(UP):



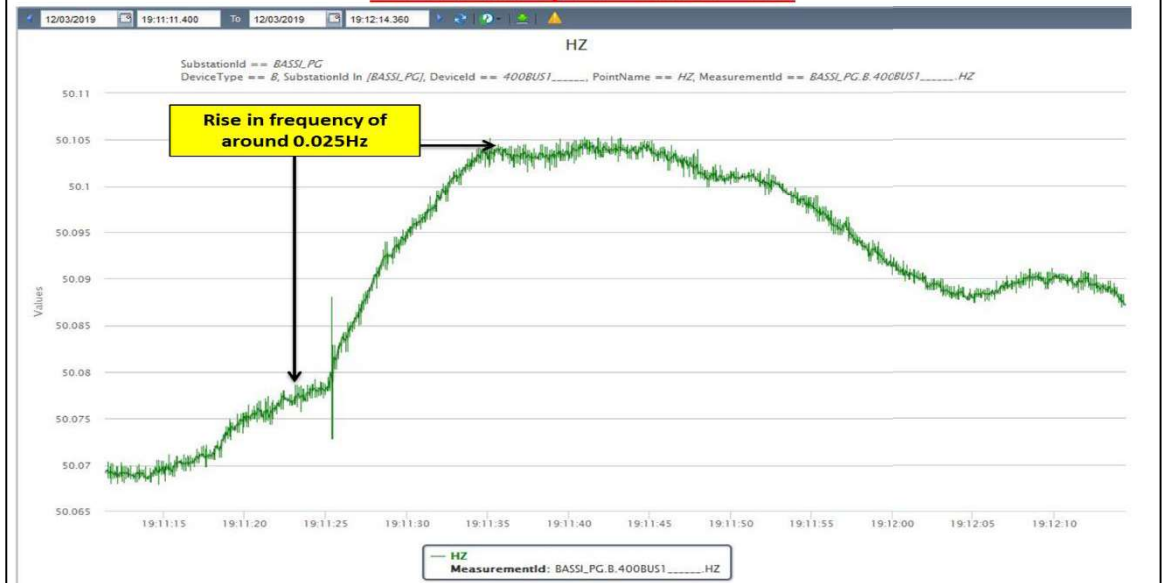
2. 400/220kV Gorakhpur(UP) is connected at 220kV level through 220kV Deoria S/C, 220kV Hata D/C, 220kV Gorakhpur-2(UP) D/C. It has DMT (double main transfer bus) bus bar scheme at 220kV level.
3. B-phase CT of 220kV side of 315MVA ICT-2 at Gorakhpur(UP) damaged.
4. This resulted in bus bar protection operation at 220kV level of Gorakhpur(UP).
5. All 220kV connected elements tripped.
6. Name of the tripped elements along with restoration:

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	500MVA ICT – I (400/220KV)	12.03.19	20:17	96, Bus Bar protection
2.	315MVA ICT – II (400/220KV)	12.03.19	23:46	-do-
3.	220KV Deoria line	12.03.19	20:23	-do-
4.	220KV Gorakhpur – I line	12.03.19	20:27	-do-
5.	220KV Gorakhpur – II line	12.03.19	21:35	-do-
6.	220KV Hata – I line	12.03.19	20:25	-do-
7.	220KV Hata – II line	12.03.19	20:24	-do-
8.	160MVA ICT - I	12.03.19	20:23	Hand Tripped
9.	160MVA ICT - II	12.03.19	20:24	-do-
10.	160MVA ICT - III	12.03.19	20:25	-do-

7. PMU plots:

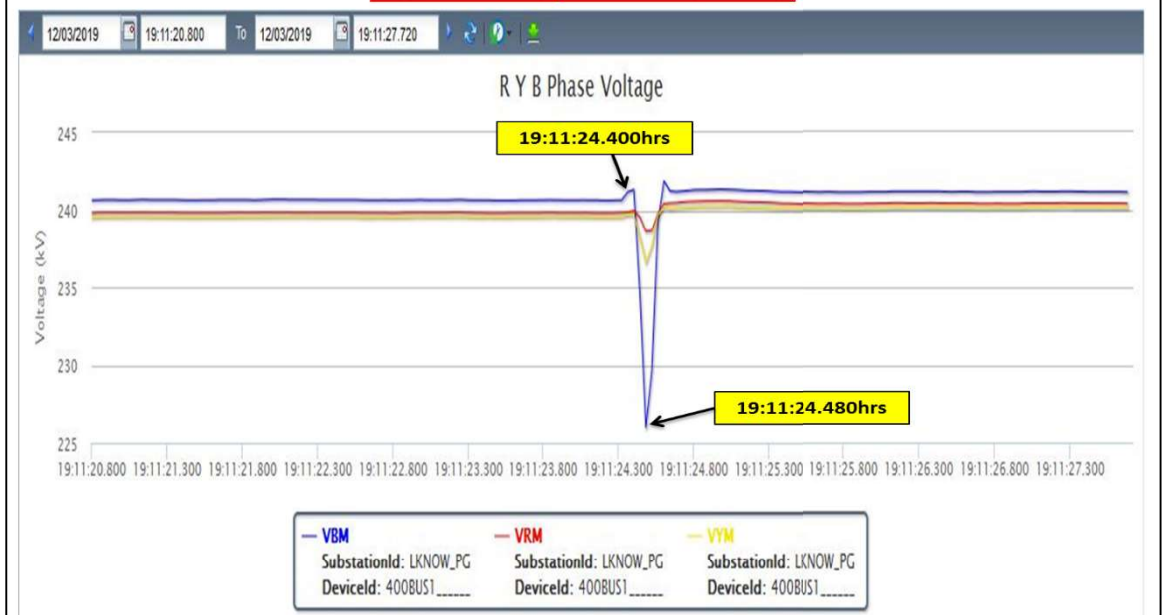
PMU Plot of frequency at Bassi(PG)

19:11hrs/12-Mar-19



PMU Plot of phase voltage magnitude at Lucknow(PG)

19:11hrs/12-Mar-19

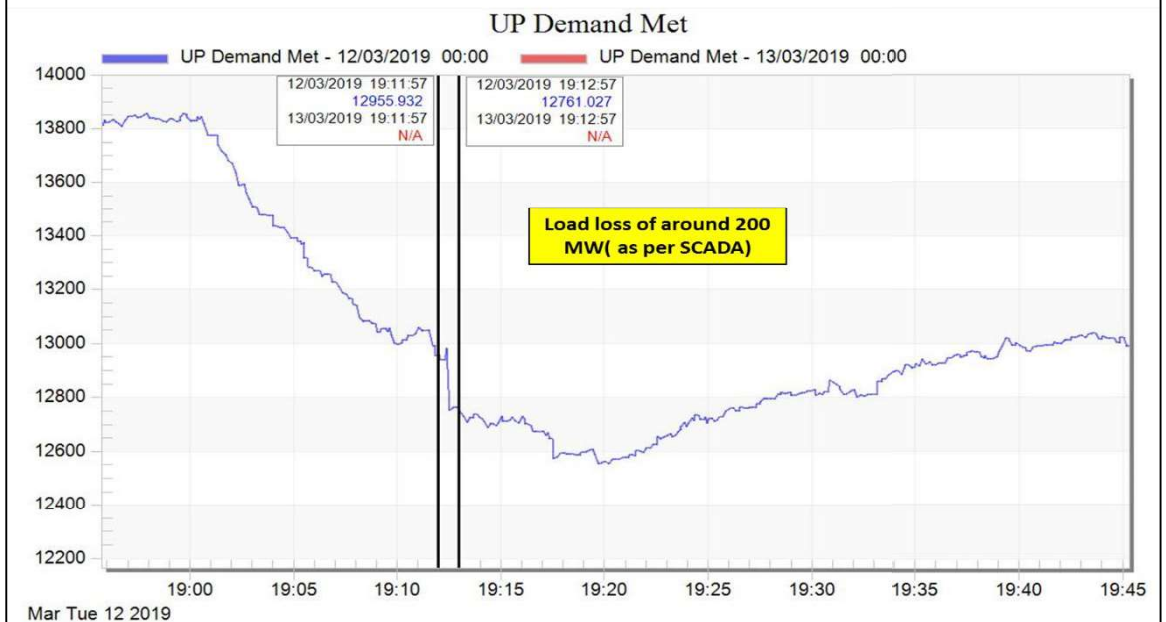


8. SCADA data and SoE:

UP SCADA SOE

Time (in hrs)	Station	Voltage (in kV)	Element	Type	Status	Remarks
19:11:24:425	GRK_1_UP	220kV	E_07(GRK_2-1)	CB	Open	CB of 220kV Gorakhpur(UP)-Gorakhpur 2(UP) ckt-1 opens.
19:11:24:428	GRK_1_UP	220kV	E_02(DORIA)	CB	Open	CB of 220kV Gorakhpur(UP)-Deorai(UP) opens.
19:11:24:429	GRK_1_UP	220kV	05MBC	CB	Open	220kV Bus coupler at 400/220 kV Gorakhpur(UP) opens.
19:11:24:429	GRK_1_UP	220kV	E_01(T1)	CB	Open	220kV side CB of 500 MVA ICT 1 at 400/220 kV Gorakhpur(UP) opens.
19:11:24:429	GRK_1_UP	400kV	F_04(T1)	CB	Open	400kV side CB of 500 MVA ICT 1 at 400/220 kV Gorakhpur(UP) opens.
19:11:24:430	GRK_1_UP	220kV	13HATA1	CB	Open	CB of 220kV Gorakhpur(UP)-Hata(UP) ckt-1 opens.
19:11:24:433	GRK_1_UP	220kV	14HATA2	CB	Open	CB of 220kV Gorakhpur(UP)-Hata(UP) ckt-2 opens.
19:11:24:444	GRK_1_UP	220kV	E_08(GRK_2-2)	CB	Open	CB of 220kV Gorakhpur(UP)-Gorakhpur 2(UP) ckt-2 opens.
19:11:24:446	GRK_1_UP	400kV	10T2	CB	Open	400kV side CB of 315 MVA ICT 2 at 400/220 kV Gorakhpur(UP) opens.
19:11:24:450	GRK2N_UP	220kV	E_04(EXTN2)	CB	disturbe	
19:11:24:451	GRK_1_UP	220kV	09T2	CB	Open	220kV side CB of 315 MVA ICT 2 at 400/220 kV Gorakhpur(UP) opens.
19:11:24:451	GRK2N_UP	220kV	E_03(EXTN1)	CB	Open	

UP Demand pattern during tripping



9. As per UP Preliminary report:

Sub: - Report on the Incident of Blackout at 400/220KV S/S Gorakhpur.

Ref: N.R.L.D.C. Letter No- 1486 CNR-GD-G

On 12.03.2019 at 19:12Hrs, LV side of all ICTs and 220KV transmission lines connected with 400/220KV S/S Gorakhpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	500MVA ICT - I (400/220KV)	12.03.19	20:17	96, Bus Bar protection
2.	315MVA ICT - II (400/220KV)	12.03.19	23:46	-do-
3.	220KV Deoria line	12.03.19	20:23	-do-
4.	220KV Gorakhpur - I line	12.03.19	20:27	-do-
5.	220KV Gorakhpur - II line	12.03.19	21:35	-do-
6.	220KV Hata - I line	12.03.19	20:25	-do-
7.	220KV Hata - II line	12.03.19	20:24	-do-
8.	160MVA ICT - I	12.03.19	20:23	Hand Tripped
9.	160MVA ICT - II	12.03.19	20:24	-do-
10.	160MVA ICT - III	12.03.19	20:25	-do-

Generation Loss = **NIL**

Load Loss = **NIL**

It has been reported by UPPTCL that due to damage of 220KV side B - phase C.T of 315MVA ICT- II, 220KV bus bar protection operated. This resulted into tripping of all 220KV lines emanating from 220KV bus at 400/220KV S/S Gorakhpur. 160MVA ICT I, II and III were hand- tripped.

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


(Zahir Ahmad)

Superintending Engineer (R&A)

10. As per PMU, SCADA SoE data:

- As per PMU, B-N fault observed at 19:11:24.400hrs.
- Fault Clearance time: **80ms**
- As per SoE, all 220kV lines along with both 400/220kV ICTs tripped around 19:11:24.430hrs.
- Tripping of 160MVA ICTs not captured in SCADA SoE.

11. Preliminary Report received within 24hrs from UP. DR, EL and detailed report are still awaited from UP.

Points for Discussion:

- Exact location of fault to be shared.
- 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

3. Antecedent buses configuration viz. feeders details on both the 220kV buses to be shared.
4. Reason for non-operation of ICT differential protection and bus bar protection instead to be shared.
5. Reason for tripping of all elements connected to both buses instead of only one bus to be shared.
6. DR, EL and detailed report needs to be submitted by UPPTCL.
7. UPPTCL shall submit the detailed report in desired format along with remedial measures taken report considering the aforesaid points

UP may elaborate the incident in line with above points, submit the detailed report, DR/EL 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 400/220kV Akal (Raj) Station at 00:53hrs of 15th Mar 2019

Event category: GD-1

Generation loss: 400 MW (Rajasthan may confirm)

Loss of load: Nil MW (Rajasthan may confirm)

Energy load: Nil MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	200ms & 360ms	
Phase of the fault	PMU data	Y-N fault followed by R-N fault	

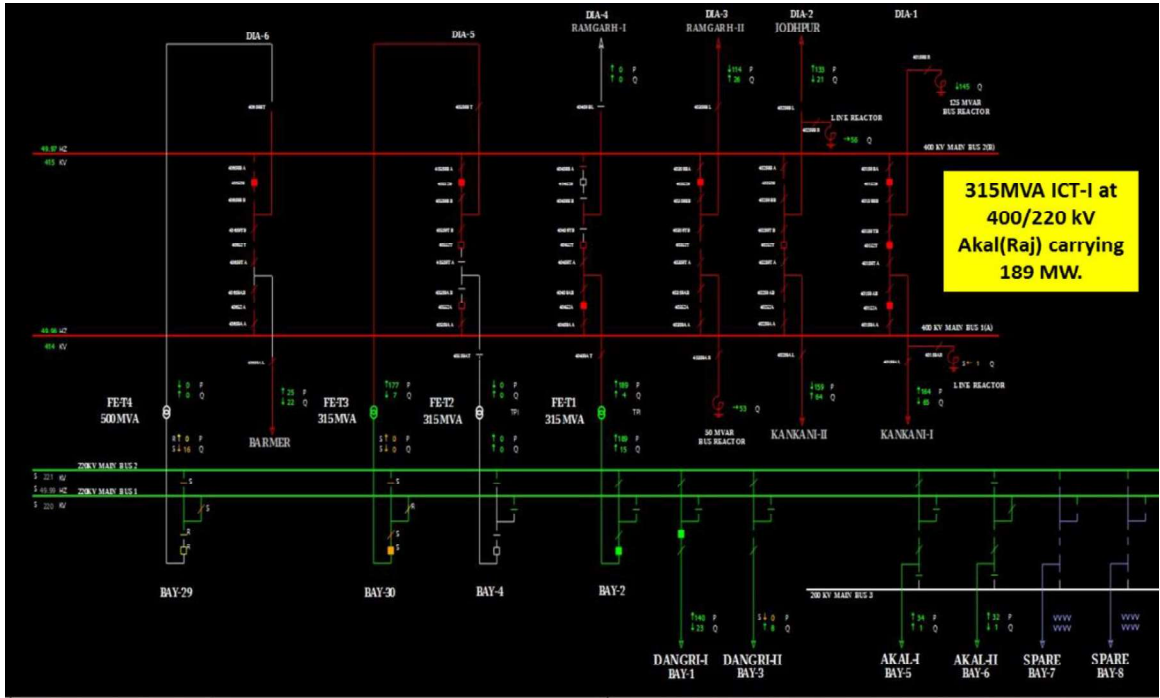
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received (after	DR/EL received partially

		24hrs)	
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

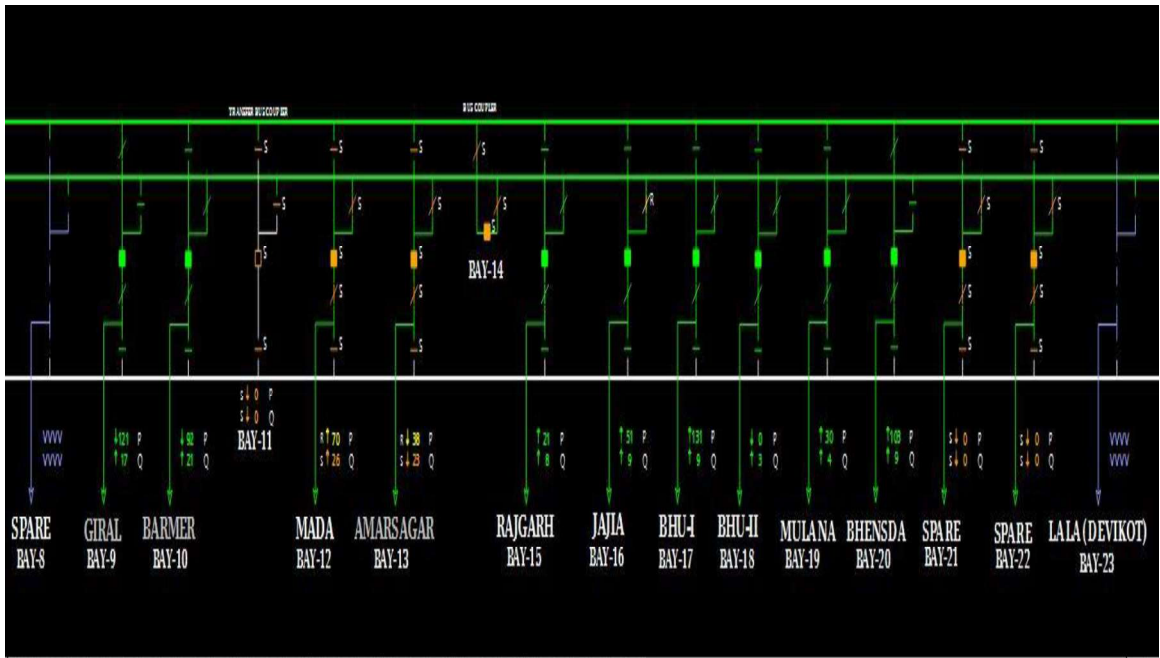
Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical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

Based on above information description of the events is:

1. Single Line Diagram and Connectivity diagram of 400/220 kV Akal (Raj):

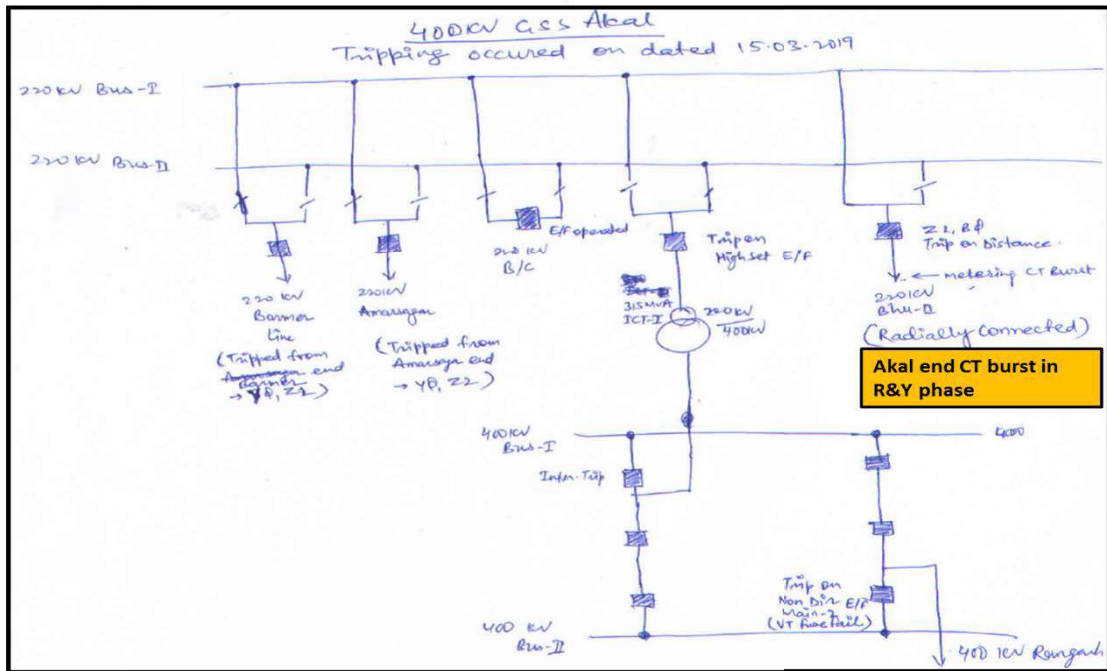


Fri March 15 2019 00:12:20



Fri March 15 2019 00:12:20

Affected area of 400/220 kV Akal station



2. 400/220 kV Akal (Raj) station has one and half breaker scheme at 400 kV side. It is connected through Kankani D/C, Ramgarh D/C, Barmer S/C and Jodhpur S/C. It also has three 315 MVA 400/220 kV ICTs & one 500MVA 400/220 kV ICT.
3. In antecedent conditions:
 - 315MVA ICT-I at 400/220 kV Akal(Raj) carrying 189 MW.
 - 220 kV bus bar protection at 400/220 kV Akal (Raj) was out of service due to communication error.
 - 400/220 kV 500MVA ICT and one 315 MVA ICT was also under outage due to damage in the ICTs.
4. Y-phase to earth fault followed by R-phase to earth fault occurred in 220 kV Akal-Bhu ckt-1 due to damage of R&Y-phase CT at Akal end.
5. Distance Z-1 tripping command issued immediately for 220 kV Akal-Bhu ckt initially for Y-phase followed by R-phase.
6. During fault in 220 kV Akal-Bhu ckt-1, 400/220 kV 315 MVA ICT-1 tripped on back up earth fault protection and 400 kV Akal-Ramgarh ckt also tripped on non-directional earth fault protection due to blocking of distance protection on fuse failure.
7. 220 kV Akal-Ramgarh and Akal-Amarsagar line tripped from remote end in Z-2
8. 220 kV Bus bar protection was not in service at 400/220 kV Akal station.
9. Complete LT supply out because the only source of LT supply is from ICT-I. Due to darkness and to start the fire fighting system immediately for controlling fire of CT, Akal S/stn had charged ICT-I without taking code in view of urgency.

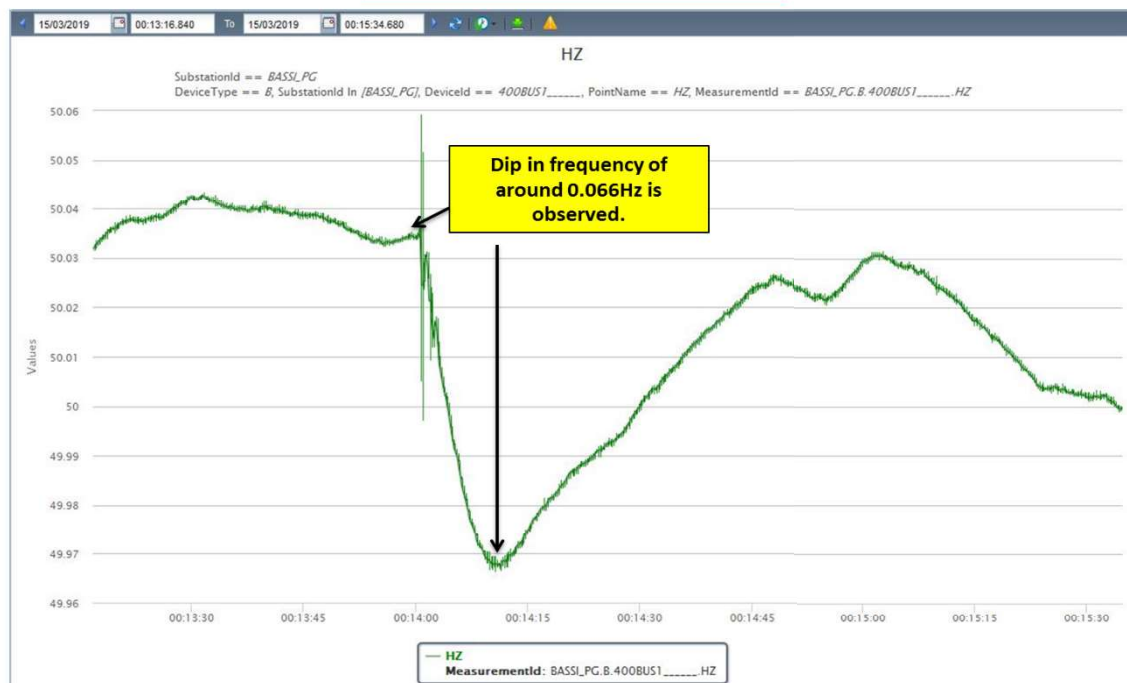
10. Name of the tripped element:

- 220kV Akal(RRVPNL)-Bhu(RRVPNL) ckt-I
- 220kV Akal(RRVPNL)-Amarsagar(RRVPNL)
- 220kV Akal(RRVPNL)-Barmer(RRVPNL)
- 220kV Akal(RRVPNL)-Dangari(RRVPNL) ckt-1
- 220kV Akal(RRVPNL)-Bhensada(RRVPNL)
- 220kV Akal(RRVPNL)-Jajia(RRVPNL)
- 400KV Akal(RRVPNL)-Ramgarh(RRVPNL) ckt-2
- 315MVA ICT-I at 400/220 kV Akal(Raj)

11. PMU plots:

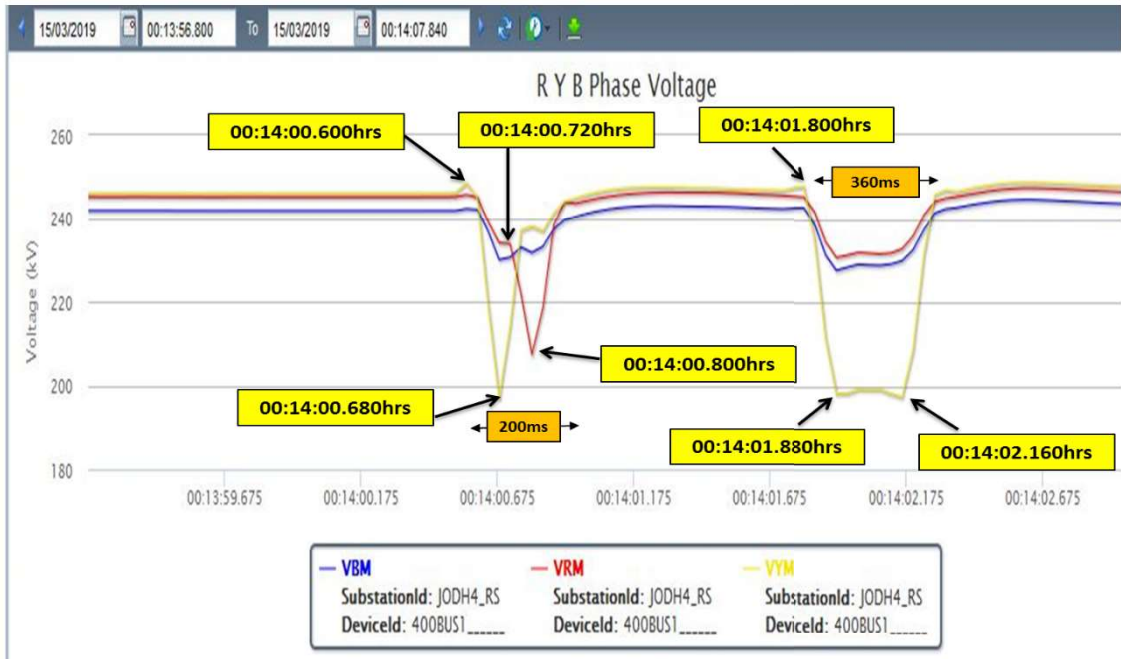
PMU Plot of frequency at Bassi(PG)

00:13hrs/15-Mar-19



PMU Plot of phase voltage magnitude at Jodhpur(Raj)

00:13hrs/15-Mar-19

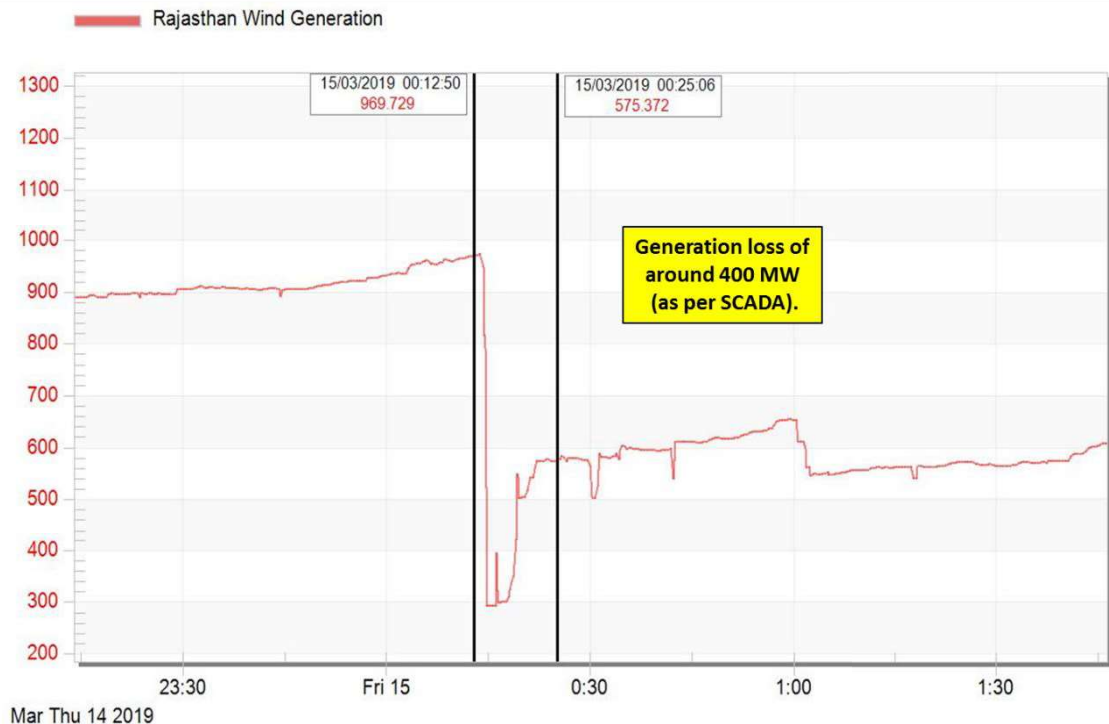


12. As per PMU data:

- Y-N fault followed by R-N fault. After 1000ms again Y-N fault
- Fault clearance time is **200ms & 360ms**.

13. SCADA data and SoE: Analog data was suspected and SoE didn't capture in NR SCADA. Wind generation loss of 400MW was captured.

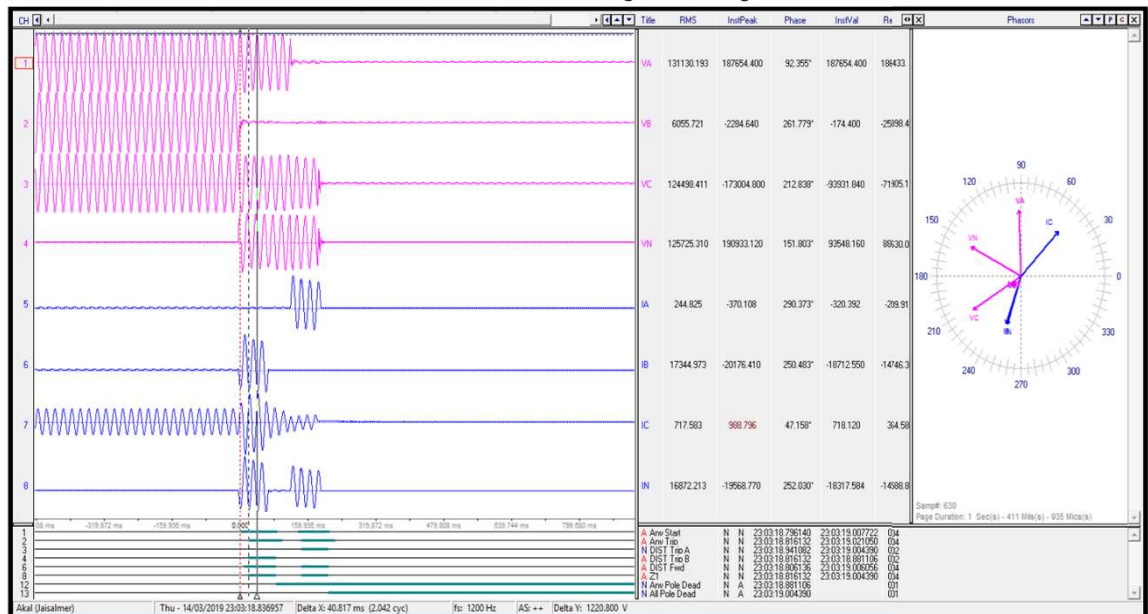
Rajasthan Wind Generation pattern during tripping



14. As per Rajasthan details:

Date & Time of event: -		: 15.03.2019 at 00.13 Hrs.					
Introduction of Event: -		: Tripping at 400 KV GSS Akal					
Total Loss of Generation		: NA					
Total Loss of Load: -		: NIL					
Triggering Incident:-							
Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	400 KV Ramgarh – Akal II	15.03.2019	00.13	15.03.2019	2.37	Akal-E/F	Y Ph Metering CT Burst at akal end of 220 Kv Akal – Bhu Line
2	400/220 Kv 315 MVA ICT II	15.03.2019	00.13	15.03.2019		O/C, E/F	
3	220 Kv Akal – Bhu	15.03.2019	00.13	15.03.2019		E/F	

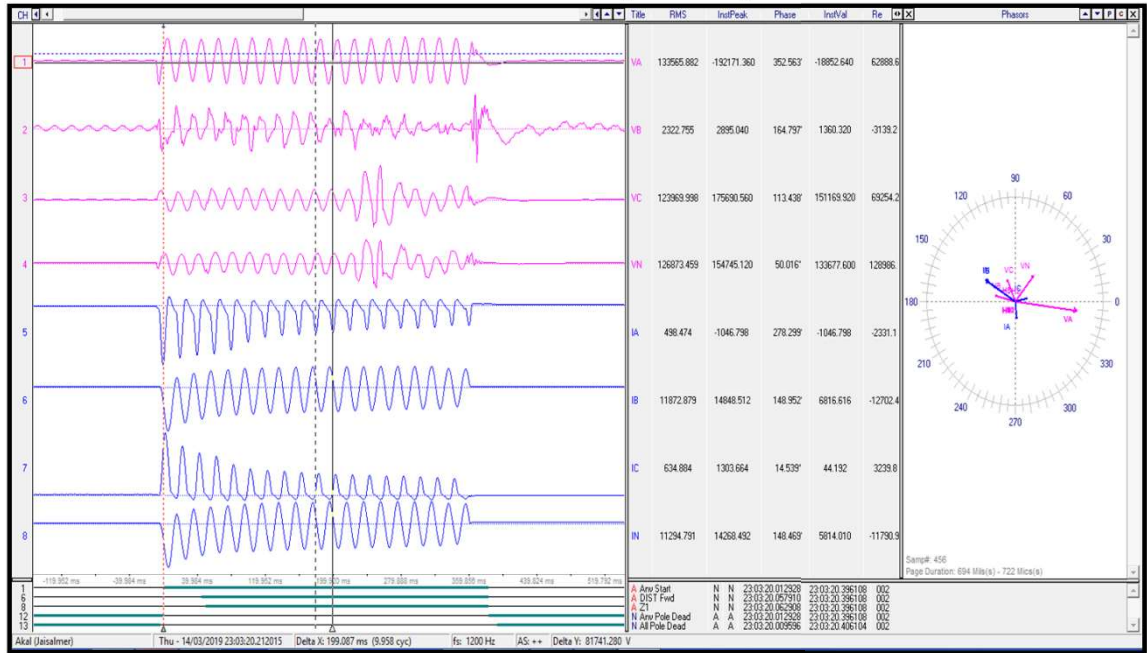
DR of 220 kV Akal (end)-Bhu ckt-1



Time Synch error?

Y-phase to earth fault followed by R-phase to earth fault

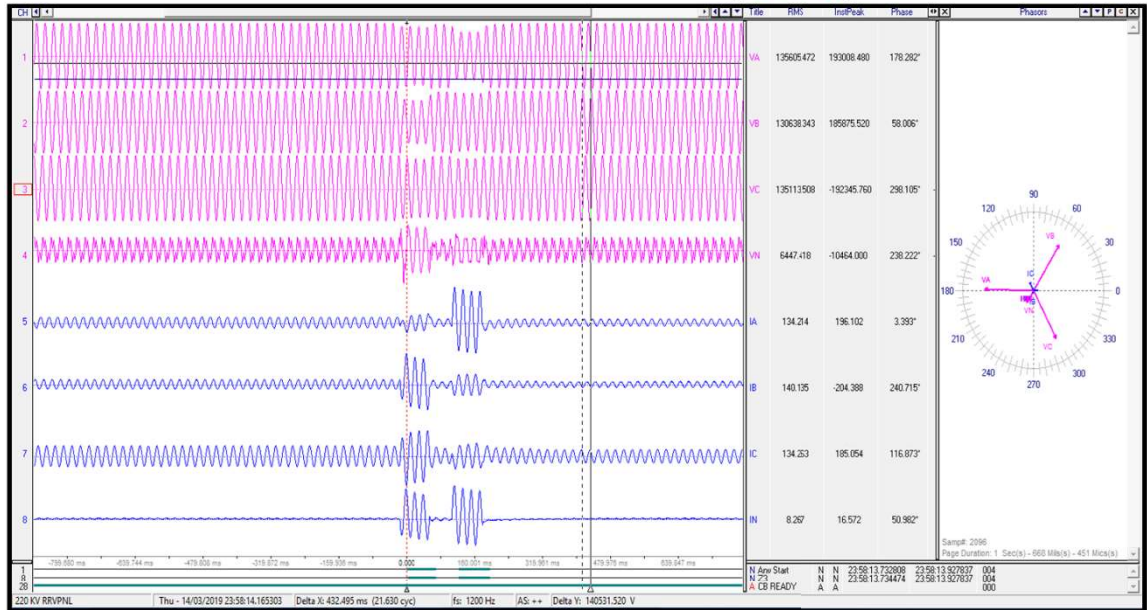
DR of 220 kV Akal (end)-Bhu ckt-1



Time Synchron error?

It seems all three phase of the line auto reclosed after three phase tripping

DR of 220 kV Barmer (end)-Akal



Time Synchron error?

Z-3 start and dropped

EL of 400 kV Akal(end)-Ramgarh

Type	Date & Time	Signal name	Status
P	15/03/2019 12:13:31:573 AM	TIE CB Rph OP	On
P	15/03/2019 12:13:31:567 AM	MCB Bph OPEN	On
P	15/03/2019 12:13:31:567 AM	TIE CB Yph OP	On
P	15/03/2019 12:13:31:566 AM	MCB Rph OPEN	On
P	15/03/2019 12:13:31:566 AM	MCB Yph OPEN	On
P	15/03/2019 12:13:31:565 AM	TIE CB Bph OP	On
P	15/03/2019 12:13:31:548 AM	AR BLOCK	On
P	15/03/2019 12:13:31:538 AM	TR_R_TBC_CB	On
P	15/03/2019 12:13:31:538 AM	TR_B_TBC_CB	On
P	15/03/2019 12:13:31:538 AM	TR_Y_TBC_CB	On
P	15/03/2019 12:13:31:538 AM	TR_Y_MAIN_CB	On
P	15/03/2019 12:13:31:538 AM	TR_R_MAIN_CB	On
P	15/03/2019 12:13:31:538 AM	TR_B_MAIN_CB	On
P	15/03/2019 12:13:31:535 AM	TRIP_3P_TBC	On
P	15/03/2019 12:13:31:535 AM	TRIP-Y	On
P	15/03/2019 12:13:31:535 AM	TRIP-R	On
P	15/03/2019 12:13:31:535 AM	TRIP_3P_MAIN	On
P	15/03/2019 12:13:31:535 AM	TRIP	On
P	15/03/2019 12:13:31:535 AM	TRIP-B	On
P	15/03/2019 12:13:31:534 AM	TEF_TRIP	On
P	15/03/2019 12:13:31:534 AM	TEF1-TRIP	On
P	15/03/2019 12:13:31:301 AM	L1 FUSE FAIL	On
P	15/03/2019 12:13:31:294 AM	EF START	On
P	15/03/2019 12:13:30:270 AM	EF START	Off
P	15/03/2019 12:13:30:263 AM	L1 FUSE FAIL	Off
P	15/03/2019 12:13:30:242 AM	L1 FUSE FAIL	On
P	15/03/2019 12:13:30:207 AM	EF START	On
P	15/03/2019 12:13:30:142 AM	EF START	Off
P	15/03/2019 12:13:30:087 AM	EF START	On

Time Synchronisation error?
Fuse fail alarm

15. As per Rajasthan Report:

- 220 kV Akal – Bhu ckt-1 tripped in Z1 from Akal end on actual fault (metering CT burst at Akal) in A & B phase.
- 400/220 kV, 315 MVA ICT-1 tripped on instantaneous E/F from 220 kV side and 400 kV side CB tripped on inter trip.
- 400 kV Akal – Ramgarh line tripped on E/F feature (Non-directional) from Akal end and CB of Akal-Ramgarh line tripped from Ramgarh end on DT received.
- 220 kV Akal – Amarsagar line tripped in Z2 from remote (Amarsagar) end.
- 220 kV Akal – Barmer line tripped in Z2 from remote (Barmer) end.

16. Reason of tripping: CB of 220 kV Akal –Bhu line took more time to clear the fault. 400/220 kV, 315 MVA transformer tripped on high set E/F which are wrongly enable. 400 kV Akal line tripped on non-directional E/F due to incorrect setting. 220kV Bus bar relay is out of order due to communication error.

17. Remedial Measures taken as per Rajasthan report:

- Setting of E/F protection in 400/220 kV 315 MVA transformer (220 kV side) has been revised.

- Stage-2 E/F setting in distance relay of 400 kV Akal (end)-Ramgarh line has been disabled and fuse fail logic settings have been revised.
- Timing of 220 kV Akal – Bhu line checked after arranging test kit and proper shutdown.
- 220 kV Bhadla – RSDCL 1 – 1 & 2 Ckt O/C setting at RSDCL-1 side revised.
- 220/132 kV, 160 MVA transformer O/F (over flux protection) setting revised at 220 kV Kanasar GSS end

18. Preliminary Report & partial DR details received but detailed report in desired format is still awaited from Rajasthan. Station EL detail is also not submitted.

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. Antecedent connectivity at 220 kV side of 400/220 kV Akal station
3. A/R functioning in 220 kV Akal-Bhu ckt-1 needs to be looked into in view of three phase A/R after 1000ms of fault initiation and tripping of all three phase of the line.
4. Reason of tripping of 220 kV Akal-Ramgarh and Akal-Amarsagar line from remote end in Z-2, as fault got clear in less than Z-2 time limit?
5. Healthiness of bus bar protection/ LBB protection at 400/220 kV Akal (Raj) needs to be ensured.
6. W.r.t. the Wind generation tripping, the aspect of tripping of Wind generation from angle of the absence Fault Ride Through (FRT) or Low Voltage Ride Through (LVRT) has asked from Rajasthan. No information in this regard received at NRLDC/ NRPC.
7. Details of Generation/ Load loss needs to be checked and reported.
8. Changes in the settings (earth fault protection setting in ICT and line and fuse failure in line) needs to be shared with NRLDC/ NRPC.
9. Protection Audit of 400/220 kV Akal station is urgently required in view of multiple times tripping in the station and important pooling station for wind generation.
10. Availability of SCADA Analog data and Digital data needs to be ensured.
11. Availability & Healthiness of station event logger needs to be ensured.
12. Time synchronization of DR/EL needs to be looked into.
13. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

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.

K. Complete outage of 220kV Salal HEP(NHPC) at 18:37hrs on 18-Mar-19

Event category: GD-1

Generation loss: 600MW (As per NHPC report)

Loss of load: Nil (J&K may confirm)

Energy load: Nil

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		400ms	As per PMU data
Phase of the fault		Dip in all three phase	As per PMU data

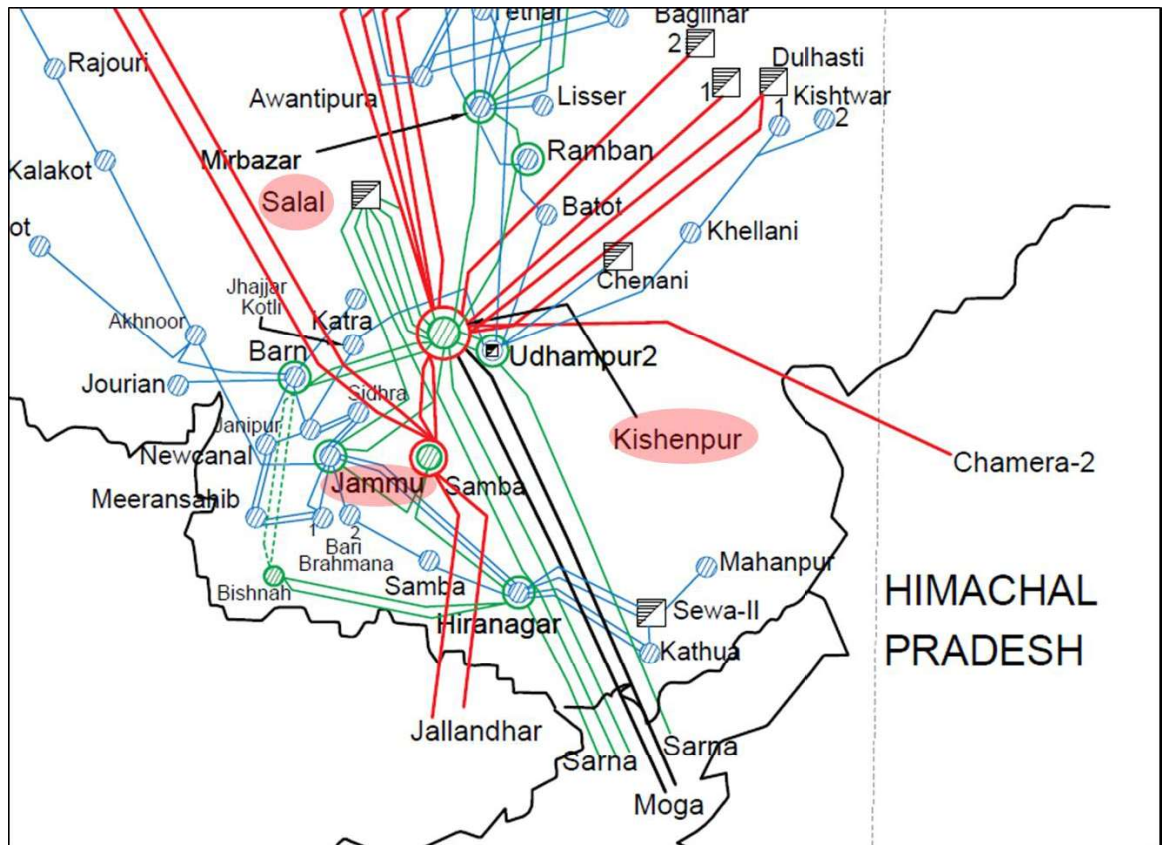
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Received	Time Synch error
DR/ EL	NHPC	Received	After 24hrs
	POWERGRID	Not Received	
	J&K	Not Received	
Preliminary Report	NHPC	Received	After 24hrs
	POWERGRID	Received	Within 24hrs
	J&K	Not Received	
Detailed Report	NHPC	Received	After 24hrs

Description	Clauses	Utility	Remarks
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Violation of Clauses	<p>1. IEGC 5.2.r & 5.9.6.c (VI)</p> <p>2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2)</p> <p>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)</p> <p>CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2</p> <p>4. CEA GRid Standard 2010-3.e & CEA Transmission Planning Criteria</p>	NHPC, J&K	<p>1. Preliminary Report, DR/EL within 24hrs</p> <p>2. Adequately Sectionalized and graded protective relaying system</p> <p>3. Incorrect/ mis-operation / unwanted operation of Protection system</p> <p>4. Delayed Clearance of fault</p>
Violation of Clauses	<p>1. IEGC 5.2.r & 5.9.6.c (VI)</p> <p>2. CEA grid Standard 15.3</p>	POWERGRID	<p>1. Preliminary Report received within 24hrs but DR/EL yet to be received</p>

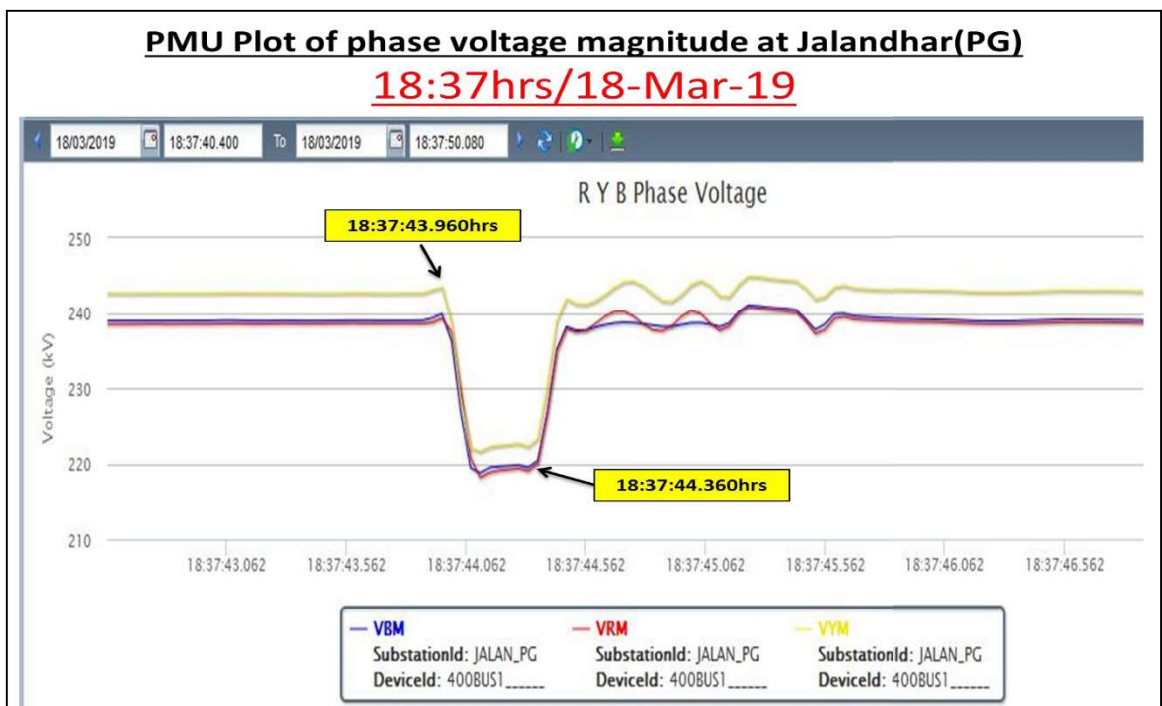
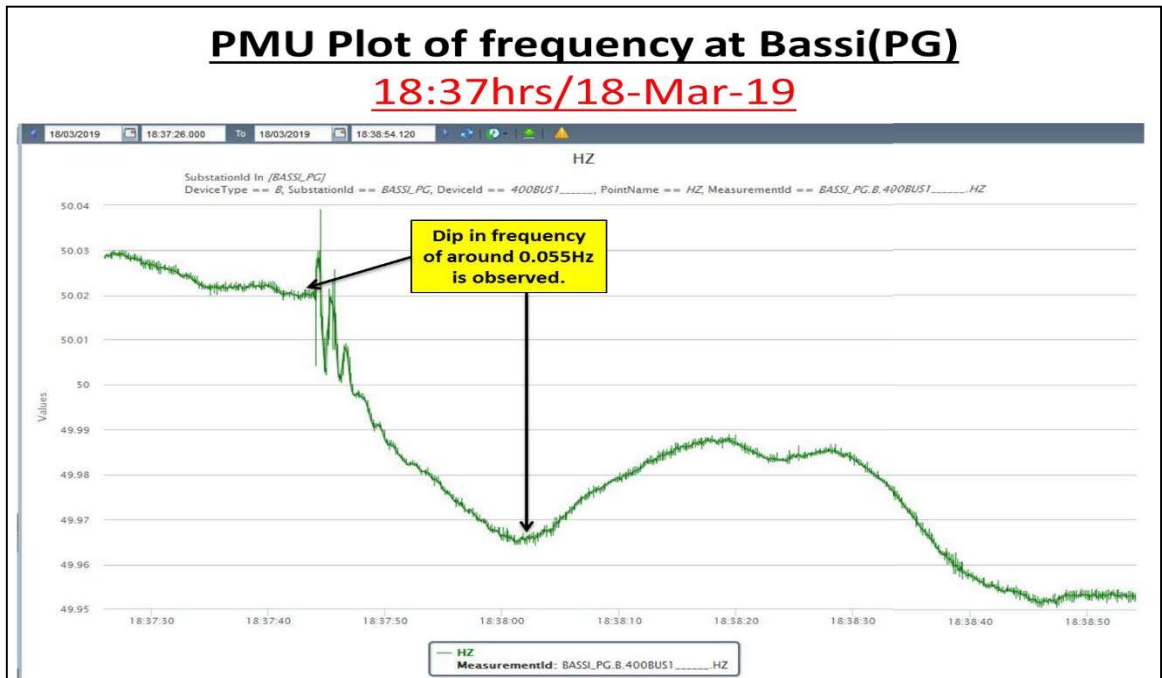
Based on above information description of the events is:

1. Connectivity diagram of 220kV Salal HEP (NHPC):



2. 220kV Salal HEP has 6 units of 115MW each. It is connected through Kishenpur(PG) 4 ckts and Jammu(PDD-JK) D/C. It has DMT (double main transfer bus) bus bar scheme.
3. In antecedent conditions:
 - Unit #1 at Salal was not in service.
 - SCADA implementation testing was going on at Salal. Kishenpur-3 line was kept at bus-2 keeping all other elements on bus-1 with BC closed.
4. At 18:37hrs on 18-Mar-19, R-phase jumper snapped. This may have resulted into bus fault of bus-1. (as no other fault observed).
5. Bus bar protection didn't operate. As a result, all 220kV elements along with units at Salal tripped.
6. All 220kV lines tripped from remote end except Jammu ckt-2. Subsequently, whole Salal generation was evacuating through single 220kV ckt (Jammu-2). As a result, power swing occurred. 220kV Jammu-2 tripped from Salal end on power swing.
7. Due to loss of evacuation, all units tripped on over frequency.
8. NHPC further provided information about commissioning of bus bar scheme at Salal and it been put in operation on 21-Apr-2019.
9. Name of the tripped element: All elements connected to 220kV Salal HEP tripped
 - Unit #2, #3, #4, #5 and #6 at Salal HEP.
 - 220kV Salal(NHPC)-Kishenpur(PG) 4 ckts
 - 220kV Salal(NHPC)-Jammu(PDD-J&K) D/C

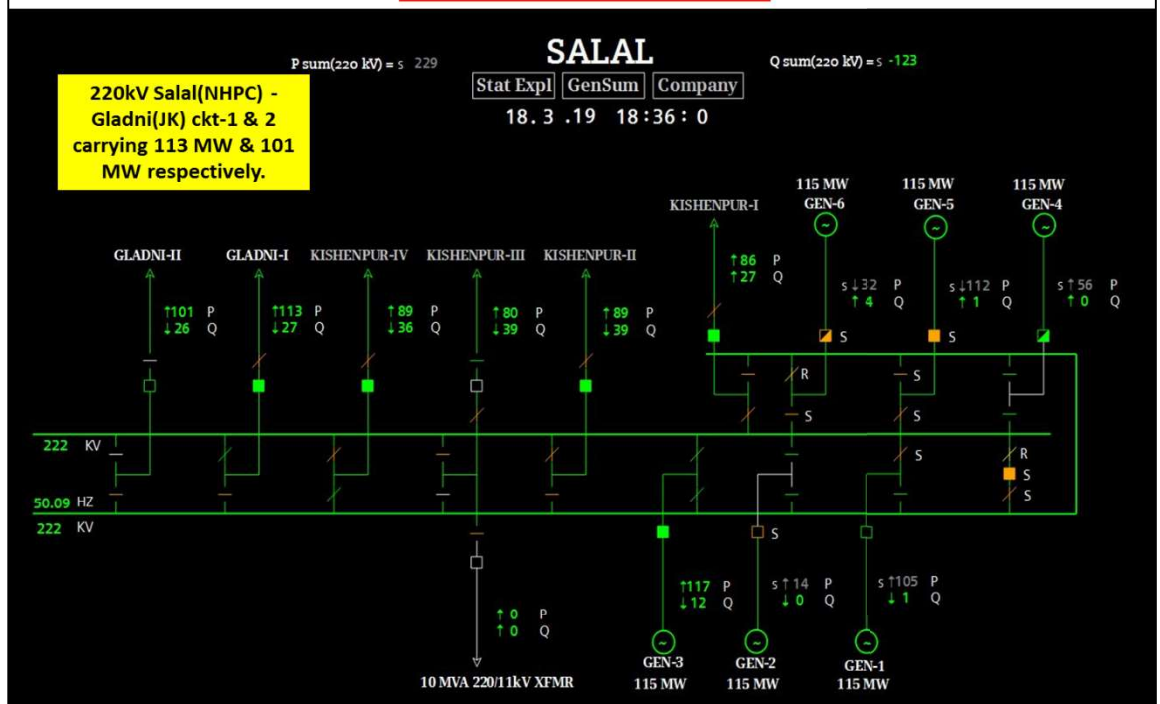
10. PMU plots:



11. SCADA data and SoE:

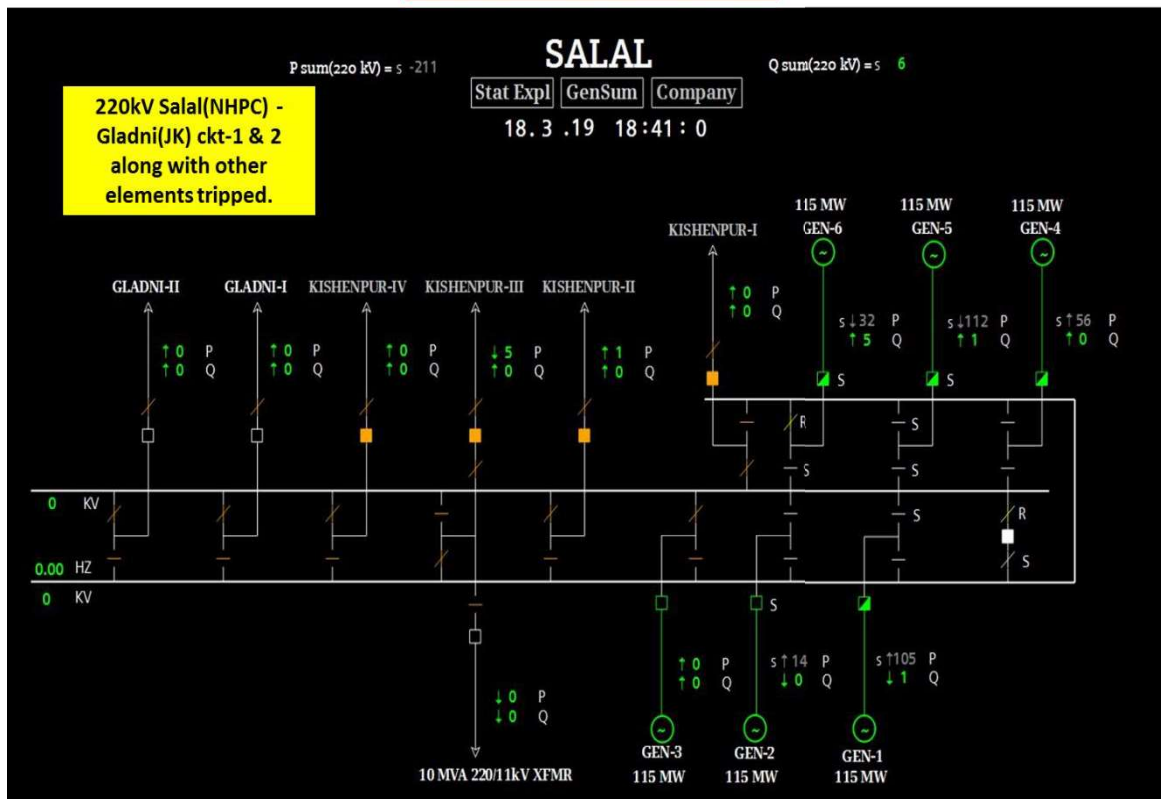
SLD of 220kV Salal(NHPC) before the incident

18:36hrs/18-Mar-19



SLD of 220kV Salal(NHPC) after the incident

18:41hrs/18-Mar-19



NR SCADA SOE

Time (in hrs)	Station	Voltage (in kV)	Element	Type	Status
18:37:44:350	KISHENPUR	220	04SALAL4	CB	Open
18:37:44:360	KISHENPUR	220	03SALAL3	CB	Open
18:37:44:371	KISHENPUR	220	01SALAL1	CB	Open
18:37:44:371	KISHENPUR	220	02SALAL2	CB	Open

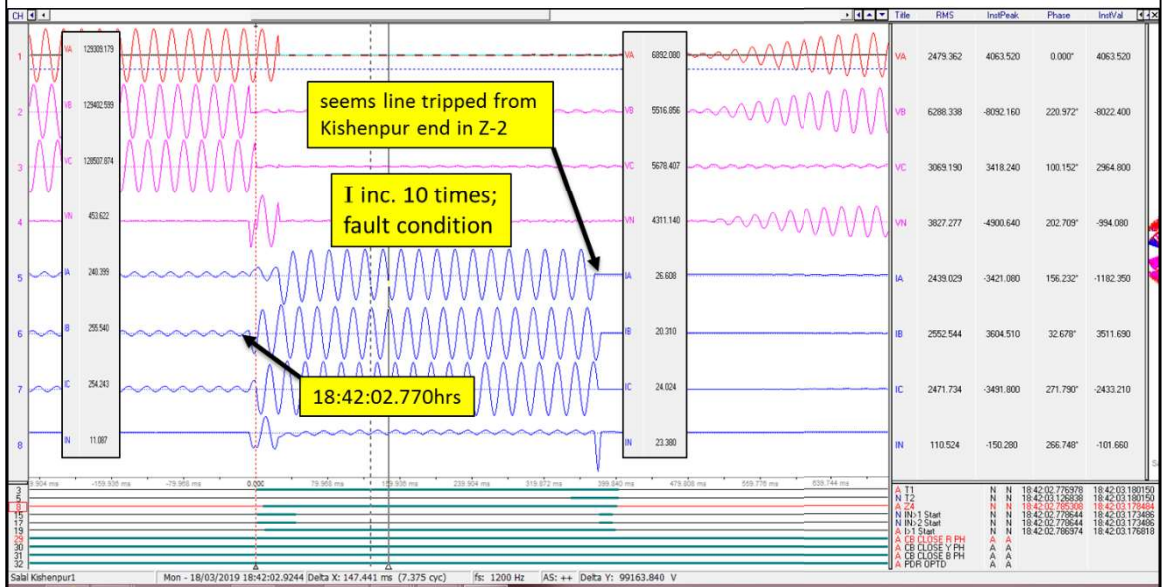
12. As per NHPC details:

NHPC Detailed Report

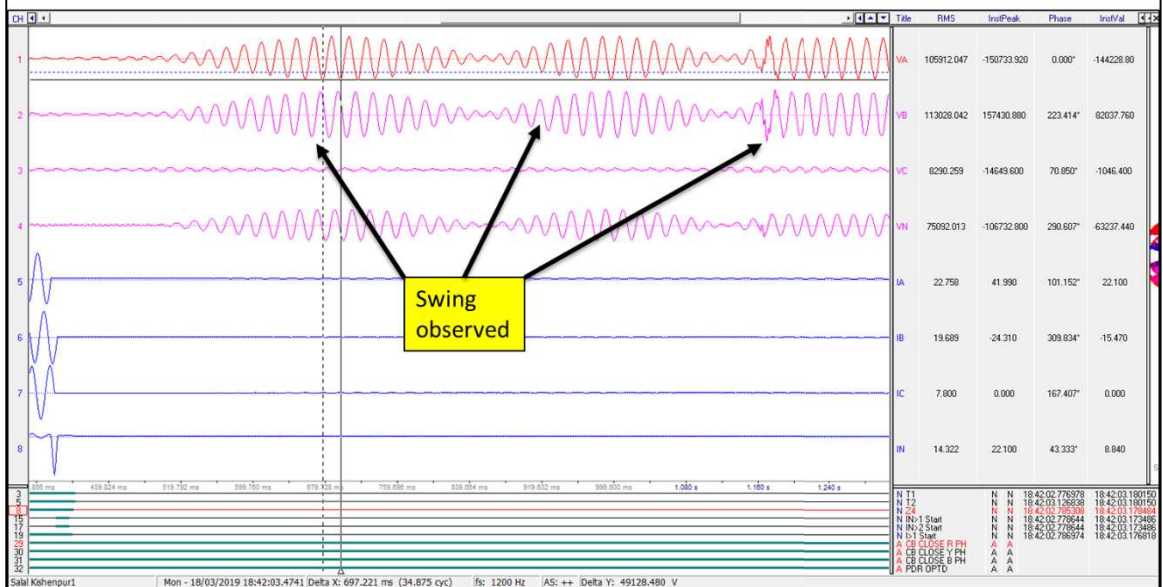
3. Brief Event summary	Five units and six lines were in operation. Due to ongoing SCADA implementation and testing, Kishanpur-3 Line was kept on Bus-2 and all other active elements were kept on Bus-1 with bus coupler in closed condition. Due to bus fault all the active elements got tripped.
B. Antecedent Conditions:	
1. Weather Information	Normal
2. Additional relevant information viz. power flow, shutdown etc.	NA
C. Event Data:	
1. Change in Frequency.	N.A.
2. Generation Loss/Load Loss.	600 MW
3. Single Line Diagram (SLD) of affected Area:	NA
4. Name and time of the tripped elements in time chronology:	Unit#2 at 18:36 hrs. on 18-Mar-2018 Unit#3 at 18:36 hrs. on 18-Mar-2018 Unit#4 at 18:36 hrs. on 18-Mar-2018 Unit#5 at 18:36 hrs. on 18-Mar-2018 Unit#6 at 18:36 hrs. on 18-Mar-2018 Kishanpur-1 at 18:36 hrs. on 18-Mar-2018 Kishanpur-2 at 18:36 hrs. on 18-Mar-2018 Kishanpur-3 at 18:36 hrs. on 18-Mar-2018 Kishanpur-4 at 18:36 hrs. on 18-Mar-2018 Jammu-1 at 18:36 hrs. on 18-Mar-2018 Jammu-2 at 18:36 hrs. on 18-Mar-2018
5. Location and type of fault.	Bus-1 fault.
6. Flag Details, DR and EL for each affected element:	Already Sent.
7. Appropriate Graphical Plot:	N.A.
8. Equipment failure (if any):	NIL.
D. Event Description/ Analysis of the Event	<p>1. From the DR of Line and Unit protection relays following is observed:</p> <p>a. Kishanpur #1, 2, 3, 4 and Jammu#1 Line tripped from remote end (may be on Zone-2).</p> <p>b. Jammu-2 Line tripped from Salal end in Zone-1 (during Power Swing) after 1.5 Sec of the fault.</p> <p>c. All running units tripped on over frequency Protection due to load throw off.</p> <p>2. Analysis:</p> <p>R-phase jumper of Kishanpur-3 line snapped and might have caused three phase fault of Bus-1(no other fault was observed in the switchyard). Bus bar differential relay did not operate and hence all the lines (except Jammu-2 line) tripped only from remote end. From the DR of Jammu-2 line it is evident that the line did not tripped from remote end in Zone-2 time and as the total generation was subject to evacuate through only one line at that instant, severe Power Swing got established. The impedance during Power Swing entered into Zone-1 and the line got tripped from Salal end.</p> <p>All the five running units got tripped on over frequency due to load throw off.</p>

E. Restoration	
1. Restoration time of tripped elements in time chronology	Unit#2 at 20:31 hrs. on 18-Mar-2018 Unit#3 at 20:01 hrs. on 18-Mar-2018 Unit#4 at- Not Restored. Unit#5 at 20:16 hrs. on 18-Mar-2018 Unit#6 at 20:21 hrs. on 18-Mar-2018 Kishanpur-1 at 19:51 hrs. on 18-Mar-2018 Kishanpur-2 at 19:51 hrs. on 18-Mar-2018 Kishanpur-3 at 21:44 hrs. on 18-Mar-2018 Kishanpur-4 at 19:51 hrs. on 18-Mar-2018 Jammu-1 at 20:04 hrs. on 18-Mar-2018 Jammu-2 at 11:15 hrs. on 19-Mar-2018
2. Special finding/ issues identified during restoration	
A. Remedial Action	
1. Remedial Action Taken.	Nil
2. Remedial Action to be taken along with time frame.	The non-operation of bus bar protection is being investigated. However, the bus bar protection panel has been shifted to switchyard from control room as per new scheme. After installation of the panel, through checking & testing of bus bar scheme shall be carried out at the earliest.
G. Lesson Learnt	
NIL.	
A. Any other Information	
NIL.	

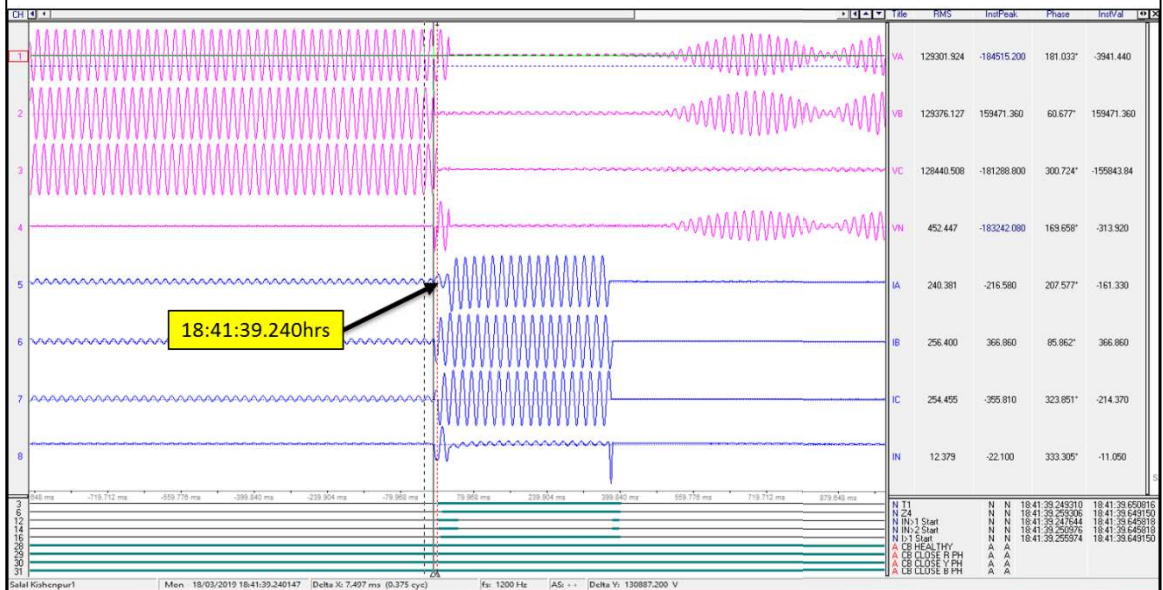
DR: 220kV Salal(end)-Kishenpur-1 (M1)



DR: 220kV Salal(end)-Kishenpur-1 (M1)

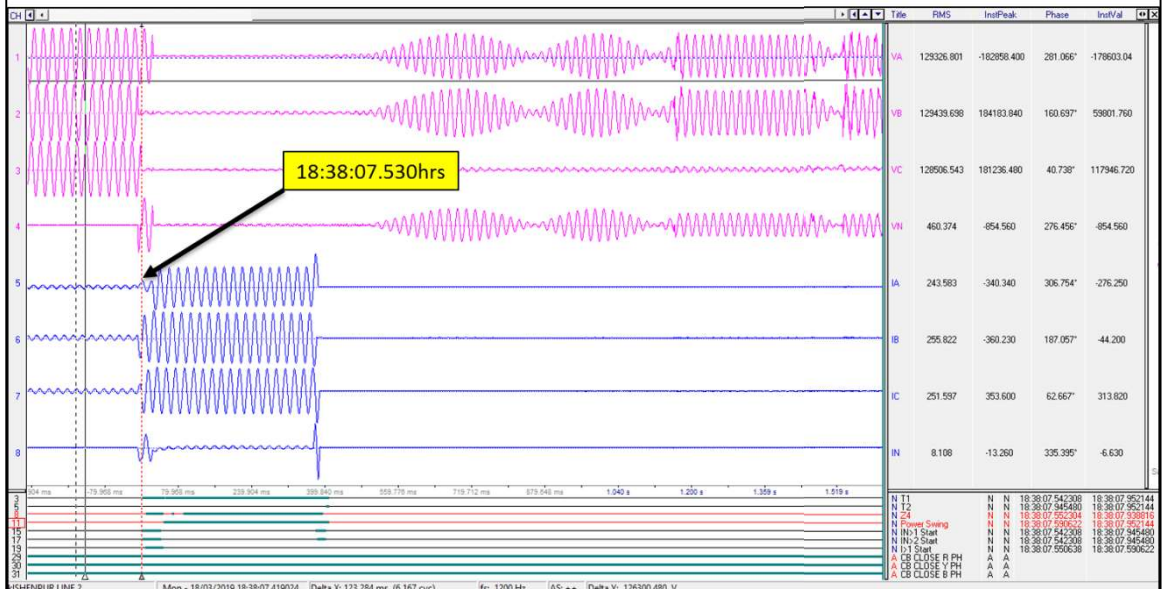


DR: 220kV Salal(end)-Kishenpur-1 (M2)

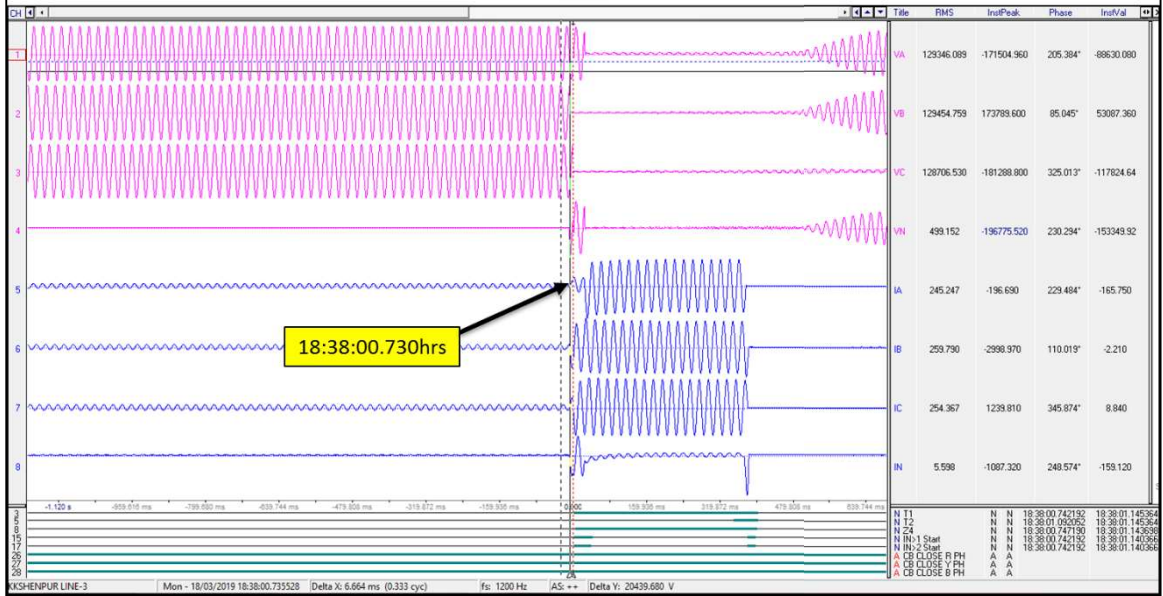


Time synchronization issue. Even M1, M2 relays are not in time synchronization.

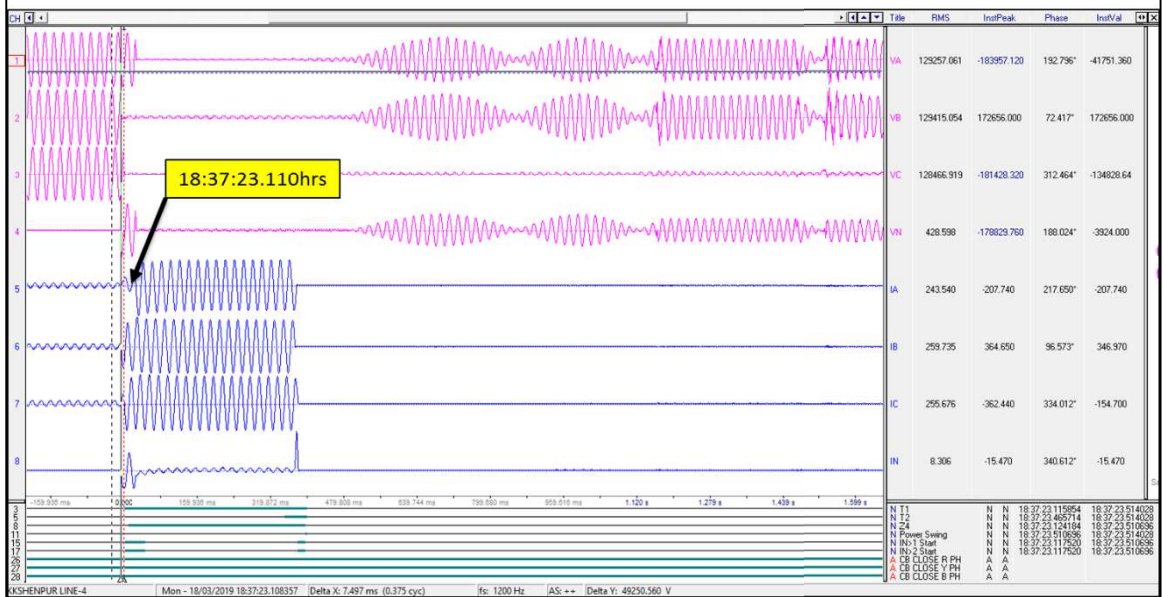
DR: 220kV Salal(end)-Kishenpur-2



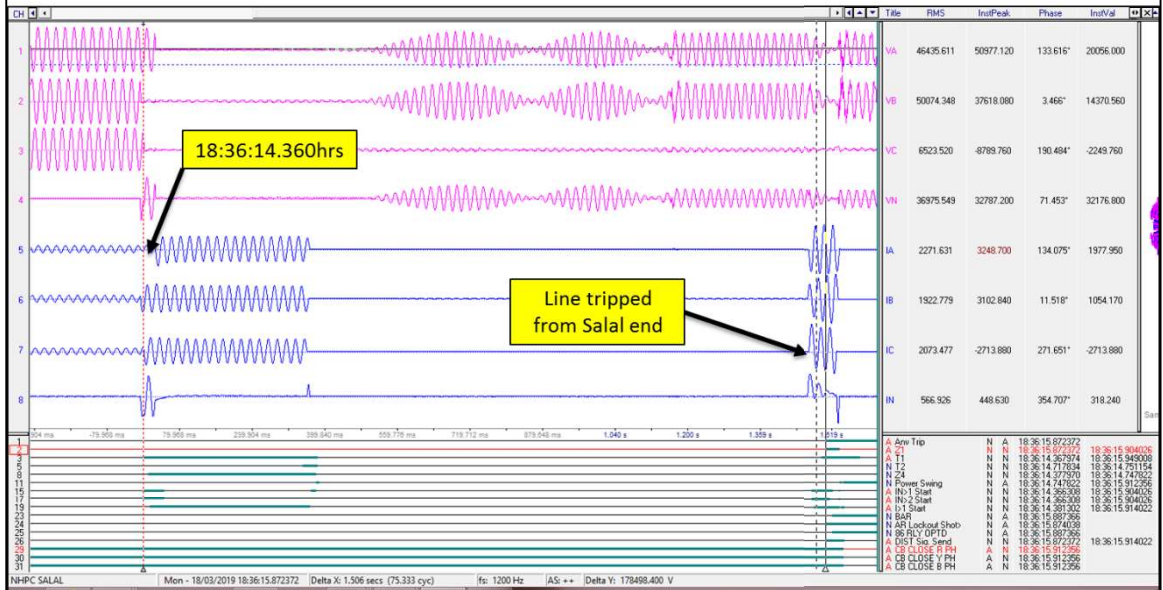
DR: 220kV Salal(end)-Kishenpur-3



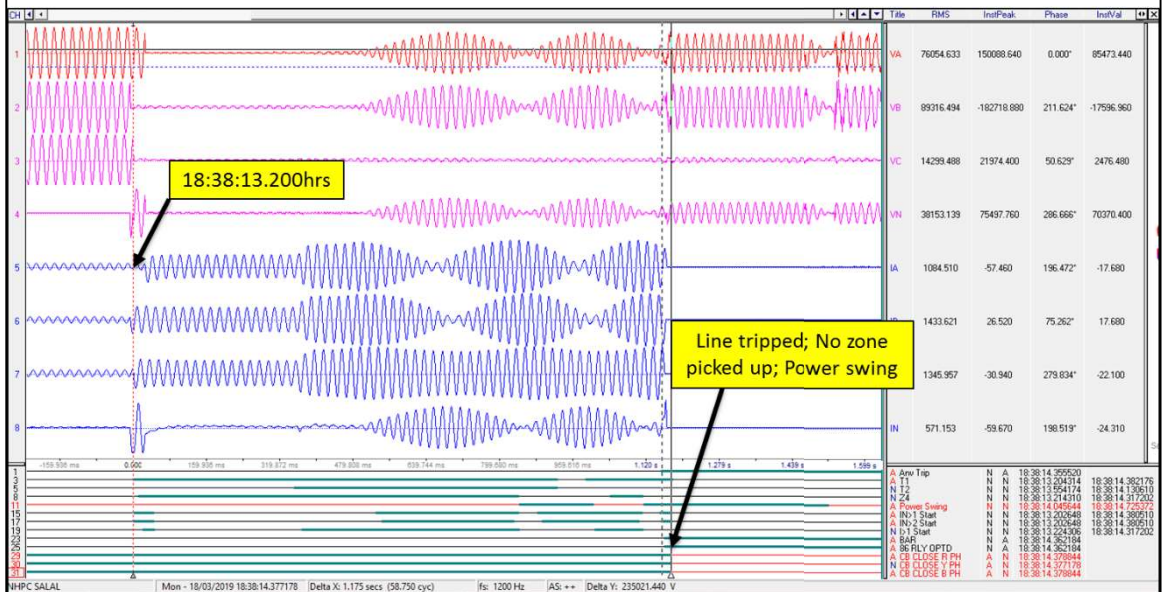
DR: 220kV Salal(end)-Kishenpur-4



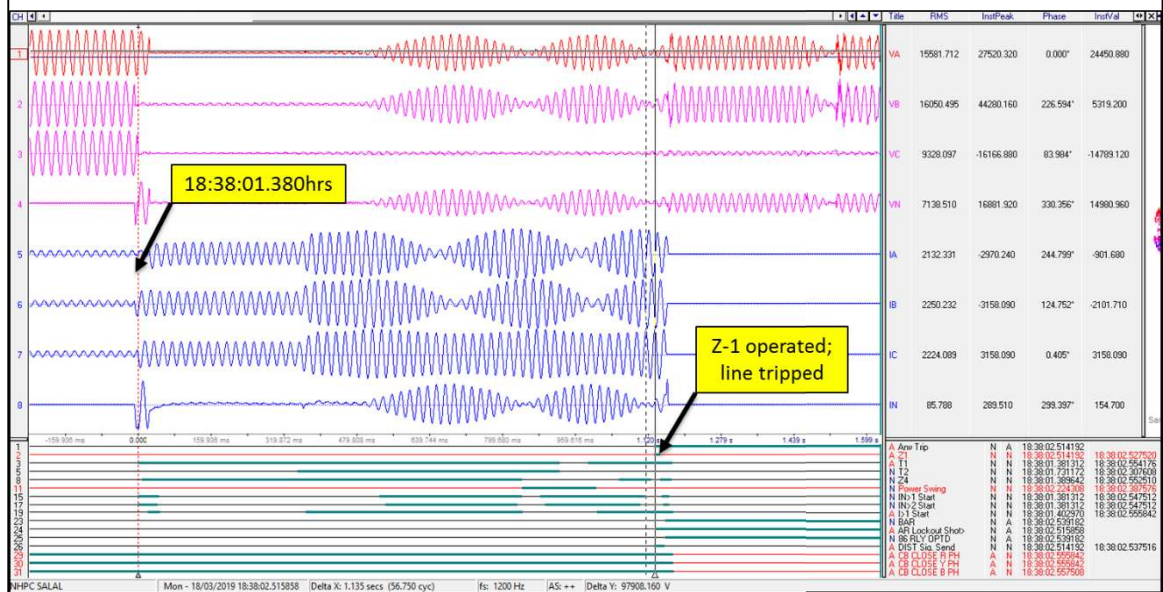
DR: 220kV Salal(end)-Jammu-1



DR: 220kV Salal(end)-Jammu-2 (M1)



DR: 220kV Salal(end)-Jammu-2 (M2)



POWERGRID Detailed Report

A. Introduction

1. Time & Date of Event : 1842 Hrs at 18.03.2019

A. Substation(s) affected along with voltage level : 400 kV Kishenpur, 220 kV Jammu

B. **Brief Event Summary** : 220 kV Salal I, II, III, IV & Salal Jammu I & II tripped from Salal end due to Bus bar operation at Salal End.

C. Antecedent Conditions :

1. Weather Information : Rainfall
2. Additional relevant information viz. power flow, shutdowns etc.:

D. Event data :

1. Change in Frequency : Nil

2. Generation Loss / Load Loss : NA

3. Single Line Diagram (SLD) of affected Area : NA

4. Name and time of the tripped elements in time chronology:

a) 220 KV Kishenpur Salal I, II, III & IV tripped on 18.03.2019 at 1842 Hrs due to Bus bar operation at Salal end.

1. DR and EL for each affected element:

2. Appropriate Graphical Plot :

3. Equipment failure (if any) : N/A

POWERGRID Detailed Report

Event Description / Analysis of the Event:

220 kV Kishenpur Salal I, II, III & IV and 220 kV salal Jammu I & II

Bus Bar operated at Salal end as confirmed by Salal. Carrier not received from Salal end.

Activities of control room shifting is going on at Salal end which includes shifting of PLCC panels. The matter is under investigation and will be rectified.

Restoration:

220 kV Kishenpur Salal I: 18.03.2019, 1922 Hrs

220 kV Kishenpur salal II: 18.03.2019, 1925 Hrs

220 kV Kishenpur Salal III: Still out

220 kV Kishenpur salal IV: 18.03.2019, 2019 Hrs

220 kV Jammu Salal I: 18.03.2019, 2006 Hrs

220 kV jammu salal II: Still out

Special finding/ issues identified during restoration:

Bus bar tripping at Salal end. No fault in Line or at POWERGRID end.

13. As per PMU, SCADA SoE AND DR data:

- As per PMU, DR and SCADA SoE, 3-phase fault occurred at 18:37:43.960hrs.
- Fault Clearance time: 400ms
- As per SoE, 220kV Salal-Kishenpur all 4 ckts tripped from Kishenpur end at around 18:37:44.360hrs.
- As per DR, 220kV Kishenpur 4 ckts and 220kV Jammu ckt-1 tripped likely from remote end.
- Salal end DRs seems to be unsynchronized.

14. Preliminary Report received within 24hrs from POWERGRID. DR/EL and detailed report received after 24hrs from NHPC. DR/EL yet to be received from POWERGRID, J&K. Report yet to be received from J&K.

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. In case of R-phase jumper snapping, how three phase fault created in the system?
3. As per NHPC report, non-operation of bus bar protection was under investigation. NHPC may share the results of the investigation.
4. For 220kV Salal-jammu-2 line, As per DR(M1) power swing tripping occurred. However, as per DR(M2) distance Z-1 operated (without power swing signal). Exact reason for tripping of aforesaid ckt to be confirmed with supporting data. Setting of power swing,

information like blocking of any distance zone in case of power swing to be shared from Salal end.

5. Reason of capturing of fault after 1.5 second in 220 kV Salal-Jammu ckt-1?
6. Reason for non-tripping of 220kV Salal-jammu-2 from Jammu end to be shared.
7. POWERGRID informed that 220 kV Kishenpur-Salal ckts tripped from Salal end only however as per information received from NHPC, it seems that these lines tripped from Kishenpur end in Z-2. POWERGRID may confirm the status of tripping of 220 kV Kishenpur-Salal line from Kishenpur end.
8. NHPC may confirm whether NRLDC was informed about the testing.
9. Time synchronization of DR (Salal end) to be looked into.

NHPC/POWERGRID/J&K may elaborate the incident in line with above points, present and submit the remaining details 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 400/220 kV Gurgaon (PG), 220/66/33kV Gurgaon sec-72 (HVPNL) at 00:38hrs of 30th Mar 2019

Event category: GD-1

Generation loss: Nil

Loss of load: 350MW (Haryana may confirm)

Energy load: 0.39MU (Haryana may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		1680ms	As per PMU data
Phase of the fault		B-N fault occurred, followed by Y-B-N fault, followed by R-Y fault	As per PMU data

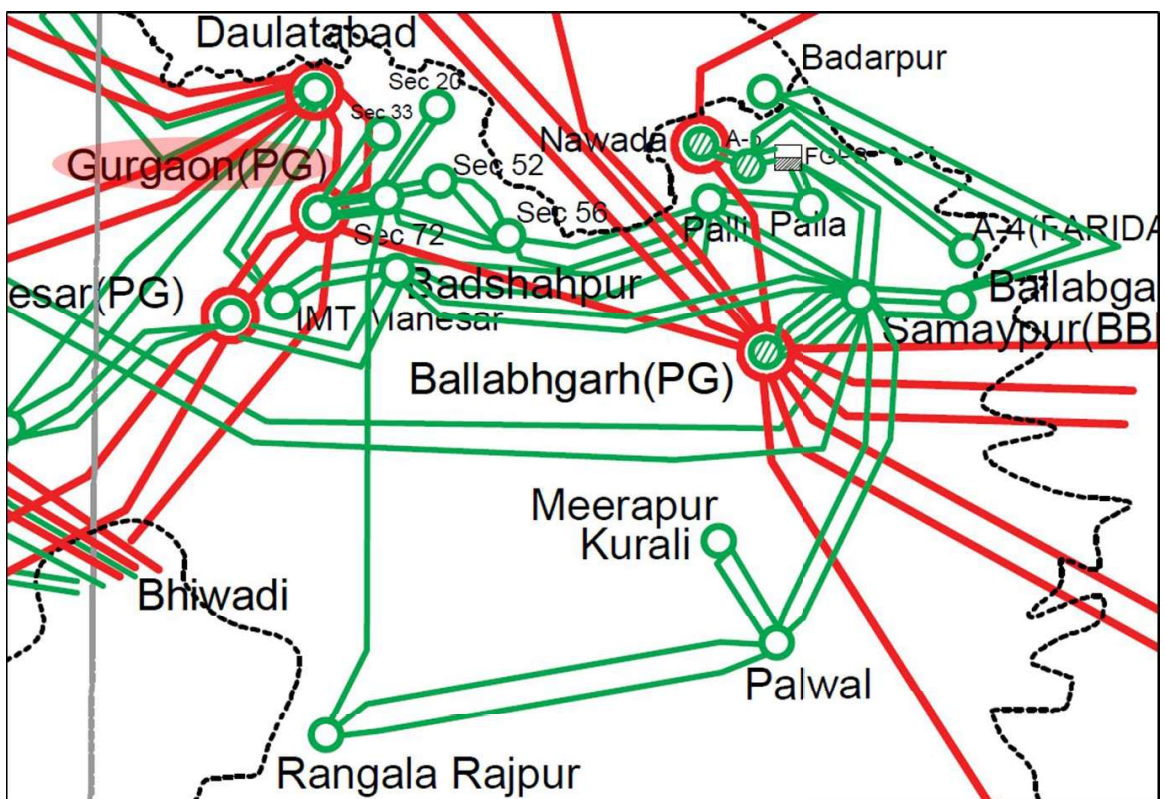
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Received	Time Synch error
DR/ EL	Haryana	Not Received	
	POWERGRID	Received	After 24hrs
Preliminary Report	Haryana	Not Received	
	POWERGRID	Received	After 24hrs
Detailed Report	Haryana	Not received	

Description	Clauses	Utility	Remarks
Violation of Clauses	<p>1. IEGC 5.2.r & 5.9.6.c (VI)</p> <p>2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2)</p> <p>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)</p> <p>CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2</p> <p>4. CEA GRid Standard 2010-3.e & CEA Transmission Planning</p>	Haryana	<p>1. Preliminary Report, DR/EL within 24hrs</p> <p>2. Detailed Report yet to be received</p> <p>3. Adequately Sectionalized and graded protective relaying system</p> <p>4. Incorrect/ mis-operation / unwanted operation of Protection system</p> <p>5. Delayed Clearance of fault</p>

	Criteria		
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	POWERGRID	1. Preliminary Report, DR/EL details received after 24hrs

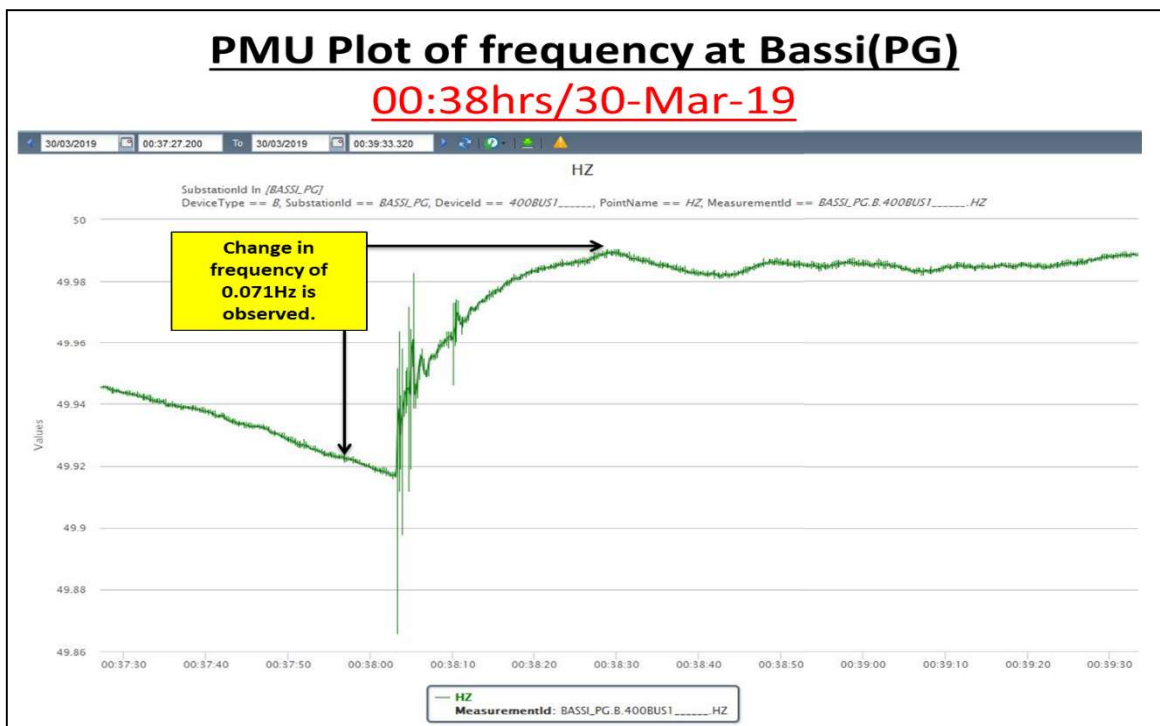
Based on above information description of the events is:

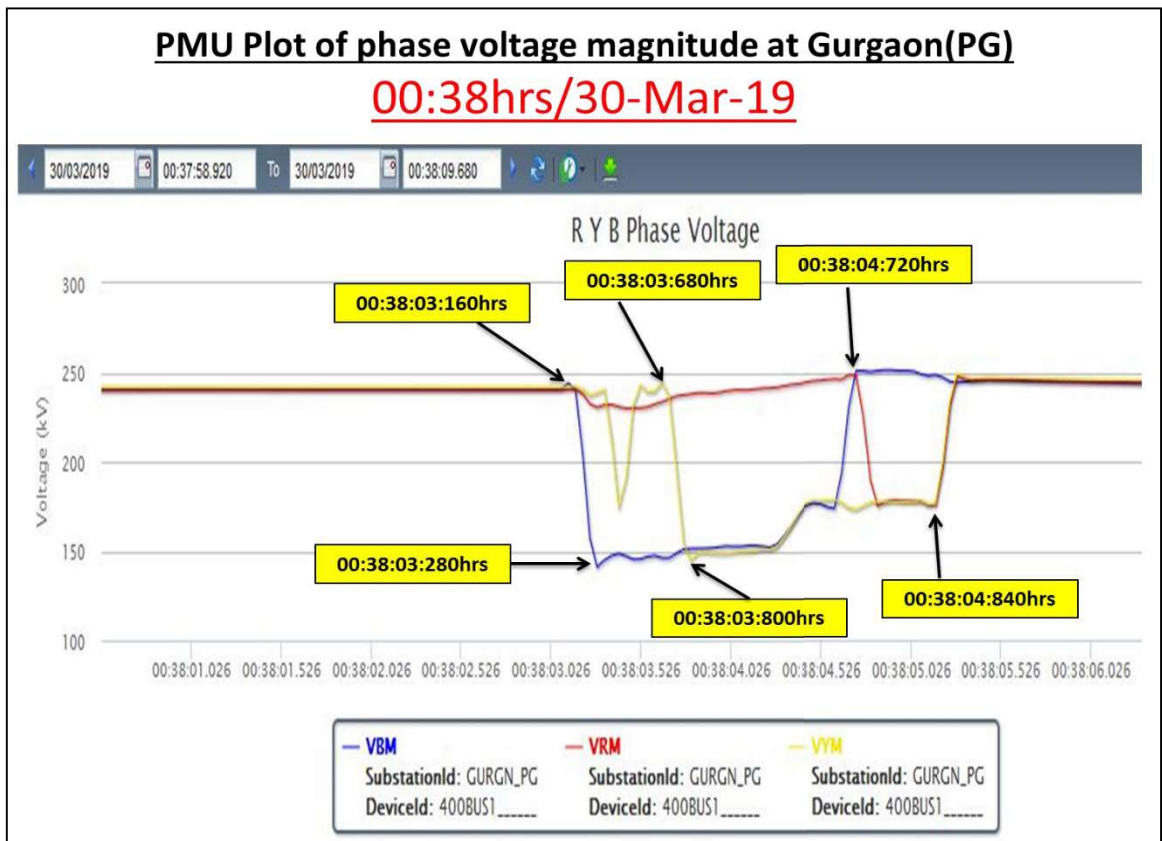
1. Connectivity diagram of Gurgaon(PG) and Gurgaon sec-72(HVPNL):



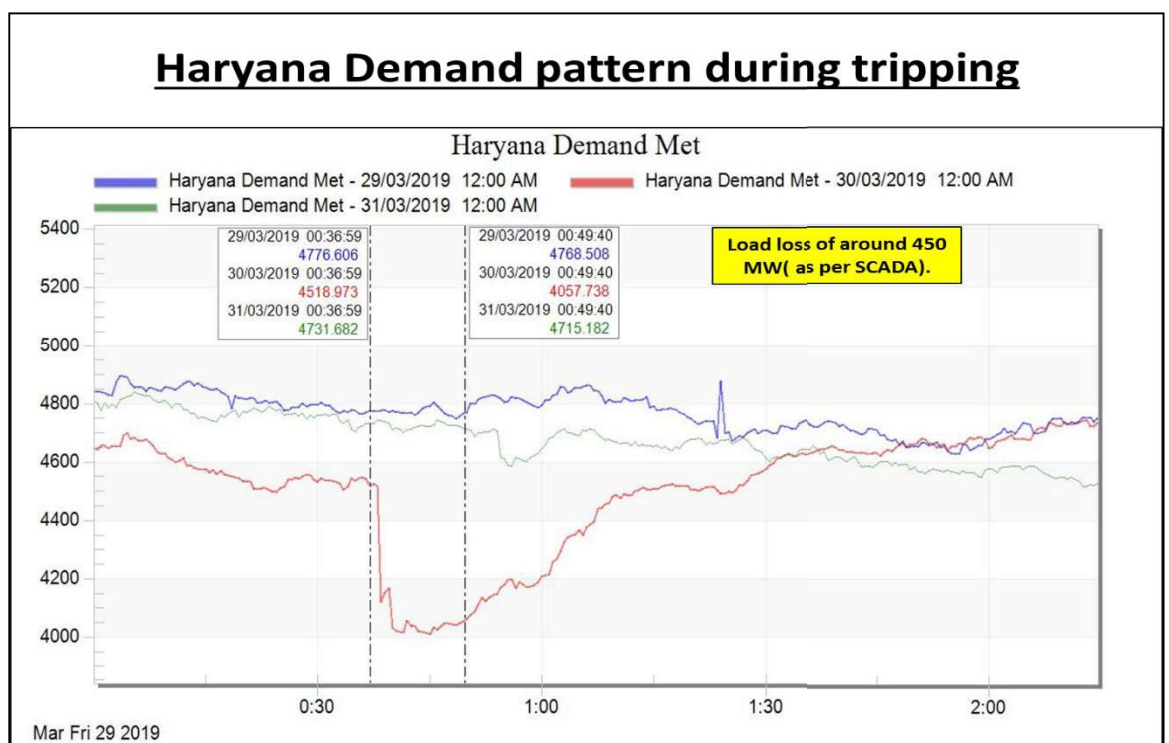
2. 400/220kV Gurgaon(PG) is connected at 220kV through sec-72(HVPNL) 4 ckts and sec-33 D/C. It has DMT (double main transfer bus) bus bar scheme. Also, it has two 500MVA 400/220kV ICTs.
3. 220kV Gurgaon Sector-72(HVPNL) is connected at 220kV through Gurgaon(PG) 4 ckts, Sector-20 D/C, Sector-56 D/C and Sector-52 D/C.

4. At 00:38hrs on 30-Mar-19, CT blasted at Gurgaon 220 kV Sector-72. Bus bar protection operated resulted in tripping of all 4 ckts of 220kV Gurgaon Sector-72(HVPNL)-Gurgaon(PG).
5. At 400/220 kV Gurgaon(PG), both 400/220 kV 500MVA ICTs tripped on back up overcurrent earth fault protection operation.
6. Name of the tripped element:
 - 220kV Gurgaon Sector-72(HVPNL)-Gurgaon(PG) ckt-1
 - 220kV Gurgaon Sector-72(HVPNL)-Gurgaon(PG) ckt-2
 - 220kV Gurgaon Sector-72(HVPNL)-Gurgaon(PG) ckt-3
 - 220kV Gurgaon Sector-72(HVPNL)-Gurgaon(PG) ckt-4
 - 160MVA ICTs at Gurgaon sec-72(HVPNL)
 - 500MVA 400/220kV ICT #1 and ICT #2 at Gurgaon(PG)
7. PMU plots:



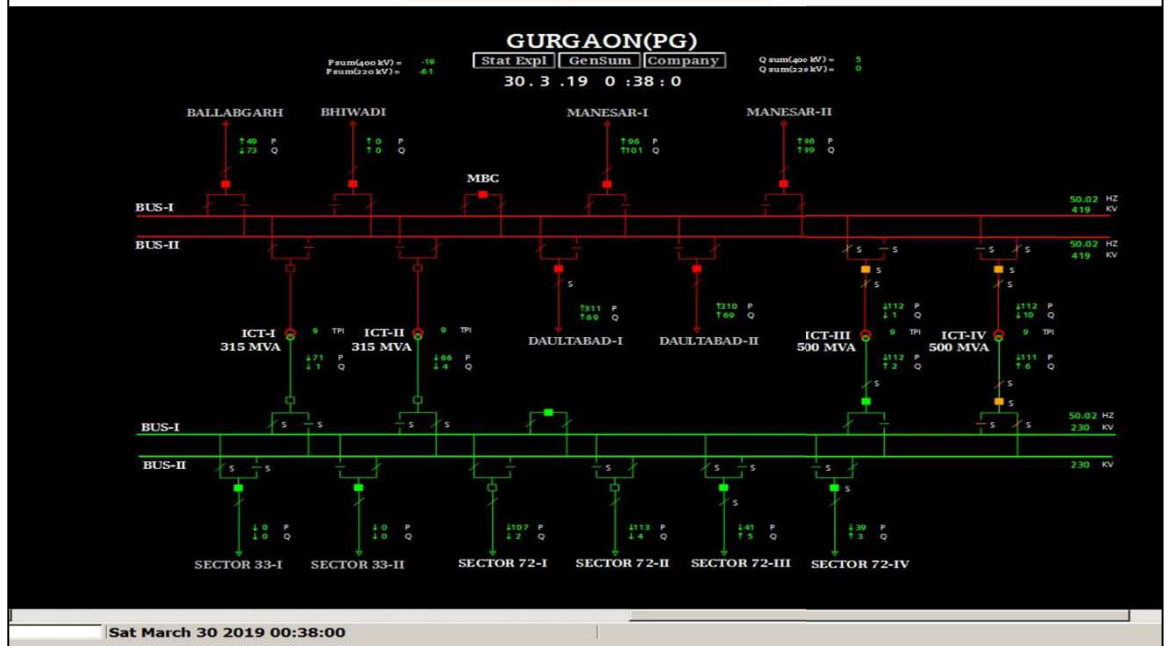


8. SCADA data and SoE:



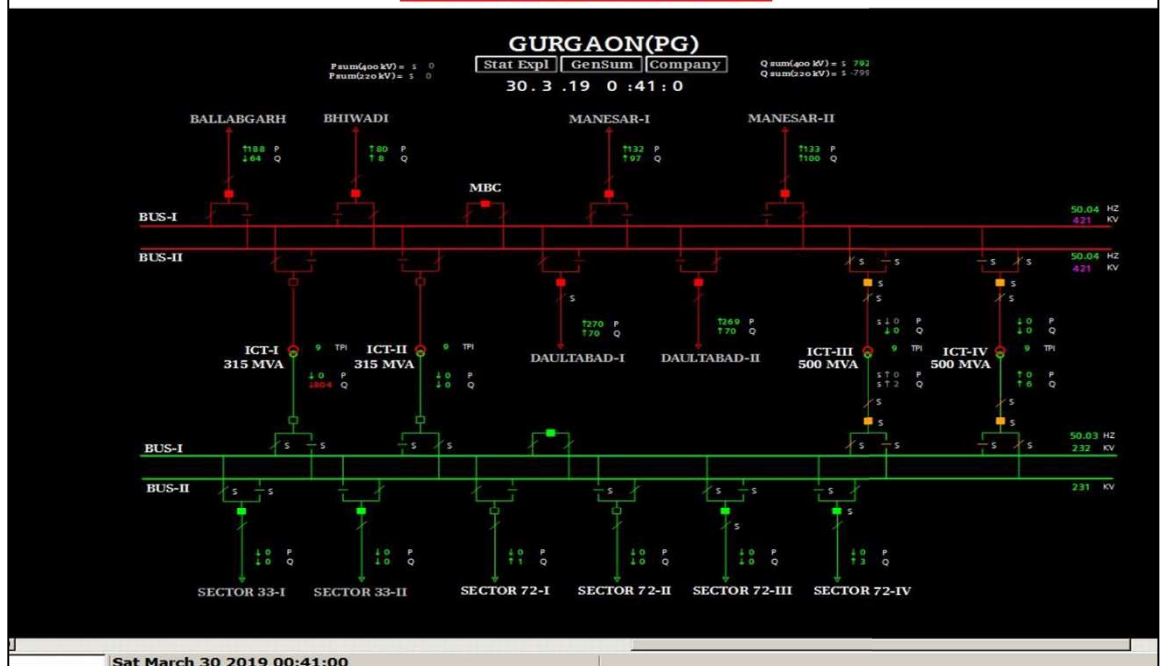
SLD of 400/220kV Gurgaon(PG) before the incident

00:38hrs/30-Mar-19



SLD of 400/220kV Gurgaon(PG) after the incident

00:41hrs/30-Mar-19

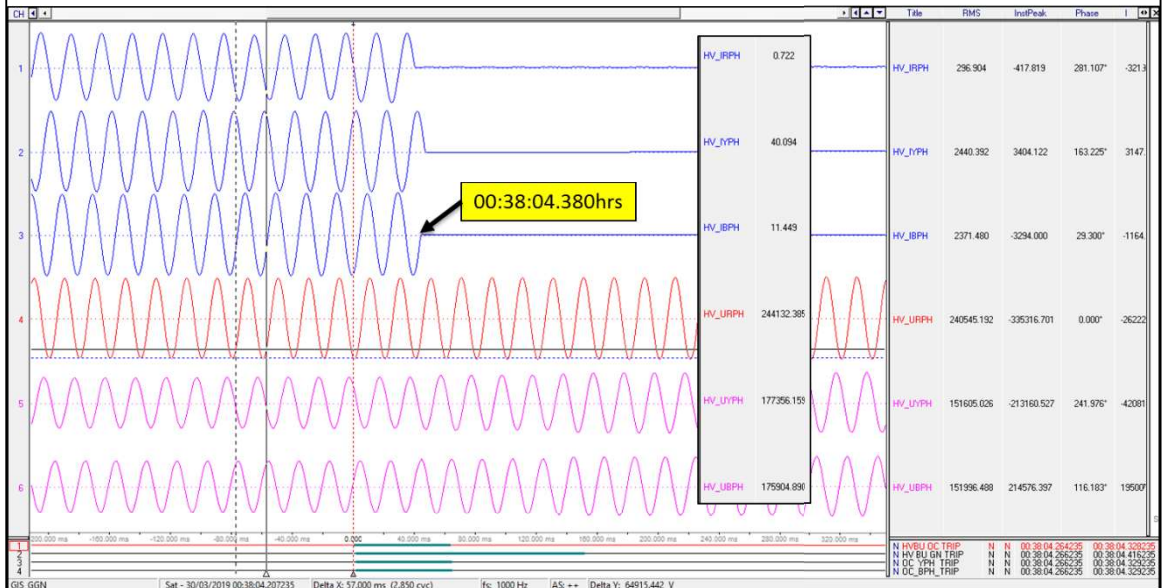


NR SCADA SOE

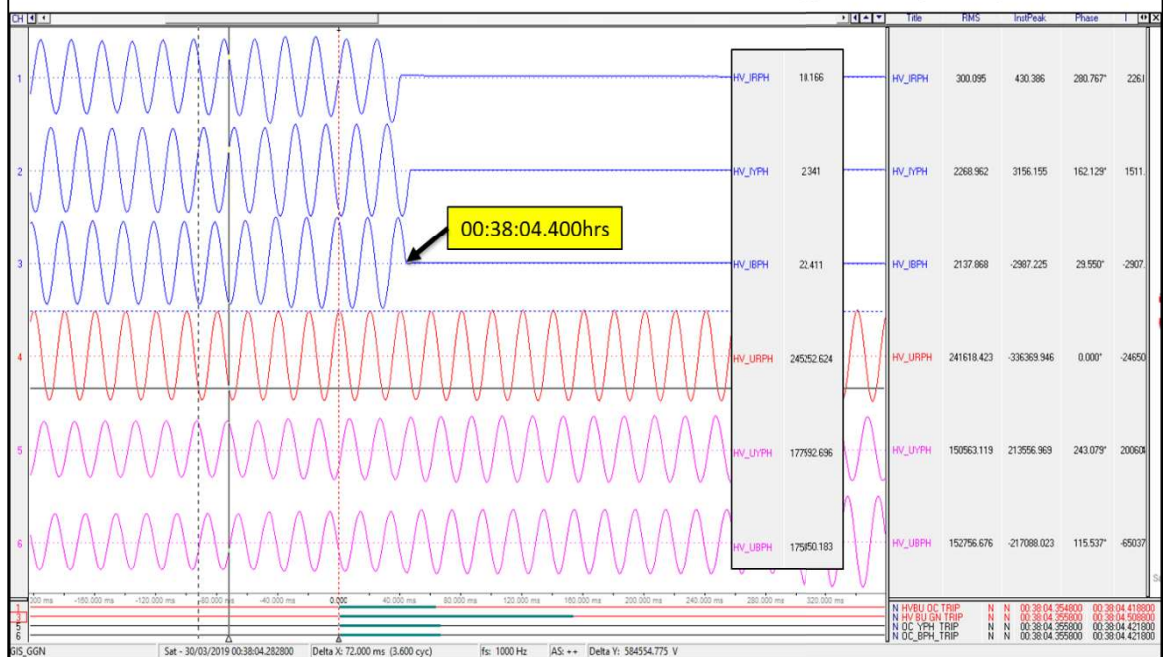
Time (in hrs)	Station	Voltage (in kV)	Element	Type	Status
00:08:04:314	GURGAON	400kV	01T1	Circuit Breaker	Open Main
00:08:04:326	GURGAON	220kV	06T1	Circuit Breaker	Open Main
00:08:04:403	GURGAON	400kV	05T2	Circuit Breaker	Open Main
00:08:04:430	GURGAON	220kV	07T2	Circuit Breaker	Open Main
00:08:04:661	GURGAON	220kV	03HVPNL1	Circuit Breaker	Open Main
00:08:05:213	GURGAON	220kV	05HVPNL2	Circuit Breaker	Open Main
00:39:02 :***	GURGAON	220kV	10T3	Line Isolator	Invalid App Invalid App
00:39:02 :***	GURGAON	220kV	10T3	Line Isolator	Invalid Disp Invalid Disp
00:39:02 :***	GURGAON	220kV	10T3	BusBar Isolator	Invalid App Invalid
00:39:02 :***	GURGAON	220kV	10T3	BusBar Isolator	Invalid App Invalid
00:39:02 :***	GURGAON	220kV	10T3	BusBar Isolator	Invalid Disp Invalid
00:39:02 :***	GURGAON	220kV	10T3	BusBar Isolator	Invalid Disp Invalid
00:39:03 :***	GURGAON	220kV	10T3	Circuit Breaker	Invalid App Invalid
00:39:03 :***	GURGAON	220kV	10T3	Circuit Breaker	Invalid Disp Invalid

9. As per NHPC details:

DR: 400/220kV ICT-1 at Gurgaon(PG)



DR: 400/220kV ICT-2 at Gurgaon(PG)



10. As per PMU, SCADA SoE AND DR data:

- As per PMU, B-N fault occurred, followed by Y-B-N fault, followed by R-Y fault.
- Fault Clearance time: **~1500ms**
- Sudden rise in frequency observed from PMU, indicating load loss.
- As per SoE, 220kV side CB of 400/220kV ICT #3 opened at around 00:39hrs.
- As per DR and reported information, ICT #1 and ICT #2 at Gurgaon(PG) tripped on back over current protection operation.

11. Preliminary report, DR received after 24hrs from POWERGRID. DR/EL, detailed report yet to be received from Haryana.

Points for Discussion:

1. Exact sequence of events in view of cause of event; protection operation/non-operation; opening/closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
2. Exact location of fault?
3. Reason for delayed clearance of fault to be shared.
4. Setting of backup overcurrent protection of 400/220kV ICTs at Gurgaon(PG) to be shared.
5. POWERGRID may confirm about the tripping/non-tripping of other two remaining ICTs at Gurgaon and the reason for the same.
6. Time synchronization of SCADA status signals to be checked and corrected.

7. Preliminary Report, DR/EL and detailed report are still awaited from Haryana.
8. Haryana shall share the detailed report considering the aforesaid points along with supporting DR/EL details

POWERGRID/Haryana may elaborate the incident in line with above points, present and submit the remaining details 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 765/220kV Lalitpur TPS at 03:21hrs of 06th Apr 2019

Event category: GD-1

Generation loss: 700 MW (UP may confirm)

Loss of load: Nil (UP may confirm)

Energy load: Nil MU (UP may confirm)

Data Summary received/available at NRLDC:

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

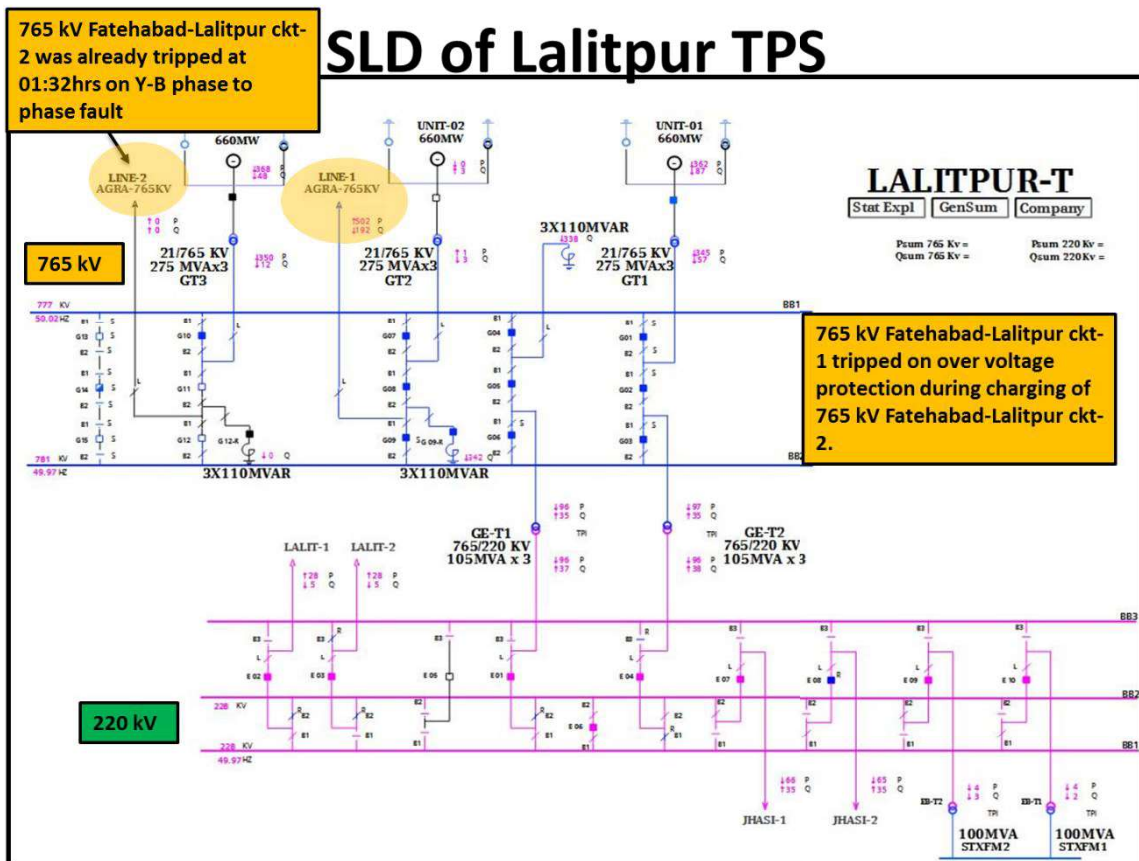
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	
DR/EL	Uttar Pradesh	Received	After 24hrs
Preliminary Report	Uttar Pradesh	Received	After 24hrs
Detailed Report	Uttar Pradesh	Not Received	

Description	Clauses	Utility	Remarks
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<p>Violation of Clauses</p>	<p>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</p>	<p>Uttar Pradesh</p>	<p>1. DR/EL within 24hrs 2. Detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system</p>
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Based on above information description of the events is:

1. Single Line Diagram of 765/220 kV Lalitpur TPS:



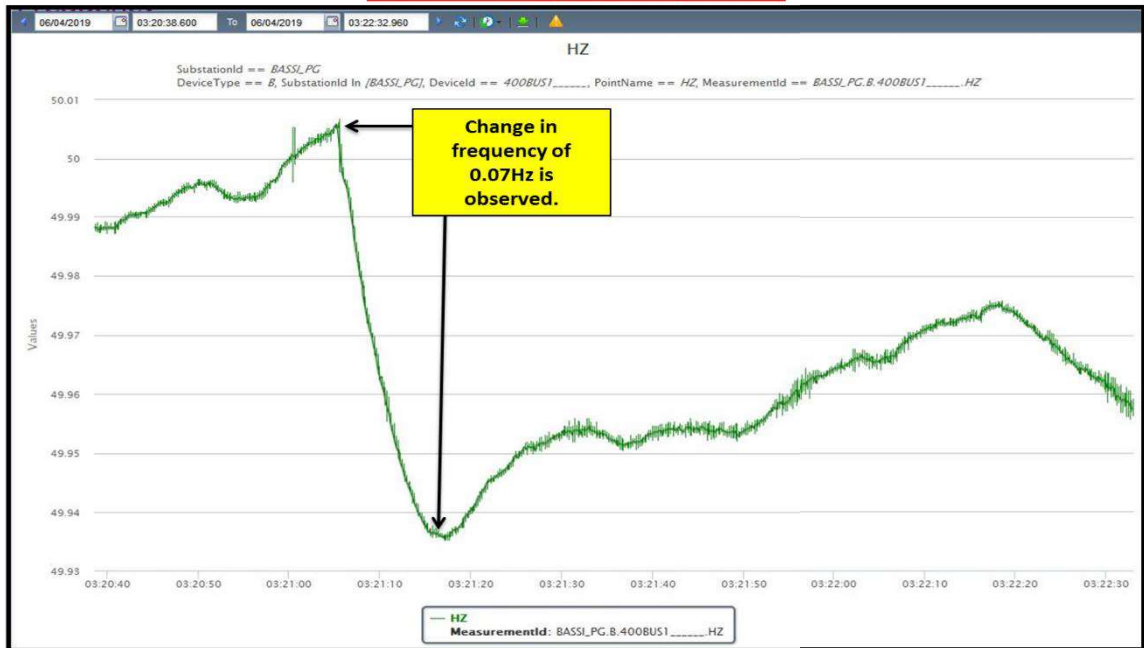
2. 765/220 kV Lalitpur SCTPS has one and half breaker scheme. It is connected through 765 kV Fatehabad D/C. It also have two 315 MVA 765/220 kV ICTs. At 220 kV voltage level, it is connected through Jhansi D/C and Lalitpur D/C local.
3. In antecedent conditions:
 - 660 MW Unit#1 & #3 carrying 362 MW & 368 MW respectively.
 - 660 MW Unit-2 was under planned outage
 - 765KV Lalitpur(UP)-Fatehabad(UP) ckt-2 was also under outage due to Y-B phase to phase fault at 01:32 hrs.
4. 765 kV Lalitpur-Fatehabad ckt-2 tripped at 01:32 hrs on Y-B phase to phase fault in the line.
5. At 03:22hrs, 765 kV Lalitpur-Fatehabad ckt-2 again charged from Fatehabad (UP) end. At the same time healthy 765 kV Lalitpur-Fatehabad ckt-1 also tripped on over voltage stage-1 protection.
6. SPS for Lalitpur generation operated and trip the 220 kV outgoing feeders and unit came on house load but running units (Unit-1 & 3) finally tripped on Eco Inlet low flow (Boiler Trip) due to station blackout.
7. Over voltage stage-1 setting is: 108 % with 5 second time delay in ckt-1 and 109% with 4 second time delay in ckt-2.
8. Name of the tripped element:
 - 765KV Lalitpur(UP)-Fatehabad(UP) ckt-1
 - 660 MW Unit#1 at 765kV Lalitpur TPS(LPGCL)

- 660 MW Unit#3 at 765kV Lalitpur TPS(LPGCL)
- 220kV Lalitpur TPS(UP)-Lalitpur(UP) ckt-1
- 220kV Lalitpur TPS(UP)-Lalitpur(UP) ckt-2
- 220kV Lalitpur TPS(UP)-Jhansi(UP) ckt-1
- 220kV Lalitpur TPS(UP)-Jhansi(UP) ckt-2

9. PMU plots:

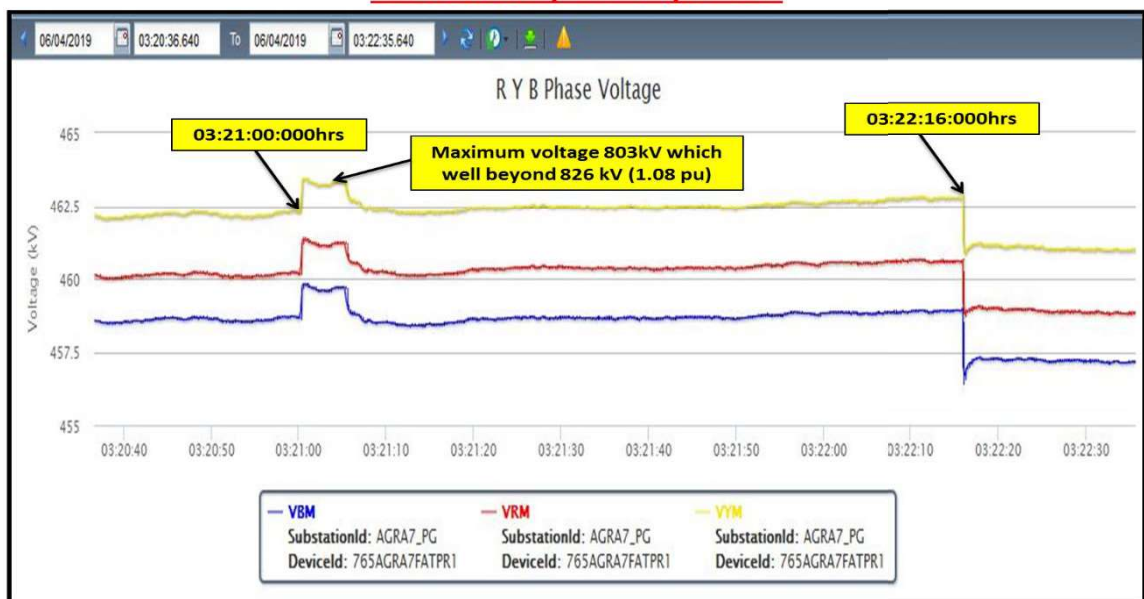
PMU Plot of frequency at Bassi(PG)

03:21hrs/06-Apr-19



PMU Plot of phase voltage magnitude at Agra(PG)

03:21hrs/06-Apr-19



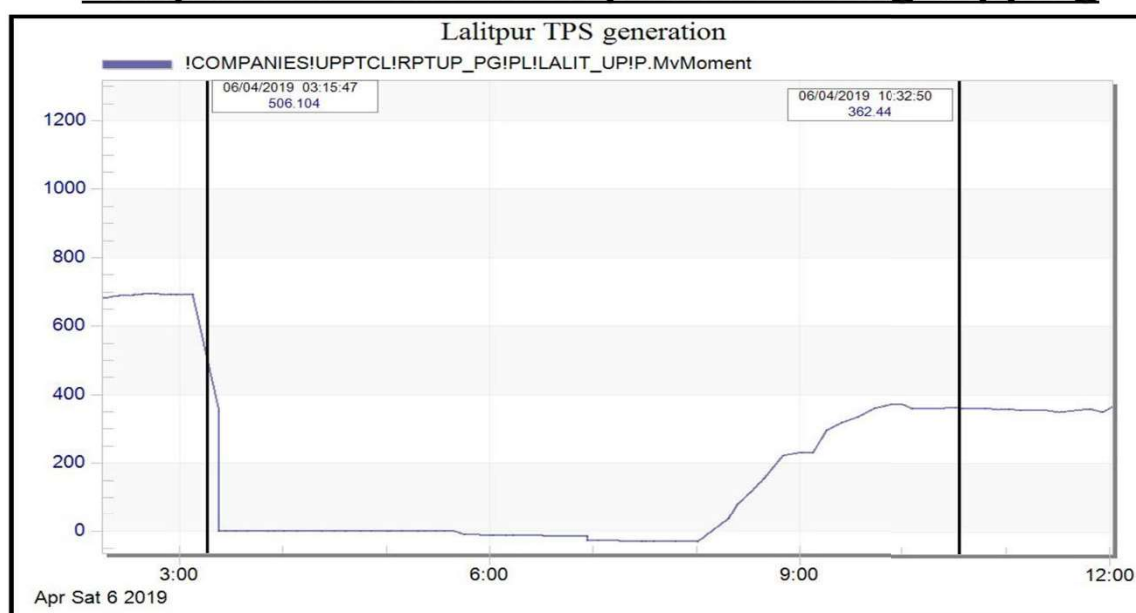
10. As per PMU data:

- As per PMU, no fault observed in the system. Over voltage tripping
- Fault Clearance time: **Not applicable**

11. SCADA data and SoE: SoE captured for tripped elements from Fatehabad end. SCADA digital status of Lalitpur TPS was not available in SCADA system.

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
03:21:00:378	AGRA7_U	765kV	07LALIT2	Circuit Breaker	disturbe	
03:21:00:380	AGRA7_U	765kV	07LALIT2	Circuit Breaker	Close	Main CB of 765KV Lalitpur(UP)-Fatehabad(UP){end} ckt-2 closed.
03:21:05:448	AGRA7_U	765kV	11LALT1	Circuit Breaker	disturbe	
03:21:05:464	AGRA7_U	765kV	11LALT1	Circuit Breaker	Open	Tie CB of 765KV Lalitpur(UP)-Fatehabad(UP){end} ckt-1 opens.
03:21:05:474	AGRA7_U	765kV	10LALIT1	Circuit Breaker	disturbe	
03:21:05:475	AGRA7_U	765kV	10LALIT1	Circuit Breaker	Open	Main CB of 765KV Lalitpur(UP)-Fatehabad(UP){end} ckt-1 opens.

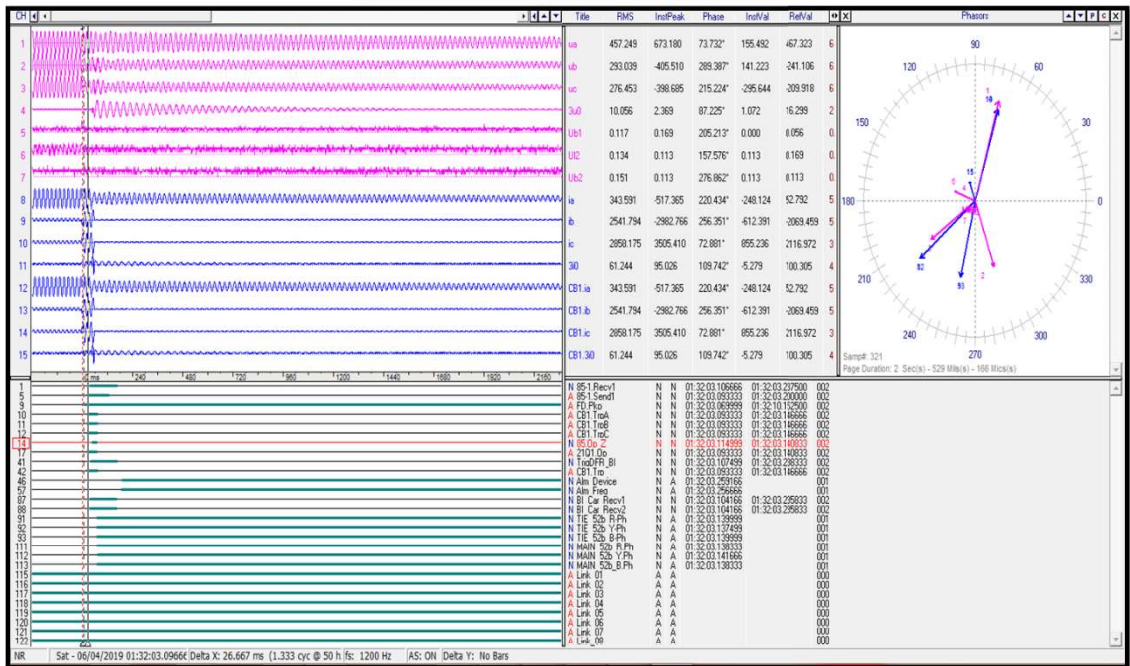
Lalitpur TPS Generation pattern during tripping



12. As per UPPTCL details:

M-1 DR of 765 kV Fatehabad (end)-Lalitpur ckt-2

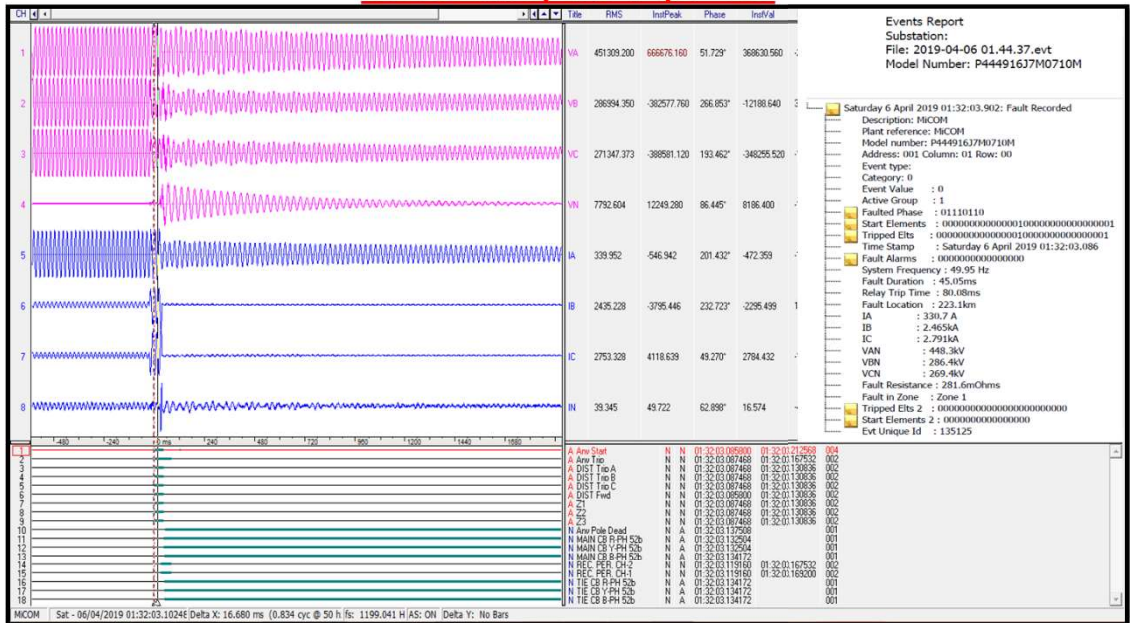
01:32hrs/06-Apr-19



Y-B phase to phase fault. Line tripped in Z-1

M-2 DR of 765 kV Fatehabad (end)-Lalitpur ckt-2

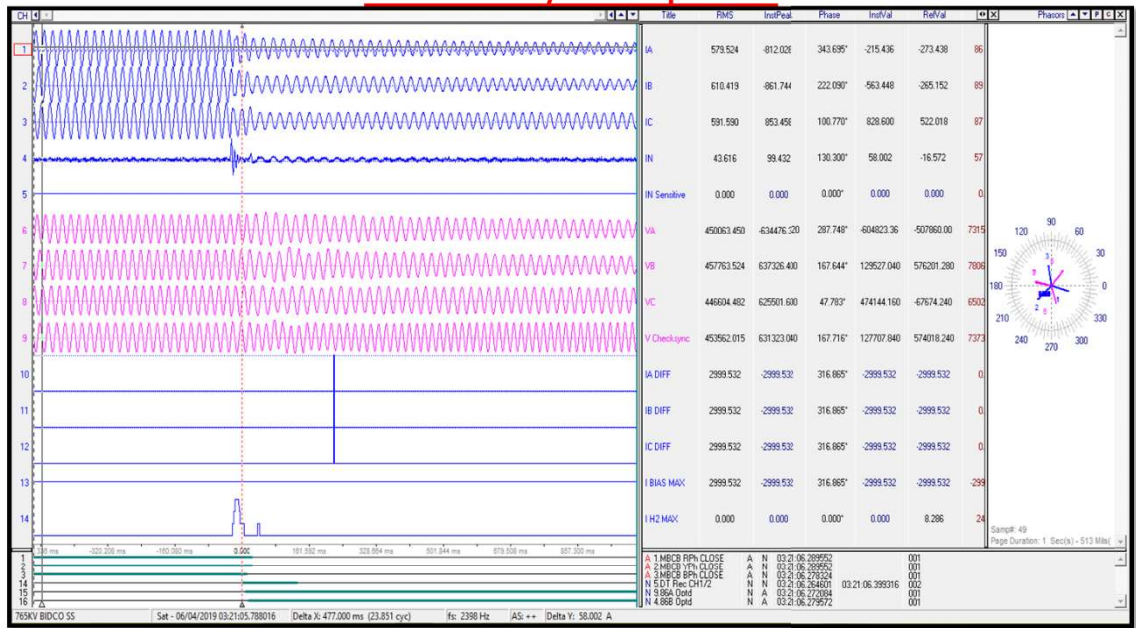
01:32hrs/06-Apr-19



Y-B phase to phase fault. Line tripped in Z-1

DR of 765 kV Lalitpur (end)-Fatehabad ckt-1 (Main-II)

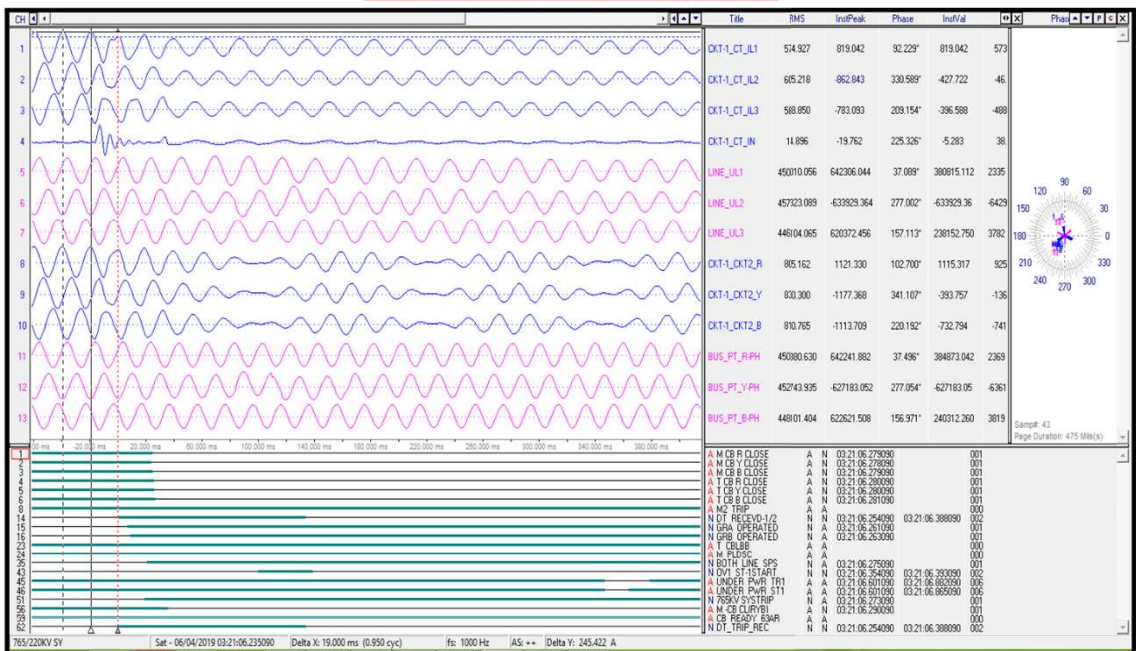
03:21hrs/06-Apr-19



No fault in the system, DT received from remote end

DR of 765 kV Lalitpur (end)-Fatehabad ckt-1 (Main-I)

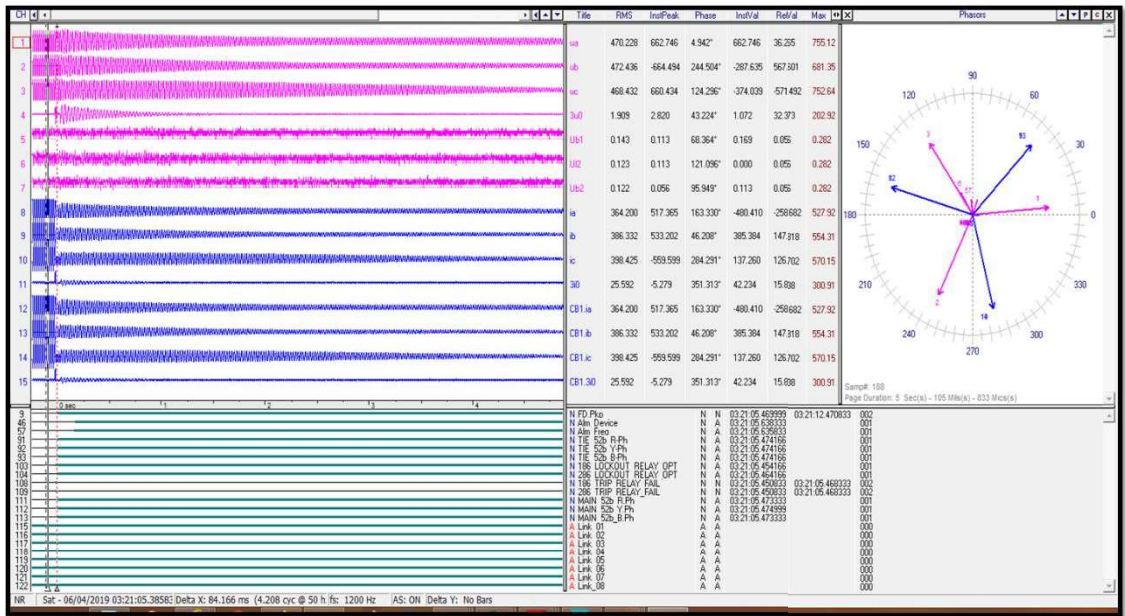
03:21hrs/06-Apr-19



No fault in the system

M-1 DR of 765 kV Fatehabad (end)-Lalitpur ckt-1

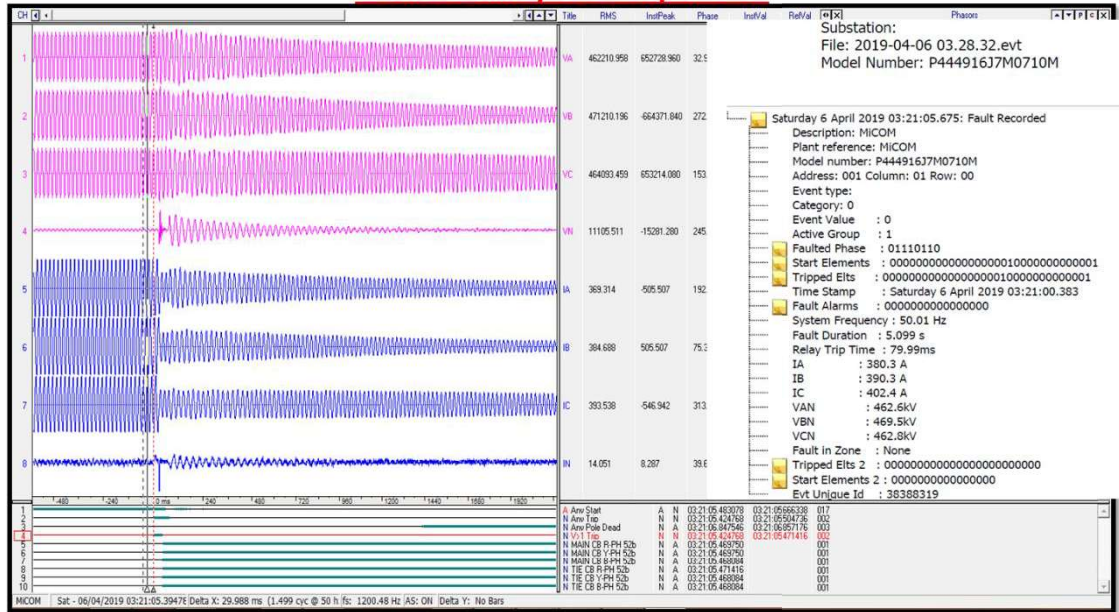
03:21hrs/06-Apr-19



Over voltage setting as reported: 108% but it seems line tripped well before the setting voltage

M-2 DR of 765 kV Fatehabad (end)-Lalitpur ckt-1

03:21hrs/06-Apr-19



Over voltage setting as reported: 108% but it seems line tripped well before the setting voltage

On 06.04.2019 at 03:21Hrs. following elements at 765KV S/S Lalitpur tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1	Unit – I at 765KV S/S Lalitpur	06.04.19	8:12	Due to operation of SPS
2	Unit – III at 765KV S/S Lalitpur	06.04.19	13:59	-do-
3	G.T-1 at 765KV S/S Lalitpur	06.04.19	05:33	-do-
4	G.T-3 at 765KV S/S Lalitpur	06.04.19	06:28	-do-
5	765KV Fatehabad –I	06.04.19	05:57	Direct trip(Over voltage) received from 765KV S/S Fatehabad
6	765KV Fatehabad –II	06.04.19	3:22	Line tripped at 1:32 hrs (Z-1,Y-B, dist- 121 km.
7	220KV Jhansi – I	06.04.19	07:38	Due to operation of SPS
8	220KV Jhansi – II	06.04.19	07:45	-do-
9	220KV Lalitpur – I	06.04.19	06:53	-do-
10	220KV Lalitpur – II	06.04.19	06:56	-do-

Analysis:-

As reported by Lalitpur TPS, 765KV Lalitpur–Fatehabad Ckt -II line tripped at 01:32Hrs. on dated 06.04.2019. While charging the said line, 765KV Lalitpur–Fatehabad Ckt - I line tripped after receiving DT signal(due to Over voltage) from Fatehabad end. This led to the operation of SPS (which operates when both 765KV Lalitpur–Fatehabad Ckts are tripped) at 765KV S/S Lalitpur, tripping of 220kV Lalitpur (220kV)- I,II and 220kV Jhansi- I,II along with generating Units-I&III. As per the SPS scheme, one unit goes into house load condition on the operation of SPS protection. The same did not happen as Economizer inlet flow was low.

1	Time & Date of Event	01:32:03 hrs. and 06-04-2019
2	Substation Name	lalitpur power generation company ltd. (LPGCL)
3	Antecedent Condition	Unit # 1 & 3 were in service & Unit 2 was under reserve shutdown. Unit #1-359 MW Unit #3- 361 MW Agra-1, Agra-2, Jhansi-1 & 2 , Lalitpur-1 & 2 lines were in service.
4	Generation Loss/Load Loss	10.863 MU
5	Name of the tripped elements & time of tripped elements	Agra Ckt #2 tripped at Time -01:32:03:870hrs. Agra Ckt #1 tripped at Time -03:21:06:254hrs. Jhansi Ckt#2 Tripped at Time-03.21.06.273 hrs. Jhansi Ckt#1 Tripped at Time -03.21.06.273hrs. Lalitpur Ckt#1 Tripped at Time -03.21.06.273 hrs. Lalitpur Ckt#2 Tripped at Time -03.21.06.273 hrs. Unit #1 Tripped at Time-03.21.27.000 hrs Unit #3 Tripped at Time-03.21.27.000 hrs
6	Primary Cause of tripping (Triggering Incident)	Agra Ckt #2 tripped on Zone -1(Z1) protection. Fault in Y & B Phase, distance 121 km. Just after charging of Agra Circuit #2 from Fatehabad End(LPGCL End Breaker was Open),Agra circuit #1 tripped at LPGCL end on DT received from Fatehabad end (Over voltage at Fatehabad End). Jhansi Ckt 1&2 ,Lalitpur Ckt 1 &2 tripped due to SPS protection. Unit 1 & Unit 3 tripped on Eco Inlet flow low.(Boiler Trip) due to station blackout.
7	Flag Details, DR/EL	Enclosed
8	Event Description	Agra Ckt #2 tripped on Zone -1(Z1) protection. Fault in Y & B Phase, distance 121 km. Just after charging of Agra Circuit #2 from Fatehabad End(LPGCL End Breaker was Open),Agra circuit #1 tripped at LPGCL end on DT received from Fatehabad end (Over voltage at Fatehabad End). Jhansi Ckt 1&2 ,Lalitpur Ckt 1 &2 tripped due to SPS protection. Unit 1 & Unit 3 tripped on Eco Inlet flow low.(Boiler Trip) due to station blackout.

		protection. Unit 1 & Unit 3 tripped on Eco Inlet flow low.(Boiler Trip) due to station blackout.
12.	Restoration Time	1.83 Hrs (06/04/2019 _03:22 Hrs) (Agra #2) 2.6 Hrs (06/04/2019 _05:57 Hrs) (Agra #1) 04.28 Hrs (06/04/2019 _07:38 Hrs) (Jhansi #1) 04.40 Hrs (06/04/2019 _07:45 Hrs) (Jhansi #2) 03.56 Hrs (06/04/2019 _06:55 Hrs) (Lalitpur #1) 03.56 Hrs (06/04/2019 _06:56 Hrs) (Lalitpur #2) 5.85 Hrs (06/04/2019 _08:12 Hrs) (Unit #1) 10.61 Hrs (06/04/2019 _13:58 Hrs) (Unit #3)
13.	Remedial Action Taken:	Not Applicable.
14.	Remedial Action to be taken:	Not Applicable.
15.	Remarks (If any)	Overvoltage setting at Fatehabad to be review by SLDC to avoid such incident in future.

Sl.No	Date	Time	Element affected	Protection details	Parameters recorded
1	06.04.2019	01.32.03.870	712-Agra Circuit#2	Main 1&2 Trip Operated	NA
2	06.04.2019	01.32.03.870	712-Agra Circuit#2	Z1 Trip(Y & B Phase)	Z1 operated in Y & B phase.Fault distance:121.0kM,Fault Current: Ia=655.905A,Ib=3275.846A,Ic=2904.138A
3	06.04.2019	01.32.03.870	712-Agra Circuit#2	Main 1&2 Carrier Send	
4	06.04.2019	01.32.03.880	712-Agra Circuit#2	86A & 86B operated(group Relay)	NA
5	06.04.2019	01.32.03.890	712-Agra Circuit#2	Main 1&2 Carrier received	NA
6	06.04.2019	01.32.03.897	712-Agra Circuit#2	Main and Tie CB opened	NA
7	06.04.2019	03.21.06.254	709-Agra Circuit#1	Main 1&2 DT Received	765 KV Line circuit#1 DT recievd due to Over voltage observed at Fahenbad end during charging of 765 KV line circuit#2 but same time 765 KV line circuit#2 breaker closed of fatehabad end and line was found under hold.
8	06.04.2019	03.21.06.261	709-Agra Circuit#1	86A & 86B operated(group Relay)	NA
9	06.04.2019	03.21.06.273	709-Agra Circuit#1	SPS Opertaed Both Line	NA
10	06.04.2019	03.21.06.290	709-Agra Circuit#1	Main and Tie CB opened	NA
11	06.04.2019	03.21.06.354	709-Agra Circuit#1	Over Voltage Stage-1 Start(03.21.06.354 to 03.21.06.393)	709 Agra Circuit#01 Over Voltage relay setting: Stage-01: 109%(833.85kV) @4Sec.

13. Remedial Measures taken as per UPPTCL report:

- Over voltage setting at Fatehabad end needs to be reviewed.
- Bus voltage at Lalitpur TPS needs to be controlled by Reactive Power Management.

- LPGCL may look into “Economizer inlet flow low” issue in order to ensure that running unit comes to house load on actuation of SPS scheme.

14. Preliminary Report, DR/EL details has been received but detailed remedial measures report is still awaited from UPPTCL.

Points for Discussion:

1. Reason of tripping of 765 kV Lalitpur-Fatehabad ckt-1 on over voltage protection and its relation with charging of 765 kV Lalitpur-Fatehabad ckt-2.
2. Over voltage setting of 765 kV Fatehabad-Lalitpur ckt-1 & 2 needs to be reviewed.
3. CVT of Fatehabad end of 765 kV Lalitpur-Fatehabad ckt-1 & 2 also needs to be checked in view of CVT error.
4. Reason of non-survival of Lalitpur units on house load and remedies taken by LPGCL.
5. Current status of actions on remedial measure identified by UPPTCL.
6. SCADA digital status of Lalitpur TPS needs to be ensured.
7. Detailed Report and Remedial measures report needs to be shared by 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.

N. Complete station outage of 400 kV G. Noida Sec-148 (UP) at 17:53hrs of 10th Apr 2019

Event category: GI-2

Generation loss: Nil (UP may confirm)

Loss of load: Nil (UP may confirm)

Energy load: Nil MU (UP may confirm)

Data Summary received/available at NRLDC:

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

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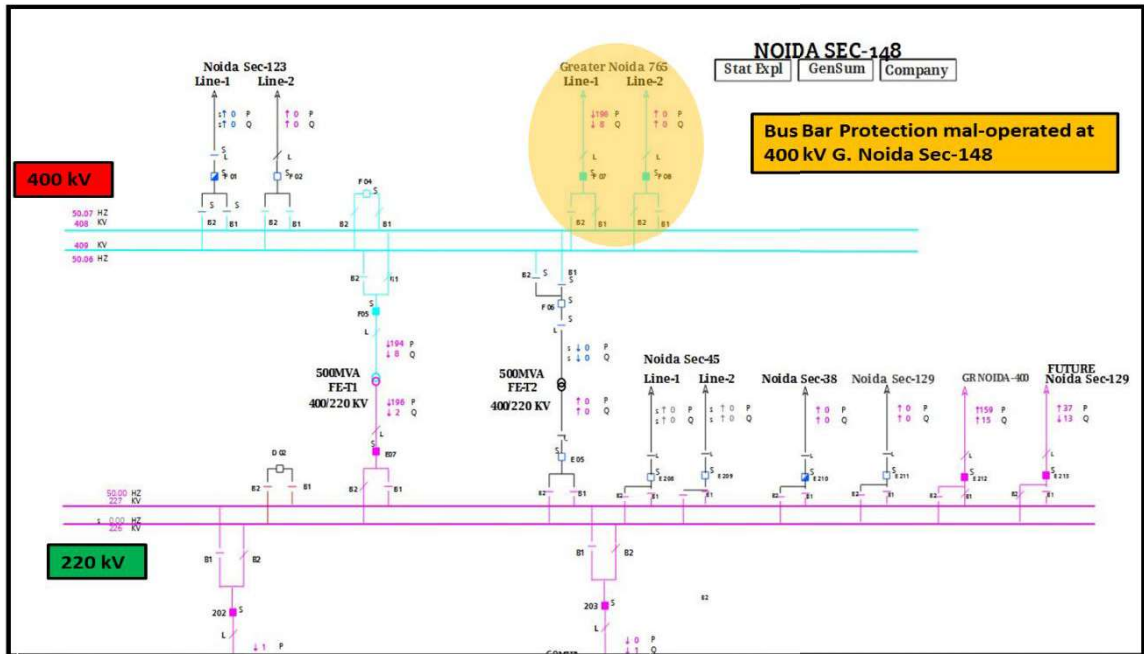
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Partially Available	
DR/EL	Uttar Pradesh	Received (Partial)	After 24hrs
Preliminary Report	Uttar Pradesh	Received	After 24hrs
Detailed Report	Uttar Pradesh	Not Received	

Description	Clauses	Utility	Remarks
Violation of Clauses	<p>1. IEGC 5.2.r & 5.9.6.c (VI)</p> <p>2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2)</p> <p>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)</p> <p>CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2</p>	Uttar Pradesh	<p>1. DR/EL within 24hrs</p> <p>2. Detailed Report yet to be received</p> <p>3. Adequately Sectionalized and graded protective relaying system</p> <p>4. Incorrect/ mis-operation / unwanted operation of Protection system</p>

Based on above information description of the events is:

1. Single Line Diagram of 400/220 kV G.Noida Sec-148:

SLD of 400 kV Noida Sector-148 (UP)



2. At 400/220 kV G. Noida Sector-148 (UP) station have double main transfer breaker scheme. It is connected through G. Noida (765/400 kV) D/C. It also have two 500 MVA 400/220 kV ICTs.
3. In antecedent conditions:
 - In antecedent conditions, 400kV G.Noida 765(UP)-Noida sec-148(UP) ckt 1 carrying 196MW.
 - 400 kV bus coupler at 400 kV Noida sec-148(UP) was in open condition.
 - 400 kV G.Noida 765(UP)-Noida sec-148(UP) ckt 2 power flow became zero as bus coupler was in open condition
4. 400kV G.Noida 765(UP)-Noida sec-148(UP) ckt 1 & 2 tripped due to operation of Bus bar protection at 400/220kV Noida sec-148(UP).
5. 400 kV bus coupler was in open condition at 400 kV G.Noida Sec-148.
6. Both 400 kV bus bar protection operated simultaneously at 400 kV G.Noida Sec-148.
7. Reason of operation of both the bus bar protection at 400 kV G.Noida Sec-148 yet to be ascertained.
8. Name of the tripped element:
 - 400kV G.Noida 765(UP)-Noida sec-148(UP) ckt 1
 - 400kV G.Noida 765(UP)-Noida sec-148(UP) ckt 2 (breaker tripped)
 - 400kV Bus 1 at 400/220kV Noida sec-148(UP)

- 400kV Bus 2 at 400/220kV Noida sec-148(UP)
- 500MVA ICT 1 at 400/220kV Noida sec-148(UP)

9. PMU plots:

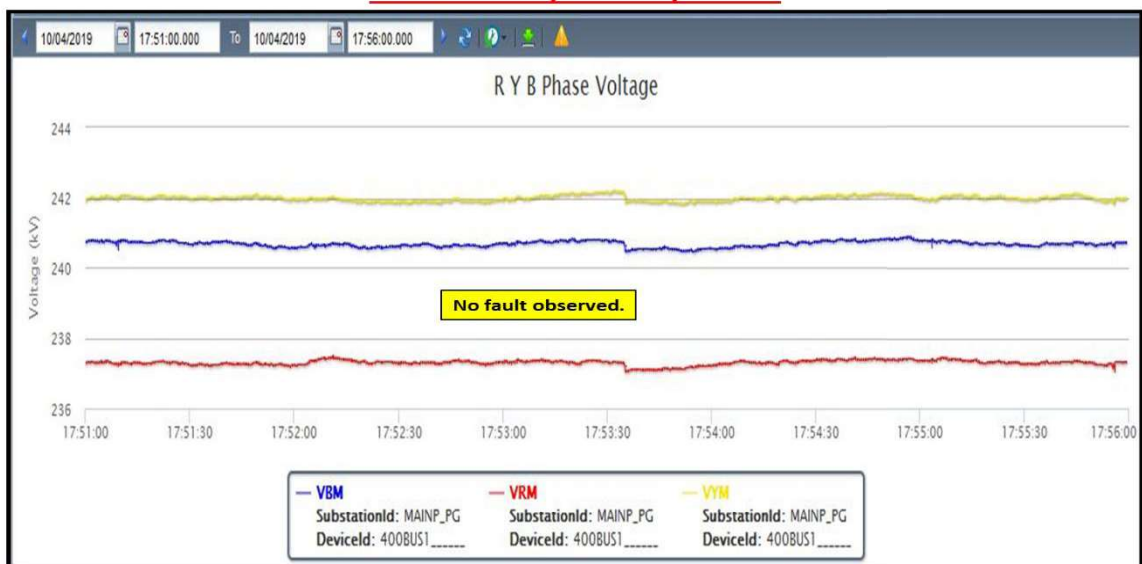
PMU Plot of frequency at Bassi(PG)

17:53hrs/10-Apr-19



PMU Plot of phase voltage magnitude at Mainpuri(PG)

17:53hrs/10-Apr-19



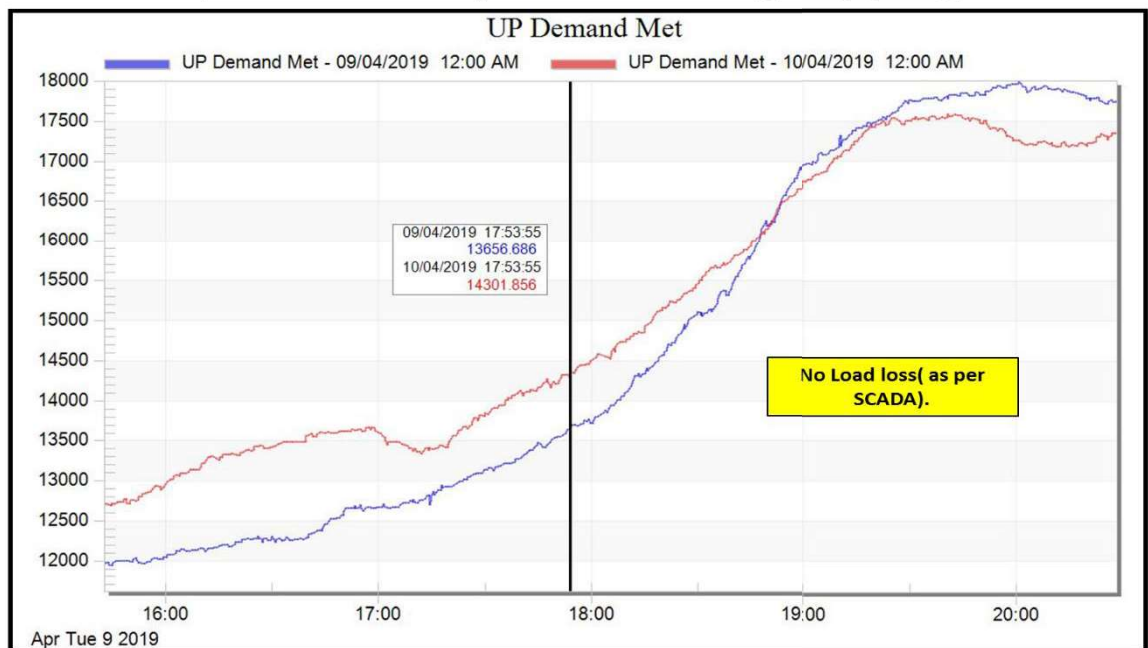
10. As per PMU data:

- As per PMU, no fault observed in the system. Over voltage tripping
- Fault Clearance time: **Not applicable**

11. SCADA data and SoE: SoE captured for ICT and 400 kV G.Noida-G.Noida Sec-148 (UP) ckt-1, for ckt-2 SoE didn't capture.

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
17:53:34:940	SC148_U	400	05T1	Circuit Breaker	Open	400kV Side CB of 500 MVA ICT 1 at 400/220kV Noida sec-148(UP) opens.
17:53:34:943	SC148_U	400	08GNOD72	Circuit Breaker	Open	CB of 400kV G.Noida 765(UP)-Noida sec-148(UP) ckt 2 opens.

UP Demand pattern during tripping



12. As per UPPTCL details:

Sub: - Report on the Incident of Simultaneous Tripping at 765/400/220 KV S/S Greater Noida.

Ref: - NRLDC letter No. NR_GD_GI/1509

On 10.04.2019 at 17:53Hrs. following elements at 765/400/220KV S/S Greater Noida tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	400KV Gr. Noida(765kv)- Noida Sec-148 Ckt.-I	10.04.19	19:11	Bus bar protection operated during checking Low Gas alarm for Bay-404
2.	400KV Gr. Noida(765kv)- Noida Sec-148 Ckt.-II	10.04.19	19:46	-do-
3.	500MVA ICT	10.04.19	19:30	-do-

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

Analysis:-

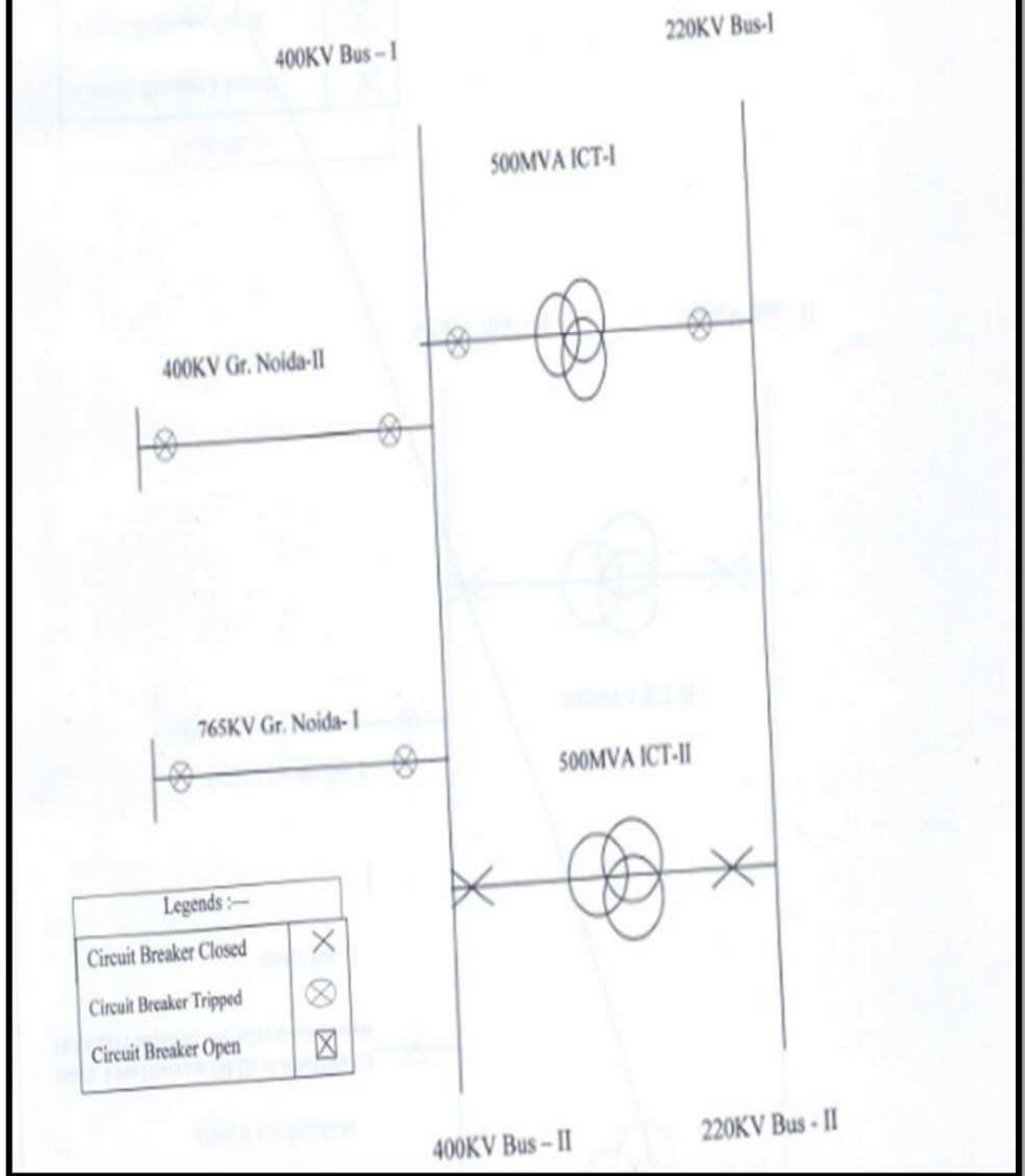
It has been reported by UPPTCL that at 17:53Hrs. on 10.04.2019 Bus bar operated at 400KV S/S Noida Sec-148 while checking the alarm of Gas Low for Bay-404. This led to the tripping of 400KV Noida Sec-148 -Gr. Noida(765kv) Ckt.-I & II and 500MVA ICT.

Remedial Measures taken/to be taken:-

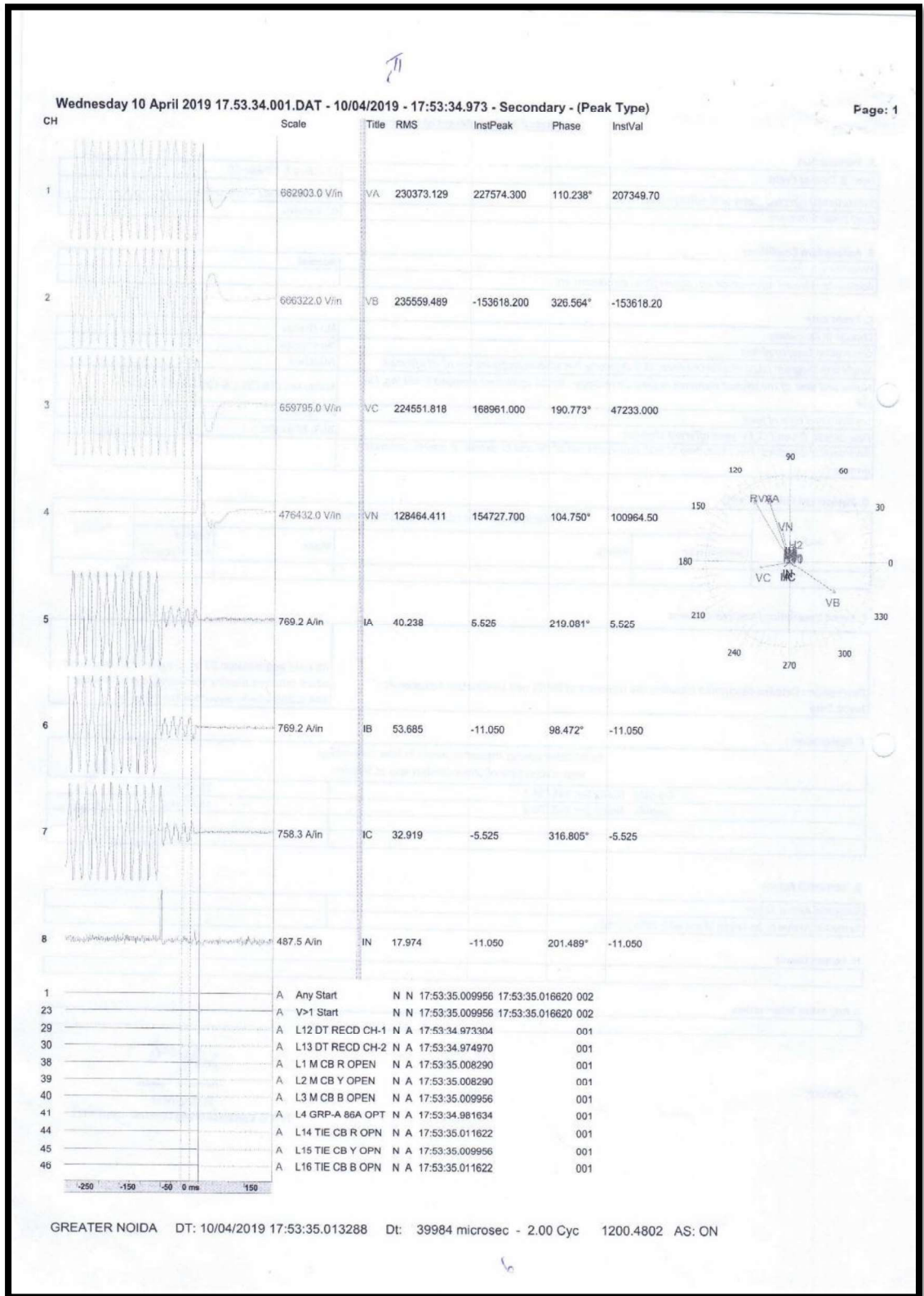
1. Field officers are required to be cautious while checking various protection system in order to avoid mal-operation of Bus bar protection.

Sr. No	Tripping date/time	Closing date/time	Name of Substation	C.B.NO. with direction code	Type of relay	Flags and Indication observed	F/L [KM]	Analysis with discrepancy in flag if any
1	10.04.19 17:53	10.04.19 19:11	400 kv S/S SEC-148, Noida	Bay-407, CKT-I, 400KV Sec-148- Gr.Noida(765KV)	Alstom	Bay Tripped due to Bus Bar Protection operate for Both Zone-I & Zone-II, Bus coupler breaker was in open condition.		Bus Bar protection operated due to checking the Alarm of Gas Low for Bay-404. <i>Bus Coupler was</i>
	10.04.19 17:53	10.04.19 19:46	400 kv S/S SEC-148, Noida	Bay-408, CKT-II, 400KV Sec-148- Gr.Noida(765KV)	Alstom			
	10.04.19 17:53	10.04.19 19:30	400 kv S/S SEC-148, Noida	500 MVA T/f, 400kv/220 Kv	Alstom			

Single Line Diagram (SLD) of 400/220KV S/S Noida Sec -148 for the tripping occurred at 17:53Hrs. dated 10.04.2019 based on the information received from UPPTCL.



Extract of DR of 400 kV G.Noida (end)-G. Noida 148:



13. Preliminary Report and DR/EL details received after 24hrs from UPPTCL but detailed report is still awaited from UPPTCL.

Points for Discussion:

1. As per PMU Data, no fault observed in the system, however Bus bar protection operated at 400/220kV Noida sec-148(UP). Reason of the same needs to be looked into.

2. As per SCADA SLD, it seems that Bus 1 and Bus 2 are segregated. Why both bus tripped needs to be looked into.
3. 400 kV bus bar protection of 400/220kV G.Noida sec-148(UP) shall be thoroughly checked and corrected.
4. Detailed Report and Remedial measures report needs to be shared by 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.

O. Complete station outage at 400/220 kV Sarnath (UP) at 13:41hrs of 19th Apr 2019

Event category: GD-1

Generation loss: Nil (UP may confirm)

Loss of load: 250 (As per Up report)

Energy load: Nil MU (UP may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		100ms & 100ms	As per PMU data
Phase of the fault		Y-B double phase to earth fault followed by R-phase to earth fault	As per PMU data

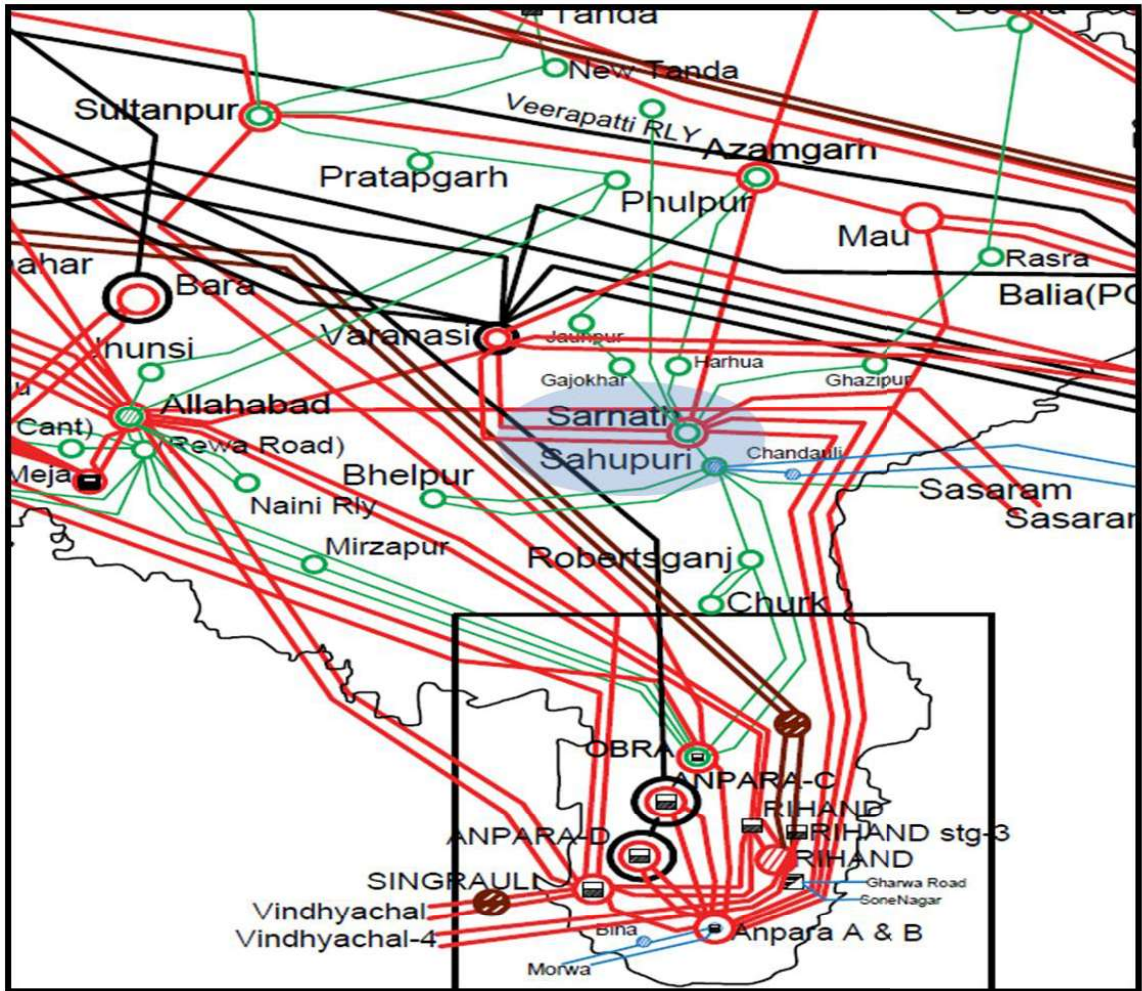
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Received	Time Synch error
DR/ EL	Uttar Pradesh	Received	After 24hrs
	POWERGRID	Received	After 24hrs

Preliminary Report	Uttar Pradesh	Received	After 24hrs
	POWERGRID	Received	After 24hrs
Detailed Report	Uttar Pradesh	Not received	

Description	Clauses	Utility	Remarks
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2) 3. 43.4.A & 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	Uttar Pradesh	1. DR/EL within 24hrs 2. Detailed Report yet to be received 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	POWERGRID	1. Preliminary Report, DR/EL yet to be received

Based on above information description of the events is:

1. Connectivity Diagram of 400/220 kV Sarnath (UP):



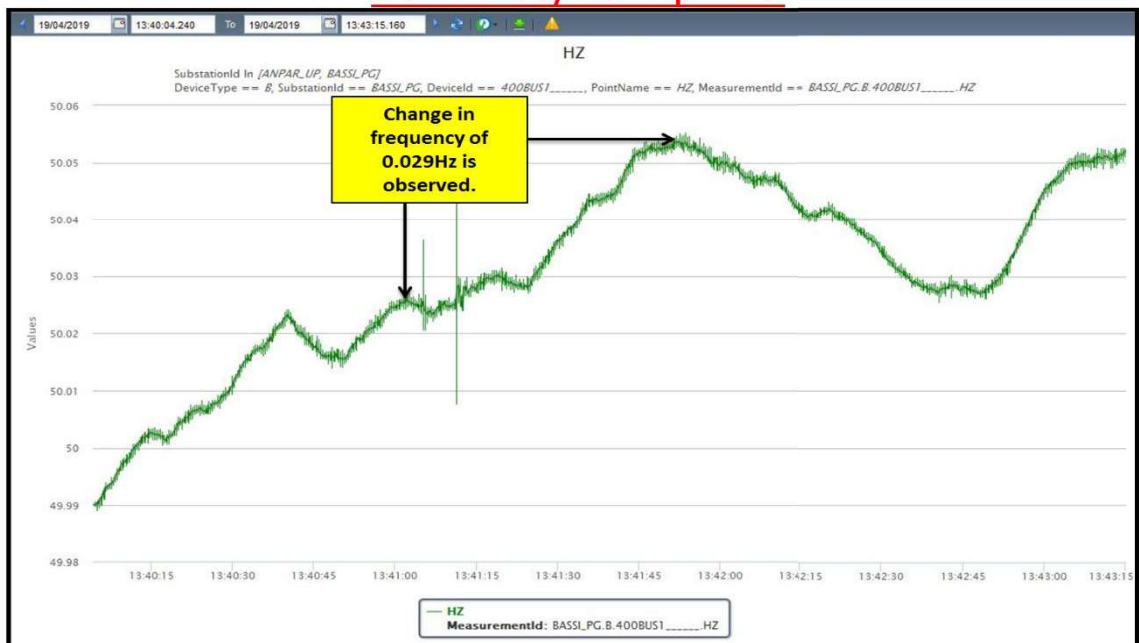
2. 400/220 kV Sarnath (UP) has double main transfer bus scheme. 400 kV Sarnath (UP) is connected with Varanasi (PG) D/C, 400 kV Anpara (UP) D/C and Azamgarh S/C. It also has three ICTs, one of 400/220 kV 315MVA and two of 500 MVA.
3. In antecedent conditions all 400 kV elements connected at 400 kV Sarnath (UP).
4. B-N fault in 400/220 kV 500MVA ICT-1 at Sarnath (UP). B-phase bushing bursted and damaged the other bushing in the vicinity & 400 kV side B-PH & Y-PH LA (Lightening Arrestor). B-ph & Y-ph jumper snapped & swing towards R-ph bus, creating R-N Bus fault at 400 kV Bus-2 of Sarnath (UP). At the time of bus fault for 400 kV bus-2, tripping command issued to bus coupler but within 20ms of issuing the command bus bar protection also send command to 400 kV bus-1.
5. Operation of both 400 kV bus bar protection resulted into complete station outage of 400 kV Sarnath (UP).
6. Details of operation of both 400 kV bus bar protection referred to OeM (SEL). Further details are awaited from OeM.
7. 400 kV Anpara-Mau ckt also tripped at the time bus fault. Reason yet to be ascertained.
8. Name of the tripped element:

- 400/220 kV 315MVA ICT-1 at Sarnath (UP)
- 400/220 kV 500MVA ICT-1 at Sarnath (UP)
- 400/220 kV 500MVA ICT-2 at Sarnath (UP)
- 400 KV Sarnath-Azamgarh
- 400 KV Sarnath-Varanasi-I
- 400 KV Sarnath-Varanasi-II
- 400 KV Sarnath-Anpara L3
- 400 KV Sarnath-Anpara L5
- 400 kV Anpara-Mau ckt

9. PMU plots:

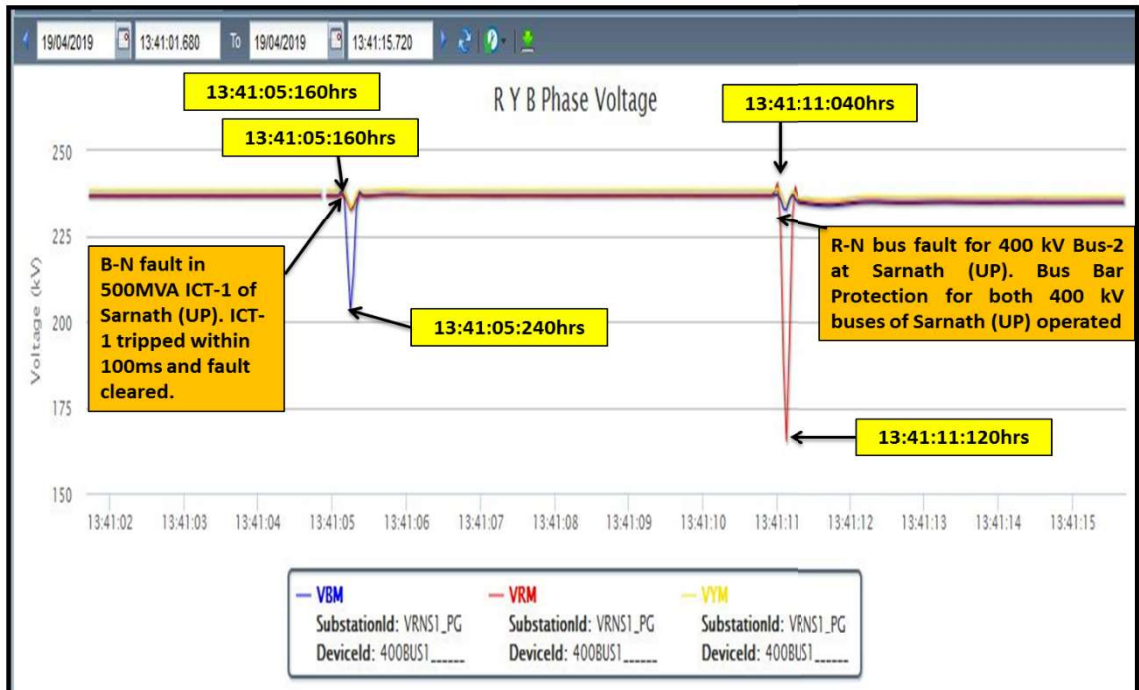
PMU Plot of frequency at Bassi(PG)

13:41hrs/19-Apr-19



PMU Plot of phase voltage magnitude at Varanasi(PG)

13:41hrs/19-Apr-19



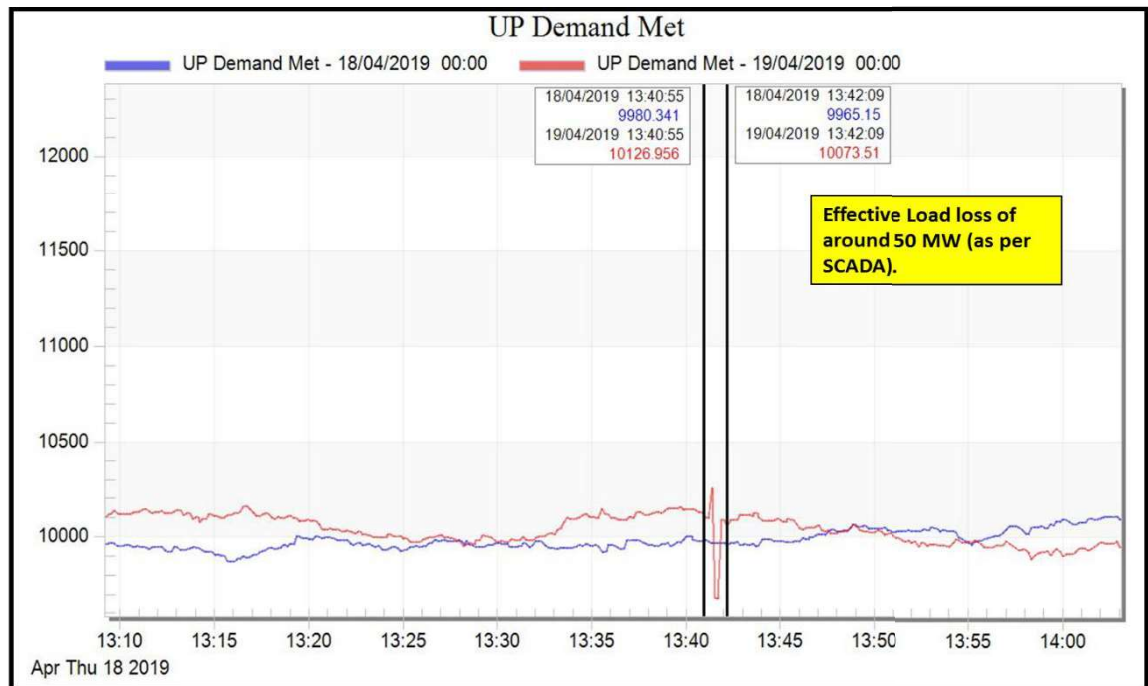
10. As per PMU data:

- Two fault, first fault in Y-B phase and second fault in R-N fault.
- Fault Clearance time: **100ms**

11. SCADA data and SoE: SoE captured all the breaker of Sarnath (UP) tripped before actual fault time (reference time from PMU data).

Time	Sequence	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
13:41:05:001	-160ms	VRNSI_UP	400kV	F_04(T1)	Circuit Breaker	Open	400kV Side CB of 500 MVA ICT1 opens.
13:41:05:032	-130ms	VRNSI_UP	220kV	E_02(T1)	Circuit Breaker	Open	200kV Side CB of 500 MVA ICT1 opens.
13:41:05:160	0ms						PMU reference time, ICT-1 tripping
13:41:10:891	-150ms	VRNSI_UP	400kV	F_02(ANPAR-1)	Circuit Breaker	disturbe	
13:41:10:904	-135ms	VRNSI_UP	400kV	F_09(AZAM1)	Circuit Breaker	Open	CB of 400kV Azamgarh(UP)-Sarnath(UP) (end) opens.
13:41:10:905	-135ms	VRNSI_UP	400kV	F_07(T2)	Circuit Breaker	Open	400kV Side CB of 500 MVA ICT2 opens.
13:41:10:906	-135ms	ANPAR_UP	400kV	F_16(VRNSI-1)	Circuit Breaker	disturbe	
13:41:10:910	-130ms	VRNSI_UP	400kV	F_03(SASAR)	Circuit Breaker	Open	CB of 400kV Sarnath(UP) (end)-Varanasi(PG) ckt-2 opens.
13:41:10:910	-130ms	VRNSI_UP	400kV	F_01(ALBAD)	Circuit Breaker	Open	CB of 400kV Sarnath(UP) (end)-Varanasi(PG) ckt-1 opens.
13:41:10:912	-130ms	VRNSI_UP	400kV	05MBC	Circuit Breaker	Open	Bus Coupler opens.
13:41:10:913	-125ms	VRNSI_UP	400kV	F_10(T3)	Circuit Breaker	Open	400kV Side CB of 315 MVA ICT3 opens.
13:41:10:915	-125ms	VRNSI_UP	400kV	F_08(ANPAR-2)	Circuit Breaker	Open	CB of 400kV Sarnath(UP) (end)-Anpara(UP) ckt-2 opens.
13:41:10:926	-115ms	VRNSI_UP	220kV	E_04(T2)	Circuit Breaker	Open	220kV Side CB of 500 MVA ICT2 opens.
13:41:10:948	-90ms	ANPAR_UP	400kV	F_17(MAU_-1)	Circuit Breaker	disturbe	
13:41:11:040	0ms						PMU reference time, Bus Fault
13:41:11:075	35ms	ANPAR_UP	400kV	F_18(VRNSI-2)	Circuit Breaker	disturbe	
13:41:11:193	150ms	VRNS1_P	400kV	LISRNT2	Protection Trip	App	
13:41:11:214	175ms	VRNS1_P	400kV	11SRNTT1	Circuit Breaker	Open	
13:41:11:214	175ms	VRNS1_P	400kV	10SRNT2	Circuit Breaker	Open	
13:41:11:229	190ms	VRNS1_P	400kV	LISRNT1	Protection Trip	App	
13:41:11:250	210ms	VRNS1_P	400kV	14BRSRN1	Circuit Breaker	Open	

UP Demand pattern during tripping



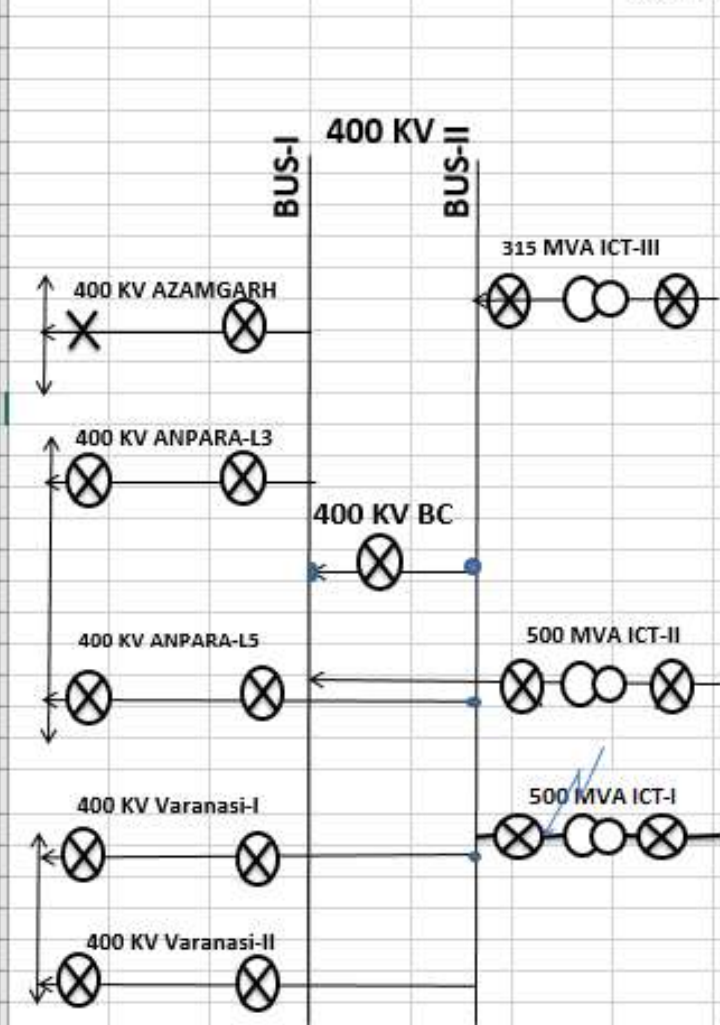
12. As per UPPTCL & POWERGRID details:

SINGLE LINE DIAGRAM OF 400/220 KV BUS AT 400 KV SARNATH SUBSTATION

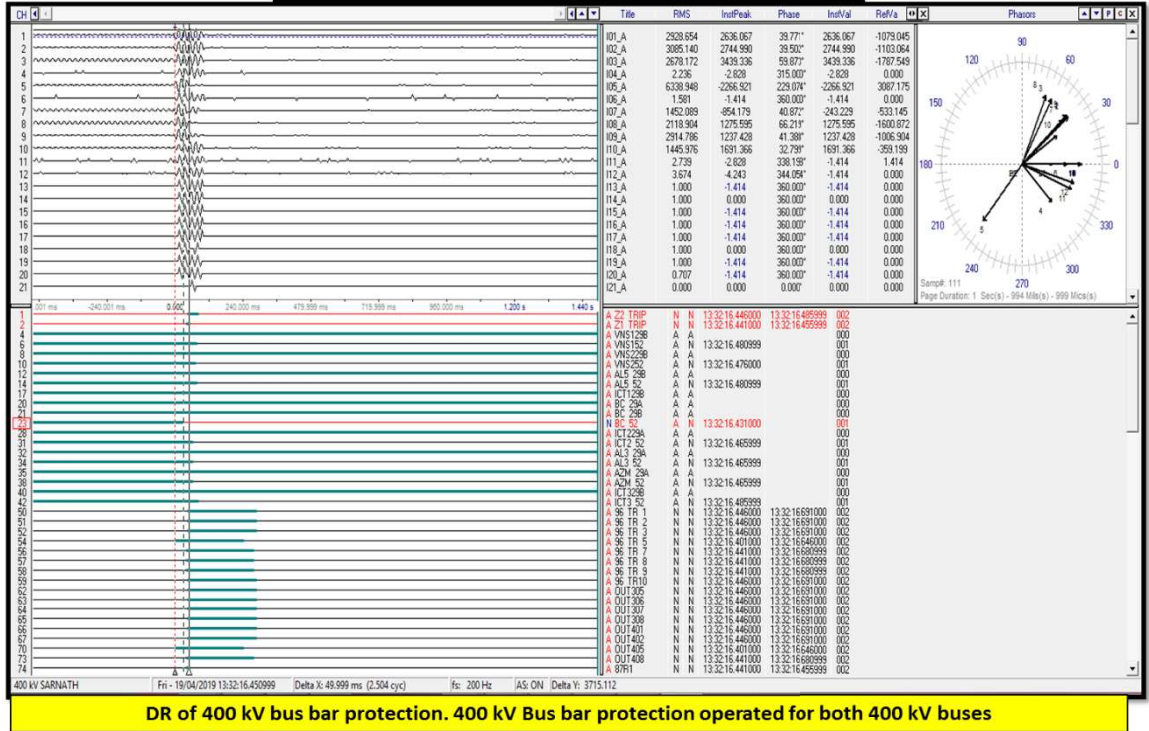
 FINAL TRIP SYMBOL
  A/R SYMBOL
  BKR CLOSE SYMBOL
  BKR ALREADY OPEN

DATED: 19.04.2019

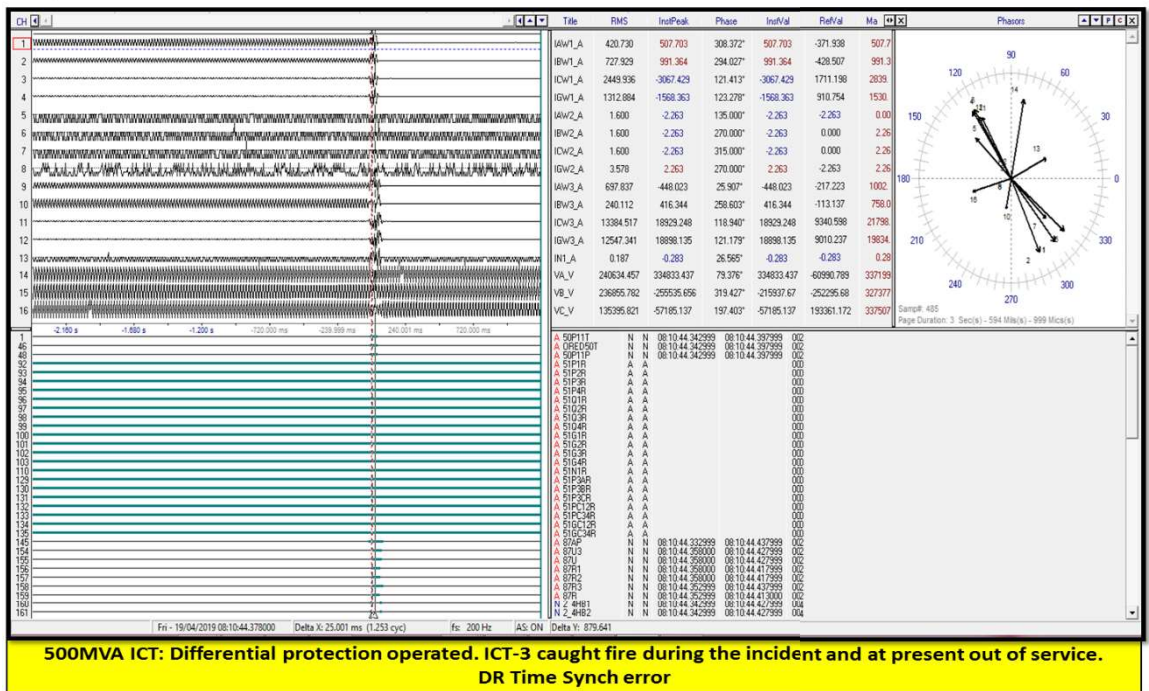
220 KV



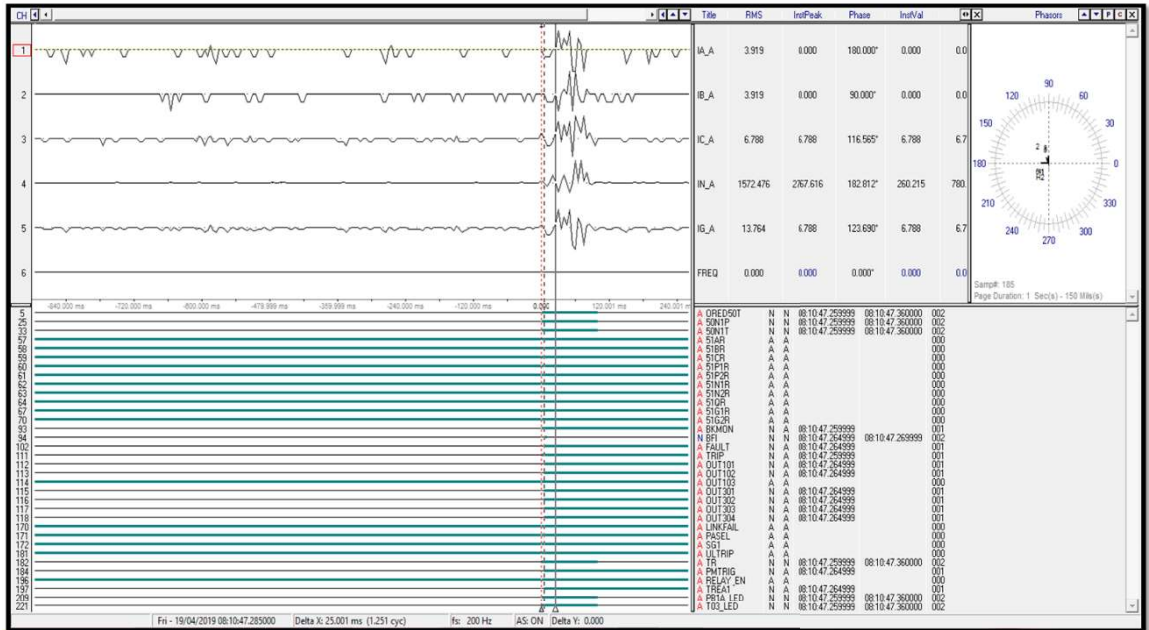
DR of 400 kV Bus Bar Protection



DR of 400/220 kV 500MVA ICT-3 differential Protection

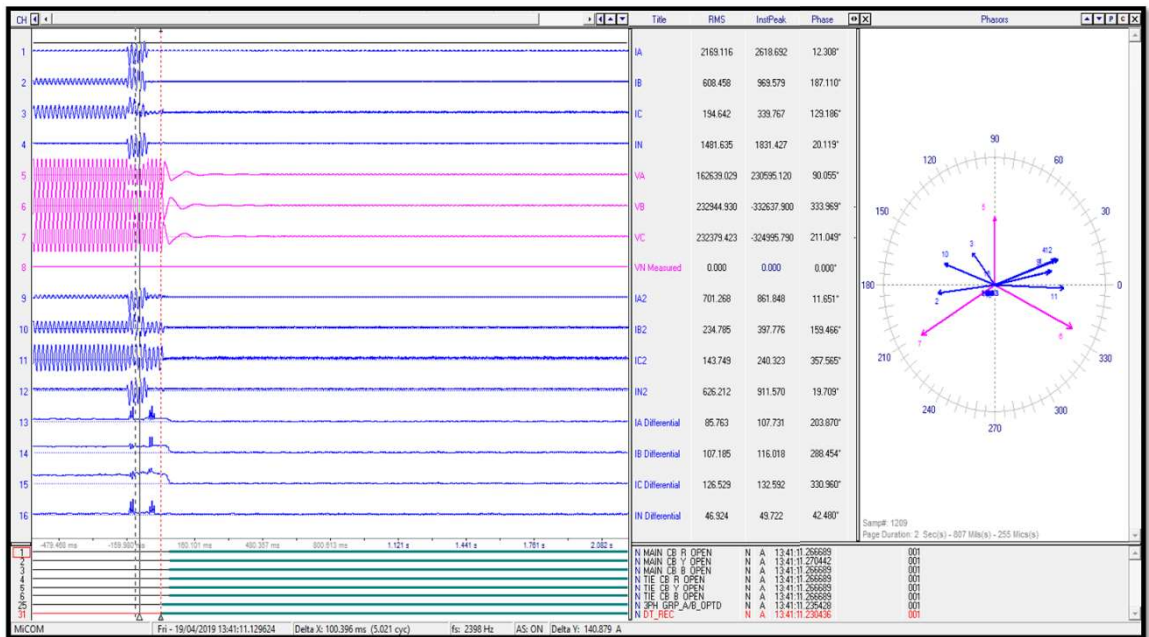


DR of 400/220 kV 500MVA ICT-3 REF Protection



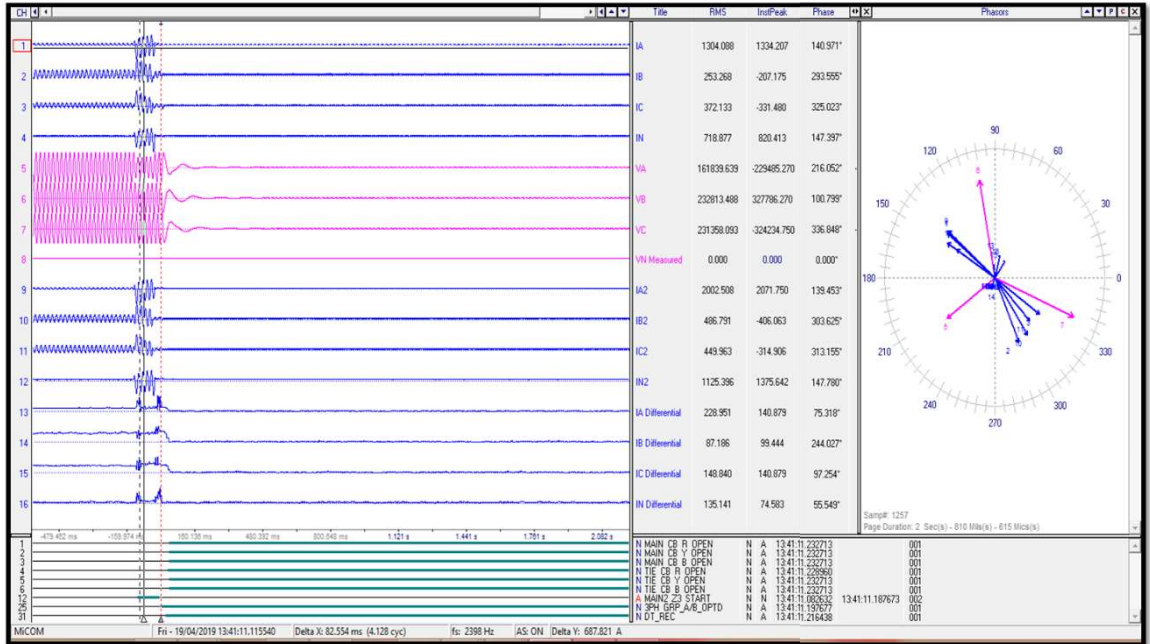
500MVA ICT: Differential protection operated. ICT-3 caught fire during the incident and at present out of service. DR Time Synch error

DR of 400 kV Varanasi (end)-Sarnath ckt-1



Tripped on DT received

DR of 400 kV Varanasi (end)-Sarnath ckt-2



It seems 3-phase tripping initiated before DT received signal, reason needs to be looked into.

Sl. No.	Description	Report
1.	Time and date of event	19.04.2019 and 13:42 Hrs.
2.	Location	Electy. 400 KV Sub Station Sarnath, Varanasi.
3.	Plant and/or Equipment directly involved	500MVA ICT-I
4.	Description and cause of event	400 kv side B-Phase bushing of 500 MVA ICT-I burst & damaged the other bushings and 400 kvs B-PH & Y-PH LA. B-ph & Y-ph jumper snapped & swing towards R-ph bus, creating Bus fault & due this all other ICTs & lines tripped at 400 kv substation sarnath.
5.	Antecedent conditions of load and generation, including frequency, voltage and the flows in the affected area at the time of tripping including weather condition prior to the event	Load at : 1. 500 MVA ICT-I : 170A, 119MW 2. 500 MVA ICT-II : 183A, 122MW 3. 315 MVA ICT-III : 116A, 79MW 4. 400 KV Sarnath-Anpara L3 : 600A, 424MW 5. 400 KV Sarnath-Anpara L5 : 692A, 477MW 6. 400 KV Sarnath-Azamgarh : 417A, 283MW 7. 400 KV Sarnath-Varanasi-I : 239A, 147MW 8. 400 KV Sarnath- Varanasi-II : 222A, 145MW
6.	Duration of interruption and demand and / or Generation (in MW and MWh) interrupted	Charging time of element: (i) 500 MVA ICT-II: HV Side:16:28Hrs IV Side:16:27HRS (ii) 315 MVA ICT-III: HV Side:16:18Hrs, IV Side:16:16 Hrs (iii) 400 KV Sarnath-Azamgarh-16:35 Hrs (iv) 400 KV Sarnath-Varanasi-I :16:53 Hrs. (vi) 400 KV Sarnath-Varansi-II: 17:07 (vi) 400 KV Sarnath-Anpara L3: 17:15 Hrs. (vii) 400 KV Sarnath-Anpara L5: 20:02 Hrs.
7.	All relevant system data including copies of records of all recording instruments including disturbance recorded, Event Logger, DAS etc.	Copy of DR of 500 MVA ICT-I and BUSBAR Protection is enclosed.
8.	Sequence of tripping with time	1. 500 MVA ICT-I :13:42 Hrs 2. 500 MVA ICT-II :13:42 Hrs. 3. 315 MVA ICT-III :13:42 Hrs. 4. 400 KV Sarnath-Anpara L3 :13:42 Hrs. 5. 400 KV Sarnath-Anpara L5 :13:42 Hrs. 6. 400 KV Sarnath-Azamgarh :13:42 Hrs. 7. 400 KV Sarnath-Varanasi-I :13:42 Hrs. 8. 400 KV Sarnath- Varanasi-II :13:42 Hrs.
9.	Details of Relay Flags (May be enclosed as a separate annexure)	400 KV lines and all ICTs Tripped. Following flags are observed: 1. 400 KV Sarnath-Azamgarh At Relay Panel : Lockout Relay optd. 2. 500 MVA ICT - I At Relay Panel : HV side 1. Diff Relay(SEL-787): Trip, Diff., Diff. Current: 933A 2. REF Relay(SEL-751): Trip, Gnd/Neutral Overcurrent. IN=5854A 30A(BUCHH. Trip), 30B(PRV Trip), 30C(OSR Trip) 30D(WTI Trip), 30E(OTI Trip), 186,286. IV Side: 1. B/U Relay(SEL-351A): Trip, 50, C,N,IA=592A, IB=590A, IC=17296A, IN=16110A 186,286 3. 400 KV Anpara-Sarnath (L3) Line At Relay Panel : Lockout Relay optd. 4. 400 KV Anpara-Sarnath (L5) Line At Relay Panel : Lockout Relay optd. 5. 400 KV Anpara-Varanasi-I Line At Relay Panel : Lockout Relay optd. 6. 400 KV Anpara-Varanasi-I Line At Relay Panel : Lockout Relay optd. BUSBAR Protection (SEL-487):- R-Ph Differential Protection: Trip, 87, Zone-I, Zone-II, 96-TR1(Varanasi-I), 96-TR2(Varanasi-II), 96-TR3 (Anpara-L5), 96-TR4(500 MVA ICT-I), 96-TR5(BC), 96-TR7(500MVA ICT-II), 96-TR8(Anpara-L3), 96-TR9(Azamgarh), 96-TR10 ((315 MVA ICT-III), DT Send to all feeders through 96 trip relay.
10.	Remedial measures	
11.	Estimated time of return to service	20:02 Hrs. on 19.04.2019
12.	Any other relevant information	
13.	Name and designation of reporting officer	Executive Engineer, Electy. 400 KV Sub Station Sarnath, Varanasi

13. Preliminary Report and DR/EL details received after 24hrs from POWERGRID.

14. Preliminary Report and DR/EL details received after 24hrs from UPPTCL. But detailed report yet to be received.

Points for Discussion:

- Reason of operation of both 400 kV bus bar protection at 400 kV Sarnath (UP) to be checked and corrected.

2. 400 kV bus bar protection setting at Sarnath (UP) needs to be looked into.
3. Tripping of 400 kV Anpara-Mau ckt during fault at Sarnath (UP) shall be checked.
4. It seems 3-phase tripping initiated before DT received signal in 400 kV Varanasi (end)-Sarnath ckt-2. It needs to be looked into b POWERGRID
5. Time Synchronization of DR of Sarnath (UP) to be checked.
6. Time synchronization of digital SCADA SoE of Sarnath(UP) needs to be looked into.
7. Remedial measures taken report considering the aforesaid points to be submitted by 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.

P. Multiple Element tripping at 220kV Khetri (Raj) Station at 21:59hrs of 23rd Apr 2019

Event category: GD-1

Generation loss: 400 MW (Rajasthan may confirm)

Loss of load: Nil MW (Rajasthan may confirm)

Energy load: Nil MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		80ms & 300ms	As per PMU data
Phase of the fault		Y-N fault followed by R-Y fault	As per PMU data

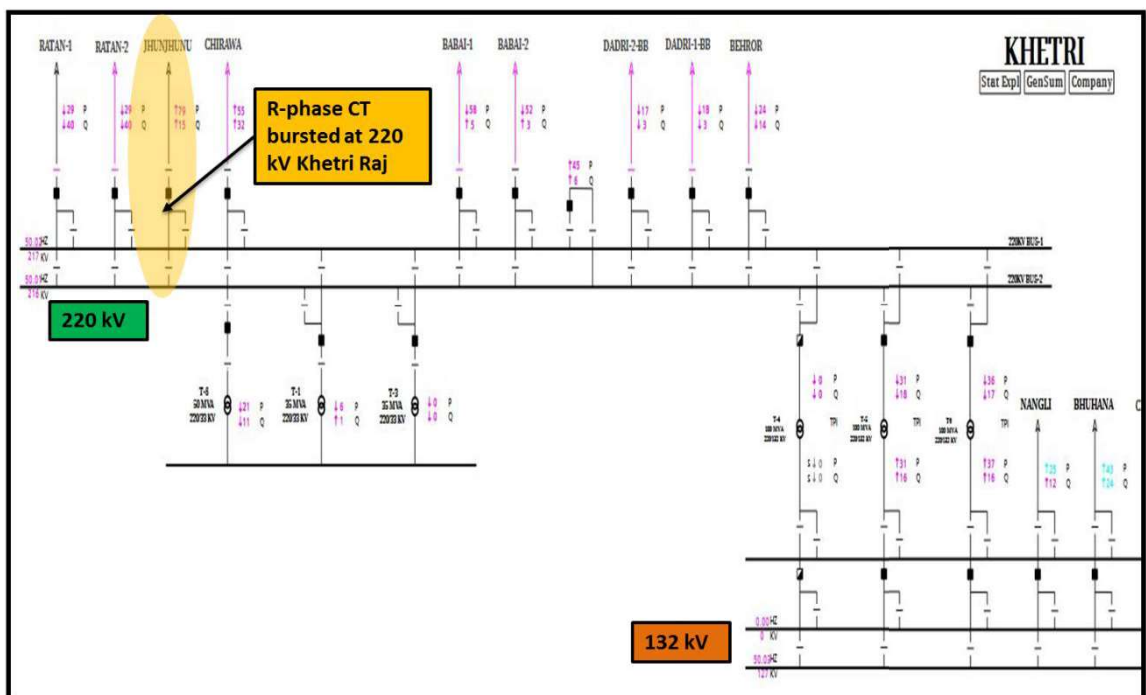
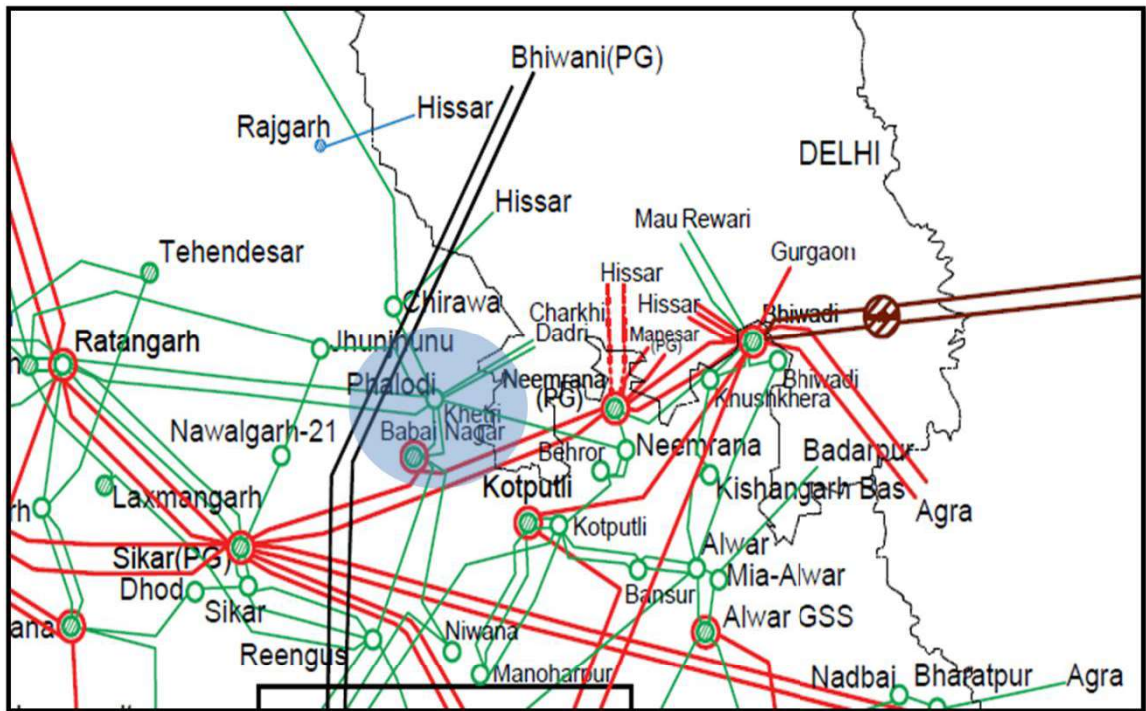
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Available	Time Synch error

DR/ EL	Rajasthan	Received	After 24hrs
	BBMB	Received	After 24hrs
Preliminary Report	Rajasthan	Received	After 24hrs
	BBMB	Received	After 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, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	Rajasthan & BBMB	1. DR/EL within 24hrs 2. Detailed Report yet to be received 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

1. Single Line Diagram and Connectivity diagram of 220 kV Khetri (Raj):



2. 220 kV Khetri (Raj) station has double bus single breaker scheme. It is connected through Charkhi Dadri BBMB D/C, Ratangarh D/C, Babai D/C, Chirawa S/C, Jhunjhunu S/C and Behror S/C. It also has three 100 MVA 220/132 kV ICTs and 2*35+1*50 MVA 220/33 kV ICTs.
3. In antecedent conditions, 220 kV bus bar protection was not healthy at 220 kV Khetri (Raj) and alternate arrangement for bus

- bar protection was also not implemented. 220 kV Khetri- Jhunjhunu & 220 kV Khetri- Chirawa carrying 53 MW & 62 MW respectively
4. B Phase (A, B, C) CT of 220 KV Khetri-Jhunjhunu Line burst at 220 kV GSS Khetri nagar and line tripped in zone 1 from Khetri end and zone 2 from Jhunjhunu end.
 5. At the same time a Fault on B phase (A, B, C) on 220 KV Khetri-Chirawa line occurred on which main breaker B pole stuck and caused the LBB operation, but fault was not cleared due to outage of BUS BAR Scheme (ABB make). LBB protection is inbuilt in BUS BAR protection. Due to this all 220 KV Feeders tripped in zone 2 and transformers tripped on back up Earth fault protection.
 6. Control room operator reported, a blast in R-phase CT of 220 kV Khetri- Jhunjhunu line at Khetri however in preliminary report it was mentioned as Y-phase CT.
 7. LBB protection of 220 kV Dadri (BBMB)- Khetri-I line at Dadri (BBMB) end operated due to wrong PSL configuration in Micom P-442 relay, tripping was mapped on LBB initiation without any time delay. It causing bus bar protection operation of 220 kV Charkhi Dadri Bus-1 and resulted into tripping of 05 nos of 220 kV line associated with 220 kV Charkhi Dadri Bus-1 and 100 MVA ICT-1 tripped.
 8. All the elements connected at 220 kV Khetri station tripped.
 9. Name of the tripped element:
 - 220 kV Bus-II at 220/132kV Khetri (Raj)
 - 220 kV Khetri(Raj)-Behror (Raj)
 - 220 kV Khetri(Raj)-Ratangarh(Raj) ckt-1 & 2
 - 220 kV Khetri(Raj)-Jhunjhunu(Raj)
 - 220 kV Khetri(Raj)-Babai (Raj) ckt-1 & 2
 - 220 kV Khetri(Raj)-Charkhi Dadri(BBMB) ckt-1 & 2
 - 100MVA ICT 4, 5 & 6 at 220/132kV Khetri (Raj)
 - 2*35 MVA+ 1*50 MVA at 220/33 kV ICT at Khetri (Raj)
 - 220 KV Bus-I at Charkhi Dadri (BBMB)
 - 220 kV Charkhi Dadri (BBMB) - Mahendergarh
 - 220 kV Charkhi Dadri (BBMB) - Bhiwani ckt-1 & 3
 - 220 kV Charkhi Dadri (BBMB) - Lula Ahir
 - 220 kV Charkhi Dadri (BBMB) - Samaypur.
 - 100 MVA ICT-I at Charkhi Dadri (BBMB)

10. PMU plots:

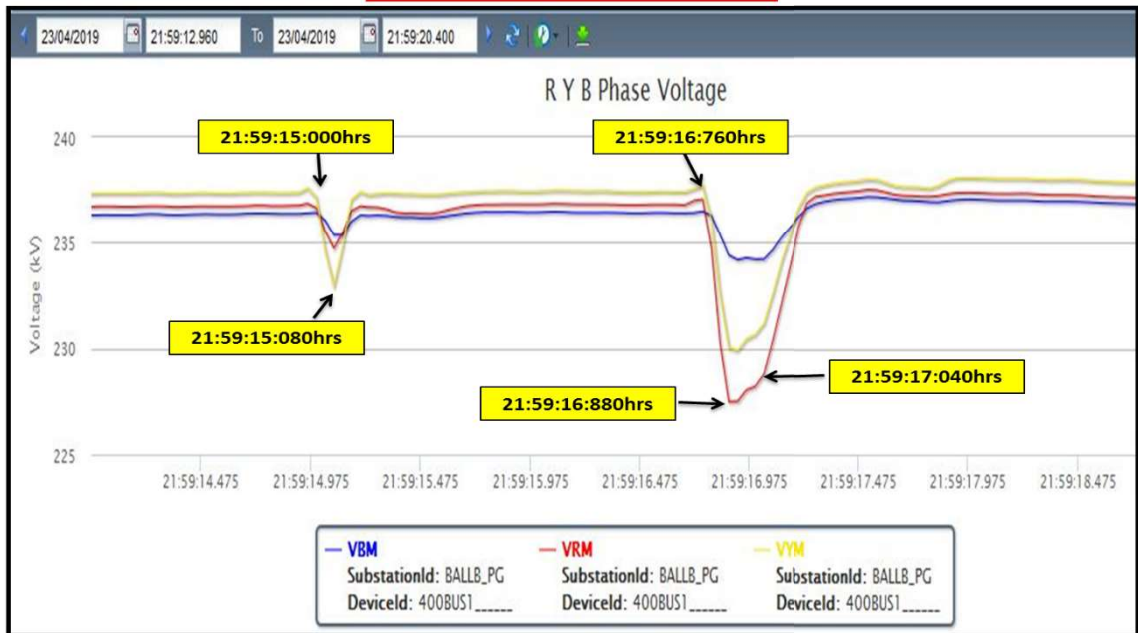
PMU Plot of frequency at Bassi(PG)

21:59hrs/23-Apr-19



PMU Plot of phase voltage magnitude at Ballabhgarh(PG)

21:59hrs/23-Apr-19



11. As per PMU data:

- Y-N fault followed by R-Y fault (after 1760ms)
- Fault clearance time is **80ms & 300ms**.

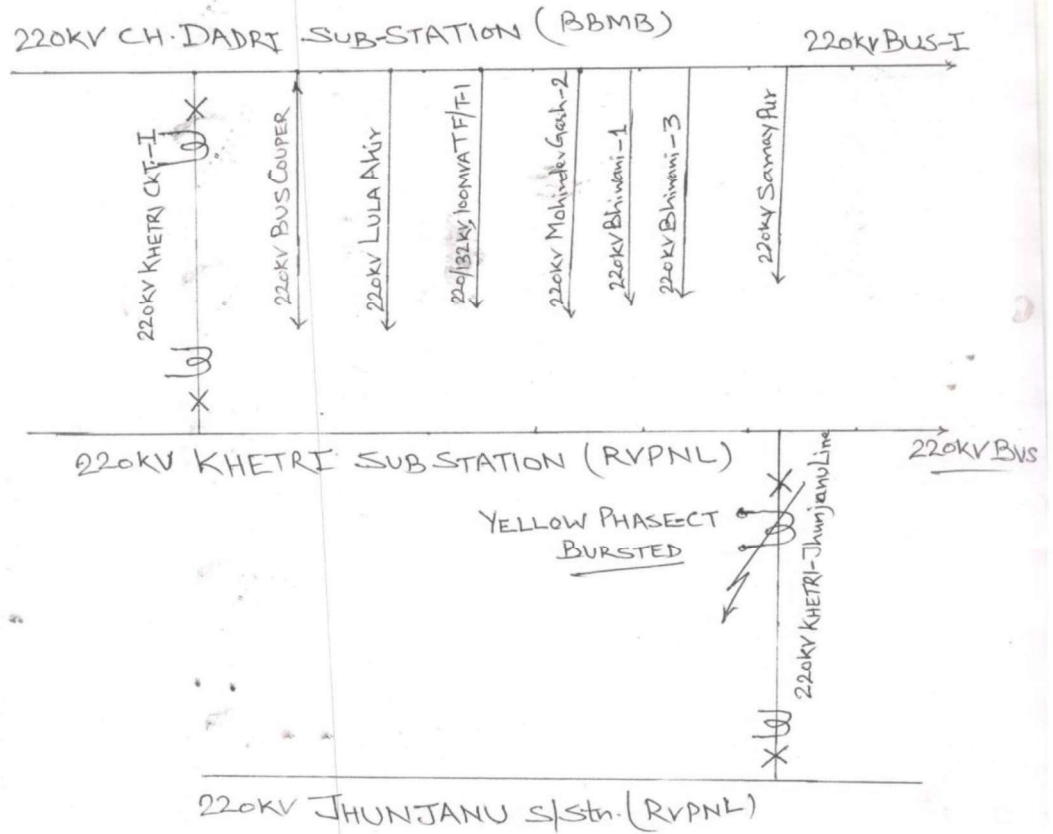
12. SCADA data and SoE: SoE captured only for some of the tripped elements. Time difference of 1 minute in actual fault and breaker digital signal captured from SCADA SoE.

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
21:59:14:088	KHETRI	220kV	E_01(JHUNJ-1)	Circuit Breaker	Open	CB of 220 kV Khetri- Jhunjhunu opens.
21:59:14:534	JHUNJNU	220kV	07MBC	Circuit Breaker	Open	
21:59:14:615	JHUNJNU	220kV	E_01(RATAN-1)	Circuit Breaker	Open	
21:59:16:054	KHETRI	220kV	E_02(CHIRW-1)	Circuit Breaker	disturbe	
21:59:16:093	KHETRI	220kV	E_10(HERP2-1)	Circuit Breaker	Open	
21:59:16:126	KHETRI	220kV	E_11(HERP2-2)	Circuit Breaker	Open	
21:59:16:748	KHETRI	220kV	E_14(DADRI-1)	Circuit Breaker	Close	
21:59:17:011	KHETRI	220kV	E_09(DADRI-2)	Circuit Breaker	Close	
21:59:17:058	RATAN400	220kV	E_03(KHTRI-2)	Circuit Breaker	Open	
21:59:17:718	KHETRI	220kV	E_02(CHIRW-1)	Circuit Breaker	Open	CB of 220 kV Khetri- Chirava opens.
21:59:17:738	CHIRAWA	220kV	E_01(KHTRI-1)	Circuit Breaker	disturbe	
21:59:17:761	CHIRAWA	220kV	E_01(KHTRI-1)	Circuit Breaker	Open	CB of 220 kV Khetri- Chirava{end} opens.

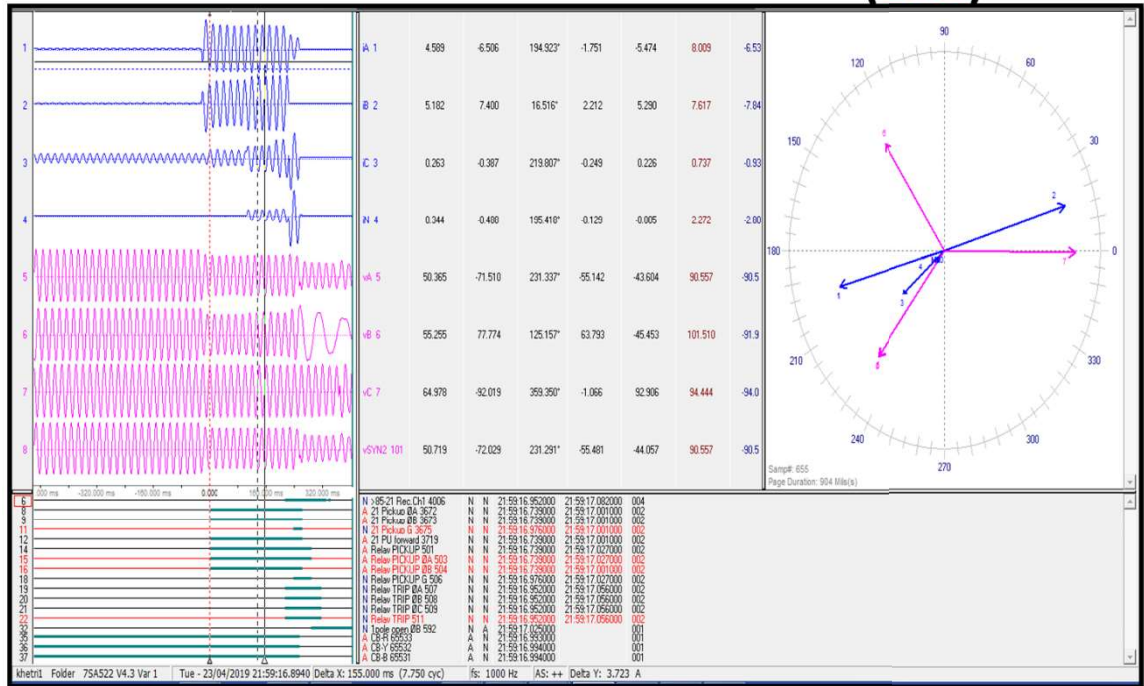
13. As per BBMB details:

- At 21:59:16Hrs, LBB Relay of 220 kV Dadri –Khetri Ckt-1 operated & tripped all the connected feeders, Transformer along with bus coupler due to bursting of Y Phase CT of 220KV Khetri- Jhunjhunu line at 220 kV substation Khetri (RVPNL). On analysing the related DRs of Siprotec 7SA522 (main 2 DP Scheme) & LBB of 220 kV Dadri-Khetri Ckt-1, operation of LBB was due to wrong configuration of tripping on initiation logic of LBB in Micom P442 (main-1 DP Scheme)
- DRs of LBB relay of 220KV Khetri-1, Siprotec (Main 2) DP Scheme & PSL of MicomP442 (Main1) were analysed and it was found that LBB relay had operated in 200ms simultaneously with the initiation of two & three phase fault of Micom P442 DP Scheme & time mismatch (41minutes) of LBB relay also observed with GPS system. all the 6 nos. feeders of 220 kV Bus1 & 220/132kV,100 MVA T/F-T-1 along with Bus Coupler tripped through Bus Bar 96 Relays

SINGLE LINE DIAGRAM SHOWING POSITION OF 220KV CKTS. 0
BUS-I, TRIPPED DUE TO OPERATION OF LBB ON 23.04.2019
AT 21:59 Hrs AT 220KV SUB STATION BBMB CH. DADRI.



DR of 220 kV Khetri-Charkhi Dadri (end) ckt-1



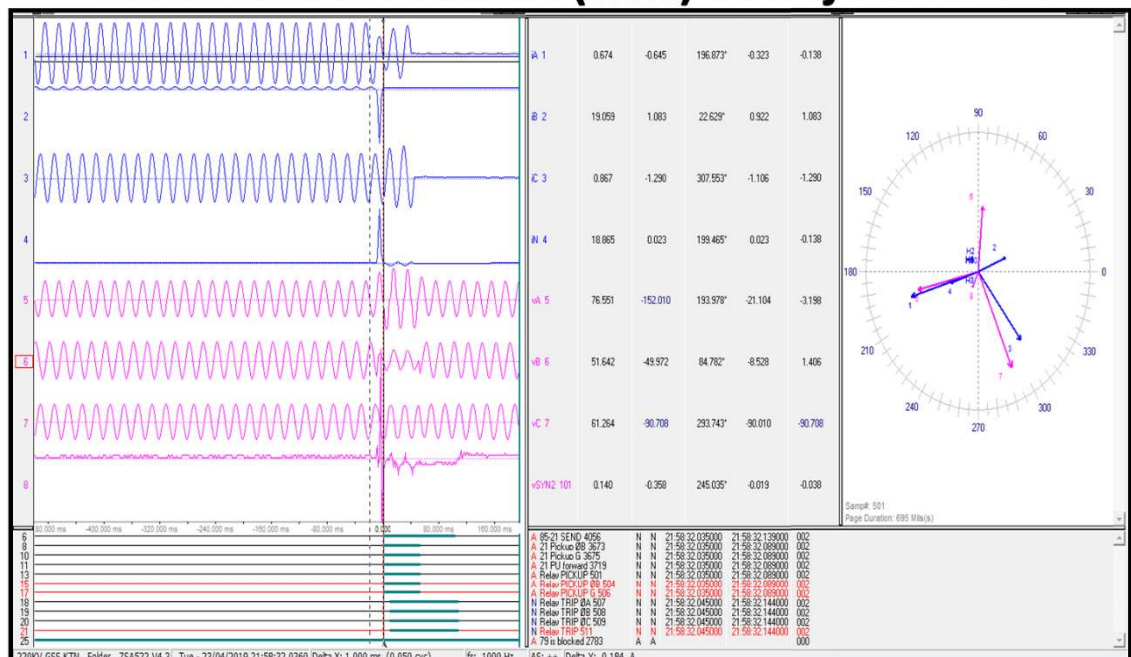
All three phase of the breaker tripped immediately within 220ms of fault occurrence. LBB protection at Charkhi Dadri end also operated during tripping of the line. PSL modified for 200 ms time delay after trip initiation.

14. As per Rajasthan details:

- B Phase (A,B,C) CT of 220 KV Khetri-Jhunjhunu Line burst at 220 KV GSS Khetri nagar and line tripped on zone 1 from Khetri end and zone 2 from Jhunjhunu end.
- At the same time a Fault on B phase (A,B,C) on 220 KV Khetri-Chirawa line occurred on which main breaker B pole stuck and caused the LBB operation, but fault was not cleared due to outage of BUS BAR Scheme (ABB make). LBB protection is inbuilt in BUS BAR protection. Due to this all 220 KV Feeders tripped on zone 2 and transformers tripped on Earth fault protection

S.No	Name of line Element along with voltage level	Relay Indication EndA	Relay Indication EndB	DR Submitted by the utility				ER Submitted by the utility				Protection operation									
				EndA		EndB		EndA		EndB		EndA					EndB				
				Set*	Reason for rt set	Set*	Reason for rt set/ REASON	Set*	Reason for rt set	Set*	Reason for rt set	M1*	M11*	Any Other Protection#	Fault locator details	Auto reclosure status	M1*	M11*	Any Other Protection#	Fault locator details	Auto reclosure status
1	220kV/Khetri- Jhunjhunu Line	Z1, BPhase Rdup, Trip ABC, AR Lockout, - 13/8.4Mr	Z2, R8B Phase, 51.7 km	YES		NO	Jhunjhunu	NO	ER not working	NO	NA	Z1, BPhase Rdup, Trip ABC, AR Lockout, - 13/8.4Mr	N/A	No	No	AR Lockout	Z2, 51.7KM A/R Lockout, Trip/ABC	N/A	No	NL	
2	220kV/Khetri- Chirawa Line	Z2, BPhase, Trip ABC	BPhase, 18.4KM	YES		NO		NO	ER not working	NO	NA	Z1, BPhase, 2.6km	N/A	No	No	AR Lockout	BPhase, 18.4KM	BPhase, 98.4KM	E/F	No	NL
3	220kV/Khetri-Dadhi 1 Line	No	A8B Phase, Trip ABC, 70.8km, Z2	YES		NO		NO	ER not working	NO	NA		N/A	No	No	No	N/A	A8B Phase, Trip ABC, 70.8km, Z2		No	NL
4	220kV/Khetri-Dadhi 2 Line	No	Z2, ABC Trip	YES		NO		NO	ER not working	NO	NA		N/A	No	No	No	Z2, Trip ABC, 67 km	Z2, Trip ABC, 35.6 km		No	NL
5	220kV/Khetri-babai 1(Rengus) Line	No	Z2, A8B Phase, Trip ABC, 35.2KM	YES		NO		NO	ER not working	NO	NA		N/A	No	No	No	Z2, A8B Phase, Trip ABC, 35.2KM	Z2, A8B Phase, Trip ABC		No	NL
6	220kV/Khetri-babai 2(Nwara) Line	No	Z2, A8B Phase, Trip ABC, 37.9KM	YES		NO		NO	ER not working	NO	NA		N/A	No	No	No	Z2, A8B Phase, Trip ABC, 37.9KM	A8B Phase, Trip ABC		No	NL
7	220kV/Khetri- Behror Line	BPhase, Trip ABC, 59.4KM	R8/Phase, Z2	YES		NO		NO	ER not working	NO	NA	BPhase, Trip ABC, - 59.4KM	N/A	No	No	No	R8/ Phase, Z2	R8/ Phase, Z2		No	NL
8	220kV/Khetri- Ratangarh 2 Line	No	Z2, 1199 km Phase Y8B	YES		NO		NO	ER not working	NO	NA		N/A	No	No	No	Z2, 1199 km Phase Y8B	Z2, 1201 km Phase Y8B		No	NL

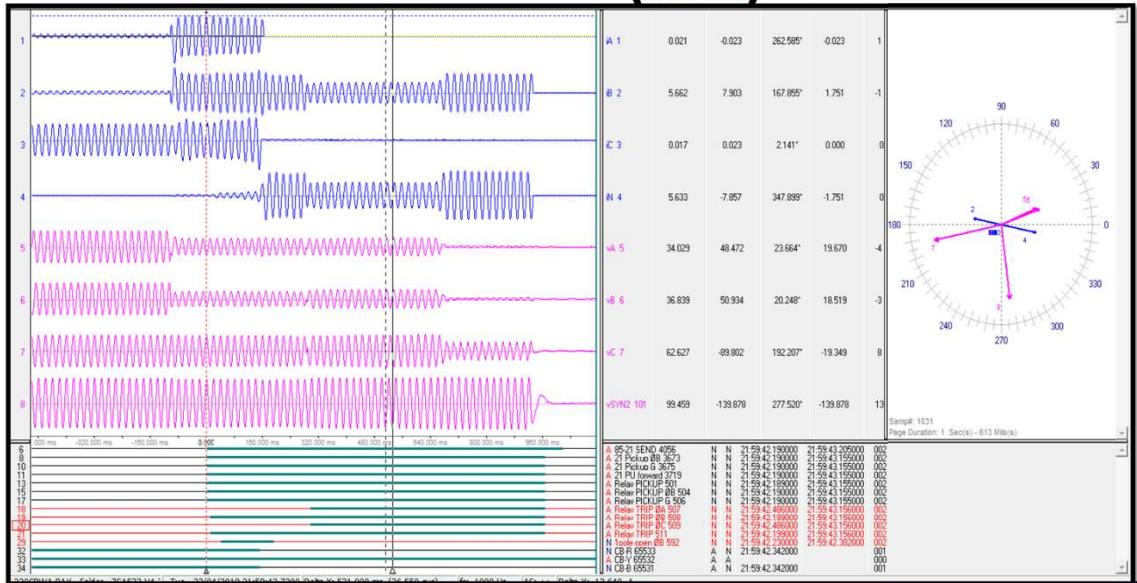
DR of 220 kV Khetri (end)-Jhunjhunu ckt



Time Ktn Synch Error

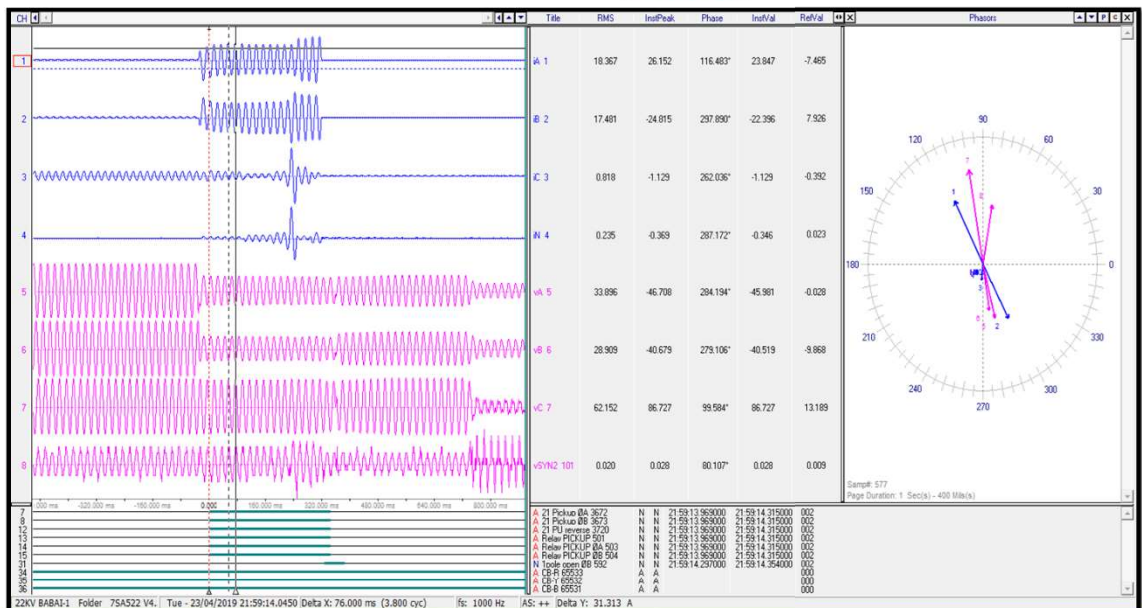
Y-phase to earth fault, all three phase of the line tripped as A/R was under blocked condition.

DR of 220 kV Khetri (end)-Chirawa ckt



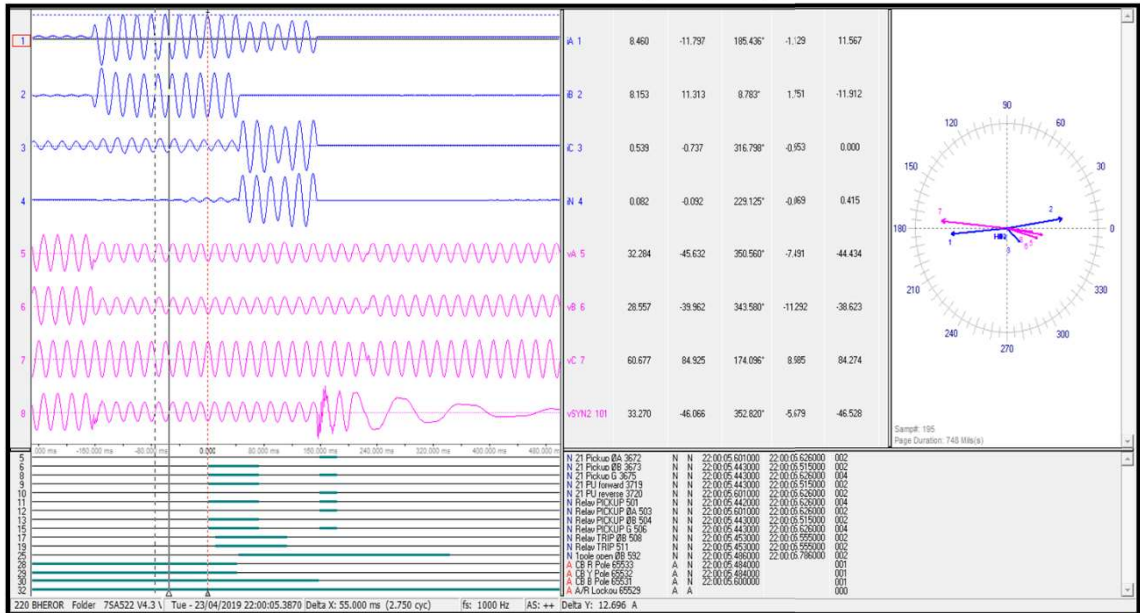
Time Sync Error
 Y-N fault, A/R blocked. Tripping command issued for all three phase, Y-phase breaker didn't open. It resulted into LBB protection operation and delayed clearance of fault. **Bus bar blocked**
 One of the ckt tripped in Z-3

DR of 220 kV Khetri (end)-Babai ckt-1



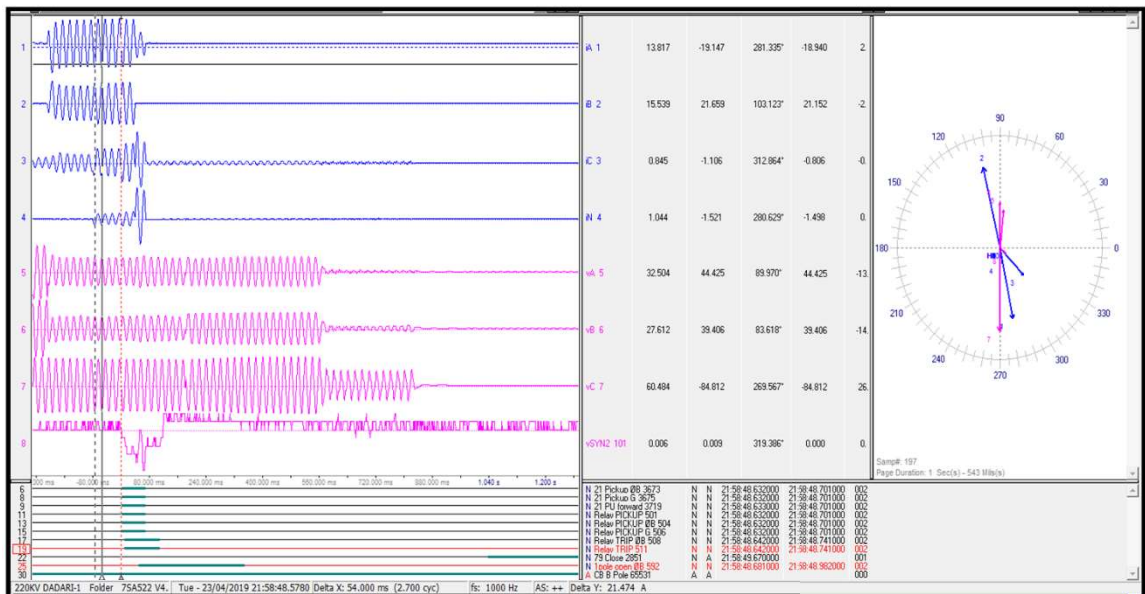
Time Sync Error
 Why 1-phase breaker open signal initiated?

DR of 220 kV Khetri (end)-Behror ckt



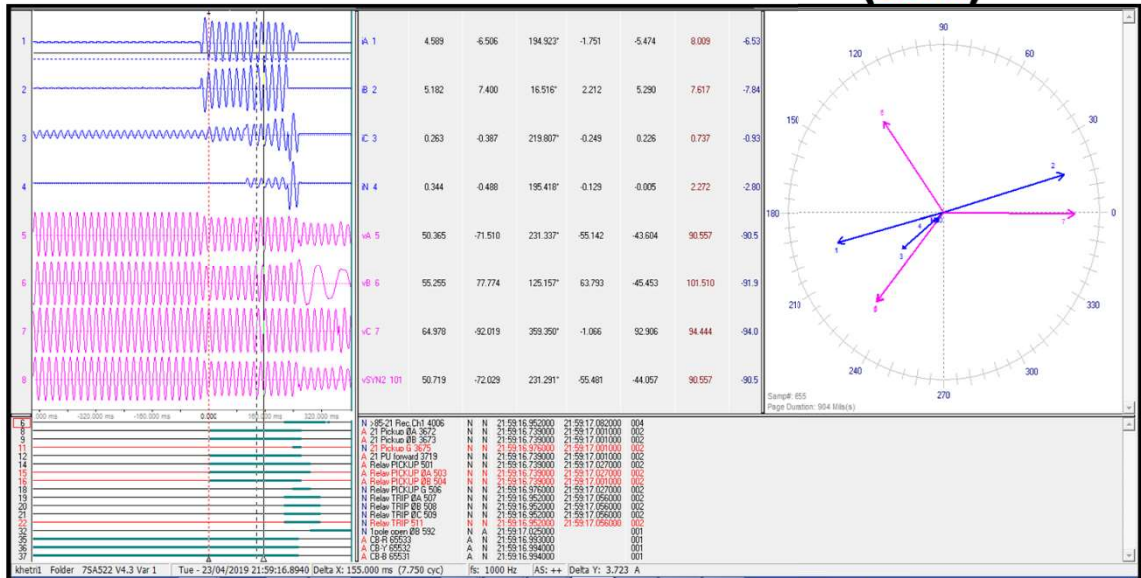
Time Synch Error
A/R blocked. Why there is a difference in opening of the breaker at Khetri end (120ms difference between R,Y and B-phase opening?)

DR of 220 kV Khetri (end)-Charkhi Dadri ckt-1



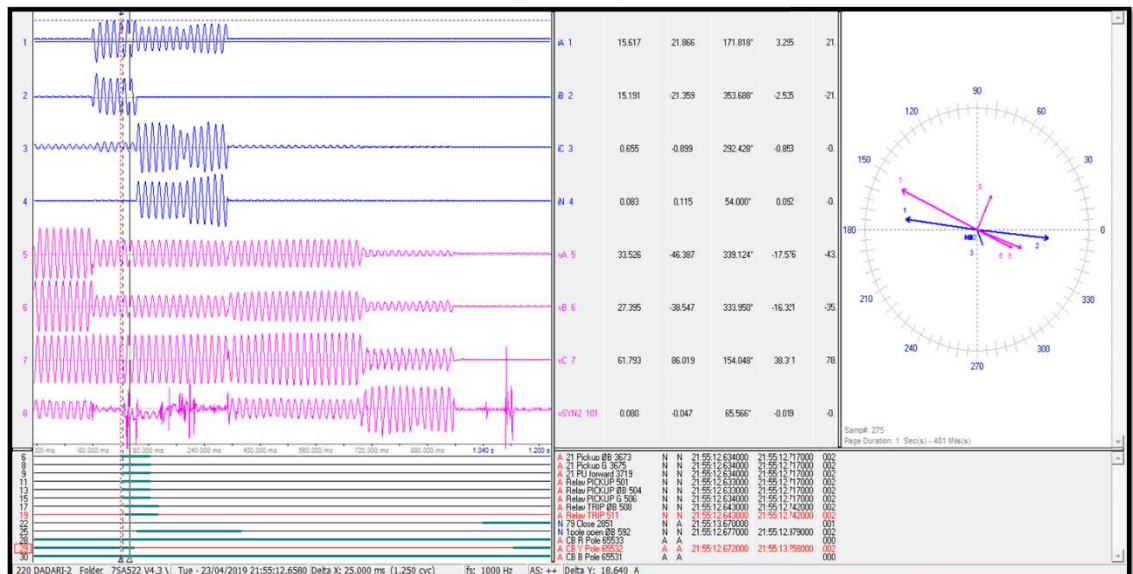
Time Synch Error
Y-phase breaker opened from Khetri end and A/R after 1000ms. Other breaker didn't open. Status of pole discrepancy after 2.5second?

DR of 220 kV Khetri-Charkhi Dadri (end) ckt-1



All three phase of the breaker tripped immediately within 220ms of fault occurrence. LBB protection at Charkhi Dadri end also operated during tripping of the line. PSL modified for 200 ms time delay after trip initiation.

DR of 220 kV Khetri (end)-Charkhi Dadri ckt-2



Time Synch Error
Y-phase breaker opened from Khetri end and A/R after 1000ms and again trip. Other breaker didn't open. Status of pole discrepancy after 2.5second?

15. Remedial Measures taken as per BBMB report:

- The PSL of main-1 (Micom P442) of 220KV Dadri -Khetri Ckt-1 has been modified and the relay has been again tested for correct operation of LBB initiation.
- The time delay of LBB protection relay corrected.

16. Remedial Measures taken as per Rajasthan report:

- Zone 4 Setting of all 220 KV feeders has been revised for 2 KM ohmic reach and tripping time of 160 ms and 220 KV Bus coupler TMS setting revised as 0.075.

17. Preliminary Report, DR/EL details and detailed report received from BBMB.
18. Preliminary Report & partial DR details received but detailed report in desired format is still awaited from Rajasthan. Station EL detail is also not submitted.

Points for Discussion:

1. Reason of complete station outage of 220 kV Khetri (Raj)?
2. It seems reverse zone protection setting operated in 220 kV connected elements from Khetri (Raj) however Tripping of all the elements despite of tripping of bus coupler at 220 kV Khetri (Raj) needs to be looked into.
3. Reason of outage of 220 kV bus bar protection at 220 kV Khetri (Raj) and tentative date of revival.
4. Healthiness of bus bar protection at 220 kV Khetri (Raj) to be ensured and also review the alternate arrangement in view of complete station outage and delayed clearance of fault.
5. In this case two LBB operation (Charkhi Dadri end and Khetri end) initiated due to failing of breaker to open, Breaker maintenance needs to be looked into.
6. LBB protection shall send the tripping command to all the breaker connected to that bus separately not through bus bar protection.
7. Healthiness of station event logger needs to be ensured at 220 kV Khetri (Raj).
8. Many of distance protection operated in forward zone however fault was in reverse zone. Protection Audit needs to be done at 220 kV Khetri (Raj)
9. Time Synchronization of DR of different 220 kV lines at Khetri end to be looked into.
10. Auto reclosing function in all 220 kV outgoing lines from 220 kV Khetri (Raj) needs to be ensured.
11. Time synchronization of digital data of 220 kV Khetri (Raj) needs to be looked into. Analog data availability of 220 kV Khetri (Raj) also to be ensured.
12. Rajasthan shall also confirm the load loss and energy loss details.
13. Detailed Report and Remedial measures report received from BBMB but still awaited from Rajasthan.
14. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

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 at 400/220kV Merta (Raj) Station at 05:07hrs of 12th May 2019

Event category: GI-2

Generation loss: Nil (Rajasthan may confirm)

Loss of load: Nil (Rajasthan may confirm)

Energy load: Nil (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	80ms	
Phase of the fault	PMU data	Blue phase to earth fault	A/R attempt was not taken.

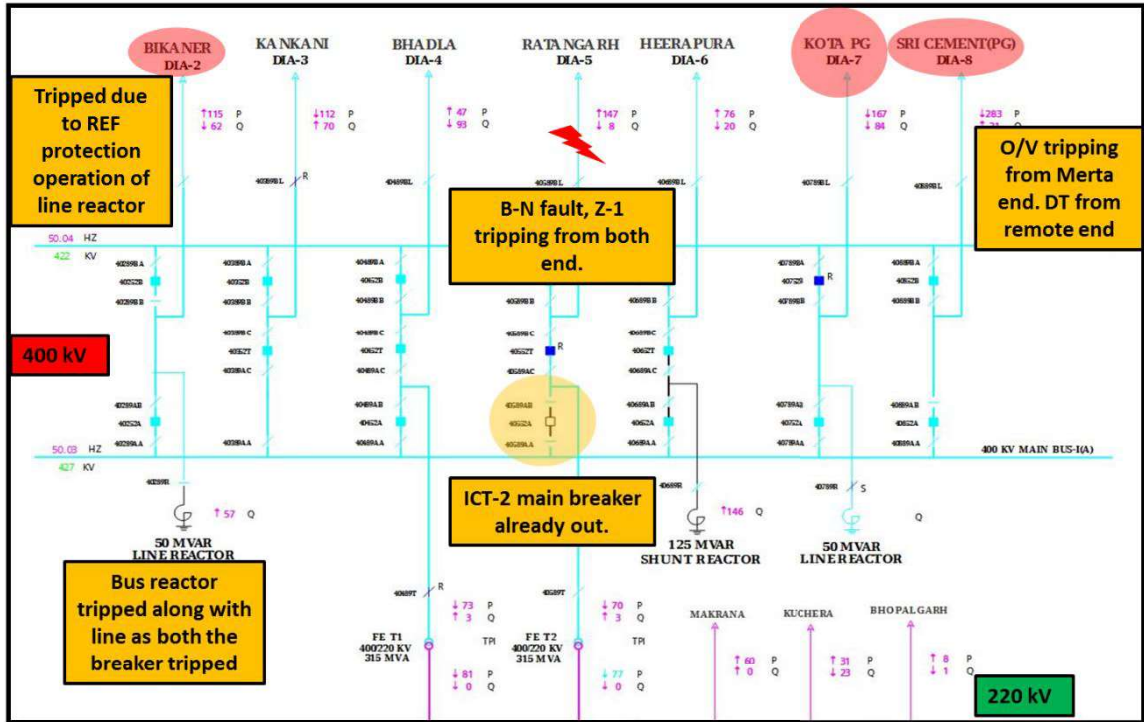
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Partially Available	
DR/EL	Rajasthan	Not Received	
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

Description	Clauses	Utility	Remarks
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<p>Violation of Clauses</p>	<p>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</p>	<p>Rajasthan</p>	<p>1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system</p>
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Based on above information description of the events is:

1. Single Line Diagram and Connectivity diagram of 400 kV Merta (Raj):



2. 400/220 kV Merta (Raj) station has one and half breaker scheme. It is connected through Bikaner S/C, Kankani S/C, Bhadla S/C, Ratangarh S/C, Heerapura S/C, Kota S/C and Shri Cement S/C. It also has two 315 MVA 400/220 kV ICTs.
3. In antecedent conditions, 400kV Kota(PG)-Merta(RRVPNL) & 400kV Shree Cement(CSL)-Merta(RRVPNL) carrying 167 MW & 283 MW respectively.
4. 400kV Merta-Ratangarh line tripped on actual (B-N fault) Blue phase to ground fault and fault cleared in zone-1, 89.09 km from Merta end zone-1, 84.70 km from Ratangarh end
5. At the same time, 400kV Kota(PG)-Merta(RRVPNL) tripped on Overvoltage (Over voltage indication at Merta end, DT received at Kota (PG) end) and 400kV Shree Cement(CSL)-Merta(RRVPNL) also tripped on overvoltage from Merta end.
6. 315 MVA ICT 2 tripped along with 400kV Ratangarh-Merta (Main bay of ICT was out already).
7. 400kV Merta-Bikaner line tripped on line reactor REF operation from Bikaner end and tripped due to DT received at Merta end.
8. Name of the tripped element:
 - 400kV Kota(PG)-Merta(RRVPNL)
 - 400kV Shree Cement(CSL)-Merta(RRVPNL)
 - 400kV Merta(RRVPNL)-Ratangarh(RRVPNL)
 - 400kV Bikaner(RRVPNL)-Merta(RRVPNL)
 - 315 MVA ICT 2 at 400/220kV Merta(RRVPNL)
 - 50 MVAr 400 kV Bus Reactor at 400 kV Merta(RRVPNL)

9. PMU plots:

PMU Plot of frequency at Bassi(PG)

05:07hrs/12-May-19



PMU Plot of phase voltage magnitude at Kota(PG)

05:07hrs/12-May-19



10. As per PMU data:

- Blue phase to earth fault
- Fault clearance time is **80ms**.

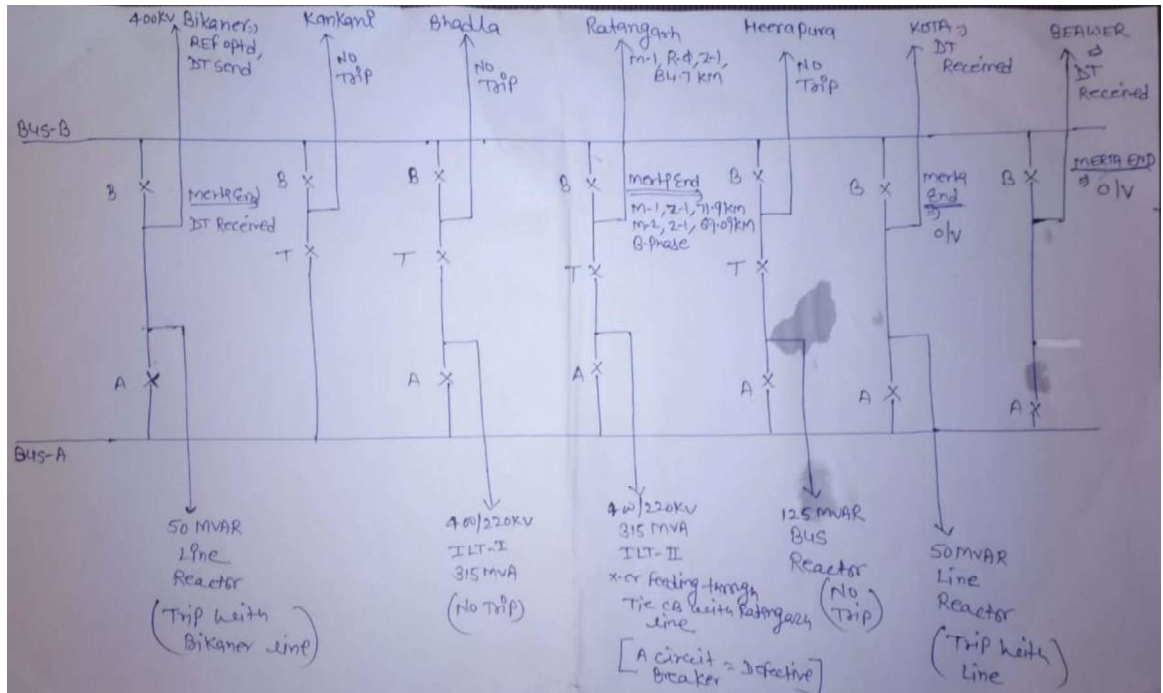
11. SCADA data and SoE: SoE captured for all the tripped elements.

Time	Sequence	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
05:07:47:200	0ms						PMU reference time
05:07:47:280	80ms						Fault clearance time
05:07:47:351	150ms	RATAN400	400kV	5T3ME4	Circuit Breaker	Open	Tie CB of 400kV Merta(RRVPNL)-Ratangarh(RRVPNL) opens.
05:07:47:360	160ms	RATAN400	400kV	4MERTA4	Circuit Breaker	Open	Main CB of 400kV Merta(RRVPNL)-Ratangarh(RRVPNL) opens.
05:07:53:170	5970ms	KOTA	400kV	2MER1SCM	Circuit Breaker	Open	Tie CB of 400kV Kota(PG)-Merta(RRVPNL) opens.
05:07:53:172	5970ms	KOTA	400kV	3MERTA1	Circuit Breaker	Open	Main CB of 400kV Kota(PG)-Merta(RRVPNL) opens.
05:08:07:613	20410ms	SHREE CEMENT	400kV	1MERTA	Circuit Breaker	Open	Main CB of 400kV Shree Cement(CSL)-Merta(RRVPNL) opens.
05:08:07:619	20420ms	SHREE CEMENT	400kV	2G1MER	Circuit Breaker	Open	Tie CB of 400kV Shree Cement(CSL)-Merta(RRVPNL) opens.

- As per SCADA SoE, it seems fault was in 400 kV Merta-Ratangarh ckt. 400 kV Kota-Merta line tripped after 6 second of fault reference time and 400 kV Merta-Sh Cement tripped after 20second of fault reference time

12. As per Rajasthan details:

- 400kV Merta-Ratangarh line tripped on actual B-phase to ground fault and fault cleared in zone-1, 89.09 km from Merta end zone-1, 84.70 km from Ratangarh end.
- At the same time 400kV Merta-Kota line and 400kV Merta-Beawar (SCL) line tripped on over voltage from Merta end and tripped on DT received from remote end.
- 400kV Merta-Bikaner line tripped on line reactor REF operation from Bikaner end and tripped due to DT received at Merta end.
- 400/220kV, 315MVA ILT-II tripped with Ratangarh line because main CB of transformer already in shutdown.
- All other feeders and transformer remain charged , details are as under:-
 - BUS-A : 400kV Kankani line, 400kV Bhadla line with Tie CB, 400kV Heerapura line with Tie CB
 - BUS-B : Tie CB Kankani line, 400/220kV, 315MVA ILT-I with Tie CB, 125 MVAR Bus Reactor with Tie CB



13. Remedial Measures taken as per Rajasthan report:

- Line reactor REF relay problem rectified at 400kV Bikaner end.

14. Preliminary Report received but DR/EL details along with detailed report in desired format 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 of tripping of 400 kV lines on over voltage protection? Actual voltage was well below 440kV.
3. Status of A/R in 400 kV Merta-Ratangarh ckt? As fault was single phase to earth fault and transient in nature.
4. Main bay of 315MVA 400/220 kV ICT-2 is still under outage. (Reason and likely time of restoration)
5. Exact problem identified in REF protection of Line Reactor at Bikaner end of 400 kV Bikaner-Merta ckt and remedial measures taken
6. Multiple times over voltage tripping occurred at Merta end however actual voltage is well below the tripping setting of 440 kV. It needs to be looked into in view of CVT error or any other reason.
7. DR/EL details yet to be received from Rajasthan.
8. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

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.

R. Multiple Element tripping at 400/220kV Barmer (Raj) Station at 08:08hrs of 12th May 2019

Event category: GD-1

Generation loss: Nil (Rajasthan may confirm)

Loss of load: 100 MW (Rajasthan may confirm)

Energy load: 0.12 MU (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	1440ms	
Phase of the fault	PMU data	R-B phase to phase to earth fault	

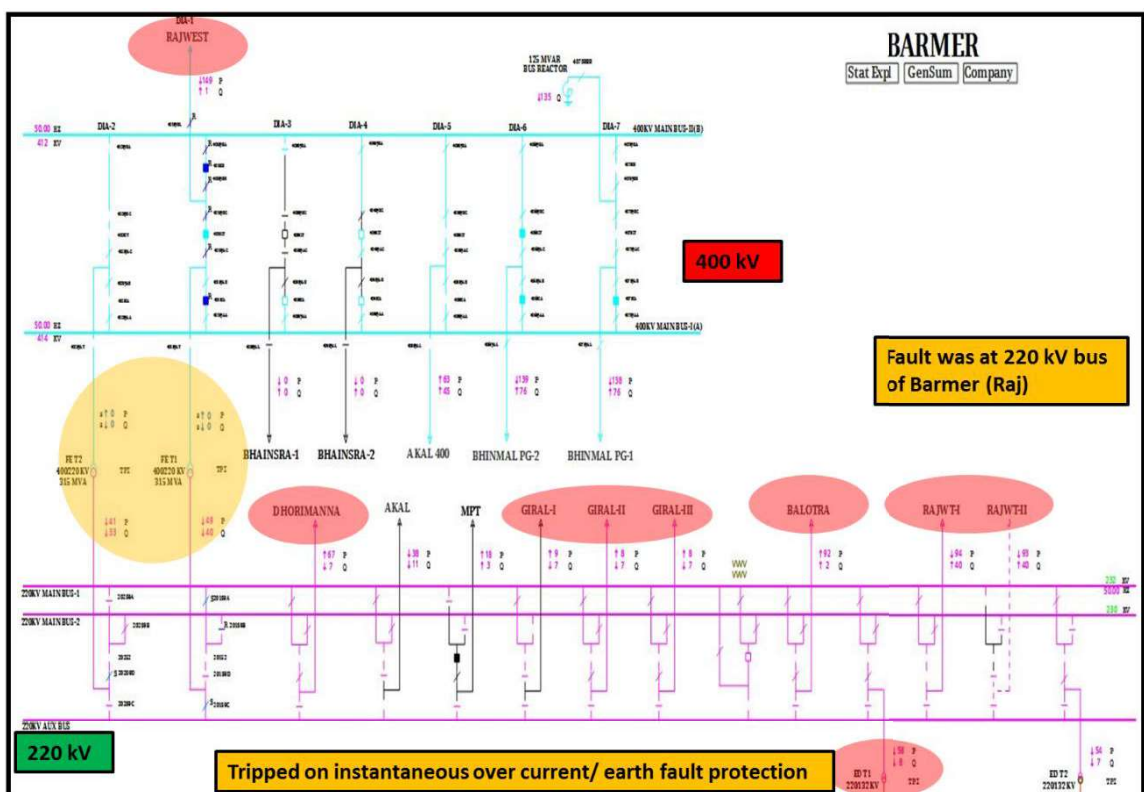
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Not Received	
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

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

1. Single Line Diagram and Connectivity diagram of 400 kV Barmer (Raj):



2. 400/220 kV Barmer (Raj) station has one and half breaker scheme. It is connected through Rajwest S/C & Akal S/C. It also has two 315 MVA 400/220 kV ICTs.
3. In antecedent conditions, 400 kV Barmer(Raj)-Rajwest(Raj) carrying 74 MW and 315 MVA ICT 1 carrying 85 MW.
4. At 08:08 Hrs, R-B phase to phase fault occurred in the system. At the same time, 400 kV Barmer(Raj)-Rajwest(Raj) tripped from Rajwest end and 315 MVA ICT 1 & 2 at 400/220kV Barmer(Raj) also tripped. Power flow on all 220 kV lines from 400/220 kV Barmer (Raj) also became zero.
5. It seems fault was in 220 kV side system, fault didn't clear from 220 kV side resulted into tripping of both 400/220 kV ICTs at Barmer and one 400 kV line (400 kV Barmer-Rajwest line).
6. 400 kV Barmer-Rajwest line tripped from Rajwest end before tripping of ICTs at Barmer.
7. Name of the tripped element:
 - 400 kV Barmer(Raj)-Rajwest(Raj)
 - 315 MVA ICT 1 & 2 at 400/220kV Barmer(Raj)
 - 220 kV Barmer(Raj)-Rajwest(Raj) ckt-1
 - 220 kV Barmer(Raj)-Rajwest(Raj) ckt-2
 - 220kV Barmer(Raj)-Balotra(Raj) ckt
 - 220 kV Barmer (Raj)-Giral ckt-1
 - 220 kV Barmer (Raj)-Giral ckt-2
 - 220 kV Barmer (Raj)-Giral ckt-3
 - 220 kV Barmer (Raj)-Dhorimanna ckt
 - 220/132 kV 100 MVA ICT-1 at 400/220/132 kV Barmer (Raj)
8. PMU plots:

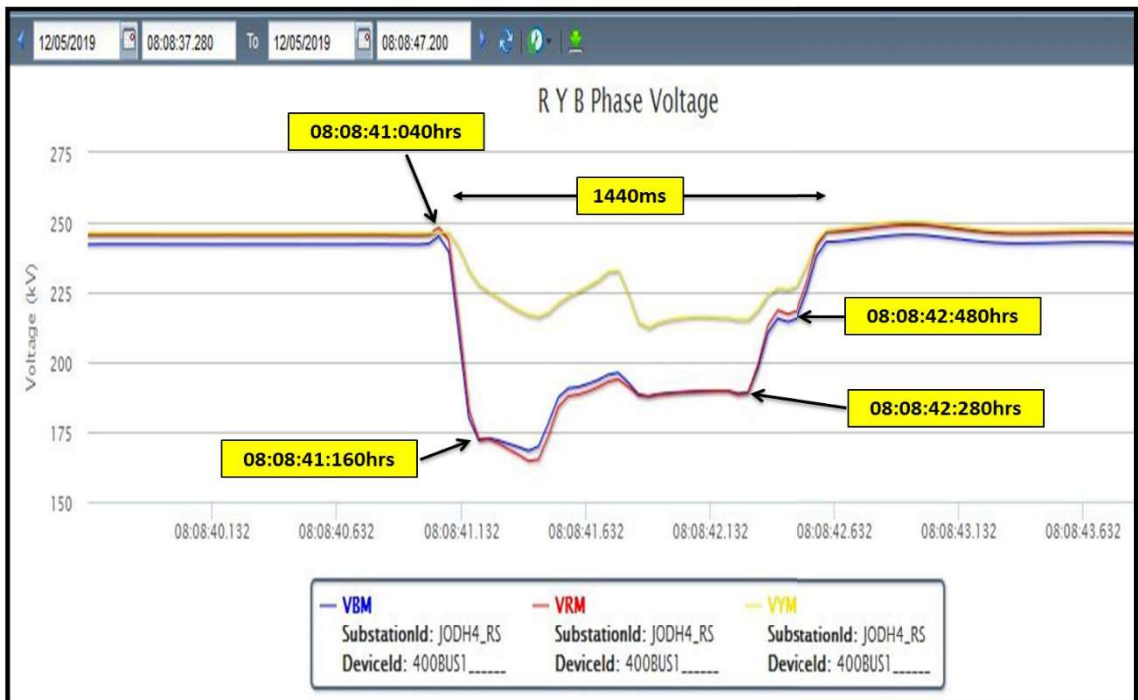
PMU Plot of frequency at Bassi(PG)

08:08hrs/12-May-19



PMU Plot of phase voltage magnitude at Jodhpur(Raj)

08:08hrs/12-May-19



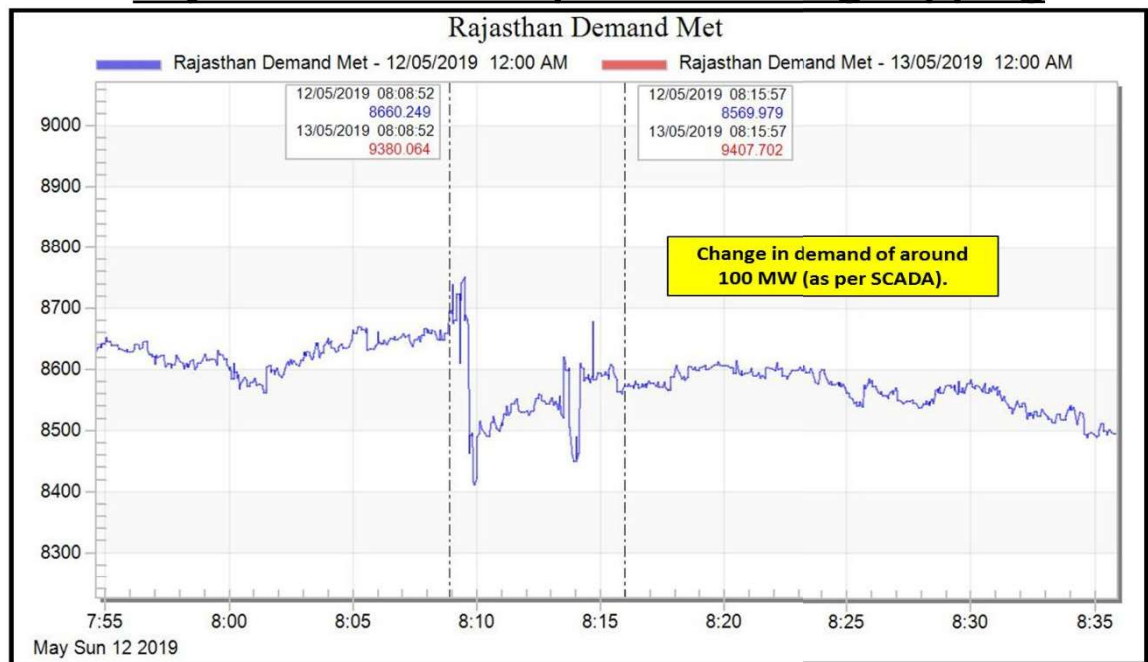
9. As per PMU data:

- Maximum dip in R-B phase voltages.
- Fault clearance time is **1440ms**.

10. SCADA data and SoE: SoE captured for some of the tripped elements.

Time	Sequence	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
08:08:41:040	0ms						PMU reference time
08:08:41:460	420ms	BALOTRA	220kV	E_14(BARMR-1)	Circuit Breaker	disturbe	
08:08:41:469	430ms	BALOTRA	220kV	E_14(BARMR-1)	Circuit Breaker	Open	Main CB of 220kV Balotra-Barmer opens.
08:08:41:480	440ms	RAJWEST	220kV	E_01_B1(BARMR-1)	Circuit Breaker	Open	Main CB of 220 kV Barmer(Raj)-Rajwest(Raj) ckt-1 opens.
08:08:41:522	480ms	RAJWEST	220kV	E_02_B1(BARMR-2)	Circuit Breaker	Open	Main CB of 220 kV Barmer(Raj)-Rajwest(Raj) ckt-2 opens.
08:08:42:342	1300ms	RAJWEST	400kV	11BARMR1	Circuit Breaker	Open	Main CB of 400 kV Barmer(Raj)-Rajwest(Raj) opens.
08:09:55:***		BARMER	220kV	E_01_B1(T1)	Circuit Breaker	Open	220kV Side CB of 315 MVA ICT 1 opens.
08:08:41:480	1440ms						PMU fault clearance time

Rajasthan Demand pattern during tripping



11. As per Rajasthan details:

- 220/132 kV, 100 MVA transformer-1 tripped on instantaneous over current, earth fault due to jumper snapped problem.
- Both 400/220 kV, 315 MVA transformer tripped on over load protection from LV side and inter trip from HV side.
- Following 220 kV feeders tripped manually at 400 kV GSS Barmer due to heavy spark on 220 kV Bus/safety purpose.
 - 220kV Balotra line
 - 220kV Rajwest-I line
 - 220kV Rajwest-II line
 - 220kV Akal line

- 220kV Giral-I line
- 220kV Giral-II line
- 220kV Giral-III line
- 400kV Barmer-Rajwest line tripped from Rajwest end on DT received.

12. Remedial Measures taken as per Rajasthan report:

- No remedial measures identified.

13. Preliminary Report received but DR/EL details along with detailed report in desired format 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. Exact location and nature of fault?
3. Reason of delayed clearance of fault and failure of which main protection?
4. Protection Co-ordination between 400 kV Rajwest-Barmer line and 400/220 kV 315MVA ICTs at Barmer needs to be looked into.
5. SCADA digital status for 400/220kV Barmer(Raj) was not available in Rajasthan SoE. Status of digital signal (CB status/ isolator status) to be ensured in SCADA SoE.
6. DR/EL details yet to be received from Rajasthan.
7. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

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.

S. Complete station outage of 400kV Bikaner (Raj) Station at 17:45hrs of 12th May 2019

Event category: GI-2

Generation loss: Nil (Rajasthan may confirm)

Loss of load: Nil (Rajasthan may confirm)

Energy load: Nil (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
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Fault Clearance Time		960ms	As per PMU data
Phase of the fault		R-N fault followed by B-N fault	As per PMU data

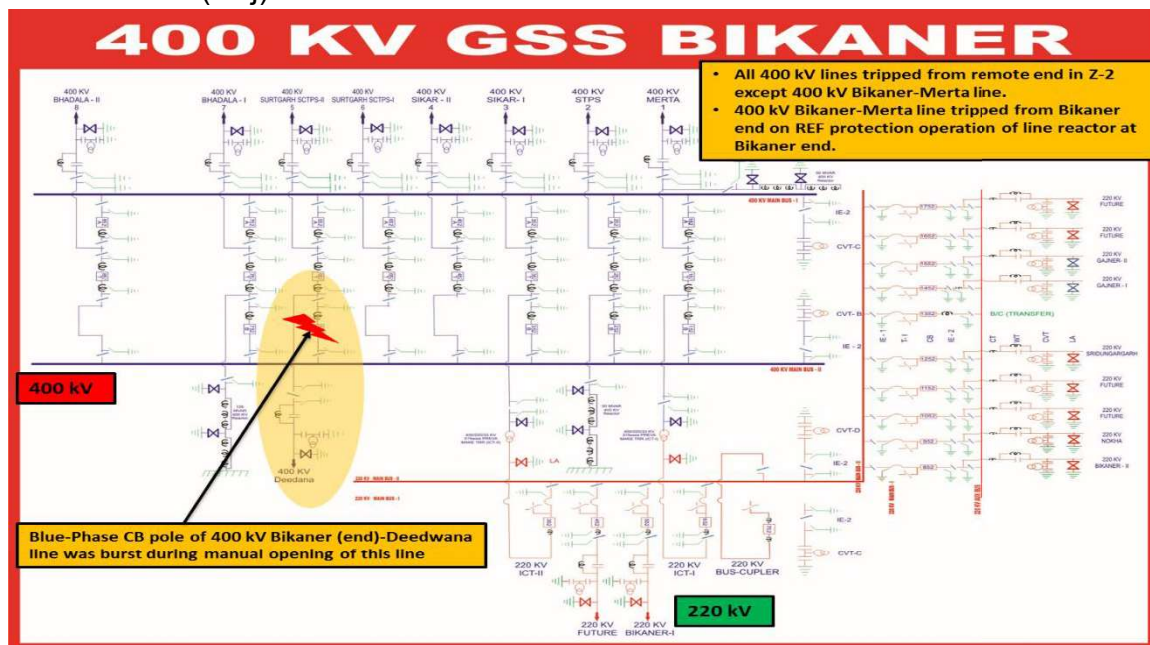
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Available	Time Synch error
DR/ EL	Rajasthan	Received	After 24hrs
	POWERGRID	Not Received	
Preliminary Report	Rajasthan	Received	After 24hrs
	POWERGRID	Not Received	
Detailed Report	Rajasthan	Not received	

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, 6.3,6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2 4. CEA Grid Standard 2010-3.e & CEA Transmission Planning	Rajasthan	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received. 3. Delayed Clearance of Fault. 4. Adequately Sectionalized and graded protective relaying system. 5. Incorrect/ mis-operation / unwanted operation of Protection system.

	Criteria		
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	POWERGRID	1. Preliminary Report, DR/EL yet to be received

Based on above information description of the events is:

1. Single Line Diagram and Connectivity diagram of 400 kV Bikaner (Raj):



2. 400/220 kV Barmer (Raj) station has one and half breaker scheme. It is connected through Rajwest S/C & Akal S/C. It also has two 315 MVA 400/220 kV ICTs.
3. In antecedent conditions, 315MVA ICT 1 & 315MVA ICT 2 carrying 103 MW & 105 MW respectively. Manual opening of 400 kV Bikaner-Deedwana line on high voltage is under process.
4. At 17:45 Hrs, “Blue” phase CB pole of 400kV Bikaner (Raj)-Deedwana ckt failed during breaker opening on high voltage.
5. 400 kV bus bar protection was out of service due to fiber communication error.
6. 400kV BKN-STPS LINE, 400kV BKN-SCTPS LINE1&2, 400kV BKN-SIKAR LINE1&2, 400kV BKN-BHADLA LINE1&2 were tripped

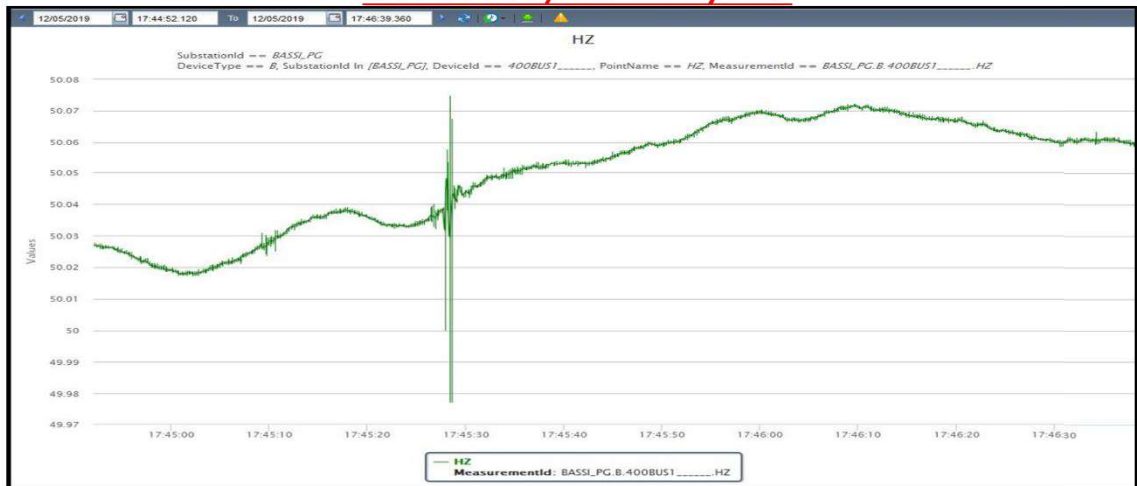
on receipt of DT from other end as the remote ends of these lines were tripped on Zone 2 fault.

7. 400 kV Bikaner-Merta feeder tripped due to REF operation of line reactor at Bikaner end and DT received at Merta end.
8. 400kV, 315MVA ILT1&2 were tripped on operation of E/F stage1 relay.
9. 125MVAR Bus reactor was tripped on operation of E/F relay feature enabled in 21R back up impedance relay.
10. 50MVAR Bus reactor was tripped on operation of Zone1 in 21R back up impedance relay.
11. Name of the tripped element:
 - 400kV Bikaner(RRVPNL)-Deedwana(RRVPNL)
 - 400kV Bikaner(RRVPNL)-Merta(RRVPNL)
 - 400kV Bikaner(RRVPNL)-SSCTPS(Raj) ckt-1 & 2
 - 400kV Bikaner(RRVPNL)-Suratgarh(Raj)
 - 400kV Bikaner(RRVPNL)-Sikar(PG) ckt-1 & 2
 - 400kV Bikaner(RRVPNL)-Bhadla(RRVPNL) ckt-1 & 2
 - 315MVA ICT 1 400/220kV Bikaner(Raj)
 - 315MVA ICT 2 400/220kV Bikaner(Raj)
 - 400kV Bus 1 & Bus 2 at 400/220kV Bikaner(Raj)
 - 50MVAR Bus Reactor 1 at 400/220kV Bikaner(Raj)
 - 125MVAR Bus Reactor 2 at 400/220kV Bikaner(Raj)

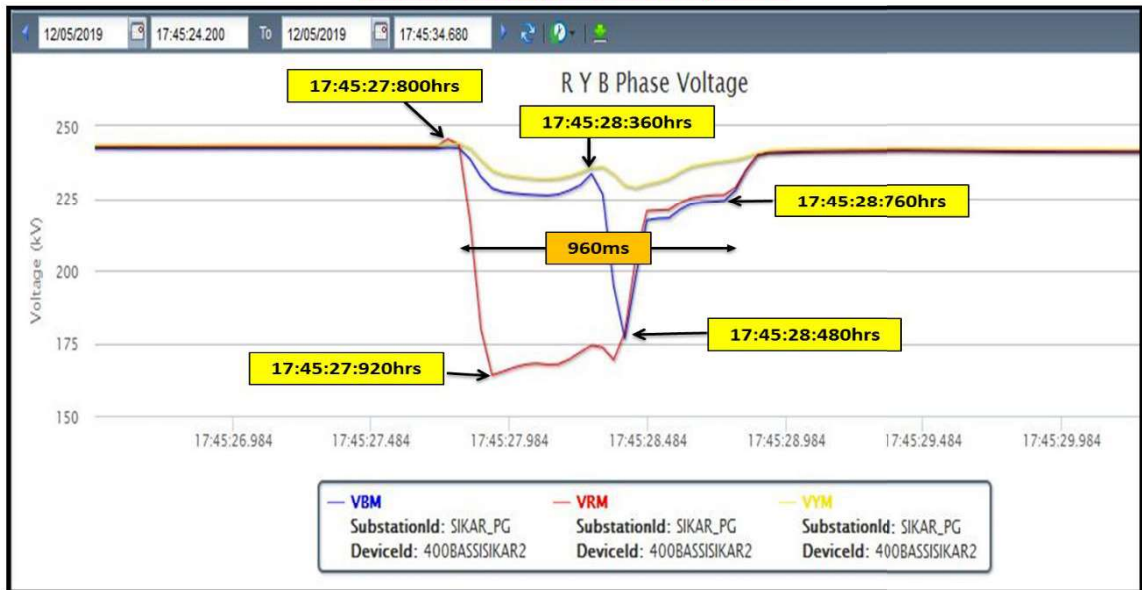
12. PMU plots:

PMU Plot of frequency at Bassi(PG)

17:45hrs/12-May-19



PMU Plot of phase voltage magnitude at Sikar(PG)
17:45hrs/12-May-19



13. As per PMU data:

- R-phase to earth fault followed by B-phase to earth fault.
- Fault clearance time is **960ms**.

14. SCADA data and SoE: SoE captured for most of the tripped elements but time synch error.

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
17:45:28:293	SCTPS_R	400kV	15BKN1	Circuit Breaker	disturbe	
17:45:28:295	SCTPS_R	400kV	17TIE	Circuit Breaker	disturbe	
17:45:28:301	SCTPS_R	400kV	15BKN1	Circuit Breaker	Close	
17:45:28:302	SCTPS_R	400kV	15BKN1	Circuit Breaker	disturbe	
17:45:28:303	SCTPS_R	400kV	17TIE	Circuit Breaker	Close	
17:45:28:304	SCTPS_R	400kV	17TIE	Circuit Breaker	disturbe	
17:45:28:309	SCTPS_R	400kV	15BKN1	Circuit Breaker	Open	Main CB of 400kV Bikaner(RRVPNL)-SSCTPS(Raj) ckt-1 opens.
17:45:28:311	SCTPS_R	400kV	17TIE	Circuit Breaker	Open	Tie CB of 400kV Bikaner(RRVPNL)-SSCTPS(Raj) ckt-1 opens.
17:45:28:822	SCTPS_R	400kV	16BKN2	Circuit Breaker	disturbe	
17:45:28:840	SCTPS_R	400kV	16BKN2	Circuit Breaker	Open	Main CB of 400kV Bikaner(RRVPNL)-SSCTPS(Raj) ckt-2 opens.

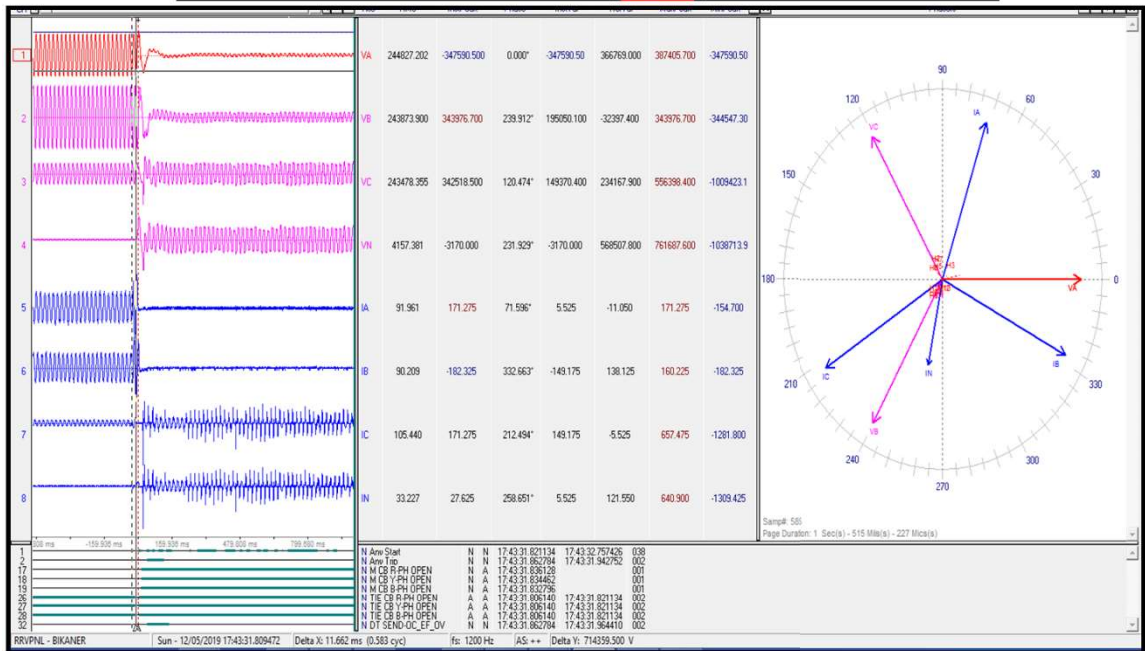
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
17:46:18:***	BIKANER400	400kV	01DEED41	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-Deedwana(RRVPNL) opens.
17:47:48:***	BIKANER400	400kV	13MERTA1	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-Merta(RRVPNL) opens.
17:47:58:***	BIKANER400	400kV	14MER_T1	CB	Open	Tie CB of 400kV Bikaner(RRVPNL)-Merta(RRVPNL) opens.
17:48:14:***	BIKANER400	400kV	18BHADL1	CB	Open	Tie CB of 400kV Bikaner(RRVPNL)-Bhadla(RRVPNL) ckt-1 opens.
17:48:17:***	BIKANER400	400kV	19BUSRE	CB	Open	Main CB of 125MVAR Bus Reactor 2 at 400/220kV Bikaner(Raj) opens.
17:48:43:***	BIKANER400	220kV	E_06(T1)	CB	Open	220kV Side CB of 315MVA ICT 1 400/220kV Bikaner(Raj) opens.
17:48:52:***	BIKANER400	400kV	15T1	CB	Open	400kV Side CB of 315MVA ICT 1 400/220kV Bikaner(Raj) opens.
17:48:55:***	BIKANER400	400kV	02DEFUT	CB	Open	Tie CB of 400kV Bikaner(RRVPNL)-Bhadla(RRVPNL) ckt-2 opens.
17:48:55:***	BIKANER400	400kV	16BHADL2	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-Bhadla(RRVPNL) ckt-2 opens.
17:48:57:***	BIKANER400	400kV	11SURFUT	CB	Open	Tie CB of 400kV Bikaner(RRVPNL)-Suratgarh(Raj) opens.
17:48:57:***	BIKANER400	400kV	24SIKAR1	CB	Open	Tie CB of 400kV Bikaner(RRVPNL)-Sikar(PG) ckt-1 opens.
17:49:00:***	BIKANER400	400kV	09T2	CB	Open	400kV Side CB of 315MVA ICT 2 400/220kV Bikaner(Raj) opens.
17:49:00:***	BIKANER400	400kV	12FUTUR	CB	Open	Main CB of 50MVAR Bus Reactor 1 at 400/220kV Bikaner(Raj) opens.
17:49:01:***	BIKANER400	220kV	04T2	CB	Open	220kV Side CB of 315MVA ICT 2 400/220kV Bikaner(Raj) opens.
17:49:10:***	BIKANER400	400kV	04SURTP2	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-SSCTPS(Raj) ckt-2 opens.
17:49:18:***	BIKANER400	400kV	17BHADL1	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-Bhadla(RRVPNL) ckt-1 opens.

15. As per Rajasthan details:

- The whole disturbance occurred due to C-phase pole of main circuit breaker of 400kV Bikaner - Deedwana line bursted after the line CB was manually tripped at 17:43 hrs on instructions of LD.
- 400kV Bus Bar scheme should have been operated in this case but the same was found unhealthy/ out of service due to fibre communication error.
- 400kV BKN-STPS LINE, 400kV BKN-SCTPS LINE1&2, 400kV BKN-SIKAR LINE1&2, 400kV BKN-BHADLA LINE1&2 were tripped on receipt of DT from other end as the remote ends of these lines were tripped on Zone 2 fault.
- 400kV BKN-MERTA LINE was tripped on operation of Reactor REF relay of 50MVAR line reactor at Bikaner end.
- 400kV, 315MVA ILT1&2 were tripped on operation of E/F stage1 relay.
- 125MVAR Bus reactor was tripped on operation of E/F relay feature enabled in 21R back up impedance relay.
- 50MVAR Bus reactor was tripped on operation of Zone1 in 21R back up impedance relay
- **Note:** As the time synchronization of these relays with GPS is also not in order so the sequence of the happening of these events cannot be ascertained

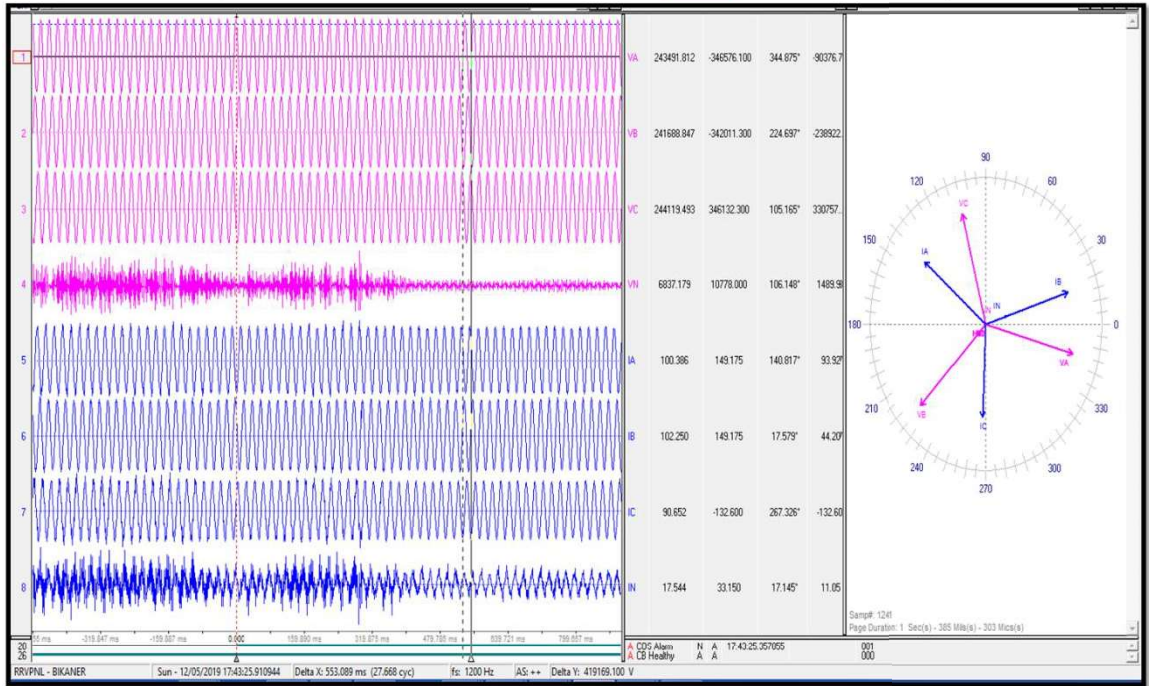
S. No.	Name Of Equipment/Line	Date Of Tripping	Time In Hrs.		Relay Indications			
			Tripping	closing	BIKANER END		REMOTE END	
					annunciation	Relay indicatoin	annunciation	Relay indication
1	400kV BKN-DEEDWANA LINE (MAIN CB C-PHASE POLE BURST at BKN end)	12.05.2019.	17:43	-		86A&B, DT sent & received		DT received
2	400kV BKN-MERTA LINE with 50MVAR REACTOR	12.05.2019.	17:43	19:35		86A&B, DT received, REF optd.		DT received
3	400kV BKN-STPS LINE	12.05.2019.	17:43	20:56		Not tripped		Zone2, L2 phase, 130.9km & O/v optd.
4	400kV BKN-SCTPS1 LINE	12.05.2019.	17:44	19:24		Not tripped		Zone2, Y optd.
5	400kV BKN-SCTPS2 LINE	12.05.2019.	17:44	19:47		Not tripped		Zone2, Y optd., 155km
6	400kV BKN-SIKAR1 LINE	12.05.2019.	17:44	19:36		Not tripped		Zone2, R-phase, 173km
7	400kV BKN-SIKAR2 LINE	12.05.2019.	17:44	19:37		Not tripped		Zone2, R-phase, 173km
8	400kV BKN-BHADLA1 LINE	12.05.2019.	17:44	19:01		Not tripped		Zone2, C-phase, M1,220km & M2, 189.1km
9	400kV BKN-BHADLA2 LINE	12.05.2019.	17:44	19:56		Not tripped		Zone2, C-phase, M1&2, 218km
10	400kV, 315MVA ICT1	12.05.2019.	17:42	19:24		86A&B, E/F optd		NA
11	400kV, 315MVA ICT2	12.05.2019.	17:44	19:49		86A&B, E/F optd		NA
12	400kV, 125MVAR BUS REACTOR	12.05.2019.	17:44	19:57		86A&B, E/F(B. up impd.21R) optd.		NA
13	400kV, 50MVAR BUS REACTOR	12.05.2019.	17:44	20:57		86A&B, B.up impd. Zone1 optd.		NA

DR of 400 kV Bikaner (end)-Deedwana ckt



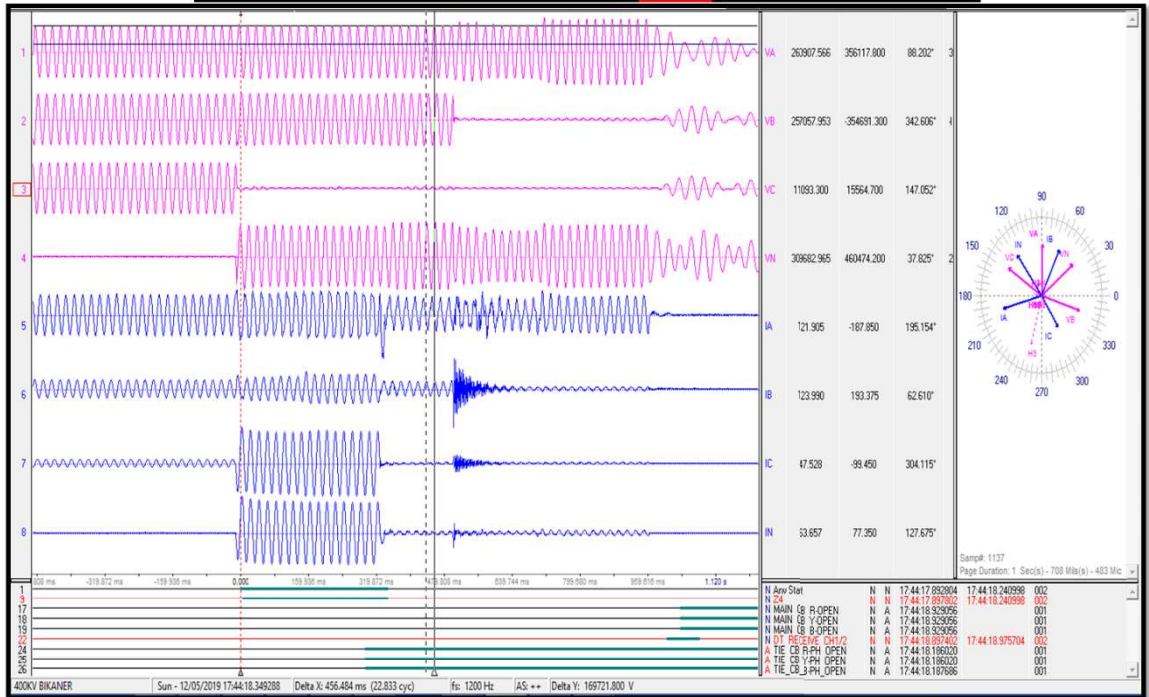
Reason of the tripping didn't clear from DR. Why master trip operated?

DR of 400 kV Bikaner (end)-Merta ckt



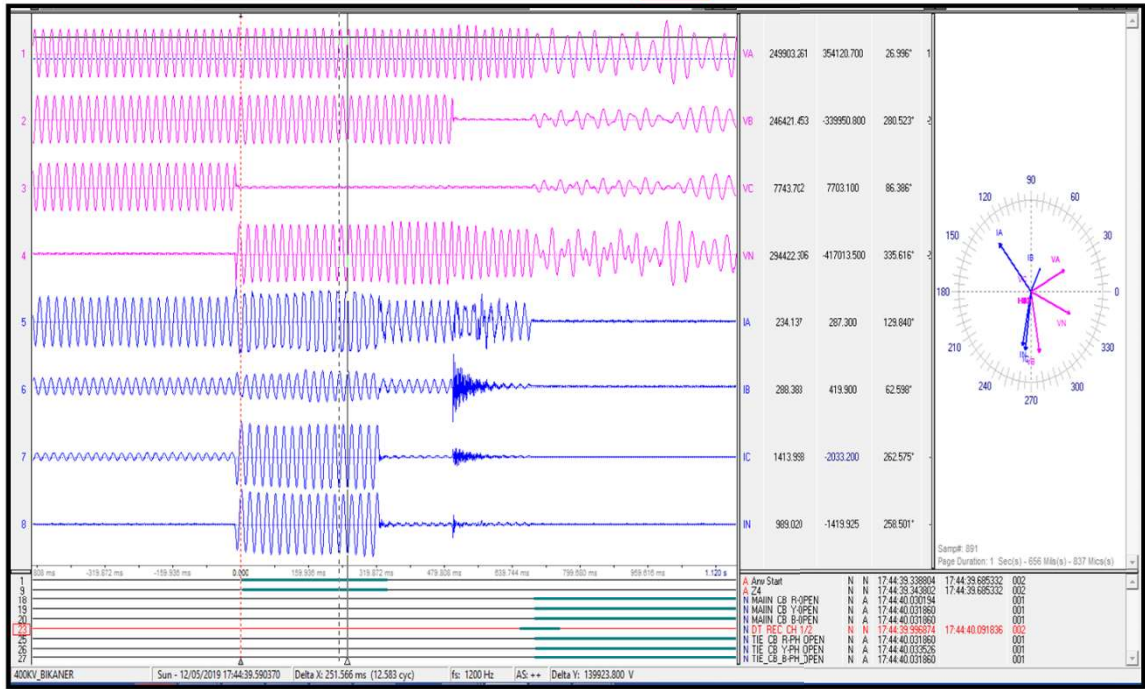
Reason of the tripping didn't clear from DR. Why master trip operated?

DR of 400 kV Bikaner (end)-Bhadla ckt-1



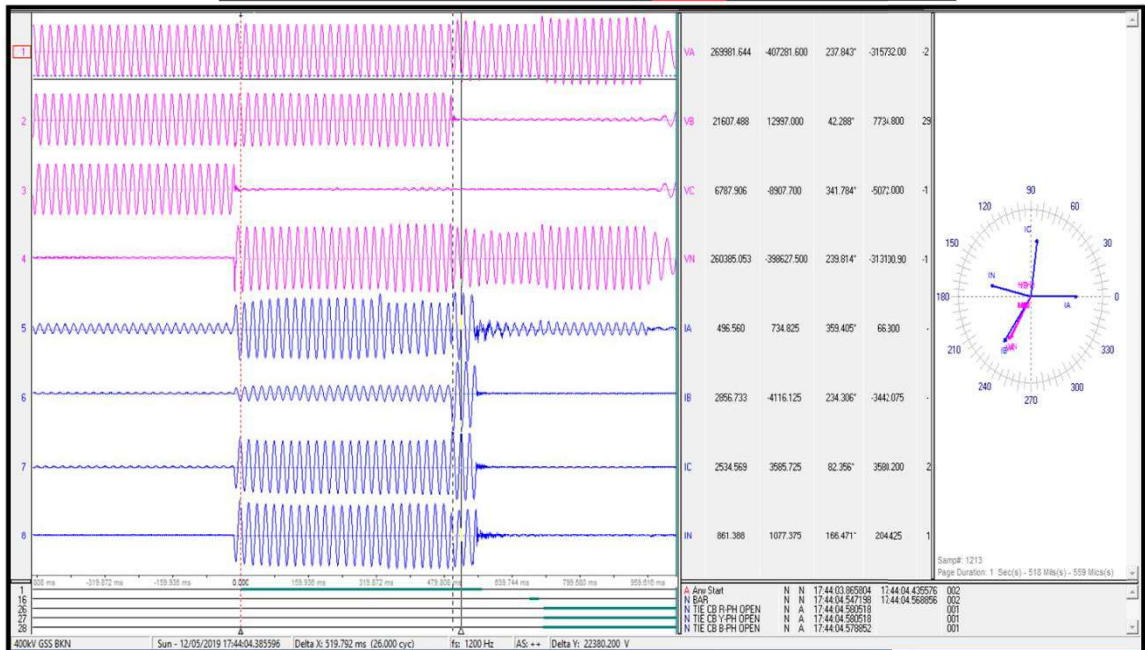
Tie CB opened within 300ms. Main CB tripped after 1000ms on DT received from remote end.

DR of 400 kV Bikaner (end)-Bhadla ckt-2



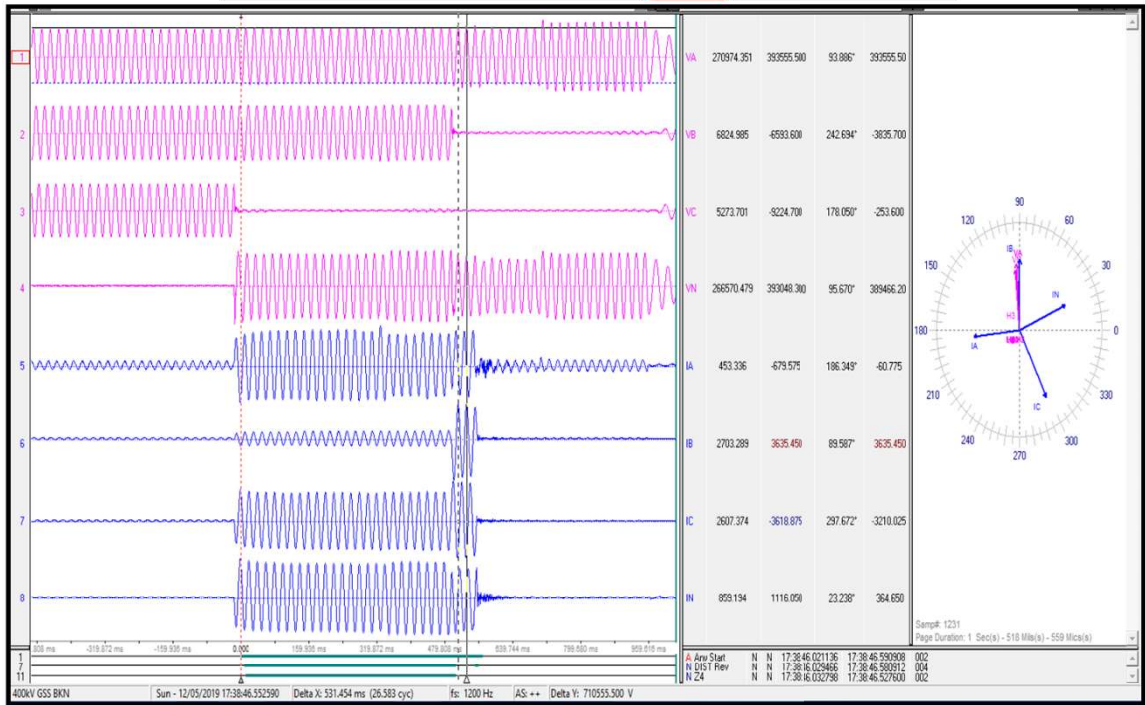
Main and Tie CB tripped after 700ms on DT received from remote end.

DR of 400 kV Bikaner (end)-Sikar ckt-1

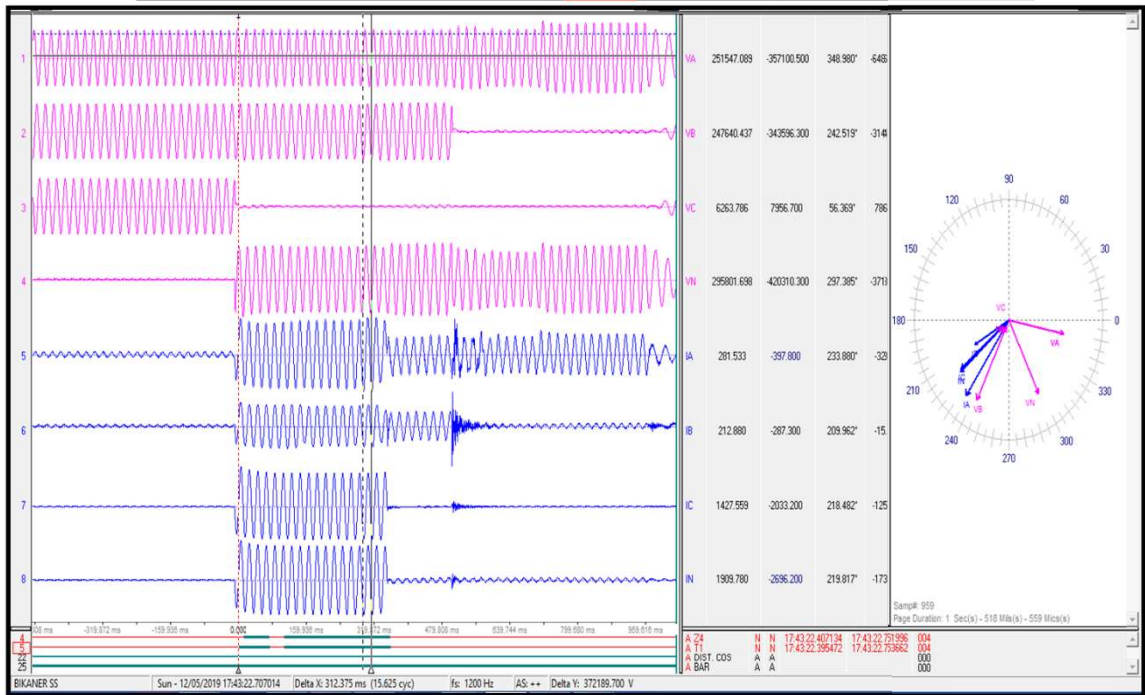


Line tripped from remote end in Z-2. Tie CB of Bikaner end tripped after 700ms of fault occurrence, at the time of tripping of ICT in same dia.

DR of 400 kV Bikaner (end)-Sikar ckt-2



DR of 400 kV Bikaner (end)-Suratgarh TPS ckt-1



DR of 400 kV Bikaner-Suratgarh TPS (end) ckt-1

Channel Number	Name	Status	Time
12	ZM03-START	On	12-05-2019 17:44:39.515
23	PHS-STFWL2	On	12-05-2019 17:44:39.515
25	PHS-STFWPE	On	12-05-2019 17:44:39.515
10	ZM02-START	On	12-05-2019 17:44:39.521
1	TRIP	On	12-05-2019 17:44:39.821

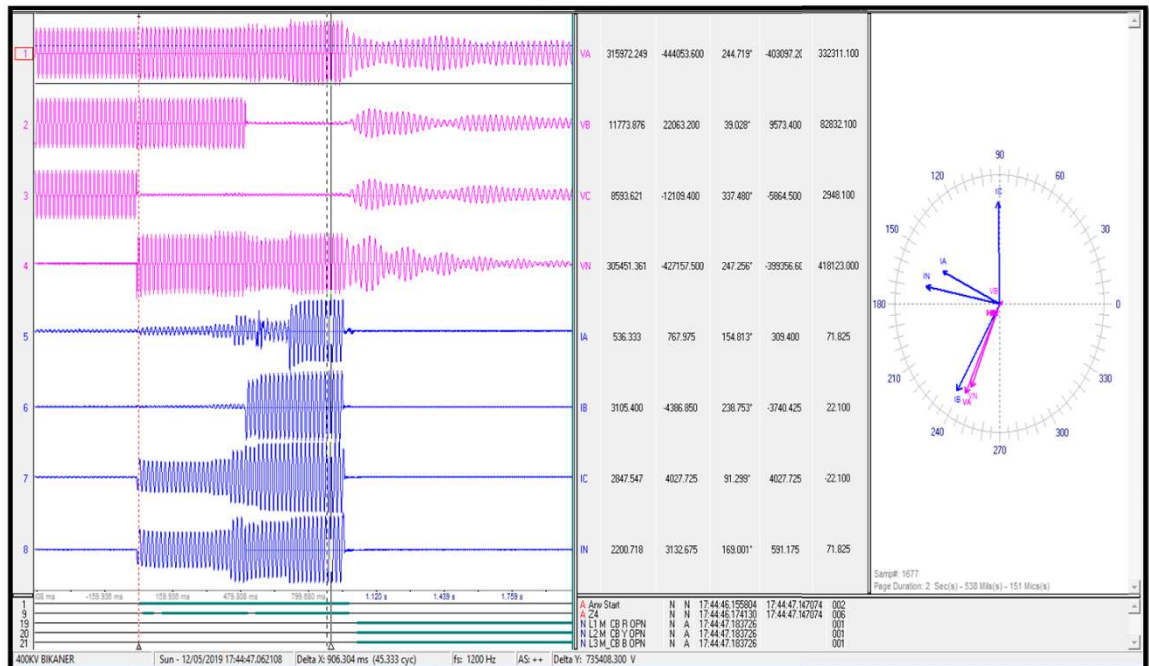
Recording File Name: C:\PCMD\dataBases\DisturbanceRecordings\NEW STPS\Substation\400 kV\Bay\REL670_BKN_AA1\2QAA1_2Q01A3201905123dd



2	TRIP-R	On	12-05-2019 17:44:39.821
3	TRIP-Y	On	12-05-2019 17:44:39.821
4	TRIP-B	On	12-05-2019 17:44:39.821
9	ZM02-TRIP	On	12-05-2019 17:44:39.821
81	TRIP R	On	12-05-2019 17:44:39.821
82	TRIP Y	On	12-05-2019 17:44:39.821
83	TRIP B	On	12-05-2019 17:44:39.821
27	DIST_OPTD	On	12-05-2019 17:44:39.824
33	M-2_REL_OPTD	On	12-05-2019 17:44:39.836
62	MAIN2-TRIP	On	12-05-2019 17:44:39.836
9	ZM02-TRIP	Off	12-05-2019 17:44:39.863
10	ZM02-START	Off	12-05-2019 17:44:39.863
12	ZM03-START	Off	12-05-2019 17:44:39.863
23	PHS-STFWL2	Off	12-05-2019 17:44:39.863
25	PHS-STFWPE	Off	12-05-2019 17:44:39.863
56	MAIN_CB_R_CL	Off	12-05-2019 17:44:39.863
27	DIST_OPTD	Off	12-05-2019 17:44:39.866
85	OV ST1 OPTD	On	12-05-2019 17:44:39.883
1	TRIP	Off	12-05-2019 17:44:39.923
2	TRIP-R	Off	12-05-2019 17:44:39.923
3	TRIP-Y	Off	12-05-2019 17:44:39.923
4	TRIP-B	Off	12-05-2019 17:44:39.923
81	TRIP R	Off	12-05-2019 17:44:39.923
82	TRIP Y	Off	12-05-2019 17:44:39.923
83	TRIP B	Off	12-05-2019 17:44:39.923
33	M-2_REL_OPTD	Off	12-05-2019 17:44:39.934
62	MAIN2-TRIP	Off	12-05-2019 17:44:39.934
86	OV ST2 OPTD	On	12-05-2019 17:44:40.227
1	TRIP	On	12-05-2019 17:44:40.229
2	TRIP-R	On	12-05-2019 17:44:40.229
3	TRIP-Y	On	12-05-2019 17:44:40.229
4	TRIP-B	On	12-05-2019 17:44:40.229
27	DIST_OPTD	On	12-05-2019 17:44:40.229
81	TRIP R	On	12-05-2019 17:44:40.229
82	TRIP Y	On	12-05-2019 17:44:40.229
83	TRIP B	On	12-05-2019 17:44:40.229
96	OC_OV_TRIP	On	12-05-2019 17:44:40.229
33	M-2_REL_OPTD	On	12-05-2019 17:44:40.300
62	MAIN2-TRIP	On	12-05-2019 17:44:40.300

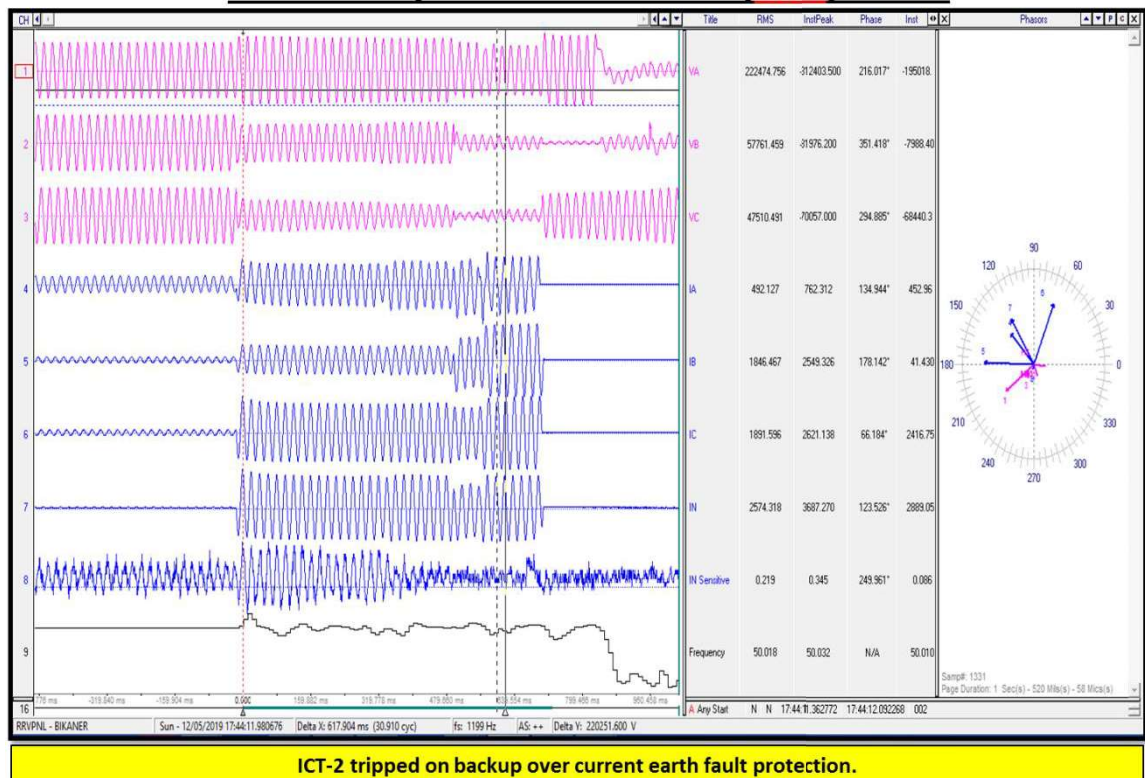
Line tripped in 300ms from Suratgarh TPS end.

DR of 400 kV Bikaner (end)-Suratgarh SCTPS ckt-2



Line tripped from Bikaner end after around 1000ms. Reason of tripping yet to be ascertained.

DR of 400/220 kV Bikaner (end) ICT-2



16. Remedial Measures taken as per Rajasthan report:

- Bus bar scheme have been put in circuit after replacing 2 nos. OFC.
- Damaged stabilizing resistance of REF relay circuit have been changed.

17. Preliminary Report received but DR/EL details along with detailed report in desired format 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. As per PSC decision, high priority alert signal shall be generated in case of blocking of bus bar protection and information shall be sent to concerned officer immediately and action to be taken. In this incident where is the lack?
3. Non-tripping of 400 kV Merta-Bikaner ckt from Merta end?
4. As per DR of 400 kV Bikaner(end)-Bhadla ckt-1, Tie CB opened within 300ms & Main CB tripped after 1000ms on DT received from remote end. Reason needs to be looked into.
5. As per DR of 400 kV Bikaner(end)-Bhadla ckt-2, Main & Tie CB opened after 700ms on DT received from remote end. Reason needs to be looked into.

6. As per DR of 400 kV Bikaner(end)-Sikar (PG) ckt-1, Line tripped from remote end in Z-2. Tie CB of Bikaner end tripped after 700ms of fault occurrence, at the time of tripping of ICT in same dia. Reason of non-receipt of DT at Bikaner end to be looked into.
7. Carrier communication in the following line needs to be checked and corrected:
 - a. 400 kV Bikaner(end)-Sikar (PG) ckt-1
 - b. 400 kV Bikaner(end)-Sikar (PG) ckt-2
 - c. 400 kV Bikaner(end)-Suratgarh TPS ckt-1
8. Mapping of Direct Trip signal in DR to be checked in all DR at Bikaner end and needs to be changed accordingly.
9. Despite of continuous discussion in PSC meeting, time synchronization issue is still persisted in most of the tripping cases. Immediately needs to be addressed.
10. Status of second bus bar protection at Bikaner (Raj), available or not? In case of non-availability, it should be commissioned immediately.
11. Availability & healthiness of station event logger needs to be ensured.
12. Time synchronization of numerical relays of Bikaner (Raj) and remote end to be ensured
13. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

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.

T. Multiple element tripping at 400 kV Bawana (DTL) at 07:44hrs on 15-May-19

Event category: GD-1

Generation loss: 171 MW (As per Delhi report)

Loss of load: Nil (As per Delhi report)

Energy load: Nil

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
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Fault Clearance Time		80ms, 80ms & 260ms	As per PMU data
Phase of the fault		R-B phase to phase to earth fault followed by Y-phase to earth fault	As per PMU data

Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Available	Time Synch error
DR/ EL	DTL	Received	Within 24hrs
	POWERGRID	Not Received	
Preliminary Report	DTL	Received	Within 24hrs
	POWERGRID	Not Received	
Detailed Report	DTL	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	Delhi	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received 3. Delayed Clearance of Fault 4. Adequately Sectionalized and graded protective relaying system 5. Incorrect/ mis-operation / unwanted operation of Protection

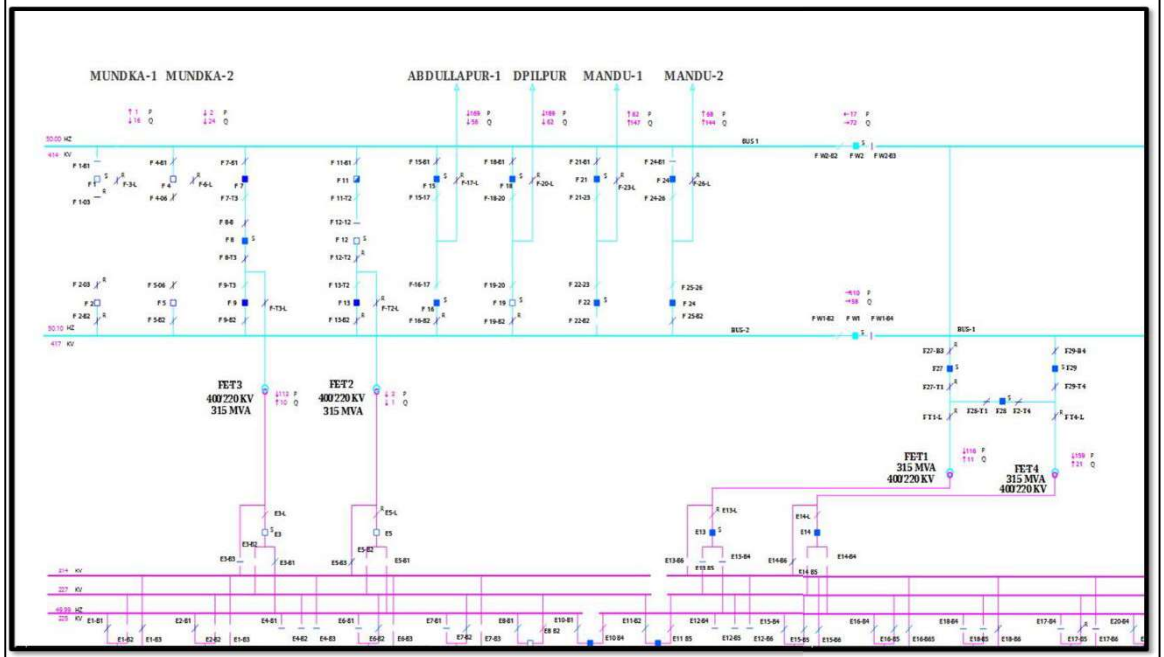
	Electric Lines; CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2 4. CEA GRid Standard 2010-3.e & CEA Transmission Planning Criteria		system
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	POWERGRID	1. Preliminary Report, DR/EL yet to be received

Based on above information description of the events is:

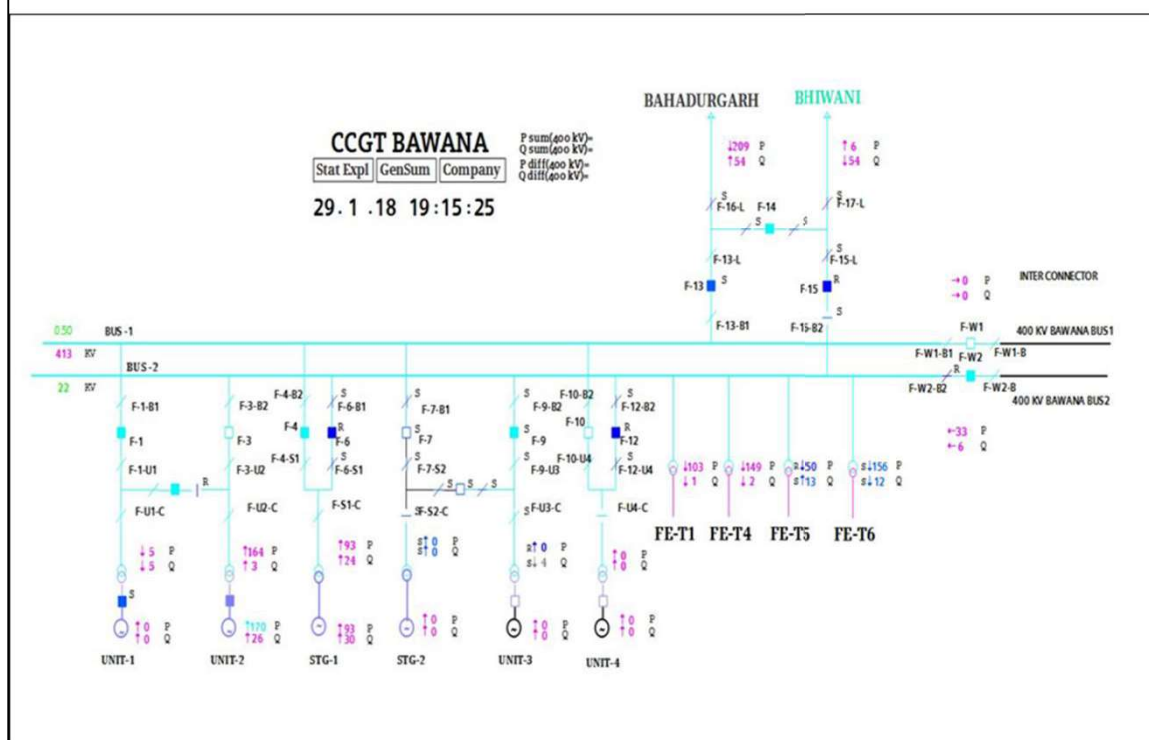
1. Connectivity diagram of 400/220kV Bawana and Bawana CCGT:



Bawana (DTL) SLD

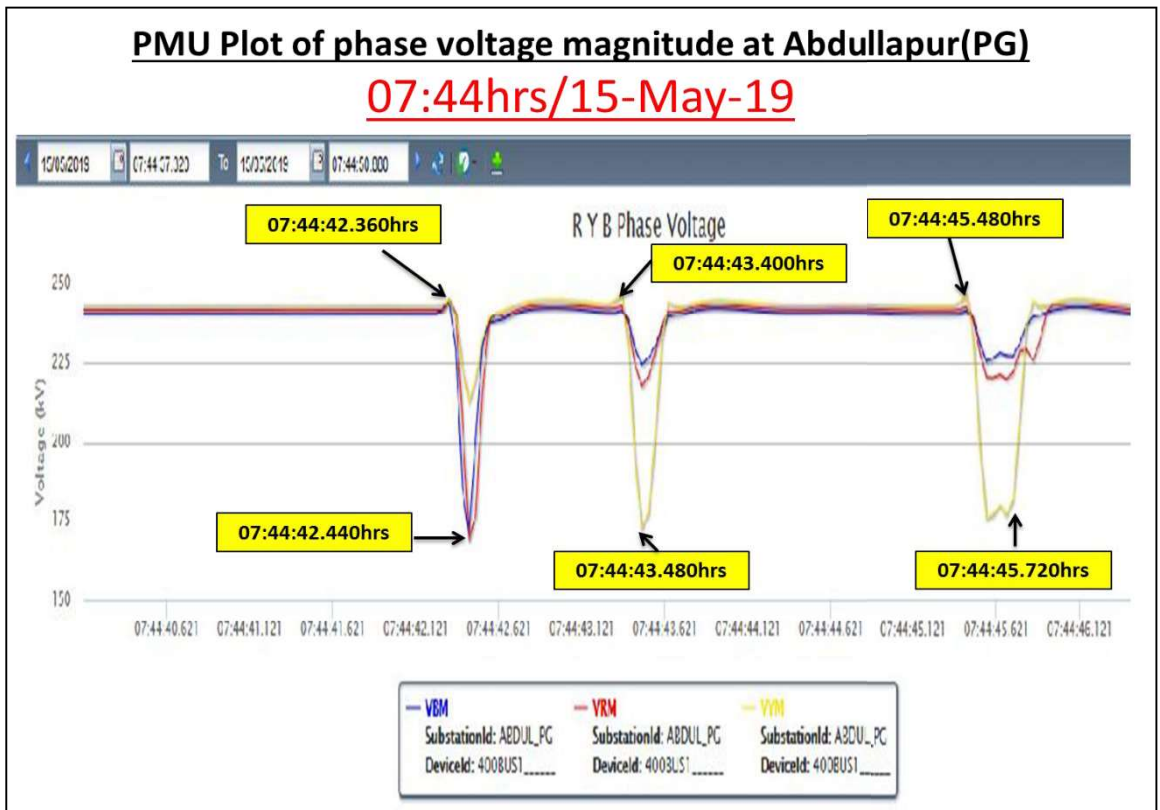
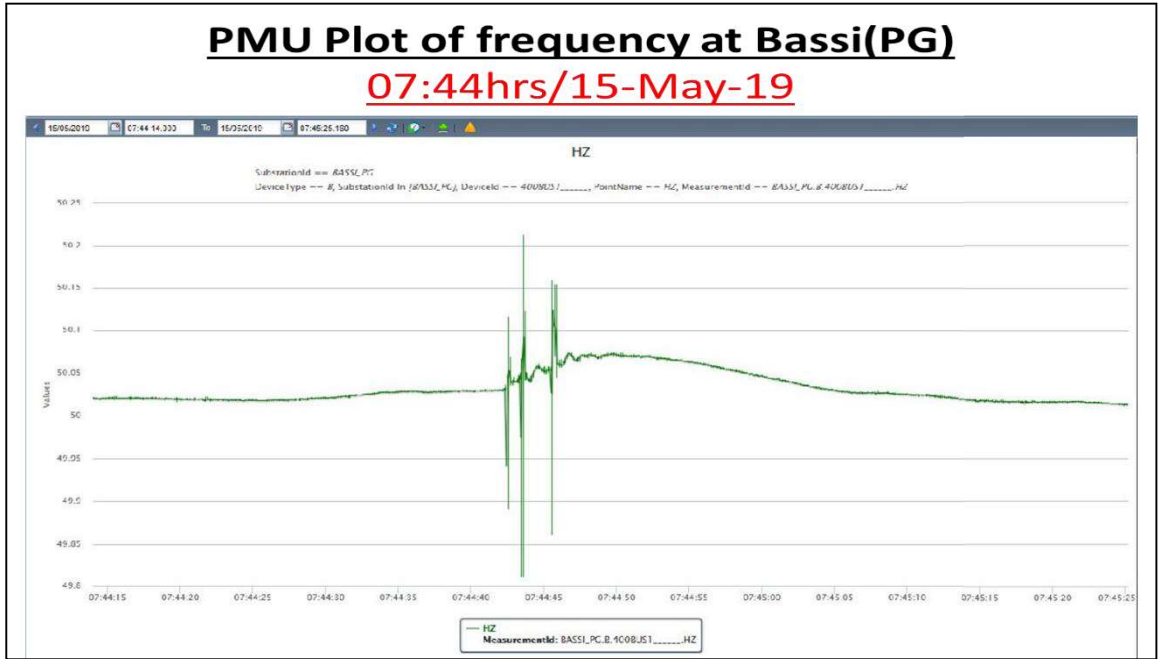


Bawana CCGT SLD



2. In antecedent condition, shut down of the 400 kV Kaithal-Hisar ckt-2 was applied for replacement of CVT.
3. 400 kV Bawana (DTL) station has one and half breaker scheme and double bus double breaker scheme. It is connected through Mandaula D/C, Mundka D/C, Abdullapur S/C, Dipalpur S/C and interconnector to Bawana CCGT. Bawana CCGT further connected with Bahadurgarh S/C, Bhiwani S/C and Dipalpur S/C. Bawana (DTL) and Bawana (CCGT) have total six 315 MVA 400/220 kV ICTs (2 at DTL and 4 at CCGT).
4. The weather turned rainy at time 7:44 AM and started raining. Tripping of all aforesaid ICT-2, 3 & 4 occurred on differential trip along with 400 KV Bawana-Abdullapur ckt on Main-1 distance relay showing Zone-1 and 400 KV Bawana-Mandola Ckt-2 tripped on Zone-4 SOTF trip by Main-1 distance relay.
5. Tripping of all the aforesaid elements occurred simultaneously due to rain but the type of fault was not common to all three 315 MVA ICT-2, 3, & 4.
6. Name of the tripped element:
 - 400kV Abdullapur(PG)-Bawana(DTL) ckt-1
 - 400kV Bawana(DTL)-Mandola(PG) ckt-2
 - 315 MVA ICT 2 at 400/220kV Bawana(DTL)
 - 315 MVA ICT 3 at 400/220kV Bawana(DTL)
 - 315 MVA ICT 4 at 400/220kV Bawana(DTL)

7. PMU plots:

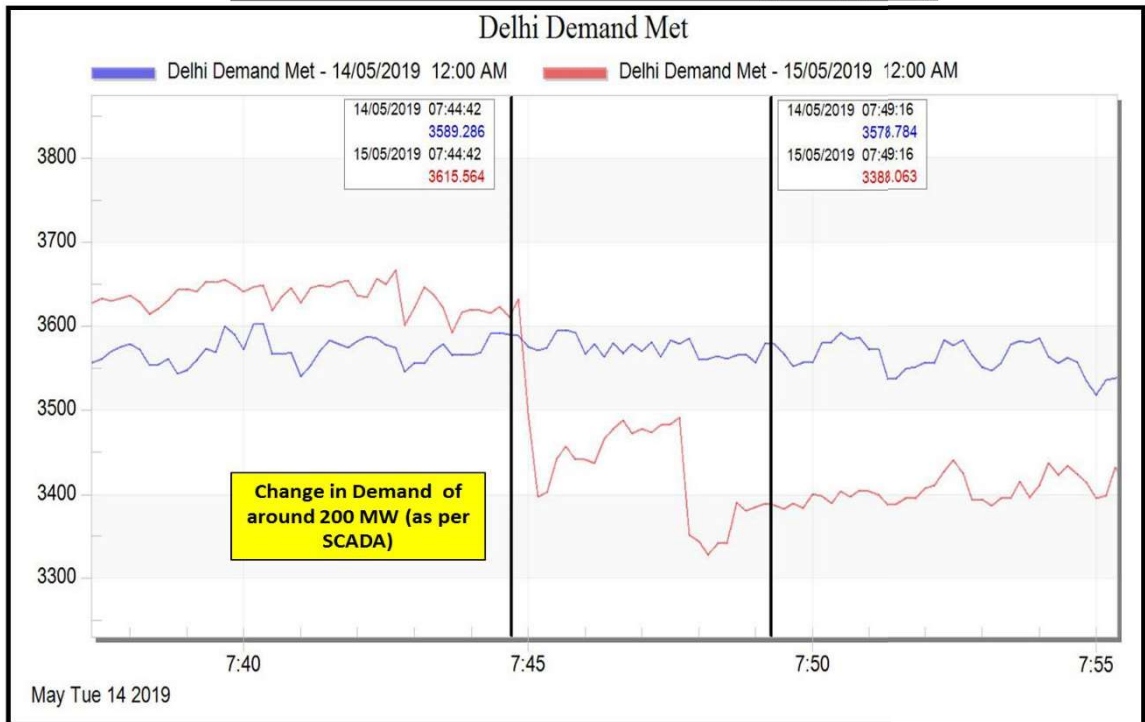


8. SCADA data and SoE:

Delhi/POWERGRID SCADA SOE

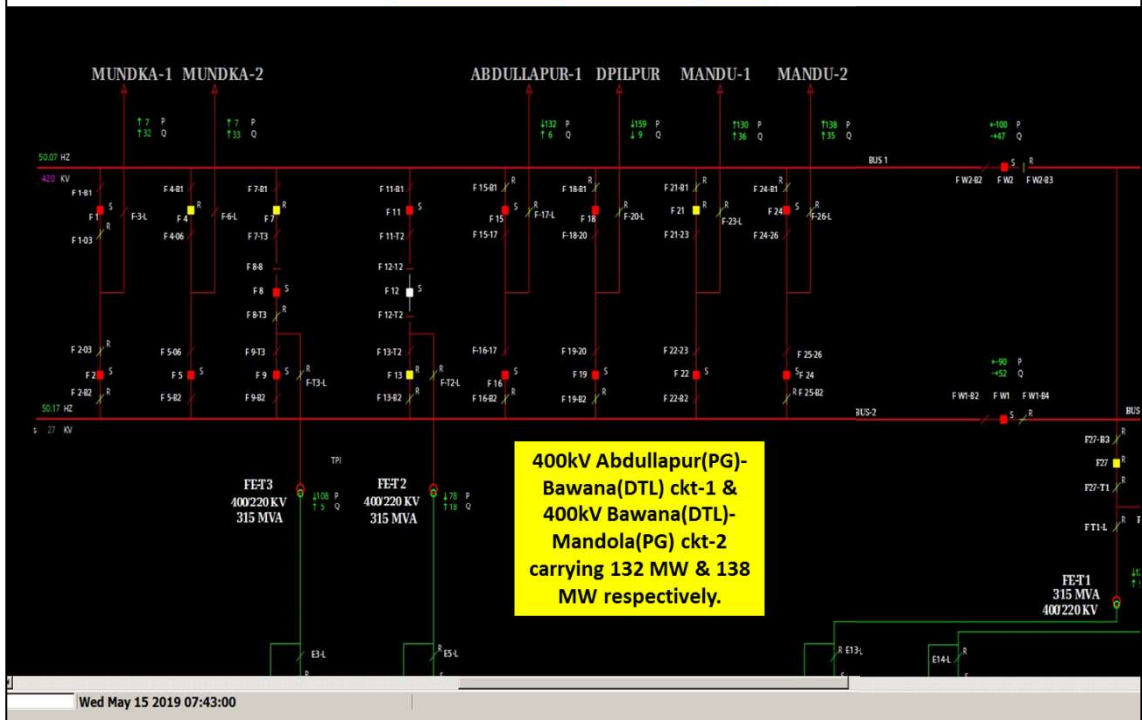
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
07:44:42:396	BAWANA	400kV	F_12(MNDRG -ICT2 TIE)	Circuit Breaker	Open	
07:44:42:405	BAWANA	220kV	E_05(T2)	Circuit Breaker	Open	220kV Side CB of 315 MVA ICT 2 at 400/220kV Bawana(DTL) opens.
07:44:42:415	BAWANA	220kV	E_03(T3)	Circuit Breaker	Open	220kV Side CB of 315 MVA ICT 3 at 400/220kV Bawana(DTL) opens.
07:44:42:417	BAWANA	400kV	F_24(MANDU-2 BUS-1)	Circuit Breaker	Open	Main CB of 400kV Bawana(DTL)-Mandola(PG) ckt-2opens.
07:44:42:423	BAWANA	400kV	F_25(MANDU-2 BUS-2)	Circuit Breaker	Open	Tie CB of 400kV Bawana(DTL)-Mandola(PG) ckt-2opens.
07:44:42:440	BAWANA	400kV	F_9(TCT-3 BUS-2)	Circuit Breaker	Open	400kV Side CB of 315 MVA ICT 3 at 400/220kV Bawana(DTL) opens.
07:44:42:444	BAWANA	400kV	F_8 BHADURG'H TIE	Circuit Breaker	Open	
07:44:42:524	SHALIMARBG	220kV	E_06(BWANA-2)	Circuit Breaker	Open	
07:44:45:693	BAWANA	400kV	F_15(ABDUL-1 BUS-1)	Circuit Breaker	Open	Main CB of 400kV Abdullapur(PG)-Bawana(DTL) ckt-1 opens.
07:44:45:693	BAWANA	400kV	F_16(ABDUL-1 BUS-2)	Circuit Breaker	Open	Tie CB of 400kV Abdullapur(PG)-Bawana(DTL) ckt-1 opens.
07:44:45:837	ABDULLAPUR	400kV	LIBWANA1	Protection Trip	App	
07:44:45:873	ABDULLAPUR	400kV	18BWANA1	Circuit Breaker	Open	
07:45:28:726	BAWANA	220kV	E_14(T4)	Circuit Breaker	Open	220kV Side CB of 315 MVA ICT 4 at 400/220kV Bawana(DTL) opens.

Delhi Demand Pattern during tripping



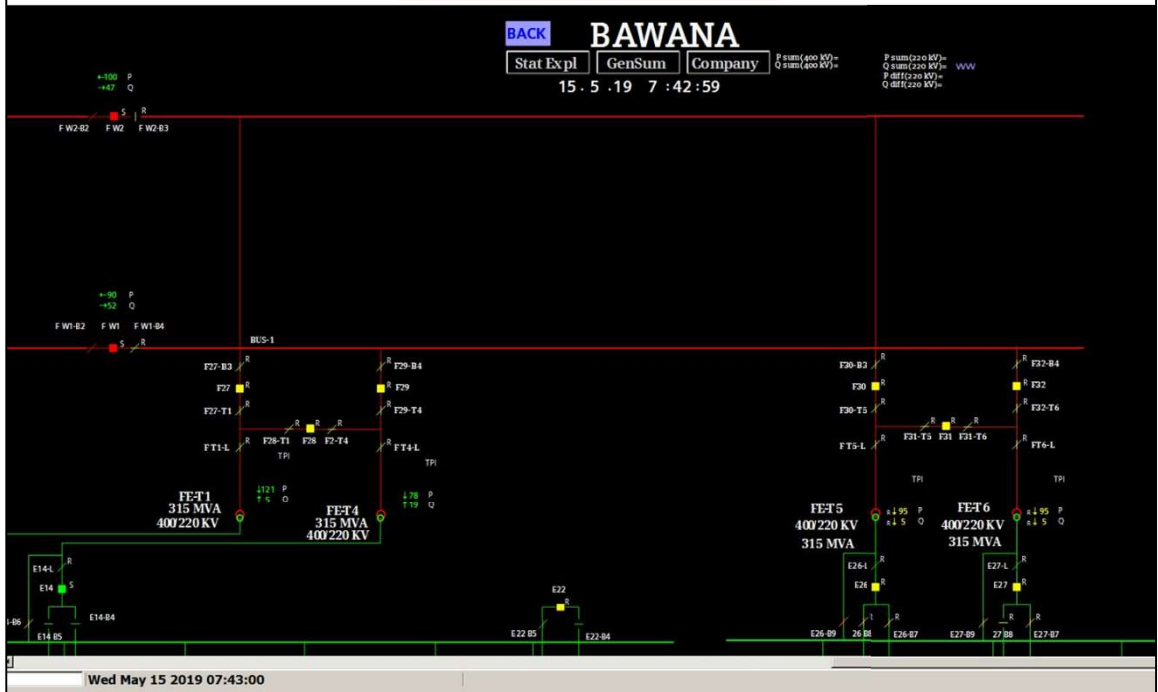
SLD of 400/220kV Bawana(DTL)(LHS) before the incident

07:43hrs/15-May-19



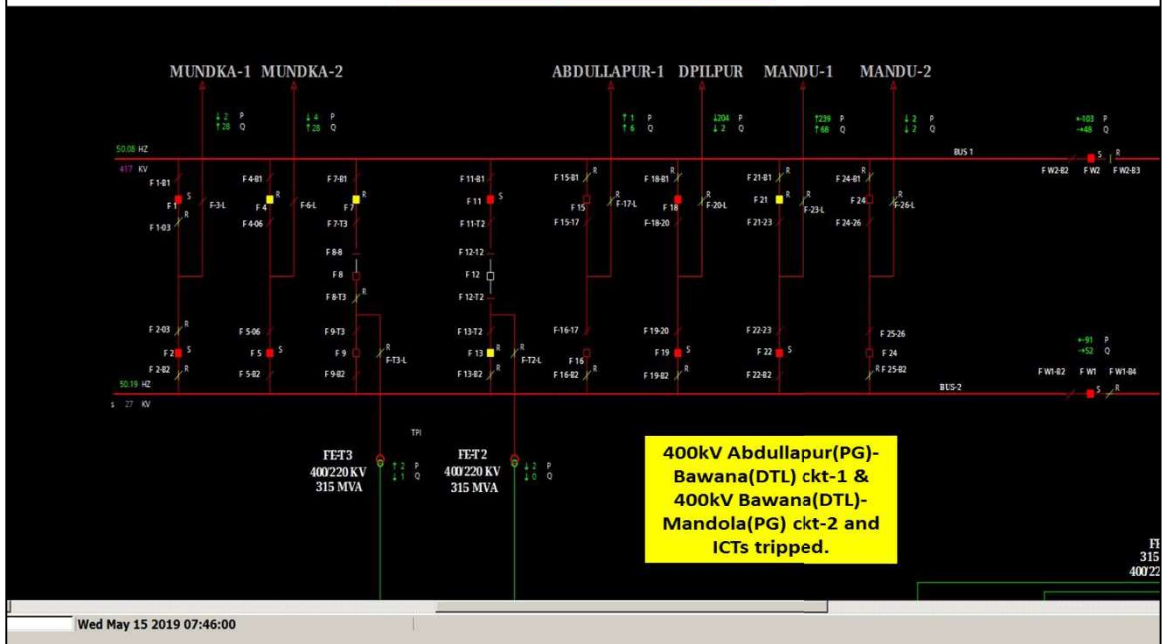
SLD of 400/220kV Bawana(DTL)(RHS) before the incident

07:43hrs/15-May-19



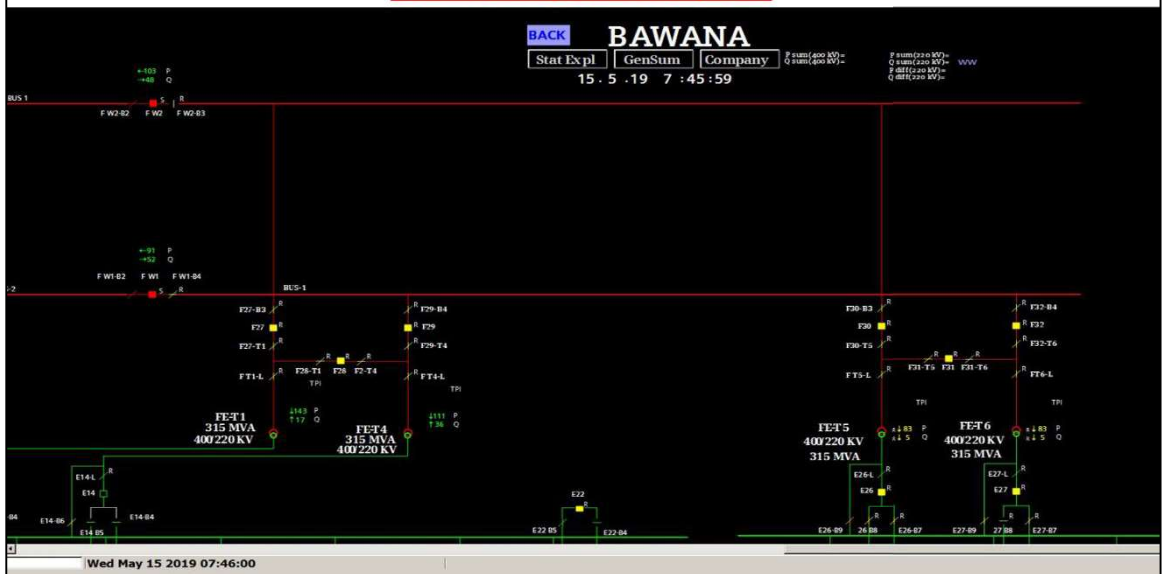
SLD of 400/220kV Bawana(DTL)(LHS) after the incident

07:46hrs/15-May-19



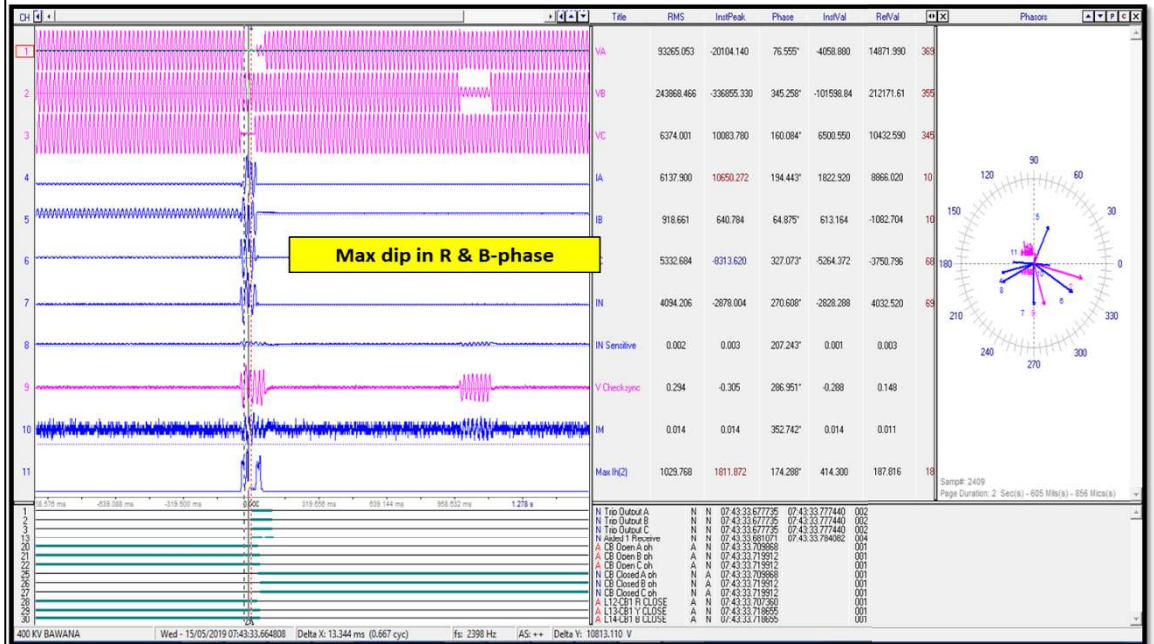
SLD of 400/220kV Bawana(DTL)(RHS) after the incident

07:46hrs/15-May-19



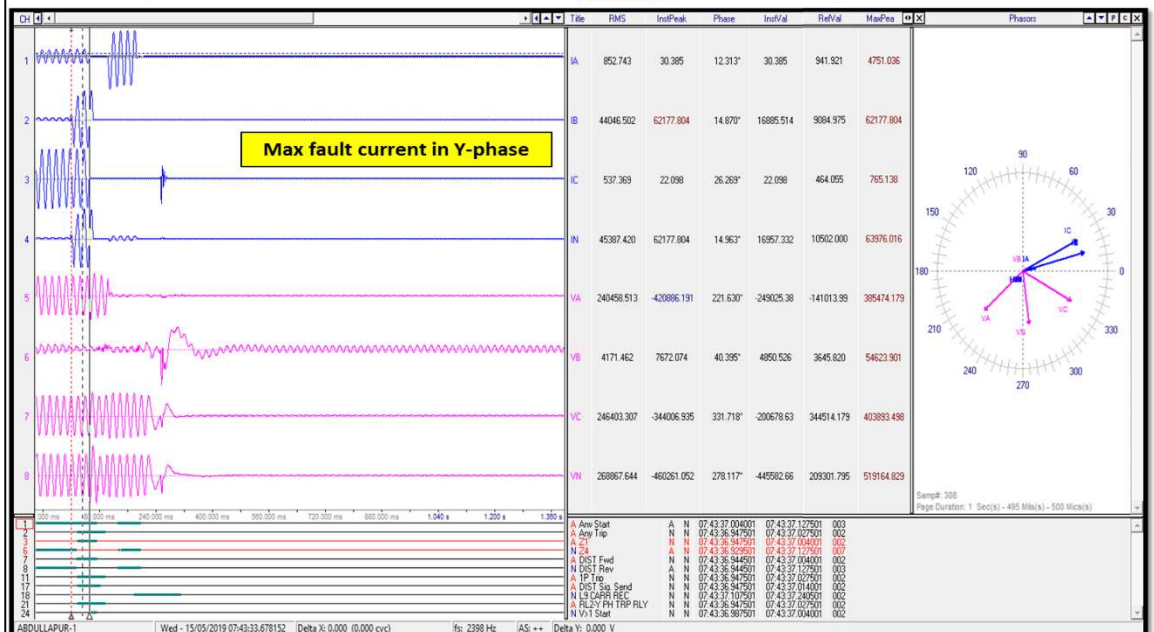
9. As per constituent details:

DR of 400 kV Bawana (end)-Mandaula ckt-2



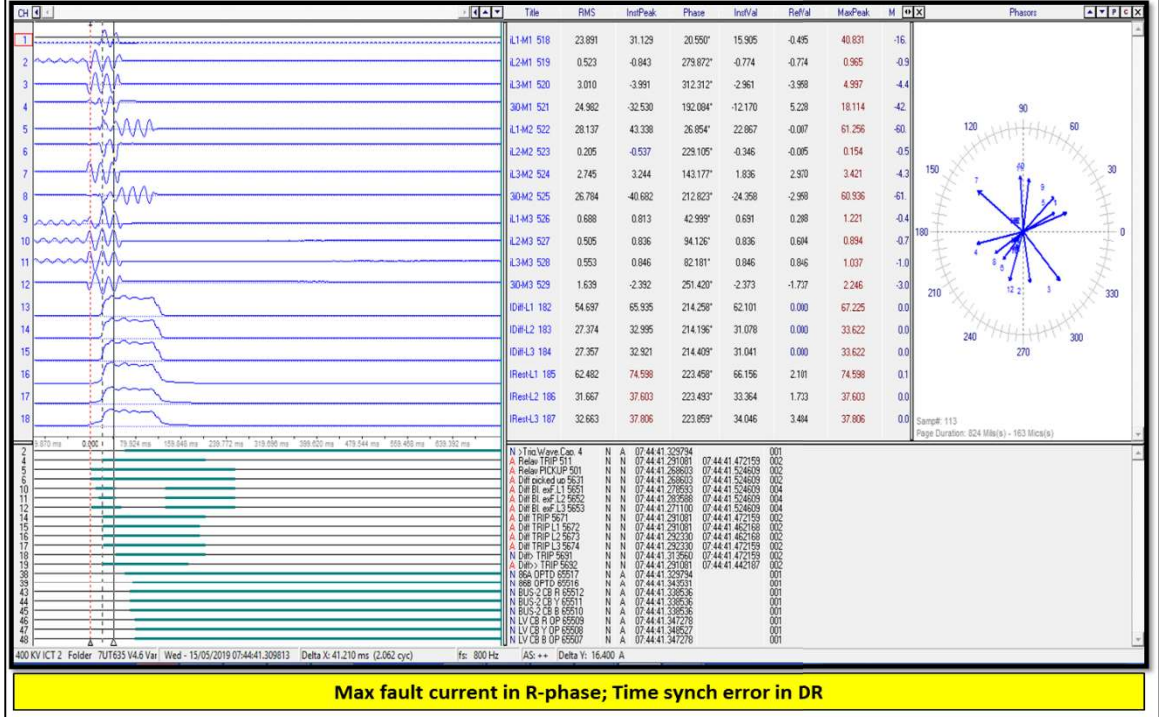
Fault was in reverse zone however line tripped from Bawana end? Time Synchron error in DR

DR of 400 kV Bawana (end)-Abdullapur ckt-1

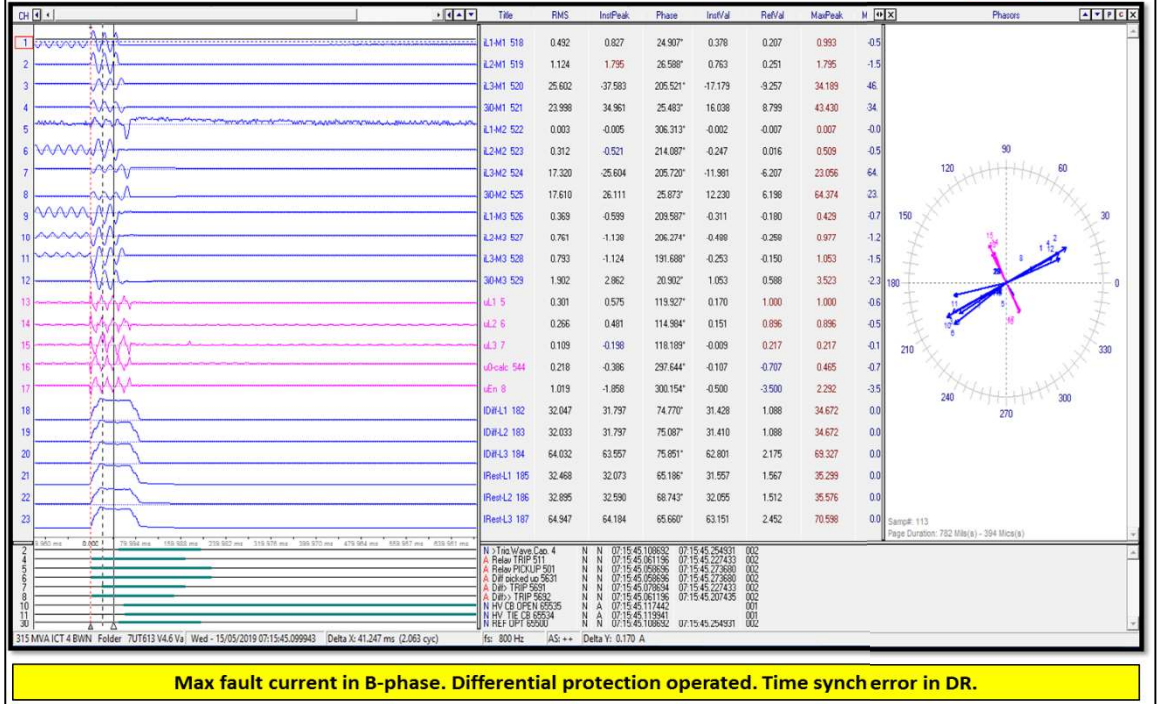


Fault sensed in reverse zone than in forward zone. Time synchron error in DR

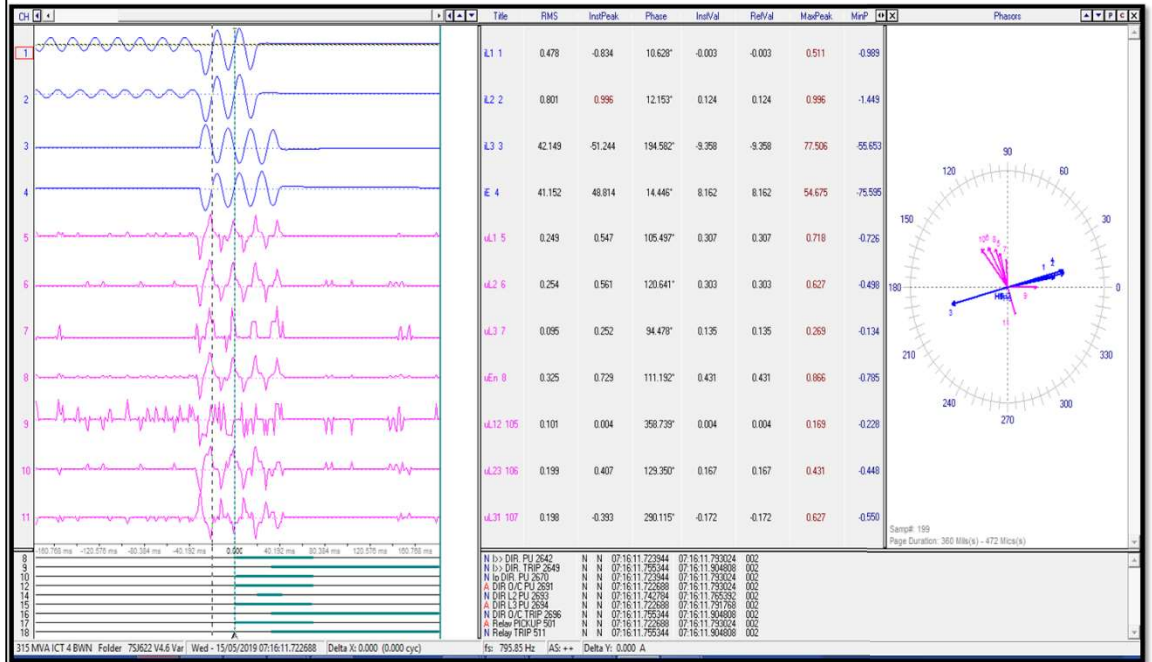
DR of 400/220 kV 315 MVA ICT-2 at Bawana (end)



DR of 400/220 kV 315 MVA ICT-4 at Bawana (end)

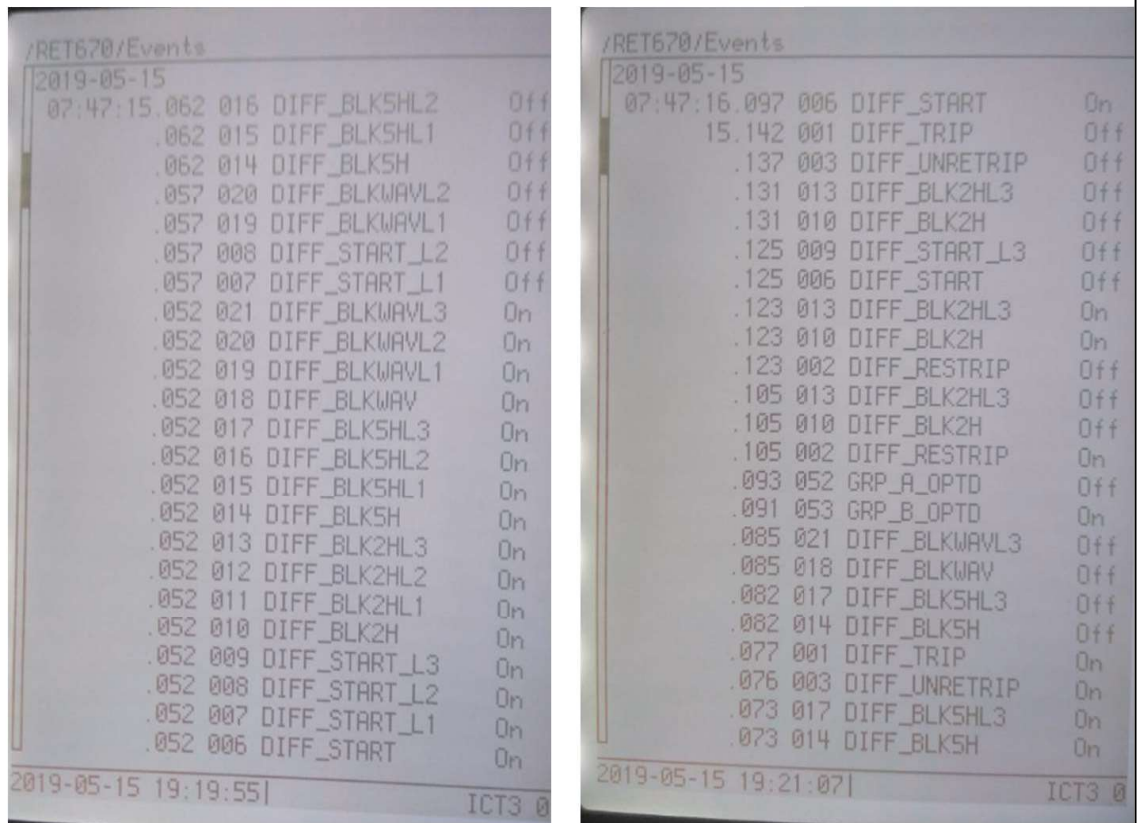


DR of 400/220 kV 315 MVA ICT-4 at Bawana (end)



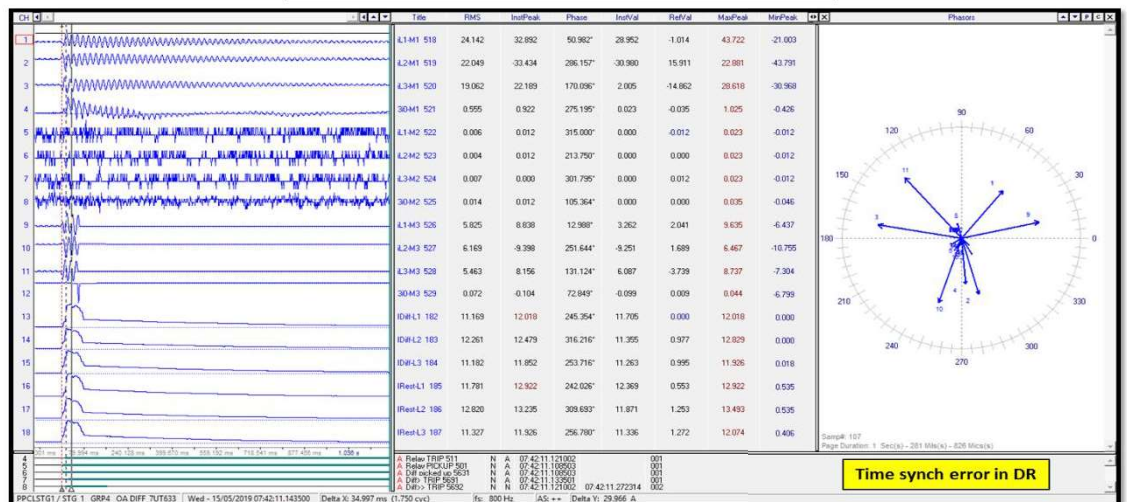
Max fault current in B-phase. Differential protection operated. Time synchron error in DR.

DR of 400/220 kV 315 MVA ICT-3 at Bawana (end)



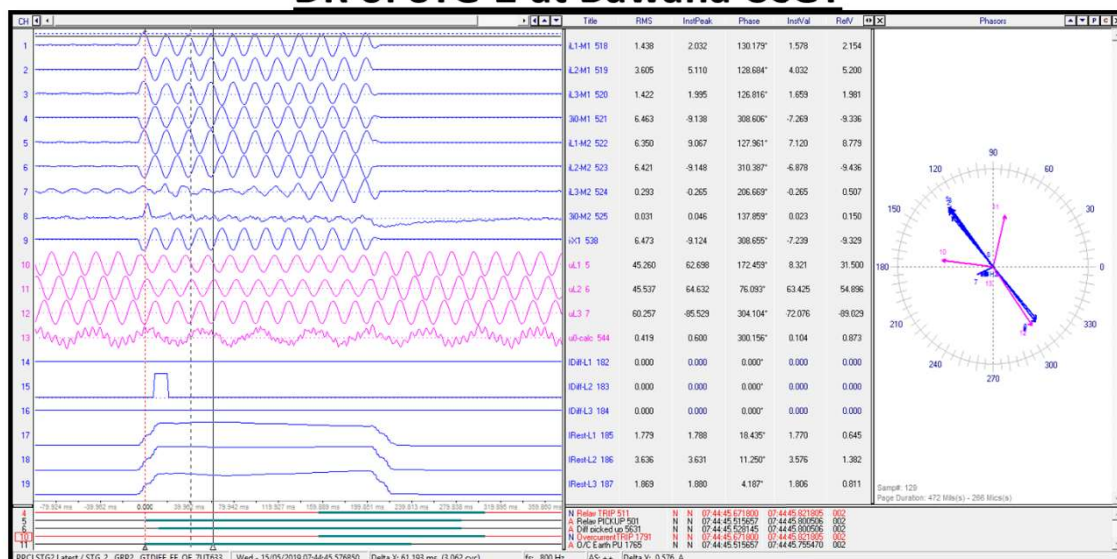
Differential protection operated. Time Sync error

DR of STG-1 at Bawana CCGT



- At 07:42:11:109 Hrs on 15.05.2019, a heavy jerk along with an explosion sound and smoke was observed from the enclosure of Excitation Transformer of STG # 1. STG # 1 tripped instantaneously on Overall Differential Protection.
- Investigation of Excitation Transformer of STG # 1 showed that R – Phase CT on the HV side (16.5 kV side) of Excitation Transformer had got dislodged from its mounting base plate and fell on the Transformer Enclosure resulting in Short Circuit of R – Phase to earth.

DR of STG-2 at Bawana CCGT



- At 07:44:45:516 Hrs, STG # 2 tripped on **Instantaneous High-set Element (Setting 6 times nominal current with 150ms)** of Stand – by Earth Fault Protection of Generator Transformer STGT # 2
- STG-2 tripped during fault at Bawana (DTL) station.

Constituent Details (DTL)

- Load of 113MW was running on 400 KV ICT-2 & 4 and load of 116 MW was running on 315 MVA (PGCIL) ICT-3, all connected on 400 KV Bus-2. 400 KV Bawana Abdullapur line was running ON at a load of 126 MW and 400 KV Bawana Mandola Ckt-2 at a load of 138 MW.
- The weather turned rainy at time 7:44 AM and started raining. Tripping of all aforesaid ICT-2, 3 & 4 occurred on differential trip along with 400 KV Bawana-Abdullapur ckt on Main-1 distance relay showing Zone-1 and 400 KV Bawana-Mandola Ckt-2 tripped on Zone-4 SOTF trip by Main-1 distance relay.
- Tripping of all the aforesaid elements occurred simultaneously due to rain but the type of fault was not common to all three 315 MVA ICT-2, 3, & 4.

Fault details:

- 315 MVA ICT-2, Differential Trip, Fault on Red-Phase (approx. 52kA), Fault on Red Phase TIE CT Flashed and started oil leakage. Time of re-energization 10:24AM
- 315 MVA (PGCIL) ICT-3, Differential Trip, Fault on Blue-Phase (approx. 40kA), Fault on Blue Phase TIE CT Flashed and started oil leakage. Time of re-energization 10:26 AM
- 315 MVA ICT-4, Differential Trip, HV Overcurrent High SET Trip, REF trip, Fault on Blue Phase (approx. 47kA), Fault on Blue Phase Bushing Flashed. Time of re-energization 12:36 PM
- 400 kv Bawana Abdullapur Ckt, Distance Zone-1 Trip, Fault on Yellow-Phase (approx. 44kA), Fault on **Yellow Phase Bus-1 CT Flashed**, corona ring on top dome of CT got burnt and fallen down on bottom dome, top dome of CT equipotential strip got burnt and started chattering. Time of re-energization 10:22 AM.
- 400 kv Bawana Mandola ckt-2, Distance Zone-4 SOTF Trip due to fault on 315 MVA ICT-2, 3 & 4 being feed by 400 kv Bawana Mandola Ckt-2 resulted in **VT supervision blocking** of distance relay feature due to low current infeed through R & B Phase fault values 6kA & 5kA in reverse direction along-with dip in line voltage R & B Phase, Line Voltage 11.5 kV and 5.9 kV approx. respectively. Thus Zone-4 SOTF feature of Main-1 distance relay cleared the fault by tripping the line immediately (39mSec.) from Bawana end. Time of re-energization 10:38 AM.
- The fault was clearly in differential relay zone of all three transformers and all the three differential relays of these transformers tripped accurately.
- All the aforesaid faults in 315 MVA ICT-2, 3 & 4 are not inter-related except initiation of fault was due to raining on pollution deposited CT insulator and transformer bushing.

- MVA ICT-4, Differential Trip, HV Overcurrent High SET Trip on 15.05.2019, GTG # 1 and STG # 1 of Module-I, Pragati Power Station-III were running at 154 MW and 87 MW respectively. GTG # 4 and STG # 2 of Module-II were running at 130 MW and 84 MW respectively. GTGT # 2 and GTGT # 3 were in back - charged condition for meeting the station auxiliary supply. At around 07:42 Hrs, a heavy jerk along with an explosion sound and smoke was observed by Control room staff. The smoke appeared to be emanating from the enclosure of Excitation Transformer of STG # 1. STG # 1 tripped on Generator Protection. Two minutes later, another jerk was observed and STG # 2 tripped on Stand – by Earth Fault Protection of Generator Transformer.

SoE (Sequence of Event):

- At 07:42:11:109 Hrs on 15.05.2019, a heavy jerk along with an explosion sound and smoke was observed from the enclosure of Excitation Transformer of STG # 1.
- STG # 1 tripped instantaneously on Overall Differential Protection.
- After two minutes, again a jerk was observed in the 400 KV system.
- At 07:44:45:516 Hrs, STG # 2 tripped on Instantaneous High-set Element of Stand by Earth Fault Protection of Generator Transformer STGT # 2.
- GTG # 1 and GTG # 4 remained stable and were running normally on Open Cycle.

Analysis of Tripping:

- At 07:42:11:109 Hrs on 15.05.2019, a heavy jerk along with an explosion sound and smoke was observed from the enclosure of Excitation Transformer of STG # 1. Investigation of Excitation Transformer of STG # 1 showed that R – Phase CT on the HV side (16.5 KV side) of Excitation Transformer had got dislodged from its mounting base plate and fell on the Transformer Enclosure resulting in Short Circuit of R – Phase to earth.

Constituent Details (Bawana CCGT)

Analysis of Tripping:

- After about two minutes, at 07:44:45:516 Hrs, a heavy jerk was again observed in the 400 KV system.
- As learnt from DTL, due to sudden heavy downpour along with hailstorm, there was a flash over on one of the CTs of DTL, Bawana Switchyard. Simultaneously, ICT – 2, ICT – 3 and ICT – 4 of DTL, Bawana tripped on Transformer Differential Protection.
- At the same time, Generator Transformer of STG # 2 tripped on the Instantaneous High – Set Element of Stand – By Earth Fault Protection.
- *It is important to mention here that, as per the deliberations and discussions at NRPC (9th PSAG meeting), the High – Set setting of the Stand- By Earth Fault Protection has been increased to a Pick up value of 6 times the nominal current along with a time delay of 150 msec.*
- The flash over on the 400 KV CT along-with tripping of 3 Nos. of ICTs of DTL, Bawana might have resulted in high fault current, resulting into tripping of STG # 2 Generator transformer on the High – set element of Stand – By Earth Fault Protection.
- GTG # 1 and GTG # 3 remained stable and kept on running in Open Cycle mode

10. As per PMU, SCADA data:

- a. As per PMU, voltage dip in R-Y phase followed by Y-phase.
- b. Fault Clearance time: **80ms, 80ms and 260ms**
- c. SoE captured only for some of the tripped elements.

11. Preliminary Report and DR/EL details received within 24hrs from DTL.

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. Instantaneous tripping of 400 kV Bawana-Mandaula ckt-2 in reverse zone needs to be checked. (Fault was in ICT-2 & 3)

3. Relay behavior during close in fault (fault at Bus CT) in 400 kV Bawana (end)-Abdullapur ckt-1, Why bus bar protection was not operated?
4. In case of non-operation of bus bar protection on bus fault why all the connected 400 kV element didn't trip in Z-2 from remote end or reverse zone from Bawana end?
5. Time synchronization of DR at Bawana to be checked and rectified.
6. Detailed Report is still awaited from DTL.

Remedial Measures received from DTL:

1. Instantaneous tripping of 400 kV Bawana-Mandaula ckt-2 in reverse zone needs to be checked. (Fault was in ICT-2 & 3)
 - SOTF function was wrongly mapped for voltage dip, it has been blocked. SOTF initiation should be mapped with breaker closing command not with quantum of voltage dip. DTL is looking in this issue.
2. Relay behavior during close in fault (fault at Bus CT) in 400 kV Bawana (end)-Abdullapur ckt-1, Why bus bar protection was not operated?
 - Bus Bar Protection was out of service due to retrofit work of bus bar protection. Healthiness of Bus Bar Protection has already been ensured by DTL.
3. Time synchronization of DR at Bawana to be checked and rectified.
 - Order has been placed for time synchronization of station GPS and DR time synchronization.

Delhi may elaborate the incident in line with above points, present and submit the DR of the tripped elements and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events

U. Multiple element tripping at 400kV Chhabra (raj) at 20:57hrs on 22-May-19

Event category: GD-1

Generation loss: 1050 MW (As per SCADA data, Rajasthan may confirm)

Loss of load: Nil (Rajasthan may confirm)

Energy load: Nil (Rajasthan may confirm)

Data Summary received/available at NRLDC:

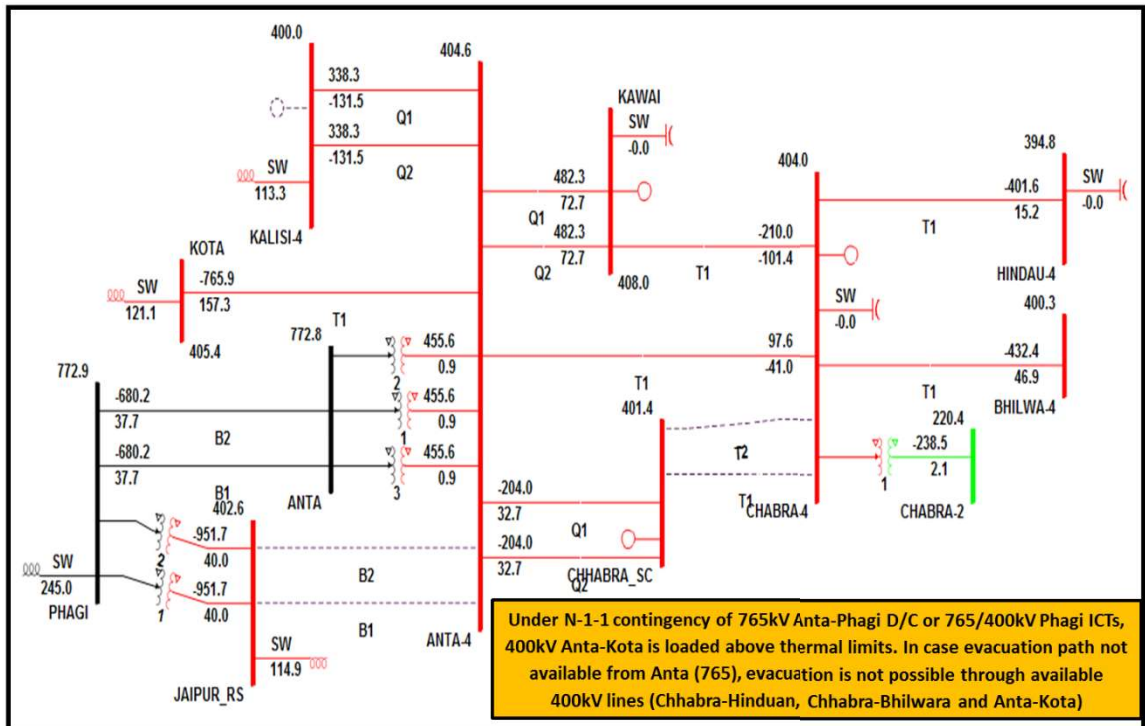
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	100ms	
Phase of the fault	PMU data	Y-phase to earth fault	

Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Partially Available	
DR/EL	Rajasthan	Partially Received	Received for 765 kV Anta-Phagi ckt-2 only
Preliminary Report	Rajasthan	Received	After 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, 6.4) CEA (Technical standard for connectivity to the Grid, Amendment Regulation 2013), part-II, B2	Rajasthan	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

1. Connectivity diagram of Chabra-Kawai-Kalisindh complex:



2. 765kV Anta(Raj)-Phagi(Raj) ckt-2 tripped on Y-N fault, 107Km from Phagi end. Line tripped on persistent nature of fault after successful A/R.

3. At the same time, 660MW Unit#5 & #6 at 400/220kV Chhabra TPS also tripped on electrical fault.

4. DR details of 765 kV Phagi (end)-Anta ckt-2 has been received after 24hrs of the event.

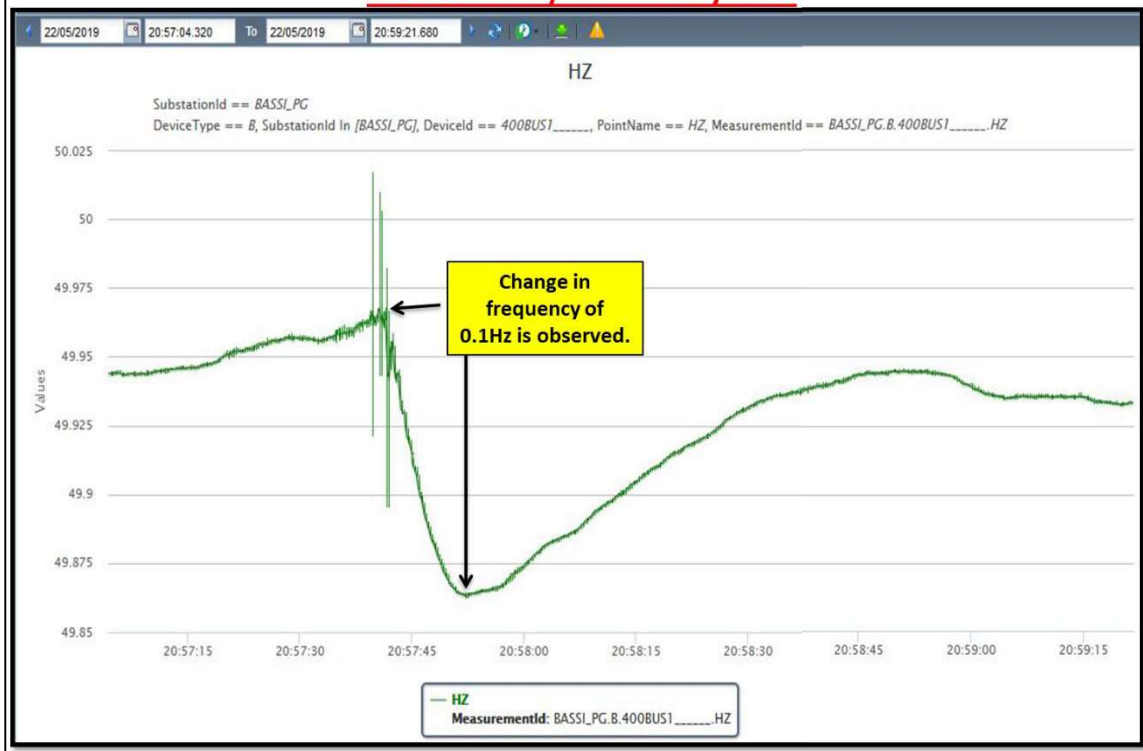
5. Name of the tripped elements:

- 765kV Anta(Raj)-Phagi(Raj) ckt-2
- 660MW Unit#5 at 400/220kV Chhabra TPS
- 660MW Unit#6 at 400/220kV Chhabra TPS

6. PMU plots:

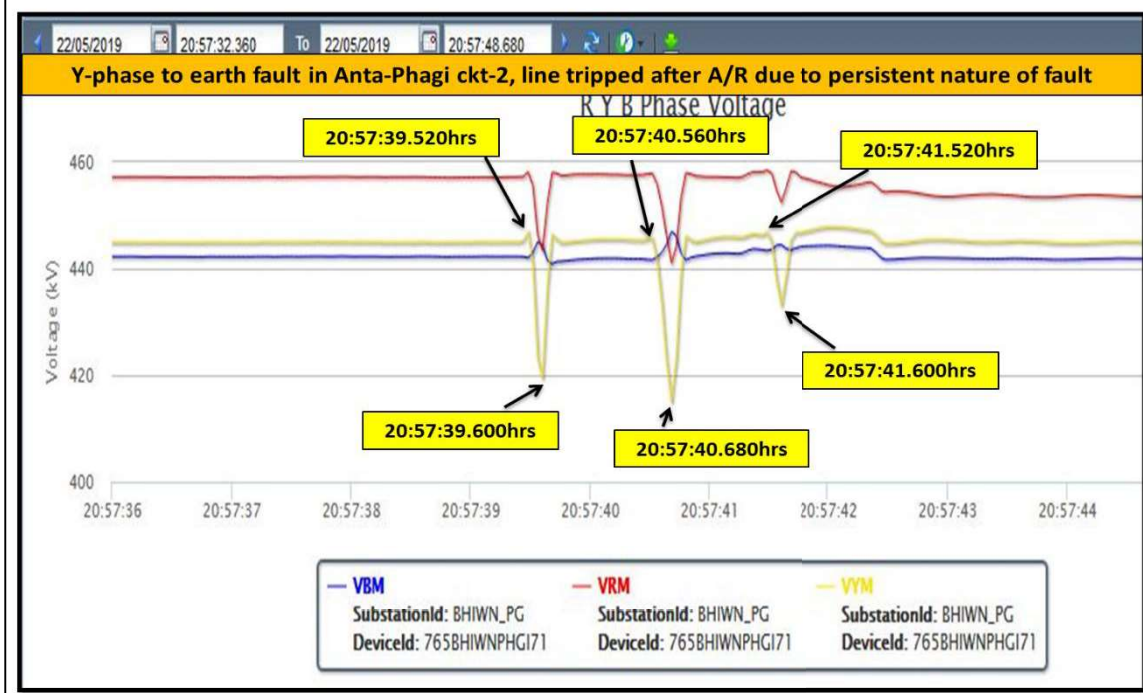
PMU Plot of frequency at Bassi(PG)

20:57hrs/22-May-19



PMU Plot of phase voltage magnitude at Bhiwani(PG)

20:57hrs/22-May-19

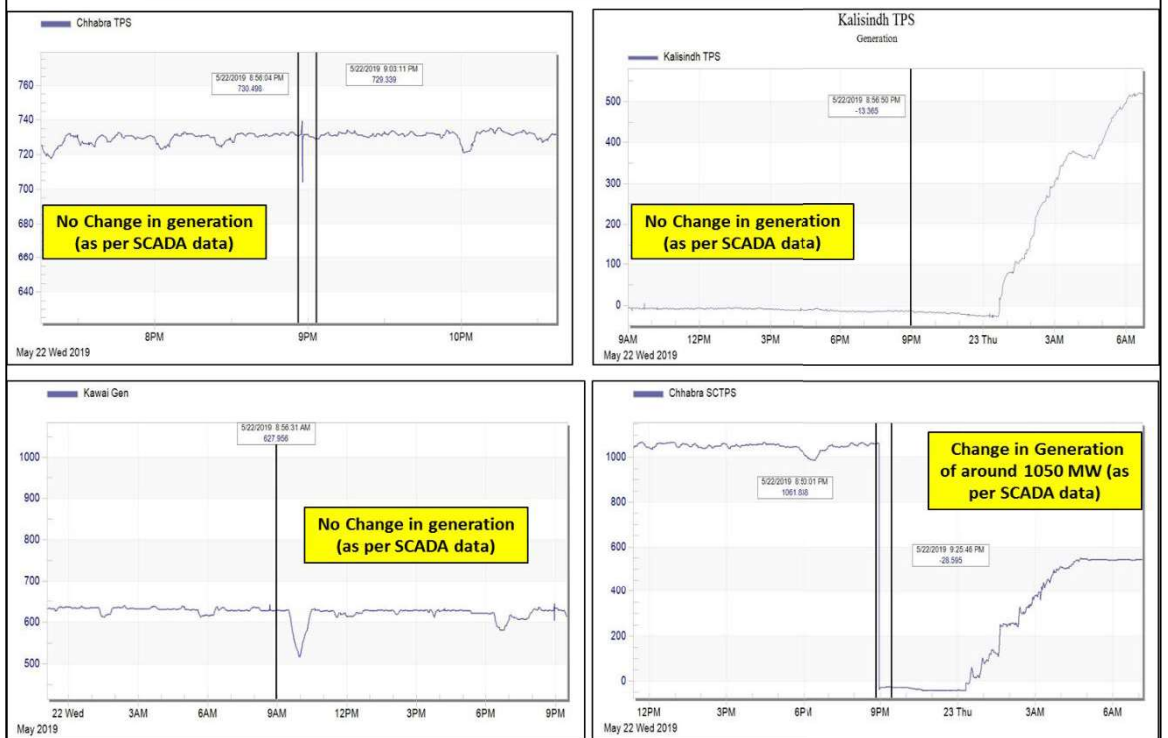


7. SCADA data and SoE:

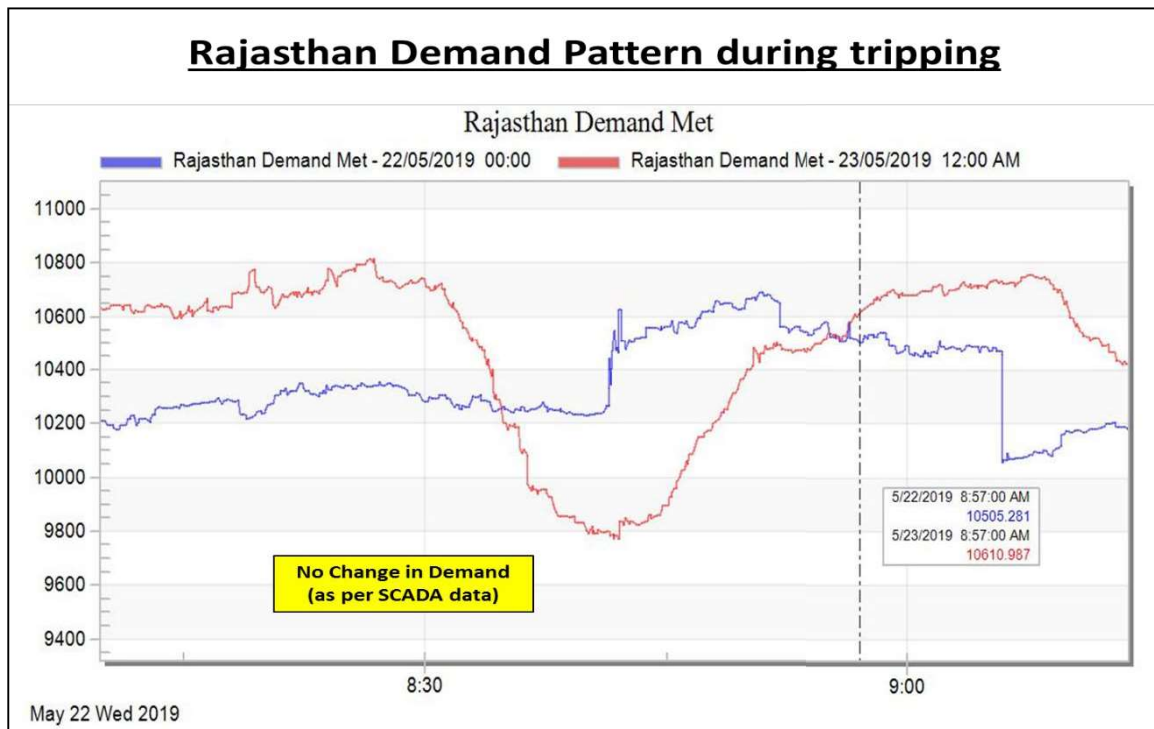
Rajasthan SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
20:57:39:607	PHGI7_RS	765kV	17GWANT2	Circuit Breaker	disturbe	
20:57:39:608	PHGI7_RS	765kV	18ANTA2	Circuit Breaker	disturbe	
20:57:39:609	ANTA765	765kV	7PHAGI2	Circuit Breaker	disturbe	
20:57:39:611	ANTA765	765kV	8T2PHG2	Circuit Breaker	disturbe	
20:57:40:668	ANTA765	765kV	7PHAGI2	Circuit Breaker	Open	Main CB of 765kV Anta(Raj)-Phagi(Raj) ckt-2 opens.
20:57:40:669	ANTA765	765kV	8T2PHG2	Circuit Breaker	Open	Tie CB of 765kV Anta(Raj)-Phagi(Raj) ckt-2 opens.
20:57:40:725	PHGI7_RS	765kV	18ANTA2	Circuit Breaker	Open	Main CB of 765kV Anta(Raj)-Phagi(Raj){end} ckt-2 opens.
20:57:41:634	ANTA765	765kV	8T2PHG2	Circuit Breaker	Invalid App	
20:57:41:638	ANTA765	765kV	8T2PHG2	Circuit Breaker	Invalid Disp	
20:57:42:409	PHGI7_RS	765kV	17GWANT2	Circuit Breaker	Open	Tie CB of 765kV Anta(Raj)-Phagi(Raj){end} ckt-2 opens.
20:57:49:374	CHHABRA	11kV	04H05	Protection Trip	Disp	

Chhabra TPS Generation Pattern during tripping

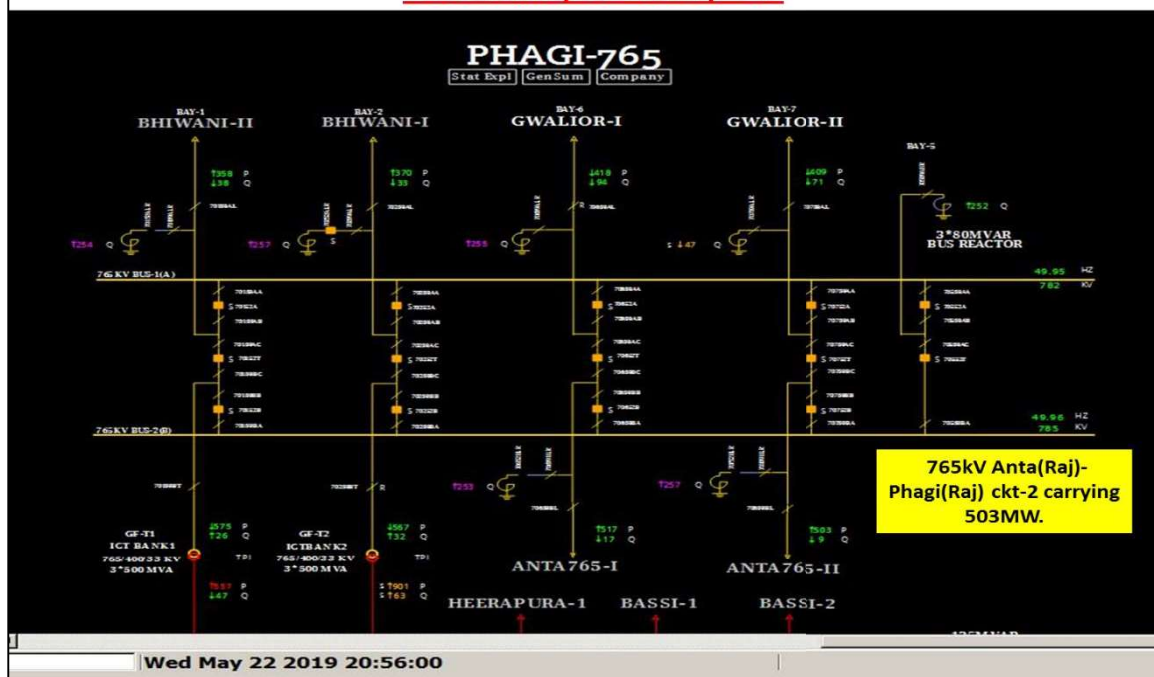


Rajasthan Demand Pattern during tripping



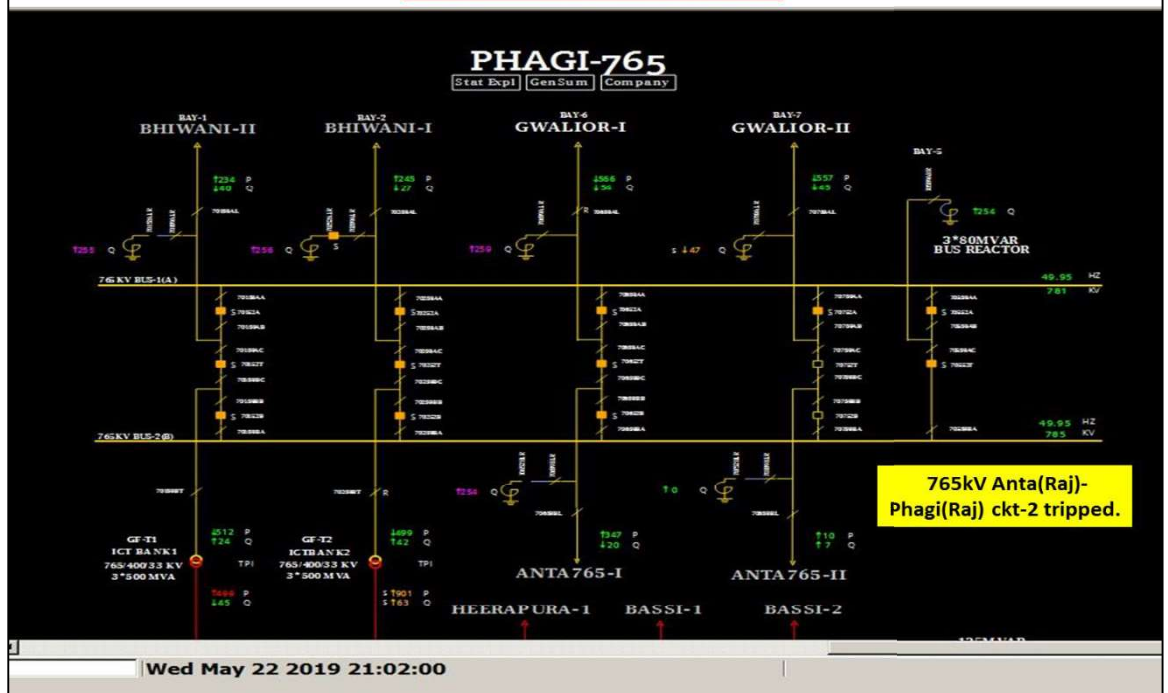
SLD of 765kV Phagi(Raj) before the incident

20:56hrs/22-May-19

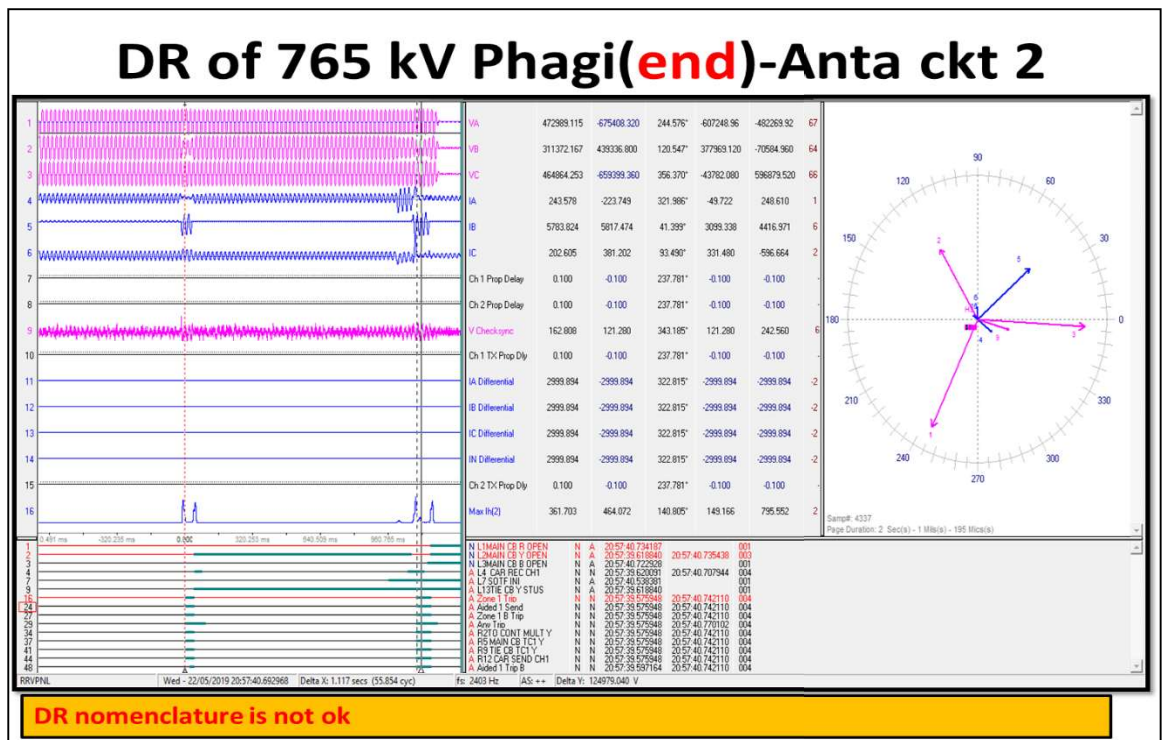


SLD of 765kV Phagi(Raj) after the incident

21:02hrs/22-May-19



8. As per Rajasthan details:



9. As per PMU, SCADA data:

- a. As per PMU, Y-N fault. Maximum dip in Y-phase. Further dip in Y-phase voltage observed after 1 sec and 2 sec of first dip.
- b. Fault Clearance time: Within **100ms**

- c. SoE captured only for 765 kV Phagi-Anta ckt-2. SoE didn't capture for unit tripping at Chhabra SCTPS.
10. Preliminary Report, DR/EL details and detailed report is still awaited from RRVUNL (Rajasthan).

Points for Discussion:

1. Reason of tripping of units at 400 kV Chhabra SCTPS?
2. Reason of non-operation of SPS in case of tripping of 765 kV Anta-Phagi one ckt.
3. As per PMU, a dip in voltage observed after 2 sec of fault. Tie CB auto-reclosing after 2sec of fault to be checked and confirmed.
4. SPS logic for Chhabra, Kawai and Kalisindh TPS complex states that in case of N-1 contingency of 765 kV Anta-Phagi ckt-1 & 2, Generation would be reduced to 65% of the installed capacity at Kawai, Kalisindh, Chhabra TPS and Chhabra SCTPS each. But two units tripped at Chhabra SCTPS and no generation backing down was observed at Chhabra, Kawai and Kalisindh. Reason of the same needs to be looked into and reported.
5. Time synchronization of digital data of 400 kV Chhabra SCTPS to be looked into.
6. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

Rajasthan may elaborate the incident in line with above points, present and submit the DR of the tripped elements and may also apprise the members about corrective actions already taken/being taken (with time line) to avoid such events.

V. Multiple element tripping at 220 kV Khetri (Raj) Station at 17:45hrs of 12th May 2019

Event category: GI-2

Generation loss: Nil (Rajasthan may confirm)

Loss of load: Nil (Rajasthan may confirm)

Energy load: Nil (Rajasthan may confirm)

Data Summary received/available at NRLDC:

Description		Fault Info	Remarks
Fault Clearance Time		400ms	As per PMU data
Phase of the fault		Dip in all three phase	As per PMU data

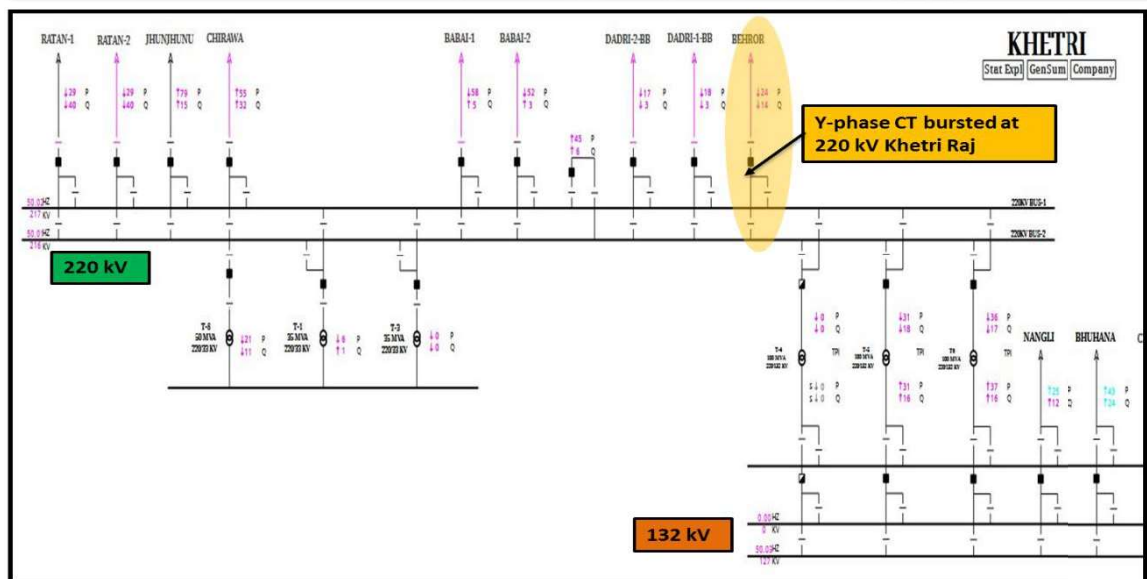
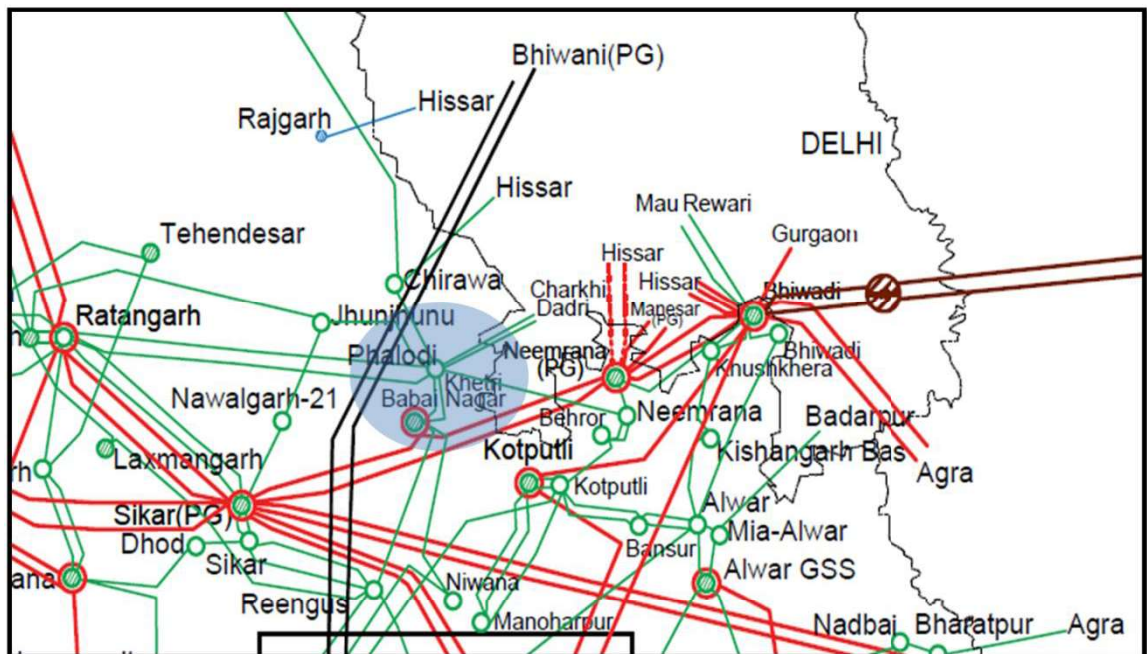
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Available	Time Synch error
DR/ EL	Rajasthan	Not Received	
	BBMB	Not Received	
Preliminary Report	Rajasthan	Received	After 24hrs
	BBMB	Not Received	
Detailed Report	Rajasthan	Not received	

Description	Clauses	Utility	Remarks
Violation of Clauses	<p>1. IEGC 5.2.r & 5.9.6.c (VI)</p> <p>2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2)</p> <p>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)</p> <p>CEA (Technical standard for connectivity to the Grid, Amendment</p>	Rajasthan	<p>1. Preliminary Report, DR/EL within 24hrs</p> <p>2. Detailed Report yet to be received</p> <p>3. Delayed Clearance of Fault</p> <p>4. Adequately Sectionalized and graded protective relaying system</p> <p>5. Incorrect/ mis-operation / unwanted operation of Protection system</p>

	Regulation 2013), part-II, B2 4. CEA GRid Standard 2010-3.e & CEA Transmission Planning Criteria		
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	BBMB	1. Preliminary Report, DR/EL yet to be received

Based on above information description of the events is:

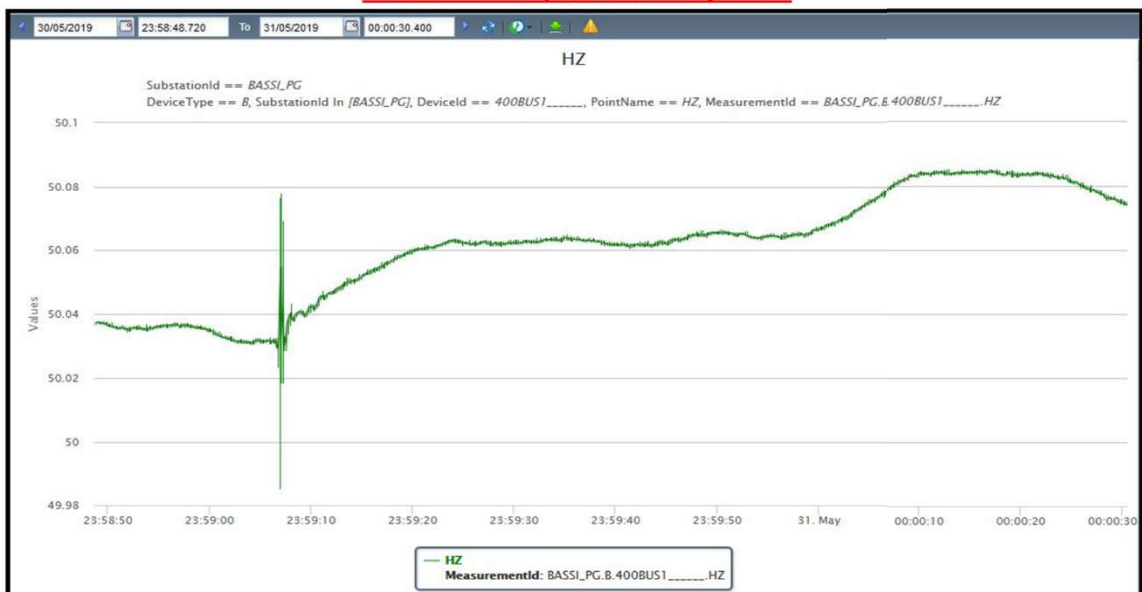
1. Single Line Diagram and Connectivity diagram of 220 kV Khetri nagar (Raj):



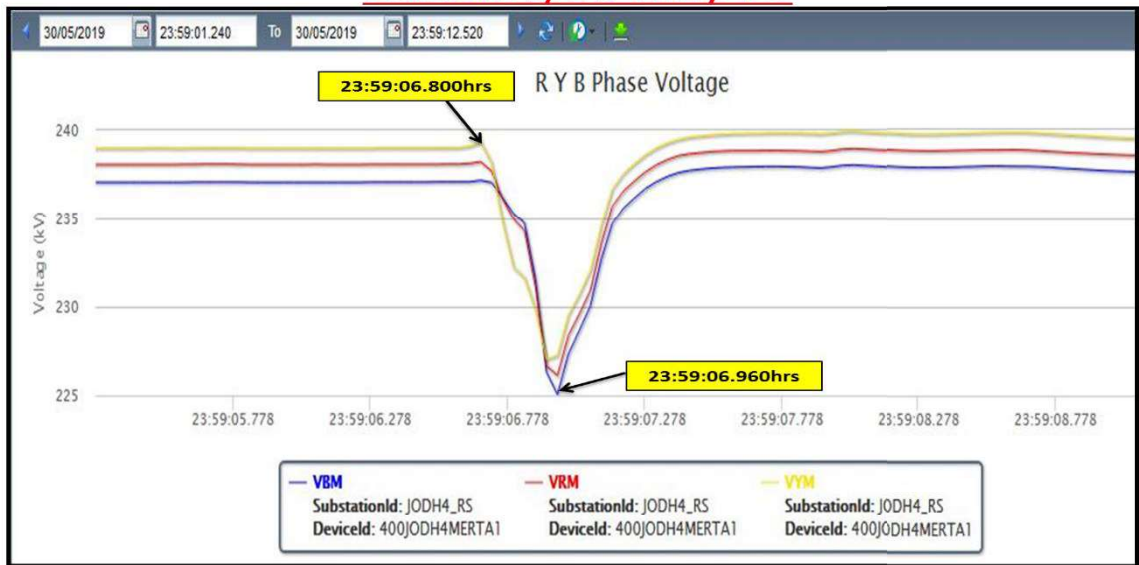
2. 220 kV Khetri (Raj) station has double bus single breaker scheme. It is connected through Charkhi Dadri BBMB D/C, Ratangarh D/C, Babai D/C, Chirawa S/C, Jhunjhunu S/C and Behror S/C. It also has three 100 MVA 220/132 kV ICTs and 2*35+1*50 MVA 220/33 kV ICTs.
3. In antecedent conditions, 220 kV bus bar protection was not healthy at Khetri (Raj) and alternate arrangement was implemented.
4. Y-phase CT of 220KV Khetri(end)-Behror(Raj) bursted and created bus fault for 220 kV Khetri Bus-II.
5. 220 kV Bus Bar Protection was not in service and alternate arrangement was implemented at 220 kV Khetri (Raj)
6. All the elements connected at 220 kV Khetri station tripped.
7. As per PMU, three phase fault is observed in the system. In antecedent conditions, 100MVA ICT 5 & 6 carrying 31MW & 36MW respectively.
8. Name of the tripped element:
 - 220KV Bus-II at 220/132kV Khetri (Raj)
 - 220KV Khetri(Raj)-Behror (Raj)
 - 220KV Khetri(Raj)-Ratangarh(Raj) ckt-1 & 2
 - 220KV Khetri(Raj)-Jhunjhunu(Raj)
 - 220KV Khetri(Raj)-Babai (Raj) ckt-1 & 2
 - 220KV Khetri(Raj)-Dadri(BBMB) ckt-1 & 2
 - 100MVA ICT 4 at 220/132kV Khetri (Raj)
 - 100MVA ICT 5 at 220/132kV Khetri (Raj)
 - 100MVA ICT 6 at 220/132kV Khetri (Raj)
 - 2*35 MVA+ 1*50 MVA at 220/33 kV ICT at Khetri (Raj)
9. PMU plots:

PMU Plot of frequency at Bassi(PG)

23:59hrs/30-May-19



PMU Plot of phase voltage magnitude at Jodhpur(Raj)
23:59hrs/30-May-19



10. As per PMU data:

- Voltage dip in all three phase.
- Fault clearance time is **400ms**.

11. SCADA data and SoE: SoE captured only for some of the tripped elements. Time difference of 1 minute in actual fault and breaker digital signal captured from SCADA SoE.

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
23:59:05:904	KHETRI	220kV	10MBC	Circuit Breaker	Open	220kV Bus coupler opens.
23:59:05:927	KHETRI	220kV	E_17(RATN4-1)	Circuit Breaker	disturbe	
23:59:05:935	KHETRI	220kV	E_11(HERP2-2)	Circuit Breaker	Open	
23:59:05:938	KHETRI	220kV	E_18(RATN4-2)	Circuit Breaker	Open	CB of 220KV Khetri(Raj)-Ratangarh(Raj) ckt-2 opens.
23:59:05:947	KHETRI	220kV	E_05(REENG-1)	Circuit Breaker	Open	
23:59:06:027	JHUNJNU	220kV	07MBC	Circuit Breaker	Open	
23:59:06:097	KHETRI	220kV	E_09(DADRI-2)	Circuit Breaker	Open	CB of 220KV Khetri(Raj)-Charkhi Dadri(BBMB) ckt-2 opens.
23:59:06:103	KHETRI	220kV	E_10(HERP2-1)	Circuit Breaker	Open	
23:59:06:110	JHUNJNU	220kV	E_01(RATAN-1)	Circuit Breaker	Open	
23:59:06:414	KHETRI	220kV	E_02(CHIRW-1)	Circuit Breaker	Close	
23:59:06:800						Fault Starting time from PMU
23:59:06:944	KHETRI	132kV	D_03(T5)	Circuit Breaker	Open	
23:59:07:200						Fault cleared

12. As per Rajasthan details:

- Y-phase CT of 220 KV Khetri nagar – Behror line bursted at 220kV GSS Khetri nagar GSS and line tripped in zone-1 from Khetri nagar end and zone-2 from Behror end. Khetri nagar end

Circuit breaker take more time to clear fault due to defective mechanism (old CB HBB make mfg. year 1988).

- All feeders and transformer emanating from 220 kV Bus-B are tripped on following indications.
 - 220kV Bus-coupler – E/F (backup over current earth fault protection)
 - 220kV Jhunjhunu line – Zone-4 at local end
 - 220kV Ratangarh-I line – Zone-4 at local end
 - 220kV Babai-I line – Zone-4 at local end
 - 220kV Dadari-II line – Zone-4 at local end
 - 220kV Babai-II line – Zone-4 at local end
 - 220/132kV, 100MVA transformer-6 – E/F (backup over current earth fault protection)
 - 220/33kV, 50MVA transformer-8 – manually trip
- All feeders and transformers emanating from 220 kV Bus-A remain closed and details are as under:
 - 220kV Chirawa line
 - 220kV Dadari-I line
 - 220kV Ratangarh-II line
 - 220/132kV, 100MVA transformer-5
 - 220/33kV, 50MVA transformer-3
 - 220/33kV, 35MVA transformer-1
- Following transformers are already off at 220kV GSS Khetri nagar:-
 - 220/132kV, 100MVA transformer-2
 - 220/132kV, 100MVA transformer-4
 - 220/33kV, 50MVA transformer-7

13. Remedial Measures taken as per Rajasthan report:

- Earth fault TMS Setting of 220kV bus-coupler and zone-4 setting of all 220kV feeders already revised on dated 25.04.2019 because bus bar scheme out of order since four month.

14. Preliminary Report and DR/EL details is still awaited from BBMB

15. Preliminary Report received but DR/EL details along with detailed report in desired format 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 of three phase fault captured through PMU data in case of damage of Y-phase CT?
3. Exact location and nature of fault?

4. Reason of tripping of complete station outage of 220 kV Khetri (Raj)?
5. It seems reverse zone protection setting operated in 220 kV connected elements from Khetri (Raj) however Tripping of all the elements despite of tripping of bus coupler at 220 kV Khetri (Raj) needs to be looked into.
6. Reason of outage of 220 kV bus bar protection at 220 kV Khetri (Raj) and tentative date of revival.
7. Healthiness of bus bar protection at 220 kV Khetri (Raj) to be ensured and also review the alternate arrangement in view of complete station outage and delayed clearance of fault.
8. Time synchronization of digital data of 220 kV Khetri (Raj) needs to be looked into. Analog data availability of 220 kV Khetri (Raj) also to be ensured.
9. Detailed Report and Remedial measures report considering the aforesaid point needs to be submitted by Rajasthan.

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.

W. Tripping other than to be discussed in 38th 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 124 multiple element tripping event reported by NRLDC to RPC and constituents for the month of Jan to May, 2019.

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

Among 124 events, around 22 events would be discussed in 38th 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://164.100.60.165/meetings/PCC/pcc38/PCC38_Grid_Incident.xls

Member may kindly submit the details.

AUDIT FORMAT TEMPLATE



PROTECTION AUDIT REPORT

General information

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

Audit Team

Name	Company name
.....
.....

Client Team

Name	Company name
.....
.....

Regional representatives:

Name	Company name
.....
.....
.....
.....
.....
.....
.....
.....

Attached documents:

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

CONCLUSIONS OF PROTECTION AUDIT REPORT

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

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

...

Line distance protection - check list

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

...
Line distance protection - check list

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

...
Transformer protection audit - check list

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

Synchro-check protection audit - check list

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

Shunt reactor protection audit - check list

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

BB protection audit - check list

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

BB protection audit - check list

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

DC system audit - check list

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

AC system audit - check list

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

Communication system - check list

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

Circuit breaker - check list

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

Current transformer - check list

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

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

Voltage transformer - check list

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

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

HVDC audit - check list

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

HVDC audit - check list

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

Northern Regional inter regional lines tripping for May-19

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)	Suggestive Remedial Measures	Remarks
			Date	Time				Date	Time						
1	800kV HVDC Champa-Kurukshetra line-2	POWERGRID	6-May-19	17:05	Nil	Due to Operation of "Common Area Neutral Protection (CNAP)" in Lane 1 at Champa end	NA	6-May-19	23:15	NA	NO	NO		Details of tripping yet to be received.	From PMU, no AC system fault observed.
2	HVDC Champa-Kurukshetra Pole-2 at Kurukshetra	POWERGRID	7-May-19	10:45	Nil	Tripping during changover of lane	NA	7-May-19	11:40	NA	NO	NO		Details of tripping yet to be received.	From PMU, AC system fault observed.
3	HVDC Champa-Kurukshetra Pole-1 at Kurukshetra	POWERGRID	7-May-19	12:25	Nil	Tripped during automatic switchgear sequence connect (a part of deblocking sequence) in Pole 3, the HVHS failed to connect	NA	7-May-19	13:26	NA	NO	NO		Details of tripping yet to be received.	From PMU, no AC system fault observed.
4	800kV HVDC Champa-Kurukshetra line-1	POWERGRID	9-May-19	9:09	Nil	Tripped due to malfunctioning of software during blocking of Pole-3 at Kurukshetra.	NA	9-May-19	17:40	NA	NO	NO		Details of tripping yet to be received.	From PMU, no AC system fault observed.
5	HVDC Champa-Kurukshetra Pole-2 at Kurukshetra	POWERGRID	30-May-19	15:33	Nil	Main and Standby AC supply for B-phase Converter transformer failed and cooling system stopped working. As a result Converter transformer tripped on WTI trip.	NA	30-May-19	16:18	NA	YES	YES	WTI tripping in place of alarm.	Alarm for supply failure needs to be monitored at control room. WTI tripping to be looked into as alarm is generally kept for WTI.	From PMU, no AC system fault observed.
6	HVDC Vindhyachal BtB block-2	POWERGRID	19-May-19	10:35	Nil	Tripped along with generation outage at Vindhyachal, WR and failure of 6.6KV auxiliary supply feeder.	NA	19-May-19	18:09	NA	NO	NO (DR provided for different time)	Sensitive DC overcurrent protection.	Details of tripping yet to be received. Sensitive DC overcurrent protection to be looked into.	From PMU, AC system fault observed.
7	HVDC Vindhyachal BtB block-1	POWERGRID	22-May-19	15:34	Nil	Both block of HVDC Vindhyachal Bi-pole tripped due to disturbance at Vindhyachal NTPC switchyard (CB blasted at NTPC end).	GI-2	22-May-19	17:40	NA	YES (After 24hrs)	YES (After 24hrs)	Sensitive DC overcurrent protection.	Sensitive DC overcurrent protection to be looked into.	From PMU, AC system fault observed.
8	HVDC Vindhyachal BtB block-2							22-May-19	18:32						
9	HVDC Vindhyachal BtB block-2	POWERGRID	28-May-19	9:30	Nil	Due to maloperation of micro switch of PRD	NA	28-May-19	12:19	NA	NO	NO	Maloperation of protection.	Details of tripping yet to be received. Maloperation of protection to be looked into.	From PMU, no AC system fault observed.
10	HVDC Vindhyachal BtB block-1	POWERGRID	28-May-19	12:09	Nil	Tripped due to DC OVERCURRENT Protection.	NA	28-May-19	13:59	NA	NO	NO	Sensitive DC overcurrent protection.	Details of tripping yet to be received. Sensitive DC overcurrent protection to be looked into.	From PMU, AC system fault observed.
11	800kV HVDC Agra-BNC pole-4 at Agra	POWERGRID	4-May-19	11:58	Nil	Blocked due to Converter Differential Protection Trip at Alipurwar end.	NA	4-May-19	17:44	NA	NO	YES (After 24hrs)		Complete details of tripping yet to be received.	From PMU, slight dip in all three voltage phases observed.
12	800kV HVDC Agra-BNC pole-4 at Agra	POWERGRID	7-May-19	15:43	Nil	Tripped on Fire Trip indication (VESDA)	NA	7-May-19	20:28	NA	YES (After 24hrs)	YES (After 24hrs)		VESDA operated but no abnormality found. VESDA protection operation needs to be checked, tuned for any unnecessary operation.	From PMU, slight dip in all three voltage phases observed.
13	800kV HVDC Agra-BNC pole-4 at Agra	POWERGRID	24-May-19	7:32	Nil	Tripped at Agra on protection indication related to Valve cooling of pole -4 at APD.	NA	24-May-19	8:06	NA	NO	YES		Complete details of tripping yet to be received. Timestamp mismatch of ~12sec observed in DR as compared to PMU data to be corrected.	From PMU, no AC system fault observed.
14	800kV HVDC Agra-BNC pole-3 at Agra	POWERGRID	30-May-19	11:46	Nil	Tripped due to Earth Fault	NA	30-May-19	13:33	NA	NO	YES		Complete details of tripping yet to be received. Timestamp mismatch of ~12sec observed in DR as compared to PMU data to be corrected.	From PMU, no AC system fault observed.
15	220kV Auraiya(NTPC)-Malanpur(MPPTCL)	NTPC/MP	13-May-19	17:38	Nil	R-N fault	NA	13-May-19	18:29	NA	NO	NO		Details of tripping yet to be received.	From PMU, multiple faults observed.

Northern Regional inter regional lines tripping for May-19

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)	Suggestive Remedial Measures	Remarks
			Date	Time				Date	Time						
16	220kV Auraiya(NTPC)-Malanpur(MPPTCL)	NTPC/MP	15-May-19	19:01	Nil	R-N fault, FC= 1.768KA, 93.38km from Auraiya end	NA	15-May-19	19:29	NA	NO	NO	Auto-reclosing didn't occur.	Details of tripping yet to be received. Auto-reclosing at Auraiya end to be put in service at the earliest.	From PMU, R-N fault observed without auto-reclosing.
17	220kV Ranpur(RRVPNL)-Bhanpura(MPPTCL)^A	Rajasthan/MP	16-May-19	17:40	Nil	B-N fault, FC= 11KA , FD=.5km from Ranpur end	NA	16-May-19	19:07	NA	YES (After 24hrs)	YES (After 24hrs)			From PMU, B-N fault observed with unsuccessful auto-reclosing.
18	220kV Ranpur(RRVPNL)-Bhanpura(MPPTCL)^A	Rajasthan/MP	31-May-19	14:46	Nil	R-Y fault , 21.8km from Ranpur. Charging attempt failed at 17.26 hrs	NA	31-May-19	12:30	NA	NO	NO		Details of tripping yet to be received.	From PMU, R-Y fault observed.
19	22kV Sahupuri(UP)-Sasaram(PG)	POWERGRID	14-May-19	12:18	Nil	B-N fault	NA	14-05-2019	13:11	NA	NO	NO	Auto-reclosing didn't occur.	Details of tripping yet to be received.	From PMU, B-N fault observed with no auto-reclosing attempt.
20	765kV Orai(PG)-Gwalior(PG)^A	POWERGRID	15-May-19	18:43	Nil	Multiple Y-N faults	NA	15-05-2019	23:38	NA	YES (After 24hrs)	YES (After 24hrs)			From PMU and DR, Multiple Y-N faults occurred. Line tripped on fault within reclaim time.
21	765kV Agra(PG)-Gwalior(PG)-2^A	POWERGRID	15-May-19	18:25	Nil	R-N fault, Fault current=5.1KA and Distance of fault=111.7KM from Agra	NA	15-05-2019	19:06	NA	YES (After 24hrs)	YES (After 24hrs)			From PMU and DR, R-N fault observed with unsuccessful auto-reclosing.
22	765kV Phagi(RRVPNL)-Gwalior(PG)-1	Rajasthan/ POWERGRID	17-May-19	16:31	Nil	Y-N fault, Dist.-29.6km, FC=10KA, from phagi end	NA	18-May-19	16:32	NA	NO	NO		Details of tripping yet to be received.	From PMU, multiple faults observed.
23	400kV Balia(PG)-Biharshariff(PG)-2	POWERGRID	30-May-19	10:19	Nil	DT received at Balia end	NA	30-05-2019	12:40	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.

^^ tripping seems to be in order as per PMU data, reported information. However, further details may be awaited.

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 non 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-19

Annexure-II

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)	Suggestive Remedial Measures	Remarks
			Date	Time				Date	Time						
1	Vindhyachal HVDC BtB Block 1	POWERGRID	2-Jun-19	19:39	Nil	Due to DC over current protection trip	NA	2-Jun-19	21:29	NA	NO	NO	Sensitive DC overcurrent protection.	Details of tripping yet to be received. Tripping of HVDC BtB on AC system temporary fault. Sensitive DC overcurrent protection to be looked into in view of relay selectivity.	From PMU, AC system fault observed.
2	Vindhyachal HVDC BtB Block 1	POWERGRID	7-Jun-19	16:34	Nil	Due to external disturbance in western system at VSTPP/NTPC HVDC Block 1	NA	7-Jun-19	17:58	NA	NO	NO	Sensitive DC overcurrent protection.	Details of tripping yet to be received. Tripping of HVDC BtB on AC system temporary fault. Sensitive DC overcurrent protection to be looked into in view of relay selectivity.	From PMU, AC system fault observed.
3	400kV Balia(PG)-Patna(PG)-4	POWERGRID	12-Jun-19	15:11	Nil	R-N fault. Fault distance 145.3 km from Balia. CB stuck resulted in LBB protection operation.	GI-2	12-Jun-19	17:14	YES	YES (After 24hrs)	YES (After 24hrs)		As reported by POWERGRID, rectification of the 413 Bay CB (Ballia Patna-4 Line Main Bay) mechanical issue is under progress. The report to be shared after the rectification.	From PMU and details received from NR end, R-N fault observed. CB stuck resulted in LBB operation.
4	400kV Balia(PG)-Patna(PG)-1	POWERGRID	12-Jun-19	15:11	Nil	B-N fault.	GI-2	13-Jun-19	13:50	NO	YES (After 24hrs)	YES (After 24hrs)	Three phase trip observed in DR. No auto-reclosing observed through DR, PMU data.	Auto-reclosing feature of the line to be checked.	From PMU and details received from NR end, B-N fault observed.
5	400kV Balia(PG)-Biharshariff(PG)-1 ^{AA}	POWERGRID	12-Jun-19	15:24	Nil	Phase to earth fault. Y-N fault. Fault distance 143 km from Balia. Fault current 3.5 kA	NA	12-Jun-19	18:57	NO	YES (After 24hrs)	YES (After 24hrs)			From PMU and details received from NR end, Y-N fault observed with unsuccessful auto-reclosing.
6	400kV Balia(PG)-Biharshariff(PG)-2 ^{AA}	POWERGRID	12-Jun-19	15:57	Nil	Phase to earth fault. R-N fault. Fault distance 181.03 km from Balia. Fault current 2.96 kA	NA	13-Jun-19	19:47	NO	YES (After 24hrs)	YES (After 24hrs)			From PMU and details received from NR end, R-N fault observed with unsuccessful auto-reclosing.
7	HVDC Champa-Kurukshetra Pole-1 at Champa	POWERGRID	17-Jun-19	16:55	Nil	Due to operation of Pole-1 blocked on Common Neutral Protection (CNAP)	GI-2	17-Jun-19	19:43	NA	YES	YES		Complete details of tripping yet to be received.	From PMU, no AC system fault observed.
8	HVDC Champa-Kurukshetra Pole-2 at Champa	POWERGRID	17-Jun-19	16:55	Nil	T-zone protection operation	GI-2	17-Jun-19	22:09	NA	YES	YES		Complete details of tripping yet to be received.	From PMU, no AC system fault observed.
9	HVDC Champa-Kurukshetra Pole-1 at Champa	POWERGRID	17-Jun-19	21:14	Nil	Tripped During Master request changeover from Champa to Kurukshetra; software problem reported	NA	17-Jun-19	22:05	NA	NO	NO		Details of tripping yet to be received.	From PMU, no AC system fault observed.
10	HVDC Champa-Kurukshetra Pole-2 at Kurukshetra HVDC	POWERGRID	27-Jun-19	15:13	Nil	Malfunction of WTI sensor of converter transformer	NA	27-Jun-19	17:33	NA	YES	YES	Malfunction of WTI sensor.	The temperature sensor along with complete RTD assembly has been replaced with healthy one.	From PMU, no AC system fault observed.
11	220kV Modak(RRPNL)-Bhanpura(MPPTCL)	Rajasthan/MP	8-Jun-19	5:44	Nil	Y-B fault, 66km (from Modak end). Line tripped from Bhanpura end only.	NA	8-Jun-19	7:16	NO	YES (After 24hrs)	NO		Complete details of tripping yet to be received. Non tripping of ckt from Modak end to be looked into.	From PMU, Y-B fault observed.
12	Sasaram HVDC BtB	POWERGRID	21-Jun-19	23:03	Nil	Tripped with BIHARSHARIF line.	NA	22-Jun-19	1:13	NA	NO	NO		Details of tripping yet to be received.	From PMU, no AC system fault observed.
13	220kV Auraiya(NTPC)-Mehgaon(MPPTCL)	NTPC/MP	21-Jun-19	5:18	Nil	B-N fault. 69 kms from Auraiya.	NA	21-Jun-19	13:14	NO	NO	NO	As per PMU data, auto-reclosing didn't occur.	Details of tripping yet to be received. Auto-reclosing at Auraiya end to be put in service at the earliest.	From PMU, B-N fault observed without auto-reclosing.

Northern Regional inter regional lines tripping for Jun-19

Annexure-II

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)	Suggestive Remedial Measures	Remarks
			Date	Time				Date	Time						
14	765kV Phagi(RRVPNL)-Gwalior(PG)-1	Rajasthan/ POWERGRID	30-Jun-19	16:27	Nil	B-N fault. Fault current 1.98 KA, Distance 284.528 Km from phagi end	NA	30-Jun-19	19:17	NO	NO	NO		Details of tripping yet to be received.	From PMU, B-N fault observed followed by Y-N fault.
<p><i># Fault Clearance time has been computed using PMU Data from nearest node available and/or DR provided by respective utilities (Annexure-II)</i></p> <p><i>*Yes, if written Preliminary report furnished by constituent(s)</i></p> <p><i>R-Y-B phase sequencing (Red, Yellow, Blue) is used in the list content. All information is as per Northern Region unless specified.</i></p> <p><i>^ tripping seems to be in order as per PMU data, reported information. However, further details may be awaited.</i></p>															
1	Fault Clearance time(>100ms for 400kV and >160ms for 220kV)	1. CEA Grid Standard-3.e 2. CEA Transmission Planning Criteria	Reporting of Violation of Regulation for various issues for above tripping												
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 non operation	1. CEA Technical Standard of Electrical Plants and Electric Lines: 43.4.C 2. CEA Technical Planning Criteria													

Status of pending rectification of defects observed during BPA

Sl. No.	Utility	No. of sub-stations covered under BPA	Expected Completion	Remarks
1	UPPTCL	21	-	Representative of UPPTCL informed that in 220 kV stations, PLCC panels were being procured from CGL and all major deficiencies have been rectified.
2	UPRVUNL	4	-	<u>Obra 'A'</u> – including rectification of time synchronization & BBP, PLCC (to be installed by UPPTCL). To be completed by November, 2016. <u>Harduaganj</u> – to be completed by March, 2017 Status could not be updated as there was no representation from UPRVUNL in the meetings.
3	HPSEB Ltd.	1	October 2017	<ul style="list-style-type: none"> • 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 127 th OCC meeting was 31.12.2016. Status could not be updated as there was no representation from UJVNL in the meetings.
5	PDD, J&K	3	Status of progress is not submitted. Target completion not known.	As informed during 33 rd NRPC meeting that deficiencies where procurement was not involved had been rectified and other works where procurement is involved are yet to be taken up. PDD J&K informed that they have submitted the proposal for PSDF funding and deficiencies will be rectified when fund will be disbursed from PSDF. As informed by PSTCL defects at 220kV Sarna-Udhampur line, pertains to PDD, J&K. Status could not be updated as there was no representation from PDD J&K in the meetings.

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

Utility	Third party protection audit carried out by	No. of substations covered/ expected to be covered	Status of Audit	Status of Report	Status of submission of action Plan for rectification of deficiencies
RRVPNL, RRVUNL	CPRI	RRVPNL-39 RRVUNL-5	Completed	Submitted	RRVPNL- Lead Acid Batteries have been procured and installed. RRVUNL- Action Plan submitted.
BBMB	-do-	20	Completed	Submitted	The action to attend the deficiencies observed in the audit is underway.
PSTCL, PSPCL	-do-	PSTCL-22 PSPCL-3	Completed	Submitted	Representative of PSTCL informed that Report on CPRI Audit already submitted and emailed.
UPRVUNL	-do-	2	Completed	Submitted	Parichha TPS and Panki TPS: All the deficiencies are likely to be rectified by March, 2018
UPPTCL	-do-	41	Completed	Shall be submitted after receipt and examination of Report, same.	Representative of UPPTCL informed that CPRI is working on this and detailed report will be submitted by June, 2019.
Rosa Power	-do-	1	Completed	Submitted	Action Plan submitted and the deficiencies observed rectified.

Utility	Third party protection on audit carried out by	No. of substations covered/ expected to be covered	Status of Audit	Status of Report	Status of submission of action Plan for rectification of deficiencies
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.
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;	Completed	Submitted	Action has already been taken. Report will be submitted.

Utility	Third party protection on audit carried out by	No. of substations covered/ expected to be covered	Status of Audit	Status of Report	Status of submission of action Plan for rectification of deficiencies
		Shalimar Bagh)			
PTCUL	-do-	4 (Pantnagar, Haridwar, Kashipur, Roorkee)	Completed	Submitted	<p>Not submitted for Haridwar, Roorkee</p> <p>Relays have been delivered at the site.</p> <p>To be completed by 31st October, 2017</p>

Status of Bus bar Protection for Northern Region Constituents

State/ Constituent	TRANSCO/ GENCO	Total no. of S/s / Sw. yards (220 kV and above)	No. of S/S/ Sw. yards where Bus bar protection is functioning	Remarks	Action Plan
Delhi	DTL	37	34	For 220 kV S/S namely, Gopalpur and Kanjhawala is being planned (Lodi Road is GSS)	PO awarded to M/s GE T&D India Ltd. for the work of Supply and ETC of 26nos. Bus Bar Schemes in 400 and 220kV DTL substations on 06.04.18. Completion period is 9 months.
Haryana	HVPNL	63	48	12 out of which 5 in process; 7(date is yet to be decided); 3 not required	Tentative date of commissioning: 30.06.2019
	HPGCL	03	03		
Rajasthan	RVPNL	53	46 (7 defective)		74 nos. New Bus bar Protection schème Under ccommissioning. 10 Commissioned.
	RVUNL	05	05		
Himachal Pradesh	HPSEB	08	04	At one s/s it was working, 2 sub-station it was defective.	04 nos. commissioned and for remaining 04 s/s to be done by Oct 2017.
Punjab	PSTCL	98(5 no 400 kV s/s)	46(5 no. 400 kV s/s)		Work in progress for BBPS protection, 46/98 (220kV) 05/05 (400kV) completed. Till then reverse zone protection time set to 160 ms. For remaining substations, work has been

					undertaken by TS organization and will be completed by 31.12.19. by TS organization. Procurement process for BBPS delayed due to re-tendering twice by Finance wing of PSTCL. Re-tendered again last month and target date is 31-12-19 & PSDF funding available. PLCC work will also be completed by 31-3-19 as procurement process is underway.
	PSPCL	03	03		
J&K	PDD	06	-		The status for the same could not be ascertained as representative from PDD, J&K was not present in the meeting.
Uttarakhand	PTCUL	10	09		Order placed for 01 defective. Would be completed by May 2017.
	UJVNL	-	-		
BBMB	BBMB	23	20	Not required at Dhulkote and Jagadhari. also for Sangrur, Kurukshetra and Delhi as no. of feeders is less than five. PSC decided that it needs to be installed.	Sangrur-commissioned 19.01.2016. For Kurukshetra and Delhi, LOI has been issued on 27.06.18 & material is likely to be received by March, 2019. For Barnala it is to be provided by PSTCL as agreed in PSC. PSTCL were to commission it by 31.12.2016.
Uttar Pradesh	UPPTCL	99	10	04 no. are pending	Representative of UPPTCL informed that SEL panels are being procured and its installation would be

					completed within 6 months.
	UVUNL	05	-		
POWERGRID	PGCIL	55	55		
Central Generating Stations	NTPC	11	11		
	NHPC	09	09		
	NPCIL	02	02		
	THDC	02	02		
	SJVNL	02	02		