भारत सरकार

Government of India

विद्युत मंत्रालय

Ministry of Power

उत्तर क्षेत्रीय विद्युत समिति

Northern Regional Power Committee

No. उ.क्षे.वि.स./प्रचालन/107/01/2019/12123-12161 दिनांक: 09.10.2019

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 के कार्यवृत्त |
Subject: Minutes of 38th Protection Sub-Committee Meeting.

संरक्षण उप-समिति की 38वीं बैठक दिनांक 01.08.2019 और 02.08.2019 को 10:30 बजे उ.क्षे.वि.स. सचिवालय, नई दिल्ली में आयोजित की गई थी | उक्त बैठक के कार्यवृत्त उत्तर क्षेत्रीय विद्युत समिति की वेबसाइट (http://www.nrpc.gov.in) पर उपलब्ध है |

The 38th meeting of Protection Sub-Committee was held on **01.08.2019 and 02.08.2019** at **10:30 Hrs** at **NRPC Secretariat, New Delhi**. The minutes of the meeting for the meeting is available on NRPC website and same can be downloaded from http://www.nrpc.gov.in .

-sd-
(सौमित्र मज़ूमदार)
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)	RRVPNL	0141-2291891
19	SE (Electrical)	RRVUNL	01509-245299
20	Chief Engineer (LD)	RRVPNL	0141-2740920
21	SE (SO&LD)	RRVPNL	0141-2740920
22	Superintending Engineer (T&C)	UPPTCL	0121-2666062
23	Chief Engineer, (L-2)	UPRVUNL	0522-2287822/2287880
24	DGM (T&C)	PTCUL	0135-2760331
25	Chief Engineer (O&M)	NHPC	0129-2272413
26	GM (O&M) NR – I	PGCIL	011-26601079
27	GM (O&M), NR-II	PGCIL	01951-237186
28	Chief Manager (TS)	N.R.L.D.C	011-26852747
29	GM(OS-NR)	NTPC	0522-2305848
30	GM (OS)	NTPC Ltd	0120-2410082/2410068
31	DGM (Maintenance)	SJVNL	0177-2673283
32	DGM (O&M)	THDC India Ltd	01376-236305
33	Director (GM division)	CEA	011-26109750
34	General Manager	APCLP	01251-266326
35	Director	JPPVL	0120-4516201/4609464/4609496
36	Addl. CE(M&P-IT)	JVVNL	-
37	GM (Production)	Jhajjar Power Ltd	01251-270155
38	GM(P&M)	APL	7925557176
39	Sh. Raj Kumar Rastogi Add. GM	TPDDL	011-66039175
40	President (Power Systems)	LPGCL	+91-22- 22048681
41	Director (NPC)	CEA	
42	NPCIL		
	1.Maintenance Superintendent	NAPS	05734-222167
	2.Maintenance Superintendent	RAPS	01475-242060

Minutes of

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 comments were received. The list of participants is enclosed as Annexure – I.

Sub-Committee confirmed 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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **SE(O) apprised the members regarding the deliberations and decisions taken in 42nd TCC/45th NRPC meeting. He informed that process of collection of data for protection setting from STUs and other transmission licensee was also carried out earlier, however complete data wasn't received despite continuous follow up. The status of Protection system database as per 33rd PSC meeting held on 22nd February, 2017 is enclosed as Annexure – II. Considering the amount of data to be collected, it was suggested that data may be collected in stage wise i.e. stage 1: 400kV and above and stage 2: 220kV.**

It was decided that utilities which have already submitted some of the data will submit updated data for stage 1 within 7 days. The utilities which were yet to share any data, will submit the data for stage 1 within 15 days.

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 of the agenda of 38th PSC*)

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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **SE(O) stated that periodicity of protection audit has been decided as 5 years and advised utilities to carry out protection audit for the substations and submit the report to NRPC/NRLDC. It was also informed that a protection audit format template as deliberated in 08th NPC meeting may be used.**

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
Talwandi Saboo (2)	NPCIL
Uttarakhand (2)	NTPC

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **Members were informed about the nominations received for the training program and it was requested to submit the nominations at the earliest.**

It was also deliberated that total 60 participants of batch 1 –and batch -2 after completion of training may be asked to do a protection audit in a team of 3-4 members as in when necessary as decided by PSC members.

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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **It was stated that issue is being regularly discussed in various meetings, however incidences of violation of Protection standards is being observed. Utilities were requested to take measures to avoid any violation.**

Representative of NRLDC informed that they are developing a portal which will monitor Preliminary report, FIR, DR/EL within 24 hrs or not status online. He further gave a demo of portal and informed that login id, passwords of the portal would be shared as soon as it is completed.

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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- Utilities (except DTL, RRVPNL, BBMB) were requested to share the details of Level-I training comprising of points such as 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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **Representative of POWERGRID informed that issue is being analysed by the Engineering department, however any results weren't obtained yet as it is a peculiar phenomenon. It was also informed that lines would be again LILO at Wangtoo and it may be checked if issue persists after LILO. He stated that Engineering department in further looking into the issue.**

Further, KWHEP was requested to share the DR/EL of the events when LA counter is increased at the time of back charging of line and also share settings of SOTF.

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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **Representative of NPCIL briefed about the problem of Overheating of reactor and informed that zero sequence current of about 25 A was flowing as indicated in DR of RAPP-Jaipur line. He further inquired about the NGR bypass scheme being implemented by POWERGRID.**

Representative of POWERGRID informed that similar phenomena were observed few years back when few reactors were failed. In pursuance of the same a NGR bypass scheme is being implemented at POWERGRID substations. He advised to take both line reactors in service

simultaneously and record the observations. If such scenario is observed again, based on that, further study and simulation may be done. He also suggested that option of NGR bypass scheme may be explored.

Further, it was agreed that NPCIL will again record the observations, if issue persists implementation of NGR bypass scheme may be explored.

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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **Representative of THDC informed that SPS logic was implemented as per deliberations in the OCC meetings, however due to FSC on both the circuits of 400 kV Koteshwar Pooling-Meerut D/C Line there is need to review the SPS scheme.**

It was deliberated that necessary studies to review the SPS logic may be done by NRLDC and issue may be deliberated in OCC meetings.

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.

37h* 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.

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.

37h* 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 informed that installation and commissioning has been done.**
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 commissioned in July, 2019.**

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 RRVPN to submit the complete islanding scheme for Rajasthan at the earliest.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **Representative of Rajasthan informed that they are implementing the islanding scheme and status as on 31.07.2019 has been shared. Rajasthan was requested to share the scheme under implementation with NRPC/NRLDC.**

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 Bhantida TPS and PSTCL was under process of implementing the scheme. Procurement process was underway and the scheme would get implemented by ***30.11.2015***. PSTCL was requested to share the approved scheme with NRPC Sectt. and NRLDC. PSTCL had agreed for the same.

31st PSC meeting 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.

38th PSC meeting held on 01.08.2019 and 02.08.2019:- **Representative of Punjab informed that scheme has been installed and commissioned. It was requested to do a mock testing of the scheme and a report along with the scheme to be shared with NRPC/NRLDC.**

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

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

Utilities were requested to 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 were 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 sub-stations where Bus Bar Protection Scheme was currently not available, time setting of bus coupler connected in between main Buses may be reduced to 100 ms (operating time) and reverse reach of feeders may be reduced to 2 km and with time of operation as 160 ms. With 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 were requested to submit the updated status of Bus-bar protection and the status of interim measures taken at their end.

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

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

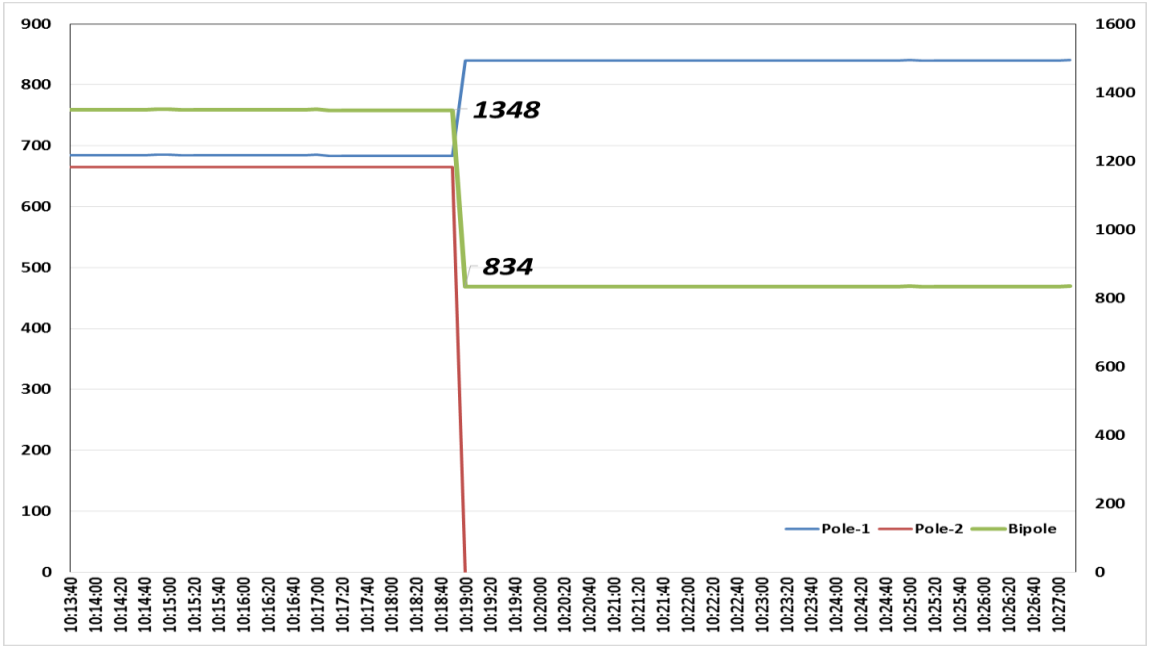
In 40th TCC/43rd NRPC meeting held on 29th and 30th October 2018 - It was informed that list of delayed clearance fault was circulated again and again but data has been only received from the utilities mentioned above. He informed that partial information received till date was submitted to CERC as show 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 were again 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		220kV Mandola-Gopalpur -I	200	1	S
	220kV Mandola-Narela -II		1		220kV Mandola-Gopalpur -II		0	S
UP	Feeders from 220/132 kV Muradnagar Old	100						
Rajasthan	220 kV Alwar-GSS Mandawar	25	27		220/132 kV Ratangarh-132 KV Sardar Sahar	26	0	S
Haryana					220/33 kV, 100 MVA Panipat (BBMB) ICT	50	37	
Punjab	220 kV Malerkotla-66 kV Malerkotla	35	0	S				
	220 kV Malerkotla-66 kV Naudhrani		0					
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					
220/132 kV, 40 MVA Modipuram ICT -III		7					
132 kV Modipuram-Mawana		0					
132 kV Modipuram-Sardhana		6					
132 kV Modipuram-Kankerkhera		28					
132 kV Kota-Talera	60	11	S	132 kV Alwar-Bansoor	59	0	
132 kV Merta-Roon		7		132 kV Alwar-Malakhera		33	
132 kV Merta-Merta Road		16	S				
220kV Samaypur-Palwal -I	140	50					
220kV Samaypur-Palwal -II		68					
66 kV Gobindgarh-Focal Point	71			66 kV Laltokalan-Gill Road -I	90	30	S
66 kV Gobindgarh-Talwara -D/C				66 kV Laltokalan-Gill Road -II		30	S
66 kV Gobindgarh-Chourwala D/C				66 kV Laltokalan-Ferozpur Road		10	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					
220/132 kV, 40 MVA Modipuram ICT -III		7					
132 kV Modipuram-Mawana		-0					
132 kV Modipuram-Sardhana		6					
132 kV Modipuram-Kankerkhera		27					
132 kV Kota-Talera	60	11	S	132 kV Alwar-Bansoor	59	0	
132 kV Merta-Roon		0		132 kV Alwar-Malakhera		0	
132 kV Merta-Merta Road		17	S				
220kV Samaypur-Palwal -I	140	0					
220kV Samaypur-Palwal -II		-0	S				
66 kV Gobindgarh-Focal Point	71			66 kV Laltokalan-Gill Road -I	90	0	
66 kV Gobindgarh-Talwara -D/C				66 kV Laltokalan-Gill Road -II		0	
66 kV Gobindgarh-Chourwala D/C				66 kV Laltokalan-Ferozpur Road		0	
	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 reciept of command	**After receipt of command**			
1	25.03.19 10:20	35	36	Following 132KV Feeders : 132 KV Morta (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	**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 cordinate 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.					

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)

POWERGRID has submitted the report which is enclosed as Annexure – VI.

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 has submitted the report which is enclosed as Annexure – VI.

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 were requested to update the status on above action points.

A.10. Tripping Events:

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

General Recommendation for NRPC-PSC meeting- NRPC suggested to all the utilities to prepare the presentation for all the tripping events for deliberation in PSC meeting. This procedure will be followed from next PSC meeting. Representative from the utilities shall collect all the information for its control area and share the details. At least one representative from each SLDC shall also be present during the meeting.

The recommendations of PSC are as follows:

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

1. Since, blocking of 220 kV bus bar protection was due to wrong input of isolator auxiliary contact. Isolator auxiliary contact needs to be checked and recorded daily for healthiness of bus bar protection. It is a general

recommendation already approved in PSC meeting and it needs to be followed. (**Action:** General Recommendation)

2. Maintenance people need to be sensitized in view of larger restoration time, damage in the equipment and increased maintenance work due to blocking of 220 kV bus bar protection. (**Action:** General Recommendation)
3. In the meeting with intra state generators, kindly also invite NRPC/ NRLDC members for understanding of the event.
4. Station Event logger has key role to finalize the sequence of event specially in case of multiple element tripping. It should always be time synchronized and in healthy condition.
5. A report covering the following points w.r.t. the tripping to be shared (**Action:** RRVPNL; **Time:** by 10.10.2019):
    a. Exact amount of Solar generation loss, load loss and Energy Loss.
    b. 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.
    c. 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.
    d. Tripping of Solar generation in view of LVRT operation/ non-operation needs to be thoroughly checked and informed.
    e. DR details of 400 kV tripped elements needs to be checked and submitted.
    f. Healthiness of station event logger to be ensured.
    g. Time Synchronization of DR of all the elements of 400/220 kV Bhadla (Raj) and 220 kV Bhadla GSS needs to be corrected.
    h. Availability of digital and analog data of 400/220 kV Bhadla (Raj) and 220 kV Bhadla GSS to be ensured.
    i. Detailed Report and Remedial measures report is still awaited from Rajasthan

B. Multiple Element tripping at 220kV Shahjahanpur (UP) Station at 01:29hrs of 22nd Jan 2019:

1. Since, Rosa TPS is in UP state control area. Therefore, UP SLDC shall keep all the details w.r.t. tripping at Rosa TPS. All SLDCs to ensure that any information or detail in respect of any event concerning state control area generator to be available with by SLDC. (**Action:** All SLDCs)
2. 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. Reason of delayed tripping of 220 kV Rosa (end)-Shahjahanpur ckts to be looked into and shared. (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019)

4. Protection co-ordination between 220kV Rosa-Shahjahanpur ckts and 400/220kV ICTs at Rosa TPS to be checked and findings to be shared. (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019)
5. Protection setting of 220kV and 400kV units of Rosa TPS needs to be thoroughly checked and findings to be shared. (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019)
6. Reason of tripping of 400kV Rosa-Lucknow (UP) ckt at Rosa end to be looked into and shared. (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019)
7. Looking at number of trippings at Rosa TPS, protection Audit to be carried out at Rosa TPS. (**Action:** NRPC by constituting a committee, **Date:** to be separately intimated by NRPC)

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

1. As advised by POWERGRID representative, bus bar protection is sensitive protection and bus bar CT inputs shall not be utilized in any other protection. (**Action:** General Recommendation)
2. If CT input as used in Bus Bar Protection is also used at other place as well, Bus Bar Protection shall be checked after any work done involving CT input. (**Action:** General Recommendation)
3. Possibility to be explored to relieve existing involvement of Bus Bar Protection CT input which is being used at CSD and replaced by other CT core input. (**Action:** SJVNL; **Time:** by 10.10.2019)

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

1. Maintenance procedures need to be followed at the time of maintenance activity at substation. (**Action:** SLDC-UP, **Time:** with immediate effect)
2. Time synchronization of SCADA SoE needs to be looked into and set right. (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019)
3. Isolator/ breaker auxiliary contacts for 400 kV Aligarh line at 400 kV Muradnagar1 (UP) to be replaced. (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019)

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

1. Since, Rosa TPS is in UP state control area. Therefore, UP SLDC shall keep all the details w.r.t. tripping at Rosa. All SLDCs to ensure that any information or detail in respect of any event concerning state control area generator to be available with by SLDC. (**Action:** All SLDCs)
2. A report covering the following points w.r.t. the tripping to be shared (**Action:** SLDC-UP, UPPTCL; **Time:** by 10.10.2019):

a. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
b. Reason for delayed clearance of fault even surpassing LBB time of 200ms needs to be looked into.
c. Antecedent configuration of feeders on 220kV buses i.e. which feeder/ICT was on which bus to be shared.
d. LBB protection would have tripped elements connected to one bus. The following may be confirmed:
    i. *Were all 220kV elements connected to one bus only?*
    ii. *If not, why elements connected to both buses tripped?*
e. 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.
f. Availability of time synchronized SCADA SoE from Rosa to be checked and corrected.
g. DR needs to be submitted by UPPTCL.

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

1. SPS of HVDC Rihand (end)-Dadri shall be checked and corrected in view of current mal-operation of SPS logic and time delay in blocking of HVDC pole. (**Action:** POWERGRID; **Time:** within 15days)
2. Time difference in blocking of Pole at both Rihand & Dadri end shall be reviewed. (**Action:** POWERGRID; **Time:** within 15days)
3. A/R and communication channel in 400 kV Dadri-Harsh Vihar ckt-1 shall be checked and corrected. (**Action:** DTL/ NTPC; **Time:** within 15days)

G. 400 kV Bus-3 & Bus-4 tripping at 400/220 kV Ballabhgarh (PG) at 10:03hrs of 25-Feb-19:

1. Maintenance team at each utilities needs to be sensitized to minimize the human error during various maintenance activities. (**Action:** General Recommendation)
2. Setting Error during commissioning activities shall be minimized. It should be cross checked at S/S level and head quarter level after each changes in the S/S. (**Action:** General Recommendation)

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

1. Mapping of LBB retrip command in name of LBB operation needs to be corrected in 220 kV Bhadla (end)-Badisid line. (**Action:** RRVPNL; **Time:** within 7days)
2. In the meeting with intra state generators, kindly also invite NRPC/ NRLDC members for understanding of the event.
3. Station Event logger has key role to finalize the sequence of event specially in case of multiple element tripping. It should always be time synchronized and in healthy condition. (**Action:** General Recommendation)
4. A report covering the following points w.r.t. the tripping to be shared (**Action:** RRVPNL; **Time:** by 10.10.2019):
    a. Exact amount of Solar generation loss, load loss and Energy Loss.
    b. Backup phase over current protection shall be disabled in all 400 kV and above voltage level in Rajasthan and also in 220 kV lines where two distance protection available.
    c. High Set setting of phase over current setting in all 220 kV lines from 400/220 kV Bhadla (Raj) & 220kV Bhadla2 GSS needs to be rechecked and corrected
    d. 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.
    e. Tripping of Solar generation in view of LVRT operation/ non-operation needs to be thoroughly checked and informed.
    f. Phase nomenclature mismatch observed at 400/220 kV Bhadla station (As per PMU data fault was in R-phase however as per DR details: Blue phase)
    g. Changes in the settings (over current, over flux etc) needs to be shared with NRLDC/ NRPC.
    h. Availability of SCADA Analog data and Digital data needs to be ensured.
    i. Availability & Healthiness of station event logger at 400/220 kV Bhadla & 220 kV Bhadla2 needs to be ensured.
    j. Time synchronization of DR/EL needs to be looked into.
    k. Detailed Report and Remedial measures report is still awaited from Rajasthan

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

1. DR w.r.t. to the tripping incident to be shared and if there is time synchronization error than same needs to be corrected. (**Action:** UPPTCL/ SLDC-UP, **Time:** by 10.10.2019)

J. Multiple Element tripping at 400/220kV Akal (Raj) Station at 00:53hrs of 15th Mar 2019:

1. Rajasthan-SLDC/STU shall check and share the details for following points: (**Action:** RRVPNL/ SLDC-Rajasthan, **Time:** by 15.10.2019)

a. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
b. 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.
c. 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?
d. 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) to be checked and shared.
e. Details of Generation/ Load loss needs to be checked and reported.
f. Changes in the settings (earth fault protection setting in ICT and line and fuse failure in line) needs to be shared with NRLDC/ NRPC.
g. Protection Audit of 400/220 kV Akal(RRVPNL) and Bhadla(RRVPNL) stations are urgently required in view of multiple times tripping events at these important wind pooling stations.
h. Availability of SCADA Analog data and Digital data needs to be ensured.
i. Time synchronization of DR/EL needs to be looked into and corrected.

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

1. Details of tripping of 220kV Salal-Jammu D/C from Jammu end to be shared. (**Action:** SLDC-J&K, JKPDD; **Time:** by 10.10.2019)
2. As reported by NHPC, time synchronization of DR to be set right. (**Action:** NHPC; **Time:** by 10.10.2019)
3. Setting of circuitry fault in BBP (Bus Bar Protection) at Salal to be looked into. Existing and revised setting to be shared. (**Action:** NHPC; **Time:** by 10.10.2019)

L. Multiple element tripping at 400/220 kV Gurgaon (PG), 220/66/33kV Gurgaon sec-72 (HVPNL) at 00:38hrs of 30th Mar 2019:

1. DEF protection to be put on 220kV Gurgaon(PG)-Sec-72 ckts at POWERGRID end in discussion with Haryana. The details of settings to be shared. (**Action:** POWERGRID, SLDC-Haryana, HVPNL; **Time:** by 10.10.2019)
2. Bus bar protection at 220kV Gurgaon Sec-72(HVPNL) to be set right and healthy for both 220 kV buses. (**Action:** SLDC-Haryana, HVPNL; **Time:** by 10.10.2019)

M. Multiple Element tripping at 765/220kV Lalitpur TPS at 03:21hrs of 06th Apr 2019

1. CVT of Fatehabad end of 765 kV Lalitpur-Fatehabad ckt-1 & 2 to be checked in view of CVT error. (**Action:** UPPTCL/ SLDC-UP, **Time:** by 10.10.2019)
2. Over voltage stage-1 setting of 765kV Lalitpur-Fatehabad ckt-1 & 2 to be set same at both corresponding ends of ckt-1 and ckt-2. (**Action:** UPPTCL / SLDC-UP, **Time:** with immediate effect)
3. In line with recommendation of 13th NRPC-PSC meeting, pick up to Drop off ratio of Over voltage relay to be set as 'High'. Possibility of setting the Pick up to Drop off ratio of over voltage to 99% or highest possible value to be explored and accordingly set as above if such provision in present in the relay. (**Action:** UPPTCL / SLDC-UP, **Time:** with immediate effect)

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

1. At 400/220kV G. Noida sec-148 station, scheme of protective relaying including DC extension to be reviewed and corrective action to be taken so that in case of non-availability of DC supply (As happened in this case due to shutting of DC MCB), mal operation of protection can be avoided. (**Action:** UPPTCL / SLDC-UP, **Time:** by 10.10.2019)

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

1. In view of the lack of information and clarity about the event the following shall be submitted (**Action:** UPPTCL / SLDC-UP, **Time:** by 10.10.2019)
    a. Reason of operation of both 400 kV bus bar protection at 400 kV Sarnath (UP).
    b. Tripping of 400 kV Anpara-Mau ckt during fault at Sarnath (UP) shall be checked and findings to be shared.

P. Multiple Element tripping at 220kV Khetri (Raj) Station at 21:59hrs of 23-Apr-19

1. Healthiness of station event logger, GPS needs to be ensured at 220 kV Khetri (Raj). A reasonable tentative date to be intimated for aforesaid work to be completed. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
2. New Bus bar protection is expected to be available by Mar'20 as reported. The same need to be expedited. A progress report in this case to be provided indicating percentage of work completed, to be completed and expected date of commissioning of bus bar protection. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)

3. At Khetri end, reason for initiation of 1-phase opening signal as per DR of Babai ckt to be reported. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)

Q. Multiple Element tripping at 400/220kV Merta (Raj) Station at 05:07hrs of 12th May 2019

1. A report covering the following points w.r.t. the tripping to be shared (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019):
    a. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared.
    b. Reason for operation/non-operation of auto-reclosure of 400kV Merta-Ratangarh during tripping to be shared.
    c. Main bay of 315MVA 400/220 kV ICT-2 is still under outage. Reason and likely time of restoration to be shared.
    d. DR/EL details w.r.t. the tripping to be shared.

2. 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. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)

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

1. Time setting of high set overcurrent setting of 400/220kV ICTs at Barmer(Raj) to be set to 100ms in place of instantaneous to avoid unnecessary tripping due to transients. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
2. DR/EL w.r.t. the tripping event to be shared. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
3. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
4. 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. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** with immediate effect)

S. Complete station outage of 400kV Bikaner (Raj) Station at 17:45hrs of 12th May 201919

1. A report covering the following points w.r.t. the tripping to be shared (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019):

a. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared
b. 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?
c. Non-tripping of 400 kV Merta-Bikaner ckt from Merta end?
d. 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.
e. 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.
f. 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.
g. Carrier communication in the following line needs to be checked and corrected:
    i. 400 kV Bikaner(end)-Sikar (PG) ckt-1
    ii. 400 kV Bikaner(end)-Sikar (PG) ckt-2
    iii. 400 kV Bikaner(end)-Suratgarh TPS ckt-1
h. Mapping of Direct Trip signal in DR to be checked in all DR at Bikaner end and needs to be changed accordingly.
i. Despite of continuous discussion in PSC meeting, time synchronization issue is still persisted in most of the tripping cases. Immediately needs to be addressed.
j. Status of second bus bar protection at Bikaner (Raj), available or not? In case of non-availability, it should be commissioned immediately.
k. Phase nomenclature mismatch between Bikaner and Sikar (PG) needs to be looked into.
l. Availability & healthiness of station event logger needs to be ensured.
m. Time synchronization of numerical relays of Bikaner (Raj) and remote end to be ensured.

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

1. Issue of burning of waste at dumping ground to be taken up with appropriate authority and measures to be explored and shared to avoid these type of multiple tripping events. (**Action:** DTL / SLDC-Delhi, **Time:** by 10.10.2019)

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

1. Since, Chabra, Kalisindh, Kawai TPS are in Rajasthan state control area. Therefore, Rajasthan SLDC shall keep all the details w.r.t. generators within their control area. All SLDCs to ensure that any information or detail in respect of any event concerning state control area generator to be available with by SLDC. (Action: All SLDCs)
2. Rajasthan may look into the concern raised by Adani representative to have a smaller route of communication of SPS signal directly from Anta to Chabra instead of existing route via Kawai. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019):

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

1. Healthiness of station event logger, GPS needs to be ensured at 220 kV Khetri (Raj). A reasonable tentative date to be intimated for aforesaid work to be completed. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
2. New Bus bar protection is expected to be available by Mar'20 as reported. The same need to be expedited. A progress report in this case to be provided indicating percentage of work completed, to be completed and expected date of commissioning of bus bar protection. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
3. At Khetri end, reason for initiation of 1-phase opening signal as per DR of Babai ckt to be reported. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)
4. 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. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** with immediate effect)
5. Reason of three phase fault captured through PMU data in case of damage of Y-phase CT only to be analyzed and shared. (**Action:** RRVPNL / SLDC-Rajasthan, **Time:** by 10.10.2019)

A.11. Follow up action on tripping discussed during PSC meeting (34th to 37th PSC meeting)

As per CEA Grid Standard and IEGC, each and every tripping needs to be analysed in details and detailed report along with remedial measures report needs to be submitted to NRPC/ NRLDC.

As per approval in PSC meeting, each utility shall submit the detailed report within 7days of the tripping. However, it seems detailed remedial measures report is still awaited for many of the trippings.

In PSC meeting, some of the tripping was discussed due to paucity of time and for remaining tripping, detailed analysis report was asked from the utilities. However, it is observed that after discussion in the PSC meeting, further remedial measures report was not submitted for many trippings. In fact, utilities are not sending the remedial measures report even for the events discussed

during the meeting.

Utility wise compilation of the tripping discussed in last three PSC meeting is attached as Annexure-1 of Additional agenda of 38th PSC.

Utilities were requested to submit the detailed report and action taken report for remaining tripping which was not discussed during last three PSC meeting. (Complete list of the tripping was mentioned in respective PSC meeting Agenda & Minutes)

A.12. Tripping other than to be discussed in 38th PSC meeting

As per CEA Grid Standard and IEGC, each and every tripping needs to be analysed in details and detailed report along with remedial measures report needs to be submitted to NRPC/ NRLDC.

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. Among 124 events, around 22 events were discussed in 38th PSC meeting.

For rest events, Utilities were requested 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 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

All the utilities were requested to go through the details of all the multiple elements tripping event available at above mentioned link and share the further action taken report with NRPC/ NRLDC.

A.13. Frequent forced outages of transmission elements

This Agenda related to frequent forced outages of transmission elements was regularly discussed during monthly OCC meeting in which NRLDC informed about the tripping of single element more than 3 times in a month.

Despite of regular OCC agenda, remedial measures report and supporting details are still awaited for most of the tripped elements.

Compiled information of monthly transmission elements outage list starting from Oct 2018 to Jun 2019 is attached as Annexure-2 of additional agenda of 38th PSC. Action taken and identified during the OCC meeting is also part of the details.

Frequent outages of such elements affect the reliability and security of the grid.

Hence, utilities were requested to look into such frequent outages and share the remedial measures taken/being taken in this respect with NRPC/NRLDC at the earliest.

A.14. Tripping of Inter-Connecting Transformers (ICTs) during Jan-Jun 2019:

Inter-Connecting Transformer is costliest equipment of transmission system and also essential part of the transmission system for stepping up/ down of the power. It is also useful to feed the major load centre in power system.

Frequent tripping of ICTs captured in the system due to protection mal-operation, protection setting issues, protection co-ordination issues with the line protection and O&M issues etc.

A total of 137 tripping of ICTs occurred in the Northern Region during Jan 2019 to Jun 2019. A list of all these trippings is attached at Annexure-3 of additional agenda of 38th PSC.

Utilities were requested to take expeditious actions to avoid such tripping in future and also share Preliminary Report & DR/EL of the trippings in line with the regulations.

A.15. Availability of station event logger at sub-station

As per clause 43.4.D of CEA Technical Standard for Construction of Electrical Plants and Electric Lines *"Each 765 kV, 400 kV and 220 kV Line shall be provided with facility for disturbance recording, distance to fault locator and time synchronization equipment (TSE). Event logger either stand alone or as a part of sub-station or switchyard automation system shall be provided for each 220 kV and higher voltage class sub-station or Switchyard. TSE complete with antenna, all cables, processing equipment's etc., shall be provided to receive synchronizing pulse through global positioning system (GPS) compatible for synchronizing of event logger, disturbance recorder and SCADA/Automation system of the sub- station or Switchyard".*

A GPS time stamped station event logger becomes very useful in case of multiple element tripping. The issue of such station event logger availability at substation has been raised in various Protection sub-committee meetings especially in 134th OCC meeting held on 24.04.2017 and 34th PSC meeting held on 04-Aug-17 wherein constituents were requested to provide the substation wise details of availability of station event log in a particular format. However, it has been observed that information is yet to be received. A format for compilation of information of Event logger at a substation is again attached at Annexure-4 of Additional agenda of 38th PSC**.** During recent analysis of all multiple element tripping from Jan-May 2019, utilities have submitted the station event logger

details for 25-30% of the total events.

Constituents were requested to kindly submit the status of station event logger or SAS based event logger in the attached format (Annexure-4 of Additional agenda of 38th PSC) for 220kV and above voltage level substations and expedite the working of healthy time synchronized event logger.

A.16. Status of bus bar protection at 220kV and above voltage level substations

According to CEA (Measures relating to Safety and Electric Supply) Regulations-2010, clause section 45(2)(vii), high speed bus bar differential protection along with local breaker back up protection shall be commissioned and shall always be available at all 132kV & above voltage substations, generating stations.

Further, as per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations-2010, clause 43(4)(c), bus bar differential protection along with local breaker back up protection shall be provided at all 220kV & above voltage substations, generating stations.

In 28th PSC meeting, constituents were requested to furnish the details related to bus bar protection in a particular format. It is observed that the information is yet to be received from most of the utilities.

Constituents were again requested to provide the details of bus bar protection in the attached format (Annexure-5 of Additional agenda of 38th PSC) and expedite the commissioning of Bus Bar protection at 132kV & above level.

A.17. Frequency of Protection sub-committee meeting

The first protection sub-committee meeting was held on 05.09.2006. Since then, 37 protection meetings have been conducted in a span of around 12 years. The average frequency of the meeting is in every 4 months. However, lately it has been observed that the PSC meetings are being held with low frequency. A summary of frequency of last ten PSC meetings is shown below:

PSC meeting	Date of meeting	Approx. time from previous meeting (in months)
29	09-Feb-15	2
30	21-Sep-15	7
31	7-Jun-16	9
32	30-Nov-16	6

33	22-Feb-17	3
34	4-Aug-17	5
35	20-Jun-18	11
36	19-Sep-18	3
37	21-Jan-19	4
38	1-Aug-19	6

It can be seen that lately the frequency of meeting has decreased. The 35th PSC meeting held almost a year after the 34th meeting.

The grid has evolved manifold. The number of disturbances occurring is the grid have also increased. Quick understanding of disturbances and related issues would help in early mitigation. It has been observed that in case the large time gap in successive meetings, it becomes difficult to address all the issues related to the disturbance. Further, follow up of remedial actions also gets affected.

38th PSC meeting held on 01.08.2019 and 02.08.2019 – It was deliberated that Protection Analysis sub-group (PSAG) may be strengthened and PSAG meetings may be held more frequently in between PSC meetings.

A.18. Formation of separate Post-Dispatch Analysis department at each SLDCs/ utility.

Post-Dispatch Analysis is very important function for load dispatch centre/ transmission licensee/ generating stations. In most of the RLDCs, Post-Dispatch analysis department is separate department and it is working on following functions:

- Tripping Analysis
  - SoPR data for ISTS licensee
  - Frequent Single element tripping in a month
  - Multiple element tripping in a month
  - Inter-Regional tripping in a month
- FRC computation and analysis
- Load Crash analysis
- Reactive Power Management in its control area
- LVRT/FRT issues or other protection related issues for renewable generators
- Protection database formation and updation
- UFR and df/dt operation
- ADMS (Automatic demand management system) related updates
- Analysis of sudden frequency excursions

- SPS operation and feedback

Post-Dispatch Analysis Group in state will co-ordinate with the site officials and prepare the detailed report of all the incidents and submit the report to NRPC/ NRLDC in stipulated time frame.

38th PSC meeting held on 01.08.2019 and 02.08.2019 – UPSLDC representative highlighted that group similar to Post-Dispatch Analysis is present in the SLDC and tripping are also discussed in separate meetings. He informed that minutes of the such meetings will be shared with NRPC/NRLDC.

Members highlighted that such groups may have protection engineers as well as grid operators which will further help in co-ordination. It was deliberated that Post-Dispatch Analysis Group in state may be created/strengthened. PSC recommended that issue may be deliberated at TCC/NRPC meetings.

Annexure - I

List of Participants for 38th Protection sub-committee meeting.

Date: 01.08.2019

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
1	SWARUP KUMAR DAS	SM (E)	NHPC	9717786721	Sdas_nhpc@yahoo.co.in	
2	ASHUTOSH GAIROLA	MANAGER	THDCIL	8126655557	ashutoshgairola@thdc.co.in	
3	SHRIKANT PANT	DEPUTY MANAGER	THDCIL	9458953353	shrikantpant@gmail.com	
4	PRAVEEN KASTOGI	S.E. (T&C)	UPPTCL	9412749817	setncmrt@gmail.com	
5	KAVINDRA SINGH	Advisor	UPPTCL	9205363621	SKAVINDRA@YAHOO.CO.IN	
6	Pankaj Malviya	SE T&C	UPPTCL Lucknow	9450909474	setnccelko@gmail.com	
7	H.C. VERMA	EE (A) SE (T&C)	UPPTCL LUCKNOW	8887137903	setncgkp@gmail.com	
8	Ajeet Kumar Prasad	A.E (T&C)	UPPTCL (U.P)	9415114028	ajeet.mnit@gmail.com	
9	Prashant Chauhan	Manager SEUPPTCL	SEUPPTCL	9720490066	765mainpuri@seupptcl.	
10	HARI MANOHAR SINGH	STE(E&I)	NAPS (NPCIL)	9412768059	hssingh@npcil.co.in	

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
11	RAJBIR SINGH WALIA	A.S.E	PSTCL	96461 – 18223	rajbir_walia74@yahoo.com	
12	Mohsin Khan	AE	UPSLDC	8004949277	sera@upsldc.org	
13	Sushil Kumar	AEN.	RRVPNL	9414061328	aen.prot.bharatpur@rvpn.co.in	
14	V.K. Sharma	X. EN	RRVPNL	9414061403	xen.mpts.jsl@rvpn.co.in	
15	K.K. Kain	ACE (MPTES)	RRVPNL	9414061417	ce.mps@rvpn.co.in	
16	B.L. GUJAR	DGM (Prot)	DTL	9999533985	bl.gujar@dtl.gov.in	
17	ABHISHEK SHARMA	Manager	DTL	9999533893	abuildtl2@gmail.com	
18	Sanjeet Singh Panwar	Asstt. Manager (E)	SJVN Ltd.	9418465432	sanjeet.sjvn@gmail.com	
19	Sanjay Bhatt	G.M. Protection.	APL. adani Power	9099005121	sanjay.bhatt@adani.com	
20	Amit Maan	AEE	HVPNL	9315315619	mpccggn@gmail.com	
21	Deepak Bhardwaj	XEN	HVPNL	9315315240	Xenmpccgbd@hvpn.org.in	

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
22	[illegible]	[illegible]	[illegible]	9417202059	dirpc@bbmb.nic.in	[illegible]
23	B. L. Yadav	AGM	NTPC	9650993044	blyadav@ntpc.co.in	
24.	Nitin Verma	DGM	PowerGrid	8005499952	nverma@powergridindia.com	
25.	Mahendra Singh Hada	DGM	Powergrid	9650555997	mshada@powergridindia.com	
26.	Praveen Kumar	DGM	POWERGRID, NR-I	9906546606	mr.praveenkumar@powergridindia.com	
27	Alok Kumar	Sr. DGM	NRLDC POSOCO	9999639321	alok.kumar@posoco.in	
28	S. Tyagi	CM	NRLDC POSOCO	9599441243	shashankaum@gmail.com	
29	R. K. SINGH	Sr. Mgr.	NTPC	9450963079	ramsingh@ntpc.co.in	
30	Naresh Bhardwaj	MS	NRPC	9899061445	nbharadwaj@gmail.com	
31	Saumitra Mazumdar	SE(O)	NRPC	9899819365	seo-nrpc@nic.in	

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
32	अंकित गुप्ता	उपप्रबंधक	उ.क्षे.भा.प्रे.के.	9560270520	ankit.gupta@posoco.in	
33	Kaushik Panditrao	AE	NRPC	9869081939	kaushik.panditrao@gov.in	
34	नितिन यादव	प्रबंधक	उ.क्षे.भा.प्रे.के.	9560050257	nitinyadav@posoco.in	
35	अमित गुप्ता	प्रबंधक	उ.क्षे.भा.प्रे.के.	88००690954	amitgupta@posoco.in	
36	श्रेय कुमार	AEE	NRPC	8826646761	shrey.cea@gov.in	
37	Ainul Hoda	EE	UPPTCL	9415311096	eetncvar@upptcl.org	
38	KISHORI LAL	SE EHV UPPTCL Agra		9458096601	setncagra@upptcl.org	
39	T.Thamarai Selvan	SE	WUPPTCL	7054205930	thamarai.wupptcl@gmail.com	
40.	Abhishek Jain	Manager	APCPL NTPC-Jhajjar	9416212489	abhishekjain01@ntpc.co.in	

List of participants for 38th Protection Sub-Committee meeting.

Date: 02.08.2019

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
1	Ashutosh Gairola	Manager	THDCIL	8126655557	ashutoshgairola@thdc.co.in	
2	Shrikant Pant	Dy. Manager	THDCIL	9458953353	shrikantpant@gmail.com	
3	S.K. Das.	SM(E)	NHPC	9717786721	sdas_nhpc@yahoo.co.in.	
4	Prashant	Dy. Manager	SEUPPTLL	9720490066	765kvmainpuri@SEUPPTLL.com	
5	H.C. VERMA	EE(A) SE(T&C)	U.P.P.T.C.L GORAKHPUR.	8887137903	setncgkp@gmail.com	
6	Ajeet Kumar Prasad	A.E(T&C)	U.P.P.T.C.L mau (U.P)	7753881084	ajeet.mnit@gmail.com	
7	Pankaj Malviya	SE T&C	UPPTCL LUCKNOW	9450969479	setncelko@gmail.com	
8	AINUL HODA.	EE. T&C	UPPTCL VARANASI	9415311096	eetnevar@uppcl.com	
9	Sanjeet Singh Panwar	Asstt. Mgr(E)	SJVN Ltd. Jhakri Shimla	9418465432	sanjeet.sjvn@gmail.com	
10	H.S. Singh	STE(E&I)	NAPS, NPCIL	9412768059	hssingh@npcil.co.in	

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
11	Rajbir Singh Walia	A.S.E	PSTCL	9646118223	rajbir_walia74@yahoo.com	[signature]
12.	PRAVEEN RASTOGI	S.E.	UPPTCL-Meerut	9412749817	setnemrt@gmail.com	[signature]
13	Arvind Kumar	EE	UPPTCL	9458096639	eedmcgzb@UPPTCL.org	[signature]
14	Satendra Singh.	SE	UPPTCL JHANSI	8874204448	setjh@UPPTCL.org	[signature]
15	RAVINDRA SINGH	Advisor	UPPTCL	9205363621	SRAVINDRA@YAHOO.CO.IN	[signature]
16	Sushil Kumar	AEN	RRVPNL	9414061328	aen.prot.bharatpur@rvpn.co.in	[signature]
17	K. K. Bain	ACE (MPTS)	RRVPNL	9414061417	~~ce~~ ce.mps@rvpn.co.in	[signature]
18	V.K. Sharma	Exe. Engr	RRVPNL	9414061403	xen.mpts.jsl@rvpn.co.in	[signature]
19.	Abhishek Jain	Manager	NTPC-Jhajjar	9416212489	abhishekjain@ntpc.co.in	[signature]
20	B.L.Gujar	DGM(HM)	DTL	9999533985	bl.gujar@dtl.gov.in	[signature]
21	Paritosh Joshi	Mgr(T)	DTL	9999533933	paritoshjoshi2013@gmail.com	[signature]
22	अरुण के चन्द्रन	निदेशक	बी बी एम बी	9417202089	dirpc@bbmb.nic.in	[signature]

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
23	AMIT Maan	AEE	HVPNL	9315315619	mpccggn@gmail.com	
24	R-K-Singh	Sr. Mgr	NTPC	9450963079	ramsksingh@ntpc.co.in	
25	B.L. Yadav	AGM	NTPC	9650993044	blyadav@ntpc.co.in	
26.	Nitin Verma	DGM	PowerGrid	8005499952	nverma@powergridindia.com	
27.	Praveen Kumar	DGM	POWERGRID NR-2	9906546606	mr.praveenkumar@powergridindia.com	
28.	Mahendra Singh Hada	DGM	POWERGRID	9650555997	mshada@powergridindia.com	
29.	Alok Kumar	Sr. DGM	NRLDC POSOCO	9999039321	alok.kumar@posoco.in	
30.	अंकित गुप्ता	उप प्रबंधक	राष्ट्रीय भा.प्रे.के.	9560270520	ankit.gupta@posoco.in	
31	Shrey kumar	AEE	NRPC	8826696161	shrey.ced@gmail.c	
32	Shashank Singh	EE	NPCIL	9569360684	em.shashank@gmail.com	
33	M. Ananthachari	DCE	NPCIL	9969872315	ananthachari@npcil.co.in	

Sl No	Name	Designation	Organization	Tel. No. / Mobile No.	E-mail	Signature
34	Ashwin K Yadav	SO/F	RAPP-7&8 NPCIL	9413356762	akyadav@npcil.co.in	
35	Amandeep Kumar	Sr. Engg	KWHEP JSWHEL	9816907687	Amandeep.kumar@JSW.in	Amandeep
36	Randeep Chauhan	XEN	HVPN	93153-53634 70654-10164	randeepchauhan2009@gmail.com	
37	Thamarai Selvan	Sr. Eng	WUPPTCC	7054205930	thamarai.wupptcl@gmail.com	
38	Satya	CGM	WUPPTC	7042793301	psraju.wupptcl@gmail.com	

Annexure - II

Status of Protection System Database as per 33rd PSC

S. No.	Name of utility	Whether Protection database submitted	If not, expected date of submission	Remarks
1.	POWERGRID	Yes		
2.	BBMB	Yes		
3.	NTPC	Partially submitted		Submitted for BTPS and Dadri Line protection
4.	NHPC	Yes		
5.	SJVNL	No		
6.	THDC	Yes		
7.	NPCIL	Partially submitted		Submitted for NAPS.
8.	UPPTCL	No		
9.	PTCUL	Yes		
10.	RVPNL	Yes		
11.	HVPNL	Partially submitted		
12.	DTL	Yes		
13.	PSTCL	No		
14.	HPSEB	No		
15.	HPPTCL	No		
16.	PDD J&K	No		
17.	UPRVUNL	Yes		
18.	RVUNL	Yes		
19.	PSPCL	No		
20.	HPGCL	Yes		
21.	UJVNL	No		
22.	APCPL	No		
23.	Jhajjar Power Limited	No		
24.	Rosa Power	No		
25.	Lanco Power	No		
26.	Adani Power	No		
27.	IPGCL	No		
28.	JSW Energy Ltd.	No		
29.	Everest Power Private Limited	No		
30.	Chandigarh	No		

Annex-III

Status of pending rectification of defects observed during BPA

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

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

Annex-IV

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

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

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

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

Annex-V

Status of Bus bar Protection for Northern Region Constituents

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

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

					ascertained as representative from PDD, J&K was not present in the meeting.
Uttarakhand	PTCUL	10	09		**Order placed for 01 defective. Would be completed by May 2017.**
	UJVNL	-	-		
BBMB	BBMB	23	20	Not required at Dhulkote and Jagadhari. also for Sangrur, Kurukshetra and Delhi as no. of feeders is less than five. PSC decided that it needs to be installed.	**Sangrur- commissioned 19.01.2016.** **For Kurukshetra and Delhi, LOI has been issued on 27.06.18 & material is likely to be received by March, 2019.** For Barnala it is to be provided by PSTCL as agreed in PSC. PSTCL were to commission it by 31.12.2016.
Uttar Pradesh	UPPTCL	141	94		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		
	NTPC	11	11		
	NHPC	09	09		

Central Generating Stations	NPCIL	02	02		
	THDC	02	02		
	SJVNL	02	02		

Annexure - VI

पावर ग्रिड कारपोरेशन ऑफ इंडिया लिमिटेड

(भारत सरकार का उद्यम)

POWER GRID CORPORATION OF INDIA LIMITED

CIN No.L40101DL1989GOI038121 (A Government of India Enterprises)

पावरग्रिड

उत्तरी क्षेत्र-III क्षेत्रीय मुख्यालय : Northern Region-III Regional Head Quarter

कार्यालय : 12, राणा प्रताप मार्ग, लखनऊ - 226 001 (उ.प्र.) : दूरभाष : 0522-2205155 ई-मेल : rhq.nr3@powergrid.co.in

Office : 12, Rana Pratap Marg, Lucknow - 226 001 (U.P.) : Tel : 0522-2205155 E-Mail : rhq.nr3@powergrid.co.in

सन्दर्भ संख्या / Ref. No. :

Ref: POWERGRID/NR-3/38 PSC/Compliance **Date: 22.08.2019**

To,

SE (Operations)
18-A, Shaheed Jeet Singh Marg,
Katwaria Sarai, New Delhi-110016

Subject: - Compliance of 38th Meeting of Protection Sub-committee of NRPC held on 01 & 02.08.19

Sir,

With reference to the 38th Meeting of Protection Sub-committee of NRPC held on 01 & 02.08.19, the compliance to certain agenda points pertaining to POWERGRID, Northern Region-III are attached as per **Annexure-I**.

For your kind information please.

Thanking You,
Yours truly,

22-08-19.

D. KUSHWAHA
GM (AM)

Annexure-I

Compliance of 38th Meeting of Protection Sub-committee of NRPC held on 01 & 02.08.19

1. **Agenda Point - A.9.1.** HVDC Rihand-Dadri Pole-2 tripping and subsequent operation of SPS on 25th Mar-2019 (158th OCC meeting) &
Agenda Point - F Multiple Element tripping at 400 kV Dadri (NTPC) Station at 09:03hrs of 14th Feb 2019

   Observation: HVDC Rihand-Dadri SPS logic needs to be checked and corrected in view of error in SPS logic or measurement equipment (incorrect case operated)

   Compliance: Matter was deliberated with OEM (M/s Synergy Energy and Solutions) for Root Cause Analysis. As already informed in the 38th PSC Meeting, based on deliberations with OEM it has been decided to replace existing Bi-directional Power Transducers with new Unipolar transducers for range / sensitivity selection. Accordingly, new MW transducers were already supplied at Rihand station and SPS shutdown was availed on 08.08.2019 for installation of new transducer and testing.

   However, during the course of commissioning, problems were faced by OEM in SPS configuration at site and could not be resolved on same day. SPS was then normalised and OEM took the entire SPS backup files for backend configuration & testing at their works. M/s Synergy Energy and Solutions is again expected to visit Rihand station in next 15 days and the issue is expected to close by 15.09.2019. A detailed Post-rectification report shall be shared after the work.

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

   Compliance: Matter was deliberated with OEM (M/s ABB, Sweden) for Root Cause Analysis. Disturbances and current order changes has provoked power oscillations in reverse power operation at various occasions. As per ABB, based on the behaviour in the supplied TFRs it can be assumed that the short circuit capacity in BNC is below the required minimum level, for operation in reverse power direction, for which the control is tuned. ABB recommended that in order to improve the performance at weak network, a filter is recommended to be added on the input signal in the controller, namely, RO-NEA800-RO-BC-00640 "LP filter in BSC_INV IdNC". This measure will make the control less sensitive to fluctuations in the system and stabilize the transmission. **The has been implemented at BNC and APD Stations on 30 July and 26 July respectively.**

   Issue may be closed.

3. **Agenda Point - A.9.3.** Load Crash in Northern Region on 12th June 2019

   Detailed reports for Multiple element trippings at Agra and Ballia substations submitted earlier are being re-submitted through email dated 22.08.2019 to seo-nrpc@nic.in, nrldcso2@posoco.in

22/8/19

Annexure - VII

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 Time	PMU data	**1080ms**	
Phase of the fault	PMU data	Y&B phase to phase to earth fault	

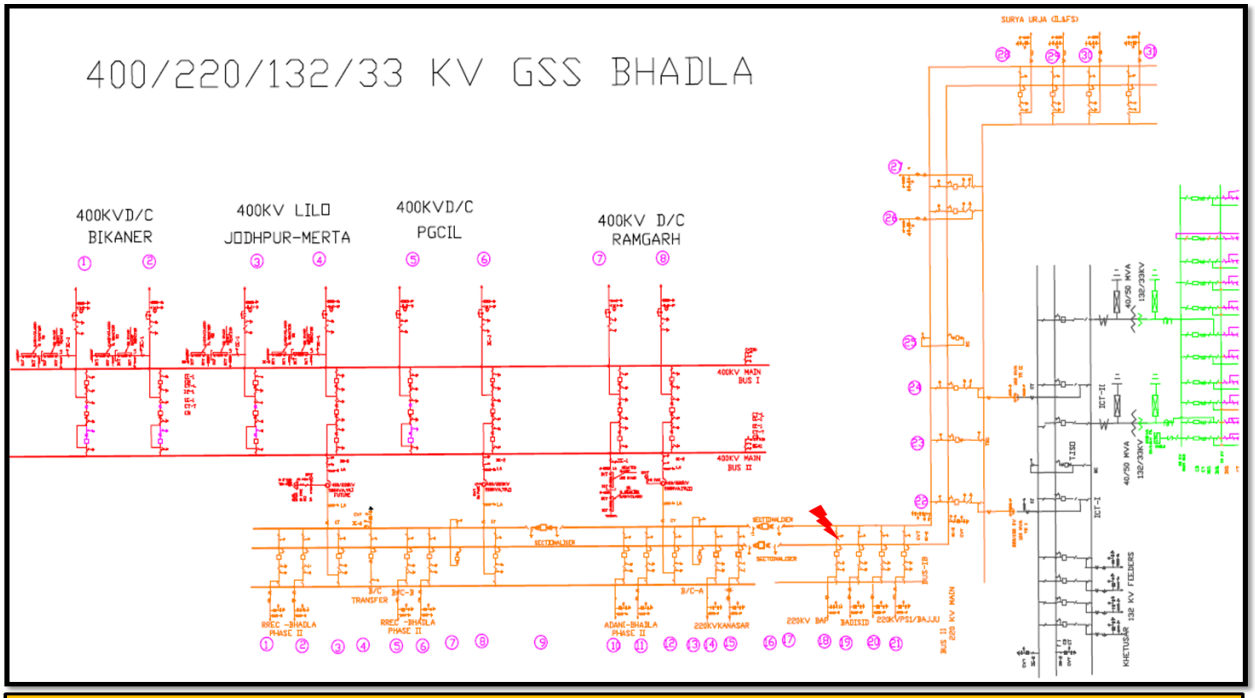
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received (after 24hrs)	DR/EL received partially
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

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 Grid, Amendment Regulation 2013), part-II, B2 4. CEA GRid Standard 2010-3.e & CEA Transmission Planning Criteria	**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

Based on above information description of the events is:

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

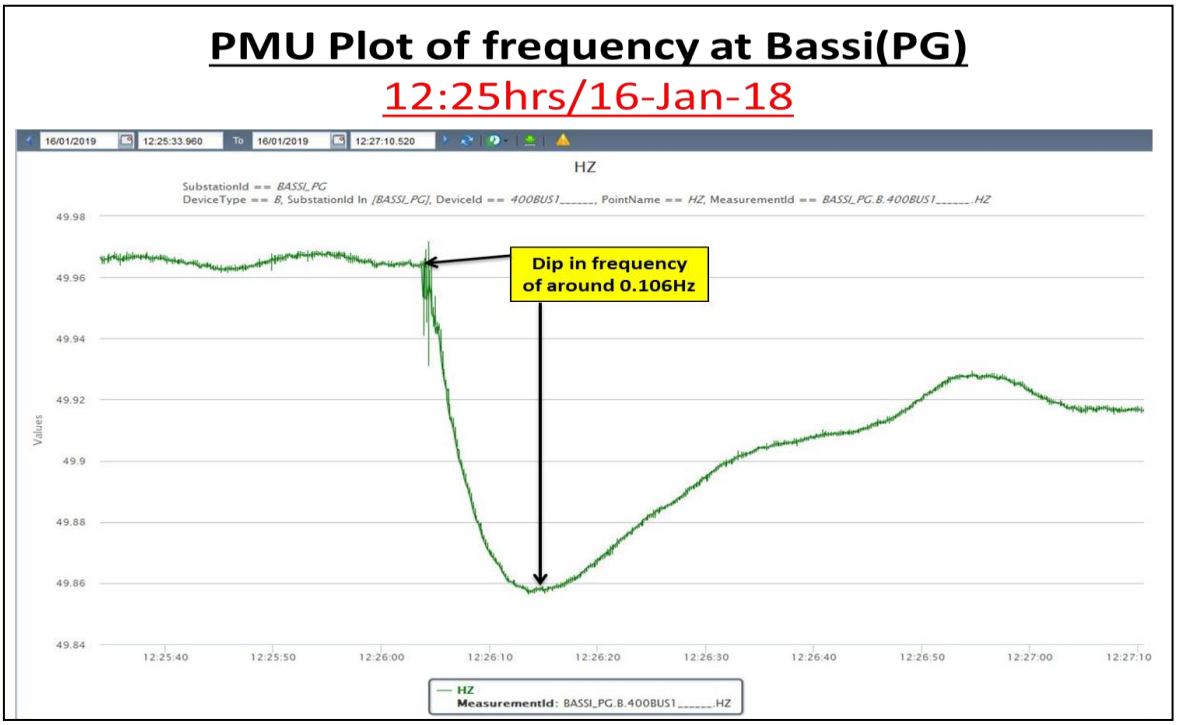


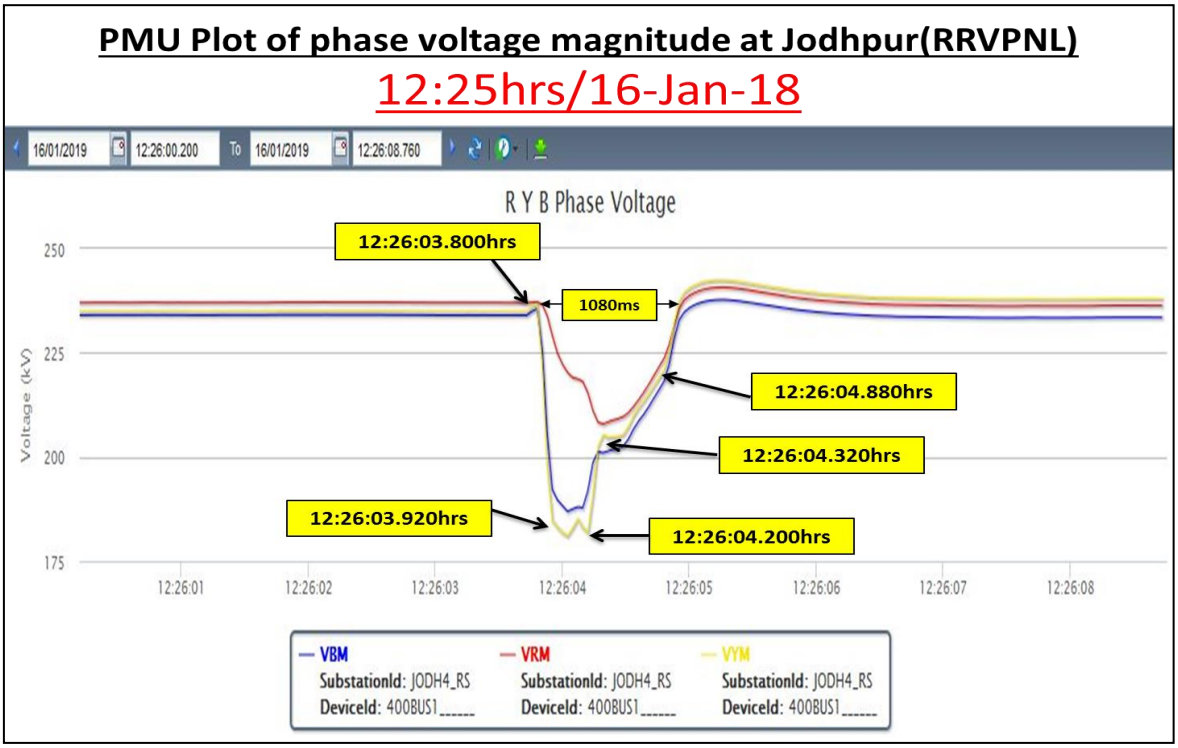
220 V bus jumper of R-phase snapped & created bus fault for 220 kV bus-1 at 220 kV2 Bhadla GSS. 220 kV Bhadla2 GSS is connected through Bus Sectionaliser to 400/220 kV Bhadla (Raj)

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 Sectionaliser. 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. In antecedent conditions, 400kV Bhadla(RRVPNL)-Bikaner(RRVPNL) ckt-1 & 2, 400kV Bhadla(RRVPNL)-Merta(RRVPNL) carrying 301 MW, 303 MW & 188 MW respectively.
4. 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.
5. 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:

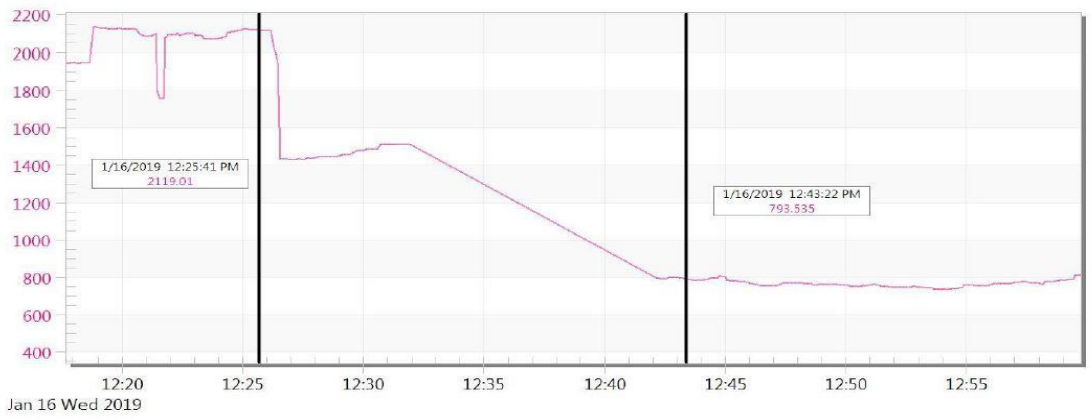




11. As per PMU data:
    - Y-B phase to phase to earth fault occurred at 12:26:03.800hrs and cleared in **1080ms**.

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

SOLAR GENERATION VARIATION:



13. As per Rajasthan details:

Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDI CATION	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	INDI CATION	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**	

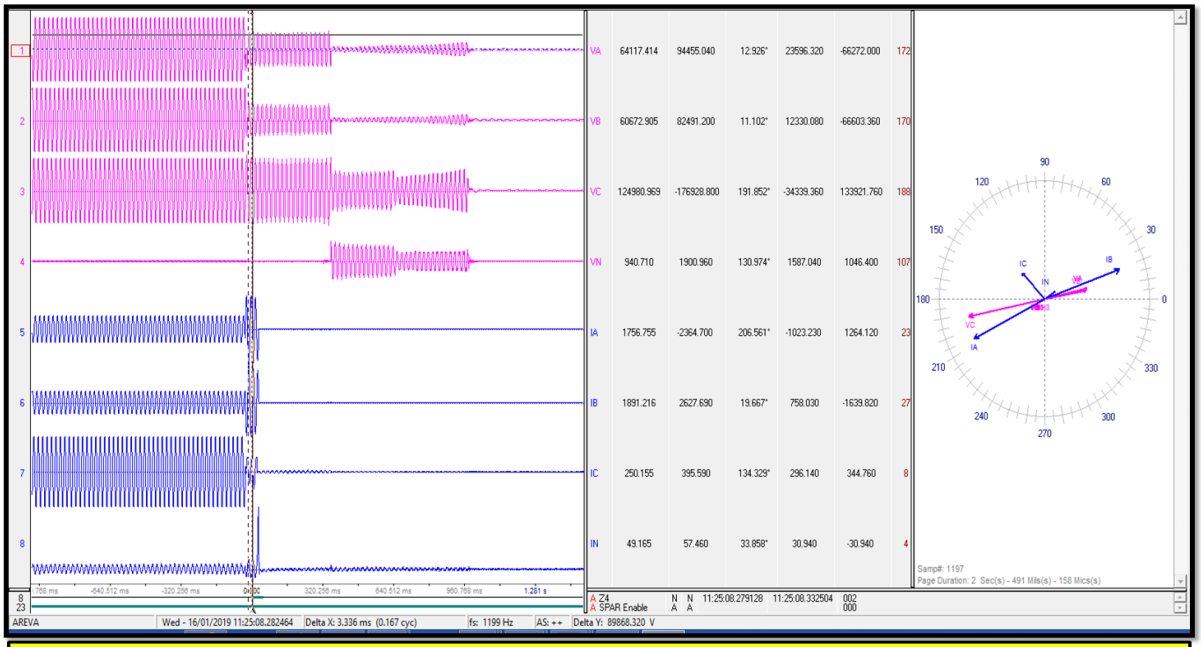
Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDI CATION	REMARKS
1	400 KV GSS Jodhpur – Bhadla	16.01.2019	12.25	16.01.2019	14.01	Jodhpur - Z2, 354.8Km , B &C Ph	

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	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.	
	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.**	
	After replacement of burnt Jumper, system of 220 KV GSS Bhadla and remaining 500 MW generation restored at 16.35 hours.	
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-1 Line-1 6. 220 KV Bhadla – RSDCL-1 Line-2 7. 220 KV Bhadla – AREPRL Line-1 8. 220 KV Bhadla – BAP Line 9. 220 KV Bhadla – Badisid Line	

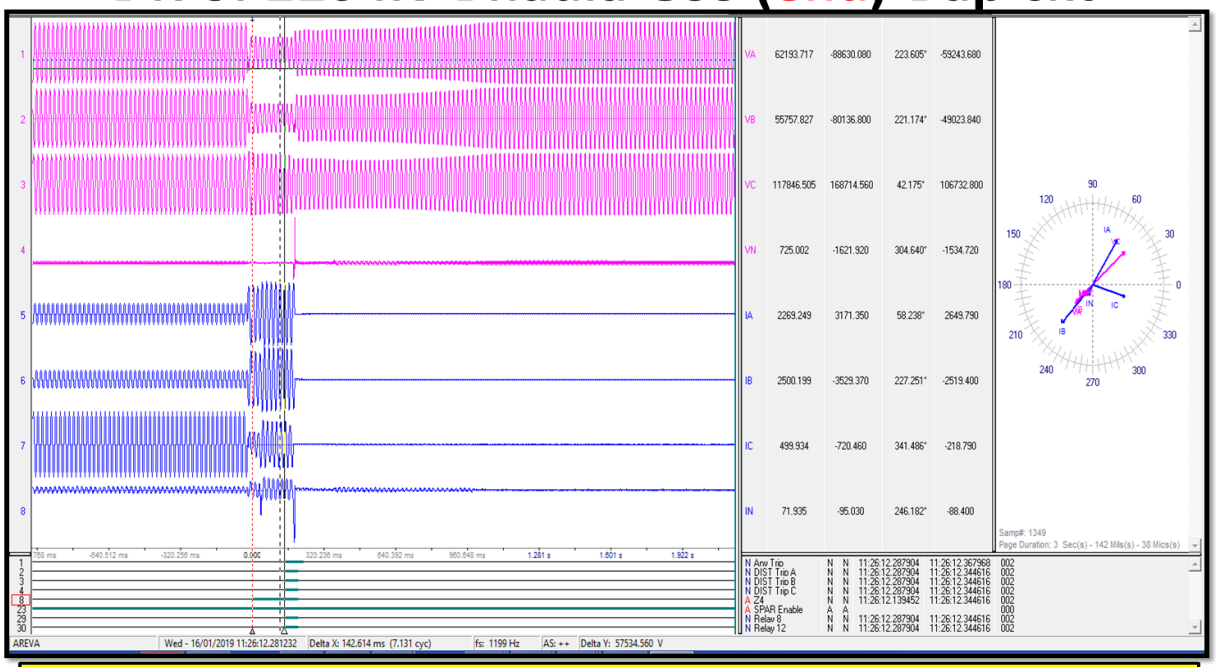
Name of GSS	Name of Line / Equipment	Date of Tripping	Time in Hours		Relay indication				Remarks
			Tripping	Closing	BHADLA END		Other END		
					Annunciation	Relay indication	Annunciation	Relay indication	
400KV GSS BHADLA	400KV Bhadla-Bikaner Line-1	16.01.2019	12:24	13:26		No Trip		Dist. Relay M-2 (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 impadance(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-Badisid	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



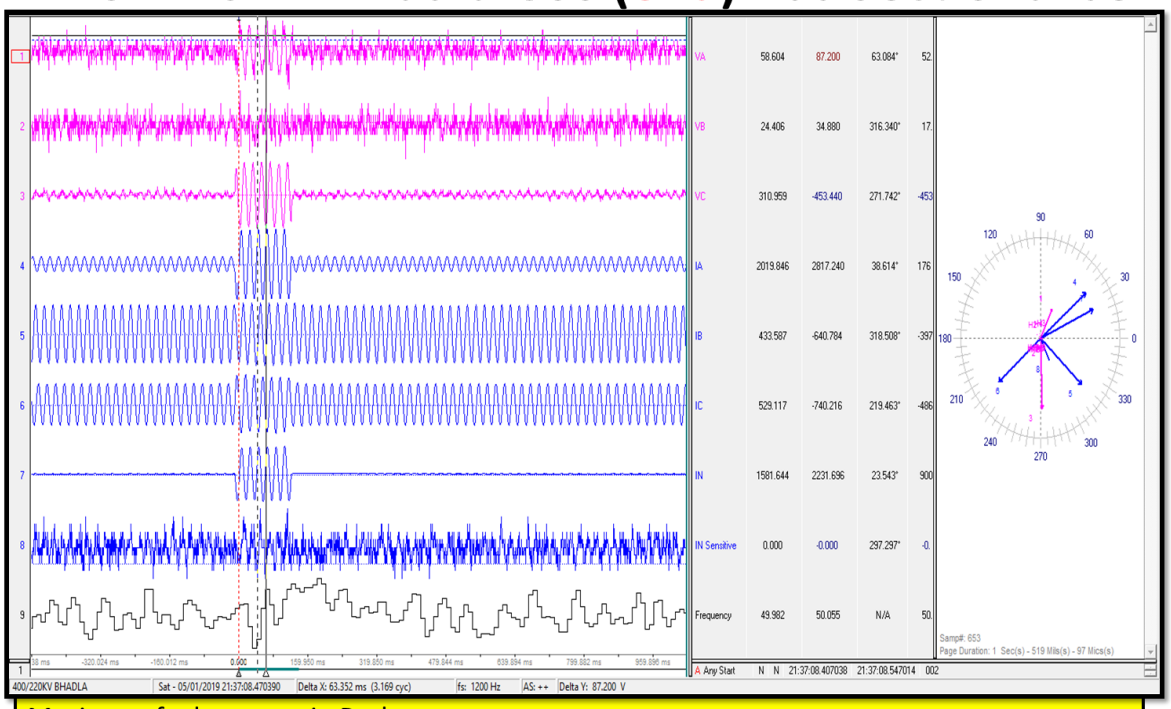
Maximum fault current in R&Y-phase
Time Synch error

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



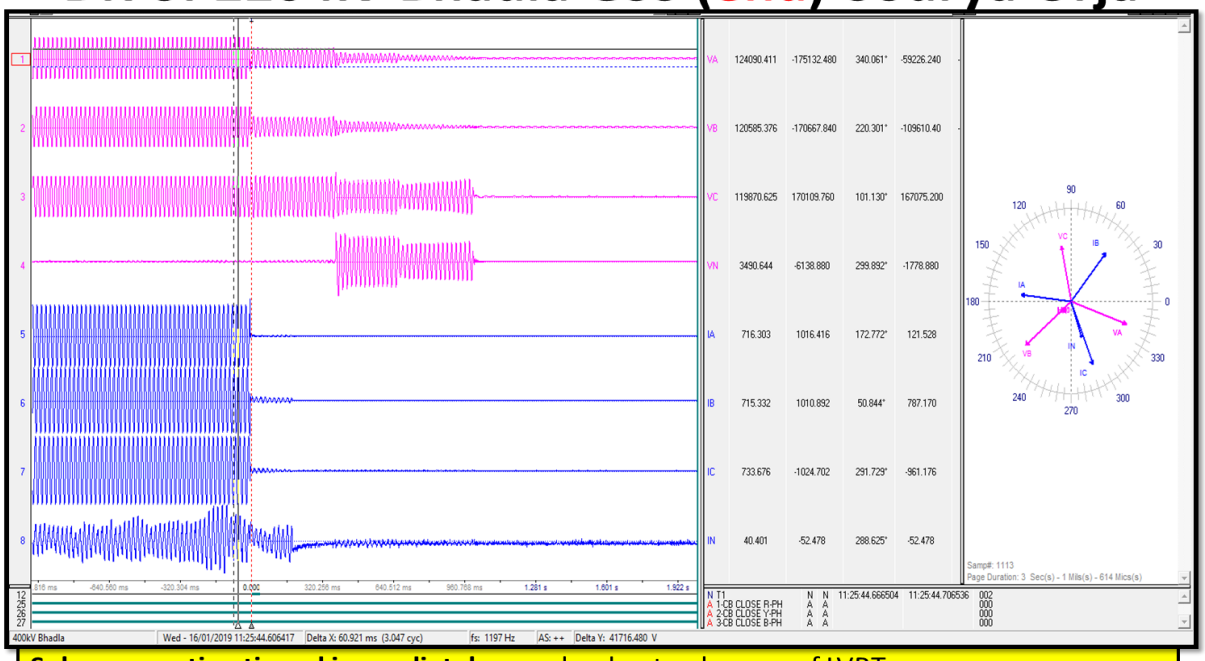
Maximum fault current in R&Y-phase
Time Synch error

DR of 220 kV Bhadla GSS (end) Bus Sectionaliser



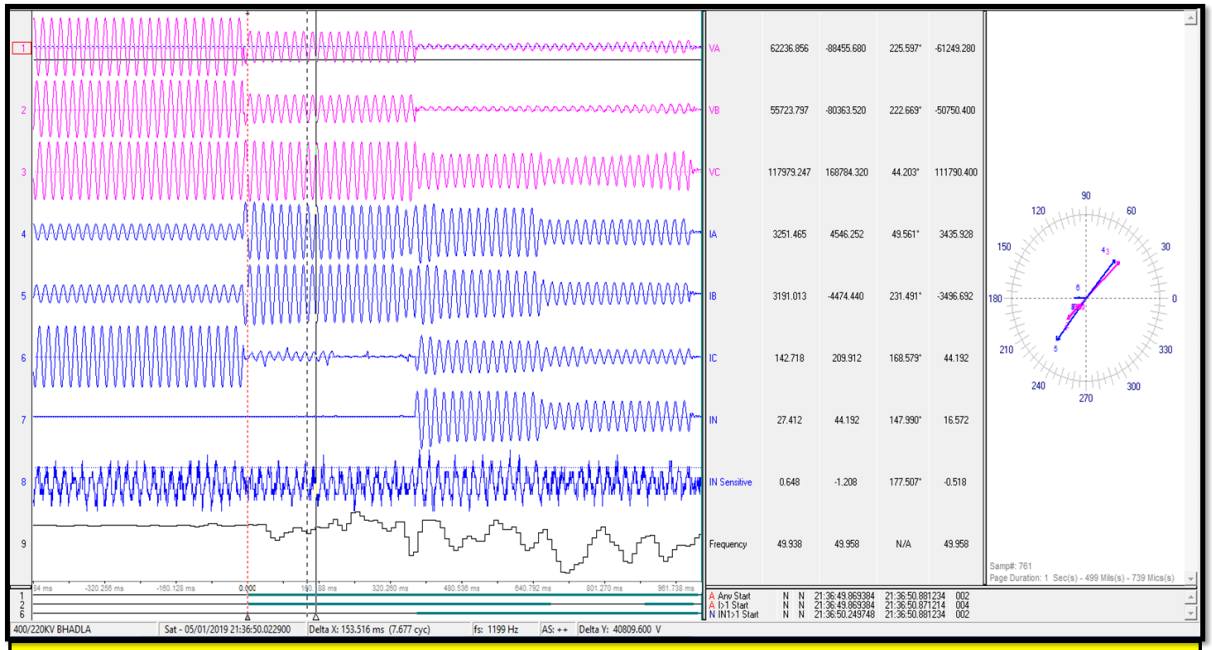
Maximum fault current in R-phase
Time Synch error

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



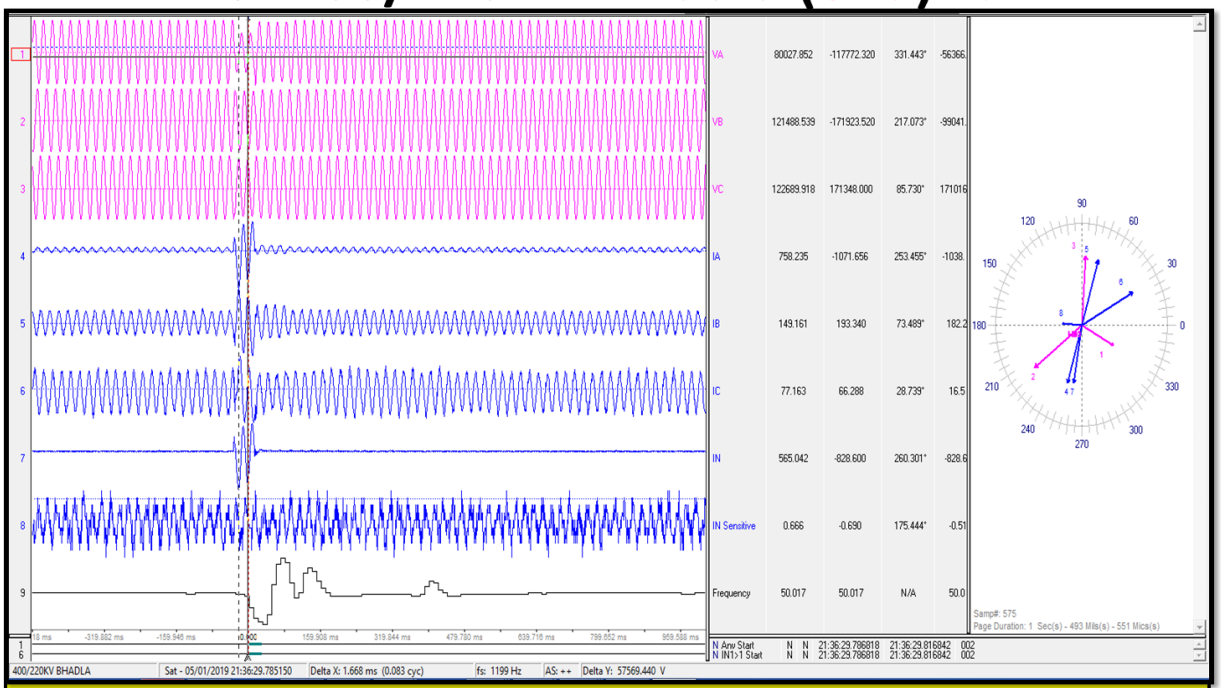
Solar generation tipped immediately, may be due to absence of LVRT
Time Synch error

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



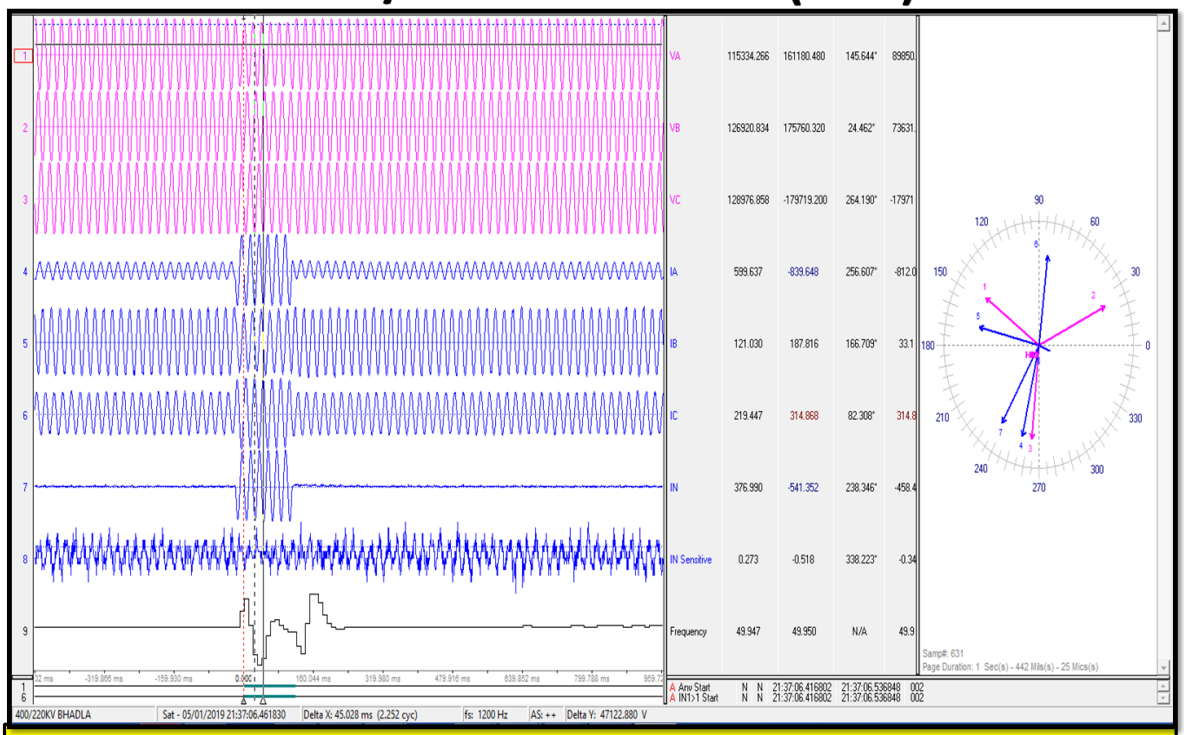
High fault current in R&Y-phase
Date and Time Synch error

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



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

14. 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.
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.

Cause of Concern:

- Non-operation of 220 kV bus bar protection at 220 kV Bhadla 2 GSS 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 2 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 at 400/220 kV Bhadla (Raj) & 220 kV Bhadla 2 GSS 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 representative informed following during the meeting*:*

1. 400/220 kV Bus Bar Protection was under blocked condition due to communication issue at 400/220 kV Bhadla (Raj) station. It has been rectified, as of now it is healthy. Reverse zone setting has also been revised according to NRPC philosophy, in case of blocking of bus bar protection revised setting will take care.
2. 220 kV Bus Bar Protection was under blocked condition due to communication issue at 220 kV Bhadla 2 (Raj) station. It has been rectified, as of now it is healthy.
3. Maintenance team didn't share the details of blocking of bus bar protection with protection team.
4. 220 kV Station Event Logger was also not healthy at 400/220 kV Bhadla (Raj) and 220 kV Bhadla 2 station.
5. Sequence of Event couldn't be established due to non-availability of station event logger details.
6. Details of RE generation outage and reason is not available, one separate meeting to be planned with intra state RE generators in view of this tripping.
7. Time synchronization of DR of all the elements of 400/220 kV Bhadla (Raj) & 220 kV Bhadla 2 GSS will be corrected within 1 month
8. Healthiness of station event logger at 400/220 kV Bhadla (Raj) & 220 kV Bhadla 2 station will be ensured within 1 month.
9. Reply of all the remaining points will be shared within 1 month

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	

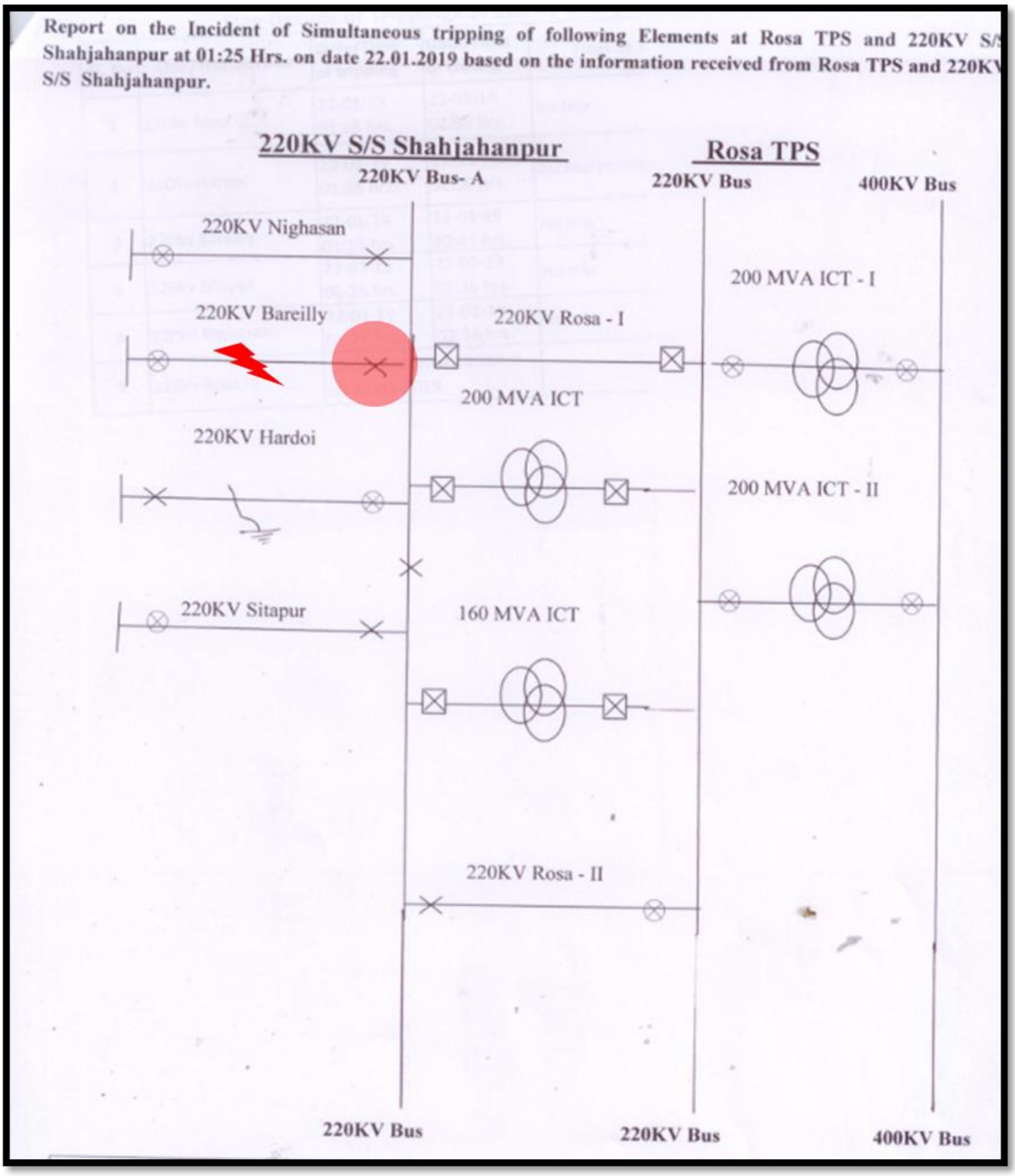
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	
DR/EL	Uttar Pradesh	Not Received	
Preliminary Report	Uttar Pradesh	Received	
Detailed Report	Uttar Pradesh	Not Received	

Description	Clauses	Utility	Remarks
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. Connectivity diagram of 220 kV Shahjahanpur (UP):

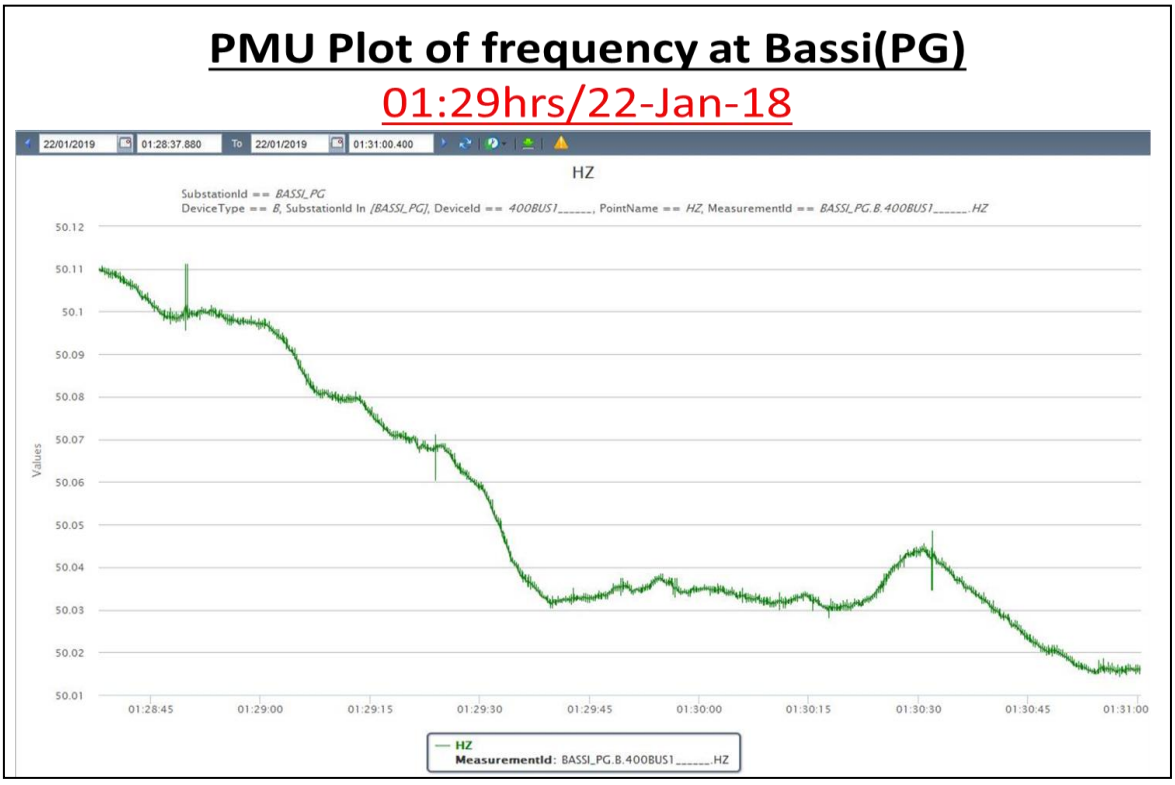
Report on the Incident of Simultaneous tripping of following Elements at Rosa TPS and 220KV S/S Shahjahanpur at 01:25 Hrs. on date 22.01.2019 based on the information received from Rosa TPS and 220KV S/S Shahjahanpur.

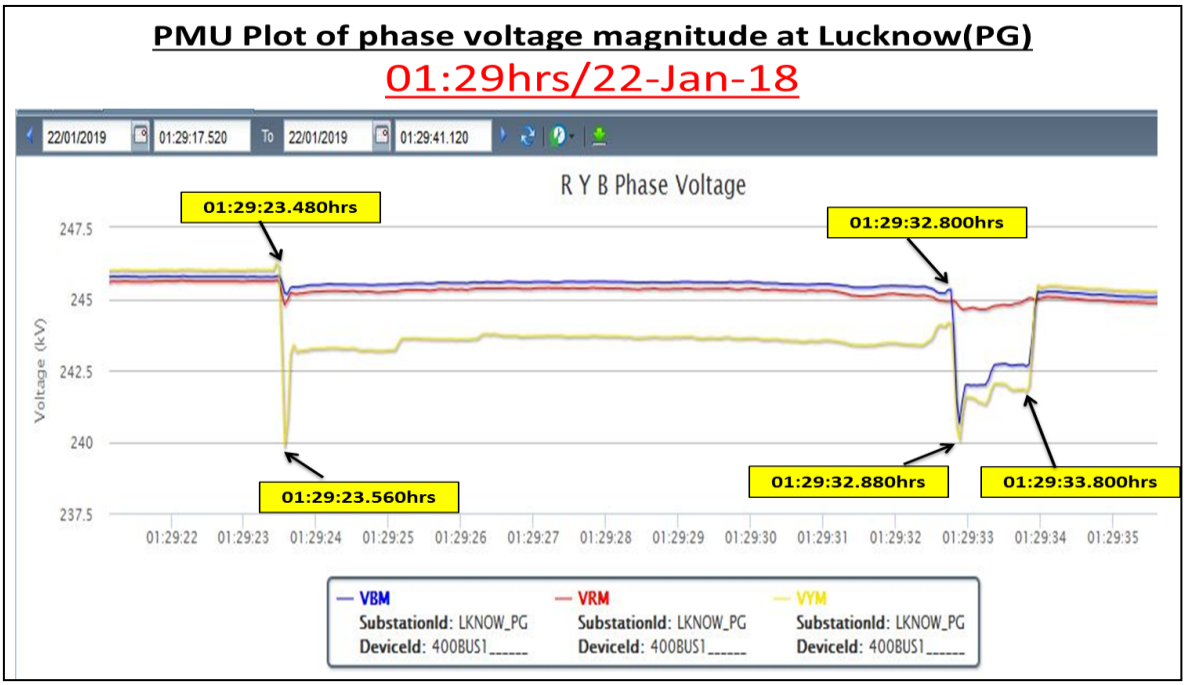


2. 220 kV Shahjahanpur station has double main transfer breaker scheme. It is connected through Rosa D/C, Bareilly S/C, Nighasen S/C, Hardoi S/C and Sitapur S/C. It also have two 160 MVA 220/132 kV ICTs.
3. In antecedent conditions, 200 MVA ICT 1 & 2 at 400/220kV Rosa(UP) carrying 14 MW & 16 MW respectively. 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 representative informed following in the meeting*:*

1. R-phase conductor in place of jumper (reported earlier) of 220 kV Shahjahanpur-Bareilly ckt snapped.
2. Open conductor condition resulted for 220kV Shahjahanpur(UP)-Bareilly(UP) ckt. 220kV Bareilly(UP) flags indicated that the ckt tripped on Y-N fault from Bareilly end. It seems open conductor which was connected from Bareilly side, created ground fault due to which it tripped from Bareilly end.

3. The distance protection relay of 220kV Shahjahanpur(UP)-Bareilly(UP)at Shahjahanpur(UP) is outdated PTYS relay of ALSTOM make. The relays have history of being unstable. At the time of fault, relay didn't pick up fault. DR at Shahjahanpur(UP) not available for the same reason as the relay was static. Relay panel has been changed and numerical relays have been installed. All other feeders at Shahjahanpur(UP) had numerical relays only.
4. Bus bar has been kept out as isolator status was not coming correct. OEM is being pursued for rectification work.
5. Tripping of ICTs at Shahjahanpur (UP) would be confirmed and informed.
6. In UP, station event log is not present at 220kV level at substations. In new substations with SCADA are equipped with the aforementioned facility.
7. Representative from Rosa was not present in the meeting.

Due to non-availability of DR/EL at Shahjahanpur(UP), sequence of events could not be established.

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

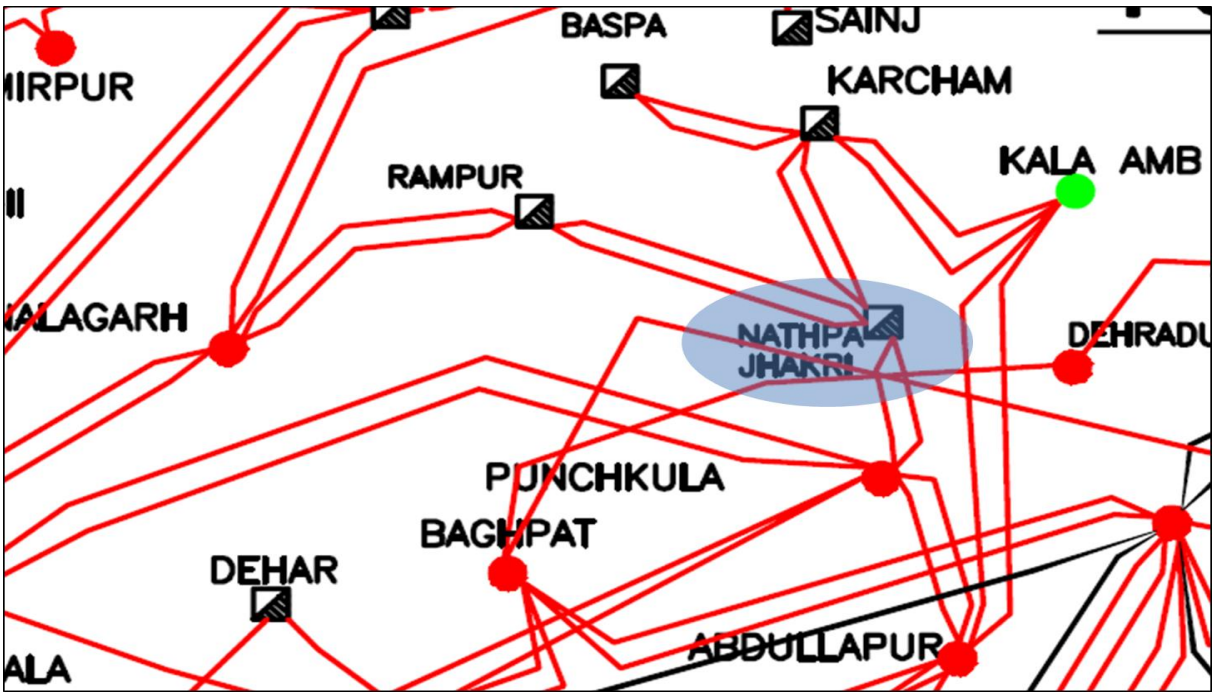
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)		Partially Received	Time Synch error
DR/ EL	NJPC	Received	Within 24hrs
	POWERGRID	Not received	
Preliminary Report	NJPC	Received	
	POWERGRID	Not received	

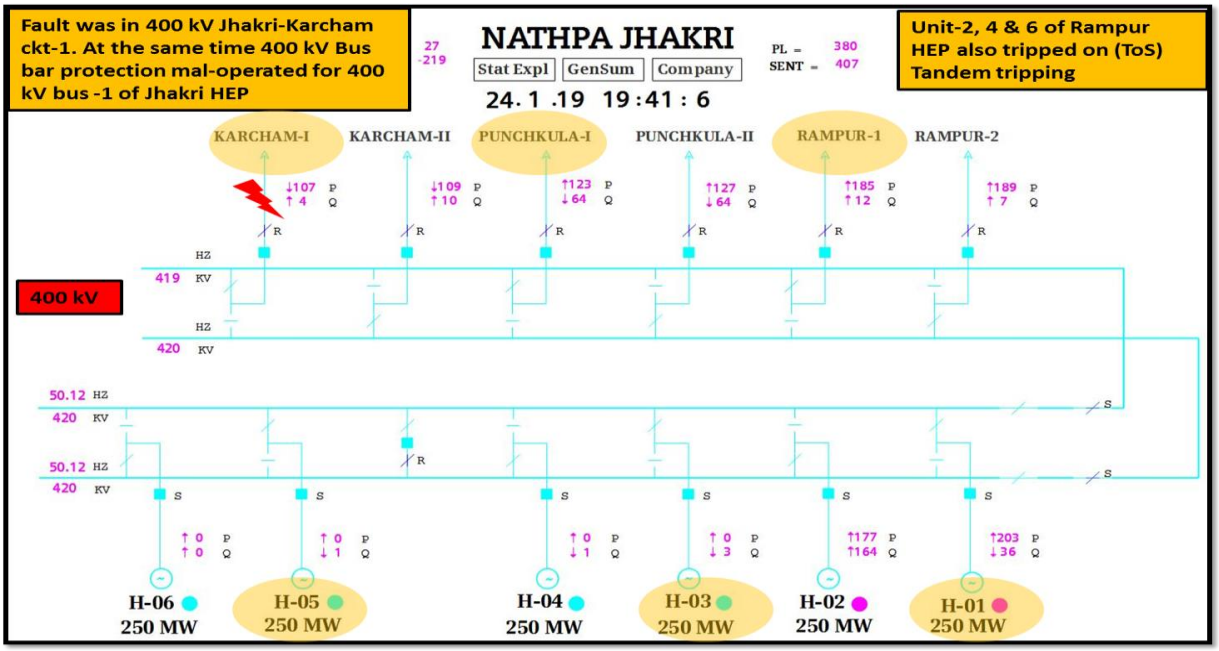
Detailed Report	NJPC	Not received	

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, 2007: Schedule Part 1. (6.1, 6.2, 6.3)	**NJPC**	1. Detailed report yet to be received 2. Adequately Sectionalized and graded protective relaying system
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**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:



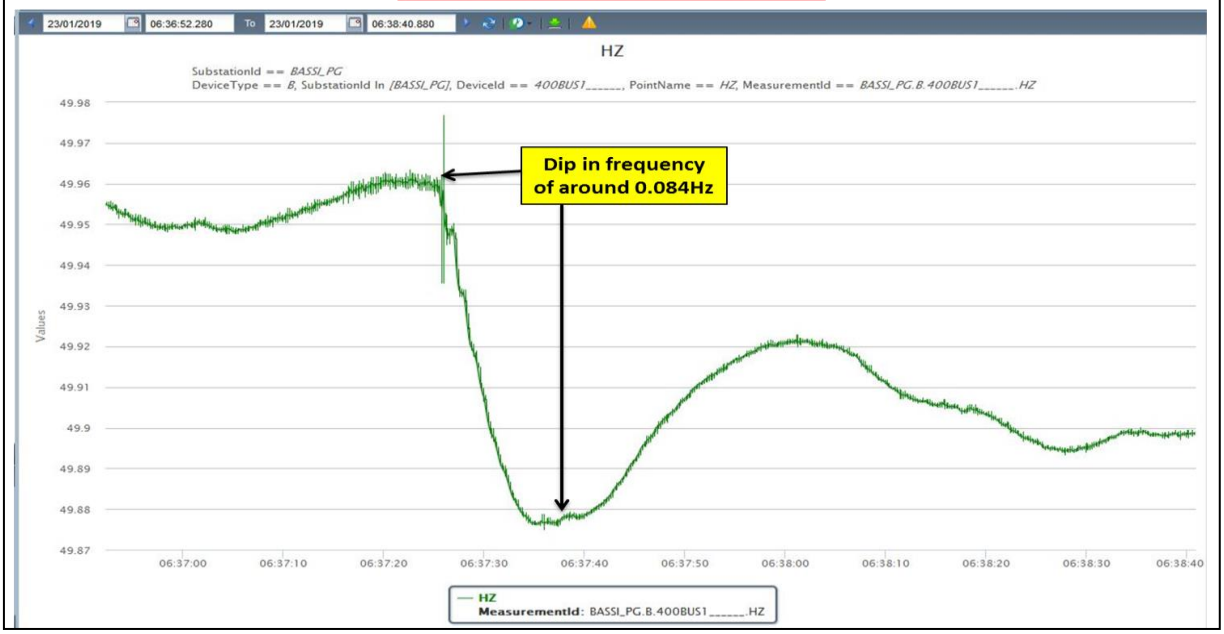


2. 400 kV Jhakri HEP station has double main single breaker bus scheme. It is connected through Karcham D/C, Rampur D/C and Panchkula D/C. It also has six units of 250MW.
3. In antecedent conditions, 400kV Jhakri(SJVNL)-Panchkula(PG) ckt-1 & 400kV Jhakri(SJVNL)-Rampur(SJVNL) ckt-1 carrying 607 MW & 416 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:

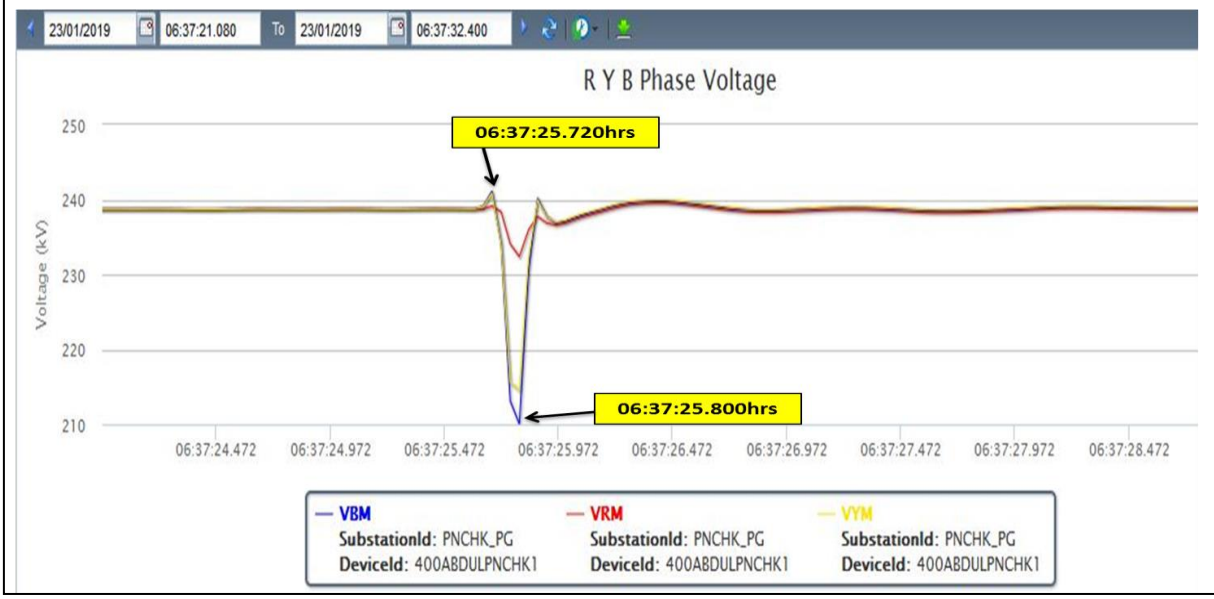
PMU Plot of frequency at Bassi(PG)

06:37hrs/23-Jan-18



PMU Plot of phase voltage magnitude at Panchkula(PG)

06:37hrs/23-Jan-18



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.

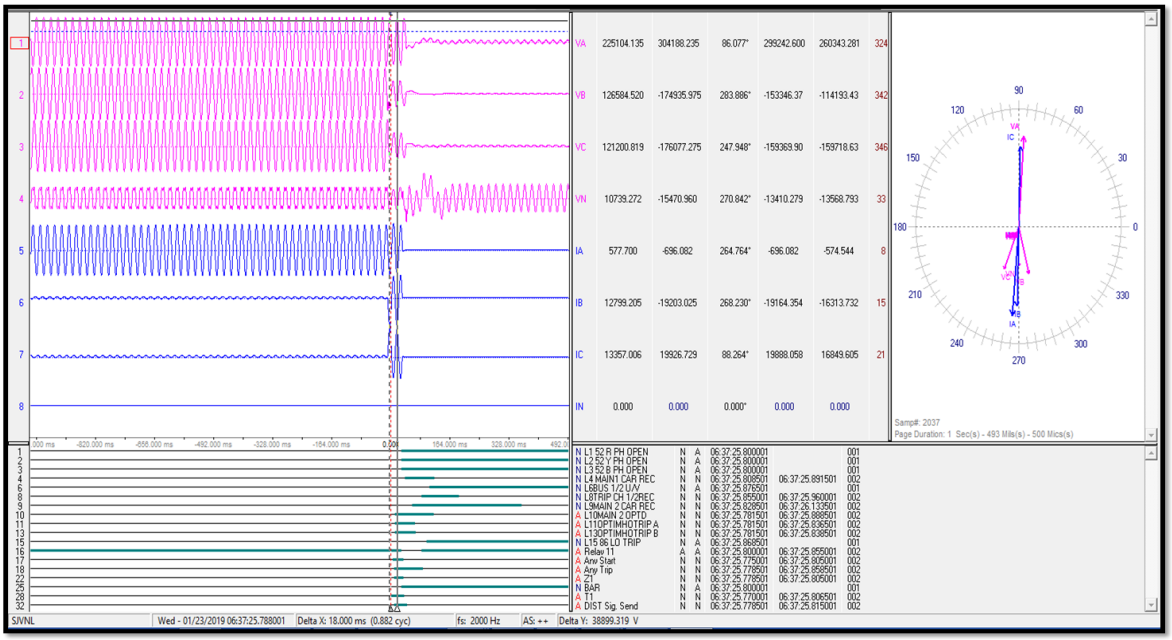
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
06:37:24: ***	NAPTHA	400kV	L5KRCHM1	Circuit Breaker	Open	Main CB of 400kV Jhakri(SJVNL)-Karchamwangtoo(JSW) ckt-1 opens.
06:37:24: ***	NAPTHA	400kV	LIRAMPR1	Circuit Breaker	Open	Main CB of 400kV Jhakri(SJVNL)-Rampur(SJVNL) ckt-1 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	LINPTHA1	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	16NPTHA1	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)

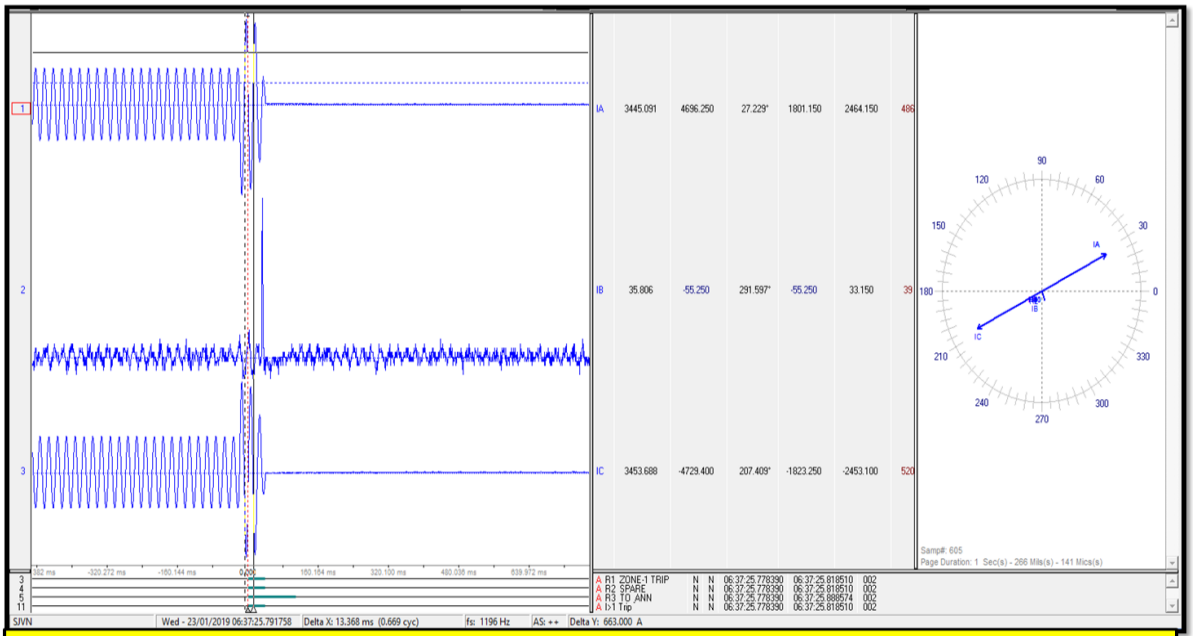
1. Time & Date of Event: 06:37:25:800 Hrs dated 23.01.2019
2. Substation Name: NJHPS Jhakri
3. **Antecedent Condition:** Generating Units (1 to 5) were running as per schedule & evacuating the power to GRID through 06 Nos Line Feeders (NJ-Panchkula-I &II, NJ- Rampur-I &II & NJ- KW-1 &II).
4. **Generation 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 report is still awaited from NJPC.
14. Remedial Measures taken report:
    - After initial investigation, it appears Mal operation of High Impedance based Bus Bar Differential relay & reason for malfunctioning was under investigation with us at that time.
    - Subsequently the matter was discussed with OEM of Bus Bar Relay (M/s GE T&D India Ltd) for Mal operation of bus bar relay based on high impedance principle as line faults should not operate Bus Bar relay and OEM assured the visit of their Engineers. OEM engineers visited the site between 03.02.2019 to 05.02.2019 and started the investigation on High Impedance based Bus Bar Protection scheme after taking the complete Shutdown on double bus system of NJHPS from NRPC. After detailed investigation, the problem found in CT connections of Control switching device (CSD) of NJ-PKL-I. Actually, we had retrofitted the NJ-PKL-1 Line prior the incident and the CT connection (R & B phase) at the Control Switching Device were found interchanged. Thus the high impedance based Bus bar protection relay read it as a fault and generated the Trip signal when the line fault occurred in the NJ- KW-1 & trip the entire element connected to Bus-1.
    - The CT connection were made as per actual and High Impedance based Bus Bar Protection scheme found working satisfactorily since then.

Points for Discussion:

1. Mal-operation of high impedance bus bar protection at 400 kV Jhakri HEP needs to be looked into: (Action already taken submitted after Agenda preparation)
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

SJVNL representative informed following in the meeting:

1. Stability of bus bar protection after correcting the CT connection of Panchkula-1 feeder at Jhakri, has been checked and found OK.
2. Bus bar CT core is used in CSD (Control Switching Devices).

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	

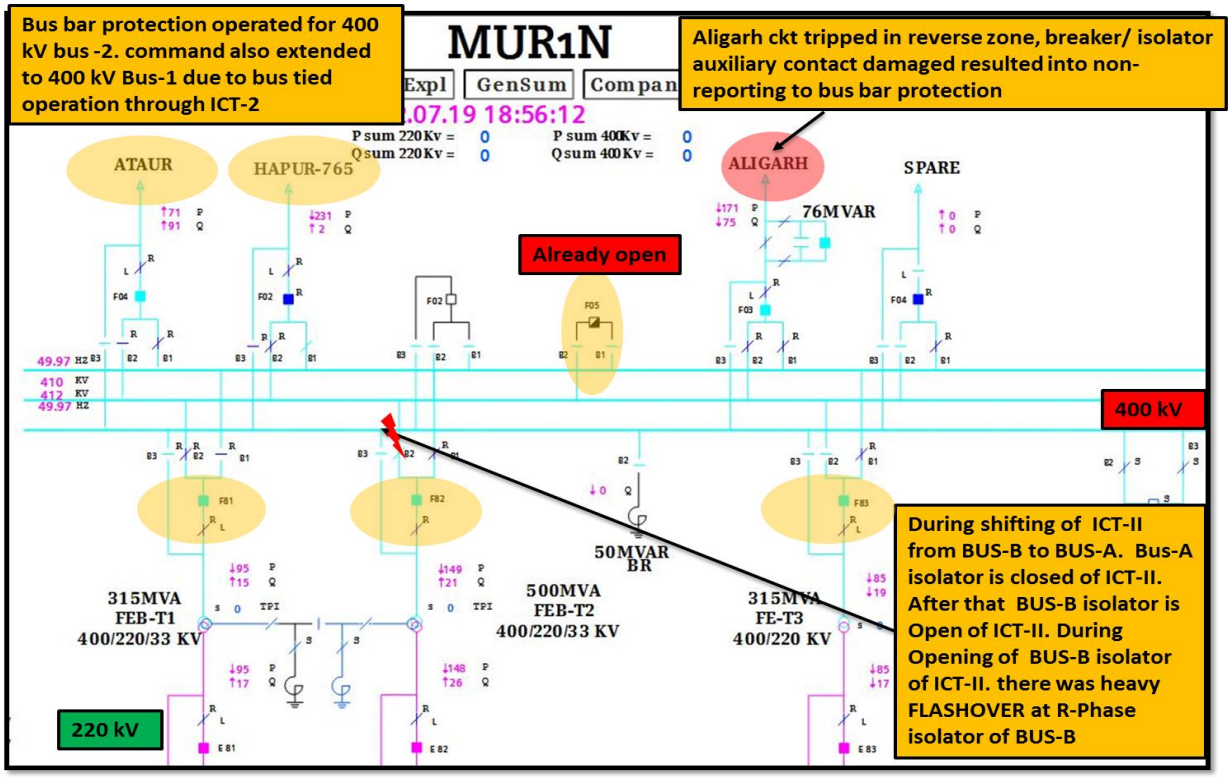
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Available	
DR/EL	Uttar Pradesh	Received	After 24hrs
Preliminary Report	Uttar Pradesh	Received	Within 24hrs
Detailed Report	Uttar Pradesh	Not Received	

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):

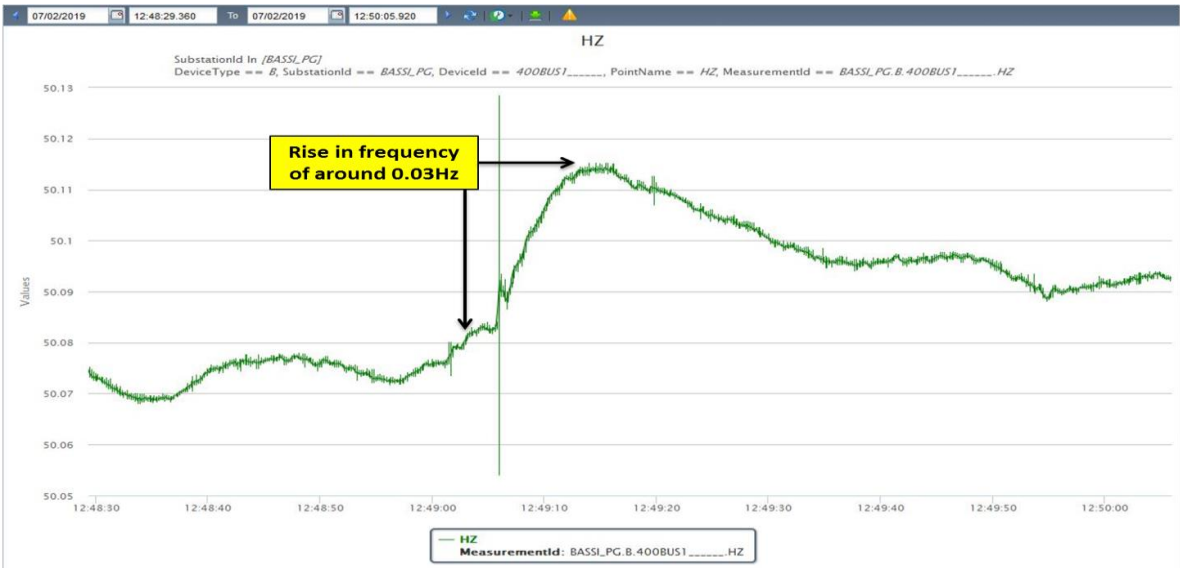


2. 400/220 kV Muradnagar (UP) station has DMT (double main transfer breaker) scheme. It is connected through Ataur S/C, Aligarh S/C and Hapur S/C. It also has two 315 MVA & one 500MVA 400/220 kV ICTs.
3. 400 kV Aligarh and ICT-II was connected through 400 kV BUS-B & 400 kV Ataur, Hapur, 400/220 kV ICT-I 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:

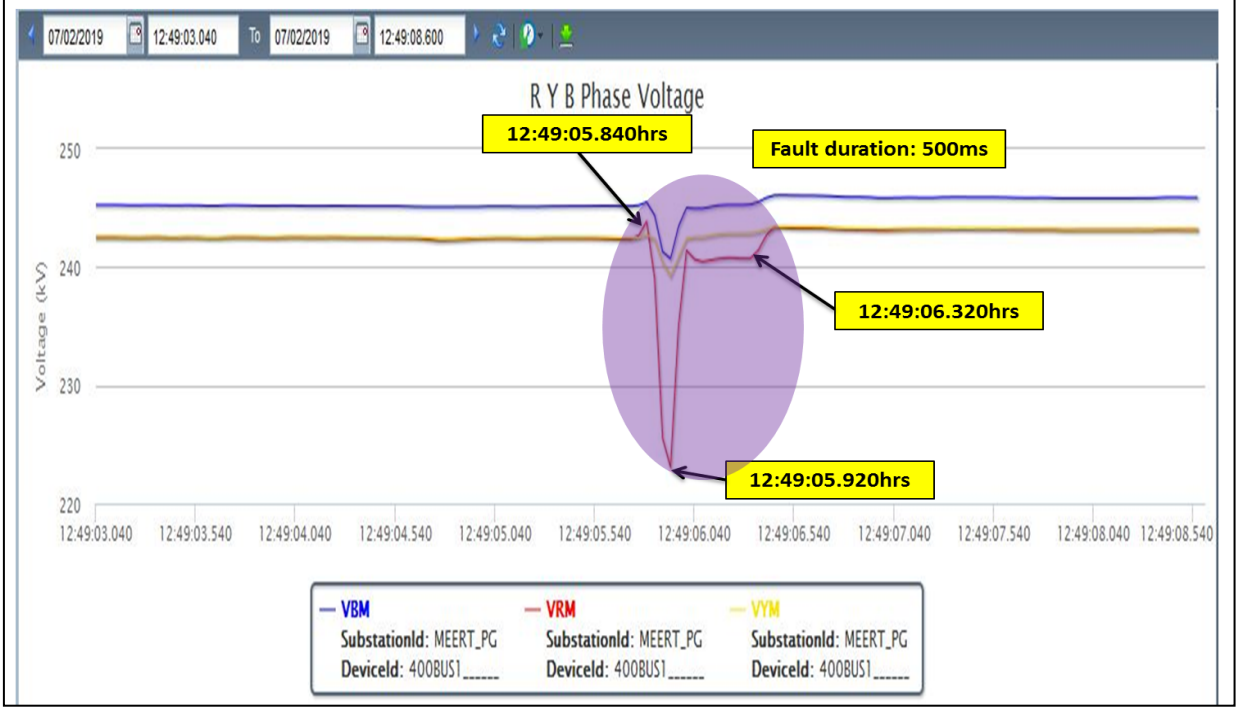
PMU Plot of frequency at Bassi(PG)

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- Ataur	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.**

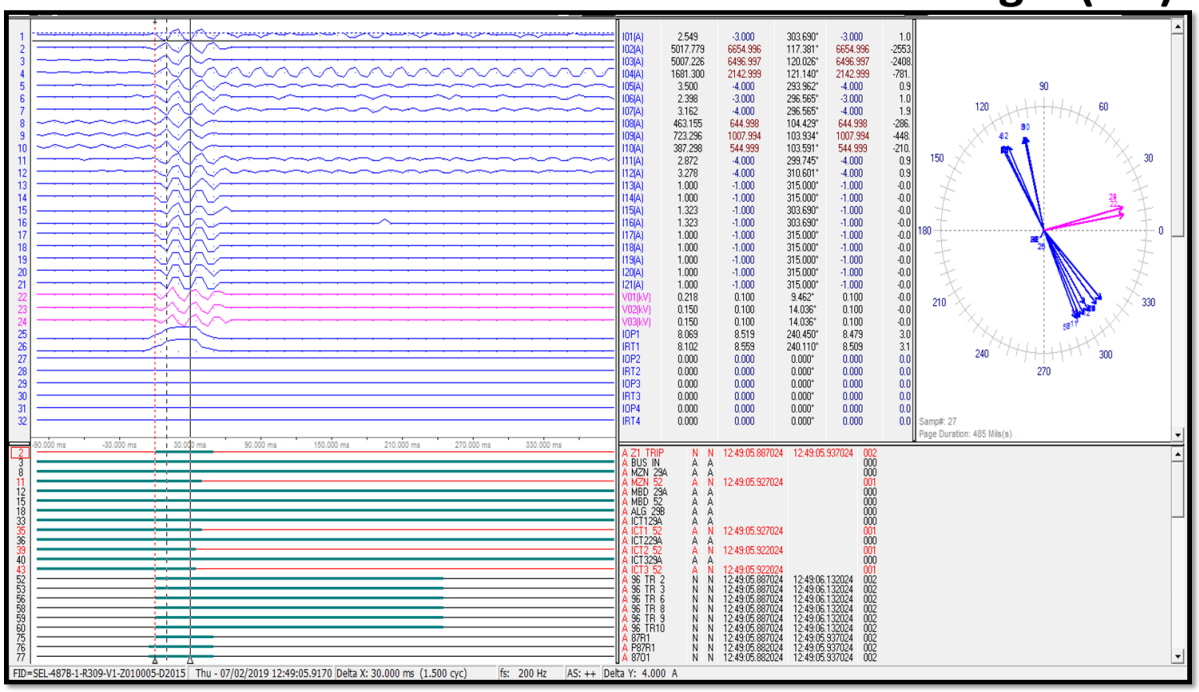
As per the information provided by UPPTCL, while working on 400KV bus coupler at 400KV S/S Muradnagar, 400KV busbar protection operated. It led to the tripping of above mentioned 400KV lines and ICTs (400/220KV).

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.

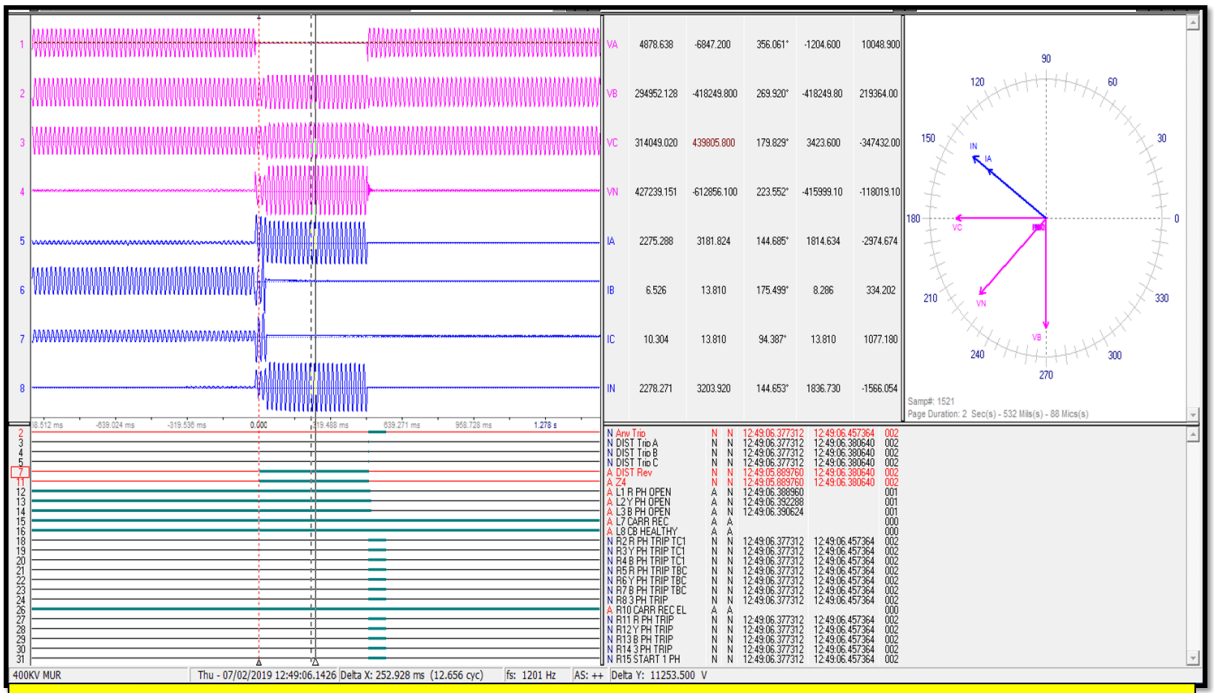
S. NO.	Tripping Date/Time	Closing Date/ Time	Name of Substation	C.B. No. with Direction (Code)	Type of Relay Scheme	Flags & Indications Observed	F/L (KM)	Analysis
1	2	3	4	5	6	7	8	9
2	07.02. 2019 12:49:05	07.02. 2019 14:04	400 KV MURAD NAGAR-I	T-92 HAPUR	MICOM REL-670	CP:- NIL RP: MI=86A MII=86B A/R Panel=Aux 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)



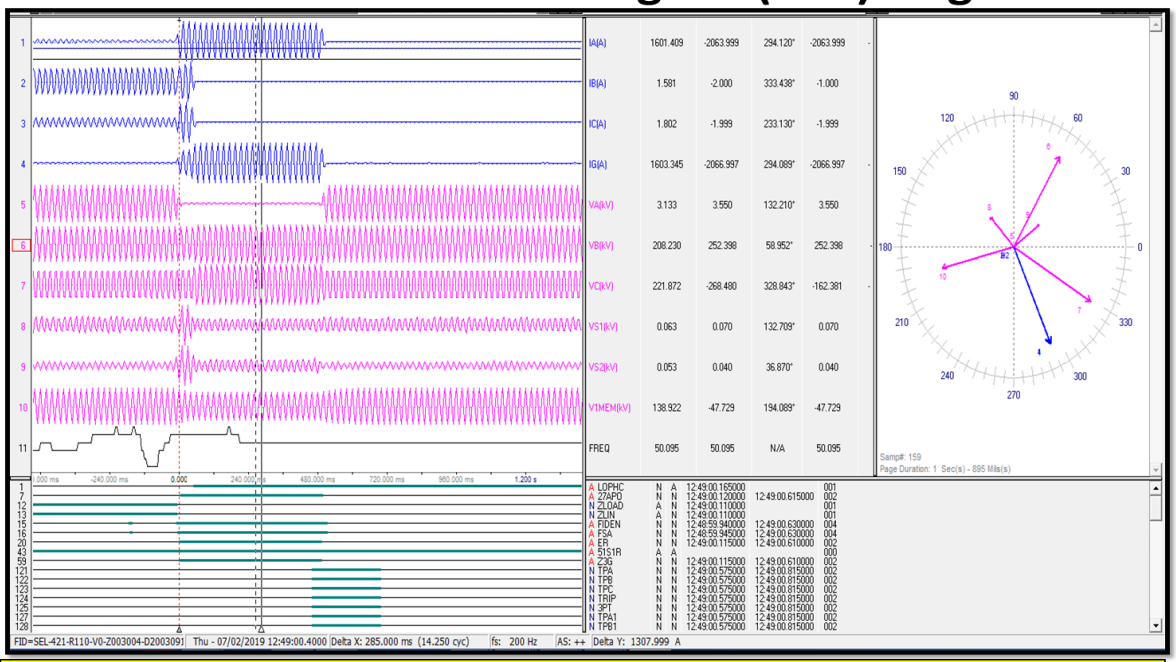
- **400 kV Bus Bar Protection operated for 400 kV Bus-B**
- **400 kV Bus-A also operated due to bus tied operation**

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 (end)-Aligarh ckt



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

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 representative informed following in the meeting:

1. Bus coupler at 400kV was in open condition. Therefore, isolator opening occurred on load.
2. Isolator/ breaker auxiliary contacts for 400 kV Aligarh line at 400 kV Muradnagar1 (UP) would be replaced in 2 days.

3. 400/220kV ICTs also tripped due to inter-tripping from 220kV side.
4. At 220kV side, only 220kV Faridnagar ckt is radial.

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	

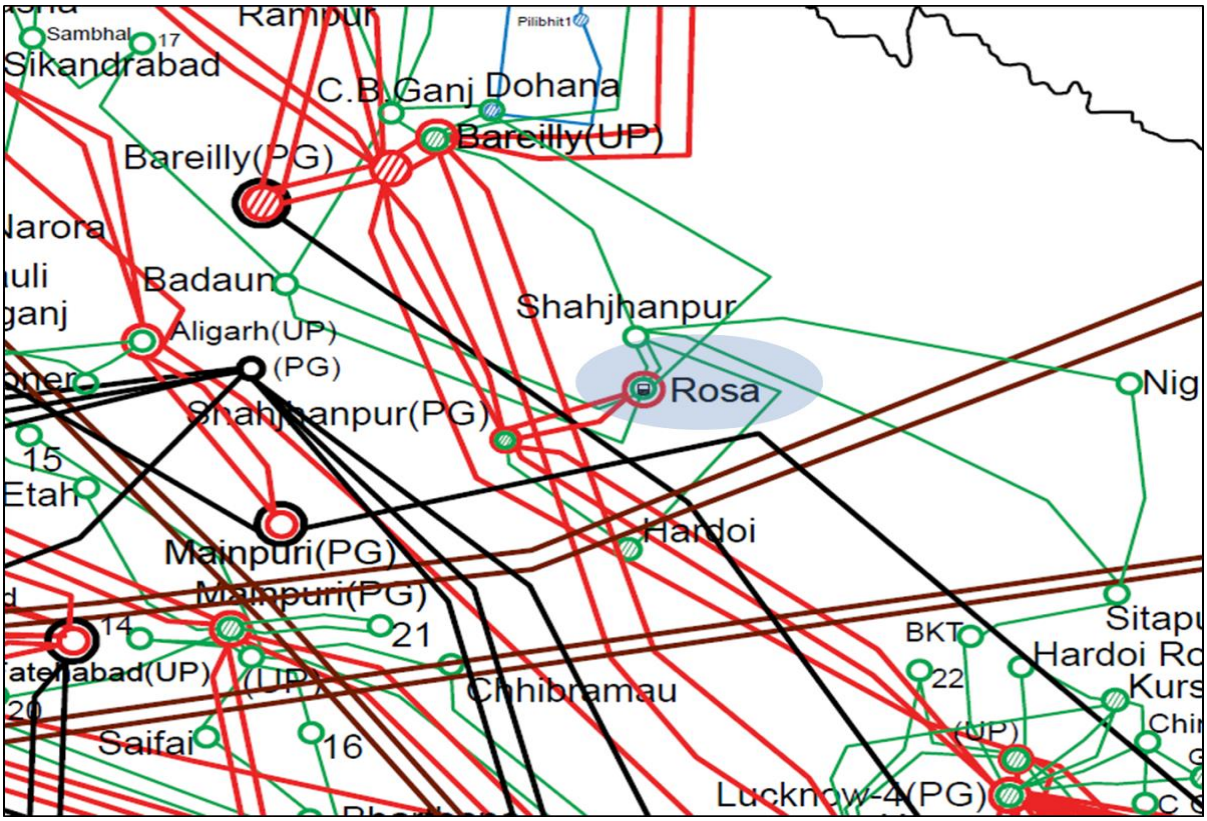
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Not Available	Available only for 220 kV Rosa-Dohna ckt
DR/EL	Uttar Pradesh	Not Received	Only EL details received after 24hrs
Preliminary Report	Uttar Pradesh	Received	Within 24hrs
Detailed Report	Uttar Pradesh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

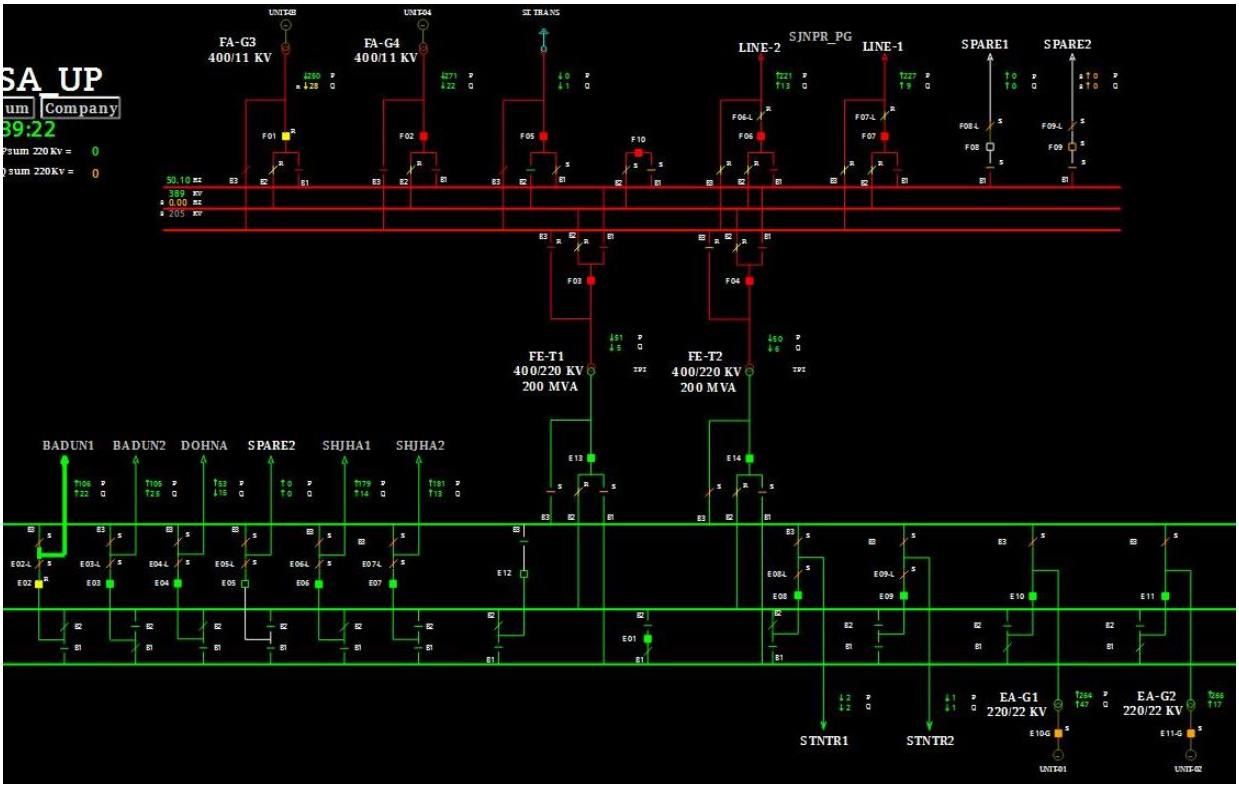
Description	Clauses	Utility	Remarks

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 3. Adequately Sectionalized and graded protective relaying system 4. Incorrect/ mis-operation / unwanted operation of Protection system 5. Delayed clearance of Fault

Based on above information description of the events is:

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





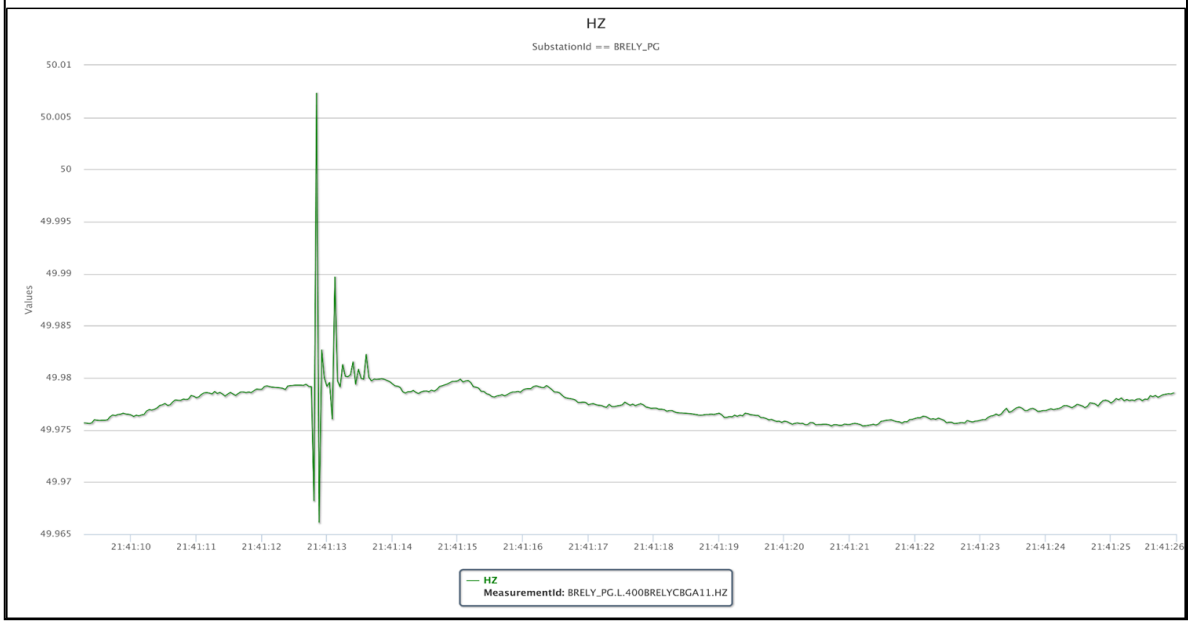
2. In antecedent condition, All the four unit of Rosa were in shutdown condition at the time of fault.
3. At 21:41hrs on 07-Feb-19, B-N fault occurred in 220kV Rosa-Dohna ckt.
4. The CB of aforesaid line failed to open resulted in LBB protection operation.
5. All 220kV connected elements tripped on LBB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

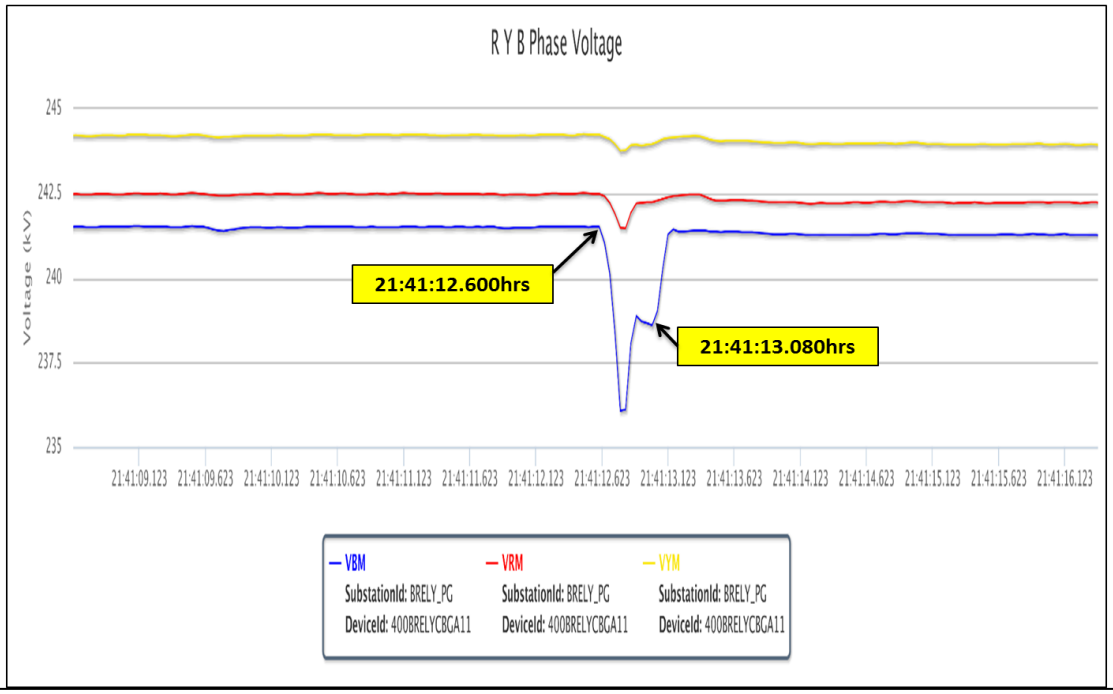
PMU Plot of frequency at Bassi(PG)

21:41hrs/07-Feb-19



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:

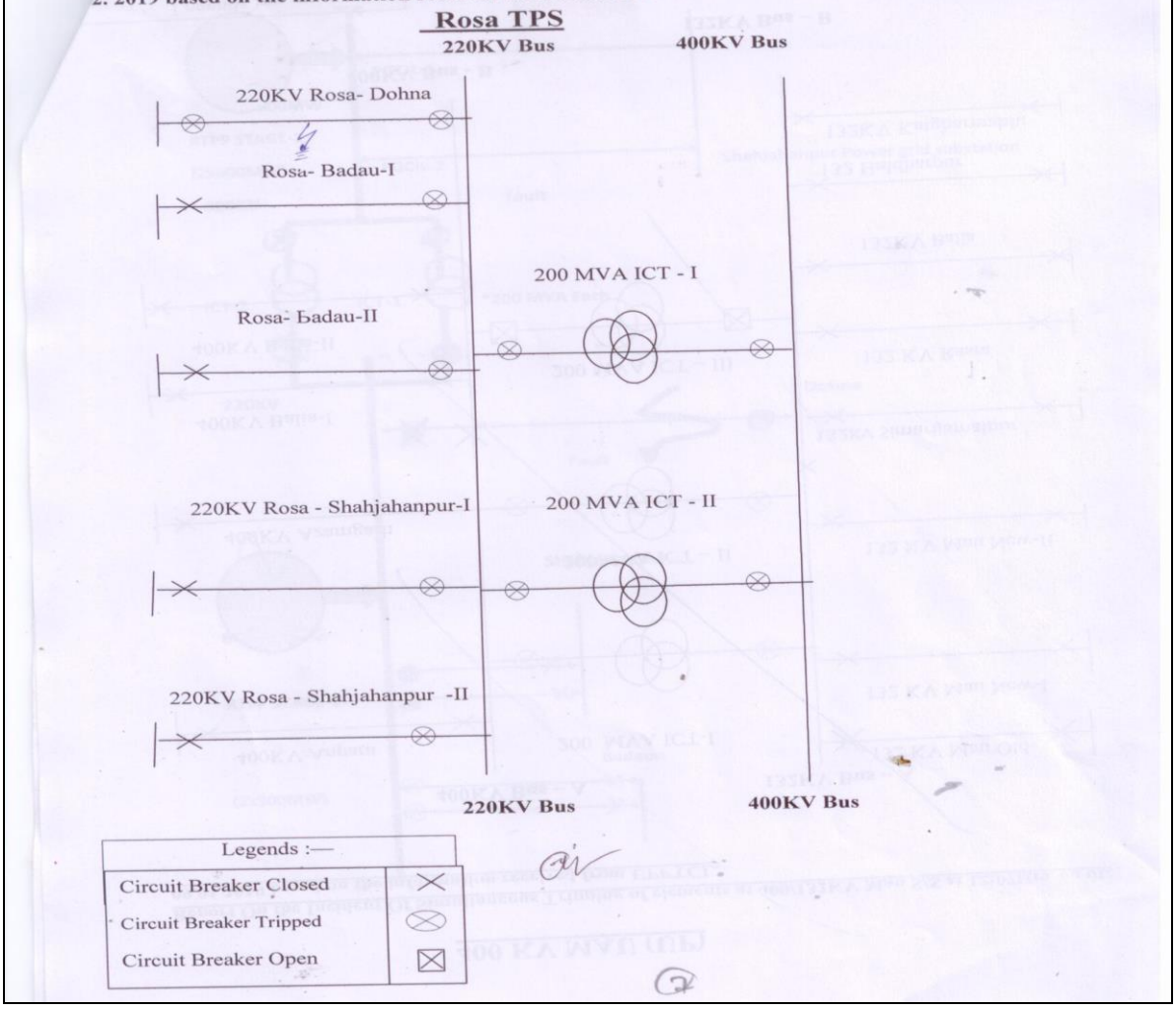
Analysis:-

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.

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



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.

No representative from Rosa TPS was present in the meeting.

SE, NRPC raised concern for non-submission of detailed report and suggested SLDC-UP to collect the information and share with NRPC.

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

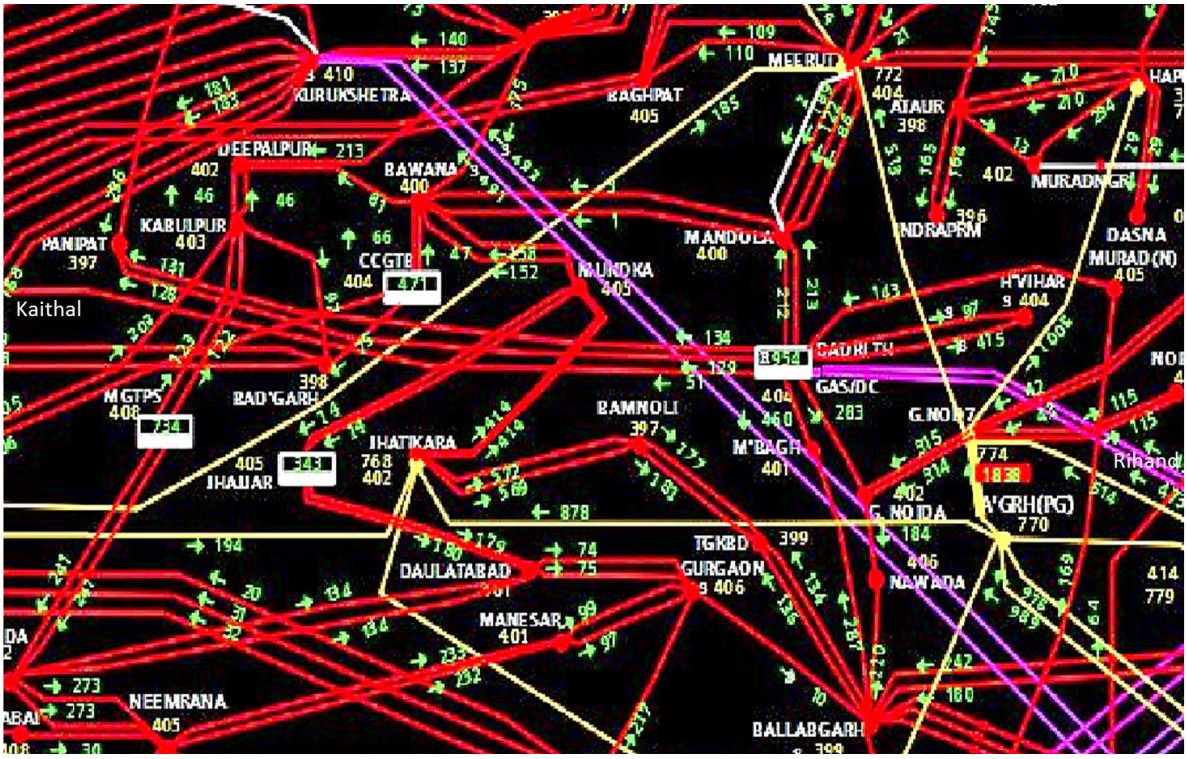
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)		Partially Received	
DR/ EL	POWERGRID	Partially Received	Within 24hrs

	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.

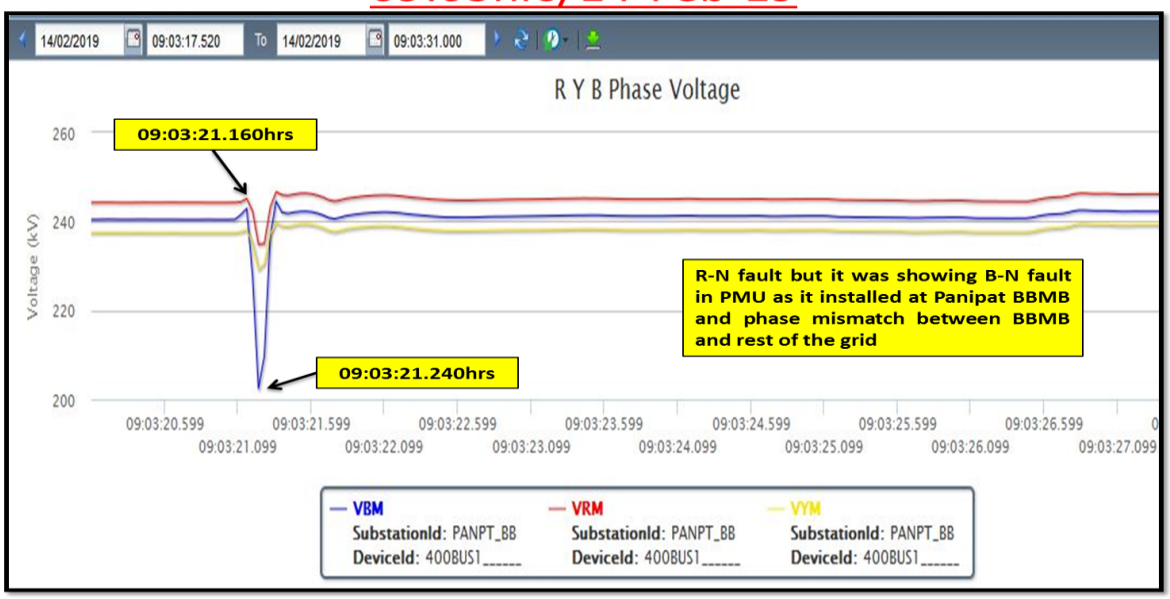
8. PMU plots:

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**.

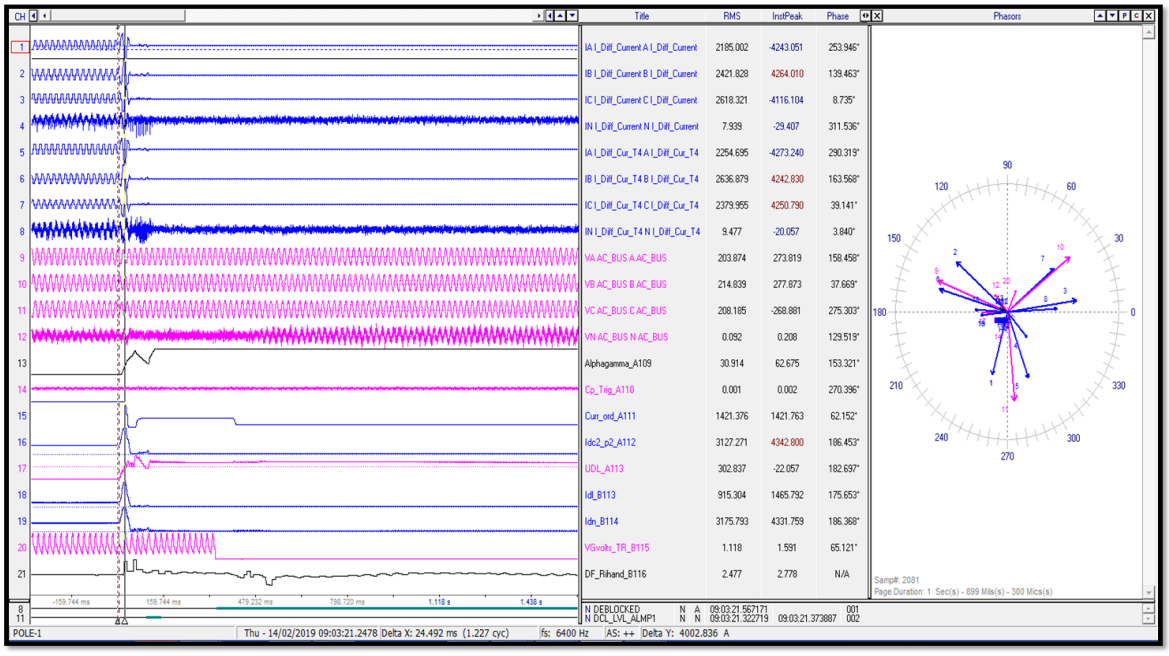
10. SCADA data and SoE: SoE captured in NR SCADA SoE for some of the tripped elements

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	6RHNHV1	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 redings 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 Tansfer 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 unsuccesful 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			
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 09:03:29.919	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)

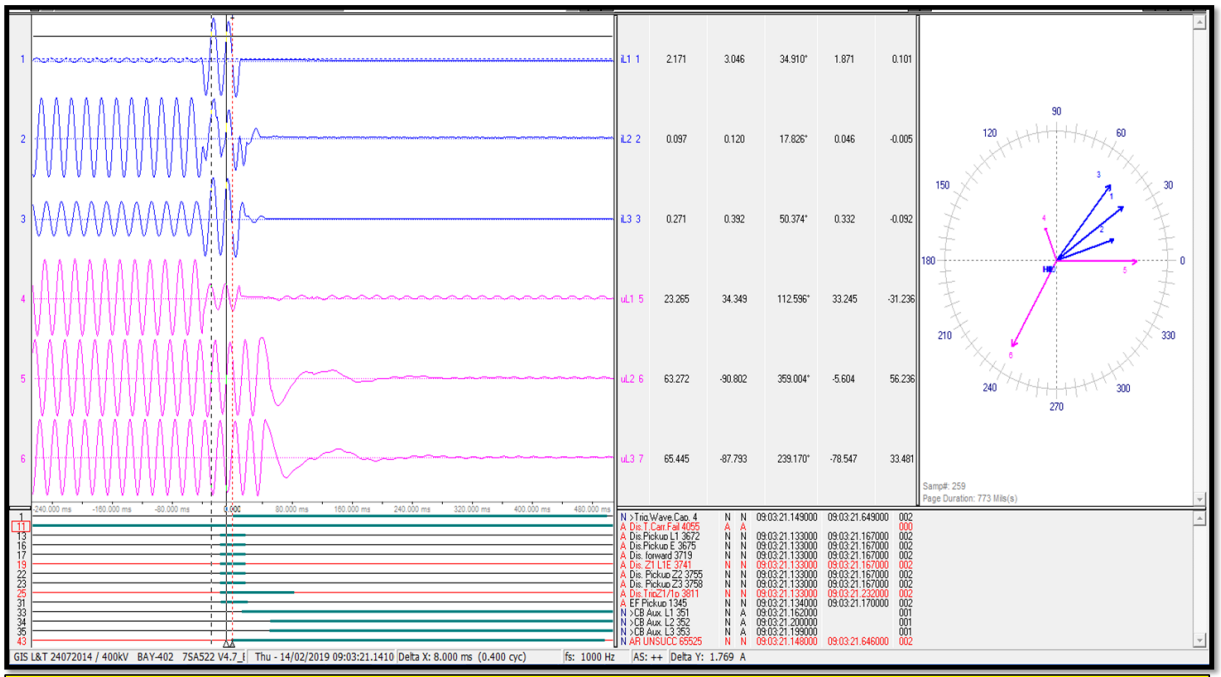
And

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.

Utilities informed during the meetting:

POWERGRID representative informed the following in the meeting:

1. Pole 1 of Rihand-Dadri HVDC Link tripped from Dadri End on Converter Transformer Differential Protection at 09:03 AM on 14.02.2019. After isolation of Pole 1 all the converter transformers were checked for any flashover marks. No flashover marks were found. Also, no trapped gas was found in the Buchholz relays of the converter transformers. No sign of the fault in the converter transformer has led to the reasoning that associated protection system may have malfunctioned. Then all the associated control cables coming from the Bushing CT Terminals were check for any fault. After Megger test One Cable coming from Pole 1 Y-Phase Converter Transformer X3 Bushing CT was found faulty. After inspection cable was found broken. Due to this broken cable Differential protection system detects the differential current in the converter transformer. This cable was replaced with the new one. Again, Megger testing of all the cables were carried out. After successful testing of all the cables Pole 1 was charged at 12:20 on 14.02.2019.

2. SPS mal-operation for HVDC Rihand-Dadri has already been taken up with OeM and will be rectified soon. Time difference of 100ms between SPS operation and pole blocking will also be discussed with OeM.
3. Reason of 265 ms time difference between both end Pole tripping of HVDC Rihand-Dadri will be checked and reported.

Delhi representative informed the following in the meeting:

1. Delhi representative informed that fault was in 400 kV Dadri-Harsh Vihar ckt-1 and line tripped without A/R attempt due to communication failure in the line. Fault was transient in nature and line charged successfully in next charging attempt.

NTPC representative informed the following in the meeting:

1. NTPC representative informed that line tripped from Dadri end in Z-1 distance protection. However report will be shared later on.

G. 400kV Bus-3 tripping at 400/220kV Ballabhgarh(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

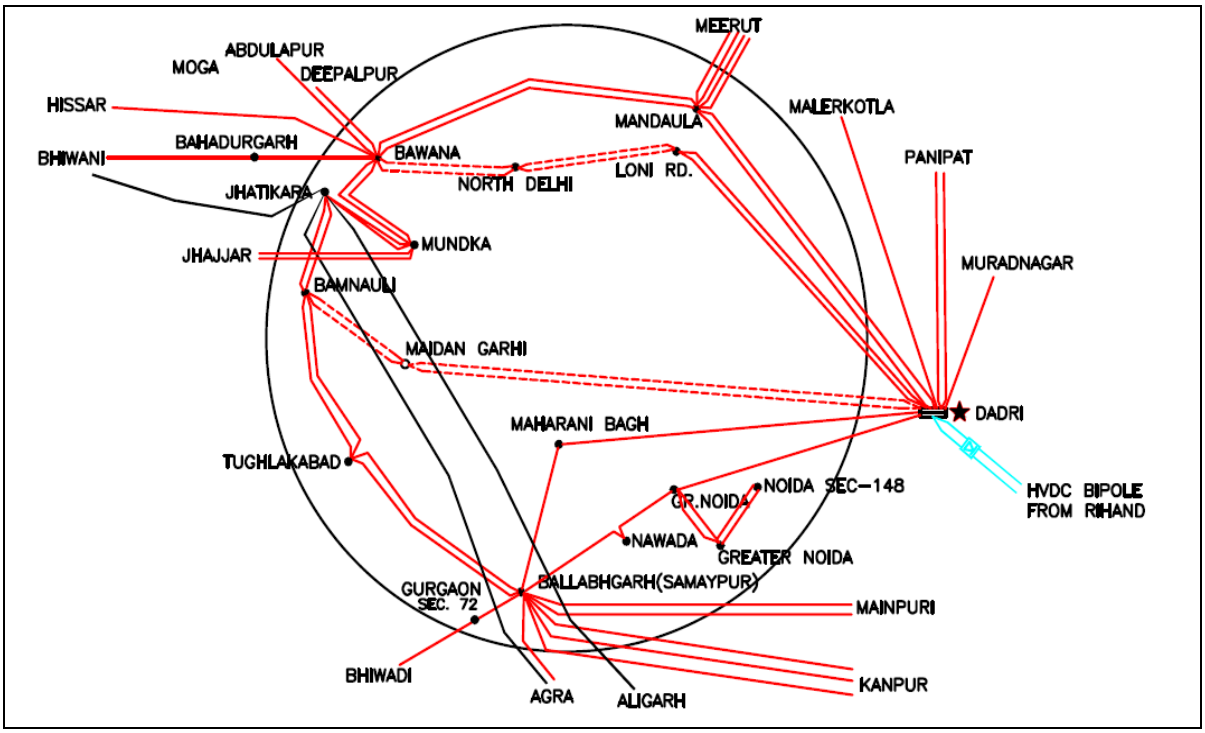
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	POWERGRID	Available	Partial data
DR/EL	POWERGRID	Received (after 24hrs)	DR/EL received partially
Preliminary Report	POWERGRID	Received (after 24hrs)	

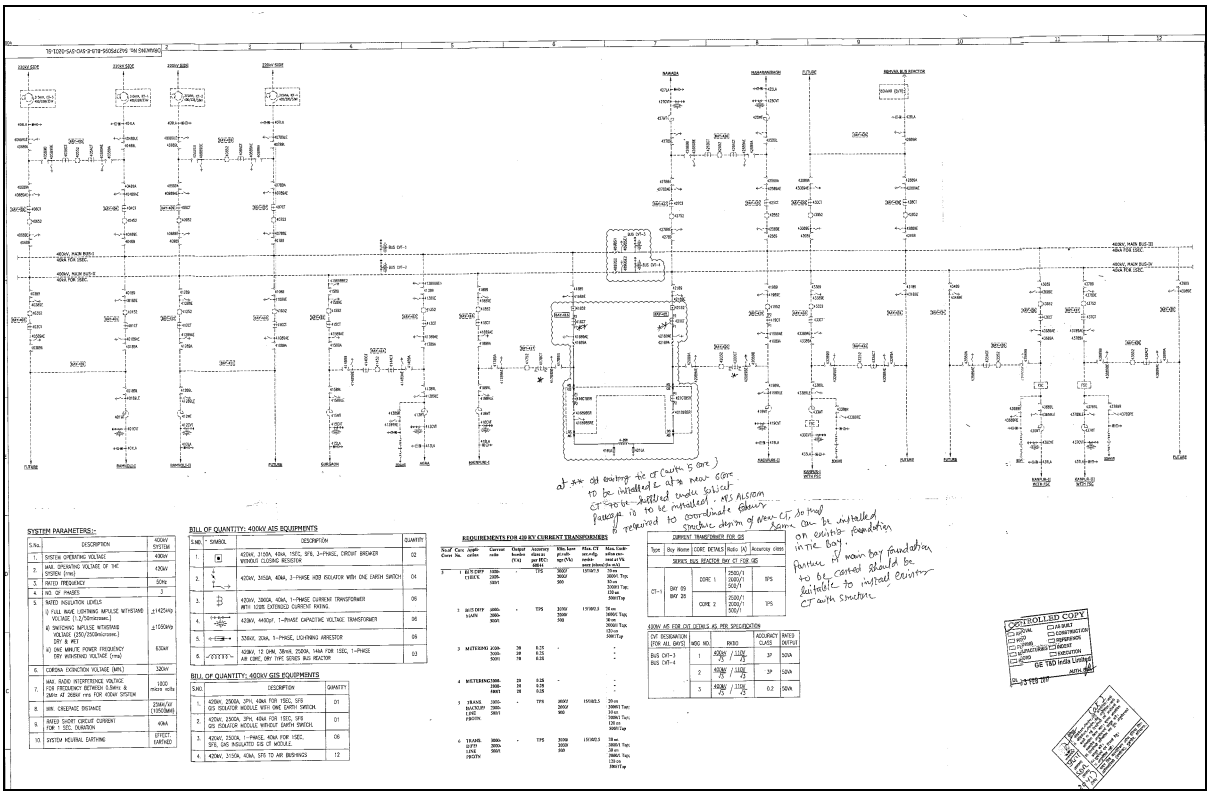
Detailed Report	POWERGRID	Not Received	

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 Ballabhgarh(PG):



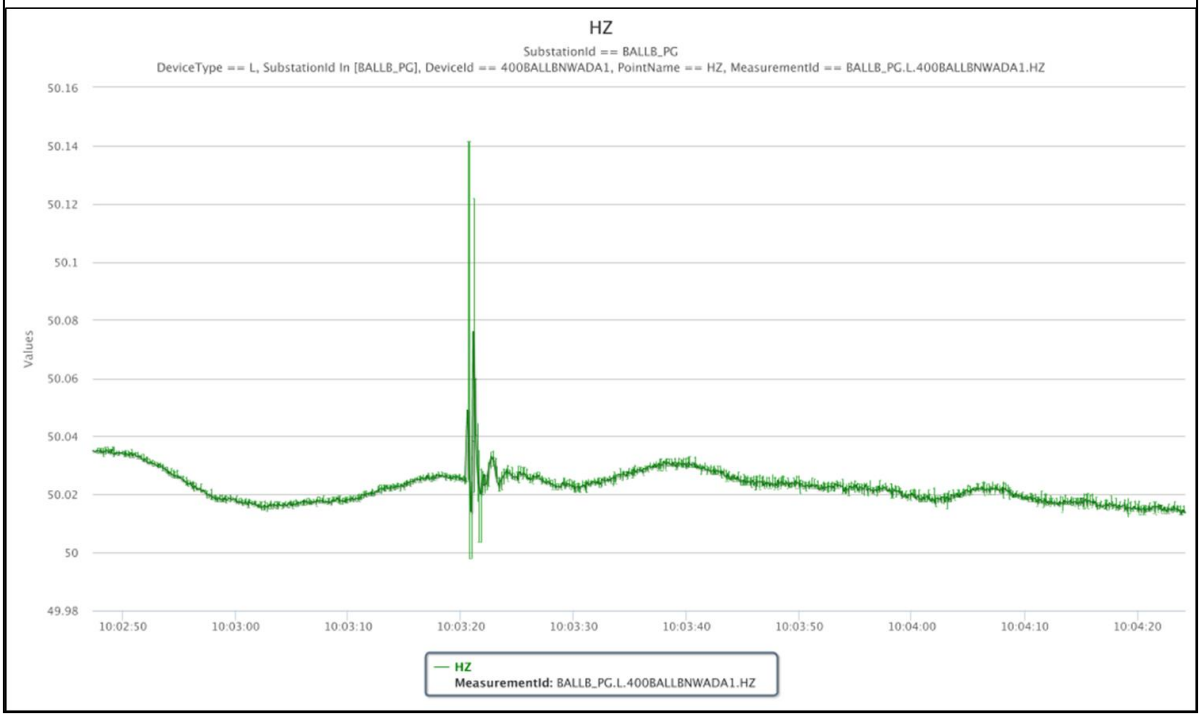


18. 400/220kV Ballabhgarh(PG) is connected at 400kV through Kanpur(PG) 3 ckts (with FSC), Maharani Bagh(PG), Nawada(HVPNL), Mainpuri(PG) D/C, Agra(PG), Gurgaon(PG) and Tughlaqabad(PG) D/C. It has one and a half breaker bus bar scheme. Recently, a series reactor has also been installed between bus-1 and 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 Ballabhgarh 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 Ballabhgarh-Kanpur 3 ckts
    - 400kV Ballabagarh-Mainpuri-2
    - 80MVAR bus reactor

22. PMU plots:

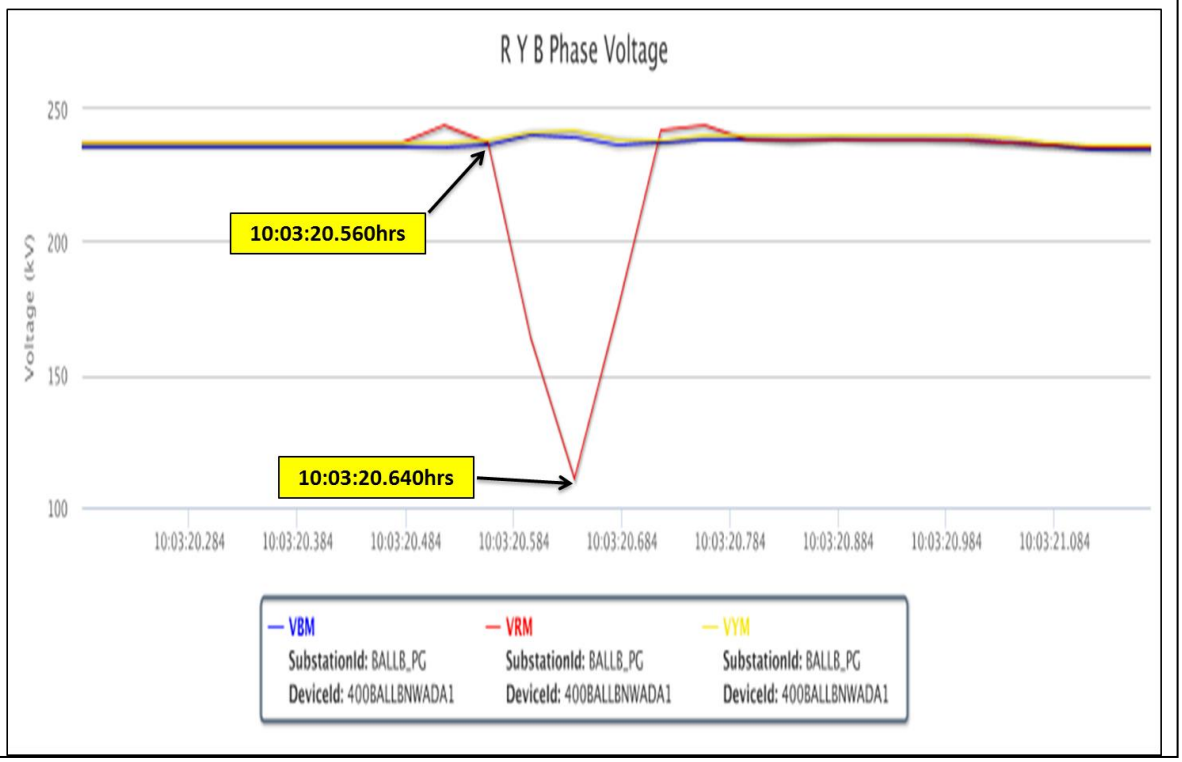
PMU Plot of frequency at Ballabgarh(PG)

10:03hrs/25-Feb-19



PMU Plot of voltage magnitude at Ballabhgarh(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.

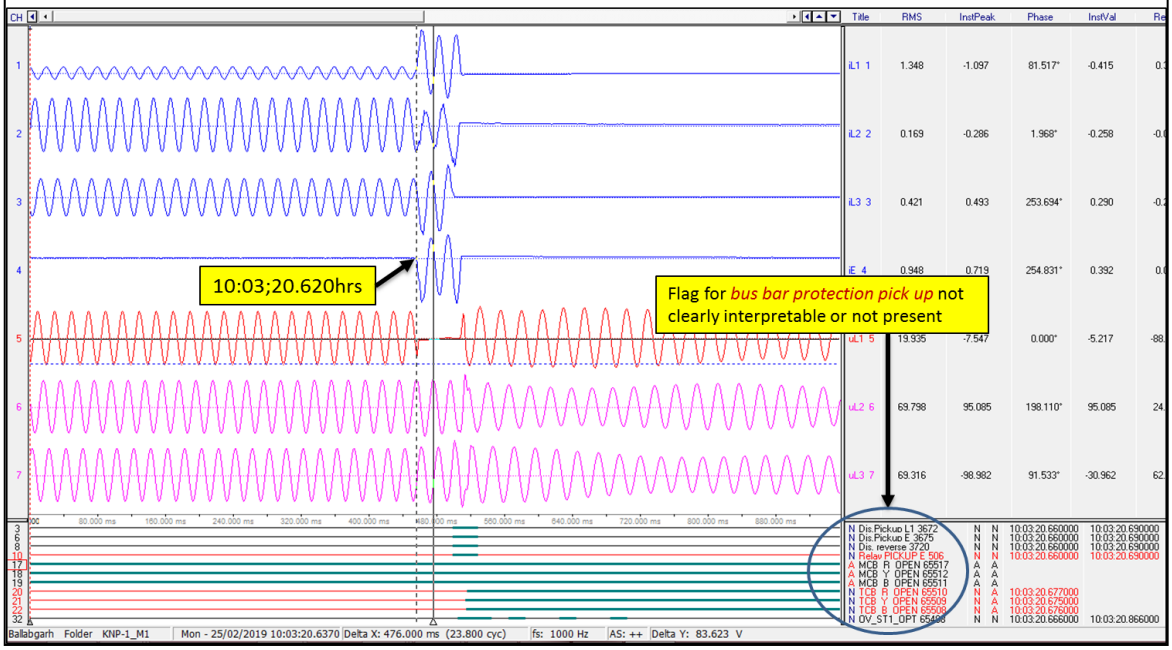
3. Outage of following transmission elements resulted during above incident:

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

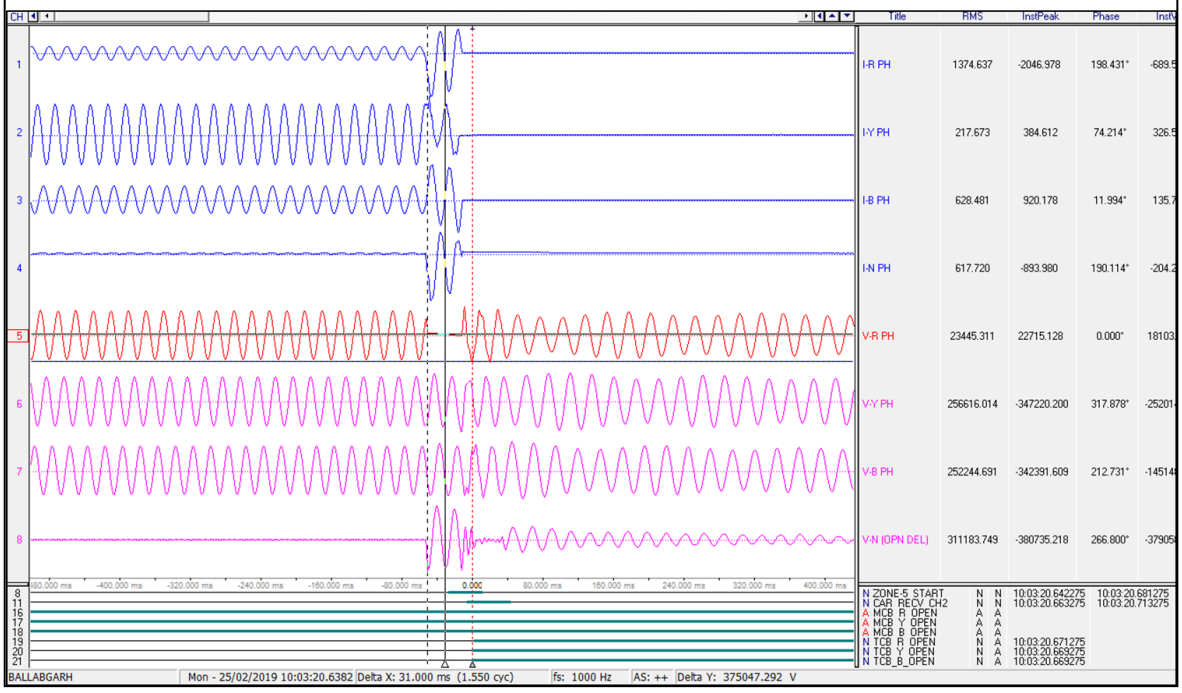
-80MVAr Bus Reactor

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

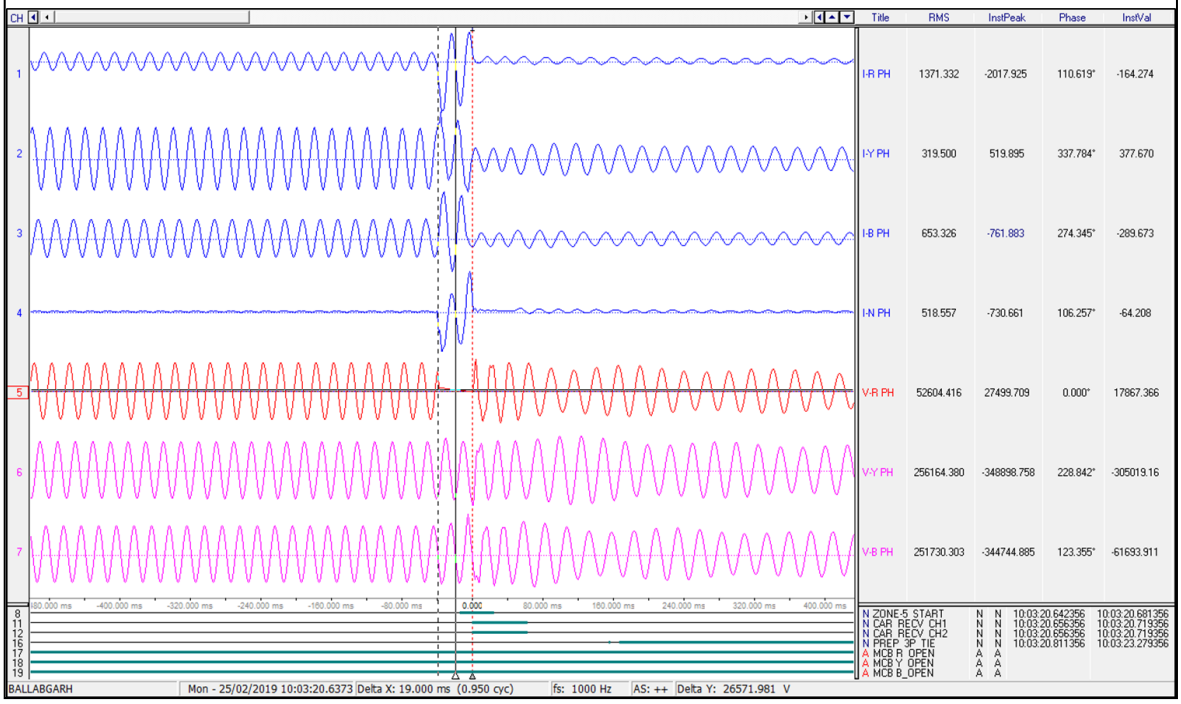
DR: 400kV Ballabgarh(end)-Kanpur-1



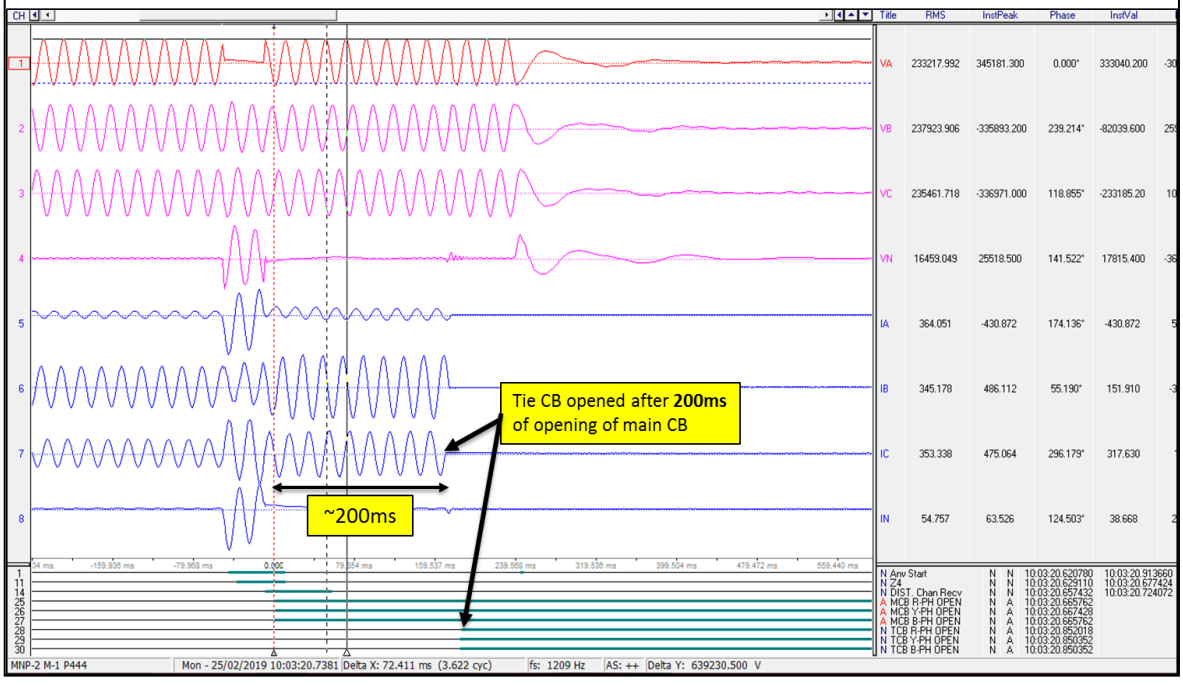
DR: 400kV Ballabgarh(end)-Kanpur-2



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



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



25. As per PMU, SCADA SoE, DR data:
    a. As per PMU, DR and SCADA SoE, R-phase fault occurred at 10:03:20.600hrs.
    b. 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 Ballabhgarh 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 representative informed the following in the meeting:

1. Cause of the incident was manual error during operation. Instruction has been issued in this regard.
2. 400 kV Bus Bar Protection at 400 kV Ballabhgarh (PG) was operated successfully for 400 kV Bus-3 & 4 at 400/220 kV Ballabhgarh (PG).
3. Mechanical Interlock was not possible being a sectionaliser isolator. Electrical interlock between bus sectionaliser and earth switch of charged bus have been some issues since commissioning. Electrical interlock has been rectified.
4. Bus Series Reactor at 400 kV Ballabhgarh (PG) have two main protections, differential protection and backup impedance protection.
5. 400 kV Ballabhgarh (PG) end-Mainpuri-2 ckt is in same dia with 400 kV series bus reactor charged through tie circuit breaker. After 150ms of bus bar protection operation, backup impedance protection of series bus reactor operated due to issue with the logic of fuse failure in the relay. It

further resulted into tripping of tie CB of 400 kV Ballabhgarh (PG) end-Mainpuri-2.

6. After operation of bus bar protection for 400 kV Bus-3 & 4, bus voltage input from Bus-3 & 4 side to backup impedance protection became zero. In case of all three phase voltage input became zero, fuse failure shall be enabled on 3-pole dead and disable the backup impedance protection but in this event relay didn't block in fuse failure. This event was again played in the relay to check the reason of non-operation of fuse failure logic but at this time relay operated perfectly and blocked the backup impedance protection during fuse failure. Issue has been taken up with OeM but event couldn't have concluded.
7. 400 kV Ballabhgarh (PG)-Kanpur ckt-2 & 3 tripped as dia was not completed and have two breakers in the dia. Thatswhy both these ckt tripped after tripping of both 400 kV buses at 400 kV Ballabhgarh (PG)

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	

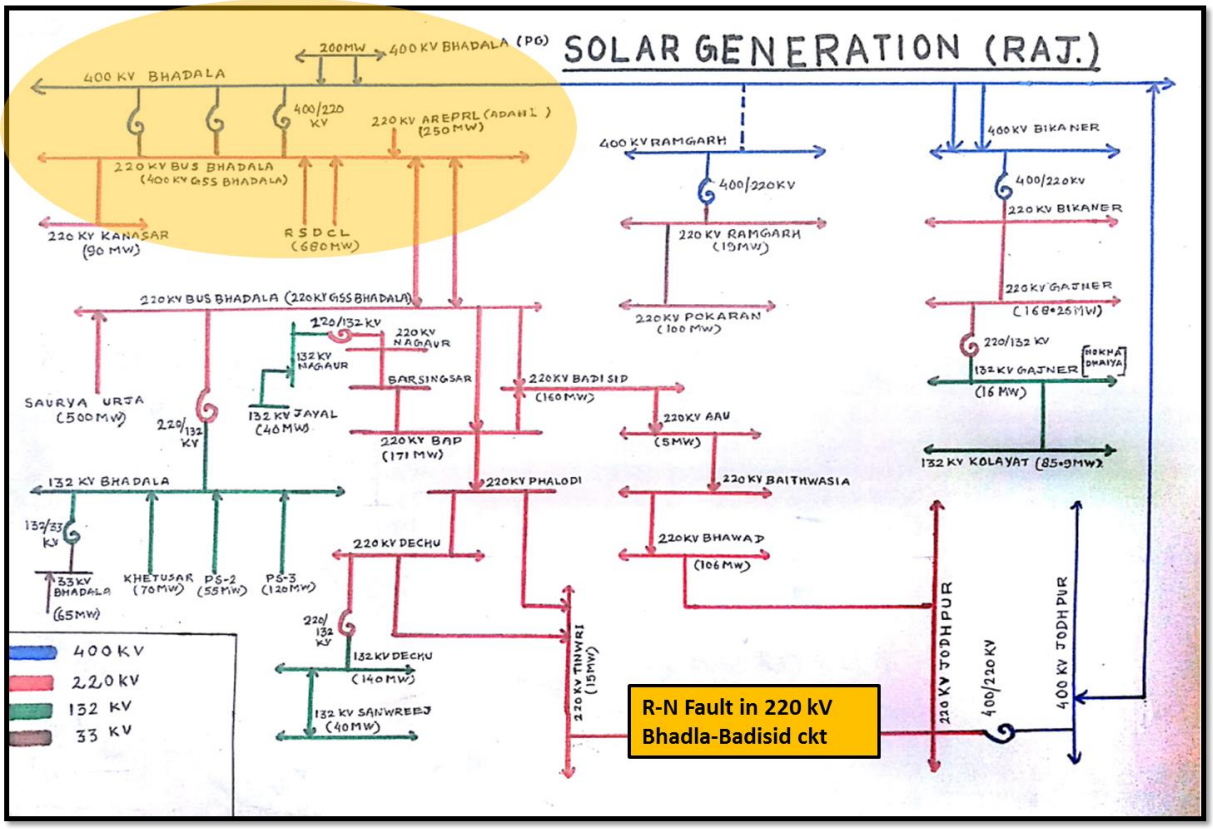
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received (after 24hrs)	DR/EL received partially
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

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 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. 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 Sectionaliser. 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 backup 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:

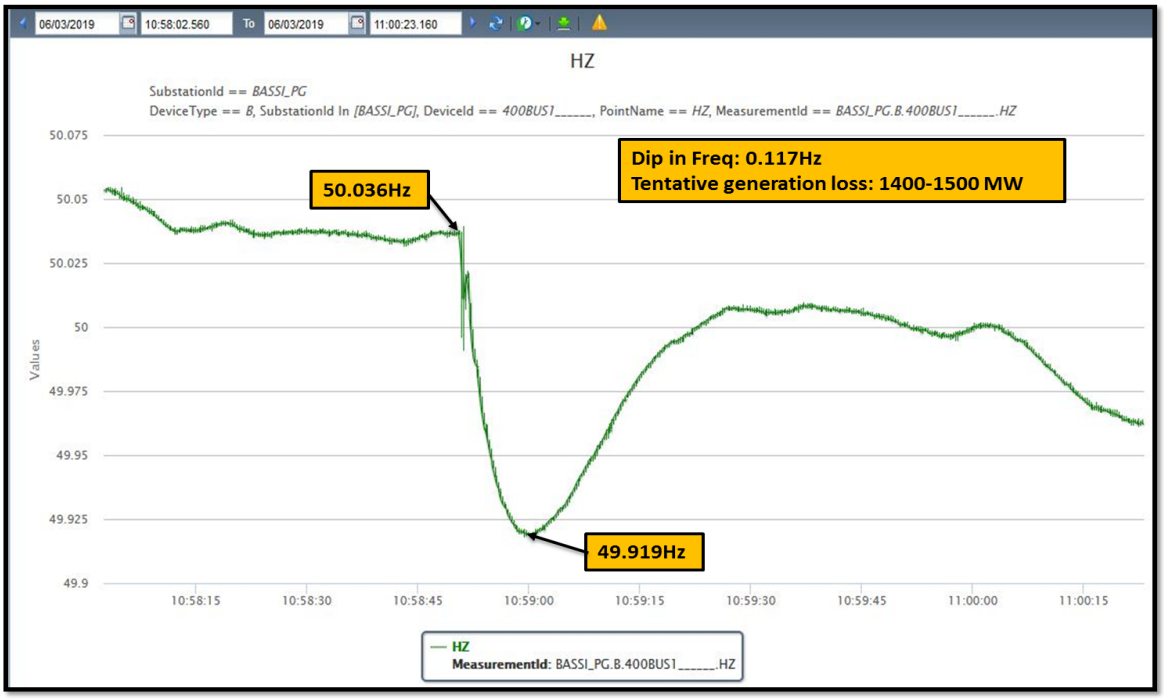
- 220kV Bhadla2(RRVPNL)-Badisid (RRVPNL) ckt-1
- 220kV Bhadla2(RRVPNL)-Saurya Urja(RRVPNL) ckt-1
- 220kV Bhadla2(RRVPNL)-Saurya Urja(RRVPNL) ckt-2
- 220 kV Bhadla2(RRVPNL)-Bap ckt
- 220kV Bhadla(RRVPNL)-RSDCL(RRVPNL) ckt-1
- 220kV Bhadla(RRVPNL)-RSDCL(RRVPNL) ckt-2
- 220kV Bhadla(RRVPNL)-Kanasar ckt

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



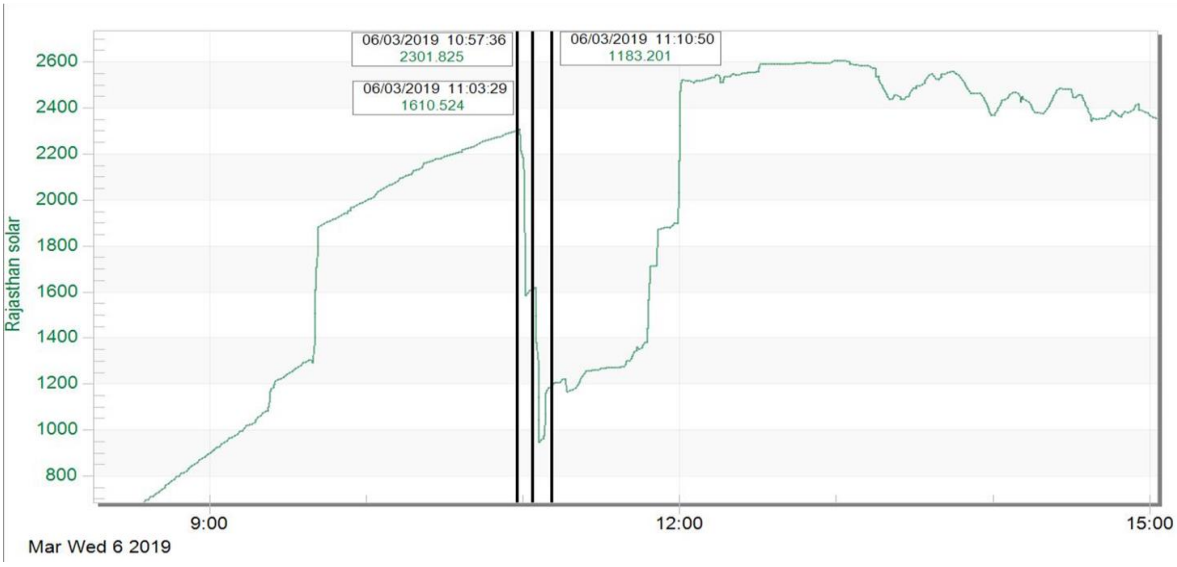
PMU Plot of phase voltage magnitude at Jodhpur(Raj)

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

Date & Time of event: - : 06.03.2019 at 11.00 Hrs.

Introduction of Event: - : Multiples tripping at 220 KV GSS Bhadla

Total Loss of Generation : 445 MW

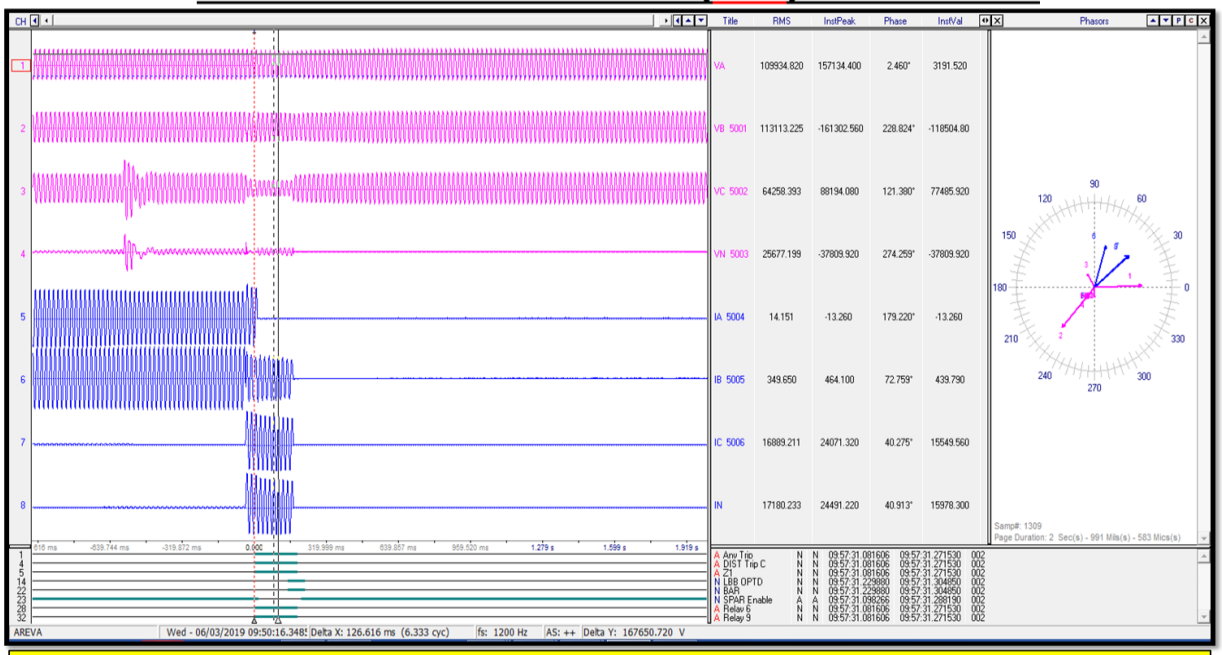
Total Loss of Load: - : NIL

Triggering Incident:-

Total Generation loss~ 1100MW (as per SCADA) however reported as 445 MW

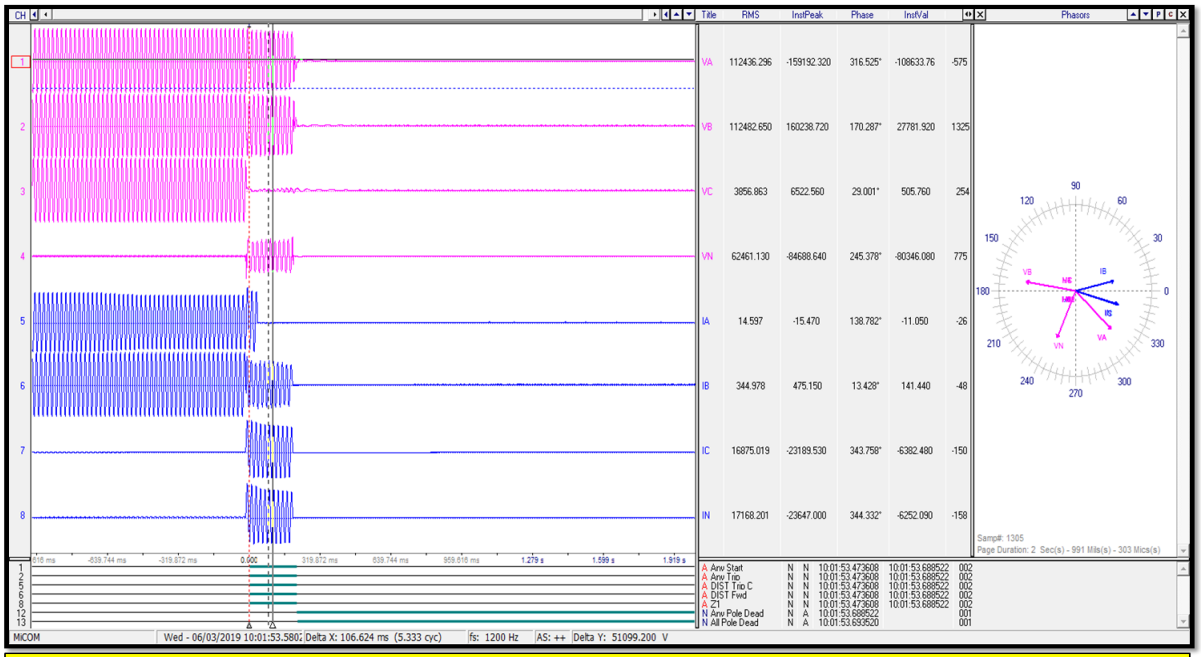
Sr. NO.	NAME OF ELEMENT	TRIPPING DATE	TRIPPING TIME	CLOSING DATE	CLOSING TIME	INDICATION	REMARKS
1	220 KV Bhadla- Badisidh	06.03.2019	11.00	06.03.2019	23.20	Bhala- C Ph, 5.824Km , Z1	R Ph wave trap Jumper broken at Bhadla
2	220 KV Baap – Badla	06.03.2019	11.00	06.03.2019	11.43	Bhadla- M1, DPS, 1.01Km , Z4	

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



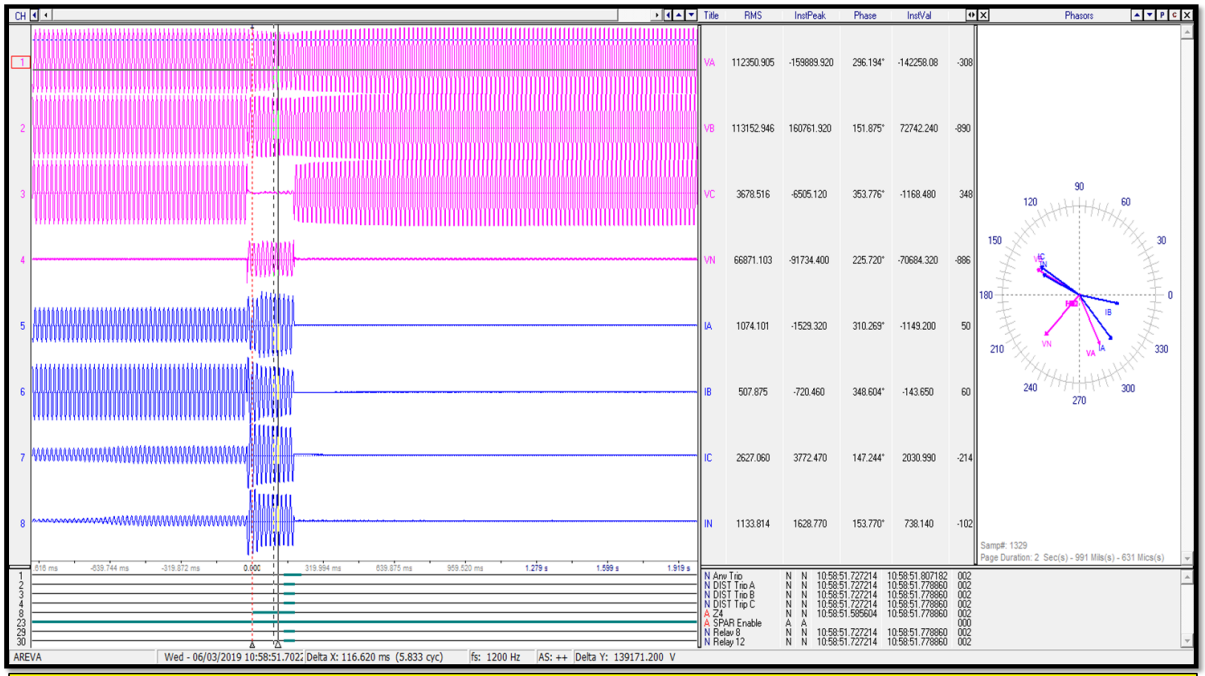
- **DR of different time or time synch error?**
- **Distance Z-1 fault in the line. Fault in Blue phase, LBB operated within 150ms**

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



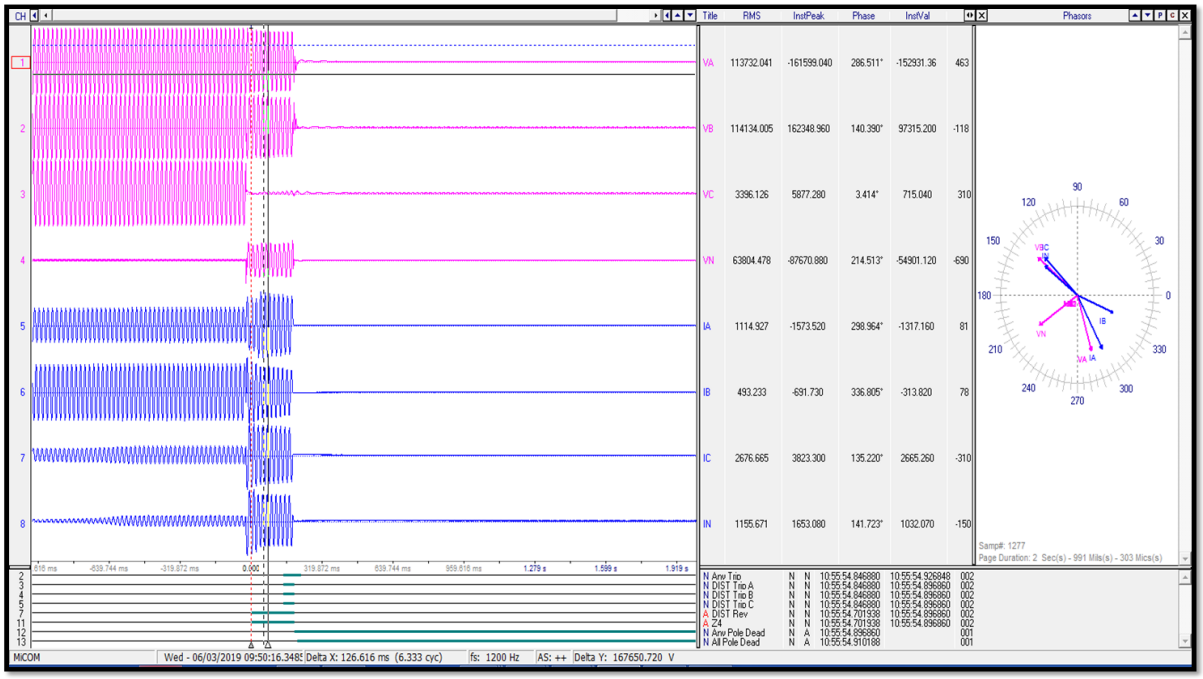
- **DR of different time or time synch error?**
- **Fault in Blue phase, All pole tripped within 220ms of fault occurrence**

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



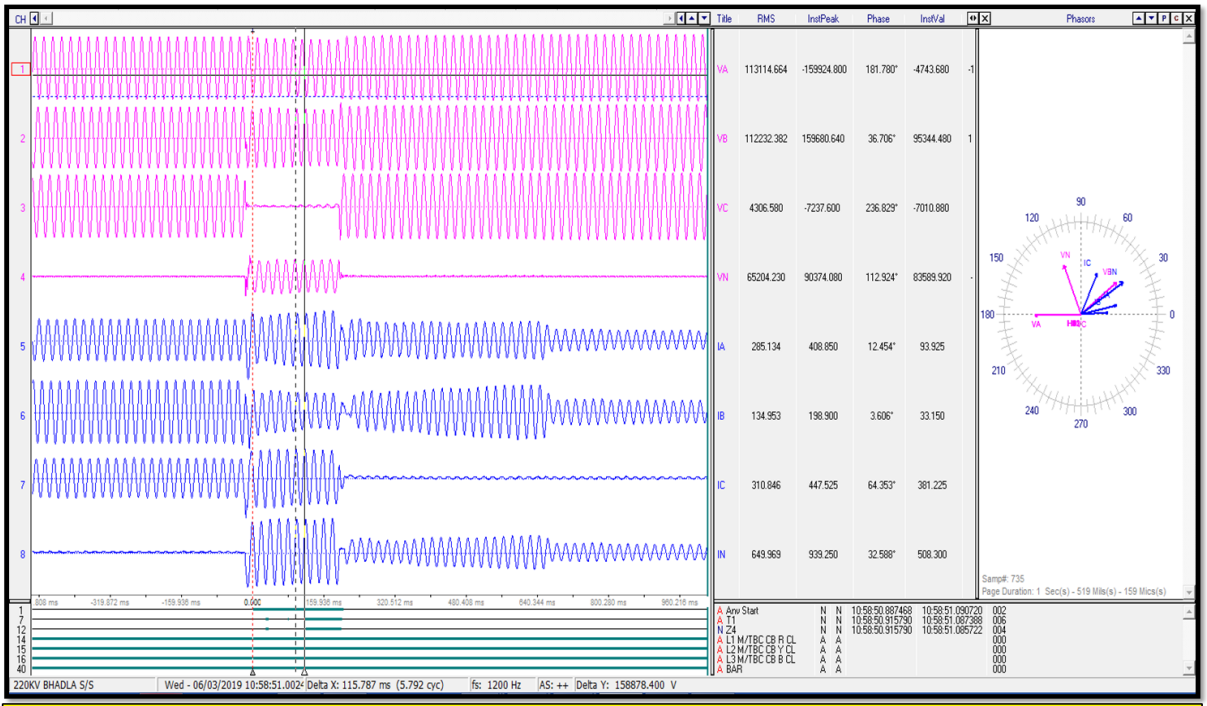
- **Fault in Blue phase, line tripped in reverse zone in 150ms**

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



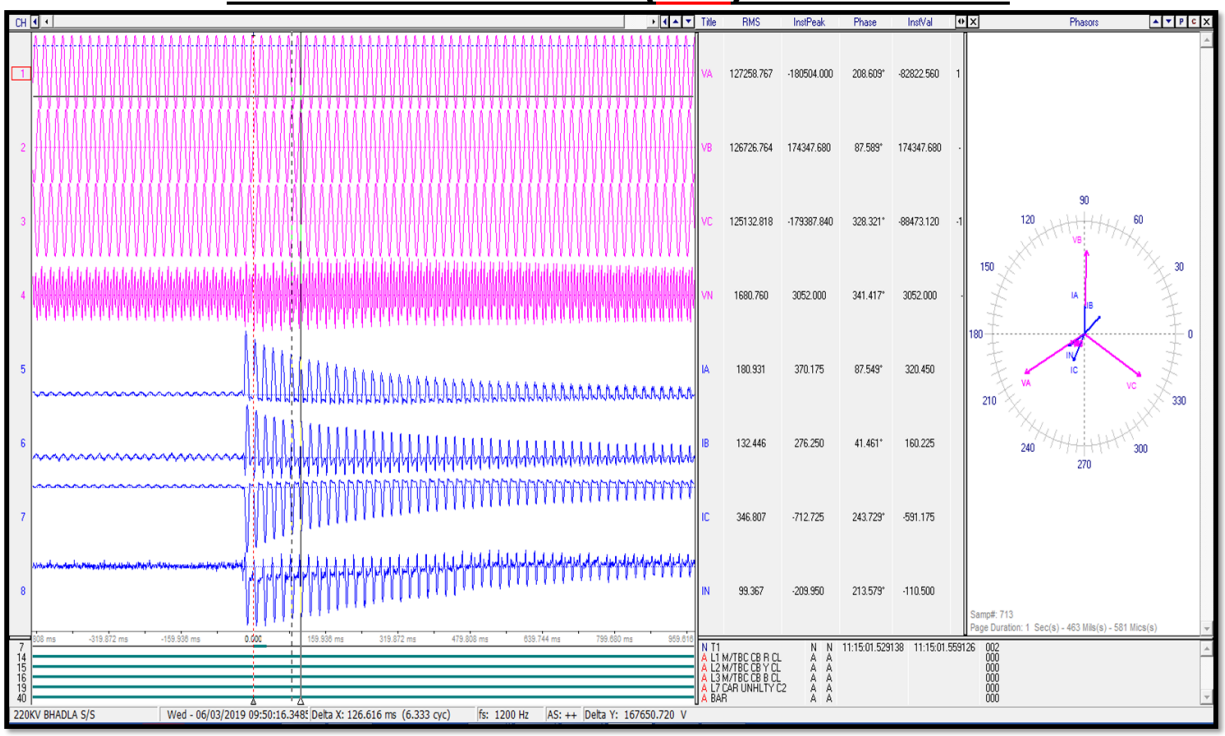
- **Time synch error?**
- **Fault in Blue phase, line tripped in reverse zone**

DR of 220 kV Bhadla (end) –Kanasar ckt

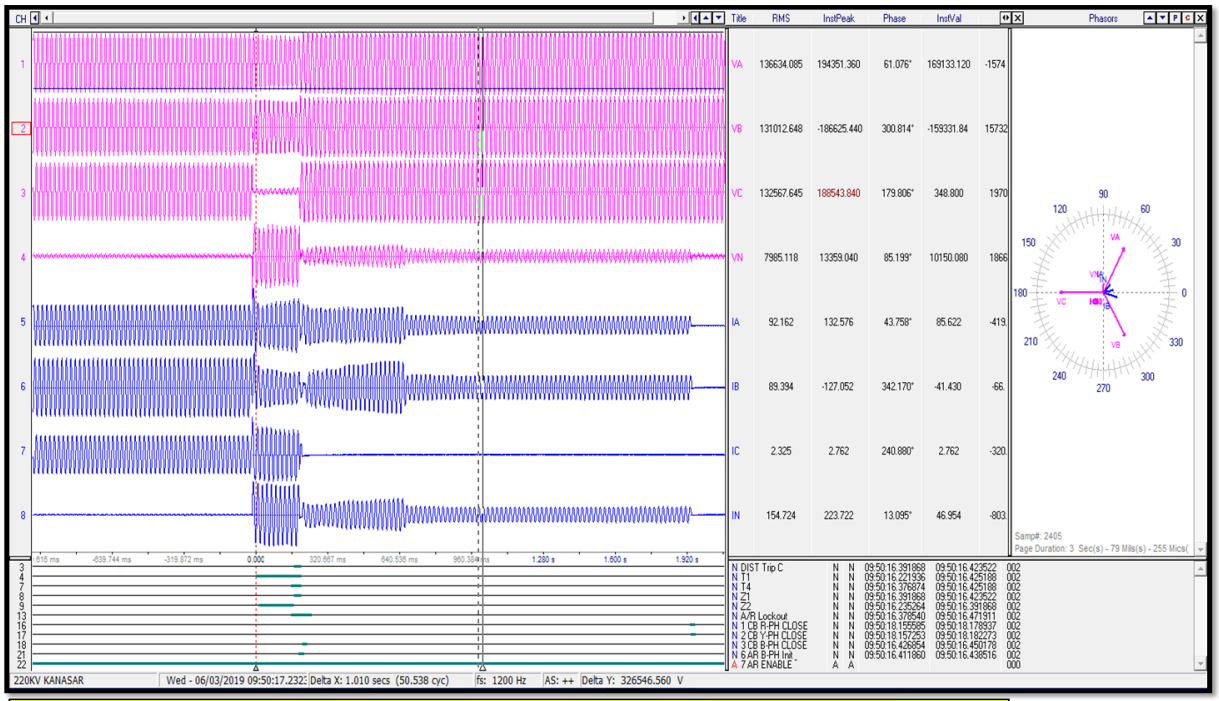


- **Fault in Blue phase, line tripped in reverse zone**

DR of 220 kV Bhadla (end) –Kanasar ckt

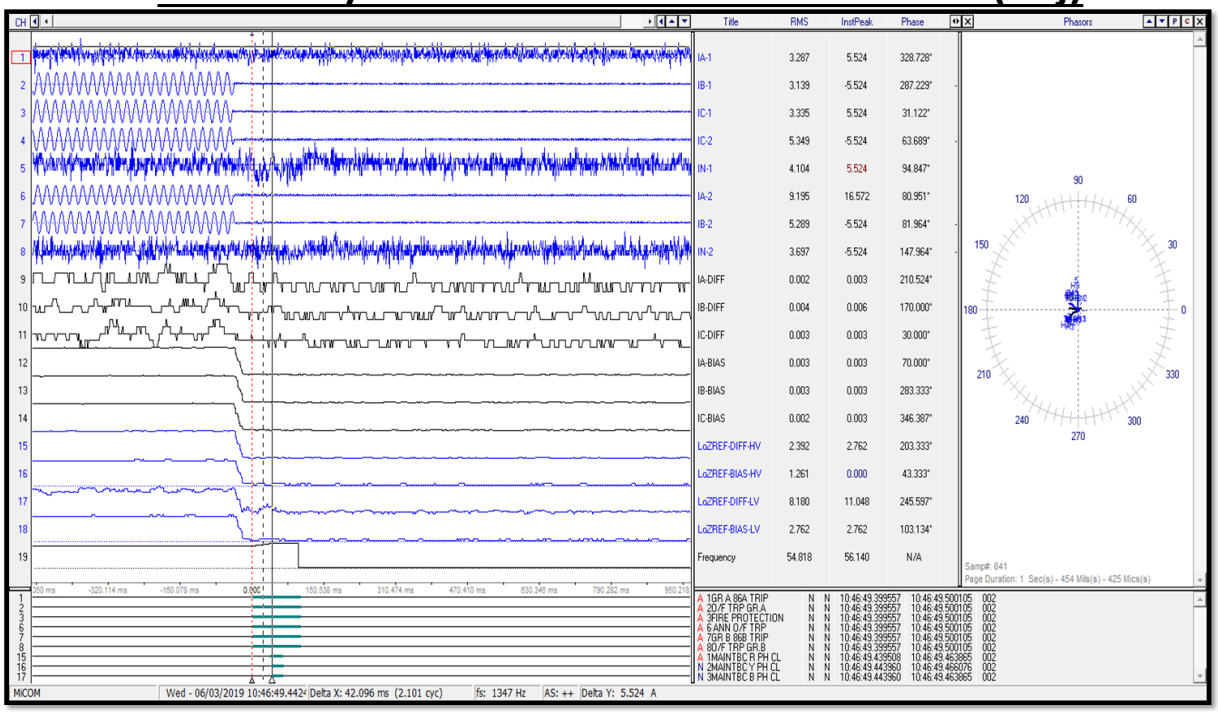


DR of 220 kV Kanasar (end) –Bhadla ckt



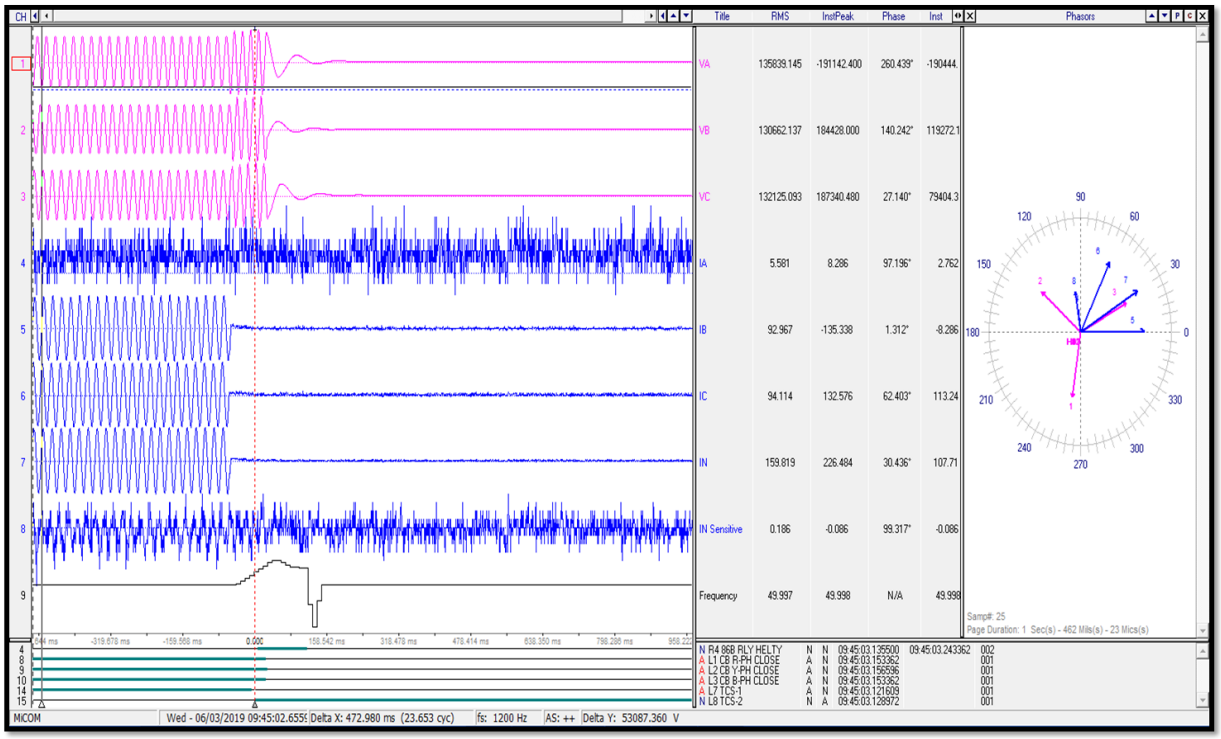
- **Time synch error?**
- **Line tripped in Z-1**

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



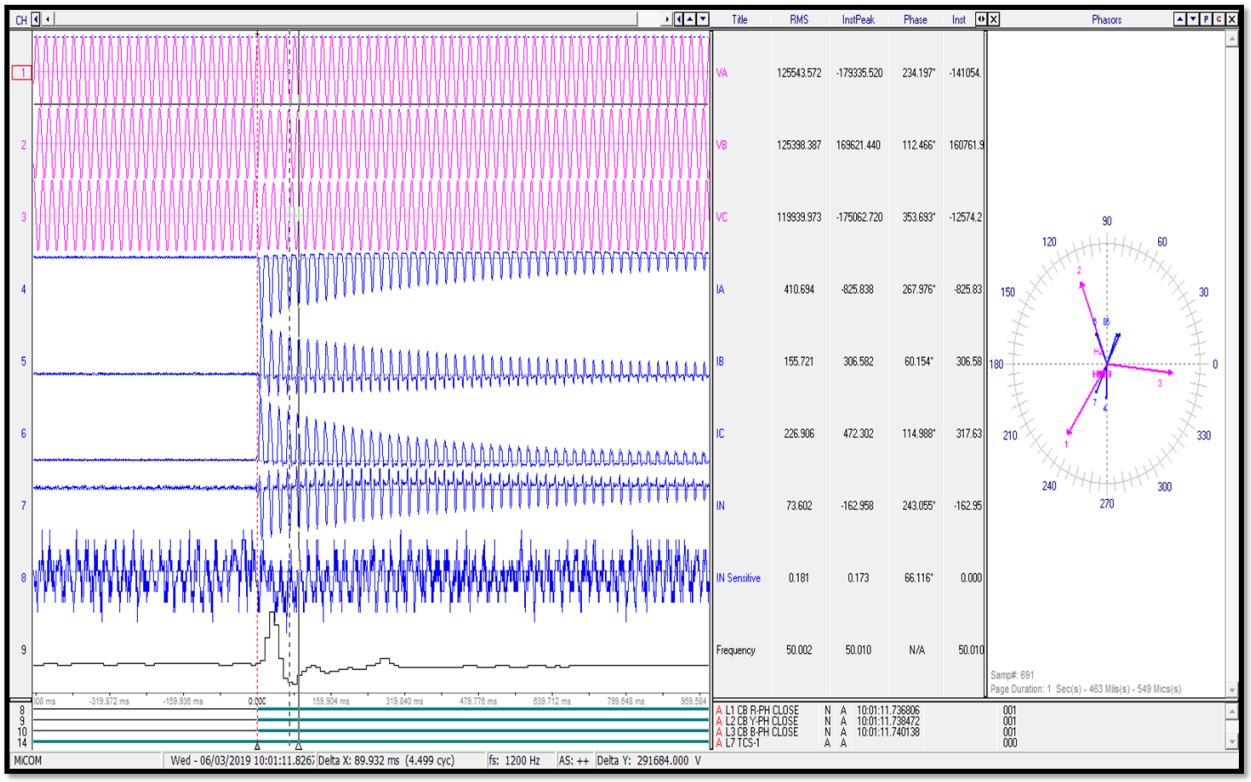
DR of different time or time synch error?

DR of Bus Sectionaliser at Bhadla (Raj)



- **DR of different time or time synch error?**

DR of Bus Sectionaliser at Bhadla (Raj)



- **DR of different time or time synch error?**

- It seems fault was in 220 kV Bhadla2-Badisid ckt.
- Time synch error in almost all the DR.
- 220 kV Bhadla2–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–RSDCL1 ckt-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 at 220 kV Bhadla 2 (Raj) & 400/220 kV Bhadla (Raj) needs to be ensured.
4. In this event, why reverse zone protection operated in 220 kV Bhadla2-Bap ckt?
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 along with energy loss needs to be checked and reported.
7. Phase nomenclature mismatch observed at 400/220 kV Bhadla station (As per PMU data fault was 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 at 400/220 kV Bhadla & 220 kV Bhadla2 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 representative informed the following in the meeting:

1. 220 kV Bhadla2-Bap line tripped instantaneously because of setting error. Reverse zone setting was set with time delay of 16 ms instead of 160ms. It resulted into instantaneous tripping of 220 kV Bhadla2-Bap ckt from 220 kV Bhadla2 end.
2. High set setting of phase overcurrent protection in 220 kV lines from 400/220 kV Bhadla (Raj) were enabled. It has been disabled after the incident.
3. Phase over current was enabled in all 220 kV outgoing lines from 400/220 kV Bhadla (Raj). It was enabled in all 220 kV lines in Rajasthan despite of distance protection available or not.
4. LBB protection signal was mapped for LBB retrip signal after 100ms of starting of LBB timer.
5. Over flux protection relays at 400/220 kV Bhadla (Raj) will be replaced with new relays.
6. 220 kV Station Event Logger was also not healthy at 400/220 kV Bhadla (Raj) and 220 kV Bhadla 2 station.
7. Sequence of Event couldn't be established due to non-availability of station event logger details.
8. Details of RE generation outage and reason is not available, one separate meeting to be planned with intra state RE generators in view of this tripping.
9. Time synchronization of DR of all the elements of 400/220 kV Bhadla (Raj) & 220 kV Bhadla2 GSS will be corrected within 1 month
10. Healthiness of station event logger at 400/220 kV Bhadla (Raj) & 220 kV Bhadla 2 station will be ensured within 1 month.
11. Reply of all the remaining points will be shared within 1 month.

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	

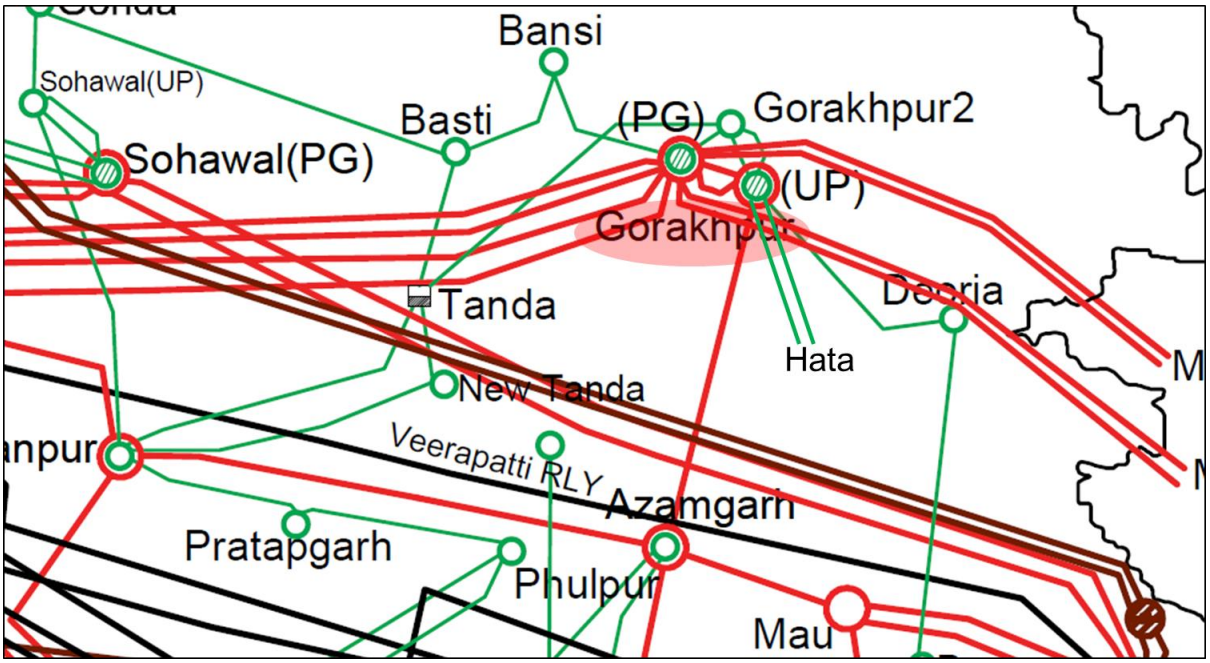
Phase of the fault	PMU data	Blue phase to earth fault	

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):



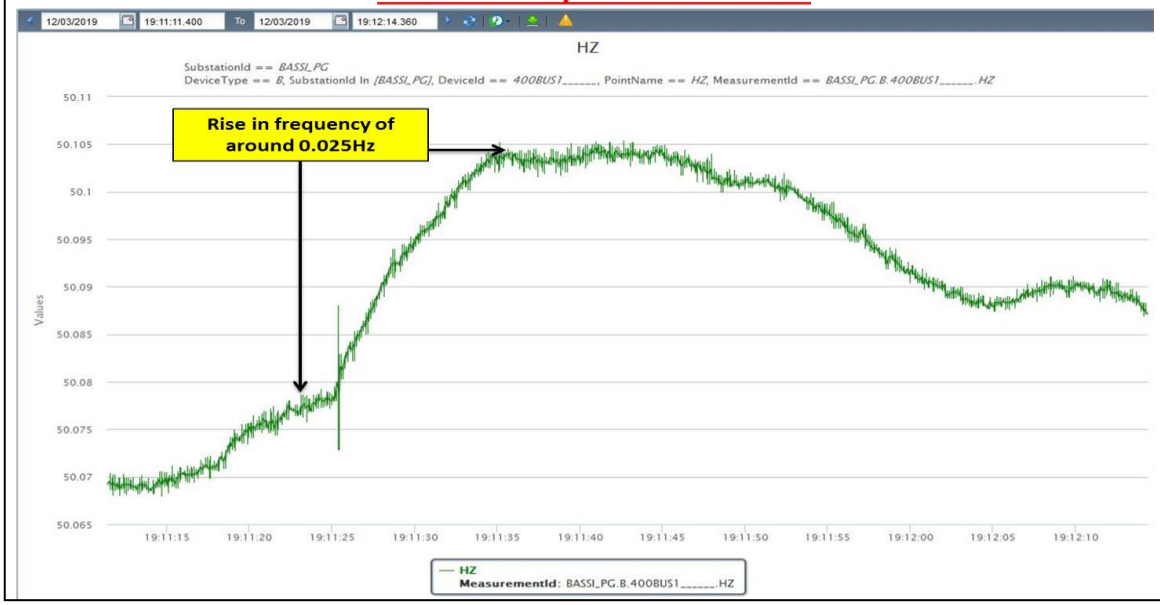
2. 400/220kV Gorakhpur(UP) is connected at 220kV level through 220kV Deoria S/C, 220kV Hata D/C, 220kV Gorakhpur-2(UP) D/C. It has DMT (double main transfer bus) bus bar scheme at 220kV level.
3. B-phase CT of 220kV side of 315MVA ICT-2 at Gorakhpur(UP) damaged.
4. This resulted in bus bar protection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

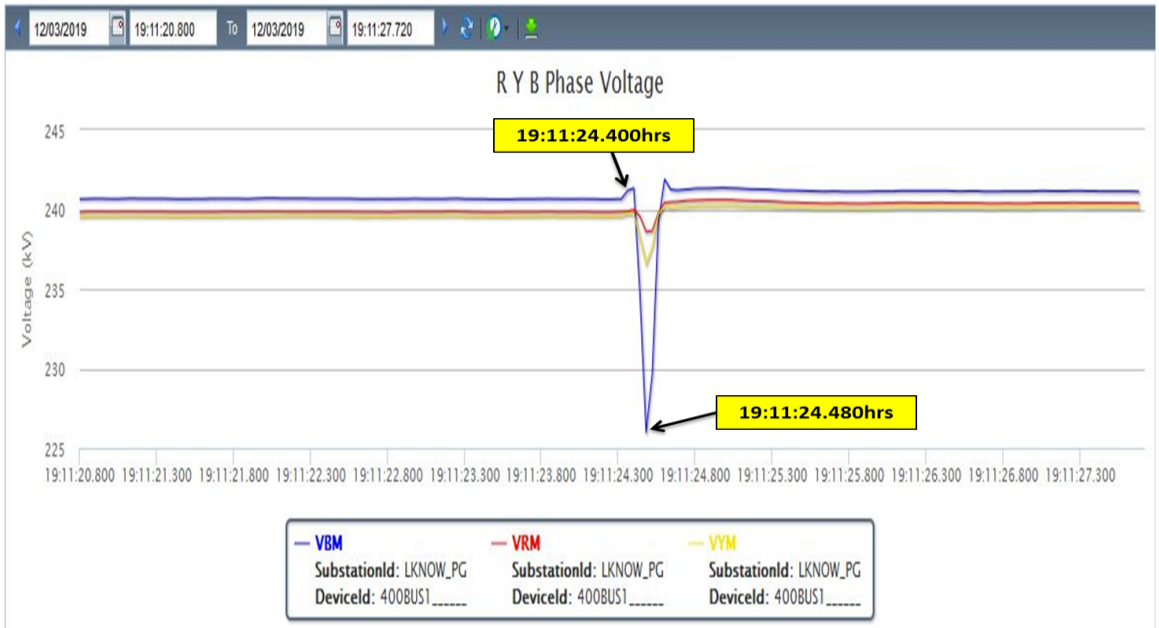
PMU Plot of frequency at Bassi(PG)

19:11hrs/12-Mar-19



PMU Plot of phase voltage magnitude at Lucknow(PG)

19:11hrs/12-Mar-19

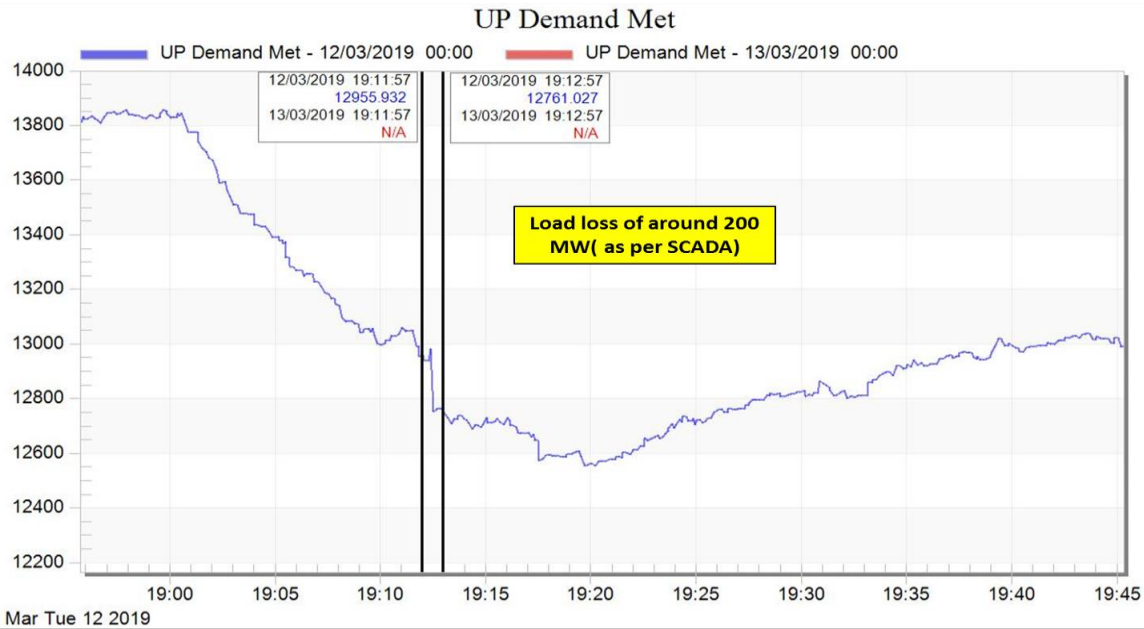


8. SCADA data and SoE:

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:
    a. As per PMU, B-N fault observed at 19:11:24.400hrs.
    b. Fault Clearance time: **80ms**
    c. As per SoE, all 220kV lines along with both 400/220kV ICTs tripped around 19:11:24.430hrs.
    d. 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*:*

1. Exact location of fault to be shared.
2. 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 operation of bus bar protection instead of ICT differential protection 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 representative informed the following in the meeting:

1. B-phase CT damaged and it is suspected that the damaged secondary core lied within the bus bar protection zone which resulted in operation of bus bar protection.
2. To further clear the doubt, differential protection of ICT was checked and found OK.
3. Due to some issue in bus coupler of 220kV, bus coupler was kept out and both the buses were tied through isolators. This resulted in tripping of both buses at the time of fault.
4. EL was not in working condition at the time of tripping on account of software issue. The same is now healthy and working.
5. DR triggered was of different time probably due to time synchronization error.

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:

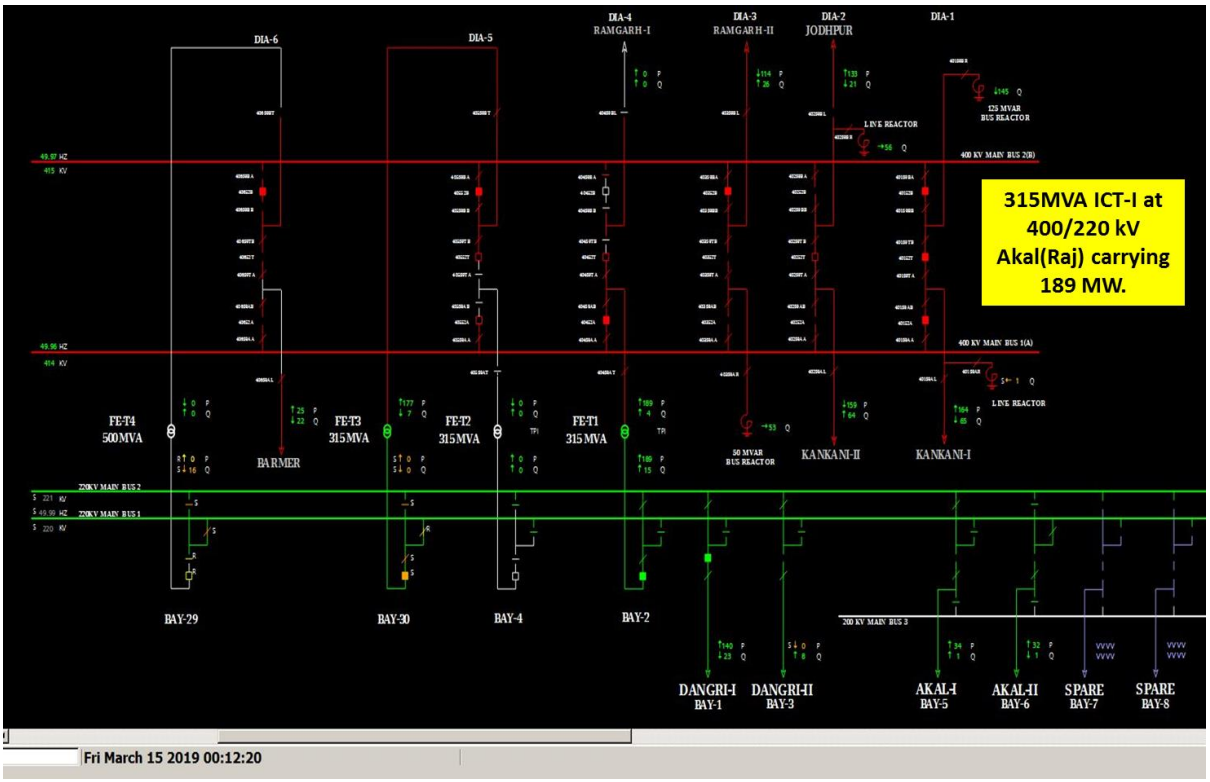
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	200ms & 360ms	
Phase of the fault	PMU data	Y-N fault followed by R-N fault	

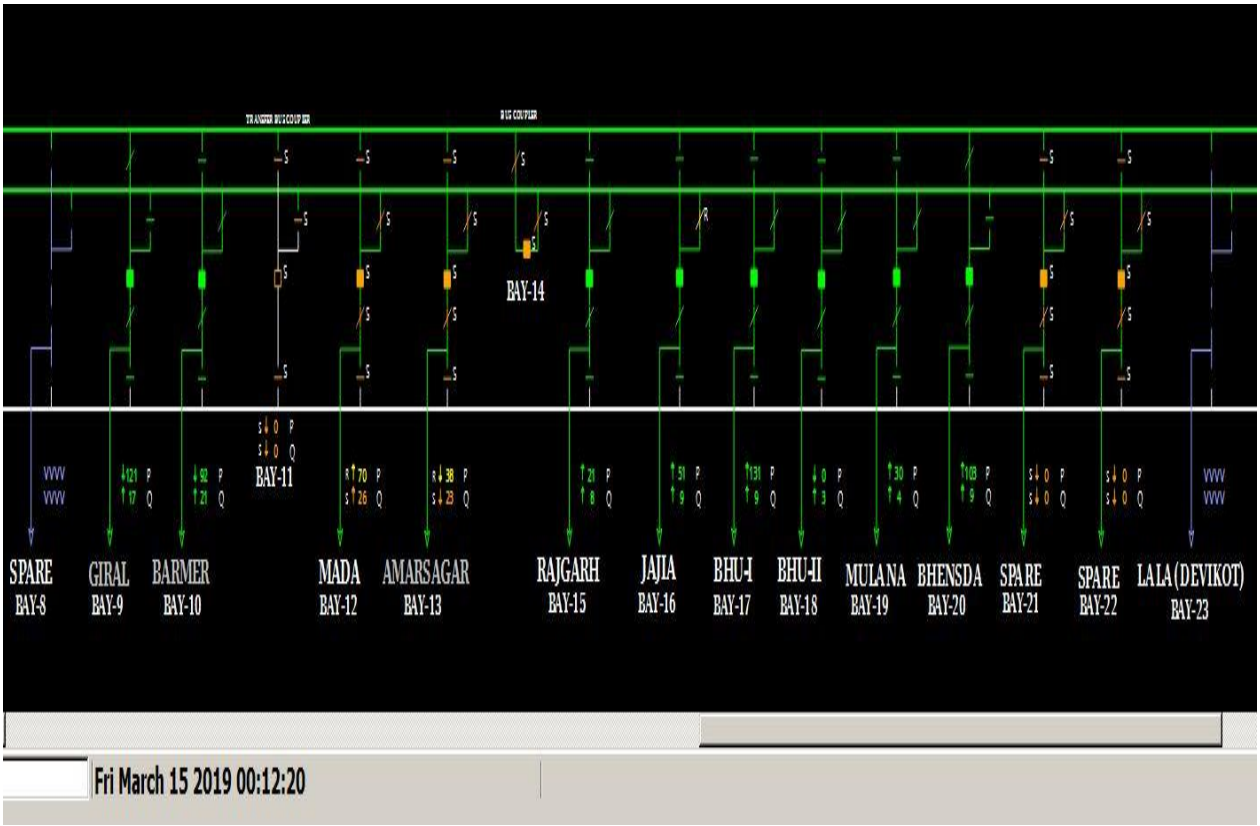
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Not Available	
DR/EL	Rajasthan	Received (after 24hrs)	DR/EL received partially
Preliminary Report	Rajasthan	Received (after 24hrs)	
Detailed Report	Rajasthan	Not Received	

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 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

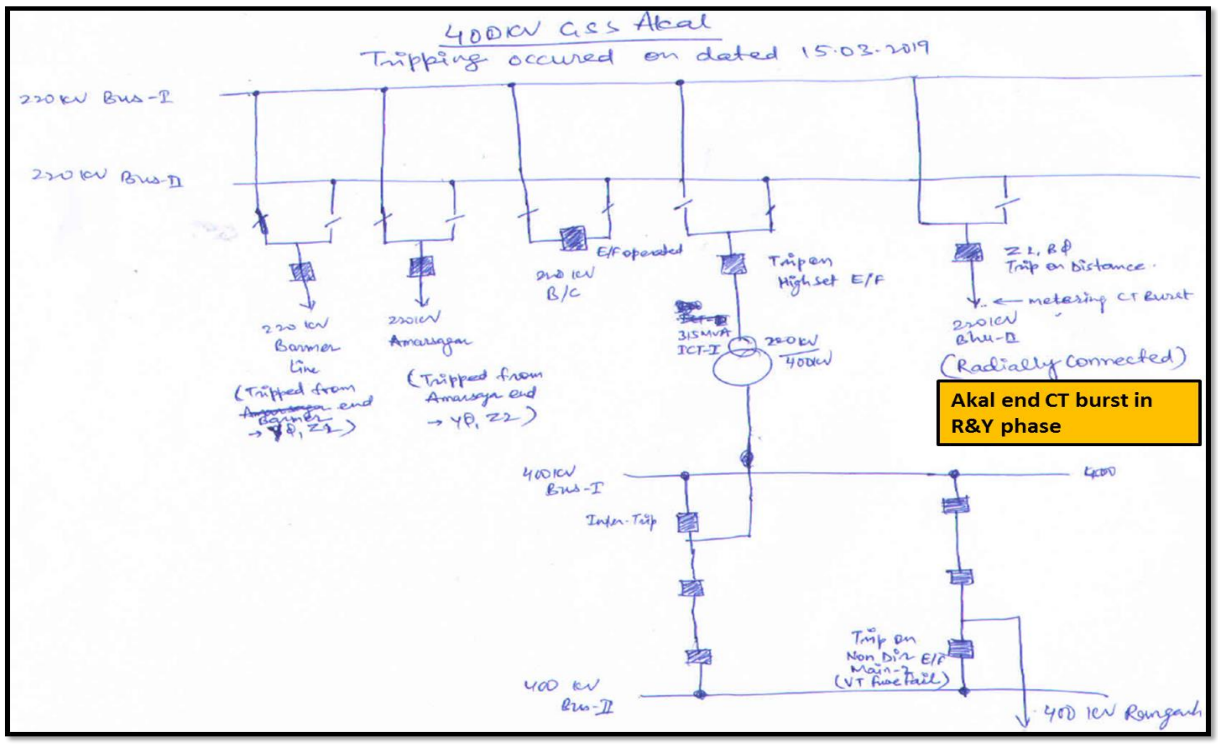
Based on above information description of the events is:

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


DIA-6
DIA-5
DIA-4
RAMGARH-I
DIA-3
RAMGARH-II
DIA-2
JODHPUR
DIA-1
125 MVAR BUS REACTOR
LINE REACTOR
400 KV MAIN BUS 2(B)
400 KV MAIN BUS 1(A)
315MVA ICT-I at 400/220 kV Akal(Raj) carrying 189 MW.
FE-T4 500MVA
FE-T3 315MVA
FE-T2 315MVA
FE-T1 315MVA
BARMER
50 MVAR BUS REACTOR
KANKANI-II
KANKANI-I
220KV MAIN BUS 2
220KV MAIN BUS 1
BAY-29
BAY-30
BAY-4
BAY-2
220 KV MAIN BUS 3
DANGRI-I BAY-1
DANGRI-II BAY-3
AKAL-I BAY-5
AKAL-II BAY-6
SPARE BAY-7
SPARE BAY-8
Fri March 15 2019 00:12:20


BAY-14
BAY-11
SPARE BAY-8
GIRAL BAY-9
BARMER BAY-10
MADA BAY-12
AMARSAGAR BAY-13
RAJGARH BAY-15
JAJIA BAY-16
BHU-I BAY-17
BHU-II BAY-18
MULANA BAY-19
BHENSDA BAY-20
SPARE BAY-21
SPARE BAY-22
LALA(DEVIKOT) BAY-23
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)
    - 400KVAkal(RRVPNL)-Ramgarh(RRVPNL) ckt-2
    - 315MVA ICT-I at 400/220 kV Akal(Raj)

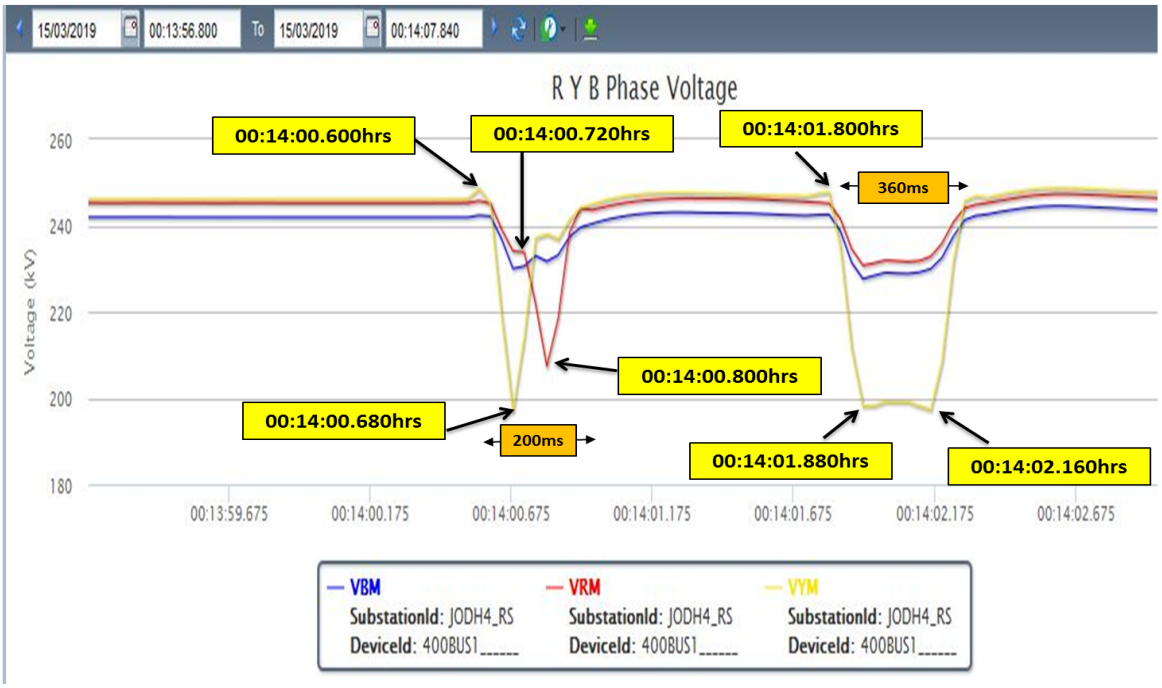
11. PMU plots:

PMU Plot of frequency at Bassi(PG)

00:13hrs/15-Mar-19

PMU Plot of phase voltage magnitude at Jodhpur(Raj)

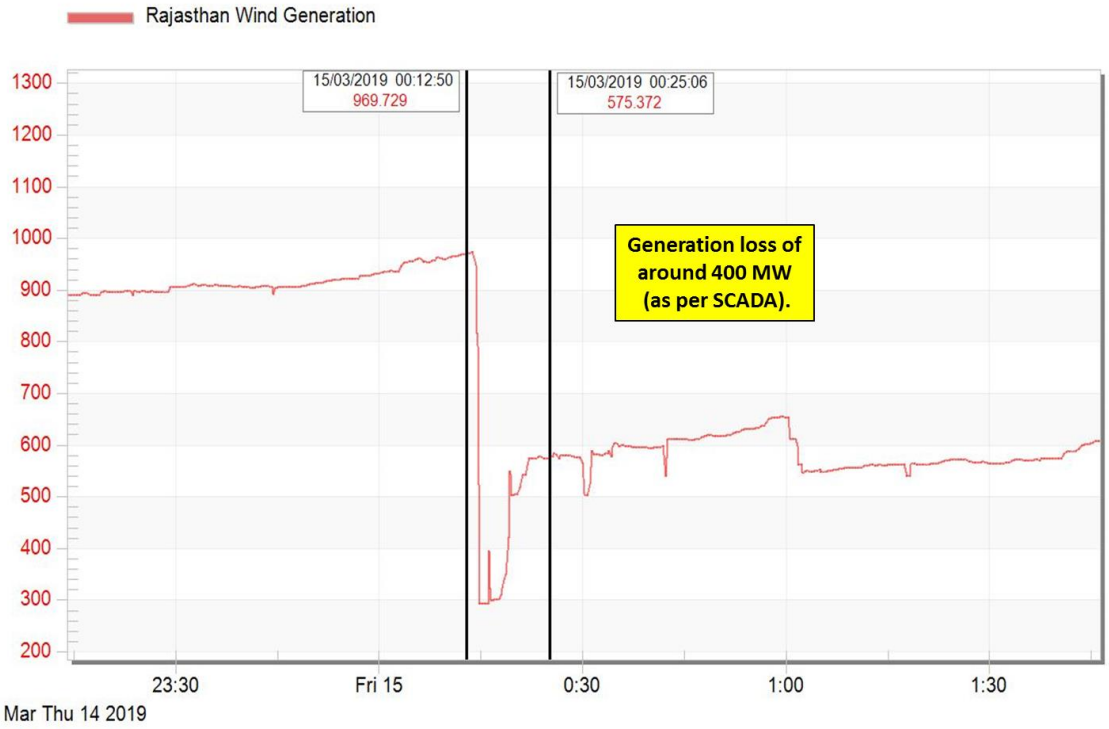
00:13hrs/15-Mar-19



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

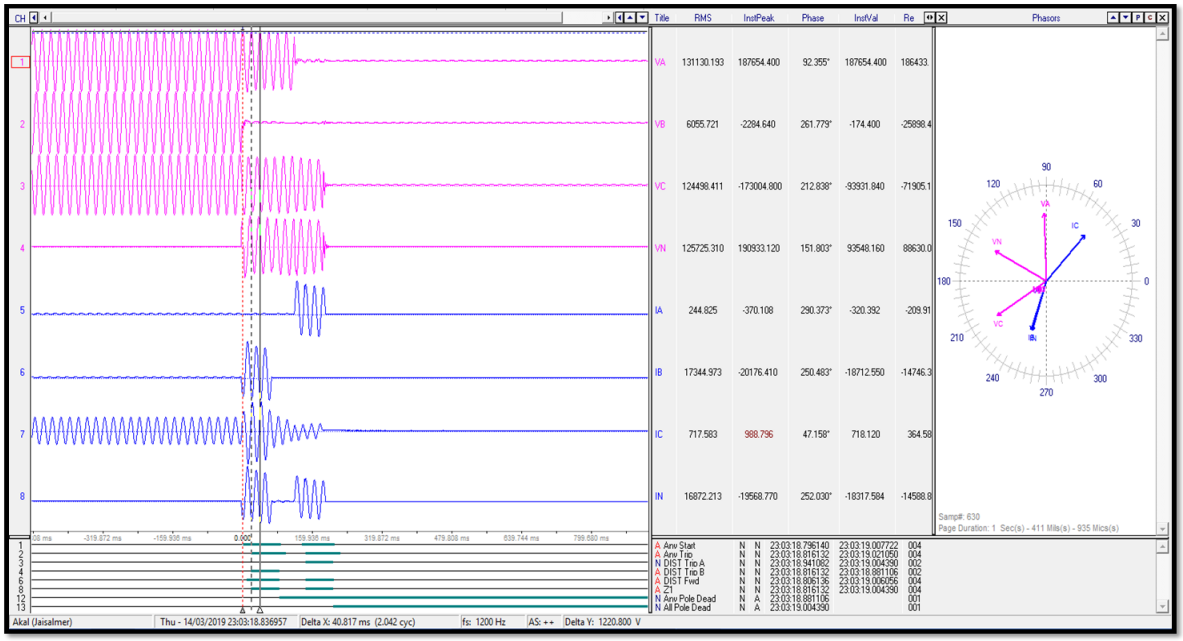


14. As per Rajasthan details:

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	

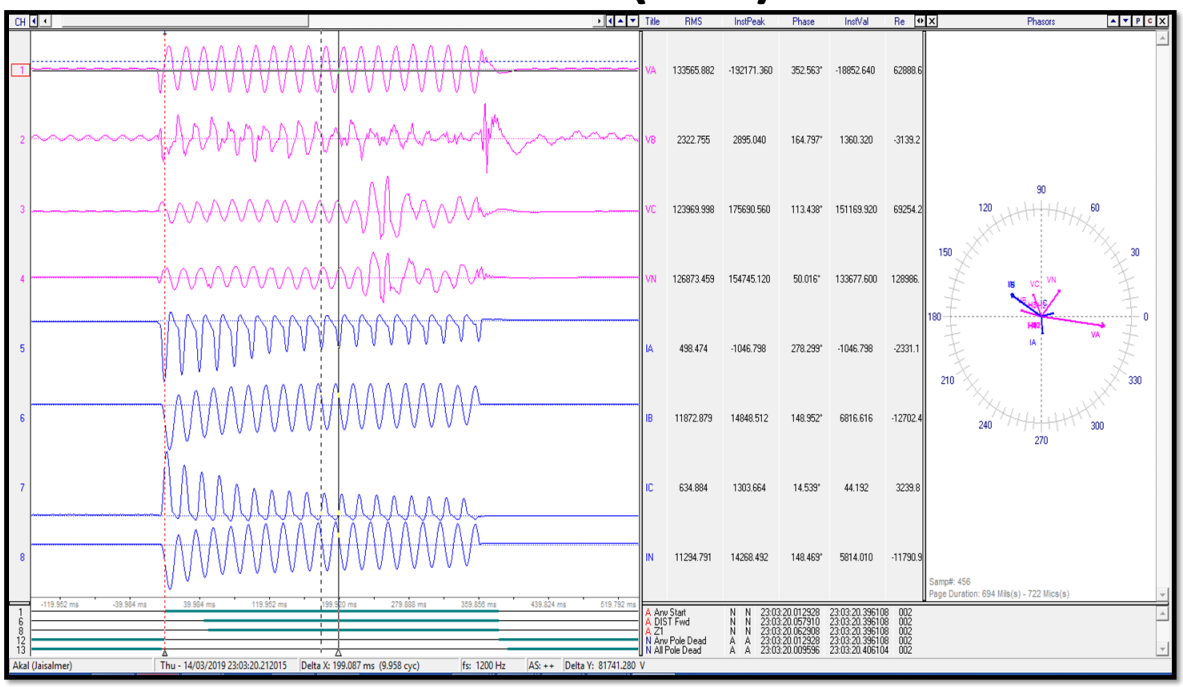
DR of 220 kV Akal (end)-Bhu ckt-1



Time Synch error?

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

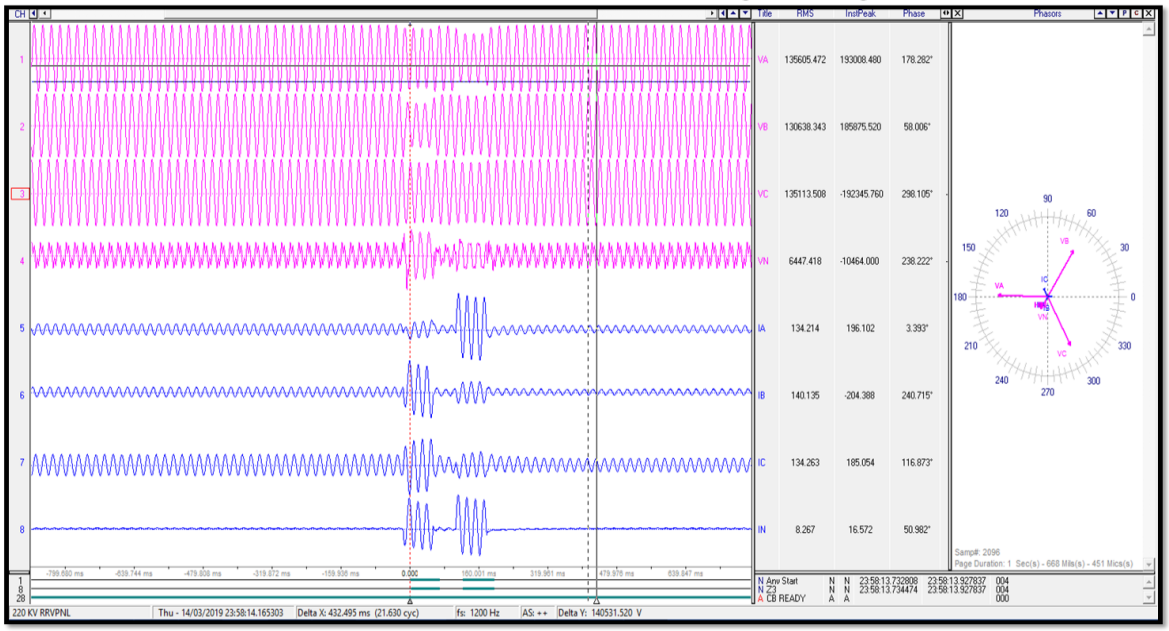
DR of 220 kV Akal (end)-Bhu ckt-1



Time Synch error?

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

DR of 220 kV Barmer (end)-Akal



Time Synch 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 Synch 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 representative informed the following in the meeting:

1. SOTF protection on lines is not enabled.
2. Event log is not installed at 400/220kV Akal (Raj). 400 kV Akal (Raj) station is a SAS based station and it has event logging in SCADA system. Time synchronization of EL was not proper earlier which has been rectified.
3. As per PMU data, it seems the third fault got cleared in 360ms. However, Rajasthan representative informed that all faults were cleared timely.

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

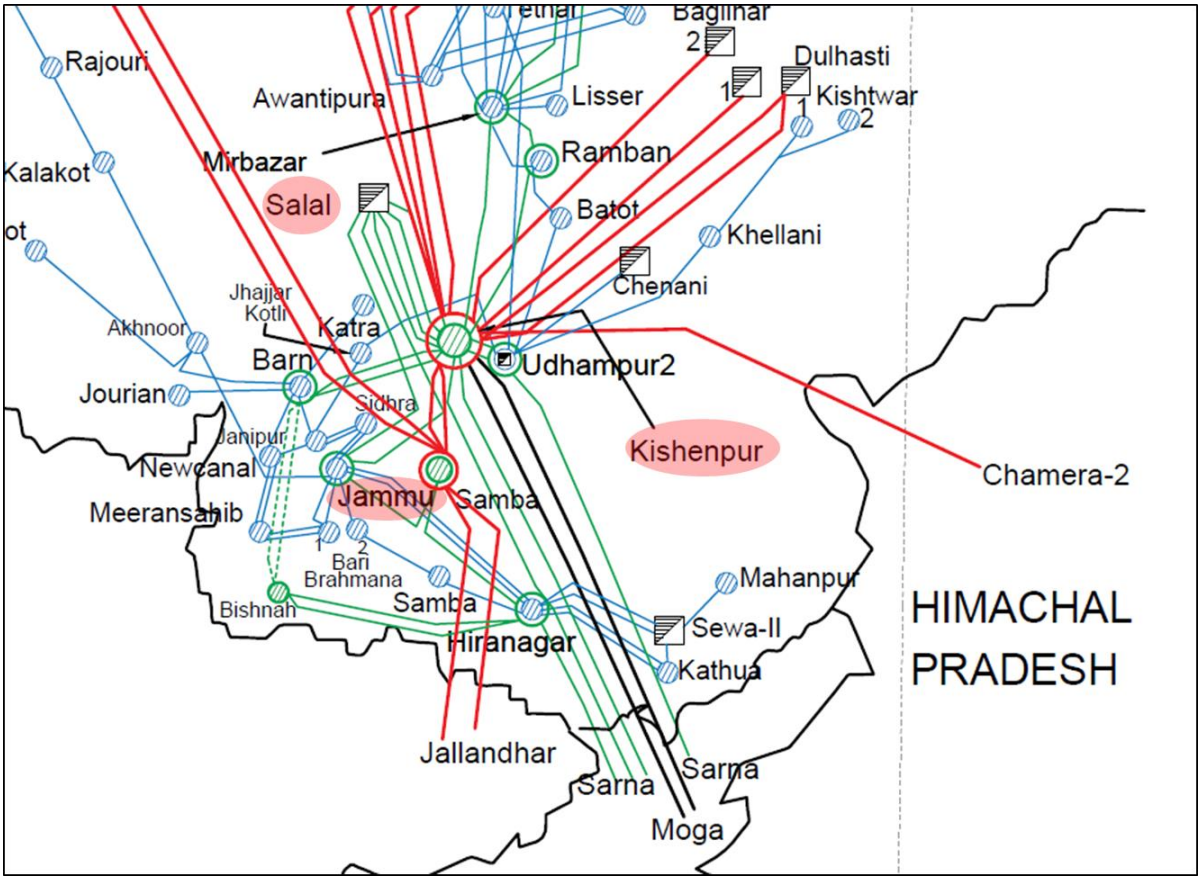
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)		Received	Time Synch error
DR/ EL	NHPC	Received	After 24hrs
	POWERGRID	Not Received	
	J&K	Not Received	
Preliminary Report	NHPC	Received	After 24hrs
	POWERGRID	Received	Within 24hrs
	J&K	Not Received	
Detailed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

Description	**Clauses**	**Utility**	**Remarks**
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	**NHPC, J&K**	1. Preliminary Report, DR/EL within 24hrs 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system 4. Delayed Clearance of fault

	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	**POWERGRID**	1. Preliminary Report received within 24hrs but DR/EL yet to be received

Based on above information description of the events is:

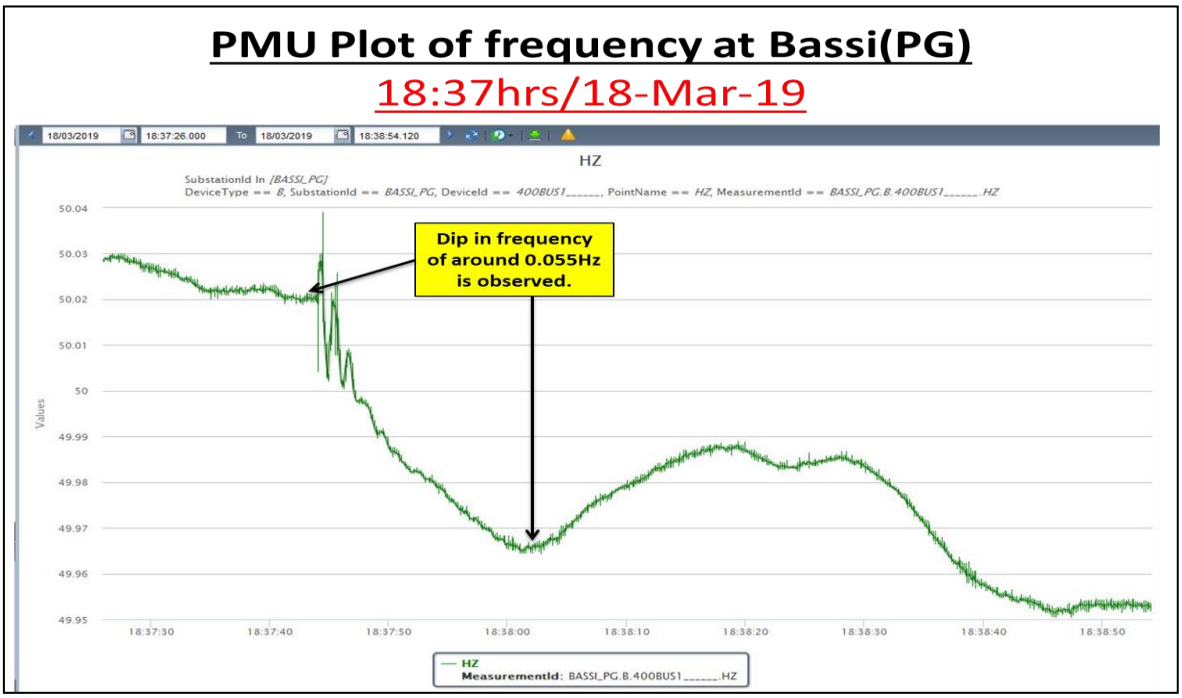
1. Connectivity diagram of 220kV Salal HEP (NHPC):



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.

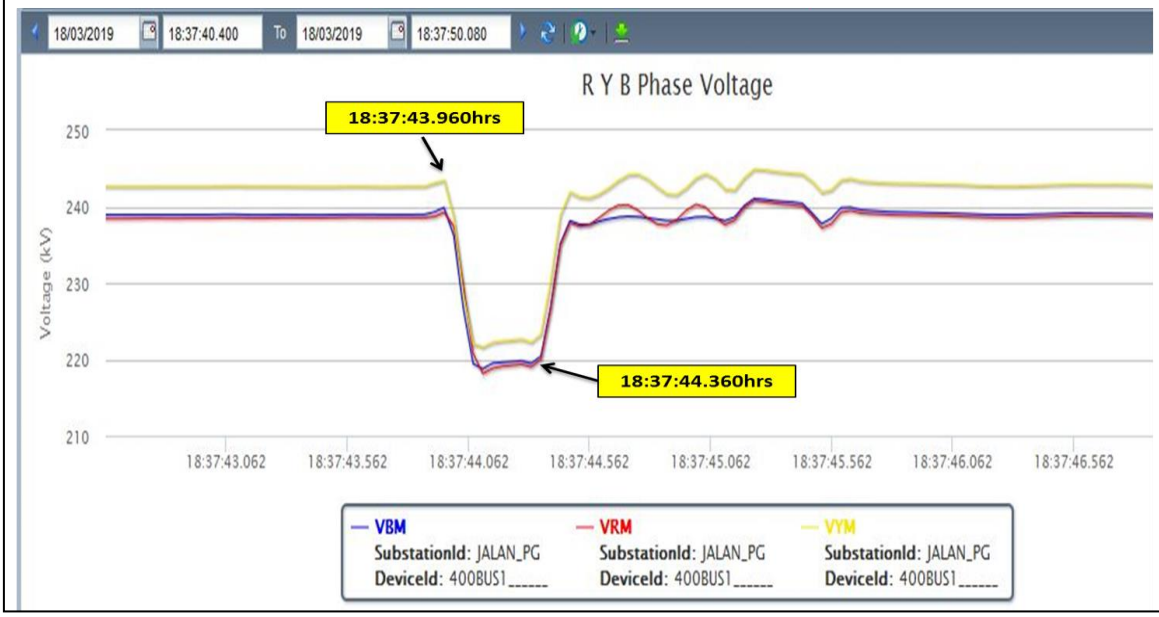
4. At 18:37hrs on 18-Mar-19, R-phase jumper snapped. This may have resulted into bus fault of bus-1. (as no other fault observed).
5. Bus bar protection didn't operate. As a result, all 220kV elements along with units at Salal tripped.
6. All 220kV lines tripped from remote end except Jammu ckt-2. Subsequently, 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:



PMU Plot of phase voltage magnitude at Jalandhar(PG)

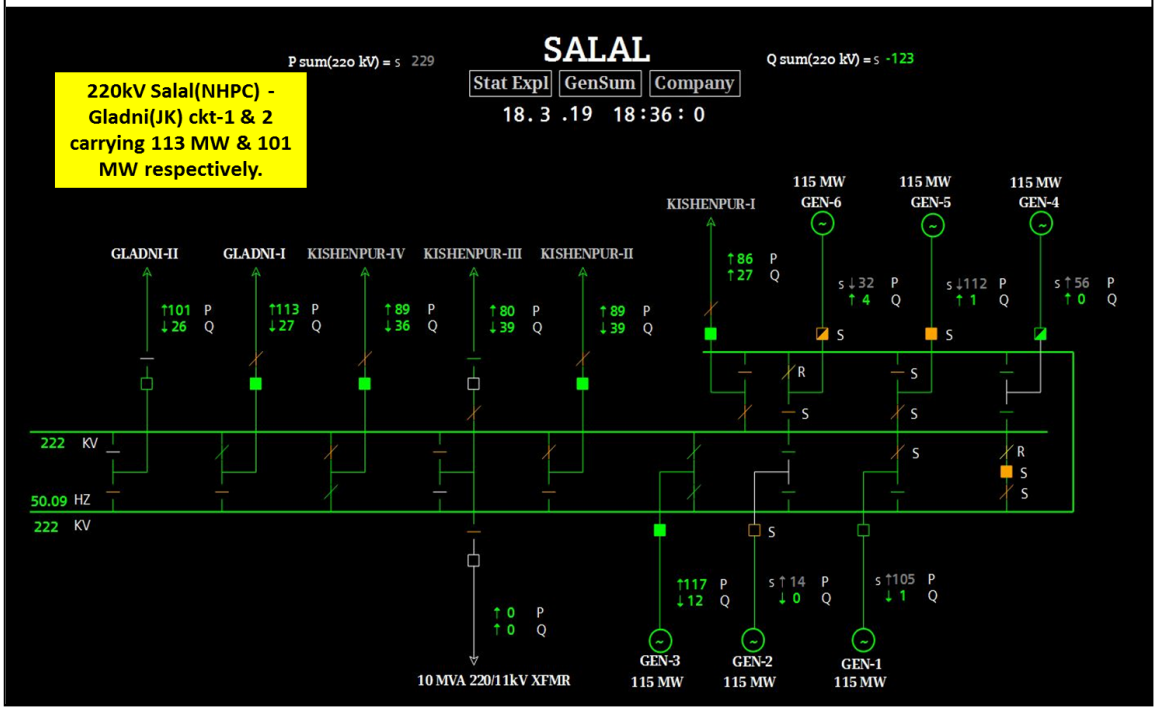
18:37hrs/18-Mar-19



11. SCADA data and SoE:

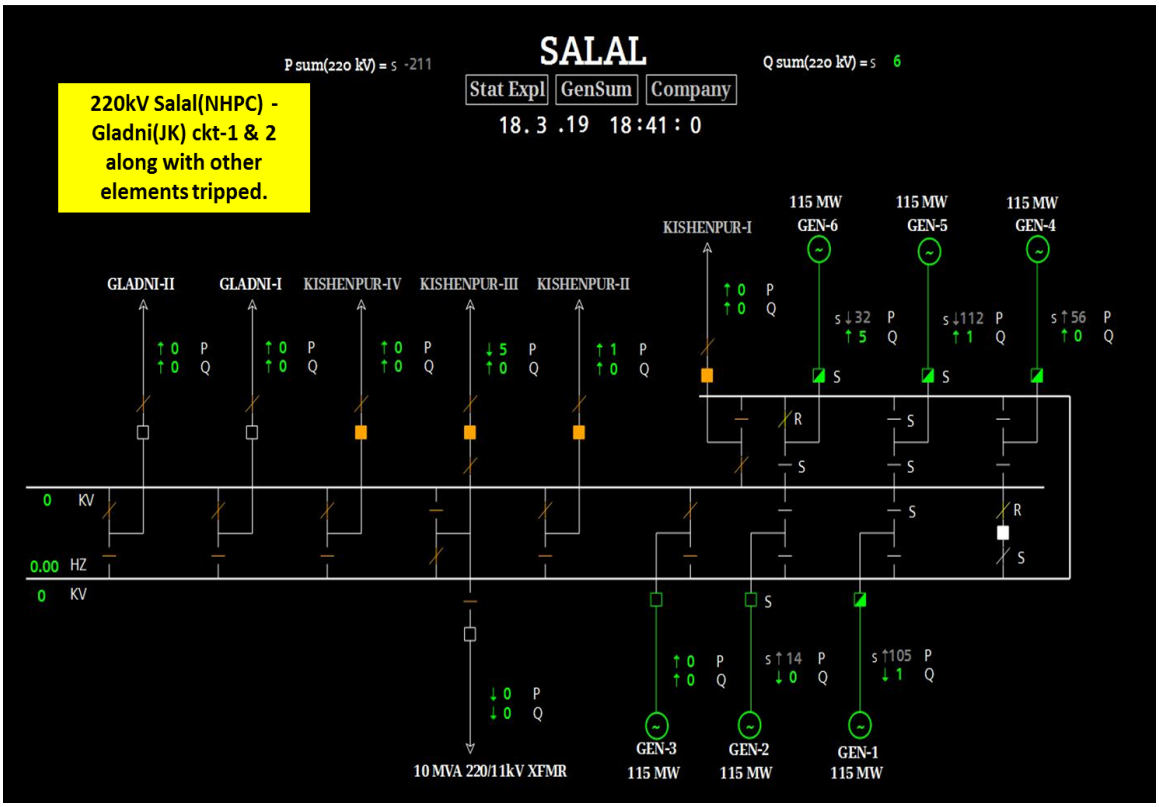
SLD of 220kV Salal(NHPC) before the incident

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

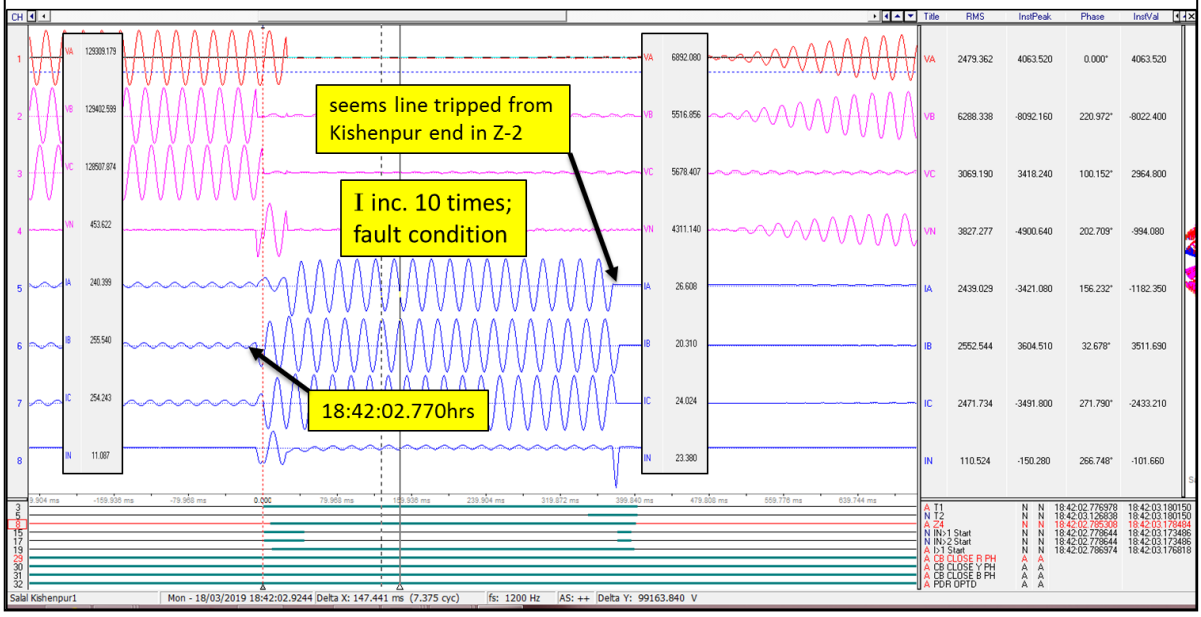
12. As per NHPC details:

NHPC Detailed Report

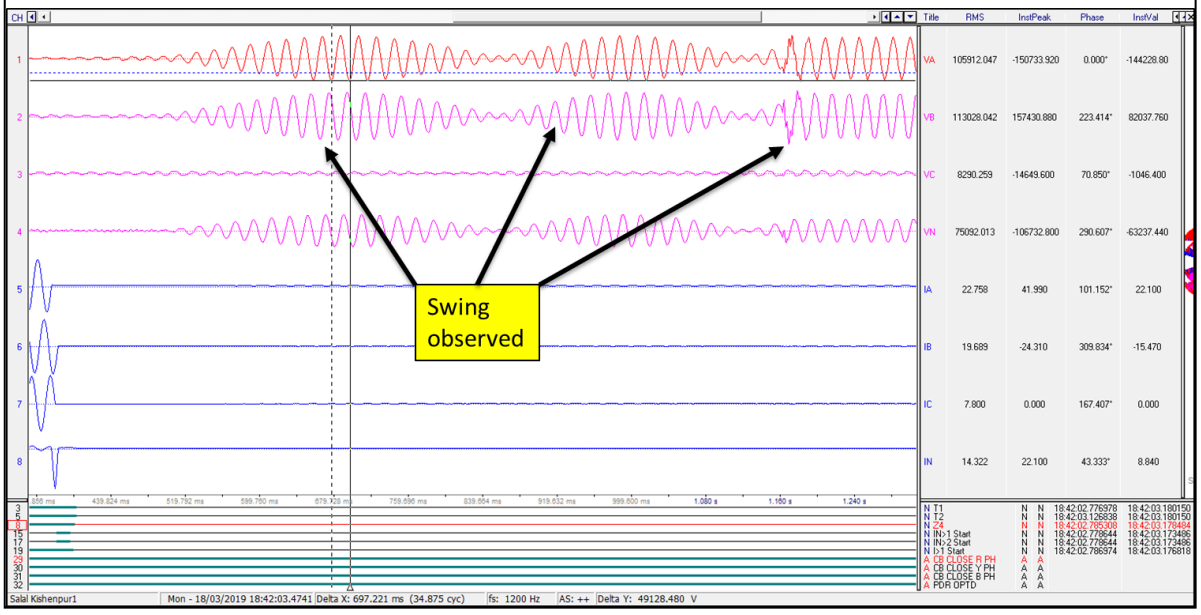
3. Brief Event summery	Five units and six lines were in operation. Due to ongoing SCADA implementation and testing, Kishanpur-3 Line was kept on Bus-2 and all other active elements were kept on Bus-1 with bus coupler in closed condition. Due to bus fault all the active elements got tripped.
B. Antecedent 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	1. From the DR of Line and Unit protection relays following is observed: a. Kishanpur #1, 2, 3, 4 and Jammu#1 Line tripped from remote end (may be on Zone-2). b. Jammu-2 Line tripped from Salal end in Zone-1 (during Power Swing) after 1.5 Sec of the fault. c. All running units tripped on over frequency Protection due to load throw off. 2. Analysis: 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 operateand 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. All the five running units got tripped on over frequency due to load throw off.

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.

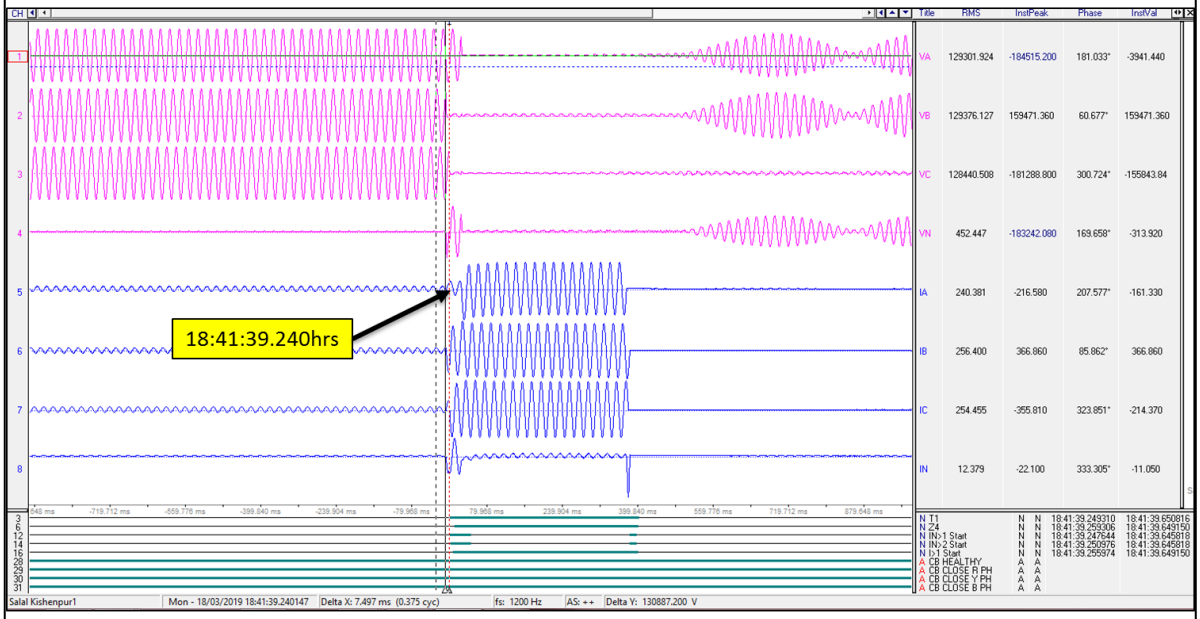
DR: 220kV Salal(end)-Kishenpur-1 (M1)



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

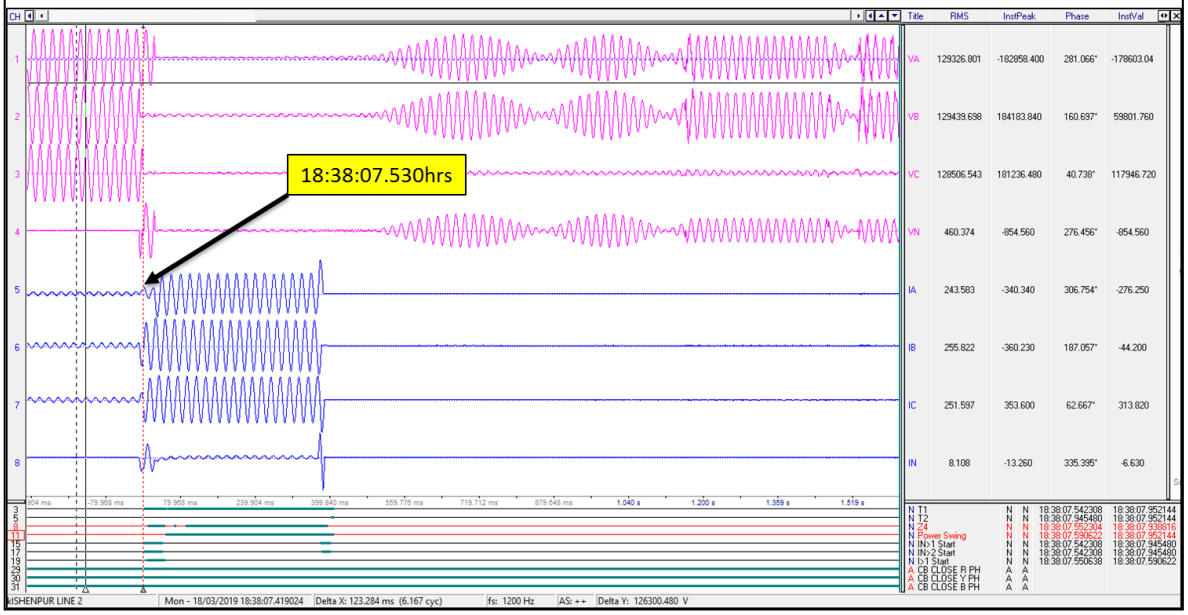


DR: 220kV Salal(end)-Kishenpur-1 (M2)

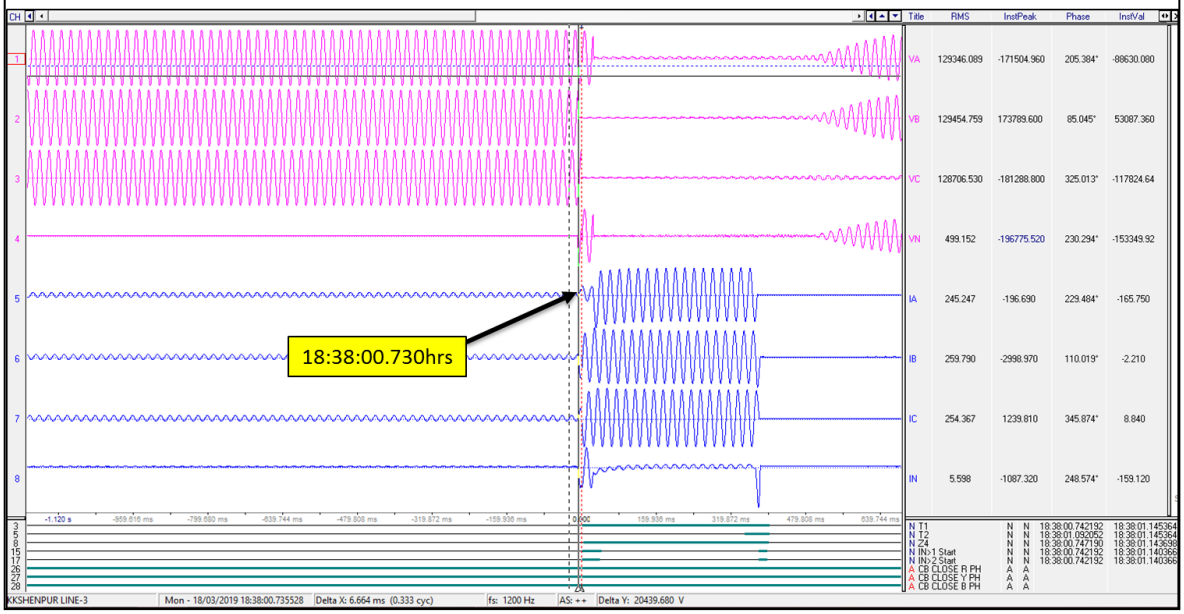


Time synchronization issue. Even M1, M2 relays are not in time synchronization.

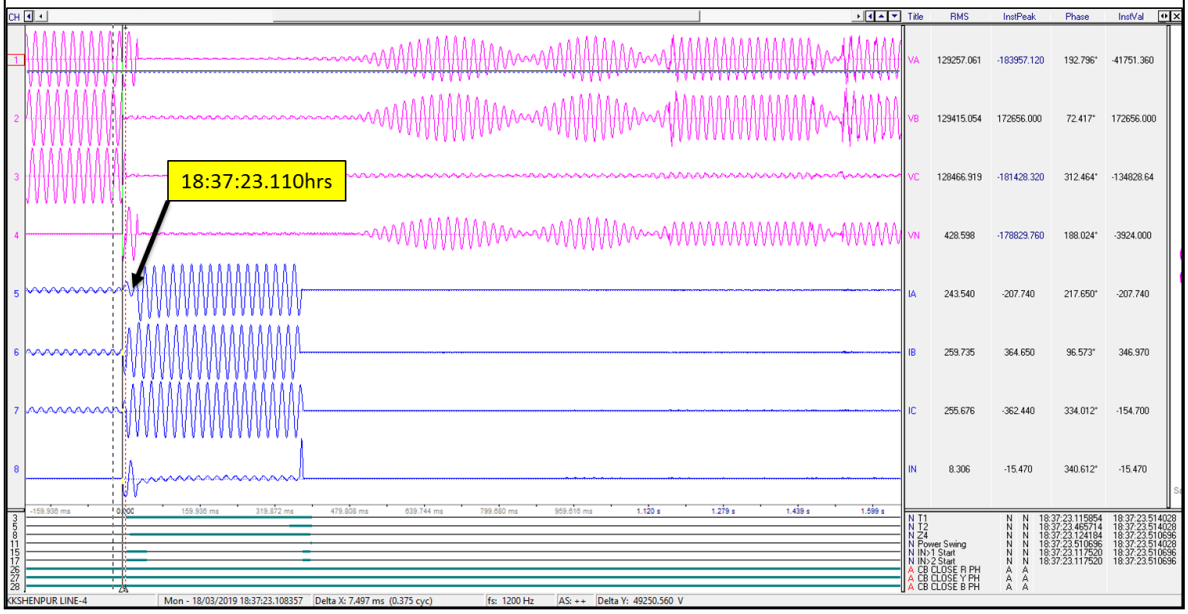
DR: 220kV Salal(end)-Kishenpur-2



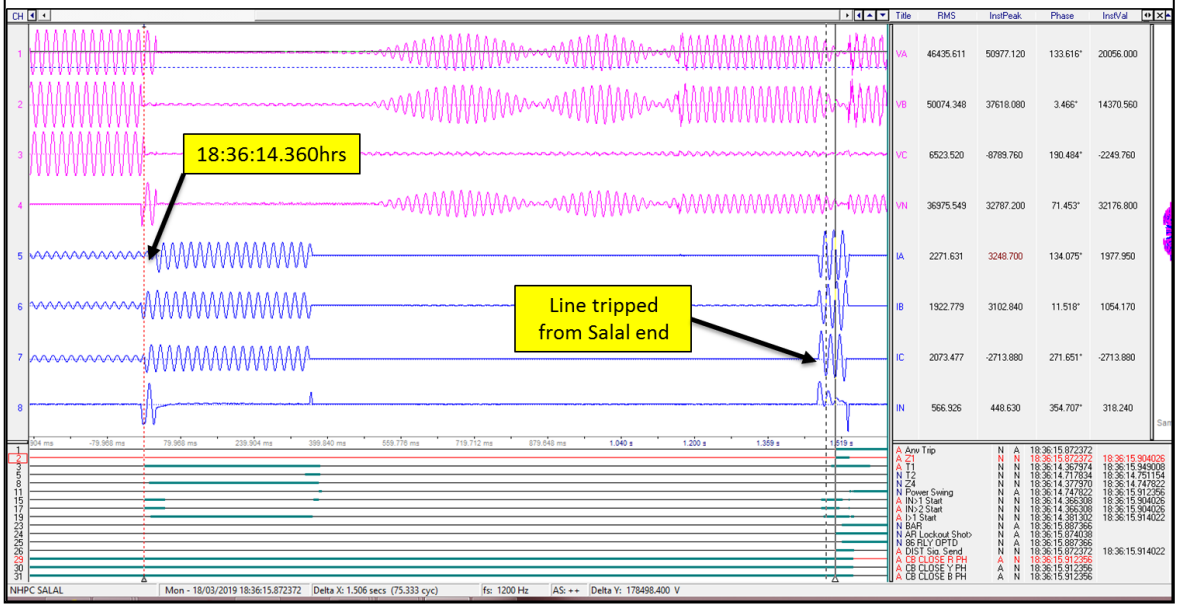
DR: 220kV Salal(end)-Kishenpur-3



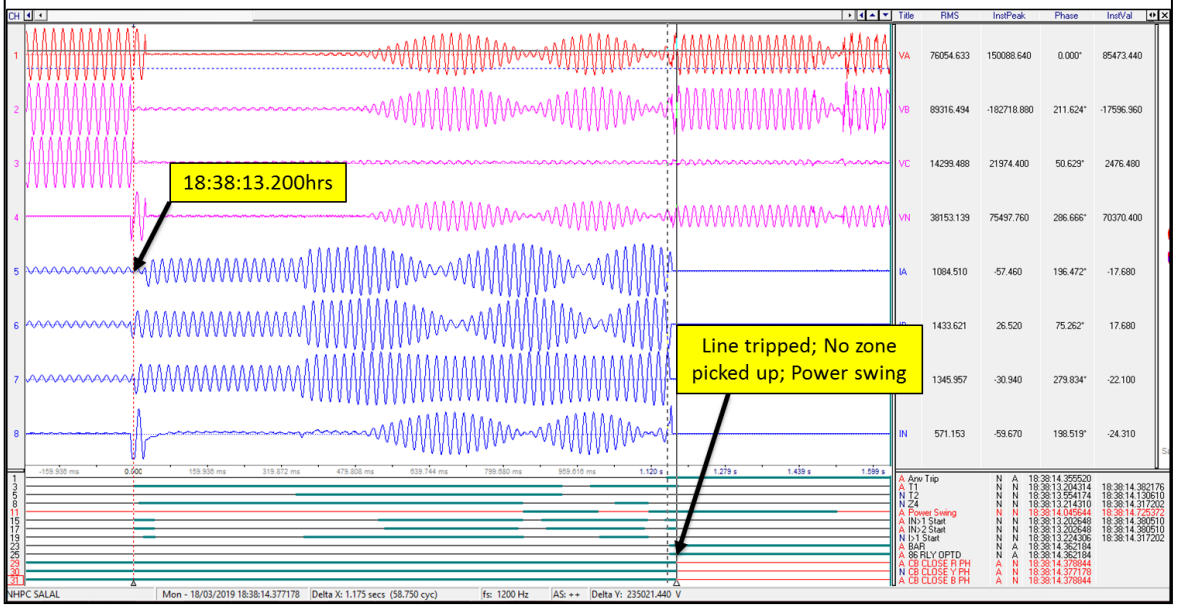
DR: 220kV Salal(end)-Kishenpur-4



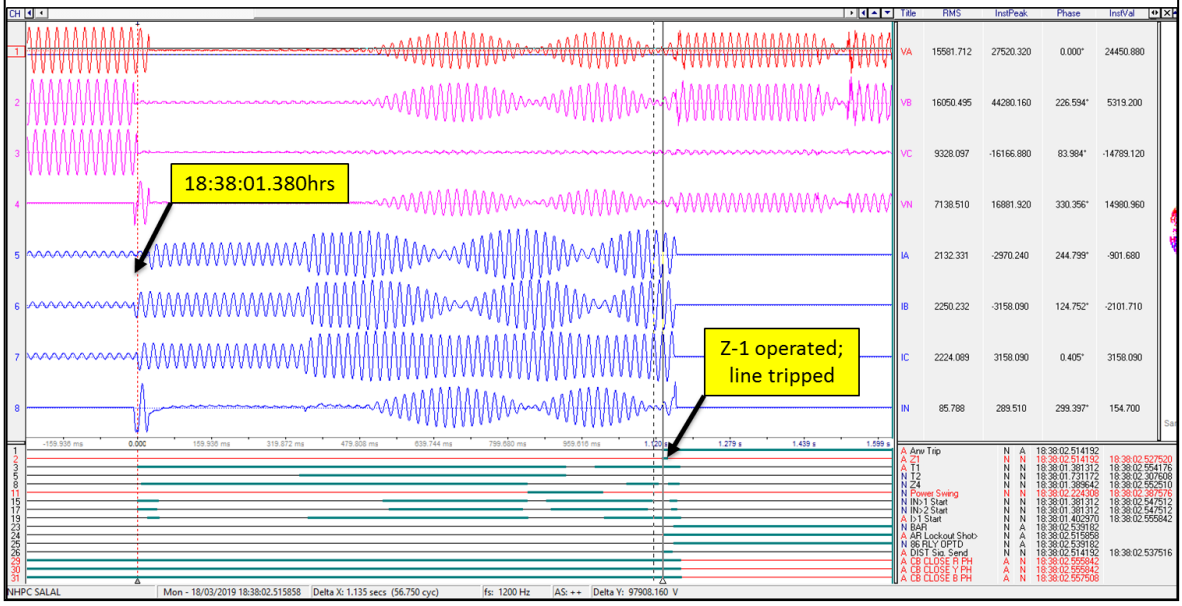
DR: 220kV Salal(end)-Jammu-1



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, II & 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 representative informed the following in the meeting:

1. SCADA implementation work was going on at Salal (NHPC). Work on all bays was completed except, Kishenpur-3 ckt.
2. Data acquisition in practice is done online. However, to avoid any major disturbance during testing of supervisory control, Kishenpur-3 was kept at separate bus.
3. Inadvertently during testing, closing command got extended to isolator of Kishenpur-3 ckt. The interlock of aforementioned isolator was not fully commissioned. As a result, isolator get closed without opening of E/S. This resulted in fault on bus-2.
4. Circuitry fault in BBP Micom-786 relay setting was ~80mA at secondary side which blocked the BBP.
5. All 4 ckts of Kishenpur tripped in Z-2 from remote end.
6. Power swing distance protection is kept at all zone blocked.
7. 220kV Salal-Jammu-1 was closed after around 1.5 sec. At this time, power swing was not captured instantly and line tripped in Z-1 from Salal end.
8. Time synchronization of DR would be set right by September end.

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

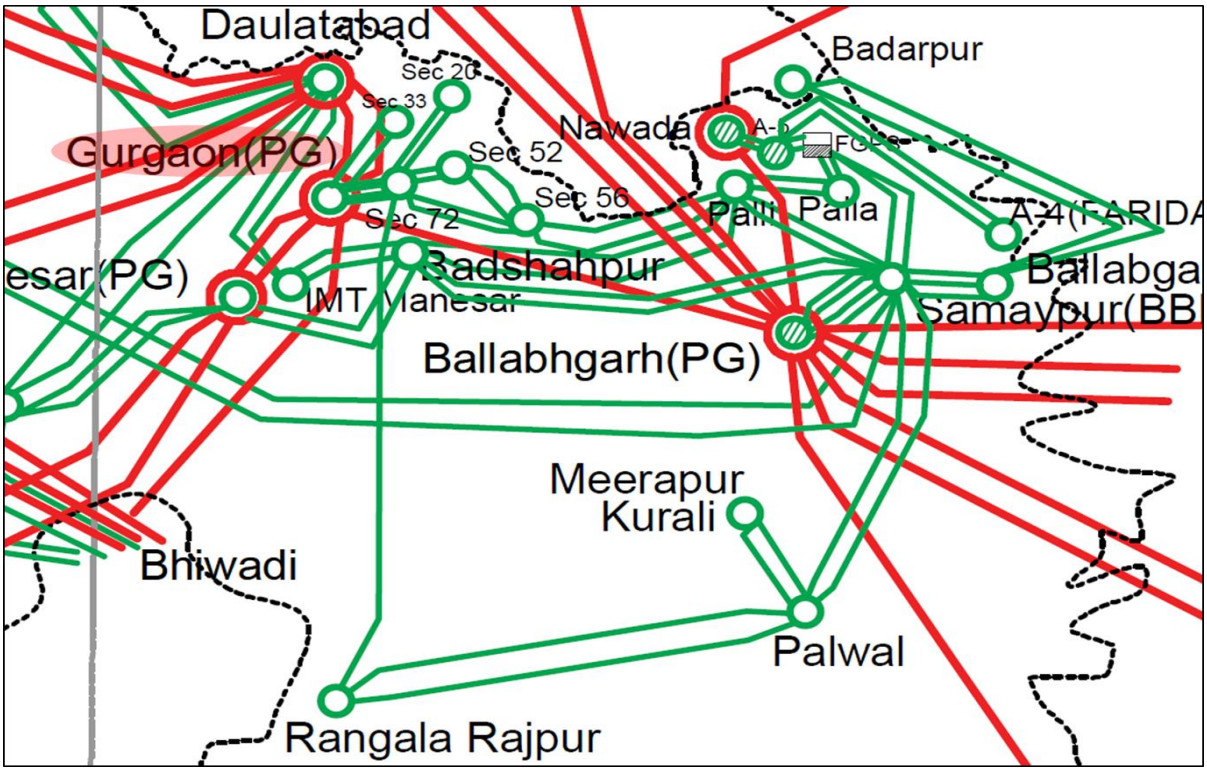
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Received	Time Synch error
DR/ EL	Haryana	Not Received	
	POWERGRID	Received	After 24hrs
Preliminary Report	Haryana	Not Received	
	POWERGRID	Received	After 24hrs
Detailed Report	Haryana	Not received	

Description	Clauses	Utility	Remarks
Violation of Clauses	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	**Haryana**	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

	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		5. Delayed Clearance of fault
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

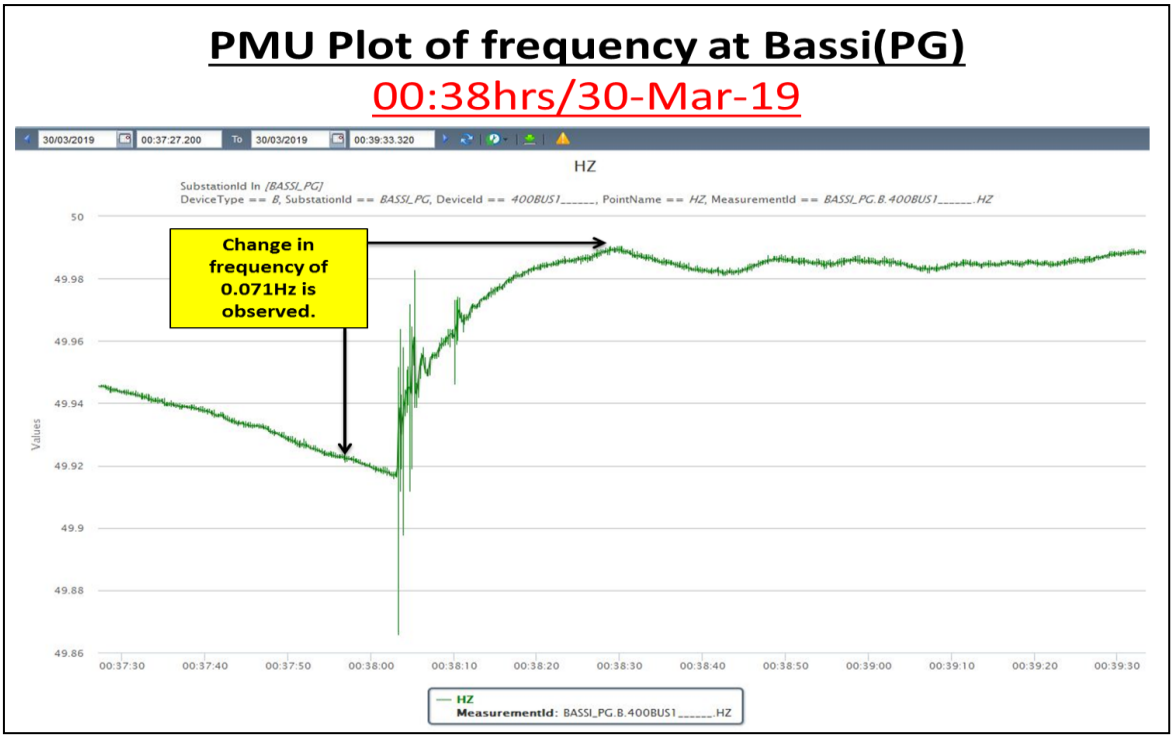
Based on above information description of the events is:

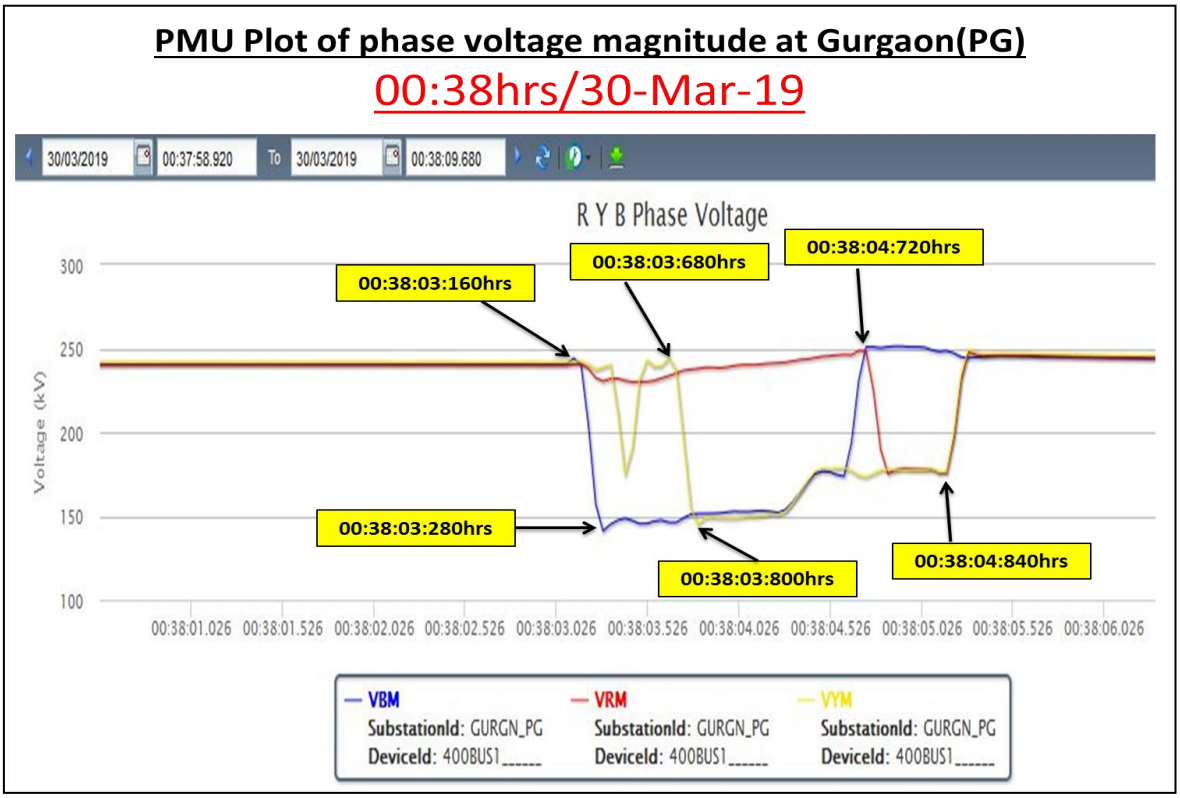
1. Connectivity diagram of Gurgaon(PG) and Gurgaon sec-72(HVPNL):



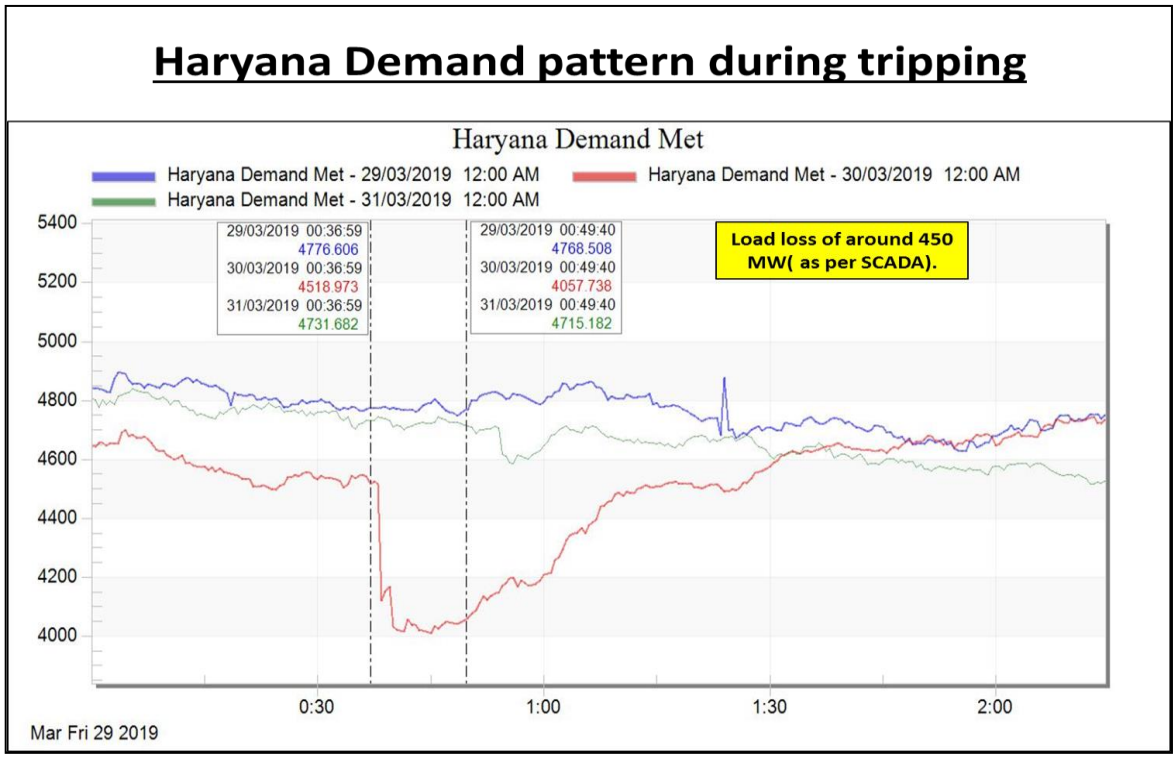
2. 400/220kV Gurgaon(PG) is connected at 220kV through sec-72(HVPNL) 4 ckts and sec-33 D/C. It has DMT (double main transfer bus) bus bar scheme. Also, it has two 500MVA 400/220kV ICTs.
3. 220kV Gurgaon Sector-72(HVPNL) is connected at 220kV through Gurgaon(PG) 4 ckts, Sector-20 D/C, Sector-56 D/C and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



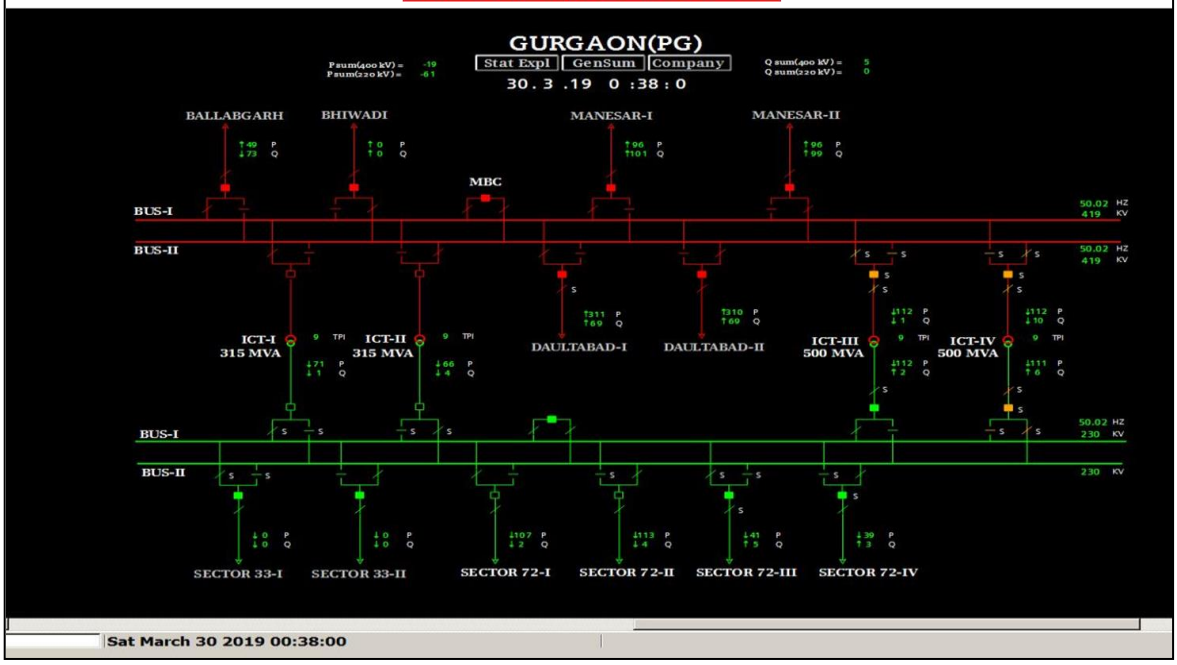


8. SCADA data and SoE:



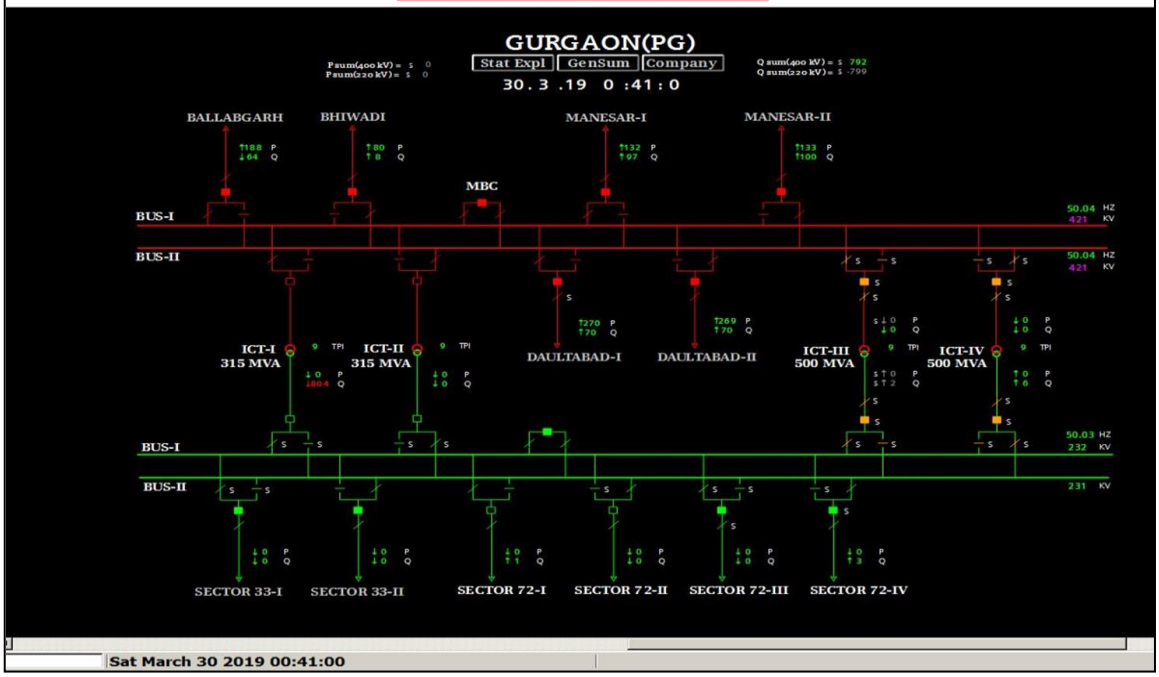
SLD of 400/220kV Gurgaon(PG) before the incident

00:38hrs/30-Mar-19



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

00:41hrs/30-Mar-19

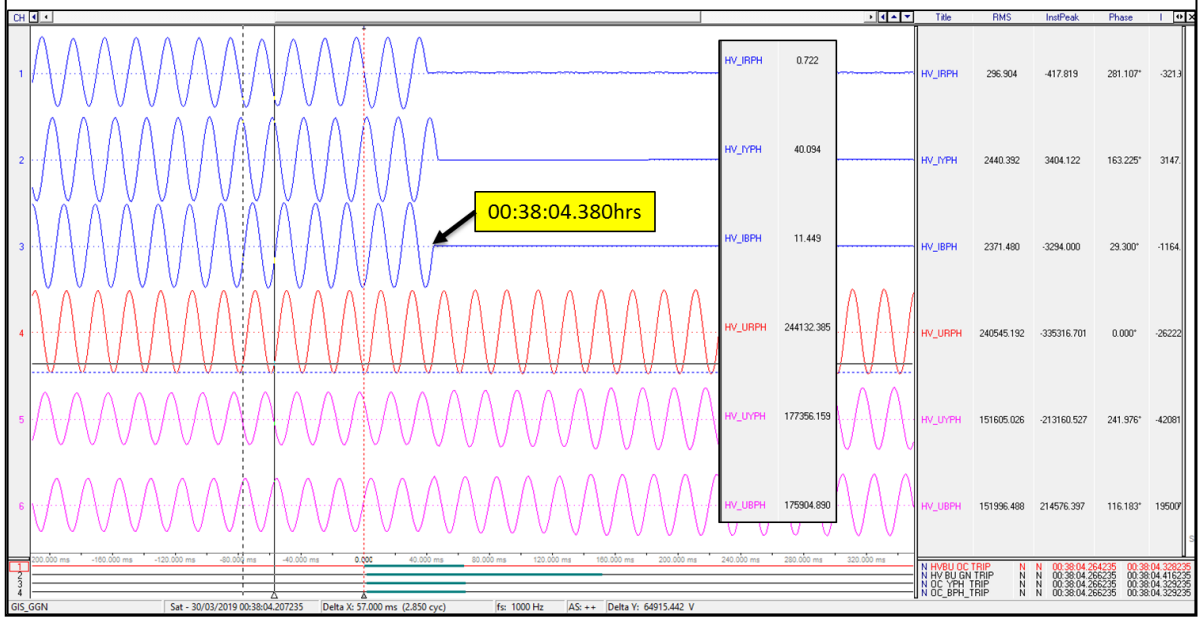


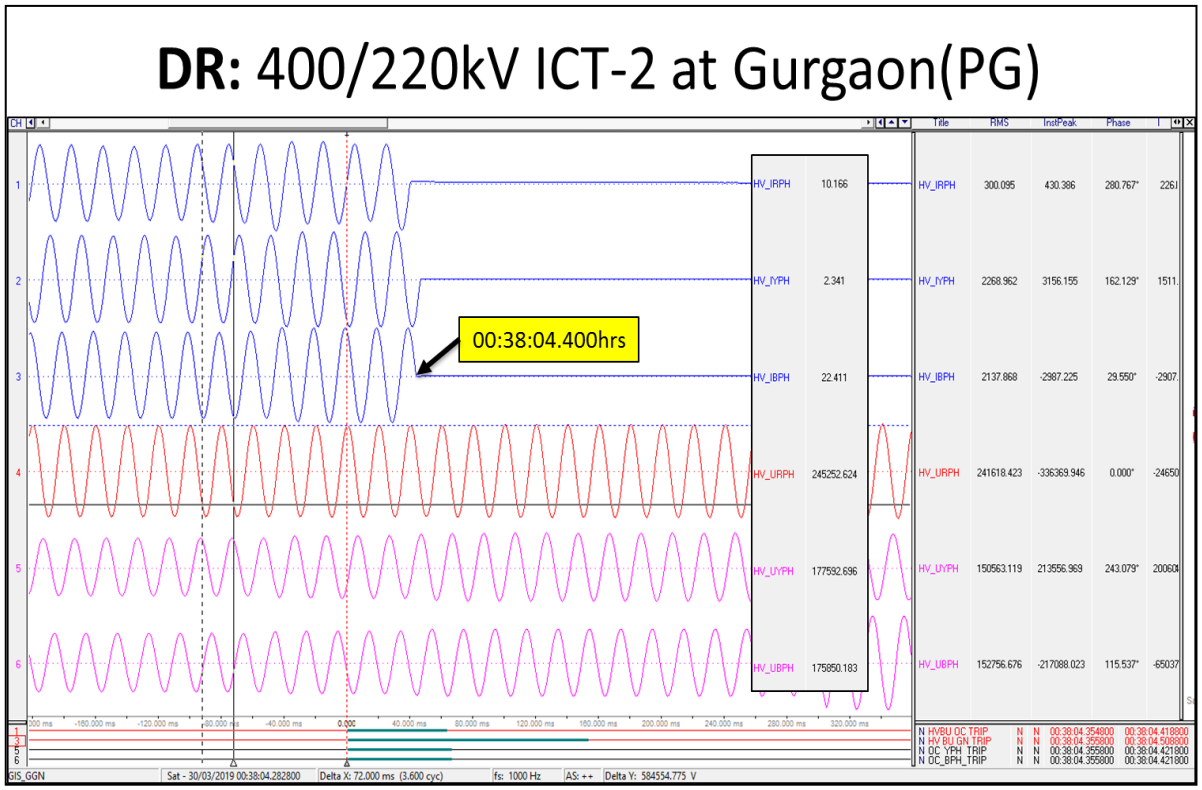
NR SCADA SOE

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)





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

Discussion during the metting:

Haryana representative informed the following in the meeting:

1. Multiple faults observed. B-ph CT of 220kV Sec-72-Sec-52 ckt-1 at Sec-72 damaged. Porcelain insulator of ckt also damaged. Bus-2 isolator's two porcelain insulator also damaged. Line tripped in Z-1. However, due to isolator damaged, bus fault occurred at bus-2. BBP of bus-2 was unhealthy since 2018,on account ofdefective card. Bus-1 BBP mal-operated and all feeders connected to bus-1 tripped from Sec-72(HVPNL) end. 220kV Gurgaon(PG)-Sec-72 ckt-1, 2 which were on bus-1 also tripped.
2. 220kV Gurgaon(PG)-Sec-72 ckts have differential protection as main protection. (Line length ~ 300m)
3. Bus fault on bus-2 kept feeding through 220kV Gurgaon(PG)-Sec-72 ckt-3, 4. 400/220kV ICTs at Gurgaon(PG) fed the fault. As a result, 500MVA ICT#1 and #2 tripped on back-up over current earth fault protection.
4. Jumper of both 220kV Gurgaon(PG)-Sec-72 ckt-3, 4 snapped at Sec-72 end. This resulted in fault and differential protection acted and both lines tripped eventually clearing the fault.
5. Bus-2 BBP would be commissioned by August'19.
6. DEF protection for 220kV Gurgaon(PG)-Sec-72 ckts to be set at Gurgaon(PG) end. In current case, if it would have been there, the fault would not have fed for such long duration.
7. Nodal officer is not present for PSC related matters. A suggestion would be given to the management for appointing the same.

POWERGRID representative informed the following in the meeting:

1. Only two ICTs out of four tripped as it is difficult to coordinate backup protection. The tripping sequence is as follows:
    a. ICT #3 - 00:38:04.720hrs
    b. ICT #4 - 00:38:04.402hrs

c. Guragaon-Sec-72 ckt-3 - 00.38:04.628hrs
d. Guragaon-Sec-72 ckt-4 - 00:38:05.180hrs

2. On suggestion of DEF protection on 220kV Gurgaon(PG)-Sec-72 ckts, settings to be discussed with Haryana and then it would be implemented.

UP representative stated that one of the reason for tripping of only two out of four ICTs tripped before tripping of rest of the sec-72 ckts was due to difference in % impedance of transformers. POWERGRID representative agreed on this.

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	

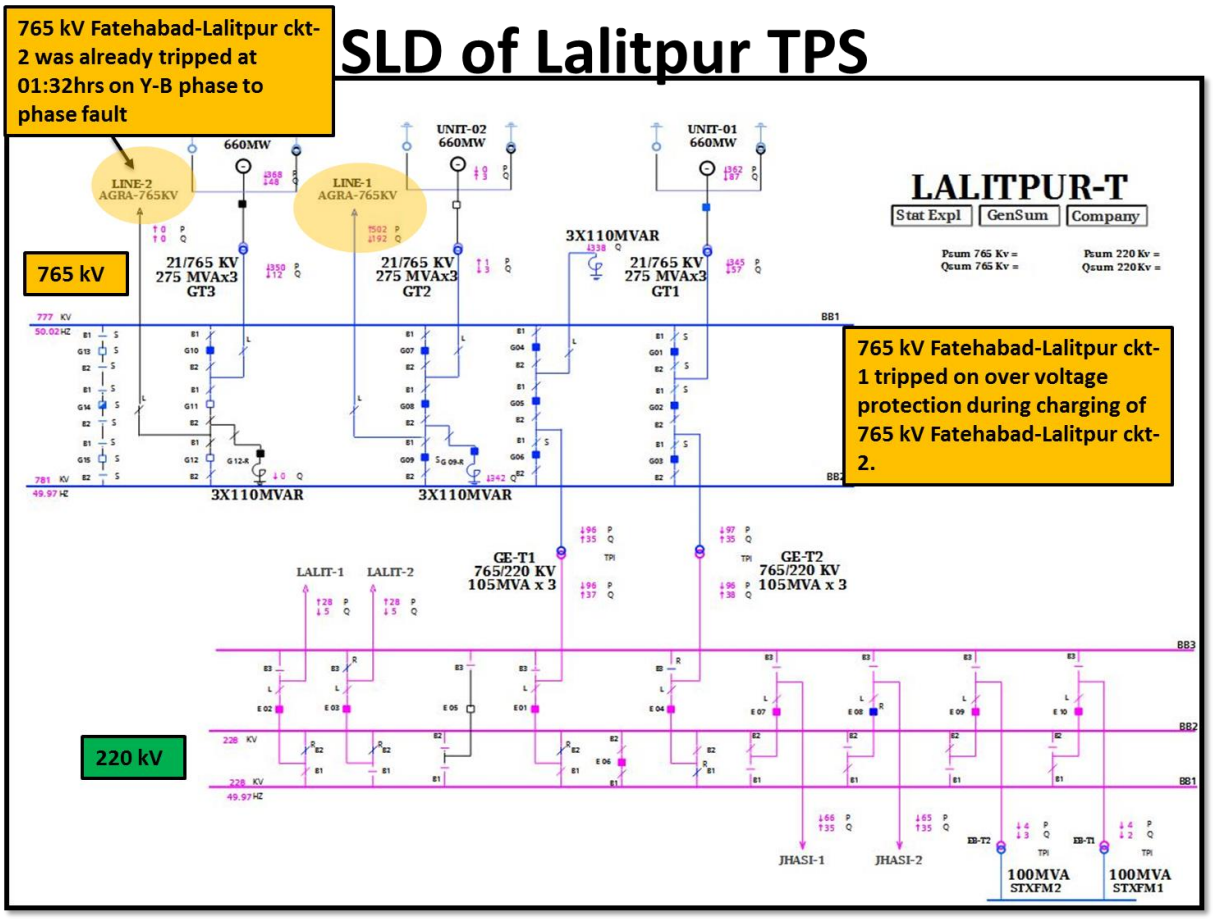
Description	Clauses	Utility	Remarks

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 2. Adequately Sectionalized and graded protective relaying system 3. Incorrect/ mis-operation / unwanted operation of Protection system

Based on above information description of the events is:

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

SLD of 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 has two 315 MVA 765/220 kV ICTs. At 220 kV voltage level, it is connected through Jhansi D/C and Lalilpur 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.

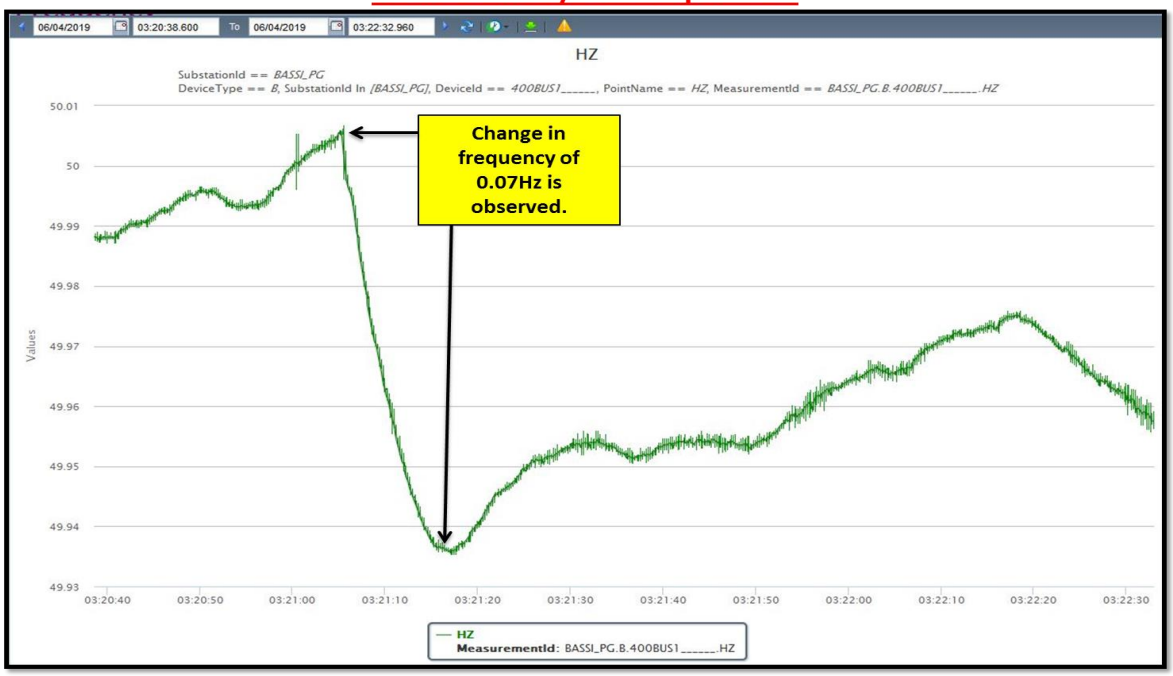
4. 765 kV Lalitpur-Fatehabad ckt-2 tripped at 01:32 hrs on Y-B phase to phase fault in the line.
5. At 03:22hrs, 765 kV Lalitpur-Fatehabad ckt-2 again charged from Fatehabad (UP) end. At the same time healthy 765 kV Lalitpur-Fatehabad ckt-1 also tripped on over voltage stage-1 protection.

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:

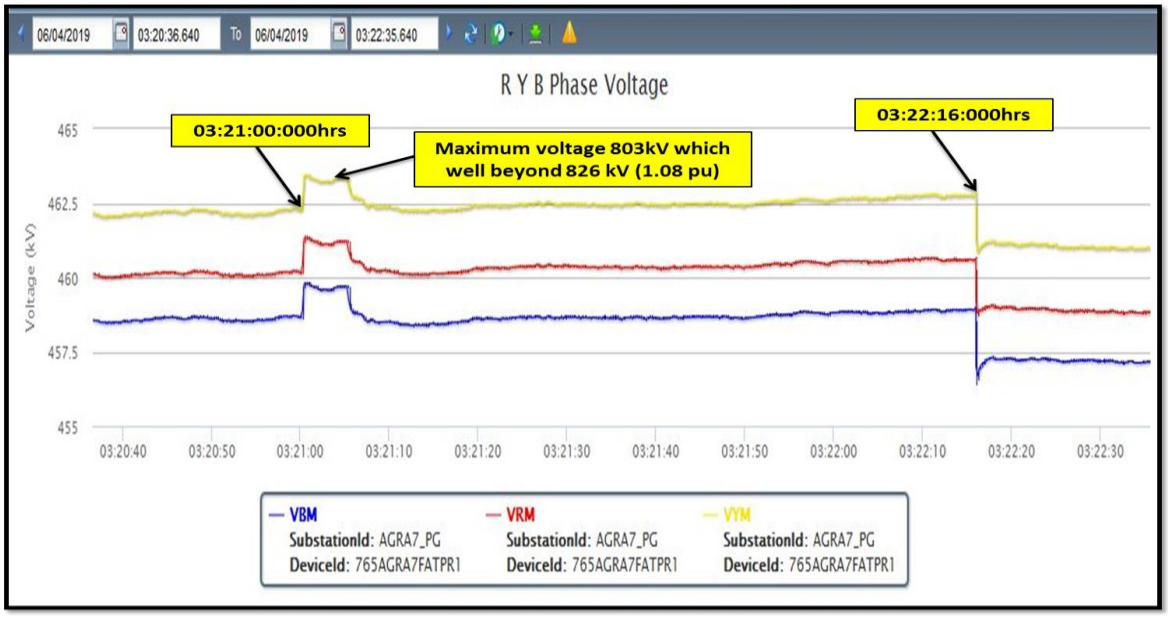
PMU Plot of frequency at Bassi(PG)

03:21hrs/06-Apr-19



PMU Plot of phase voltage magnitude at Agra(PG)

03:21hrs/06-Apr-19

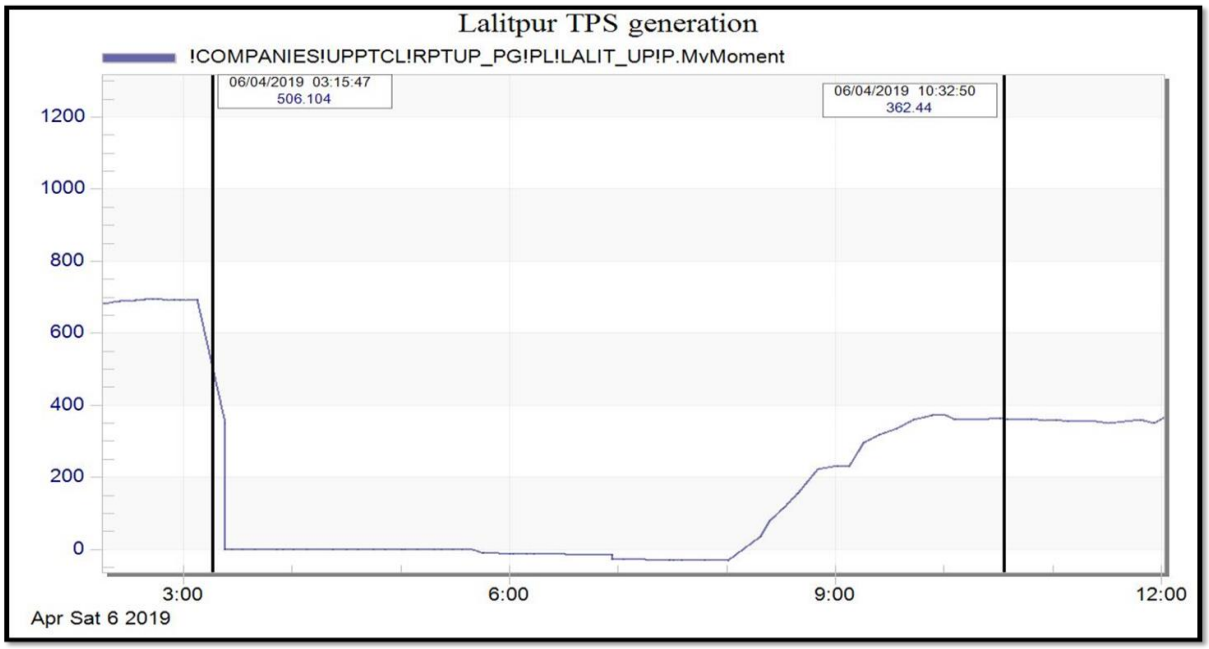


10. As per PMU data:
    - As per PMU, no fault observed in the system. Over voltage tripping
    - Fault Clearance time: **Not applicable**

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.

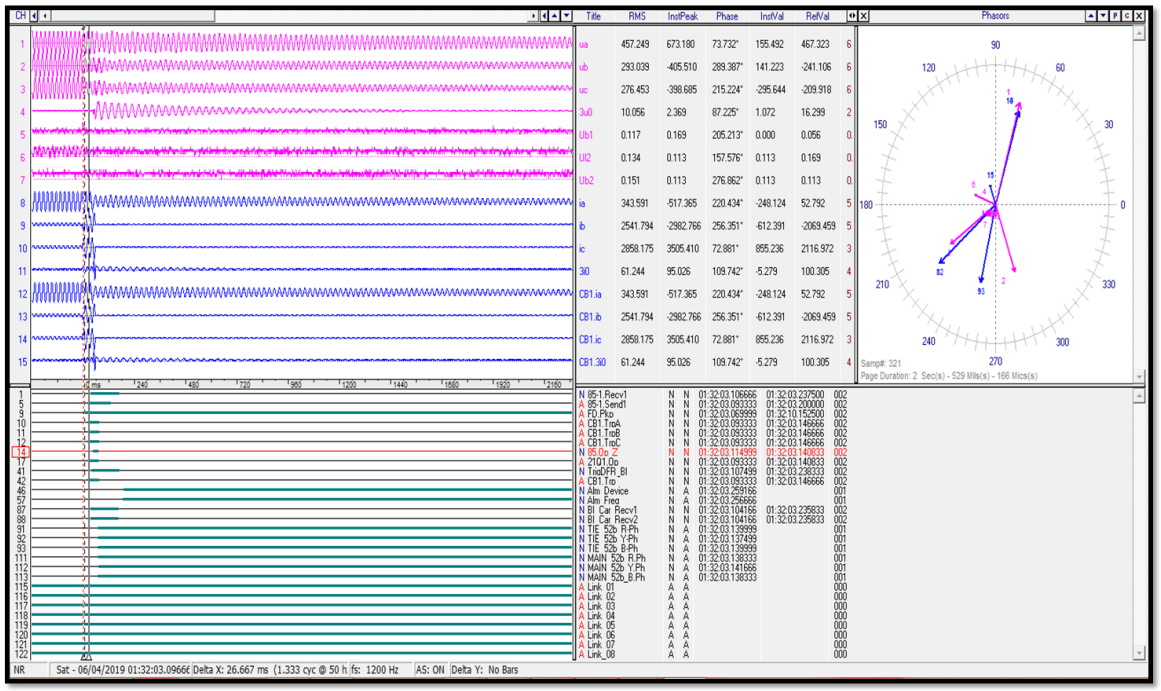
Lalitpur TPS Generation pattern during tripping



12. As per UPPTCL details:

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

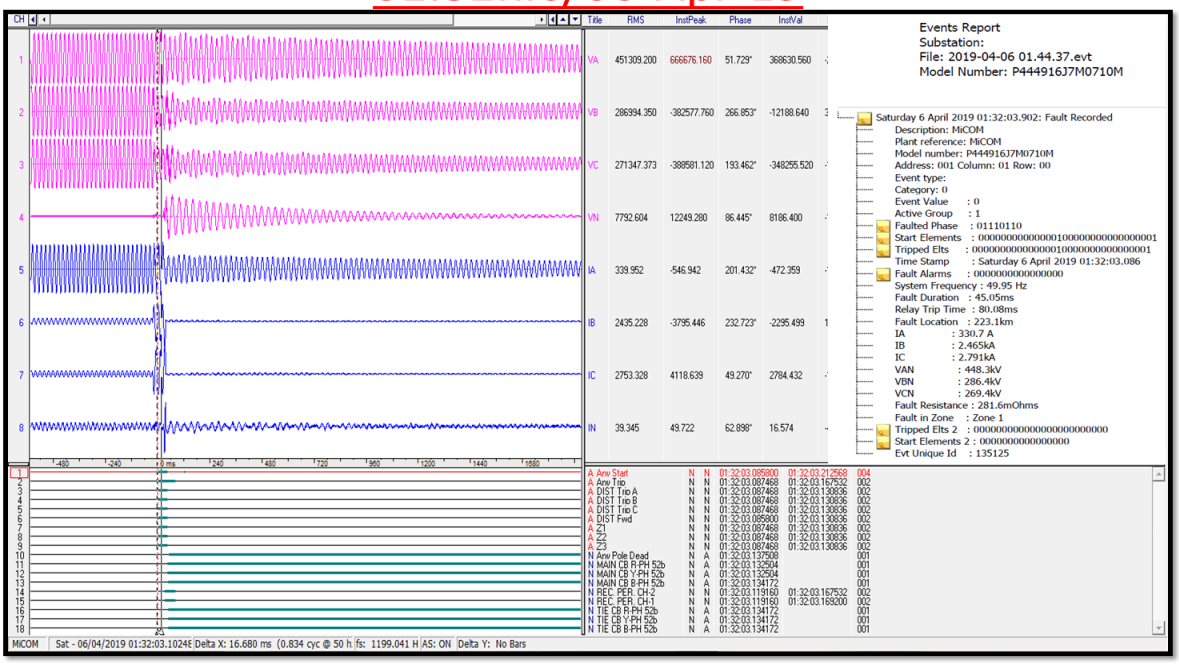
01:32hrs/06-Apr-19



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

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

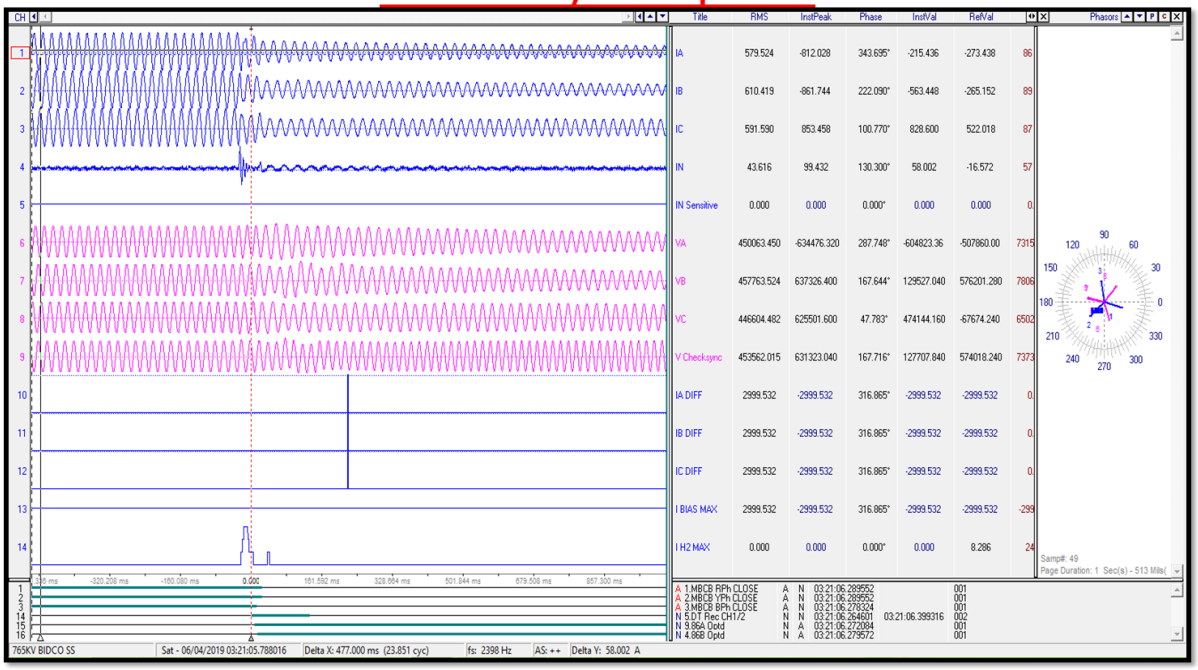
01:32hrs/06-Apr-19



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

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

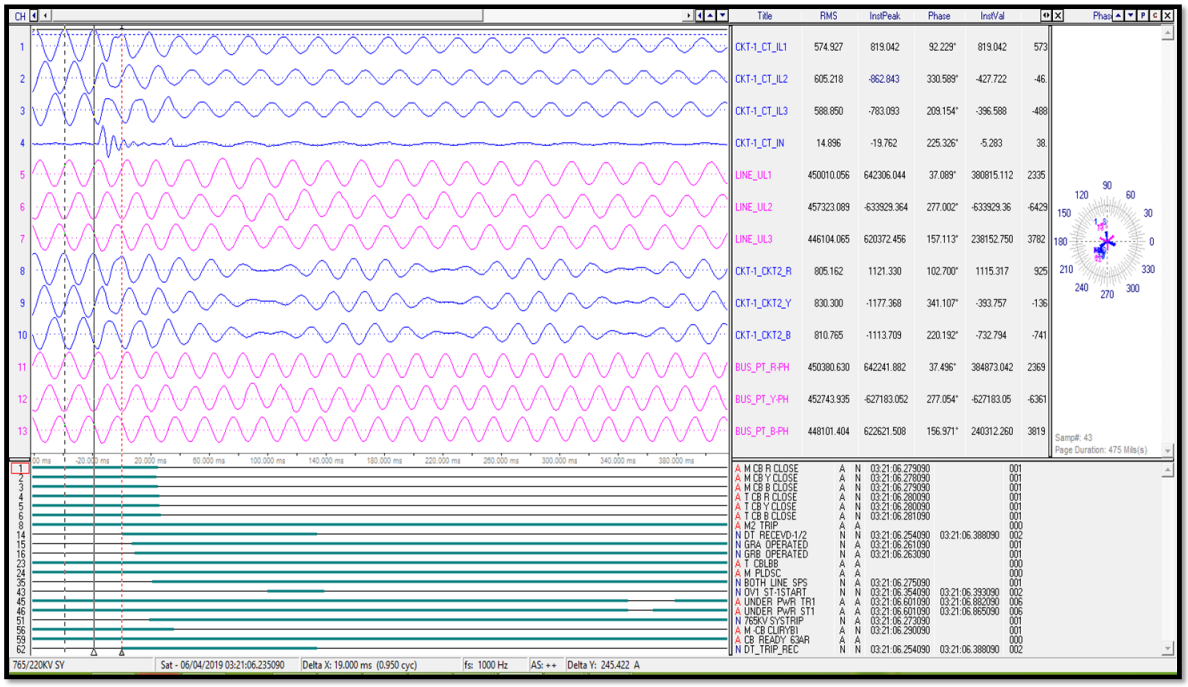
03:21hrs/06-Apr-19



No fault in the system, DT received from remote end

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

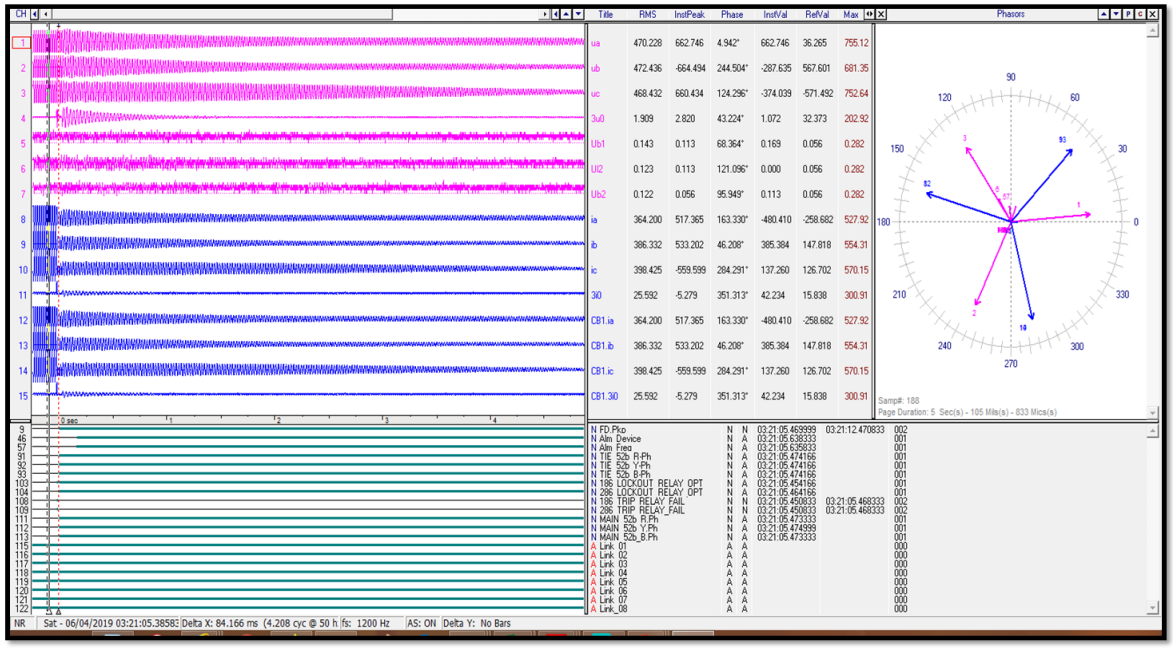
03:21hrs/06-Apr-19



No fault in the system

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

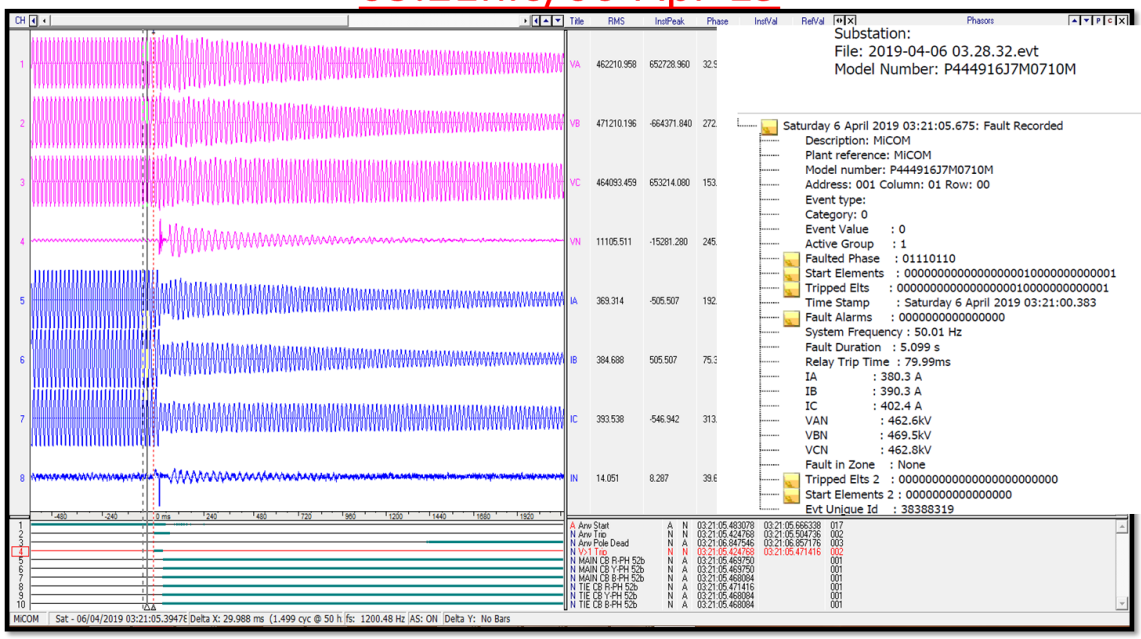
03:21hrs/06-Apr-19



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 Laltipur, 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,Ib=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.

UP representative informed the following in the meeting:

1. Over voltage stage-1 setting at 765kV Fatehabad end is 108 % with 5 second time delay in ckt-1 and 109% with 6 second time delay in ckt-2.
2. The over voltage setting at Lalitpur end is opposite to that of corresponding Fatehabad end.

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	

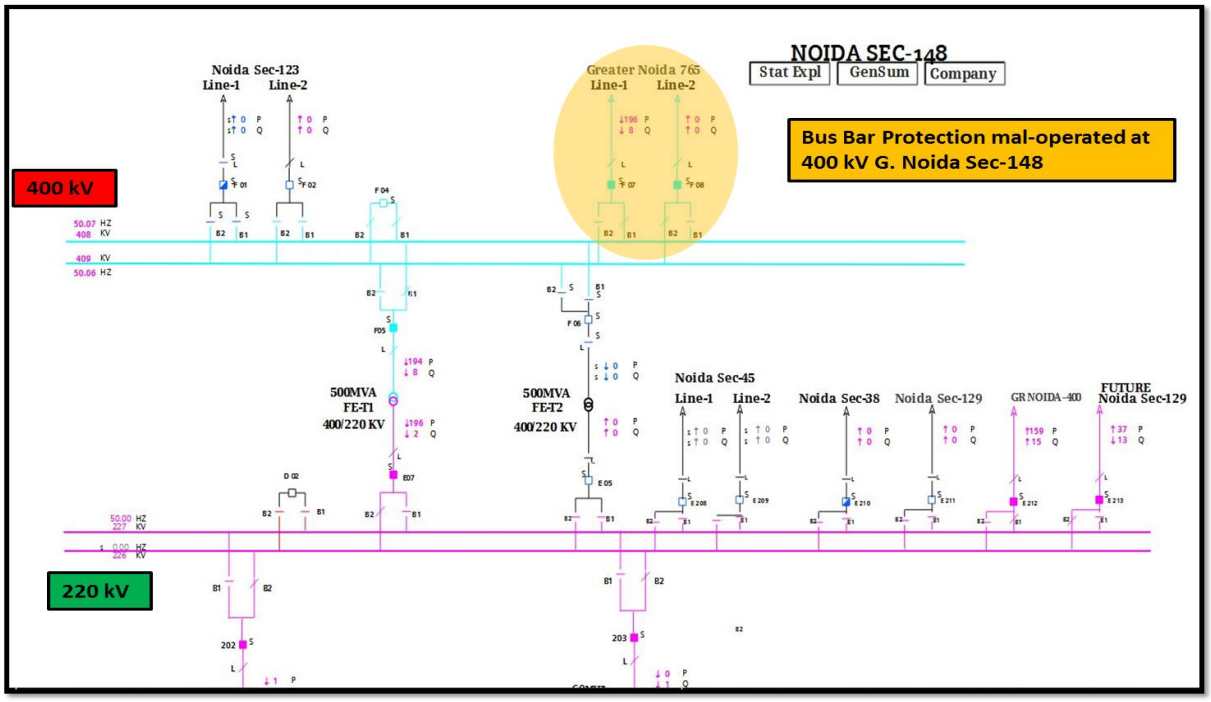
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Uttar Pradesh	Partially Available	
DR/EL	Uttar Pradesh	Received (Partial)	After 24hrs
Preliminary Report	Uttar Pradesh	Received	After 24hrs
Detailed Report	Uttar Pradesh	Not Received	

Description	Clauses	Utility	Remarks
Violation of Clauses	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. 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)

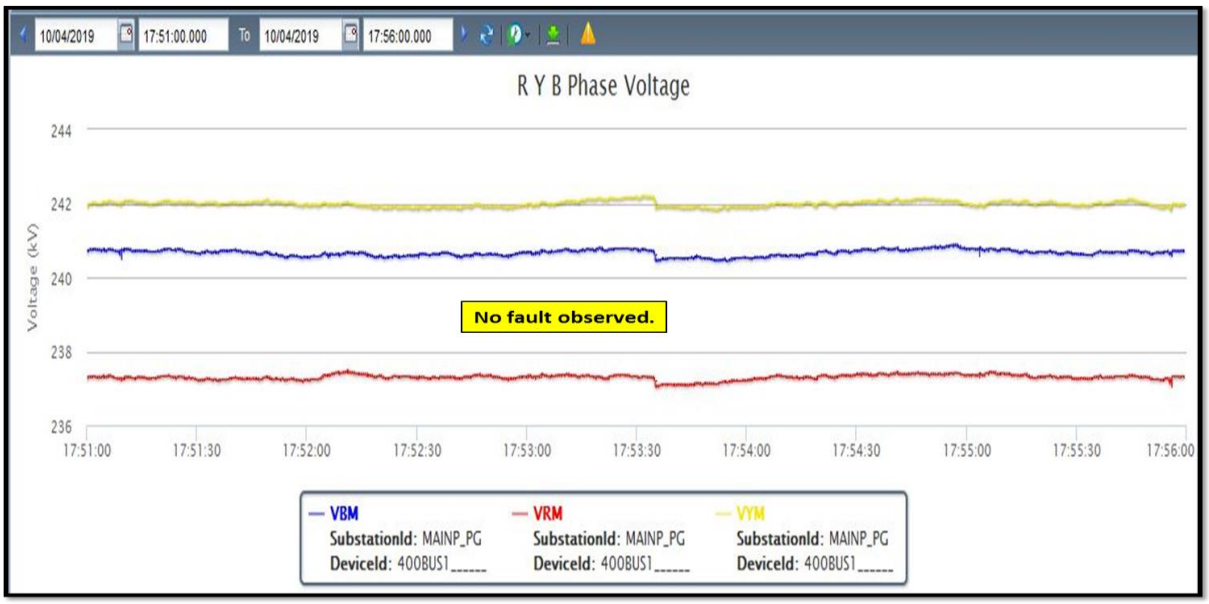
9. PMU plots:

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

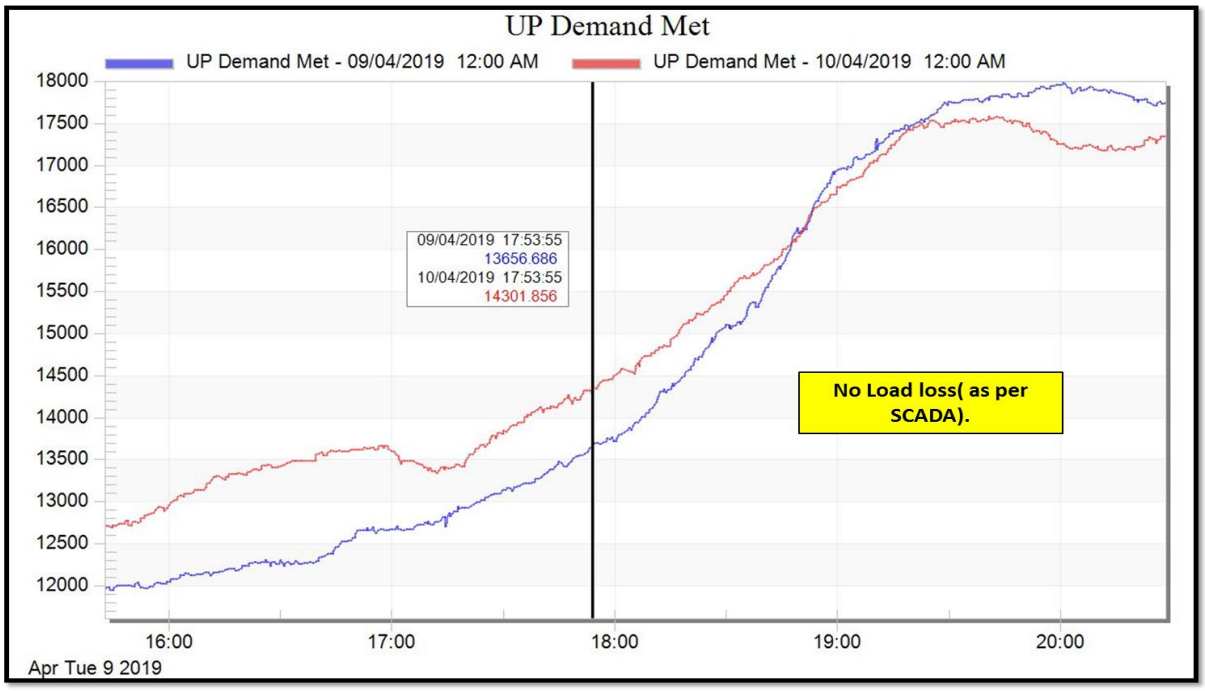


10. As per PMU data:
    - As per PMU, no fault observed in the system. Over voltage tripping
    - Fault Clearance time: **Not applicable**

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.

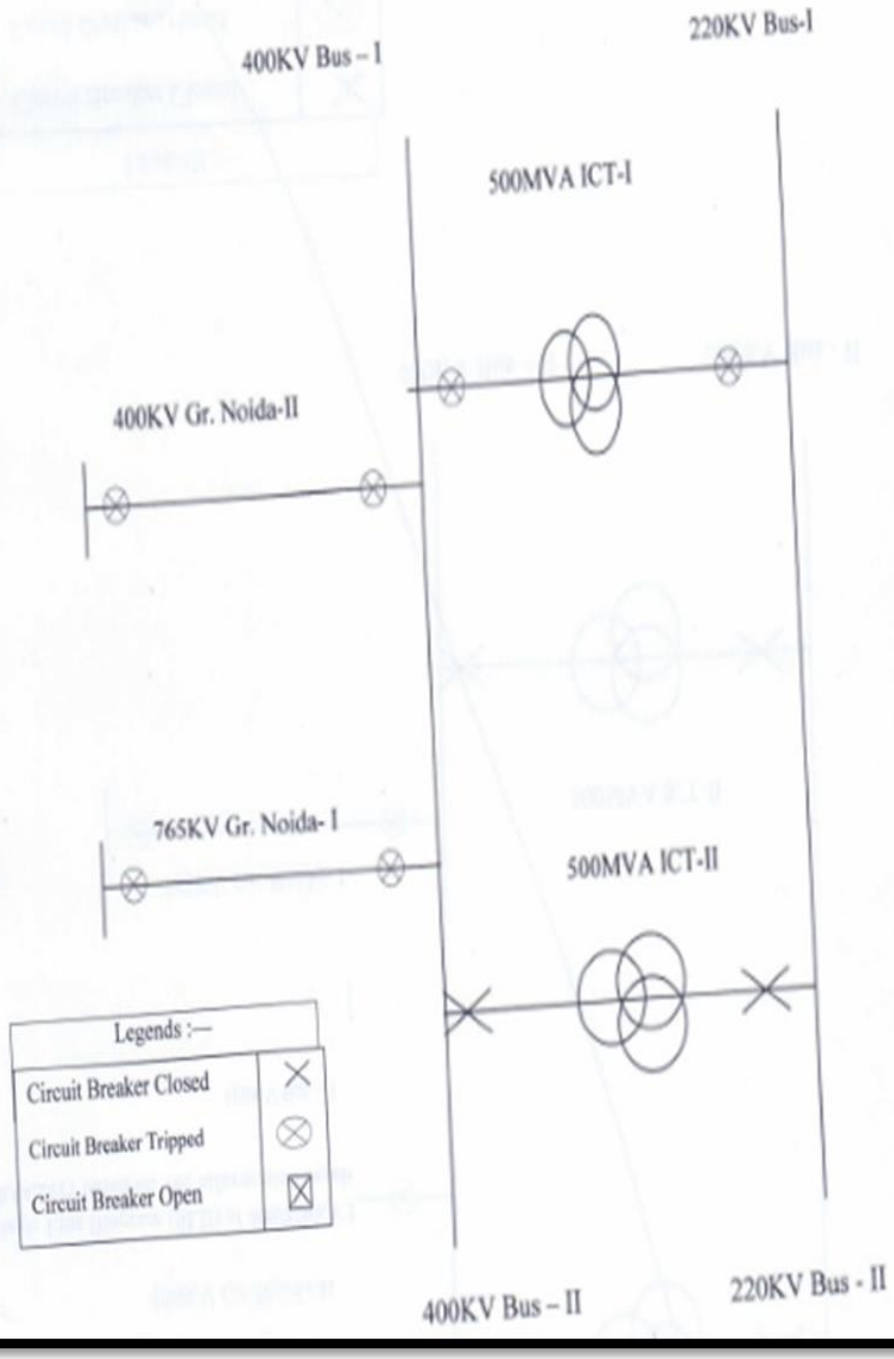
Remedial Measures taken/to be taken:-

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

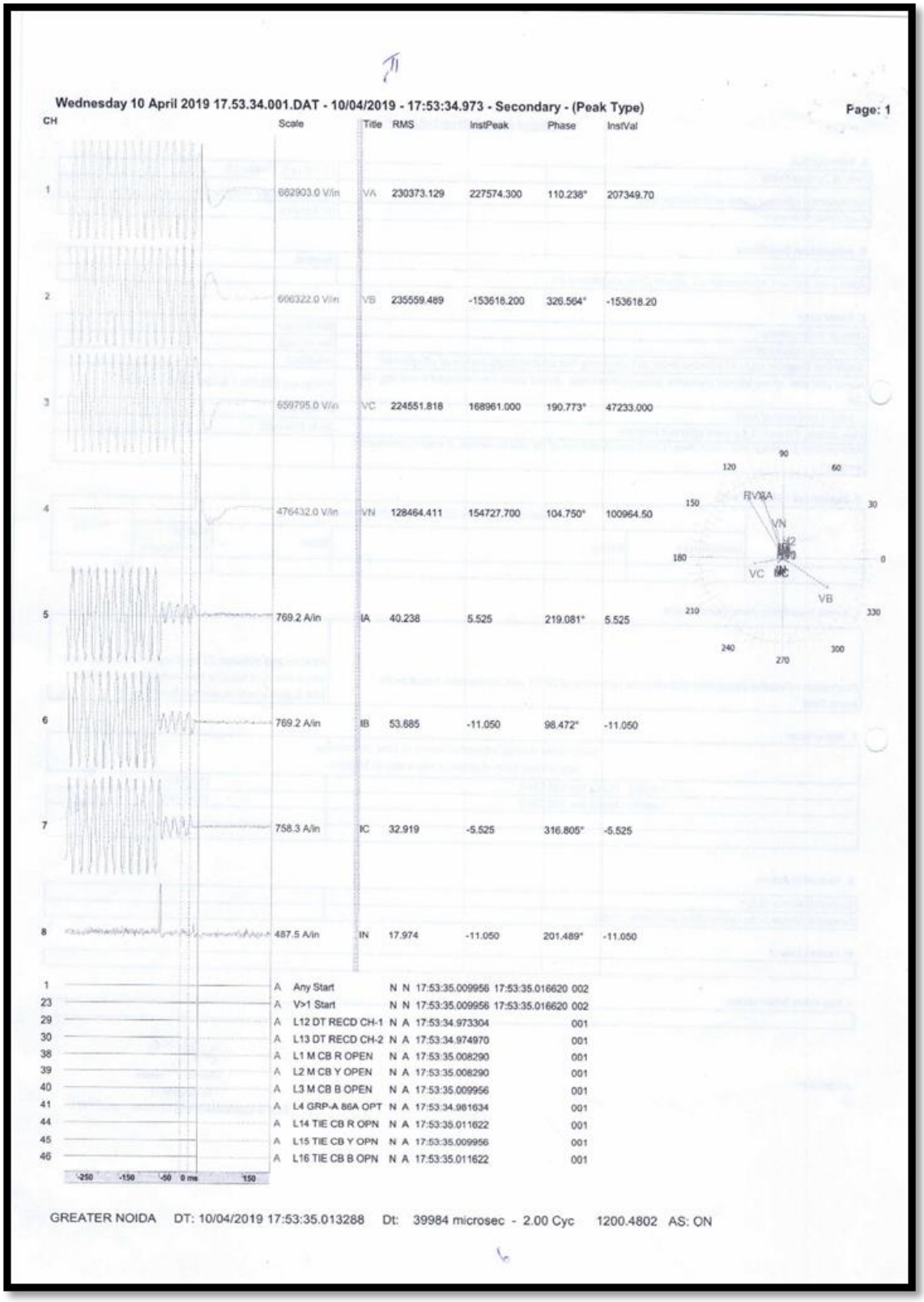
FAULT ANALYSIS

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 discripency 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. Bus coupler was
	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:



Wednesday 10 April 2019 17.53.34.001.DAT - 10/04/2019 - 17:53:34.973 - Secondary - (Peak Type) Page: 1

CH	Scale	Title	RMS	InstPeak	Phase	InstVal
1	662903.0 V/in	VA	230373.129	227574.300	110.238°	207349.70
2	666322.0 V/in	VB	235559.489	-153618.200	326.564°	-153618.20
3	659795.0 V/in	VC	224551.818	168961.000	190.773°	47233.000
4	476432.0 V/in	VN	128464.411	154727.700	104.750°	100964.50
5	769.2 A/in	IA	40.238	5.525	219.081°	5.525
6	769.2 A/in	IB	53.685	-11.050	98.472°	-11.050
7	758.3 A/in	IC	32.919	-5.525	316.805°	-5.525
8	487.5 A/in	IN	17.974	-11.050	201.489°	-11.050

1	A	Any Start	N	N	17:53:35.009956	17:53:35.016620 002
23	A	V>1 Start	N	N	17:53:35.009956	17:53:35.016620 002
29	A	L12 DT RECD CH-1	N	A	17:53:34.973304	001
30	A	L13 DT RECD CH-2	N	A	17:53:34.974970	001
38	A	L1 M CB R OPEN	N	A	17:53:35.008290	001
39	A	L2 M CB Y OPEN	N	A	17:53:35.008290	001
40	A	L3 M CB B OPEN	N	A	17:53:35.009956	001
41	A	L4 GRP-A 86A OPT	N	A	17:53:34.981634	001
44	A	L14 TIE CB R OPN	N	A	17:53:35.011622	001
45	A	L15 TIE CB Y OPN	N	A	17:53:35.009956	001
46	A	L16 TIE CB B OPN	N	A	17:53:35.011622	001

-250 -150 -50 0 ms 150

GREATER NOIDA DT: 10/04/2019 17:53:35.013288 Dt: 39984 microsec - 2.00 Cyc 1200.4802 AS: ON

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.

UP representative informed the following in the meeting:

1. G. Noida Sector-148 station is a GIS station. During commissioning period was going on. Low gas alarm appeared for 400kV bus coupler. However, the pressure was found OK. The DC supply to bus coupler was turned off as a result the contacts of bus coupler became NO (Normally Open) from NC (Normally Closed). However, gas pressure low alarm was present. Both situations result in extending tripping command to both buses.
2. Construction firm has been told to do any such work after intimating to testing and commissioning department.

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

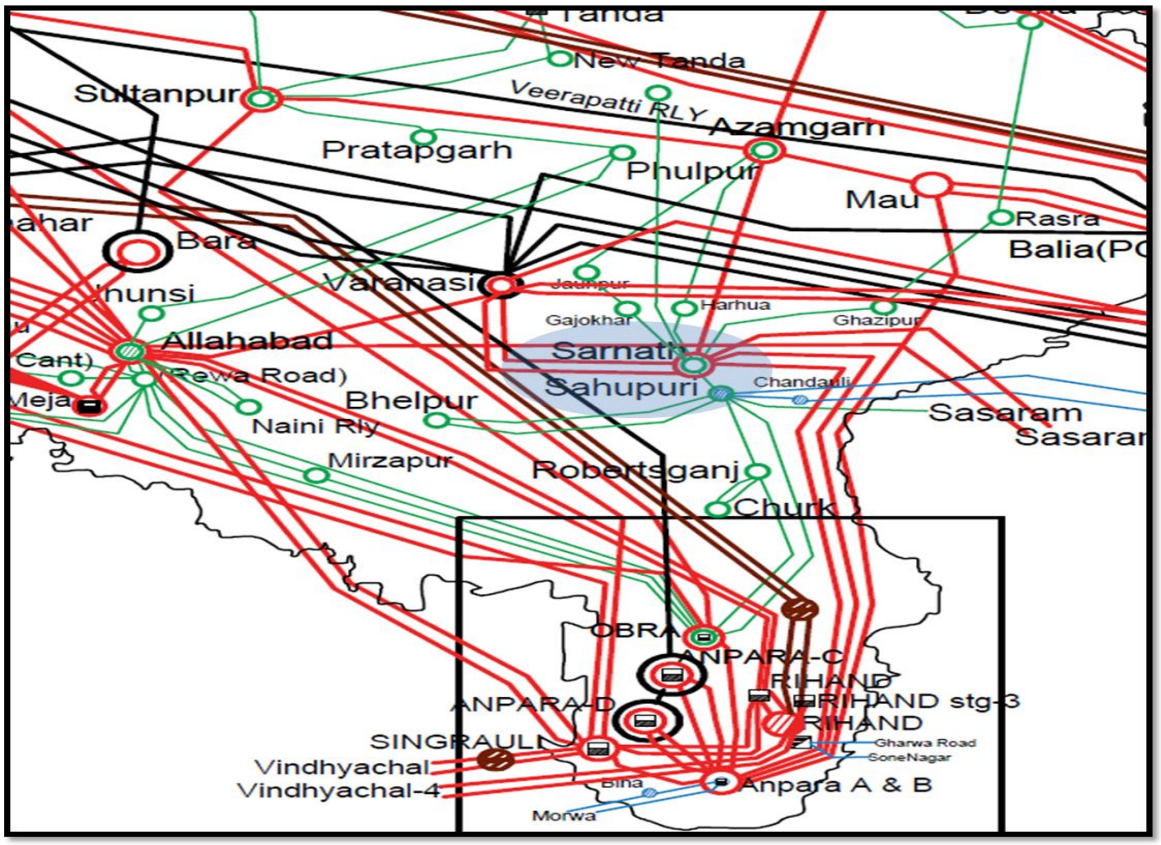
Phase of the fault		B-phase to earth fault followed by R-phase to earth fault	As per PMU data

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 of 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

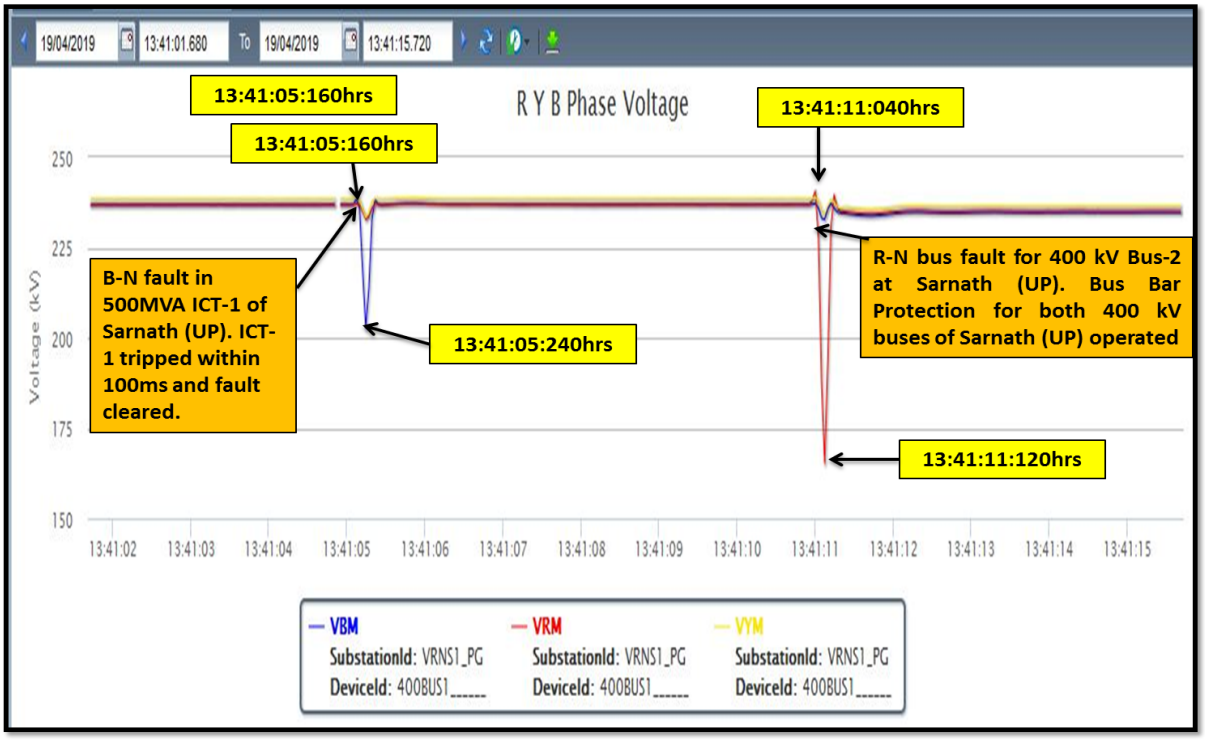
9. PMU plots:

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

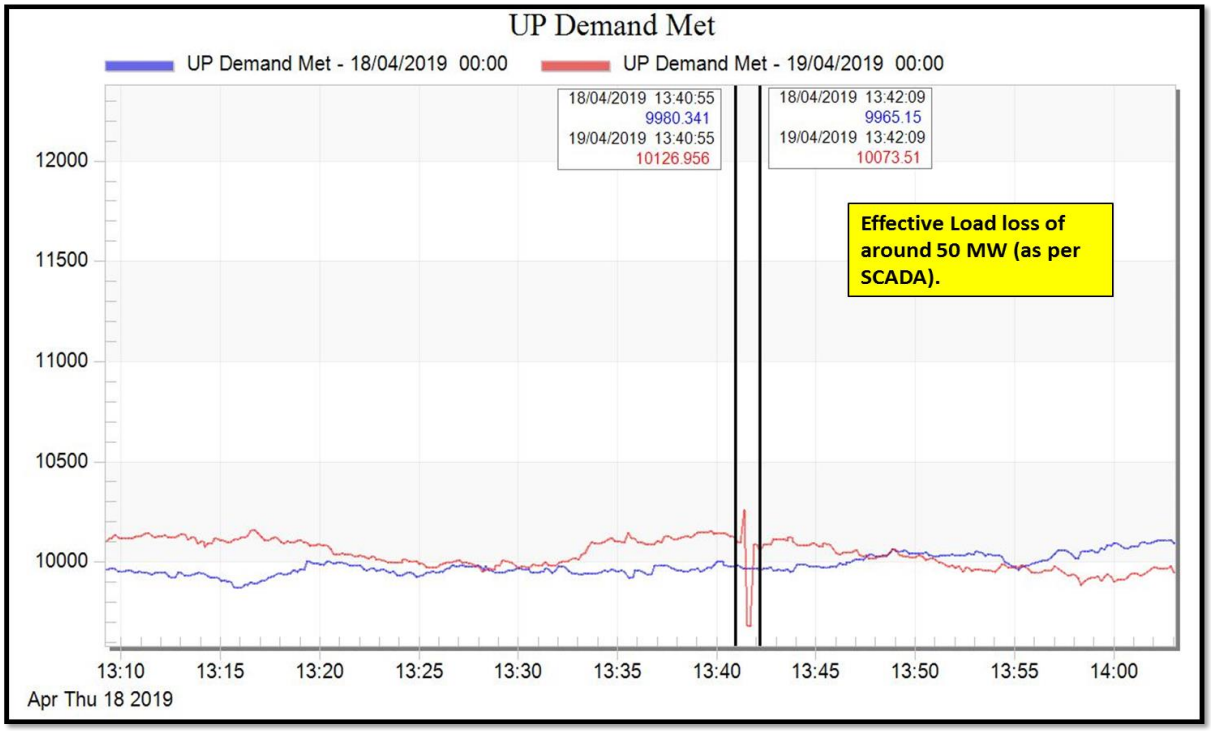


10. As per PMU data:
    - Two fault, first fault in Y-B phase and second fault in R-N fault.
    - Fault Clearance time: **100ms**

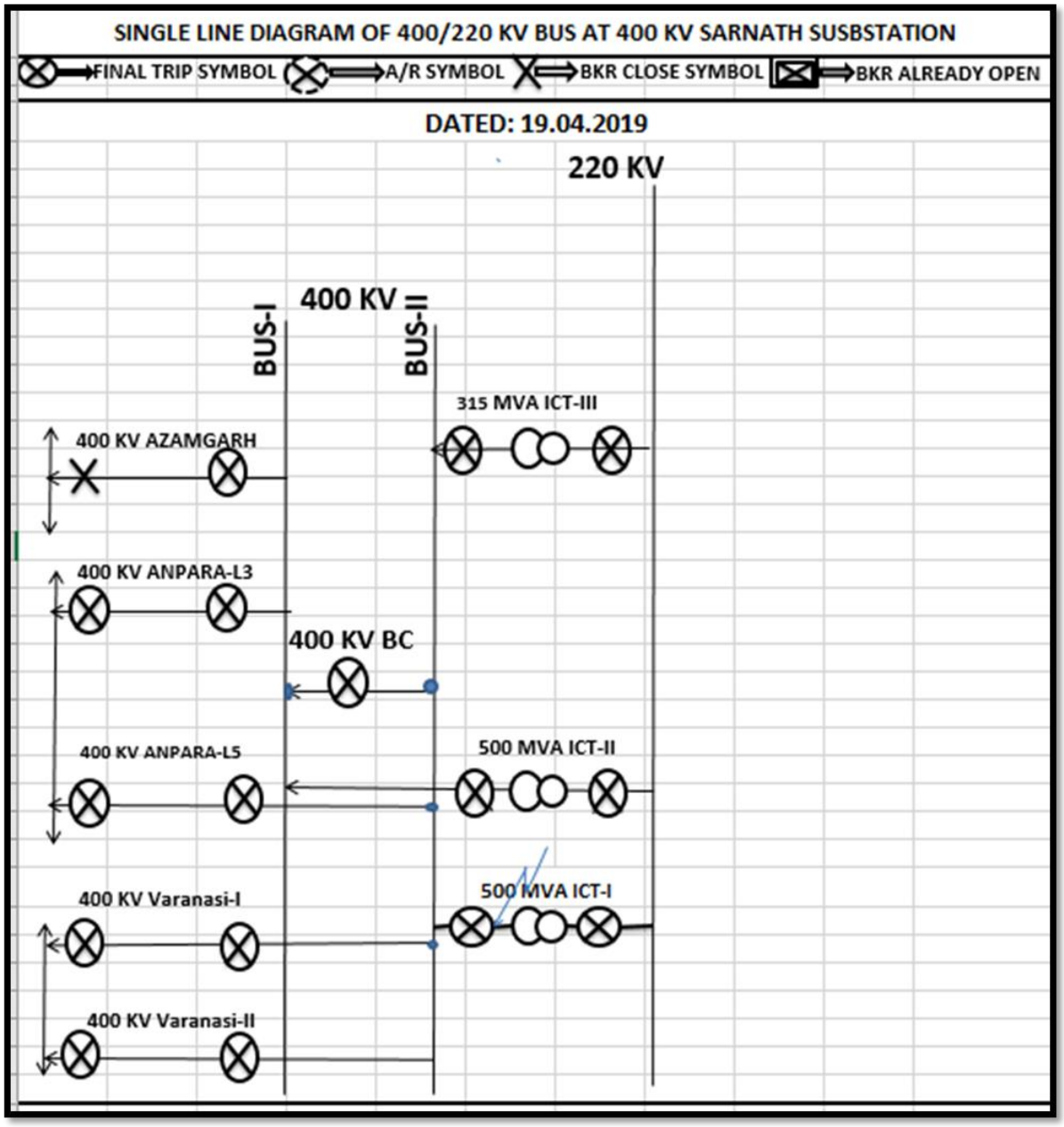
11. SCADA data and SoE: SoE captured all the breaker of Sarnath (UP) tripped before actual fault time (reference time from PMU data).

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	LISRNTH2	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	LISRNTH1	Protection Trip	App	
13:41:11:250	210ms	VRNS1_P	400kV	14BRSRN1	Circuit Breaker	Open	

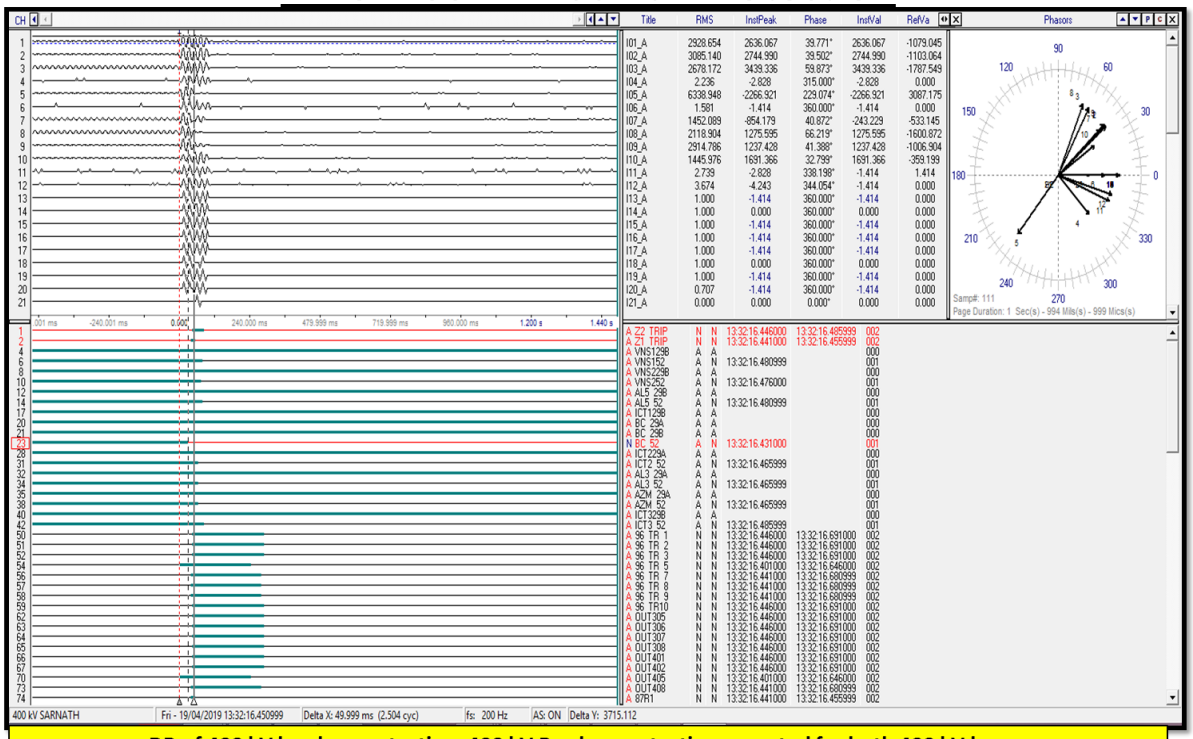
UP Demand pattern during tripping



12. As per UPPTCL & POWERGRID details:

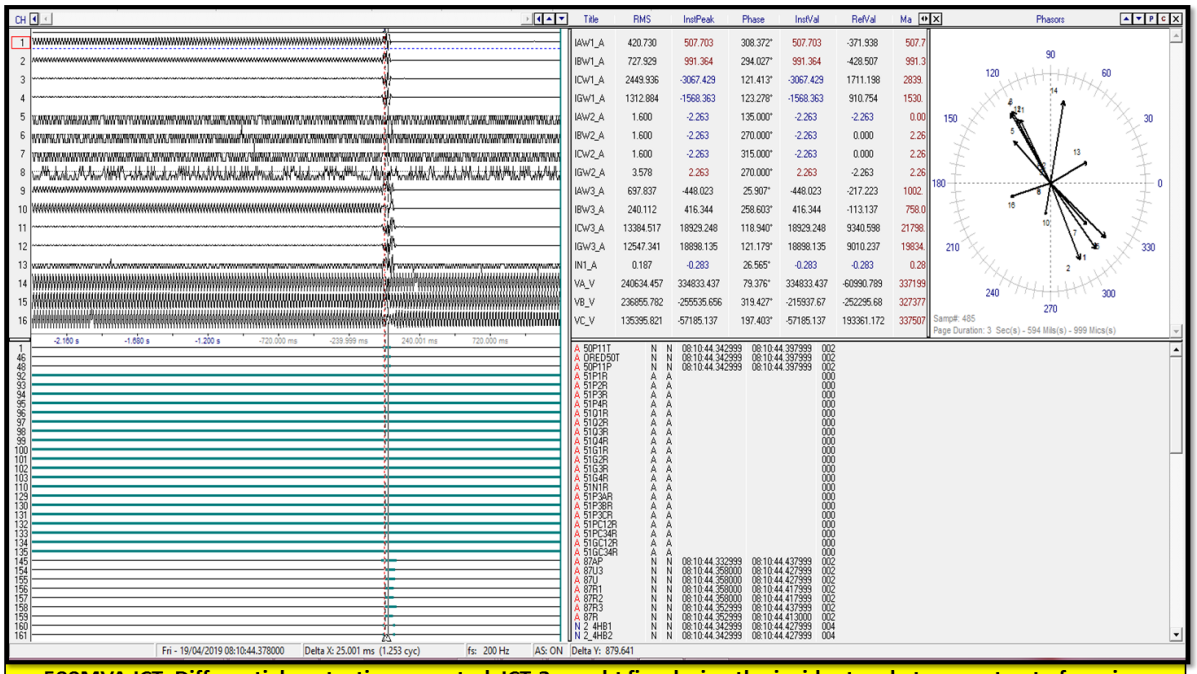


DR of 400 kV Bus Bar Protection



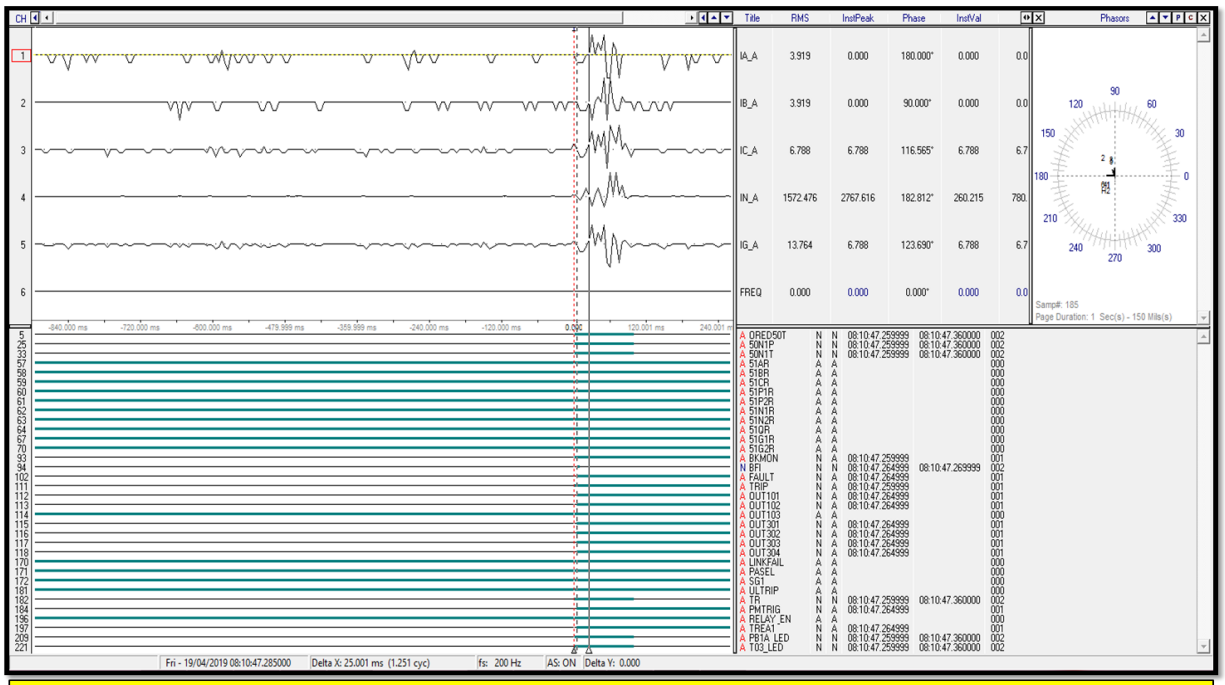
DR of 400 kV bus bar protection. 400 kV Bus bar protection operated for both 400 kV buses

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



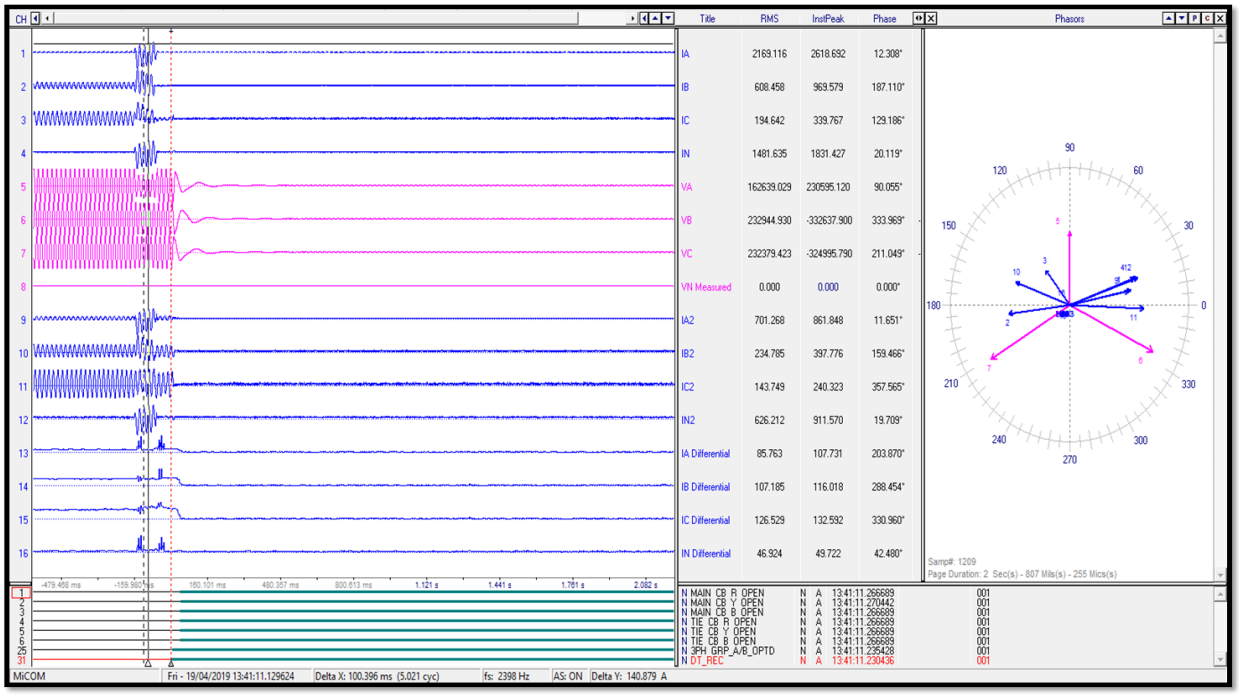
500MVA ICT: Differential protection operated. ICT-3 caught fire during the incident and at present out of service.
DR Time Synch error

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



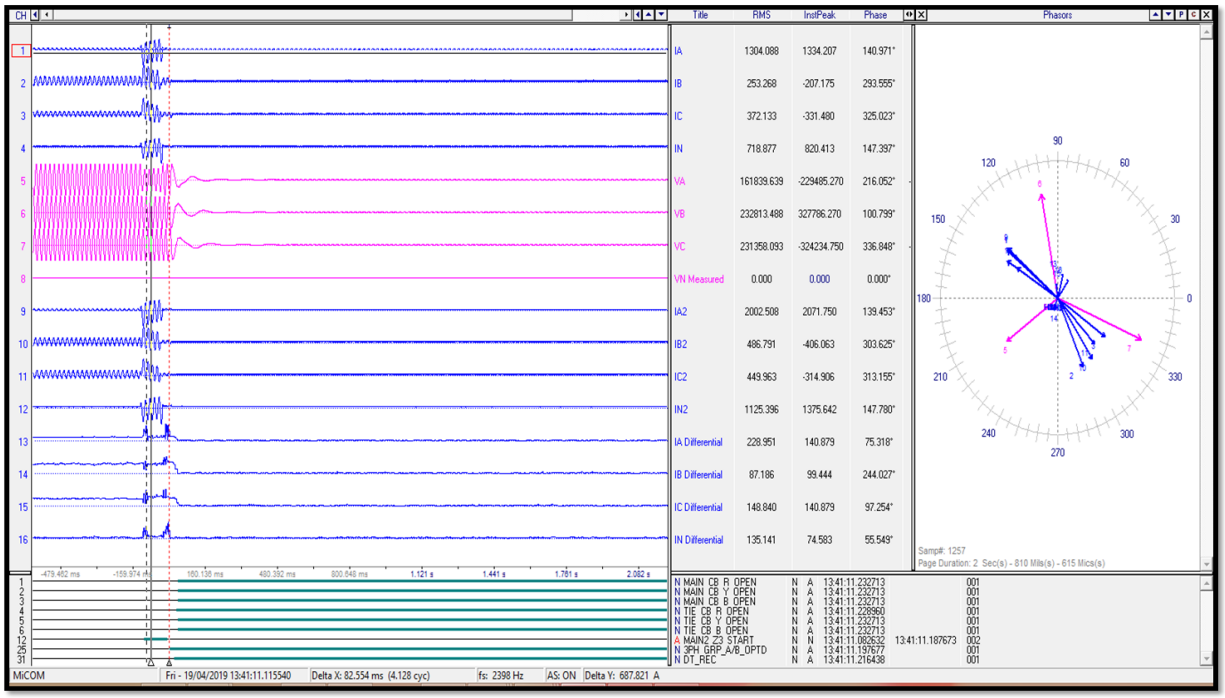
500MVA ICT: Differential protection operated. ICT-3 caught fire during the incident and at present out of service. DR Time Synch error

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*:*

1. 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.

Sarnath(UP) representative was not present at the time of discussion. The following is as per the report submitted earlier in the meeting:

1. Time synchronization of DR, SCADA SoE checked and corrected on 07.07.2019.
2. To check the bus bar protection, SEL was called. The report submitted by SEL is as follows:

OeM

From 400SNT By email on 06.5.19
Er. RizwanulChauhan.

SCHWEITZER ENGINEERING LABORATORIES PRIVATE LIMITED
Plot No. 166, 5th A Cross Road • Bommasandra Industrial Area • Bommasandra • Bangalore 560 099 • Karnataka, INDIA
Tel: 91-080-42464200 • www.selinc.com
Corporate Identity Number (CIN): U74999DL2006PTC150892

EVENT ANALYSIS REPORT

Customer: UPPTCL, 400KV Sarnath. **Date: 29/04/2019**

Issue Reported:

SEL-487B relay tripped on Zone-1 and Zone-2 as the Fault is on Zone-2 only.

Analysis of events:

From the event file of SEL-487B it was observed that, when there was a bus fault in Zone-2, relay issued trip command to Bus coupler (BC) breaker first, this is because of Coupler security logic configured in the relay. After that relay issued Zone-1 & 2 trips because relay detected differential current in both the Zones. It is also observed that current was continuing in BC CT even after BC CB open.

Case-1: Bus coupler security logic

A fault between a bus coupler circuit breaker and CT usually results in the loss of multiple zones as well as in delayed fault clearance, Preventing the loss of multiple bus-zones requires two steps. First the coupler security logic allows the differential elements to trip only the bus coupler circuit breaker, thereby interrupting the fault current from the unfaulted bus-zone.
Then, this logic removes the bus coupler CTs from all differential calculations. Removing the bus coupler CTs from the differential calculations of the unfaulted buszone has no effect on the stability of this bus-zone because it no longer contributes to the fault current. However, removing the bus coupler CTs from the differential calculations of the faulted bus-zone causes the differential elements of the faulted bus-zone to operate.

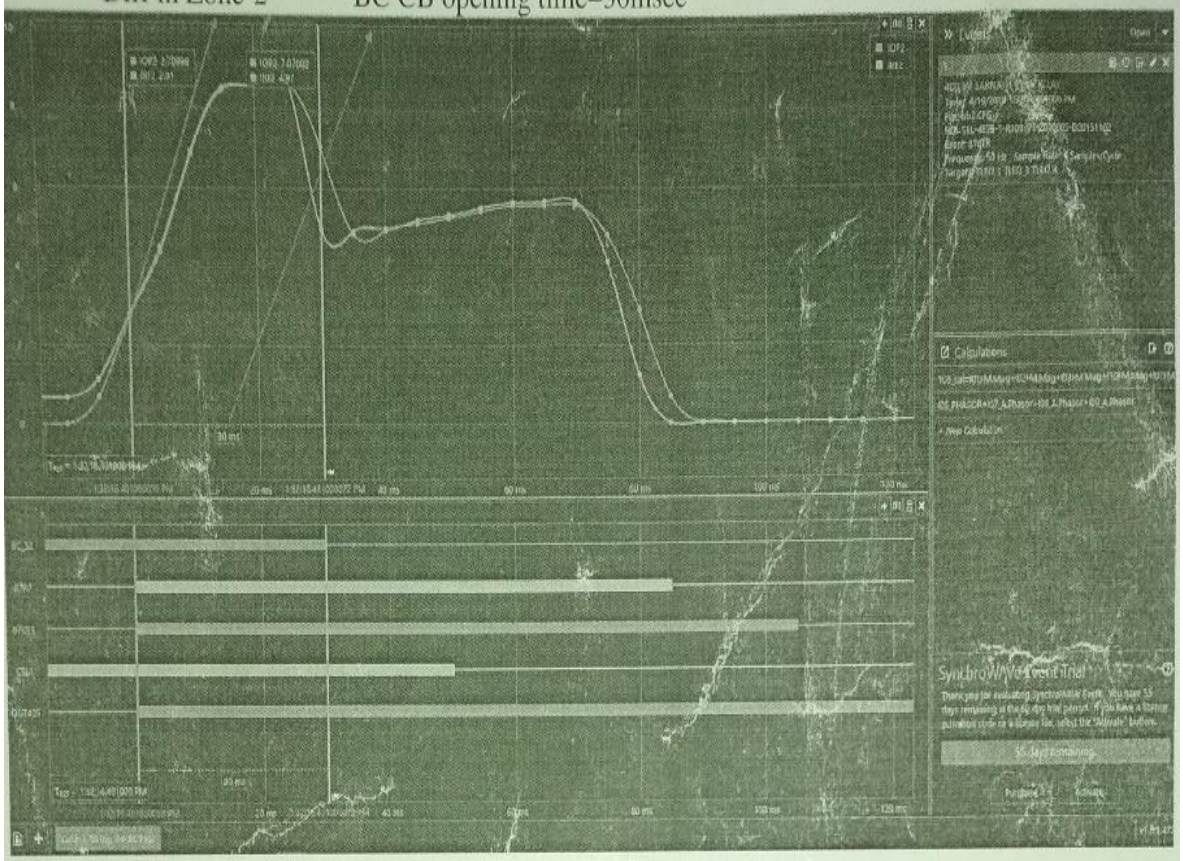
As per below DR-1 it is found that, the relay sensed fault in Bus-2(87R2) and issued trip command to Bus coupler CB(OUT405) as per the coupler security logic.

It is also observed that after issuing trip command to bus coupler CB, it took 30msec to dropped off the BC close status contact (Digital input-BC_52) from the time of Trip.

SCHWEITZER ENGINEERING LABORATORIES PRIVATE LIMITED
Plot No. 166, 5th A Cross Road • Bommasandra Industrial Area • Bommasandra • Bangalore -560 099 • Karnataka, INDIA
Tel: 91-080-42464200 • www.selinc.com
Corporate Identity Number(CIN): U74999DL2006PTC150882

EVENT ANALYSIS REPORT

Observed
Diff in Zone-2 BC CB opening time=30msec



DR-2

Case-2

Condition-1

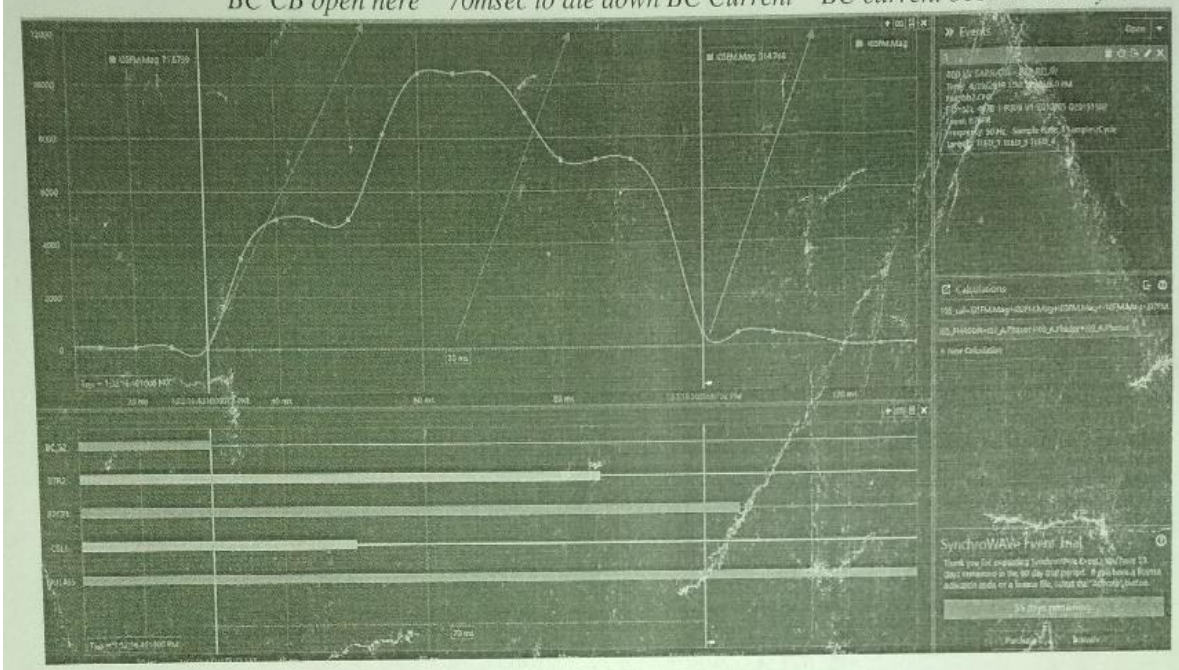
As per below DR-2 it is observed that, the Bus coupler CT current (I05 Terminal) is continuing even after BC breaker open. It took nearly 70 msec to die down.

These phenomena may be because of arc quenching of BC CB or Breaker Auxiliary contact (52A) dropped off before actual breaker open.

SCHWEITZER ENGINEERING LABORATORIES PRIVATE LIMITED
Plot No. 166, 5th A Cross Road • Bommasandra Industrial Area • Bommasandra • Bangalore -560 099 • Karnataka, INDIA
Tel: 91-080-42464200 • www.selinc.com
Corporate Identity Number(CIN): U74999DL2006PTC150882

EVENT ANALYSIS REPORT

BC CB open here 70msec to die down BC Current BC current become nearly zero



DR-3

Condition-2: Reason for Zone-1 trip

As per the relay configuration, once the bus coupler CB open, relay will remove bus coupler CT from the differential calculation.

The terminals ICT-2(I07), AL-2(I08), AZM (I09) are belongs to Zone-1 at the time of fault condition. If we observe the phasor sum of above terminals, it will give differential current in Zone-1.

In this condition, we will calculate the differential current experienced by relay in Zone-1.

Phasor sum=I07 phasor+I08 phasor+I09 phasor

Color	Name	Mag	Angle
	I07_A.Phasor	1861.95	0°
	I08_A.Phasor	2332.35	25.55°
	I09_A.Phasor	3295.13	3.64°
	PHASORSUM	7355.78	9.51°

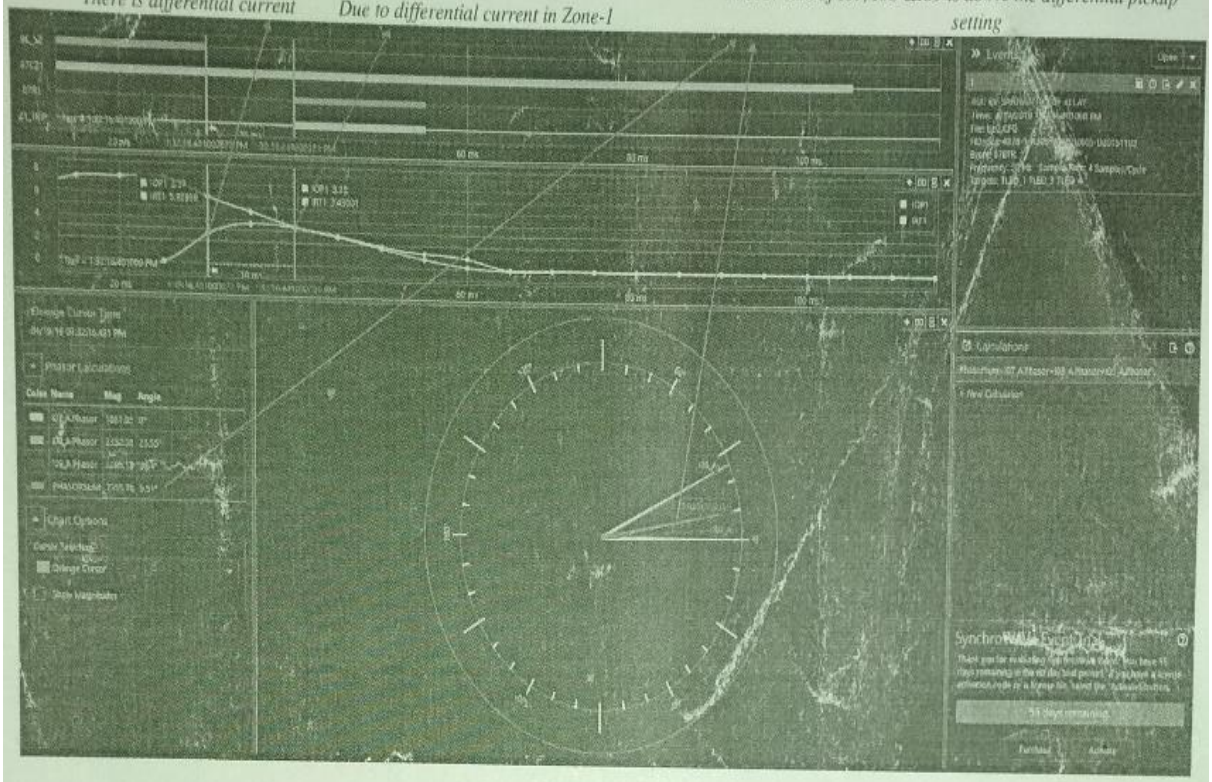
SCHWEITZER ENGINEERING LABORATORIES PRIVATE LIMITED
Plot No. 166, 5th A Cross Road • Bommasandra Industrial Area • Bommasandra • Bangalore -560 099 • Karnataka, INDIA
Tel: 91-080-42464200 • www.selinc.com
Corporate Identity Number(CIN): U74999DL2006PTC150882

EVENT ANALYSIS REPORT

When BC CB open, There is differential current

Zone-1 tripped, Due to differential current in Zone-1

Phasor sum of I07, I08 &I09 is above the differential pickup setting



DR-4

Case-3: Reasons for Zone-2 trip

As per the relay configuration, once the bus coupler CB open, relay will remove bus coupler CT from the differential calculation.

Because of the fault in Bus-2, relay detected the differential current in Zone-2 which caused tripping in Zone-2.

The terminals VNS1 (I01), VNS2 (I02), AL5 (I03) & ICT-3(I10) are belongs to Zone-2 at the time of fault condition. If we observe the phasor sum of above terminals, it will give differential current in Zone-2.

In this case, we will calculate the differential current experienced by relay in Zone-2.

Phasor sum=I01 phasor+I02 phasor+I03 phasor+I10 phasor

SCHWEITZER ENGINEERING LABORATORIES PRIVATE LIMITED
Plot No. 166, 5th A Cross Road • Bommasandra Industrial Area • Bommasandra • Bangalore -560 099 • Karnataka, INDIA
Tel: 91-080-42464200 • www.selinc.com
Corporate Identity Number(CIN): U74999DL2006PTC150882

EVENT ANALYSIS REPORT

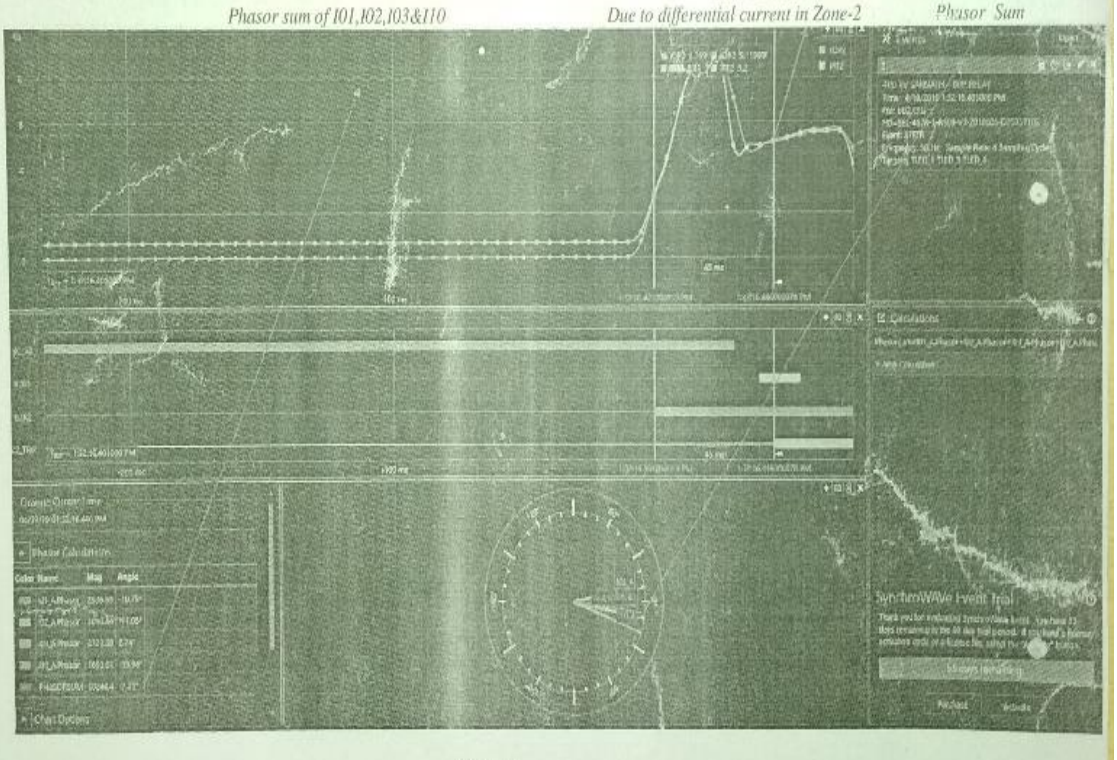
Phasor Calculations

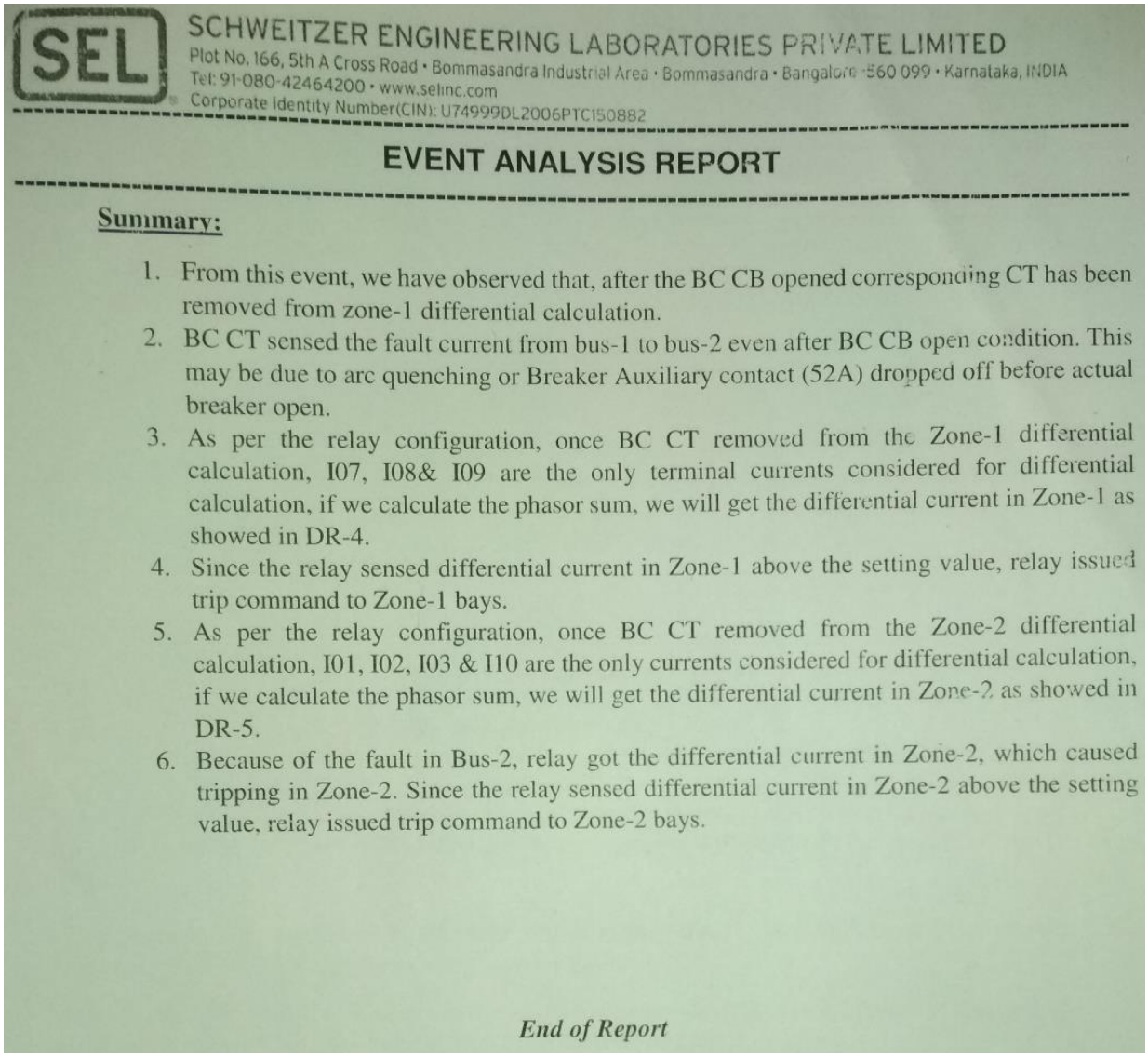
Color	Name	Mag	Angle
	I01_A.Phasor	2936.53	-10.79°
	I02_A.Phasor	3090.44	-11.05°
	I03_A.Phasor	2721.89	8.74°
	I10_A.Phasor	1653.61	-19.94°
	PHASORSUM	10244.4	-7.25°

Phasor sum of I01,I02,I03&I10

Zone-2 tripped,
Due to differential current in Zone-2

Phasor Sum





SCHWEITZER ENGINEERING LABORATORIES PRIVATE LIMITED
Plot No. 166, 5th A Cross Road • Bommasandra Industrial Area • Bommasandra • Bangalore -560 099 • Karnataka, INDIA
Tel: 91-080-42464200 • www.selinc.com
Corporate Identity Number(CIN): U74999DL2006PTC150882

EVENT ANALYSIS REPORT

Summary:

1. From this event, we have observed that, after the BC CB opened corresponding CT has been removed from zone-1 differential calculation.
2. BC CT sensed the fault current from bus-1 to bus-2 even after BC CB open condition. This may be due to arc quenching or Breaker Auxiliary contact (52A) dropped off before actual breaker open.
3. As per the relay configuration, once BC CT removed from the Zone-1 differential calculation, I07, I08& I09 are the only terminal currents considered for differential calculation, if we calculate the phasor sum, we will get the differential current in Zone-1 as showed in DR-4.
4. Since the relay sensed differential current in Zone-1 above the setting value, relay issued trip command to Zone-1 bays.
5. As per the relay configuration, once BC CT removed from the Zone-2 differential calculation, I01, I02, I03 & I10 are the only currents considered for differential calculation, if we calculate the phasor sum, we will get the differential current in Zone-2 as showed in DR-5.
6. Because of the fault in Bus-2, relay got the differential current in Zone-2, which caused tripping in Zone-2. Since the relay sensed differential current in Zone-2 above the setting value, relay issued trip command to Zone-2 bays.

End of Report

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 &**	As per PMU data

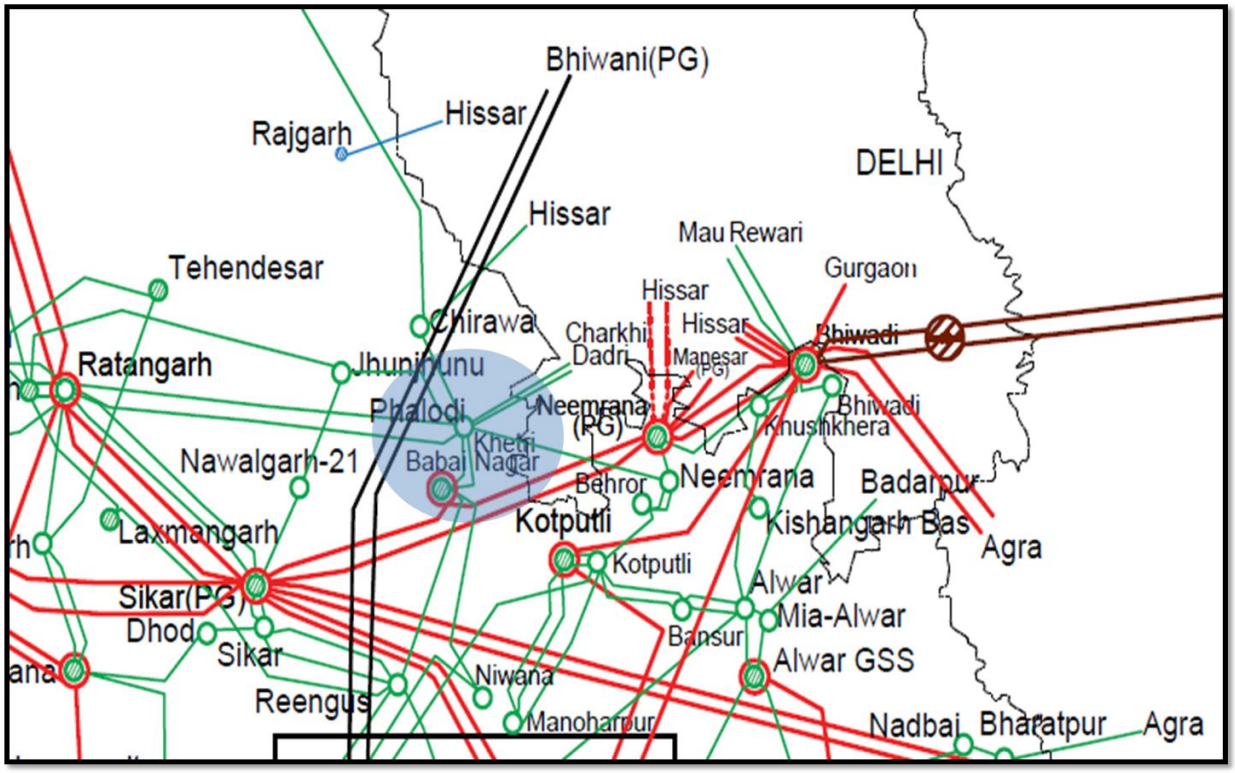
		300ms	
Phase of the fault		Y-N fault followed by R-Y fault	As per PMU data

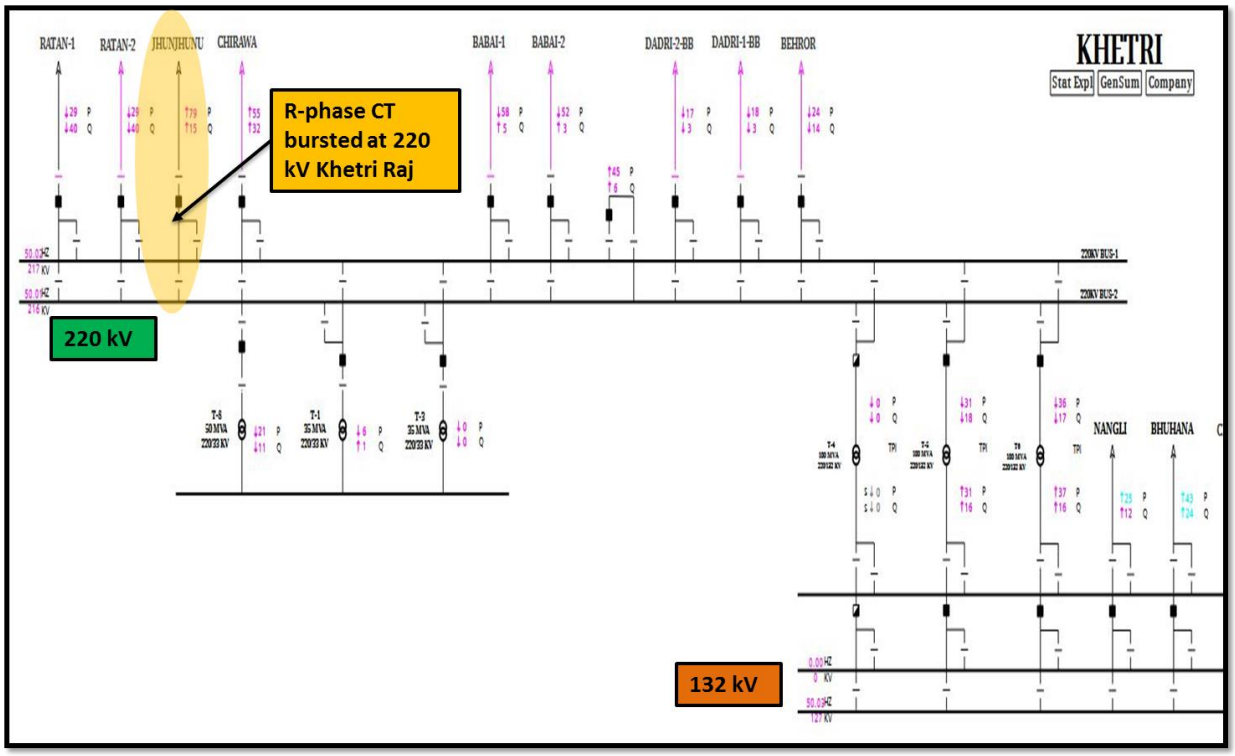
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)		Partially Available	Time Synch error
DR/ EL	Rajasthan	Received	After 24hrs
	BBMB	Received	After 24hrs
Preliminary Report	Rajasthan	Received	After 24hrs
	BBMB	Received	After 24hrs
Detailed Report	Rajasthan	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):


Bhiwani(PG)
Hissar
Rajgarh
DELHI
Hissar
Mau Rewari
Gurgaon
Tehendesar
Hissar
Chirawa
Charkhi
Hissar
Bhiwadi
Dadri
Mapesar
(PG)
Ratangarh
Jhunjhunu
Phalodi
Neemrana
(PG)
Bhiwadi
Khushkhera
Khetri
Nawalgarh-21
Babai
Nagar
Behror
Neemrana
Badarpur
Kotputli
Kishangarh
Bas
Laxmangarh
Agra
Kotputli
Alwar
Sikar(PG)
Mia-Alwar
Dhod
Bansur
Sikar
Alwar GSS
Niwana
Reengus
Manoharpur
Nadbai
Bharatpur
Agra


RATAN-1
RATAN-2
JHUNJHUNU
CHIRAWA
BABAI-1
BABAI-2
DADRI-2-BB
DADRI-1-BB
BEHROR
KHETRI
Stat Expl
GenSum
Company
R-phase CT bursted at 220 kV Khetri Raj
220KV BUS-1
220KV BUS-2
220 kV
NANGLI
BHUHANA
132 kV

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)

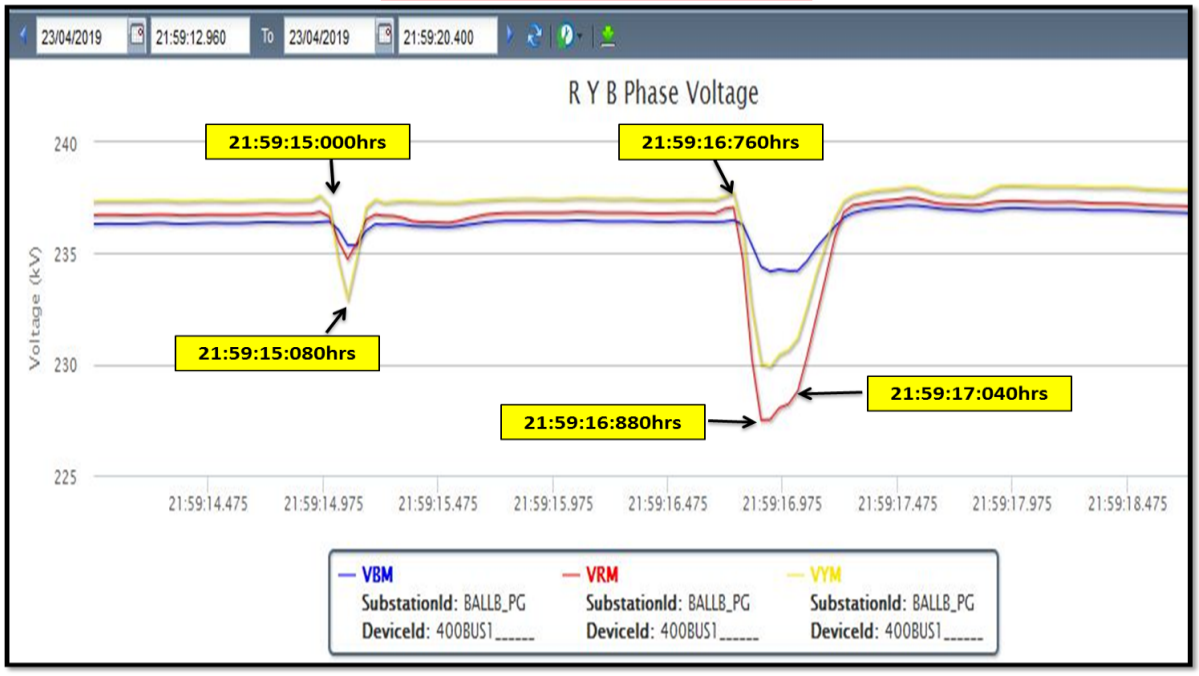
10. PMU plots:

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



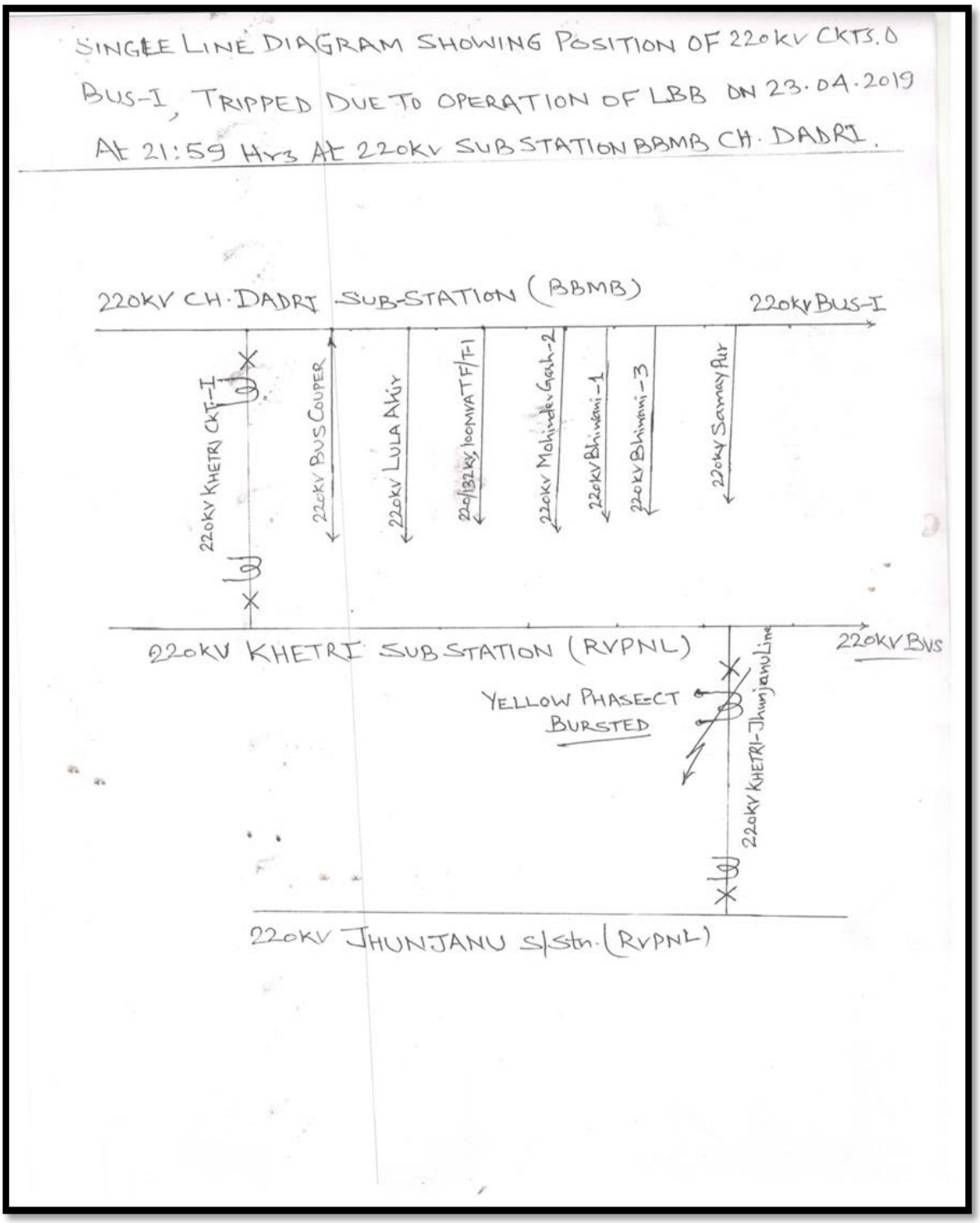
11. As per PMU data:
    - Y-N fault followed by R-Y fault (after 1760ms)
    - Fault clearance time is **80ms & 300ms**.

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.

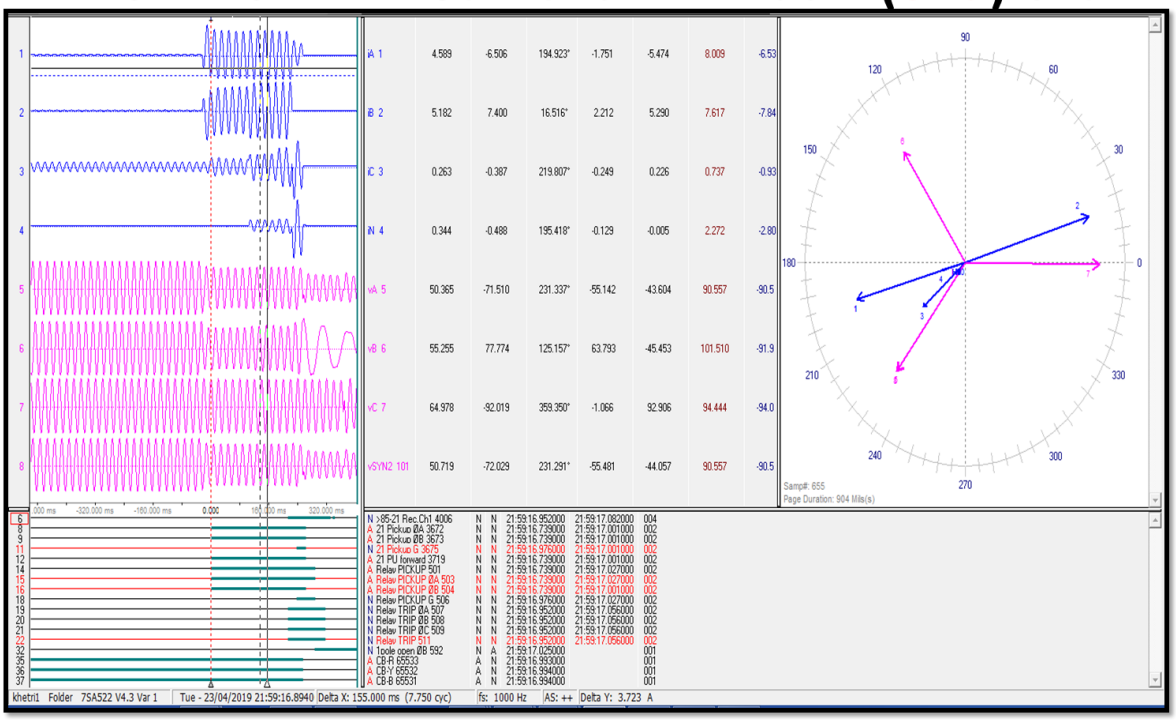
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
21:59:14:088	KHETRI	220kV	E_01(JHUNJ-1)	Circuit Breaker	Open	CB of 220 kV Khetri- Jhunjhunu opens.
21:59:14:534	JHUNJNU	220kV	07MBC	Circuit Breaker	Open	
21:59:14:615	JHUNJNU	220kV	E_01(RATAN-1)	Circuit Breaker	Open	
21:59:16:054	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



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

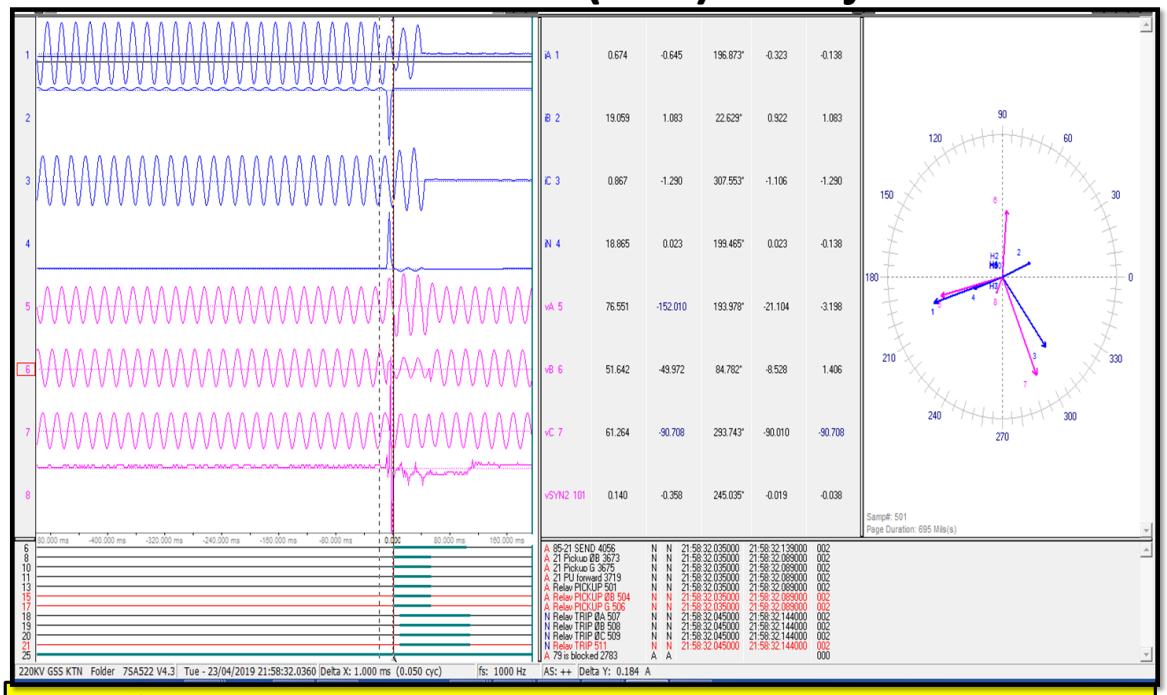


All three phase of the breaker tripped immediately within 220ms of fault occurrence.
LBB protection at Charkhi Dadri end also operated during tripping of the line. PSL modified for 200 ms time delay after trip initiation.

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 the Element along with voltage level	Relay Indication End A	Relay Indication End B	DR submitted by the utility				EL submitted by the utility				Protection operation								
				End A		End B		End A		End B		End A					End B			
				Sent*	Reason if not sent	Sent*	Reason if not sent/ PERTAIN TO	Sent*	Reason if not sent	Sent*	Reason if not sent	M-I*	M-II*	Any Other Protection#	Fault locator details	Auto reclosure status	M-I*	M-II*	Any Other Protection#	Fault locator details	Auto reclosure status
1	220KV Khetri-Jhunjhunu Line	Z-1, B-Phase Pickup, Trip ABC, AR Lockout, - 1378.4Mtr	Z-2, R&B Phase, 51.7 Km	YES		NO	Jhunjhunu	NO	EL not working	NO	NA	Z-1, B-Phase Pickup, Trip ABC, AR Lockout, - 1378.4Mtr	Not Operated	No	No	AR Lockout	Z-2, 51.7KM, A/R Lockout, Trip ABC	Not Operated		No	NIL
2	220KV Khetri-Chirawa Line	Z-2, B-Phase, Trip ABC,	B-Phase, 18.4KM	YES		NO		NO	EL not working	NO	NA	Z-1, B-Phase, 2.6Km	Not Operated	No	No	AR Lockout	B-Phase, 18.4KM	B-Phase, 98.4 Km	E/F	No	NIL
3	220KV Khetri-Dadri-1 Line	No	A&B Phase, Trip ABC, 70.8Km, Z-2	YES		NO		NO	EL not working	NO	NA	Not Operated	Not Operated	No	No	No	Not Operated	A&B Phase, Trip ABC, 70.8Km, Z-2		No	NIL
4	220KV Khetri-Dadri-2 Line	No	Z-2, ABC Trip	YES		NO		NO	EL not working	NO	NA	Not Operated	Not Operated	No	No	No	Z-2, Trip ABC, 66.7 Km	Z-2, Trip ABC, 305.6 Km		No	NIL
5	220KV Khetri-babai-1(Reengus) Line	No	Z-2, A&B Phase, Trip ABC, 36.22KM	YES		NO		NO	EL not working	NO	NA	Not Operated	Not Operated	No	No	No	Z-2, A&B Phase, Trip ABC, 36.22KM	Z-2, A&B Phase, Trip ABC		No	NIL
6	220KV Khetri-babai-2(Niwana) Line	No	Z2,A&B Phase, Trip ABC, 37.5KM	YES		NO		NO	EL not working	NO	NA	Not Operated	Not Operated	No	No	No	Z2,A&B Phase, Trip ABC, 37.5KM	A&B Phase, Trip ABC		No	NIL
7	220KV Khetri-Behror Line	B-Phase, Trip ABC, -59.4KM	R&Y Phase, Z-2	YES		NO		NO	EL not working	NO	NA	B-Phase, Trip ABC, - 59.4KM	Not Operated				R&Y Phase, Z-2	R&Y Phase, Z-2		No	NIL
8	220KV Khetri-Ratangarh-2 Line	No	Z-2, 119.9 Km, Phase Y&B	YES		NO		NO	EL not working	NO	NA	Not Operated	Not Operated				Z-2, 119.9 Km, Phase Y&B	Z-2, 120.1 Km, Phase Y&B		No	NIL

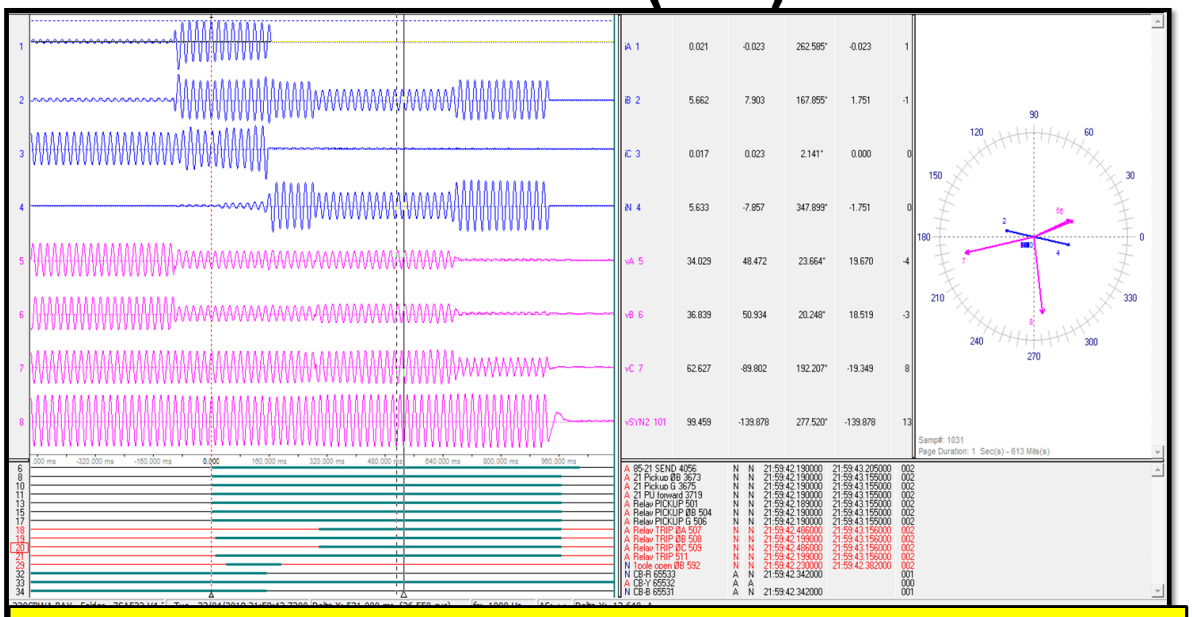
DR of 220 kV Khetri (end)-Jhunjhunu ckt



Time 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

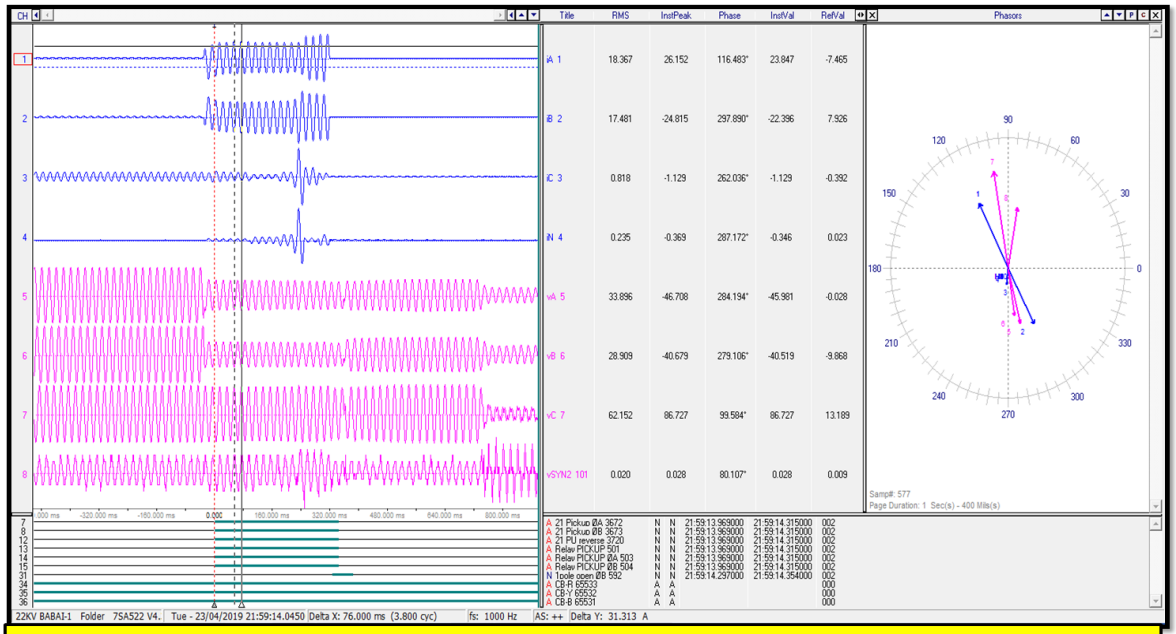


Time Synch Error

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

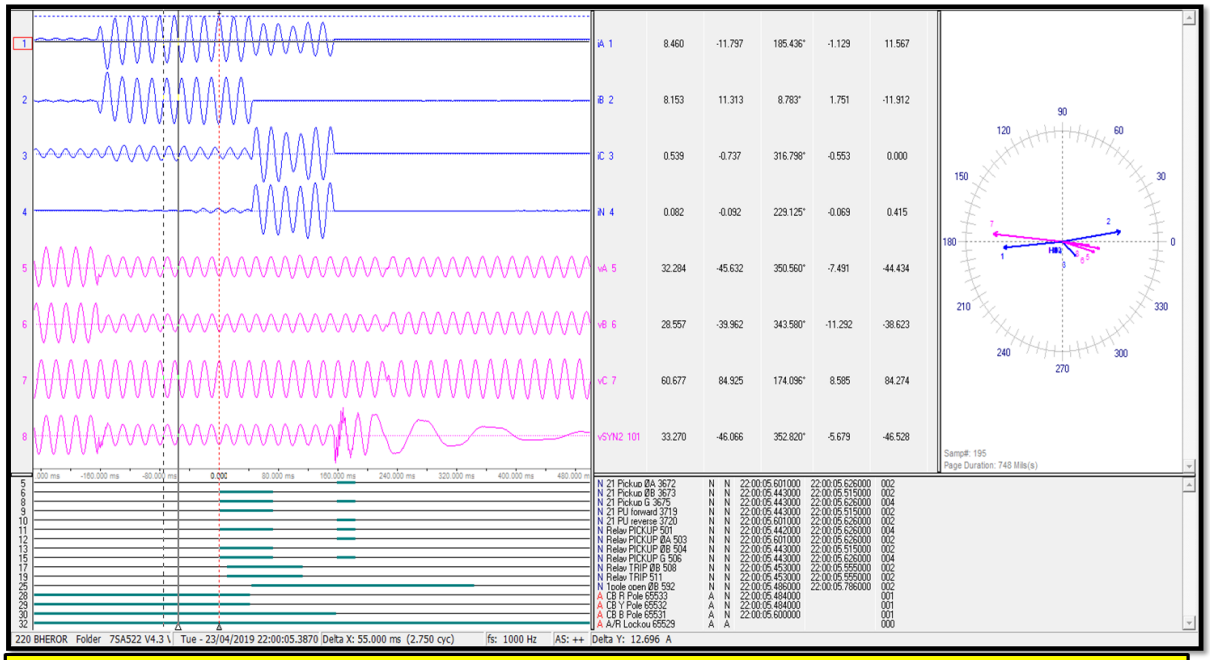
DR of 220 kV Khetri (end)-Babai ckt-1



Time Synch Error

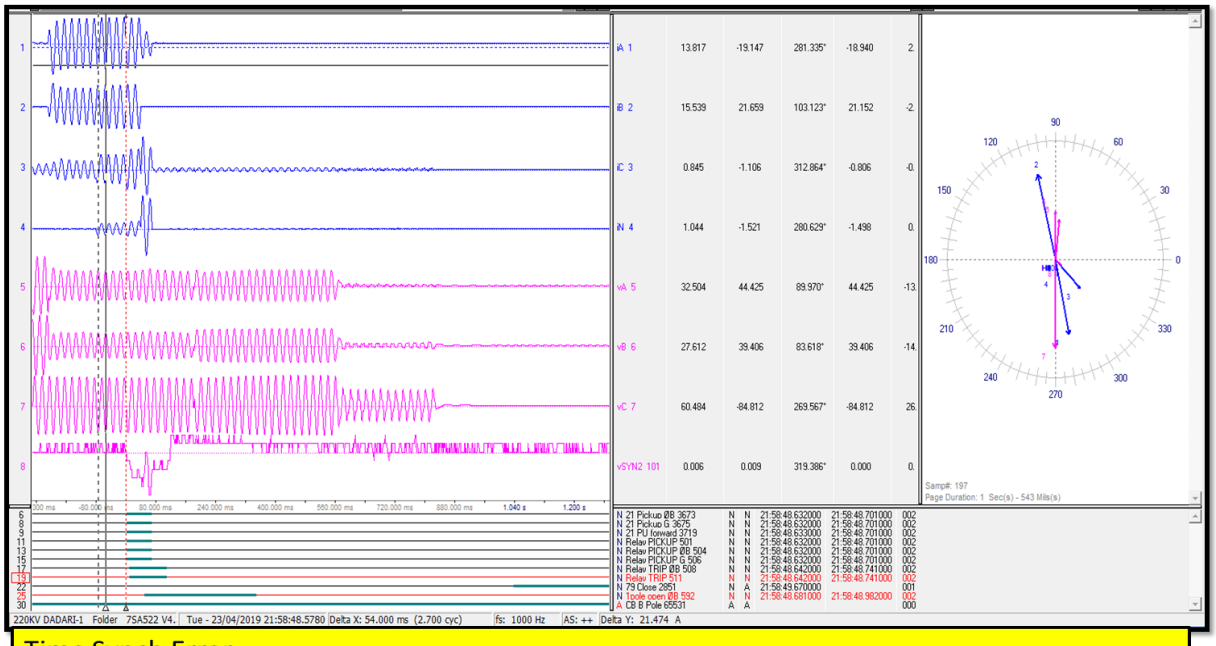
Why 1-phase breaker open signal initiated?

DR of 220 kV Khetri (end)-Behror ckt



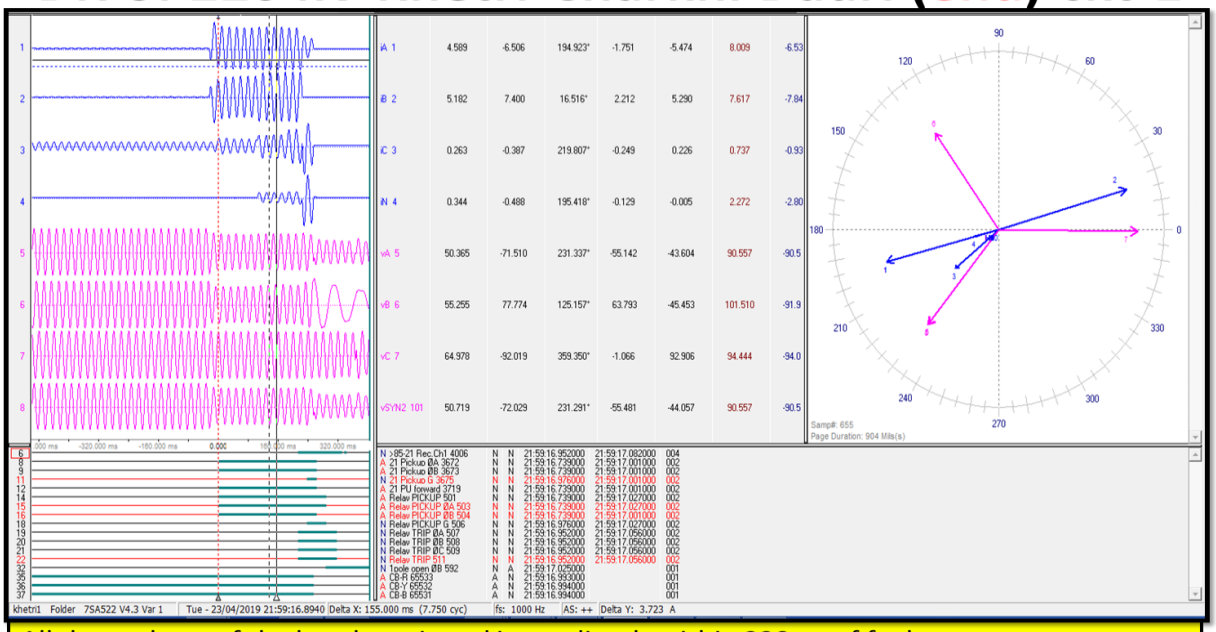
Time Synch Error
A/R blocked. Why there is a difference in opening of the breaker at Khetri end (120ms difference between R,Y and B-phase opening?

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



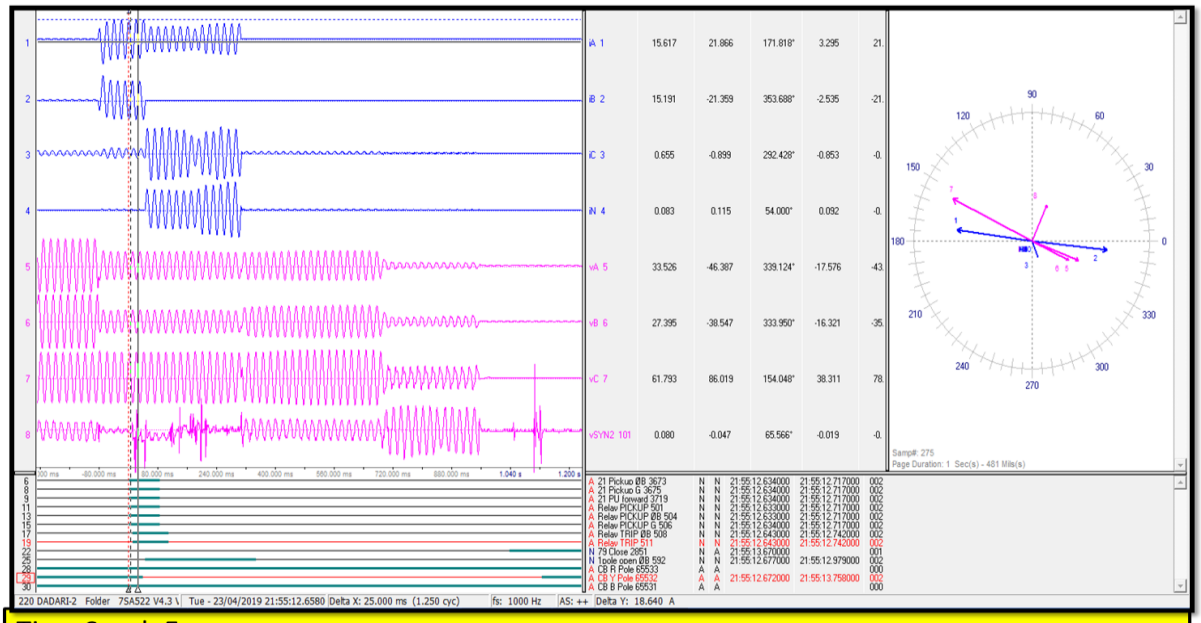
Time Synch Error
Y-phase breaker opened from Khetri end and A/R after 1000ms.
Other breaker didn't open. Status of pole discrepancy after 2.5second?

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 representative informed the following in the meeting:

1. Bus bar protection at 220kV Khetri was out since Dec'18. Interim/alternate arrangement of bus bar protection as approved in 25th NRPC-PSC meeting was not implemented.
2. Alternate arrangement of bus bar protection was implemented on 25.04.2019 after the above incident.
3. New Bus bar protection is expected to be available by Mar'20.
4. Circuit Breakers have been checked. Replacement of few CBs is also under process.
5. EL is not available at Khetri station.
6. SoE data not time synchronized because of GPS not healthy at Khetri station.
7. 220kV Behror line tripped in Z-1 at Khetri end instead of Z-4. Out of two main relays (Siprotec, Micom). Siprotec relay picked Z-1 though fault was in reverse zone.

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:

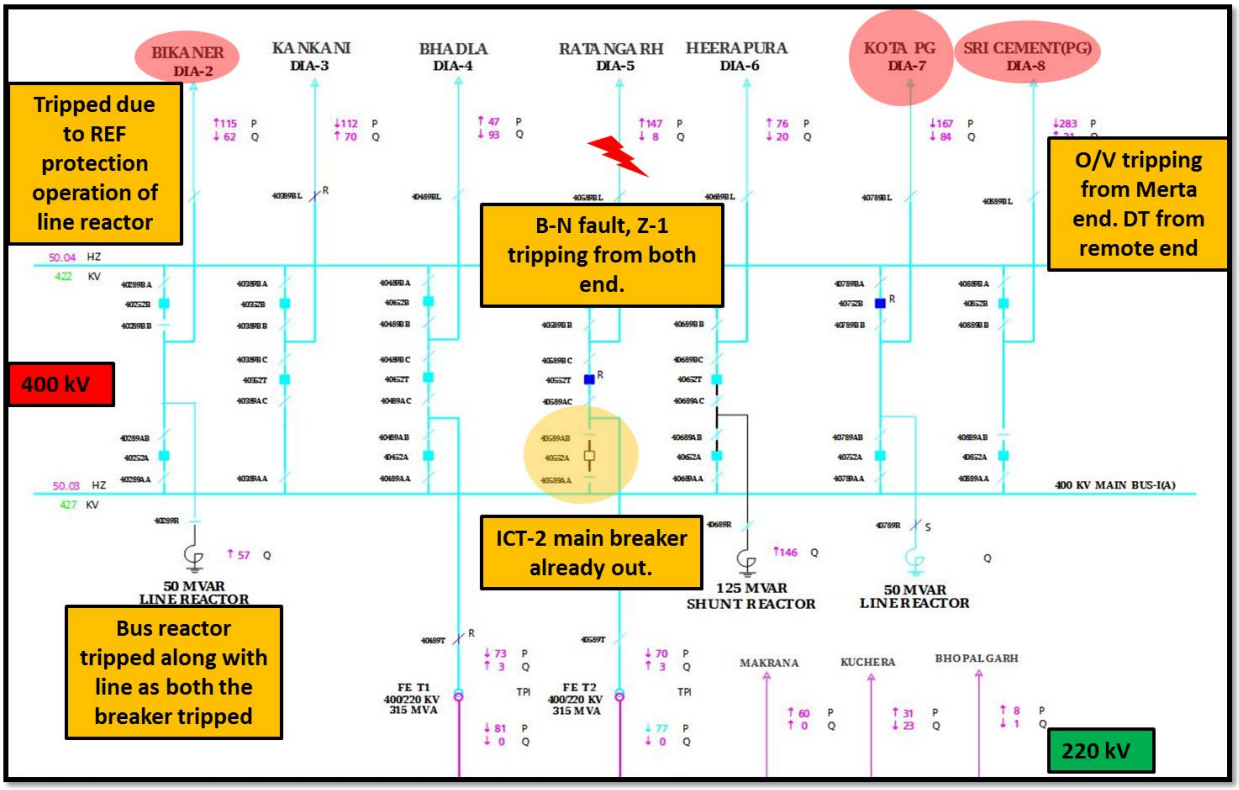
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	80ms	
Phase of the fault	PMU data	Blue phase to earth fault	A/R attempt was not taken.

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
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 kV Merta (Raj):



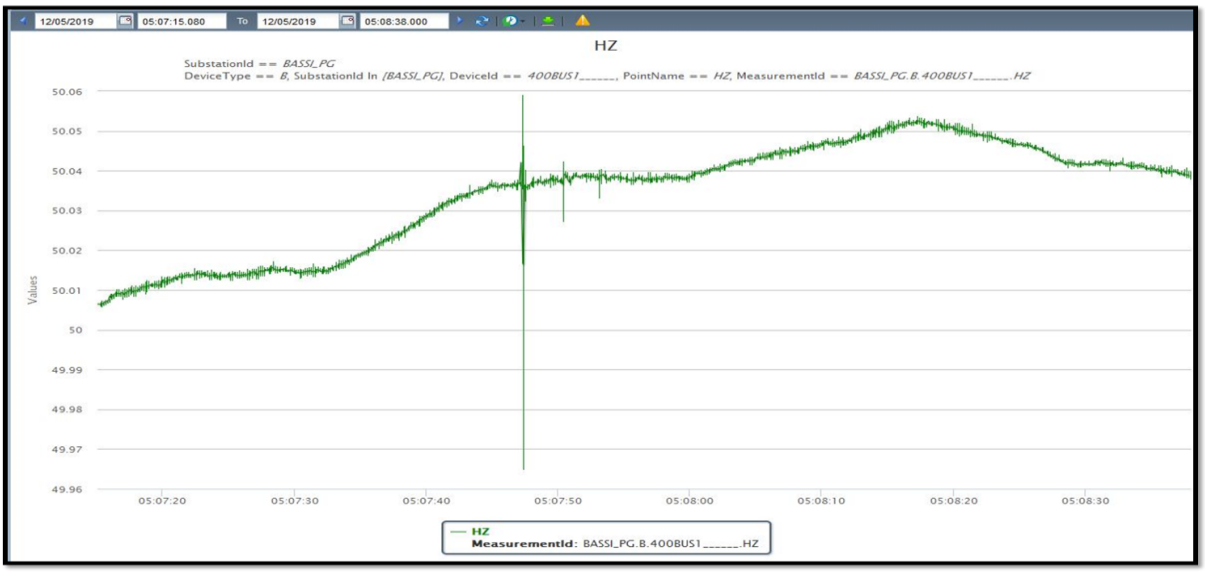
2. 400/220 kV Merta (Raj) station has one and half breaker scheme. It is connected through Bikaner S/C, Kankani S/C, Bhadla S/C, Ratangarh S/C, Heerapura S/C, Kota S/C and Shri Cement S/C. It also has two 315 MVA 400/220 kV ICTs.
3. In antecedent conditions, 400kV Kota(PG)-Merta(RRVPNL) & 400kV Shree 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(SCL)-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(SCL)-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:

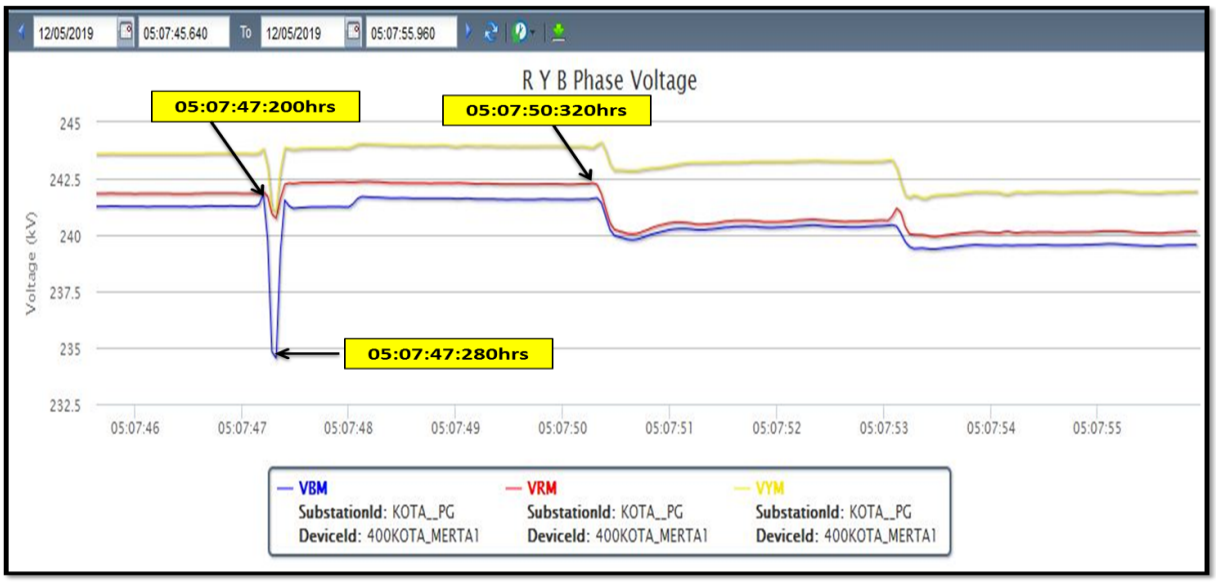
PMU Plot of frequency at Bassi(PG)

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**.

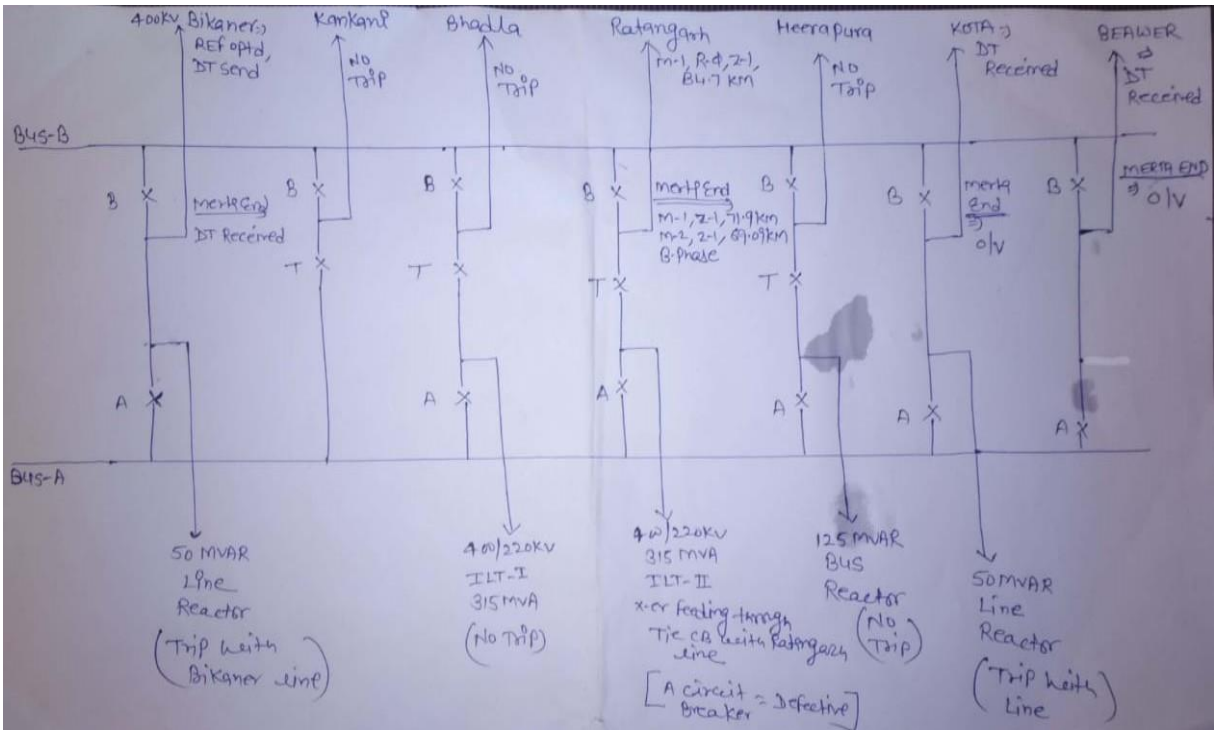
11. SCADA data and SoE: SoE captured for all the tripped elements.

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 rectify 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 representative informed the following in the meeting:

1. Over voltage setting of 400kV Merta-Kota and 400kV Merta-Shri cement was 108% for 5 second for both lines. The settings have been revised.
2. Auto-reclosure of 400kV Merta-Ratangarh was in service. However, line tripped due to operation of Line Reactor REF protection at Merta end. Line Reactor REF protection operated due to multiple grounding. The same was taken care of.

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:

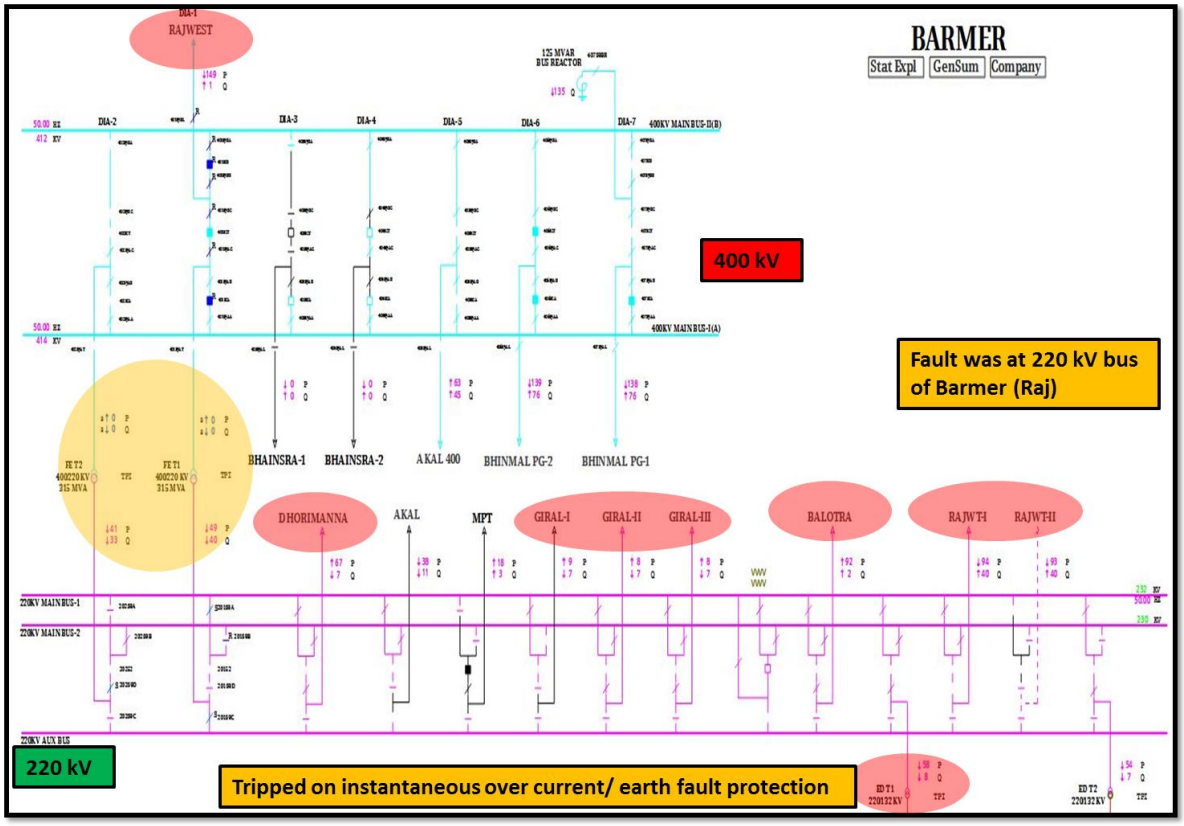
Description	Reference	Fault Info	Remarks
Fault Clearance Time	PMU data	1440ms	
Phase of the fault	PMU data	R-B phase to phase to earth fault	

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
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	**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

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)

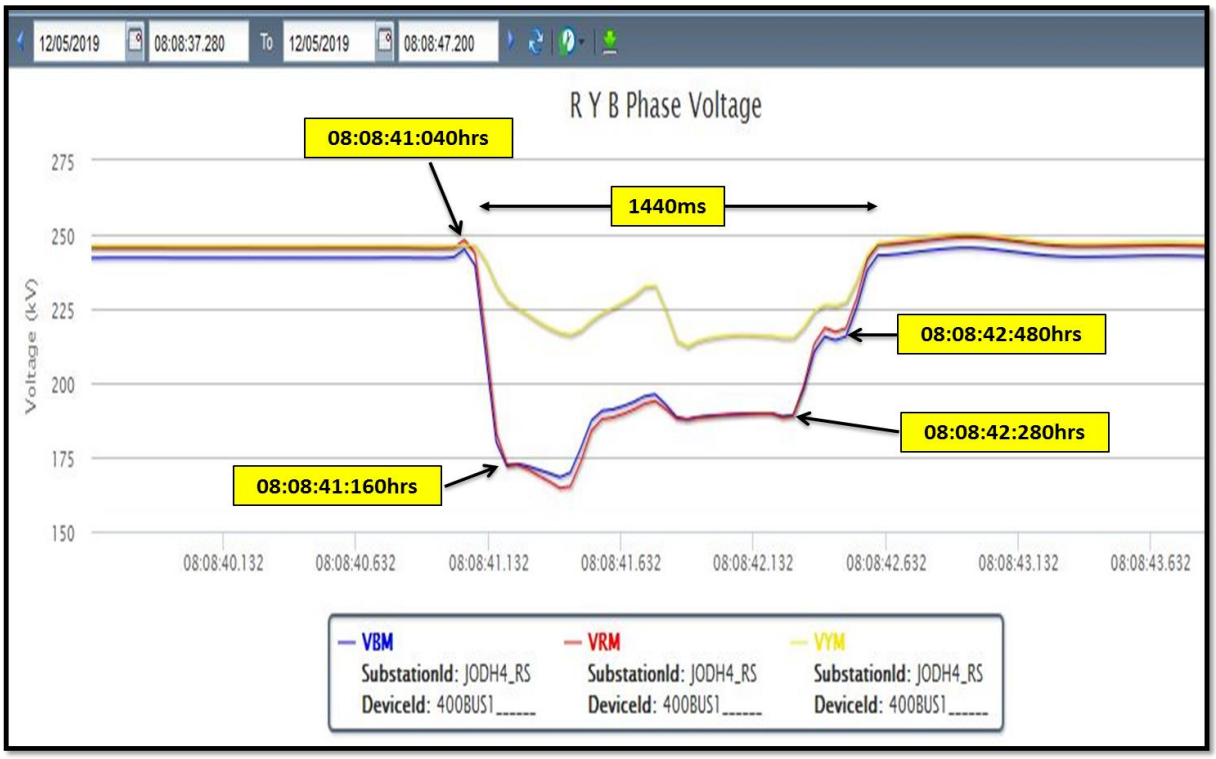
8. PMU plots:

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

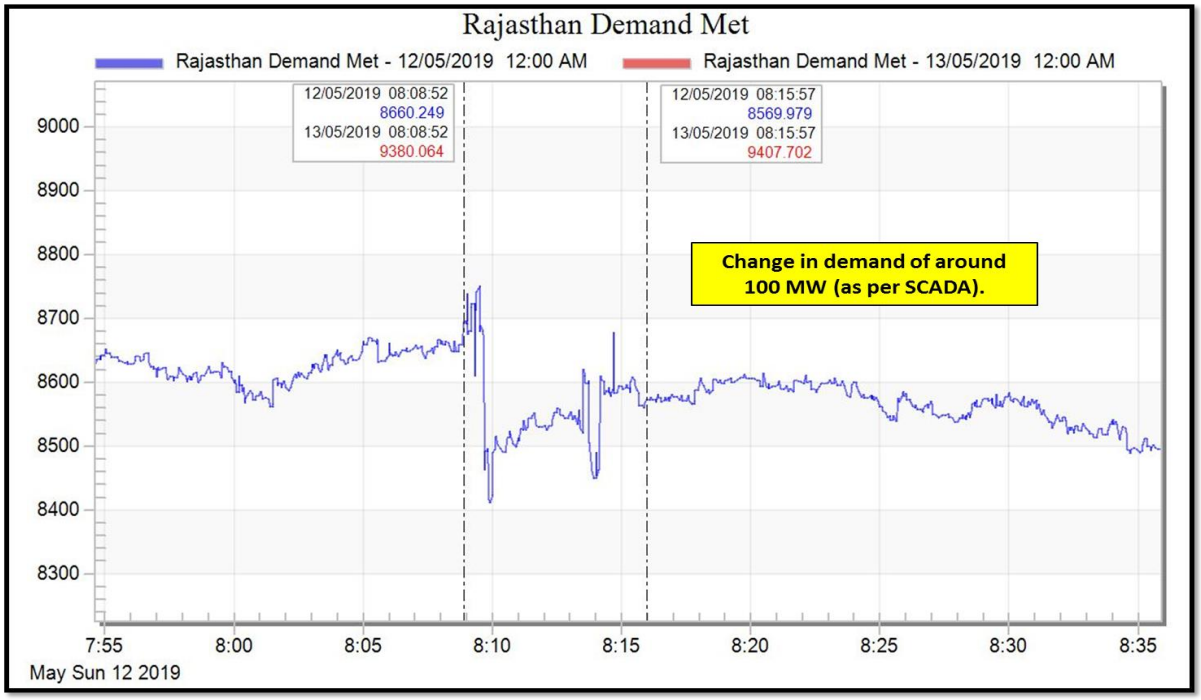


9. As per PMU data:
   - Maximum dip in R-B phase voltages.
   - Fault clearance time is **1440ms**.

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 representative informed the following in the meeting:

1. 220kV Bus jumper snapped and touched the isolator of B-phase of transformer resulted in phase-to-phase fault.
2. 220 kV Bus bar protection was defective. The same has been set right.
3. Z-3 setting of 400kV Rajwest-Barmer was encroaching towards LV side of transformer. The same has been revised.

4. 400/220kV ICTs at Barmer tripped on overcurrent protection (High set). However, there was time setting issue in the setting because of which ICTs tripped with delay. The aforesaid setting has been revised to trip instantly. Current setting of High set is 8 times of full load current.

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

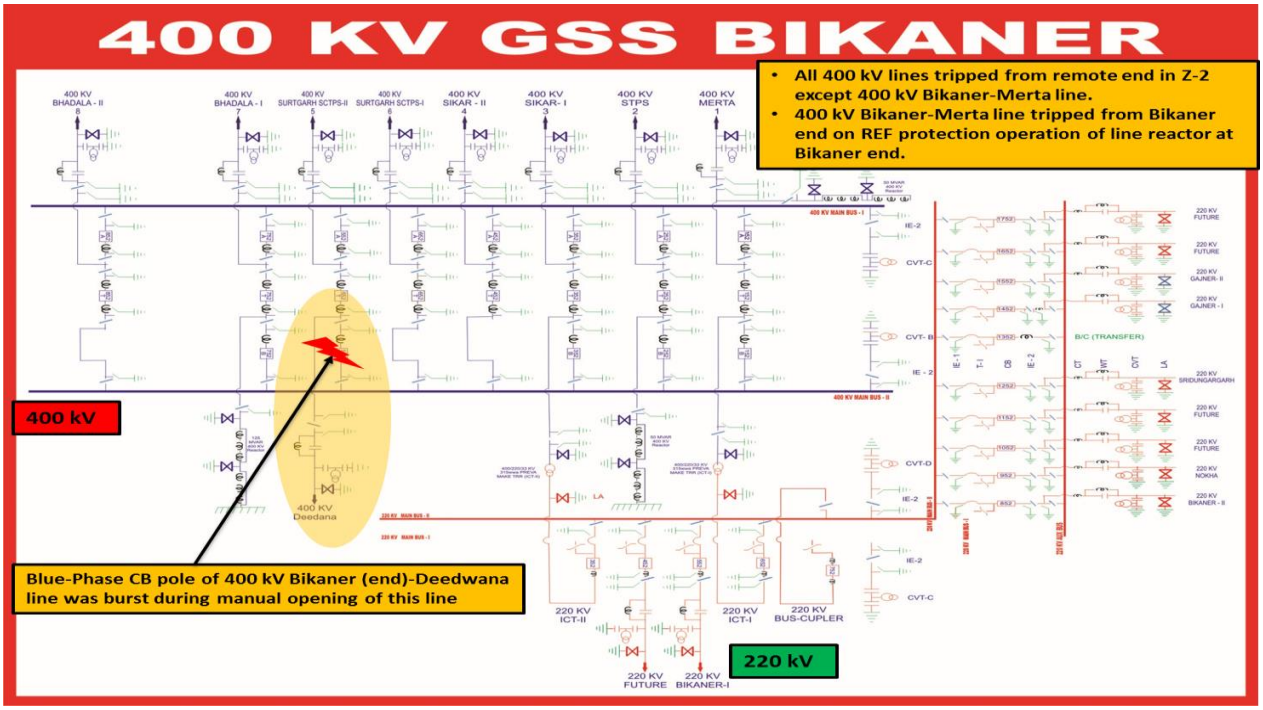
Description	**Utilities**	**Present Status**	**Remarks**
Availability of Digital Data (SCADA Data)		Available	Time Synch error
DR/ EL	Rajasthan	Received	After 24hrs
	POWERGRID	Not Received	
Preliminary Report	Rajasthan	Received	After 24hrs
	POWERGRID	Not Received	
Detailed Report	Rajasthan	Not received	

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	**Rajasthan**	1. Preliminary Report, DR/EL within 24hrs 2. Detailed Report yet to be received. 3. Delayed Clearance of

	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		Fault. 4.Adequately Sectionalized and graded protective relaying system. 5. 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. Single Line Diagram and Connectivity diagram of 400 kV Bikaner (Raj):



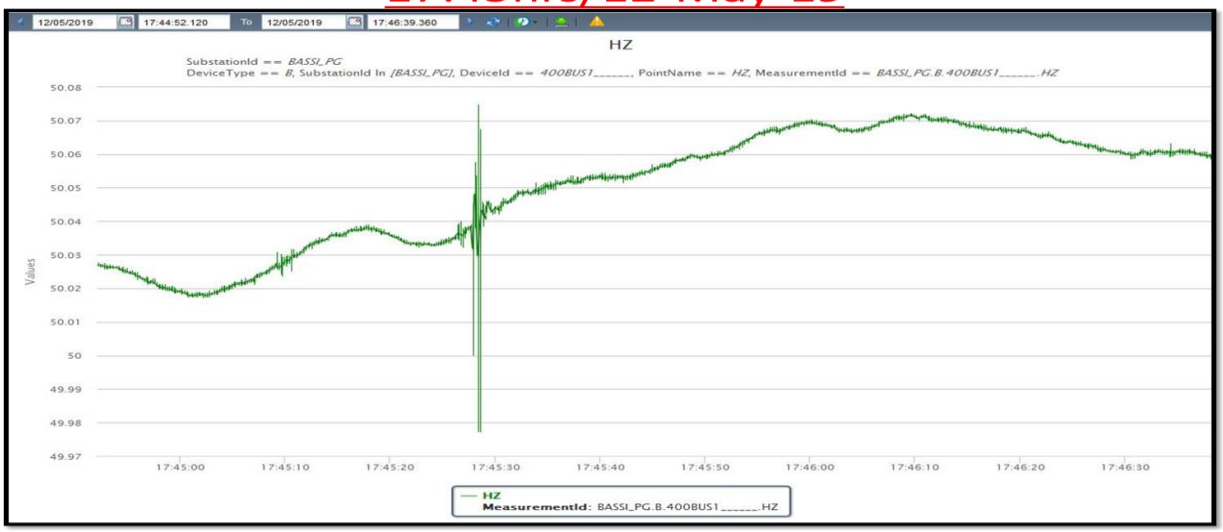
2. 400/220 kV Barmer (Raj) station has one and half breaker scheme. It is connected through Rajwest S/C & Akal S/C. It also has two 315 MVA 400/220 kV ICTs.

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:

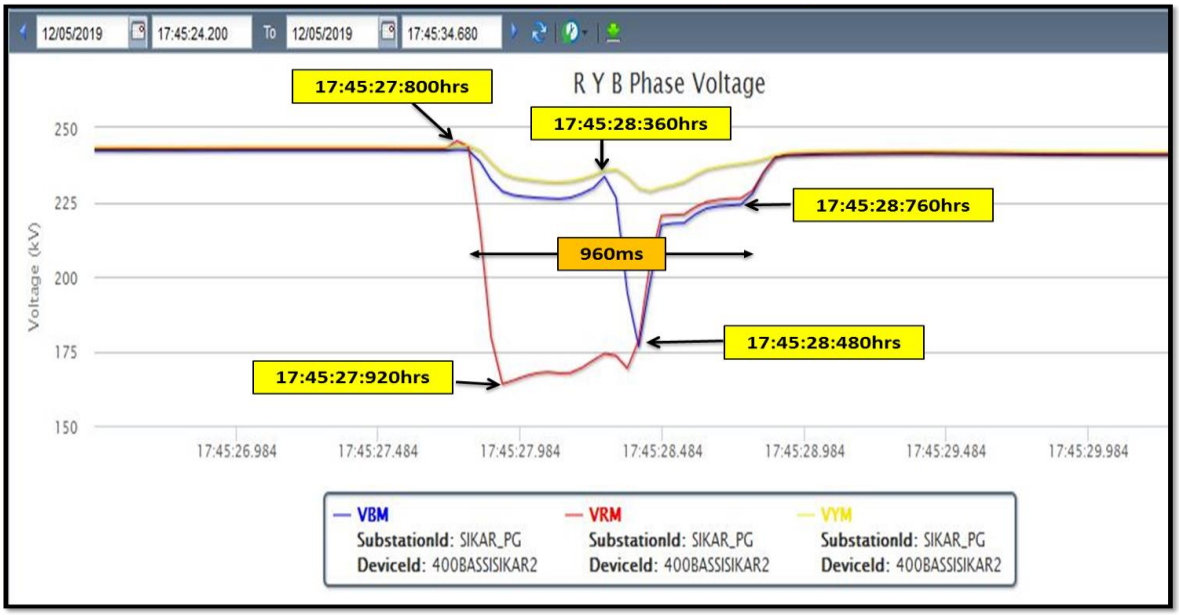
PMU Plot of frequency at Bassi(PG)

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.

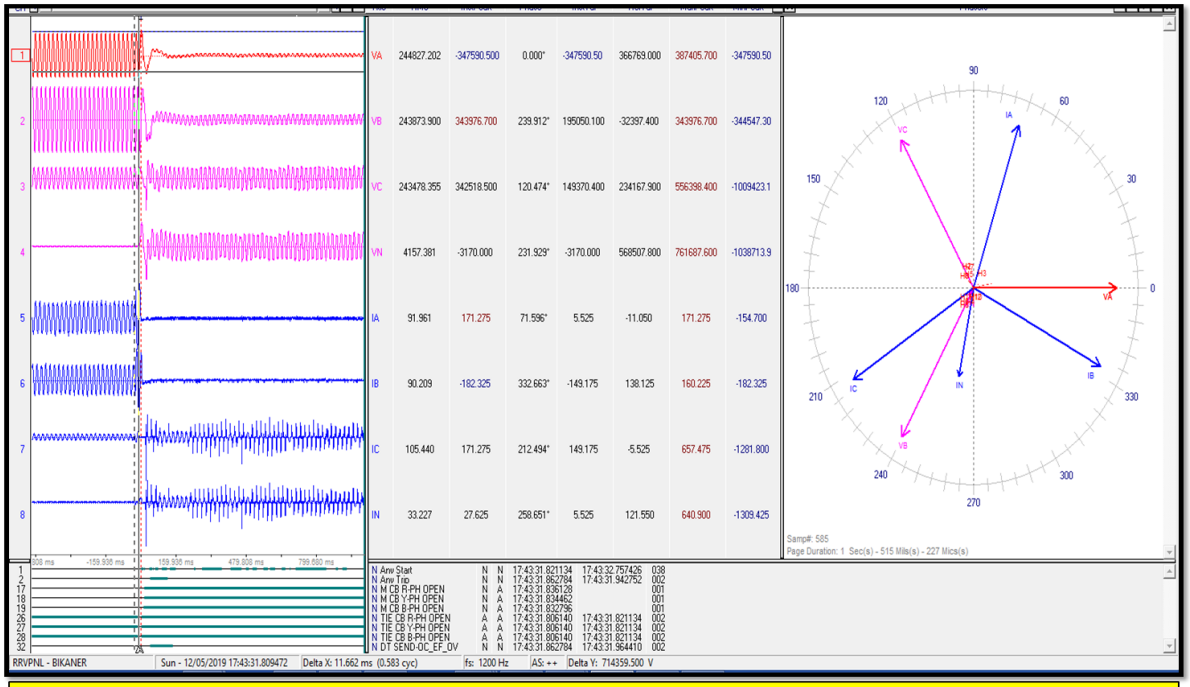
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
17:46:18:***	BIKANER400	400kV	01DEED41	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-Deedwana(RRVPNL) opens.
17:47:48:***	BIKANER400	400kV	13MERTA1	CB	Open	Main CB of 400kV Bikaner(RRVPNL)-Merta(RRVPNL) opens.
17:47:58:***	BIKANER400	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	02DEDFUT	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

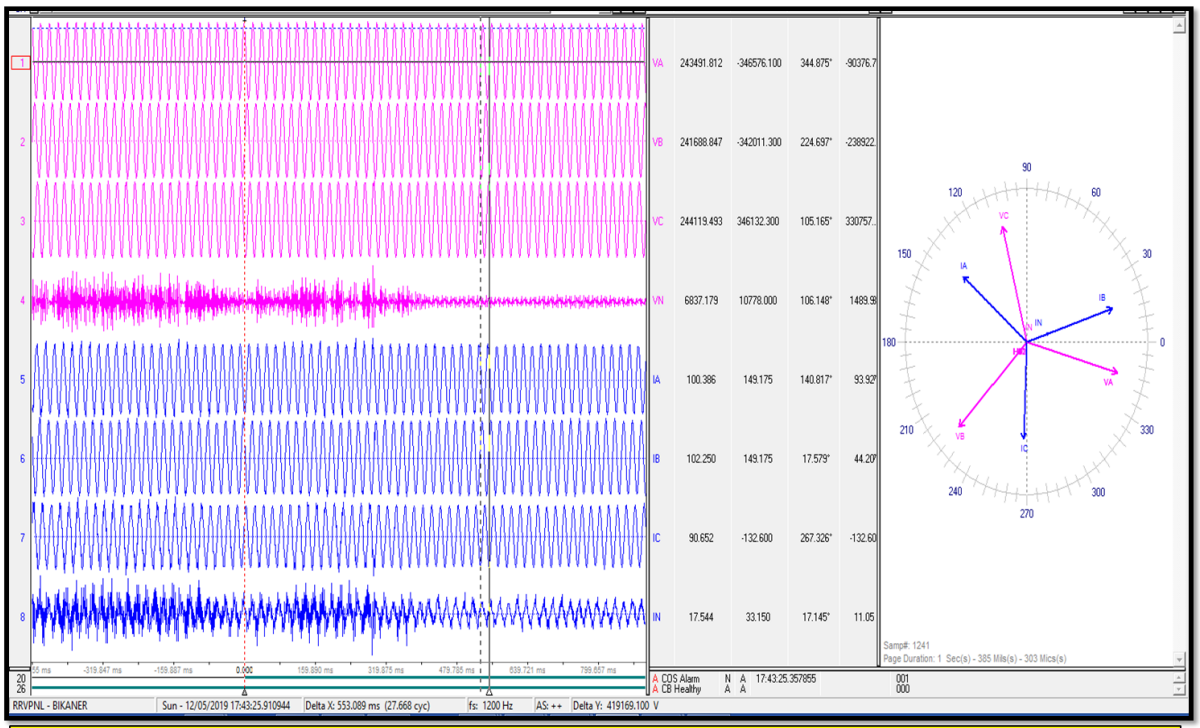
S. No.	Name Of Equipment/Line	Date Of Tripping	Time In Hrs.		Relay Indications			
					BIKANER END		REMOTE END	
			Tripping	closing	annunciation	Relay indicatoin	annunciation	Relay indication
1	400kV BKN-DEEDWANA LINE (**MAIN CB C-PHASE POLE BURST at BKN end**)	12.05.2019.	17:43	-		86A&B, DT sent & received		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 imped.21R) optd.		NA
13	400kV, 50MVAR BUS REACTOR	12.05.2019.	17:44	20:57		86A&B, B.up imped. Zone1 optd.		NA

DR of 400 kV Bikaner (end)-Deedwana ckt



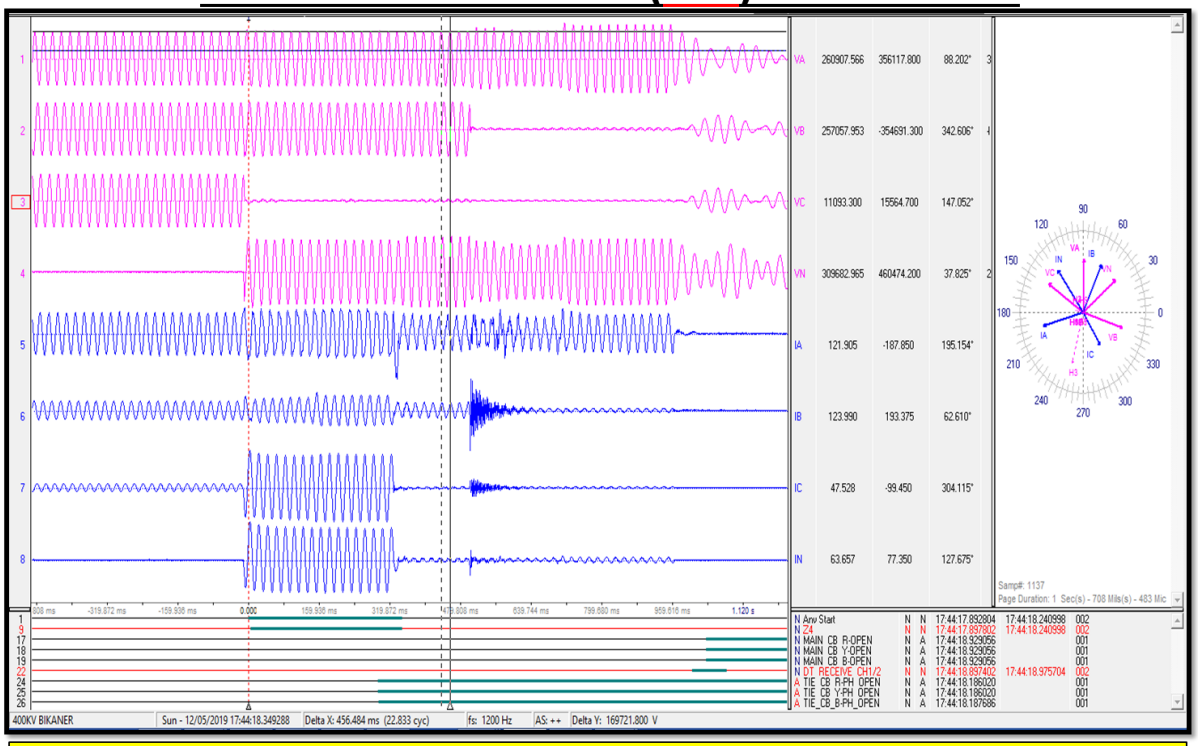
Reason of the tripping didn't clear from DR. Why master trip operated?

DR of 400 kV Bikaner (end)-Merta ckt



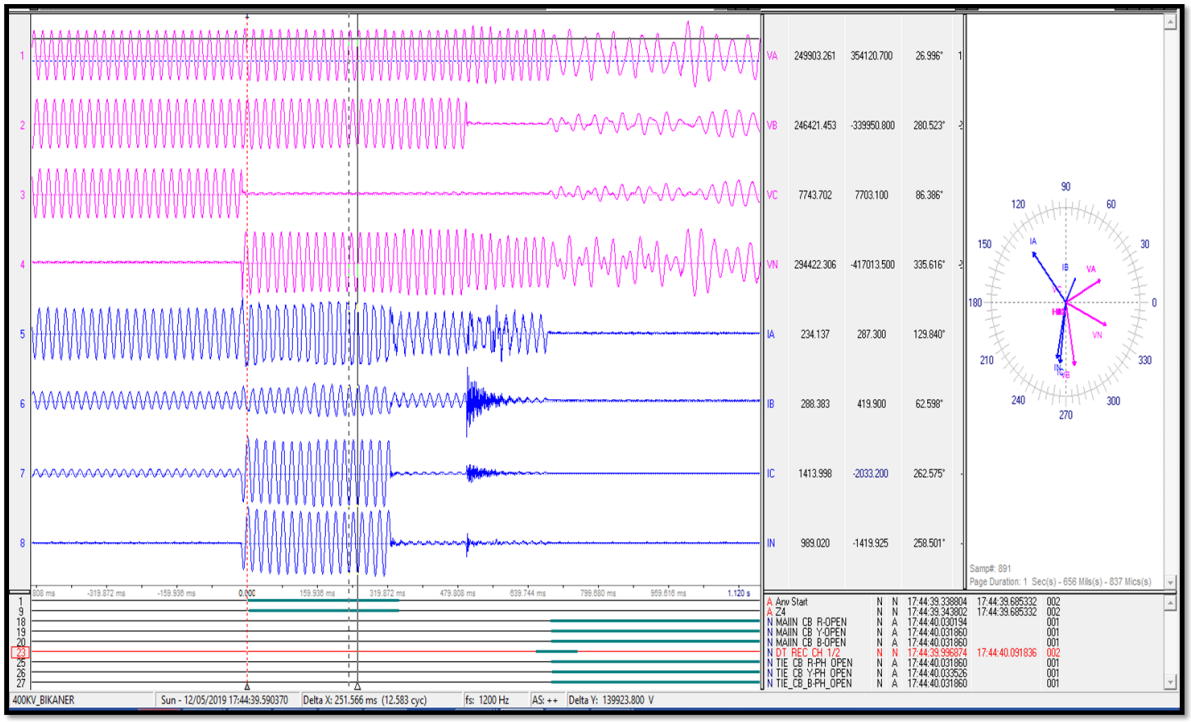
Reason of the tripping didn't clear from DR. Why master trip operated?

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



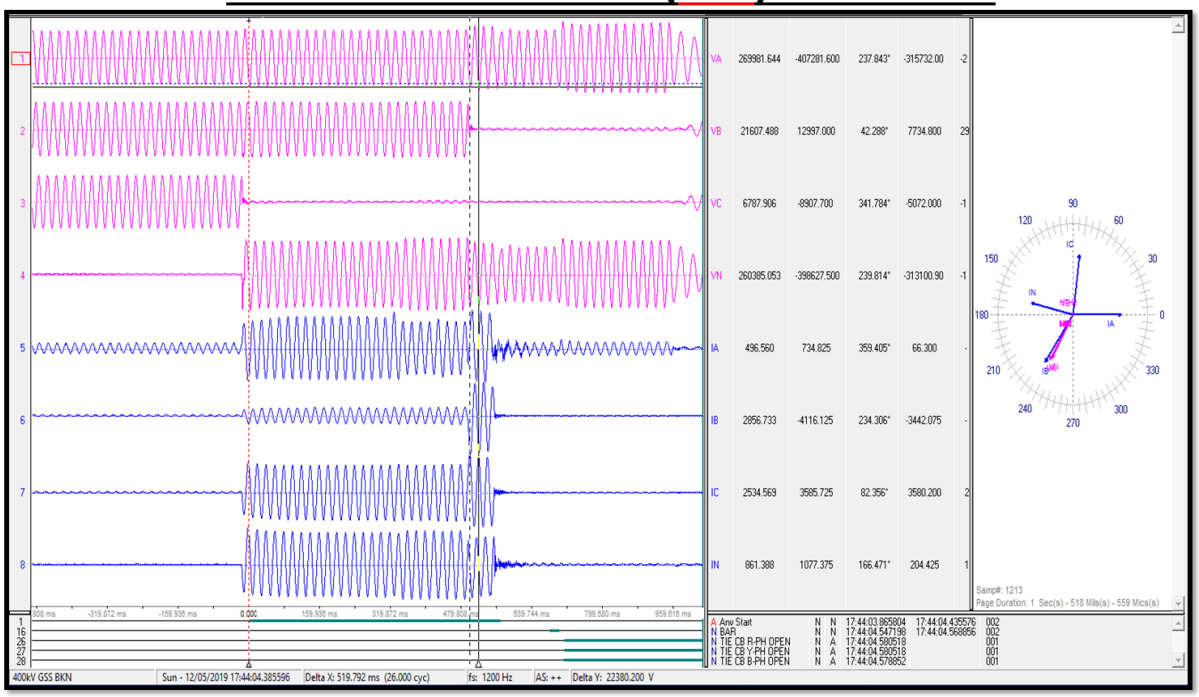
Tie CB opened within 300ms. Main CB tripped after 1000ms on DT received from remote end.

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



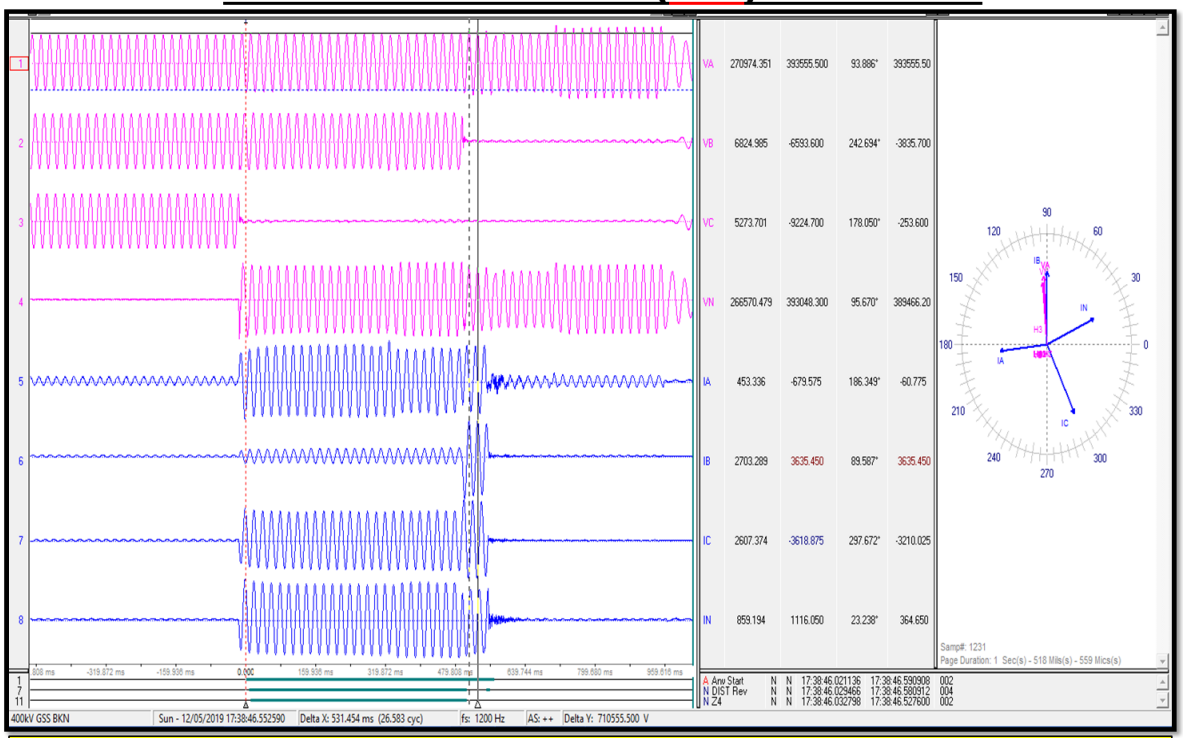
Main and Tie CB tripped after 700ms on DT received from remote end.

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



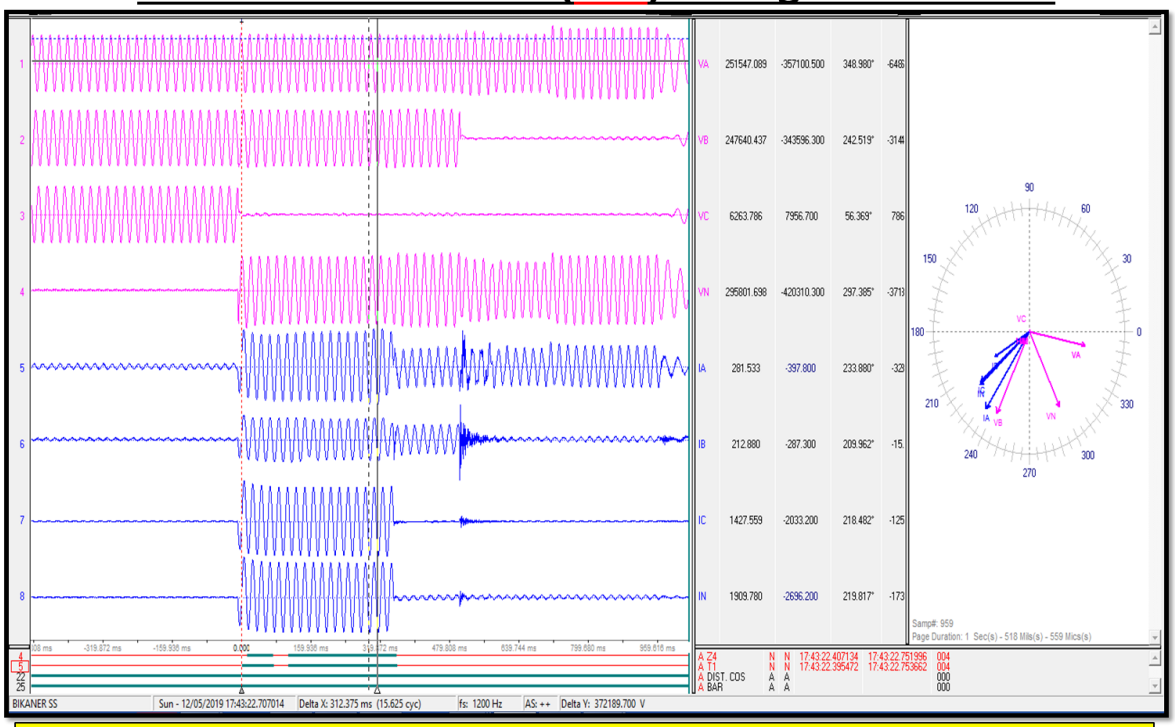
Line tripped from remote end in Z-2. Tie CB of Bikaner end tripped after 700ms of fault occurrence, at the time of tripping of ICT in same dia.

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



Line tripped from remote end.

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



Line tripped from remote end.

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

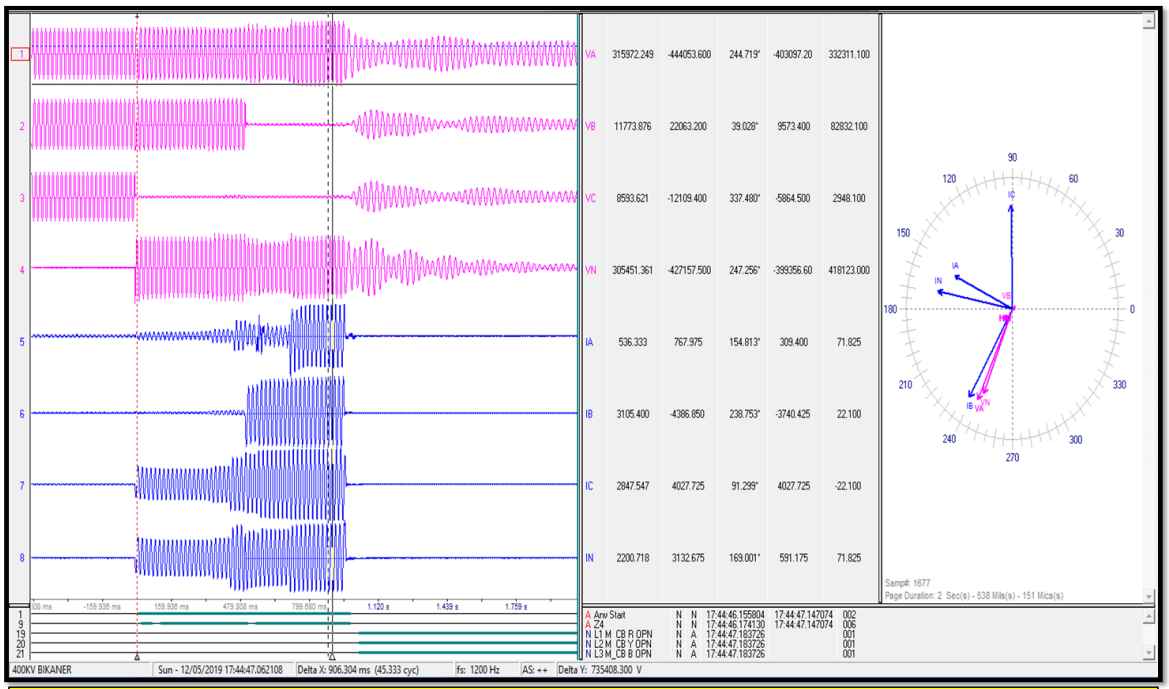
Recording File Name:C:\PCMDataBases\DisturbanceRecordings\NEW STPS\Substation\400 kV\Bay\REL670_BKN_AA1J2Q
\AA1J2Q01A320190512 3dd

ABB

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

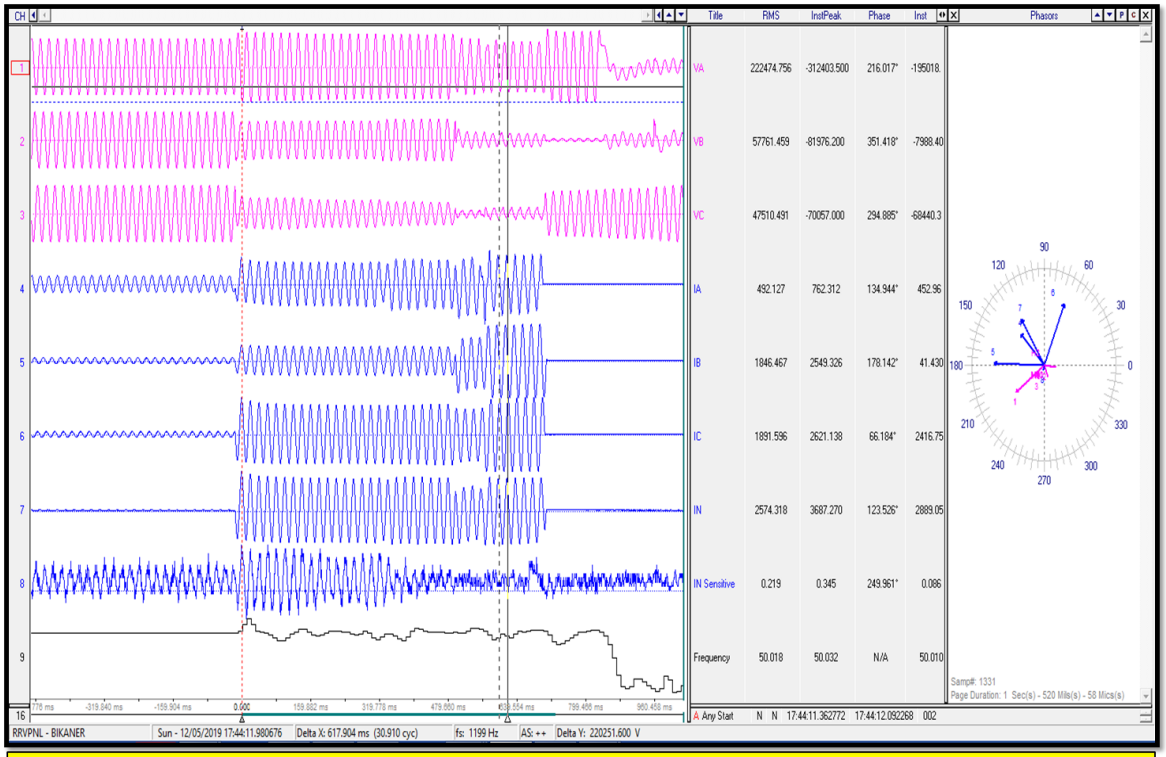
Line tripped in 300ms from Suratgarh TPS end.

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



ICT-2 tripped on backup over current earth fault protection.

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.

Discussion during the meeting*:*

1. Rajasthan representative informed that event has not been concluded yet.

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
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

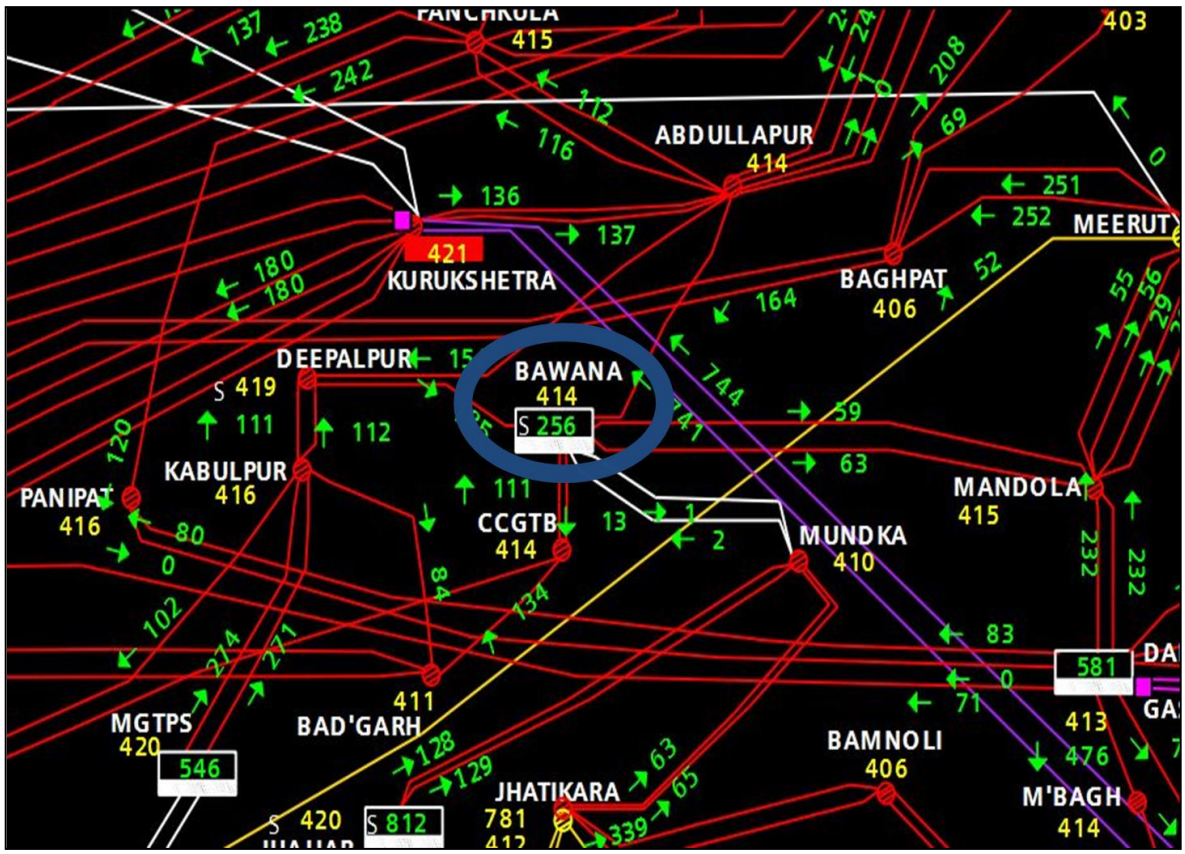
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Available	Time Synch error
DR/ EL	DTL	Received	Within 24hrs
	POWERGRID	Not Received	
Preliminary Report	DTL	Received	Within 24hrs
	POWERGRID	Not Received	
Detailed Report	DTL	Not received	

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 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	**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 system

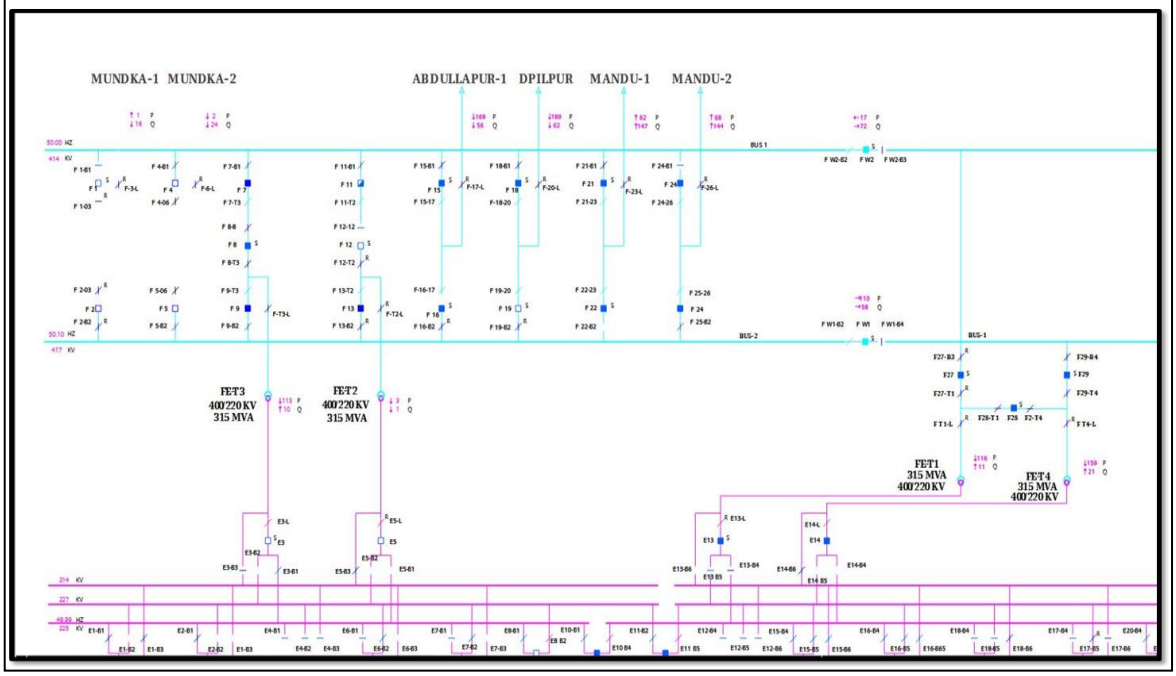
Violation of Clauses	1. IEGC 5.2.r & 5.9.6.c (VI) 2. CEA grid Standard 15.3	**POWERGRID**	1. Preliminary Report, DR/EL yet to be received

Based on above information description of the events is:

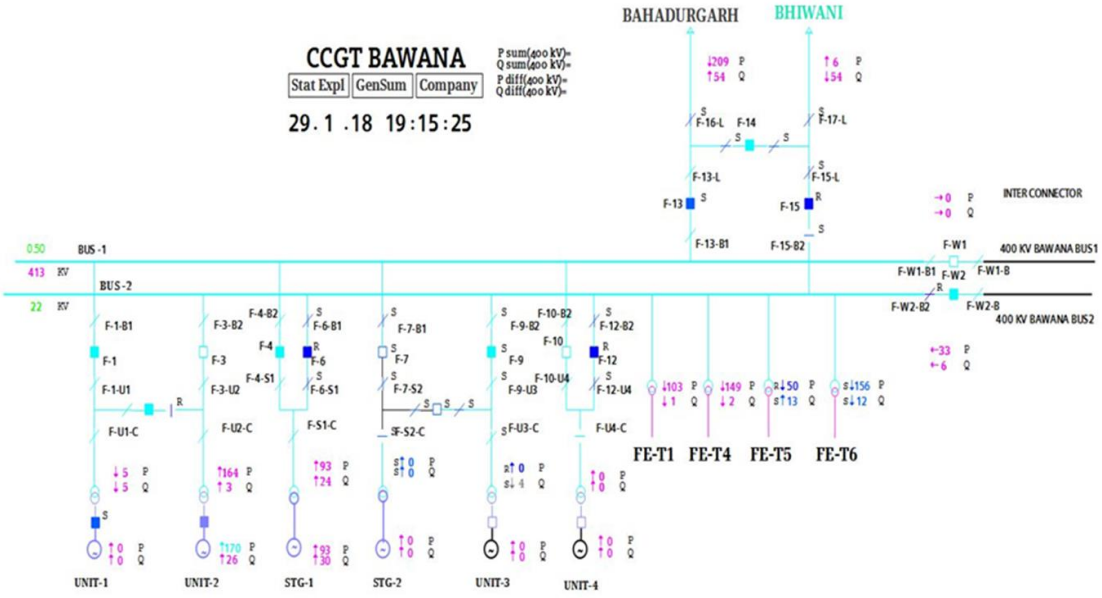
1. Connectivity diagram of 400/220kV Bawana and Bawana CCGT:



Bawana (DTL) SLD

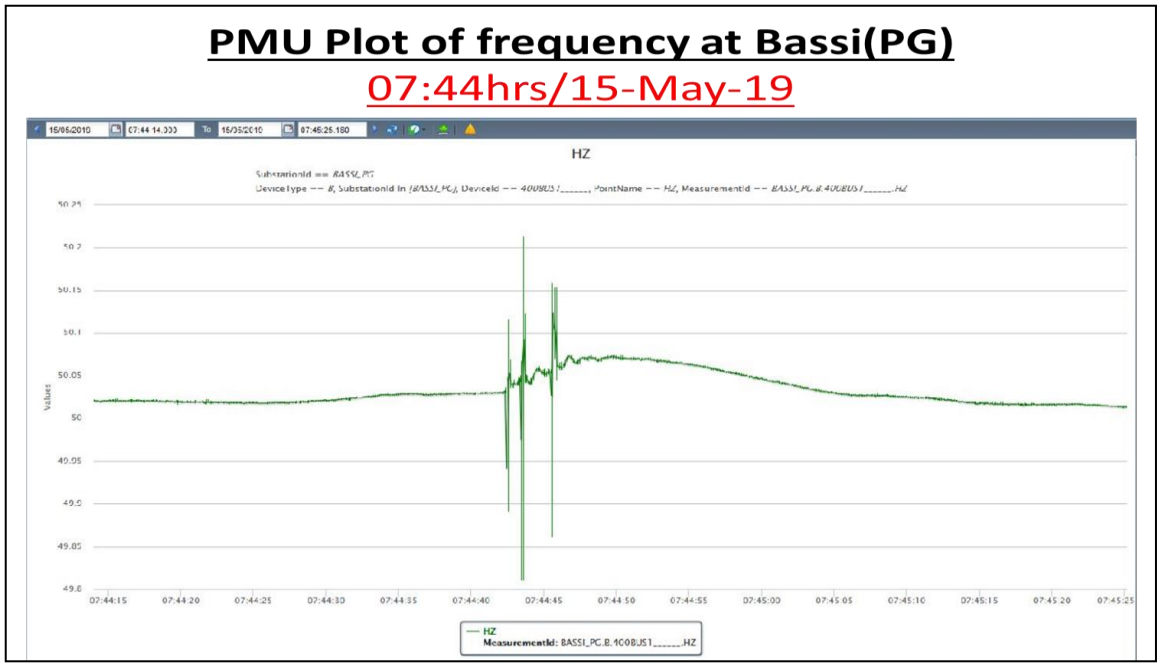


Bawana CCGT SLD



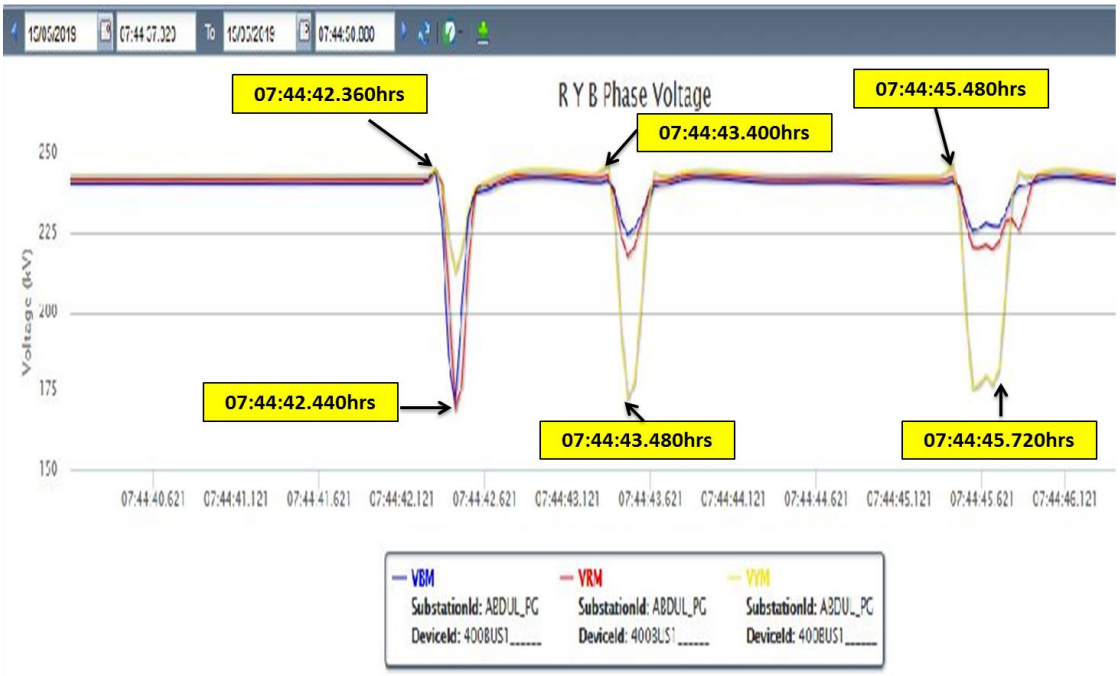
2. In antecedent condition, shut down of the 400 kV Kaithal-Hisar ckt-2 was applied for replacement of CVT.
3. 400 kV Bawana (DTL) station has one and half breaker scheme and double bus double breaker scheme. It is connected through Mandaula D/C, Mundka D/C, Abdullapur S/C, Dipalpur S/C and interconnector 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:



PMU Plot of phase voltage magnitude at Abdullapur(PG)

07:44hrs/15-May-19

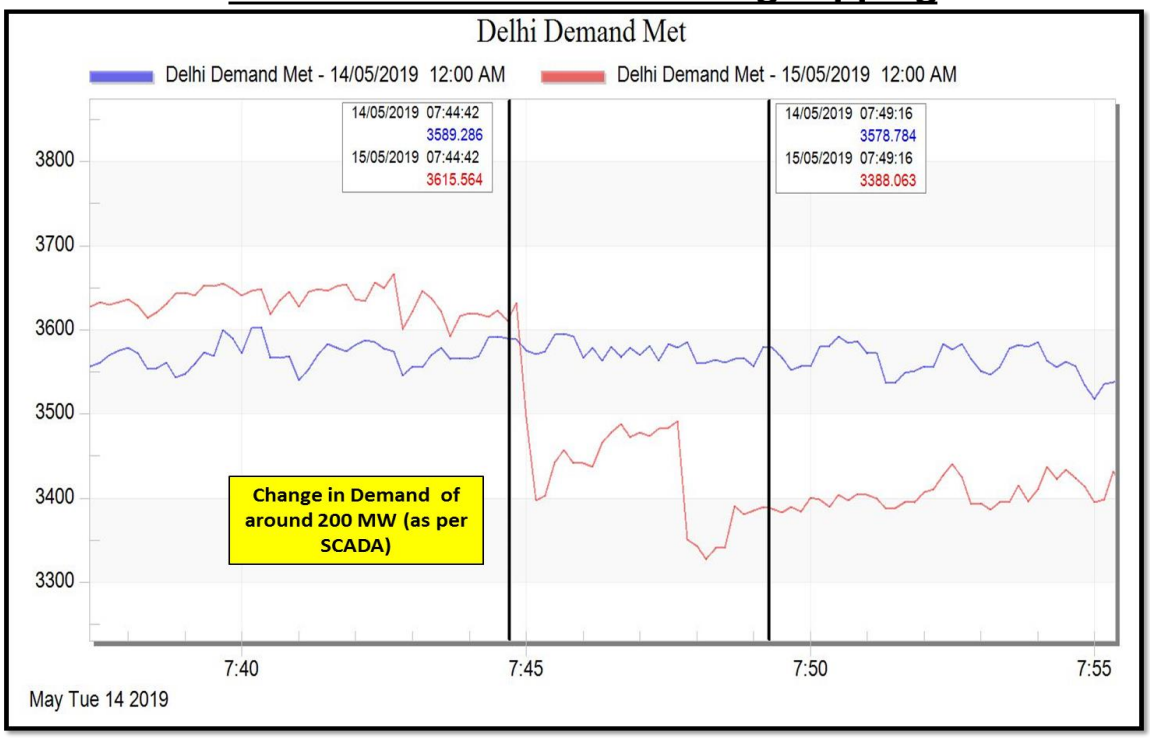


8. SCADA data and SoE:

Delhi/POWERGRID SCADA SOE

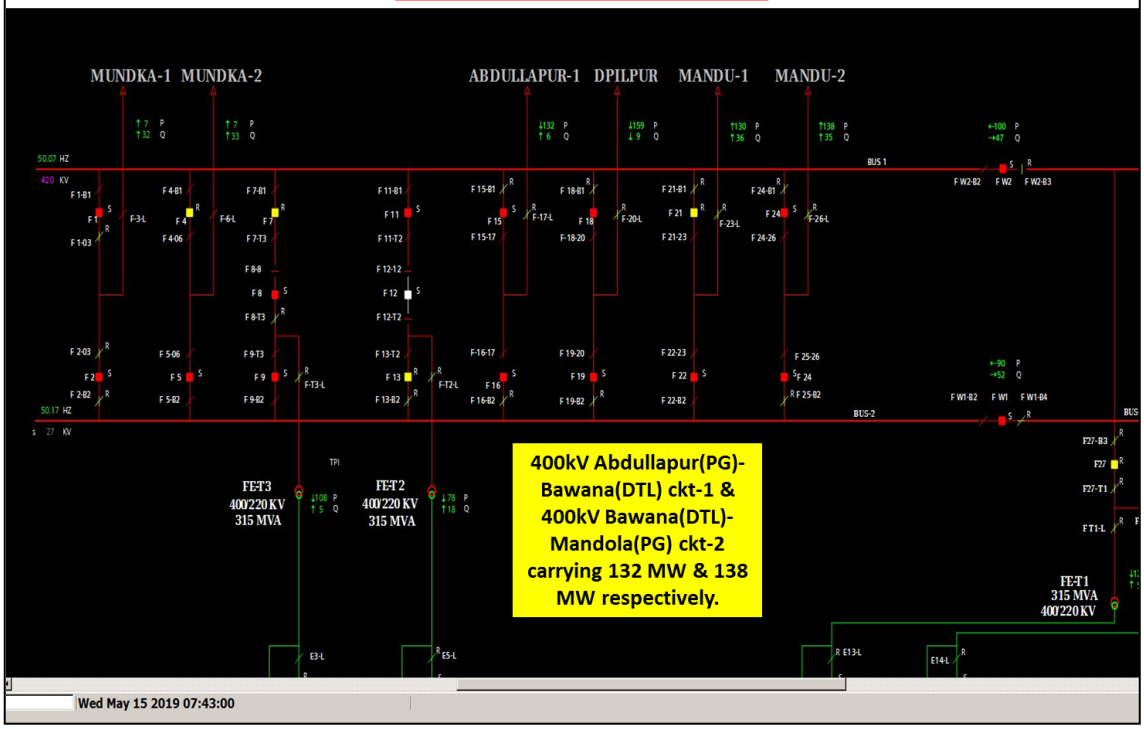
Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
07:44:42:396	BAWANA	400kV	F_12(MNDRG -ICT2 TIE	Circuit Breaker	Open	
07:44:42:405	BAWANA	220kV	E_05(T2)	Circuit Breaker	Open	220kV Side CB of 315 MVA ICT 2 at 400/220kV Bawana(DTL) opens.
07:44:42:415	BAWANA	220kV	E_03(T3)	Circuit 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 of400kV Bawana(DTL)-Mandola(PG) ckt-2opens.
07:44:42:423	BAWANA	400kV	F_25(MANDU-2 BUS-2)	Circuit Breaker	Open	Tie CB of400kV 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



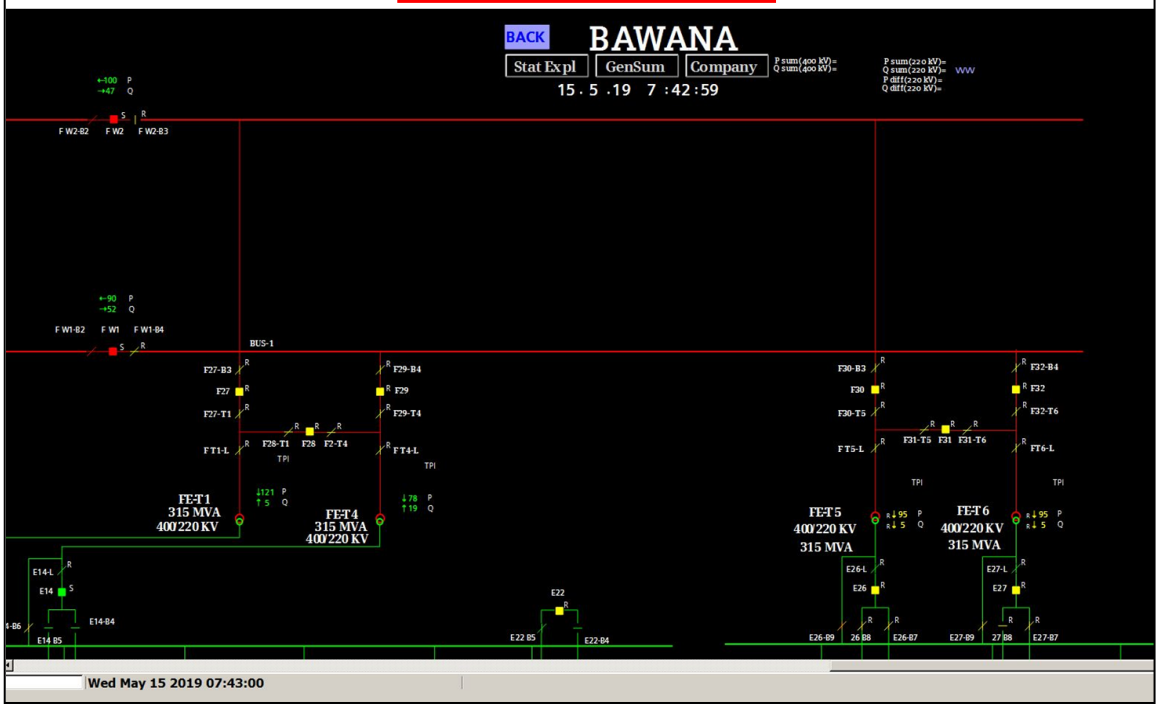
SLD of 400/220kV Bawana(DTL)(LHS) before the incident

07:43hrs/15-May-19



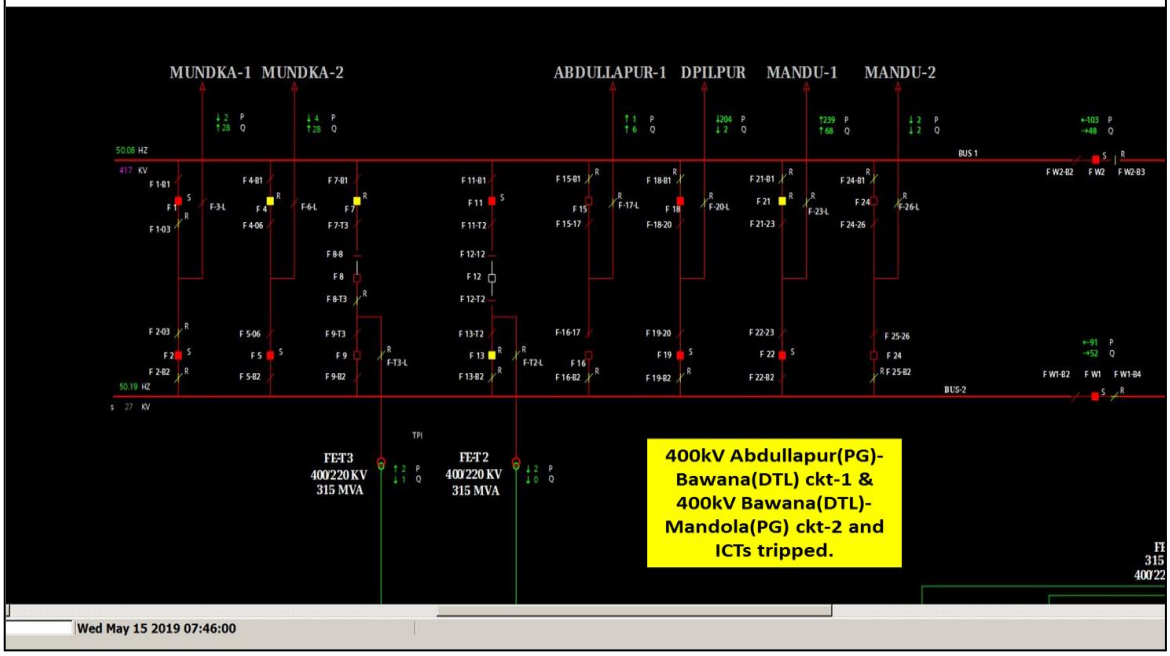
SLD of 400/220kV Bawana(DTL)(RHS) before the incident

07:43hrs/15-May-19



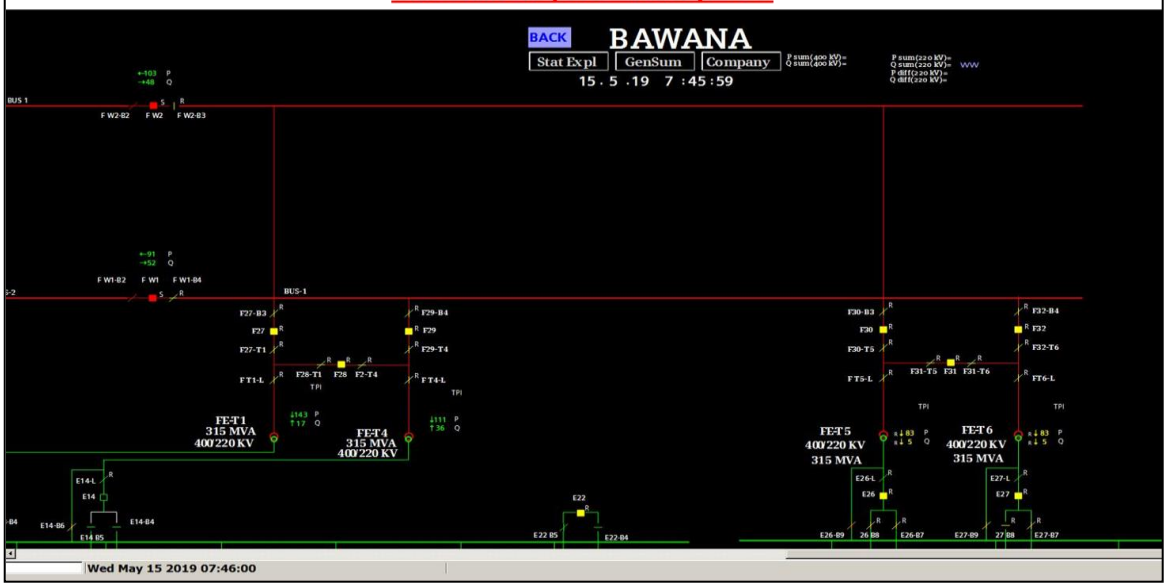
SLD of 400/220kV Bawana(DTL)(LHS) after the incident

07:46hrs/15-May-19



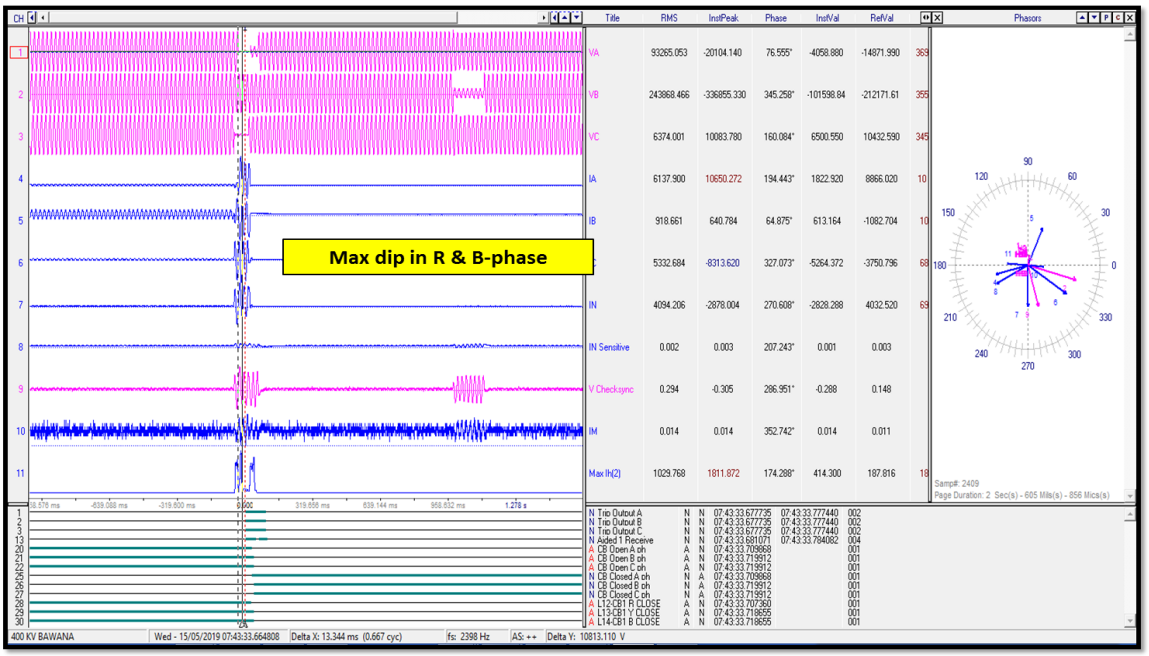
SLD of 400/220kV Bawana(DTL)(RHS) after the incident

07:46hrs/15-May-19



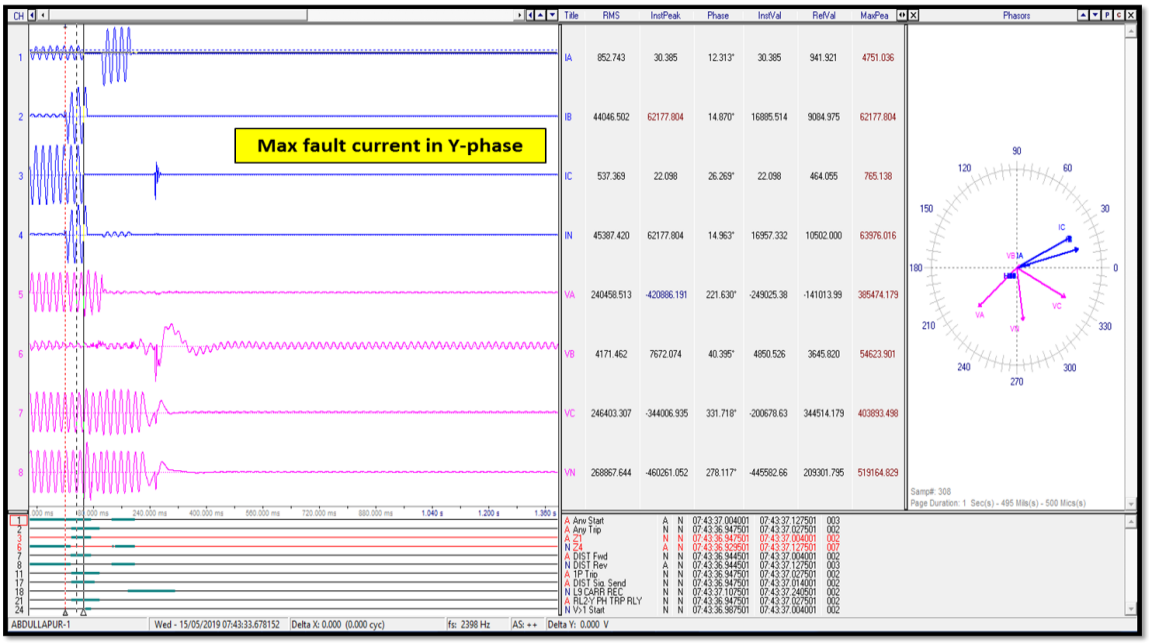
9. As per constituent details:

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



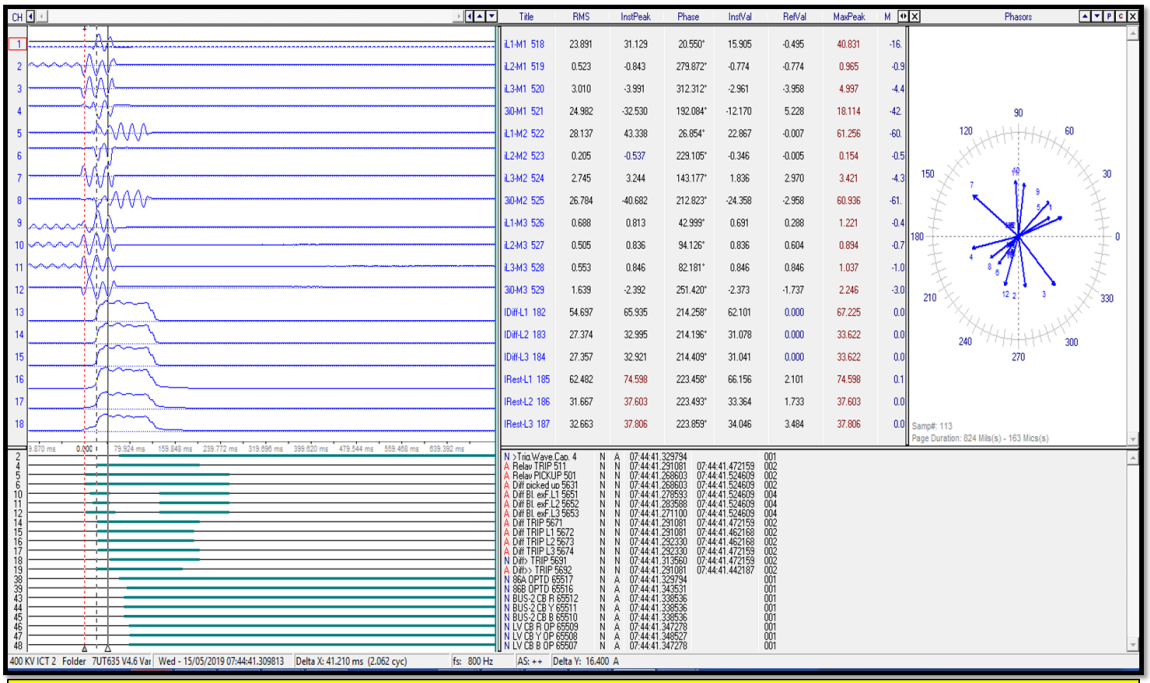
Fault was in reverse zone however line tripped from Bawana end? Time Synch error in DR

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



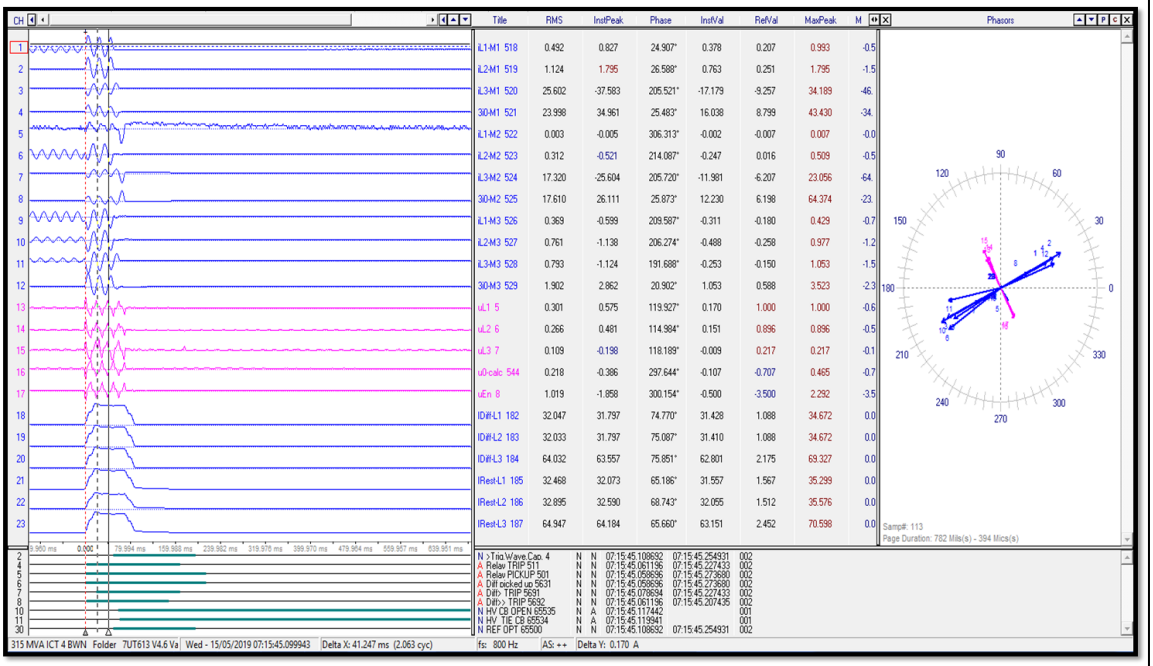
Fault sensed in reverse zone than in forward zone. Time synch error in DR

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



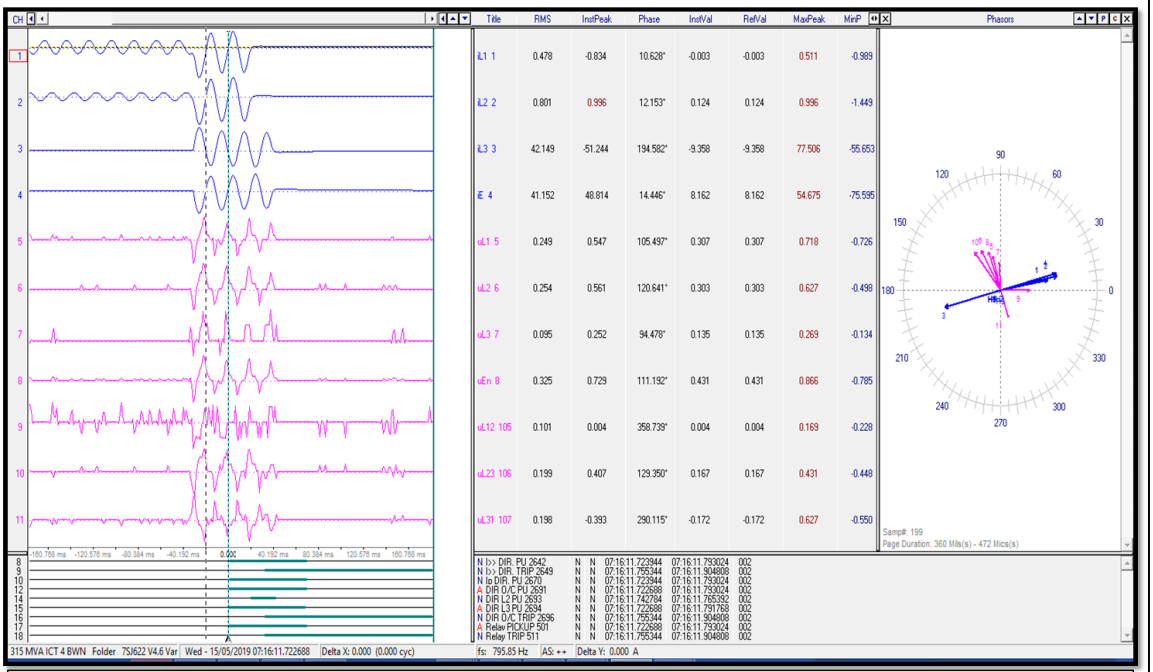
Max fault current in R-phase; Time synch error in DR

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



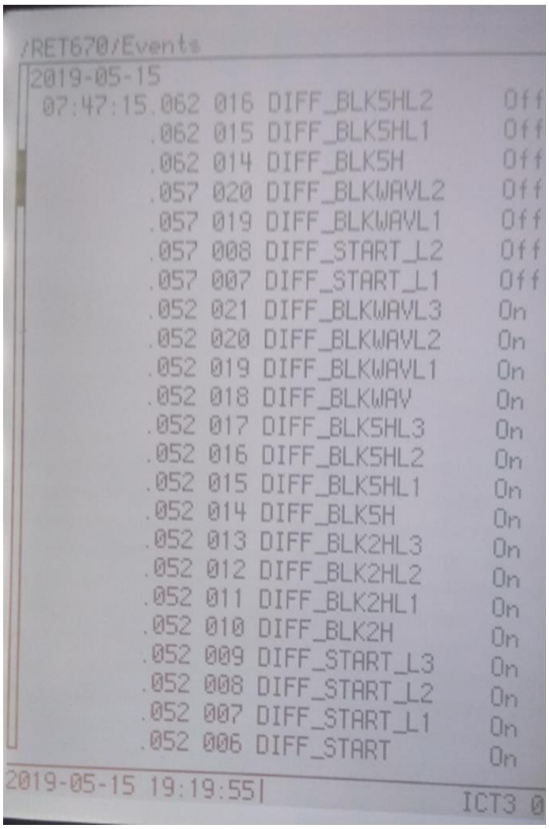
Max fault current in B-phase. Differential protection operated. Time synch error in DR.

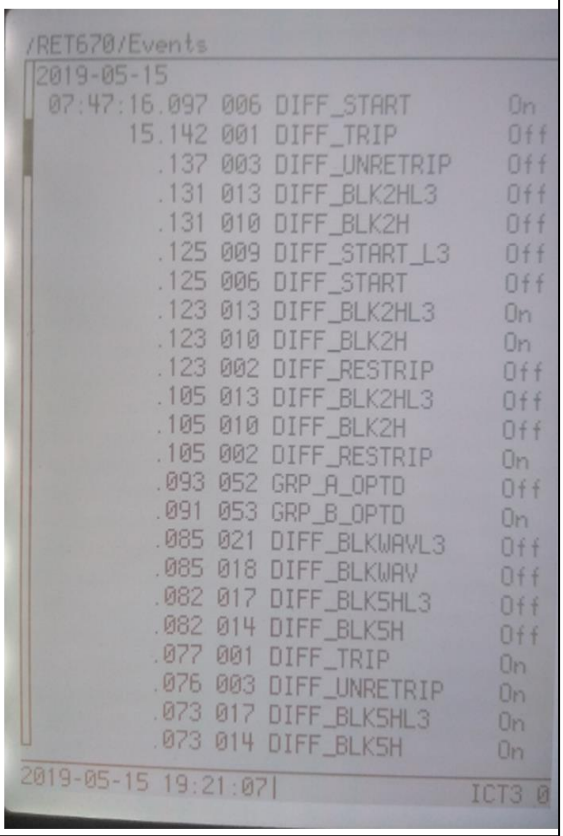
DR of 400/220 kV 315 MVA ICT-4 at Bawana (end)



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

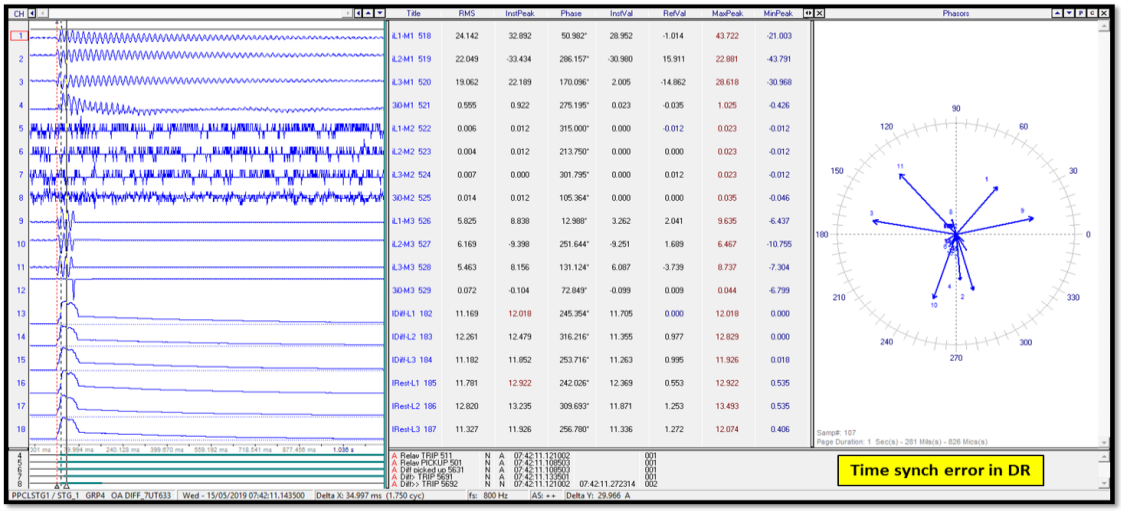
DR of 400/220 kV 315 MVA ICT-3 at Bawana (end)





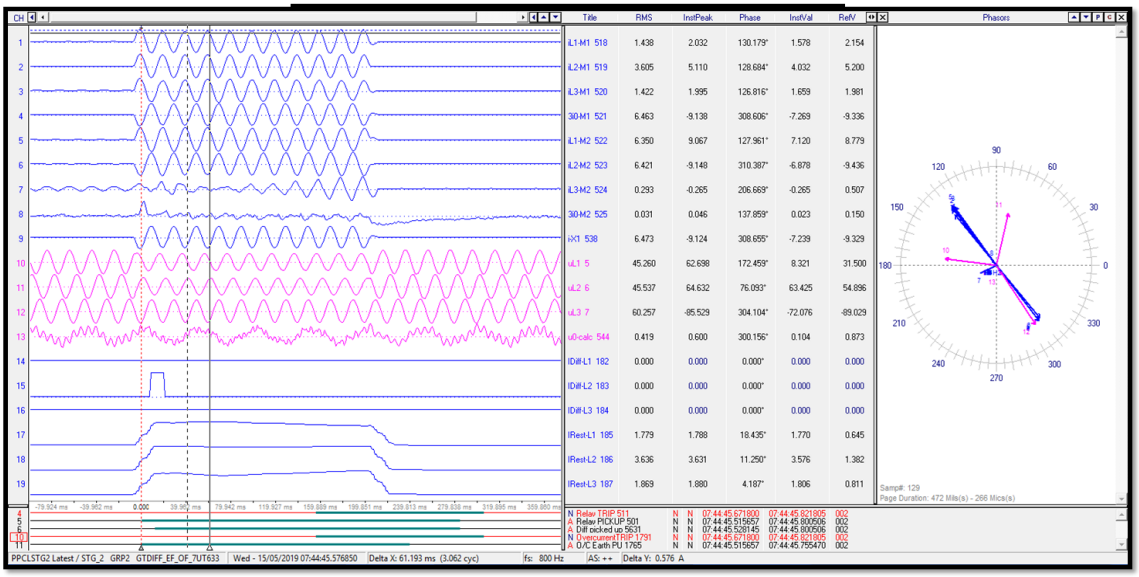
Differential protection operated. Time Synch error

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 msecs.***
- 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 # 1and 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 retrofitment 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 representative informed the following in the meeting:

1. The fault was not in bus bar zone. 400 kV Bawana (end)-Abdullapur ckt-1 tripped with proper protection operation. As multiple faults occurred during the event, the same are getting reflected in the DR.
2. Dumping ground being in the vicinity of Bawana station sometimes causes multiple tripping events due to pollution caused by burning.

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	

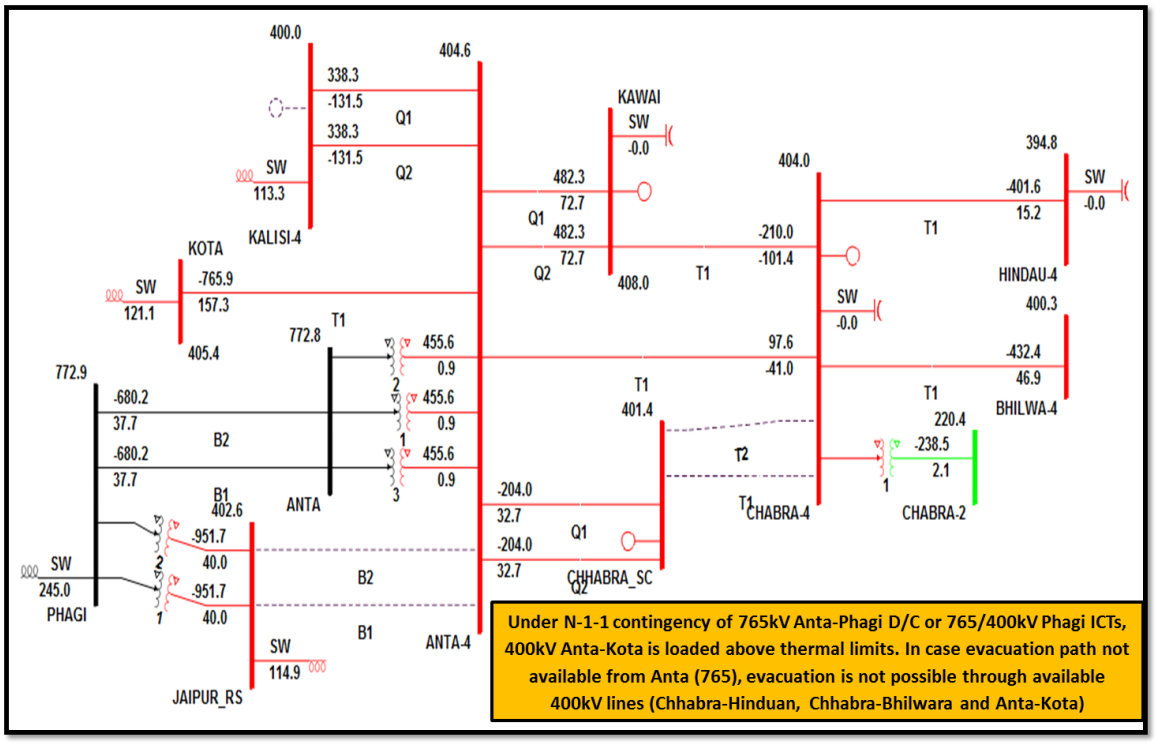
Description	Utilities	Status	Remarks
Availability of Digital Data (SCADA Data)	Rajasthan	Partially Available	
DR/EL	Rajasthan	Partially Received	Received for 765 kV Anta-Phagi ckt-2 only
Preliminary Report	Rajasthan	Received	After 24hrs
Detailed Report	Rajasthan	Not Received	

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

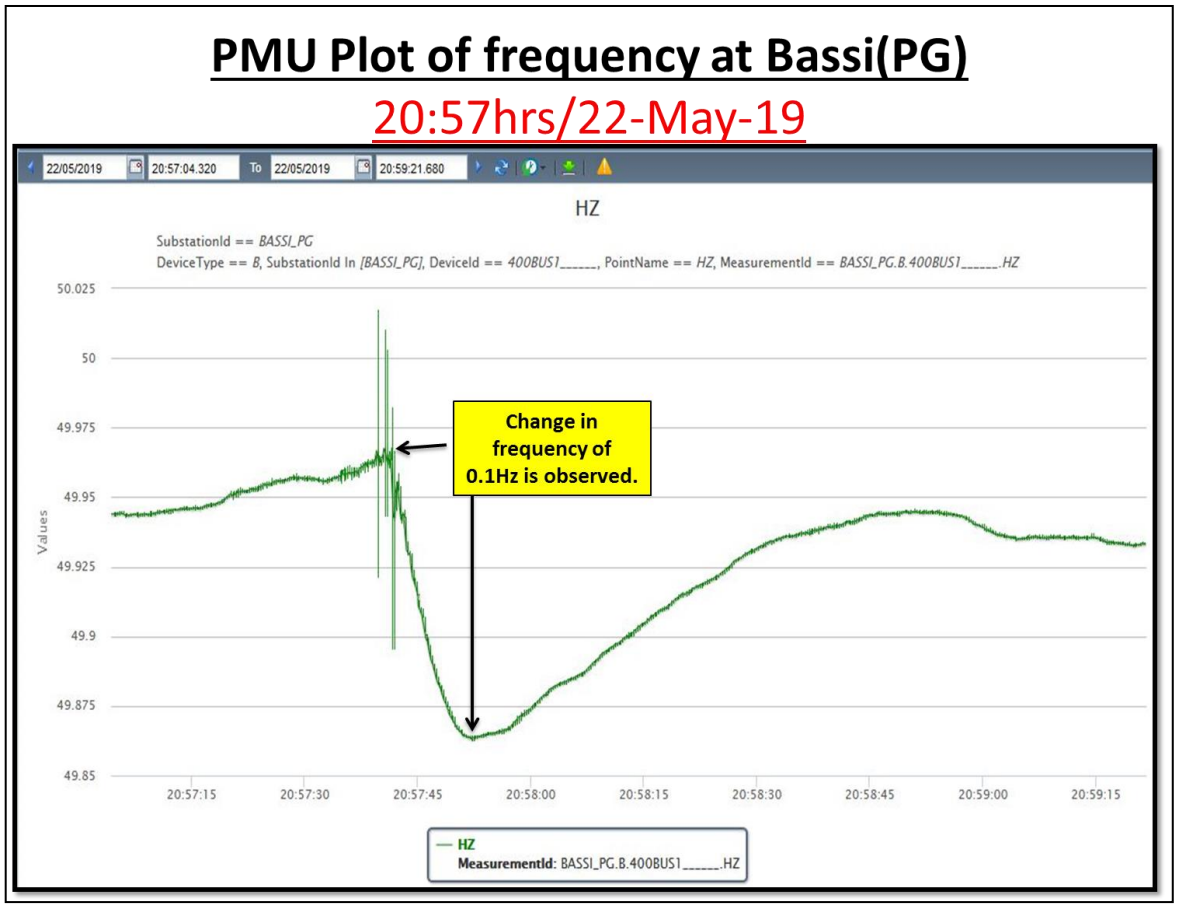
Based on above information description of the events is:

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



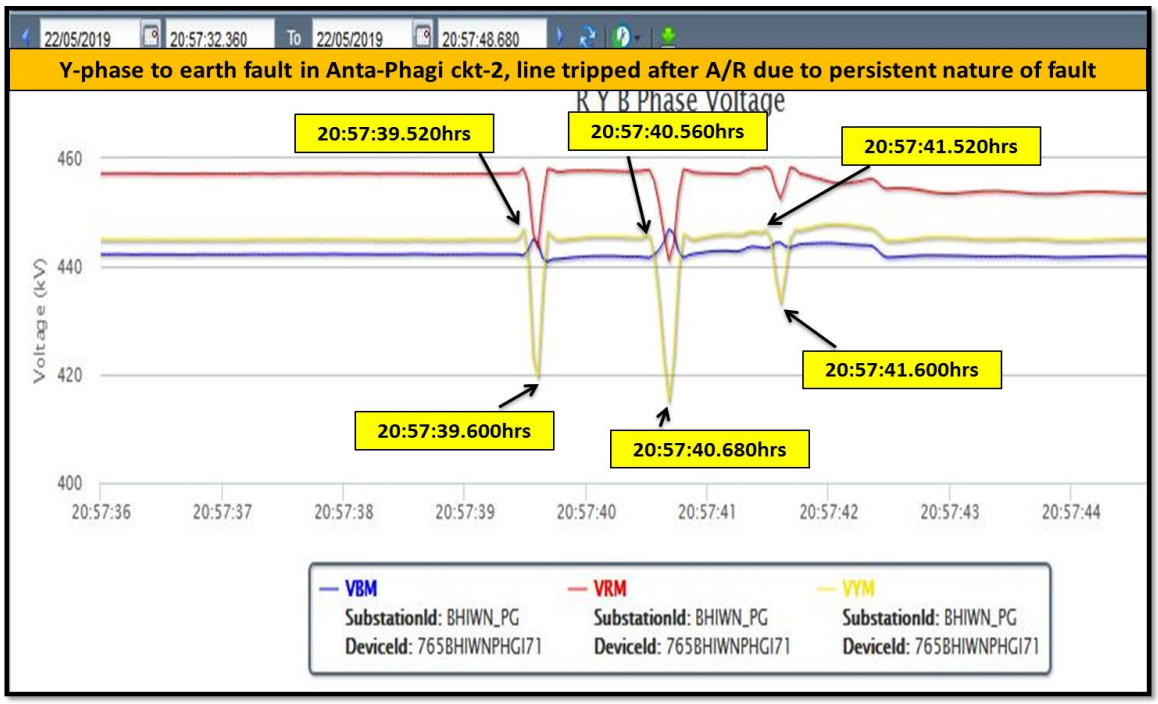
2. 765kV Anta(Raj)-Phagi(Raj) ckt-2 tripped on Y-N fault, 107Km from Phagi end. Line tripped on persistent nature of fault after successful A/R.
3. At the same time, 660MW Unit#5 & #6 at 400/220kV Chhabra TPS also tripped on electrical fault.
4. DR details of 765 kV Phagi (end)-Anta ckt-2 has been received 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 phase voltage magnitude at Bhiwani(PG)

20:57hrs/22-May-19

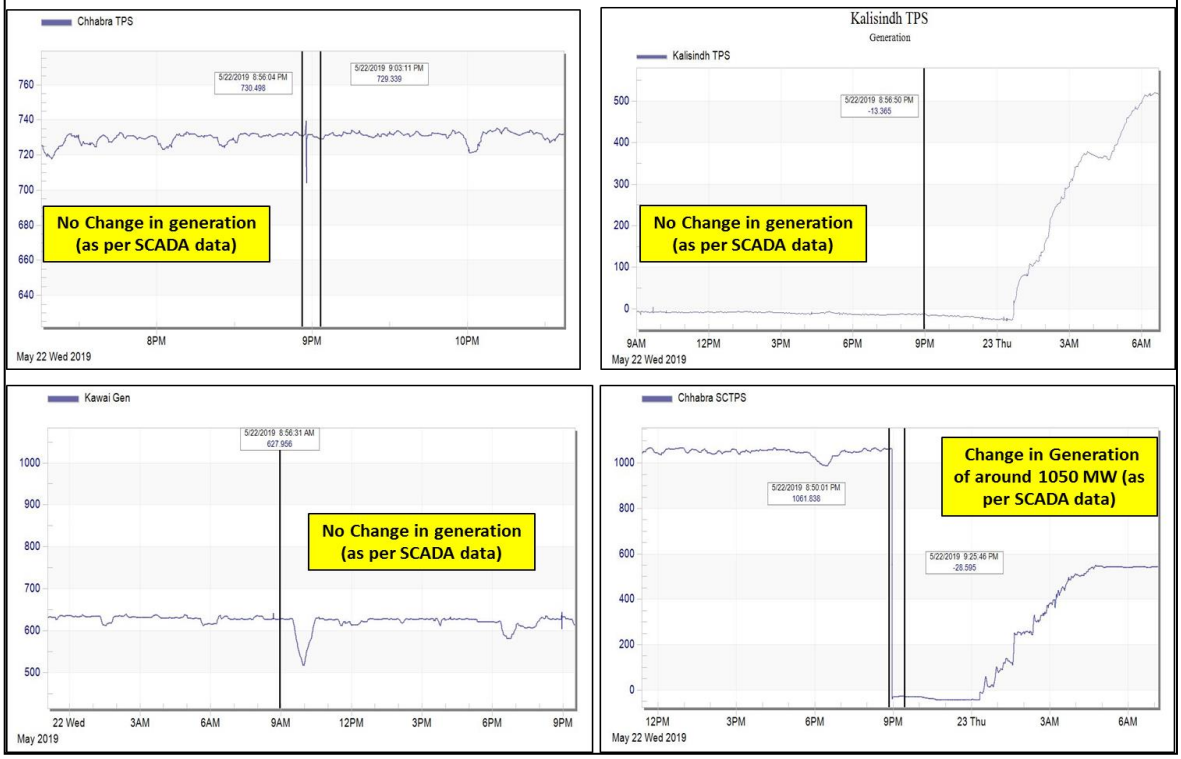


7. SCADA data and SoE:

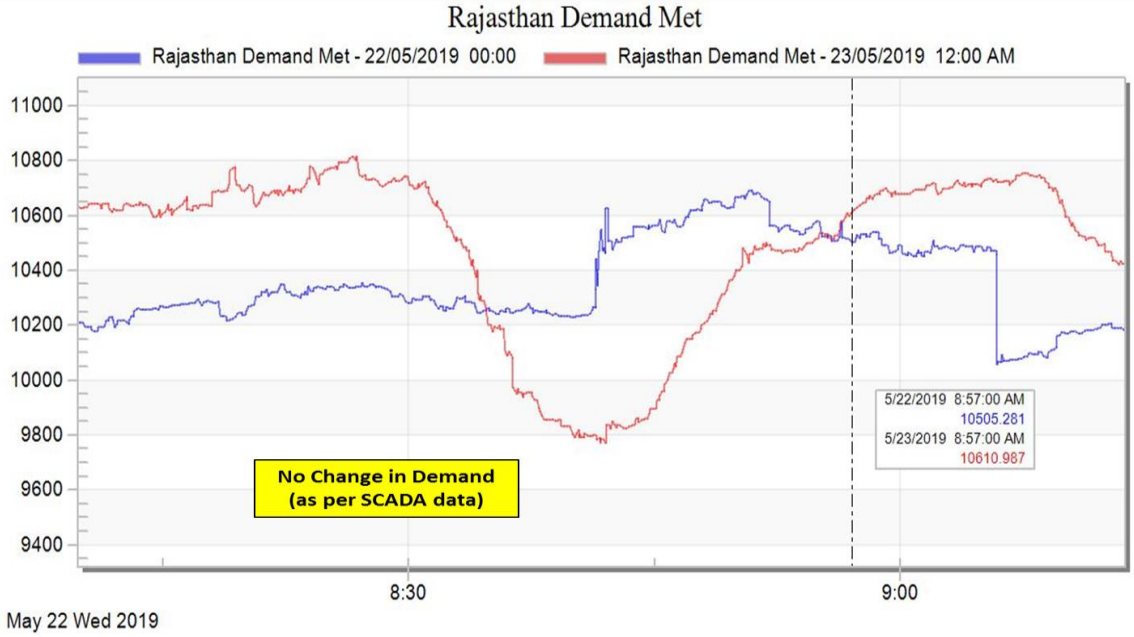
Rajasthan SCADA SOE

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

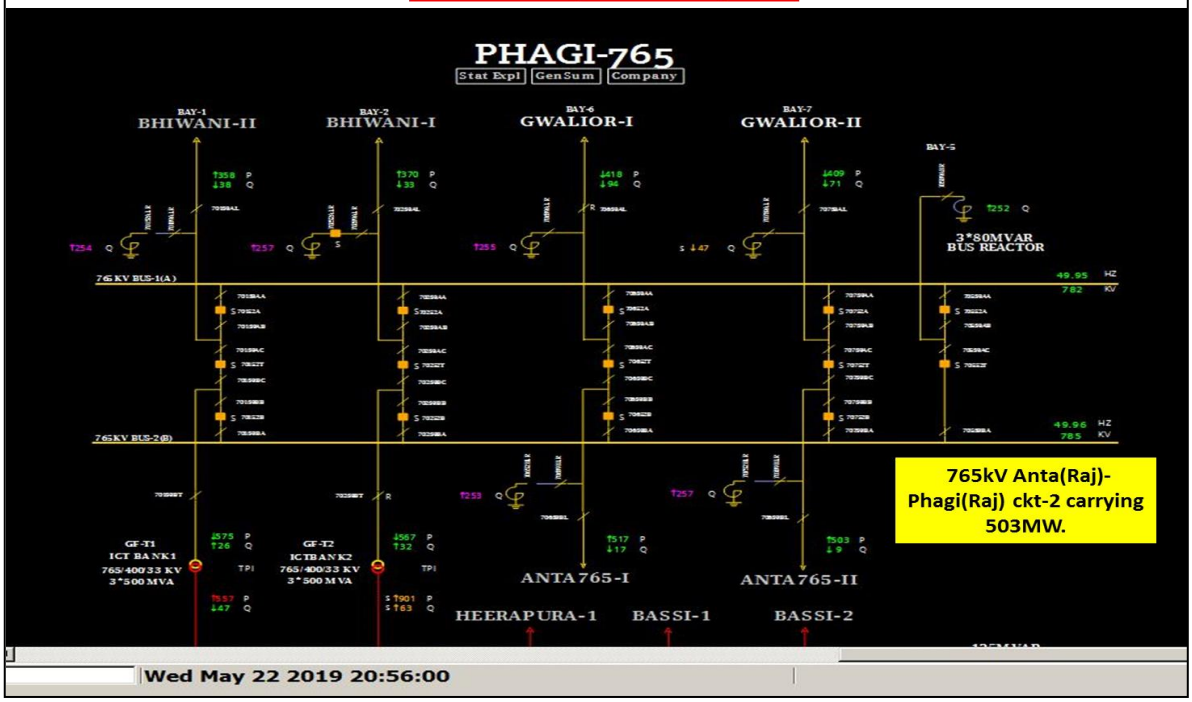


Rajasthan Demand Pattern during tripping



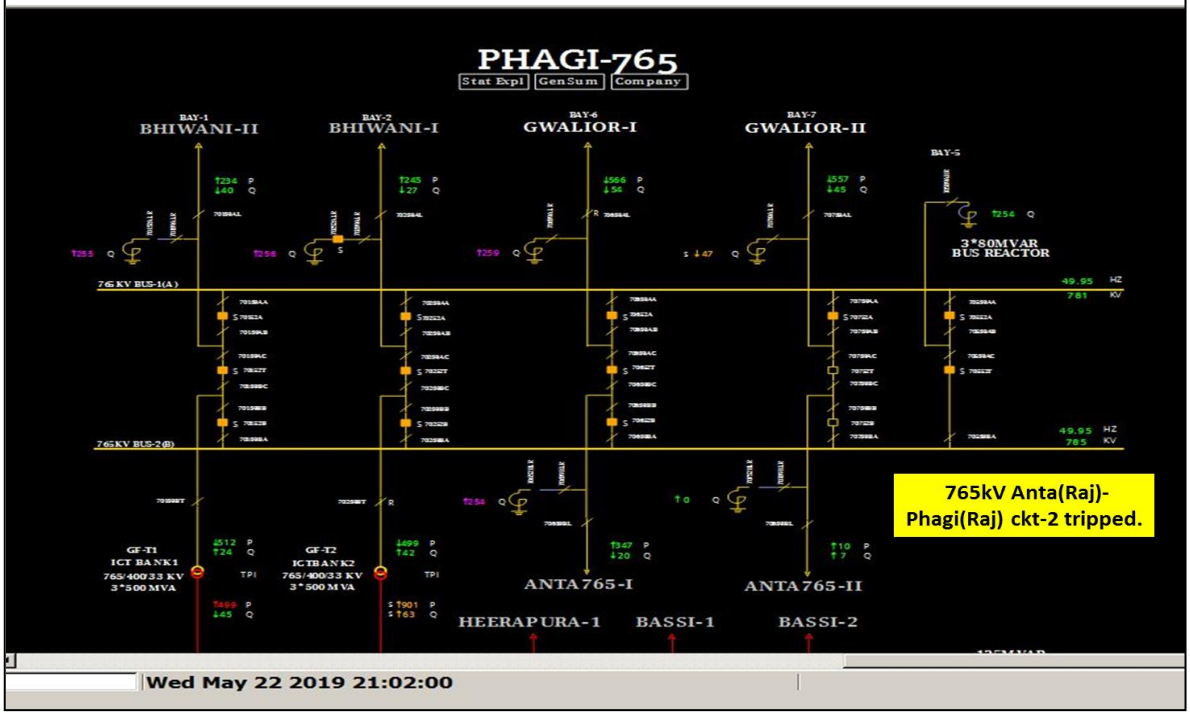
SLD of 765kV Phagi(Raj) before the incident

20:56hrs/22-May-19

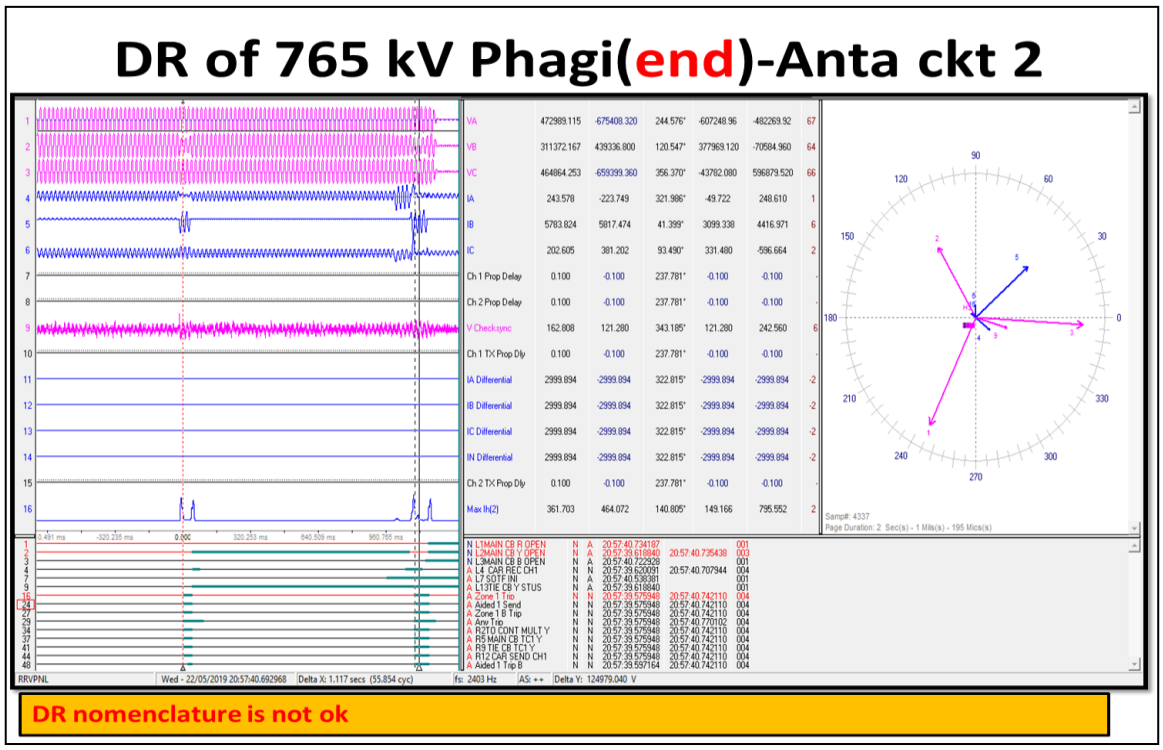


SLD of 765kV Phagi(Raj) after the incident

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.

No representative of RRVUNL was present in the meeting at the time of discussion of the event.

Adani representative submitted the following:

1. The unit at Kawai TPS was under shut down. Therefore, no SPS affect observed at Kawai TPS.
2. The SPS signal to Chabra is routed through Anta-Kawai-Chabra. However, as 400kV Anta-Chabra link is now present the signal can be routed directly through above link.

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

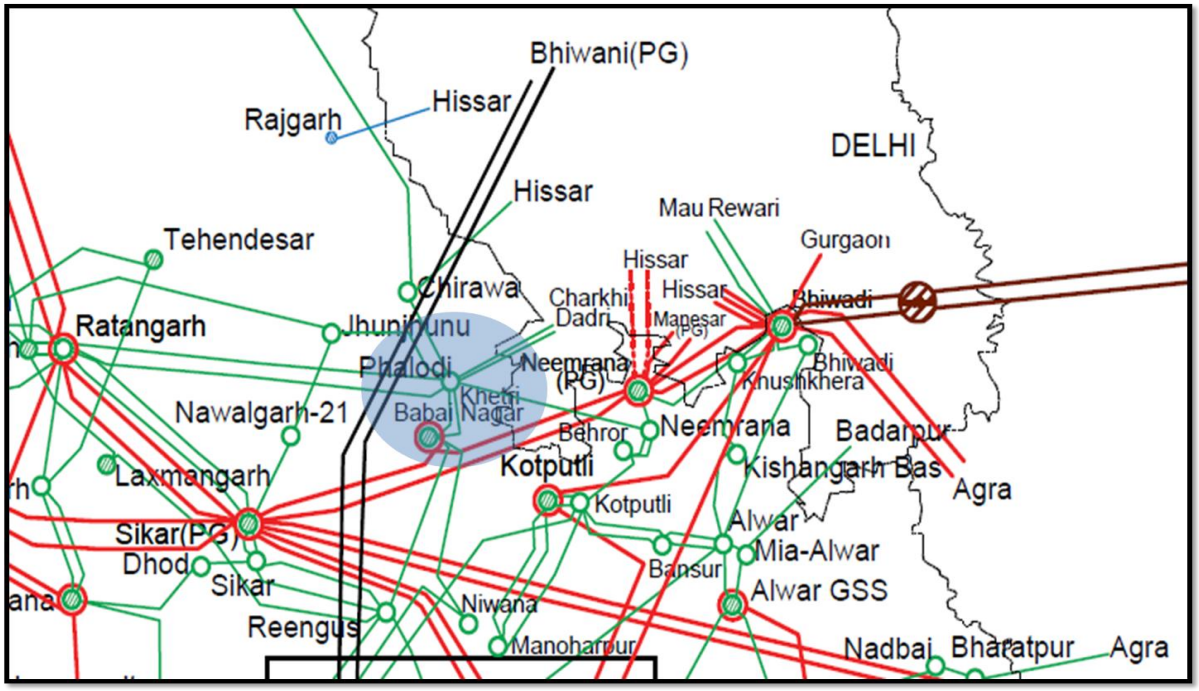
Description	Utilities	Present Status	Remarks
Availability of Digital Data (SCADA Data)		Partially Available	Time Synch error
DR/ EL	Rajasthan	Not Received	
	BBMB	Not Received	
Preliminary Report	Rajasthan	Received	After 24hrs

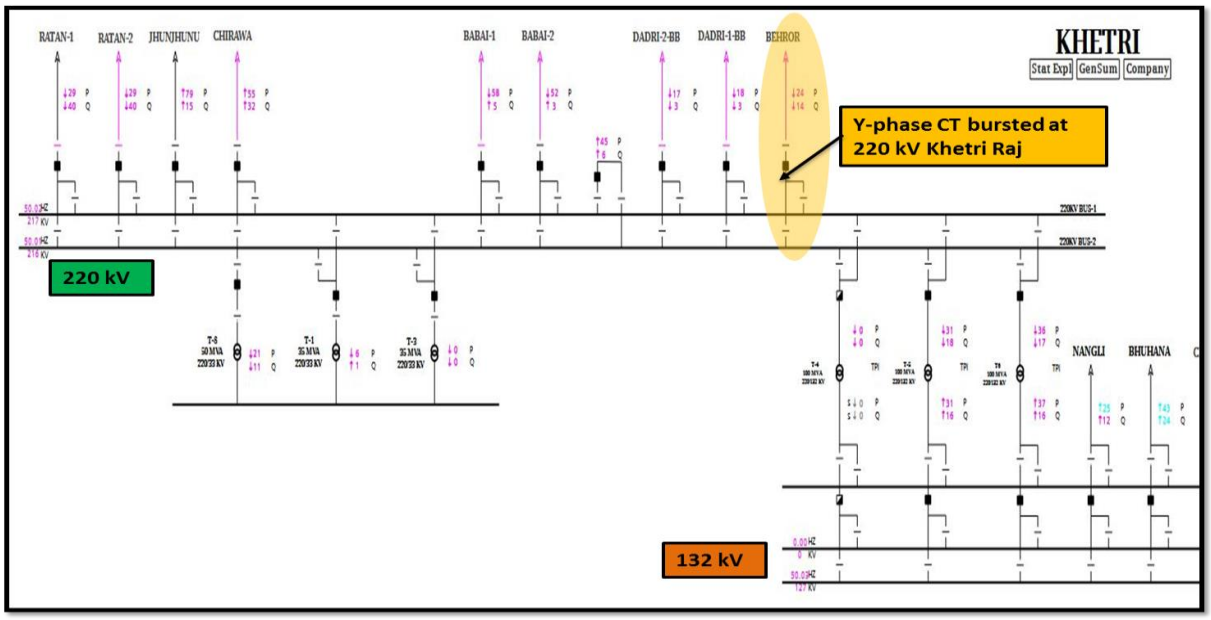
	BBMB	Not Received	
Detailed Report	Rajasthan	Not received	

Description	**Clauses**	**Utility**	**Remarks**
Violation of Clauses	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	**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
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):





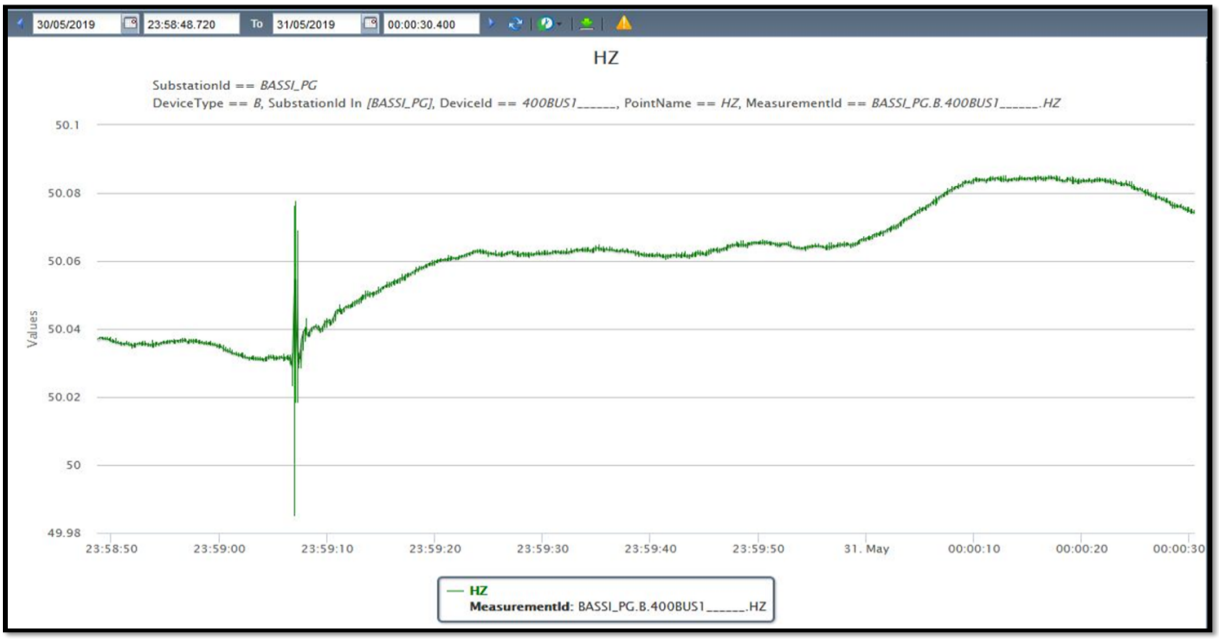
2. 220 kV Khetri (Raj) station has double bus single breaker scheme. It is connected through Charkhi Dadri BBMB D/C, Ratangarh D/C, Babai D/C, Chirawa S/C, Jhunjhunu S/C and Behror S/C. It also has three 100 MVA 220/132 kV ICTs and 2*35+1*50 MVA 220/33 kV ICTs.
3. In antecedent conditions, 220 kV bus 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:

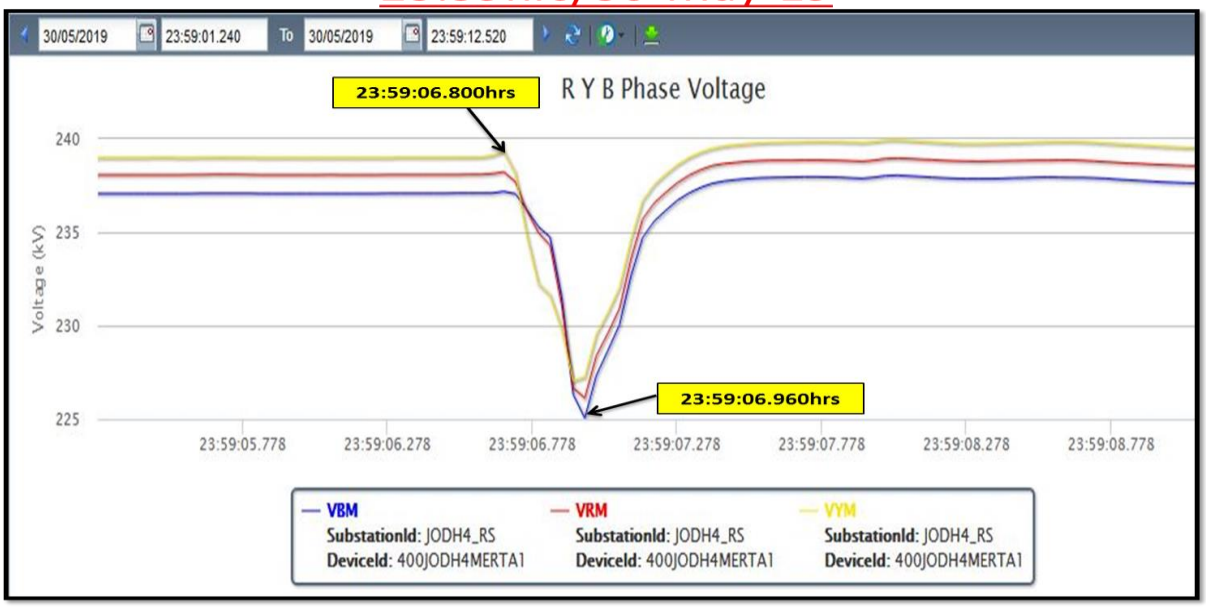
PMU Plot of frequency at Bassi(PG)

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 representative informed the following in the metting:

1. Y-phase CT of 220KV Khetri(end)-Behror(Raj) bursted. Line fault occurred. However, CB of line at Khetri failed to operate. The CB was very old. Alternate arrangement of bus bar protection operated and CBs connected to Bus-B opened. Bus-A remained intact.