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

No. उ.क्षे.वि.स./प्रचालन/107/01/2020/ 3079-3117 दिनांक: 20.03.2020

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

विषय: संरक्षण उप-समिति की 40 वीं बैठक के कार्यवृत्त |
Subject: Minutes of 40th Protection Sub-Committee Meeting.

संरक्षण उप-समिति की 40वीं बैठक दिनांक 02.03.2020 को 10:00 बजे उ.क्षे.वि.स. सचिवालय, नई दिल्ली में आयोजित की गई थी | उक्त बैठक के कार्यवृत्त उत्तर क्षेत्रीय विद्युत समिति की वेबसाइट (https://www.nrpc.gov.in) पर उपलब्ध है |

The 40th meeting of Protection Sub-Committee was held on **02.03.2020** at **10:00 hrs** at **NRPC Secretariat, New Delhi**. The minutes of the aforesaid meeting are available on NRPC website and same can be downloaded from https://www.nrpc.gov.in.

20/03/2020

(सौमित्र मज़ूमदार)
अधीक्षण अभियंता (प्रचालन)

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List of Members of PSC

Sl. No.	Designation	Organization	Fax No.
1	Director (P&C)	BBMB	0172-2652054
2	General Manager (SLDC)	DTL	011-23236462
3	GM (O&M)	Delhi Transco Limited	011-23236462
4	GM (T)	Common Services IPGCL	011-23370247
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
9	SE(T&C)	PTCUL	0135-2451826
10	Chief Engineer (SLDC)	UPPTCL	0522-2287880
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 (Comml. & Survey Wing)	PDD	0191-2474233
16	Chief Engineer (SLDC)	PSTCL	0175-2365340
17	Chief Engineer (P&M)	PSTCL	0161-2741280
18	CE (M&P)	RRVPNL	0141-2291891
19	SE (Electrical)	RRVUNL	01509-245299
20	Chief Engineer (LD)	RRVPNL	0141-2740920
21	SE (SO&LD)	RRVPNL	0141-2740920
22	Superintending Engineer (T&C)	UPPCL	0121-2666062
23	Chief Engineer, (L-2)	UPRVUNL	0522-2287822
24	DGM (T&C)	PTCUL	0135-2760331
25	General Manager (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
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
36	Assistant Vice President	BRPL	39996055
37	GM (Production)	Jhajjar Power Ltd	01251-270155
38	GM(P&M)	APL	7925557176
39	Sh. Umesh Gupta, AsVP	BRPL	011-26419833
40	Director (NPC)	CEA	-
41	1.Maintenance Superintendent	NAPS, NPCIL	05734-222167
	2.Maintenance Superintendent	RAPS, NPCIL	01475-242060

Minutes of 40th Meeting of Protection Sub-committee

40th meeting of Protection Sub-Committee of NRPC was held on 02.03.2020 at NRPC Secretariat, New Delhi. The list of participants for the meeting is enclosed at **Annexure–I**.

A.1. Confirmation of minutes of 39th meeting of protection sub-committee

Minutes of 39th meeting of Protection Sub-committee were issued vide letter of even no. dated 30.01.2020. The Minutes are available on NRPC's website at http://www.nrpc.gov.in. No comment has been received.

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

Members were apprised about the status of nodal officer, protection setting data submitted and observations during the site visit to NTAMC, Manesar.

Rajasthan and UP were requested that relay settings to be submitted through nodal officer after due verification and may not be submitted separately for each zone/circle. Hence, it was requested that Nodal Officer may be nominated at the earliest. It was also decided that a nominated Nodal officer from each utility/state will co-ordinate for submitting new as well as updating the settings.

The status of Nodal Officer is as followed:

Sr. No.	Name of the utility	Name and no. of the Nodal officer
1.	BBMB	Er. Vijay Singh Mob No. 9466120870
2.	POWERGRID NR - 1	Mahendra Singh Hada, DGM(AM), NR-I, mshada@powergridindia.com, 09650555997
3.	POWERGRID NR - 2	Praveen Kumar, DGM(AM), NR-II, mr.praveenkumar@powergridindia.com,

		09906546606
4.	POWERGRID NR - 3	Nitin Verma, DGM(AM), NR-III, nverma@powergridindia.com, 08005499952
5.	NAPS	Sh. H.S.Singh , Senior Technical Engineer (E&I) Mobile No. 9412768059
6.	NHPC	Sh. S. K. Das , Sr. manager (E) Mob No. 9717786721
7.	PSTCL	Er Rajbir Singh Walia, Adll S.E, P&M

It was decided that DO letter to top management of utilities will be written for early submission of details of Nodal officer who will co-ordinate for submitting new as well as updating the protection relay settings database.

Status of Protection setting data submitted is as followed:

Sr. No.	Utilities who have submitted the data	Date of data submission
1.	BBMB	13.01.2020
2.	NAPS/RAPP - D	18.12.2019/05.03.2020
3.	PPCL – CCGT Bawana	06.06.2020
4.	UPPTCL (Central Zone 400kV)	23.09.2019
5.	UPPTCL (South Central 400kV Orai)	13.02.2020
6.	POWERGRID NR – 1/ NR - 3	22.02.2020/26.02.2020
7.	RVPNL	28.02.2020
8.	PSTCL (400kV)	13.03.2020
9.	NHPC	02.03.2020

It was also deliberated that detailed information as in Protection template needs to be reviewed and web based database designing requires freezing up the format. Hence, it was decided that it is necessary to have a web based protection setting database which can be updated by utilities periodically. In this regards, separate meeting to be held by NRPC, NRLDC, POWERGRID to freeze up the format for protection relay setting in which database can be created.

It was deliberated that NRLDC has element details database which may be extended for web based Protection setting database with additional details from SLDCs. It was decided that NRLDC may explore estimated cost for web based Protection setting database project which may be funded from NRPC, if approved.

A.3. Final report of the Committee to suggest measures for bringing improvement in the field of Power System Protection among the utilities in Northern Region

Member were informed that 1st and 2nd batch of Level – 2 training program has been successfully held from 03rd February, 2020 to 07th February, 2020 for 26 participants and 24th February to 28th February, 2020 for 23 participants respectively, at PAL, Manesar.

It was decided that 2 batches of Level – 3 training program may be held in the month of April, 2020.

A.4. Follow up action on outstanding issues from previous meetings

A.4.1. Non- availability/defective PLCC link of STU Lines terminated at POWERGRID (NR-2) substations

40th* PSC *meeting on 02.03.2020 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 end to end testing has been completed in last week of Feb, 2020 and PLCC has been commissioned successfully.

A.4.2. Islanding scheme for Rajasthan and Punjab

Members were informed that Enquiry Committee on grid disturbance has recommended to design islanding scheme based on frequency sensing relays so that in case of imminent grid failure, electrical islands can be formed.

Delhi representative was requested that details of generation, feeder wise loads to be supplied in islanding and feeder wise UFR/df/dt load reduction to be informed at the earliest. Similar, information was sought from NAPS and RAPS which was to be submitted by 05.03.2020.

Representative of DTL, NAPS and RAPS agreed for the same.

A.4.2.1. Islanding scheme for Rajasthan

Rajasthan representative informed that Mahi HPS has been excluded from

RAPS islanding scheme. He clarified that details being submitted are for islanding of RAPP – A, B wherein Mahi HPS is excluded. It was also deliberated that islanding scheme for Kawai-Kalisindh-Chhabra generation complex may also be planned.

NRLDC informed that separate islanding scheme need to be designed for every state and islanding for NPCIL need to be kept separate as it is focused on unit survival.

Rajasthan was requested to plan the schemes for Rajasthan islanding which may include Chhabra complex and other state generation.

A.4.2.2. Islanding scheme for Punjab

Representative of Punjab stated that internal issue of transfer of ownership of GNTDP S/S from PSPCL to PSTCL is being resolved and mock testing will be completed by 31.03.2020.

Punjab and UP (Unchahar scheme) were requested to submit the islanding schemes by 04.03.2020.

Further, it was highlighted that proposed islanding scheme of Kashmir Valley as in System Restoration procedure of NRLDC need to reviewed and implemented hence, it was decided that separate meeting to be held by NRLDC for the proposed islanding scheme of Kashmir Valley before next PSC meeting.

A.4.3. 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-II.**

Utilities were requested to update the latest status.

A.4.4. 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 again requested to submit the same at the earliest. Status of actions taken on Third Party Protection Audit is enclosed as **Annexure-III**.

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

A.4.5. 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.

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

The status has been received from BBMB, NPCIL, THDC – Koteshwar, UPPTCL, PSTCL, NJHPS as decided in 38th PSC meeting (Annexure-5 of Additional agenda of 38th PSC meeting).

Other utilities were requested to update the status of Bus Bar Protection and the status of interim measures taken at their end.

A.4.6. CERC order on Petition No. 9/SM/2014 and 10/SM/2014

The status of details received is as given below:

Description	Information submitted by
Details regarding List events of delayed clearance of faults from 01.04.2014 to 31.03.2016	UPPTCL, NJHPS, POWERGRID, NHPC, DTL, RRVPNL,PPCL and BBMB.

Utilities were requested to submit the information.

A.5. Tripping Events:

Detailed presentation of NRLDC and presentation submitted by different entities is available at **Annexure – V**.

General Recommendation for NRPC-PSC meeting- As approved in 39th 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 400kV Koteshwar (THDC) Station at 14:58hrs of 01st Dec 2019

1. Discussion during the meeting:
    a. NRLDC representative informed the following:
        i. Bus Bar Protection operation at 400 kV Koteshwar (THDC) needs to be looked into in view of actual bus fault or setting issue. (400 kV Bus Bar Zone-2 tripping, what about check zone protection before operation of bus bar protection.

ii. Reason of tripping of 400 kV Koteshwar (THDC)-Koteshwar (PG) ckt-1 needs to be relooked.
iii. Reason of delayed operation/ opening of 400 kV bus coupler needs to be checked and corrected.
iv. Time synch error of 400 kV Koteshwar (THDC)-Koteshwar (PG) ckt-1 needs to be looked into.
v. Analog and digital data (SCADA SoE) status to be checked and corrected.

b. THDC representative informed the following:
   i. There was actual bus fault due to damage of bus side insulator string. Porcelain insulator strings to be replaced with polymer insulator in phased manner.
   ii. Reason of tripping of 400 kV Koteshwar (THDC)-Koteshwar (PG) ckt-1 yet to be ascertained, as per DR details SOTF and I3>1 operated. He further informed that issue has been taken up with OEM and exact reason and remedial measures would be submitted before 15th March, 2020.

2. PSC Recommendations:
   a. Protection setting of 400 kV Koteshwar (THDC)-Koteshwar (PG) ckt-1 shall be checked and corrected. Changes in the setting to be shared with NRPC/ NRLDC. (Action: THDC; Time: by 15.03.2020)
   b. Reason of delayed operation/ opening of 400 kV bus coupler needs to be checked and corrected. (Action: THDC; Time: by 15.03.2020)
   c. DR time synch of all the 400 kV elements at 400 kV Koteshwar (THDC) to be corrected. (Action: THDC; Time: by 15.03.2020)
   d. Availability of Analog and digital data of 400 kV Koteshwar (THDC) needs to be ensured. (Action: THDC; Time: by 15.03.2020)
   e. Remedial action taken report needs to be shared by THDC. (Action: THDC; Time: by 15.03.2020)

B. Multiple Element tripping at 400kV Manesar (PG) Station at 12:34hrs of 05st Dec 2019

1. Discussion during the meeting:
   a. NRLDC representative sought information on the following:
      i. Reason of mal-operation of contactor of SF6 gas zone tripped bus isolator of 400 kV Neemrana-Manesar (PG) ckt-1.
      ii. Modification for SF6 gas zone tripping in view of frequent tripping at multiple locations in NR
   b. POWERGRID representative informed the following:
      i. Reason of mal-operation of contactor of SF6 gas zone trip of bus isolator of 400 kV Neemrana-Manesar (PG) ckt-1 yet to be ascertained. The Contactor has been replaced and the matter is under discussion with GIS manufacturer to rectify the same and to avoid any such incidence in future.

ii. Tripping of both bus bar protections at Manesar (PG) was as per existing bus bar scheme for tripping of both the buses in case of low gas pressure in particular compartment

iii. This zone tripping in GIS was also taken up with CC-engineering but there was no uniformity in zone tripping philosophy in POWERGRID.It depends on manufacturer to manufacturer. POWERGRID is following manufacturer recommendation for zone tripping logic in bus bar protection. In case of Manesar (PG), GIS manufacturer recommended for tripping of both 400 kV buses in case of Gas zone tripping in common compartment. After this incident scheme has been modified for tripping of one bus depending on position of isolator switch.

iv. The protection scheme at Manesar (PG) has been modified such that-

- For bus coupler both the zone of bus bar protection will not be operated.
- Remove the looping of 4 contacts of KZ00, K101, K102, K103.
- Parallel the contact of only 2 contactors of KZ00 and K103, wired to bus bar bay unit and configure for tripping of bus bar based on bus isolator status.
- Parallel the contact of K101 for all 400kV feeders and wired to bus bar central unit for tripping of 400kV Bus Bar-1.
- Parallel the contact of contact of K102 for all 400kV feeders and wired to bus bar central unit for tripping of 400kV Bus Bar-2.

v. Gas zone protection based tripping for both 400 kV bus bar protection in case of bus coupler has been disabled in POWERGRID-NR1.

vi. POWERGRID-NR 2 & NR-3 representative stated that they will check the existing scheme and revert back about correct status and modifications if any.

c. General Recommendation during the meeting:

i. NRLDC representative further informed that multiple element tripping has been captured on account of gas zone tripping at various locations of NR and he requested PSC to finalize the common philosophy for all to follow in the region. POWERGRID representative stated that IEC don't recommend anything specific for gas zone tripping and POWERGRID is following GIS manufacturer's recommendation. He further stated that zone tripping was not there in GIS which came into system in initial stage.

ii. For tripping of 06th Dec 2019, both the buses were manually opened under emergency shutdown due to gas leakage in bus VT compartment.

iii. In GIS station, SF6 gas alarm is most crucial alarm for the operator and to be attended on priority. He further informed that in new GIS, one and half breaker scheme has been implemented.
iv. POWERGRID-NR1 representative confirmed that tripping extension to both bus bar has been disabled for gas based zone tripping.
v. Delhi representative informed that at some places, scheme is like tripping in case of DC input became zero to contactor related to gas zone. POWERGRID representative suggested for DC supervision in series of tripping for bus zone to prevent such tripping.

2. PSC Recommendations:
   a. Reason of mal-operation of contactor of SF6 gas zone trip of bus isolator of 400 kV Neemrana-Manesar (PG) ckt-1 needs to be taken up with OEM and identified. Outcome report to be shared with NRPC/ NRLDC. (Action: POWERGRID; Time: by 15.03.2020)
   b. POWERGRID shall submit the detailed report including action taken in POWERGRID-NR to prevent the unwanted tripping or sensitive setting of gas based zone tripping in GIS. (Action: POWERGRID; Time: by 15.03.2020)
   c. DC supervision shall be done for the scheme in which gas zone tripping extends on the basis of zero DC input to the contactor. (Action: General Recommendation for all the members)

C. Multiple Element tripping at 400kV Manesar (PG) Station at 17:44hrs of 06th Dec 2019

1. Discussion during the meeting:
   a. NRLDC representative sought information on the following:
      i. Reason of operation of 400 kV bus bar protection for 400 kV Bus-1 at Manesar PG on 06th Dec 2019 needs to be updated.

   b. POWERGRID representative informed the following:
      i. For tripping of 06th Dec 2019, both the buses were manually opened under emergency shutdown due to gas leakage in bus VT compartment.
2. PSC Recommendations:
   a. There is no need of recommendations in view of Manual tripping.

D. Multiple Element tripping at 400kV Chhabra TPS Station at 18:14hrs of 17th Dec 2019

1. Discussion during the meeting:
   a. NRLDC representative sought information on the following:
      i. Exact location of fault and nature of fault.

ii. Was it actual operation or mal-operation of bus bar protection at Chhabra TPS. If it was mal-operation, then action identified by the RRVUNL may be intimated.
iii. 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.
iv. Auto reclosure function in 400 kV Chhabra SCTPS-Anta D/C line needs to checked and corrected
v. Time difference of 400 ms between tripping of inter connector and unit CB needs to be checked and corrected.
vi. Analog and digital data (SCADA SoE) status to be checked and corrected

b. Rajasthan representative informed the following:
i. Fault location was in Y-phase CT of bus interconnector between Chhabra TPS and Chhabra SCTPS.
ii. It was actual bus fault as bus bar protection operated correctly for both 400 kV buses at Chhabra TPS and Chhabra SCTPS each.
iii. Auto reclosure function in 400 kV Chhabra SCTPS-Anta D/C will be checked and intimated.
iv. Tripping was as per order, reason of delayed opening of unit CB will be further checked.

2. PSC Recommendations:
a. Auto reclosure function in 400 kV Chhabra SCTPS-Anta D/C shall be checked and reported. Outcome report to be shared with NRPC/ NRLDC. (Action: Rajasthan; Time: by 15.03.2020)
b. Reason of delayed opening of unit CB shall be checked & corrected. Details shall be shared with NRPC/ NRLDC (Action: Rajasthan; Time: by 15.03.2020)
c. Analog and digital data (SCADA SoE) status shall be checked and corrected.
d. Detailed report considering the reply of aforesaid points or another point shall be shared with NRLDC/ NRPC. (Action: Rajasthan; Time: by 15.03.2020)

E. Multiple Element tripping at 400kV Sultanpur (UP) Station at 02:54hrs of 22nd Dec 2019

1. Discussion during the meeting:
a. NRLDC representative sought information on the following:
i. Exact fault clearance time.
ii. Fault captured in PMU at 2:54:00.600hrs needs to be established. Whether the fault was timely cleared or not?
iii. 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.

iv. Status of breaker over hauling & its report for 400/220 kV ICT-1 and 220 kV Sultanpur (end)-Pratapgarh ckt. Exact reason of delayed operation needs to established.
v. 150ms time delay in tripping of Sultanpur-Lucknow (end) Sultanpur-Tanda (end) line needs to be looked into on view of PLCC communication delay
vi. Healthiness of 220 kV bus bar protection at 400/220 kV Sultanpur (UP) needs to be corrected. Isolator auxiliary contact status input shall be checked regularly on daily basis.
vii. Particular reason of operational issue like all three ICTs running on same bus at 400 kV side.
viii. Time synch error in various triggered DR needs to be corrected.
ix. Status of station event logger, details yet to be shared.
x. Analog and digital data (SCADA SoE) status to be checked and corrected.
xi. Detailed report considering the aforesaid points and submit the remedial measures report

b. UPPTCL representative informed the following:
    i. At 2:54:00.600hrs, there might be fault in 220 kV Sultanpur-Pratapgarh ckt; line A/R successfully; however, details will be further checked and findings will be shared.
    ii. At 02:54:03.920hrs, R-phase to earth fault occurred in 220 kV Sultanpur-Pratapgarh ckt. Sultanpur (UP) end sensed the fault in Z-1 after some time and issued tripping command however 400/220 kV ICT-1 at Sultanpur (UP) end sensed the fault in over current earth fault stage-2 due to sensitive protection setting. 400/220 kV ICT-1 also tripped within desired time of 100ms; however LBB protection of ICT-1 operated after 200ms of fault initiation and further resulted into tripping of all 400 kV elements connected to that bus (400 kV Bus-A).
    iii. 220 kV bus bar (ERL make) protection at 400/220 kV Sultanpur (UP) is under off condition as isolator contact is not healthy and OEM support is also not available. ERL company is presently not operational.
    iv. Station Event Logger is available at 400 kV Sultanpur (UP) but not available at 220 kV side.
    v. Major cause of event:
        - Delayed tripping of 220kV Sultanpur-Pratapgarh Line C.B. (Bus Transfer) at Sultanpur end for R phase fault.
        - Sensitive over current earth fault protection setting of 400/220 kV ICTs at Sultanpur (UP).
        - After thorough investigation of trip logic & DR of S.E.L. make L.B.B. relay (type SEL-487) installed on HV side of ICT1 it was found that even after isolation

of fault leading to normal phase current, the 'SV05' bit in trip logic of the relay remained high leading to spurious operation of LBB relay and hence tripping of all element connected to 400kV Bus A at Sultanpur (UP).

vi. Action taken:
- The CB timing of 220 kV TBC (Transfer Bus Coupler), 400/220 kV side C.B. of ICT1 measured.
- 220kV Pratapgarh Line DPR & ICT1 LBB relay tested.
- High set (stage-2) over current earth fault setting of 400/220kV ICT 1 & 3 modified. Earlier setting was 1.4A (secondary side) has been revised with 6A with 100ms
- Matter regarding configuration logic of LBB relay referred to Design/M/s S.E.L (OEM).
- Operational instruction has issued for distribution of ICTs on both 400 kV buses instead of ICTs on one 400 kV bus as connected during this event.

vii. Action to be taken:
- Configuration logic to be modified in all S.E.L. make LBB relay.
- CB timings are required to be checked from time to time

viii. 150ms time delay in tripping of Sultanpur-Lucknow (end) & Sultanpur-Tanda (end) line will be checked in next shutdown.

ix. Tripping of 220 kV Sultanpur-Pratapgarh (end) ckt to be checked from delayed clearance of fault (620ms fault clearance time)

2. PSC Recommendations:
   a. LBB (Local Breaker Backup) protection setting at 400kV Sultanpur (UP) shall be checked & corrected. Remedial measures report to be shared with NRPC/ NRLDC. (Action: UPPTCL; Time: by 15.03.2020)
   b. Breaker operating time of both end 220 kV Sultanpur-Pratapgarh ckt shall be checked in view of delayed clearance of fault and status of A/R function at the time of tripping. (Action: UPPTCL; Time: by 15.03.2020)
   c. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared. (Action: UPPTCL; Time: by 15.03.2020)
   d. Healthiness of 220 kV bus bar protection (ERL make) at 400/220 kV Sultanpur (UP) shall be ensured. (Action: UPPTCL; Time: by 15.06.2020)
   e. Availability of station event logger at 220 kV Sultanpur (UP) needs to be ensured. Time frame in which station event logger will be

available at 220 kV Sultanpur (UP) station, also needs to be informed. (Action: UPPTCL; Time: to be reported by UPPTCL)

f. Time synch error in various triggered DR needs to be corrected. (Action: UPPTCL; Time: by 15.03.2020)
g. Analog and digital data (SCADA SoE) status shall be checked and corrected.
h. Detailed report considering the reply of aforesaid points shall be shared with NRLDC/ NRPC. (Action: UPPTCL; Time: by 15.03.2020)
i. Healthiness of station event logger needs to be ensured at each 220 kV and above station (Action: General Recommendation for all the NR utilities)

F. Multiple Element tripping at 400kV Chhabra TPS Station at 07:53hrs of 29th Dec 2019

1. Discussion during the meeting:
   a. NRLDC representative sought information on the following:
      i. Exact location of fault and nature of fault.
      ii. Chhabra SCTPS unit-5 & 6, Generator differential protection setting needs to be checked and corrected in view of unwanted tripping on through fault.
      iii. As per SoE data, it is observed that Chhabra SCTPS - UNIT 5 & UNIT 6 tripped after 3s of tripping of 400 KV Anta(RS)-Kawai SCTPS(APR) (RS) Ckt-2. Reason of the same needs to be looked into.
      iv. 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.
      v. Remedial measures taken report also needs to be shared.
      vi. Analog and digital data (SCADA SoE) status to be checked and corrected
   b. Rajasthan representative informed the following:
      i. Fault was in 400 kV Anta-Kawai ckt-2, Line finally tripped after unsuccessful auto reclosing.
      ii. At the same time 400 kV Unit-5 & 6 of Chhabra SCTPS also tripped on generator differential protection. This issue has been taken up with OEM and exact reason yet to be identified.
2. PSC Recommendations:
   a. Generator differential protection setting & other protection setting of unit-5 & 6 of Chhabra SCTPS shall be checked & corrected. Remedial measures report to be shared with NRPC/ NRLDC. (Action: Rajasthan; Time: by 15.03.2020)
   b. There is a time difference between A/R at both end of 400 kV Anta-Kawai ckt-2. Auto reclosing timing at both end of 400 kV Anta-Kawai ckt-2 needs to be checked and corrected. (Action: Rajasthan; Time: by 15.03.2020)

c. Exact sequence of events in view of cause of event; protection operation/non-operation; opening, closing of breaker, isolator; relevant alarms and any other relevant detail to be shared. Details shall be shared with NRPC/ NRLDC (Action: Rajasthan; Time: by 15.03.2020)
d. Analog and digital data (SCADA SoE) status shall be checked and corrected.
e. Detailed report considering the reply of aforesaid points shall be shared with NRLDC/ NRPC. (Action: Rajasthan; Time: by 15.03.2020)
f. Healthiness of station event logger needs to be ensured at each station (220 kV and above) (Action: Rajasthan; Time: by 15.03.2020)

G. Tripping of all HVDC pole (three pole) of Champa-Kurukshetra poles at 10:26hrs of 30th Dec 2019

1. Discussion during the meeting:
   a. NRLDC representative sought information on the following:
      i. Action taken for addressing the frequent tripping of HVDC Champa-Kurukshetra due to mal-operation or software bug.
      ii. Details of CNAP protection in HVDC.
      iii. Outcome of discussion with OEM to be shared with NRPC/ NRLDC.
      iv. Remedial measures taken report to be shared by POWERGRID.
   b. POWERGRID representative informed the following:
      i. When all HVDC poles are in service, neutral current in common area must be zero as per logic. But after charging of Pole-3, its current was not reflected properly for the common neutral area protection. At that time Lane-2 of Pole-3 (BiPole-2) was communicating for common area current.
      ii. There was no abnormality in the system but due to improper reflection of Pole-3 current for common area, Pole-1 & 2 (Bipole-1) was blocked.
      iii. Further, as per scheme there is intercommunication between Bipole-1 (Pole-1 &2) and BiPole-2 (Pole-3 right now) for the said pole-1 but there was no feedback from Bipole-2, hence pole-3 also got tripped.
      iv. Issue has been taken up with OEM. OEM is taking care of these conditions during commissioning of Pole-4. Report from OEM is still awaited. Detailed report including OEM findings will be shared within 7days
   c. NRLDC representative stated that HVDC is very important for the reliability and security of the grid and its protection mal-operation shall be taken seriously to prevent further unwanted operation.
2. PSC Recommendations:
   a. POWERGRID shall share the detailed report and OEM findings with NRPC/ NRLDC. (Action: POWERGRID; Time: by 15.03.2020)

H. Multiple Element tripping at 400kV Rewa Road (UP) Station at 02:38hrs of 11th Jan 2020

1. Discussion during the meeting:
    a. NRLDC representative sought information on the following:
        i. Reason of delayed clearance of fault (It was more than 600ms; although in case of correct LBB protection it should be maximum 300ms)
        ii. 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.
        iii. Sensitive distance protection setting of 400 kV Rewa Road-Banda ckt-1 to be looked in view of Z-1 tripping (verified from station EL) of the line. Breaker operation time needs to be tested and reported.
        iv. Why pole discrepancy in 400 kV Rewa Road-Banda ckt-1 came into picture and line tripped within 620ms of fault occurrence?
        v. Sensitive distance protection setting of 400 kV Panki (end)-Obra B ckt also to be checked and corrected.
        vi. Reason of operational issue like connectivity of all 400 kV elements on 400 kV Bus-1 at Rewa Road (UP) to be informed.
        vii. Correction of time synch error of 400 kV LBB/ Bus bar protection DR of Rewa Road (end).
        viii. Detailed report considering the aforesaid points and submit the remedial measures report.
        ix. Pending submission of detailed report of tripping and remedial measure report on multiple element tripping at Rewa Road (UP) that occurred on 16th June 2019 and discussed in 39th PSC meeting.
    b. UPPTCL representative informed the following:
        i. Reason of delayed clearance of fault yet to be ascertained.
        ii. Fault was in tie bay CT of 400 kV Banda (end)-Orai ckt-2, Tie Bay blue phase CT busted. Orai end of 400 kV Banda-Orai ckt-2 tripped in Z-1. 400 kV Bus reactor connected in same bay also tripped on differential protection operation.
        iii. Setting of 400 kV Orai (end)-Banda ckt-2 has been revised, details to be sent.
        iv. Due to CT blast in B-phase of 400KV Banda-Orai transmission line at Banda Substation, the fault reflected on 400KV Rewa Road-Banda ckt#1 at 400KV Rewa road Substation end and Zone-1 Earth fault sensed (B phase) at 2:38:04:624 hrs. The AR operate and open the B- phase breaker at 2.38.04.660 hrs. but the fault current (225 A) still in Y-phase so the AR gives 3 phase trip at 2.38.04.734 hrs and the R-ph breaker open at 2.38.04.916 hrs but still Y-ph breaker in close condition

v. Due to above condition LBB/ BFP initiated at 2:38:04:866hrs and the other lines along with ICTs, Reactor were tripped. and Y-phase breaker of Banda ckt-1 is open at 2.38.06.832hrs

vi. Action taken:
    - Now Feeders and ICTs distributed on both 400 kV buses equally at 400 kV Rewa Road (UP).
    - M/s ABB service team is being arranged to test the Banda Ckt-1 GIS CB module.
    - Due to wiring looseness issue 400 kV Meja feeder did not trip on BB (Bus Bar) and the same has been rectified later.

vii. Action to be taken:
    - Concerned officer may give status of tie bay CT replacement in 400 kV Banda (end)-Orai ckt-2.
    - Concerned officer may give exact reason for connecting all the elements in 400 kV Bus-1 at Rewa Road (UP).
    - Concerned authority may carry out thorough testing of breakers and relays.

2. PSC Recommendations:
    a. Event couldn't be discussed thoroughly due to insufficient information from the utilities. It was decided during the meeting that UPPTCL shall internally review the protection setting of 400 kV Banda (UP), Orai & Rewa Road station. Remedial measures report to be shared with NRPC/ NRLDC. (Action: UPPTCL; Time: by 15.03.2020)
    b. A report covering the following points w.r.t. the tripping to be shared (Action: SLDC-UP, UPPTCL; Time: by 15.03.2020):
        - Reason of delayed clearance of fault? (More than 600ms, in case of correct LBB protection it should be maximum 300ms)
        - 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.
        - Sensitive distance protection setting of 400 kV Rewa Road-Banda ckt-1 needs to be looked in view of Z-1 tripping (verified from station EL) of the line. Breaker operation time needs to be tested and reported.
        - Why pole discrepancy in 400 kV Rewa Road-Banda ckt-1 came into picture and line tripped within 620ms of fault occurrence?
        - A/R function in 400 kV Rewa Road (end)-Banda ckt needs to be checked and corrected.
        - Sensitive distance protection setting of 400 kV Panki (end)-Obra B ckt also needs to be checked and corrected.

- Reason of operational issue like connectivity of all 400 kV elements on 400 kV Bus-1 at Rewa Road (UP) needs to be informed.
- Time synch error of 400 kV LBB/ Bus bar protection DR of Rewa Road (end) needs to be corrected.
- Thorough protection setting review needs to be done at 400 kV Banda, Orai & Rewa Road ckts
- Observation mentioned in UP report needs to relooked in view of aforesaid points.
- Detailed report in NRPC approved format to be submitted considering the aforesaid points

c. UPPTCL shall also do internal protection audit considering the points for discussion in this event and earlier event of 16th Jun 2019 discussed during 39th PSC meeting.

d. A Committee comprising of representatives from NRPC Secretariat, NRLDC, POWERGRID & UPPTCL shall do protection audit for 400 kV Rewa Road (UP), Banda (UP) & Orai (UP). (Action: NRPC, UPPTCL before 41st PSC meeting).

I. Multiple element tripping at 220 kV Wagoora (PG) & 400 kV Chamera-II HEP at 13:21hrs of 13th Jan 2020

1. Discussion during the meeting:

a. NRLDC representative sought information on the following:

i. Exact location of fault and nature of fault.
ii. Reason of delayed clearance of fault.
iii. Reason for tripping of two 220 kV lines on single phase to earth fault.
iv. Tripping of 220 kV Wagoora-Pampore ckt-2 on DEF protection needs to be looked into.
v. Reason of tripping of 400 kV Chamera 1-Chamera 2 ckt. and 400 kV Chamera 1-Kishenpur ckt.
vi. Over voltage setting at 400kV Chamera II(NHPC) needs to be looked into. Reset ratio of over voltage protection setting also needs to be checked. Voltage at the time of tripping was well below the set value of 1.1 PU, which is 254kV per phase.
vii. 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.
viii. Analog and digital data (SCADA SoE) status to be checked and corrected.

b. POWERGRID representative informed the following:

i. Fault was in downward network of Pampore(J&K).
ii. Protection at 220 kV Pampore J&K didn't operate properly.
iii. Both the 220kV lines sensed the fault at 220 kV Wagoora (PG), line tripped correctly.

iv. DEF protection setting of 220 kV Wagoora-Pampore ckt-2 to be checked and corrected.

c. NHPC representative informed the following:

i. 400 kV Chamera 1-Chamera 2 ckt. and 400 kV Chamera 1-Kishenpur ckt tripped on over voltage stage-1 protection. Setting is 1.1 PU with 5 second and 7 second time delay respectively.

d. NRLDC representative raised concern about poor reset ratio of over voltage protection and also suggested for DR triggering on start of over voltage.

2. PSC Recommendations:

a. DEF (Directional Earth Fault) protection setting of 220 kV Wagoora-Pampore ckt-2 needs to be checked and corrected. Remedial measures report to be shared with NRPC/ NRLDC (Action: POWERGRID; Time: by 15.03.2020)

b. Reset ratio of over voltage protection of 400 kV Chamera2-Chamera1 & Chamera2-Kishenpur ckt shall be checked and reported. (Action: NHPC; Time: by 15.03.2020)

c. DR triggering on over voltage start shall be enabled for all 400 kV and above transmission lines. (Action: General Recommendation for all the NR utilities)

J. Multiple element tripping at 220 kV Malerkotla (Punjab) at 19:27hrs of 28th Jan 2020

1. Discussion during the meeting:

a. NRLDC representative sought information on the following:

- Ensuring healthiness of 220 kV bus bar protection at 220 kV Malerkotla (Punjab).
- Checking of healthiness of isolator auxiliary contact and correcting the same as multiple manual operations may result into frequent blocking of bus bar protection. Need for replacement may be assessed and action to be taken.
- Bus Bar Protection blocking alarm needs to be prioritized and attended immediately.
- Backup over current earth fault protection setting of 400/220 kV ICTs needs to be relooked. Present status of replacement of backup over current earth fault protection at 400/220 kV 315 MVA ICTs at Malerkotla (PG) to be intimated.
- Protection philosophy has been revised, Z-3 setting needs to be rechecked in view of encroachment in 220 kV side of 400/220 kV ICTs.
- Such delayed clearance of fault may have resulted into major catastrophe in the grid and needs to be addressed properly.

- SoE didn't capture any of the tripped elements, Availability of digital data (SCADA SoE) needs to be available in NR/ Punjab SCADA SoE.
- Submission of the detailed report considering the aforesaid points and the remedial measures report.

b. Punjab representative informed the following:

i. Antecedent weather conditions: Heavy rain & winds

ii. R-phase insulator string (Before CB, i.e. Bus side) of 220 kV Malerkotla - Dhuri circuit No. 2 (which was connected to Busbar-1) snapped and jumpers fell on 220 kV Busbar-2 leading to 220 kV Bus-bar fault on both the 220 kV buses.

iii. Fault entered in differential zone of 220 kV Busbar-2 (220 kV Bus bar-l was charged but not loaded at time of incident) but differential protection feature of the relay was blocked as Open CT (OCT) Alarm was raised for both the 220 kV buses (Za & Zb) before the fault instant.

iv. One day before i.e. on 27th January, there was a fault on 220 kV bus-1, so all the circuits were shifted to 220 kV bus-2 and system was running as per that arrangement.

v. Since at Malerkotla auxiliary switches of isolators are not working properly so they have installed two way switches in the respective panels to manually select each isolator's (i.e for bus isolator I and 2) status given to bus bar relay. After doing all isolator operations when operator comes to control room, he manually changes the position of switches as per the connectivity of that bay to bus-bar.

vi. In this case it is observed that while shifting the bay-9 (Sandhaur circuit-l) to bus-2 on 27-01-20(previous day), operator changed the isolator status input to relay manually through switches after charging/loading the line. This led to raising of blocking signal. Since this alarm was well indicated by LED on relay, he failed to reset this high signal unknowingly.

vii. Since for the OCT feature of the Bus Bar Protection Relay, it was set to "Block" which led to blocking of Differential Protection and relay was in block mode since 27-01-20.

viii. Reason of raising of OCT alarm:

- Unavailability of Healthy Isolator status from switch yard (due to old/outdated isolators)
- A scheme of two way electrical switches (two for each bay (bus-1 & bus-2)) is devised to manually simulate the similar isolator status to the relay as per actual arrangement in the switchyard
- Any mismatch or performing wrong sequence of switch operation leads to raising of OCT Alarm which is the in-built feature of this relay model.

ix. Cause of OCT alarm in this event:

- BBPS (Bus Bar Protection) for 220 kV Bus-1 at Malerkotla (PG) was operated on previous day (i.e. 27.01.20)
- While re-energizing the tripped circuits on 27.01.20, due to human error, wrong sequence of operating the simulator switches for isolator status led to raising of OCT Alarm.
- This alarm was not acknowledged & reset, which left Bus-bar differential protection in blocked state

x. Since bus-bar differential protection feature of BBPS Relay was in blocked state, it failed to clear the bus-bar fault at 220 kV Malerkotla.

xi. Fault was in reverse zone of the connected circuits, so their Distance Protection Relays got picked in Z4.

xii. Fault feeding continued until the connected circuits tripped from remote end (Zone-2 at their ends).

xiii. Remedial measures taken/to be taken:
- Settings changed from "BLOCK" to SUPERVISE so that whenever Id crosses threshold value the scheme will operate irrespective of BLOCK.
- To educate the operating staff regarding intimation to S/S incharge in case of bus bar block alarm in the station.
- Isolator auxiliary switches (status) from 220 kV switch-yard to be made healthy to avoid human error.
- In future cleaning/ strengthening of insulators with silicon RTV coating etc. has been suggested to O&M staff.
- Until healthy isolator status from switchyard are available in Bus Bar Protection Panel, Operator/staff has been instructed to perform the manual simulation in proper sequence and reset & acknowledge the alarms as soon as raised.

xiv. Event logger is not in service at 220 kV Malerkotla (Punjab)

c. POWERGRID representative informed the following:
- Sensitive Z-3 protection setting of 400 kV Ludhiana-Malerkotla ckt & 400 kV Patiala-Malerkotla ckt has been revised to prevent impedance reach coverage downward (220 kV side) of ICTs at Malerkotla (PG). The settings have been revised as per latest template. The zone-3 time has been changed from 1.0 sec to 1.5 sec. Exact changes in the setting will be shared shortly.
- CDD relays are installed in 400/220 kV 315 MVA ICT-1 & ICT-2 at Malerkotla (PG), which are having minimum secondary value of 0.2A. The relays are set at minimum value. The relays are being replaced under Process bus project

d. In reply of query of NRLDC, POWERGRID representative informed that they have implemented backup impedance protection for ICTs instead of low set backup over current protection at most of the places. In Malerkotla (PG), process bus is being implemented and old protection replacement is also planned with bus bar replacement. POWERGRID representative further informed that wherever backup impedance protection has been enabled in ICTs, low set backup over current protection has been disabled. High set over current protection is enabled everywhere.
e. NRLDC representative raised concern about poor reset ratio of over voltage protection and also suggested for DR triggering on start of over voltage.

2. PSC Recommendations:
   a. Healthiness of isolator auxiliary contact shall be checked and corrected as manual operation every times may be resulted into frequent blocking of bus bar protection. Isolator auxiliary contacts shall be replaced (Action: Punjab; Time: by 15.03.2020)
   b. As per earlier general recommendation, Bus Bar Protection blocking alarm needs to be prioritized for operators and needs to be attended on priority. Recommendations approved in earlier PSC meetings shall be adhered to by all the utilities. (Action: Punjab & other NR utilities)
   c. Healthiness of station event logger details shall be ensured at 220 kV Malerkotla (Punjab). (Action: Punjab; Time: by 15.06.2020)
   d. Lesson Learnt:
      - Wherever, REB 670 bus bar differential protection implemented there is three different options available as given below

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or not. One of the following two alternatives shall be selected for every function block:

1. *On*: when this mode is selected the zone differential trip is supervised by the operation of the built-in Check Zone
2. *Off*: when this mode is selected the zone differential trip is not supervised by the operation of the built-in Check Zone

- *SlowOCTOper*: this setting determines operation of the slow OCT algorithm. One of the following three alternatives shall be selected for every function block:

1. *Off*: when this mode is selected the slow OCT feature is completely disabled
2. *Block*: when this mode is selected the operation of the slow OCT feature completely blocks the operation of the differential protection. It shall be noted that this blocking is selective (that is, zone and phase wise)
3. *Supervise*: when this mode is selected the operation of the slow OCT feature only supervises the operation of the differential protection. As soon as differential current is bigger than the pre-set level determined by

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Technical reference manual

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Section 5
Differential protection

      - Slow OCT features shall be used only for supervision not for blocking of bus bar differential protection.

e. Wherever numerical protection is available for ICTs, backup impedance protection can be enabled instead of low set backup over current protection. POWERGRID shall share the detailed setting of backup impedance protection implemented for ICTs in POWERGRID-NR. (Action: General Recommendation for all the NR utilities)

K. Tripping other than to be discussed in 40th PSC meeting:

For better reliability of power system each and every multiple element tripping should be analysed properly and remedial measures to be taken by utilities. Total 29 multiple element tripping event reported by NRLDC to NRPC and constituents for the month of December,2019 and January, 2020.

Among 29 events, around 10 events were discussed in 40th PSC meeting. For rest events, utilities were requested to 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/pcc40/PCC40_Grid_Incident.xlsx

A.6. Frequent Tripping of 220kV Alsteng-Leh Transmission line leading tripping of Nimoo Bazgo & Chutak Power Stations. (Additional Agenda by NHPC)

NHPC representative informed that 220kV Alsteng-Kargil-Leh line is highly unstable and trips very frequently leading to tripping of NHPC generating units and generation loss and highlighted trippings from 01.02.2020 to 15.02.2020.

NRLDC informed that during this period 220 kV Alsteng-Leh grid was connected to main grid at 132 kV level and trippings were due to mismatch of load and generation since there was restriction on drawal of power from main grid. NRLDC further informed that 220kV Alsteng-Leh has been now connected to main Grid at 220kV level on 15.02.2020. It was highlighted that only 01 no. tripping has been observed since 15.02.2020.

It was decided that issue may be discussed in next meeting only if substantial trippings are observed in future.

A.7. Increased fault level at Bawana (Table agenda by IPGCL/PPCL)

PPCL representative informed that fault level as high as 62 kA was observed during fault on 11.02.2020 which was bus fault (CT failure); while a fault occurred

on 28.12.2019 when 40 kA fault level was observed for L-G fault when generation was around 200 MW.

NRLDC requested PPCL to submit DR and other event details for detailed examinations. If high fault level is observed in studies, then option such as bus splitting or reactor may be explored.

PPCL stated that interconnector may be opened; however it will affect islanding scheme and other conditions may also be checked. Delhi was requested to review the same and submit its input at the earliest.

It was decided that NRLDC will carry out the studies for increased Fault Level considering network change in Delhi network.

List of participants for 40th Protection sub-committee meeting.

Date: 02.03.2020

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Annexure-II

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 have been 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). **Harduaganj** – to be updated by UPRVUNL. **No representative was present from UPRVUNL.**
3	HPSEB Ltd.	1	-	• Out of 12 deficiencies observed, 8 already rectified. • To be updated by HPSEB. **No representative was present from HPSEB.**
4	UJVNL	1	-	Breaker for 220 kV Khodri-I & II needs to be replaced. **No representative was present from UJVNL.**
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. **No representative was present from J&K.**

Annex-III

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.
UPRVUNL	-do-	2	Completed	Submitted	**Parichha TPS and Panki TPS:** Updated status to be submitted by UPRVUNL.
UPPTCL	-do-	41	Completed	Submitted for 1st phase of 41 S/s.	**UPPTCL informed 68 nos. 220kV substations work awarded to CPRI in 2nd Phase which is yet to be completed. Report awaited from CPRI.**
UJVNL	-do-	2 (Chilla, Chhibra)	Completed	Submitted	Action Plan not submitted**.**
PDD J&K	-do-	3 (Janipur, Amargarh, Hiranagar)	Completed	Submitted	Action Plan for **Heeranagar** and **Amargarh** not submitted.

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
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.
UT Chandigarh	-do-	1 (Kishengarh)	Completed	Submitted	Not submitted.
Budhil Power	-do-	1	Completed	Submitted	Not submitted.
HVPNL	-do-	4 (Sector 72, Gurgaon ; Tepla; Bastara; A-5, Faridabad)	Completed	Submitted	
DTL	-do-	4 (Rohini; Mehrauli; Mundka; Shalimar Bagh)	Completed	Submitted	Report submitted.
PTCUL	-do-	4 (Pantnagar, Haridwar, Kashipur, Roorkee)	Completed	Submitted	Not submitted for Haridwar, Roorkee.

Annexure-IV

Status of Bus bar Protection for Northern Region Constituents

State/ Constituent	TRANSCO / GENCO	Total no. of S/s or Switch yards (220 kV & above)	No. of S/S or Switchyards where Bus bar protection is functioning	Remarks	Action Plan
Delhi	DTL	37	34	For 220 kV S/S namely, Gopalpur and Kanjhawala to be completed by 31.03.2020. At Raj Ghat and Subzi Mandi S/s, there is no bus.	**P.O. for 26 Nos. of substations has been awarded and out of which scheme at 10 Nos. of new scheme (Numerical) have been commissioned.**
Haryana	HVPNL	63	48	12 out of which 5 in process; 7 (date is yet to be decided); 3 not required.	Initially, tentative date of commissioning was informed to be **June 2019**. **No representation from HVPNL.**
Rajasthan	RVPNL	144	120 (7 defective)		74 new Bus bar Protection Scheme have been commissioned. Remaining 24 schemes, including 7 defective scheme are under procurement.
Himachal Pradesh	HPSEB	08	04	At one S/s it was working and at 2 S/s, it was defective.	04 nos. BBP schemes commissioned and for remaining 04 s/s to be done by 2017. **No representation from HPSEB.**
Punjab	PSTCL	101 Nos. of 220kV and 5 Nos. of 400 kV s/s	48 Nos. of 220kV and 5 Nos. of 400 kV s/s		Order has been placed for 45 Sub-Stations and it is expected to be completed in 3-4 months. Remaining 10 nos. of 220 kV Sub-Stations are newly commissioned in

					past 3-4 years and these stations have not been covered under Bus Bas Protection Scheme till date. For remaining S/s, reverse zone protection time set to 160 ms.
UTs of J&K and Ladakh	-	06	-		
Uttarakhand	PTCUL	10	09	-	Order placed for 01 defective.
BBMB	BBMB	23	20	Not required at Dhulkote and Jagadhari. For Sangrur, Kurukshetra and Delhi as no. of feeders is less than five. PSC decided that it needs to be installed.	For Barnala it is to be provided by PSTCL as agreed in PSC. PSTCL informed that it will be commissioned in 3-4 months. **BBP is being provided at Kurukshetra and Delhi substations. New Numerical Bus Bar Protection for both the substations has been received at site and likely to be commissioned by 31.03.2020.**
Uttar Pradesh	UPPTCL	141	85		Representative of UPPTCL informed that SEL panels were procured and its installation would be completed 31.05.2020.

Annexure - V

Welcome to all the participants in 40th PSC meeting

02.03.2020 at NRPC Delhi

A.5.1 Multiple element tripping 400 kV Koteshwar THDC

01.12.2019 at 14:58hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

Unit-2 was operating as per schedule and power evacuation was done Through both lines, Further bus reactor was in service too, which was connected to bus-2 through transfer Bus coupler (TBC).

System Parameters Before Tripping (At 14:45 Hrs)		
	Unit MW (Unit#2)	92.16
	Unit MVAR	-5.8
	Unit Voltage(L-L)	13.6 KV
	Unit Current	3915 A
	System Frequency	50.03 Hz
	Line-1 MW	44.97
	Line-1 MVAR	-69.04
	Line-1 Voltage(L-L)	418 KV
	Line-1 Current	113.58 A
	Line-2 MW	46.57
	Line-2 MVAR	-71.59
	Line-2 Voltage(L-L)	417 KV
	Line-2 Current	118.2 A
	Bus-1 Voltage(L-L)	418 KV
	Bus-2 Voltage(L-L)	419 KV

Following elements tripped:-

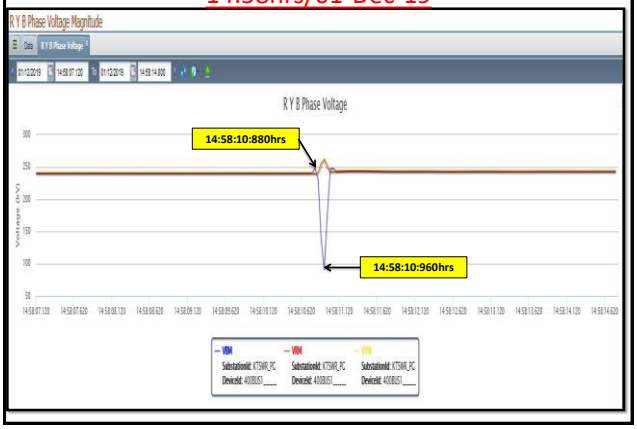
1. 400 kV Koteswar(th)-Koteshwar(pg) (pg) ckt-2
2. 400 kV bus 2 at Koteswar(th)
3. 400 kV bus 1 at Koteswar(th)
4. 100 MW Koteshwar hps - unit 2
5. 400 kV Koteswar(th)-Koteshwar(pg) (pg) ckt-1
6. 125 MVAr bus reactor no 1 at 400kv Koteswar(th)

PMU Plot of frequency at Koteshwar (PG)

14:58hrs/01-Dec-19

PMU Plot of phase voltage magnitude at Kota(PG)

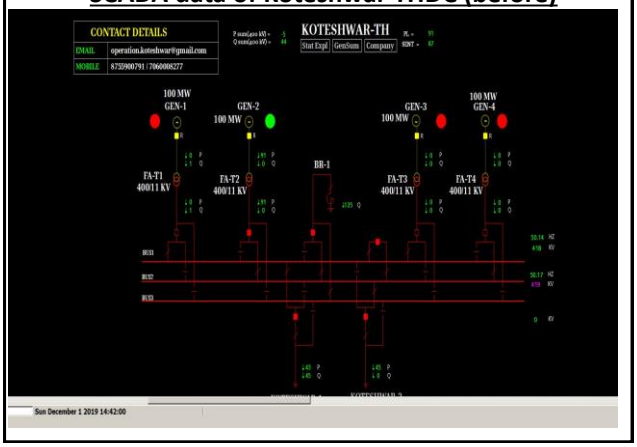
14:58hrs/01-Dec-19



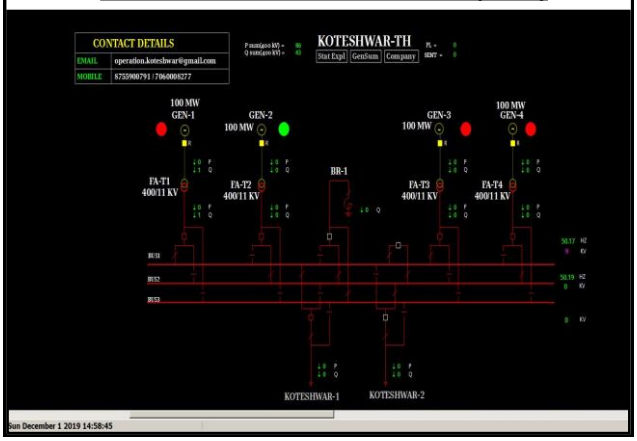
NRLDC SCADA SOE

TIME	Time (in ms)	S/S NAME	Voltage level (in kV)	Element Name	Element Type	Status	Comment
14:44:25, 311	~14 minutes before	KOTESHWAR	400kV	03H02	Circuit Breaker	Open	
14:44:25, 312	~14 minutes before	KOTESHWAR	400kV	04KTSWR1	Circuit Breaker	Open	
14:44:25, 313	~14 minutes before	KOTESHWAR	400kV	06KTSWR2	Circuit Breaker	Open	
14:44:26, 011	~14 minutes before	KOTESHWAR	400kV	08MBC	Circuit Breaker	Open	
14:44:30, 071	~14 minutes before	KOTESHWAR	11kV	03H02	Protection Trip	Disp	
14:44:32, 021	~14 minutes before	KOTESHWAR	400kV	02TBC	Circuit Breaker	Open	
14:58:10, 920	0ms						PMU reference time
14:58:10, 958	40ms	KOTESHWAR	400kV	07TH1	Circuit Breaker	disturbe	
14:58:10, 971	60ms	KOTESHWAR	400kV	08TH2	Circuit Breaker	disturbe	
14:58:10, 978	70ms	KOTESHWAR	400kV	08TH2	Circuit Breaker	Open	
14:58:12, 166	1260ms	KOTESHWAR	400kV	07TH1	Circuit Breaker	Close	
15:12:15, 358		KOTESHWAR	400kV	08MBC	BusBar Isolator	disturbe	
15:12:21, 699		KOTESHWAR	400kV	08MBC	BusBar Isolator	Open	

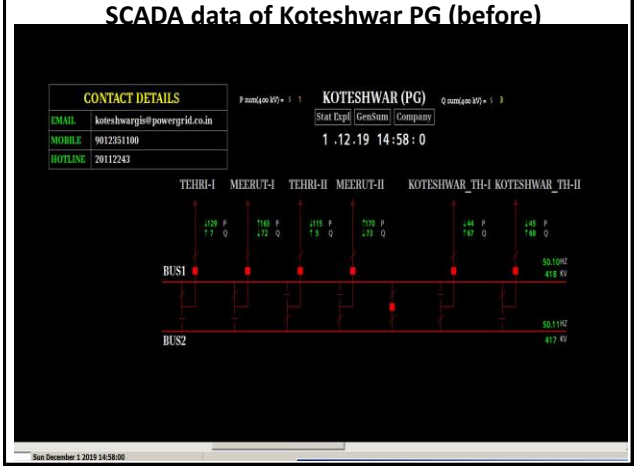
SCADA data of Koteshwar THDC (before)



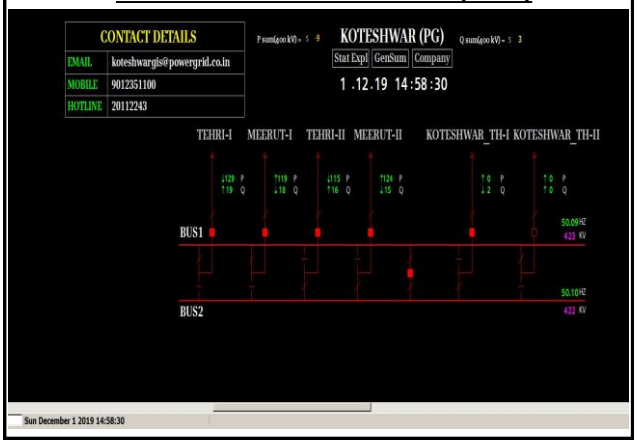
SCADA data of Koteshwar THDC (after)



SCADA data of Koteshwar PG (before)



SCADA data of Koteshwar PG (after)



Koteshwar THDC details

1.	Unit/ Line Which Tripped/FO	Unit # 2, Line-1 & Line -2			
2.	Date and Time of Tripping	01.12.18 ,14:58 Hrs			
3.	System Parameters Before Tripping (At 14:45 Hrs)	Unit MW (Unit#2)	92.16		
		Unit MVAR	-5.8		
		Unit Voltage(L-L)	13.6 KV		
		Unit Current	3915 A		
		System Frequency	50.03 Hz		
		Line-1 MW	44.97		
		Line-1 MVAR	-69.04		
		Line-1 Voltage(L-L)	418 KV		
		Line-1 Current	113.58 A		
		Line-2 MW	46.57		
		Line-2 MVAR	-71.59		
		Line-2 Voltage(L-L)	417 KV		
		Line-2 Current	118.2 A		
		Bus-1 Voltage(L-L)	418 KV		
		Bus-2 Voltage(L-L)	419 KV		
4.	System Parameter after restoration (At 19:00 Hrs)	Unit MW (Unit#2)	-		
		Unit MVAR	-		
		Unit Voltage(L-L)	-		
		Unit Current	-		
		System Frequency	50.06 Hz		
		Line-1 MW	153.39		
		Line-1MVAR	-8.9		
		Line-1 Voltage(L-L)	415 KV		
		Line-1 Current	213.47 A		
		Line-2 MW	150.53		
		Line-2MVAR	-8.9		
		Line-2 Voltage(L-L)	414 KV		
		Line-2 Current	210.3 A		
		Bus-1 Voltage(L-L)	410		
		Bus-2 Voltage(L-L)	-		
5.	Configuration at the time of Tripping	Unit Switch Position	Line-1 Switch Position	Line-2 Switch Position	Bus Coupler Position
		UI#1-189M1-Bus 1-Closed, UI#2-389M2-Bus 2-Closed, UI#3-589M1-Bus 1-Closed, UI#4-789M2-Bus 2-Closed	89M1-Bus 1-Closed	89M2-Bus 2-Closed	Closed

Koteshwar THDC details

6.	Remote end information	
7.	Details of Alarms/Protection Relays	Z2 operated (Busbar protection), L1 R,Y,B Main 1/2 Operated, L2 R,Y,B Main 1/2 Operated
8.	Damage to equipments	Bus-2 String Insulator (Y-Phase)
9.	Analysis	U # 2 was operating as per schedule and power evacuation was being done through both lines. Further bus reactor was in service too ,which was connected to bus-2 through transfer bus coupler (TBC). At 14:58 Hrs, fault occurred in Y-Phase string insulator of Bus -2 resulting in operation of bus bar protection and consequential tripping of breakers connected to bus-2 i.e. TBC, BC, U # 2 CB & Line # 2 CB. Line #1 breaker got tripped at KHEP end due to operation of I>3 protection element. Unit # 2 came to mechanical spinning mode from gen mode.
10.	Restoration Actions	After complete investigation, Isolations & support were provided to the faulty bus for ensuring safety hence power evacuation from Koteshwar HEP got affected just after the incidence. After isolations of bus-2, power evacuation was started from Koteshwar HEP at 17:30 Hrs through Bus-1. Bus-2 string insulators have been replaced and bus has been charged on 03.12.19.
11.	Restoration Time	03.12.19, 14:30 Hrs
12	Enclosures	

Y-phase is inadvertently mentioned instead of B-phase

Koteshwar THDC details (EL details)

```
01/Dec/19 14:58:11.641   SQ   4TFR_BC_CB_OPN          Digital_State Old=  0.00 New=OPERATED 4SE TRNSFR BUS CPLR BRKR OPEN
01/Dec/19 14:58:11.623   SQ   3TFR_BC_CB_OPN          Digital_State Old=  0.00 New=OPERATED 3SE TRNSFR BUS CPLR BRKR OPEN
01/Dec/19 14:58:11.402   SQ   2TFR_BC_CB_OPN          Digital_State Old=  0.00 New=OPERATED 2SE TRNSFR BUS CPLR BRKR OPEN
01/Dec/19 14:58:10.967   SQ   5L1_PLCC_C1_2CAR        Digital_State Old=  0.00 New=PRESENT SYRD L1 PLCC CH1/2 DIST CARRIER
01/Dec/19 14:58:10.960   SQ   2400KV_BRKR_OPN         Digital_State Old=  0.00 New=PRESENT 2SEQ U2 400KV BREAKER OPEN FDBK
01/Dec/19 14:58:10.956   SQ   5L2_PLCC_C1_2CAR        Digital_State Old=  0.00 New=PRESENT SYRD L2 PLCC CH1/2 DIST CARRIER
01/Dec/19 14:58:10.954   SQ   5BT_252_OPN             Digital_State Old=  0.00 New=PRESENT SYRD 52 BT BREAKER OPEN (BAY-2)
01/Dec/19 14:58:10.940   SQ   5L1R_Y_B_LV_HTHY        Digital_State Old=  0.00 New=PRESENT SYRD L1 R/Y/B LINE VOLTAGE HEAL
01/Dec/19 14:58:10.919   SQ   5L1MN1_Z_YPH_TRP        Digital_State Old=  0.00 New=SELECTED SYR L1 MAIN 1/2 Y PH DIST TRIP
01/Dec/19 14:58:10.917   SQ   5L1MN1_Z_RPH_TRP        Digital_State Old=  0.00 New=SELECTED SYR L1 MAIN 1/2 R PH DIST TRIP
01/Dec/19 14:58:10.916   SQ   5L2MN1_Z_BPH_TRP        Digital_State Old=  0.00 New=SELECTED SYR L2 MAIN 1/2 BPH DIST TRIP
01/Dec/19 14:58:10.915   SQ   5L1MN1_Z_BPH_TRP        Digital_State Old=  0.00 New=SELECTED SYR L1 MAIN 1/2 B PH DIST TRIP
01/Dec/19 14:58:10.914   SQ   5BB_PRTN296_FLTY        Digital_State Old=  0.00 New=PRESENT SYRD BUS BAR PROTN 296 FAULTY
01/Dec/19 14:58:10.913   SQ   5ZONE_2_OPTD            Digital_State Old=  0.00 New=OPERATED SYR ZONE-2  OPERATED
01/Dec/19 14:58:10.913   SQ   5L2MN1_Z_YPH_TRP        Digital_State Old=  0.00 New=SELECTED SYR L2 MAIN 1/2 YPH DIST TRIP
01/Dec/19 14:58:10.913   SQ   5L2MN1_Z_RPH_TRP        Digital_State Old=  0.00 New=SELECTED SYR L2 MAIN 1/2 RPH DIST TRIP
01/Dec/19 14:58:10.028   SQ   1TFR_BC_CB_OPN          Digital_State Old=  0.00 New=OPERATED 1SE TRNSFR BUS CPLR BRKR OPEN
```

Bus coupler CB tripped with time delay of around 500ms

Koteshwar THDC details (Bus Bar Protection DR)

```
* Maximum/Minimum Analog Summary:
* -------------------------------
>  Max-Inst     Min-Inst      Max-RMS     Min-RMS    One-Bit   Inst-Diff    RMS-Diff   pUnits    Description
     56.000      -56.000       27.227       7.303     8.0000       0.000      19.924     A         1-IA Diff
     64.000      -56.000       46.188       7.659     8.0000       8.000      38.529     A         2-IB Diff
  15920.000   -15240.000    11453.972       9.282     8.0000     680.000   11444.689     A         3-IC Diff
  15904.000   -15176.000    11441.819       0.000     8.0000     728.000   11441.819     A         4-IN Diff
   2848.000       24.000     2642.953      31.416     8.0000    2824.000    2611.536     A         5-IA Bias
   2312.000       24.000     2132.080      26.931     8.0000    2288.000    2105.149     A         6-IB Bias
  15928.000       32.000    15194.062      38.906     8.0000   15896.000   15155.155     A         7-IC Bias
  15936.000       40.000    15129.146      40.000     8.0000   15896.000   15089.145     A         8-IN Bias

* Events/Sensors Activity Summary:
* ---------------------------------
>Fst  Lst  Fst-Change       Lst-Change       Changes    Description
  N    N    14:57:59.804080  14:58:00.070800  002          2-RL3 Z2 OPTD
  N    N    14:57:59.804080  14:57:59.869093  002          9-Fault Phase C
  N    N    14:57:59.804080  14:57:59.869093  002         11-Flt 87BB Zone 2
  N    N    14:57:59.805747  14:58:00.070800  002         19-Trip 87BB Zone 2
  N    N    14:57:59.805747  14:58:00.070800  002         31-Trip 87BB
```

Bus bar Zone-2 tripping, what about check zone protection before operation of bus bar protection

Koteshwar THDC details (Unit-2 DR)

```
Click Here to upgrade to
Unlimited Pages and Expanded Features                    MINISTRATOR\MY DOCUMENTS\S1 STUDIO\400KV-THDC\THDC\400KV BUS BAR\P742
      Prefault Time: 01/12/2019 14:57:59.427000
         Fault Time: 01/12/2019 14:57:59.810000
          Save Time: 12/02/2019 12:15:18
       Process Time: 12/02/2019 12:15:27
 Start Date && Time: 01/12/2019 14:57:59.427000
   End Date && Time: 01/12/2019 14:58:00.705589
     File Duration: 1  Sec(s) - 278 Mils(s) - 589 Mics(s)
 Sampling Frequency: 599.880024, 1667.000  Microsecond Rate
     Line Frequency: 50.000000

* Maximum/Minimum Analog Summary:
* -------------------------------
>  Max-Inst     Min-Inst      Max-RMS     Min-RMS    One-Bit   Inst-Diff    RMS-Diff   pUnits    Description
   1209.975    -1038.700     817.474       6.175     5.5250     171.275     811.299     A         1-IA
   911.625     -685.100      592.917       3.908     5.5250     226.525     589.009     A         2-IB
   1011.075    -1502.800     941.472       4.216     5.5250     491.725     937.256     A         3-IC
   3071.900    -3243.175    2316.663       3.589     5.5250     171.275    2313.074     A         4-IN

* Events/Sensors Activity Summary:
* ---------------------------------
>Fst  Lst  Fst-Change       Lst-Change       Changes    Description
  A    A    xx:xx:xx.xxxxxx  xx:xx:xx.xxxxxx  000          2-L2 89A OPEN
  A    A    xx:xx:xx.xxxxxx  xx:xx:xx.xxxxxx  000          3-L3 89B CLOSED
  A    A    xx:xx:xx.xxxxxx  xx:xx:xx.xxxxxx  000          4-L4 89C OPEN
  N    N    14:57:59.863754  xx:xx:xx.xxxxxx  001          8-L10 52 BKR OPEN
  N    N    14:57:59.832081  xx:xx:xx.xxxxxx  001         10-L15 TRP RLY OPTD
  N    N    14:57:59.810410  14:58:00.073796  002         11-R1 GRP ENG RLY
  N    N    14:57:59.810410  14:58:00.073796  002         12-R4 TO 96 TRIP
  N    N    14:57:59.810410  14:58:00.073796  002         13-R6 SPARE # 1
  N    N    14:57:59.810410  14:58:00.073796  002         14-R7 BB OPTD
  A    A    14:57:59.867088  xx:xx:xx.xxxxxx  001         15-CB Closed
  N    N    14:57:59.812077  14:58:00.078797  002         20-Trip Zone 2
  N    N    14:57:59.810410  14:58:00.073796  002         27-Trip 87BB
  N    N    14:57:59.810410  14:58:00.075463  002         32-Any Trip
```

DR of 400 kV Unit-2 at Koteshwar THDC

Koteshwar THDC details (P442 Line1)

```
* Maximum/Minimum Analog Summary:
* -------------------------------
>  Max-Inst     Min-Inst      Max-RMS     Min-RMS    One-Bit   Inst-Diff    RMS-Diff   pUnits    Description
 409659.100  -421134.500  295056.375   24662.600    31.7000   11475.400  270393.775     V         1-VA
 505076.100  -394601.600  331388.938  241247.969    31.7000  110474.500   90140.969     V         2-VB
 626899.200  -436223.700  282415.313    5979.438    31.7000  190675.500  276435.875     V         3-VC
 570473.200  -610668.800  393324.375    1688.155    31.7000   40195.600  391636.220     V         4-VN
    673.928     -513.732     411.345       1.585     2.7620     160.196     409.760     A         5-IA
    814.790     -411.538     443.333       1.288     2.7620     403.252     442.045     A         6-IB
   9934.914    -7322.062    5591.530       8.286     2.7620    2612.852    5583.244     A         7-IC
   9802.338    -6233.834    5211.636       2.762     2.7620    3568.504    5208.874     A         8-IN

* Events/Sensors Activity Summary:
* ---------------------------------
>Fst  Lst  Fst-Change       Lst-Change       Changes    Description
  N    N    14:41:54.240904  14:41:54.317448  004          1-Any Start
  N    N    14:41:54.252552  14:41:54.332424  002          2-Any Trip
  N    N    14:41:54.290824  xx:xx:xx.xxxxxx  001         13-All Pole Dead
  N    N    14:41:54.252552  14:41:54.309128  002         18-I>3 Trip
  N    N    14:41:54.300808  14:41:54.339080  002         21-DIST. Chan Recv
  A    A    14:41:54.287496  xx:xx:xx.xxxxxx  001         25-A PHASE CLOSE
  A    A    14:41:54.289160  xx:xx:xx.xxxxxx  001         26-B PHASE CLOSE
  A    A    14:41:54.289160  xx:xx:xx.xxxxxx  001         27-C PHASE CLOSE
```

DR of 400 kV Koteshwar THDC (end)-Koteshwar PG ckt-1
I>3 trip meaning?
Time synch error?

Koteshwar PG details (Line2)

Tripping Analysis Report of 400KV KOTESHWR-KHEP-II at 14:58 Hrs on 1st December,2019

Name of Element: 400KV KOTESHWR-KHEP-II

Date & Time of Tripping: 01/12/19 14:58

Date & Time of Restoration: 01/12/19 18:58

Details of Fault: Tripped only from KHEP end on Bus bar protection operated at Koteshwar(KHEP) switchyard due to B-phase insulator string failed. DT received at Powergrid end.

Observations

- Event Category: GD-1
- Generation Loss (in MW): 90 MW
- Load Loss (in MW): Nil (As per UP report)

Analysis of tripping (As reported):

- At 400 kV Koteshwar (THDC) station have double main transfer breaker scheme. It is connected through Koteshwar PG D/C. It also have four units of 100M and one 125MVAr bus reactor.
- Only 100 MW unit-2 was running as per schedule and power evacuation was being done through both lines. Further bus reactor was in service too, which was connected to 400 kV bus-2 through TBC.
- At 14:58 hrs fault occurred in B-phase string insulator of 400 kV Bus-2 resulting in operation of bus bar protection and consequential tripping of breakers connected to 400 kV bus-2 i.e. TBC, BC, unit-2 CB and Line-2 CB. Line-1 breaker got tripped at KHEP end due to operation of I>3 protection element.
- 100 MW Unit-2 came to mechanical spinning mode from generation mode.
- After complete investigation & isolations, support were provided for faulty bus to ensure the safety hence power evacuation from Koteshwar HEP got affected just after the incidence. After isolation of 400 kV Koteshwar (THDC) bus-2, power evacuation was started from Koteshwar HEP at 17:30hrs through 400 kV Bus-1. 400 kV Bus-2 string insulators have been replaced and bus has been charged on 03.12.2019.

Observations

As per PMU, SCADA data:

- As per PMU, B-phase to earth fault.
- Fault Clearance time: **100ms**
- SoE captured only for some of the tripped elements.

As per DR details:

- As per DR of 400 kV Koteshwar THDC (end)-Koteshwar PG ckt-1, I>3 trip meaning? & Time synch error?
- 400 kV Bus bar Zone-2 tripping, what about check zone protection before operation of bus bar protection.
- Bus coupler CB tripped with time delay of around 500ms
- Y-phase is inadvertently mentioned instead of B-phase

Restoration:

- 400 kV KOTESHWAR(TH)-KOTESHWAR(PG) (PG) CKT-1 along with 400kV Bus I is 17:13 Hrs
- 400 kV KOTESHWAR(TH)-KOTESHWAR(PG) (PG) CKT-2 is 18:59 Hrs

Points for Discussion

- Bus Bar Protection operation at 400 kV Koteshwar (THDC) needs to be looked into in view of actual bus fault or setting issue. (400 kV Bus bar Zone-2 tripping, what about check zone protection before operation of bus bar protection)
- 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.
- Reason of tripping of 400 kV Koteshwar (THDC)-Koteshwar (PG) ckt-1? In case of over current protection, why it is enabled in 400 kV line?
- Reason of delayed operation of 400 kV bus coupler needs to be checked and corrected.
- Time synch error of 400 kV Koteshwar (THDC)-Koteshwar (PG) ckt-1 needs to be looked into.
- Analog and digital data (SCADA SoE) status to be checked and corrected.

- THDC shall submit the detailed report considering the aforesaid points and submit the remedial measures report.

A.5.2 & A.5.3 Multiple element tripping 400 kV Manesar PG

05.12.2019 at 12:34hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

- All 400kV Lines (Gurgaon-1 & 2, Neemrana-1 & 2) ICTs (ICT-1 &2) and 400 KV Bus Reactor-1 & 2 along with 220kV lines (Badshahpur-1 & 2 (HVPNL Line) and Mau-1 & 2 (HVPNL Line) were in service.

Following elements tripped:-

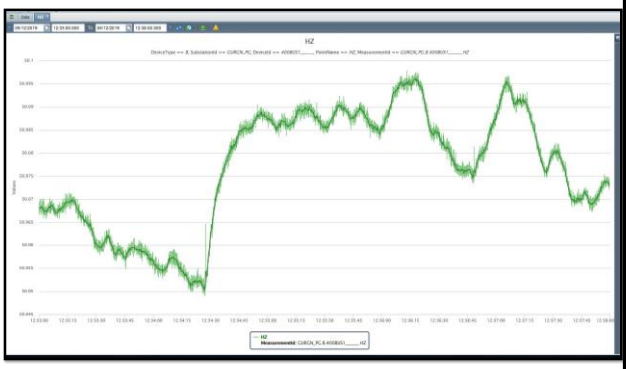
1) 125 MVAr bus reactor no 1 at 400kv Manesar(pg)
2) 400 kV Gurgaon-Manesar (pg) ckt-1 & 2
3) 400 kV Neemrana-Manesar (pg) ckt-1 & 2
4) 125 MVAr bus reactor no 2 at 400kv Manesar(pg)
5) 400/220 kV 500 MVA ICT 1 & 2 at Manesar(pg)
6) 220 kV Manesar(pg)-Mau(hv) (hvpnl) ckt-1 & 2
7) 220 kV Manesar(pg)-Badshahpur(hv) (hvpnl) ckt-1 & 2

PMU Plot of frequency at Koteshwar (PG)

12:34hrs/05-Dec-19

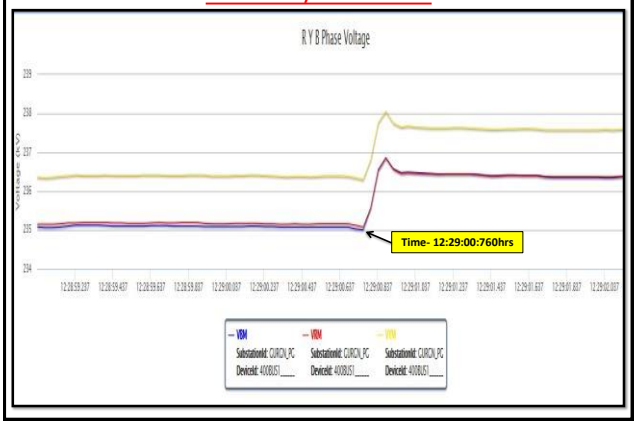
PMU Plot of frequency at Koteshwar (PG)

12:34hrs/05-Dec-19



PMU Plot of phase voltage magnitude at Kota(PG)

12:29hrs/05-Dec-19



PMU Plot of phase voltage magnitude at Kota(PG)

12:34hrs/05-Dec-19

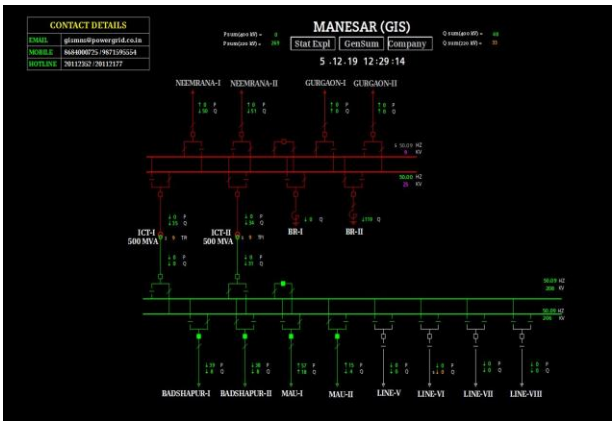
PMU Plot of phase freq & phase voltage magnitude

17:44hrs/06-Dec-19

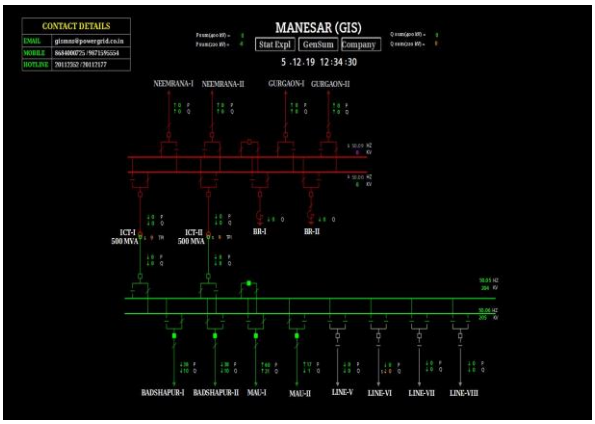
NRLDC SCADA SOE

TIME	S/S Name	Voltage level	Element Name	Element Type	Status	Comment
12:29:00,829	MANESAR	400kV	9BR2	Circuit Breaker	Open	
12:29:00,861	MANESAR	400kV	1T1	Circuit Breaker	Open	
12:29:00,880	MANESAR	400kV	4MBC	Circuit Breaker	Open	
12:29:00,908	NEEMRANA	400kV	11MA2TIE	Circuit Breaker	Open	
12:29:00,911	MANESAR	400kV	3NMRNA2	Circuit Breaker	Open	
12:29:00,947	MANESAR	400kV	8T2	Circuit Breaker	Open	
12:29:00,948	GURGAON	400kV	06MANSR1	Circuit Breaker	Open	
12:29:00,953	MANESAR	400kV	5RE	Circuit Breaker	Open	
12:29:01,022	MANESAR	400kV	7GURGN2	Circuit Breaker	Open	
12:29:01,043	NEEMRANA	400kV	14MA1R1	Circuit Breaker	Open	
12:29:01,076	GURGAON	400kV	07MANSR2	Circuit Breaker	Open	
12:29:01,087	MANESAR	220kV	5T1	Circuit Breaker	Open	
12:29:01,096	MANESAR	400kV	6GURGN1	Circuit Breaker	Open	
12:29:01,106	MANESAR	220kV	7T2	Circuit Breaker	Open	
12:29:01,526	MANESAR	400kV	2NMRNA1	Circuit Breaker	Open	
12:29:02,922	NEEMRANA	400kV	13MANSR1	Circuit Breaker	Open	
12:29:03,072	NEEMRANA	400kV	10MANSR2	Circuit Breaker	Open	

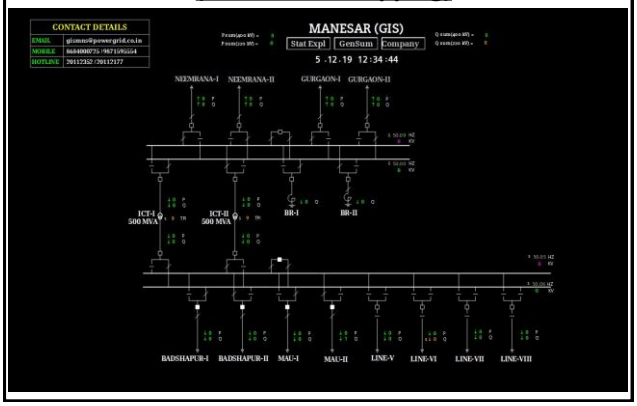
SCADA data of Manesar PG (before)



SCADA data of Manesar PG (after)

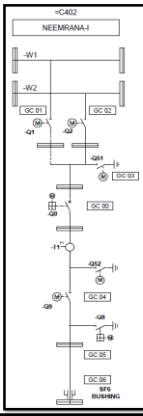


SCADA data of Manesar PG (after 220 kV tripping)



POWERGRID details

In typical 400kV lines (Say Neemrana-1) total 07 no. SF6 Gas Zone trip contactors are available



KZ00 – For GC00 Compartment (Q0/CB)

K101 – For GC01 Compartment (Q1/89A)

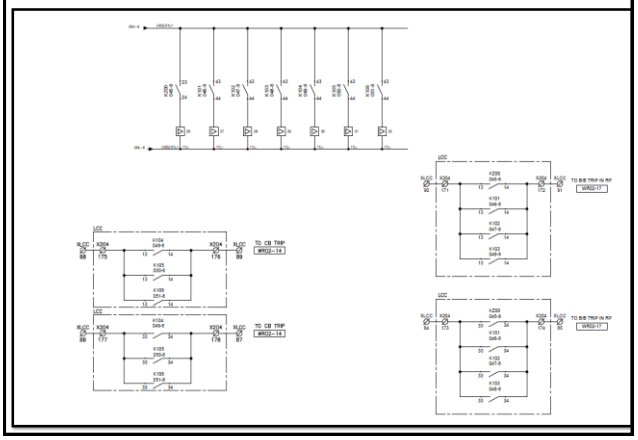
K102 – For GC02 Compartment (Q2/89B)

K103 – For GC03 Compartment (T-section)

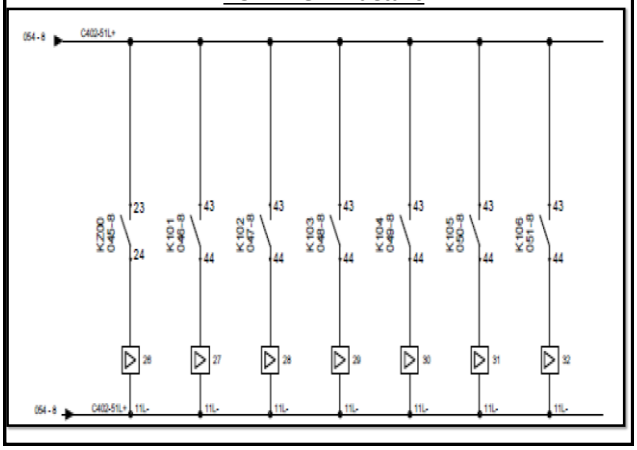
K104 – For GC04 Compartment (Q9/89L)

K105/106 – For GC05/06 Compartment (GIB)

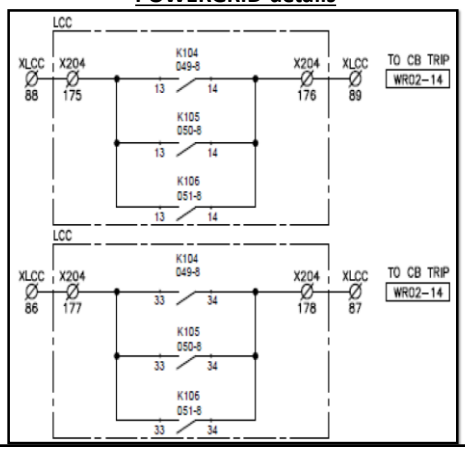
POWERGRID details



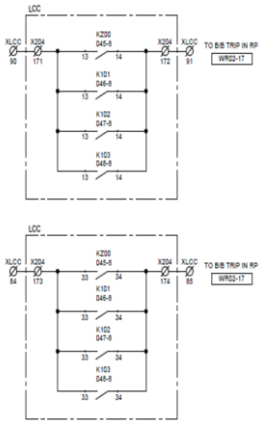
POWERGRID details



POWERGRID details

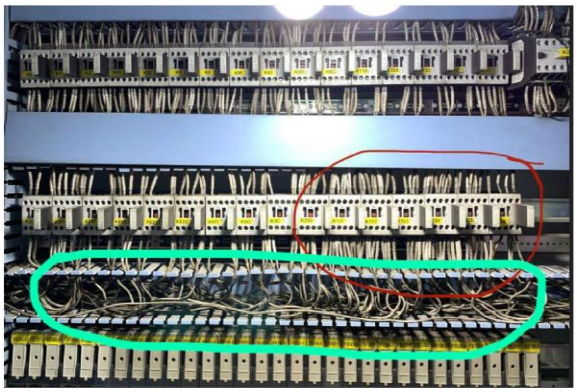


POWERGRID details



- As per the present zone trip scheme, in case of SF6 gas lockout condition in any of the 4 compartments (GC00/01/02/03-Gas compartments towards bus including CB), all four contacts looped in parallel and wired to Bus Bar Bay unit for **isolation of both 400kV buses simultaneously.**
- In case of SF6 gas lockout condition in any of the 3 compartments (GC04/05/06 Gas compartments towards Feeder excluding CB), all three contacts looped in parallel and wired for **respective feeder CB tripping.**

POWERGRID details (Reason for tripping)



- One of the 7 contactors, K101 mal-functioned.

POWERGRID details (Corrective action)

- The Contactor has been replaced and, the matter is in discussion with GIS manufacturer to rectify the same and to avoid any such incidence in future.
- The protection scheme is being modified such that-
  - Remove the looping of 4 contacts of KZ00, K101, K102, K103.
  - Parallel the contact of only 2 contactor of KZ00 and K103, wired to bus bar bay unit and configure for tripping of bus bar based on bus isolator status.
  - Parallel the contact of contact of K101 for all 400kV feeders and wired to bus bar central unit for tripping of 400kV Bus Bar-1.
  - Parallel the contact of contact of K102 for all 400kV feeders and wired to bus bar central unit for tripping of 400kV Bus Bar-2.

POWERGRID details (Restoration)

- All elements were charged as per following:
  - 400kV Neemrana-1: 13:13 Hrs on 05.12.19
  - 400kV Gurgaon-1: 13:21 Hrs on 05.12.19
  - 400/220kV ICT-1: 13:41 Hrs on 05.12.19
  - 400/220kV ICT-2: 13:53 Hrs on 05.12.19
  - 400kV Bus Reactor-1: 13:58 Hrs on 05.12.19
  - 400kV Bus Reactor-2: 14:00 Hrs on 05.12.19
  - 400kV Gurgaon-2: 14:08 Hrs on 05.12.19
  - 400kV Neemrana-2: 14:10 Hrs on 05.12.19

Observations

- Event Category: GD-1
- Generation Loss (in MW): Nil
- Load Loss (in MW): 200 (Haryana may confirm about load loss)
- Energy Loss: 0.07 MU

Analysis of tripping (As reported):

- At 400 kV Manesar (PG) station have double bus single breaker scheme. It is connected through 400 kV Gurgaon (PG) D/C & Neemrana (PG) DC. It also have two 500MVA 400/220 kV ICTs and two 125MVAr bus reactor. At 220 kV level, it is connected with Badshahpur D/C & Mau D/C
- One of the 7 contactors of GIS station, K101 mal-functioned, it further resulted into tripping of both 400 kV bus bar protection at Manesar (PG) due to scheme problem.
- Corrective measures has been taken and 400 kV bus bar protection scheme has been modified.
- On 06th Dec2019, again bus bar protection for 400 kV bus-1 at Manesar (PG) operated and further resulted into tripping of 400 kV bus-1 and connected elements.

Observations

As per PMU, SCADA data:

- As per PMU, no fault in the system.
- Fault Clearance time: **NA**
- SoE captured only for some of the tripped elements.

Points for Discussion

- Reason of mal-operation of contactor of SF6 gas zone trip of bus isolator of 400 kV Neemrana-Manesar (PG) ckt-1?
- Modification for SF6 gas zone tripping in view of frequent tripping at multiple locations in NR?
- Status & setting of alarm in the scheme before actual gas zone tripping?
- Reason of operation of 400 kV bus bar protection for 400 kV Bus-1 at Manesar PG on 06th Dec 2019 needs to be discussed? (No fault captured through PMU data)
- POWERGRID shall submit the detailed report and outcome of discussion with OeM regarding exact reason of mal-operation and design flaw (tripping of both bus bar protection)?

A.5.4 Multiple element tripping 400 V Chhabra SCTPS

17.12.2019 at 18:14hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

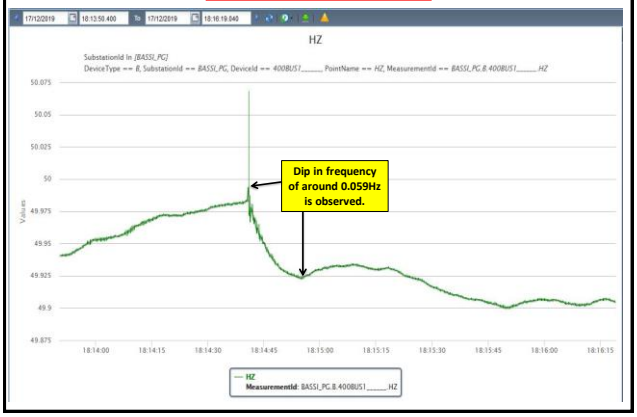
- 400kV Anta-Chhabra SCTPS ckt-1 & 2 tripped at 04:48hrs and 04:51hrs respectively; Patrolling was under progress.
- Only one interconnector of Chhabra TPS and Chhabra SCTPS is commissioned.

Following elements tripped:-

1. 400 kV bus 1 at Chhabra (rvun) TPS
2. 400 kV Chhabra TPS-Chhabra Sctps (rs) ckt-1
3. 660 MW Chhabra SCTPS- unit 5
4. 660 MW Chhabra SCTPS- unit 6

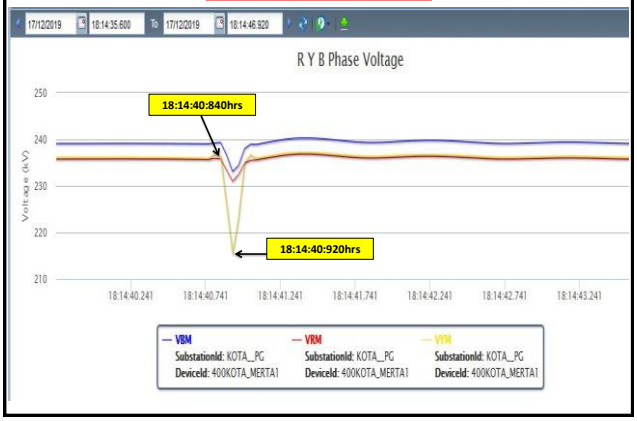
PMU Plot of frequency at Bassi(PG)

18:14hrs/17-Dec-19



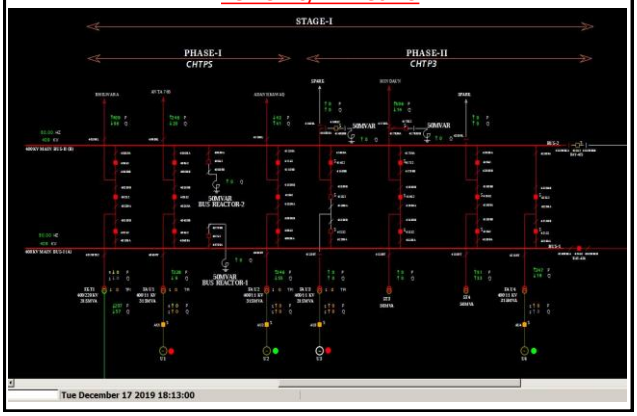
PMU Plot of phase voltage magnitude at Kota(PG)

18:14hrs/17-Dec-19



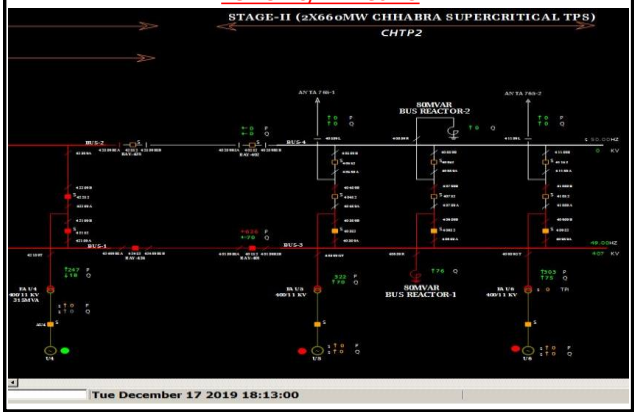
SLD of 400/220kV Chabra(Raj)LHS before the incident

18:13hrs/17-Dec-19



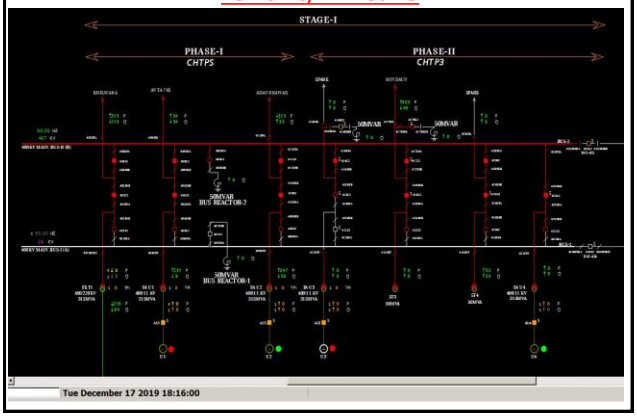
SLD of 400/220kV Chabra(Raj)RHS before the incident

18:13hrs/17-Dec-19



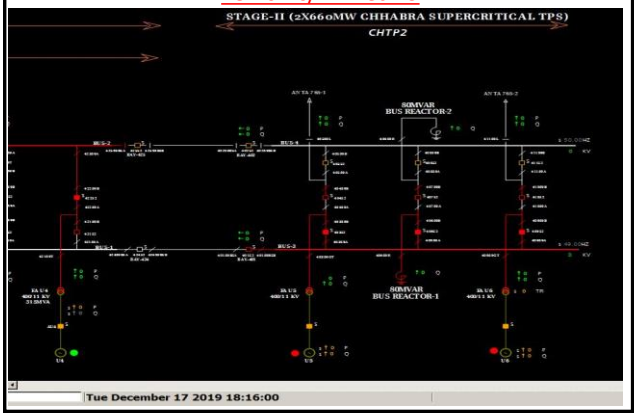
SLD of 400/220kV Chabra(Raj)LHS after the incident

18:16hrs/17-Dec-19



SLD of 400/220kV Chabra(Raj)RHS after the incident

18:16hrs/17-Dec-19



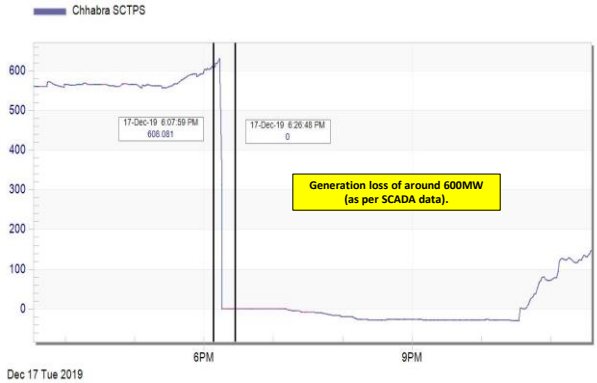
Rajasthan SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
18:14:40:535	CHHABRA	400kV	27B5B1B3	Circuit Breaker	disturbe	
18:14:40:547	CHHABRA	400kV	27B5B1B3	Circuit Breaker	Open	400kV Chabra-Chabra SCTPS interconnector (between bus-1 and bus-3) opens.
18:14:40:936	CHHABRA	400kV	09U2	Circuit Breaker	disturbe	
18:14:40:941	CHHABRA	400kV	01T1	Circuit Breaker	disturbe	
18:14:40:948	CHHABRA	400kV	04U1	Circuit Breaker	Open	Main CB of Unit#1 at 400/220kV Chabra opens.
18:14:40:951	CHHABRA	400kV	01T1	Circuit Breaker	Open	Main CB of 315MVA ICT 1 at 400/220kV Chabra opens.
18:14:40:955	CHHABRA	400kV	09U2	Circuit Breaker	Open	Main CB of Unit#2 at 400/220kV Chabra opens.
18:14:41:650	CHHABRA	400kV	424BAY	Circuit Breaker	Open	

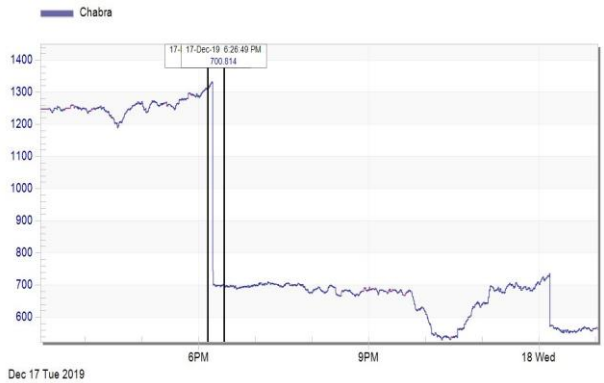
Tripping Time and Restoration Time

Name of Elements	Tripping Time	Restoration Time
Bus-1 at Chabra TPS	18:14hrs	19:34hrs
Chhabra Unit #5 (660MW)	18:14hrs	
Chhabra Unit #6 (660MW)	18:14hrs	
400kV Chabra-Chabra SCTPS interconnector (between bus-1 and bus-3)	18:14hrs	

Chabra SCTPS Generation pattern during tripping



Chabra Total Generation pattern during tripping



Observations

- Event Category: GD-1
- Generation Loss: 625 MW
- Load Loss: Nil (Rajasthan may confirm)

Analysis of tripping (As reported):

- At 400 kV Chhabra SCTPS have one and half breaker scheme. It is connected with Anta through D/C line and Chhabra TPS through two inter connector. It also have two 660 MW units and one 80MVAr bus reactor.
- Only one interconnector of Chhabra TPS and Chhabra SCTPS is commissioned.
- 400kV Anta-Chhabra SCTPS ckt-1 & 2 tripped at 04:48hrs and 04:51hrs respectively; Patrolling was under progress.
- Y-phase jumper of 400kV Chhabra-Chhabra SCTPS interconnector (between 400 kV bus-1 at Chhabra & bus-3 at Chhabra SCTPS) snapped and created bus fault of 400 kV Bus-1 at Chhabra TPS. This resulted in tripping of all CBs connected to 400 kV bus-1 at Chhabra TPS including interconnector.
- As, Chhabra SCTPS-Anta D/C was already out, running generation of 625MW at Chhabra SCTPS (Unit #5, #6) tripped due to loss of evacuation.
- 400 kV Anta-Chhabra ckt-2 tripped without A/R operation.
- Preliminary report has been received from Rajasthan however DR/EL and detailed report are still awaited.

Observations

As per PMU, SCADA data:

- As per PMU, Y-phase to earth.
- Fault Clearance time: **100ms**
- SoE captured only for some of the tripped elements.

Points for Discussion

- Exact location of fault and nature of fault.
- Is it actual operation or mal-operation of bus bar protection at Chhabra TPS. If it is mal-operation, action identified by the RRVUNL?
- 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.
- Auto reclosure function in 400 kV Chhabra SCTPS-Anta D/C line needs to checked and corrected
- Time difference of 400 ms between tripping of inter connector and unit CB needs to be checked and corrected.
- Analog and digital data (SCADA SoE) status to be checked and corrected.

- Rajasthan shall submit the detailed report considering the aforesaid points and submit the remedial measures report along with DR/EL of tripped elements.

A.5.5 Multiple element tripping 400/220 kV Sultanpur (UP)

22.12.2019 at 02:54hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

- At 220kV substation Sultanpur, 220kV Sultanpur – Pratapgarh line charged through TBC.
- All three 400/220 kV ICTs connected at 400 kV Bus-A at 400 kV side

Following elements tripped:-

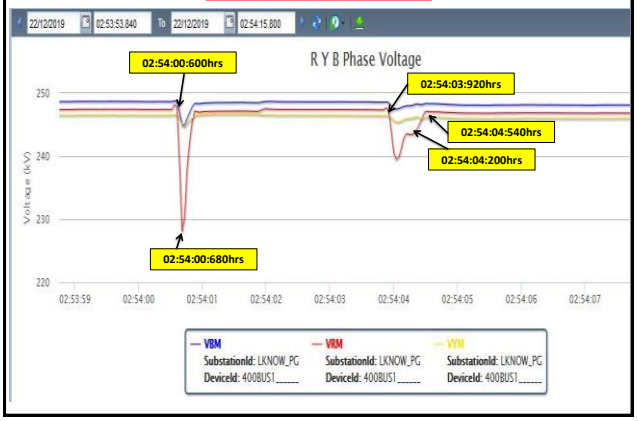
1. 400/220 kV 315 MVA ICT-3 at Sultanpur(up)
2. 400 kV Sultanpur(UP)-lucknow_1(PG) (up) ckt-1
3. 400 kV Tanda (NTPC)-Sultanpur(UP) (up) ckt-1
4. 400 kV bus 1 at Sultanpur(UP)
5. 400/220 kV 240 MVA ICT-2 at Sultanpur (up)
6. 400 kV Obra B-Sultanpur (UP) Ckt-1
7. 400/220 kV 315 MVA ICT 1 at Sultanpur (UP)

PMU Plot of frequency at Bassi(PG)

02:54hrs/22-Dec-19

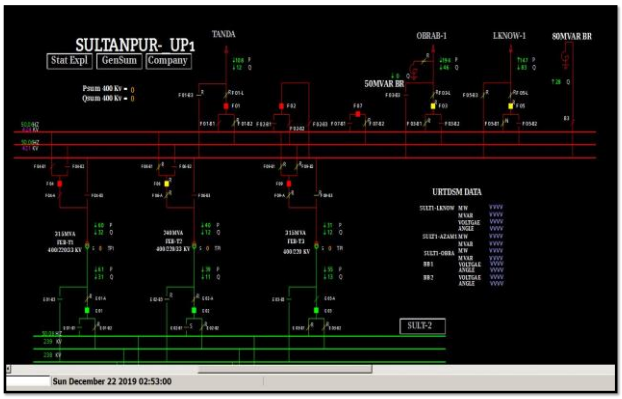
PMU Plot of phase voltage magnitude at Lucknow(PG)

02:54hrs/22-Dec-19



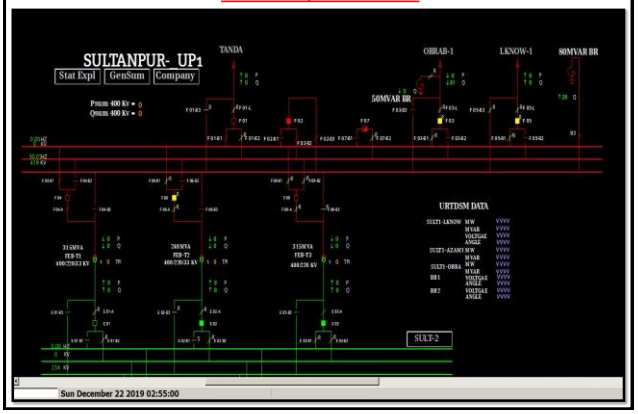
SLD of 400/220kV Sultanpur UP before the incident

02:53hrs/22-Dec-19



SLD of 400/220kV Sultanpur UP after the incident

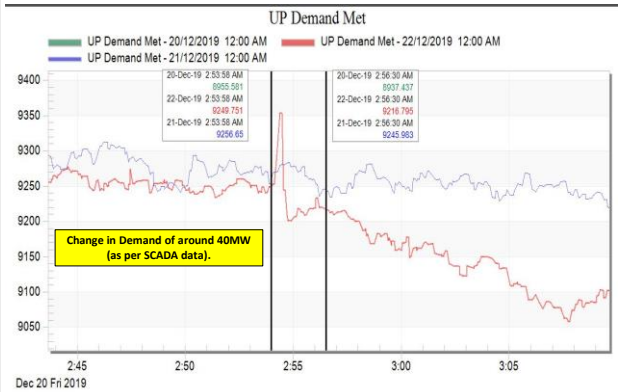
02:53hrs/22-Dec-19



UP SCADA SOE

Time	S/S Name	Reference time	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
02:54:03,920		0ms					PMU reference time
02:54:04,200		280ms					
02:54:04:346	SULT1_UP	415ms	400kV	F_04(T1)	CB	Open	400kV side CB of 315MVA ICT 1 at 400/220kV Sultanpur(UP) opens.
02:54:04:357	SULT1_UP	425ms	220kV	E_01(T1)	CB	Open	220kV side CB of 315MVA ICT 1 at 400/220kV Sultanpur(UP) opens.
02:54:04,540		620ms					PMU fault clearing time
02:54:04:550	**SULT1_UP**	**630ms**	**400kV**	**07MBC**	**CB**	**disturbe**	**Bus coupler at 400 kV side**
02:54:04:580	SULT1_UP	660ms	400kV	F_01(AZAM1)	CB	Open	CB of 400kV Sultanpur(UP)-Tanda (UP) opens.
02:54:04:588	SULT1_UP	670ms	400kV	09T3	CB	Open	400kV side CB of 315MVA ICT 3 at 400/220kV Sultanpur(UP) opens.
02:54:04:598	SULT1_UP	680ms	400kV	F_05(LKNOW)	CB	Open	CB of 400kV Sultanpur(UP)-Lucknow(PG) opens.
02:54:04:762	**SULT2_UP**	**840ms**	**220kV**	**04BC**	**CB**	**Open**	**Bus coupler opens.**
02:54:04:832	Lucknow_PG	910ms	400 kV		CB	open	**DR data of 400 kV Lucknow PG end-Sultanpur ckt**
02:54:04:836	TNDA1_U	915ms	400kV	LISULT1	Protection Trip	App	
02:54:04:860	TNDA1_U	940ms	400kV	05SLTFT	CB	Open	Tie CB of 400kV Sultanpur(UP)-Tanda(UP){end} opens.
02:54:04:860	TNDA1_U	940ms	400kV	04SULT1	CB	Open	Main CB of 400kV Sultanpur (UP)-Tanda (UP){end} opens.

UP Demand pattern during tripping



UTTAR PRADESH DETAILS

Extract of UP report

On 22.12.2019 at 02:54Hrs. 400KV ICTs and 400KV lines tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	400KV Sultanpur – Tanda	22.12.19	04:35	Busbar protection operated
2.	400KV Sultanpur – Lucknow	22.12.19	04:40	-do-
3.	315MVA ICT I (400/220KV)	22.12.19	18:04	-do-
4.	240MVA ICT – II (400/220KV)	22.12.19	04:19	- do-
5.	315 MVA ICT-III (400/220KV)	22.12.19	04:20	-do-
6.	400KV Bus coupler	22.12.19	04:20	-do-
7.	220KV Sultanpur-Pratapgarh	22.12.19	03:47	Z1, Z2, R-phase fault, distance 11.3km from Sultanpur end

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

Analysis report of the tripped elements, DR, single line diagram, flags and analysis report of the relevant portion of the grid is attached with sent mail.

Extract of UP report

Analysis:-

The analysis of aforementioned incident can be summarised under following points:-

1. There was earth fault on R-phase of 220KV Sultanpur – Pratapgarh line. Due to this Distance protection operated and gave command to clear the fault.
2. 220KV side both buses (A&B) was decoupled and LV side of 315 MAV ICT I is only connected to Bus- B in which 220KV Sultanpur – Pratapgarh line was connected. The other two 400/220KV ICT were connected to other bus (i.e. Bus- A) at 220KV side while HV side of all three ICT was connected to same bus.
3. As the command was give to CB to trip the 220KV Sultanpur – Pratapgarh line but it took more time to clear the fault which should not be happened.
4. Also Bus bar protection at 220KV side was off since the Isolator contact was not healthy as informed by 400KV Sultanpur.
5. Since CB took more time (480msec), 315MVA ICT I which is directly connected to fault feeding bus at 220KV side sense the O/C earth fault and gave command to trip the ICT.
6. Here again, it took more than 200msec which cause to operate LBB protection.
7. Due to LBB command all element (mentioned above) connected to 400KV bus A got tripped.
8. Final report in prescribed format is also enclosed herewith.

Remedial Measures taken/to be taken:-

1. Concerned officer may give reason for operating 220KV Pratapgarh line through bus coupler/bus transfer, instead of main CB.
2. Concerned officer may give reason for connecting the HV side of all three 400/220KV ICTs on same bus (i.e. Bus-A) if all would be distributed to both buses than ICT connected to Bus – B would not be tripped.
3. 400kv and 220kV circuit breakers timings should be checked due to delayed operation.
4. CB timings are required to be checked from time to time.

Extract of UP report

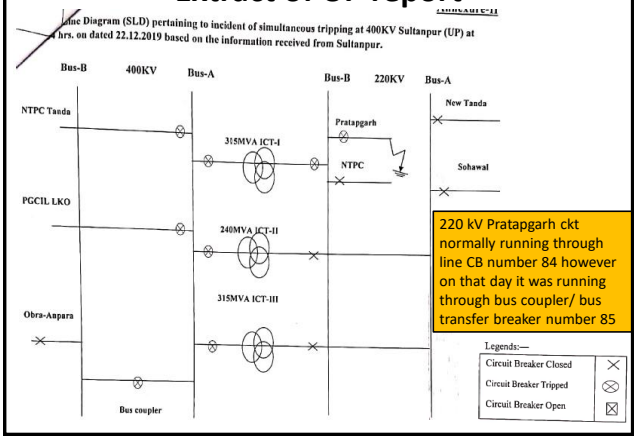
Bus Position Before Fault:

315MVA ICT1------	400KV side- A Bus	220 KV Side- B Bus
240MVA ICT2 ------	400KV side- A Bus	220 KV Side- A Bus
315MVA ICT 3-------	400KV side- A Bus	220 KV Side- A Bus
400KV Sultanpur Tanda Thermal line,	400KV side- A Bus	
400KV Sultanpur Lucknow PG line	400KV side- A Bus	
400KV Sultanpur Obra Anpara line	400KV side- B Bus	
80MVAR Bus Reactor (through Transfer)	400KV side- B Bus	

Bus Position After Normalization:

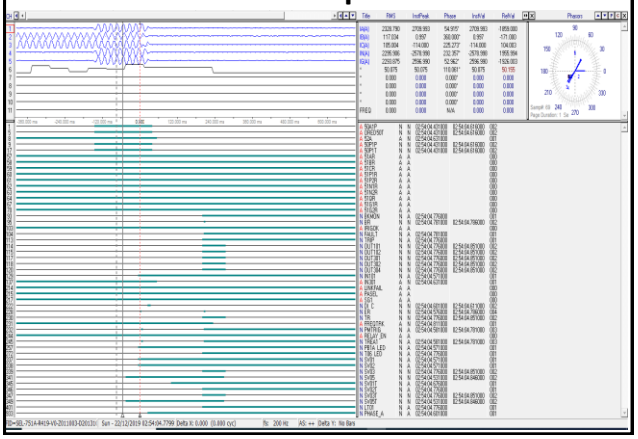
315MVA ICT1------	U/S/D	
240MVA ICT2 ------	400KV side- A Bus	220 KV Side- A Bus
315MVA ICT 3-------	400KV side- A Bus	220 KV Side- A Bus
400KV Sultanpur Tanda Thermal line,	400KV side- A Bus	
400KV Sultanpur Lucknow PG line	400KV side- A Bus	
400KV Sultanpur Obra Anpara line	400KV side- B Bus	
80MVAR Bus Reactor (through Transfer)	400KV side- B Bus	

Extract of UP report

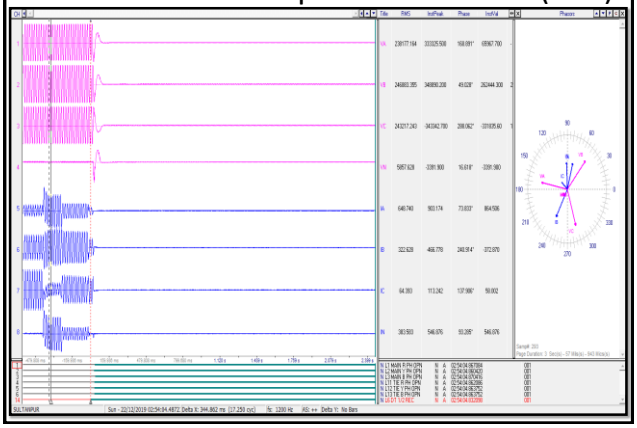


220 kV Pratapgarh ckt normally running through line CB number 84 however on that day it was running through bus coupler/ bus transfer breaker number 85

DR of bus bar protection



DR of 400 kV Sultanpur-Lucknow PG (end)



Flag details

Serial Number	Tripping Date/Time	Closing Date/Time	Name of Sub-Stations	C.B. Number/ Direction	Type of Protection Scheme	Flags observed: This end – Relay Flags	Flags observed: This end – F.L. Reading	Flags observed: Other end – Relay Flags	Flags observed: Other end – F.L. Reading	Analysis
1	2	3	4	5	6	7	8	9	10	11
SB-64	22.12.2019 02:54	22.12.2019 03:47	220 KV SS, Sultanpur	220 KV Pratapgarh line	ABB REL 650 & GE D60	**Main1**: Gen. trip, Rip , Z-1, Z2 trip , fuse fail/A/R opnd. IL1 6043.30A IL2 2622.03A, IL3 487.19A, IN 5306.70A,Fault dist 16.939Km **Main2**: AG, other phase ABC, Neutral Ground, Gen. trip, Z1, Z2 trip, R,Y&B@ trip, power swing block, 86A, 86B, Dist. 11.3Km,Reclose shot 0		R,N, Dist 62.2km (79.7%)	-	220kV Pratapgarh line connected to Bus B in decoupled condition through 220kV Bus transfer C.B.. C.B. tripped for R phase to earth Z-1 (Dist-11km) fault at 02:54Hrs on dated 22.12.2019.
SA-11	22.12.2019 02:54	22.12.2019 18:04	400KV Sub Station Sultanpur	983/383 315MVA ICT-I	SEL-387Z, 351	**HV SIDE** SEL 351A Relay (Hs, OC, E/F relay, 67) Inst. 50, Backup E/F trip, Group B trip, 286HV, 286LV, Event- AGT I_a=1728A, I_b=149A, I_c=267A, I_n=1333A, I_g=1833A, 3I_0=1833A SEL 751A Relay (LBB relay 50Z) Event- AG, I_a=1716.6A, I_b=142.1A, I_c=268.7A, I_n=1265A, I_g=1325.16A, **LV Side** SEL 751A Relay (LBB relay 50Z) Event- AG, I_a=3374.1A, I_b=175.1A, I_c=340.1A, I_n=3347.9A, I_g=3368.70A,				The C.B. took around 480msec to clear the fault leading to detection of earth by O/C, E/F relay installed on HV side of 400/220kV 315MVA ICT-I, which was the only 400/220kV ICT coupled to 220kV Bus B at the time and subsequent tripping on high set setting (CTR: 5000/1, I: 1.4A, T: 100msec.) of E/F relay.

Flag details

U.P. POWER TRANSMISSION CORPORATION LIMITED
ELECTRICITY TEST & COMMISSIONING DIVISION, SULTANPUR
FAULT ANALYSIS STATEMENT OF PROTECTION GEARS FOR THE MONTH OF DECEMBER, 2019
400 KV TRIPPINGS

Serial Number	Tripping Date/Time	Closing Date/Time	Name of Sub-Stations	C.B. Number/ Direction	Type of Protection Scheme	Flags observed: This end – Relay Flags	Flags observed: This end – F.L. Reading	Flags observed: Other end – Relay Flags	Flags observed: Other end – F.L. Reading	Analysis
1	2	3	4	5	6	7	8	9	10	11
SA-17	22.12.2019 02:54	22.12.2019 04:20	400KV Sub Station Sultanpur	91 Bus Coupler	SEL-487, Bus bar relay	Flags observed on CP-8/BP -SEL-487B (R,Y&B phase) SBFTR LBB trip, Breaker Failure 96TR-1 NTPC Tanda 96TR-6 (Bus Coupler) 96TR-5 (315 MVA ICT-I) 96TR-6 PGCIL Lucknow 96TR-7 (240 MVA ICT-II) 96TR-8 (315 MVA ICT-III)				The HV& LV side C.B of 400/220kV 315MVA ICT-I (C.B. No. 983 & 883 respectively) also took more than 200msec time for fault clearance, leading to initiation of LBB trip command and tripping of all the bus elements connected to 400kV Bus A alongwith 400kV Bus coupler.
	22.12.2019 04:35			93 400KV NTPC Tanda Line				Circuit Breaker operated on D.T.R. Command.		
	22.12.2019 18:04			983 240MVA ICT-I						
	22.12.2019 04:40			92 400KV PGCIL Lucknow Line				Circuit Breaker operated on D.T.R. Command.		
	22.12.2019 04:19			984 240MVA ICT-II						
	22.12.2019 04:32			985 315MVA ICT-III						

Counter Reading: For 400kV NTPC Tanda

	Bus-I Y-N	Bus-I R-N	Bus-I Y-B	Bus-I R-B	Bus-II Y-N	Bus-II R-N	Bus-II Y-B	Bus-II R-B
Before Fault	03	02	20	30	10	32	20	02
After Fault	03	32	22	00	10	32	22	02

Counter Reading: For 400kV PGCIL Lucknow line

	Bus-I Y-1	Bus-I R-1	Bus-I Y-2	Bus-I R-2	Bus-I Y-3	Bus-I R-3	Bus-II Y-1	Bus-II R-1	Bus-II Y-2	Bus-II R-2	Bus-II Y-3	Bus-II R-3
Before Fault	41	19	52	11	40	12	55	20	58	20	40	05
After Fault	41	19	52	11	40	12	55	20	58	20	41	05

EXECUTIVE ENGINEER (T&C)

Restoration time (as per UP report)

- 400 kV Sultanpur – PG Lucknow line at 04:40 hrs
- 400 kV Bus Coupler at 04:20 hrs
- 400/220kV 315 MVA T/F –1 at 18:04 hrs
- 400/220kV 240 MVA T/F –II at 04:19 hrs
- 400/220kV 315 MVA T/F –III at 04:32 hrs
- 400kV Sultanpur – NTPC Tanda line at 04:35 hrs

POWERGRID DETAILS

Extract of POWERGRID report

1. Time & Date of Event:	22/12/2019 02:54:00 Hrs.
2. Substation Name:	400 KV Lucknow(PG)
3. Name of the tripped elements & time of tripped elements:	• 400 KV Lucknow Sultanpur Line, 02:54:00 Hrs.
4. Triggering Incident:	DT Receive
5. Flag Details, DR/EL	Attached
6. Event Description	As per below:
• In 400 KV Lucknow Sultanpur Line, DT Receive signal occurs at Lucknow end. • Relay issued three-phase trip to Main and Tie CBs . • This results three-phase trip to main and Tie CB.	
7. Restoration Time:	22/12/2019 04:40:00 Hrs.
8. Remedial Action Taken:	

Observations

- Event Category: GI-2
- Generation Loss: Nil
- Load Loss: Nil (As per UP report)

Analysis of tripping (As reported):

- At 400/220 kV Sultanpur (UP) station have double main transfer breaker scheme both at 400 kV & 220 kV side. It is connected through Tanda S/C, Lucknow (PG) S/C, and Anpara (via Obra) S/C. It also have two 315 MVA & one 240MVA 400/220 kV ICTs and one 80MVAr bus reactor. At 220 kV level it further connected with Pratapgarh S/C, Sohawal S/C, Tanda S/C & Tanda New S/C.
- At 220kV substation Sultanpur, 220kV Sultanpur – Pratapgarh line charged through TBC (TBC charged from 220kV bus B) tripped on R-ph fault in zone-1. 220 kV side breaker didn't trip within 160ms.
- Due to heavy fault current 6kA, high set backup over current earth fault protection (**definite time with time delay of 100ms**) of 315MVA ICT-1 operated. But delayed opening of 400kV and 220kV circuit breakers of ICT-1, 400 kV side LBB operated which resulted into operation of 400 kV bus bar protection and tripping of 400 kV bus A and its connected elements at 400/220 kV Sultanpur (UP).
- Preliminary report, DR/EL and detailed report received from UPPTCL & POWERGRID.

Observation

Analysis:-

The analysis of aforementioned incident can be summarised under following points:-

1. There was earth fault on R-phase of 220KV Sultanpur – Pratapgarh line. Due to this Distance protection operated and gave command to clear the fault.
2. 220KV side both buses (A&B) was decoupled and LV side of 315 MAV ICT I is only connected to Bus- B in which 220KV Sultanpur – Pratapgarh line was connected. The other two 400/220KV ICT were connected to other bus (i.e. Bus- A) at 220KV side while HV side of all three ICT was connected to same bus.
3. As the command was give to CB to trip the 220KV Sultanpur – Pratapgarh line but it took more time to clear the fault which should not be happened.
4. Also Bus bar protection at 220KV side was off since the Isolator contact was not healthy as informed by 400KV Sultanpur.
5. Since CB took more time (480msec), 315MVA ICT I which is directly connected to fault feeding bus at 220KV side sense the O/C earth fault and gave command to trip the ICT.
6. Here again, it took more than 200msec which cause to operate LBB protection.
7. Due to LBB command all element (mentioned above) connected to 400KV bus A got tripped.
8. Final report in prescribed format is also enclosed herewith.

Observations

As per PMU, SCADA data:

- As per PMU, R-phase to earth.
- Fault Clearance time: **620ms**
- SoE captured only for some of the tripped elements.

Remedial Action Taken (As per UP report):

- 400 kV and 220 kV circuit breakers timings are being checked

Remedial Measures taken/to be taken:-

1. Concerned officer may give reason for operating 220KV Pratapgarh line through bus coupler/bus transfer, instead of main CB.
2. Concerned officer may give reason for connecting the HV side of all three 400/220KV ICTs on same bus (i.e. Bus-A) if all would be distributed to both buses than ICT connected to Bus – B would not be tripped.
3. 400kv and 220kV circuit breakers timings should be checked due to delayed operation.
4. CB timings are required to be checked from time to time.

Lesson learnt (As per UP report):

- CB timings are required to be checked from time to time

Points for Discussion

- Exact fault clearance time .
- Fault captured in PMU at 2:54:00,600hrs needs to be established? Timely cleared
- 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.
- Status of breaker over hauling & its report for 400/220 kV ICT-1 and 220 kV Sultanpur (end)-Pratapgarh ckt. Exact reason of delayed operation needs to established.
- 150ms time delay in tripping of Sultanpur-Lucknow (end) Sultanpur-Tanda (end) line needs to be looked into on view of PLCC communication delay
- Healthiness of 220 kV bus bar protection at 400/220 kV Sultanpur (UP) needs to be corrected. Isolator auxiliary contact status input shall be checked regularly on daily basis.
- Particular reason of operational issue like all three ICTs running on same bus at 400 kV side.
- Time synch error in various triggered DR needs to be corrected.
- Status of station event logger, details yet to be shared.
- Analog and digital data (SCADA SoE) status to be checked and corrected.
- UPPTCL shall submit the detailed report considering the aforesaid points and submit the remedial measures report.

A.5.6 Multiple element tripping 400 kV Chhabra SCTPS

29.12.2019 at 07:53hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

- Only one interconnector of Chhabra TPS and Chhabra SCTPS is commissioned.
- In antecedent conditions, Chhabra SCTPS - UNIT 5 & UNIT 6 generating 408MW & 361MW respectively

Following elements tripped:-

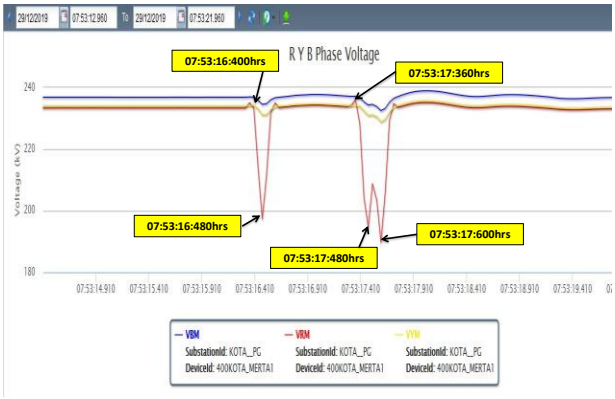
1. 660 MW Chhabra SCTPS - UNIT 6
2. 660 MW Chhabra SCTPS - UNIT 5
3. 400 KV Anta(RS)-Kawai SCTPS(APR) (RS) Ckt-2

PMU Plot of frequency at Bassi(PG)

07:53hrs/29-Dec-19

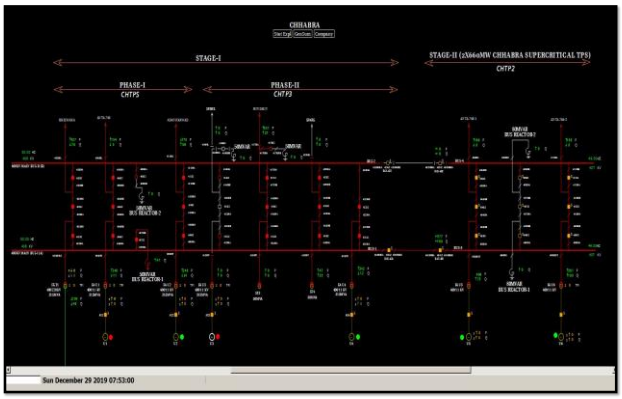
PMU Plot of phase voltage magnitude at Kota(PG)

07:53hrs/29-Dec-19



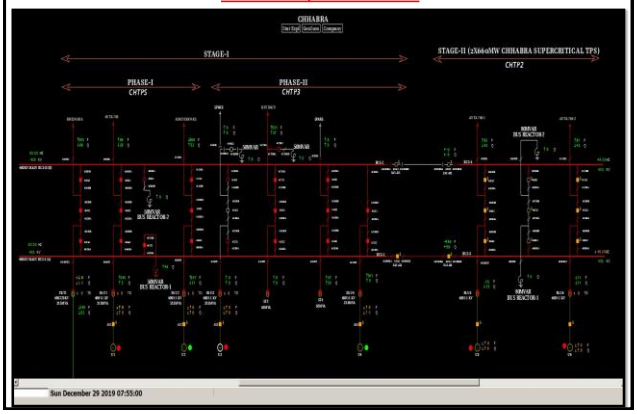
SLD of 400/220kV Chhabra SCTPS before the incident

07:53hrs/29-Dec-19



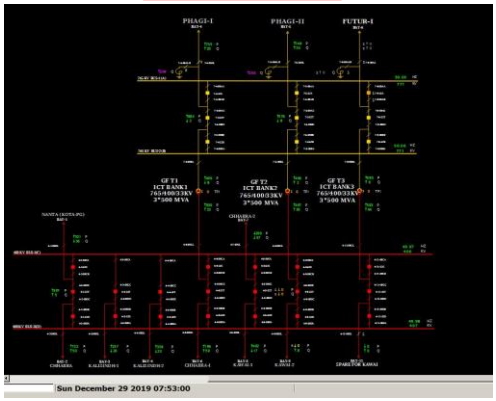
SLD of 400/220kV Chhabra SCTPS after the incident

07:53hrs/29-Dec-19



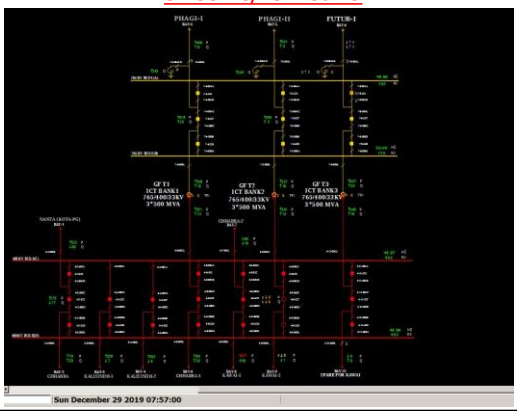
SLD of 400/220kV Anta before the incident

07:53hrs/29-Dec-19

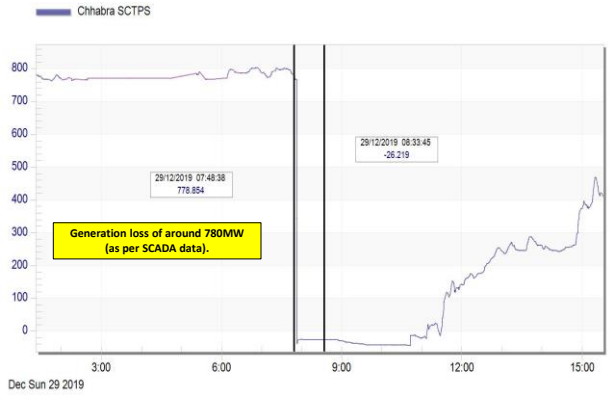


SLD of 400/220kV Anta after the incident

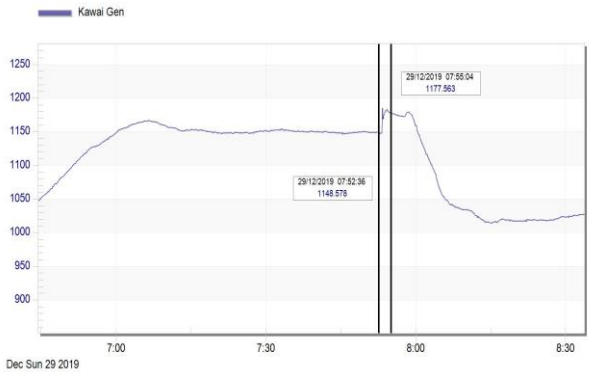
07:53hrs/29-Dec-19



Chhabra TPS Generation pattern during tripping



Kawai Generation pattern during tripping



Rajasthan SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
07:53:16:495	ANTA765	400kV	17T2KAW2	Circuit Breaker	disturbe	
07:53:16:496	ANTA765	400kV	18KAWAI2	Circuit Breaker	disturbe	
07:53:16:515	ADANI	400kV	7ANTA2	Circuit Breaker	disturbe	
07:53:16:515	ADANI	400kV	8ANT2R2A	Circuit Breaker	disturbe	
07:53:17:551	ADANI	400kV	7ANTA2	Circuit Breaker	Close	
07:53:17:607	ADANI	400kV	8ANT2R2A	Circuit Breaker	Open	Tie CB of 400kV Adani Kawai(end)-Anta(765kV) ckt-2 opens.
07:53:17:631	ANTA765	400kV	17T2KAW2	Circuit Breaker	Open	Main CB of 400kV Adani Kawai-Anta(765kV)(end) ckt-2 opens.
07:53:17:636	ADANI	400kV	7ANTA2	Circuit Breaker	Open	Main CB of 400kV Adani Kawai(end)-Anta(765kV) ckt-2 opens.
07:53:19:233	ANTA765	400kV	18KAWAI2	Circuit Breaker	Open	Tie CB of 400kV Adani Kawai-Anta(765kV)(end) ckt-2 opens.
07:53:22:478	CHHABRA	11kV	04H05	Protection Trip	Disp	
07:53:22:478	CHHABRA	11kV	04H06	Protection Trip	Disp	

DR 400 kV Anta (end)-Kawai ckt-2

Channel Number	Name	Status	Time
22	PHS-STFWL1	On	29-Dec-19 7:53:16:462 AM
25	PHS-STFWPE	On	29-Dec-19 7:53:16:462 AM
1	TRIP	On	29-Dec-19 7:53:16:465 AM
2	TRIP-R	On	29-Dec-19 7:53:16:465 AM
7	ZM01-TRIP	On	29-Dec-19 7:53:16:465 AM
8	ZM01-START	On	29-Dec-19 7:53:16:465 AM
10	ZM02-START	On	29-Dec-19 7:53:16:465 AM

Recording File Name:C:\PCMDataBases\DisturbanceRecordings\rvprd(2)\ANTHA400KV\KAWAI_2\KAWAI_2_M1_KAWAI_2\KAWAI_2_M12019122914

ABB

12	ZM03-START	On	29-Dec-19 7:53:16:465 AM
84	CARR_SEND	On	29-Dec-19 7:53:16:465 AM
81	TR_R_MAIN_CB	On	29-Dec-19 7:53:16:468 AM
85	TR_R_TBC_CB	On	29-Dec-19 7:53:16:468 AM
65	TIE_R_OPEN	On	29-Dec-19 7:53:16:494 AM
45	MAIN_R_OPEN	On	29-Dec-19 7:53:16:495 AM
51	CARR_RECVD	On	29-Dec-19 7:53:16:501 AM
7	ZM01-TRIP	Off	29-Dec-19 7:53:16:537 AM
8	ZM01-START	Off	29-Dec-19 7:53:16:537 AM
10	ZM02-START	Off	29-Dec-19 7:53:16:537 AM
12	ZM03-START	Off	29-Dec-19 7:53:16:537 AM
22	PHS-STFWL1	Off	29-Dec-19 7:53:16:537 AM
25	PHS-STFWPE	Off	29-Dec-19 7:53:16:537 AM
84	CARR_SEND	Off	29-Dec-19 7:53:16:537 AM
51	CARR_RECVD	Off	29-Dec-19 7:53:16:597 AM
1	TRIP	Off	29-Dec-19 7:53:16:615 AM
2	TRIP-R	Off	29-Dec-19 7:53:16:615 AM
81	TR_R_MAIN_CB	Off	29-Dec-19 7:53:16:618 AM
85	TR_R_TBC_CB	Off	29-Dec-19 7:53:16:618 AM
49	CB_MANUAL_CLS	On	29-Dec-19 7:53:17:338 AM
45	MAIN_R_OPEN	Off	29-Dec-19 7:53:17:420 AM
22	PHS-STFWL1	On	29-Dec-19 7:53:17:446 AM
25	PHS-STFWPE	On	29-Dec-19 7:53:17:446 AM
1	TRIP	On	29-Dec-19 7:53:17:449 AM
2	TRIP-R	On	29-Dec-19 7:53:17:449 AM
7	ZM01-TRIP	On	29-Dec-19 7:53:17:449 AM
8	ZM01-START	On	29-Dec-19 7:53:17:449 AM
10	ZM02-START	On	29-Dec-19 7:53:17:449 AM
12	ZM03-START	On	29-Dec-19 7:53:17:449 AM
84	CARR_SEND	On	29-Dec-19 7:53:17:449 AM
81	TR_R_MAIN_CB	On	29-Dec-19 7:53:17:452 AM
85	TR_R_TBC_CB	On	29-Dec-19 7:53:17:452 AM
45	MAIN_R_OPEN	On	29-Dec-19 7:53:17:496 AM
66	TIE_Y_OPEN	On	29-Dec-19 7:53:17:520 AM
67	TIE_B_OPEN	On	29-Dec-19 7:53:17:520 AM
7	ZM01-TRIP	Off	29-Dec-19 7:53:17:533 AM
8	ZM01-START	Off	29-Dec-19 7:53:17:533 AM
10	ZM02-START	Off	29-Dec-19 7:53:17:533 AM
12	ZM03-START	Off	29-Dec-19 7:53:17:533 AM
22	PHS-STFWL1	Off	29-Dec-19 7:53:17:533 AM
25	PHS-STFWPE	Off	29-Dec-19 7:53:17:533 AM
84	CARR_SEND	Off	29-Dec-19 7:53:17:533 AM
65	TIE_R_OPEN	Off	29-Dec-19 7:53:17:554 AM
22	PHS-STFWL1	On	29-Dec-19 7:53:17:578 AM
25	PHS-STFWPE	On	29-Dec-19 7:53:17:578 AM
7	ZM01-TRIP	On	29-Dec-19 7:53:17:581 AM
8	ZM01-START	On	29-Dec-19 7:53:17:581 AM
10	ZM02-START	On	29-Dec-19 7:53:17:581 AM
12	ZM03-START	On	29-Dec-19 7:53:17:581 AM
84	CARR_SEND	On	29-Dec-19 7:53:17:581 AM
51	CARR_RECVD	On	29-Dec-19 7:53:17:594 AM
65	TIE_R_OPEN	On	29-Dec-19 7:53:17:630 AM
18	ZCOM-TRIP	On	29-Dec-19 7:53:17:650 AM
1	TRIP	Off	29-Dec-19 7:53:17:665 AM
2	TRIP-R	Off	29-Dec-19 7:53:17:665 AM
7	ZM01-TRIP	Off	29-Dec-19 7:53:17:665 AM
8	ZM01-START	Off	29-Dec-19 7:53:17:665 AM
10	ZM02-START	Off	29-Dec-19 7:53:17:665 AM
12	ZM03-START	Off	29-Dec-19 7:53:17:665 AM
22	PHS-STFWL1	Off	29-Dec-19 7:53:17:665 AM

Recording File Name:C:\PCMDataBases\DisturbanceRecordings\rvprd(2)\ANTHA400KV\KAWAI_2\KAWAI_2_M1_KAWAI_2\KAWAI_2_M12019122914

ABB

25	PHS-STFWPE	Off	29-Dec-19 7:53:17:665 AM
84	CARR_SEND	Off	29-Dec-19 7:53:17:665 AM
81	TR_R_MAIN_CB	Off	29-Dec-19 7:53:17:668 AM
85	TR_R_TBC_CB	Off	29-Dec-19 7:53:17:668 AM
51	CARR_RECVD	Off	29-Dec-19 7:53:17:686 AM
18	ZCOM-TRIP	Off	29-Dec-19 7:53:17:692 AM
49	CB_MANUAL_CLS	Off	29-Dec-19 7:53:18:027 AM

DR 400 kV Anta-Kawai (end) ckt-2

Channel Number	Name	Status	Time
49	CB_MANUAL_CLS	On	29-Dec-19 7:53:17:338 AM
45	MAIN_R_OPEN	Off	29-Dec-19 7:53:17:420 AM
22	PHS-STFWL1	On	29-Dec-19 7:53:17:446 AM
25	PHS-STFWPE	On	29-Dec-19 7:53:17:446 AM
1	TRIP	On	29-Dec-19 7:53:17:449 AM

Recording File Name:C:\PCMDataBases\DisturbanceRecordings\rvprd(2)\ANTHA400KV\KAWAI_2\KAWAI_2_M1_KAWAI_2\KAWAI_2_M12019122915

ABB

2	TRIP-R	On	29-Dec-19 7:53:17:449 AM
7	ZM01-TRIP	On	29-Dec-19 7:53:17:449 AM
8	ZM01-START	On	29-Dec-19 7:53:17:449 AM
10	ZM02-START	On	29-Dec-19 7:53:17:449 AM
12	ZM03-START	On	29-Dec-19 7:53:17:449 AM
84	CARR_SEND	On	29-Dec-19 7:53:17:449 AM
81	TR_R_MAIN_CB	On	29-Dec-19 7:53:17:452 AM
85	TR_R_TBC_CB	On	29-Dec-19 7:53:17:452 AM
45	MAIN_R_OPEN	On	29-Dec-19 7:53:17:496 AM
66	TIE_Y_OPEN	On	29-Dec-19 7:53:17:520 AM
67	TIE_B_OPEN	On	29-Dec-19 7:53:17:520 AM
7	ZM01-TRIP	Off	29-Dec-19 7:53:17:533 AM
8	ZM01-START	Off	29-Dec-19 7:53:17:533 AM
10	ZM02-START	Off	29-Dec-19 7:53:17:533 AM
12	ZM03-START	Off	29-Dec-19 7:53:17:533 AM
22	PHS-STFWL1	Off	29-Dec-19 7:53:17:533 AM
25	PHS-STFWPE	Off	29-Dec-19 7:53:17:533 AM
84	CARR_SEND	Off	29-Dec-19 7:53:17:533 AM
65	TIE_R_OPEN	Off	29-Dec-19 7:53:17:554 AM
22	PHS-STFWL1	On	29-Dec-19 7:53:17:578 AM
25	PHS-STFWPE	On	29-Dec-19 7:53:17:578 AM
7	ZM01-TRIP	On	29-Dec-19 7:53:17:581 AM
8	ZM01-START	On	29-Dec-19 7:53:17:581 AM
10	ZM02-START	On	29-Dec-19 7:53:17:581 AM
12	ZM03-START	On	29-Dec-19 7:53:17:581 AM
84	CARR_SEND	On	29-Dec-19 7:53:17:581 AM
51	CARR_RECVD	On	29-Dec-19 7:53:17:594 AM
65	TIE_R_OPEN	On	29-Dec-19 7:53:17:630 AM
18	ZCOM-TRIP	On	29-Dec-19 7:53:17:650 AM
1	TRIP	Off	29-Dec-19 7:53:17:665 AM
2	TRIP-R	Off	29-Dec-19 7:53:17:665 AM
7	ZM01-TRIP	Off	29-Dec-19 7:53:17:665 AM
8	ZM01-START	Off	29-Dec-19 7:53:17:665 AM
10	ZM02-START	Off	29-Dec-19 7:53:17:665 AM
12	ZM03-START	Off	29-Dec-19 7:53:17:665 AM
22	PHS-STFWL1	Off	29-Dec-19 7:53:17:665 AM
25	PHS-STFWPE	Off	29-Dec-19 7:53:17:665 AM
84	CARR_SEND	Off	29-Dec-19 7:53:17:665 AM
81	TR_R_MAIN_CB	Off	29-Dec-19 7:53:17:668 AM
85	TR_R_TBC_CB	Off	29-Dec-19 7:53:17:668 AM
51	CARR_RECVD	Off	29-Dec-19 7:53:17:686 AM
18	ZCOM-TRIP	Off	29-Dec-19 7:53:17:692 AM
49	CB_MANUAL_CLS	Off	29-Dec-19 7:53:18:027 AM
47	MAIN_B_OPEN	On	29-Dec-19 7:53:19:230 AM
46	MAIN_Y_OPEN	On	29-Dec-19 7:53:19:233 AM

Observations

- Event Category: GD-1
- Generation Loss: 625 MW
- Load Loss: Nil (Rajasthan may confirm)

Analysis of tripping (As reported):

- At 400 kV Chhabra SCTPS have one and half breaker scheme. It is connected with Anta through D/C line and Chhabra TPS through two inter connector. It also have two 660 MW units and one 80MVAr bus reactor.
- Only one interconnector of Chhabra TPS and Chhabra SCTPS is commissioned.
- As reported, 400 KV Anta(RS)-Kawai SCTPS(APR) (RS) Ckt-2 tripped on R-N fault after unsuccessful auto reclosing. At the same time, 660 MW Chhabra SCTPS - UNIT 5 & UNIT 6 tripped due to operation of Generator differential Protection..
- Preliminary report has been received from Rajasthan however DR/EL and detailed report are still awaited. Unit tripping details yet to be shared.

Observations

As per PMU, SCADA data:

- As per PMU, R-N fault with unsuccessful auto reclosing is observed.
- Fault Clearance time: **100ms & 220 ms**
- SoE captured only for some of the tripped elements.

Points for Discussion

- Exact location of fault and nature of fault?
- Reason of delayed clearance of fault?
- GT differential protection setting needs to be checked and corrected in view of unwanted tripping on through fault.
- As per SoE data, it is observed that Chhabra SCTPS - UNIT 5 & UNIT 6 tripped after 3s of tripping of 400 KV Anta(RS)-Kawai SCTPS(APR) (RS) Ckt-2. Reason of the same needs to be looked into.
- 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.
- Remedial measures taken report also needs to be shared.
- Analog and digital data (SCADA SoE) status to be checked and corrected.

- Rajasthan shall submit the detailed report considering the aforesaid points and submit the remedial measures report along with DR/EL of tripped elements.

A.5.7 Tripping of all poles of HVDC Champa-Kurukshetra

30.12.2019 at 10:26hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

- In antecedent condition power flow on HVDC Pole 1-1050 MW, Pole 2- 250 MW, Pole 3-200MW
- All lines, ICTs and Reactors in service at HVDC Kurukshetra.

Following elements tripped during event:-

- 800 kV HVDC Champa(PG)- Kurukshetra(PG) Pole-1
- 800 kV HVDC Champa(PG)- Kurukshetra(PG) Pole-2
- 800 kV HVDC Champa(PG)- Kurukshetra(PG) Pole-3

PMU Plot of frequency at Bassi(PG)

10:26hrs/30-Dec-19

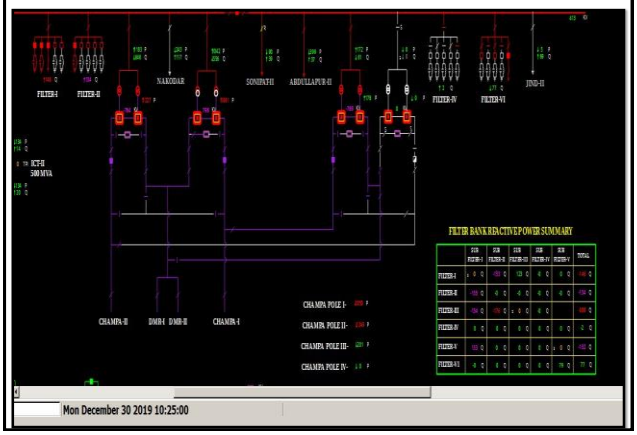
PMU Plot of phase voltage magnitude at Kurukshetra(PG)

10:26hrs/30-Dec-19

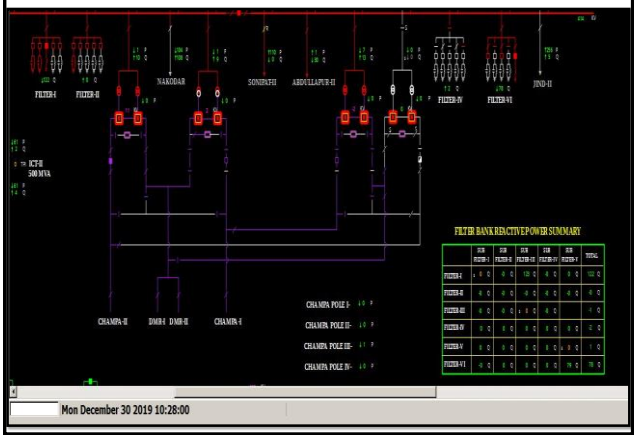
PMU Plot of phase voltage magnitude at Kurukshetra(PG)

11:51hrs/30-Dec-19

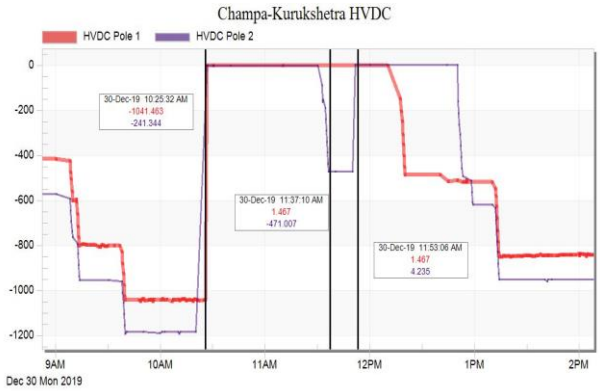
SCADA data of HVDC Kurukshetra (before)



SCADA data of HVDC Kurukshetra (after)



Champa-Kurukshetra HVDC Flowpattern during tripping



POWERGRID SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status
10:26:34:004	KURHV_P	800kV	808_A	Circuit Breaker	Open
10:26:34:004	KURHV_P	800kV	808_A	Circuit Breaker	disturbe
10:26:34:004	KURHV_P	400kV	BKC5_1	Circuit Breaker	Open
10:26:34:004	KURHV_P	800kV	810_A	BusBar Isolator 1	Open
10:26:34:004	KURHV_P	800kV	810_A	BusBar Isolator 1	disturbe
10:26:34:055	KURHV_P	800kV	802_B	Circuit Breaker	Open
10:26:34:055	KURHV_P	400kV	BKC1_1	Circuit Breaker	Open
10:26:34:055	KURHV_P	400kV	BKC1_2	Circuit Breaker	Open
10:26:34:055	KURHV_P	400kV	BKC2_1	Circuit Breaker	Open
10:26:34:055	KURHV_P	400kV	BKC3_1	Circuit Breaker	Open
10:26:34:055	KURHV_P	400kV	BKC3_2	Circuit Breaker	Open
10:26:34:055	KURHV_P	800kV	804_B	BusBar Isolator 1	Open
10:26:35:272	KURHV_P	800kV	802_B	BusBar Isolator 1	disturbe
10:26:35:814	KURHV_P	800kV	808_A	BusBar Isolator 1	disturbe
10:26:56:628	KURHV_P	800kV	802_B	BusBar Isolator 1	Open
10:26:56:628	KURHV_P	800kV	802_B	BusBar Isolator 1	disturbe
10:27:02:833	KURHV_P	800kV	808_A	BusBar Isolator 1	Open
10:27:02:833	KURHV_P	800kV	808_A	BusBar Isolator 1	disturbe
10:27:17:142	KURHV_P	800kV	802_B	BusBar Isolator 1	Open
10:27:17:142	KURHV_P	800kV	804_B	BusBar Isolator 1	disturbe
10:27:17:840	KURHV_P	800kV	808_A	BusBar Isolator 1	Open
10:27:19:852	KURHV_P	800kV	810_A	BusBar Isolator 1	disturbe
10:27:25:441	KURHV_P	800kV	804_B	BusBar Isolator 1	Open
10:27:25:858	KURHV_P	800kV	810_A	BusBar Isolator 1	Open

POWERGRID SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status
11:51:30:519	KURHV_P	400kV	BKC2_1	Circuit Breaker	Open
11:51:30:519	KURHV_P	400kV	BKC2_2	Circuit Breaker	Open
11:51:30:519	KURHV_P	400kV	BKC3_1	Circuit Breaker	Open
11:51:30:550	KURHV_P	800kV	804_B	BusBar Isolator 1	Open
11:51:30:550	KURHV_P	800kV	804_B	BusBar Isolator 1	disturbe
11:51:32:781	KURHV_P	400kV	19KURHV1	Circuit Breaker	Open
11:51:32:781	KURHV_P	400kV	20HV1TIE	Circuit Breaker	Open
11:51:32:781	KURHV_P	400kV	15KUR2TI	Circuit Breaker	Open
11:51:32:781	KURHV_P	400kV	14KURHV2	Circuit Breaker	Open
11:51:34:402	KURHV_P	400kV	30KURHV3	Circuit Breaker	Open
11:51:34:402	KURHV_P	400kV	31HV3TIE	Circuit Breaker	Open
11:51:34:402	KURHV_P	400kV	BKC5_2	Circuit Breaker	Open
11:51:34:402	KURHV_P	400kV	BKC6_1	Circuit Breaker	Open
11:51:36:196	KURHV_P	800kV	808_A	Circuit Breaker	Open
11:51:36:196	KURHV_P	800kV	808_A	Circuit Breaker	disturbe
11:51:36:196	KURHV_P	800kV	810_A	BusBar Isolator 1	Open
11:51:36:196	KURHV_P	800kV	810_A	BusBar Isolator 1	disturbe
11:51:38:661	KURHV_P	800kV	808_A	BusBar Isolator 1	disturbe
11:51:41:064	KURHV_P	800kV	804_B	BusBar Isolator 1	Open
11:51:56:975	KURHV_P	800kV	808_A	BusBar Isolator 1	Open
11:51:58:972	KURHV_P	800kV	808_A	BusBar Isolator 1	disturbe
11:52:19:252	KURHV_P	800kV	808_A	BusBar Isolator 1	Open
11:52:19:252	KURHV_P	800kV	810_A	BusBar Isolator 1	disturbe
11:52:28:518	KURHV_P	800kV	810_A	BusBar Isolator 1	Open

Observations

- Event Category: GI-2
- Generation Loss (in MW): Nil
- Load Loss (in MW): Nil

Analysis of tripping (As reported):

- HVDC Pole-3 was manually out on voltage regulation since previous night. At the time of start of these multiple tripping Pole-3 was brought into service
- 800kV HVDC Champa-Kurukshetra pole 1, pole 2 & pole 3 tripped at 1026Hrs due to CNAP (Common Neutral Area Protection) protection alarm present at Champa. 800kV HVDC Champa-Kurukshetra pole 2 & pole 3 charged at 1132Hrs & 1145Hrs respectively and again got tripped at 1151Hrs due to same reason.
- When all the poles are in service, their neutral current in common area must be zero as per logic. But after charging of Pole-3 its current was not reflected properly for the common neutral area. At that time Lane-2 of Pole-3 (BiPole-2) was communicating for common area current.
- There was no abnormality in the system but due to improper reflection of Pole-3 current for common area, Pole-1 & 2 was blocked. Further, as per scheme there is intercommunication between Bipole-1 (Pole-1 &2) and BiPole-2 (Pole-3 right now) for the said pole-1 but there was no feedback from Bipole-2, hence all pole-3 also got tripped.

Observations

Analysis of tripping (As reported):

- **Special finding/ issues identified during restoration**: There is some bits communication issue between Bipole-1 and Bipole-2, which is the cause of such mal operations.

S. No.	Name of the Element (along with voltage level	Corrective Action Implemented		Corrective Action Recommended		Time frame for pending Recommendation		Remarks
		End A	End B	End A	End B	End A	End B	
1	800 kV HVDC Pole-1, 2, & 3	The cause of maloperation i.e. intercommunication problem or any bug issue has been taken up with OEM. OEM ensured to rectify it during coming shut down for Pole-4 under commissioning.						

Restoration time of HVDC: 12:17 Hrs, 30.12.2019

Observations

As per PMU, SCADA data:

- As per PMU, no fault captured.
- Fault Clearance time: **NA**
- SoE captured only for some of the tripped elements.

Points for Discussion

- Frequent tripping of HVDC Champa-Kurukshetra due to mal-operation or software bug needs to be addressed.
- HVDC is very important for reliability and security of the grid and its protection needs to be intact for such kind of mal-operation.
- Details of CNAP protection in HVDC to be shared during meeting
- Outcome of discussion with OeM also to be shared with NRPC/ NRLDC.
- Remedial measures taken report also needs to be shared by POWERGRID.

A.5.8 Multiple element tripping 400 kV Banda UP

11.01.2020 at 02:38hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

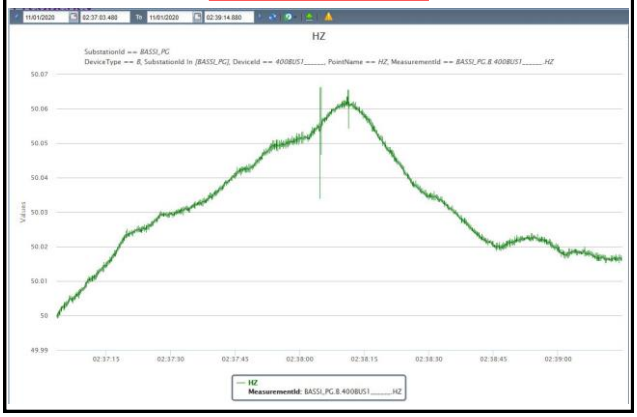
1. 400kV Banda-Orai ckt-1 opened on High voltage
2. 400kV Banda-Rewa Road ckt-2 opened on High Voltage
3. 400KV RR-OBRA Line Load: 74MW,Current: 188A,Voltage:434KV.
4. 400KV RR-PANKI Line Load: 86MW,Current: 162A,Voltage:405KV.
5. 400KV RR-Banda ckt#1 Line Load: 11MW,Current: 168A,Voltage:428KV.
6. 400KV RR-Masauli Line Load: 23MW,Current: 95A,Voltage:428KV.
7. 315 MVA ICT#1 Load: 69MW,Current: 103A,Voltage:423KV.
8. 315 MVA ICT#2 Load: 71MW,Current: 103A,Voltage:424KV.

Following elements tripped:-

1. 400KV Bus 1 at Banda(UP)
2. 400 KV Banda-Orai (UP) Ckt-2
3. 400 KV Obra_B-Rewa Road (UP) Ckt-1
4. 400 KV Rewa Road-Masoli (UP) Ckt-1
5. 400 KV Rewa Road-Panki (UP) Ckt-1
6. 400 KV Banda-Rewa Road (UP) Ckt-1
7. 400/220 kV 315 MVA ICT 1 & 2 at Rewa Road(UP)
8. 63 MVAR Bus Reactor No 1 at 400KV Banda(UP)

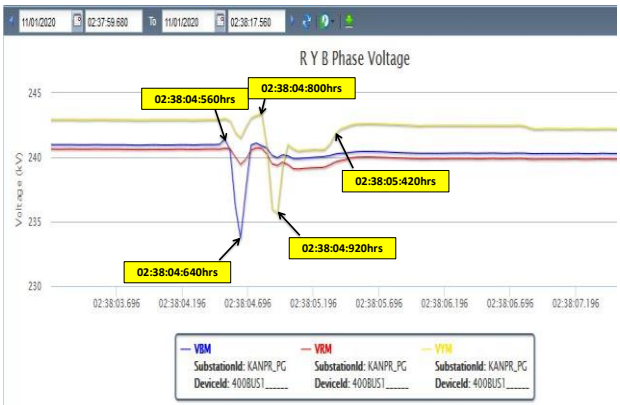
PMU Plot of frequency at Bassi(PG)

02:38hrs/11-Jan-20



PMU Plot of phase voltage magnitude at Kanpur(PG)

02:38hrs/11-Jan-20



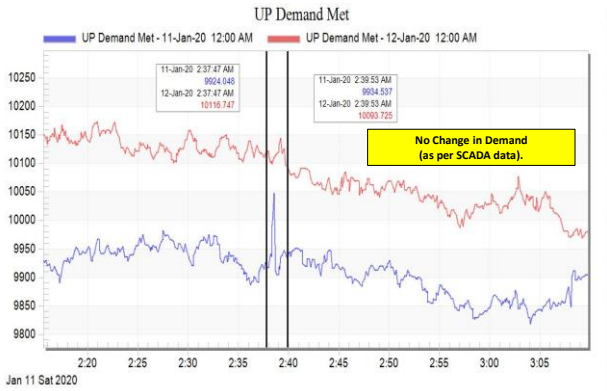
UP SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
02:38:04:664	**ALHA1_U**	**400kV**	**04BANDA1**	**Circuit Breaker**	**disturbe**	
02:38:04:667	ORAI1_U	400kV	05BNDFT2	Circuit Breaker	disturbe	
02:38:04:683	BNDA1_U	400kV	405BRORI	Circuit Breaker	Open	Tie CB of 400kV Orai(UP)-Banda(UP){end} ckt-2 opens.
02:38:04:686	ORAI1_U	400kV	06BANDA2	Circuit Breaker	Open	Main CB of 400kV Orai(UP)-Banda(UP) ckt-2 opens.
02:38:04:696	BNDA1_U	400kV	404BR	Circuit Breaker	Open	
02:38:04:735	**PANK1_UP**	**400kV**	**F_06(OBRAB)**	**Circuit Breaker**	**disturbe**	
02:38:04:738	**PANK1_UP**	**400kV**	**F_06(OBRAB)**	**Line Isolator**	**Open**	
02:38:04:919	ALHA1_U	400kV	01BR	Circuit Breaker	Open	Main CB of 125MVAR Bus reactor at 400kV Rewa Road(UP) opens.
02:38:04:919	ALHA1_U	400kV	04BANDA1	Circuit Breaker	disturbe	
02:38:04:922	ALHA1_U	400kV	09T2	Circuit Breaker	Open	400kV side Main CB of 315MVA ICT 2 at 400/220kV Rewa Road(UP) opens.
02:38:04:922	ALHA1_U	400kV	06T1	Circuit Breaker	Open	400kV side Main CB of 315MVA ICT 1 at 400/220kV Rewa Road(UP) opens.

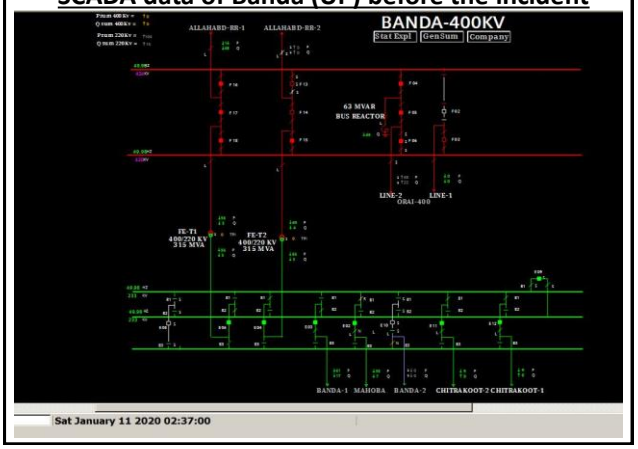
UP SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
02:38:04:922	ALHA1_U	400kV	08MBC	Circuit Breaker	Open	Bus coupler at 400kV Rewa Road(UP) opens.
02:38:04:922	ALHA1_U	400kV	10CHPAR	Circuit Breaker	Open	CB of 400kV Rewa Road(UP)-Masauli(UP) opens.
02:38:04:922	ALHA1_U	400kV	13PANKI	Circuit Breaker	Open	CB of 400kV Rewa Road(UP)-Panki(UP) opens.
02:38:04:924	CHPAR_U	400kV	LIALHA1	Protection Trip	App	
02:38:04:925	ALHA1_U	400kV	14OBRAB	Circuit Breaker	Open	CB of 400kV Rewa Road(UP)-Obra B(UP) opens.
02:38:04:934	ORAI1_U	400kV	05BNDFT2	Circuit Breaker	Open	Tie CB of 400kV Orai(UP)-Banda(UP) ckt-2 opens.
02:38:04:939	ALHA1_U	220kV	01T2	Circuit Breaker	Open	220kV side Main CB of 315MVA ICT 2 at 400/220kV Rewa Road(UP) opens.
02:38:04:939	ALHA1_U	220kV	03T1	Circuit Breaker	Open	220kV side Main CB of 315MVA ICT 1 at 400/220kV Rewa Road(UP) opens.
02:38:04:976	CHPAR_U	400kV	01ALHA1	Circuit Breaker	Open	
02:38:04:981	CHPAR_U	400kV	02ALHT1	Circuit Breaker	Open	
02:38:04:985	**BNDA1_U**	**400kV**	**416ALHA1**	**Circuit Breaker**	**Open**	**Main CB of 400kV Banda(UP){end}-Rewa Road(UP) ckt-1 opens.**
02:38:04:990	**BNDA1_U**	**400kV**	**417ALHT1**	**Circuit Breaker**	**Open**	**Tie CB of 400kV Banda(UP){end}-Rewa Road(UP) ckt-1 opens.**
02:38:06:196	ALHA1_U	400kV	04BANDA1	Protection Trip	App	
02:38:06:836	ALHA1_U	400kV	04BANDA1	Circuit Breaker	Open	CB of 400kV Rewa Road(UP)-Banda(UP) opens.
02:38:09:950	ALHA1_U	400kV	14OBRAB	Protection Trip	App	
02:38:11:042	ORAI1_U	400kV	05BNDFT2	Circuit Breaker	Close	
02:38:11:096	ORAI1_U	400kV	05BNDFT2	Circuit Breaker	Open	Tie CB of 400kV Orai(UP)-Banda(UP) ckt-2 opens.

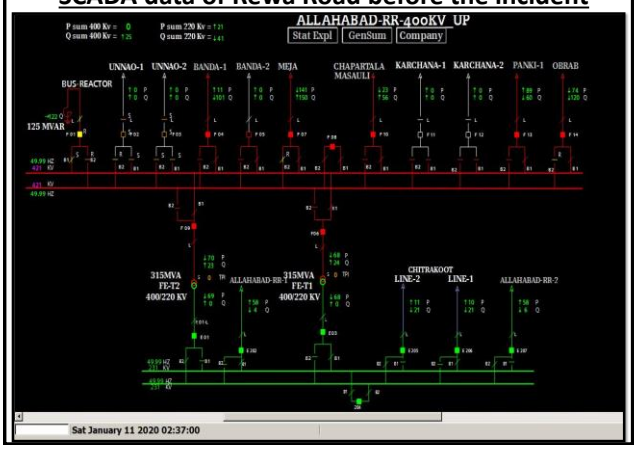
UP Demand pattern during tripping



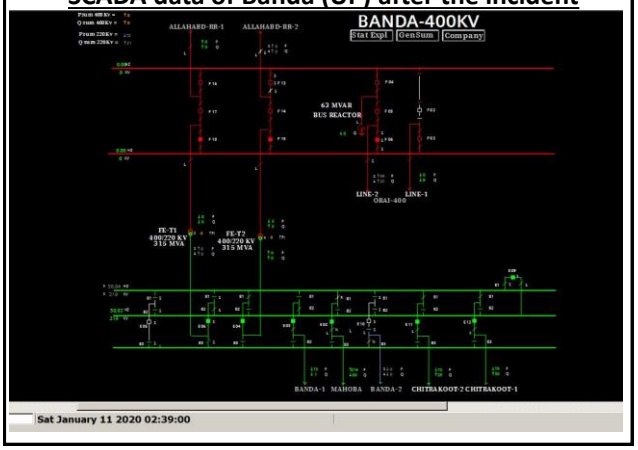
SCADA data of Banda (UP) before the incident



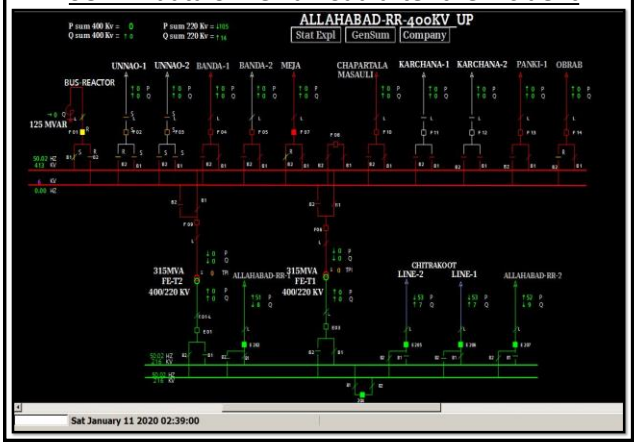
SCADA data of Rewa Road before the incident



SCADA data of Banda (UP) after the incident



SCADA data of Rewa Road after the incident



Extract of UP report

Sub: - Report on the Multiple Tripping at 400/220 S/S Banda.

At 02:38Hrs. on 11.01.2020 following elements at 400/220KV S/S Banda tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	400KV Banda- Rewa Road – I	11.01.20	05:02	DT rec., Z-4 pickup, O/V pickup
2.	400KV Banda- Orai – II	11.01.20	B/D	M-1,B-phase, Z-1 trip, Z-4 pickup, distance 0.837km.
3.	63MVAR Reactor	11.01.20	13:52	B-phase differential optd.

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

Analysis report of the tripped elements, DR, single line diagram, flags and analysis report of the relevant portion of the grid is enclosed at annexure (through mail).

Analysis:-

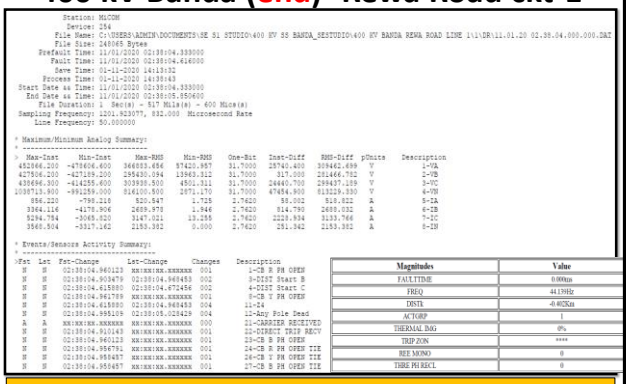
The analysis of aforementioned incident can be summarised under the following points:-

1. B-phase CT of Tie Bay of 400KV Banda – Orai –II got blast due to which the said line tripped.
2. Although faulty section isolated with the tripping of Tie and Main CB yet 400KV Banda-Rewa Road-I line sensed the fault and got tripped in Z-2 from Rewa Road end and sent DT command to 400KV Banda end and 400KV Banda – Rewa Road-I line tripped.
3. The other two line that is 400KV Banda – Orai –I and 400KV Banda – Rewa Road –II was already open due to high voltage.

Remedial Measures taken/to be taken:-

1. Concerned officer may give the status of Tie Bay CT replacement work.

400 kV Banda (end)- Rewa Road ckt-1



```
          Station: MLCOM
           Device: 254
        File Name: C:\USERS\ADMIN\DOCUMENTS\SE S1 STUDIO\400 KV SS BANDA_SESTUDIO\400 KV BANDA REWA ROAD LINE 1\1\DR\11.01.20 02.38.54.000.000.DAT
        File Size: 248065 Bytes
    Prefault Time: 11/01/2020 02:38:04.333000
      Fault Time: 11/01/2020 02:38:04.616000
      Save Time: 01-11-2020 14:13:32
     Process Time: 01-11-2020 14:38:43
 Start Date as Time: 11/01/2020 02:38:04.333000
  End Date as Time: 11/01/2020 02:38:05.950600
     File Duration: 1  Sec(s) - 517 Mils(s) - 600 Mics(s)
 Sampling Frequency: 1201.923077, 832.000  Microsecond Rate
    Line Frequency: 50.000000

* Maximum/Minimum Analog Summary:
*
>  Max-Inst     Min-Inst     Max-RMS     Min-RMS    One-Bit   Inst-Diff   RMS-Diff  pUnits    Description
 452566.200  -478606.600   366853.656   87420.957   31.7000   25740.400   309462.699   V         1-VA
 427506.200  -427189.200   295430.094   13963.312   31.7000     317.000   281466.782   V         2-VB
 436696.300  -414255.600   303938.500    4501.311   31.7000   24440.700   299437.189   V         3-VC
1038713.900  -991259.000   814100.500    2871.170   31.7000   47454.900   813229.330   V         4-VN
    866.220     -798.216      820.547       1.725    2.7620      58.002      818.822   A         5-IA
   3364.116    -4178.906     2659.973       1.946    2.7620     314.790     2658.022   A         6-IB
   5294.784    -3065.820     3147.021      13.255    2.7620    2229.934     3133.766   A         7-IC
   3545.504    -3317.162     2153.382       0.000    2.7620     291.342     2153.382   A         8-IN

* Events/Sensors Activity Summary:
* ---------------------------------
>Fst  Lst  Fst-Change        Lst-Change        Changes   Description
 N    N    02:38:04.340125   XX:XX:XX.XXXXXX   001       1-CB R PH OPEN
 N    N    02:38:04.903479   02:38:04.940453   002       5-DIST Start B
 N    N    02:38:04.615800   02:38:04.672456   002       4-DIST Start C
 N    N    02:38:04.941798   XX:XX:XX.XXXXXX   001       7-CB Y PH OPEN
 N    N    02:38:04.615800   02:38:04.940453   004       11-Z4
 N    N    02:38:04.995109   02:38:05.028428   004       12-Any Pole Dead
 A    A    XX:XX:XX.XXXXXX   XX:XX:XX.XXXXXX   000       21-CARRIER RECEIVED
 N    N    02:38:04.910143   XX:XX:XX.XXXXXX   001       22-DIRECT TRIP RECV
 N    N    02:38:04.340125   XX:XX:XX.XXXXXX   001       23-CB B PH OPEN
 N    N    02:38:04.956791   XX:XX:XX.XXXXXX   001       24-CB B PH OPEN TIE
 N    N    02:38:04.958487   XX:XX:XX.XXXXXX   001       26-CB Y PH OPEN TIE
 N    N    02:38:04.958487   XX:XX:XX.XXXXXX   001       27-CB B PH OPEN TIE
```

Magnitudes	Value
FAULTTIME	0.000ms
FREQ	44.139Hz
DISTA	-0.402Km
ACTGRP	1
THERMAL IMG	0%
TRIP ZON	****
REF MONO	0
THRE PI RECL	0

400 kV Banda (end)-Rewa Road ckt-1 - Z-4 (reverse zone protection) protection start and DT received (It seems line tripped on DT receipt from remote end)

Extract of UP report

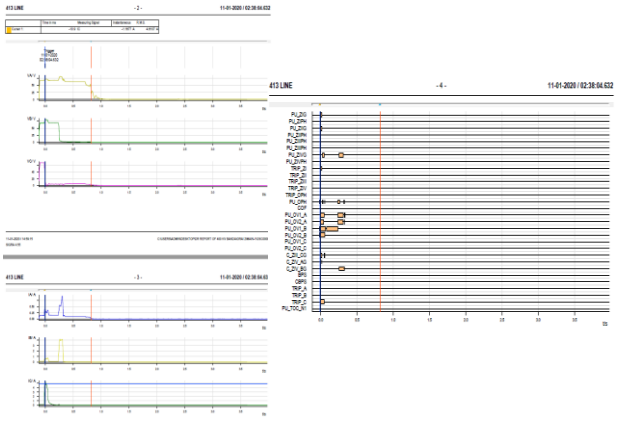
A. Introduction

Time & Date of Event:	02.38 hrs 11.01.2020
Substation(s) affected along with voltage level:	400 KV S/S BANDA
Brief Event Summary:	B Phase CT of tie bay (405) of 400 KV BANDA-ORAI-II ckt. Blast.

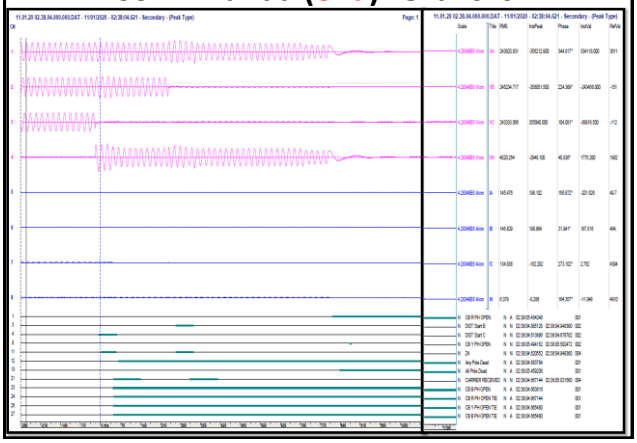
B. Antecedent Conditions

Weather Information:	-
Additional relevant information viz. power flow, shutdowns etc:	On Dt. 11.01.2020 at 00.13Hrs 400KV Banda- Orai Line I & on dt. 11.01.2020 at 1.37Hrs 400KV Banda-Rewa Road line II were opened due to over voltage as per instruction of control.
Name and time of the tripped elements in time chronology: Based upon time stamped event log, DR etc.	1- 63 MVAR Reactor, at 02.38 hrs 2- 400 KV BANDA-ORAI LINE-II, at 02.38 hrs. 3- 400 KV BANDA-REWA ROAD LINE-I, at 02.38 hrs.
Location and type of fault:	B Phase CT of tie bay (405) of 400 KV BANDA-ORAI-II ckt. Blast.
Flag Details, DR and EL for each affected element:	**1-63 MVAR REACTOR-** B phase differential optd. **2-400 KV BANDA-ORAI LINE-II-** MAIN-I B phase trip, zone-1 trip, zone-4 pickup, Dist. .837 KM, Fault Ic-3.28A **Main-II** zone-4 pickup, O/V start V>1,2. **3-400 KV BANDA-REWA ROAD LINE-I-** Zone-4 Pickup, O/V pickup. MAIN-II zone-4 pickup, O/V start V>1,2, DT Received.

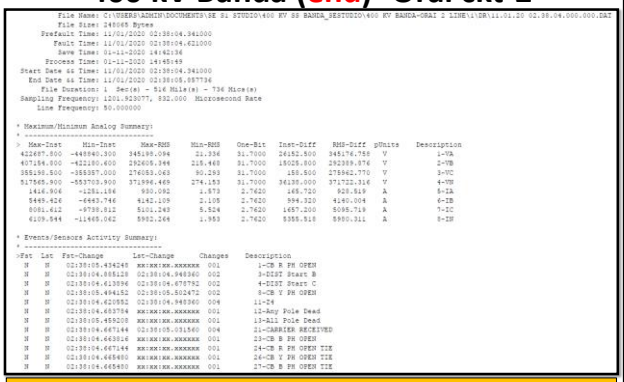
400 kV Banda (end)- Orai ckt-2



400 kV Banda (end)- Orai ckt-2



400 kV Banda (end)- Orai ckt-2



R-phase opened after 800ms of fault occurrence. Y-phase open signal was showing after 850ms however voltage became zero in 260ms.

Extract of UP report

On 11.01.2020 at 02:38Hrs. 400KV transmission lines connected with 400/220KV S/S Rewa Road tripped. Normalization time of the elements is mentioned below:-

Sl. No.	Name of Element	Date & time of Normalization		Remark
1.	400KV Rewa Road – Obra line	11.01.20	10:29	GT, O/V, 86A, 86B optd.,BB optd.
2.	400KV Rewa Road – Banda – I	11.01.20	05:01	GT, Y-phase, B-phase, Z-2, DIF optd.
3.	400KV Rewa Road – Panki	11.01.20	07:38	O/V trip, BB optd.
4.	400KV Rewa Road – Masauli	11.01.20	07:05	E/F, BB optd.
5.	315MVA ICT- I	11.01.20	04:34	86A, 86B optd.
6.	315MVA ICT-II	11.01.20	04:19	-do-
7.	125MVAR Bus Reactor	11.01.20	07:47	BB optd.

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

Analysis report of the tripped elements, DR, single line diagram, flags and analysis report of the relevant portion of the grid is enclosed at annexure (through mail).

Analysis:-

The analysis of aforementioned incident can be summarised under the following points:-

1. On 11.01.2020 at 02:38Hrs. B-phase CT of Tie Bay of 400KV Banda – Orai- II blasted at 400KV Banda S/S.
2. Since 400KV Banda S/S is connected to 400KV Rewa Road S/S through double circuit line in which circuit –II was already open due to high voltage and ckt.-I at 400KV S/S Rewa Road sensed the fault in Z-2 with above mentioned flag.
3. At 400KV S/S Rewa Road due to pole discrepancy in the CB of 400KV Rewa Road-Banda line– I, R-phase, Y-phase pole opened but B-phase pole opened with some time delay so the line did not trip timely which caused LBB to operate.
4. At that moment all the elements was connected to same bus so all the element at 400KV side tripped except 400KV Rewa Road – Meja line.
5. As per information received, protection cable of relay of 400KV Rewa Road – Meja line was loose so that no tripping command was given to 400KV Rewa Road – Meja line.

Extract of UP report

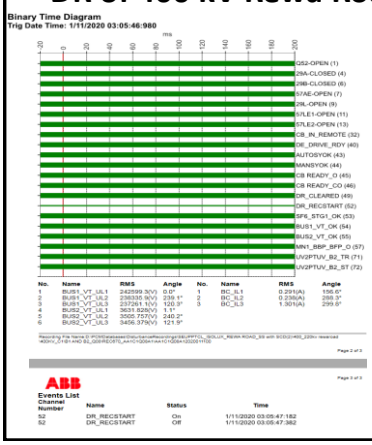
Remedial Measures taken/ to be taken:-

- 400 kV Breaker in which pole discrepancy was found, has been tested and found ok.
- Protection cable of relay of 400 kV Meja-Rewa Road line has been inspected and corrective action had been taken on 11.01.2020
- Concerned officer may give reason for connecting all the elements in 400 kV Bus-1 at Rewa Road (UP)
- Concerned authority may carry out thorough testing of breakers and relays

Flag Details

SI 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	11.01.2020/02:38hrs	11.01.2020/05:01hrs	400kV GIS SS Rewa Road - Banda ckt#1	404	ABB REL-670 & REC-670 P444	General trip Y-Ph trip B-Ph trip Zone-2 DIF Operated	172.9KM	Due to CT blast in B-phase of 400KV Banda-Orai transmission line at Banda Substation,the fault reflected on 400KV Rewarwad-Banda ckt#1 at400KV Rewarwad Substation end and Zone-2 Earth fault sensed at 2:38:04:660hrs.But the breaker of same line couldn't not open properly.So LBB/BFP initiated at 2:38:04:866 hrs and the other lines along with ICTs, Reactor were tripped. Note: All loads was in a single bus at that moment.
2	11.01.2020/02:38hrs	11.01.2020/07:47hrs	400kV GIS SS 125MVAr Reactor	401	REB 670	BB Optd	N/A	
3	11.01.2020/02:38hrs	11.01.2020/07:05hrs	400kV GIS SS Rewa Road - Masauli	410	ABB REL-670 & REC-670 P444	Earth fault BB Optd	not found	
4	11.01.2020/02:38hrs	11.01.2020/07:38hrs	400kV GIS SS Rewa Road - Panki ckt	413	ABB REL-670 & REC-670	Over Voltage Trip BB Optd	N/A	
5	11.01.2020/02:38hrs	11.01.2020/10:29hrs	400kV GIS SS Rewa Road - Obra ckt	414	ABB REL-670 & REC-670 P444	General trip Over voltage trip 86A & 86B OPTD BB Optd	N/A	
6	11.01.2020/02:38hrs	11.01.2020/04:34hrs	400kV GIS SS 315 MVA ICT#1	406	ABB RET 670 REC 670	86A & 86B Operated	N/A	
7	11.01.2020/02:38hrs	11.01.2020/04:19hrs	400kV GIS SS 315 MVA ICT#2	409	ABB RET 670 REC 670	86A & 86B Operated	N/A	

DR of 400 kV Rewa Road (end) Bus Bar



Time Synch error in bus bar DR

DR of 400 kV Rewa Road (end)-Banda 1

Channel Number	Name	Status	Time
70	TEF1-STFW	On	1/11/2020 02:38:04:608
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:608
91	PHS START	On	1/11/2020 02:38:04:615
24	PHS-STFWL3	On	1/11/2020 02:38:04:618
25	PHS-STFWPE	On	1/11/2020 02:38:04:618
10	ZM02-START	On	1/11/2020 02:38:04:621
12	ZM03-START	On	1/11/2020 02:38:04:621
3	TRIP L3	On	1/11/2020 02:38:04:624
7	ZM01-TRIP	On	1/11/2020 02:38:04:624
8	ZM01-START	On	1/11/2020 02:38:04:624
69	TEF1-START	On	1/11/2020 02:38:04:624
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:624
62	CB_OPEN_Bph	On	1/11/2020 02:38:04:660
66	MN_CB_OPEN	On	1/11/2020 02:38:04:663
69	TEF1-START	Off	1/11/2020 02:38:04:664
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:664
65	MN_CB_CLOSED	Off	1/11/2020 02:38:04:666
87	BRC START	On	1/11/2020 02:38:04:672
24	PHS-STFWL3	Off	1/11/2020 02:38:04:681
25	PHS-STFWPE	Off	1/11/2020 02:38:04:681
91	PHS START	Off	1/11/2020 02:38:04:681
70	TEF1-STFW	Off	1/11/2020 02:38:04:688
71	TEF1-STRV	On	1/11/2020 02:38:04:688
7	ZM01-TRIP	Off	1/11/2020 02:38:04:690
8	ZM01-START	Off	1/11/2020 02:38:04:690
10	ZM02-START	Off	1/11/2020 02:38:04:690
12	ZM03-START	Off	1/11/2020 02:38:04:690
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:696
63	PRE3ph_TRIP	On	1/11/2020 02:38:04:737
3	TRIP L3	Off	1/11/2020 02:38:04:777
87	BRC START	Off	1/11/2020 02:38:04:784
34	DRP-RECSTART	On	1/11/2020 02:38:04:790
70	TEF1-STFW	On	1/11/2020 02:38:04:864
71	TEF1-STRV	Off	1/11/2020 02:38:04:864
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:864
87	BRC START	On	1/11/2020 02:38:04:872
23	PHS-STFWL2	On	1/11/2020 02:38:04:873
25	PHS-STFWPE	On	1/11/2020 02:38:04:873
91	PHS START	On	1/11/2020 02:38:04:873
10	ZM02-START	On	1/11/2020 02:38:04:876
12	ZM03-START	On	1/11/2020 02:38:04:876
1	TRIP L1	On	1/11/2020 02:38:04:879
2	TRIP L2	On	1/11/2020 02:38:04:879
3	TRIP L3	On	1/11/2020 02:38:04:879
7	ZM01-TRIP	On	1/11/2020 02:38:04:879
8	ZM01-START	On	1/11/2020 02:38:04:879
69	TEF1-START	On	1/11/2020 02:38:04:880
70	TEF1-STFW	Off	1/11/2020 02:38:04:880
71	TEF1-STRV	On	1/11/2020 02:38:04:880
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:880
53	DTS_CH1_PLCC	On	1/11/2020 02:38:04:888
60	CB_OPEN_Rph	On	1/11/2020 02:38:04:916
69	TEF1-START	Off	1/11/2020 02:38:04:960
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:960
80	TOV1-START	On	1/11/2020 02:38:04:960
71	TEF1-STRV	Off	1/11/2020 02:38:04:968
7	ZM01-TRIP	Off	1/11/2020 02:38:04:969

Recording File Name:D:\PCM\Databases\DisturbanceRecordings\SEUPPTCL_ISOLUX_REWA ROAD_SS with SCD(2)\400\400KV_C1\BANDA 1_Q24\REL670_AA1C1Q24FP1\AA1C1Q24FP1202001113a3

ABB

8	ZM01-START	Off	1/11/2020 02:38:04:969
23	PHS-STFWL2	Off	1/11/2020 02:38:04:969
25	PHS-STFWPE	Off	1/11/2020 02:38:04:969
91	PHS START	Off	1/11/2020 02:38:04:969
10	ZM02-START	Off	1/11/2020 02:38:04:972
12	ZM03-START	Off	1/11/2020 02:38:04:972
69	TEF1-START	On	1/11/2020 02:38:04:976
70	TEF1-STFW	On	1/11/2020 02:38:04:976
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:976
34	DRP-RECSTART	Off	1/11/2020 02:38:04:992
80	TOV1-START	Off	1/11/2020 02:38:05:016
1	TRIP L1	Off	1/11/2020 02:38:05:029
2	TRIP L2	Off	1/11/2020 02:38:05:029
3	TRIP L3	Off	1/11/2020 02:38:05:029
87	BRC START	Off	1/11/2020 02:38:05:072
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:134

Z-2 start than Z-1 trip in Y-phase to earth fault, A/R didn't operate, other phase breaker trip on pole discrepancy. B-phase failed to operate further resulted into LBB protection.

DR of 400 kV Rewa Road (end)-Masauli

Events List

Channel Number	Name	Status	Time
71	TEF1-STRV	On	1/11/2020 02:38:04:615
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:615
87	BRC START	On	1/11/2020 02:38:04:615
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:623
71	TEF1-STRV	Off	1/11/2020 02:38:04:671
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:671
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:687
34	DRP-RECSTART	On	1/11/2020 02:38:04:720
87	BRC START	Off	1/11/2020 02:38:04:783
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:863
71	TEF1-STRV	On	1/11/2020 02:38:04:879

Recording File Name:D:\PCM\Databases\DisturbanceRecordings\SEUPPTCL_ISOLUX_REWA ROAD_SS with SCD(2)\400\400KV_C1\MASAULI_Q10\REL670_AA1C1Q10FP1\AA1C1Q10FP1202000111 2a4

ABB

72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:879
87	BRC START	On	1/11/2020 02:38:04:879
53	DTS_CH1_PLCC	On	1/11/2020 02:38:04:887
63	PRE3ph_TRIP	On	1/11/2020 02:38:04:905
60	CB_OPEN_Rph	On	1/11/2020 02:38:04:917
61	CB_OPEN_Yph	On	1/11/2020 02:38:04:917
62	CB_OPEN_Bph	On	1/11/2020 02:38:04:917
65	MN_CB_CLOSED	Off	1/11/2020 02:38:04:919
66	MN_CB_OPEN	On	1/11/2020 02:38:04:919
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:920
34	DRP-RECSTART	Off	1/11/2020 02:38:04:920
71	TEF1-STRV	Off	1/11/2020 02:38:04:927
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:935
78	TUV1-START	On	1/11/2020 02:38:04:944
87	BRC START	Off	1/11/2020 02:38:05:031
34	DRP-RECSTART	On	1/11/2020 02:38:06:320
34	DRP-RECSTART	Off	1/11/2020 02:38:06:520
33	DRP-RECMADE	On	1/11/2020 02:38:06:920
33	DRP-RECMADE	Off	1/11/2020 02:38:07:321

Line tripped on LBB protection

DR of 400 kV Rewa Road (end)-Obra

Events List

Channel Number	Name	Status	Time
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:608
71	TEF1-STRV	On	1/11/2020 02:38:04:616
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:624
71	TEF1-STRV	Off	1/11/2020 02:38:04:672
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:672
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:688
34	DRP-RECSTART	On	1/11/2020 02:38:04:748
34	DRP-RECSTART	Off	1/11/2020 02:38:04:749
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:864
71	TEF1-STRV	On	1/11/2020 02:38:04:872
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:880

Recording File Name:D:\PCM\Databases\DisturbanceRecordings\SEUPPTCL_ISOLUX_REWA ROAD_SS with SCD(2)\400\400KV_C1\OBRA_Q14\REL670_AA1C1Q14FP1\AA1C1Q14FP1202001111240

ABB

53	DTS_CH1_PLCC	On	1/11/2020 02:38:04:889
60	CB_OPEN_Rph	On	1/11/2020 02:38:04:918
61	CB_OPEN_Yph	On	1/11/2020 02:38:04:918
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:920
65	MN_CB_CLOSED	Off	1/11/2020 02:38:04:921
66	MN_CB_OPEN	On	1/11/2020 02:38:04:921
62	CB_OPEN_Bph	On	1/11/2020 02:38:04:922
71	TEF1-STRV	Off	1/11/2020 02:38:04:928
80	TOV1-START	On	1/11/2020 02:38:04:928
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:936
34	DRP-RECSTART	On	1/11/2020 02:38:06:348
34	DRP-RECSTART	Off	1/11/2020 02:38:06:548
33	DRP-RECMADE	On	1/11/2020 02:38:06:948
33	DRP-RECMADE	Off	1/11/2020 02:38:07:349

Line tripped on LBB protection

DR of 400 kV Rewa Road (end)-Panki

Events List

Channel Number	Name	Status	Time
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:609
71	TEF1-STRV	On	1/11/2020 02:38:04:618
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:625
87	BRC START	On	1/11/2020 02:38:04:625
34	DRP-RECSTART	On	1/11/2020 02:38:04:660
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:673
71	TEF1-STRV	Off	1/11/2020 02:38:04:681
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:690
87	BRC START	Off	1/11/2020 02:38:04:769

Recording File Name:D:\PCM\Databases\DisturbanceRecordings\SEUPPTCL_ISOLUX_REWA ROAD_SS with SCD(2)\400\400KV_C1\PANKI_Q13\REL670_AA1C1Q13FP1\AA1C1Q13FP1202001113f

ABB

34	DRP-RECSTART	Off	1/11/2020 02:38:04:859
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:865
71	TEF1-STRV	On	1/11/2020 02:38:04:882
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:882
53	DTS_CH1_PLCC	On	1/11/2020 02:38:04:888
87	BRC START	On	1/11/2020 02:38:04:889
63	PRE3ph_TRIP	On	1/11/2020 02:38:04:902
61	CB_OPEN_Yph	On	1/11/2020 02:38:04:918
62	CB_OPEN_Bph	On	1/11/2020 02:38:04:918
60	CB_OPEN_Rph	On	1/11/2020 02:38:04:919
72	TEF1-2NDHARMD	On	1/11/2020 02:38:04:921
65	MN_CB_CLOSED	Off	1/11/2020 02:38:04:923
66	MN_CB_OPEN	On	1/11/2020 02:38:04:923
71	TEF1-STRV	Off	1/11/2020 02:38:04:930
72	TEF1-2NDHARMD	Off	1/11/2020 02:38:04:937
78	TUV1-START	On	1/11/2020 02:38:05:009
80	TOV1-START	On	1/11/2020 02:38:05:017
87	BRC START	Off	1/11/2020 02:38:05:026
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:034
78	TUV1-START	Off	1/11/2020 02:38:05:041
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:079
78	TUV1-START	On	1/11/2020 02:38:05:081
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:103
78	TUV1-START	Off	1/11/2020 02:38:05:105
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:109
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:121
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:154
78	TUV1-START	On	1/11/2020 02:38:05:161
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:163
78	TUV1-START	Off	1/11/2020 02:38:05:170
80	TOV1-START	Off	1/11/2020 02:38:05:170
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:175
78	TUV1-START	On	1/11/2020 02:38:05:177
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:184
78	TUV1-START	Off	1/11/2020 02:38:05:185
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:193
78	TUV1-START	On	1/11/2020 02:38:05:194
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:205
78	TUV1-START	Off	1/11/2020 02:38:05:209
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:214
78	TUV1-START	On	1/11/2020 02:38:05:218
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:232
78	TUV1-START	Off	1/11/2020 02:38:05:233
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:235
78	TUV1-START	On	1/11/2020 02:38:05:242
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:250
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:256
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:271
78	TUV1-START	Off	1/11/2020 02:38:05:273
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:274
78	TUV1-START	On	1/11/2020 02:38:05:281
32	L1 FUSE FAIL	On	1/11/2020 02:38:05:289
78	TUV1-START	Off	1/11/2020 02:38:05:290
32	L1 FUSE FAIL	Off	1/11/2020 02:38:05:295
78	TUV1-START	On	1/11/2020 02:38:05:297
34	DRP-RECSTART	On	1/11/2020 02:38:06:259
34	DRP-RECSTART	Off	1/11/2020 02:38:06:459
33	DRP-RECMADE	On	1/11/2020 02:38:07:077

Line tripped on LBB protection

Station EL 400 kV Rewa Road (end)

#			Time (ET+EM)	Station	Bay	Device	Object Text	Event Text
477	*		2020-01-11 02:38:04.624	REWAROAD	404	RELM1	Directional E/F Start	Alarm
478	*		2020-01-11 02:38:04.624	REWAROAD	404	RELM1	Protection Trip B-Phase	Alarm
479	*		2020-01-11 02:38:04.624	REWAROAD	404	RELM1	Protection Trip	Alarm
480			2020-01-11 02:38:04.709	REWAROAD	410	RELM1	Power Swing Detected	External deblocke
481			2020-01-11 02:38:04.678	REWAROAD	404	P444	General Protection Start	Off
482			2020-01-11 02:38:04.678	REWAROAD	404	P444	Earth Fault Stage-1 Start	Off
483			2020-01-11 02:38:04.711	REWAROAD	407	RELM1	Power Swing Detected	External deblocke
484			2020-01-11 02:38:04.677	REWAROAD	404	P444	Zone-2 Start	Off
485	*		2020-01-11 02:38:04.625	REWAROAD	404	P444	Zone-2 Start	On
486			2020-01-11 02:38:04.608	REWAROAD	409	RET2	Over Excitation alarm	Normal
487			2020-01-11 02:38:04.674	REWAROAD	407	P444	General Protection Start	Off
488			2020-01-11 02:38:04.674	REWAROAD	407	P444	Earth Fault Stage-1 Start	Off
489			2020-01-11 02:38:04.609	REWAROAD	409	RET1	Over Excitation Alarm	Normal
490	*		2020-01-11 02:38:04.635	REWAROAD	404	REC	AR in Progress	Alarm
491			2020-01-11 02:38:04.635	REWAROAD	404	REC	AR Ready	Normal
492	*		2020-01-11 02:38:04.631	REWAROAD	4BB1	REB1	Bay C04 3-phase LBB initiation	Alarm
493	*		2020-01-11 02:38:04.631	REWAROAD	4BB1	REB2	Bay C04 3-phase LBB initiation	Alarm
494	*		2020-01-11 02:38:04.631	REWAROAD	4BB1	REB3	Bay C04 B-phase LBB initiation	Alarm
495	*		2020-01-11 02:38:04.631	REWAROAD	4BB1	REB3	Bay C04 3-phase LBB initiation	Alarm
496		<	2020-01-11 02:38:04.612	REWAROAD	414	RELM1	Power Swing Detected	External blocked
497		<	2020-01-11 02:38:04.612	REWAROAD	414	RELM1	Power Swing Detected	Obsolete status
498		<	2020-01-11 02:38:04.611	REWAROAD	413	RELM1	Power Swing Detected	External blocked
499		<	2020-01-11 02:38:04.611	REWAROAD	413	RELM1	Power Swing Detected	Obsolete status
500		<	2020-01-11 02:38:04.609	REWAROAD	404	RELM1	Power Swing Detected	External blocked
501		<	2020-01-11 02:38:04.609	REWAROAD	404	RELM1	Power Swing Detected	Obsolete status
502		<	2020-01-11 02:38:04.610	REWAROAD	410	RELM1	Power Swing Detected	External blocked
503		<	2020-01-11 02:38:04.610	REWAROAD	410	RELM1	Power Swing Detected	Obsolete status
504	*		2020-01-11 02:38:04.614	REWAROAD	407	P444	General Protection Start	On
505	*		2020-01-11 02:38:04.614	REWAROAD	407	P444	Earth Fault Stage-1 Start	On
506	*		2020-01-11 02:38:04.612	REWAROAD	404	P444	General Protection Start	On
507	*		2020-01-11 02:38:04.612	REWAROAD	404	P444	Earth Fault Stage-1 Start	On
508		<	2020-01-11 02:38:04.609	REWAROAD	407	RELM1	Power Swing Detected	External blocked
509		<	2020-01-11 02:38:04.609	REWAROAD	407	RELM1	Power Swing Detected	Obsolete status

Why station event logger in not time stamped

Station EL 400 kV Rewa Road (end)

425	*		2020-01-11 02:38:04.941	REWAROAD	410	P444	Over Voltage Stage-1 Start	On
426	*		2020-01-11 02:38:04.941	REWAROAD	410	P444	General Protection Start	On
427	*		2020-01-11 02:38:04.903	REWAROAD	410	REC	CB readu fro C-O operation	Normal
428	*		2020-01-11 02:38:04.901	REWAROAD	410	REC	AR block	Alarm
429	*		2020-01-11 02:38:04.927	REWAROAD	414	P444	Over Voltage Stage-1 Start	On
430	*		2020-01-11 02:38:04.927	REWAROAD	414	P444	General Protection Start	On
431			2020-01-11 02:38:04.909	REWAROAD	413	P444	Prepare 3-ph trip	On
432	*		2020-01-11 02:38:04.904	REWAROAD	2BB1	REB1	BAY D03 3-phase LBB initiation	Alarm
433	*		2020-01-11 02:38:04.903	REWAROAD	2BB1	REB1	BAY D01 3-phase LBB initiation	Alarm
434	*		2020-01-11 02:38:04.868	REWAROAD	404	P444	Earth Fault Stage-1 Start	On
435			2020-01-11 02:38:04.911	REWAROAD	410	P444	Prepare 3-ph trip	On
436	*	<	2020-01-11 02:38:04.911	REWAROAD	407	MUXU1	Current L2	Overflow
437	*		2020-01-11 02:38:04.887	REWAROAD	408	REC	Main-1 BFP/BBP operated	Alarm
438	*		2020-01-11 02:38:04.887	REWAROAD	410	REC	96 Operated	Alarm
439	*		2020-01-11 02:38:04.893	REWAROAD	410	P444	DTS Channel-2 PLCC counter	On
440	*		2020-01-11 02:38:04.896	REWAROAD	413	P444	DTS Channel-2 PLCC counter	On
441	*		2020-01-11 02:38:04.896	REWAROAD	414	P444	DTS Channel-2 PLCC counter	On
442	*		2020-01-11 02:38:04.877	REWAROAD	407	P444	General Protection Start	On
443	*		2020-01-11 02:38:04.877	REWAROAD	407	P444	Earth Fault Stage-1 Start	On
444	*	<	2020-01-11 02:38:04.876	REWAROAD	404	MUXU1	Current L2	Overflow
445			2020-01-11 02:38:04.967	REWAROAD	406	RET1	Over Excitation Alarm	Normal
446	*		2020-01-11 02:38:04.876	REWAROAD	404	RELM1	Zone-3 Start	Alarm
447	*		2020-01-11 02:38:04.876	REWAROAD	404	RELM1	Zone-2 Start	Alarm
448			2020-01-11 02:38:04.783	REWAROAD	4BB1	REB1	Bay C04 3-phase LBB initiation	Normal
449			2020-01-11 02:38:04.783	REWAROAD	4BB1	REB2	Bay C04 3-phase LBB initiation	Normal
450			2020-01-11 02:38:04.791	REWAROAD	4BB1	REB3	Bay C04 B-phase LBB initiation	Normal
451			2020-01-11 02:38:04.783	REWAROAD	4BB1	REB3	Bay C04 3-phase LBB initiation	Normal
452			2020-01-11 02:38:04.705	REWAROAD	414	RELM1	Power Swing Detected	External deblocked
453			2020-01-11 02:38:04.701	REWAROAD	413	RELM1	Power Swing Detected	External deblocked
454	*		2020-01-11 02:38:04.691	REWAROAD	404	P444	Over Voltage Stage-1 Start	On
455	*		2020-01-11 02:38:04.691	REWAROAD	404	P444	General Protection Start	On
456			2020-01-11 02:38:04.776	REWAROAD	404	QF1 B	Disconn. open interlocked	Off
457	*		2020-01-11 02:38:04.731	REWAROAD	404	REC	Prepare 3ph trip from AR	Alarm
458			2020-01-11 02:38:04.700	REWAROAD	404	REC	AR start	Normal
459			2020-01-11 02:38:04.677	REWAROAD	404	QF9 B	Disconn. open interlocked	Off
460			2020-01-11 02:38:04.677	REWAROAD	404	QA1	Breaker close interlocked	Off
461			2020-01-11 02:38:04.677	REWAROAD	404	QA1	Breaker open interlocked	On
462	*		2020-01-11 02:38:04.664	REWAROAD	404	QA1	Breaker position indication	Intermediate
463	*		2020-01-11 02:38:04.649	REWAROAD	404	REC	CB readu fro C-O operation	Normal
464	*		2020-01-11 02:38:04.637	REWAROAD	404	REC	AR start	Alarm
465			2020-01-11 02:38:04.777	REWAROAD	404	RELM1	Protection Trip B-Phase	Normal
466			2020-01-11 02:38:04.777	REWAROAD	404	RELM1	Protection Trip	Normal
467	*		2020-01-11 02:38:04.737	REWAROAD	404	RELM1	Prepare 3-phase trip	Alarm
468			2020-01-11 02:38:04.690	REWAROAD	404	RELM1	Zone-3 Start	Normal
469			2020-01-11 02:38:04.690	REWAROAD	404	RELM1	Zone-2 Start	Normal
470			2020-01-11 02:38:04.690	REWAROAD	404	RELM1	Zone-1 Operated	Normal
471			2020-01-11 02:38:04.690	REWAROAD	404	RELM1	Zone-1 Start	Normal
472			2020-01-11 02:38:04.664	REWAROAD	404	RELM1	Directional E/F Start	Normal
473	*		2020-01-11 02:38:04.621	REWAROAD	404	RELM1	Zone-3 Start	Alarm
474	*		2020-01-11 02:38:04.621	REWAROAD	404	RELM1	Zone-2 Start	Alarm
475	*		2020-01-11 02:38:04.624	REWAROAD	404	RELM1	Zone-1 Operated	Alarm
476	*		2020-01-11 02:38:04.624	REWAROAD	404	RELM1	Zone-1 Start	Alarm

Sequence of tripping at Rewa Road

Tripping Sequence-

- 125MVAr Bus Reactor 2:38:04:919 hrs on 11.01.2020
- 400KV Rewa road-Panki line 2:38:04:922 on 11.01.2020
- 400KV Rewa road-Masauli line 2:38:04:922 on 11.01.2020
- 315MVA ICT#1 2:38:04:922 on 11.01.2020
- 315MVA ICT#2 2:38:04:922 on 11.01.2020
- 400KV Rewa road-Obra line 2:38:04:925 on 11.01.2020
- 400KV Rewa road-Banda ckt#1 i line 2:38:06:836 on 11.01.2020 (**Breaker failed to operate, LBB protection operated**)

As flags in ABB Relay (M1 & M2)-

- 125MVAr Bus Reactor (BB optd)
- 400KV Rewaroad-Panki line (Over voltage Trip,BB Optd)
- 400KV Rewaroad-Masauli line (BB Optd)
- 315MVA ICT#1 (BB Optd)
- 315MVA ICT#2 (BB Optd)
- 400KV Rewaroad-Obra line (General Trip,OV Trip,BB Trip,86A & 86B Optd)
- 400KV Rewaroad-Banda ckt#1(General Trip,Y-Ph trip,B-ph trip,Zone-2 Trip,Earth fault,Distance-170.9km)

Observations

- Event Category: GI-2
- Generation Loss (in MW): Nil
- Load Loss (in MW): Nil (As per UP report)

Analysis of tripping (As reported):

- At 400 kV Banda (UP) station have one and half breaker scheme. It is connected through Rewa Road D/C & Orai D/C. It also have two 400/220 kV 315 MVA ICTs and one 63 MVAr bus reactor. Further 400 kV Rewa Road station have double bus single breaker scheme. It is connected with 400 kV Banda D/C, Meja S/C, Masauli S/C, Panki-1 S/C & Obra B. It also have 125 MVAr bus reactor and two 315 MVA 400/220 kV ICTs.
- In antecedent condition, 400kV Banda-Orai ckt-1 opened on High voltage & 400kV Banda-Rewa Road ckt-2 opened on High Voltage.
- Y-phase CT of tie bay of 400 kV Banda-Orai ckt-2 bursted and finally tripped but at the same time 400 kV Banda-Rewa Road (end)- ckt-1 also sensed the fault in Z-1 and issued tripping command for B-phase breaker. B-phase breaker failed to operate and further resulted into LBB (Local breaker backup) protection operation.
- LBB protection operation resulted into operation of 400 kV bus bar protection for 400 kV bus-1 at Rewa Road. All the elements at 400 kV Rewa Road (UP) station were connected on 400 kV Bus-1 and all the elements tripped due to LBB operation except 400 kV Rewa Road-Meja ckt, it didn't trip due to loose protection control cable.

Observations

Analysis of tripping (As reported):

- 63 MVAr bus reactor at Banda (UP) operated on differential protection as it was connected with faulted tie bay (CT bursted).
- All the 400 kV elements at Rewa Road were connected on 400 kV Bus-1 at Rewa Road (UP).
- 400 kV bus-1 of Banda (UP) station also became dead after tripping of 400 kV Banda-Rewa Road ckt-1
- Multiple element tripping at Rewa Road (UP) also occurred on 16th Jun 2019 discussed in 39th PSC meeting. Detailed report of the tripping and remedial measure report is still awaited.

Observations

As per PMU, SCADA data:

- As per PMU, B-phase to earth fault followed by Y-phase to earth fault.
- Fault Clearance time: **100ms & 620ms**
- SoE captured only for some of the tripped elements.
- As per SoE 400 kV Panki (end)-Obra B ckt also tripped during the incident.

Remedial Measures taken/ to be taken:-

- 400 kV Breaker in which pole discrepancy was found, has been tested and found ok.
- Protection cable of relay of 400 kV Meja-Rewa Road (end) line has been inspected and corrective action had been taken on 11.01.2020
- Concerned officer may give status of tie bay CT replacement in 400 kV Banda (end)-Orai ckt-2
- Concerned officer may give reason for connecting all the elements in 400 kV Bus-1 at Rewa Road (UP)
- Concerned authority may carry out thorough testing of breakers and relays

Points for Discussion

- Reason of delayed clearance of fault? (More than 600ms, in case of correct LBB protection it should be maximum 300ms)
- 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.
- Sensitive distance protection setting of 400 kV Rewa Road-Banda ckt-1 needs to be looked in view of Z-1 tripping (verified from station EL) of the line. Breaker operation time needs to be tested and reported.
- Why pole discrepancy in 400 kV Rewa Road-Banda ckt-1 came into picture and line tripped within 620ms of fault occurrence?
- Sensitive distance protection setting of 400 kV Panki (end)-Obra B ckt also needs to be checked and corrected.
- Reason of operational issue like connectivity of all 400 kV elements on 400 kV Bus-1 at Rewa Road (UP) needs to be informed.
- Time synch error of 400 kV LBB/ Bus bar protection DR of Rewa Road (end) needs to be corrected.
- UPPTCL shall submit the detailed report considering the aforesaid points and submit the remedial measures report.

Outcome of 38th PSC meeting (Event date 16th Jun 2019 & 15:13hrs)

- Event couldn't be discussed thoroughly due to insufficient information from the utilities. It was decided during the meeting that UPPTCL shall internally review the protection setting of 400 kV Banda (UP) & Rewa Road station.
- A report covering the following points w.r.t. the tripping to be shared (Action: SLDC-UP, UPPTCL; Time: by 15.01.2020):
  - Sensitive distance zone protection setting at 400 kV Banda station needs to be checked and corrected.
  - Sensitive DEF protection setting in 400 kV Banda (end)-Rewa Road ckt-1 needs to be relooked.
  - Reason of tripping of 400kV Rewa Road (end)-Banda ckt-2 in Z-1 protection and over voltage protection also needs to be looked into.
  - Reverse zone protection setting in 400 kV Rewa Road (end)-Orai ckt-2 needs to be checked in view of reverse zone coverage upto transmission line from remote bus, single phase tripping & A/R in reverse zone.
  - Thorough protection setting review needs to be done at 400 kV Banda & Rewa Road ckts
  - Observation mentioned in UP report needs to relooked in view of aforesaid points.
  - Detailed report in NRPC approved format to be submitted considering the aforesaid points

A.5.9 Multiple element tripping 220 kV Wagoora (PG)

13.01.2020 at 13:21hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

- 220 KV Wagoora(PG)-Pampore (PDD) (PDD JK) Ckt-1 & 2 carrying 121MW & 125MW respectively.

Following elements tripped during the event:-

1. 400 KV Chamera_2(NH)-Chamera_1(NH) (PG) Ckt-1
2. 400 KV Chamera_2(NH)-Kishenpur(PG) (PG) Ckt-1
3. 220 KV Wagoora(PG)-Pampore(PDD) (PDD JK) Ckt-2
4. 220 KV Wagoora(PG)-Pampore(PDD) (PDD JK) Ckt-1

PMU Plot of frequency at Bassi(PG)

13:21hrs/13-Jan-20

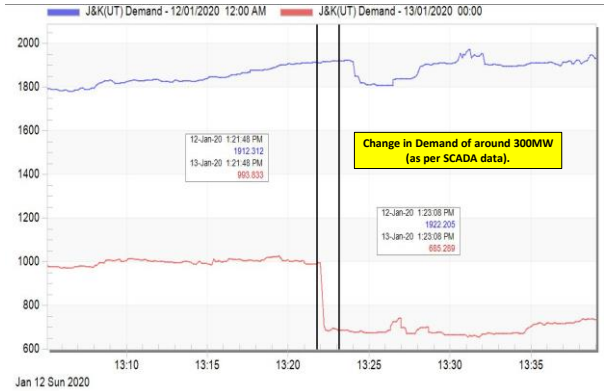
PMU Plot of phase voltage magnitude at Kishenpur(PG)

13:21hrs/13-Jan-20

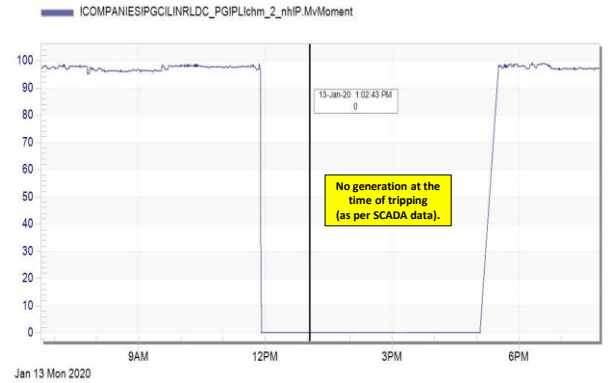
POWERGRID/NHPC SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
13:21:58:198	SRINAGAR	220kV	06PAMPO2	Circuit Breaker	Open	CB of 220kV Wagoora(PG)-Pampore(JK) ckt-2 opens.
13:21:58:221	SRINAGAR	220kV	07PAMPO1	Circuit Breaker	Open	CB of 220kV Wagoora(PG)-Pampore(JK) ckt-1 opens.
13:22:02:525	CHAMERA I	400kV	L6CHM2	Circuit Breaker	Open	CB of 400kV Chamera I(NHPC)- Chamera II(NHPC) opens.
13:22:03:251	KISHENPUR	400kV	09CHMR	Circuit Breaker	Open	CB of 400kV Kishenpur(PG)-Chamera II(NHPC) opens.

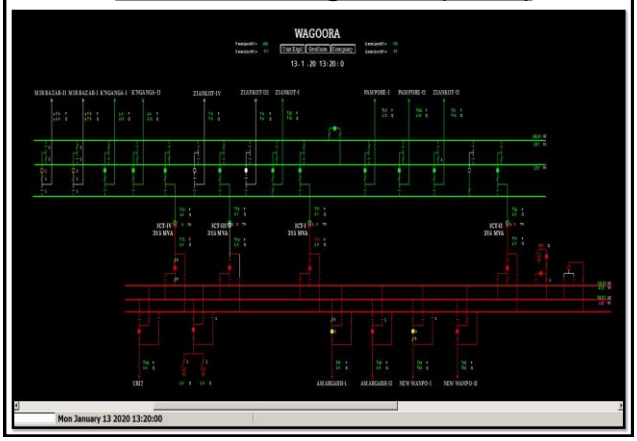
J&K Demand pattern during tripping



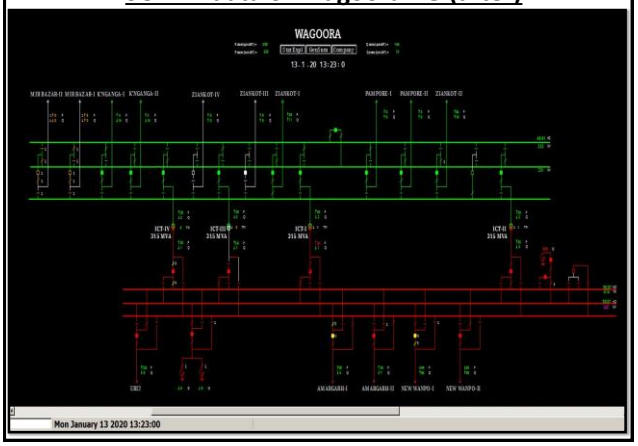
Chamera II Generation pattern during tripping



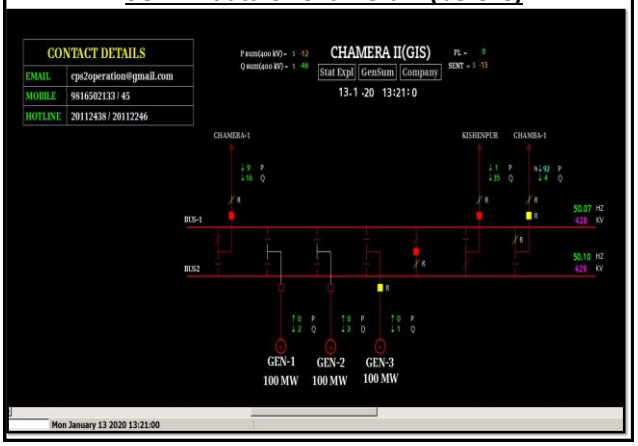
SCADA data of Wagoora PG (before)



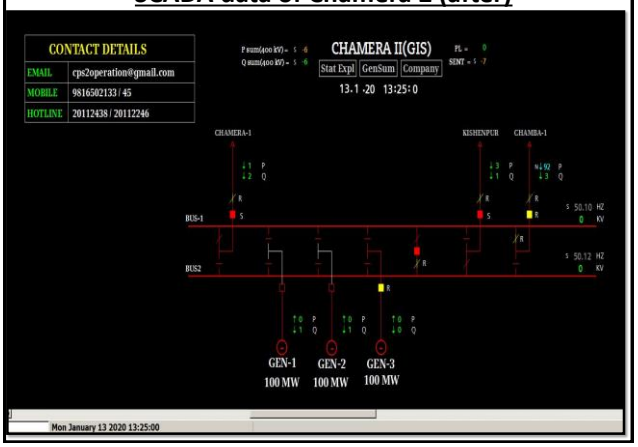
SCADA data of Wagoora PG (after)



SCADA data of Chamera 2 (before)



SCADA data of Chamera 2 (after)

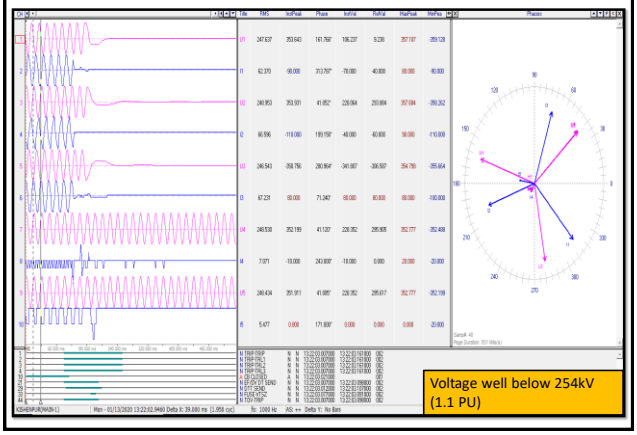


NHPC DETAILS

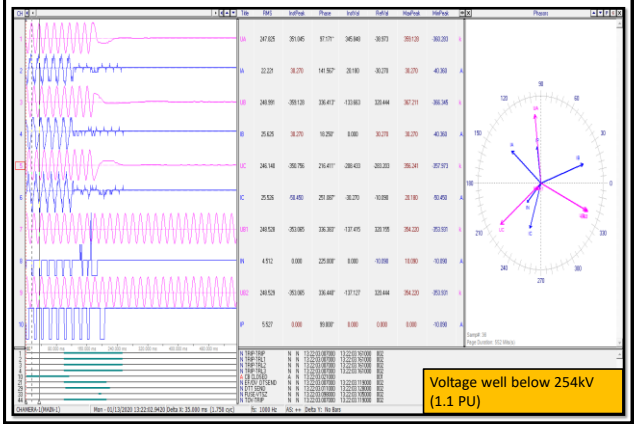
Extract from NHPC

A. Introduction:	
1. Time and Date of Event	**On 13/01/2020 at 13:22 hrs.**
2. Substation(s) Affected along with voltage level	चमेरा-II पावर स्टेशन
3. Brief Event summery	
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.	NIL.
3. Single Line Diagram (SLD) of affected Area:	NA
4. Name and time of the tripped elements in time chronology:	Chamera2-Kishanpur Line#1 at 13:22 hrs. on 13-Jan-2020 Chamera2-Chamera1 Line#2 at 13:22 hrs. on 13-Jan-2020
5. Location and type of fault.	Over Voltage in B-Phase
6.Flag Details, DR and EL for each affected element:	Enclosed.
7. Appropriate Graphical Plot:	N.A.
8. Equipment failure (if any):	NIL.
D. Event Description/ Analysis of the Event	1. Line#1: It is evident from the DR of the distance protection relay of Chamera2-Kishanpur Line-I that maximum increase in voltage is 249.27 KV in B-phase. Accordingly at 13:22:03.007 Hrs, Over voltage protection relay operated & Line CB opened at 13:22:03.021 Hrs. The Direct trip Send to remote end at 13:22:03.012 Hrs as evident from DR. 2. Line#2: It is evident from the DR of the distance protection relay of Chamera2-Chamera1 Line-II that maximum increase in voltage is 249.39 KV in B-phase. Accordingly at 13:22:03.008 Hrs, Over voltage protection relay operated & Line CB opened at 13:22:03.021 Hrs. The Direct trip Send to remote end at 13:22:03.008 Hrs as evident from DR.
E. Restoration	
1. Restoration time of tripped elements in time chronology	Chamera2-Kishanpur Line#1 at 17:31 hrs. on 13-Jan-2020Chamera2-Chamera1 Line#2 at 17:10 hrs. on 13-Jan-2020
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.	NIL.
G. Lesson Learnt	NIL.
A. Any other Information	NIL.

DR of 400 kV Chamera2 (end)-Kishenpur1 ckt



DR of 400 kV Chamera2 (end)-Chamera1 ckt



POWERGRID DETAILS

Extract of POWERGRID report

A. Introduction

1. Time & Date of Event :13:21 hrs on 13.01.2020

B. Substation(s) affected along with voltage level: 220 kV Wagoora

C. Brief Event Summary: Both Lines tripped on B-N fault due to fault at 220kV Pampore S/S. Bus Voltage at 220 kV Pampore substation becomes zero.

D. Antecedent Conditions :

1. Weather Information: Clear.
2. Additional relevant information viz. power flow, shutdowns etc.: All 400 and 220 kV lines and ICTs were in service with following load distribution on 220 kV side:

(i) 315 MVA ICT-1 & 3 were connected to bus-1.
(ii) 315 MVA ICT-2 & 4 were connected to bus-2.
(iii) 220 kV Pampore -1 & Zainakot-1 were connected to bus -1
(iv) 220 kV Pampore -2 & Zainakot-2 were connected to bus -2

E. Event data :

1. Change in Frequency: Nil
2. Generation Loss/Load Loss: approx.
3. Single Line Diagram (SLD) of affected Area: NA
4. Name and time of the tripped elements in time chronology:

Sl No	Element Tripped	Time	Remarks
1	220 kV Wagoora Pampore-1	13:21:58.210	Tripped in Z3
2	220 kV Wagoora Pampore-2	13:21:58.180	Tripped in Z3

5. DR for each affected element: Enclosed
6. Appropriate Graphical Plot: N/A
7. Equipment failure (if any):

Sl. No.	Name of the Element (along with voltage level	Details to be filled in case of Equipment failure					Reason
		Element type	Rating	Make	Year of Manufacturing	Year of Commissioning	
1							

A. Event Description / Analysis of the Event: Both Lines tripped on B-N fault in Zone-3. The fault location observed at Wagoora is 47.5 km and 42.5 km for ckt-1 and 2 respectively. However, the total line is 10.29 km only. Fault lies in the 220 kV or 132 kV level of J&KPCL (JKPDD). It is also learnt that bus Voltage at 220 kV Pampore substation became zero.

B. Restoration:

Element Name	Restoration Time
220 kV Wagoora Pampore-1	14:14 hrs
220 kV Wagoora Pampore-2	14:14 hrs

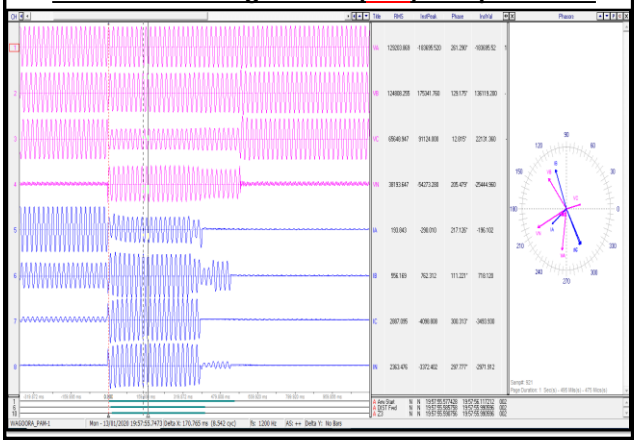
C. Special finding/ issues identified during restoration: NIL

I. Remedial Action:

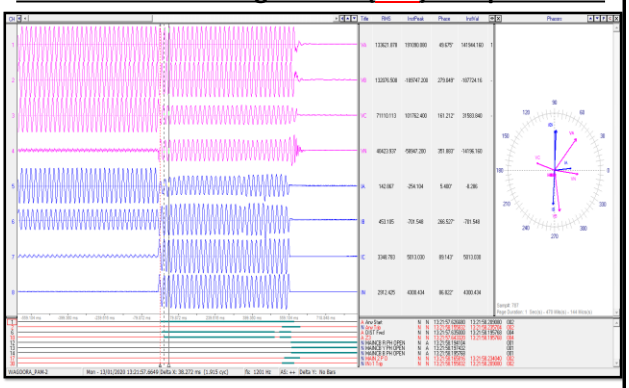
S. No.	Name of the Element (along with voltage level	Corrective Action Implemented		Corrective Action Recommended		Time frame for pending Recommendation		Remarks
		End A	End B	End A	End B	End A	End B	
1		NA	NA					

J. Any other Information: NA

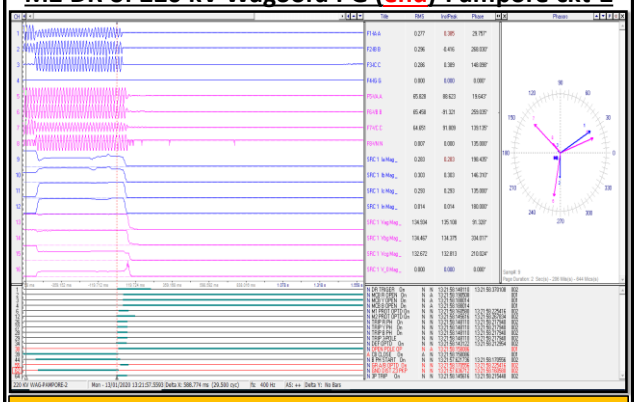
DR of 220 kV Wagoora PG (end)-Pampore ckt-1



M1 DR of 220 kV Wagoora PG (end)-Pampore ckt-2



M2 DR of 220 kV Wagoora PG (end)-Pampore ckt-2



M-2 operated on DEF (directional earth fault protection). Sensitive DEF setting needs to be looked into.

Observations

- Event Category: GD-1
- Generation Loss (in MW): Nil
- Load Loss (in MW): 300 MW (J&K may confirm)

Analysis of tripping (As reported):

- At 400/220 kV Wagoora (PG) station have double main transfer breaker scheme. It is connected through New Wanpoh D/C, Amargarh D/C & Uri-2 ckt. It also have four 400/220 kV 315 MVA ICTs. At 220 kV level, it is connected with Pampore D/C, Zainakote D/C & Kishanganga D/C
- In antecedent conditions, 220 KV Wagoora(PG)-Pampore (PDD) (PDD JK) Ckt-1 & 2 carrying 121MW & 125MW respectively.
- As reported, 220 kV Wagoora(PG)-Pampore (PDD) (PDD JK) Ckt-1 & 2 tripped on B-N fault.
- After 4-5 second of above tripping, 400 kV Chamera_2(NH)-Chamera_1(NH) (PG) Ckt-1, 400 KV Chamera_2(NH)-Kishenpur (PG) (PG) Ckt tripped on overvoltage.
- As per PMU, B-N fault with delayed clearance of 560ms is observed in the system.
- Preliminary report, DR/EL and detailed report are still awaited from POWERGRID & NHPC.

Observations

As per PMU, SCADA data:

- As per PMU, B-phase to earth fault.
- Fault Clearance time: **560ms**
- As per SCADA soe, 400 kV Chamera I-Chamera2 ckt tripped after 4.2 second of fault clearance and 400 kV Chamera 2-Kishenpur ckt tripped after 5 second of fault clearance.

Points for Discussion

- Exact location of fault and nature of fault. (May be in J&K network)
- Reason of delayed clearance of fault? (Protection didn't operate in J&K N/W)
- Why two 220 kV lines tripped on single phase to earth fault needs to be looked into.
- Tripping of 220 kV Wagoora-Pampore ckt-2 on DEF protection needs to be looked into.
- Exact reason of tripping of 400 kV Chamera 1-Chamera 2 ckt. and 400 kV Chamera 1-Kishenpur ckt. needs to be checked and reported.
- Over voltage setting at 400kV Chamera II(NHPC) needs to be looked into. Reset ratio of over voltage protection setting also needs to be checked. Voltage at the time of tripping was well below the set value of 1.1 PU, which is 254kV per phase.
- 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.
- Analog and digital data (SCADA SoE) status to be checked and corrected.
- POWERGRID/ NHPC shall submit the detailed report considering the aforesaid points and submit the remedial measures report.

A.5.10 Multiple element tripping 400 kV Malerkotla PG & 220 kV Malerkotla (Punjab)

28.01.2020 at 19:27hrs

Antecedent Condition and Tripped Elements

Antecedent Condition:-

Unit-2 was operating as per schedule

Following elements tripped at 22:55hrs:-

1. 400/220 kV 315 MVA ICT 2 at Malerkotla (PG)
2. 400/220 kV 500 MVA ICT 3 at Malerkotla (PG)
3. 400/220 kV 315 MVA ICT 1 at Malerkotla (PG)
4. 400 KV Ludhiana-Malerkotla (PG) Ckt-1
5. 400 KV Malerkotla-Patiala (PG) Ckt-1
6. 220 kV Malerkotla (Punjab)-Dhuro ckt-1 & 2
7. 220 kV Malerkotla (Punjab)-Sandhaur ckt-1 & 2
8. 220 kV Malerkotla (Punjab)-Ikolaha ckt
9. 220 kV Malerkotla (Punjab)-Amloh ckt
10. 220 kV Malerkotla (Punjab)-Malerkotla (PG) ckt-1,2&3
11. 100MVA 220/66 kV ICT-1 & 2 (160 MVA & 100 MVA)

PMU Plot of frequency at Bassi(PG)

19:27hrs/28-Jan-20

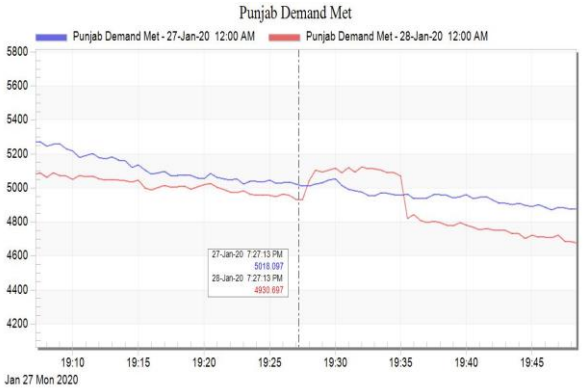
PMU Plot of phase voltage magnitude at Malerkotla(PG)

19:27hrs/28-Jan-20

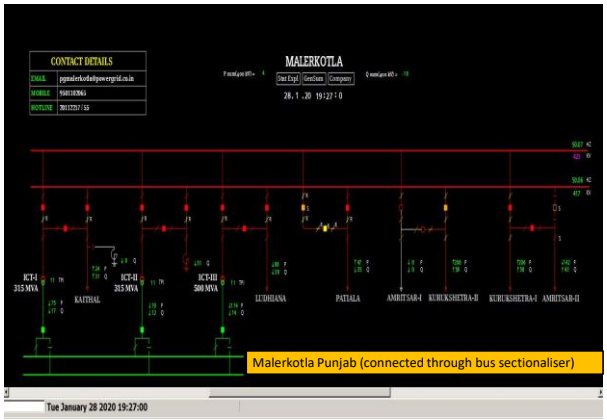
POWERGRID SCADA SOE

Time	S/S Name	Voltage Level (in kV)	Element Name	Element Type	Status	Remarks
19:27:46:***	PATIALA	400kV	2PA1MLE	Circuit Breaker	Open	Tie CB of 400kV Patiala(PG)(End)-Malerkotla(PG) opens.
19:27:46:***	PATIALA	400kV	3MLERK	Circuit Breaker	Open	Main CB of 400kV Patiala(PG)(End)-Malerkotla(PG) opens.

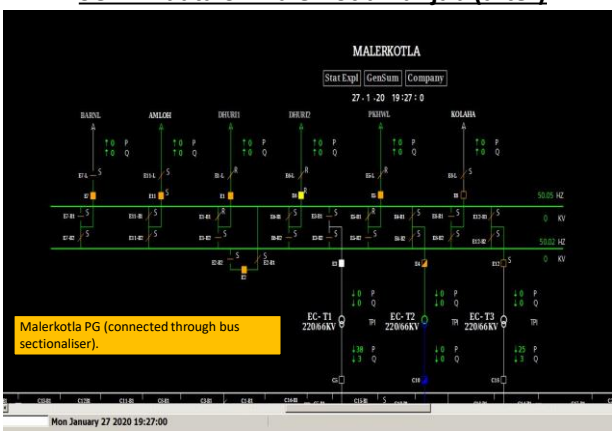
Punjab Demand pattern during tripping



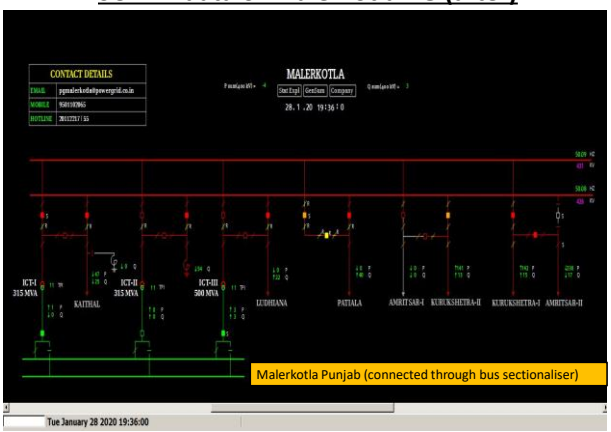
SCADA data of Malerkotla PG (before)



SCADA data of Malerkotla Punjab (after)



SCADA data of Malerkotla PG (after)



As per Punjab report

Element Tripped: - 220kV Malerkotla – Dhurickts- 1&2, 220kVMalerkotla – Sandhaur ckts-1&2, 220 kV Malerkotla - Ikolaha,220 kV Malerkotla - Amloh, PGCIL ckts-1, 2 & 3,100 MVA Transformer T- 2,100 MVA Transformer T- 3

1.	Confirm the actual load loss.	320MW
2.	Reason of bus fault.	R-phase Insulator string (between CB and Bus isolator) of Dhuri Ckt-2 (Connected to Busbar-1) snapped and jumper fell on Busbar-2 leading to Bus fault.
3.	Action being taken to prevent such incident in future.	Attached
4.	Reason of delayed clearance of fault as per IEGC.	Bus bar relay was in blocked condition
5	Detailed Report	
a.	Time and date of event (GPS Sync time)	**28.01.202019:27Hrs**
b.	Location.	220kV S/S Malerkotla(Punjab)
c.	Plant and/or Equipment directly involved.	**220kV Malerkotla – Dhuri ckts-1 &2** **220kVMalerkotla – Sandhaur ckts-1& 2** **220 kV Malerkotla–Ikolaha** **220 kV Malerkotla - Amloh** **PGCIL ckts-1, 2 & 3** **100 MVA Transformer T- 2** **100 MVA Transformer T- 3**
d.	Single line diagram showing the connection (isolators) of various 220 KV lines, bus coupler, ICT's etc	Attached
e.	Description and cause of event.	R-phase Insulator string (between CB and Bus isolator) of Dhuri Ckt-2 (Connected to Busbar-1) snapped and jumper fell on Busbar-2 leading to Bus Fault on both Bus-bars.
f.	Antecedent conditions of load and generation, including frequency, voltage and the flows in the affected area.	Generation Loss – NIL Load Loss – 320MW Frequency – 49.96Hz Voltage –234kv
g.	Time duration of tripping including Weather Condition prior to the event.	Weather Condition - Rainy
h.	Duration of interruption and Demand and/or Generation (in MW and MWh) interrupted.	Nil
i.	All Relevant system data including copies of records of all recording instruments including Disturbance Recorder, Event Logger, DAS etc of DPR's of affected lines.	Attached
j.	Sequence of tripping with time.	Attached
k.	Details of Relay Flags.	Attached
l.	Remedial measures.	Attached

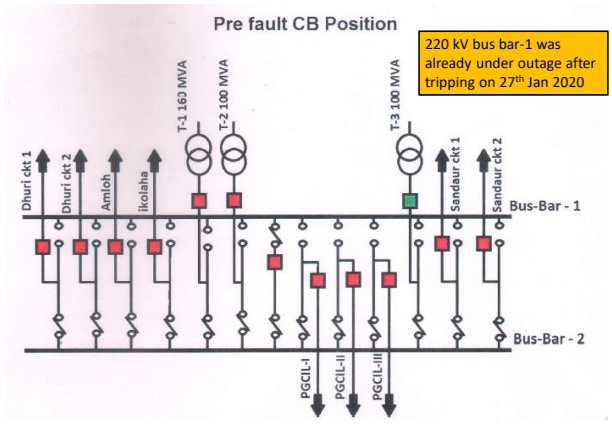
As per Punjab report

220 kV Sub-station PSTCL Malerkotla

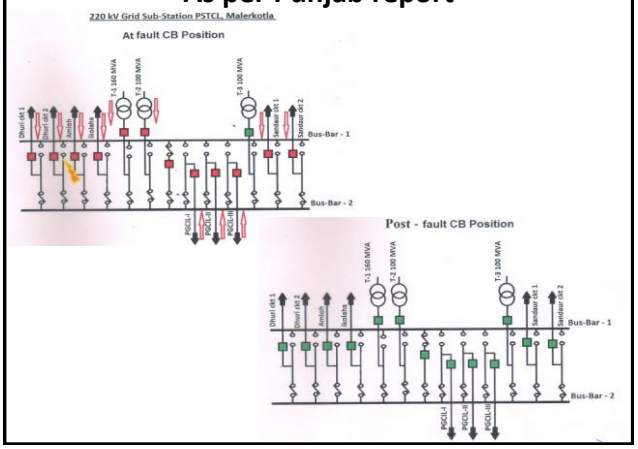
Loading condition Before and After the Power System Fault Occurrence

Sr No	T/Line or T/F Description	Bus (1/2)	BEFORE (19:00 HRS) Load in Amp/MW	AFTER (20:00 HRS) Load in Amp/MW
1	220kV Malerkotla – Dhuri ckt 1	2	-47 Amp	OFF
2	220kV Malerkotla – Dhuri ckt 2	2	-47 Amp	OFF
3	220 kV Malerkotla – Amloh	2	+177 Amp	OFF
4	220kV Malerkotla – Sandhaur ckt 1	2	+154 Amp	OFF
5	220kV Malerkotla – Sandhaur ckt 2	2	+154 Amp	OFF
6	220 kV Malerkotla – Ikolaha	2	+146 Amp	OFF
7	220 kV PGCIL ckt 1	2	-196 Amp	OFF
8	220 kV PGCIL ckt 2	2	-196 Amp	OFF
9	220 kV PGCIL ckt 3	2	-300 Amp	OFF
10	160 MVA Transformer T-1	2	104 Amp	OFF
11	100 MVA Transformer T- 2	2	68 Amp	OFF
12	100 MVA Transformer T- 3	2	OFF	OFF
13	Bus Coupler	-	ON	OFF

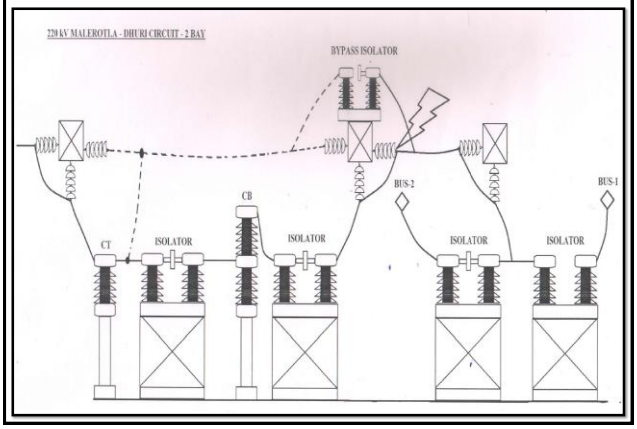
As per Punjab report



As per Punjab report



As per Punjab report

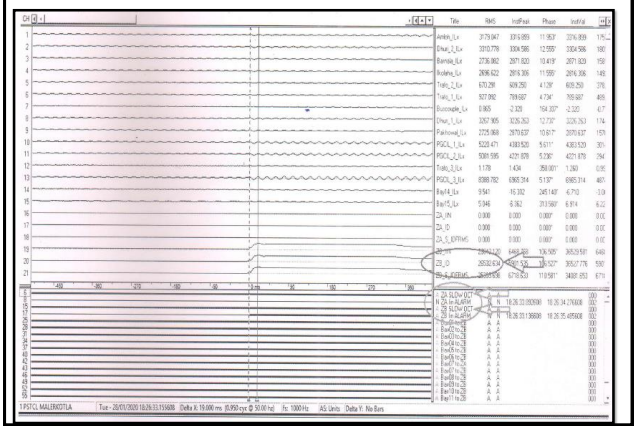


As per Punjab report

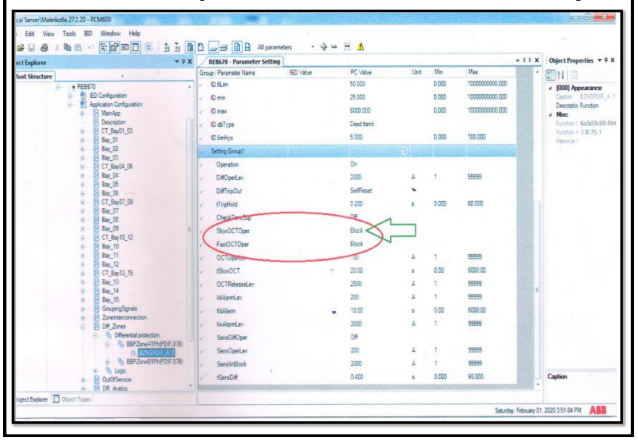
BUS-BAR PROTECTION SCHEME:

- R-phase insulator string (Before CB, i.e. Bus side) of 220 kV Malerkotla - Dhuri circuit No. 2 (which was connected to Busbar-1) snapped and jumpers fell on 220 kV Busbar-2 leading to 220 kV Bus-bar fault on both the 220 kV buses.
- Fault entered in differential zone of 220 kV Busbar-2 (220 kV Bus bar-I was charged but not loaded at time of incident) but differential protection feature of the relay was blocked as Open CT (OCT) Alarm was raised for both the 220 kV buses (Za & Zb) before the fault instant.
- One day before i.e. on 27th January, there was a fault on 220 kV bus-1, so all the circuits were shifted to 220 kV bus-2 and system was running as per that arrangement.
- Since at Malerkotla auxiliary switches of isolators are not working properly so they have installed two way switches in the respective panels to manually select each isolator's (i.e for bus isolator I and 2) status given to bus bar relay. After doing all isolator operations when operator comes to control room, he manually changes the position of switches as per the connectivity of that bay to bus-bar.
- In this case it is observed that while shifting the bay-9 (Sandhaur circuit-I) to bus-2 on 27-01-20(previous day), operator changed the isolator status input to relay manually through switches after charging/loading the line. This led to raising of blocking signal. Since this alarm was well indicated by LED on relay, he failed to reset this high signal unknowingly.
- Since for the OCT feature of the Bus Bar Protection Relay, it was set to "Block" which led to blocking of Differential Protection and relay was in block mode since 27-01-20.

DR of bus bar protection at Malerkotla Punjab



DR of bus bar protection at Malerkotla Punjab



DR of bus bar protection at Malerkotla Punjab

or not. One of the following two alternatives shall be selected for every function block:

1. *On*: when this mode is selected the zone differential trip is supervised by the operation of the built-in Check Zone
2. *Off*: when this mode is selected the zone differential trip is not supervised by the operation of the built-in Check Zone

- *SlowOCTOper*: this setting determines operation of the slow OCT algorithm. One of the following three alternatives shall be selected for every function block:

1. *Off*: when this mode is selected the slow OCT feature is completely disabled
2. *Block*: when this mode is selected the operation of the slow OCT feature completely blocks the operation of the differential protection. It shall be noted that this blocking is selective (that is, zone and phase wise)
3. *Alarm*: when this mode is selected the operation of the slow OCT feature only supervises the operation of the differential protection. As soon as differential current is bigger than the pre-set level determined by

96

Technical reference manual

1MRK505178-UEN C

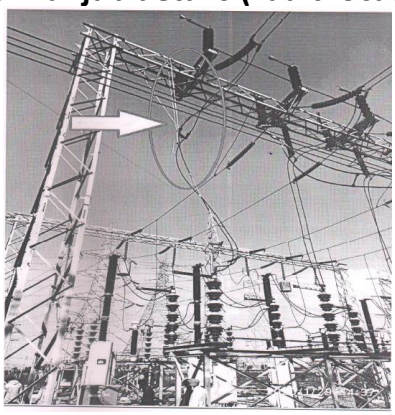
Section 5
Differential protection

As per Punjab details

- **220 kV Malerkotla – Dhuri Circuit – 1**
  - Distance Protection Relay picked the fault in R-ph in Zone – 4 (Reverse Zone).
  - Fault cleared from remote end in around 350 msec.
- **220 kV Malerkotla – Ikolaha**
  - Distance Protection Relay picked the fault in R-ph in Zone – 4 (Reverse Zone).
  - Fault cleared from remote end in around 400 msec.
- **220 kV Malerkotla – Sandaurh Circuit – 1**
  - Fault cleared from remote end in zone 2.
- **220 kV Malerkotla – Sandaurh Circuit – 2**
  - Distance Protection Relay picked the fault in R-ph in Zone – 4 (Reverse Zone).
  - Fault cleared from remote end in around 360 msec.
- **220 kV Malerkotla – Amloh**
  - Fault cleared from remote end in zone 2.
- All other circuits also tripped from remote ends leading to complete blackout at 220 kV Substation Malerkotla.

As per Punjab details (Fault location)

As per Punjab details (Fault location)



Conclusion and Remedial measures

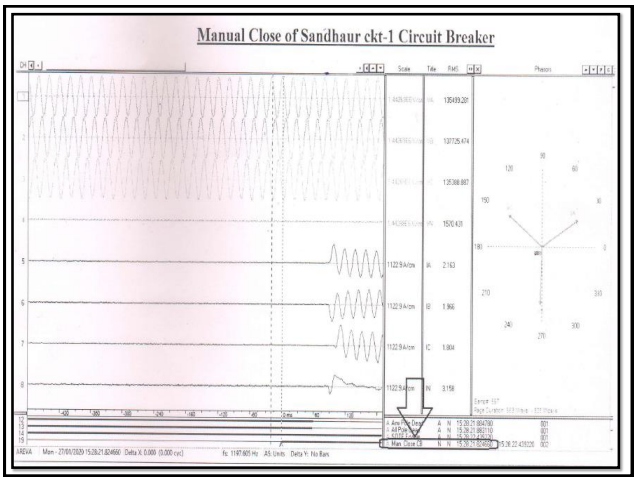
Conclusion:

- Differential protection of the bus bar protection relay was in blocked state so bus bar protection failed to operate. Fault feeding to bus-bar continued until the delayed tripping from remote ends.

Remedial Measures:

- In future cleaning/ strengthening of insulators with silicon RTV coating etc. has been suggested to O&M staff.
- To make isolator auxiliary switches healthy to avoid human error.
- Settings changed from "BLOCK" to SUPERVISE so that whenever Id crosses threshold value the scheme will operate irrespective of BLOCK.
- To educate the operating staff regarding intimating to S/S incharge

ACTION TAKEN ON 27TH JAN 2020



EL of 220 kV Malerkotla (Punjab)-Sandhaur ckt-1

Relay not GPS time synchronized
Time difference : approx. (-)1 Hour

Date & Time	Signal name	Status	Additional info
27-Jan-20 2:45:24 PM	Bay08 to ZA	On	20-01-27 14.45;24.362,Bay08 to ZA,1
27-Jan-20 2:45:24 PM	Bay09 to ZB	On #Bay09: Sandhaur 1	20-01-27 14.45;24.362,Bay09 to ZB,1
27-Jan-20 2:45:24 PM	Bay10 to ZA	On	20-01-27 14.45;24.362,Bay10 to ZA,1
27-Jan-20 2:45:24 PM	Bay11 to ZB	On	20-01-27 14.45;24.362,Bay11 to ZB,1
27-Jan-20 2:45:24 PM	Bay12 to ZB	On	20-01-27 14.45;24.362,Bay12 to ZB,1
27-Jan-20 2:45:24 PM	Bay13 to ZB	On	20-01-27 14.45;24.362,Bay13 to ZB,1
27-Jan-20 2:45:24 PM	ZA Id ALARM	Off	20-01-27 14.45;24.362,ZA Id ALARM,0
27-Jan-20 2:45:24 PM	ZB Id ALARM	Off	20-01-27 14.45;24.362,ZB Id ALARM,0
27-Jan-20 2:45:24 PM	ZI ALARM	On	20-01-27 14.45;24.362,ZI ALARM,1
27-Jan-20 2:32:42 PM	ZA Id ALARM	On	20-01-27 14.32;42.615,ZA Id ALARM,1
27-Jan-20 2:32:42 PM	ZB Id ALARM	On	20-01-27 14.32;42.615,ZB Id ALARM,1
27-Jan-20 2:31:57 PM	ZA SLOW OCT	On	20-01-27 14.31;57.483,ZA SLOW OCT,1
27-Jan-20 2:31:57 PM	ZB SLOW OCT	On	20-01-27 14.31;57.483,ZB SLOW OCT,1
27-Jan-20 1:42:53 PM	ZA COMON TRIP	Off	20-01-27 13.42;53.636,ZA COMON TRIP,0
27-Jan-20 1:42:53 PM	ZA Iin ALARM	Off	20-01-27 13.42;53.432,ZA Iin ALARM,0
27-Jan-20 1:42:53 PM	ZB Iin ALARM	Off	20-01-27 13.42;53.423,ZB Iin ALARM,0
27-Jan-20 1:42:53 PM	ZB Iin ALARM	On	20-01-27 13.42;53.309,ZB Iin ALARM,1
27-Jan-20 1:42:53 PM	ZA COMON TRIP	On	20-01-27 13.42;53.306,ZA COMON TRIP,1
27-Jan-20 1:42:53 PM	ZA Iin ALARM	On	20-01-27 13.42;53.303,ZA Iin ALARM,1

POWERGRID DETAILS

As per POWERGRID report

1. Time & Date of Event: 28.01.2020 19:27:44.810
2. Name of the tripped elements:
   a. 400/220kV 315MVA ICT-1 at Malerkotla 28.01.2020 19:27:47.150
   b. 400/220kV 315MVA ICT-2 at Malerkotla 28.01.2020 19:27:46.221
   c. 400/220kV 500MVA ICT-3 at Malerkotla 28.01.2020 19:27:45.907
   d. 400kV Patiala – Malerkotla line from Patiala end 28.01.2020 19:27:45.844
   e. 400kV Ludhiana – Malerkotla line from Ludhiana end 28.01.2020 19:27:45.850
3. Primary Cause of tripping:
   a. R-N Bus fault in 220kV malerkotla substation of PSTCL.
4. Event Description:
   a. During rainy period, R-phase to earth fault occurred in 220kV bus bar in PSTCL Malerkotla substation. The reported reason is learnt to be the insulator string failure in the PSTCL station. The Bus Bar did not operate at PSTCL, Malerkotla. Due to non-operation of bus bar relay at PSTCL Malerkotla, all the three ICTs at POWERGRID Malerkotla substation tripped on Backup earth fault protection (HV side) operation. During this event 400kV Patiala line and 400kV Ludhiana line tripped from remote ends in Zone-3.
   b. The fault clearance time is 2.3 sec, ICT-1 tripped at last.
5. Restoration Time:
   a. 400/220kV 315MVA ICT-1 at Malerkotla 29.01.2020 06:28
   b. 400/220kV 315MVA ICT-2 at Malerkotla 29.01.2020 10:03
   c. 400/220kV 500MVA ICT-3 at Malerkotla 29.01.2020 14:51
   d. 400kV Patiala – Malerkotla line from Patiala end 28.01.2020 19:55
   e. 400kV Ludhiana – Malerkotla line from Ludhiana end 28.01.2020 20:00

As per POWERGRID report

Analysis and Remedial actions-

- The non-operation of 220 kV bus bar protection is being taken up with PSTCL Malerkotla.
- CDD relays are installed in 400/220 kV 315 MVA ICT-1 & ICT-2 at Malerkotla (PG), which are having minimum secondary value of 0.2A. The relays are set at minimum value. The relays are being replaced under Process bus project.
- 400kV Patiala line and 400kV Ludhiana line, which tripped from remote end in zone-3 encroached into 220kV level. The settings have been revised as per latest template. The zone-3 time has been changed from 1.0 sec to 1.5 sec.

Observations

- Event Category: GD-1
- Generation Loss (in MW): Nil
- Load Loss (in MW): 320 (As per Punjab details)
- Energy Loass: (Punjab may confirm)

Analysis of tripping (As reported):

- At 220 kV Malerkotla (Punjab) have double bus single breaker scheme, it is extension of 220 kV side of Malerkotla (PG), 220 kV side of 400/220 kV three ICTs at Malerkotla (PG) is directly connected in 220 kV Malerkotla (Punjab) switchyard. 220 kV Malerkotla (Punjab) is further connected with Sandaur D/C, Dhuri D/C, ikolaha S/C, Amloh S/C and 220/66 kV 160MVA one ICT & 100 MVA two ICTs.
- R-phase insulator string (Before CB, i.e. Bus side) of 220 kV Malerkotla - Dhuri circuit No. 2 (which was connected to Busbar-1) snapped and jumpers fell on 220 kV Busbar-2 leading to 220 kV Bus-bar fault on both the 220 kV buses.
- Fault entered in differential zone of 220 kV Busbar-2 (220 kV Bus bar-l was charged but not loaded at time of incident) but differential protection feature of the relay was blocked as Open CT (OCT) Alarm was raised for both the 220 kV buses (Za & Zb) before the fault instant.
- One day before i.e. on 27th January, there was a fault on 220 kV bus-1, so all the circuits were shifted to 220 kV bus-2 and system was running as per that arrangement.

Observations

Analysis of tripping (As reported):

- Since at Malerkotla auxiliary switches of isolators are not working properly so they have installed two way switches in the respective panels to manually select each isolator's (i.e for bus isolator I and 2) status given to bus bar relay. After doing all isolator operations when operator comes to control room, he manually changes the position of switches as per the connectivity of that bay to bus-bar.
- In this case it is observed that while shifting the bay-9 (Sandhaur circuit-I) to bus-2 on 27-01-20(previous day), operator changed the isolator status input to relay manually through switches after charging/loading the line. This led to raising of blocking signal. Since this alarm was well indicated by LED on relay, he failed to reset this high signal unknowingly.
- Since for the OCT feature of the Bus Bar Protection Relay, it was set to "Block" which led to blocking of Differential Protection and relay was in block mode since 27-01-20
- During rainy period, R-phase to earth fault occurred in 220kV bus bar in PSTCL Malerkotla substation. The reported reason is learnt to be the insulator string failure in the PSTCL station. The Bus Bar did not operate at PSTCL, Malerkotla.
- Due to non-operation of bus bar relay at PSTCL Malerkotla, all the three ICTs at POWERGRID Malerkotla substation tripped on Backup earth fault protection (HV side) operation. During this event 400kV Patiala line and 400kV Ludhiana line tripped from remote ends in Zone-3.

Observations

Analysis of tripping (As reported):

- On 27th Jan 2020, 220 kV bus bar protection operated for 220 kV bus-1 at Malerkotla (Punjab). Bus bar protection correctly operated and tripped all the 220 kV elements connected at 400/220 kV Malerkotla (Punjab).

Observations

Conclusion:

- Differential protection of the bus bar protection relay was in blocked state so bus bar protection failed to operate. Fault feeding to bus-bar continued until the delayed tripping from remote ends.

Remedial Measures (Punjab):

- In future cleaning/ strengthening of insulators with silicon RTV coating etc. has been suggested to O&M staff.
- To make isolator auxiliary switches healthy to avoid human error.
- Settings changed from "BLOCK" to SUPERVISE so that whenever Id crosses threshold value the scheme will operate irrespective of BLOCK.
- To educate the operating staff regarding intimating to S/S in charge.

Analysis and Remedial actions (POWERGRID)-

- CDD relays are installed in 400/220 kV 315 MVA ICT-1 & ICT-2 at Malerkotla (PG), which are having minimum secondary value of 0.2A. The relays are set at minimum value. The relays are being replaced under Process bus project.
- 400kV Patiala line and 400kV Ludhiana line, which tripped from remote end in zone-3 encroached into 220kV level. The settings have been revised as per latest template. The zone-3 time has been changed from 1.0 sec to 1.5 sec.

Observations

As per PMU, SCADA data:

- As per PMU, R-phase to earth fault.
- Fault Clearance time: **2320ms**
- SoE didn't capture for any of the tripped elements.
- SCADA digital status for 400/220kV Malerkotla(PG) & Malerkotla (Punjab) was not available in POWERGRID & Punjab SoE.

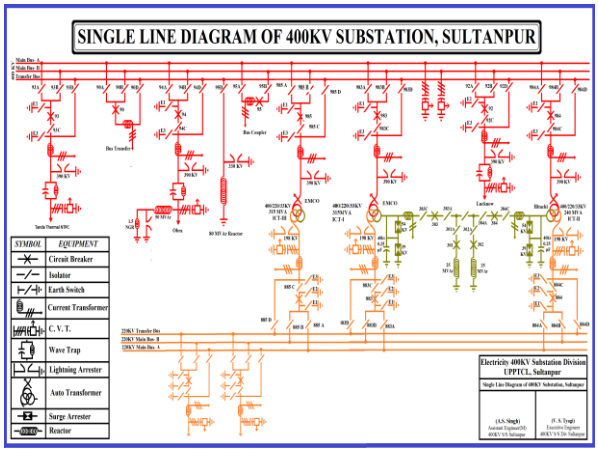
Points for Discussion

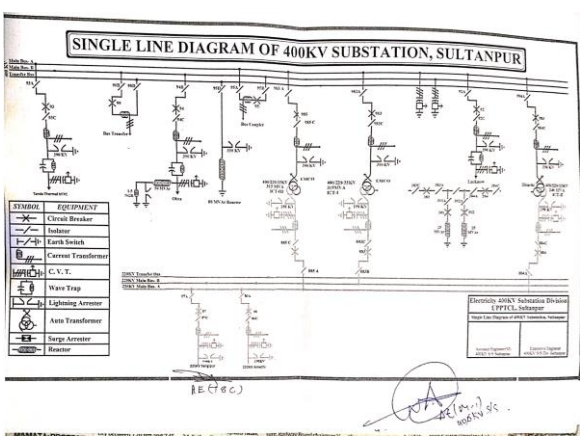
- Healthiness of 220 kV bus bar protection at 220 kV Malerkotla (Punjab) shall be ensured.
- Healthiness of isolator auxiliary contact shall be checked and corrected as manual operation every times may have resulted into frequent blocking of bus bar protection. If it needs replacement than same shall be done.
- Bus Bar Protection blocking alarm needs to be prioritized and attended immediately.
- Backup over current earth fault protection setting of 400/220 kV ICTs needs to be relooked. Present Status of replacement of backup over current earth fault protection at 400/220 kV 315 MVA ICTs at Malerkotla (PG)?
- Protection philosophy has been revised, Z-3 setting needs to be rechecked in view of encroachment in 220 kV side of 400/220 kV ICTs.
- Such delayed clearance of fault may have resulted into major catastrophe in the grid and needs to be addressed properly.
- SoE didn't capture for any of the tripped elements, Availability of digital data (SCADA SoE) needs to be available in NR/ Punjab SCADA SoE.
- PSTCL shall submit the detailed report considering the aforesaid points and submit the remedial measures report.

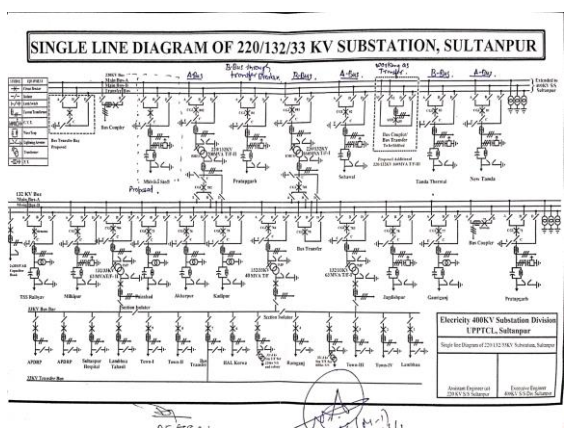
UPPTCL- Transmission Central

400 kV s/s Sultanpur

Tripping on 22.12.2019 (02:54hrs)







Bus Position Before Fault:

315MVA ICT1------	400KV side- A Bus	220 KV Side- B Bus
240MVA ICT2 ------	400KV side- A Bus	220 KV Side- A Bus
315MVA ICT 3--------	400KV side- A Bus	220 KV Side- A Bus
400KV Sultanpur Tanda Thermal line,	400KV side- A Bus	
400KV Sultanpur Lucknow PG line	400KV side- A Bus	
400KV Sultanpur Obra Anpara line	400KV side- B Bus	
80MVAR Bus Reactor (through Transfer)	400KV side- B Bus	

Bus Position After Normalization:

315MVA ICT1------	U/S/D	
240MVA ICT2 ------	400KV side- A Bus	220 KV Side- A Bus
315MVA ICT 3--------	400KV side- A Bus	220 KV Side- A Bus
400KV Sultanpur Tanda Thermal line,	400KV side- A Bus	
400KV Sultanpur Lucknow PG line	400KV side- A Bus	
400KV Sultanpur Obra Anpara line	400KV side- B Bus	
80MVAR Bus Reactor (through Transfer)	400KV side- B Bus	

Load at 02:00hrs on 22/12/2020 at 400KV &220KV Substation Sultanpur

Line/Transformer	Load	Bus Pos
400KV Tanda Thermal line	109MW (Import)	A
400KV Obra-Anpara line	194MW(Import)	B
400KV Lucknow PG line	144MW(Export)	A
315MVA ICT 1 400kV side	60MW (Export)	A
240MVA ICT 2 400kV side	39MW (Export)	A
315MVA ICT 3 400kV side	60MW (Export)	A
315MVA ICT 1 220kV side	60MW (Import)	B
240MVA ICT 2 220kV side	39MW (Import)	A
315MVA ICT 3 220kV side	60MW (Import)	A
220KV Amethi line	37MW (Export)	A
220KV New Tanda line	16MW (Import)	A
220KV Tanda Thermal line	37MW (Import)	B
220KV Sohawal line	21MW (Export)	A
220KV Pratapgarh line	51MW (Export)	B
200MVA Transformer	60MW(Export)	A
160MVA Transformer	44MW(Export)	B

Provisional Tripping report at 400KV S/S Sultanpur Dated 22.12.2019

At 400KV substation sultanpur on dated 22/12/2019, 315MVA ICT 1 tripped 02:54hrs along with 240MVA ICT2 on 400KV side only, 315MVA ICT 3 on 400KV sides only, 400KV Sultanpur Tanda Thermal line, 400KV Sultanpur Lucknow PG line,400KV bus coupler

Following were the flags on 315MVA ICT 1 :

400KV Side:

Dir. O/C ,E/F relay 67
Event AG
Ia- 1728A, Ib- 149A, Ic-267A, In-1333A, Ig-1332A, inst 50

LBB relay 50Z
Event AG Ia-1716A, Ib-142A, Ic-268A, In- 1265A,Ig-1325A

220KV Side:

LBB relay 50Z
Event AG Ia-3374A, Ib-175A, Ic-140A, In- 3347A,Ig-3348A

Following were the flags on Bus Bar Protection Relay on 400KV side :

BB-R Relay
SBFTR
BB-Y Relay
SBFTR
BB-B Relay
SBFTR

96 TR1- NTPC Tanda, 96 TR4- Bus Coupler, 96 TR5- 315MVA ICT-1, 96 TR6- PGCIL Lucknow, 96 TR7 240MVA ICT 2, 96 TR8- 315MVA ICT 3

No flags were found on 240MVA ICT2 , 315MVA ICT 3, 400KV Sultanpur Tanda Thermal line, 400KV Sultanpur Lucknow PG line

Element were charged as-
240MVA ICT2 -04:19, Bus Coupler- 04:20, 315MVA ICT 3-04:32Hrs, 400KV Sultanpur Tanda Thermal line-04:35hrs, 400KV Sultanpur Lucknow PG line-04:40hrs

Coincidently at the same time 02:54hrs at 220KV Substation -- 220KV Sultanpur Pratapgarh Line tripped with following flags
General trip, Z1, Z2, R-phase fault, A/R operated, neutral ground, RYB phase trip, PSB , distance -11.3km, 86A, 86B
Bus Postion of 220KV Sultanpur Pratapgarh line through transfer breaker- B bus, TBC was being used as transfer breaker

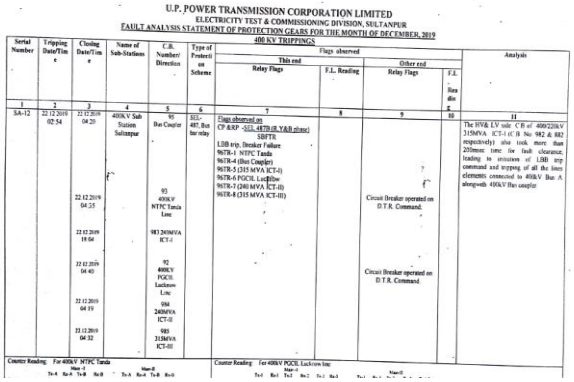
L No. 713 /E T&C S (S) / Dt. 26.12.2019
S.E. (T&C) Lucknow

U.P. POWER TRANSMISSION CORPORATION LIMITED
ELECTRICITY TEST & COMMISSIONING DIVISION, SULTANPUR
FAULT ANALYSIS STATEMENT OF PROTECTION GEARS FOR THE MONTH OF DECEMBER, 2019
220/400 KV TRIPPINGS

Serial Number	Tripping Date/Time	Closing Date/Time	Name of Sub-Stations	C.B. Number/ Diversion	Type of Protection Scheme	Flags observed: This end, Relay Flags	Flags observed: This end, F.I. Reading	Flags observed: Other end, Relay Flags	Flags observed: Other end, F.I. Reading	Analysis
1	2	3	4	5	6	7	8	9	10	11
SA-44	22.12.2019 02:54	22.12.2019 03:47	220 KV S/S, Sultanpur	220 KV Pratapgarh line	ABB REL 670 & GE D60	Main1: Gen. trip, Rg , Z-1, Z2 trip , Inst 50, A/R opd. I1 =6663.20A, I2.2 262.03A, I0.3 487.19A, IN 3306.70A,Fault dist 10.91Km Main2: AG, other phase ABC, Neutral Ground, Gen. trip, Z1, Z2 trip, R-7.8.0M trip, power swing block, 86A, 86B, Dist. 11.3Km,Reclose shot-0		R,N, Dist 62.2km (79.7%)	-	220kV Pratapgarh line connected to Bus B in disrupted condition through 220kV Bus transfer C B. C B tripped for R phase to earth Z-1 (Over 11km) fault at 02.54Hrs on dated 22.12.2019
SA-11	22.12.2019 02:54	22.12.2019 18:04	400KV Sub Station Sultanpur	945-BRD 315MVA ICT-4	SEL-387/316-301	86 SIDE SEL 311A Relay (Dir. OC, E/F relay, 67) Inst. 50, Backup E/F trip, Group B trip, 2860V, 2861V, Event- ag27 Ia=1728A, Ib=149A, Ic-267A, In=1333A, Ig=1332A, 3I0=1825A SEL 701A Relay (LBB relay 50Z) Event- AG, Ia=1716.6A, Ib=142.1A, Ic-268.7A, Ig=1265A, Ig=1325.1A, LV Side SEL 701A Relay (LBB relay 50Z) Event- AG, Ia=3374.1A, Ib=175.1A, Ic-140.1A, Ig=3347.38A, Ig=3348.70A,			-	The above C B took around 480msec to clear the fault leading to detection of earth by O/C, E/F relay installed on HV side of 400/220kV,315MVA ICT-4, which was the only 400/220kV ICT coupled to 220kV Bus B at the time and subsequent tripping on high set setting (CTR, 500/1, I 1.4A, T 100msec) of E/F relay

* 220kV Pratapgarh line normally runs through Main C B no. 89. However, it was running through Bus Coupler / Bus Transfer

EXECUTIVE ENGINEER (T&C)



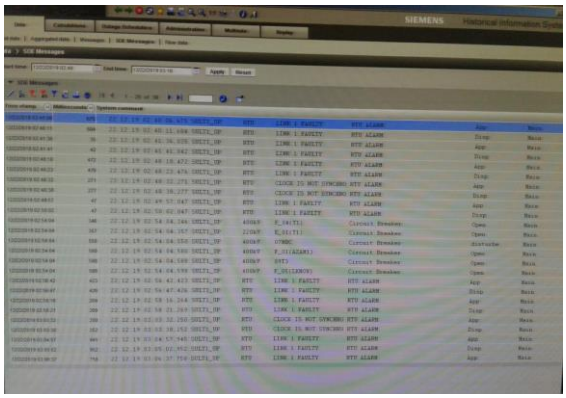
U.P. POWER TRANSMISSION CORPORATION LIMITED
ELECTRICITY TEST & COMMISSIONING DIVISION, SULTANPUR
FAULT ANALYSIS STATEMENT OF PROTECTION GEARS FOR THE MONTH OF DECEMBER, 2019
400 KV TRIPPINGS

Serial Number	Tripping Date/Time	Closing Date/Time	Name of Sub-Stations	C.B. Number/ Direction	Type of Protection Scheme	Flags observed: This end – Relay Flags	This end – F.L. Reading	Other end – Relay Flags	Other end – F.L. Reading	Analysis
1	2	3	4	5	6	7	8	9	10	11
SA-12	22.12.2019 02.54	22.12.2019 04.20 22.12.2019 04.25 22.12.2019 10.04 22.12.2019 04.40 22.12.2019 04.19 22.12.2019 04.22	400kV Sub Station Sultanpur	95 Bus Coupler 95 400kV NTPC Tanda Line 983 240MVA ICT-I 92 400kV PGCIL Lucknow Line 984 240MVA ICT-II 985 315MVA ICT-III	REL-487, Bus bar relay	Flags observed on (?? &87 -SEL-487B (R_YB/B phase) SBFTB: LBB trip, Breaker Failure. 96TR-1 NTPC Tanda 96TR-4 (Bus Coupler) 96TR-5 (315 MVA ICT-I) 96TR-6 PGCIL Lucknow 96TR-7 (240 MVA ICT-II) 96TR-8 (315 MVA ICT-III)		Circuit Breaker operated on D.T.R. Command. Circuit Breaker operated on D.T.R. Command.		The HV& LV side C.B of 400/220kV 315MVA ICT-I (C.B No. 982 & 882 respectively) also took more than 200msec time for fault clearance, leading to mission of LBB trip command and tripping of all the bus elements connected to 400kV Bus A alongwith 400kV Bus coupler

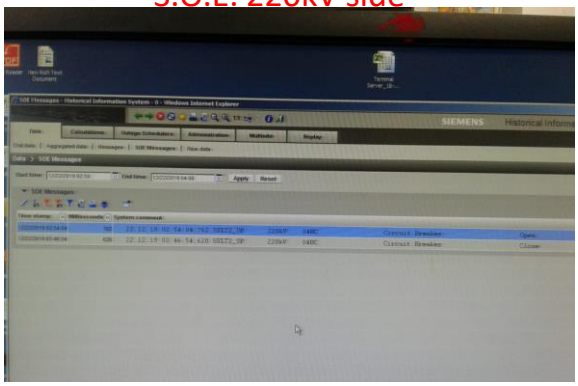
Counter Reading: For 400kV NTPC Tanda Main-I Tx-4 Rx-4 Tx-8 Rx-8 Main-II Tx-4 Rx-4 Tx-8 Rx-8

Counter Reading: For 400kV PGCIL Lucknow line Main-I Tx-1 Rx-1 Tx-2 Rx-2 Tx-3 Rx-3 Main-II Tx-1 Rx-1 Tx-2 Rx-2 Tx-3 Rx-3

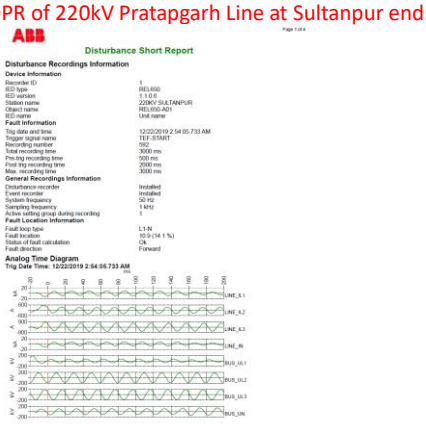
S.O.E. 400kV side



S.O.E. 220kV side



Main1 DPR of 220kV Pratapgarh Line at Sultanpur end



ABB

Disturbance Short Report

Disturbance Recordings Information

Device Information

Recorder ID	1
IED type	REL650
IED version	1.1.0.0
Station name	220kV SULTANPUR
Object name	REL650-A01
IED name	Unit name

Fault Information

Trig date and time	12/22/2019 2:54:05.733 AM
Trigger signal name	TEF-START
Recording number	592
Total recording time	3000 ms
Pre-trig recording time	500 ms
Post trig recording time	2000 ms
Max. recording time	3000 ms

General Recordings Information

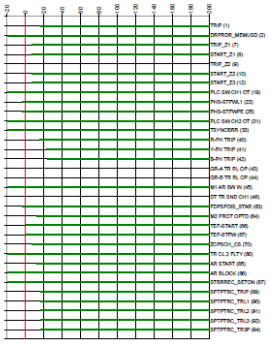
Disturbance recorder	Installed
Event recorder	Installed
System frequency	50 Hz
Sampling frequency	1 kHz
Active setting group during recording	1

Fault Location Information

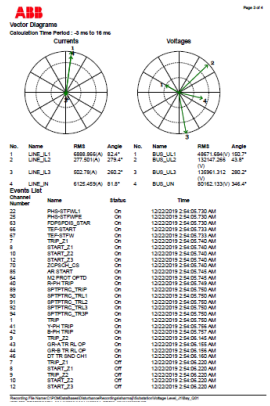
Fault loop type	L1-N
Fault location	10.9 (14.1 %)
Status of fault calculation	Ok
Fault direction	Forward

Analog Time Diagram
Trig Date Time: 12/22/2019 2:54:05.733 AM

Main1 DPR of 220kV Pratapgarh Line at Sultanpur end



Main1 DPR of 220kV Pratapgarh Line at Sultanpur end



ABB

Page 3 of 4

Vector Diagrams

Calculation Time Period : -0 ms to 16 ms

Currents

Voltages

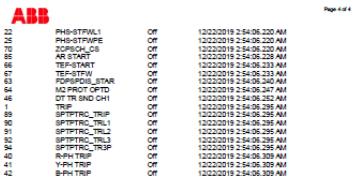
No.	Name	RMS	Angle	No.	Name	RMS	Angle
1	LINE_L1	688.868(A)	82.4°	1	BUS_UL1	48871.664(V) (V)	182.7°
2	LINE_L2	277.501(A)	279.4°	2	BUS_UL2	132147.266 (V)	43.9°
3	LINE_L3	502.78(A)	260.2°	3	BUS_UL3	130961.312 (V)	280.2°
4	LINE_IN	6125.409(A)	91.8°	4	BUS_UN	50162.132(V)	346.4°

Events List

Channel Number	Name	Status	Time
22	PHS-STFWL1	On	12/22/2019 2:54:06.730 AM
25	PHS-STFWFE	On	12/22/2019 2:54:06.730 AM
63	FDPSPDIS_STAR	On	12/22/2019 2:54:06.730 AM
66	TEF-START	On	12/22/2019 2:54:06.733 AM
67	TEF-STFW	On	12/22/2019 2:54:06.733 AM
8	START_Z1	On	12/22/2019 2:54:06.740 AM
10	START_Z2	On	12/22/2019 2:54:06.740 AM
12	START_Z3	On	12/22/2019 2:54:06.740 AM
70	ZCPSCH_CS	On	12/22/2019 2:54:06.742 AM
85	AR START	On	12/22/2019 2:54:06.745 AM
64	M2 PROT OPTD	On	12/22/2019 2:54:06.745 AM
40	R-PH TRIP	On	12/22/2019 2:54:06.749 AM
89	SPTPTRC_TRIP	On	12/22/2019 2:54:06.750 AM
90	SPTPTRC_TRL1	On	12/22/2019 2:54:06.750 AM
91	SPTPTRC_TRL2	On	12/22/2019 2:54:06.750 AM
92	SPTPTRC_TRL3	On	12/22/2019 2:54:06.750 AM
94	SPTPTRC_TR3P	On	12/22/2019 2:54:06.750 AM
1	TRIP	On	12/22/2019 2:54:06.752 AM
41	Y-PH TRIP	On	12/22/2019 2:54:06.756 AM
42	B-PH TRIP	On	12/22/2019 2:54:06.757 AM
7	TRIP_Z1	On	12/22/2019 2:54:06.160 AM
43	GR-A TR RL OP	On	12/22/2019 2:54:06.165 AM
44	GR-B TR RL OP	On	12/22/2019 2:54:06.165 AM
46	DT TR SND CH1	On	12/22/2019 2:54:06.165 AM
7	TRIP_Z1	Off	12/22/2019 2:54:06.220 AM
8	START_Z1	Off	12/22/2019 2:54:06.220 AM
9	TRIP_Z2	Off	12/22/2019 2:54:06.220 AM
10	START_Z2	Off	12/22/2019 2:54:06.220 AM
12	START_Z3	Off	12/22/2019 2:54:06.220 AM

Recording File Name:C:\PQMSoftBased\DisturbanceRecordingstation\@EstesIn\Village Level_\Filter_001

Main1 DPR of 220kV Pratapgarh Line at Sultanpur end

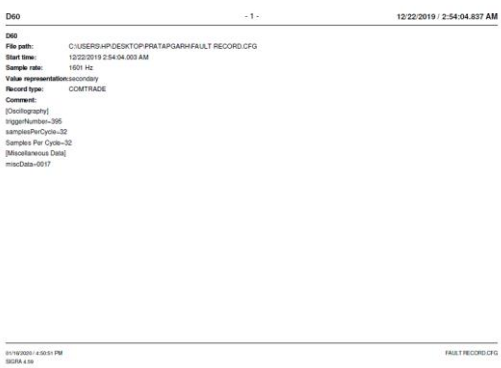


ABB

Page 4 of 4

22	PHS-STFWL1	Off	12/22/2019 2:54:06.220 AM
25	PHS-STFWFE	Off	12/22/2019 2:54:06.220 AM
70	ZCPSCH_CS	Off	12/22/2019 2:54:06.220 AM
85	AR START	Off	12/22/2019 2:54:06.228 AM
66	TEF-START	Off	12/22/2019 2:54:06.233 AM
67	TEF-STFW	Off	12/22/2019 2:54:06.233 AM
63	FDPSPDIS_STAR	Off	12/22/2019 2:54:06.340 AM
64	M2 PROT OPTD	Off	12/22/2019 2:54:06.347 AM
46	DT TR SND CH1	Off	12/22/2019 2:54:06.352 AM
1	TRIP	Off	12/22/2019 2:54:06.296 AM
89	SPTPTRC_TRIP	Off	12/22/2019 2:54:06.295 AM
90	SPTPTRC_TRL1	Off	12/22/2019 2:54:06.295 AM
91	SPTPTRC_TRL2	Off	12/22/2019 2:54:06.295 AM
92	SPTPTRC_TRL3	Off	12/22/2019 2:54:06.295 AM
94	SPTPTRC_TR3P	Off	12/22/2019 2:54:06.295 AM
40	R-PH TRIP	Off	12/22/2019 2:54:06.309 AM
41	Y-PH TRIP	Off	12/22/2019 2:54:06.309 AM
42	B-PH TRIP	Off	12/22/2019 2:54:06.309 AM

Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



D60 - 1 - 12/22/2019 / 2:54:04.837 AM

D60

File path: C:\USERS\HP\DESKTOP\PRATAPGARH\FAULT RECORD.CFG

Start time: 12/22/2019 2:54:04.003 AM

Sample rate: 1600 Hz

Value representation: secondary

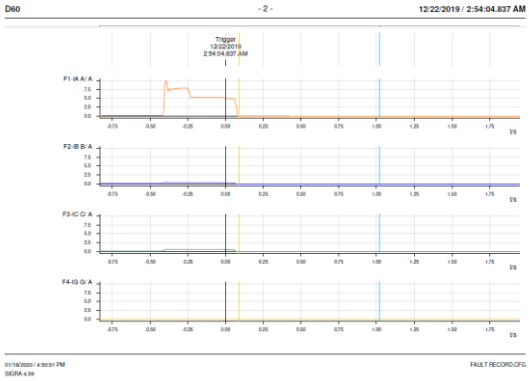
Record type: COMTRADE

Comment:

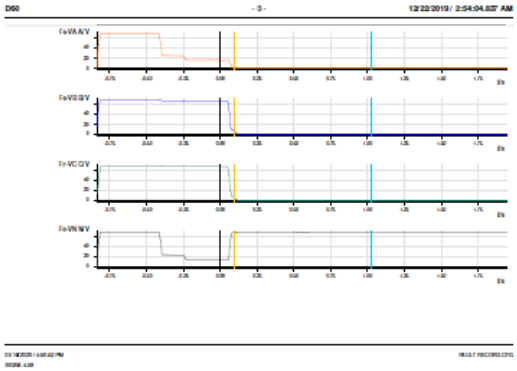
[Oscillography]
triggerNumber=395
samplesPerCycle=32
Samples Per Cycle=32
[Miscellaneous Data]
miscData=0017

01/16/2020 / 4:50:51 PM FAULT RECORD.CFG
SIGRA 4.59

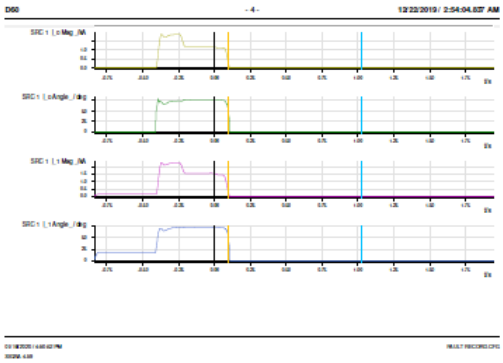
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



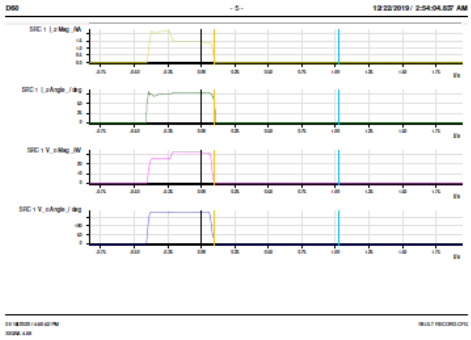
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



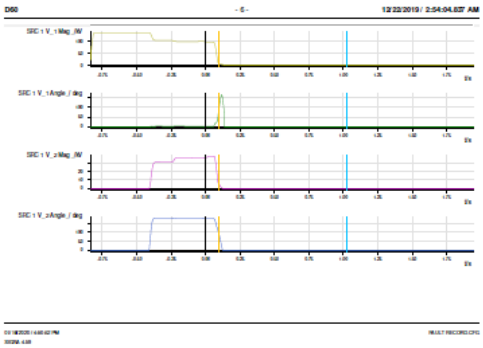
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



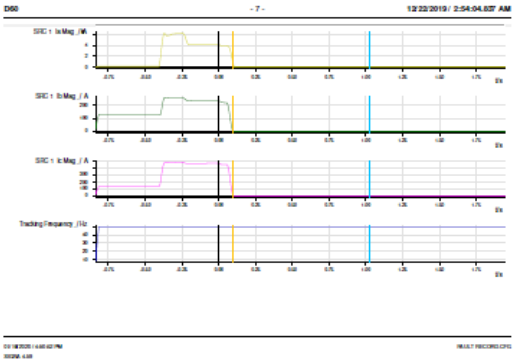
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



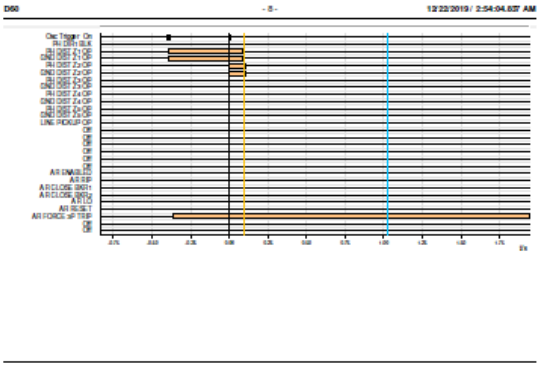
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



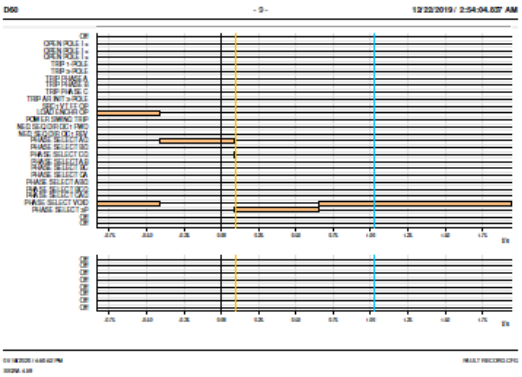
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



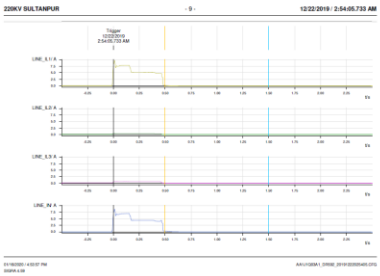
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



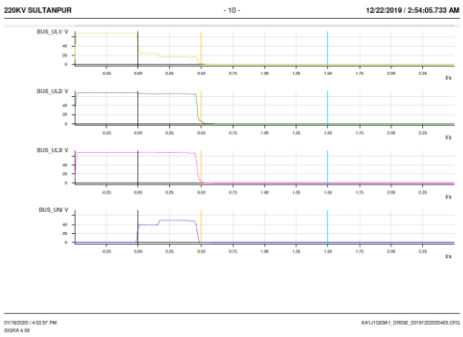
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



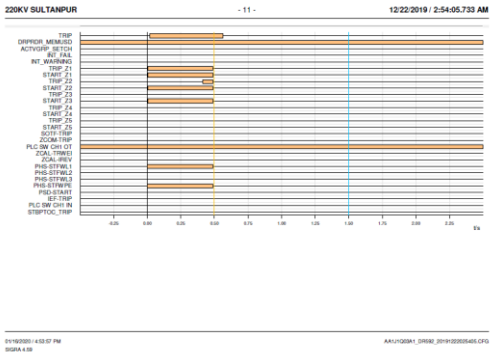
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



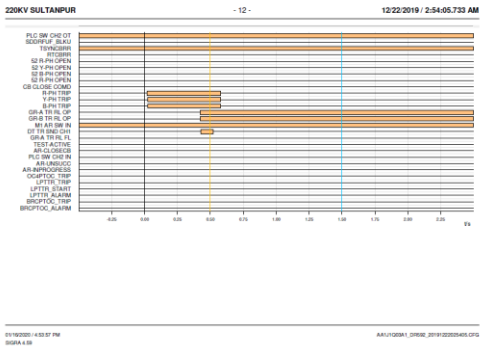
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



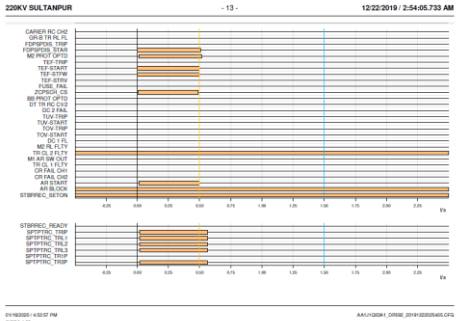
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end

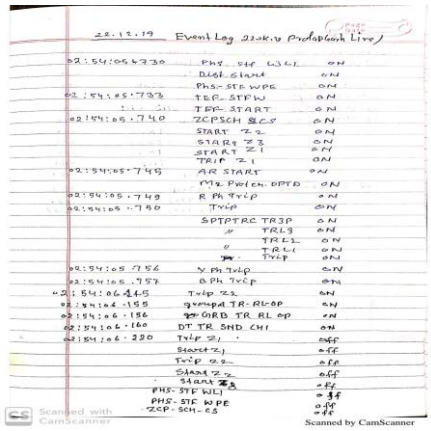


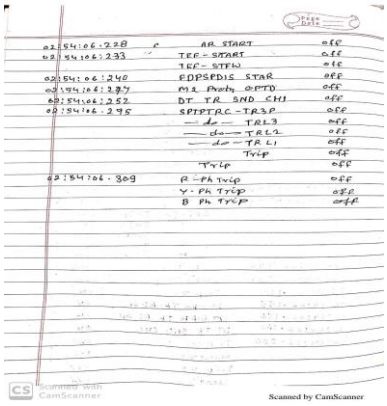
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



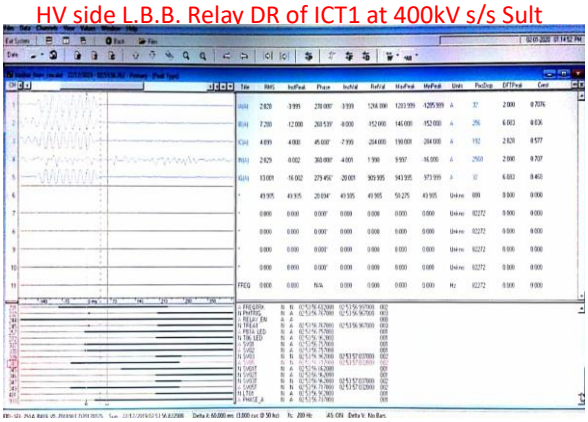
Main2 DPR of 220kV Pratapgarh Line at Sultanpur end



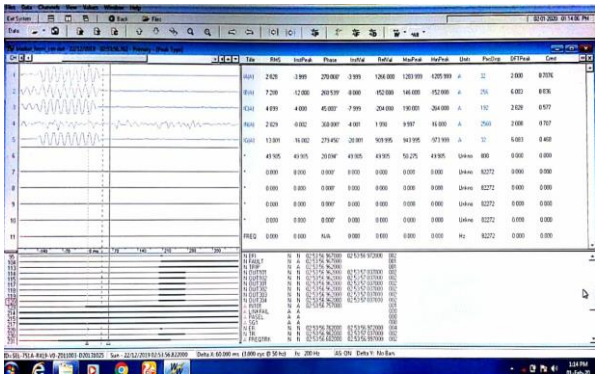




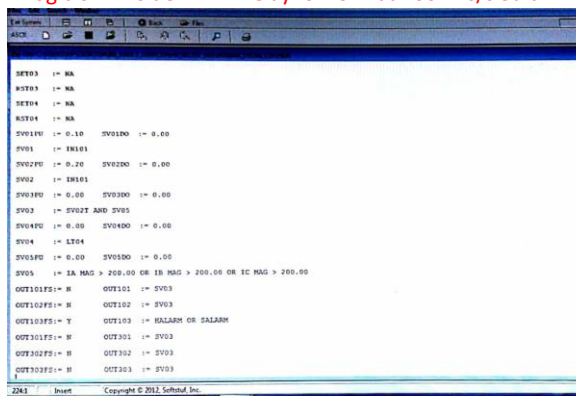
HV side L.B.B. Relay DR of ICT1 at 400kV s/s Sult



HV side L.B.B. Relay DR of ICT1 at 400kV s/s Sult



Logic of HV side L.B.B. Relay for ICT1 at 400kV s/s Sult



```
SET03   := NA
RST03   := NA
SET04   := NA
RST04   := NA
SV01PU  := 0.10    SV01DO  := 0.00
SV01    := IN101
SV02PU  := 0.20    SV02DO  := 0.00
SV02    := IN101
SV03PU  := 0.00    SV03DO  := 0.00
SV03    := SV02T AND SV05
SV04PU  := 0.00    SV04DO  := 0.00
SV04    := LT04
SV05PU  := 0.00    SV05DO  := 0.00
SV05    := IA MAG > 200.00 OR IB MAG > 200.00 OR IC MAG > 200.00
OUT101FS:= N       OUT101  := SV03
OUT102FS:= N       OUT102  := SV03
OUT103FS:= Y       OUT103  := HALARM OR SALARM
OUT301FS:= N       OUT301  := SV03
OUT302FS:= N       OUT302  := SV03
OUT303FS:= N       OUT303  := SV03
```

Highlights

- Cause of Event
- Delayed tripping of 2200kV Sultanpur-Pratapgarh Line C.B. (Bus Transfer) at Sultanpur end for Rph fault.
- After thorough investigation of trip logic & DR of S.E.L. make L.B.B. relay (type SEL-487) installed on HV side of ICT1 it was found that even after isolation of fault leading to neglegible phase current 'SV05' bit in trip logic of the relay remained high leading to spurious operation of LBB relay and hence tripping of all elementd connected to 400kV Bus A.

- Action Taken
- The CB timing of 220 kV BT , 400/220 kV side C.B. of ICT1 measured
- 220kV Pratapgarh Line DPR & ICT1 LBB relay tested.
- High set setting of 400/220kV ICT 1 & 3 modified.
- Matter regarding configuration logic of LBB relay referred to Design/S.E.L.

- Action to be taken
- Configuration logic to be modified in all S.E.L. make LBB relay.

Thank you

Detailed Analysis

Event : Multiple Tripping / Blackout

Location : 220 kV S/s PSTCL Malekotla PUNJAB

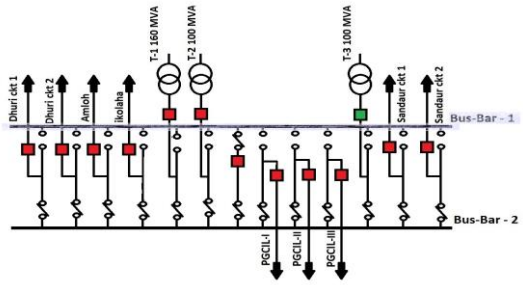
Date & Time : 28.01.2020 at 19:27 Hours

Weather : Heavy Rainfall

Type of Fault : Bus Bar Fault

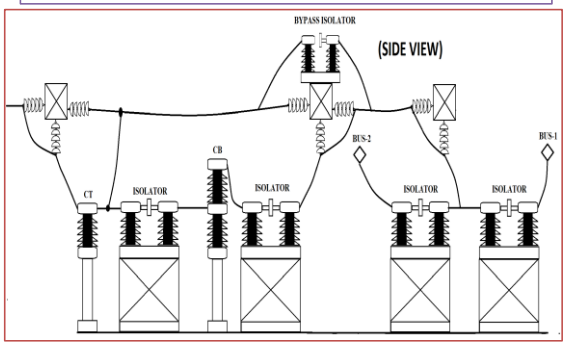
Pre Fault Situation

- All the circuits connected to Bus-Bar – 2
- Bus-Bar – 1 is charged through Bus Coupler without any load connected

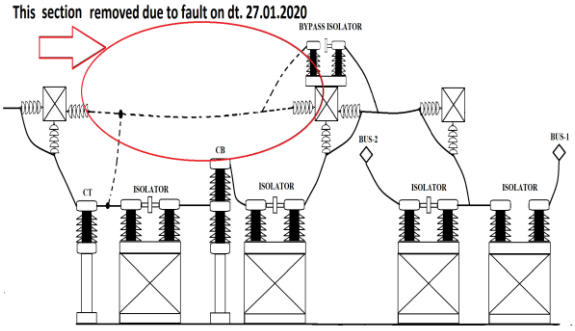


General Layout of affected Bay

(220 kV Malerkotla – Dhuri Ckt -2)

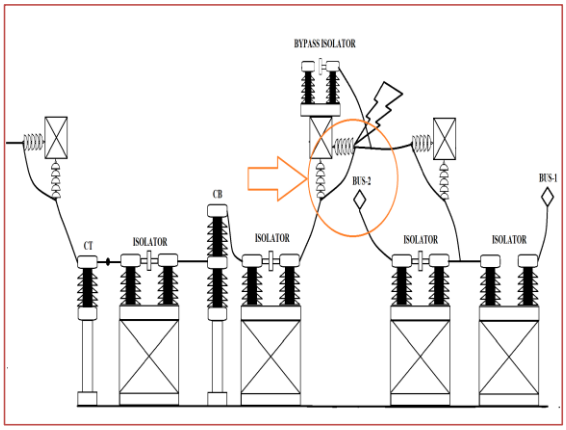


Actual situation (Before Fault)



Fault Event

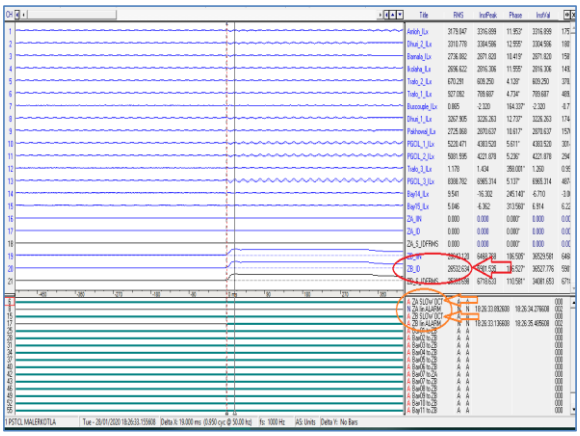
- R-phase insulator string (Before CB, i.e. Bus side) of 220 kV Malerkotla – Dhuri circuit No. 2 snapped.
- Weather conditions : Heavy rain & winds
- Jumpers fell on Busbar-2 leading to Bus-bar fault.



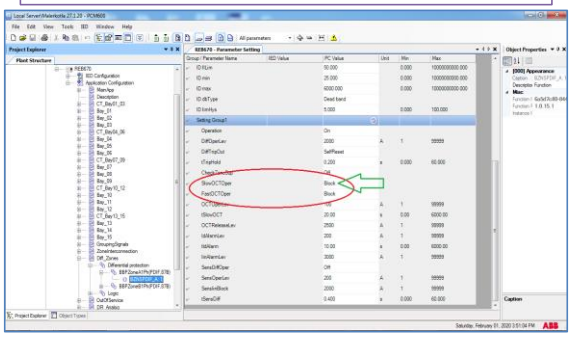
Damaged segment passing over Busbar-2

Response Of BUS BAR PROTECTION RELAY

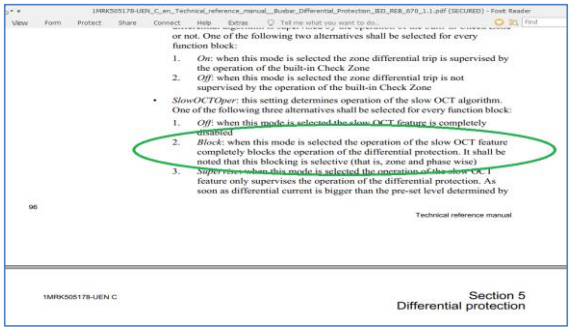
- The fault current (Id) entered in bus-2 differential zone (Zb) of the R-ph BBPS Relay (ABB make REB 670).
- No TRIP was issued by the bus bar differential protection relay.
- Za & Zb SLOW OCT (Open CT) Alarm was found to be already raised before fault event (which had blocked the differential protection feature of the relay).



Settings which blocked the relay



Literature of the relay
(BLOCKING the differential protection feature)



1MRK505178-UEN_C_en_Technical_reference_manual__Busbar_Differential_Protection_BED_REB_670_1.1.pdf (SECURED) - Foxit Reader

View Form Protect Share Connect Help Extras Tell me what you want to do... Find

or not. One of the following two alternatives shall be selected for every function block:

1. *On*: when this mode is selected the zone differential trip is supervised by the operation of the built-in Check Zone
2. *Off*: when this mode is selected the zone differential trip is not supervised by the operation of the built-in Check Zone

- *SlowOCTOper*: this setting determines operation of the slow OCT algorithm. One of the following three alternatives shall be selected for every function block:

1. *Off*: when this mode is selected the slow OCT feature is completely disabled
2. *Block*: when this mode is selected the operation of the slow OCT feature completely blocks the operation of the differential protection. It shall be noted that this blocking is selective (that is, zone and phase wise)
3. *Supervise*: when this mode is selected the operation of the slow OCT feature only supervises the operation of the differential protection. As soon as differential current is bigger than the pre-set level determined by

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Technical reference manual

1MRK505178-UEN C

Section 5
Differential protection

Reason for raising of OCT Alarm

- Unavailability of Healthy Isolator status from switch yard (due to old/outdated isolators)
- A scheme of two way electrical switches (two for each bay (bus-1 & bus-2)) is devised to manually simulate the similar isolator status to the relay as per actual arrangement in the switchyard
- Any mismatch or performing wrong sequence of switch operation leads to raising of OCT Alarm which is the in-built feature of this relay model.

Cause of OCT Alarm in this case

- BBPS operated on previous day (i.e. 27.01.20)
- While re-energizing the tripped circuits on 27.01.20, due to human error, wrong sequence of operating the simulator switches for isolator status led to raising of OCT Alarm.
- This alarm was not acknowledged & reset, which left Bus-bar differential protection in blocked state.

Fault clearing

- Since bus-bar differential protection feature of BBPS Relay was in blocked state, it failed to clear the bus-bar fault.
- Fault was in reverse zone of the connected circuits, so their Distance Protection Relays got picked in Z4.
- Fault feeding continued until the connected circuits tripped from remote end (Zone-2 at their ends).

Remedial Measures taken

- Isolator auxiliary switches (status) from switch-yard to be made healthy to avoid human error
- Cleaning/strengthening of insulators with silicon coating, etc
- Until healthy isolator status from switchyard are available in Busbar Protection Panel, Operator/staff has been instructed to perform the manual simulation in proper sequence and reset & acknowledge the alarms as soon as raised