

I/31633/2023



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

No. उ.क्षे.वि.स./प्रचालन/107/01/2023/

दिनांक: 15.11.2023

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

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

विषय: संरक्षण उप-समिति की 48 वीं बैठक की कार्यवृत्त ।

Subject: Minutes of the 48th Protection Sub-Committee Meeting.

संरक्षण उप-समिति की 48 वीं बैठक, दिनांक 11.10.2023 को 10:30 बजे से एनआरपीसी सचिवालय, कटवारिया सराय, नई दिल्ली में आयोजित की गयी थी । उक्त बैठक की कार्यवृत्त संलग्न है । यह उत्तर क्षेत्रीय विद्युत् समिति की वेबसाइट (<http://164.100.60.165/>) पर भी उपलब्ध है ।

The 48th meeting of Protection Sub-Committee was held on 11.10.2023 at 10:30 Hrs at NRPC Secretariat, Katwaria Sarai, New Delhi. The minutes of the meeting is attached herewith. The same is also available on NRPC website (<http://164.100.60.165/>).

Signed by Reeturaj Pandey

Date: 15-11-2023 16:02:06

Reason: Approved

(ऋतुराज पाण्डेय)

(Reeturaj Pandey)

कार्यपालक अभियंता (संरक्षण)

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***Contents**

A.1.	Confirmation of the minutes of the 47 th meeting of Protection Sub-Committee.....	3
A.2.	Protection Philosophy of Northern Region (agenda by NRPC Sectt.).....	3
A.3.	Implementation of IEGC 2023 (agenda by NRPC Secretariat).....	6
A.4.	Furnishing and approval of protection setting by NRPC (agenda by NRPC Secretariat).....	6
A.5.	Annual protection audit plan for FY 2024-25 (agenda by NRPC Secretariat).....	8
A.6.	Submission of protection performance indices to NRPC Secretariat on monthly basis (agenda by NRPC Secretariat).....	9
A.7.	Intimation of performance of SPS (agenda by NRPC Secretariat).....	10
A.8.	Furnishing of details of non-compliant Disturbance Recorder (agenda by NRPC Secretariat) ..	11
A.9.	Power evacuation issues from the Switchyard of 6x250MW, SSTPS, RRVUNL, Suratgarh (agenda by RVUN).....	11
A.10.	Non-operational Busbar protection at 220kV GSS Sakatpura (agenda by RVUN).....	16
A.11.	Status of Bus bar protection (agenda by NRLDC).....	17
A.12.	Replacement of electromechanical relays with numerical relays (agenda by NRLDC).....	18
A.13.	Unsatisfactory Frequent tripping events in J&K(UT) control area (multiple events of load loss) (agenda by NRLDC).....	20
A.14.	Status of remedial actions recommended during the 47 PSC meeting (agenda by NRLDC)..	21
A.15.	Analysis of the tripping events occurred during June-2023 to August-2023 and status of remedial action taken (agenda by NRLDC).....	22

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

Minutes of the
48th Meeting of Protection Sub-Committee (PSC) of
Northern Regional Power Committee

Date and time of meeting : 11.10.2023 10.30 Hrs.

Venue : Conference Hall, NRPC Secretariat,
Katwaria Sarai, New Delhi

MS, NRPC welcomed the participants. Participant list is attached as **Annexure-P**.

A.1. Confirmation of the minutes of the 47th meeting of Protection Sub-Committee

A.1.1 EE (P), NRPC apprised that the 47th PSC meeting was held on 23.06.2023. Minutes of the meeting were issued vide letter dtd. 18.09.2023. No comment has been received till the date.

Decision taken by Forum:

Forum approved the minutes of the 47th PSC meeting as issued.

A.2. Protection Philosophy of Northern Region (agenda by NRPC Sectt.)

A.2.1. EE (P), NRPC apprised that in compliance of decisions of 42nd and 45th PSC meeting, an expert group was constituted by NRPC vide letter dtd. 08.12.2022, comprising members from NRPC Sectt, NRLDC, BBMB, POWERGRID, STUs, State GENCOs, NTPC, NHPC, and RE Generator to study various recommendations related to Protection setting as well as adopted philosophy in other regions/utilities and further, to propose updated protection philosophy in time bound manner.

A.2.2. The 1st meeting of the expert group was held on 20.01.2023, wherein members were requested to share protection guidelines followed in their organization or any other protection to be added in philosophy along with supporting document.

A.2.3. He further informed that the 2nd meeting of the expert group was held on 04.08.2023, wherein existing protection philosophy of Northern Region was discussed and revision was finalized. Draft of revised philosophy (**Annexure-I**) was discussed in meeting.

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- A.2.4. EE (P), NRPC apprised about suggestions of HPPTCL (**Annexure-II**) on draft of revised philosophy regarding distance protection zone 3 setting. HPPTCL has proposed that as per Ramakrishna committee report, typical recommended zone -3-time setting is 800ms to 1000ms. Members agreed with this suggestion.
- A.2.5. EE (P), NRPC further mentioned about another suggestion of HPPTCL regarding overvoltage protection setting. HPPTCL mentioned to use different time setting in case of multi circuit i.e., Low set Stage time delay = 5 sec for Ckt -1 and Low set Stage time delay = 6 or 7 sec for Ckt -2.
- A.2.6. NRLDC representative informed that voltage grading and time grading both may be incorporated in overvoltage protection setting.
- A.2.7. SE (O), NRPC asked about time grading method for multi circuits. POWERGRID representative replied that they are implementing time grading at low voltage level stage for first couple of circuit and same time grading at higher voltage stage for another couple of circuit.
- A.2.8. UPPTCL representative conveyed that they are having low voltage settings at 110%, 5 sec delays for first circuit and 112%, 6 sec delays for second circuit.
- A.2.9. Subsequently, EE (P), NRPC advised to use both voltage and time grading in case of overvoltage protection depending upon no. of circuits, length of lines, reactive power calculation and other operational characteristics.
- A.2.10. DTL representative requested to include overvoltage protection for cables as well in draft of revised philosophy. Forum agreed on the same.
- A.2.11. RVUNL representative stressed on the proper coordination of time setting in case of overvoltage protection for lines emanating from generating stations to avoid generating unit tripping. Forum agreed for the same.
- A.2.12. UPSLDC, and BBMB representatives emphasized on issuing guideline for overvoltage protection in case of 220kV lines. It was decided that there is no need to include overvoltage protection for 220kV lines and draft of revised philosophy will be amended accordingly.
- A.2.13. EE (P), NRPC apprised about suggestions of BBMB (**Annexure-III**) on draft of

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

revised philosophy. Firstly, that the existing protection philosophy is of year 2010. DD, BBMB added following inputs as below-

- 1) To include Polygon characteristic in numerical relay for protection scheme in case of 220kV and above. Forum agreed for the same.
- 2) In protection scheme of 132kV and below, one non-switched distance protection scheme and, directional over current and earth fault relays, should be provided as back up. Forum agreed for the same.
- 3) In zone 2 setting of distance protection, BBMB suggested not to have time settings depending on line length mentioned in draft revised philosophy. He mentioned to use the same as per Ramkrishna report. Forum agreed to adopt.
- 4) In zone 4 setting, BBMB suggested that reverse reach setting shall be 50% of shortest line connected to the local bus in order to avoid over reach of long line emanating from the same bus and in pursuance of decision taken in the 25th PSC meeting, the reverse reach may be 2 km of line length and time setting may be 160msec where bus bar protection is not provided.

A.2.14. Regarding Zone-4 setting, forum decided that setting in terms of line length may not be suitable for each location. However, setting may be kept as such to cover bus bar adequately.

A.2.15. Further, UPPTCL representative suggested modifications in the draft revised philosophy for following points (**Annexure-IV**) as below-

- 1) In direct inter trip, UPTTCL suggested to include manual trip and reactor protection. Forum agreed for the same.
- 2) Other points suggested by UPPTCL were already discussed under HPPTCL & BBMB inputs.

A.2.16. DTL representative requested to elaborate about different make or different type of the relays. He suggested to use both relays of different make if the both relays are used for same purpose. Otherwise, both relays being used for different purpose may be of same make.

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

A.2.17. RVUNL representative advised to mention as different make or different type/algorithm relay.

A.2.18. After detailed deliberation, draft philosophy (**Annexure-V**) was finalized for approval of NRPC.

Decision taken by Forum:

After detailed deliberation and considering suggestions from members, the draft revised protection philosophy was finalized for approval in next NRPC meeting.

A.3. Implementation of IEGC 2023 (agenda by NRPC Secretariat)

A.3.1 EE (P), NRPC apprised that IEGC 2023 has become effective since 01.10.2023 as per notification issued by Hon'ble CERC. A new chapter has been added in IEGC 2023 for Protection Code. He presented and apprised above chapter in detail.

A.3.2 He conveyed that a workshop had been also been held on 04.09.2023 at NRPC for all chapters of IEGC, 2023 including Protection chapter as well, wherein all clauses such as uniform protection philosophy, protection coordination, audit plan etc. were highlighted.

A.3.3 MS, NRPC stressed for compliance of IEGC 2023 and requested members to understand every clause so that addressed timeline may be followed.

Decision taken by Forum:

Forum requested every member to comply IEGC 2023.

A.4. Furnishing and approval of protection setting by NRPC (agenda by NRPC Secretariat)

A.4.1 EE (P), NRPC apprised that as per clause 14 (2) of IEGC 2023:

All users connected to the grid shall:

- *furnish the protection settings implemented for each element to respective RPC in a format as prescribed by the concerned RPC;*
- *obtain approval of the concerned RPC for (i) any revision in settings, and (ii) implementation of new protection system;*
- *intimate to the concerned RPC about the changes implemented in protection*

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

system or protection settings within a fortnight of such changes;

A.4.2 Further, he informed that as per clause 14 (3) (a) of IEGC 2023:

RPCs shall maintain a centralized database and update the same on periodic basis in respect of their respective region containing details of relay settings for grid elements connected to 220 kV and above (132 kV and above in NER).

A.4.3 Utilities asked that whether protection settings shall be required to be approved for non-members of NRPC also. EE (P) clarified that as per IEGC regulation, all utilities connected at 220 kV and above is required to submit the protection settings for approval of NRPC.

A.4.4 MS, NRPC emphasized to intimate RE developers about Protection chapter as per IEGC, 2023. He requested concerned SLDCs to inform RE stations in their region about IEGC changes. Accordingly, coordination may be done among all Generating stations and Transmission system.

A.4.5 In view of above, EE (P) proposed the following:

- i. Utilities may intimate nodal officer responsible for furnishing the protection settings implemented for each element to NRPC Secretariat. Utilities may nominate more than one officers, if required.
- ii. Utilities may send their proposal for revision in existing setting as well as new settings two weeks advance to NRPC Secretariat for approval.
- iii. Utilities may send intimation to NRPC Secretariat after implementation of approved settings within a fortnight.

A.4.6 DGM, NRLDC stated that proposal of protection settings received during FTC shall be forwarded to NRPC as per grid code for approval. As of now, protection settings were scrutinized and approved by NRLDC.

Decision taken by Forum:

After detailed discussion, Forum agreed on following points as below: -

1. *To send nomination(s) of nodal officer to NRPC Secretariat for furnishing the protection settings implemented for each element. Format is attached as **Annexure-VI***
2. *To intimate NRPC Secretariat two weeks advance about proposal for revision*

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

*in existing setting as well as new settings. Format is attached as **Annexure-VII***

3. *To inform NRPC Secretariat about implementation of approved settings within a fortnight. Format is attached as **Annexure-VIII**.*

A.5. Annual protection audit plan for FY 2024-25 (agenda by NRPC Secretariat)

A.5.1 EE (P), NRPC apprised that as per clause 15 of IEGC 2023;

- *All users shall conduct internal audit of their protection systems annually, and any shortcomings identified shall be rectified and informed to their respective RPC. The audit report along with action plan for rectification of deficiencies detected, if any, shall be shared with respective RPC for users connected at 220 kV and above (132 kV and above in NER).*
- *Annual audit plan for the next financial year shall be submitted by the users to their respective RPC by 31st October. The users shall adhere to the annual audit plan and report compliance of the same to their respective RPC.*

A.5.2 MS, NRPC enquired about preparation of utilities regarding the same and stated that utilities may submit a tentative plan for substations to be audited along with its duration.

A.5.3 Accordingly, utilities were requested to submit annual audit plan for FY 2024-25 latest by 31.10.2023 to NRPC Secretariat.

A.5.4 Utilities asked for format of audit. EE (P), NRPC clarified that checklist for audit is available in IEGC 2023. Same may be used.

A.5.5 CM, POWERGRID NR-2 suggested to do special protection audit for elements which fail to operate properly more than one time consecutively.

A.5.6 EE (P), NRPC highlighted that based on frequency of operation of any element related to grid incidence, this forum may decide whether third party protection audit is required by owner. However, a 3rd party protection audit is must within 5 years for each substation.

Decision taken by Forum:

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

*Utilities agreed to submit substation wise annual audit plan for FY 2024-25 latest by 31.10.2023 to NRPC Secretariat. Format for audit plan calendar is attached as **Annexure-IX**.*

A.6. Submission of protection performance indices to NRPC Secretariat on monthly basis (agenda by NRPC Secretariat)

A.6.1 *EE (P), NRPC apprised that as per clause 15 (6) of IEGC 2023;*

- *Users shall submit the following protection performance indices of previous month to their respective RPC and RLDC on monthly basis for 220 kV and above (132 kV and above in NER) system, which shall be reviewed by the RPC:*

*(a) The **Dependability Index** defined as $D = N_c / (N_c + N_f)$*

where,

N_c is the number of correct operations at internal power system faults and

N_f is the number of failures to operate at internal power system faults.

*b) The **Security Index** defined as $S = N_c / (N_c + N_u)$*

Where,

N_c is the number of correct operations at internal power system faults

N_u is the number of unwanted operations.

*c) The **Reliability Index** defined as $R = N_c / (N_c + N_i)$*

Where,

N_c is the number of correct operations at internal power system faults

N_i is the number of incorrect operations and is the sum of N_f and N_u

- *Each user shall also submit the reasons for performance indices less than unity of individual element wise protection system to the respective RPC and action plan for corrective measures. The action plan will be followed up regularly in*

I/31633/2023

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM**the respective RPC.*

- A.6.2 Accordingly, it was proposed that utilities may submit above performance indices of previous month by the 7th day of current month.
- A.6.3 DGM, NRLDC informed that POWERGRID and BBMB are already providing these indices to the NRLDC. He also briefed about these indices, calculation and stated that failure of protection and DC battery system may also be included in calculation of the same.
- A.6.4 NHPC representative asked about mechanical protection to be taken under consideration for calculation. EE (P), NRPC clarified that there is no need to include mechanical protection such as mechanical vibration or boiler heating issues.
- A.6.5 Utilities asked whether performance indices are to be reported if there is no fault in a particular month. EE (P) clarified that in that case "Not Applicable due to no fault" may be mentioned in monthly reporting.

Decision taken by Forum:

*Utilities decided to submit above performance indices of previous month by the 10th day of current month in attached format (**Annexure-X**) starting from October 2023.*

A.7. Intimation of performance of SPS (agenda by NRPC Secretariat)

- A.7.1 EE (P), NRPC apprised that as per clause 16 of IEGC 2023;
- *The users and SLDCs shall report about the operation of SPS immediately and detailed report shall be submitted within three days of operation to the concerned RPC and RLDC in the format specified by the respective RPCs.*
 - *The performance of SPS shall be assessed as per the protection performance indices specified in these Regulations. In case, the SPS fails to operate, the concerned User shall take corrective actions and submit a detailed report on the corrective actions taken to the concerned RPC within a fortnight.*
- A.7.2 In view of above, it was proposed that utilities may submit dependability index, security index, and reliability index of previous month by the 7th day of current month.
- A.7.3 EE (P), NRPC further stated that as soon as website of NRPC will get updated, then

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

all these protection system operation data will be available on the same. Till then these information and data may be provided in format attached as **Annexure-X**.

Decision required from Forum:

*Forum decided that utilities may comply above regulation for reporting/non-reporting of SPS operation. Performance indices of previous month are to be submitted by the 10th day of current month in format attached as **Annexure-X**.*

A.8. Furnishing of details of non-compliant Disturbance Recorder (agenda by NRPC Secretariat)

A.8.1 EE (P), NRPC apprised that as per clause 17 of IEGC 2023;

The time synchronization of the disturbance recorders shall be corroborated with the PMU data or SCADA event loggers by the respective RLDC. Disturbance recorders which are non-compliant shall be listed out for discussion at RPC.

A.8.2 Accordingly, utilities were requested to share list of DRs which are non-complaint.

A.8.3 GM, NRLDC highlighted that there are several substations that do not having time synchronization. Therefore, he suggested to send DRs details monthly of such substations and an entry may be added in the same mentioning about last date when time synchronization was checked by owner.

A.8.4 SE (O), NRPC stated that the purpose of this exercise is to improve the overall performance of system.

Decision taken by Forum:

Forum requested the concerned utilities to do the needful for time synchronization of disturbance recorders with PMU data or SCADA event loggers. Utilities were requested to share list of DRs which are non-complaint within one month's time.

A.9. Power evacuation issues from the Switchyard of 6x250MW, SSTPS, RRVUNL, Suratgarh (agenda by RVUN)

A.9.1 EE (RRVUNL, SSTPS, Suratgarh) apprised that after the commercial power

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

generation from both the 2x660MW units of SSCTPP, Switchyard of STPS-O&M is continuously overstressed because their entire power generation (2x660MW) is being evacuated through the switchyard of STPS (O&M) as SSCTPP is having total four 400KV feeders out of which 2x400KV SSCTPP-Babai feeders are still not commissioned and 2x400KV SSCTPP-Bikaner feeders do not cater loads i.e. lightly loaded/imports solar power from Bikaner during day time. So, entire generation by 2x660MW, SSCTPP is being evacuated through the feeders of STPS only. Besides this, considerable solar generation during day time (approx 550MW) at Bikaner is also being evacuated through the Switchyard of STPS via 3x400KV Bikaner feeders (two from SSCTPP and one from STPS-O&M). In nutshell, Switchyard of STPS-O&M is evacuating approx. 1000-1100MW extra power generation continuously in addition to its own 1500MW generation capacity i.e. 60-80% overloading.

A.9.2 Due to this entire phenomenon, either 2x315MVA, 400KV/220KV ILTs or 2x400KV STPS-Ratangarh lines and sometimes all the four power elements operate near their border line load. The details of impact on our Switchyard are as under:

(a) **2x400KV Ratangarh Feeders:**

During the period Dec'21 to May'23 isolator arms/jumpers/joints of these feeders got damaged during peak day hours when all the three Bikaner lines imports power was more than 550MW alongwith all the generation of the SSCTPP. It has also been observed that for attending these emergency breakdowns, generation of STPS & SSCTPP were back-down and also running units of STPS-O&M were desynchronized sometimes. Moreover, NRLD and LD do not issue written messages for generation back-down/de-synchronization of generating units which had resulted into generation loss both at STPS-O&M & SSCTPP end.

It is also observed that LD & NRLD usually takes 5-6 hours for providing shut-down codes, meanwhile, isolator arms of the healthy lines get weakened because of passage of double current for 5-6 hours and this plays a vital role for creation of the next emergency break-down.

Besides this, all such emergencies were created during peak day hours but their breakdown maintenance were taken up during the night hours sometimes whole night because LD permits to work during lean load period irrespective of the emergencies.

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***(b) 2x315MVA, 400KV/220KV ILTs at STPS**

In STPS, Unit 1 & 2 are connected at 220KV side and unit# 3 to 6 at 400KV side. Both the ILTs at STPS are loaded up in such way that if either unit#1 or 2 trips then loading on ILTs crosses the overload setting causing critical situation (as the time taken to control the loading on the ILTs is quite high) and there was every possibility that in case of tripping of any ILT might have resulted in tripping of the other ILT thereby isolation of 220KV and 400KV switchyards. Further, if none of the outgoing 220KV feeder is connected to grid (Generally operates in radial mode) then no supply shall be available at 220KV side and shall lead to tripping of all the station transformers (220KV/6.6KV) resulting in tripping of all the unit auxiliaries and finally tripping of all the units of STPS. The case of cascade tripping of ILTs and all the generating units of STPS has already occurred on 05.06.2022.

So, for the stabilization, it becomes necessary to run the unit #1/2/both at STPS always and during their tripping/down period there is extra burden on STPS to maintain the ILT loading through the LD/NRLD.

(c) Proposal of SPS Scheme:

Looking to issues of power evacuation, already a proposal for implementing SPS scheme to save the overloading of ILTs by tripping the 220KV STPS-Bhadra line has been initiated in May'22 but approval from the RVPN is still pending

(d) Drawl of high MVAR:

Since solar power attracts much MVAR, so there is excessive drawl of MVAR from our units causing bad effect on our Generators (Low pf than the design value, low Gen voltage, heating in Exciter etc.).

(e) Violation of N-1 Philosophy:

Presently, seven power sources are connected at 400KV Switchyard of STPS-O&M (4x250MW generating units of STPS-O&M + 2x400KV Inter-connectors from SSCTPP (2x660MW) + 400KV STPS-Bikaner line during day time) but only four power receiving elements are connected for evacuation of these sources of power (2x400KV STPS-

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

Ratangarh lines + 2x315MVA ILTs). This does not meet the CEA guidelines for the basic principle of N-1 security in power network wherein N is the number of power receiving elements and N-1 is the power sources. It is clear that for 400KV switchyard of STPS-O&M, sources are more by 3 numbers than the power receivers. In such cases, if any power receiving element trips, then the Grid may collapse.

(f) Difficulty in availing planned shutdowns at STPS:

Due to heavy loading in Switchyard of STPS, planned/preventive shutdowns of power elements like 220KV Buses, 400KV Buses, ILTs are deferred/cancelled/ squeezed by LD even after approved by the OCC. Recently, OCC approved shutdown of ILT-1 was not allowed by LD even after emergency conditions at STPS-site. Also, preventive maintenance and routine tests are carried out during down time of units of both STPS and SSCTPP simultaneously. Only breakdown maintenance are carried out and that is also permitted by LD during lean/night hours.

A.9.3 All such problems were also taken up in agenda of the 208th OCC dtd 15.06.2023. Recently, CE(T&C), RRVUNL along with their team also visited STPS on 24.09.23 to study & analyse the problems.

A.9.4 It was also informed that the 220KV switchyard of STPS was charged in the year 1997 and 400KV switchyard in 2001 i.e., both the switchyards are more than 21 years old as of now and this continuous overloading of the power elements of the Switchyard in longer run may turn into disaster. So, following remedial measures were proposed for the stable and safe operation of the switchyards of STPS(O&M):

A) Solar generation at Bikaner is treating as a load centre. So, the import on 3x400KV Bikaner Lines (one from STPS and two from SSCTPP) during day time must be avoided.

B) Approval of the proposed SPS scheme to save the overloading of ILTs.

C) It is requested to arrange in writing the standing direction to STPS to trip the 220KV outgoing lines selectively from STPS end whenever the loading on ILTs exceeds their rated capacity.

D) Arrange to conduct load flow studies for the existing system and analyse the phenomenon of overloading at STPS Switchyard.

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

E) Arrange to conduct the study of the higher MVAR demand and low voltage profile in nearby area and accordingly the operation of both Bus and line Reactors installed at SSCTPP plant.

F) SLDC & NRLDC usually takes considerable time for providing shut-down codes during emergencies and that is also without any written messages of generation backdown/desynchronisation of generating units/ management of loads. As such, STPS-O&M is to be allowed to trip the faulty lines after reducing the generation either by backdown or desynchronisation of the generating units without any DSM charges.

G) Early completion of 2x400 KV SSCTPP-Babai Lines.

H) Generation from SSCTPP should be evacuated through their 2x400KV Bikaner lines till the completion of Babai Lines. If possible, independent operation of both super critical plant and O&M plants may be permitted.

I) Early completion of proposed 400KV GSS at village Kenchiya, Hanumangarh. It is also proposed that for this GSS, LILO of 400kV feeders of SSCTPP rather than STPS should be considered otherwise loading on STPS Switchyard through both the SSCTPP-STPS Interconnectors shall remain intact.

J) Planned shutdown of Power elements of 400KV system requires OCC approval which has to be applied at least 30 days in advance but at the time of execution same are cancelled/deferred/ squeezed by the SLDC even after approval by the OCC because of highly unpredictable load patterns resulting non- cooperation from the service engineers for the ETC/service work, specialized labours and machines hired etc at STPS end. So, the planned shutdowns of 400KV elements of STPS should be provided by the SLDC within 1-2 days of planning after mutual communication till the problem of power evacuation is resolved and the procedure of OCC approval should be taken up by the SLDC with NRLDC at their end.

A.9.5 SE (O), NRPC enquired about construction status of 2x400 KV SSCTPP-Babai Lines. EE (RRVUNL, SSTPS, Suratgarh) replied that these are under RVPN.

A.9.6 She further informed that chances of conductor theft are high on these lines. The construction process has taken approximately 5 years. The PO for Babai end conductor has been done 2 years before but no conductor has been received till now.

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- A.9.7 She expressed that RVPN is not extending support to resolve the issue. Even though the issues have already been communicated and discussed in OCC.
- A.9.8 MS, NRPC stated that in Solar hours, power will be there. Therefore, you may go ahead with proposal of SPS as 2x400 KV SSCTPP-Babai Lines construction is also under process.
- A.9.9 EE (RRVUNL, SSTPS, Suratgarh) presented the proposed SPS at Bhadra to decrease the load at ILTs. She further conveyed that proposal has been submitted to RVPN one and half year back. RVPN informed RVUNL that the same has been sent to NRPC.
- A.9.10 EE(P), NRPC asked about wiring of proposed SPS at Bhadra. EE (RRVUNL, SSTPS, Suratgarh) replied that wiring will be done by RRVUNL with the retrofitting work going on currently.
- A.9.11 SE, NRPC stated that issue is bilateral and RVPN and RRVUNL should sit together to resolve it.
- A.9.12 MS, NRPC recommended that this matter is not related to protection. He requested RVUNL to address this agenda in upcoming 212th OCC meeting scheduled on 20.10.2023.

Decision taken by Forum:

Forum requested RVUNL to present the power evacuation issues from the Switchyard of 6x250MW, SSTPS, RRVUNL, Suratgarh in the 212th OCC meeting scheduled on 20.10.2023. RRVUNL was also suggested to escalate the issue at higher level in RVPN.

A.10. Non-operational Busbar protection at 220kV GSS Sakatpura (agenda by RVUN)

- A.10.1 EE, RRVUNL apprised that Bus Bar protection scheme is not in operation at 220kV GSS Sakatpura since long. Due to this reason, 220 kV Bus faults at GSS Sakatpura are not cleared in time at GSS Sakatpura end. These faults are fed through 04 Nos. KTPS- Sakatpura feeders and are cleared later during delayed tripping (In Zone 2 time or back up protection) creating system instability at KSTPS Kota, which many times results in tripping of running KSTPS generating units and feeders etc. causing huge

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

revenue loss to RVUNL.

A.10.2 He further stated that the same matter has already been raised to concerned but bus bar protection is yet to be implemented.

A.10.3 EE, RVPN informed that bus bar protections are required at 42 locations and out of that, equipment have been procured for 31 locations, rest are under the process of procurement. He committed that commissioning and operational starting of all bus bar protection system will be done by the end this Financial Year i.e., 2023-24.

Decision taken by Forum:

RVPN was requested to expedite the commissioning of all the bus bar protection system.

A.11. Status of Bus bar protection (agenda by NRLDC)

A.11.1 NRLDC representative apprised that clause - 4 in schedule - V of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2010 reads as

"Bus bar protection and local breaker backup protection shall be provided in 220kV and higher voltage interconnecting sub- stations as well as in all generating station switchyards".

A.11.2 He highlighted that during analysis of many grid incidents/disturbances, it has been found that the Busbar protection at the affected substation was not present or non-operational which resulted in considerably increasing both the number of affected elements and fault clearance time. Accordingly, it becomes critical to monitor and keep Busbar protection at all the 220 kV and above voltage level substations healthy and operational.

A.11.3 Further, he informed that constituents were requested vide NRLDC letter dated 28th Dec 2022 to furnish status of Busbar protection in the prescribed format in their control area.

A.11.4 Details are yet to be received from J&K.

A.11.5 NRLDC representative stated that constituent wise status of bus bar protection where bus bar protection is either not installed or installed but not operational along with

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

present status as per detail received from constituents is attached as Annexure-IV of agenda.

- A.11.6** NRLDC representative asked members to appraise about the status of remedial action taken/to be taken regarding commissioning and healthiness of bus bar protection at 220kV & above substations and also expedite the implementation of bus bar protection.
- A.11.7** Haryana representative informed that bus bar panel has been commissioned at 220kV Mohindergarh on 28th October, 2023. Bus bar at few of the remaining stations will be commissioned by December-2023 and at rest of the stations by March 2024. Station wise details will be shared via mail.
- A.11.8** BBMB representative informed that bus bar protection at 220kV Samaypur will be installed by December-2023. Bus bar protection at 220kV Dhulkote, Jagadhari and Barnala is not feasible as per the network configuration.
- A.11.9** UP representative informed that bus bar protection has been commissioned at 220kV Amariya, 220kV Bansi, 400kV Agra(UP), 220kV Farrukhabad and 220kV Hardoi Road. Bus bar at remaining stations will be commissioned by December-2023.
- A.11.10** HP representative informed that issue w.r.t. bus bar protection has been taken up with OEM and same will be commissioned by December-2023.
- A.11.11** Punjab representative informed that bus bar panels has been procured, cabling has also been done, ABB has started that commissioning work and same would be completed by December 2023.
- A.11.12** Rajasthan representative informed that out of 42 substations, material has been procured for 31 number of stations, installation work has been started. Bus bar protection at all the stations will be completed by March 2024.
- A.11.13** Representative from Uttarakhand was not present during the meeting.
- A.11.14** NRLDC representative stated all the concerned members to share the updated details via mail and also take necessary actions to expedite the commissioning/restoration of bus bar protection at 220kV & above substations. Constituents agreed for the same.
- A.11.15** Constituent wise status of bus bar protection as per details received from respective members is attached as **Annexure-XI**.

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***Decision taken by Forum:**

Forum requested all the constituents to update the status of bus bar protection at S/s of their control area and also expedite the commissioning and implementation work of bus bar protection system.

A.12. Replacement of electromechanical relays with numerical relays (agenda by NRLDC)

- A.12.1 NRLDC representative apprised that clause-5.2(r) of IEGC, clause-15(4) of CEA Grid standards and clause-48(4) of CEA Construction Standards 2022 mandates that *“each line or transformer or reactor or any other bay shall be provided with facility for disturbance recording, event logging and time synchronizing equipment”*.
- A.12.2 He stressed that during analysis of grid incidents/disturbances, it has been found that there are few stations where electromechanical relays are still in use and thus disturbance recorders are not available there which accounts for violation of Clause-5.2(r) of IEGC, clause-15(4) of CEA Grid Standards and clause 48(4) CEA Construction Standards 2022.
- A.12.3 In addition, clause-3 in part III (Grid Connectivity Standards applicable to Transmission Line and Sub-Station) of Standards for Connectivity to the Grid, 2007 reads as *“Two main numerical Distance Protection Schemes shall be provided on all the transmission lines of 220 kV and above for all new sub-stations. For existing sub-stations, this shall be implemented in a reasonable time frame”*
- A.12.4 Further, He highlighted that disturbance recorder (DR) is essential for analysis of grid incidents/disturbances. Its non-availability eventually affects the proper analysis of grid incidents/disturbances and monitoring of protection system.
- A.12.5 Deliberation on same subject has also been done during 207th OCC meeting. During the meeting, all the constituents/SLDC/STU were requested to review the same in their control area and to expedite actions to replace electromechanical relays with numerical relays.
- A.12.6 Constituent wise details of static/electromechanical type protection relays at their respective substations along with its present status per detail received from constituents is attached as Annexure-V of agenda.

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- A.12.7 Constituents were requested to share the status of electromechanical relays and remedial action taken/to be taken regarding replacement of static/electromechanical relay with numerical relays at 220kV & above substations and also expedite the process of replacement of static/electromechanical relay with numerical relays.
- A.12.8 HP representative informed that relays has been procured and timelines of installation and further work is not received yet. NRLDC requested to share the timeline of the same.
- A.12.9 Rajasthan representative informed that due to legislative elections in Rajasthan, tendering process has been delayed and same will be resumed from December, 2023 and process will be taken up on priority.
- A.12.10 Haryana representative informed that all the line distance protection relays are of numerical type, few protection relays in transformers and some of the backup relays are of electromechanical type. New relays are being procured and same will be replaced on priority. NRLDC requested to share the tentative timeline of the replacement work.
- A.12.11 UP representative informed that requirement has been sent to headquarter, further process will be done after procurement. NRLDC requested UP transmission representative to share the status of remedial action to SLDC-UP and SLDC-UP will further share to NRLDC. It was further requested to expedite the process so that most of the replacement work would be completed by March 2024.

Decision taken by Forum:

Forum requested all the constituents to update the status of type of protection relays at S/s of their control area and also expedite the replacement work of static/electromechanical type protection relays with numerical relays.

A.13. Unsatisfactory Frequent tripping events in J&K(UT) control area (multiple events of load loss) (agenda by NRLDC)

- A.13.1 NRLDC representative apprised that frequent events of multiple elements tripping leading to load loss has been observed in J&K (UT) control area. Majorly affected substation are 220kV Ziankote, Barn, Mirbazar, Jammu (Gladini) & Pampore and 400kV Baglihar. Details of tripping events occurred at aforementioned sub stations during period of Jun'23-Aug'23 are enclosed in Annexure-VI of agenda. Such

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

frequent grid events are very detrimental to the safety and security of the state grid as well as to that of regional and national grid.

- A.13.2 He informed that during analysis of the grid events based on the available data, following protection related issue are observed:
- i. Non-operation of A/R during single phase to earth fault: During 46th PSC meeting J&K stated that *“in next financial year, work of installation of OPGW in all the transmission lines will be started. Follow-up actions are being done regarding the same. OPGW work will be followed by installation of PLCC”*. However, no further update received from J&K.
 - ii. Issue related protection settings in transmission elements: Protection system are also not well coordinated with remote substations. Unwanted tripping of the elements are also observed. Hence, reviewing of protection settings of transmission elements at J&K (UT) substations and ensuring its proper coordination with the nearby substation is to be ensured.
 - iii. Poor status in submission of event reports, DR/EL etc.
- A.13.3 J&K (UT) was requested to share the details of actions taken to address aforementioned issues. Also requested to share the status of follow-up actions taken/ to be taken in this regard.
- A.13.4 J&K representative informed that PLCC installation work was done some of the station in coordination with POWERGRID. However, their integration with protection relays haven't been done yet. A/R also not functional in the lines.
- A.13.5 NRLDC representative requested to expedite the process of integration of protection relays with PLCC and take necessary actions to make A/R functional in transmission lines. It was also requested to J&K to conduct third party protection audit of substation in J&K control area in view of protection non-operation and maloperation during frequent grid events.

Decision taken by Forum:

Forum requested J&K to expedite the work related to PLCC/DTPC installation and implementation of A/R function in relays. J&K was requested to submit internal protection audit report of their sub-stations.

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***A.14. Status of remedial actions recommended during the 47 PSC meeting (agenda by NRLDC)**

A.14.1 NRLDC representative apprised that the list of tripping events along with remedial actions points recommended during 47th PSC meeting is attached as Annexure-VII of agenda. It is expected that necessary actions would have taken place. In view of the same, constituents were requested to share the status of remedial actions taken.

Decision taken by Forum:

Members were requested to share their inputs via mail within one (01) week.

A.15. Analysis of the tripping events occurred during June-2023 to August-2023 and status of remedial action taken (agenda by NRLDC)

A.15.1 The list of major tripping events occurred during June-2023 to August-2023 was discussed and attached as Annexure-VII of agenda. Concerned constituents/utilities were requested to share the detailed analysis of the tripping elements along with status of remedial action taken/to be taken.

A.15.2 Discussed tripping events are as below-

A. Multiple elements tripping at 400/220 kV Daulatabad(HV) & 400kV Gurgaon(PG) Station at 06th June 2023, 00:10 hrs.**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 400/220kV Daulatabad(Har) S/s has one and half breaker bus scheme. 400/220kV 315MVA ICT-1,2,3&4 and 400kV Daulatabad-Dhanonda D/C were connected at 400kV Bus-2 and the rest of the elements i.e., 400kV Daulatabad-Gurgaon(PG) D/C & 400kV Daulatabad-Jhajjar(APCPL) D/C were connected at 400kV Bus-1.
- As per PMU, DR/EL & tripping report received, sequence of the event are as follows:
 - At 00:10:35:400hrs, B-N phase to earth fault occurred on 400 KV Gurgaon(PG)-Daulatabad(HV) (HV) Ckt-2. On this fault, A/R started at Daulatabad end, however line tripped from both end on DT received from Gurgaon(PG) end within ~60msec of A/R start.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Further at 00:10:36:500hrs, B-N phase to earth fault occurred on 400 KV Gurgaon(PG)-Daulatabad(HV) (HV) Ckt-1. On this fault, A/R started at Daulatabad end, however line tripped from both end on DT received from Gurgaon(PG) end within ~50msec of A/R start.
 - DT received from Gurgaon(PG) end might be due to PLCC mal-operation. POWERGRID has been communicated regarding the same to take necessary corrective actions at their end.
 - At the same time, Bus bar protection of 400kV Bus-2 at Daulatabad also mal-operated and all the Main CB connected at 400kV Bus-2 opened. As reported, there was some issue in bay unit of ICT-4. Issue has been already taken up with OEM (Siemens).
 - Due to operation of bus bar protection, 400/220kV 315MVA ICT-3&4 tripped.
 - During same time, 400/220kV 315MVA ICT-2 at Daulatabad was also hand tripped. As reported, there was some issue in auxiliary contacts of CB at LV side of ICT-2. Issue w.r.t. ICT-2 has been corrected.
 - Further, it is also observed that, on tripping command of Bus bar protection of bus bar-2, Y & B ph pole of CB of ICT-4 tripped instantaneously however, R-ph pole of CB didn't open and it later opened after ~1300msec on O/C E/F protection operation. As reported, issue w.r.t. ICT-4 CB has been taken up.
- As per SCADA, no change in demand of Haryana control area is observed.
- Major observations:
- Issue w.r.t. bus bar protection and 400/220kV ICT-4 at Daulatabad(Haryana) need to be resolved on priority.
 - Why did DT send from Gurgaon(PG) end in 400 KV Gurgaon(PG)-Daulatabad(HV) (HV) D/C? Any necessary corrective actions required may be taken at Gurgaon(PG) end.
 - DR of bus bar relay at Daulatabad end need to be shared.
 - Why did bus bar protection operate at Daulatabad end?

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Why did 400/220kV ICT-2 at Daulatabad trip?
- Report of remedial action taken to be shared.

b. HVPNL & POWERGRID representative and others informed the following:

- HVPNL representative informed that fault was of transient nature on 400kV Gurgaon-Daulatabad ckt-1&2.
- At the same time bus bar protection maloperated. Maloperation occurred due to faulty ICT-4 bay unit due to which its communication was not available with central unit.
- Healthy bay unit has been arranged and same will be replaced on priority as per availability of shutdown opportunity. Thereafter, bus bar protection will not maloperate. Till then, Z-4 time delay setting is kept as 160msec.
- On observation of DT sent from Gurgaon end, POWERGRID representative informed that on the day before the event, SCADA upgradation work was done at Gurgaon and A/R system at Gurgaon S/s is in BCU. After SCADA upgradation A/R of all the lines at Gurgaon went into default state which was OFF, that's why A/R didn't operate during single phase to earth fault in line. And as per A/R scheme, if A/R is OFF then DT will be sent.
- After notice of this issue, all the A/Rs were made ON and guidelines were also circulated to POWERGRID substation to review the A/R setting after and SCADA upgradation work.

2. Forum Recommendations_

- *Expedite the replacement of bay unit of ICT-4 at Daulatabad(Haryana) and ensure healthiness of protection system at 400/220kV Daulatabad (Haryana).*

B. Multiple elements tripping at 220 kV Mohana (Har) Station at 09th June 2023, 21:09 hrs

1. Discussion during the meeting:

- a. NRLDC representative raised following points during the meeting:**

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- 220/132kV Mohana(Haryana) has double main bus scheme at both 220kV & 132kV level. There are six 220kV lines connected at 220kV level i.e., 220kV Mohana-Sonipat(PG) D/C, 220kV Mohana-Sampla (Haryana) D/C and 220kV Mohana-Samalakha (Haryana) D/C. Samalakha is further connected 220kV Chhajpur(Haryana) which is further connected to 400/220kV Panipat (BBMB).
- As reported, at 21:09 hrs on 09th Jun23, R-phase CT at Mohana end of 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-1 damaged and line tripped. At the same time, two limbs of CB at Mohana end of 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-2 also damaged and ckt-2 also tripped.
- As per telephonic communication with Mohana S/s, fault was in Z-4 from Mohana end having time delay setting of 1sec and bus bar protection operation was also not healthy due to issue in isolator status, hence fault didn't clear. Further, 220kV Mohana-Sampla (Haryana) D/C tripped in Z-2 from Sampla end. 220kV Mohana-Samalakha (Haryana) D/C also became dead due to tripping of 220kV Panipat-Chhajpur ckt-1&2 due to conductor snapping. With this, 220/132kV Mohana S/s became dead.
- At 22:35hrs, supply to Mohana S/s was restored through 220kV Mohana-Sampla (Haryana) D/C.
- As per DR received from Sonipat(PG) end, 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-1 tripped within 120msec on R-N fault and 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-2 tripped with the delay of ~360msec on B-N fault in Z-2.
- As per PMU, R-N fault which cleared within 120msec followed by B-N fault with delayed clearance of 360 msec is observed.
- As per SCADA, change in demand of approx. 370MW is observed in Haryana control area.
- Major observations:
 - Healthiness of Bus bar protection at Mohana S/s need to be ensured. Z-4 time delay setting at Mohana end need to be reviewed?
 - DR/EL of Mohana S/s end need to be shared.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As per analysis report of HVPNL, replacement of Main-II relays of Sonipat(PG) ckt-1&2 was recommended. Status of the same need to be shared.
- Remedial action taken report to be shared.

b. HVPNL & POWERGRID representative and others informed the following:

- Fault first occurred on 220kV Mohana-Sonipat ckt-1 due to CT blast at Mohana end. At the same time, Y & B phase pole of CB of 220kV Mohana-Sonipat ckt-2 also damaged.
- Bus bar protection at 220kV Mohana was not healthy due to issue in isolator status. Hence, bus bar protection didn't operate.
- Now, issues related to isolator status has been rectified and bus bar protection is now healthy.
- On Z-4 time delay setting, Haryana representative informed that earlier Z-4 time delay setting was kept as 1000msec instead of 160msec. NRLDC representative advised to keep Z-4 time delay setting as per protection guidelines.
- On fault sensed by Sonipat end in Z-1, POWERGRID representative informed that initially fault was sensed in Z-2 and later it came under Z-1. It might occurred due to over reach of distance protection due to high fault current.
- POWERGRID representative raised concern over delayed clearance of fault in downward 220kV network which affect healthiness of ICTs due to high fault feeding duration.

2. Forum Recommendations:

- *Healthiness of protection system need to be ensured to avoid delayed clearance of faults.*
- *Haryana is requested to ensure the timely submission of DR of all the tripped elements during grid event.*

C. Multiple elements tripping at 400/220 kV Bahadurgarh(PG) Station at 25th July 2022, 14:44 hrs

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 220kV side of 400/220kV Bahadurgarh(PG) has double main & transfer bus scheme.
- As reported, at 14:22 hrs, sparking was observed in Y-phase isolator of 400/220 kV 315 MVA ICT 2 at Bahadurgarh(PG) and ICT 2 tripped. POWERGRID has been communicated to share the exact detail of protection operation.
- Further at 14:44 hrs, bus bar protection operated at 220KV Bus 1 & 2 at Bahadurgarh(PG) and 400/220 kV 315 MVA ICT 1 at Bahadurgarh(PG) along with 220 KV Bahadurgarh(PG)-Nuna Majra(HV) (HVPNL) Ckt-1 & 2 tripped. POWERGRID has been communicated to share the exact nature and location of fault.
- As per DR of 220 KV Bahadurgarh(PG) Nuna Majra(HV) (HVPNL) Ckt-2 of POWERGRID end, line tripped on B-N phase to earth fault in Z-2.
- As per PMU at Bahadurgarh(PG), B-N phase to earth fault with delayed fault clearance time of 240 ms is observed.
- As per SCADA, change in demand of approx. 190MW in Haryana control area.
- Major observations:
 - As reported, fault was on 220kV Bahadurgarh-Nunamjara ckt-2. Reason of tripping of multiple elements?
 - Why did both Bus-1&2 at Bahadurgarh(PG) trip?
 - Reason of delayed clearance of fault need to be shared.
 - DR/EL along with tripping report need to be shared.
 - Remedial action taken report need to be shared.

b. POWERGRID representative and others informed the following:

- Bus bar protection didn't operate at Bahadurgarh end.
- At 14:22:25 hrs, damage in Y-phase Isolator caused loss of current in Y-phase and operation of B/U EF protection in ICT-2 at Bahadurgarh.

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Further at 14:44:58hrs, fault occurred on 220 kV Bahadurgarh-Nun-amajra ckt-2. LV side bay unit of O/C E/F protection of 400/220kV ICT-1 operated on this fault due to failure of voltage selection.
- TMS of BU O/C E/F relay found sensitive and same has been corrected.

2. Forum Recommendations:

- *Proper coordination of protection system need to be ensured.*
- *Healthiness of protection system need to be ensured to avoid delayed clearance of faults.*

D. Multiple elements tripping at 220/132 kV Verpal (Punjab) Station at 18th June 2023, 00:07 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 220/132/66kV Wadala(PS) and 220/132/66kV Verpal(PS) has double main bus scheme at 220kV level.
- As reported, at 00:07hrs, 220/132kV ICT 1 & 4 at Wadala(PS) tripped (exact reason of tripping yet to be shared). As per SCADA, during the same time, 220/132kV ICT 3, 4 & 5 at Verpal(PS) along with all the 132kV feeders at Verpal(PS) also tripped and 132kV buses at Verpal(PS) became dead.
- As per SCADA SOE, 132kV Wadala-Batla ckt-1, 2 & 3, 132kV Wadala-Hargo ckt-1 and 132/11KV ICT 2 at Wadala(PS) also tripped during the same time.
- As per information received from SLDC Punjab, at 00:14 hrs, R-phase CT of 220 kV Verpal(PS) –Amritsar(PG) ckt-2 blasted at Verpal(PS) end. Further, fire was also observed in the cable of 220 kV Verpal(PS) –Amritsar(PG) ckt-1. As per SCADA, during the same time, 220 kV Verpal(PS) –Wadala(PS) ckt-1 and 220 kV Verpal(PS) –Wadala(PS) ckt-2 also tripped.
- As per information received from CPCC2, 220kV Verpal(PS) –Amritsar(PG) ckt-1 tripped only from Verpal(PS) end and line remained charged from Amritsar(PG) end.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As per DR of 220 kV Verpal(PS) –Amritsar(PG) (end) ckt-2, R-N phase to earth fault (fault sensed in zone-2) is observed with fault current of approx. 27.65kA in R-phase and fault clearing time of 145ms.
- As per PMU at Amritsar(PG), Y-N phase to earth fault with delayed clearance of 440msec is observed at 00:07hrs and R-N phase to earth fault with delayed clearance of 240msec is observed at 00:14hrs.
- As per SCADA, change in demand of approx. 315MW at 00:07hrs and 350MW at 00:14hrs is observed in Punjab control area.
- Major observations:
 - Exact reason of tripping of 220/132kV ICT 1 & 4 at Wadala(PS) and 220/132kV ICT 3, 4 & 5 at Verpal(PS) need to be shared.
 - Why did 220 kV Verpal(PS) –Amritsar(PG) ckt-1 not trip from Powergrid end? Whether Main-II relay(distance protection) of Amritsar ckt-1 has been restored? (discussed in OCC 209)
 - Reason of delayed clearance of fault need to be shared.
 - As per SCADA SOE, 132kV Wadala-Batla ckt-1, 2 & 3, 132kV Wadala-Hargo ckt-1 and 132/11KV ICT 2 at Wadala(PS) also tripped during the same time. Reason of tripping of these elements need to be shared.
 - DR/EL along with tripping report need to be shared from Punjab.
 - As reported, Main-1&2 relay of Amritsar ckt-2 is not healthy at Verpal end? Status of the same need to be shared.
 - Remedial action taken report to be shared.

b. Punjab representative and others informed the following:

- Fault occurred on 220kV Amritsar-Verpal ckt-2 due to R-ph CT damaged at Verpal end. At the same time, line protection relays also damaged.
- Line length of 220kV Amritsar-Verpal ckt-1 & 2 is approx. 500meter. Differential protection in line was not healthy. Distance protection at Amritsar end sensed fault in Z-2 and line tripped from remote end (Amritsar(PG)). 220kV Amritsar-Verpal ckt-1 sensed this fault in Z-4, but line got tripped from remote end in Z-2.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- 220/132kV ICT 1 & 4 at Wadala(PS) tripped due to over loading. Exact loading details recorded before tripping is not available.
- 220kV Verpal-Wadala ckt-1&2 also tripped from remote end in Z-2.
- Tan delta of CT was also found in the range of 0.6. Guidelines for proper monitoring of CTs wherever Ten delta is in higher range has been circulated.

2. Forum Recommendations:

- *Proper monitoring and maintenance of protection system need to be ensured.*
- *Review of protection settings, their healthiness and protection coordination need to be done.*
- *Punjab is requested to ensure the timely submission of DR of all the tripped elements during grid event.*

E. Multiple elements tripping at 220kV Verpal(Punjab) Station on 22nd August 2023, 21:51 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 220/132/66kV Verpal(PS) has double main bus scheme at 220kV level.
- As reported, at 21:51 hrs, R-N phase to earth fault occurred in 220kV Verpal(PS)-Rashiana(PS) Ckt; fault sensed in zone-1 at Rashiana(PS) end. Line tripped only from Rashiana(PS) end.
- As CB at Verpal(PS) end of 220kV Verpal(PS)-Rashiana(PS) Ckt failed to operate, all other lines connected at 220kV Verpal(PS) tripped from remote end on zone-3 distance protection operation.
- Due to this tripping, 220/132/66kV Verpal(PS) S/s became dead.
- As per DR at Amritsar(PG) end, 220 kV Verpal(PS) –Amritsar(PG) ckt-1&2 tripped on R-N phase to earth fault with fault current of ~3.2kA from Amritsar(PG) end with fault clearance time of ~830ms; fault was sensed in zone-3.
- As per PMU at Lucknow(PG), R-N phase to earth fault is observed in the system with delayed fault clearance time of 880ms.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As per SCADA, change in demand of approx. 590 MW is observed in Punjab control area.
- Major observations:
 - Exact reason of fault need to be shared.
 - Why did CB at Verpal(PS) end of 220kV Verpal(PS)-Rashiana(PS) Ckt fail to operate? Healthiness of protection system at Verpal(PS) end need to be ensured.
 - Why did LBB protection not operate at 220kV Verpal(PS)?
 - As reported, Bus bar protection was in blocked condition. Status of bus bar protection need to be shared.
 - DR/EL along with tripping report need to be shared from Punjab for all the elements.
 - Remedial action taken report to be shared.

b. Punjab representative and others informed the following:

- Fault was on 220kV Verpal-Rashiana ckt. Line was in opened condition from Rashiana end. Distance protection relay at Verpal failed to operate on this fault.
- Fault cleared with the tripping of 220kV Amritsar-Verpal ckt-1&2 from Amritsar end in Z-3.
- O/C E/F protection at Verpal end sensed the fault but fault cleared with the tripping of lines from Amritsar end in Z-3.
- 220kV Rashiana ckt is proposed to be shifted at 220kV Amritsar from 220kV Verpal within next 15-20 days then protection issues will be resolved. Otherwise, relay panel will be replaced with the healthy one.
- Time sync issue at Verpal S/s has been resolved in coordination with the OEM.

2. Forum Recommendations:

- *Proper monitoring and maintenance of protection system need to be ensured.*
- *Review of protection settings, their healthiness and protection coordination need to be done.*

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- *Punjab is requested to ensure the timely submission of DR of all the tripped elements during grid event.*

F. Multiple elements tripping at 400/220kV Moga(PG) & 220kV Mogan(Punjab) stations on 29th June 2023, 21:07 hrs

1. Discussion during the meeting:

a. NRLDC representative raised following points during the meeting:

- As reported, at 21:07hrs, earth wire of 220 KV Moga(PG)-Mehal-Kalan(PS) (PSTCL) Ckt-1 & 2 snapped between Moga S/s Gantry and tower location no. 1. Fault current was around 30kA. On this fault, bus bar protection at 220kV Bus-1 at Moga(PG) maloperated and elements connected to 220kV Bus-1 i.e., 220 KV Moga(PG)-Mogan(PS) (PSTCL) Ckt-4, 400/220 kV 500 MVA ICT 1 at Moga(PG) and 400/220 kV 315 MVA ICT 4 at Moga(PG) tripped. (Bus bar relay at 220kV Moga(PG) is of static type and sometimes maloperates during high current through fault. POWERGRID(NR-2) intimated that new bus bar relay (numerical type) will be commissioned in next 3 months tentatively).
- 220 KV Moga(PG)-Mehal- Kalan(PS) (PSTCL) Ckt-1 (connected at 220kV Bus-2) tripped due to DT received at Moga(PG) end. (Punjab has been communicated to share the reason of DT sent). During the same time, 220 KV Moga(PG)-Ajitwal(PS) (PSTCL) Ckt-1 (connected at 220kV bus-2) also tripped on R-Y-N double phase to earth fault.
- As per DR of Moga(PG) end, R-N phase to earth fault ($I_r \sim 30.73\text{kA}$, fault sensed in zone-1) followed by Y-B phase to phase fault ($I_y \sim 30.83\text{kA}$, $I_b \sim 30.56\text{kA}$) are observed in 220 KV Moga(PG)-Mehal-Kalan(PS) (PSTCL) Ckt-2, fault distance was 70m from Moga(PG) end. At the same time, R-Y-N double phase to earth fault ($I_r \sim 42.66\text{kA}$, $I_y \sim 44.11\text{kA}$) with fault clearance time of 90ms is observed in 220 KV Moga(PG) (end)-Ajitwal(PS) (PSTCL) Ckt-1, fault distance was 0.6m from Moga(PG) end.
- As per SCADA SOE, 220/66 kV ICT 2 at Mehal- Kalan(PS) and 220kV Mogan(PS)-Baghapurana(PS) Ckt-1 also tripped during the same time (Reason yet to be shared).

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As per PMU at Allahabad(PG), multiple faults are observed.
- Whole event leads to load loss of Baghapurana (feeding through Mogan (Punjab)), Jagraon (feeding through Ajitwal) and load of Mehal-Kalan. As per SCADA, change in demand of approx. 995 MW is observed in Punjab control area.
- vii) As reported, 220 kV Baghapurana & Jagraon load revived within 5-10 minutes.
- Major observations:
 - Bus-wise arrangement of elements need to be shared.
 - As per isolator status from SCADA, 220 KV Moga(PG)-Badhni ckt and 220 KV Moga(PG)-Mogan(PS) Ckt-2 are also connected to 220kV bus-1 at Moga(PG). Did they also trip due to bus bar protection operation?
 - Commissioning work of new bus bar relay need to be expedite.
 - As per SCADA SOE, 220/66 kV ICT 2 at Mehal- Kalan(PS) and 220kV Mogan(PS)-Baghapurana(PS) Ckt-1 also tripped during the same time Reason of the same need to be shared.
 - SCADA data was not healthy at 220kV Mogan(PS), Ajitwal & Baghapurana S/s. Availability and healthiness of SCADA data need to be ensured.
 - DR, EL status along with tripping report need to be shared from Punjab end.
 - Why did DT receive from Mogan (PS) end in 220kV Moga-Mahalkalan ckt-1?
 - Nature and location of all the faults?
 - Remedial action taken report need to be shared.

b. POWERGRID & Punjab representatives and others informed the following:

- At 21:07:12.858, 220kV Maog-Ajitwal ckt tripped on R-Y-N Fault, Z-1 from Moga end. Conductor snapped between Moga S/s Gantry and tower location no. 1.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Further at 21:07:13.983, 220kV Moga-Mehalkalan ckt-2 tripped R-N Fault, Z-1 from Moga end. Earth wire snapped between Moga S/s Gantry and tower location no. 1.
- Further after 817msec, 220kV Bus bar protection maloperated at Moga S/s on through fault. Earlier stabilizer resistors as per 20KA fault level. Now setting has been done for 40KA Fault level.
- Process of procurement of new bus bar panel at Moga(PG) is in process. New bus bar panel will be commissioned By February-2024.
- Differential protection in the line is not healthy.

2. Forum Recommendations:

- *Commissioning of new bus bar protection at Moga (PG) need to be expedited.*
- *Healthiness of differential protection in 220kV lines need to be ensured.*
- *Proper monitoring and maintenance of protection system need to be ensured.*
- *Timely submission of DR of all the tripped elements during grid event need to be ensured.*

G. Multiple elements tripping at 220kV Pong(BBMB) on 18th August 2023, 12:29 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- During antecedent condition, all 6*66MW units were running and generating approx. 364 MW in total. Unit-1, 3 & 5, 220/66kV 40MVA Transformer and 220kV feeders to Bairasiul, Jalandhar ckt-1 and Dasuya ckt-1 were connected at 220kV Bus-1 and Unit-2, 4 & 6 & 220kV feeders to Jalandhar ckt-2, Jessore ckt-1 and Dasuya ckt-2 were connected at 220kV Bus-2.
- As reported, at 12:29 hrs, 220 KV Pong(BB)-Dasuya(PS) (BBMB) Ckt-1 tripped on Y-B phase to phase fault with fault current of 5.895kA and 5.21kA in Y and B phase respectively and fault distance of 17.09 km from Dasuya(PS) end; zone-1 distance protection operated at

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

Dasuya(PS) end. Line tripped from Dasuya(PS) end due to disc flashover at Dasuya(PS) end, but did not trip from Pong(BB) end as relay did not operate at Pong(BB) end (relay was not healthy).

- As per protection logic at Pong(BB), if earth fault is picked up and CB is open (auxiliary contact of CB closed), tripping to bus bar is initiated detecting CB flashover condition. As reported, on the above fault, back up earth fault protection of 66MW Pong HPS – Unit 5 picked up and auxiliary contact of the CB got closed. However due to inherent delay in CB opening, earth fault protection did not get reset immediately and thus as per CB flashover protection logic tripping initiated to bus bar and all the elements connected to 220kV Bus-1 at Pong(BB) tripped. BBMB has already been communicated to share the exact protection logic of the tripping.
- At the same time, all the elements connected to 220kV Bus-2 at Pong(BB) also tripped. (Exact reason of bus bar protection operation yet to be shared)
- Due to tripping of both 220kV Bus-1 & 2 at Pong(BB), 220kV Pong(BB) S/s became dead.
- As per PMU at Jalandhar(PG), Y-B phase to phase fault is observed with fault clearing time of 2160ms.
- As per SCADA, total generation loss of approx. 364MW is observed at Pong HEP(BBMB).
- Major observations:
 - Healthiness of relay at Pong(BB) end need to be checked and corrective actions need to be taken in this regard. Healthiness of protection system at Pong(BB) end need to be ensured.
 - As stated by BBMB in OCC 211, protection settings and logic of bus bar protection will be reviewed. Status of the same need to be shared.
 - Reason of delayed clearance of fault need to be shared.
 - DR/EL of the trippings are not uploaded on tripping portal for all the tripped elements. Timely submission of the details need to be ensured.
 - Remedial action taken report to be shared.

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***b. BBMB & Punjab representative and others informed the following:**

- Fault occurred on 220kV Pong-Dasuya ckt-1. On this fault, line tripped from Dasuya end however, protection relay at Pong end didn't operate.
- Later, fault was then cleared by tripping of all the generating units on back up standby earth fault protection operation.
- At the same time, head flashover protection of Unit-2 & 5 at Pong(BB) operated which led to tripping of all the elements connected to both the 220kV bus.
- Head flashover protection has been kept by BBMB at their Bhakhra and Pong HEP as additional protection of units for incidents of pole stuck of unit breaker.
- Faulty line protection relay of 220kV Pong-Dasuya ckt-1 at Pong end has been replaced with new numerical type relay.

2. Forum Recommendations:

- *BBMB was requested to share to recommendation proposal to keep head flashover protection for unit protection at their power houses.*
- *Proper monitoring and maintenance of protection system need to be ensured.*
- *Timely submission of DR of all the tripped elements during grid event need to be ensured.*

H. Multiple elements tripping at 400/220kV Bareilly(UP) on 01st July 2023, 06:39 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 400/220kV Bareilly(UP) has double main transfer bus scheme at both 400kV & 220kV level. During antecedent condition, 400/220 kV 315 MVA ICT 3 at Bareilly(UP), 400 KV Bareilly-Unnao (UP) Ckt-1, 400 KV Bareilly(UP)-Bareilly(PG) (PG) Ckt-1 and 80 MVAR Bus Reactor No 1 at 400KV Bareilly(UP) were connected to 400KV Bus 1 at Bareilly(UP) and rest of the elements were connected to Bus 2.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As reported, at 06:39 hrs on 01st July, 2023, 400KV Bus 1 at Bareilly(UP) tripped due to bus bar protection mal-operation and hence all the elements connected to Bus 1 also tripped and Bus 1 became dead.
- As per PMU at 400kV Bareilly(PG), no fault is observed in the system.
- As per SCADA, no change in demand is observed in UP control area. After tripping load shifted to remaining 400/220/33 kV 315 MVA ICT 1 & 2 at Bareilly(UP).
- Major observations:
 - As reported by SLDC-UP, DR of 400kV Bus bar could not be extracted due to non-numerical relay installed at Bareilly(UP). As per the IEGC provision under clause 5.2 (r), all the Users, STU/SLDC and CTU shall send information/data including disturbance recorder/sequential event recorder output to RLDC within 24 hours for purpose of analysis of any grid disturbance/event. Hence, non-numerical relays at Bareilly(UP) S/s need to be replaced with numerical relays on priority.
 - As informed by UP in OCC 210, bus bar protection is kept out of service. Expeditious implementation of numerical bus bar relay was agreed during the meeting. Status of the same need to be shared.
 - Remedial action taken report to be shared.

b. UP representative and others informed the following:

- Reason of maloperation of bus bar protection couldn't be ascertained yet. Bus bar relay is of electromechanical type.
- Proposal of replacement of bus bar relay with numerical bus bar relay has been sent to headquarter. It will be replaced by March 2024.

2. Forum Recommendations:

- *UP is requested to expedite the commissioning and implementation of numerical type bus bar relay at Bareilly(PG)*
- *DR time window at Bareilly(UP) need to be standardised.*

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***I. Multiple elements tripping at 400/220kV Gr. Noida(UP) on 26th July 2023, 04:46 hrs****1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 400kV side of 400/220/132kV Gr.Noida(UP) has double main & transfer bus scheme.
- During antecedent condition, power was flowing from 400kV side to 220kV side through 400/220 kV 315 MVA ICT 1 & 2 and 400/220 kV 500 MVA ICT 5 & 6 at Gr.Noida(UPC).
- As reported, at 04:46 hrs, B-ph conductor of 400KV Bus 1 at Gr.Noida(UPC) broke and fell on Y-ph bay of 400 KV Dadri(NT)-Gr.Noida(UPC) (PG) Ckt-1 which created Y-B phase to phase fault at Bus 1. Due to this bus bar protection operated and elements on Bus 1 tripped.
- It is further reported that due to delayed operation of bus coupler CB, elements on Bus 2 also tripped during the same time. Eventually 400/220/132kV Gr.Noida(UP) S/s became dead.
- As per DR, 400 KV Dadri(NT)-Gr.Noida(UPC) (DR end) (PG) Ckt-1 tripped on Y-B phase to phase fault with fault currents of 16.57kA and 15.56kA respectively in Y and B phase; fault sensed in zone-4.
- As per PMU at Agra(PG), Y-B phase to phase fault with delayed fault clearance time of 440ms is observed.
- As per SCADA, change in demand of approx. 430MW in UP control area.
- Major observations:
 - Reason of delayed operation of bus coupler CB need to be identified and rectified.
 - Healthiness of protection system need to be ensured.
 - Reason of delayed clearance of fault need to be shared.
 - DR of bus bar relay need to be shared.
 - Remedial action taken report need to be shared.

b. UP representative and others informed the following:

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- B-ph conductor of 400kV Bus-1 snapped and came into contact with Y-ph conductor of 400kV Dadri bay.
- On this fault bus bar protection of 400kV Bus-1 operated. And due to delayed operation of bus coupler bay 400kV bus-2 also tripped.
- From DR, it was observed that isolator status signal was lapsed for approx. 300msec. As per relay engineer observation, this occurred due to DC supply fluctuation which had led to the delay.
- Timing testing was also done, bus bar protection was found healthy.
- In coordination with relay engineer, DC monitoring system has been enabled. Real time DC healthiness status can be monitored through this.

2. Forum Recommendations:

- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*
- *Healthiness and monitoring of DC supply also need to be ensured.*
- *Timely submission of DR need to be ensured.*

J. Multiple elements tripping at 220kV Nara(UP) on 26th July 2023, 05:30 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 220kV side of 220/132kV Muzaffarnagar2(Nara)(UP) has main and transfer bus scheme.
- As reported, at 05:30 hrs, 220kV Nara(UP)-Roorkee(UK) (UP) Ckt tripped from Roorkee end only on R-N fault.
- This fault was sensed by Nara(UP) end in Z-1 with fault current of approx. 4.8 kA and fault distance of 31.9 km. However, relay at Nara(UP) failed to initiate tripping command.
- Due to this, 220 KV Meerut(PG)-Nara(UP) (PG) Ckt (fault current 3.517kA as per DR), 220kV Nara(UP)-Jansath(UP) Ckt (fault distance 82.9km from Nara) and 220kV Nara(UP)-Muzaffarnagar(UP) Ckt (fault current 2.63kA from Nara) tripped from remote end. Fault was sensed in zone-3 (as per DR).

I/31633/2023

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- During this time, 220/132kV 160MVA ICT-1 at Nara(UP) also tripped due to over-current earth fault protection operation.
- With the tripping of all the aforementioned elements, feeding source to Nara(UP) S/s lost and 220/132kV Muzaffarnagar2(Nara)(UP) S/s became dead.
- As per SCADA SOE, 220kV Muzaffarnagar(UP)-Jansath(UP) Ckt also tripped during the same time (reason yet to be shared).
- As per PMU at Roorkee(PG), R-N phase to earth fault with delayed fault clearance time of 1400 ms is observed.
- As reported by SLDC-UP, change in demand of approx. 105MW occurred in UP control area.
- Major observations:
 - Reason of failure of operation of relay at Nara end?
 - Healthiness of protection system need to be ensured.
 - Issue related to Main-1&2 relay at Nara end in Roorkee ckt has been in discussion since OCC 208 however replacement of Main-II relay at Nara end still pending. Expedious replacement of the relay is required.
 - Remedial action taken report need to be shared.

b. UP representative and others informed the following:

- Both Main-1 & Main-2 relay of 220kV Nara-Roorkee ckt is healthy now. A/R is functional in Main-1 relay and A/R function is not available in Main-2.

2. Forum Recommendations:

- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*

K. Multiple elements tripping at 220/132kV Shahjhanpur (UP) on 22th August 2023, 12:39 hrs**1. Discussion during the meeting:**

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***a. NRLDC representative raised following points during the meeting:**

- During antecedent condition, 300MW Rosa TPS(UP) Unit-1 and 2 were generating 274MW and 278MW respectively. Rosa TPS is connected with 220kV Shahjhanpur thorough 220kV Rosa-Shahjhanur ckt-1&2.
- As reported, at 12:39 hrs, R-N phase to earth fault occurred in 220kV Shahjhanpur(UP)-Azizpur(UP) Ckt; fault sensed in zone-1 at both the ends. Fault distance was 12.92km from Azizpur(UP) end and 22.125km from Shahjhanpur(UP) end. As per DR, fault current was approx. 6.56kA from Shahjhanpur(UP) end. Line tripped only from Azizpur(UP) end, line didn't trip from Shahjhanpur end.
- As fault didn't clear from Shahjhanpur end, all other lines connected at 220kV Shahjhanpur(UP) tripped from remote end on zone-3 distance protection operation.
- Due to this tripping, 220/132/33kV Shahjhanpur(UP) S/s became dead.
- During the same time, 300MW Rosa TPS(UP) Unit-1 & 2 tripped on standby earth fault protection operation. As per DR of 300MW Rosa TPS(UP) Unit-1, fault current was approx. 3.37kA.
- As per SCADA SOE, 132kV Jalalbad-Azizpur (UP) Ckt and 400kV Bareilly -Unnao (UP) Ckt-1 tripped during the same time. (Exact reason yet to be shared)
- As per PMU at Lucknow(PG), R-N phase to earth fault converted to R-Y phase to phase fault is observed in the system with delayed fault clearance time of 2840ms.
- As reported by SLDC-UP, load loss of ~55MW and generation loss of approx. 550MW occurred in UP control area.
- Major observations:
 - Mechanical healthiness of elements need to be ensured.
 - Status of replacement of relay in Azizpur ckt?
 - Time sync issue at Shahjhanpur end need to be resolved.
 - DR/EL of all the elements need to be shared for both the ends.
 - Remedial action taken report need to be shared.

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***b. UP representative and others informed the following:**

- Replacement of Ajijpur line electromechanical relay with numerical relay and repair work of GPS clock to rectify time sync issue haven't been done yet. Feedback for the same has already been sent to headquarter.

2. Forum Recommendations:

- UP is requested to further raise the highlighted issue to expedite the remedial actions and share the copy of the same to NRPC also.

L. Multiple elements tripping at 400kV Bhadla(PG) on 18th July 2023, 19:56 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 400/220kV Bhadla(Raj) has one and half breaker scheme at 400kV side and double main & transfer bus scheme at 220kV side.
- During antecedent condition, 400/220 kV 500 MVA ICT 1&3 at Bhadla(RS) were carrying ~141MW each and 400/220 kV 500 MVA ICT 2 at Bhadla(RS) was not in service.
- As reported, at 19:56hrs, R-N phase to earth fault occurred on 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2. Fault was in Z-1 from Bhadla(RS) end and in Z-2 from Bhadla(PG) end.
- On this fault, Main-1 relay (distance protection) at Bhadla(RS) of 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2 didn't operate due to issue in DC supply and Main-2 relay (differential protection) at Bhadla(RS) also didn't operate due to issue in signal communication. (Rajasthan has been communicated to resolve the issues in Main protection of the line at the earliest)
- Distance protection at Bhadla(PG) end of 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2 sensed the fault in Z-2. However, line tripped in ~250msec on directional earth fault O/C protection operation. As reported, TMS setting of the O/C relay was sensitive and same has been corrected to ensure its proper operation.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Distance protection of adjacent 400kV lines at Bhadla(RS) sensed the fault in Z-4 from Bhadla(RS) end. 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-1 tripped from Bhadla(RS) end in Z-4 with ~160msec delay and 400 KV Bhadla-Ramgarh (RS) Ckt-1 & 2 tripped from Ramgarh end in Z-2 with ~300msec delay (Z-4 time delay of these lines at Bhadla(RS) was 450msec). Rajasthan has been communicated to review the time delay setting of distance protection relay and keep them in line with the NR protection philosophy.
- As fault was also fed by 220kV side through ICTs, it cleared with the tripping of 220kV Bus sectionalizer on O/C E/F with ~200msec delay.
- 220kV Bus-1(B) was remain intact.
- As per PMU at Bhadla(PG), R-N fault with the delayed clearance in ~320msec is observed.
- As per SCADA, no change in load in Rajasthan control area is observed.
- Major observations:
 - Issues related to Main protection (Main-I&II) of 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2 at Bhadla(RS) end need to be resolved at the earliest.
 - Time delay setting of distance protection relay (Z-2 & Z-4) at Bhadla(RS) end need to be reviewed and to be kept in line with the NR protection philosophy.
 - DR of Bhadla(RS) end are not time synced. Time syncing of the same need to be ensured.
 - DRs of Ramgarh end not received yet, same need to be shared.
 - Remedial action taken report to be shared.

b. Rajasthan representative and others informed the following:

- Fault was on 400kV Bhadla(PG)-Bhadla(RS) ckt-2. Distance protection relay at Bhadla(RS) end didn't operate due to issue in DC supply. Now DC supply is healthy.
- Other feeders at Bhadla(RS) end sensed the fault in Z-4 except Ramagrh circuits as its time delay was inadvertently kept as 1sec.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

Now, it has kept as 160msec as bus bar protection at Bhadla(RS) also not healthy.

- Regarding query of differential protection healthiness, it was informed that differential protection is healthy in line. Both Main-1 & 2 protections in line is healthy now.
- On time sync issue, it was informed that GPS panel is with bus bar panel which is under commissioning stage. It will be commissioned on priority.

2. Forum Recommendations:

- *Expedite the commissioning of Bus bar panel along with GPS panel at Bhadla(Rajasthan) S/s.*
- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*
- *DR time window need to be standardised.*

M. Multiple elements tripping at 220/132kV Bhiwadi(RS) on 24th July 2023, 03:29 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 220/132kV Bhiwadi(RS) has double main bus scheme at 220kV side.
- As reported, at 03:29hrs, 220/132kV 160MVA ICT-1 at Bhiwadi(RS) caught fire which created internal fault in the ICT and due to this LBB operated. Rajasthan has been asked to share the reason of LBB operation.
- During this time, 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-1 & 2 and 220/132kV 160MVA ICT-2 & 3 at Bhiwadi(RS) tripped which resulted in complete blackout of 220/132kV Bhiwadi(RS) S/s. Rajasthan has been asked to share the reason of tripping of all the elements at Bhiwadi(RS).
- As reported by SLDC Rajasthan, 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-1 tripped from 220KV Bhiwadi(RS) end only. Line was manually tripped from PGCIL end. 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-2 tripped from both ends.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As per DR of Bhiwadi(PG) of 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-2, Y-N fault at distance of ~7.7km (Z-2) & fault current of 13.68kA is observed.
- As per PMU at Bhiwadi(PG), two consecutive Y-N phase to earth faults with the delayed clearance of 360msec are observed.
- As per SCADA, change in demand of approx. 205MW in Rajasthan control area is observed.
- Major observations:
 - Exact nature and location of both the Y-N faults?
 - Reason of delayed clearance of fault?
 - Why did both 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-1 & 2 and also 220/132kV 160MVA ICT-2 & 3 at Bhiwadi(RS) trip? Details of protection operation at Bhiwadi(RS) need to be shared.
 - Remedial action taken report to be shared.

b. Rajasthan representative and others informed the following:

- 400/220kV ICT-1 & 2 tripped on differential protection. Fault occurred on both the ICTs.
- HV side Y-ph pole of CB got stuck and didn't open. On this, LBB of HV side bay of ICT-2 operated which sent tripping command to other circuits.
- 220kV Bhiwadi(RS)-Bhiwadi(PG) ckt-1 tripped on LBB operation however, ckt-2 didn't open as its Y-ph pole of CB at Bhiwadi(RS) end also got stuck. Bhiwadi(PG) ckt-2 tripped from Bhiwadi(PG) end in Z-2.
- HV side CB of 400/220kV ICT-2 at Bhiwadi(PG) ckr-2 at Bhiwadi(RS) end has been replaced with the healthy one.

2. Forum Recommendations:

- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*
- *DR of the tripping event also not received yet. Timely submission of DR/EL and tripping details need to be ensured.*

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***N. Multiple elements tripping at 400/220kV Ratangarh(RS) on 20th June 2023, 05:21 hrs****1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- 400/220kV Ratangarh(Raj) has double main & transfer bus scheme at 220kV side.
- During antecedent condition, 400/220 kV 315 MVA ICT 2 at Ratangarh(RS) and 220kV feeders to Badnu, Sikar(PG)-II, Ratangarh-I and Khetri-I connected at 220kV Bus-B. Remaining elements were connected at 220kV Bus-A.
- As reported at 05:21 hrs, B-ph bus jumper of 220 KV Ratangarh-Badnu (Raj) Ckt broke and created B-N phase to earth bus fault on 220kV bus-B. 220kV Badnu ckt tripped in Z-1 from Ratangarh end (distance relay at Ratangarh end sensed fault in Z-1, forward direction due to issue of improper fault selection by relay in case of near fault).
- 220kV Bus bar protection was in blocked condition due to some circuitry fault and hence, bus bar protection didn't operate.
- Continuous pickup and reset of Z-4 is observed in adjacent 220kV lines connected at 220kV Bus-B due to which none of the lines tripped in Z-4 from Ratangarh end (Z-4 time delay setting is kept as 160msec at Ratangarh end). As fault was still persisting 220kV lines connected at 220kV Bus-B tripped from remote end on distance protection operation in Z-2. Rajasthan has been communicated to check the operation of Z-4 distance protection at Ratangarh end.
- 220kV Ratangarh-Sikar ckt-1 connected at 220kV Bus-A also tripped in Z-4 as bus coupler breaker opened with the time delay more than Z-4 time delay (160msec).
- After approx. 600msec of the fault, 400/220kV 315MVA ICT-2 at Ratangarh(Raj) tripped on over current E/F protection operation and fault cleared with the tripping of this ICT.
- 220kV Badnu S/s became dead during the tripping event as it was having feeding from 400/220kV Ratangarh(Raj) only.
- As per SCADA, change in load of approx. 280MW is observed in Rajasthan control area.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- As informed by Rajasthan, issue w.r.t. bus bar protection at 220kV side of 400/220kV Ratangarh(Raj) has been corrected and bus bar protection is now healthy and in service.
- Major observations:
 - Periodic review of protection system and their healthiness need to be ensured.
 - Operation of Z-4 (distance protection) at 220kV Ratangarh end need to be reviewed.
 - It was informed that DR of 400/220kV 315MVA ICT-2 at Ratangarh(Raj) is not available as relay is of electromechanical type. Electromechanical relay need to be replaced with numerical relay on priority.
 - DR of Ratangarh(Raj) end are not time synced, same has been communicated to Rajasthan to take necessary corrective action at the earliest.
 - Remedial action taken report to be shared.

b. Rajasthan representative and others informed the following:

- Fault was on 220kV Ratangarh-Badnu ckt. Fault occurred due to snapping of jumper at Ratanagrh end.
- Bus bar protection at Ratangarh end was not operational during the event, work is in process.
- All 220kV lines except 220kV Sikar tripped on Z-4 protection operation at Ratangarh end. 220kV Sikar ckt tripped from Sikar end in Z-2. Z-4 time delay setting of Sikar ckt was inadvertently kept as 1sec, same has been corrected to 160msec.
- Numerical relays for transformers has been arranged and same will be replaced as per shutdown availability.
- On time sync issue, it was informed that GPS panel is with bus bar panel which is under commissioning stage. It will be commissioned on priority.

2. Forum Recommendations:

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Expedite the commissioning of Bus bar panel along with GPS panel at Ratangarh S/s.
- Issue related to phase sequence also observed at Ratangarh S/s. Uniformity of phase sequence in all the feeders need to be ensured.
- Proper monitoring, healthiness and maintenance of protection system need to be ensured.
- DR time window need to be standardised.
- Rajasthan is further requested to review the time syncing and standardisation of DR time window at all the stations of their control area.

O. Multiple elements tripping at 220kV Khodri(Utt) & 220kV Majri(HP) on 26th July 2023, 07:07 hrs

1. Discussion during the meeting:

a. NRLDC representative raised following points during the meeting:

- 220/132kV Majri (HP) has double main bus scheme at both 220kV & 132kV level. During antecedent condition, active power flowing through 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-1 & 2 was 72MW each respectively.
- As reported, at 07:07 hrs, 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-1 tripped on Y-B phase to phase fault. As per DR of Khodri end, Y-B phase to phase fault in Z-2 with fault current of 3.42kA each respectively in Y and B phase and fault clearance time of 384ms is observed.
- During the same time, 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-2 also tripped due to over-current protection operation ($I_y \sim 1.959\text{kA}$ and $I_b \sim 1.785\text{kA}$) from Majri end. Line tripped from Majri end only and remained charged from Khodri end.
- As per PMU at Shahrampur(PG), Y-B phase to phase fault with delayed fault clearance time of 400ms is observed in the system.
- As per SCADA, change in demand of approx. 125MW is observed in HP control area.
- Major observations:
 - Exact reason of tripping need to be analysed.
 - Reason of delayed clearance of fault need to be shared.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Why did ckt-2 trip from Majri end?
- DR/EL along with tripping report need to be shared.
- Remedial action taken report to be shared. In OCC 210, Uttarakhand agreed to share the analysis report of the event, however no report regarding event received yet.

b. HP & Uttarakhand representative and others informed the following:

- Y-B fault occurred on 220k Khodri-Majri ckt-1 due to tree fall.
- On query regarding reason of tripping of 220k Khodri-Majri ckt-2, HP representative stated that analysis of tripping of Khodri ckt-2 hasn't done yet. Analysis report of the event will be shared.

Uttarakhand representatives were not present in the meeting.

2. Forum Recommendations:

- *Analysis report of the events need be shared.*
- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*

P. Multiple elements tripping at 400/220kV Gumma(HP) on 18th August 2023, 10:59 hrs**1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- During antecedent condition, total MW loading of 400 KV Panchkula(PG)-Gumma(HP) (PG) Ckt-1 & 2 were approx. 575MW each.
- As reported, at 10:59hrs, 400 KV Panchkula(PG)-Gumma(HP) (PG) Ckt-2 tripped as DT received at Panchkula(PG) end due to mal-operation of relay. Due to tripping of 400 KV Panchkula(PG)-Gumma(HP) (PG) Ckt-2, MW loading of 400 KV Panchkula(PG)-Gumma(HP) (PG) Ckt-1 increased and eventually exceeded 850MW (max. MW loading reached was 853MW as per PMU), hence SPS operated for reliable evacuation of power.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Due to SPS operation, 250 MW Nathpa-Jhakri HPS - UNIT 3, 250 MW Karcham Wangtoo HPS - UNIT 2, 68.67 MW Rampur HEP - UNIT 5 and 40MW Sawra Kuddu HPS- UNIT 1 tripped.
- As per DR of 400 KV Panchkula(PG)-Gumma(HP) (PG) Ckt-2, no fault is observed at Gumma(HP) and DT received at Panchkula(PG) which clearly indicates mal-operation of relay.
- As per DR of 400 KV Panchkula(PG)-Gumma(HP) (PG) Ckt-1, currents in R , Y and B phase are respectively ~1222A, ~1291A and ~1228A. Current loading required for SPS operation is $[850/(1.732*400)] \approx 1227A$. This indicates correct operation of SPS.
- As per PMU at Panchkula(PG), no fault is observed in the system.
- As per SCADA, generation loss of approx. 260MW at Naptha Jhakri, 80MW at Rampur, 290MW at Karcham and 40MW at Sawra Kuddu is observed.
- Major observations:
 - Reason of mal-operation of protection at Gumma end?
 - Remedial action taken report need to be shared.
 - Whether protection at Gumma S/s is healthy or not?

b. HP representative and others informed the following:

- DT was sent from Gumma end due to wrong wiring of PLCC channel-2.
- DT sent signal initiated due to DC voltage dip during changeover of automatic to manual switch of DC charger.
- After correction of PLCC wiring issue has been rectified.

2. Forum Recommendations:

- *In view of large number of maloperation incidents at Gumma S/s which is directly connected to major hydro generation complex, HP is requested to conduct an internal protection audit of 400/220kV Gumma S/s.*
- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*

*48th Protection Sub-Committee Meeting (11th October, 2023)-MoM***Q. Multiple elements tripping at 220kV Kunihar(HP) on 21st August 2023, 11:27 hrs****1. Discussion during the meeting:****a. NRLDC representative raised following points during the meeting:**

- As reported, at 11:27 hrs, bus-bar protection operated at 220 kV Bus 2 at Kunihar(HP). (Exact reason yet to be shared)
- Due to this, all the elements connected to 220 kV Bus 2 at Kunihar(HP) got tripped and Bus-2 became dead.
- At the same time, as reported by SLDC HP, 132 kV Kunihar-Baroti-wala Ckt 1, 132 kV Kunihar-Solan(HP) Ckt 1 & 2, 132 kV Kunihar-Shimla(HP) Ckt 1 and 132 kV Kunihar-Malyana(HP) Ckt 2 also tripped. (Exact reason yet to be shared)
- As per SCADA SOE, 30MW Unit-1 at Giri(HP) and 132 kV Kunihar-Jutog (HP) Ckt-2 also tripped during the same time. As per communication with SLDC HP, 30MW Unit-1 & 2 at Giri(HP) (connected at 132kV level) tripped during the same time. (Exact reason yet to be shared)
- As per PMU at Panchkula(PG), no fault is observed in the system, but fluctuation in voltage is observed.
- As per SCADA, change in demand of approx. 330MW in HP control area is observed. But as reported by SLDC-HP, load loss of approx. 250MW occurred during the event.
- As per SCADA, generation loss of approx. 60MW is observed in HP hydro generation.
- Major observations:
 - Exact location and nature of fault?
 - Sequence of tripping of elements?
 - DR/EL w.r.t. all the tripped elements not received yet. Timely submission of details need to be ensured.
 - Analysis report along with remedial action taken report need to be shared.

b. HP representative and others informed the following:

- Protection and testing team reviewed the protection relays, some loose connections were found and same were tightened. However, again on 21st August maloperation of bus bar relay occurred.

48th Protection Sub-Committee Meeting (11th October, 2023)-MoM

- Issue has been taken up with ABB. Protection review in coordination with ABB will be done during next available shutdown.
- On NRLDC query of another event on 19th August at Kunihar, it was informed that location of fault couldn't be ascertained yet. NRLDC raised concern over issue in protection operation and its coordination at Kunihar and nearby stations.

2. Forum Recommendations:

- *In view of large number of incidents at Kunihar S/s and non-availability of proper details of disturbance recording devices, HP is requested to conduct a third party audit of 220kV Kunihar S/s.*
- *Proper monitoring, healthiness and maintenance of protection system need to be ensured.*

A.15.3 Tripping analysis details of all the tripping discussed during 48 PSC meeting is attached as **Annexure-XII**.

Meeting ended with vote of thanks to the chair.

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Protection Philosophy agreed for implementation in Northern Region

S.No	Protection Setting	Reach & Time
1.	Long lines Zone-1	80% of the Protected line, Instantaneous
	Zone-2	100% of the Protected line + 50% of the shortest line emanating from the far end bus bar or 120% of the Protected line which ever is higher. Time Setting: 350ms for short lines ($\leq 100\text{km}$) and 500ms for long lines $> 100\text{km}$.
	Zone-3	120% of the protected line + 100% of the longest line emanating from the far end bus bar or 100% of the Protected line + 100% of the longest line emanating from the far end bus bar + 25% of the longest line emanating from the far end of the second line considered, which ever is lower. The zone setting to be limited such that it will not reach into the next voltage level. Time Setting: 1000m sec.
	Zone- 3R	25% of the Zone-1 reach. Time Setting: 1000m sec
2.	Lines with Series and other compensations in the vicinity of Substation	80% of the Protected line. 100ms-time delay for allowing correct distance measurement after the series capacitor is bypassed.
3.	Power Swing Blocking	Block tripping in all zones, all lines. Out of Step tripping to be applied on all inter regional tie lines Deblock time delay = 2s
4.	Protection for broken conductor	Negative Sequence current to Positive Sequence current ratio more than 0.2 ($I_2/I_1 \geq 0.2$) Only for alarm: Time delay = 3-5 sec
5.	Carrier Protection	To be applied on all 400kV and 220kV lines with the only exception of radial feeders.
6.	Back up Protection	1) On 400 & 220kV lines with 2 Main Protections, back up Earth Fault protections alone to be provided. No Over current protection to be applied. 2) On 220kV and lower voltage lines with only one Main protection Back up protection by IDMT O/C and E/F to be applied.
7.	Auto Re-closing with dead time.	Single pole trip and re-closing Dead time = 1.0s. Reclaim time = 25.0s
8	LBB Protection and bus bar protection	To be applied on all 400kV and 220kV sub stations with the only exception of 220kV radial fed bus bars. LBB Current sensor $I > 20\% I_n$ LBB time delay = 200ms

Draft of Revised Protection Philosophy/Protocol of Northern Region

S.N.	ProtectionSetting/Protocol	Mandated Setting
1	Protection Scheme	<p>220kV and above:</p> <p>Independent Main-I and Main-II protection (of different make OR different type) of non-switched numerical type is to be provided with carrier aided scheme.</p> <p>132kV and below:</p> <p>One non-switched distance protection scheme and, one distance scheme or, directional over current and earth fault relays, should be provided as back up.</p>
2	Distance Protection Zone-1	<p>80% of the Protected line;</p> <p>Time Setting: Instantaneous.</p>
3	Distance Protection Zone-2	<p>Single Circuit Line: 120% of length of principle line section.</p> <p>Double circuit line: 150% coverage of line to take care of under reaching due to mutual coupling effect.</p> <p>Time Setting:350ms for short lines(≤ 100km); 500ms for long lines>100km.</p>
4	Distance Protection Zone-3	<p>Zone-3 should overreach the remote terminal of the longest adjacent line by an acceptable margin (typically 20% of highest impedance seen) for all fault conditions.</p> <p>Time Setting: 1000 ms</p>
5	Distance Protection Zone- 4	<p>Reach is to be kept at 25% of zone-1 reach.</p> <p>Time setting: equal to Zone-2 time delay.</p>
6	Lines with Series and other compensations in the vicinity of Substation	<ul style="list-style-type: none"> • Zone-1: 80% of the protected line with 100ms-time delay. POR Communication scheme logic is modified such that relay trip sinstantaneously in Zone-1 on carrier receive. • Zone-2: 120 % of uncompensated line impedance for single circuit line.For Double circuit line, settings may be decided on basis of dynamic study in view of zero sequence mutual coupling.

		<ul style="list-style-type: none"> Phase locked voltage memory is used to cope with the voltage inversion. Alternatively, an intentional time delay may be applied to overcome directionality problems related to voltage inversion. over-voltage stage-I setting for series compensated double circuit lines may be kept higher at 113%.
7	Power Swing Blocking	<p>Block tripping in all zones, all lines.</p> <p>Out of Step tripping to be applied on all interregional tie lines.</p> <p>Deblock time delay= 2s</p>
8	Protection for broken conductor	<p>Negative Sequence current to Positive Sequence current ratio more than 0.2(i.e. $I_2/I_1 \geq 0.2$)</p> <p>Only for alarm: Time delay=3-5sec</p>
9	Switch on to fault (SOTF)	<p>Switch on to fault (SOTF) function to be provided in distance relay to take care of line energization on fault</p>
10	VT fuse fail detection function	<p>VT fuse fail detection function shall be correctly set to block the distance function operation on VT fuse failure.</p>
11	Carrier Protection	<p>To be applied on all 220kV and above lines with the only exception of radial feeders.</p>
12	Backup Protection	<p>On 220kV and above lines with 2 Main Protections:</p> <ul style="list-style-type: none"> Back up Earth Fault protections alone to be provided. No Over current protection to be applied. <p>At 132kV and below lines with only one Main protection:</p> <ul style="list-style-type: none"> Backup protection by IDMTO/C and E/F to be applied.
13	Auto Re-closing with dead time.	<p>AR shall be enabled for 220 kV and above lines for single pole trip and re-closing.</p> <p>Deadtime=1.0s.Reclaimtime =25.0s</p> <p>Auto-recloser shall be blocked for following:</p> <ul style="list-style-type: none"> faults in cables. Breaker Fail Relay Line Reactor Protections O/V Protection Received Direct Transfer trip signals Busbar Protection

		<ul style="list-style-type: none"> • Zone 2/3 of Distance Protection • Circuit Breaker Problems.
14	Bus bar protection	To be applied on all 220kV and above sub stations with the only exception of 220kV radial fed bus bars.
15	Local Breaker Backup (LBB)	<p>For 220 kV and above level substations as well as generating stations switchyards, LBB shall be provided for each circuit breaker.</p> <p>LBB Current sensor $I > 20\% I_n$</p> <p>LBB time delay=200ms</p>
16	Line Differential	<p>For cables and composite lines, line differential protection with built in distance back up shall be applied as Main-I protection and distance relay as Main-II protection.</p> <p>For very short line (less than 10 km), line differential protection with distance protection as backup (built-in Main relay or standalone) shall be provided mandatorily as Main-I and Main-II.</p>
17	Over Voltage Protection	<p>400kV LINES:</p> <p>Low set stage (Stage-I): 110% - 112% (typically 110%) with a time delay of 5 seconds.</p> <p>High set stage (Stage-II): 140% - 150% with a time delay of 100milliseconds.</p> <p>FOR 765kV LINES:</p> <p>Low set stage (Stage-I): 106% - 109% (typically 108%) with a time delay of 5 seconds.</p> <p>High set stage (Stage-II): 140% - 150% with a time delay of 100milliseconds.</p> <p>Drop-off to pick-up ratio of overvoltage relay: better than 97%</p>
18	Resistive reach / blinder setting to prevent load point encroachment	<p>Following criteria may be considered for deciding load point encroachment:</p> <ul style="list-style-type: none"> • Maximum load current (I_{max}) may be considered as 1.5 times the thermal rating of the line or 1.5 times the

		<p>associated bay equipment current rating (the minimum of the bay equipment individual rating) whichever is lower. (Caution: The rating considered is approximately 15minutes rating of the transmission facility).</p> <ul style="list-style-type: none"> • Minimum voltage (V_{min}) to be considered as 0.85pu (85%).
19	Direct Inter-trip	<p>To be sent on operation of following:</p> <p>Overvoltage Protection</p> <p>LBB Protection</p> <p>Busbar Protection</p>
20	Permissive Inter-trip	To be sent on operation of Distance Protection

Annexure-II
Reeturaj Pandey

Email

Re: Minutes of the 2nd meeting of the expert group constituted to study and recommend changes in existing NR Protection Philosophy - reg.

From : LALIT KUMAR <er.lalit.tcl@hpmail.in>

Mon, Sep 18, 2023 11:43 AM

Subject : Re: Minutes of the 2nd meeting of the expert group constituted to study and recommend changes in existing NR Protection Philosophy - reg.

 Pending

To : Reeturaj Pandey <pandeyr.cea@gov.in>

Sir,

As per trailing mail, after study of the draft of revised NR Protection philosophy, following changes/ additions are recommended as below:-

S.No.	Protection Setting/Protocol	Mandated Settings	Recommendations
4	Distance Protection Zone-3	Time Setting: 1000 ms	As per Ramakrishna committee Typical recommend zone -3 time 800ms to 1000ms
17	Over Voltage Protection	Low set stage time delay= 5 sec	Low set Stage time delay = 5 sec for(CKt -1) Low set Stage time delay = 6 or 7 sec for(CKt -2)

These recommendations may also be discussed with other members.

From: "Reeturaj Pandey" <pandeyr.cea@gov.in>

To: "Sh V K Singh" <ms-nrpc@nic.in>, "Anzum Parwej" <anjum.parwej@nic.in>, "Reeturaj Pandey" <pandeyr.cea@gov.in>, "lokesh agarwal" <lokesh.agarwal@gov.in>, "RAVI LAL" <ddpntjmp@bbmb.nic.in>, ravilal348@gmail.com, "bl gujar" <bl.gujar@dtl.gov.in>, "hiteshkumar dtl" <hiteshkumar.dtl@gmail.com>, paritoshjoshi2013@gmail.com, shashank@posoco.in, sugata@grid-india.in, sandeepyadav@powergrid.in, onm-protection@nhpc.nic.in, "LALIT KUMAR" <er.lalit.tcl@hpmail.in>

Cc: "Sh V K Singh" <ms-nrpc@nic.in>, "Santosh Kumar" <seo-nrpc@nic.in>, "LokeshAgrawal" <lokesh.cea@gov.in>

Sent: Saturday, September 9, 2023 8:32:34 PM

Existing Protection Philosophy agreed for implementation in Northern Region (11th PSC Meeting on dt.23.04.2010)

S.No	Protection Setting	Reach & Time
1.	Long lines Zone-1	80% of the Protected line, Instantaneous
	Zone-2	100% of the Protected line + 50% of the shortest line emanating from the far end bus bar or 120% of the Protected line which ever is higher. Time Setting: 350ms for short lines ($\leq 100\text{km}$) and 500ms for long lines $> 100\text{km}$.
	Zone-3	120% of the protected line + 100% of the longest line emanating from the far end bus bar or 100% of the Protected line + 100% of the longest line emanating from the far end bus bar + 25% of the longest line emanating from the far end of the second line considered, which ever is lower. The zone setting to be limited such that it will not reach into the next voltage level. Time Setting: 1000m sec.
	Zone- 3R	25% of the Zone-1 reach. Time Setting: 1000m sec
2.	Lines with Series and other compensations in the vicinity of Substation	80% of the Protected line. 100ms-time delay for allowing correct distance measurement after the series capacitor is bypassed.
3.	Power Swing Blocking	Block tripping in all zones, all lines. Out of Step tripping to be applied on all inter regional tie lines Deblock time delay = 2s
4.	Protection for broken conductor	Negative Sequence current to Positive Sequence current ratio more than 0.2 ($I_2/I_1 \geq 0.2$) Only for alarm: Time delay = 3-5 sec
5.	Carrier Protection	To be applied on all 400kV and 220kV lines with the only exception of radial feeders.
6.	Back up Protection	1) On 400 & 220kV lines with 2 Main Protections, back up Earth Fault protections alone to be provided. No Over current protection to be applied. 2) On 220kV and lower voltage lines with only one Main protection Back up protection by IDMT O/C and E/F to be applied.
7.	Auto Re-closing with dead time.	Single pole trip and re-closing Dead time = 1.0s. Reclaim time = 25.0s
8	LBB Protection and bus bar protection	To be applied on all 400kV and 220kV sub stations with the only exception of 220kV radial fed bus bars. LBB Current sensor $I > 20\% I_n$ LBB time delay = 200ms

Draft of Revised Protection Philosophy/Protocol of Northern Region

S.N.	ProtectionSetting/Protocol	Mandated Setting
1	Protection Scheme	<p>220kV and above:</p> <p>Independent Main-I and Main-II protection (of different make OR different type) ^{having Polygon Characteristic} of non-switched numerical type is to be provided with carrier aided scheme.</p> <p>132kV and below:</p> <p>One non-switched distance protection scheme and, one distance scheme or, directional over current and earth fault relays, should be provided as back up.</p>
2	Distance Protection Zone-1	<p>80% of the Protected line;</p> <p>Time Setting: Instantaneous.</p>
3	Distance Protection Zone-2	<p>Single Circuit Line: 120% of length of principle line section.</p> <p>Double circuit line: 150% coverage of line to take care of under reaching due to mutual coupling effect.</p> <p>Time Setting: 350ms for short lines(≤ 100km); 500ms for long lines>100km.</p>
4	Distance Protection Zone-3	<p>Zone-3 should overreach the remote terminal of the longest adjacent line by an acceptable margin (typically 20% of highest impedance seen) for all fault conditions.</p> <p>Time Setting: 1000 ms</p>
5	Distance Protection Zone- 4	<p>Reach is to be kept at 25% of zone-1 reach.</p> <p>Time setting: equal to Zone-2 time delay.</p>
6	Lines with Series and other compensations in the vicinity of Substation	<ul style="list-style-type: none"> Zone-1: <p>80% of the protected line with 100ms-time delay.</p> <p>POR Communication scheme logic is modified such that relay trip sinstantaneously in Zone-1 on carrier receive.</p> Zone-2: <p>120 % of uncompensated line impedance for single circuit line.For Double circuit line, settings may be decided on basis of dynamic study in view of zero sequence mutual coupling.</p>

		<ul style="list-style-type: none"> Phase locked voltage memory is used to cope with the voltage inversion. Alternatively, an intentional time delay may be applied to overcome directionality problems related to voltage inversion. over-voltage stage-I setting for series compensated double circuit lines may be kept higher at 113%.
7	Power Swing Blocking	<p>Block tripping in all zones, all lines.</p> <p>Out of Step tripping to be applied on all interregional tie lines.</p> <p>Deblock time delay= 2s</p>
8	Protection for broken conductor	<p>Negative Sequence current to Positive Sequence current ratio more than 0.2(i.e. $I_2/I_1 \geq 0.2$)</p> <p>Only for alarm: Time delay=3-5sec</p>
9	Switch on to fault (SOTF)	<p>Switch on to fault (SOTF) function to be provided in distance relay to take care of line energization on fault</p>
10	VT fuse fail detection function	<p>VT fuse fail detection function shall be correctly set to block the distance function operation on VT fuse failure.</p>
11	Carrier Protection	<p>To be applied on all 220kV and above lines with the only exception of radial feeders.</p>
12	Backup Protection	<p>On 220kV and above lines with 2 Main Protections:</p> <ul style="list-style-type: none"> Back up Earth Fault protections alone to be provided. No Over current protection to be applied. <p>At 132kV and below lines with only one Main protection:</p> <ul style="list-style-type: none"> Backup protection by IDMTO/C and E/F to be applied.
13	Auto Re-closing with dead time.	<p>AR shall be enabled for 220 kV and above lines for single pole trip and re-closing.</p> <p>Deadtime=1.0s.Reclaimtime =25.0s</p> <p>Auto-recloser shall be blocked for following:</p> <ul style="list-style-type: none"> faults in cables. Breaker Fail Relay Line Reactor Protections O/V Protection Received Direct Transfer trip signals Busbar Protection

		<ul style="list-style-type: none"> • Zone 2/3 of Distance Protection • Circuit Breaker Problems.
14	Bus bar protection	To be applied on all 220kV and above sub stations with the only exception of 220kV radial fed bus bars.
15	Local Breaker Backup (LBB)	<p>For 220 kV and above level substations as well as generating stations switchyards, LBB shall be provided for each circuit breaker.</p> <p>LBB Current sensor $I > 20\% I_n$</p> <p>LBB time delay=200ms</p>
16	Line Differential	<p>For cables and composite lines, line differential protection with built in distance back up shall be applied as Main-I protection and distance relay as Main-II protection.</p> <p>For very short line (less than 10 km), line differential protection with distance protection as backup (built-in Main relay or standalone) shall be provided mandatorily as Main-I and Main-II.</p>
17	Over Voltage Protection	<p>400kV LINES:</p> <p>Low set stage (Stage-I): 110% - 112% (typically 110%) with a time delay of 5 seconds.</p> <p>High set stage (Stage-II): 140% - 150% with a time delay of 100milliseconds.</p> <p>FOR 765kV LINES:</p> <p>Low set stage (Stage-I): 106% - 109% (typically 108%) with a time delay of 5 seconds.</p> <p>High set stage (Stage-II): 140% - 150% with a time delay of 100milliseconds.</p> <p>Drop-off to pick-up ratio of overvoltage relay: better than 97%</p>
18	Resistive reach / blinder setting to prevent load point encroachment	<p>Following criteria may be considered for deciding load point encroachment:</p> <ul style="list-style-type: none"> • Maximum load current (I_{max}) may be considered as 1.5 times the thermal rating of the line or 1.5 times the

		<p>associated bay equipment current rating (the minimum of the bay equipment individual rating) whichever is lower. (Caution: The rating considered is approximately 15minutes rating of the transmission facility).</p> <ul style="list-style-type: none"> • Minimum voltage (Vmin) to be considered as 0.85pu (85%).
19	Direct Inter-trip	<p>To be sent on operation of following:</p> <p>Overvoltage Protection</p> <p>LBB Protection</p> <p>Busbar Protection</p>
20	Permissive Inter-trip	<p>To be sent on operation of Distance Protection</p>

Email

Reeturaj Pandey

Re: Minutes of the 2nd meeting of the expert group constituted to study and recommend changes in existing NR Protection Philosophy - reg.

From : RAVI LAL <ddpntjmp@bbmb.nic.in>

Mon, Sep 11, 2023 08:51 AM

Subject : Re: Minutes of the 2nd meeting of the expert group constituted to study and recommend changes in existing NR Protection Philosophy - reg. Pending**To :** Reeturaj Pandey <pandeyr.cea@gov.in>

Sir,

In continuation of the trailing mail it further mentioned below the references from the Task Force Committee Report 2013 for underlining the use of distance relays with quadrilateral / polygon characteristic :-

1. Appendix-9.1 (Page 4/7 of Appendix) 7. LOAD IMPEDANCE ENCROACHMENT :

With the extended Zone-3 reach settings, that may be required to address the many under reaching factors already considered, load impedance encroachment is a significant risk to long lines of an interconnected power system. Not only the minimum load impedance under expected modes of system operation be considered in risk assessment, but also the minimum impedance that might be sustained for seconds or minutes during abnormal or emergency system conditions. Failure to do so could jeopardize power system security. Ideal solution to tackle load encroachment may be based on the use of blinders or by suitably setting the resistive reach of specially shaped impedance elements or by use of polygon type impedance elements. It is recommended that all the distance relays should have quadrilateral / polygon characteristic.

2. Appendix-9.4**CHECK LIST TO ENABLE AUDIT OF PRACTICES FOLLOWED IN PROTECTION APPLICATION & CRITERIA USED FOR SETTING CALCULATIONS IN 220KV, 400KV & 765KV SUBSTATIONS****CHECK-LIST: Check list for different protected objects & elements in fault clearance system are as under: (put mark in the appropriate box) A. Transmission Lines (OHL and Cables)**

(i). Independent Main-I and Main-II protection (of different make OR different type) is provided with carrier aided scheme :YES /NO

(ii). Are the Main-I & Main-II relays connected to two separate DC sources (Group-A and Group-B) :YES /NO

(iii). Is the Distance protection (Non-switched type, suitable for 1- ph & 3-ph tripping) as Main1 and Main2 provided to ensure selectivity & reliability for all faults in the shortest possible time: YES/ NO

(iv). Is both main-I & Main-II distance relay are numerical design having Quadrilateral or Polygon operating characteristic :YES /NO

It is further mentioned that the following points may be considered during the finalization of Protection Philosophy:

1. Standardization of Disturbance Record.
2. Detailed setting parameters of df/dt Relays (in order to avoid indiscriminate tripping

during very small duration frequency dip)

Regards,

(इं. रवि लाल)

उप निदेशक, पी. एवं टी. सेल,

बीबीएमबी, जमालपुर, लुधियाना।

From: "RAVI LAL" <ddpntjimp@bbmb.nic.in>

To: "Reeturaj Pandey" <pandeyr.cea@gov.in>

Sent: Sunday, September 10, 2023 7:36:21 PM

Subject: Re: Minutes of the 2nd meeting of the expert group constituted to study and recommend changes in existing NR Protection Philosophy - reg.

महोदय /Sir,

Please find enclosed here with the observations and amendments suggested in the "Draft of Protection Philosophy/ Protocol of Northern Region" based upon "Task Force Committee Report (Ramakrishna Committee Report)- Aug. 2013" and field experiences. The changes have been marked on the original pdf draft soft copy with remarks in colored letters

and popup boxes and basically related with the settings of Zone -2 and Zone-4 . This is for your kind information and further necessary action .

सादर /Regards,

(इं. रवि लाल)

उप निदेशक, पी. एवं टी. सेल,

बीबीएमबी, जमालपुर, लुधियाना।

From: "Reeturaj Pandey" <pandeyr.cea@gov.in>

To: eeemd1https@gmail.com, "xen prot alwar" <xen.prot.alwar@rvpn.co.in>, "Bharat Lal Gujar" <bl.gujar@dtl.gov.in>, "Paritosh Joshi" <paritosh.joshi@dtl.gov.in>, ravilal348@gmail.com, "RAVI LAL" <ddpntjimp@bbmb.nic.in> ,

sandeepyadav@powergrid.in, shashank@posoco.in, npdewangan@ntpc.co.in,

abhishekkumarsingh02@ntpc.co.in, vivekpushpakar@ntpc.co.in, "RAJAT SHARMA"

<smprot1.tcl@hpmail.in>, "ASHISH KUMAR KAUSHAL" <ashish.ku.tcl@hpmail.in> ,

onm-protection@nhpc.nic.in, "SUNIL DESAI3" <SUNIL.DESAI3@adani.com>

Sent: Saturday, September 9, 2023 8:31:47 PM

Subject: Minutes of the 2nd meeting of the expert group constituted to study and recommend changes in existing NR Protection Philosophy - reg.

महोदय/महोदया,

Sir/Madam,

COMMENTS ON PROPOSED PROTECTION PHILOSOPHY BY UPPTCL

Northern Regional power Committee has circulated a new proposed protection philosophy to be discussed in 48th PSC meeting to be held on 11.10.2023. Following clarifications needed on the points mentioned therein,

1) Zone-2 Time setting has been proposed 350ms for short lines (<100 km); 500ms for long lines>100 km.

While in the report of the task force on Power System Analysis Under Contingencies states that: A zone-2 timing of 0.35 seconds is recommended. However, if a long line is followed by short line, then a higher setting (typically 0.6 second) may be adopted on long line to avoid indiscriminate tripping through zone-2 operation on both lines.

Instead of following this criteria in Zone-2 time of **long line followed by a short line**, line distances of line length of 100 km has been taken which is not correct. There are many 400 kv and 220 kv substations in UPPTCL where most lines are less than 100 km and at 220 kv substations all lines are below 100 km, in that case this philosophy will allow indiscriminate tripping. Such types of tripping have taken place in past in UPPTCL system.

This needs review.

2) Zone-3 Time setting has been proposed 1000 ms for both 400 kv and 220 kv system.

At present Zone-3 time setting has been taken in UPPTCL 1000ms for 400 kv and 800ms for 220 kv system. This is also being followed by Power Grid at all substations situated in UP connecting UPPTCL substations. Reduced settings of Zone-3 also avoids unwanted tripping of 400/220/33 kv ICTs.

This also needs review.

3)Distance protection Zone-4: Reach is to be kept at 25%of Zone-1reach. Time setting: equal to Zone-2 time delay.

As per Ramakrishna committee report, with a **reverse reach setting of less than the zone-1 reach of the distance protection for the shortest line connected to the local bus bar**, the zone-4 time delay would only need to coordinate with bus bar main protection fault clearance and with zone-1 fault clearance for lines out of the same substation. For this reason this can be set according to the zone-2 time setting guidelines.

If zone-4 impedance is taken 25% of zone-1 reach, then unwanted tripping will take place as in some cases 25% of zone-1 impedance will cover in reverse the complete line even beyond. Further zone-4 time taken by M/S TRACTABEL, Romania in all their setting calculations 500ms.

This also needs review.

4)Direct inter-trip has been taken only on the operation of following,

- a) Over voltage protection ,
- b) LBB protection, and
- c) Busbar protection.

While this should also cover Manual trip and Reactor protection.

5) Further when Busbar protection is not in operation due to some reason, an immediate alternative to this was allowed by NRPC vide its minutes of 25th PSC meeting no. NRPC/OPR/107/01/2014 dt.16.04.2014 and it has been found very useful in many cases.

The settings of 400/220 kv Bus coupler time settings be set at 100ms (DT) and reverse zone setting be set 02 km and time 160 ms. When BBP becomes healthy, zone-4 settings be put to normal.

Draft of Revised Protection Philosophy/Protocol of Northern Region

S.N.	Protection Setting/Protocol	Mandated Setting
1	Protection Scheme	<p>220kV and above:</p> <p>Independent Main-I and Main-II protection (of different make OR different type/different algorithm) of non-switched numerical type is to be provided with carrier aided scheme.</p> <p>132kV and below:</p> <p>One non-switched distance protection scheme and, directional over current and earth fault relays, should be provided as back up.</p>
2	Distance Protection Zone-1	<p>80% of the Protected line;</p> <p>Time Setting: Instantaneous.</p>
3	Distance Protection Zone-2	<p>Single Circuit Line: 120% of length of principle line section. Double circuit line: 150% coverage of line to take care of under reaching due to mutual coupling effect.</p> <p>Time setting:</p> <ol style="list-style-type: none"> 1. 0.35 second <i>(considering LBB time of 200mSec, CB open time of 60ms, resetting time of 30ms and safety margin of 60ms)</i> 2. For a long line followed by a short line: 0.6 second

4	Distance Protection Zone-3	Zone-3 should overreach the remote terminal of the longest adjacent line by an acceptable margin (typically 20% of highest impedance seen) for all fault conditions. Time Setting: 800-1000 msec
5	Distance Protection Zone- 4	The Zone-4 reverse reach must adequately cover expected levels of apparent bus bar fault resistance. Time may be coordinated accordingly. Where Bus Bar protection is not available, time setting: 160 msec .
6	Lines with Series and other compensations in the vicinity of Substation	<ul style="list-style-type: none"> • Zone-1: 80% of the protected line with 100ms-time delay. POR Communication scheme logic is modified such that relay trips instantaneously in Zone-1 on carrier receive. • Zone-2: 120 % of uncompensated line impedance for single circuit line. For Double circuit line, settings may be decided on basis of dynamic study in view of zero sequence mutual coupling. • Phase locked voltage memory is used to cope with the voltage inversion. Alternatively, an intentional time delay may be applied to overcome directionality problems related to voltage inversion. • over-voltage stage-I setting for series compensated double circuit lines may be kept higher at 113%.
7	Power Swing Blocking	Block tripping in all zones, all lines. Out of Step tripping to be applied on all inter

		<p>regional tie lines.</p> <p>Deblock time delay = 2s</p>
8	Protection for broken conductor	<p>Negative Sequence current to Positive Sequence current ratio more than 0.2 (i.e. $I_2/I_1 \geq 0.2$)</p> <p>Only for alarm: Time delay = 3-5 sec</p>
9	Switch on to fault (SOTF)	<p>Switch on to fault (SOTF) function to be provided in distance relay to take care of line energization on fault</p>
10	VT fuse fail detection function	<p>VT fuse fail detection function shall be correctly set to block the distance function operation on VT fuse failure.</p>
11	Carrier Protection	<p>To be applied on all 220kV and above lines with the only exception of radial feeders.</p>
12	Back up Protection	<p>On 220kV and above lines with 2 Main Protections:</p> <ul style="list-style-type: none"> • Back up Earth Fault protections alone to be provided. • No Over current protection to be applied. <p>At 132kV and below lines with only one Main protection:</p> <ul style="list-style-type: none"> • Back up protection by IDMT O/C and E/F to be applied.
13	Auto Re-closing with dead time.	<p>AR shall be enabled for 220 kV and above lines for single pole trip and re-closing.</p> <p>Dead time = 1.0s. Reclaim time = 25.0s</p> <p>Auto-recloser shall be blocked for following:</p> <ul style="list-style-type: none"> • faults in cables. • Breaker Fail Relay • Line Reactor Protections • O/V Protection • Received Direct Transfer trip signals • Busbar Protection

		<ul style="list-style-type: none"> • Zone 2/3 of Distance Protection • Circuit Breaker Problems.
14	Busbar protection	To be applied on all 220kV and above sub stations with the only exception of 220kV radial fed bus bars.
15	Local Breaker Backup (LBB)	<p>For 220 kV and above level substations as well as generating stations switchyards, LBB shall be provided for each circuit breaker.</p> <p>LBB Current sensor $I > 20\% I_n$</p> <p>LBB time delay = 200ms</p>
16	Line Differential	<p>For cables and composite lines, line differential protection with built in distance back up shall be applied as Main-I protection and distance relay as Main-II protection.</p> <p>For very short line (less than 10 km), line differential protection with distance protection as backup (built-in Main relay or standalone) shall be provided mandatorily as Main-I and Main-II.</p>
17	Over Voltage Protection	<p>FOR 765kV LINES/CABLE:</p> <p>Low set stage (Stage-I): 106% - 109% (typically 108%) with a time delay of 5 seconds.</p> <p>High set stage (Stage-II): 140% - 150% with a time delay of 100 milliseconds.</p> <p>400kV LINES/CABLE:</p> <p>Low set stage (Stage-I): 110% - 112% (typically 110%) with a time delay of 5 seconds.</p> <p>High set stage (Stage-II): 140% - 150% with a time delay of 100 milliseconds.</p>

		<p>FOR 220 KV LINES: No over-voltage protection shall be used.</p> <p>FOR 220 KV CABLE: Low set stage (Stage-I): 110% - 112% (typically 110%) with a time delay of 5 seconds. High set stage (Stage-II): 140% - 150% with a time delay of 100 milliseconds.</p> <p>Drop-off to pick-up ratio of overvoltage relay: better than 97%</p> <p>Grading: Voltage as well as time grading may be done for multi circuit lines/cable.</p>
18	Resistive reach / blinder setting to prevent load point encroachment	<p>Following criteria may be considered for deciding load point encroachment:</p> <ul style="list-style-type: none"> • Maximum load current (I_{max}) may be considered as 1.5 times the thermal rating of the line or 1.5 times the associated bay equipment current rating (the minimum of the bay equipment individual rating) whichever is lower. (Caution: The rating considered is approximately 15minutes rating of the transmission facility). • Minimum voltage (V_{min}) to be considered as 0.85pu (85%).
19	Direct Inter-trip	<p>To be sent on operation of following:</p> <p>Overvoltage Protection LBB Protection Busbar Protection Reactor Protection Manual Trip</p>

20	Permissive Inter-trip	To be sent on operation of Distance Protection
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Format**Intimation of nodal officer for protection setting database****(for elements connected at 220 kV and above)****Name of Utility:.....**

Name of Officer	Designation	Mobile No	E-mail	Posting Location (HQ/Regional)

Format No.-PSA-01

Application of protection settings for approval of NRPC
(for elements connected at 220 kV and above)

1. Name of Utility:
2. Sub-station:
3. Unit (Generator/ICT/GT/Reactor etc.)
4. Purpose of approval: New/Revision
5. Tentative date for implementation:
6. Settings proposed:

S.N.	Protection	Setting	Time	Whether as per protection philosophy of NRPC
	Distance			
	Differential			

Separate sheet may also be attached.

7. Supporting Calculation for submission:

Separate sheet may be attached.

Signature with date and seal

Format No.-PSI-01

**Intimation of protection settings implemented after approval of NRPC
(for elements connected at 220 kV and above)**

1. **Name of Utility:**
2. **Sub-station:**
3. **Unit (Generator/ICT/GT/Reactor etc.)**
4. **Purpose of approval: New/Revision**
5. **Approval date:**
6. **Settings approved:**

S.N.	Protection	Setting	Time	Whether as per protection philosophy of NRPC
	Distance			
	Differential			

Separate sheet may also be attached.

7. **Date of implementation:**

Signature with date and seal

Format**Internal Protection Audit Calendar****(for elements connected at 220 kV and above)****FY 2023-24****Name of Utility:.....**

S.N.	Name of Sub-station	Voltage level	Next Internal Audit schedule	Last Audit conducted (Month/Year)
1				
2				

Format No.-PI-01

Reporting of performance indices for protection system

(for elements connected at 220 kV and above)

Name of Utility:

Month:

S.N.	Sub-station	Unit (SPS/Line/ICT/GT/ etc)	Nc	Nf	Nu	Ni	Dependability Index (D)	Security Index (S)	Reliability Index (R)

Justification for less than one index may be attached separately.

Nc is the number of correct operations at internal power system faults

Nf is the number of failures to operate at internal power system faults

Nu is the number of unwanted operations

Ni is the number of incorrect operations and is the sum of Nf and Nu

Status of Bus bar protection				
Constituent Name	Name of Station	Status of Bus bar protection(as reported)	Expected date of revival(as reported)	Present Status
Uttarakhand	220 KV Substation, Ramnagar, Roorkee	Blocked due to more elements added at 220 KV Voltage level.		
	220 KV Sub Station, SIDCUL, Haridwar			
	220KV Jhajhra, Dehradun	Not commissioned yet		
	400KV Kashipur (220KV side)	Available but Non operational	31 December 2023	process.
	220kv Haldwani	Not Available	31 December 2024	Budget for FY 2023-24.
	220kv Pantnagar	Available but Non operational	31 December 2023	and submitted for approval.
	220KV Rishikesh	Available but Non operational	31 December 2024	It has been Taken in Budget for FY 2023-24.
220KV Chamba	Not commissioned yet	31 December 2024	It has been Taken in Budget for FY 2023-24.	
Haryana	220KV S/Stn Badshahpur	Not Installed	15.01.2023	Commissioned on 20.02.2023
	220KV S/Stn Sec-52A, Gurgaon	Not Installed	31.12.2023	Due to summer season, auxiliary switch connection in Isolators can not be made. shutdown will be required to connect each ckt in Bus bar panel
	220KV S/Stn Sec-1 Manesar	Installed, Non-Operational		Commissioned on 26.02.2023
	220KV S/Stn Panchgaon	Not Installed	31.10.2023	<ul style="list-style-type: none"> Matter was taken up with the firm for commissioning of Busbar. Now, the firm i.e. M/s Siemens has submitted the offer for commissioning of Bus Bar at 220KV substation Panchgaon and work order for the same is in process of approval. Likely to be completed by 15.09.2023.
	220KV S/Stn Rewari	Not Installed	31.03.2024	Requirement of protection panel submitted in IMS. Not available in DD store.
	220KV S/Stn Narnaul	Not Installed	31.12.2023	work awarded to M/s Absolute Projects.
	220KV S/Stn Mohinder Garh	Not Installed	15.09.2023	Commissioned on 28.10.2023
	220 KV S/Stn Palwal	Not Installed	31.11.2023	Case for administrative approval for cabling, wiring, configuration, and testing of bus bar panel has been mooted in e-office. The same is in process of approval. Some observation has been raised and same shall be addressed at earliest.
	220 KV S/Stn Rangala Rajpur	Installed but Non-Operational	31.10.2023	Commissioned on 22.06.2023
	220 KV Unispur	Installed but Non-Operational	31.11.2023	
	220 KV Nissing	Installed but Non-Operational	31.11.2023	Panel withdrawn from DD store. Matter has been taken with M/s Ziv automation for necessary relay setting.
	220KV Pehowa	Installed but Non-Operational	31.03.2024	
	220KV Kaithal	Not Installed	31.03.2024	ii. Demand Raised for 220kv Bus-Bar Protection panel. Yet to be allocated.
	220 KV Sonepat	Not Installed	31.03.2024	Note:- Already 220KV Bus-Bar Protection Panel shifted from 220KV Kaithal to 220KV Sonepat. The estimate for Bus Bar Protection Scheme is under sanctioning process from the competent authority. After sanctioning of the estimate & allocation of material, the work will be completed within 45 days.
	220 KV REGC, Sonepat	Not Installed	31.11.2023	Panel withdrawn from DD store.
	220KV Jind	Installed but Non-Operational	15.06.2023	Commissioned on dated 27.06.23.
	220 KV Fatehabad	Installed but Non-Operational	01.06.2023	Commissioned & made operational on dated 22.07.23
	220 KV Hukmawali	Installed but Non-Operational	30.10.2023	Bus-coupler CB defective & new panel withdrawn from DD store. Erection work under progress & the same will be completed 31.08.23.
	220 KV Bhuna	Installed but Non-Operational	30.10.2023	
	220 KV Sirsa	Not Installed		Not required being single source of supply
220 KV Rania	Not Installed	31.03.2024	Bus bar protection panel is under procurement by Purchase wing	
220 KV Bhiwani	Not Installed	30.10.2023	Equipment requirement raised in PR, busbar protection is proposed in integrated planning likely to be completed in FY 2023-24.	
220KV Madanpur	Not Installed	31.03.2024		
220KV Tepla	Installed but Non-Operational	31.03.2024		
220KV Rajokheri	Installed but Non-Operational	30.10.2023	The contract no. HDP-2351/REC-224/XEN/Tr.(P) dated 30-07-2018 awarded to M/s IKE Electric Pvt. Ltd. JV Deesan Agrotech Pvt. Ltd. was terminated vide CE/PD&C, HVPNL, Panchkula office memo no. Ch-122/HDP-2351/Vol-II/Xen/Tr.(P) Dated - 24.02.2023. Matter is taken up with bus-bar protection firm engineer for commissioning.	
BBMB	220KV Charkhi Dadri	Installed, under commissioning yet	15.01.2023	commissioned on 31.01.2023
	220KV Samaypur	Installed but Non-Operational	31.12.2023	
	220kv Dhulkote	Not Installed		Not feasible
	220KV Jagadhari	Not Installed		
	220KV Barnala	Not Installed		
UP	220KV Parichha	Installed but Non-Operational	30.06.2023	
	220KV Partapur	Installed but Non-Operational	Jan-23	
	220KV Bareilly (400/220KV Bareilly)	Installed but Non-Operational	Dec-23	Old panel capacity exhausted. New relay panel supplied & need to be
	220KV Pilibhit	Not Installed	Dec-23	New Relay panel supplied & need to be commissioned by Service Engineer
	220KV Amariya	Installed but Non-Operational	Dec-23	commissioned on 15th July 2023
	220KV Sultanpur	Installed but Non-Operational		Isolator contact status are not received due to damage of contacts on every
	220KV New Tanda	Not Installed		Busbar protection panel available on 03.03.2023 but not commissioned
	220KV Shahjhanpur	Installed but Non-Operational		NC/No switch status of bus isolator were improper & require control cable for
	220KV Ajiipur	Installed but Non-Operational		1. HV side 220kV CT of 160MVA T/F-I & II has bot proper ratio for bus bar
	220KV Nirpura	Installed but Non-Operational	Jan-23	
	220KV IITGNL	Installed but Non-Operational	Mar-23	
	220KV Rampur	Installed but Non-Operational	31.03.2024	
	220KV Barahua	Installed but Non-Operational		As Per Ex-En Transmission Approval is Pending at HQ Level As Per Ex-En
	220KV Bansi	Not Installed	to be declared by transmission wing	commissioned on 10th August 2023
	220 KV S/S Azamgarh-2(Bargahan)	Installed but Non-Operational		
	220KV Chandausi	Not Installed	to be declared by transmission wing	220KV Chandausi on 13th September 2023
	220KV Rampur	Installed but Non-Operational	Jul-23	Main relay of bus bar protection is not working.
	220KV Sec - 148, Noida	Installed but Non-Operational	Jan-23	
	220KV sec. 38A, Botanic Garden	Not Installed	31.03.2024	Bus Bar protection panel not allotted
	220KV sec.-62, Noida	Not Installed	Aug-23	Relay and wiring Work Pending
	220KV Dadri	Not Installed	Sep-23	Relay and wiring Work Pending
	400KV S/S Agra	Installed but Non-Operational		commissioned on 13th September 2023
	220KV S/S Bah	Not Installed		
	220KV Sinsaganj	Not Installed		
	220KV S/S Farrukhabad (New)	Not Installed		commissioned on 25th August 2023
	220KV Boner	Not Installed		SINGLE BUS
	220KV Kasganj (Soron)	Installed but Non-Operational		
	220KV Khair	Installed but Non-Operational		
	220KV Kidwainagar	Installed but Non-Operational		
	220KV Chhata	Installed but Non-Operational		
220KV Harduaganj	Installed but Non-Operational	31.12.2023		
220KV Lalitpur	Not Installed	23-Apr	INSTALLATION IS NOT DONE DUE TO UNAVAILABLE OF CABLES. CABLE REQUEST HAS BEEN SENT TO LUCKNOW HQ.	
220KV Sarnath	Installed but Non-Operational	Nov-23		
220KV Sirathu, Kaushambi	Not Installed	Mar-23		

	220KV substation Fatehpur	Installed but Non-Operational	Mar-23	
	220KV S/S Bhelupur	Not Installed	Mar-23	
	220KV Hardoi Road, Lucknow	Installed but Non-Operational	30.09.2023	commissioned on 08th October 2023
	220KV CG City, Lucknow	Installed but Non-Operational	31.08.2023	Configurational error
	220KV Barabanki	Installed but Non-Operational	30.09.2023	Relay configuration is required for additional 220KV Jehta 1 & 2 bays
	220KV Kursi Road, Lucknow	Installed but Non-Operational	30.09.2023	1- 87BB Auxillary busbar relay at 160MVA T/F not available
	220KV BKT, Lucknow	Installed but Non-Operational	31.08.2023	Mlan bus bar relay defective
	220KV Gombi Nagar, Lucknow	Installed but Non-Operational		Mal operating
	400 KV Substation Sarnath	Installed but Non-Operational		New operational
	220KV S/S Raja Taliab	Installed but Non-Operational	15.11.2023	RELAY DEFECTIVE
	20KV S/S Harahua	Installed but Non-Operational	31.11.2023	NOT COMMISSIONED
	220KV S/S Sahupuri	Installed but Non-Operational	Requirement for panel has been raised,not received from	Defective
	220KV S/S Mirzapur	Not Installed	3 Month	-
HP	220KV Chamba	Main-2 non operational		relay has been sent to OEM for repair
	220KV MattaSidh	Installed but Non-Operational	Dec-23	ABB has started the review work and within 02 months all the bus bar
	220KV kangoo	Installed but Non-Operational		
	220KV Nangal	Installed but Non-Operational		
	220KV Katha Baddi	Installed but Non-Operational		
Punjab	220 KV S/S Kotlisurat Malhi	Not Installed		
	220 KV S/S Maur	Not Installed		
	220 KV S/S Science city	Not Installed		
	220 KV S/S Banga	Not Installed	Dec-23	
	220 KV S/S Hoshiarpur	Not Installed		
	220 KV S/S Goraya	Not Installed		
	220 KV S/S Badhni kalan	Not Installed		
	220 KV S/S Bhari	Not Installed		
	220 KV S/S Bhawanigarh	Not Installed		
	765 KV GSS Phagi	Installed but non operational		CU of Alstom make Bus-Bar is defective. Purchas case will be taken up
	220 kv GSS Vatika	Not installed	Dec-23	As M/s ER did not finished the project, so it was awarded to M/s Kaycee infra on risk-cost basis , however the bus bar scheme has not been commissioned yet. Matter has been taken up with firm
	220 kv GSS Niwana	Not installed		To be commissioned shortly
	220 kv GSS Alwar	Not installed		CU defective in existing ABB make Bus bar Scheme. Matter has been taken up with firm
	220 kv GSS Bansur	Not installed		To be commissioned shortly
	220 kv GSS Behror	Not installed		To be commissioned shortly
	220KV GSS Hindaun	Not installed		To be commissioned shortly
	220KV GSS Dooni	Not installed		To be commissioned shortly
	220KV GSS Bhawanimandi	Not installed		commissioned
	220 KV GSS Sakatpura, Kota	Not installed		Work is pending on the part of M/s GE and S.E. (T&C), RVPN, Kota due to defective Central Control Unit. CU will be send to firm for repair
	400 KV GSS Ajmer (220 KV BUS)	Installed but non operational		Isolator status of in 87BB of respective 220 KV bay No. 213,214, 215 & 216 was not available due to this 220 KV Main Bus-bar-II is out of ckt. work under progress
	220 kv GSS, Beawar	Not installed		New Bus Bar protection commissioning work is ongoing of M/S Danish. Case has been taken up with firm
	220 kv GSS Jethana	Not installed	Dec-23	New Bus Bar protection commissioning work is ongoing of M/S Danish. To be commissioned shortly
	220 kv GSS Kuchaman City	Installed but non operational		due to problem in Central Unit Relay (87CU) Since 28.01.2022, CU has been removed due to defective & replacement / repair under process at GSS Part. Case has been taken up with firm
	220 kv GSS Bherunda	Not installed		New Bus Bar protection commissioning work is ongoing of M/S Danish. To be commissioned shortly
	220 kv GSS Kuchera	Not installed		New Bus Bar protection commissioning work is ongoing of M/S Danish. To be commissioned shortly
	220 kv GSS Reengus	Installed but non operational		New Bus Bar Scheme has been proposed and approved for replacement from defective Bus-Bar Scheme. The Replacement work will be carried out by firm shortly
Rajasthan	220 KV GSS Laxmangarh	Not installed		Commissioned
	220KV GSS Khetri Nagar	Installed but non operational		The newly Bus bar protection scheme has been proposed and approved for replacement of defective bus bar scheme. hence the work of replacement will be carried out by the firm shortly
	400 KV GSS, Babai	Installed but non operational	Dec-23	PU of 315 MVA ICT-III is defective with error code 0X83720007. Matter has been taken up with firm
	220 kv GSS Chittorgarh	Installed but non operational		All bay units of the BUS BAR scheme are defective. Matter has been taken up with firm
	400 kv GSS BHILWARA(220 KV BUS)	Installed but non operational		BAY UNIT OF 220 KV TBC DEFECTIVE. Matter has been taken up with firm
	220 kv GSS MANDALGARH	Not installed		commissioned
	220KV GSS Debari	Not installed		Going to be install / commission new bus bar protection scheme supply by Danish.
	220KV GSS Amberi	Not installed		Going to be install / commission new bus bar protection scheme supply by Danish.
	220KV GSS Madri	Not installed		Going to be install / commission new bus bar protection scheme supply by Danish.
	400 kv GSS Surpura (Jodhpur) 220 KV	Installed but non operational		Allotted & Panel Received
	400 kv GSS Akal (Jaisalmer) 220 KV	Installed but non operational		One PU defective. Case has been taken up with firm
	220 kv GSS Jodhpur	Installed but non operational		A&F&S and TS issued. Case has been send for approval
	220 kv GSS NPH Jodhpur	Not installed		To be commissioned shortly
	220 kv GSS Badisid	Not installed	Dec-23	Allotted & Panel Received. To be commissioned shortly
	220 kv GSS Bhadia	Not installed		Allotted & Panel Received. To be commissioned shortly
	220 kv GSS Pali	Installed but non operational		New bays to be incorporated and GPS defective. work under progress
	220 kv GSS Ramgarh	Not installed		Allotted & Panel Received. To be commissioned shortly
	220 kv GSS Balotra	Installed but non operational		Isolator status issue. work under progress
	220 kv GSS Sawla	Not installed		Allotted & Panel Received. To be commissioned shortly
	400 kv GSS Bikaner 400 KV BUS	Installed but non operational		Not operational (Areva Make) Communication fiber error. Matter has been
220 kv GSS Ratangarh	Not installed		Allotted & Panel Received. To be commissioned shortly	
220 kv GSS Sujangarh	Not installed		Allotted & Panel Received. To be commissioned shortly	
220 kv GSS Halasar	Not installed		Allotted & Panel Received. To be commissioned shortly	
220 kv GSS Tehandesar	Not installed		Allotted & Panel Received. To be commissioned shortly	
220 kv GSS Rawatsar	Not installed		Allotted & Panel Received. To be commissioned shortly	

Multiple elements tripping at 400kV Daulatabad(HR)

06th June 2023

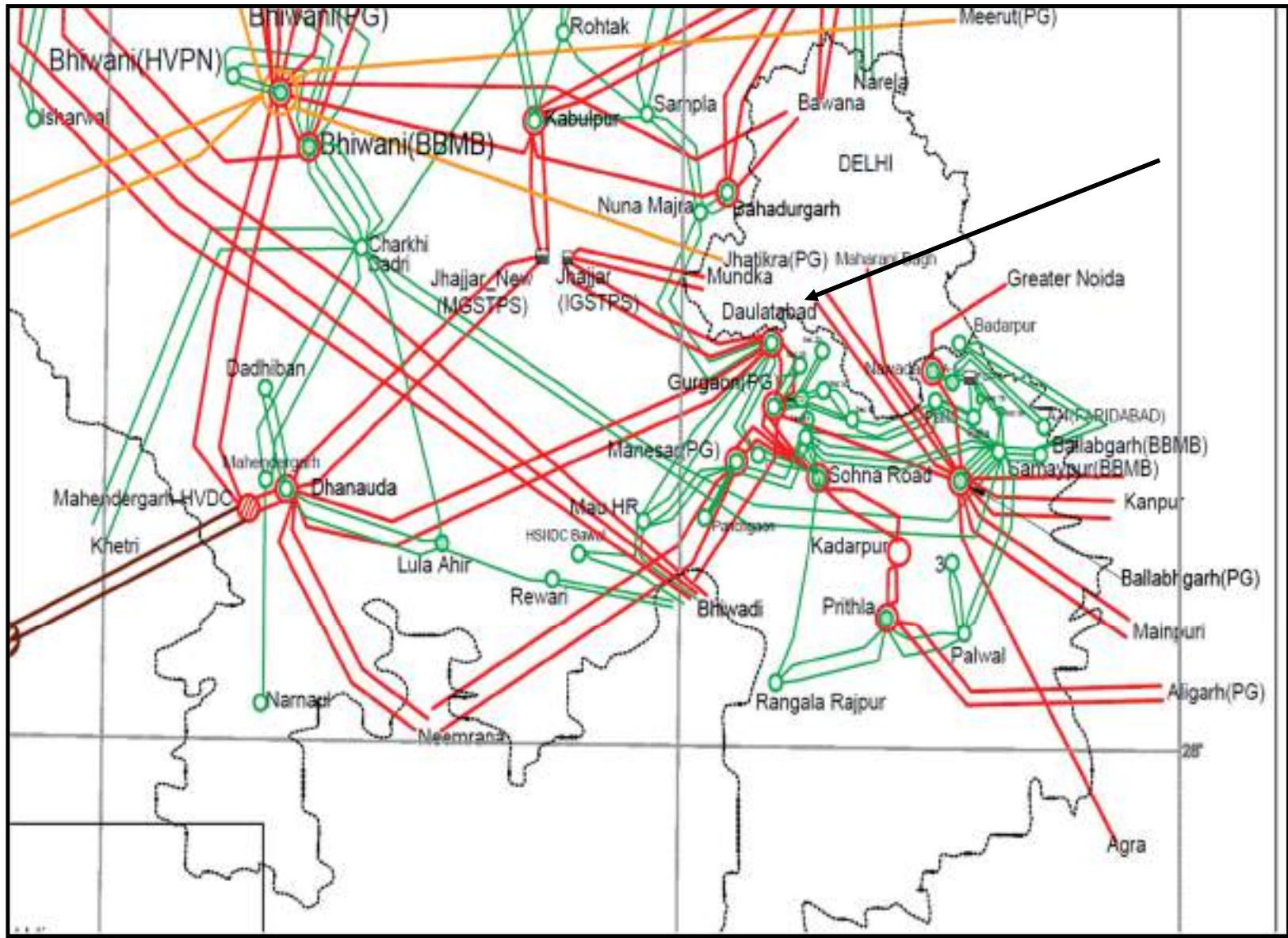
Brief of event:

- 400/220kV Daulatabad(Har) S/s has one and half breaker bus scheme. 400/220kV 315MVA ICT-1,2,3&4 and 400kV Daulatabad-Dhanonda D/C were connected at 400kV Bus-2 and the rest of the elements i.e., 400kV Daulatabad-Gurgaon(PG) D/C & 400kV Daulatabad-Jhajjar(APCPL) D/C were connected at 400kV Bus-1.
- As per PMU, at 00:10:35:400hrs, **B-N phase to earth fault** occurred on **400 KV Gurgaon(PG)-Daulatabad(HV) (HV) Ckt-2**.

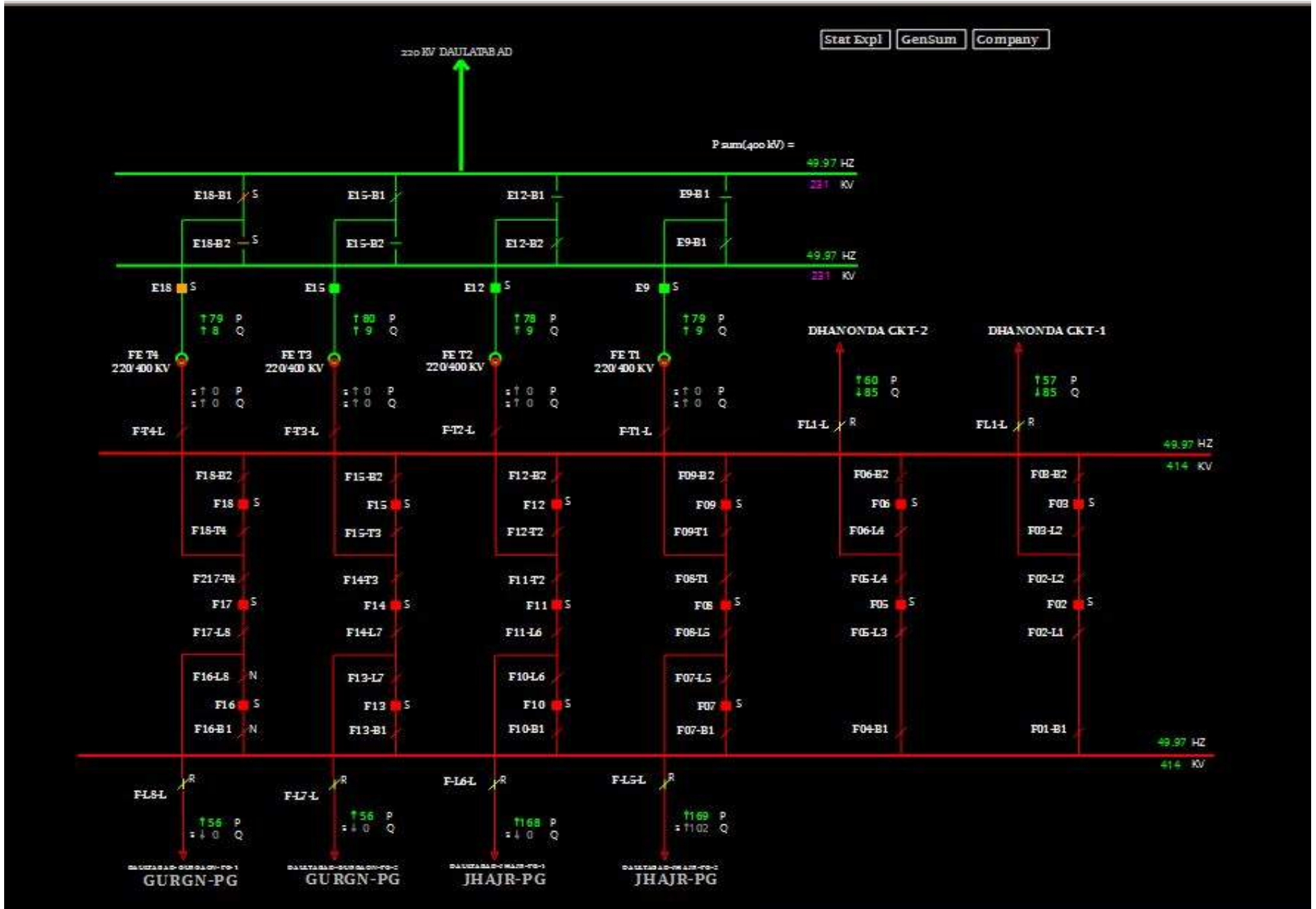
Elements tripped:

- i. 400 KV Gurgaon(PG)-Daulatabad(HV) (HV) Ckt-1
- ii. 400 KV Gurgaon(PG)-Daulatabad(HV) (HV) Ckt-2
- iii. 400KV Bus 2 at Daulatabad(HV)
- iv. 400/220 kV 315 MVA ICT 4 at Daulatabad(HV)
- v. 400/220 kV 315 MVA ICT 3 at Daulatabad(HV)
- vi. 400/220 kV 315 MVA ICT 2 at Daulatabad(HV)

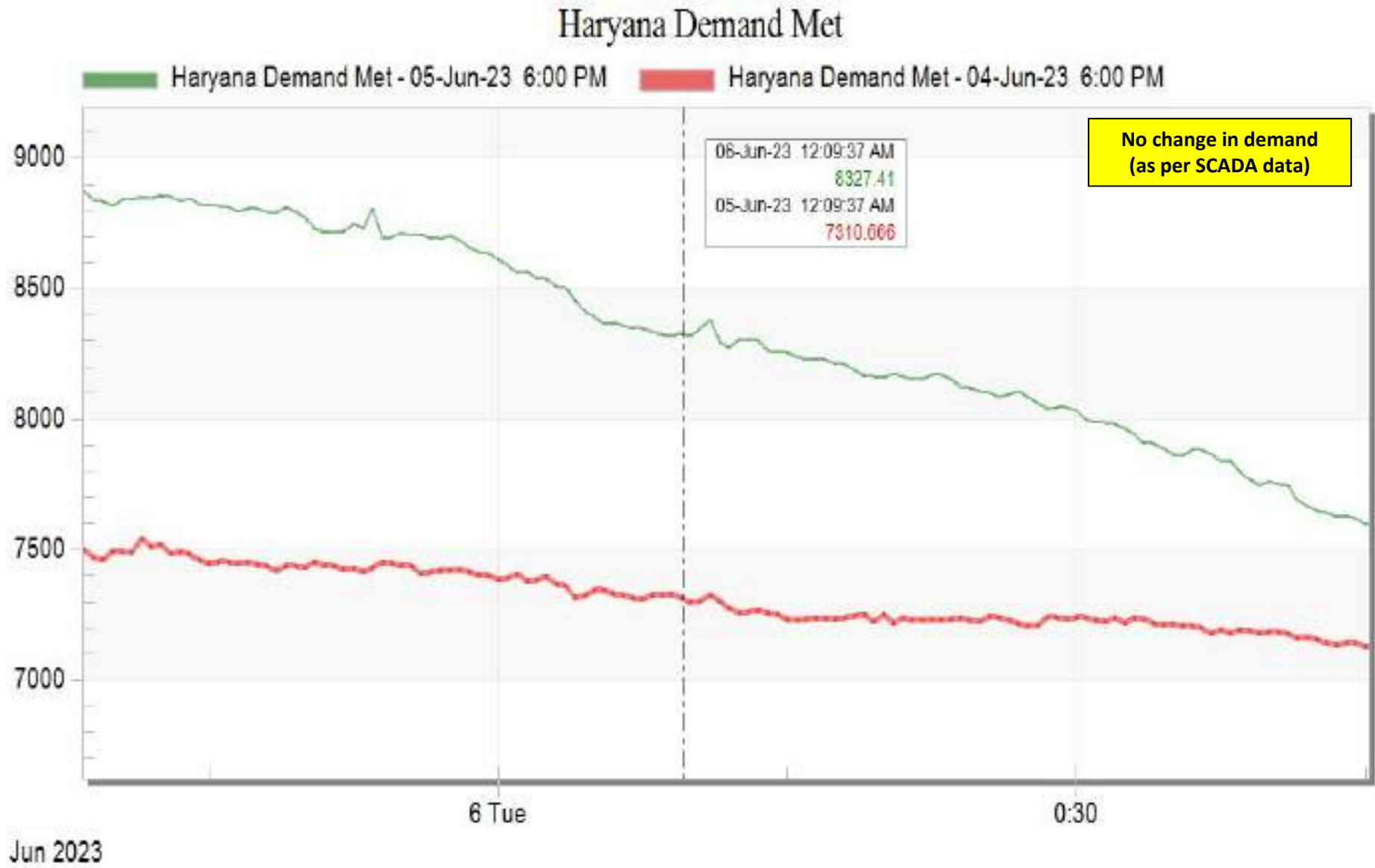
Network diagram



SCADA SLD of 400/220kV Daulatabad(HS)

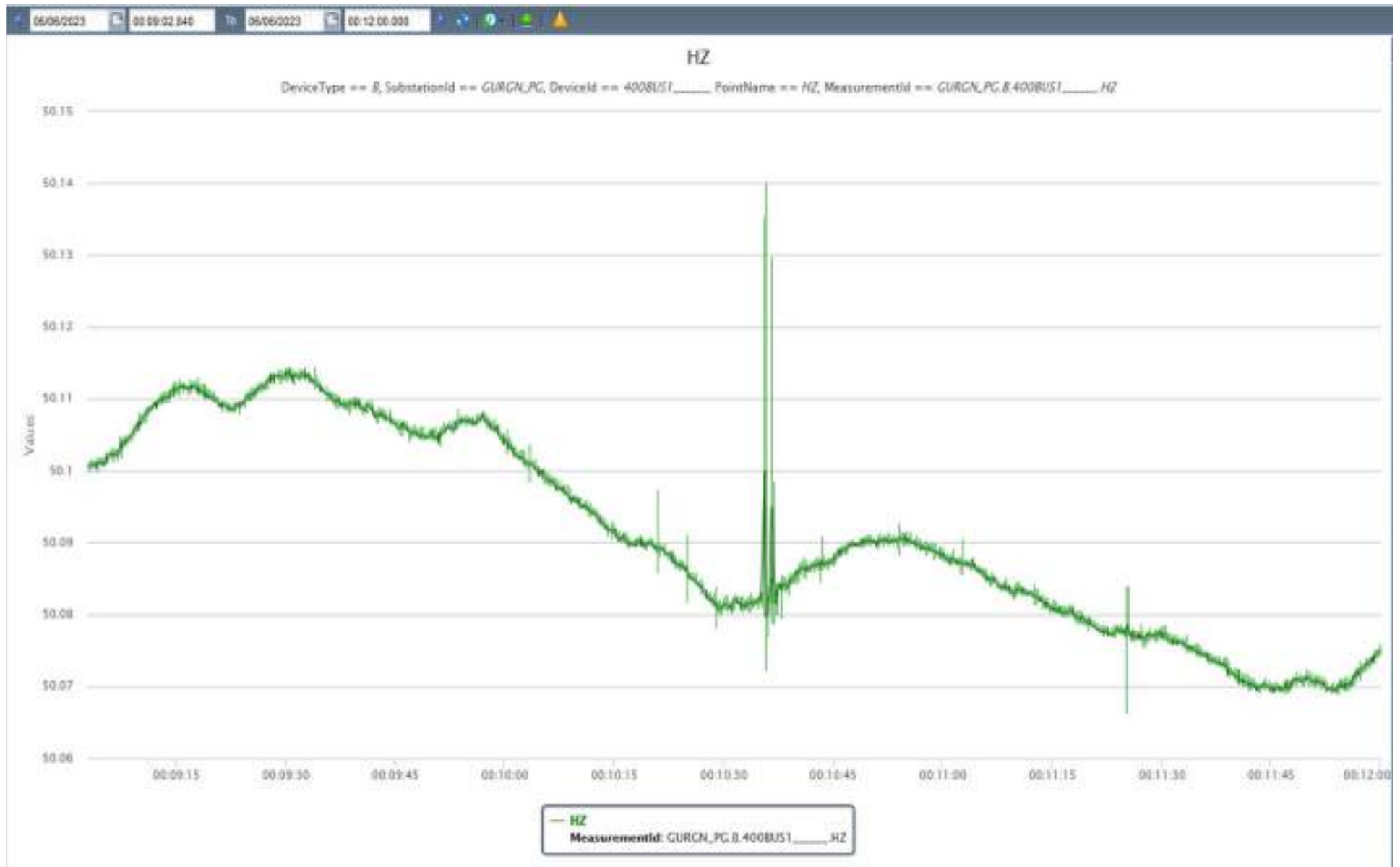


Haryana demand during the event



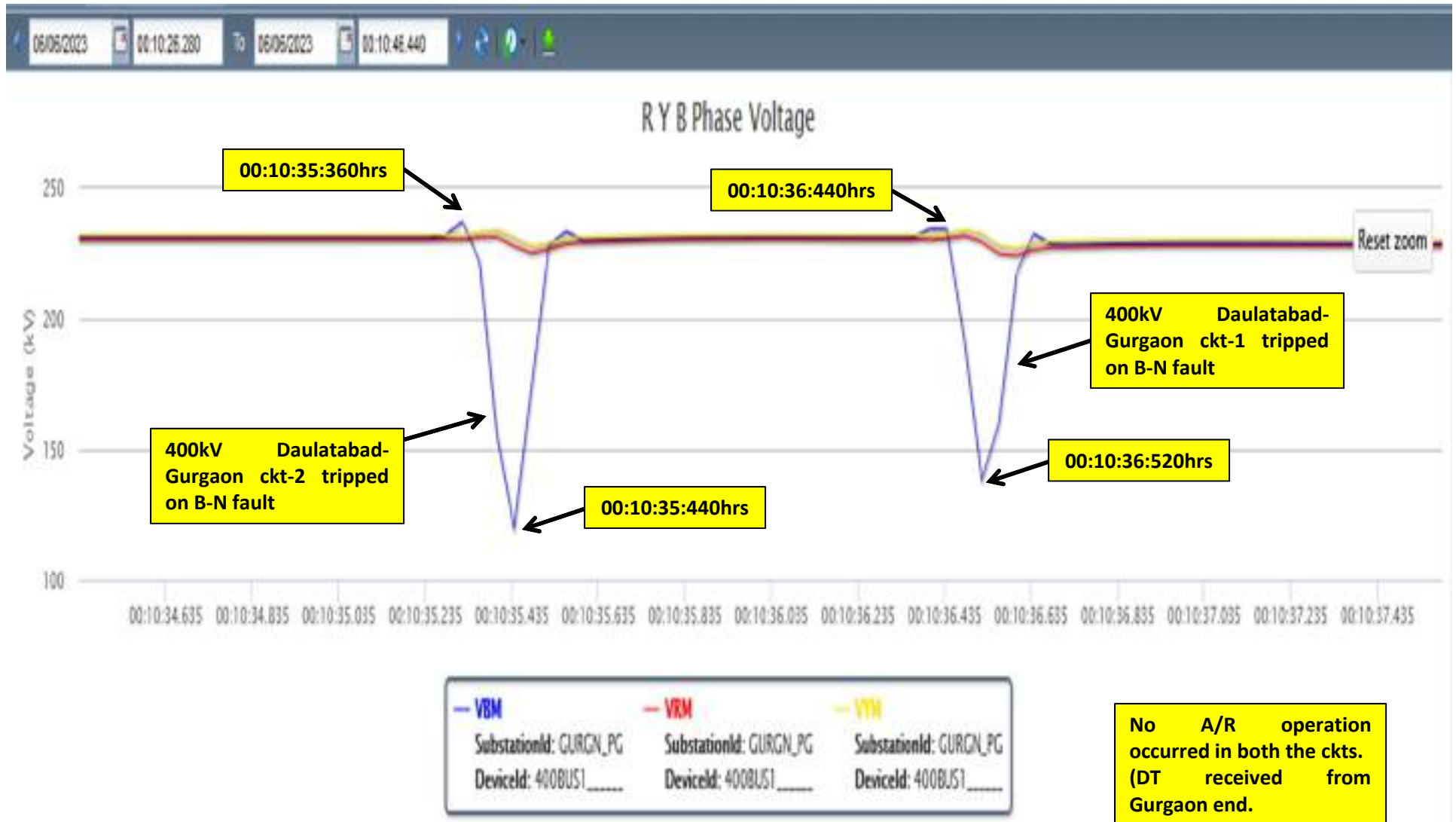
PMU Plot of frequency at Gurgaon(PG)

00:10hrs/06-Jun-23

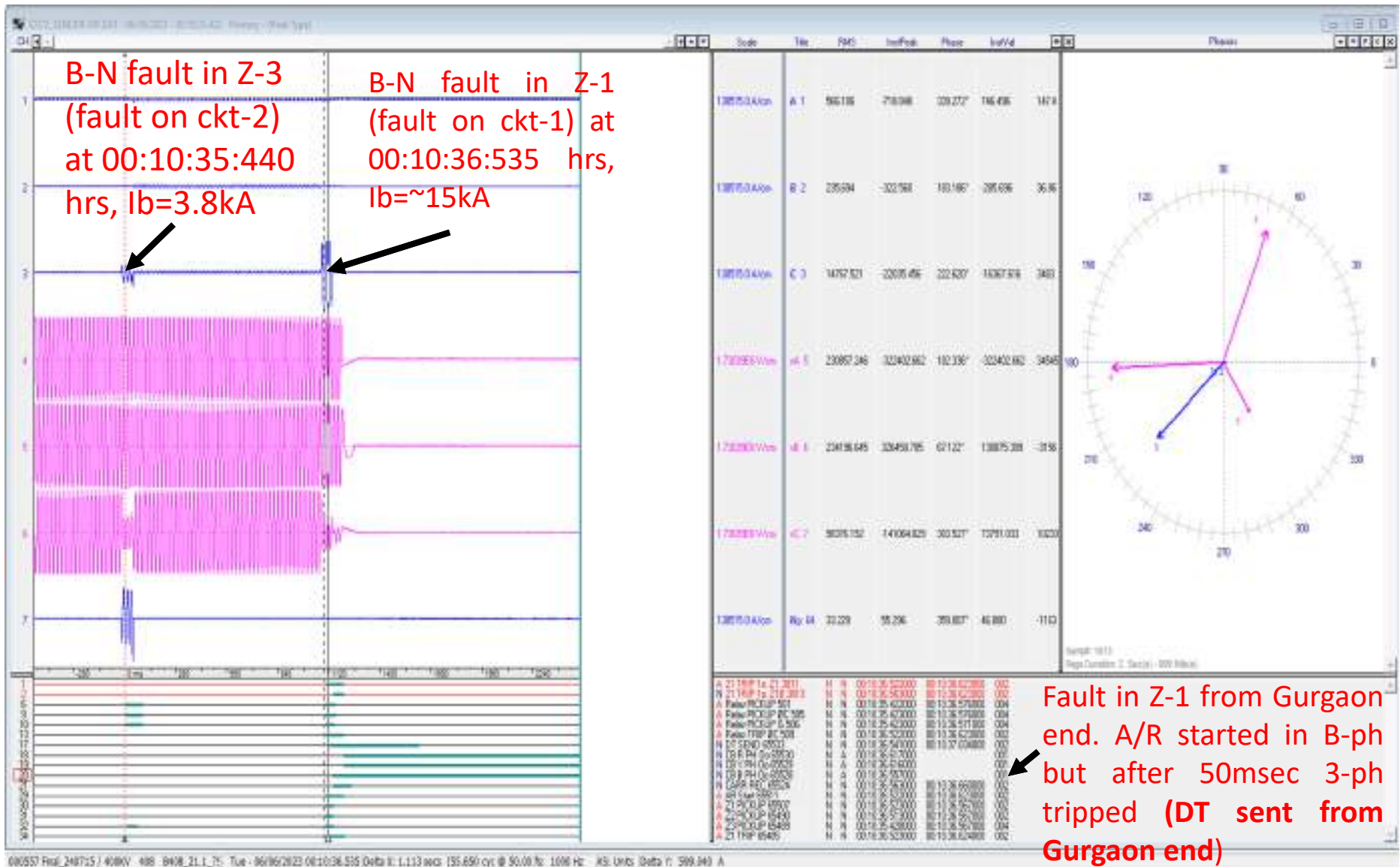


PMU Plot of phase voltage magnitude at Gurgaon(PG)

00:10hrs/06-Jun-23



DR of 400 KV Gurgaon(PG)(end)-Daulatabad(HV) (HV) Ckt-1



- ✓ Reason of 3-ph trip during A/R operation?
- ✓ Reason of DT send from Gurgaon end?

DR of 400 KV Gurgaon(PG)-Daulatabad(HV)(end) (HV) Ckt-1



- ✓ A/R operation not observed on B-N fault. As per event logger at Daulatabad end, DT received at their end.
- ✓ Proper channel name also need to be ensured i.e., Z-1 , Z-2, Z-3 start; A/R start; Z-1/Z-2/Z-3 trip; carrier send/received etc.

EL of 400 KV Gurgaon(PG)-Daulatabad(HV)(end) (HV) Ckt-1

SIEMENS

B416 21_1 7SA522_prn_01_04_05

SIMATIC

Event Log - 06-06-23 -

HVPNL_DLTB_030315 / 400KV / Bay

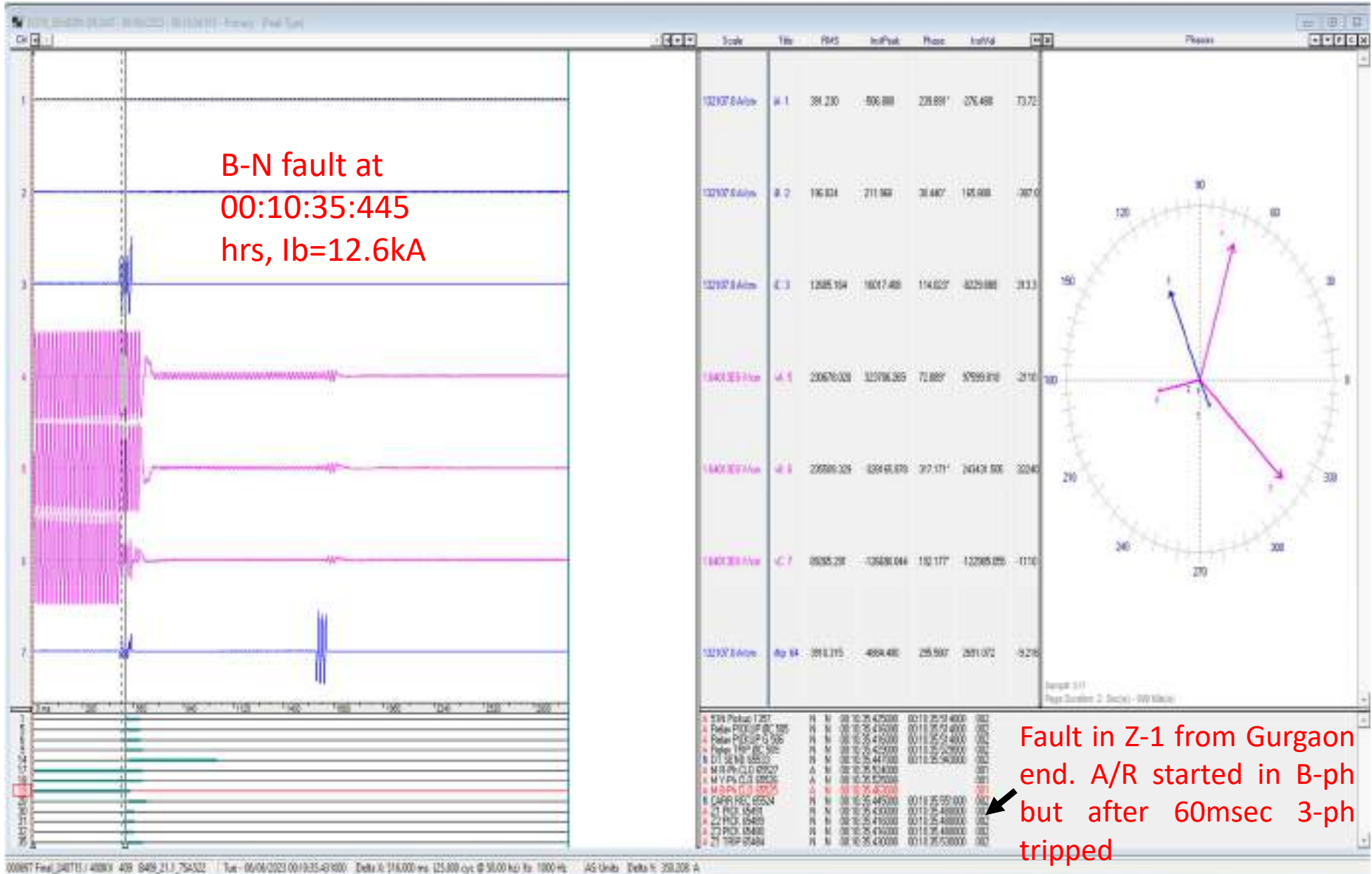
06.06.23 01:04:05

Event Log - 06-06-23 - HVPNL_DLTB_030315 / 400KV / Bay 416 / B416 21.1 7SA522/7SA522 V04.76.02(3)

Number	Indication	Value	Date and time	Cause	State
00301	Power System fault	130 - OFF	06.06.2023 00:10:37.161	Spontaneous Com.Issued=AutoLocal	
	DT RECEIVE	OFF	06.06.2023 00:10:37.156	Spontaneous	
04417	>Direct Transfer Trip INPUT Phases ABC	OFF	06.06.2023 00:10:37.156	Spontaneous Com.Issued=AutoLocal	
04006	>85-21 Carrier RECEPTION, Channel 1	OFF	06.06.2023 00:10:36.671	Spontaneous Com.Issued=AutoLocal	
	Direct Trip Receiver CH 1	9	06.06.2023 00:10:36.582	Spontaneous Com.Issued=AutoLocal	
	DT RECEIVE	ON	06.06.2023 00:10:36.578	Spontaneous	
	Carrier Receive CH1 Code 1	2	06.06.2023 00:10:36.578	Spontaneous Com.Issued=AutoLocal	
04006	>85-21 Carrier RECEPTION, Channel 1	ON	06.06.2023 00:10:36.578	Spontaneous Com.Issued=AutoLocal	
04417	>Direct Transfer Trip INPUT Phases ABC	ON	06.06.2023 00:10:36.578	Spontaneous Com.Issued=AutoLocal	
	Main CB B-Phase Open	ON	06.06.2023 00:10:36.557	Spontaneous	
	Main CB Y-Phase Open	ON	06.06.2023 00:10:36.556	Spontaneous	
	Main CB R-Phase Open	ON	06.06.2023 00:10:36.556	Spontaneous	

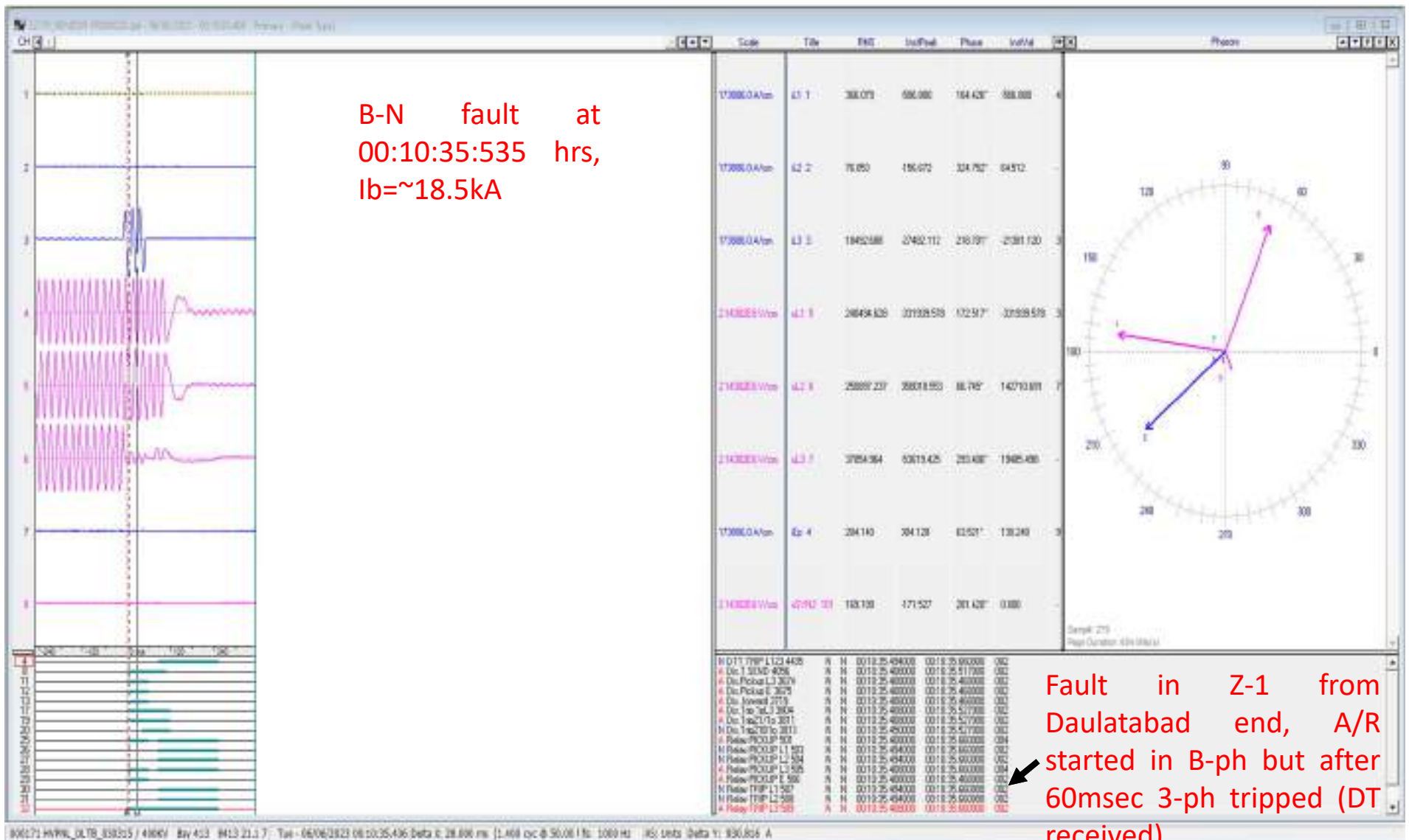
✓ As per event logger at Daulatabad end, DT received at their end.

DR of 400 KV Gurgaon(PG)(end)-Daulatabad(HV) (HV) Ckt-2



- ✓ Reason of 3-ph trip during A/R operation?
- ✓ Reason of DT send from Gurgaon end?

DR of 400 KV Gurgaon(PG)-Daulatabad(HV)(end) (HV) Ckt-2



✓ A/R operation not observed on B-N fault. As per event logger at Daulatabad end, DT received at their end.

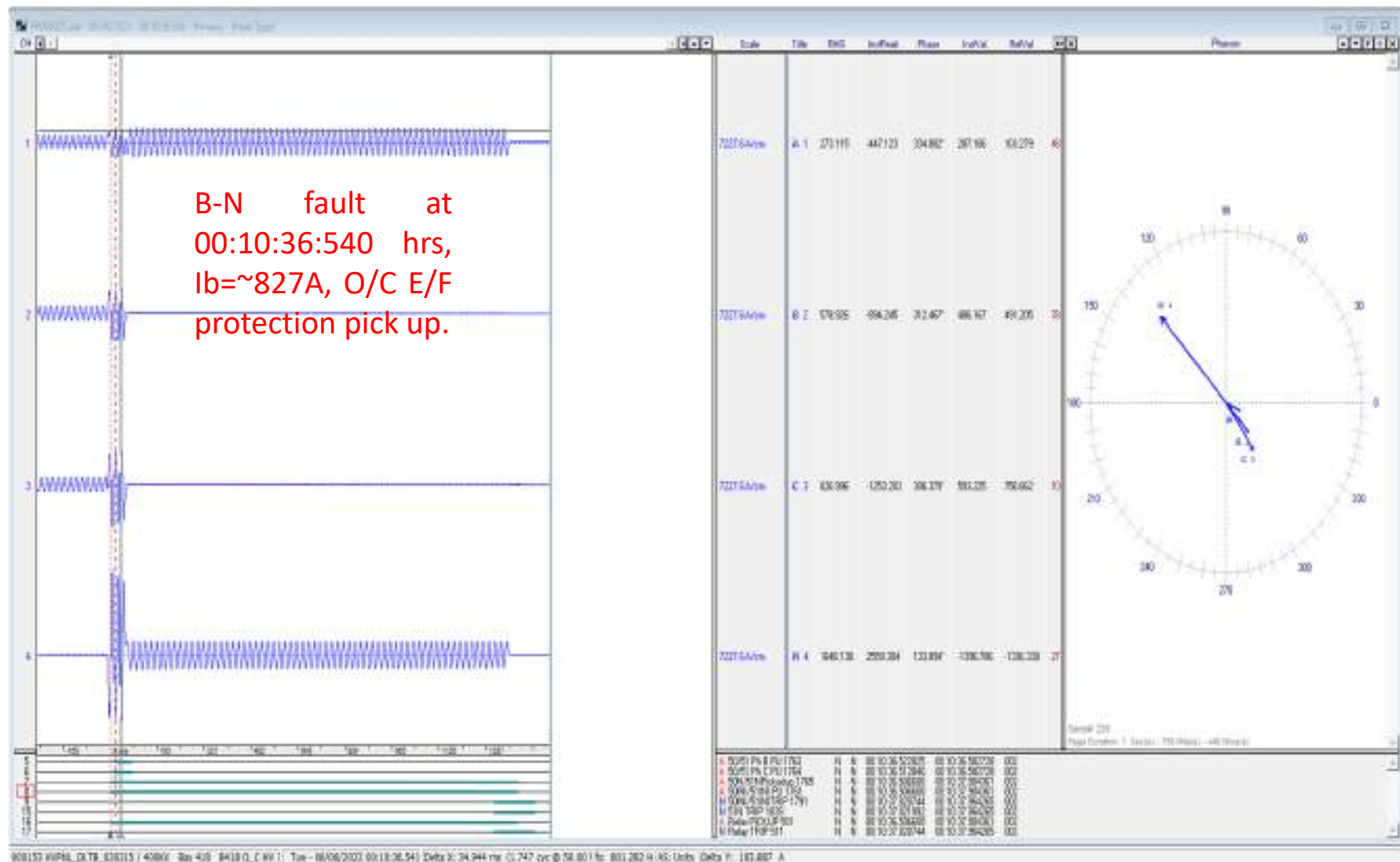
EL of 400 KV Gurgaon(PG)-Daulatabad(HV)(end) (HV) Ckt-2

Event Log - 06-06-23 - HVPNL_DLTB_030315 / 400KV / Bay 413 / B413 21.1 7SA522/7SA522 V04.76.02

Number	Indication	Value	Date and time	Cause	State
	No Voltage in Line	ON	06.06.2023 00:37:55.056	Spontaneous Com.Issued=AutoLocal	
	No Voltage in Line	OFF	06.06.2023 00:37:54.556	Spontaneous Com.Issued=AutoLocal	
	86.2 Trip Relay Supervision	ON	06.06.2023 00:10:36.554	Spontaneous	
	86.2 Trip Relay Supervision	OFF	06.06.2023 00:10:36.548	Spontaneous	
	No Voltage in Line	ON	06.06.2023 00:10:36.043	Spontaneous Com.Issued=AutoLocal	
	86.2 Trip Relay Supervision	ON	06.06.2023 00:10:35.919	Spontaneous	
00301	Power System fault	170 - OFF	06.06.2023 00:10:35.663	Spontaneous Com.Issued=AutoLocal	
	DT RECEIVE	OFF	06.06.2023 00:10:35.658	Spontaneous	
04417	>Direct Transfer Trip INPUT 3ph L123	OFF	06.06.2023 00:10:35.658	Spontaneous Com.Issued=AutoLocal	
	Direct Trip Receiver CH 1	13	06.06.2023 00:10:35.500	Spontaneous Com.Issued=AutoLocal	
	DT RECEIVE	ON	06.06.2023 00:10:35.494	Spontaneous	
04417	>Direct Transfer Trip INPUT 3ph L123	ON	06.06.2023 00:10:35.494	Spontaneous Com.Issued=AutoLocal	
04006	>Dis.Tele. Carrier RECEPTION Channel 1	OFF	06.06.2023 00:10:35.480	Spontaneous Com.Issued=AutoLocal	
04010	>Dis.Tele. Carrier RECEPTION Channel 2	OFF	06.06.2023 00:10:35.480	Spontaneous Com.Issued=AutoLocal	

✓ As per event logger at Daulatabad end, DT received at their end.

DR of 400/220 KV 315MVA ICT-4 at Daulatabad(HV)



- ✓ As per DR, Y & B phase current became zero instantaneously (on bus bar protection operation), however B-ph pole of CB didn't open which later opened on O/C E/F protection after approx. 1300msec.

Point of discussion

- i. Issue w.r.t. bus bar protection and 400/220kV ICT-4 at Daulatabad(Haryana) need to be resolved on priority.
- ii. Why did DT send from Gurgaon(PG) end in 400 KV Gurgaon(PG)-Daulatabad(HV) (HV) D/C? Any necessary corrective actions required may be taken at Gurgaon(PG) end.
- iii. DR of bus bar relay at Daulatabad end need to be shared.
- iv. Why did bus bar protection operate at Daulatabad end?
- v. Why did 400/220kV ICT-2 at Daulatabad trip?
- vi. Report of remedial action taken to be shared.

**Multiple elements tripping at
220kV Mohana(HR)**

09th June 2023

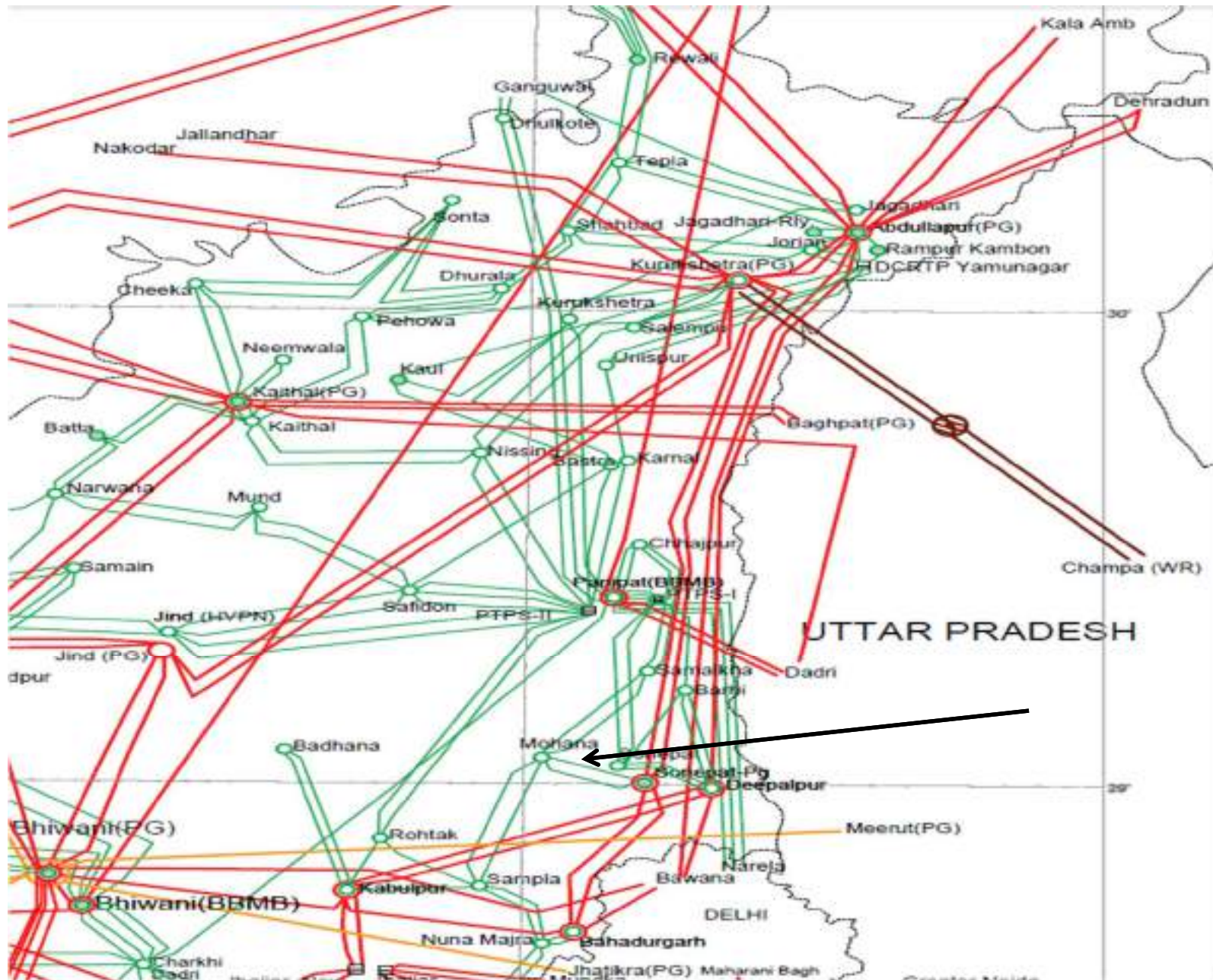
Brief of event:

- 220/132kV Mohana(Haryana) has double main bus scheme at both 220kV & 132kV level. There are six 220kV lines connected at 220kV level i.e., 220kV Mohana-Sonipat(PG) D/C, 220kV Mohana-Sampla (Haryana) D/C and 220kV Mohana-Samalakha (Haryana) D/C. Samalakha is further connected 220kV Chhajpur(Haryana) which is further connected to 400/220kV Panipat(BBMB)
- As reported, at 21:09 hrs, **R-phase CT at Mohana end of 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-1** damaged and line tripped. At the same time, **two limbs of CB at Mohana end of 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-2** also **damaged** and ckt-2 also tripped.

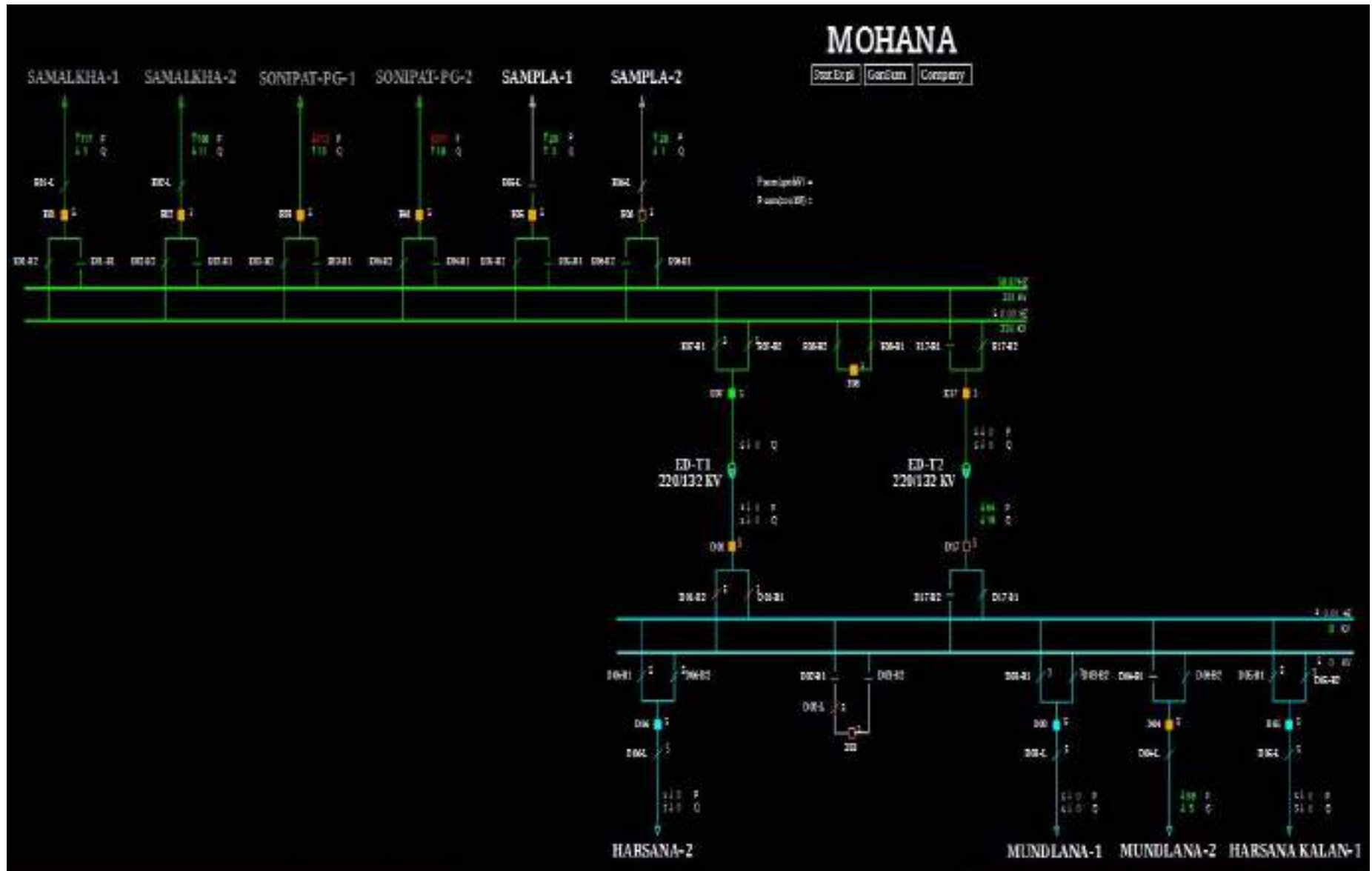
Elements tripped:

- i. 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-1
- ii. 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-2
- iii. 220kV Mohana-Sampla ckt-1
- iv. 220kV Mohana-Sampla ckt-2

Network diagram

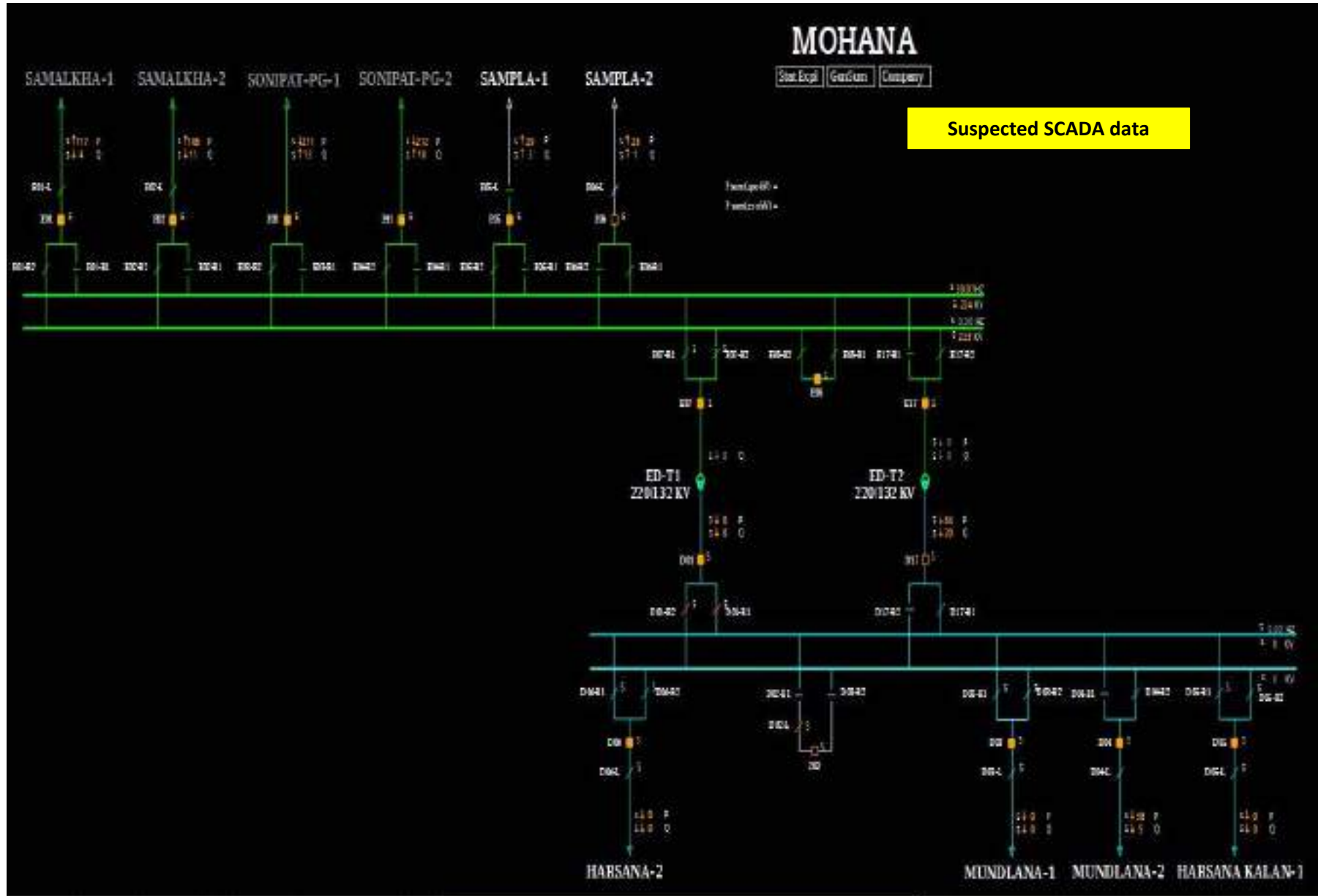


SLD of 220/132kV Mohana(Haryana) before the tripping

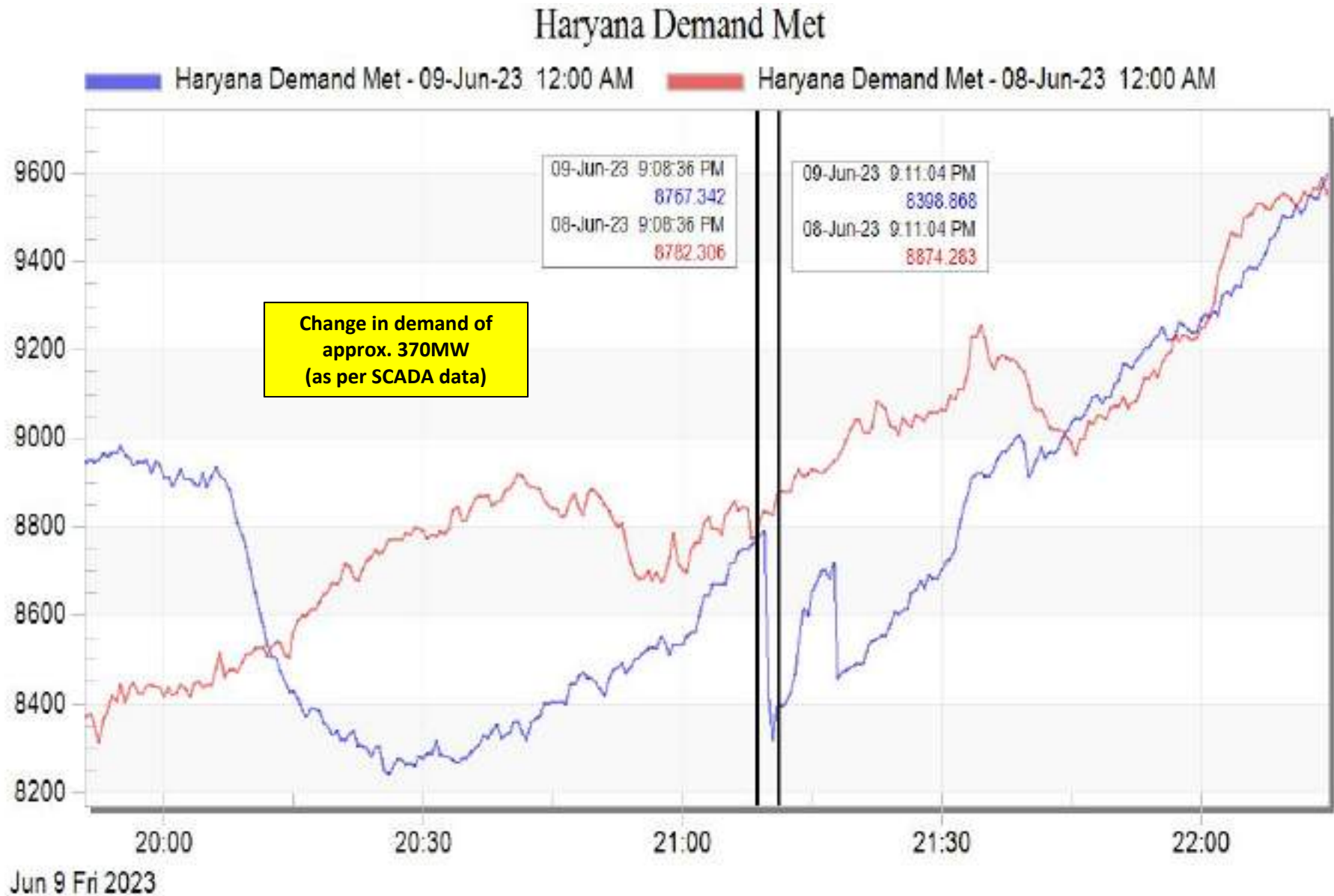


Fri June 9 2023 21:07:00

SLD of 220/132kV Mohana(Haryana) after the tripping

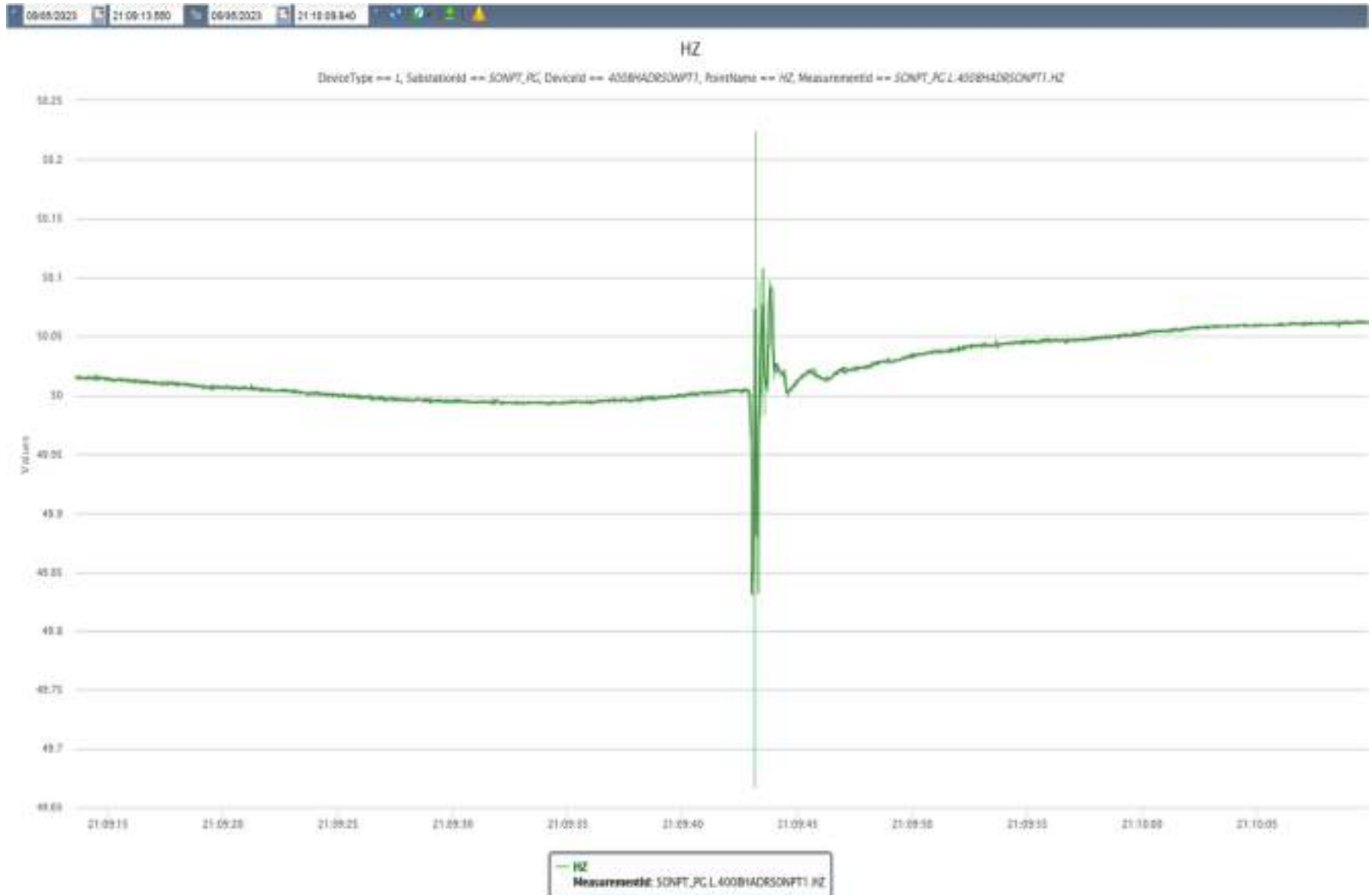


Haryana demand during the event



PMU Plot of frequency at Sonipat(PG)

21:09hrs/09-Jun-23

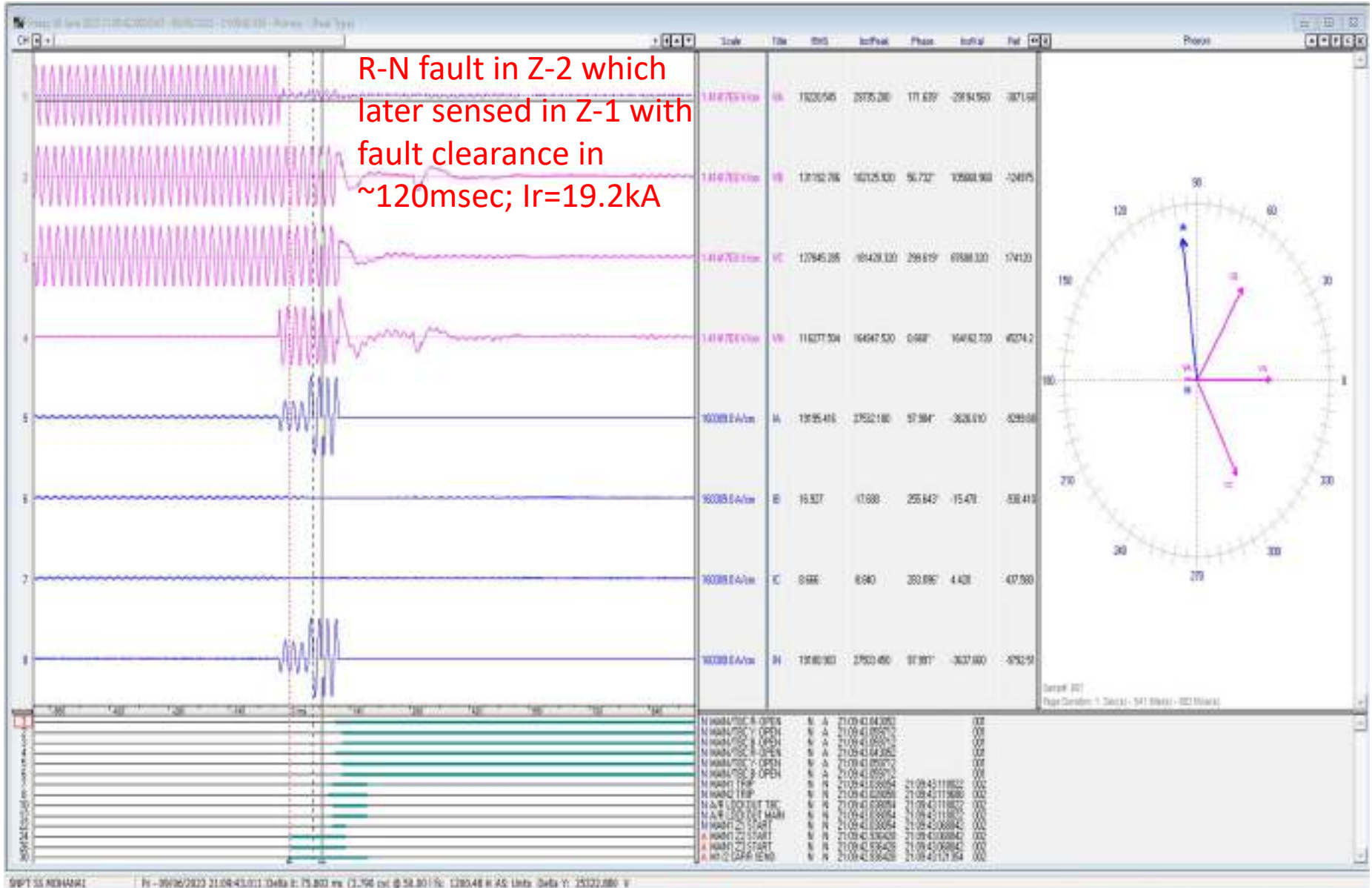


PMU Plot of phase voltage magnitude at Sonipat(PG)

21:09hrs/09-Jun-23

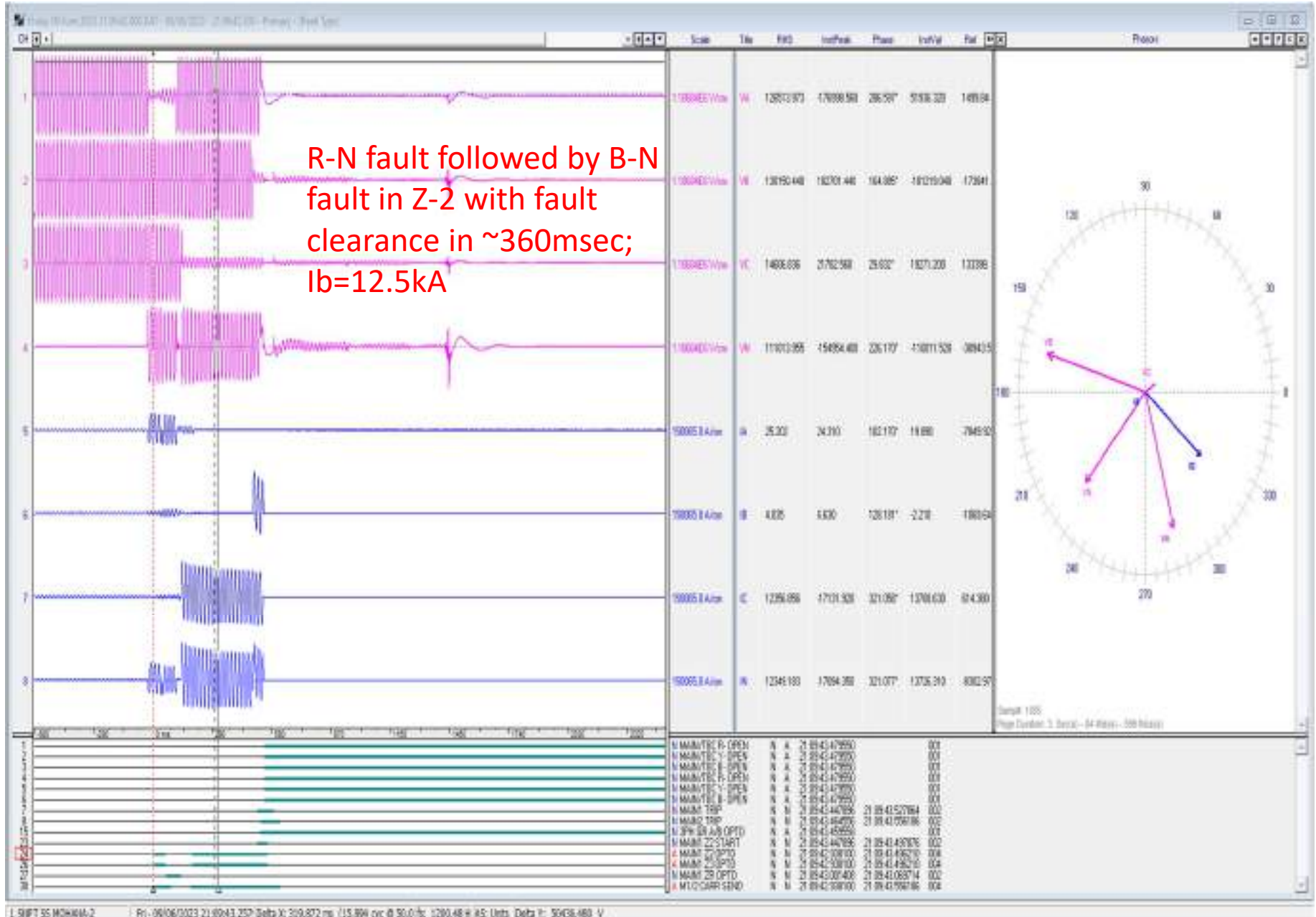


DR of 220 KV Mohana(HV)-Sonipat(PG) (end) (HVPNL) Ckt-1



As reported, fault occurred due to damage of CT at Mohana end. What was the fault distance from Sonipat (PG) end, as it was sensed in Z-1?

DR of 220 KV Mohana(HV)-Sonipat(PG) (end) (HVPNL) Ckt-2



SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remarks
21:09:43,059	SONIPAT	220kV	01MHANA1	Circuit Breaker	Open	Line CB at Sonipat(PG) end of 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-1 opened
21:09:43,474	SONIPAT	220kV	02MHANA2	Circuit Breaker	Open	Line CB at Sonipat(PG) end of 220 KV Mohana(HV)-Sonipat(PG) (HVPNL) Ckt-2 opened
21:09:44,384	SMPLA_H	220kV	1MHANA1	Circuit Breaker	disturbe	
21:09:44,395	SMPLA_H	220kV	2MHANA2	Circuit Breaker	disturbe	

Event analysis details shared by Haryana

7. Analysis: -

As per the analysis of events It is observed that: -

- At 220KV substation Mohana the controlling breaker(Y and B-phase limbs) of 220KV Mohana-Jhajji ckt-II got damaged and explode into pieces. Due to explosion in breaker limbs, porcelain pieces may have damaged the R-phase CT of adjacent 220KV Mohana-Jajji ckt-I along with damage of Isolators and L&E switches.
- 220KV Mohana-Jajji ckt II and I tripped from 400KV s/stn Jajji in Z-2 but no relay operated at 220KV Substation Mohana end. DPRs on 220KV Mohana-Sampla and 220KV Mohana-Samalkha ckts may not operate due to reverse zone fault i.e. Zone-4 for these ckts because operating time for Zone-4 is 1000 ms which is higher than operating time for Zone-1 & 2.
- 220KV Mohana-Sampla ckt-I & II tripped from 220KV Sampla in zone-2(operating time=350ms) and no relay operated at 220KV Mohana substation as the fault was in Z-4 (operating time=1s). Before sensing the fault in Z-4 at 220KV Mohana substation the relay at 220KV substation Sampla sensed the fault in Z-2 and tripped from 220KV substation Sampla.
- As the complete load of 220KV S/stn Mohana was running in synchronization mode from 400KV Jajji, 220KV S/stn Sampla and 220KV S/stn Samalkha via 220KV Chhajpur from 400KV BBMB. Due to tripping on both 220KV Mohana-Jajji ckts, overloading on 220KV Mohana-Samalkha ckt-I & II and 220KV Mohana-Sampla ckt-I & II arises resultant into tripping with snapping of the conductor of 220 KV Chajpur-BBMB Panipat ckt-1 and at the same time 220 KV Chajpur-BBMB Panipat ckt-2 got tripped off in Zone-1. Due to this 220 KV Samalkha substation doesn't have any power feeding source. So DPRs installed between 220 KV Samalkha & 220 KV Mohana don't sense any fault current and these DPRs not tripped off.

Recommendation shared by Haryana

1. As the 400KV Jhajji (PGCIL) is the main feeding source to 220KV substation Mohana. Sifang(ER) make relays installed on 220KV Mohana-Jhajji ckt 1 & 2 and misbehave sometimes as the relay start showing a setting group error, CPU card fail alarm, and relay went into blocking mode. Sometimes these alarms got reset by switching the relay ON/OFF. So, it is recommended that the Main-II relay of both PGCIL circuits may be replaced with new numerical relay because Main-I & II are of the same manufacturer.
2. SSE is advised for the maintenance of CTs as per Nigam's instruction.

Point of discussion

- i. Healthiness of Bus bar protection at Mohana S/s need to be ensured. Z-4 time delay setting at Mohana end need to be reviewed?
- ii. DR/EL of Mohana S/s end need to be shared.
- iii. As per analysis report of HVPNL, replacement of Main-II relays of Sonipat(PG) ckt-1&2 was recommended. Status of the same need to be shared.
- iv. Remedial action taken report to be shared.

**Multiple elements tripping at
400/220kV Bahadurgarh(PG)**

**25th July 2023 at
14:44 hrs**

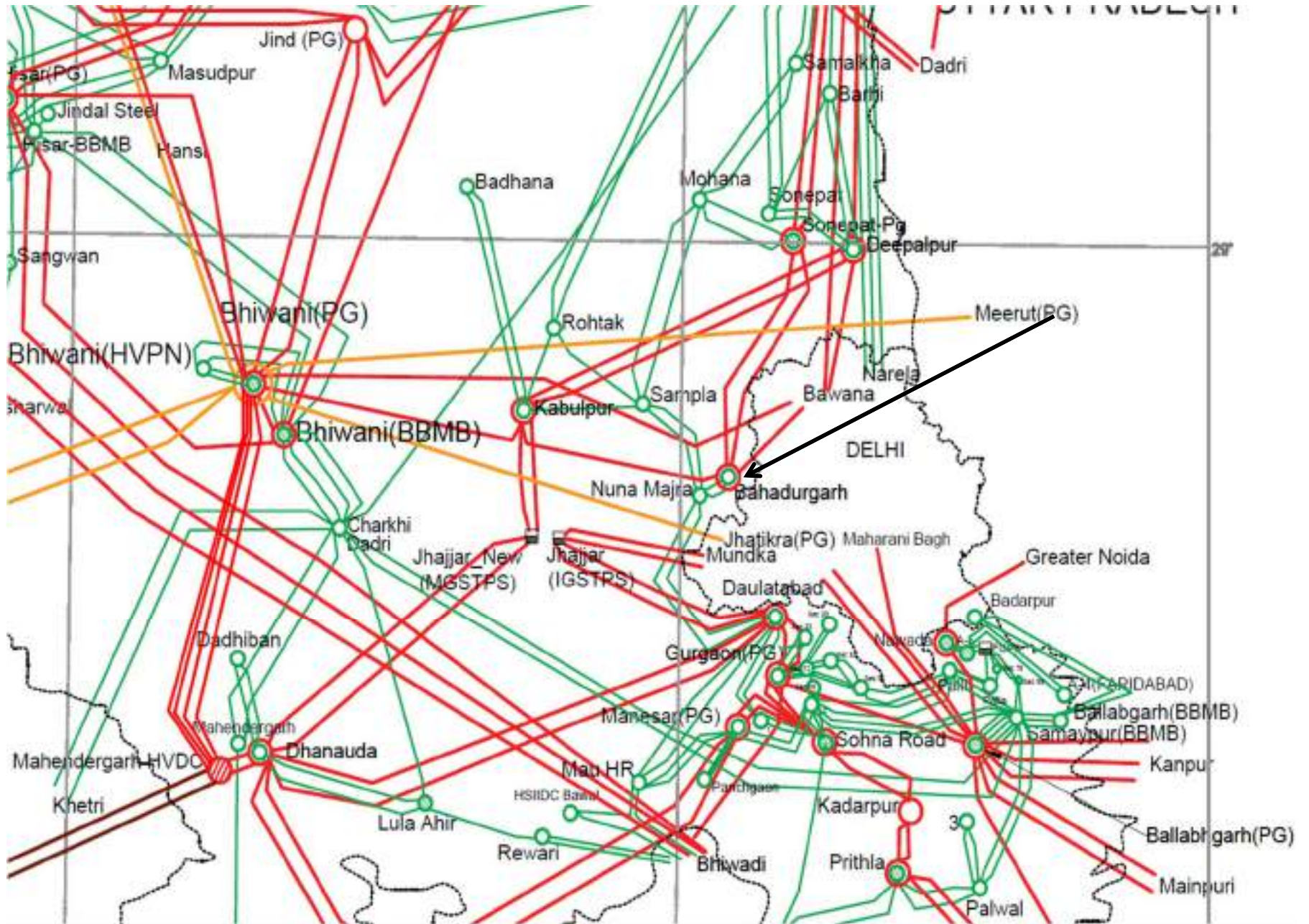
Brief of event:

- 220kV side of 400/220kV Bahadurgarh(PG) has double main & transfer bus scheme.
- As reported, at 14:22 hrs, sparking was observed in Y-phase isolator of 400/220 kV 315 MVA ICT 2 at Bahadurgarh(PG) and ICT 2 tripped. POWERGRID has been communicated to share the exact detail of protection operation.
- Further at 14:44 hrs, bus bar protection operated at 220KV Bus 1 & 2 at Bahadurgarh(PG) and 400/220 kV 315 MVA ICT 1 at Bahadurgarh(PG) along with 220 KV Bahadurgarh(PG)-Nuna Majra(HV) (HVPNL) Ckt-1 & 2 tripped. POWERGRID has been communicated to share the exact nature and location of fault.

Elements tripped:

- i. 400/220 kV 500 MVA ICT 2 at Bahadurgarh(PG)
- ii. 220KV Bus 1 at Bahadurgarh(PG)
- iii. 220KV Bus 2 at Bahadurgarh(PG)
- iv. 220 KV Bahadurgarh(PG)-Nuna Majra(HV) (HVPNL) Ckt-1
- v. 220 KV Bahadurgarh(PG)-Nuna Majra(HV) (HVPNL) Ckt-2
- vi. 400/220 kV 315 MVA ICT 1 at Bahadurgarh(PG)

Network Diagram

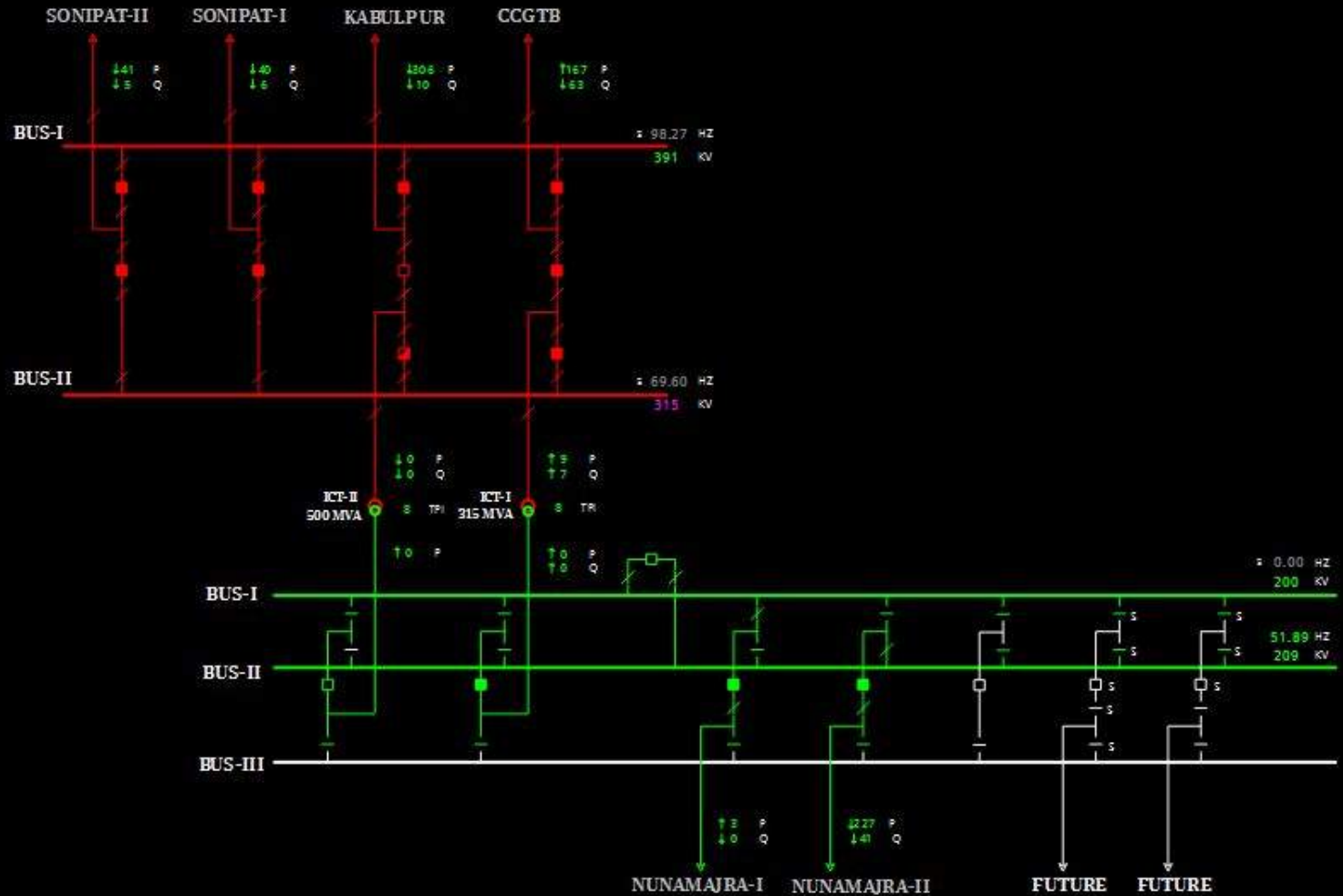


SLD of 400/220kV Bahadurgarh(PG) before the event

CONTACT DETAILS	
EMAIL	bahadurgarh@powergrid.co.in
MOBILE	9034008680 / 9729872313
HOTLINE	20112256 / 20112172

BAHADURGARH
 Stat Expl GenSum Company
 25.7 . 14:42:0

P sum(400 kV) = 225 Q sum(400 kV) = 32
 P sum(220 kV) = 225 Q sum(220 kV) = 42



SLD of 400/220kV Bahadurgarh(PG) after the event

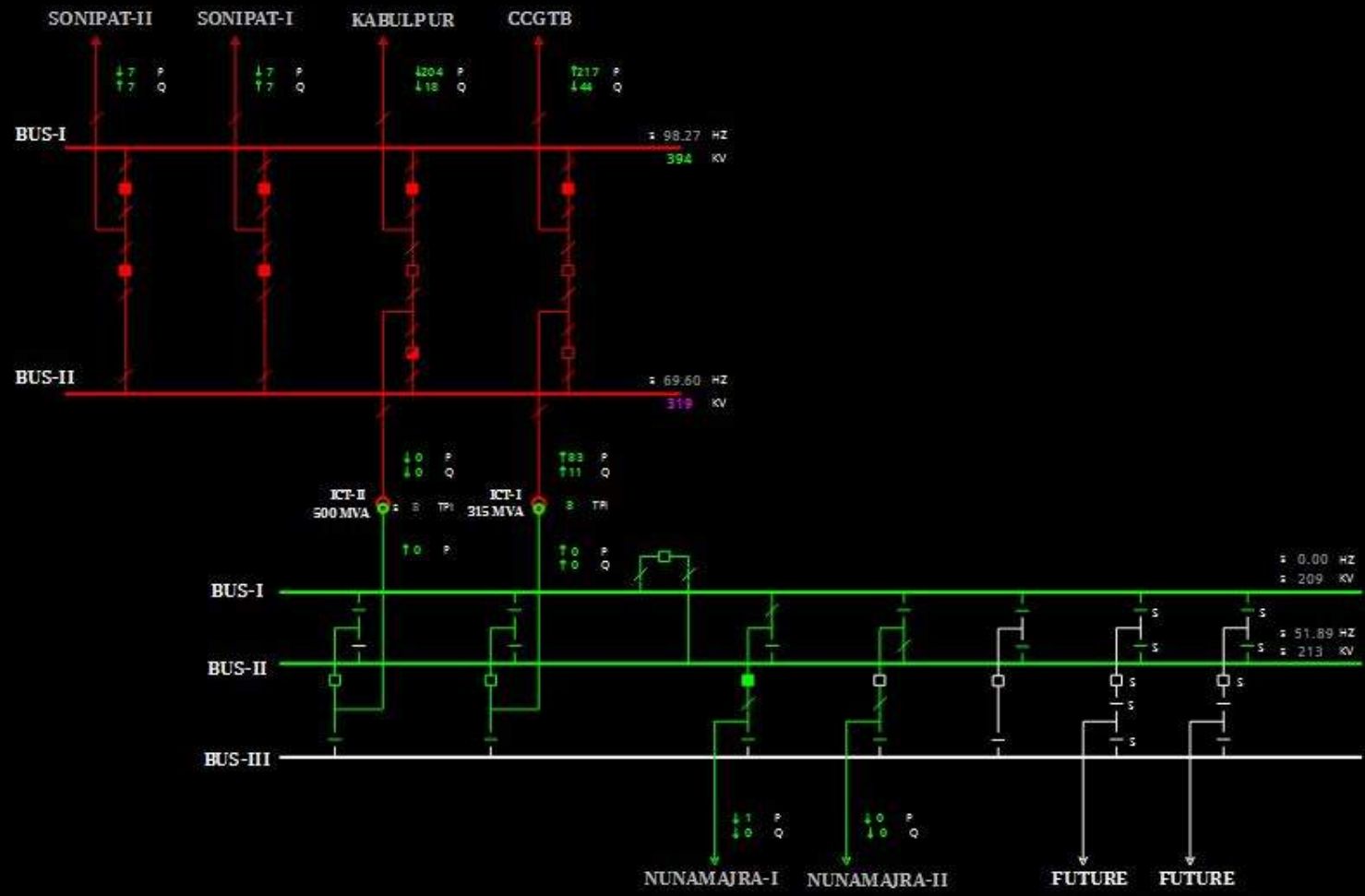
CONTACT DETAILS	
EMAIL	bahadurgarh@powergrid.co.in
MOBILE	9034008680 / 9729872313
HOTLINE	20112256 / 20112172

BAHADURGARH

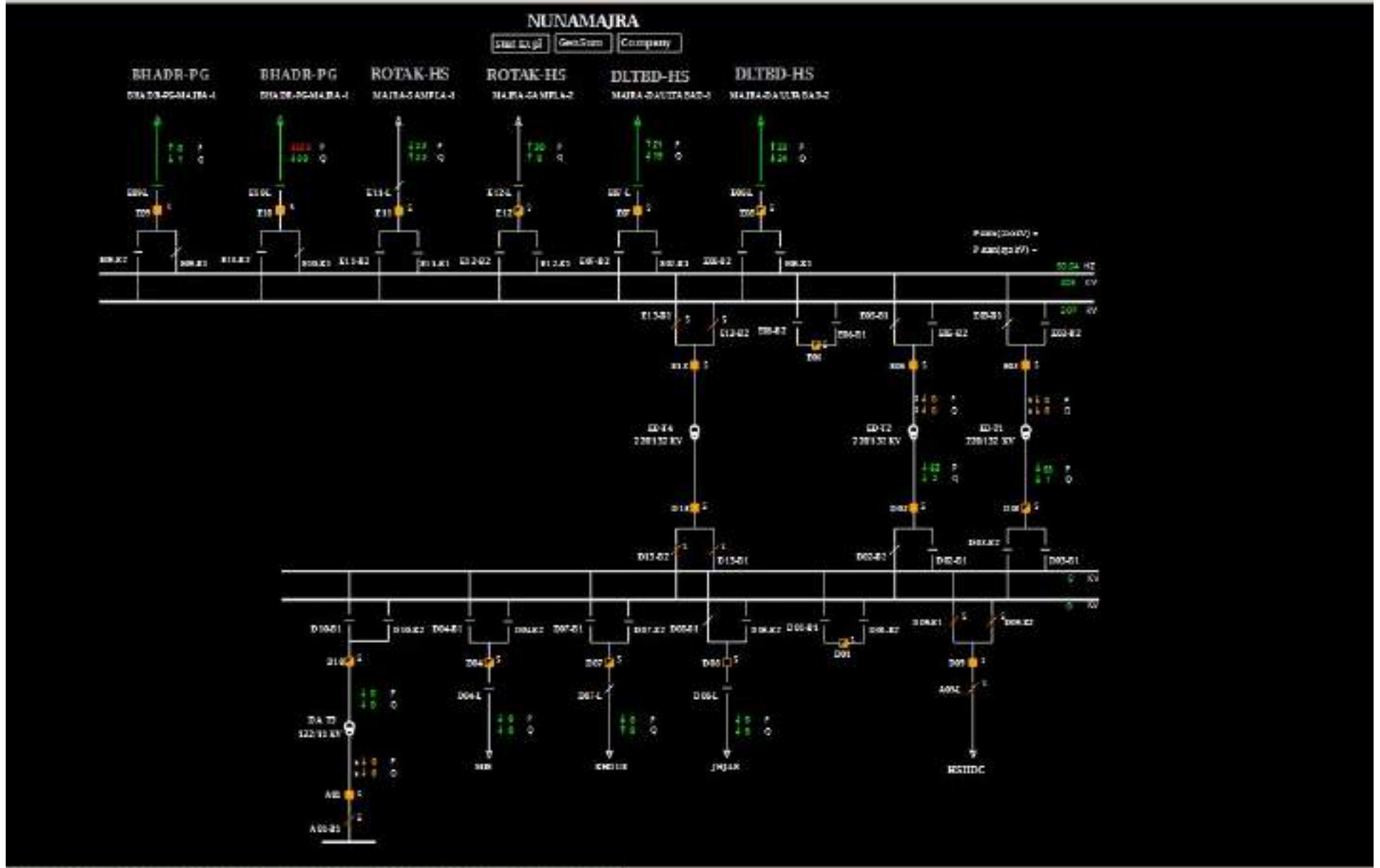
Stat Expl GenSum Company

25.7 . 14:47:0

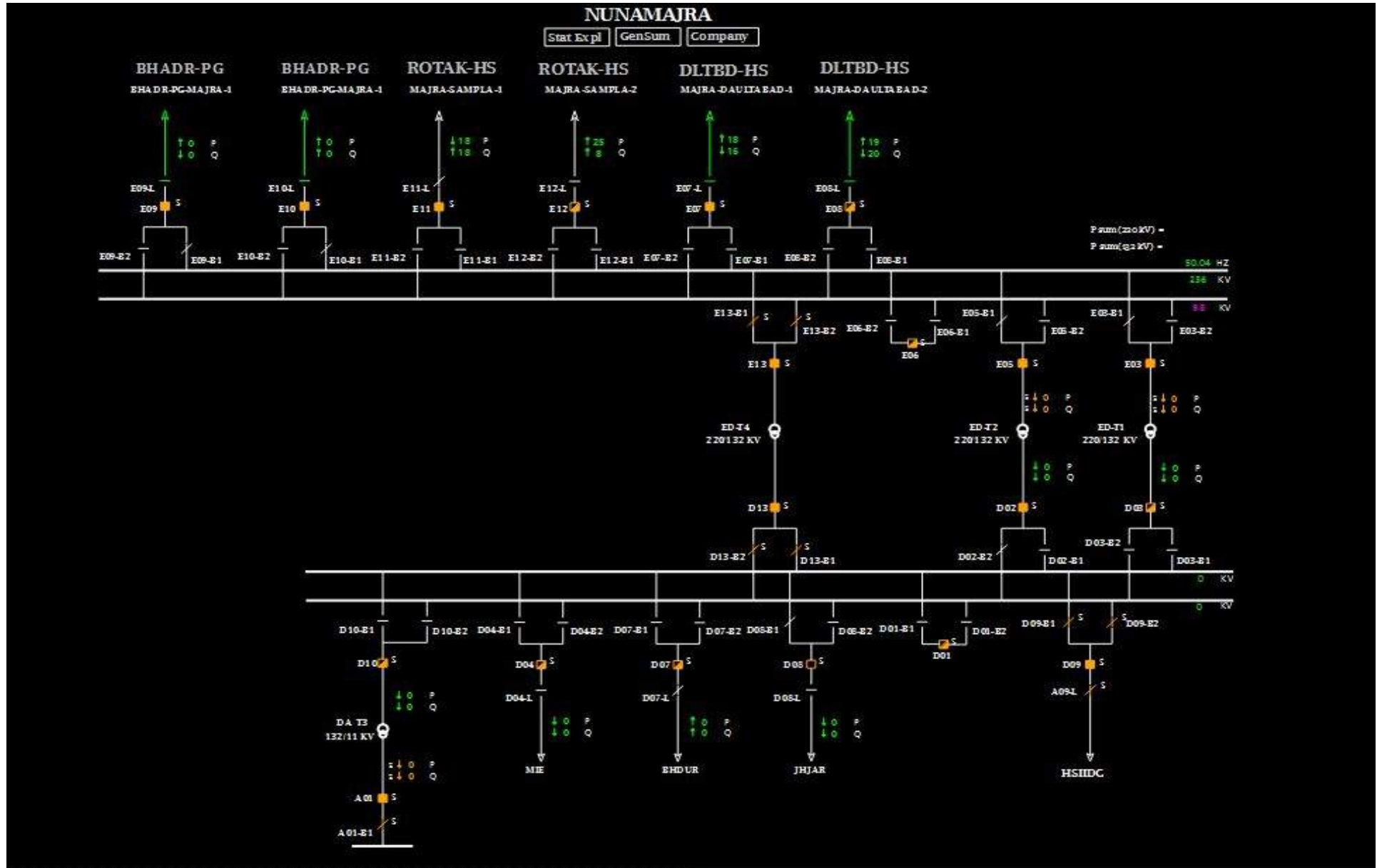
P sum(400 kV) = -84 Q sum(400 kV) = -47
P sum(220 kV) = 0 Q sum(220 kV) = 0



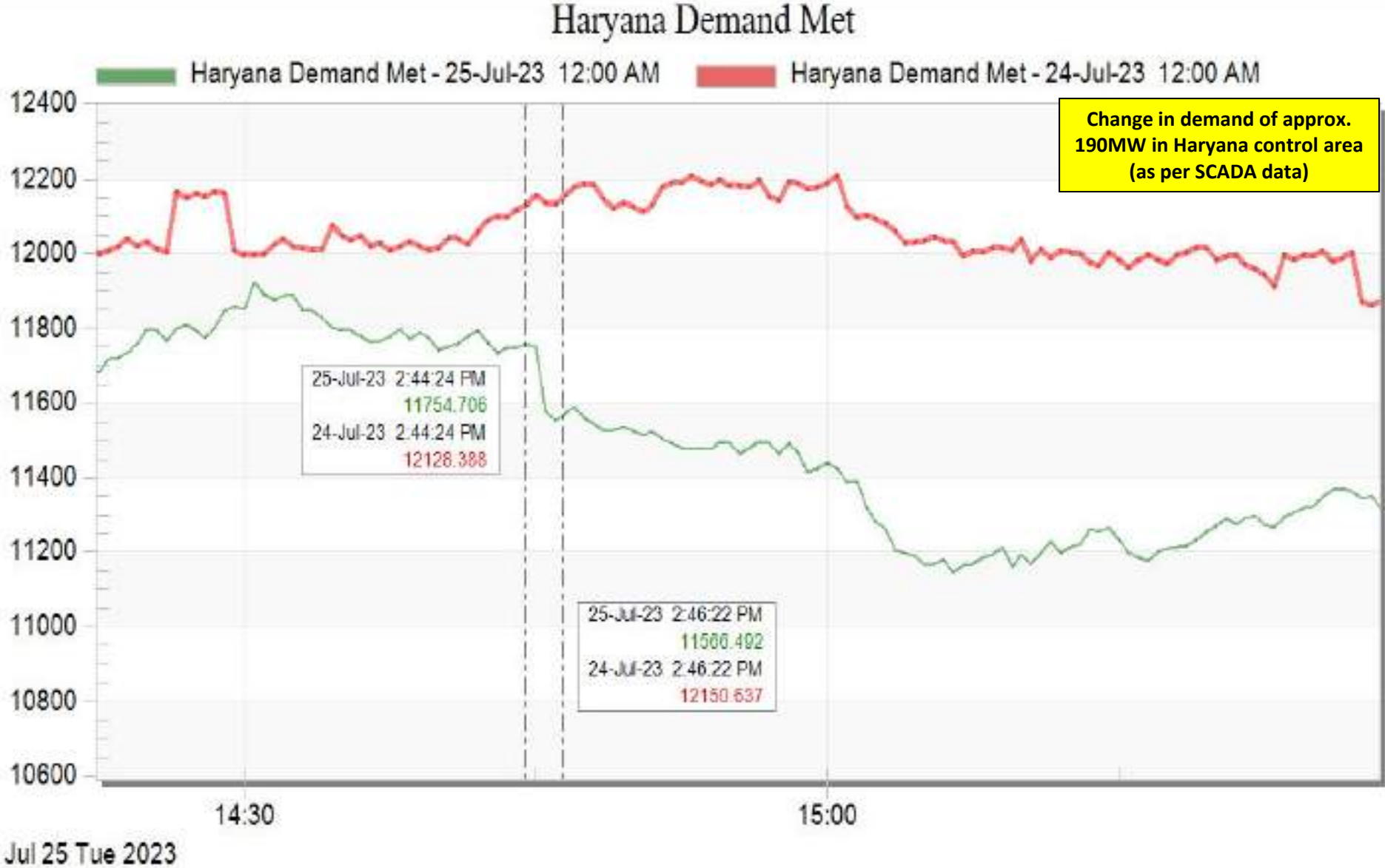
SLD of 220/132kV Nunamajra(HR) before the event



SLD of 220/132kV Nunamajra(HR) after the event



Haryana demand during the event



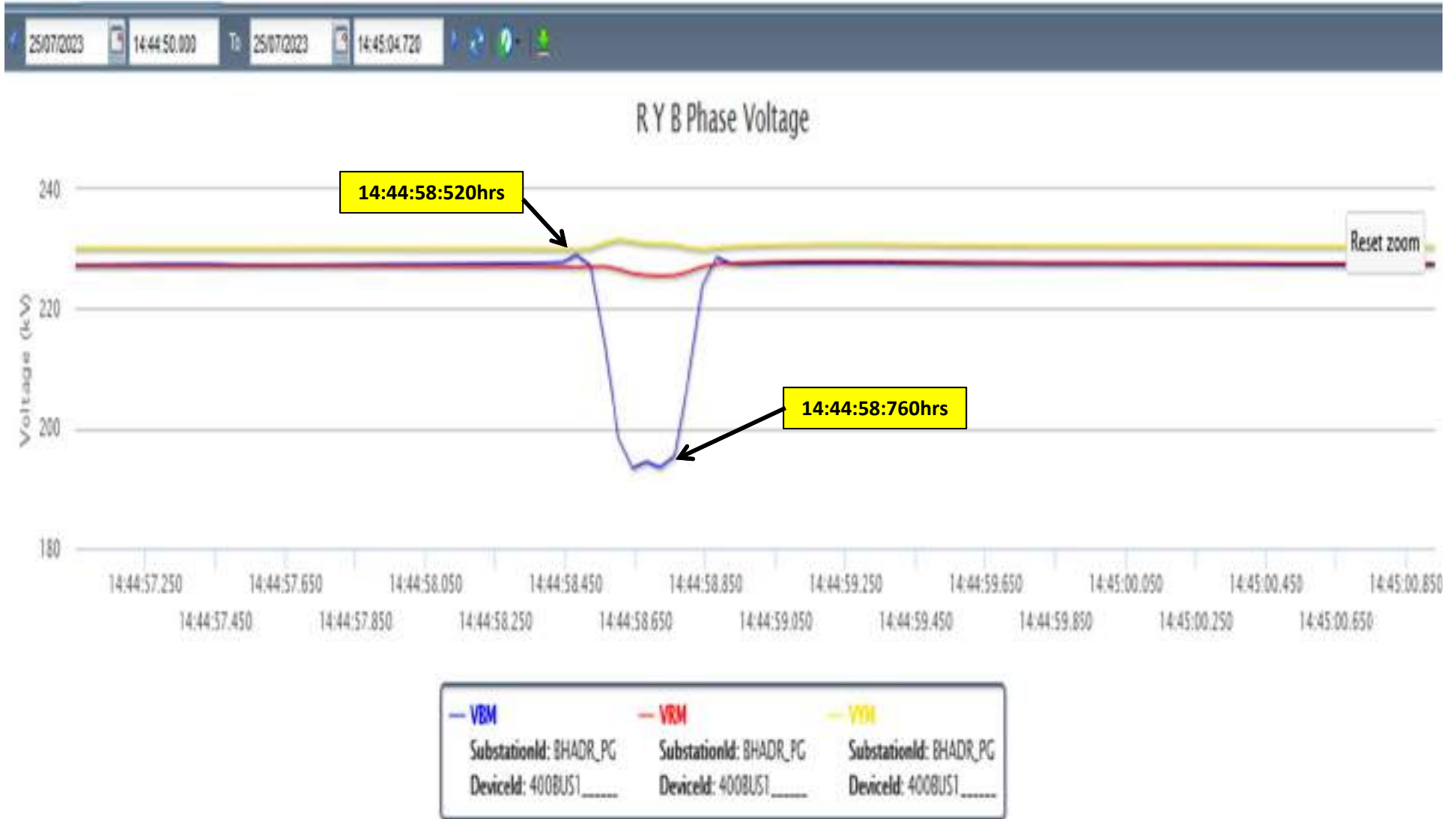
PMU Plot of frequency at Bahadurgarh(PG)

14:44 hrs/25-Jul-23

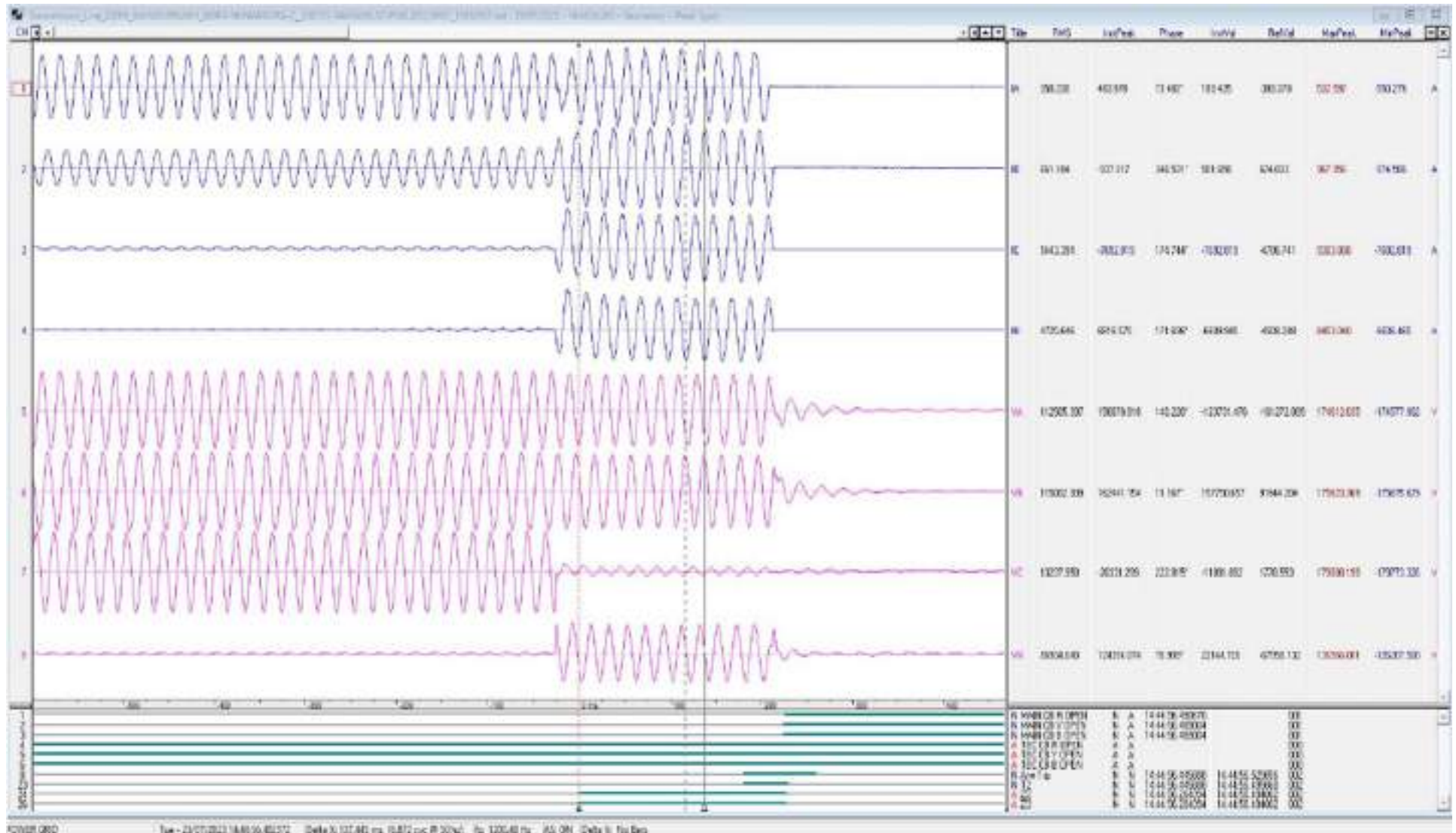


PMU Plot of phase voltage magnitude at Bahadurgarh(PG)

14:44 hrs/25-Jul-23



DR of 220 KV Bahadurgarh(PG) (end)-Nuna Majra(HV) (HVPNL) Ckt-2



- ✓ B-N phase to earth fault
- ✓ Fault sensed in zone-2

SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
14:44:58,562	BHADR_PG	220kV	5MAJRA2	Circuit Breaker	Open	Line CB at Bahadurgarh(PG) end of 220 KV Bahadurgarh(PG)-Nuna Majra(HV) (HVPNL) Ckt-2 opened
14:44:58,564	BHADR_PG	400kV	2T1BWA	Circuit Breaker	Open	Tie CB at 400kV side of 400/220 kV 315 MVA ICT 1 at Bahadurgarh(PG) opened
14:44:58,569	BHADR_PG	220kV	2T1	Circuit Breaker	Open	CB at 220kV side of 400/220 kV 315 MVA ICT 1 at Bahadurgarh(PG) opened
14:44:58,571	BHADR_PG	400kV	3T1	Circuit Breaker	Open	Main CB at 400kV side of 400/220 kV 315 MVA ICT 1 at Bahadurgarh(PG) opened

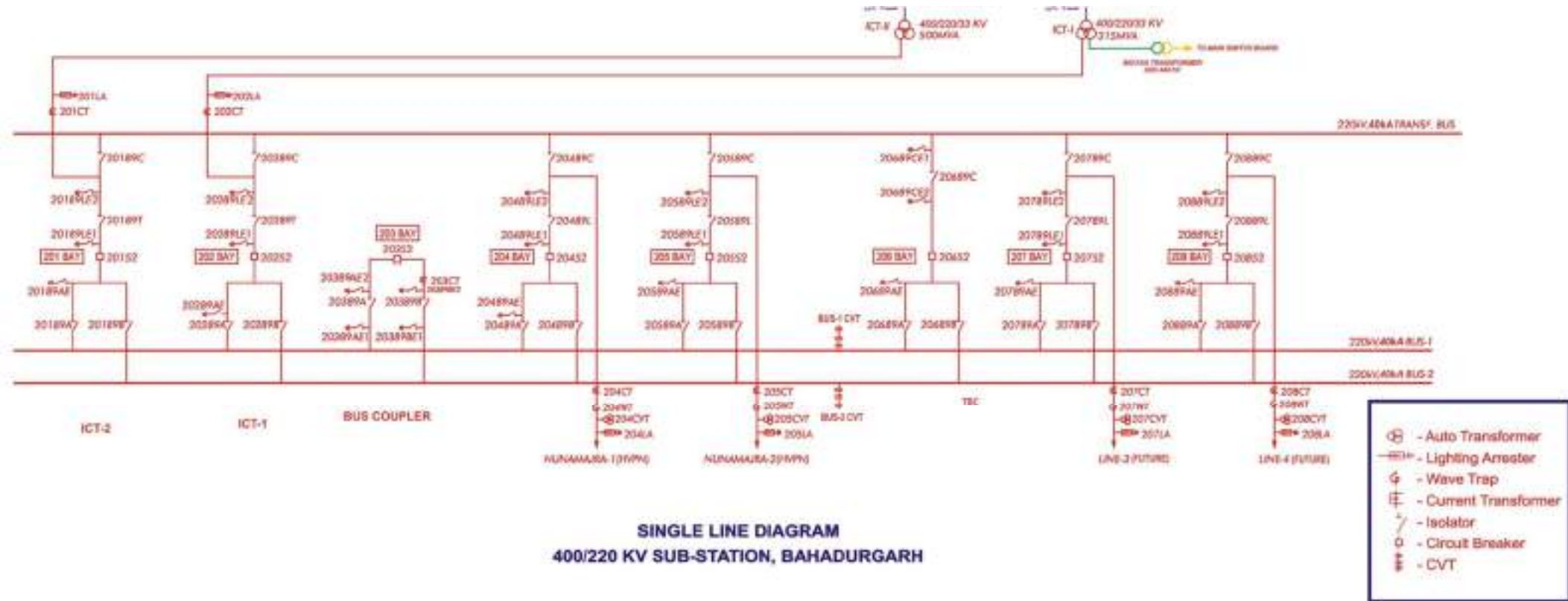
Point of discussion

- i. As reported, fault was on 220kV Bahadurgarh-Nunamjara ckt-2. Reason of tripping of multiple elements?
- ii. Why did both Bus-1&2 at Bahadurgarh(PG) trip?
- iii. Reason of delayed clearance of fault need to be shared.
- iv. DR/EL along with tripping report need to be shared from both the ends.
- v. Remedial action taken report need to be shared.

Multiple elements tripping at 400kV
Bahadurgarh(PG)

(analysis by POWERGRID)

SLD 220kV Bahadurgarh

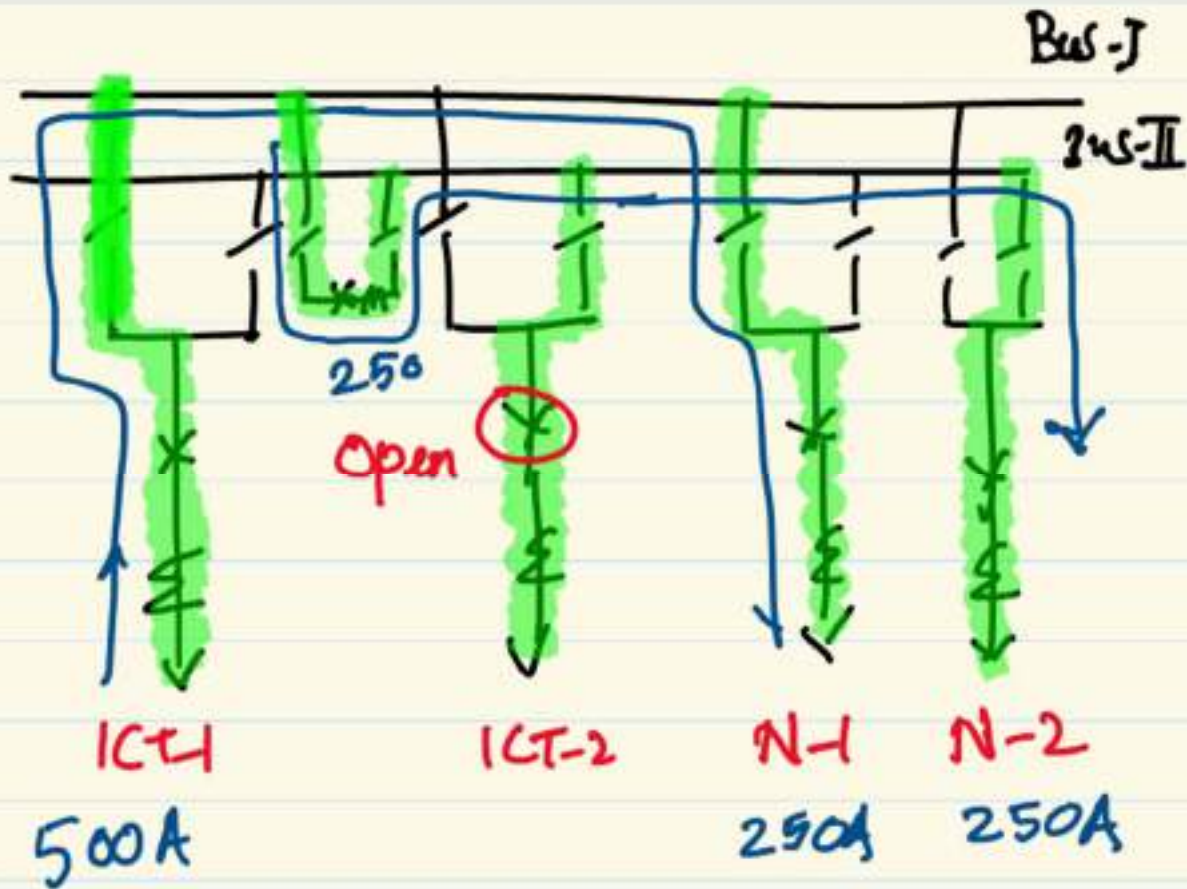




14:22:25 hrs

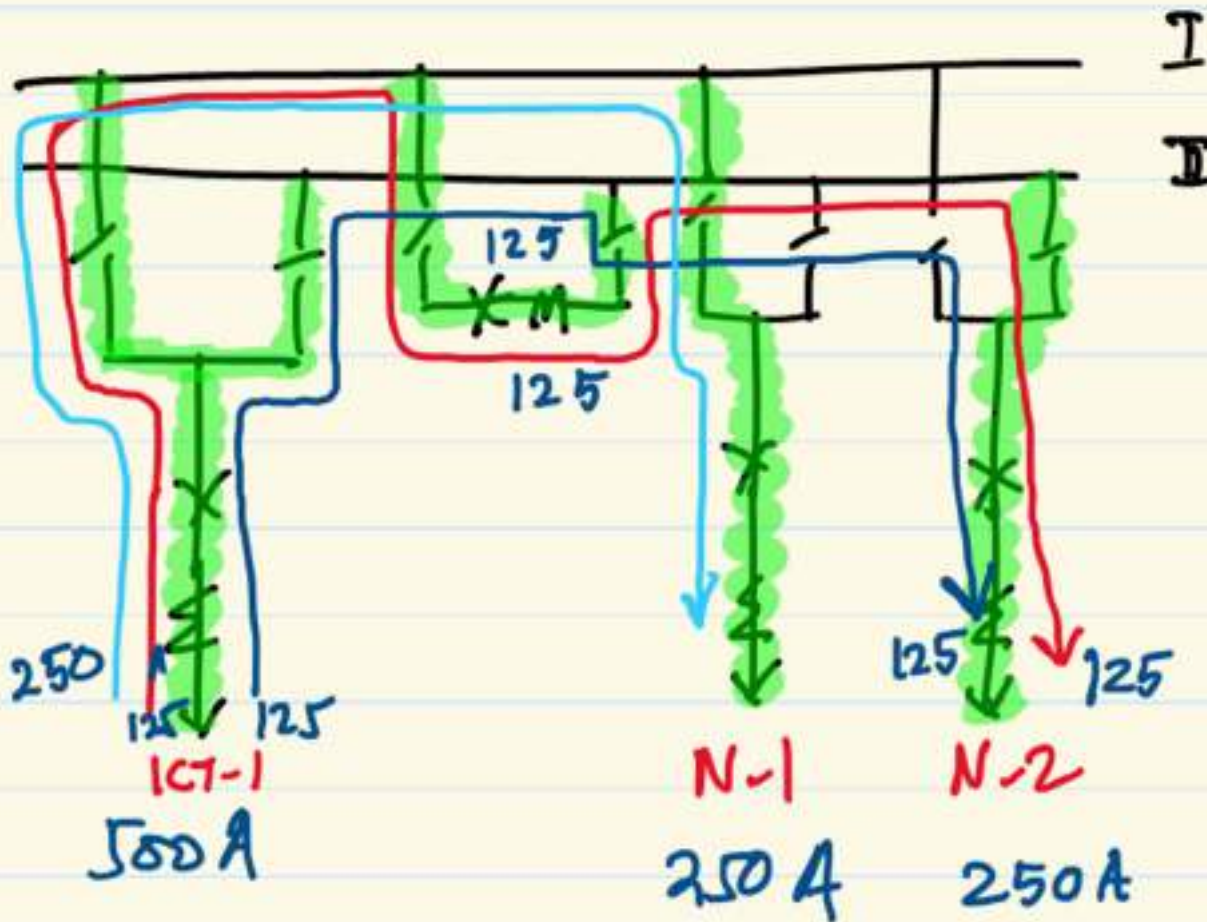
**Arcing in 220kV
89T (ICT-2)**

- Damage in Y-phase Isolator caused loss of current in Y-phase and operation of B/U EF protection in ICT-2



Snapshot after Tripping of ICT-2

- Loading on ICT-1 increased and sparking observed in 89A Isolator
- ICT-1 was planned to be shifted to Bus-2



14:36 hrs

Shifting of ICT-1 from Bus-1 to Bus-2

- 89B was closed
- 89A was opened- *(did not open fully and caused arcing)- manually opened*

$$\text{Zone-A: } \vec{BC} + \vec{N-1} = 250 + 250 = 500 \text{ A}$$

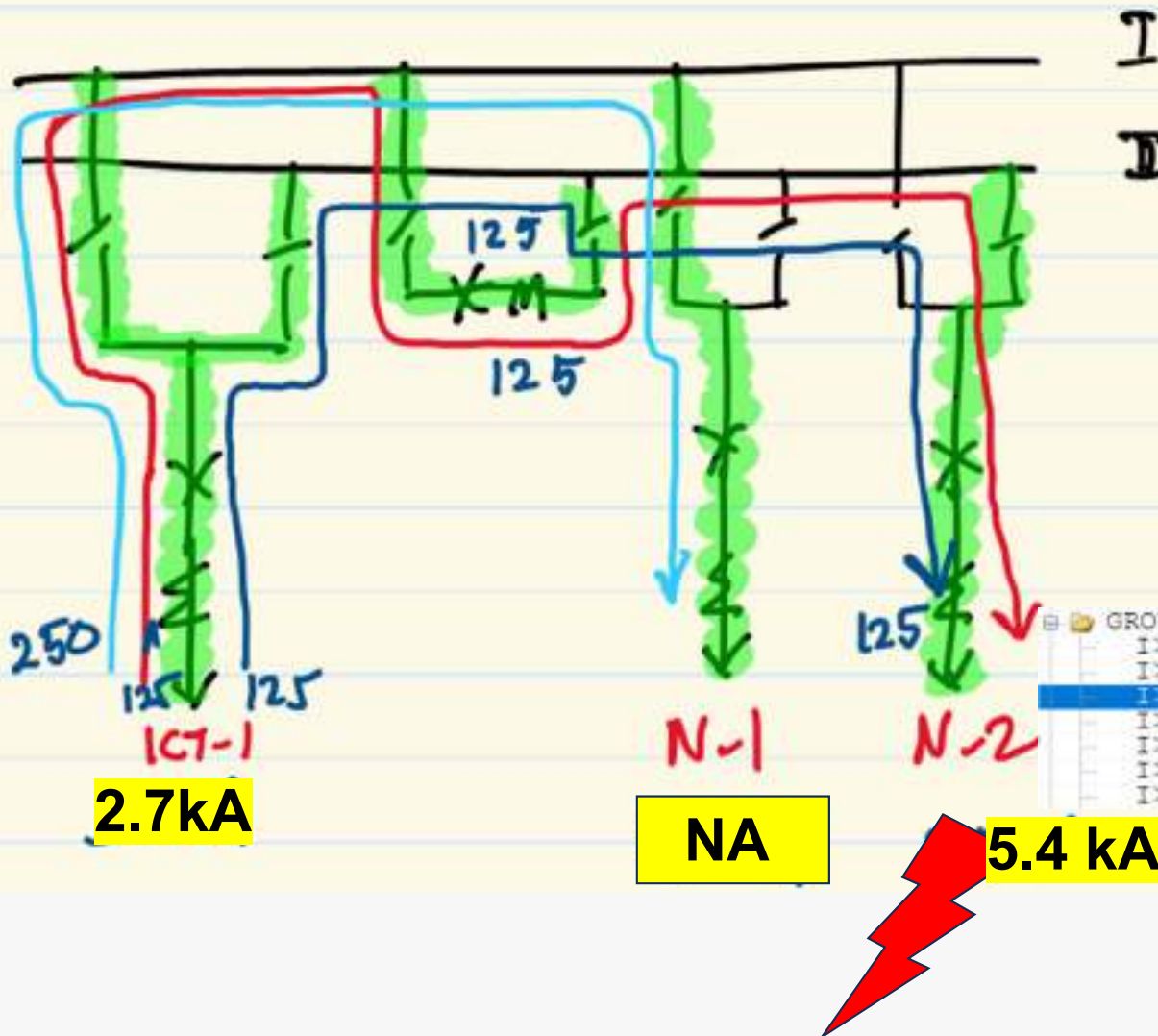
$$\begin{aligned} \text{Zone-B: } & -\vec{ICT-1} - \vec{BC} + \vec{N-2} \\ & = -500 - 250 + 250 \\ & = -500 \text{ A} \end{aligned}$$

$$\begin{aligned} \text{Check Zone: } & -\vec{ICT-1} + \vec{N-1} + \vec{N-2} \\ & = -500 + 250 + 250 \\ & = 0 \text{ A} \end{aligned}$$

14:44 hrs

Fault in 220kV Nuna-Majra-2

- Voltage selection failure
- “VTS fail” in LV side BU OC/EF relay
- Fault in 220kV Nuna-Majra-2



2.7kA

NA

5.4 kA

- LV BU OC operated in ICT-1

Notable points

- **After failure of ICT-2 at Bahadurgarh (2014) due to prolonged fault feeding (fault in downstream HVPNL system), all backup zones and ICT zones were shortened.**
- **Zone-2 time delays- 200ms**
- **TMS of BU OC & EF relays- 0.1**

**Multiple elements tripping at
220kV Verpal & Wadala(HR)**

**18th June 2023 at
00:07 hrs & 00:14 hrs**

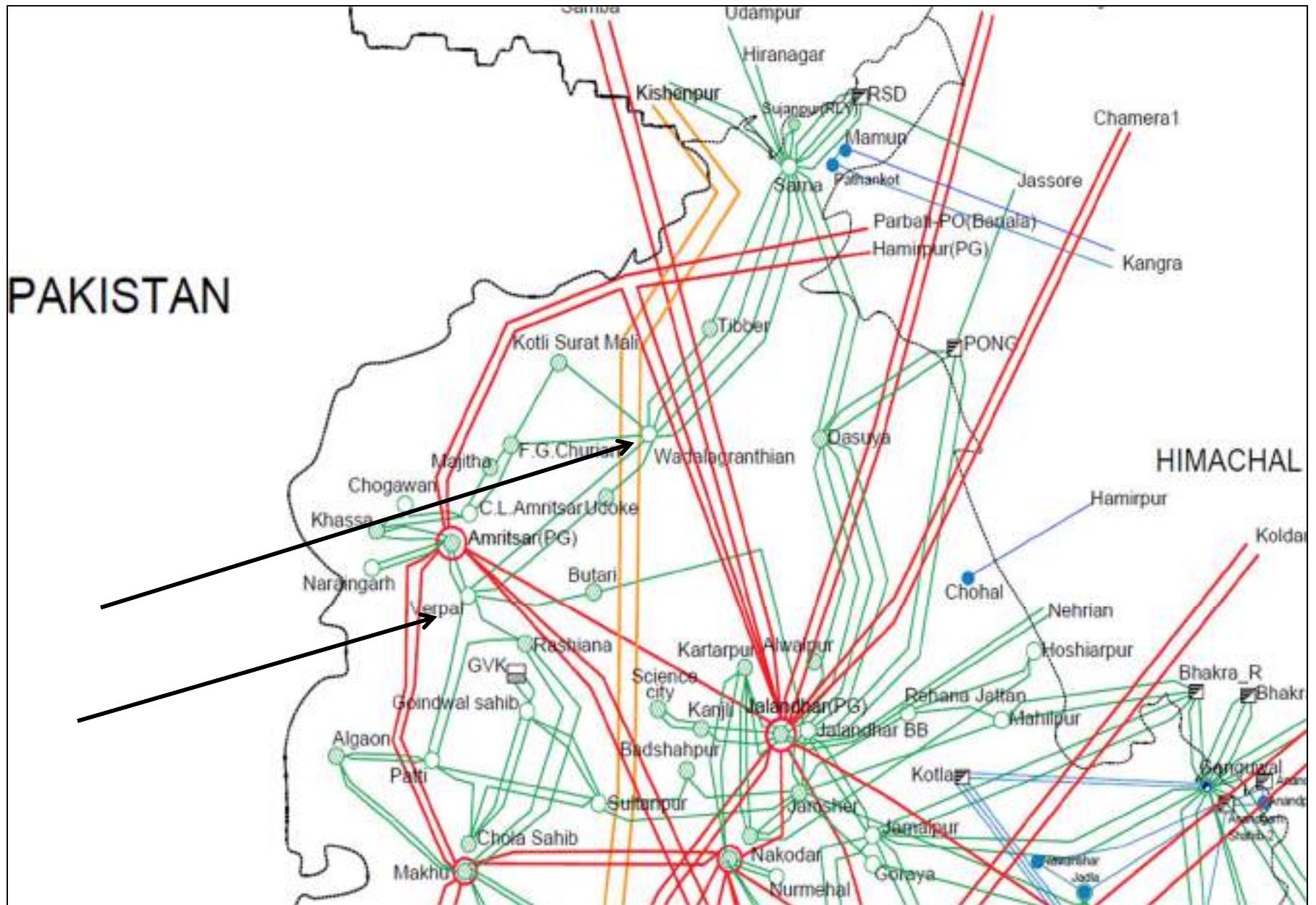
Brief of event:

- 220/132/66kV Wadala(PS) and 220/132/66kV Verpal(PS) has double main bus scheme at 220kV level.
- As reported, at 00:07hrs, 220/132kV ICT 1 & 4 at Wadala(PS) tripped (exact reason of tripping yet to be shared). As per SCADA, during the same time, 220/132kV ICT 3, 4 & 5 at Verpal(PS) along with all the 132kV feeders at Verpal(PS) also tripped and 132kV buses at Verpal(PS) became dead.
- At 00:14 hrs, R-phase CT of 220kV Verpal – PGCIL Amritsar ckt -2 got blast.

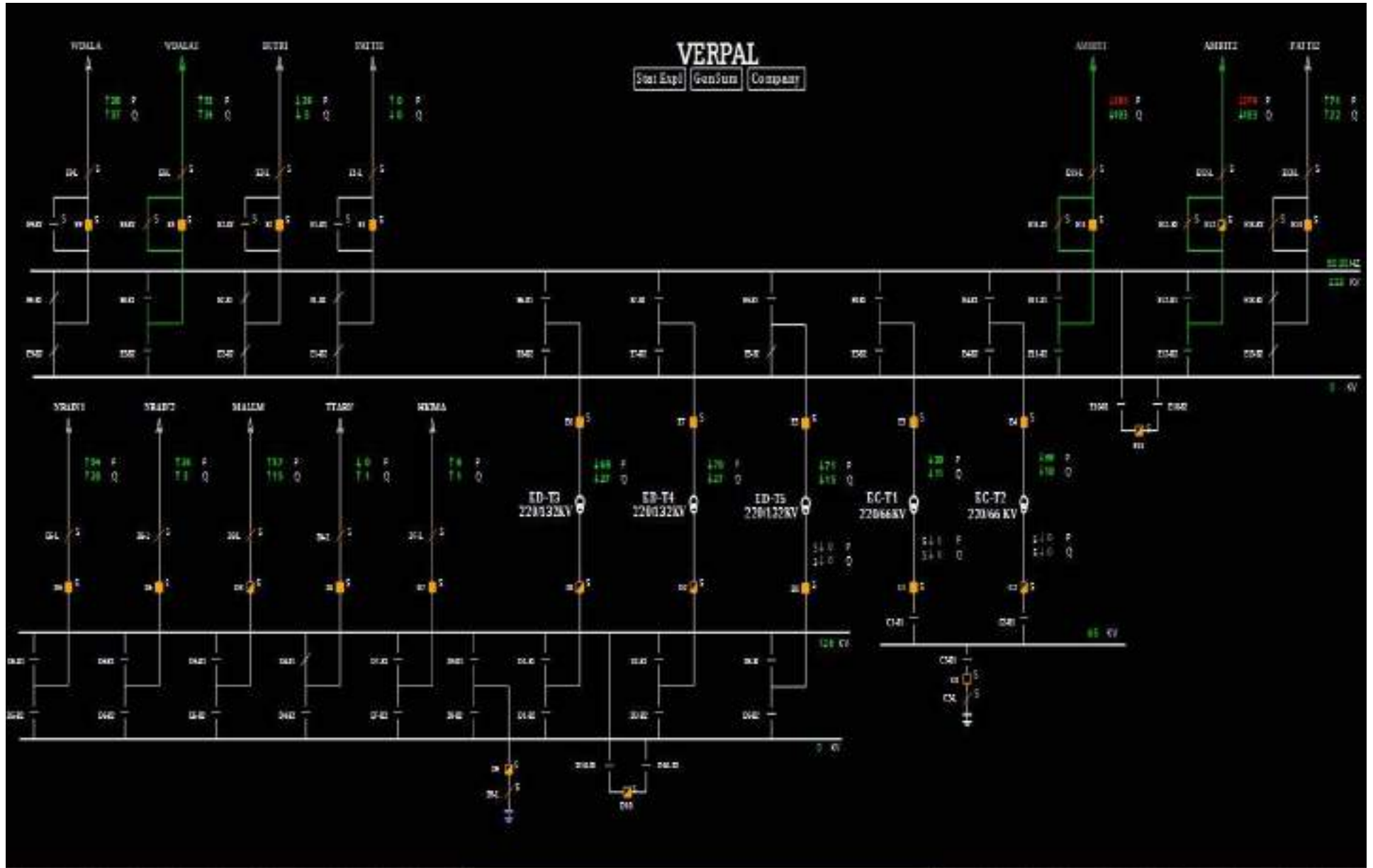
Elements tripped:

- i. 220/132kV ICT 1 at Wadala(PS)
- ii. 220/132kV ICT 4 at Wadala(PS)
- iii. 220/132kV ICT 3 at Verpal(PS)
- iv. 220/132kV ICT 4 at Verpal(PS)
- v. 220/132kV ICT 5 at Verpal(PS)
- vi. 220 kV Verpal(PS) –Wadala(PS) ckt-1
- vii. 220 kV Verpal(PS) –Wadala(PS) ckt-2
- viii. 220 kV Verpal(PS) –Amritsar(PG) ckt-1 (tripped from Verpal end only)
- ix. 220 kV Verpal(PS) –Amritsar(PG) ckt-2

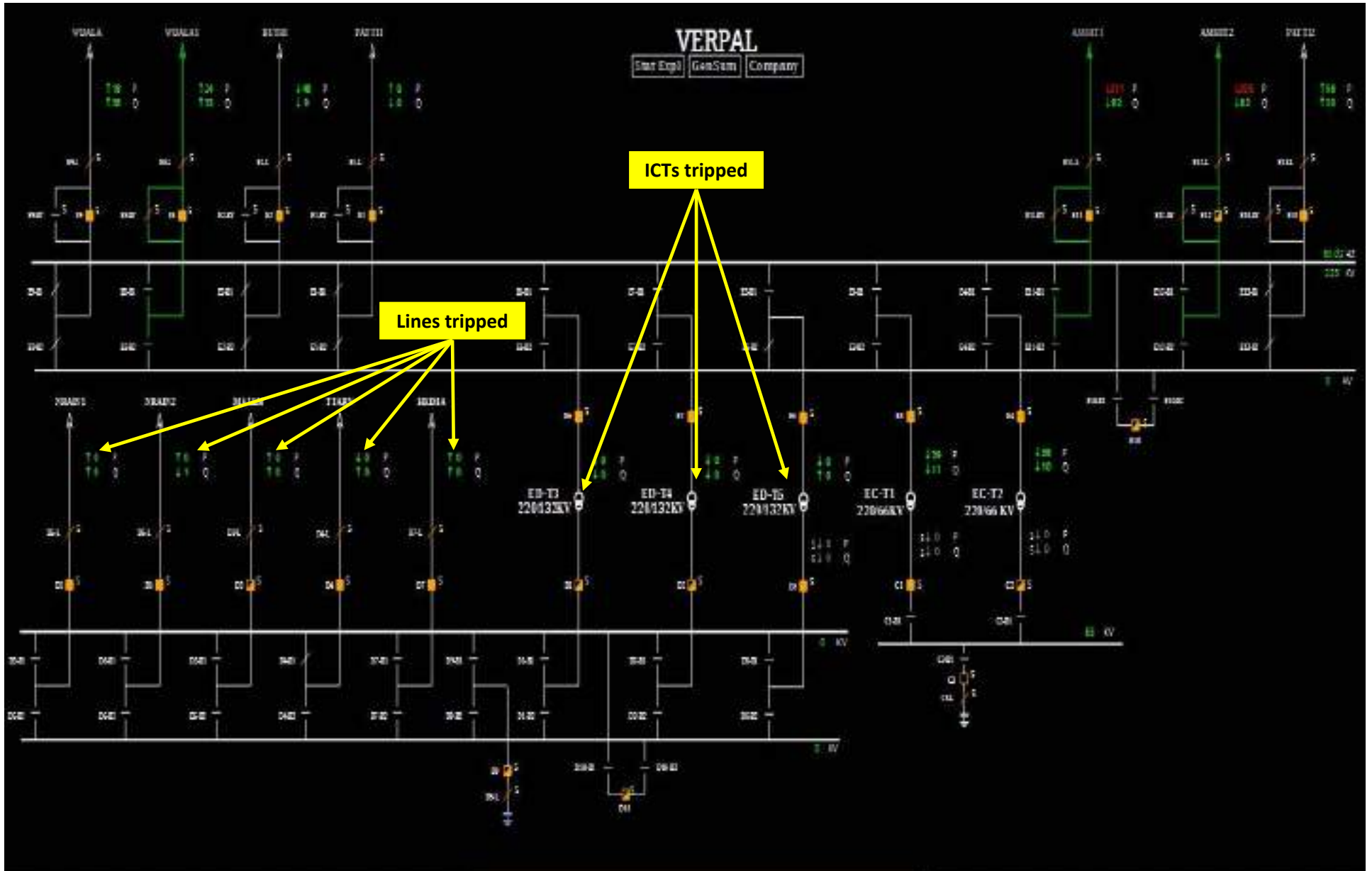
Network diagram



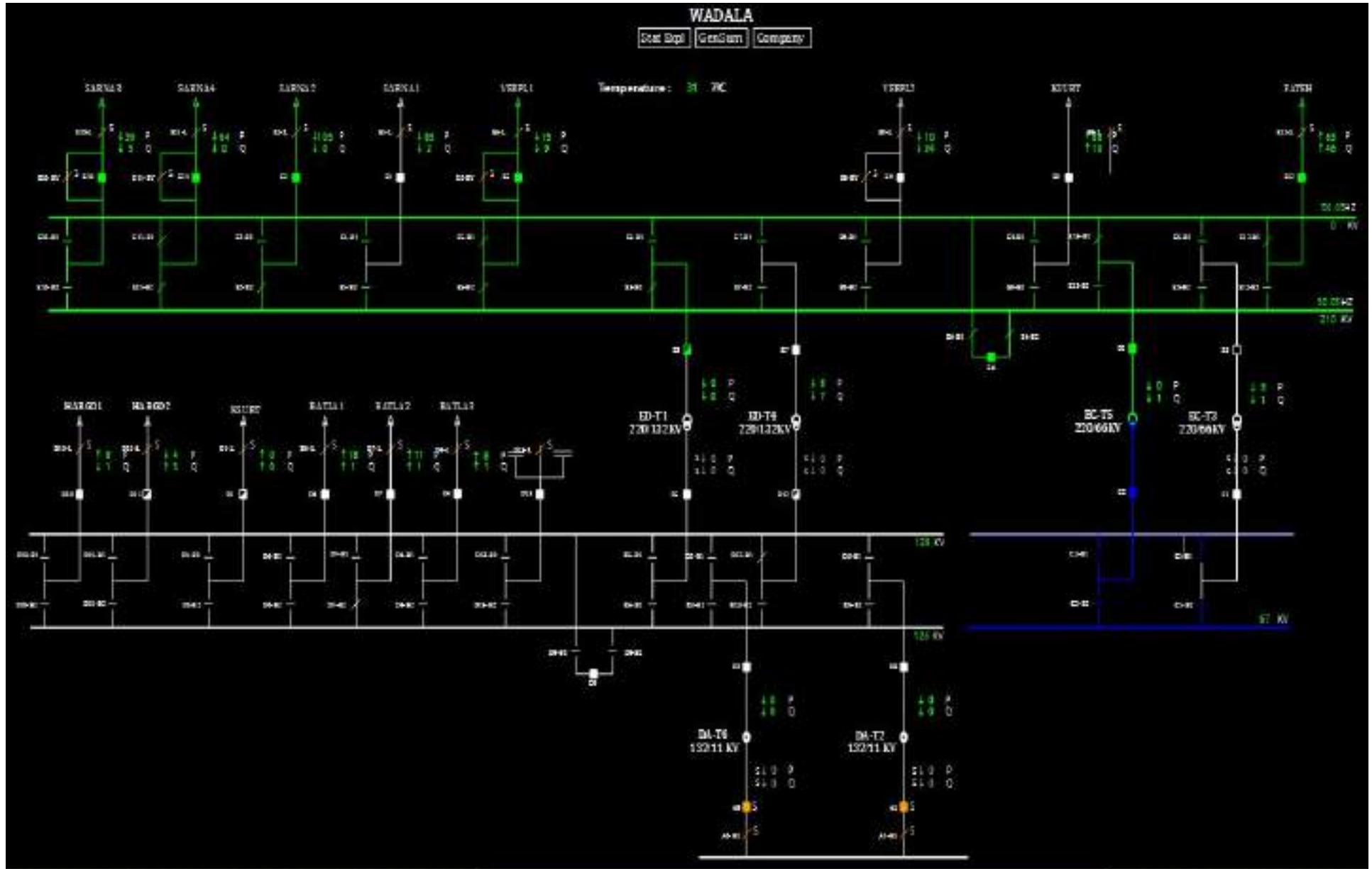
SLD of 220/132/66kV Verpal(PS) before the event @00:07hrs



SLD of 220/132/66kV Verpal(PS) after the event @00:07hrs

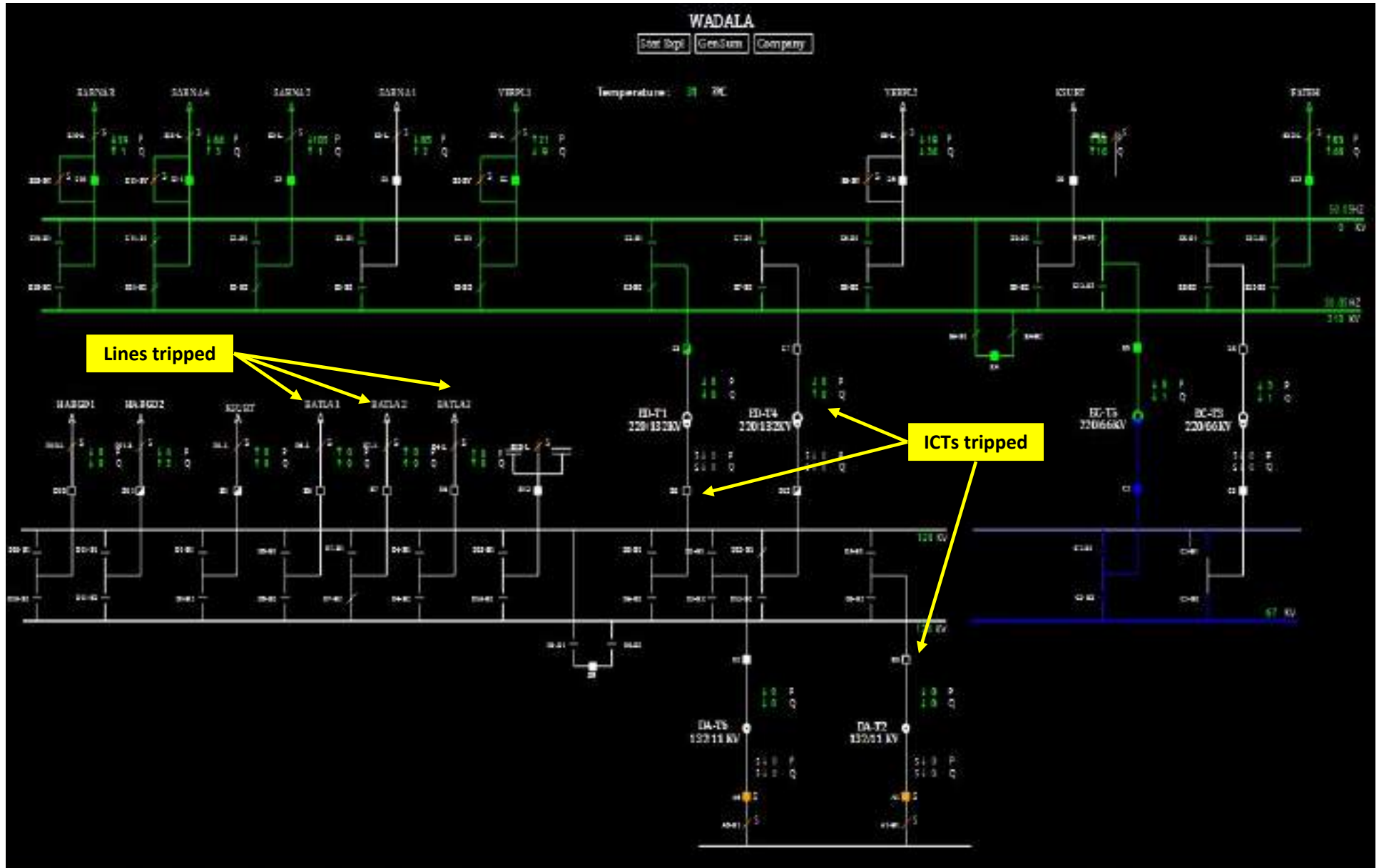


SLD of 220/132/66kV Wadala(PS) before the event @00:07hrs

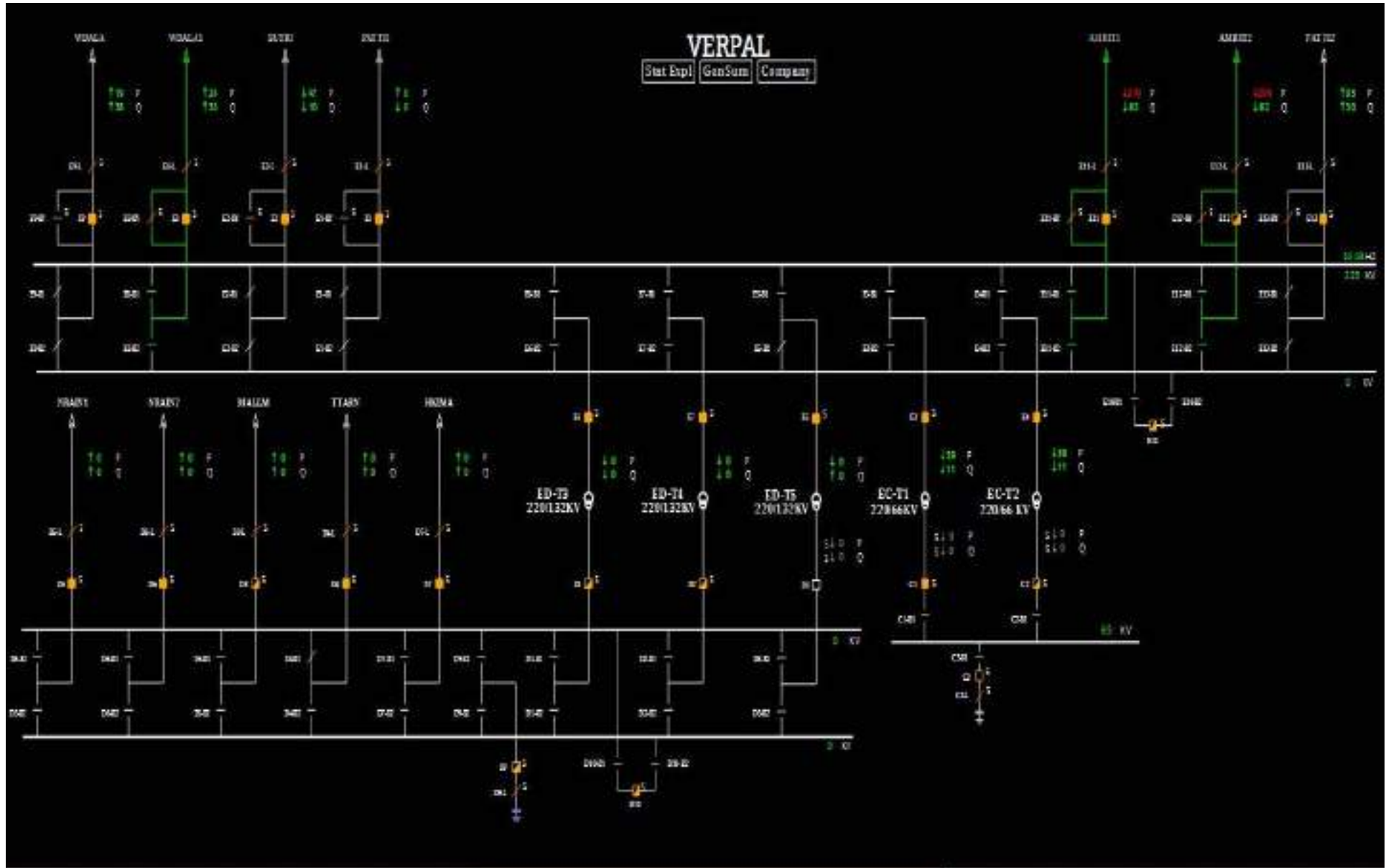


Sun June 18 2023 00:05:00

SLD of 220/132/66kV Wadala(PS) after the event @00:07hrs

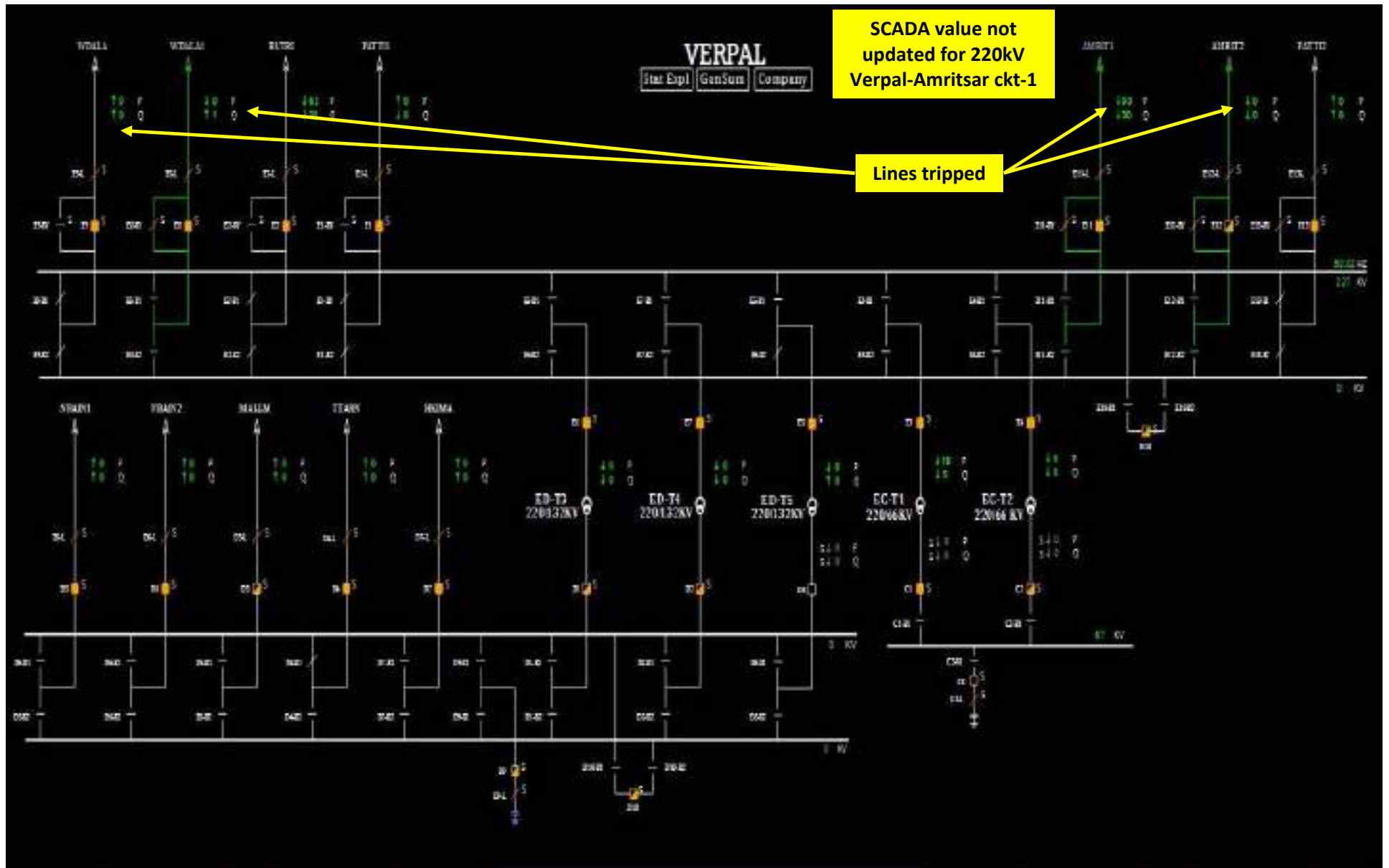


SLD of 220/132/66kV Verpal(PS) before the event @00:14hrs



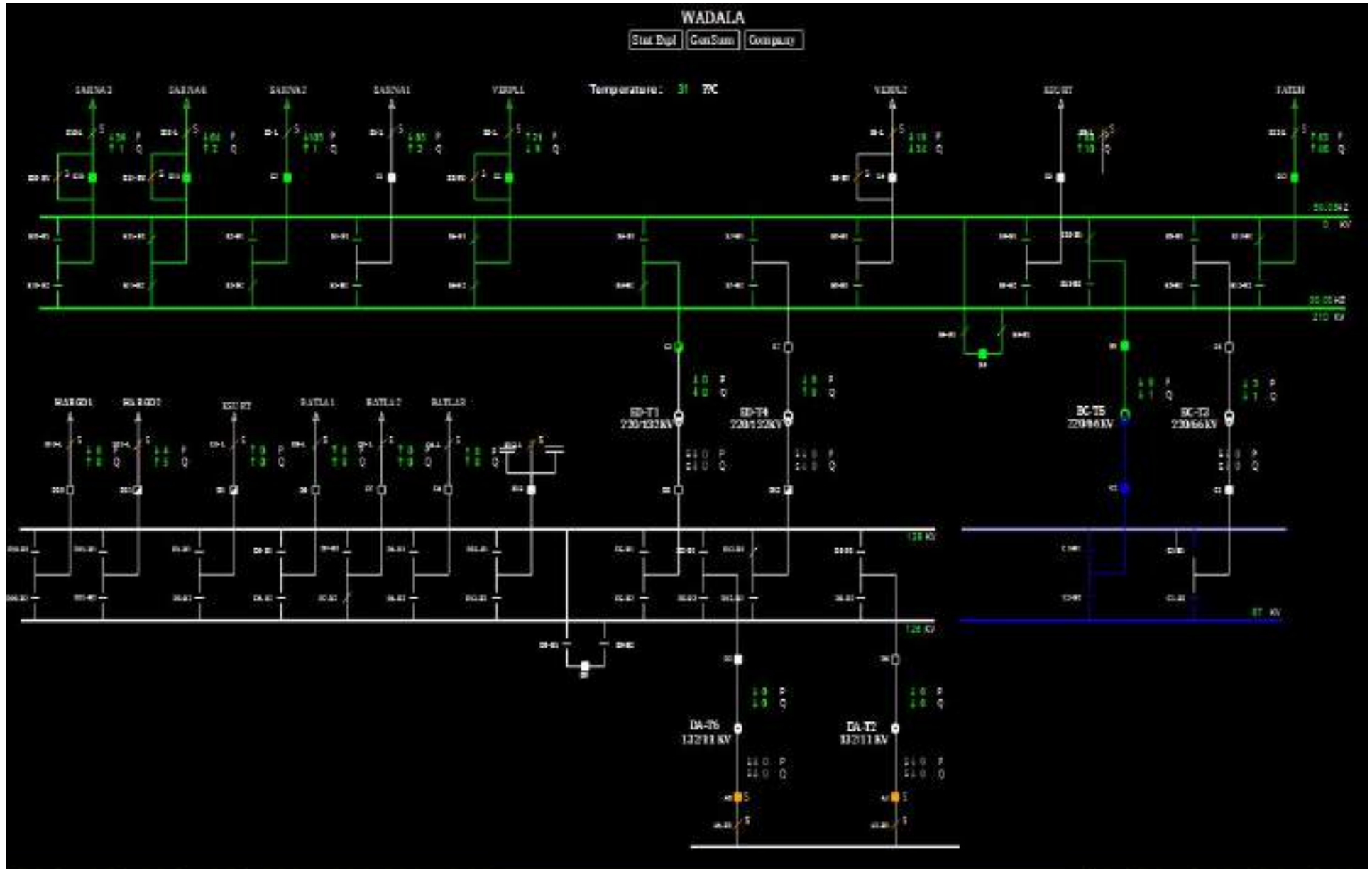
Sun June 18 2023 00:12:00

SLD of 220/132/66kV Verpal(PS) after the event @00:14hrs



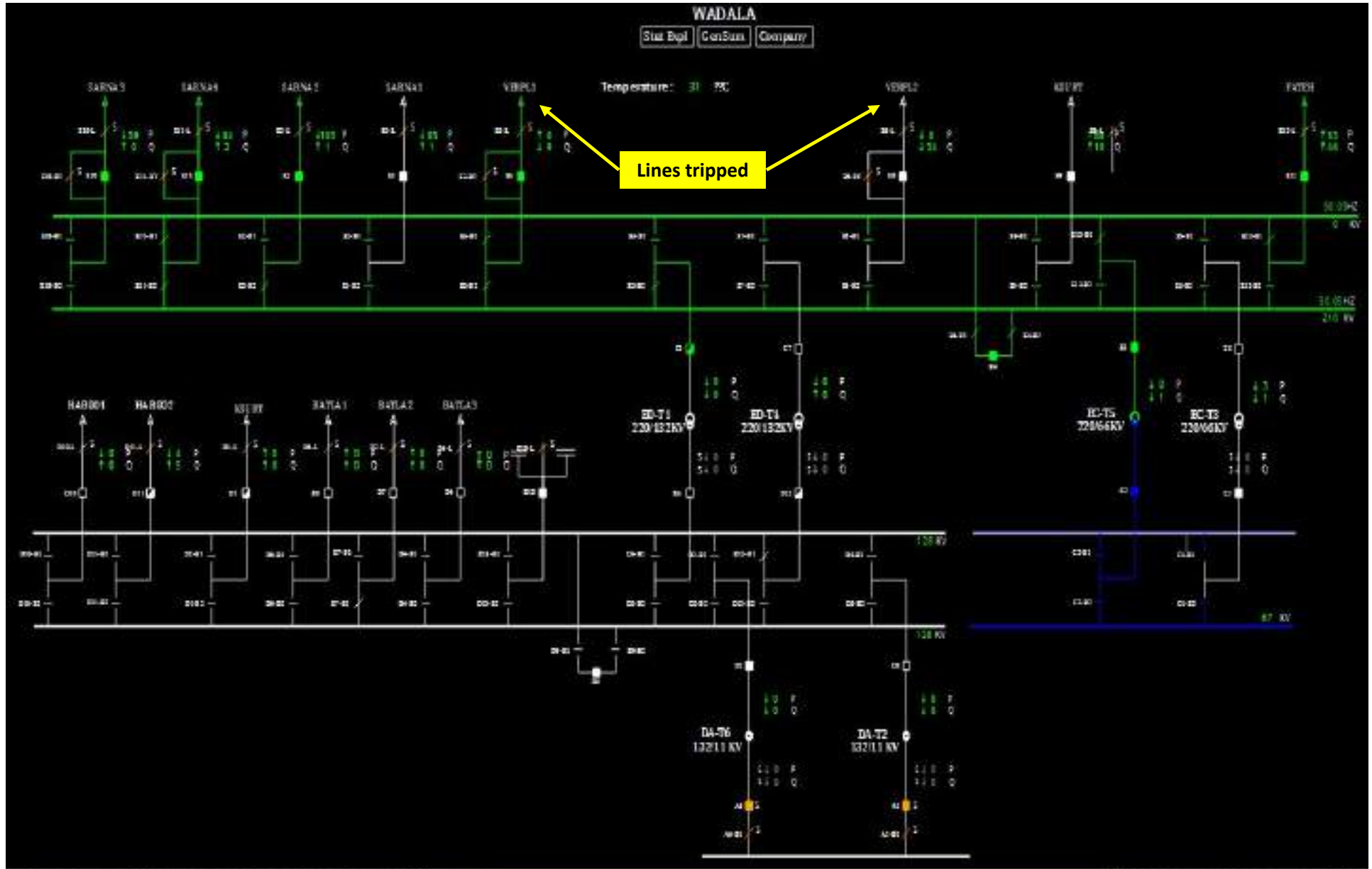
Sun June 18 2023 00:16:00

SLD of 220/132/66kV Wadala(PS) before the event @00:14hrs



Sun June 18 2023 00:12:00

SLD of 220/132/66kV Wadala(PS) after the event @00:14hrs



Sun June 18 2023 00:16:00

Punjab demand during the event



Jun 18 Sun 2023

PMU Plot of frequency at Amritsar(PG)

00:07hrs/18-Jun-23



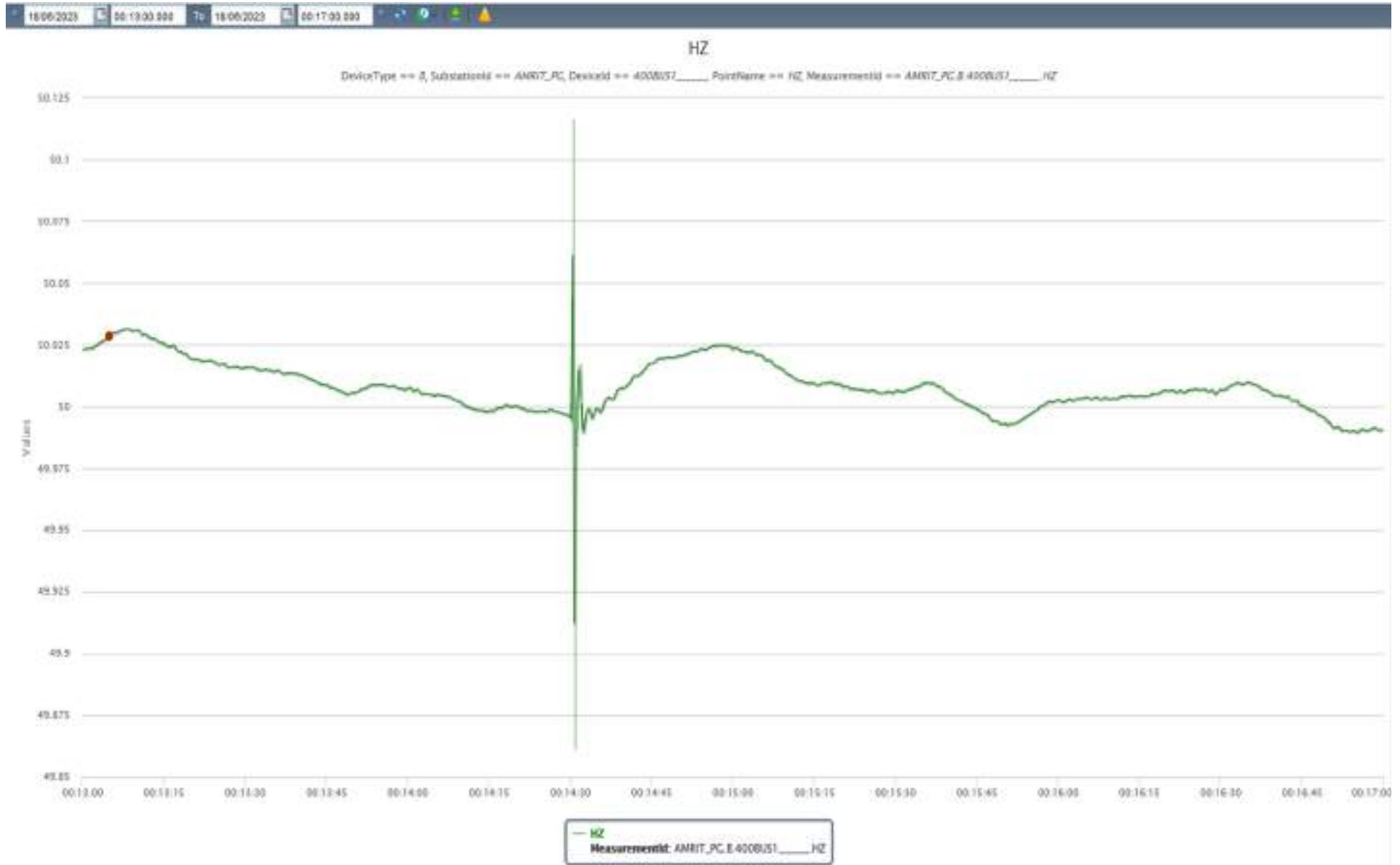
PMU Plot of phase voltage magnitude at Amritsar(PG)

00:07hrs/18-Jun-23



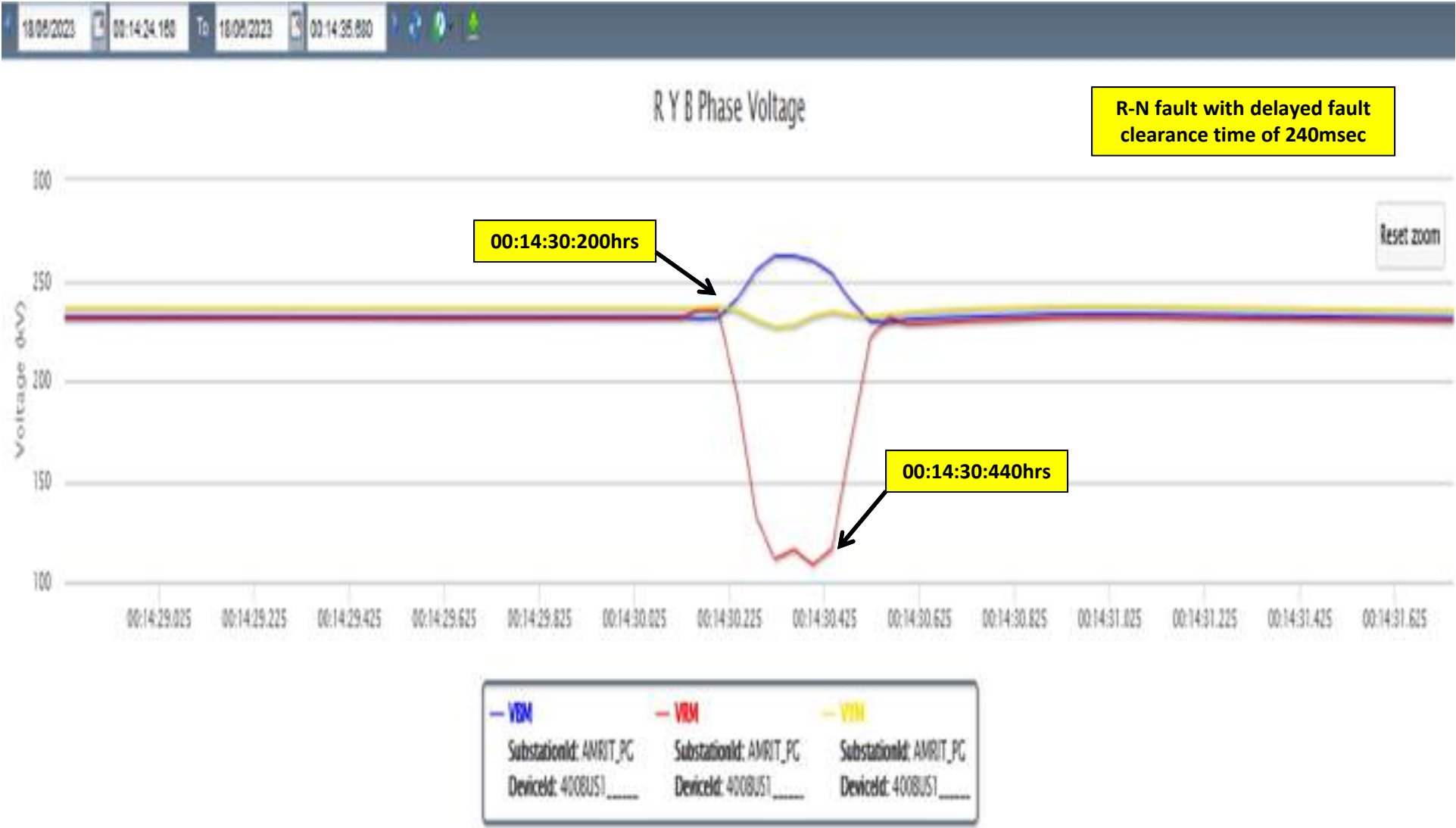
PMU Plot of frequency at Amritsar(PG)

00:14hrs/18-Jun-23

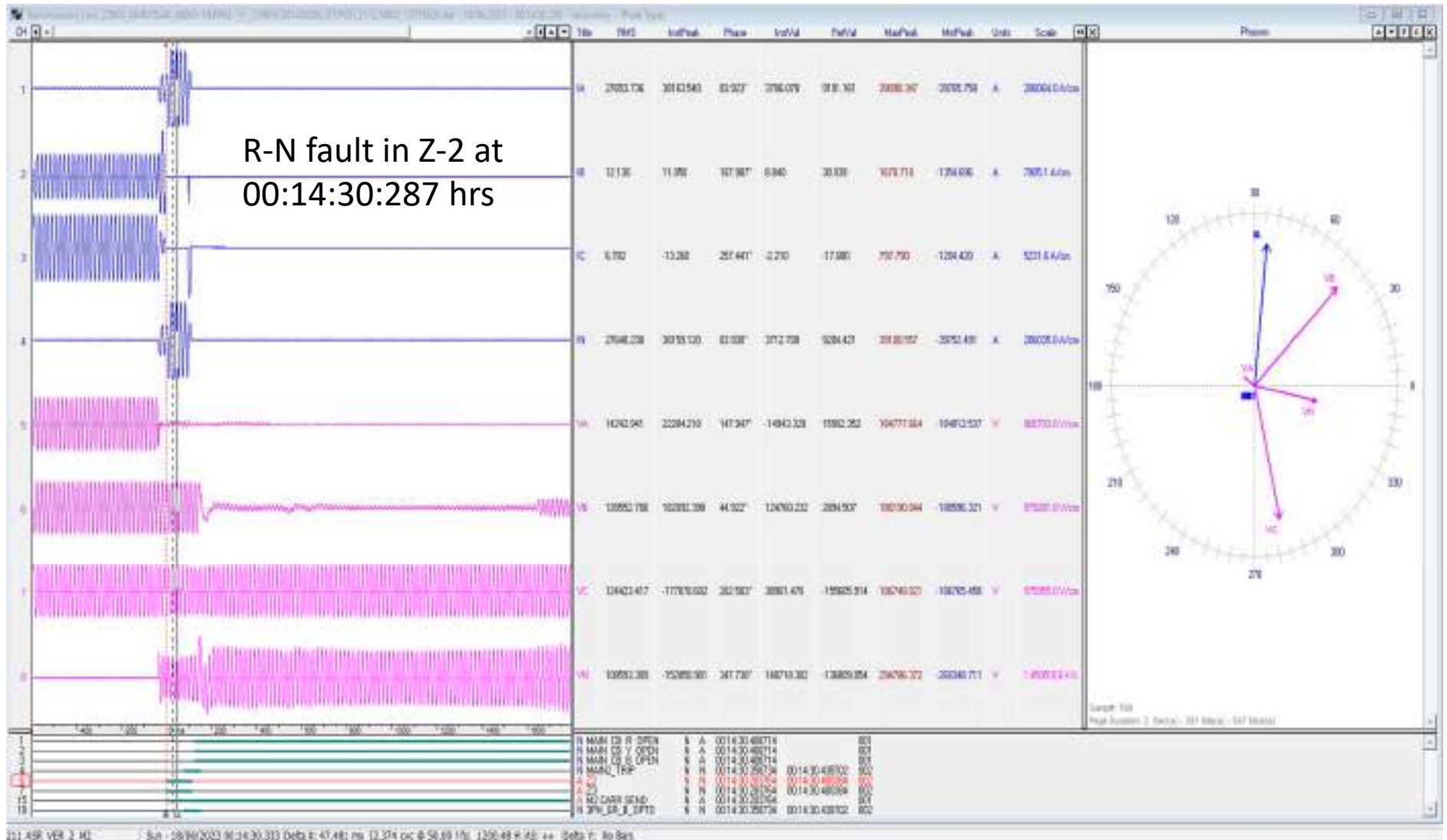


PMU Plot of phase voltage magnitude at Amritsar(PG)

00:14hrs/18-Jun-23



DR of 220 kV Verpal(PS) –Amritsar(PG) (end) ckt-2



- ✓ R-N phase to earth fault; fault sensed in zone-2
- ✓ Fault current= ~27.65kA in R-phase
- ✓ Fault clearing time= ~145ms (time delay setting of Z-2 at Amritsar end?)

SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remarks
00:07:28,430	220WADALA	220kV	7T4	Circuit Breaker	Open	CB at 220kV side of 220/132KV ICT 4 at Wadala(PS) opened
00:07:28,530	220WADALA	132kV	7BATLA2	Circuit Breaker	Open	Line CB at Wadala(PS) end of of 132kV Wadala-Batla ckt-2 opened
00:07:28,638	220WADALA	132kV	6BATLA1	Circuit Breaker	Open	Line CB at Wadala(PS) end of of 132kV Wadala-Batla ckt-1 opened
00:07:28,661	220WADALA	132kV	10HARGO1	Circuit Breaker	Open	Line CB at Wadala(PS) end of of 132kV Wadala-Hargo ckt-1 opened
00:07:28,789	220WADALA	132kV	5T1	Circuit Breaker	Open	CB at 132kV side of 220/132KV ICT 1 at Wadala(PS) opened
00:07:29,095	220WADALA	132kV	4BATLA3	Circuit Breaker	Open	Line CB at Wadala(PS) end of of 132kV Wadala-Batla ckt-3 opened
00:07:29,140	220WADALA	132kV	8T2	Circuit Breaker	Open	CB at 132kV side of 132/11KV ICT 2 at Wadala(PS) opened
00:10:28,716	VERPAL	132kV	8T5	Circuit Breaker	Open	CB at 132kV side of 220/132KV ICT 5 at Verpal(PS) opened
00:14:30,621	AMRITSAR	220kV	11VRPL2	Circuit Breaker	Open	Line CB at Amritsar(PG) end of 220kV Verpal(PS)- Amritsar(PG) ckt-2 opened

Event analysis details shared by Punjab

- 132kV Wadala Granthian – Batala ckt- 3 tripped for Zone-2 line fault at 00:07 Hrs. 132kV Wadala Granthian – Batala ckt- 1&2 also tripped. As 132kV transmission network is interconnected (as shown in SLD attached) with 220kV S/s Wadala Granthian, 220kV S/s Verpal and 220kV Naraingarh as source of supply for 132kV S/s Batala, Jayantipur, Kathu Nangal, Verka, Power Colony, Mall Mandi, GT Road, Skatri Bagh and Hakima Gate, thus 220kV S/s Wadala Granthian got isolated from 132kV transmission. This resulted in overload condition at 220 kV S/s Verpal and 220 kV Naraingarh (at 220kV Substation Civil line, transformer 220/132kV T-4 was already in OFF condition), therefore 220/132kV T/F (T-3, T-4, T-5) Incomers at 220kV Verpal got tripped due to this overloading at 00:07 Hrs.
- After appr. 7 min, R-phase CT of 220kV Verpal – PGCIL Amritsar ckt -2 got blast and 220/132kV Transformers was already tripped from incomer side.

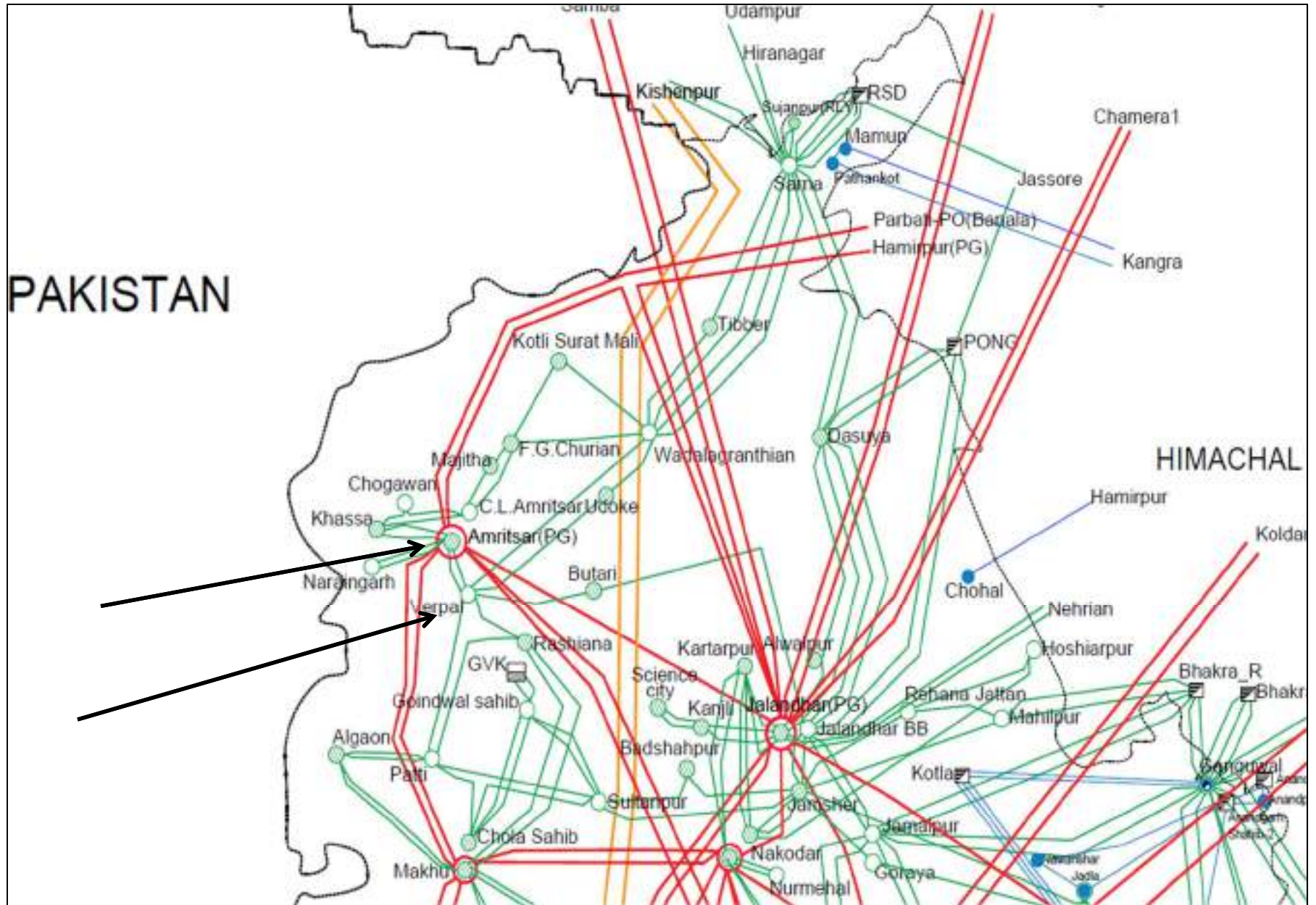
Point of discussion

- i. Exact reason of tripping of 220/132kV ICT 1 & 4 at Wadala(PS) and 220/132kV ICT 3, 4 & 5 at Verpal(PS) need to be shared.
- ii. Why did 220 kV Verpal(PS) –Amritsar(PG) ckt-1 not trip from Amritsar end? Whether Main-II relay(distance protection) of Amritsar ckt-1 has been restored at Verpal end? (discussed in OCC 209)
- iii. Reason of delayed clearance of fault need to be shared.
- iv. As per SCADA SOE, 132kV Wadala-Batla ckt-1, 2 & 3, 132kV Wadala-Hargo ckt-1 and 132/11KV ICT 2 at Wadala(PS) also tripped during the same time. Reason of tripping of these elements need to be shared.
- v. DR/EL along with tripping report need to be shared from Punjab.
- vi. As reported, Main-1&2 relay of Amritsar ckt-2 is not healthy at Verpal end? Status of the same need to be shared.
- vii. Remedial action taken report to be shared.

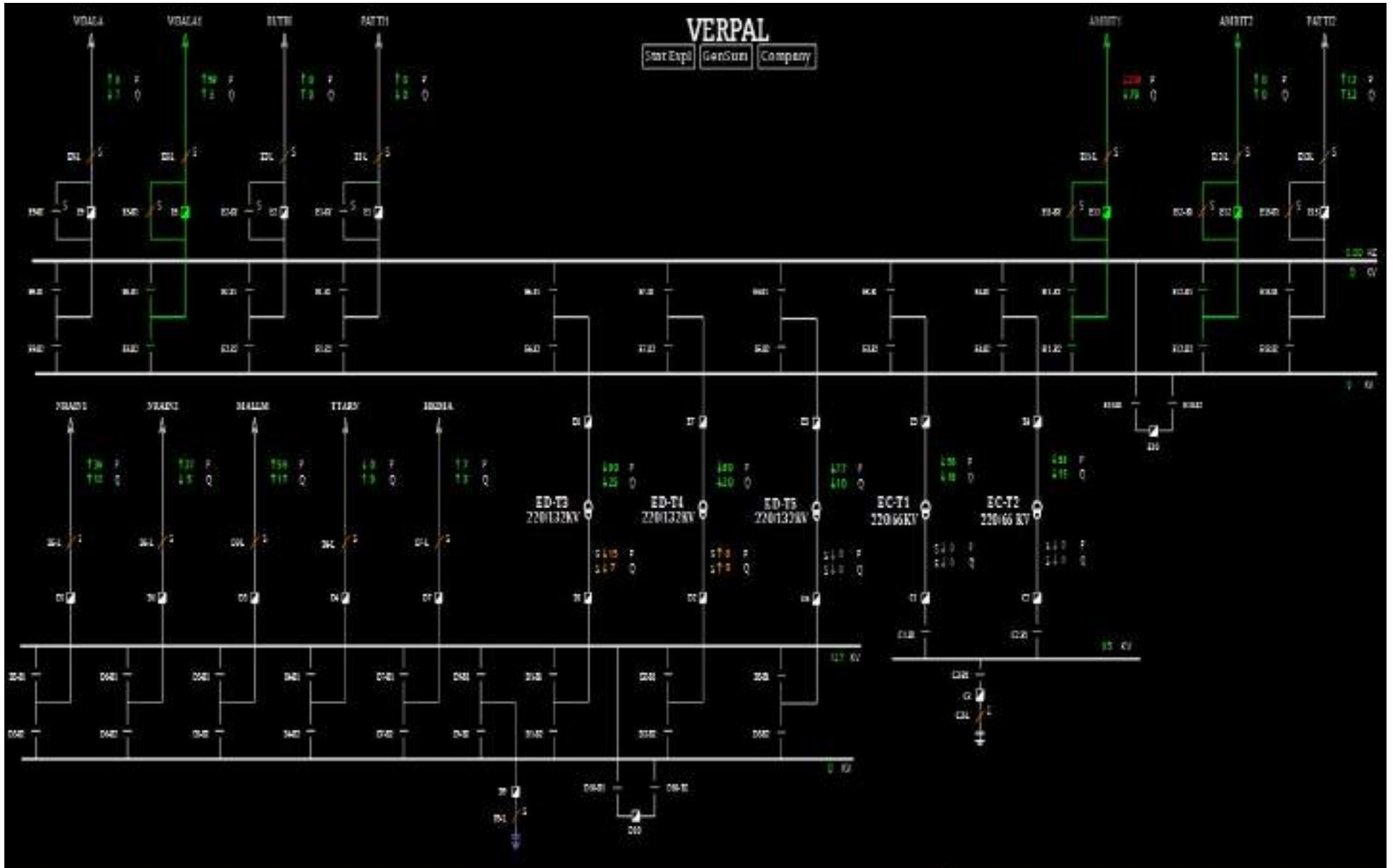
**Multiple elements tripping at
220kV Verpal(PS)**

**22nd August 2023 at
21:51 hrs**

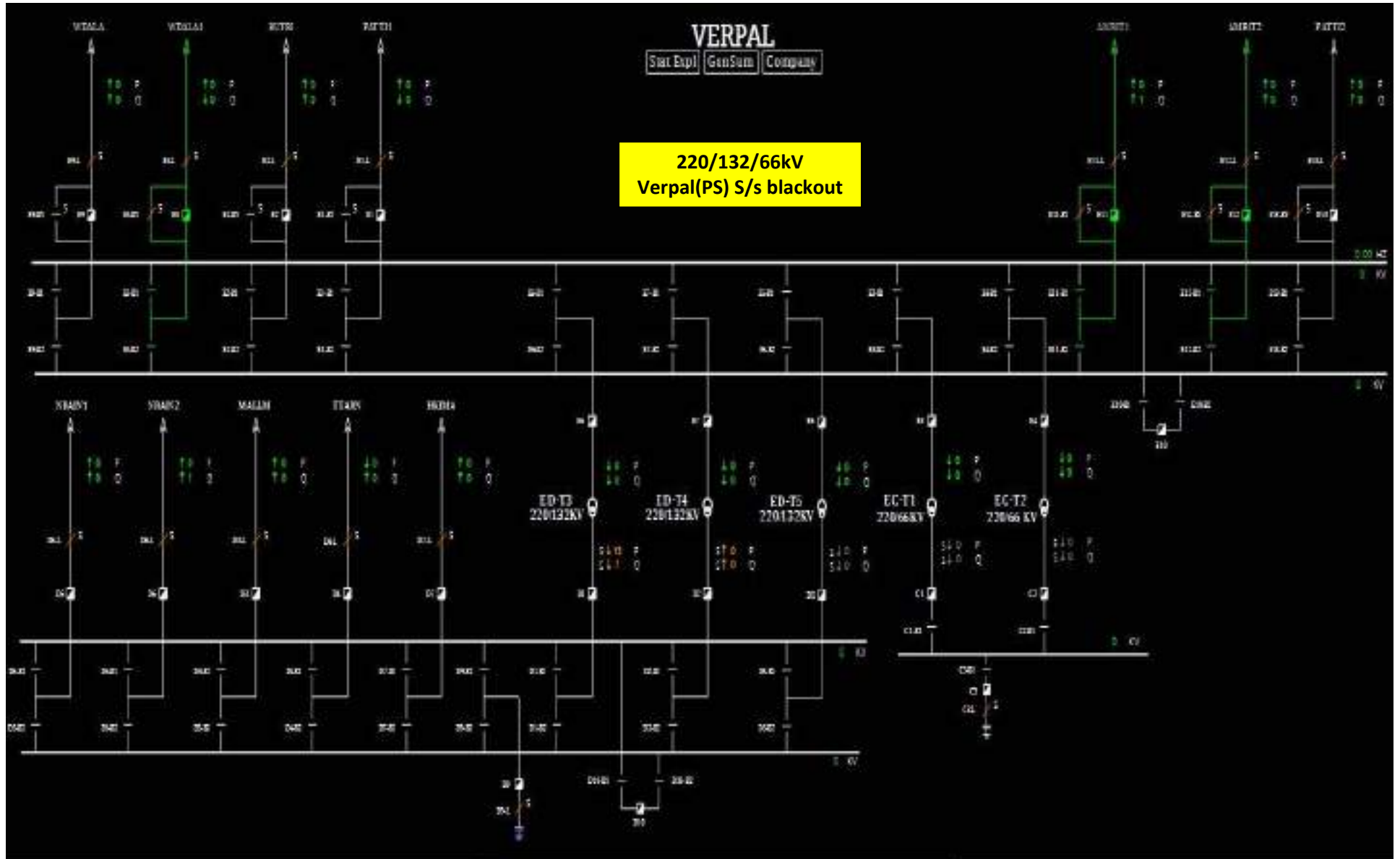
Network diagram



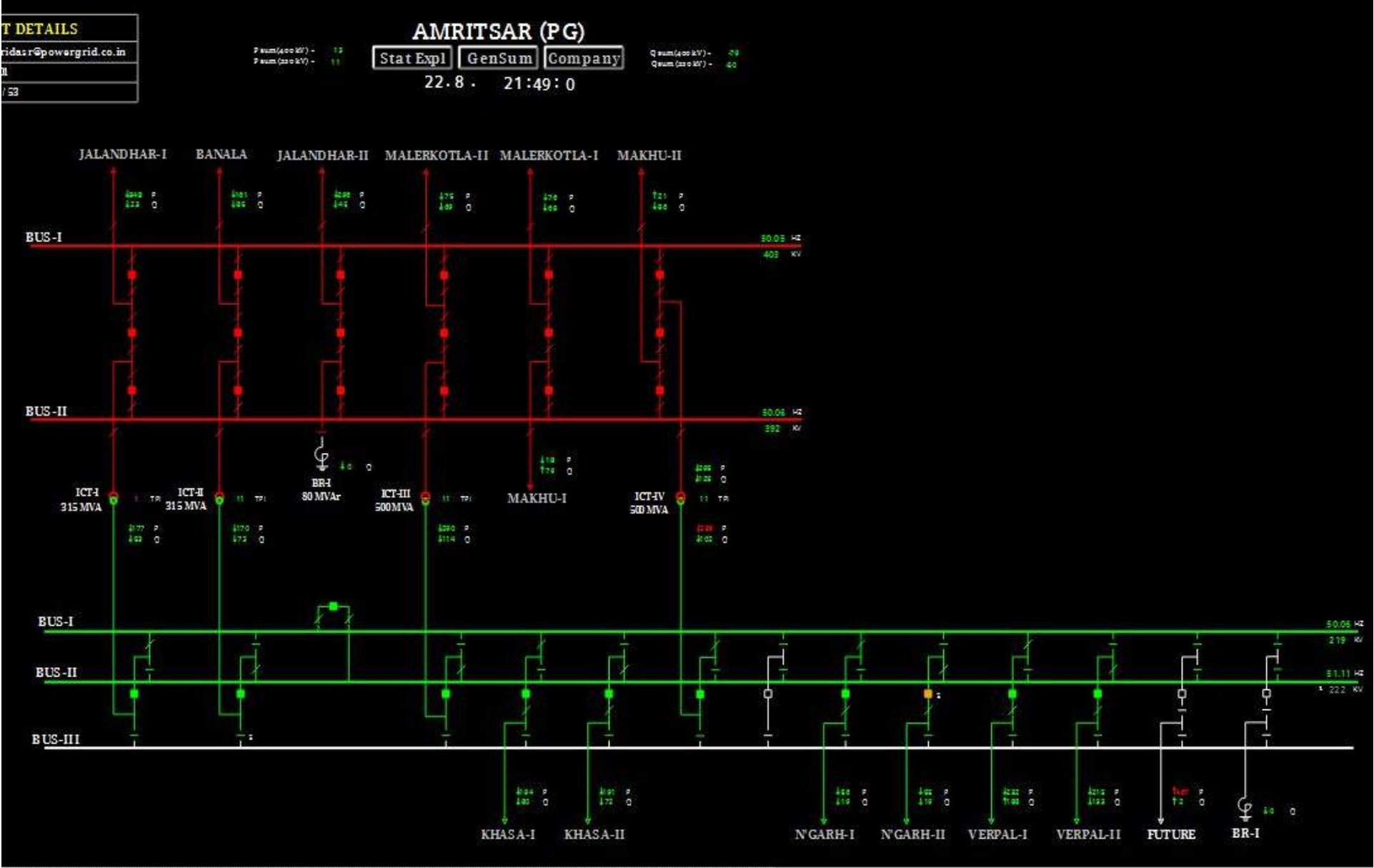
SLD of 220/132/66kV Verpal(PS) before the event



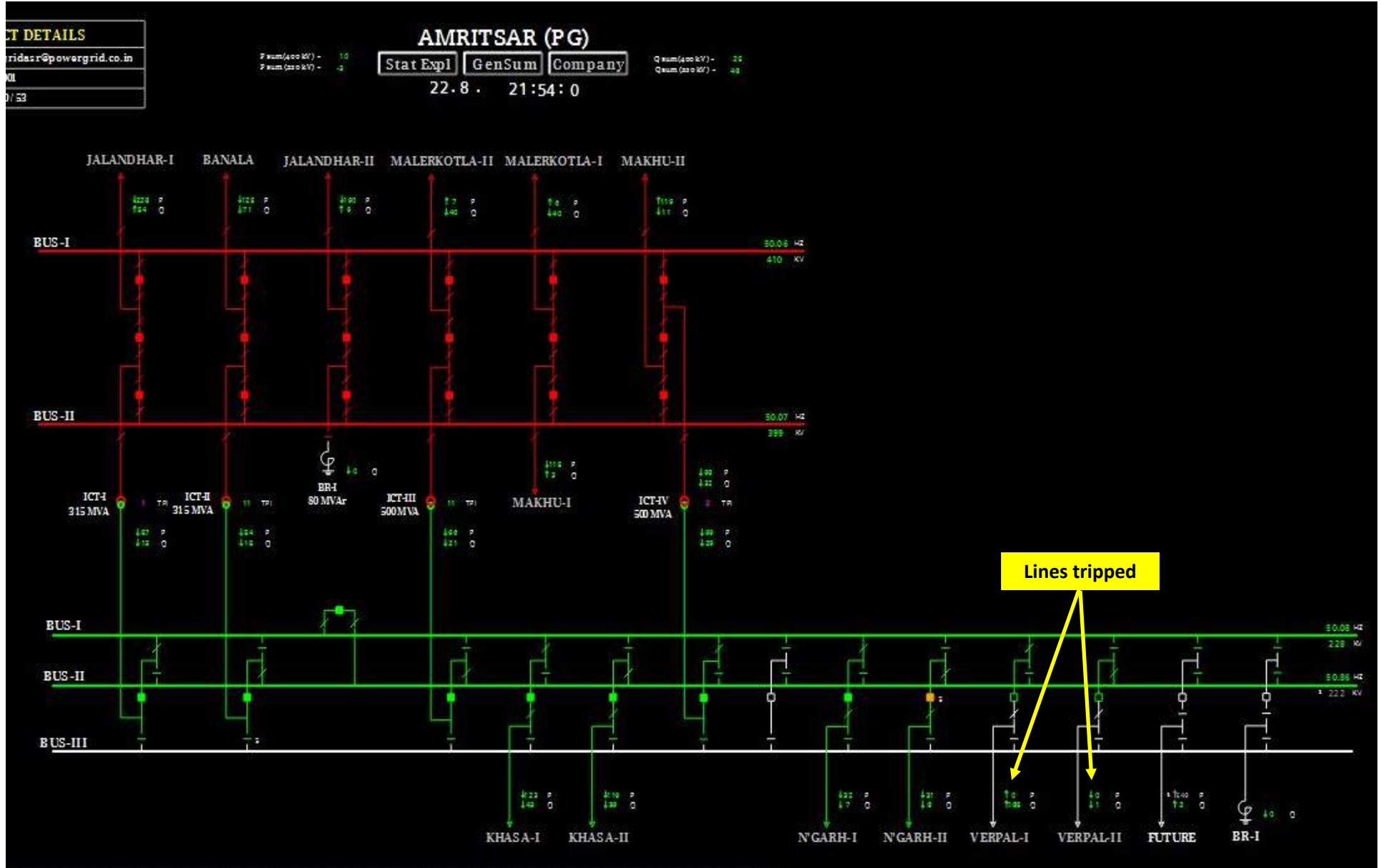
SLD of 220/132/66kV Verpal(PS) after the event



SLD of 400/220kV Amritsar(PG) before the event



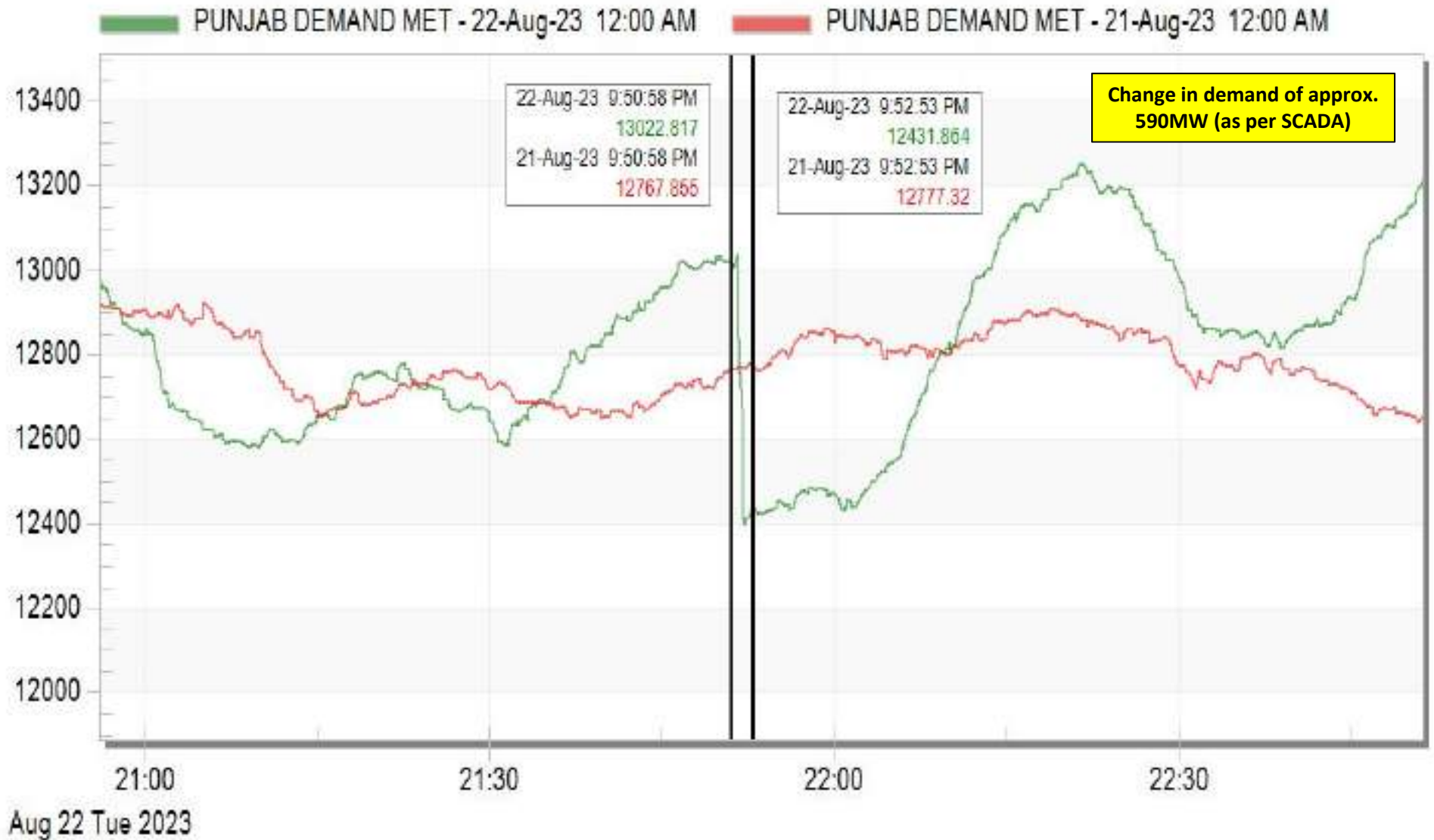
SLD of 400/220kV Amritsar(PG) after the event



Tue August 22 2023 21:54:00

Punjab demand during the event

Punjab Demand



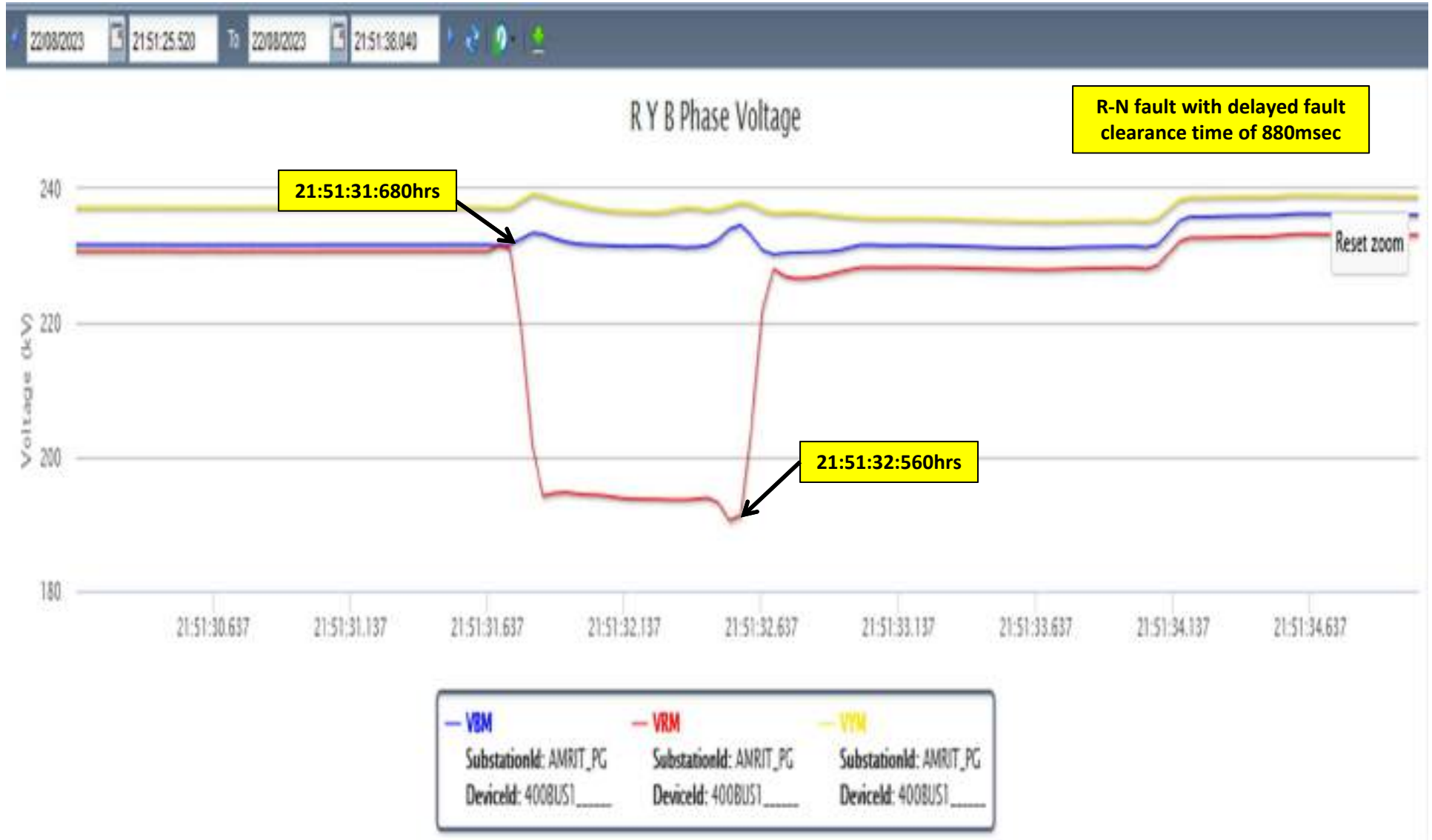
PMU Plot of frequency at Amritsar(PG)

21:51hrs/22-Aug-23

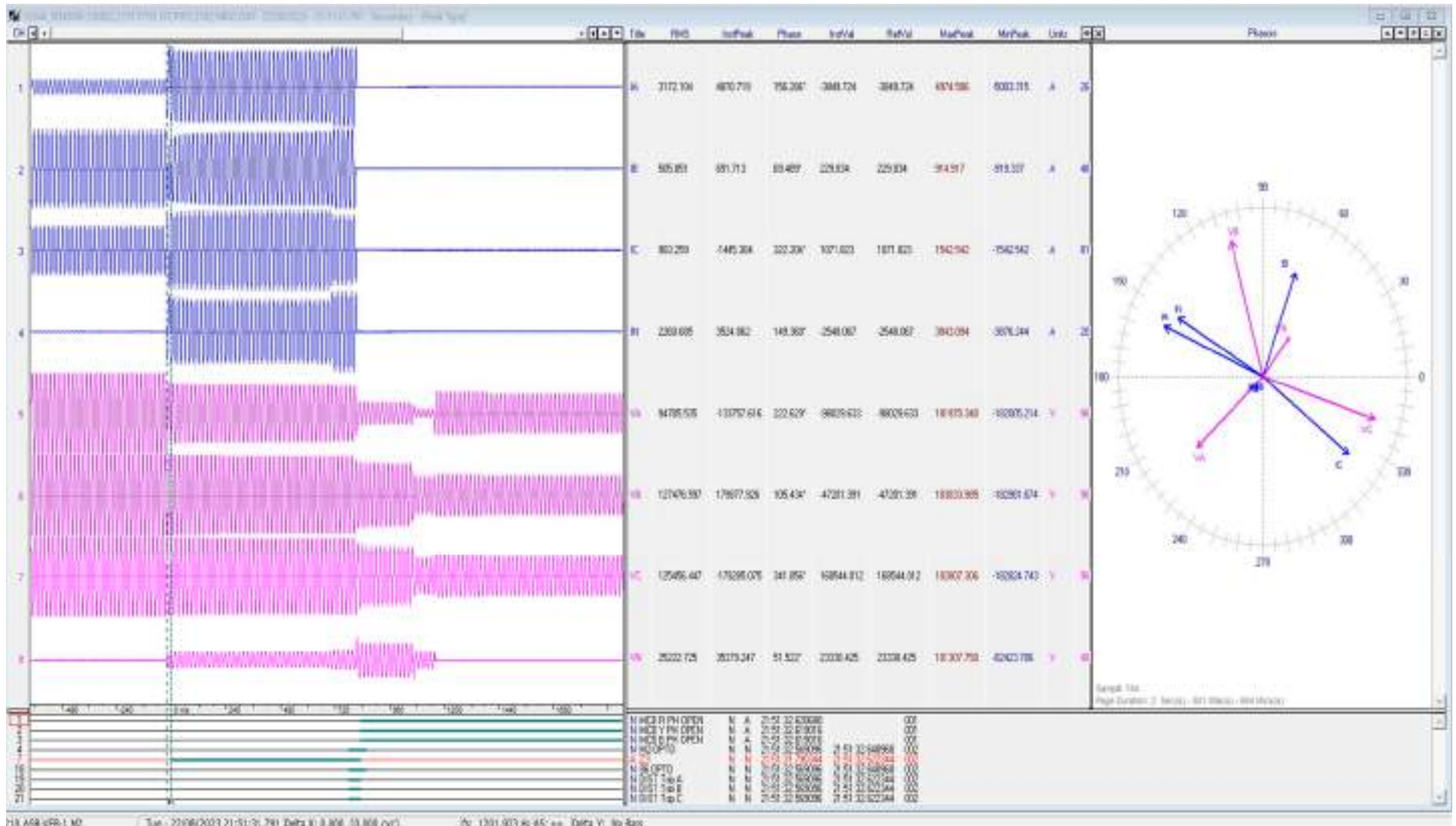


PMU Plot of phase voltage magnitude at Amritsar(PG)

21:51hrs/22-Aug-23

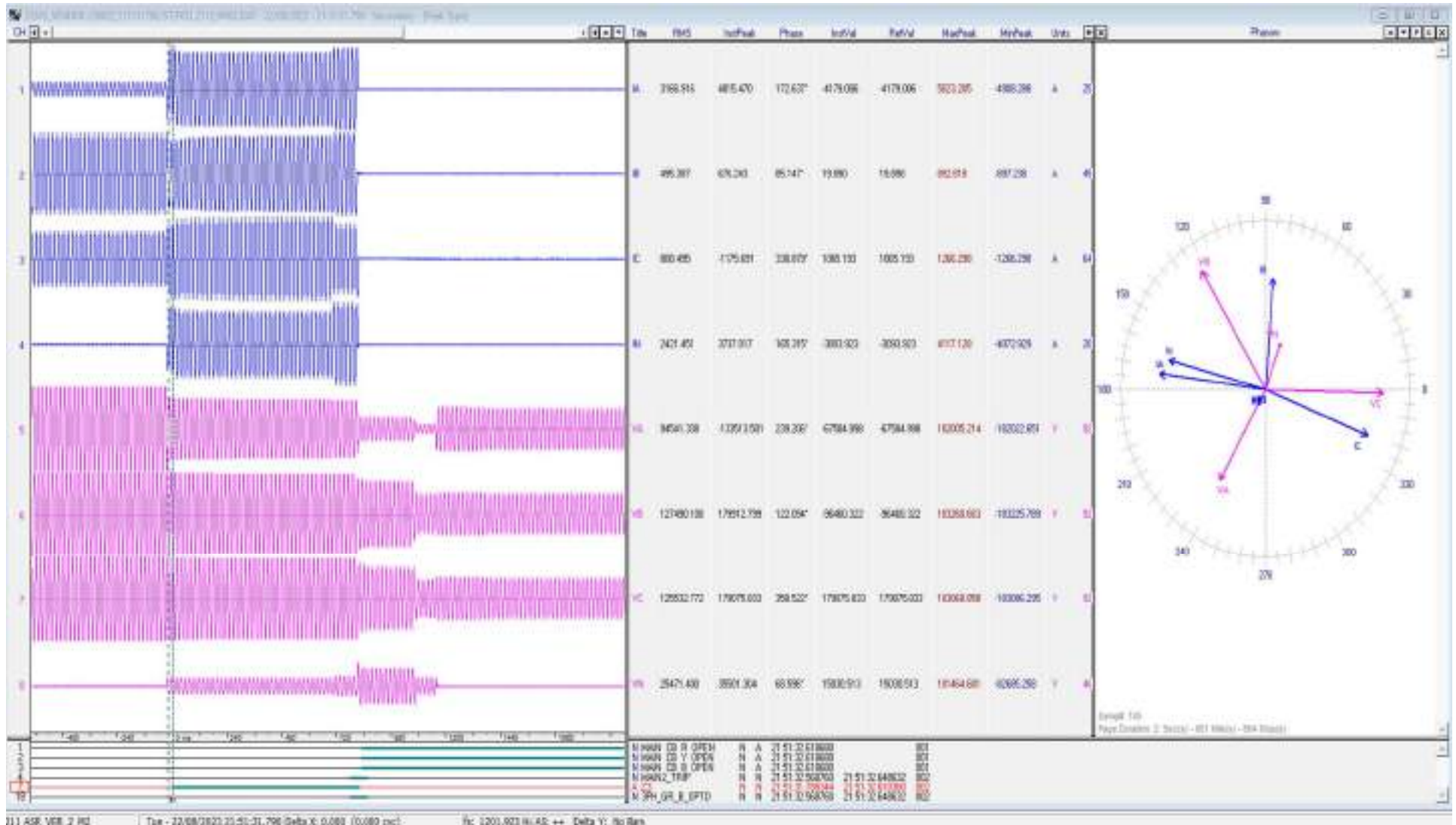


DR of 220 kV Verpal(PS) –Amritsar(PG) (end) ckt-1



- ✓ R-N phase to earth fault; fault sensed in zone-3
- ✓ Fault current= ~3.172kA in R-phase
- ✓ Fault clearing time= ~830ms

DR of 220 kV Verpal(PS) –Amritsar(PG) (end) ckt-2



- ✓ R-N phase to earth fault; fault sensed in zone-3
- ✓ Fault current= ~3.166kA in R-phase
- ✓ Fault clearing time= ~830ms

SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
21:50:47,875	BUTRI_PS	220kV	2VERPL	Circuit Breaker	Open	Line CB at Butri(PS) end of 220kV Verpal(PS)-Butri(PS) ckt opened
21:51:32,664	AMRIT_PG	220kV	10VRPL1	Circuit Breaker	Open	Line CB at Amritsar(PG) end of 220kV Verpal(PS)-Amritsar(PG) ckt-1 opened
21:51:32,671	AMRIT_PG	220kV	11VRPL2	Circuit Breaker	Open	Line CB at Amritsar(PG) end of 220kV Verpal(PS)-Amritsar(PG) ckt-2 opened

**Multiple elements tripping at
765/400/220kV Moga(PG)**

**29th June 2023 at
21:07 hrs**

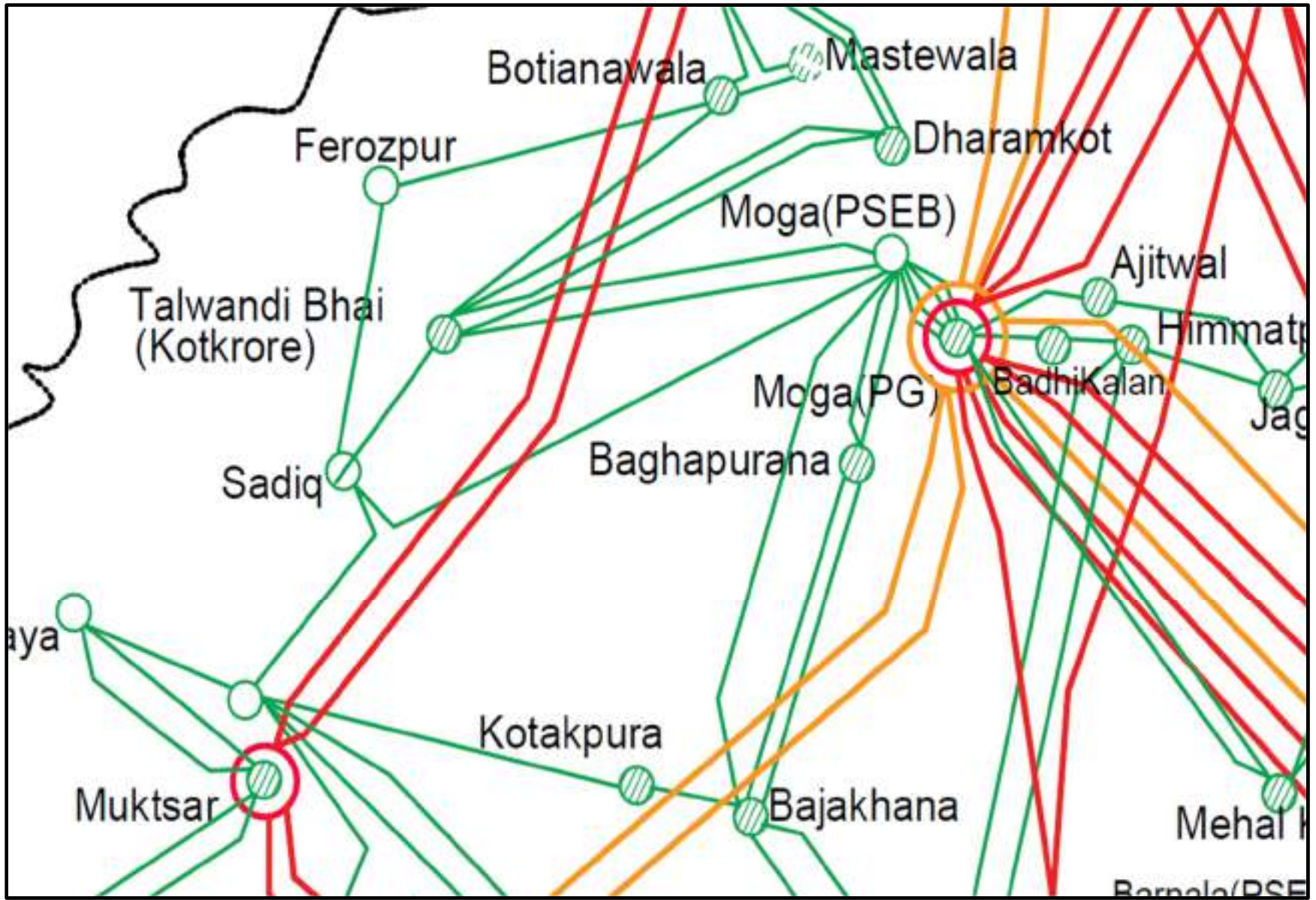
Brief of event:

- As reported, at 21:07hrs, earth wire of 220 KV Moga(PG)-Mehal- Kalan(PS) (PSTCL) Ckt-1 & 2 snapped between Moga S/s Gantry and tower location no. 1. Fault current was around 30kA. On this fault, bus bar protection at 220kV Bus-1 at Moga(PG) maloperated and elements connected to 220kV Bus-1 i.e., 220 KV Moga(PG)-Mogan(PS) (PSTCL) Ckt-4, 400/220 kV 500 MVA ICT 1 at Moga(PG) and 400/220 kV 315 MVA ICT 4 at Moga(PG) tripped.

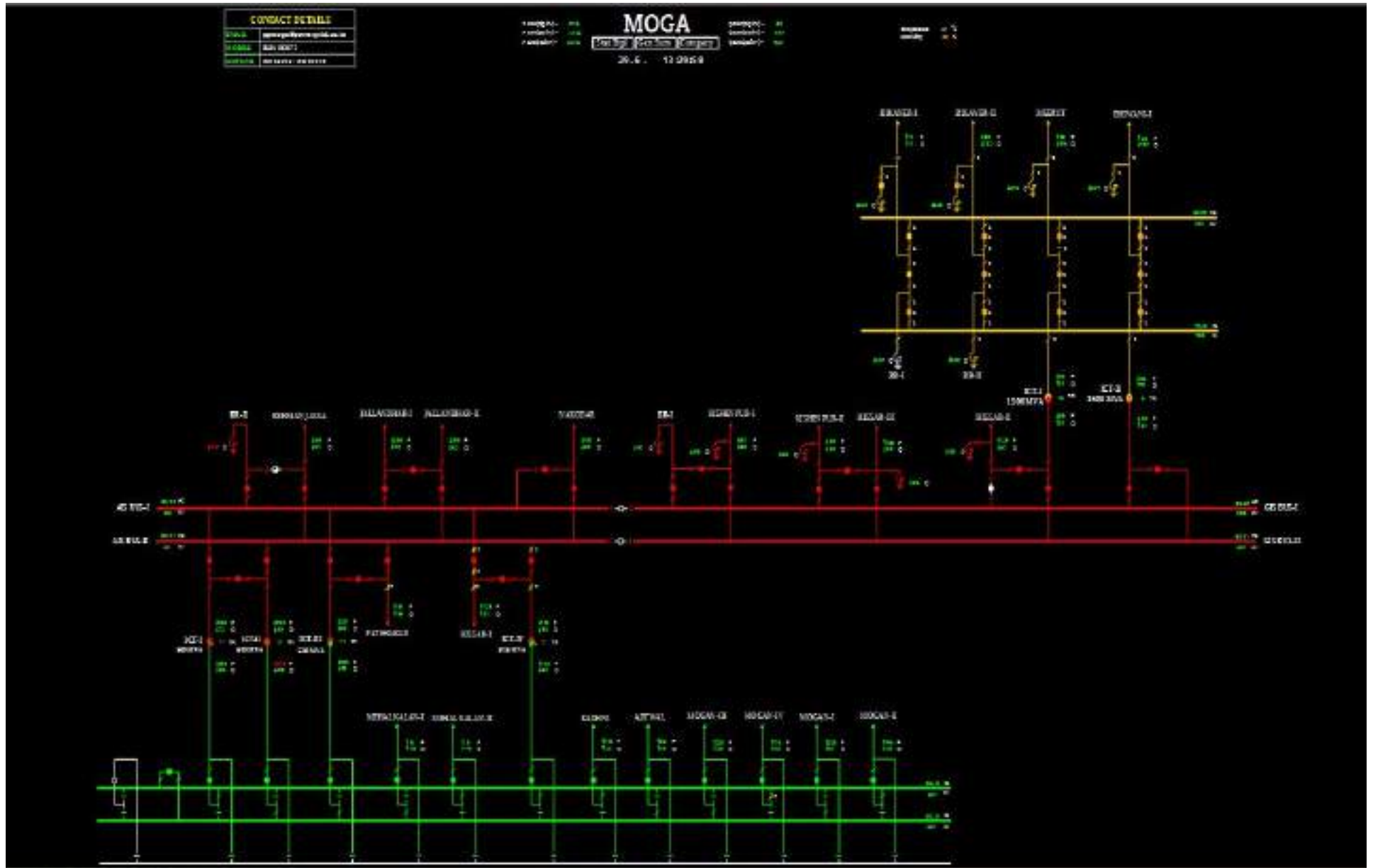
Elements tripped:

- i. 220 KV Moga(PG)-Mehal- Kalan(PS) (PSTCL) Ckt-1 (DT received from Mogan end)
- ii. 220 KV Moga(PG)-Mehal- Kalan(PS) (PSTCL) Ckt-2
- iii. 220 KV Moga(PG)-Ajitwal(PS) (PSTCL) Ckt-1 (R-Y-B fault)
- iv. 220 KV Moga(PG)-Mogan(PS) (PSTCL) Ckt-4
- v. 400/220 kV 500 MVA ICT 1 at Moga(PG)
- vi. 400/220 kV 315 MVA ICT 4 at Moga(PG)
- vii. 220kV Mogan-Bhagwanpura ckt

Network diagram

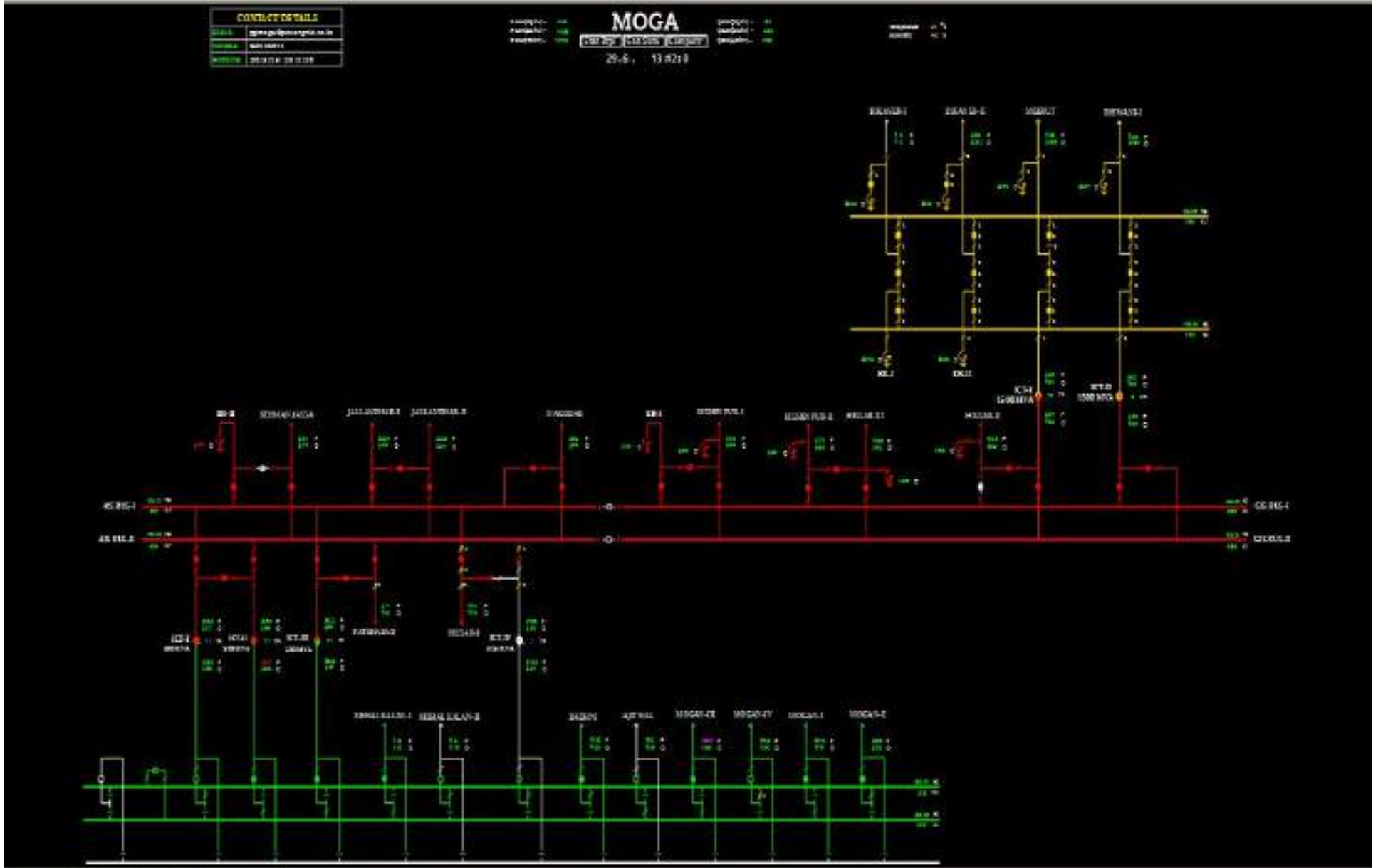


SLD of 220/132kV Moga(PS) before the event



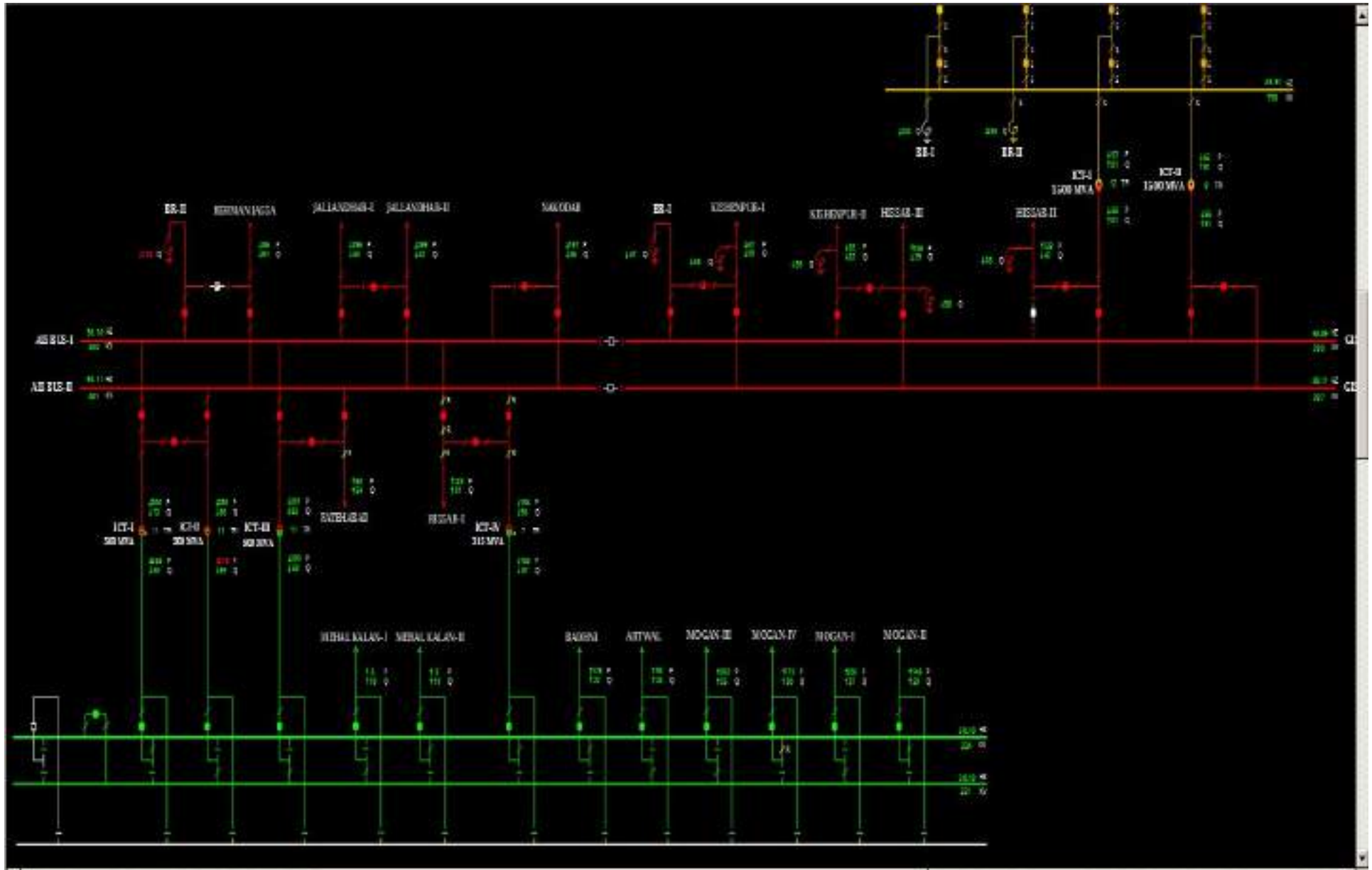
Thu June 29 2023 21:05:00

SLD of 220/132kV Moga(PS) after the event

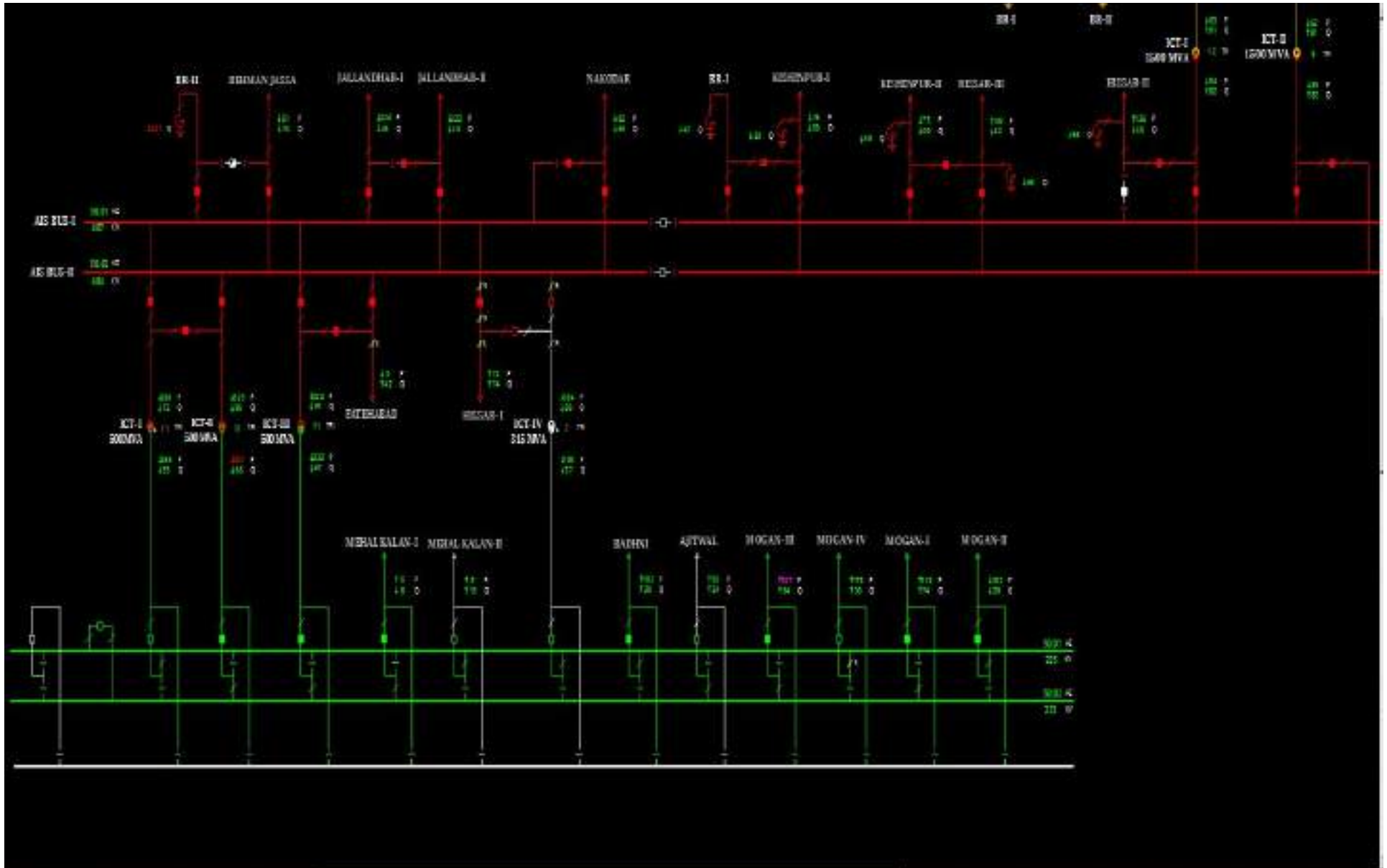


Thu June 29 2023 21:12:00

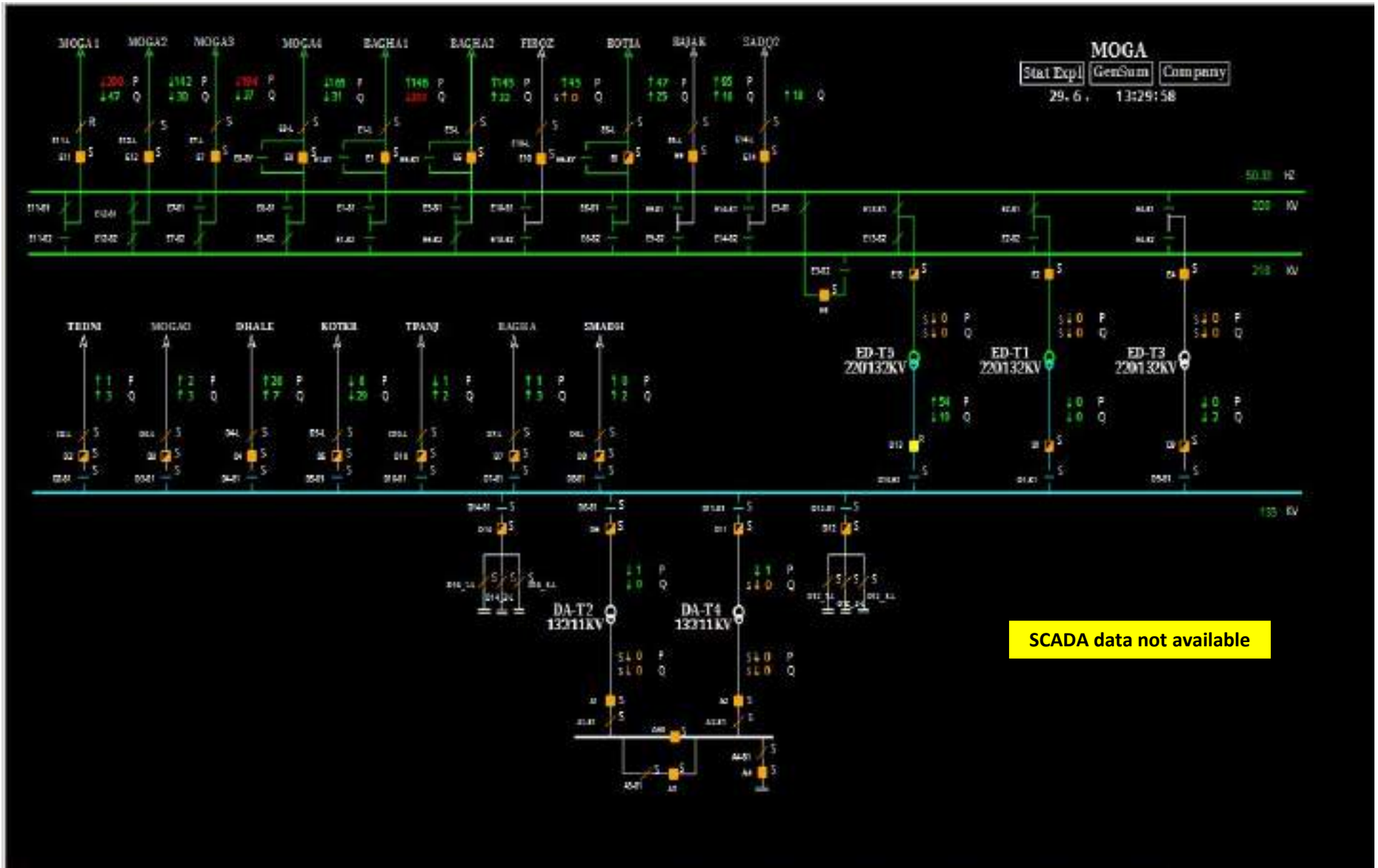
SLD of 765/400/220kV Moga(PG) before the event (zoomed)



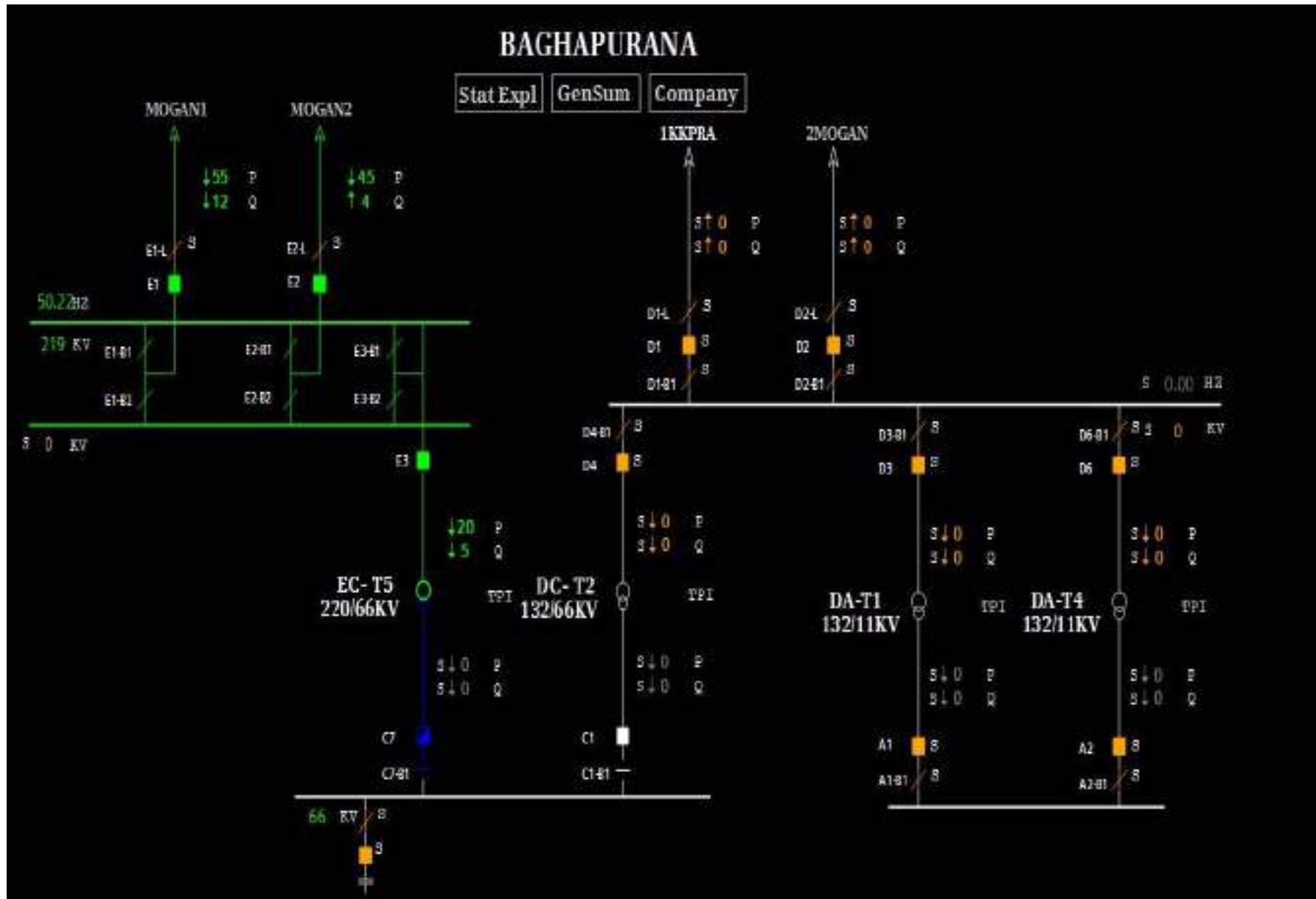
SLD of 765/400/220kV Moga(PG) after the event (zoomed)



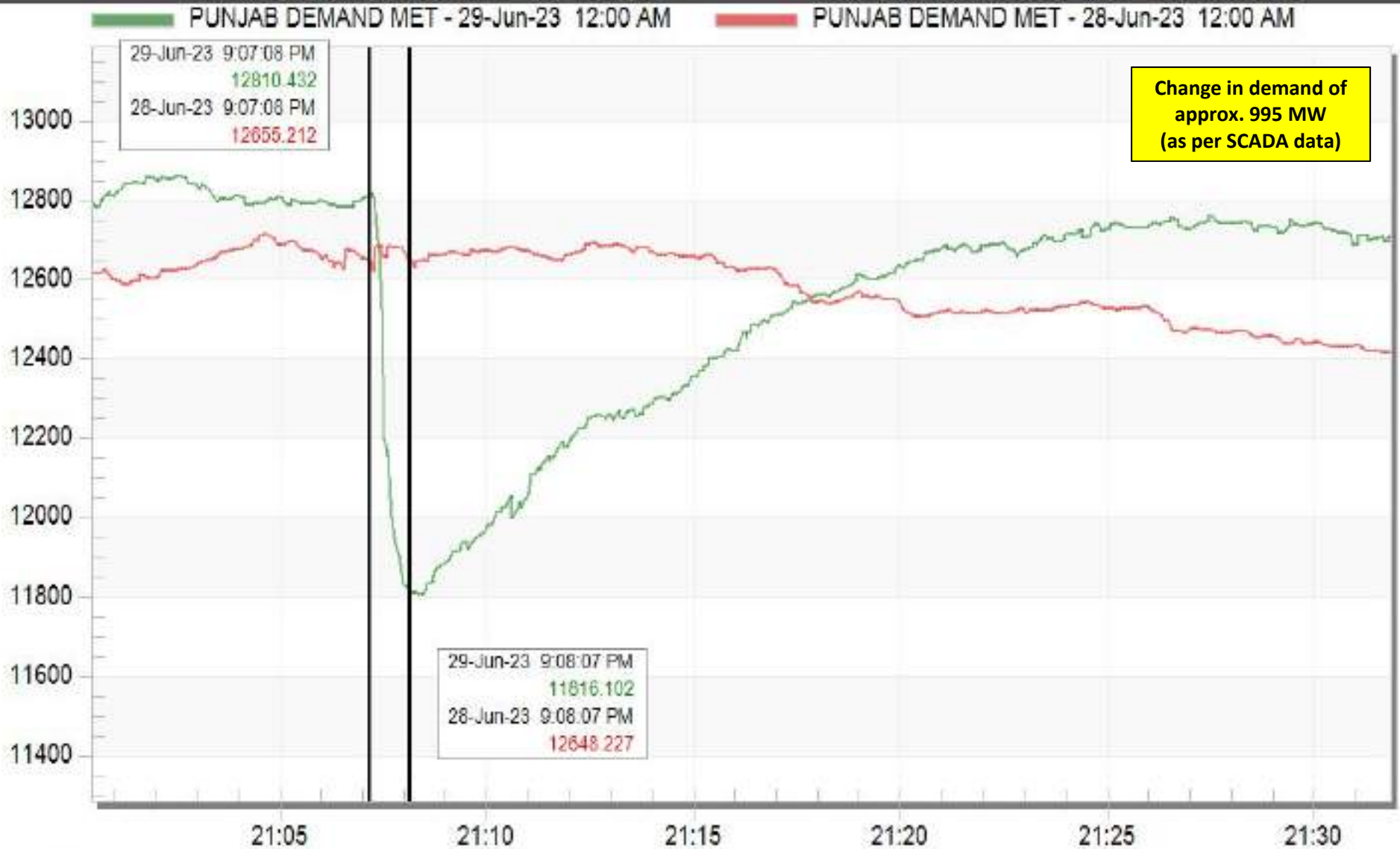
SLD of 220/132kV Moga(PS) before the event



SLD of 220/132kV Moga(PS) before the event



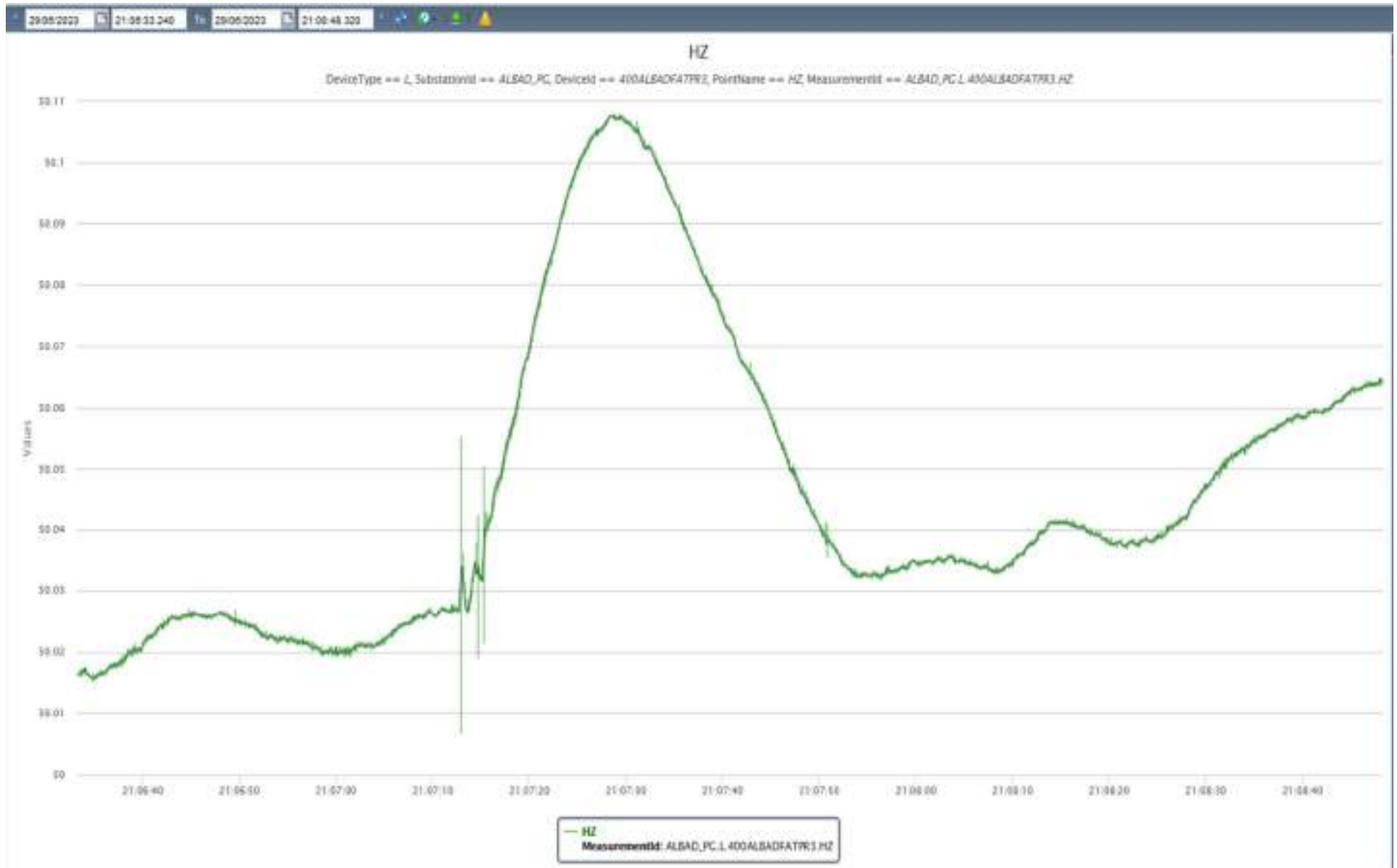
Punjab demand during the event



Jun 29 Thu 2023

PMU Plot of frequency at Allahabad(PG)

02:28hrs/28-Jun-23

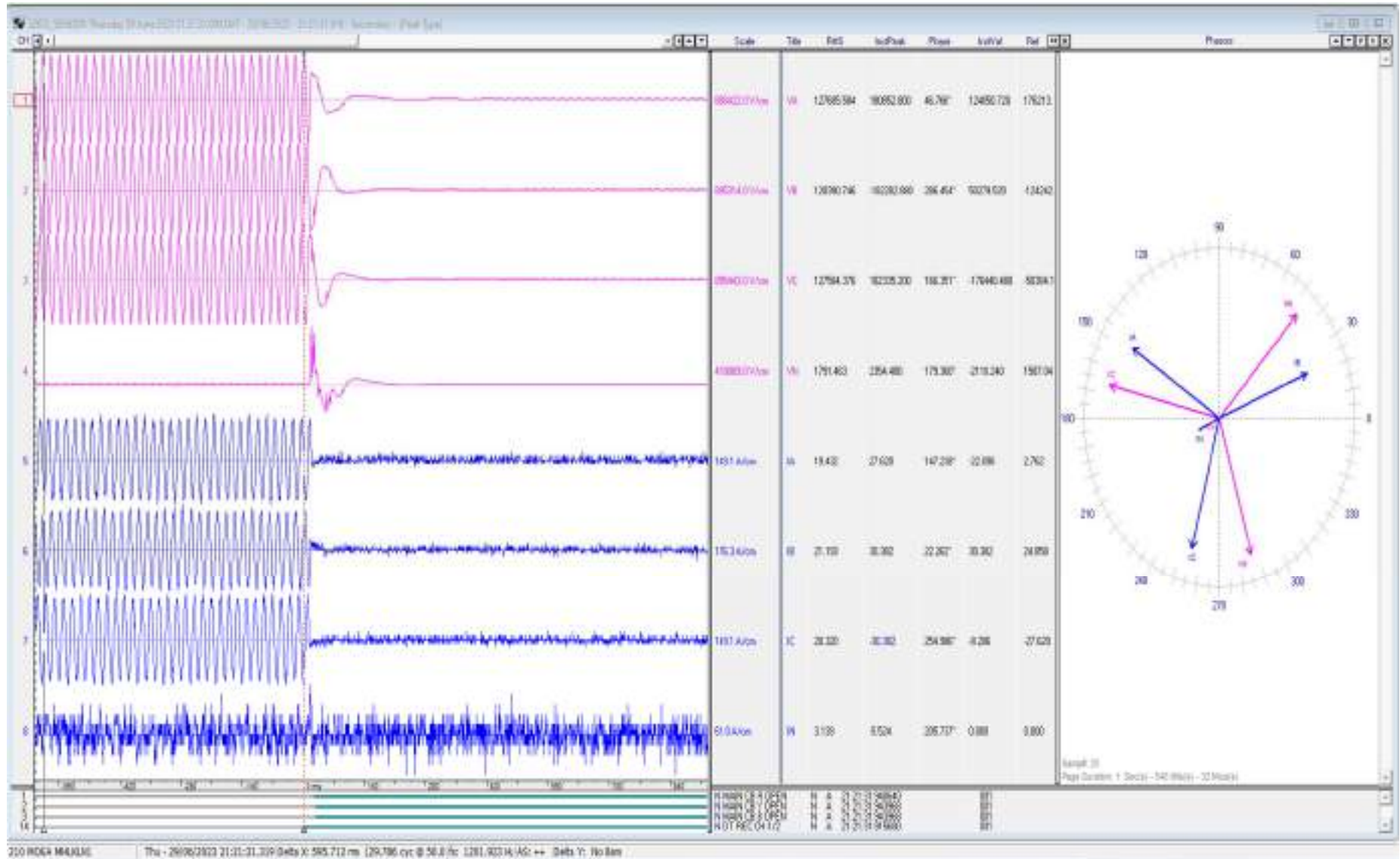


PMU Plot of phase voltage magnitude at Allahabad(PG)

02:28hrs/28-Jun-23

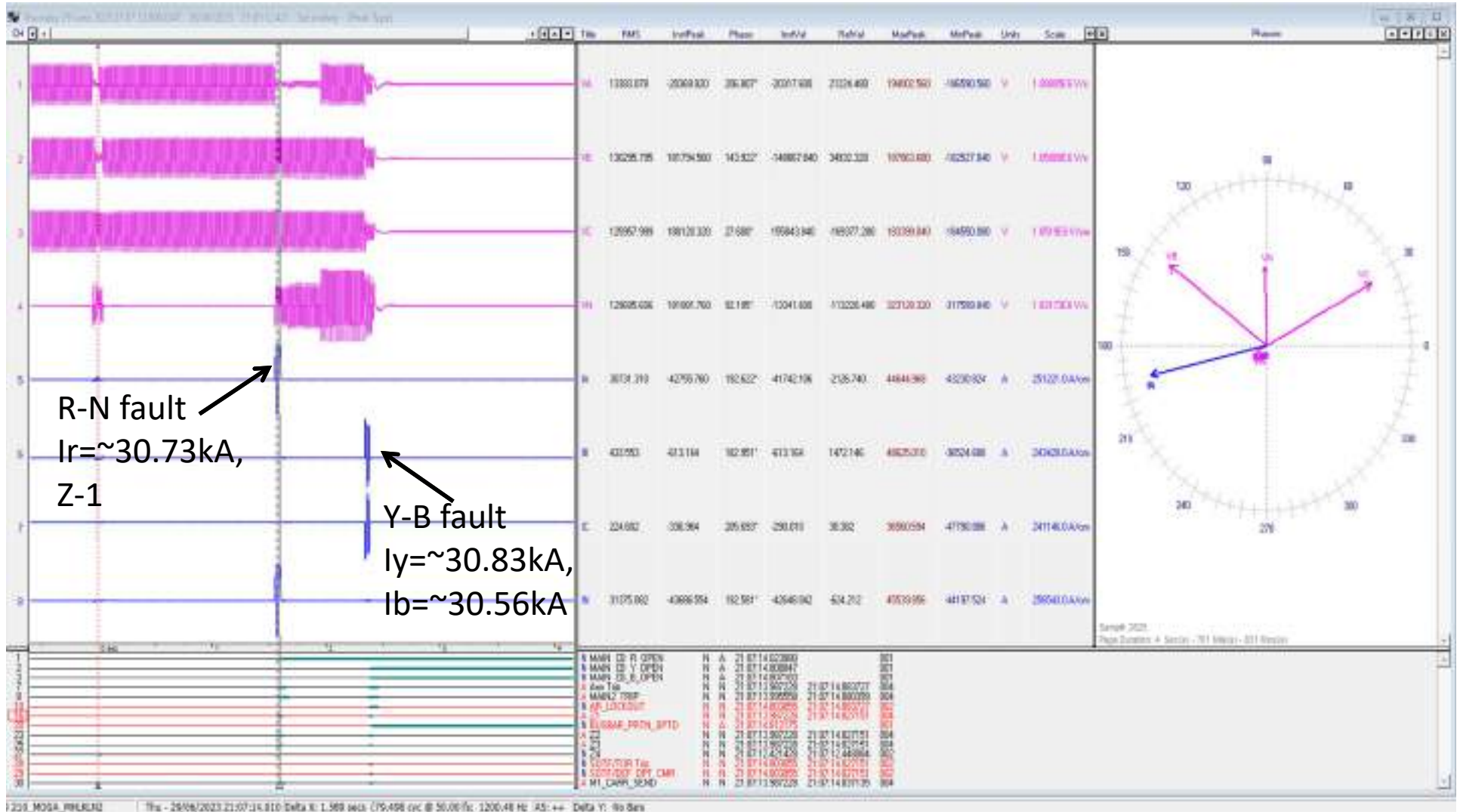


DR of 220 KV Moga(PG) (end)-Mehal-Kalan(PS) (PSTCL) Ckt-2



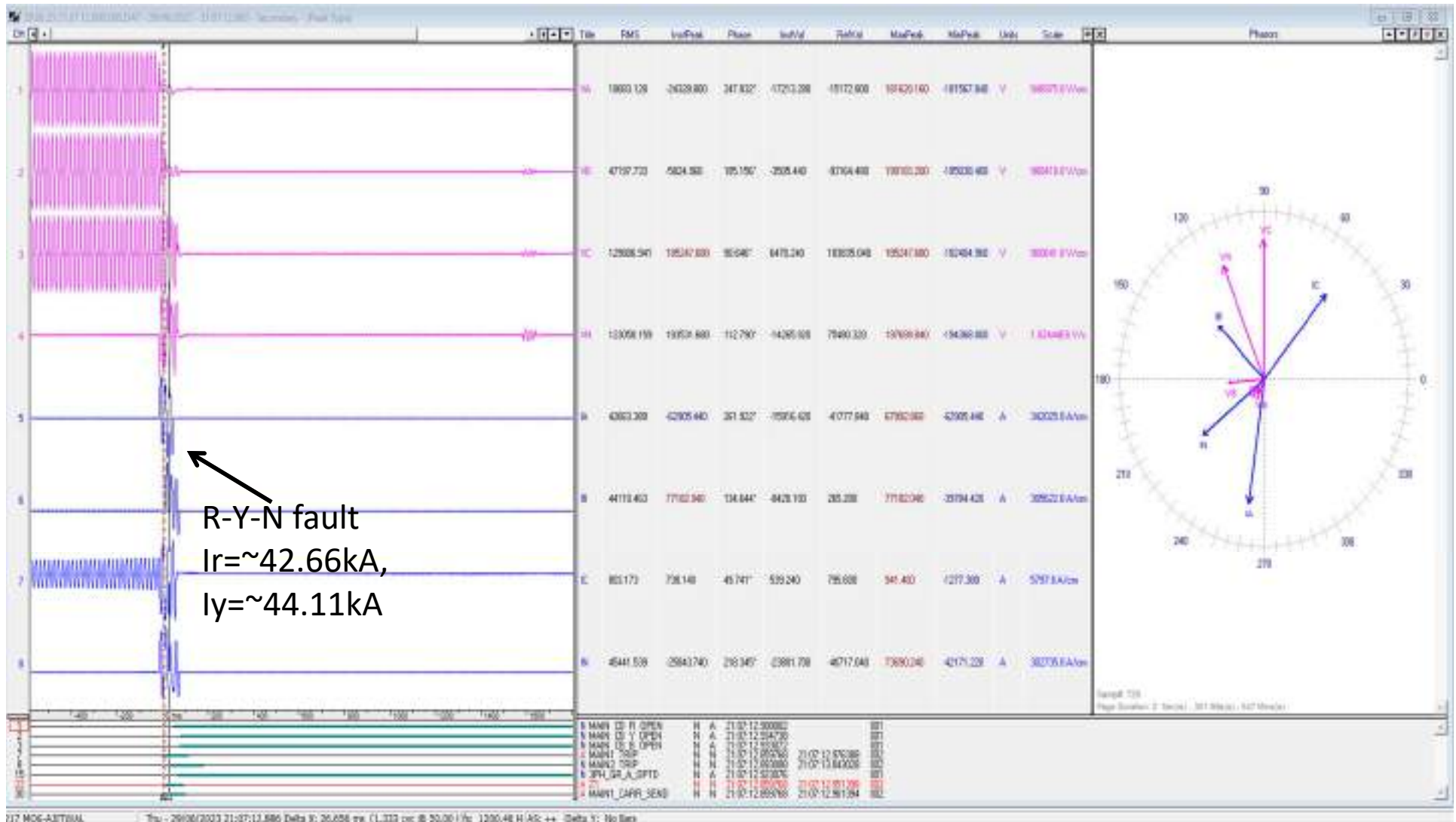
✓ DT received at Moga end at 21:21 hrs

DR of 220 KV Moga(PG) (end)-Mehal-Kalan(PS) (PSTCL) Ckt-2



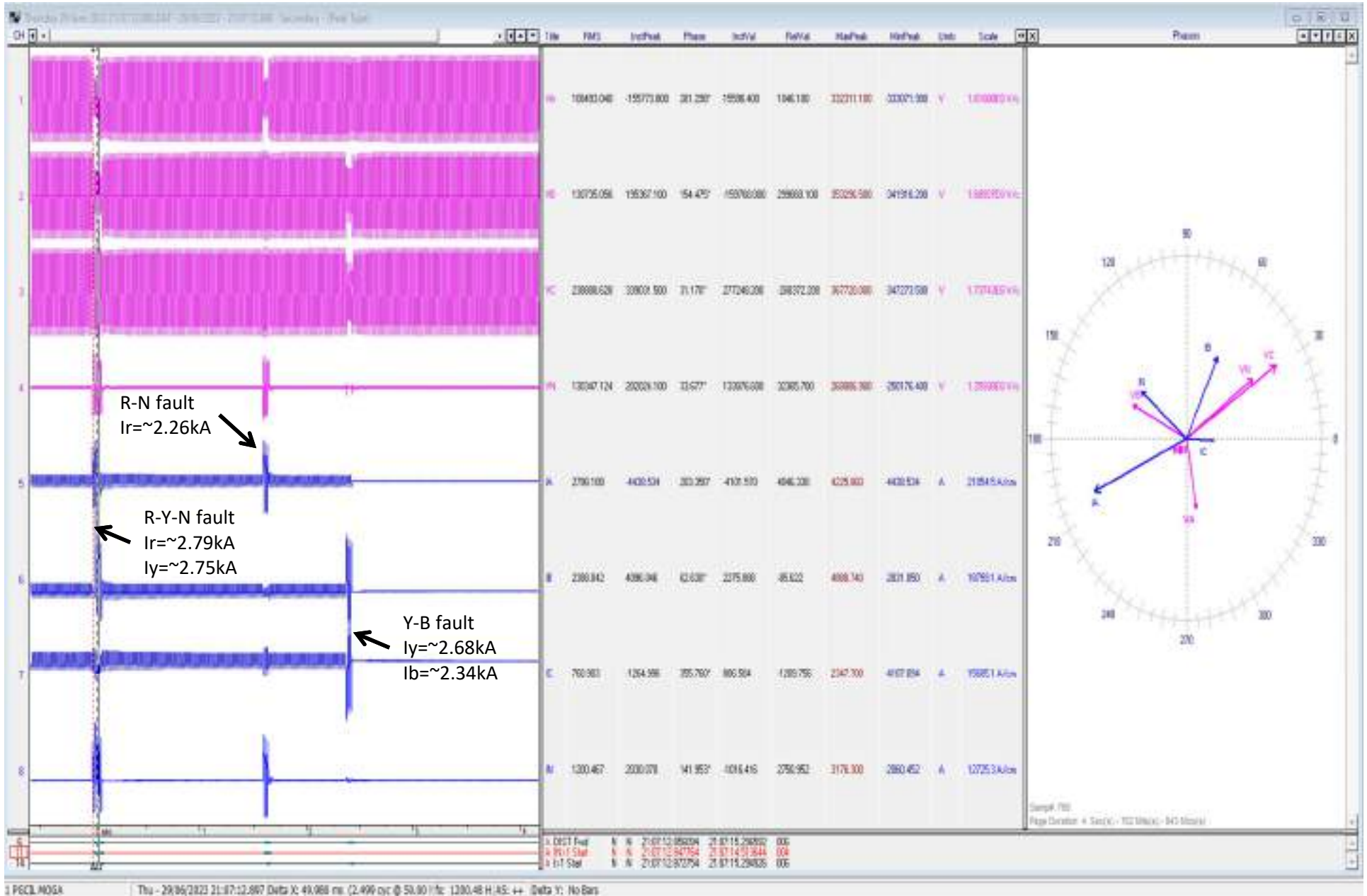
- ✓ R-N phase to earth fault (A/R Started) followed by Y-B phase to phase fault (bus bar operated)
- ✓ Fault sensed in zone-1
- ✓ Bus-bar protection operated

DR of 220 KV Moga(PG) (end)-Ajitwal(PS) (PSTCL) Ckt-1

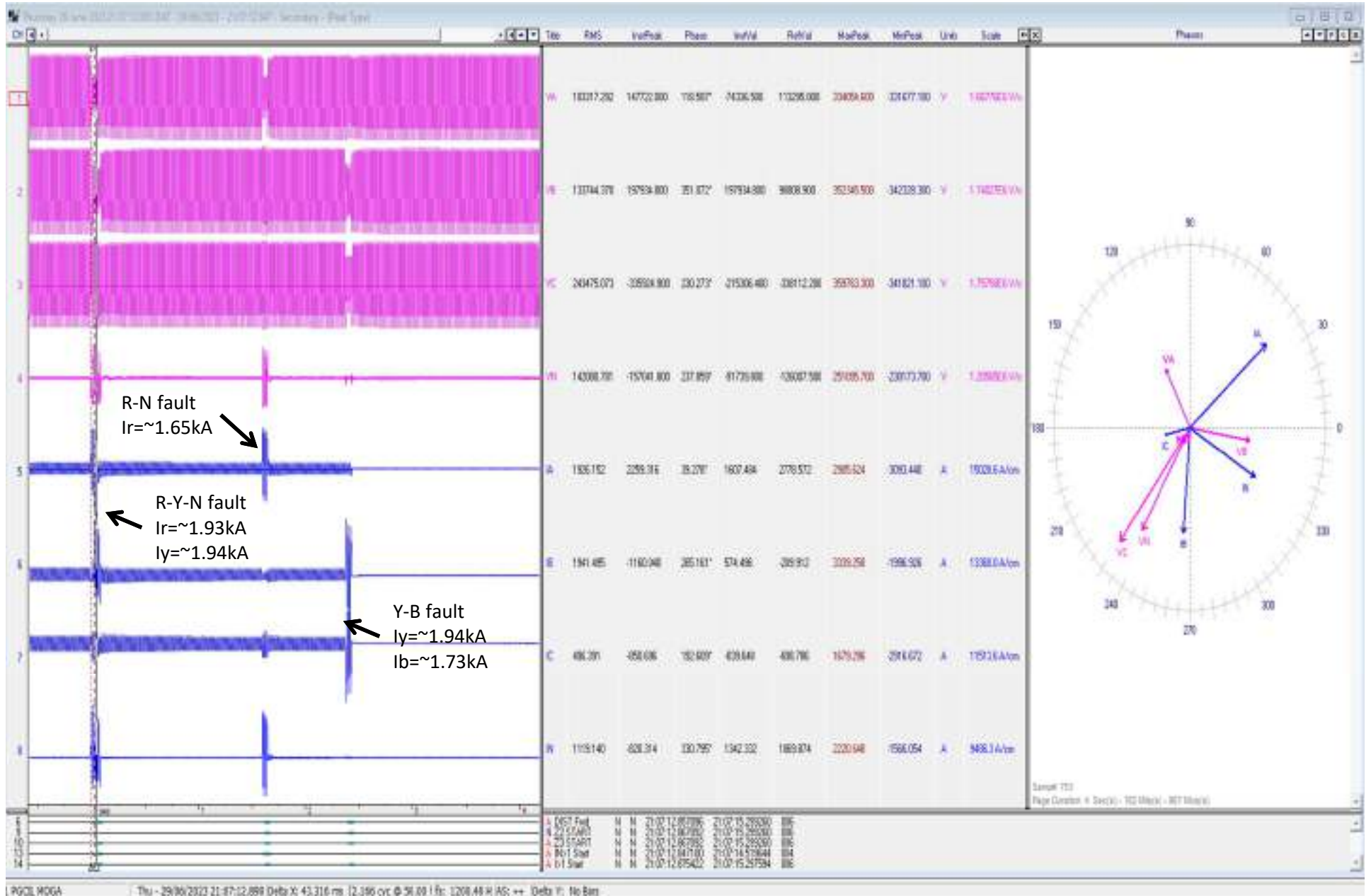


- ✓ R-Y-N double phase to earth fault
- ✓ Fault sensed in zone-1 (carrier sent)
- ✓ Fault clearing time= $\sim 90\text{ms}$

DR of 400/220 kV 500 MVA ICT 1 at Moga(PG)



DR of 400/220 kV 315 MVA ICT 4 at Moga(PG)



SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remarks
21:07:12,459	MOGAN_PS	220kV	1BAGHA1	Circuit Breaker	disturbe	
21:07:12,936	MOGA__PG	220kV	17AJTWL	Circuit Breaker	Open	Line CB at Moga(PG) of 220 KV Moga(PG)-Ajitwal(PS) (PSTCL) Ckt-1 opened
21:07:14,907	MEHAL_PS	66kV	7T2	Circuit Breaker	Open	CB at 66kV side of 220/66 kV ICT 2 at Mehal-Kalan(PS) opened
21:07:15,281	MOGA__PG	220kV	11MKLAN2	Circuit Breaker	Open	Line CB at Moga(PG) of 220 KV Moga(PG)-Mehal- Kalan(PS) (PSTCL) Ckt-2 opened
21:07:15,291	MOGA__PG	220kV	05MOGAN4	Circuit Breaker	Open	Line CB at Moga(PG) of 220 KV Moga(PG)-Mogan(PS) (PSTCL) Ckt-4 opened
21:07:15,297	MOGA__PG	220kV	12T4	Circuit Breaker	Open	CB at 220kV side of 400/220 kV 315 MVA ICT 4 at Moga(PG) opened
21:07:15,299	MOGA__PG	220kV	02MBC	Circuit Breaker	Open	Bus coupler CB at 220kV Moga(PG) opened
21:07:15,299	MOGA__PG	220kV	04T1	Circuit Breaker	Open	CB at 220kV side of 400/220 kV 500 MVA ICT 1 at Moga(PG) opened
21:07:15,315	MOGA__PG	400kV	08T4HS1	Circuit Breaker	Open	Tie CB at 400kV side of 400/220 kV 315 MVA ICT 4 at Moga(PG) opened
21:07:15,325	MOGA__PG	400kV	09T4	Circuit Breaker	Open	Main CB at 400kV side of 400/220 kV 315 MVA ICT 4 at Moga(PG) opened
21:07:21,140	BAGHA_PS	220kV	1MOGAN1	Circuit Breaker	Open	Line CB at Baghapurana(PS) of 220kV Mogan(PS)-Baghapurana(PS) Ckt-1 opened
21:07:24,229	SADQ2_PS	66kV	2DSWLA	Circuit Breaker	disturbe	

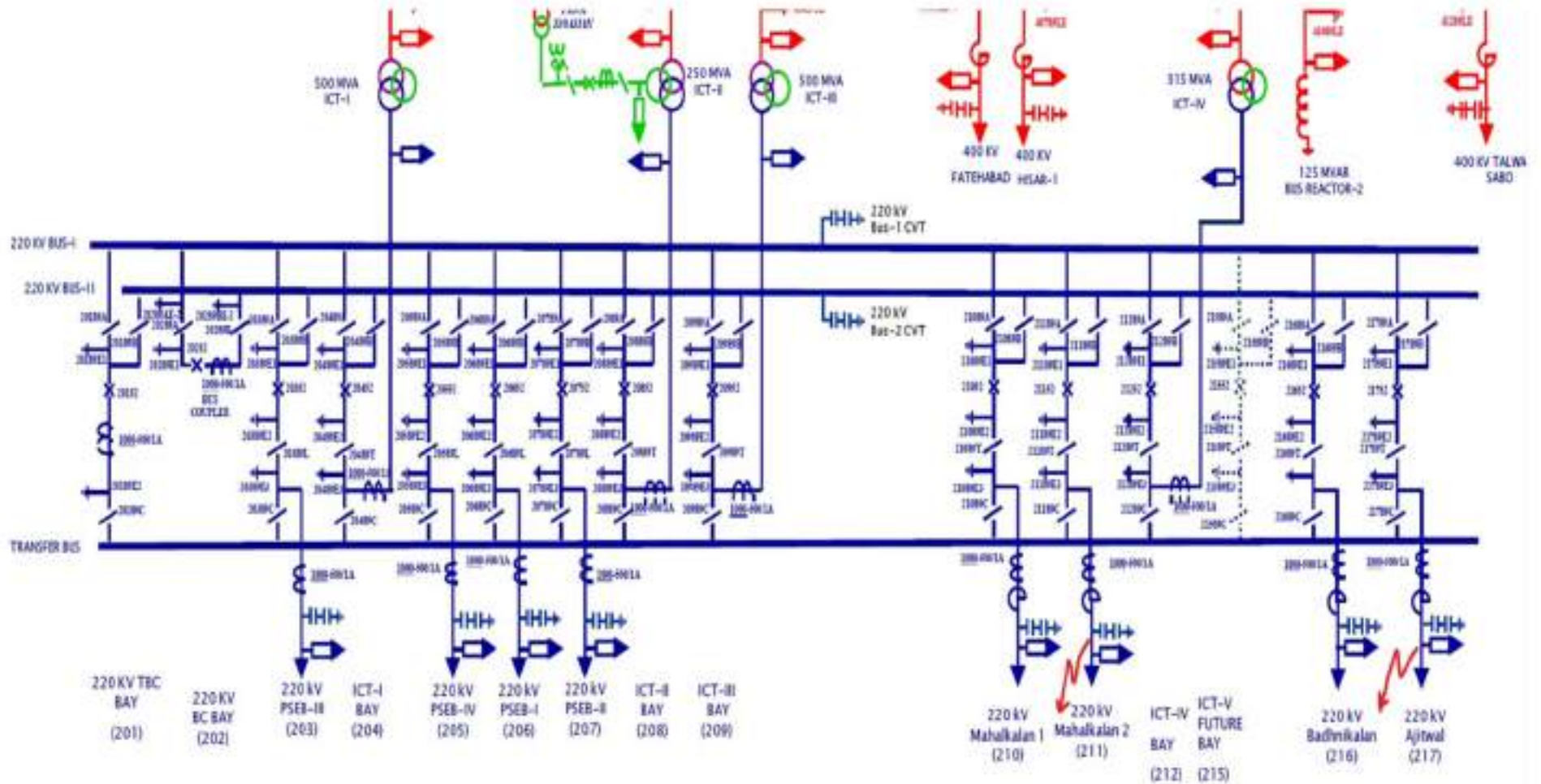
Point of discussion

- i. Bus-wise arrangement of elements need to be shared.
- ii. As per isolator status from SCADA, 220 KV Moga(PG)-Badhni ckt and 220 KV Moga(PG)-Mogan(PS) Ckt-2 are also connected to 220kV bus-1 at Moga(PG). Did they also trip due to bus bar protection operation?
- iii. Commissioning work of new bus bar relay need to be expedite.
- iv. As per SCADA SOE, 220/66 kV ICT 2 at Mehal- Kalan(PS) and 220kV Mogan(PS)-Baghapurana(PS) Ckt-1 also tripped during the same time Reason of the same need to be shared.
- v. SCADA data was not healthy at 220kV Mogan(PS), Ajitwal & Baghapurana S/s. Availability and healthiness of SCADA data need to be ensured.
- vi. DR, EL status along with tripping report need to be shared from Punjab end.
- vii. why did DT receive from Mogan(PS) end in 220kV Moga-Mahalkalan ckt-1?
- viii. Nature and location of all the faults?
- ix. Remedial action taken report need to be shared.

Multiple elements tripping at 220kV
Moga(PG)

(analysis by POWERGRID)

SLD 220KV SYSTEM, MOGA



Bays connection before Fault:

<u>220kv Bus-1</u>	<u>220kv Bus-2</u>
400/220kV ICT-1 (Bay 204)	PSEB Line-3 (Bay 203)
PSEB Line-4 (Bay 205)	PSEB Line-1 (Bay 206)
PSEB Line-2 (Bay 207)	400/220kV ICT-2 (Bay 208)
MahalaKalan Line-2 (Bay 211)	400/220kV ICT-3 (Bay 209)
400/220kV ICT-4 (Bay 212)	Mahalkalan Line-1 (Bay 210)
Badnikalan Line (Bay 216)	Ajitwal Line (Bay 217)

Bays connection before Fault:

<u>Bus-1</u>	<u>Bus-2</u>
400/220kV ICT-1 (Bay 204)	PSEB Line-3 (Bay 203)
PSEB Line-4 (Bay 205)	PSEB Line-1 (Bay 206)
PSEB Line-2 (Bay 207)	400/220kV ICT-2 (Bay 208)
(2) MahalaKalan Line-2 (Bay 211): BB Operate	400/220kV ICT-3 (Bay 209)
400/220kV ICT-4 (Bay 212)	(3) Mahalkalan Line-1 (Bay 210): Line Trip
Badnikalan Line (Bay 216)	(1) Ajitwal Line (Bay 217)-Line Trip

Report of Tripping of 220 kV Bus-1 at Moga S/S on 29.06.2023

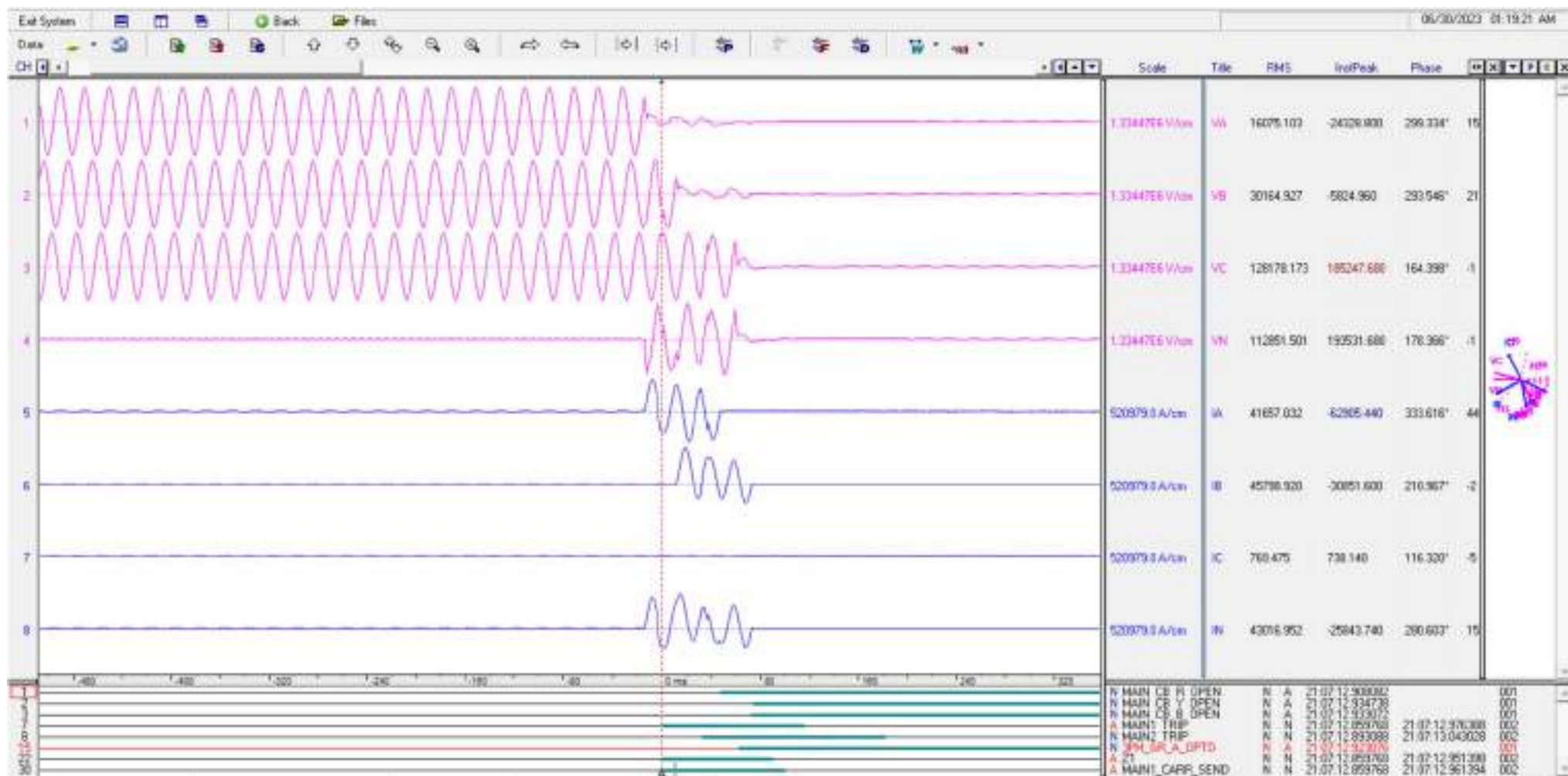
On 29.06.2023 at 21:07:15 hrs., 220 kV Bus-1 Tripped on **Bus Bar Differential Protection** at Moga S/S.

S.No.	Event	Time	
01	29.06.2023 21:07:12.858	220KV Ajitwal Line: R-Y-N Fault, Z1 IR= 42kA, IY=41kA; Line Trip	Conductor snapped between Moga S/s Gantry and tower location no. 1.
02	29.06.2023 21:07:13.983	220KV Mahalakalan Line-2: R-N Fault, Z11 IR=31 kA, Fault Location= 73m, After 817msec, 220kV BB protection operated on through fault	Earth wire snapped between Moga S/s Gantry and tower location no. 1. Earlier stabilizer resistors as per 20KA fault level. Now setting done for 40KA Fault level.
02	29.06.2023	220KV Mahalakalan Line-1 tripped on receipt of D/T	Direct trip command received from PSTCL S/S./T from PSTCL SS

220kV Moga-Ajitwal Line 2



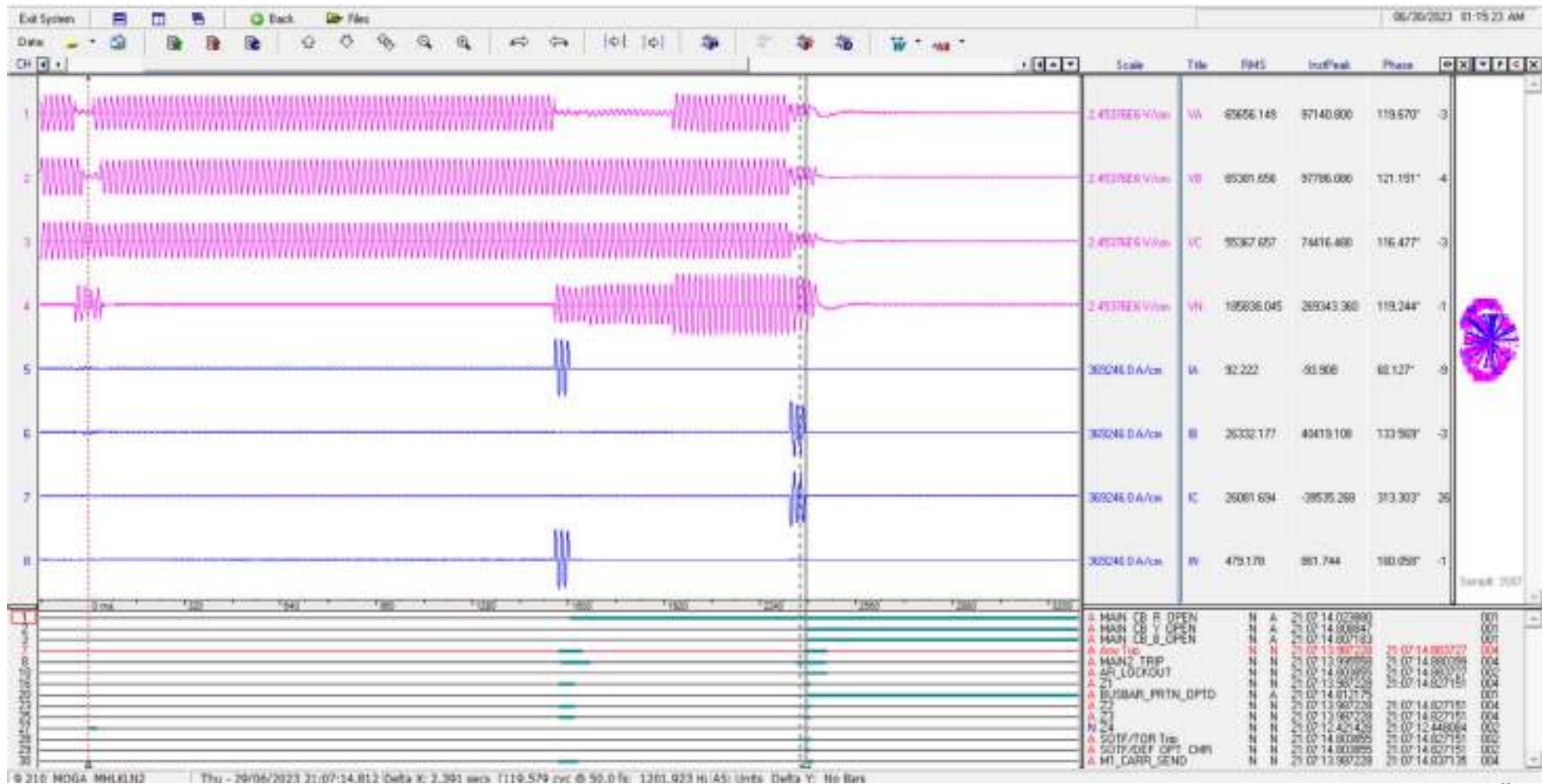
220kV Moga-Ajitwal Line fault details: at 21:07:12.858 Line tripped on RY-N fault



220kV Moga-Mahalkalan Line-2 fault details:



220kV Moga-Mahalkalan Line-2 fault details:



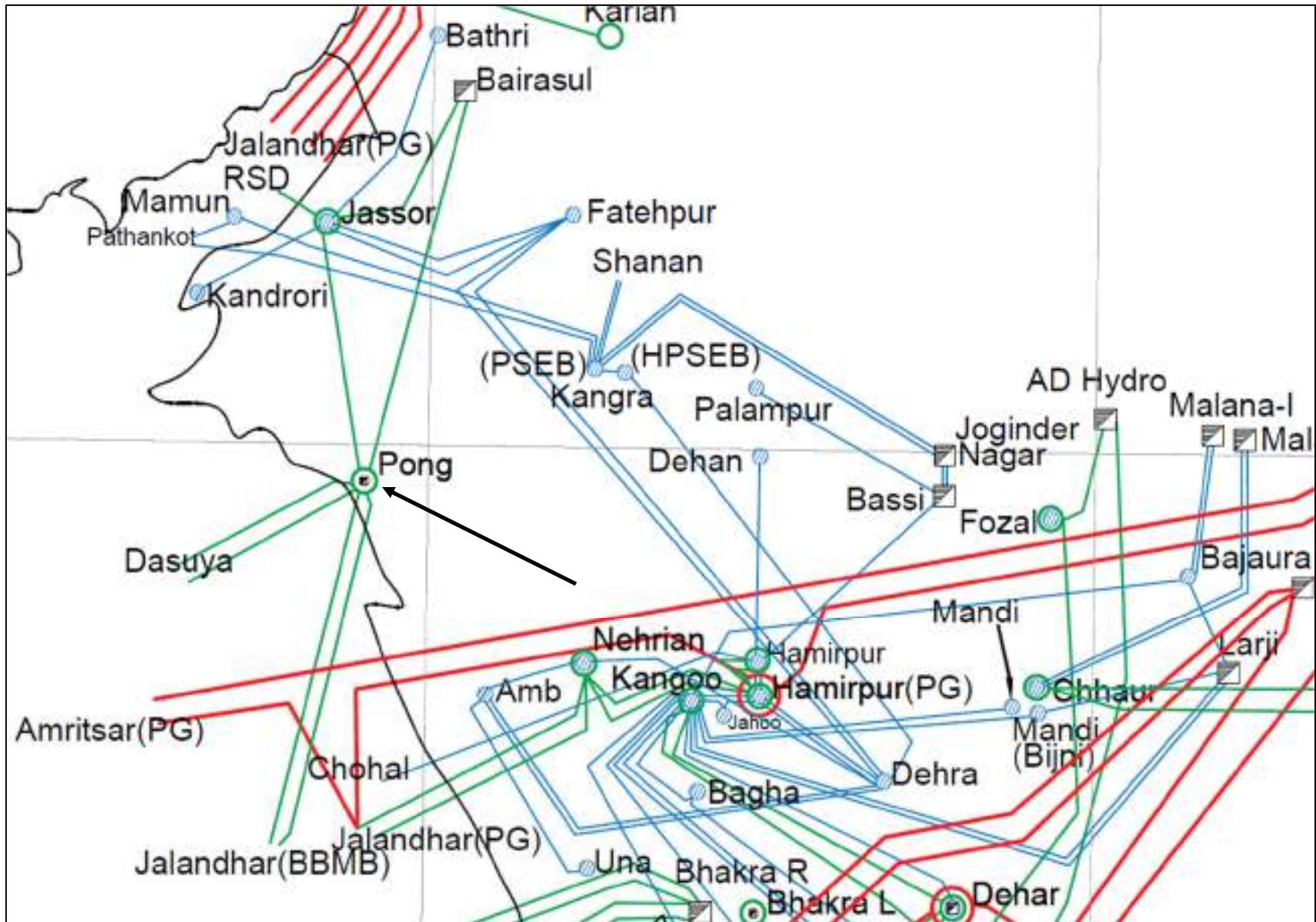
220KV Bus bar relay replacement status

- 1. LOA placed in Jun'2023**
- 2. OEM Engineer visiting site next week for drawing finalization.**
- 3. Decentralized BB, CU(743) & PU(741) Make GE**
- 4. Work to start : 2nd Week of Nov'23**
- 5. Target : Jan'2023**

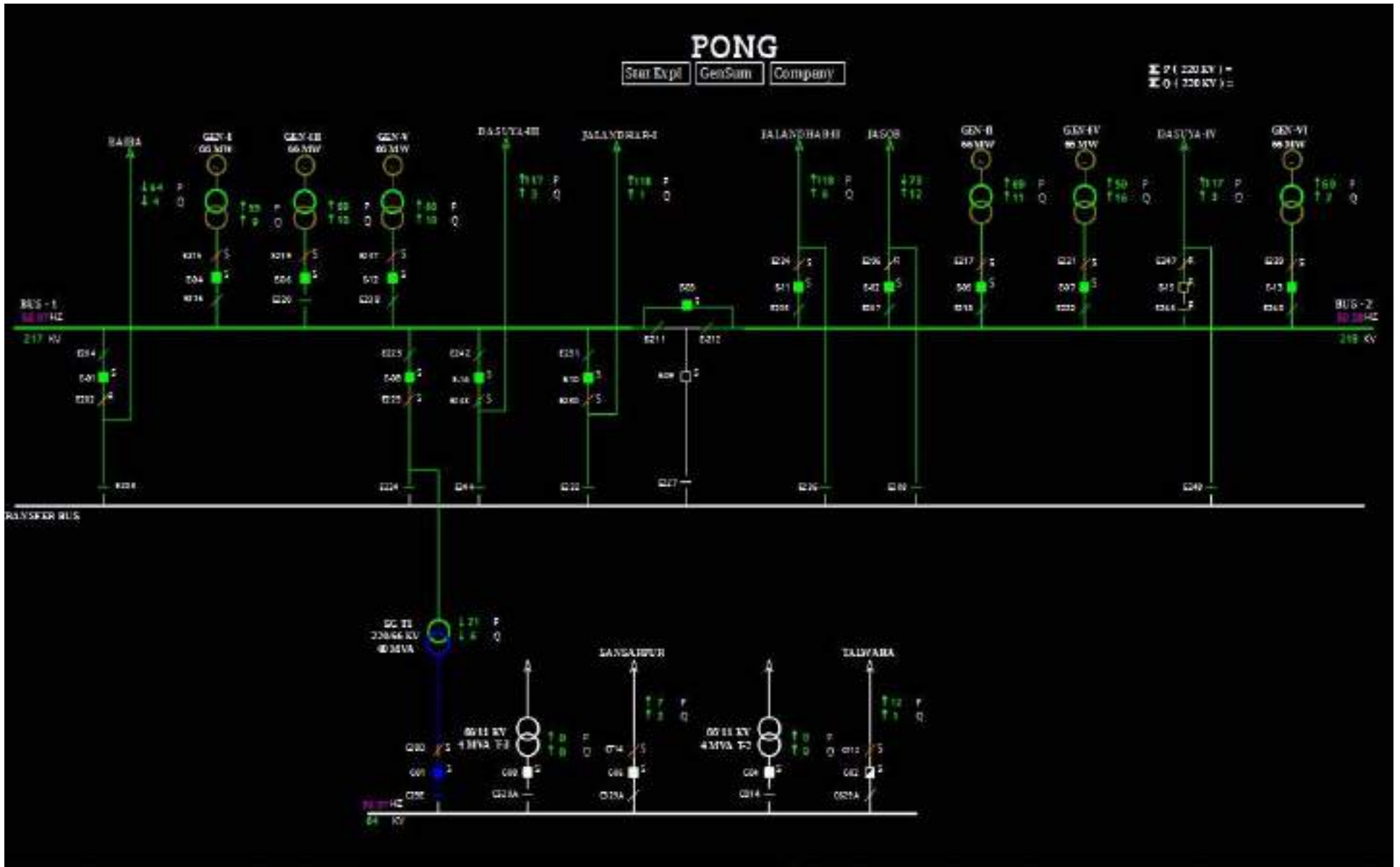
**Multiple elements tripping at
220kV Pong(BBMB)**

**18th August 2023 at
12:29 hrs**

Network Diagram

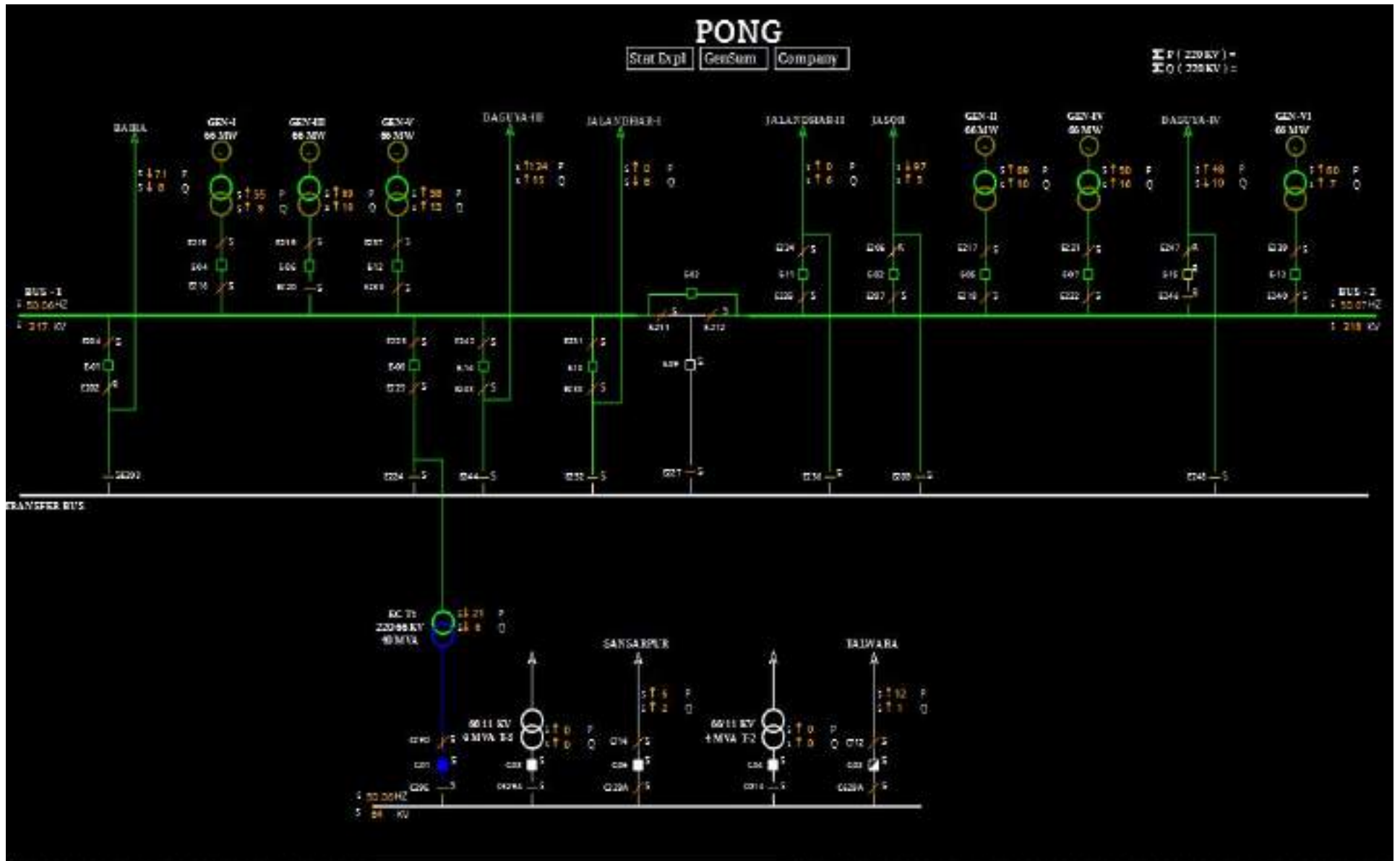


SLD of 220/66kV Pong(BBMB) before the event



Fri August 18 2023 12:27:00

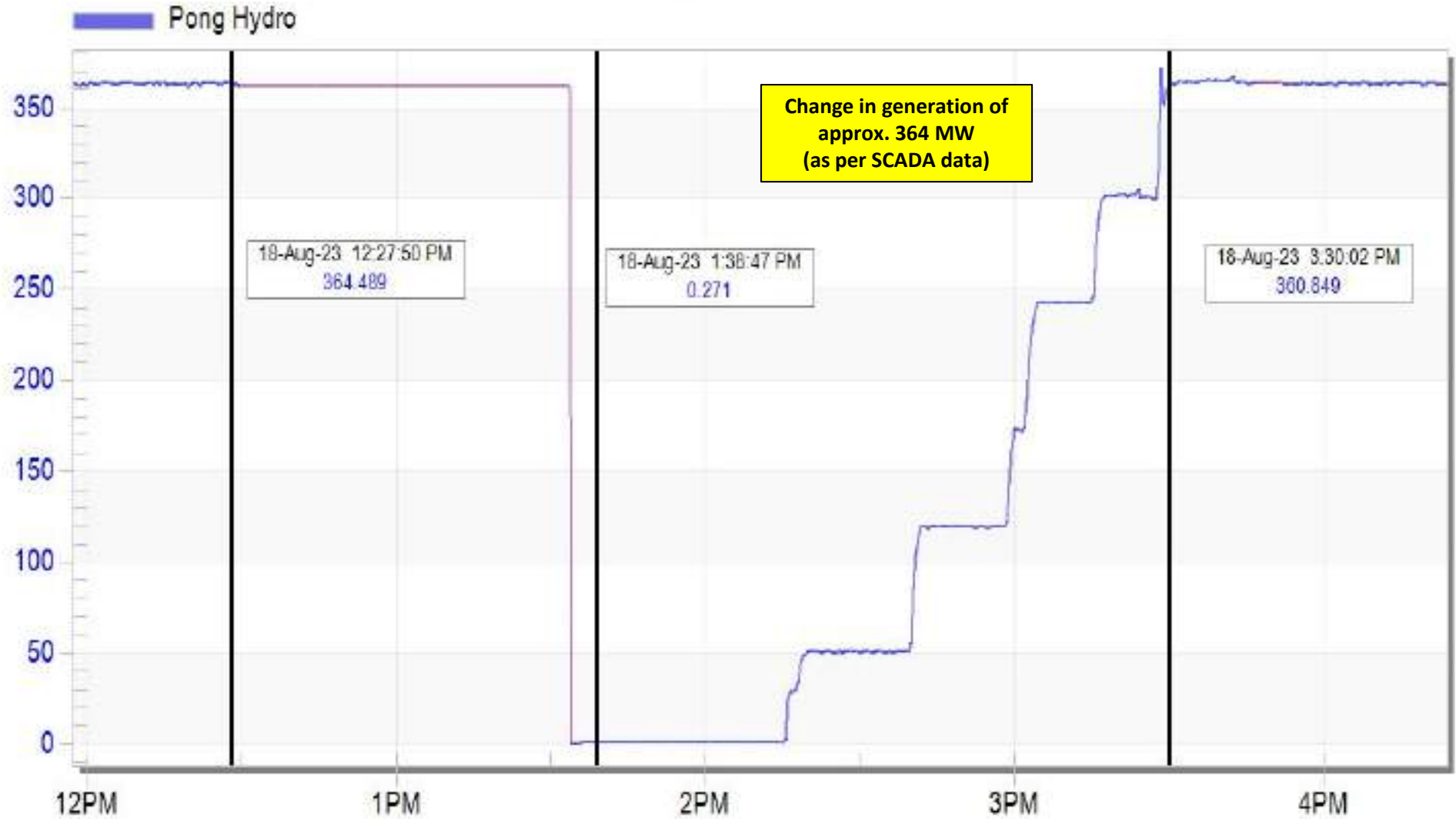
SLD of 220/66kV Pong(BBMB) after the event



Fri August 18 2023 12:32:00

Pong HEP generation during the event

Pong Generation



Aug 18 Fri 2023

PMU Plot of frequency at Jalandhar(PG)

12:29hrs/18-Aug-23



PMU Plot of phase voltage magnitude at Jalandhar(PG)

12:29hrs/18-Aug-23



SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
12:29:05,267	PONG__BB	220kV	13H06	Circuit Breaker	Open	CB of 66MW Unit-6 at Pong(BB) opened
12:29:05,784	PONG__BB	220kV	04H01	Circuit Breaker	Open	CB of 66MW Unit-1 at Pong(BB) opened
12:29:05,809	PONG__BB	220kV	07H04	Circuit Breaker	Open	CB of 66MW Unit-4 at Pong(BB) opened
12:29:05,817	PONG__BB	220kV	12H05	Circuit Breaker	Open	CB of 66MW Unit-5 at Pong(BB) opened
12:29:05,818	PONG__BB	220kV	05H02	Circuit Breaker	Open	CB of 66MW Unit-2 at Pong(BB) opened
12:29:05,875	PONG__BB	220kV	11JLNDR2	Circuit Breaker	Open	Line CB at Pong(BB) end of 220 KV Jalandhar-Pong (BB) Ckt-2 opened
12:29:05,887	PONG__BB	220kV	08T1	Circuit Breaker	Open	CB at 220kV side of 220/66kV 40MVA ICT-1 at Pong(BB) opened
12:29:05,888	PONG__BB	220kV	03MBC	Circuit Breaker	Open	Bus coupler CB at 220kV Pong(BB) opened
12:29:05,889	PONG__BB	220kV	10JLNDR1	Circuit Breaker	Open	Line CB at Pong(BB) end of 220 KV Jalandhar-Pong (BB) Ckt-1 opened
12:29:05,894	PONG__BB	220kV	02JASOR	Circuit Breaker	Open	Line CB at Pong(BB) end of 220 KV Jessore(HP)-Pong(BB) (PG) Ckt opened
12:29:05,900	PONG__BB	220kV	01BAIRA	Circuit Breaker	Open	Line CB at Pong(BB) end of 220 KV Bairasiul(NH)-Pong(BB) (PG) Ckt opened
12:29:05,909	PONG__BB	220kV	14DASYA1	Circuit Breaker	Open	Line CB at Pong(BB) end of 220 KV Pong(BB)-Dasuya(PS) (BBMB) Ckt-1 opened
12:29:05,918	PONG__BB	220kV	06H03	Circuit Breaker	Open	CB of 66MW Unit-3 at Pong(BB) opened
12:29:06,951	DASYA_PS	220kV	7PONG2	Circuit Breaker	Open	Line CB at Dasuya(PS) end of 220 KV Pong(BB)-Dasuya(PS) (BBMB) Ckt-1 opened

Multiple elements tripping at 220kV
Pong(BBMB)

(analysis by Pong(BBMB))

1. On 18.08.2023 all running Units (i.e. Unit No.1 to Unit No. 6), 40 MVA Power Transformer and all 220kV Feeders of Pong Power House Tripped at 12:29 Hrs.
2. Tripping of Unit No. 1 to Unit No. 6 was observed on Generator Transformer Stand by Earth Fault Protection and Over frequency trip.
3. Bus Bar Protection for Zone I & Zone 2 had also given trip to all running Units and 220kV Feeders & 40 MVA Transformer.. Zone I & Zone 2 elements tripping as under:

ZONE 1

Unit 1, Unit 3 &Unit 5

220kV Pong-Bairasuel Ckt,

220kV Pong-Jalandhar-I Ckt, 220kV Pong –Dasuya-III Ckt.

40 MVA 220kV /66kV Transformer

ZONE 2

Unit 2, Unit 4 & Unit 6

220kV Pong-Jassur Ckt,

220kV Pong-Jalandhar-II Ckt,

220kV Pong Dasuya-IV Ckt

4. 220kV Dasuya Sub Station reported tripping of 220kV Pong-Dasuya Ckt from their end on Line to earth fault at 33kM FROM Dasuya end.

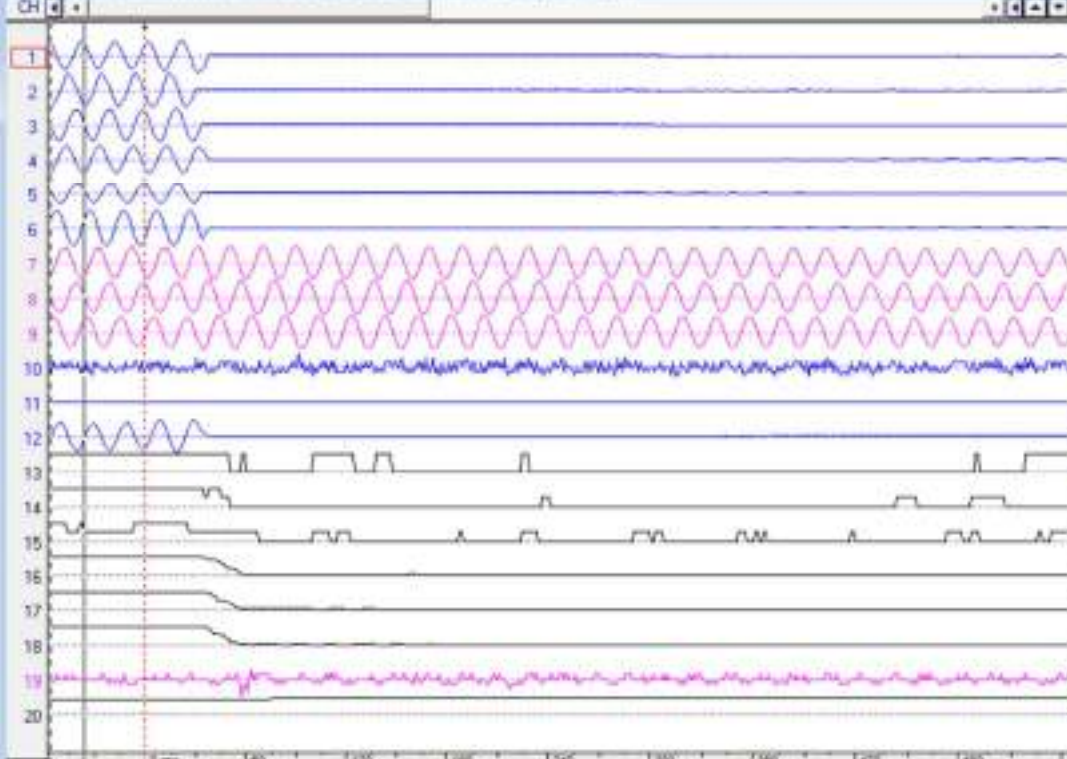
ANALYSIS

There was Phase to Earth fault on Pong- Dasuya Ckt-III at 6.6 Km from Pong end (as per DPR records of Pong-Dasuya Ckt-III feeder at PSTCL S/S Dasuya) and Protection System of Pong –Dasuya circuit at Pong end was faulty and hence as faulty line could not be isolated from Pong End. Fault feeding continued from Pong 220kV Bus. This led to tripping of all running machines on Stand by Earth Fault Protection (Set at $I_N > 200\text{mA}$ TMS 350ms) in 530ms. In the mean time Head Flash Over Protection of Unit 2 & Unit 5 also operated.

Head Flashover Protection of Unit 2 gave tripping command to Bus Bar Protection Zone 2 and led to tripping of entire system on Bus Bar 2.

Head Flashover Protection of Unit 5 gave tripping command to Bus Bar Protection Zone 1 and led to tripping of entire system on Bus Bar 1.

23.08.18 12.27.01.000.000.DAT - 16/08/2023 - 12.27.01.285 - Secondary - (Peak Type)



File	RMS	InstPeak	Phase	InstVal	Phase
IA-1	160.686	228.141	22.463°	206.598	179.9
IB-1	82.638	123.185	161.707°	-128.423	-13.81
IC-1	355.471	501.579	85.444°	23.753	467.3
IA-3	2656.760	-3812.250	188.661°	-3790.150	-2221.
IB-3	3989.386	5613.400	71.741°	1679.600	5563.
IC-3	3662.501	-5005.690	292.183°	2099.500	-3348.
VA-N	6498.625	-9076.479	206.521°	-8426.042	-7427.
VB-N	6390.094	8512.562	81.596°	967.809	8696.
VC-N	6024.667	-8958.905	324.502°	6611.618	-442.9
IN-1	0.422	0.552	206.729°	-1.105	0.000
IN-2	0.000	0.000	0.000°	0.000	0.000
IN-3	453.790	-657.908	257.336°	-112.137	-632.4
IA-DIFF	0.003	0.003	53.130°	0.003	0.003
IB-DIFF	0.006	0.006	53.130°	0.006	0.006
IC-DIFF	0.005	0.005	300.000°	0.005	0.005
IA-BIAS	0.734	0.735	256.000°	0.732	0.729
IB-BIAS	0.837	0.837	73.379°	0.837	0.829
IC-BIAS	1.051	1.052	30.000°	1.052	1.047
Vv	0.004	0.009	182.632°	0.000	0.009
Frequency	50.047	50.050	N/A	50.043	50.04



A	Arm Start	A	N	12.27.01.342949	001	
N	Arm Trip	N	N	12.27.01.335457	12.27.01.342949	002
A	EF 1 IN-1 Trip	A	N	12.27.01.342949	001	
N	L1 GT CB R-OPEN	N	A	12.27.01.335457	001	
N	L2 GT CB Y-OPEN	N	A	12.27.01.332958	001	
N	L3 GT CB B-OPEN	N	A	12.27.01.332958	001	
N	L21 BR RETWT	N	A	12.27.01.209477	001	
N	RB CB FD-OPTDFCB	N	N	12.27.01.337966	12.27.01.342949	003
N	R13 TO FCB OPTD	N	N	12.27.01.337956	12.27.01.342949	002

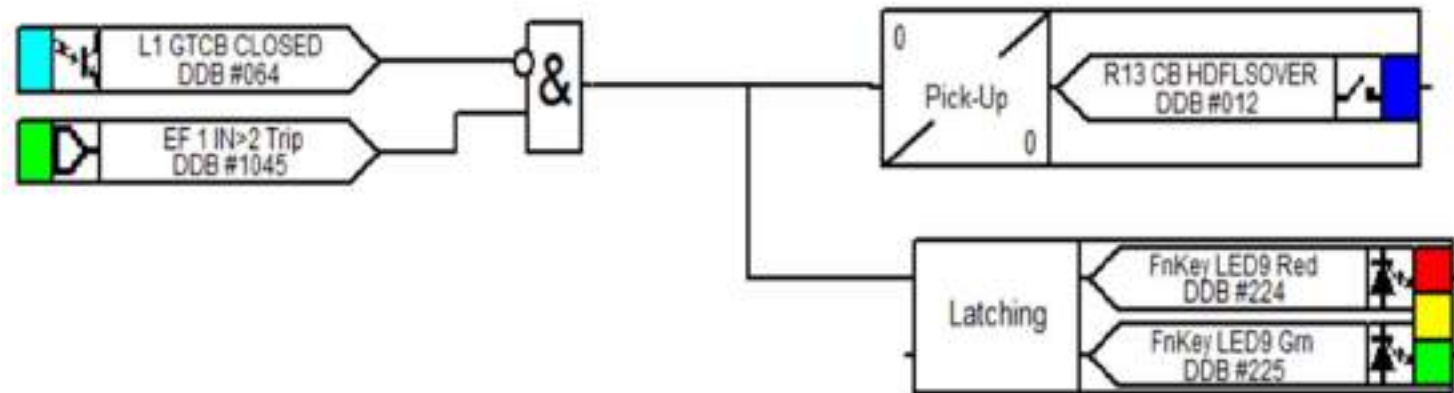
Graph 25
 Page Duration: 400 Micro - 825 Micro

HEAD FLASH OVER PROTECTION ON MACHINES

HEAD FLASHOVER PROTECTION HAS BEEN PROVIDED ON GENERATING UNITS OF PONG POWER HOUSE FOR PROTECTION AGAINST CIRCUIT BREAKER FLASHOVER DURING SYNCHRONIZATION OF MACHINES.

HEAD FLASHOVER PROTECTION IS AND OUTPUT OF FOLLOWING:

- A. EARTHFALT PROTECTION (DEFINITE TIME) FED FROM CT PROVIDED IN NEUTRAL OF GENERATOR TRANSFORMER SET AT IN 800mA TIME DELAY 150ms.
- B. CIRCUIT BREAKER OPEN CONTACT STATUS.



REASON FOR OPERATION OF HEAD FLASHOVER PROTECTION IN UNIT 2 & UNIT 5

Earth Fault protection relay operated due to feeding of fault from Pong Bus and same did not dropout immediately after open status of Circuit breaker and both condition had overlapping for 6-8ms in Unit 2 & Unit 5 as observed from Disturbance recorder of Unit 2 & Unit 5. This led to operation of Head Flashover Protection in Unit 2 & Unit 5 and thus tripping of Bus Bar Protection Zone 1 and Zone 2.

REMEDIAL MEASURE TO AVOID SUCH TYPES OF FAULT IN FUTURE

1. Faulty protection system of 220kV Pong-Dasuya Circuit was replaced with Numerical Type Protection Relays (Main-1 & Main -2) after arranging Numerical DPR Relays from PSTCL as 220kV Bay of this Circuit at Pong end is property of PSTCL.
2. Logic of Head Flashover Protection shall be amended during annual maintenance. Sufficient time delay (30ms) after AND Gate shall be provided in Head Flashover Protection to give sufficient time for dropout of earth fault protection.

**Multiple elements tripping at
400/220kV Bareilly(UP)**

**01st July 2023 at
06:39 hrs**

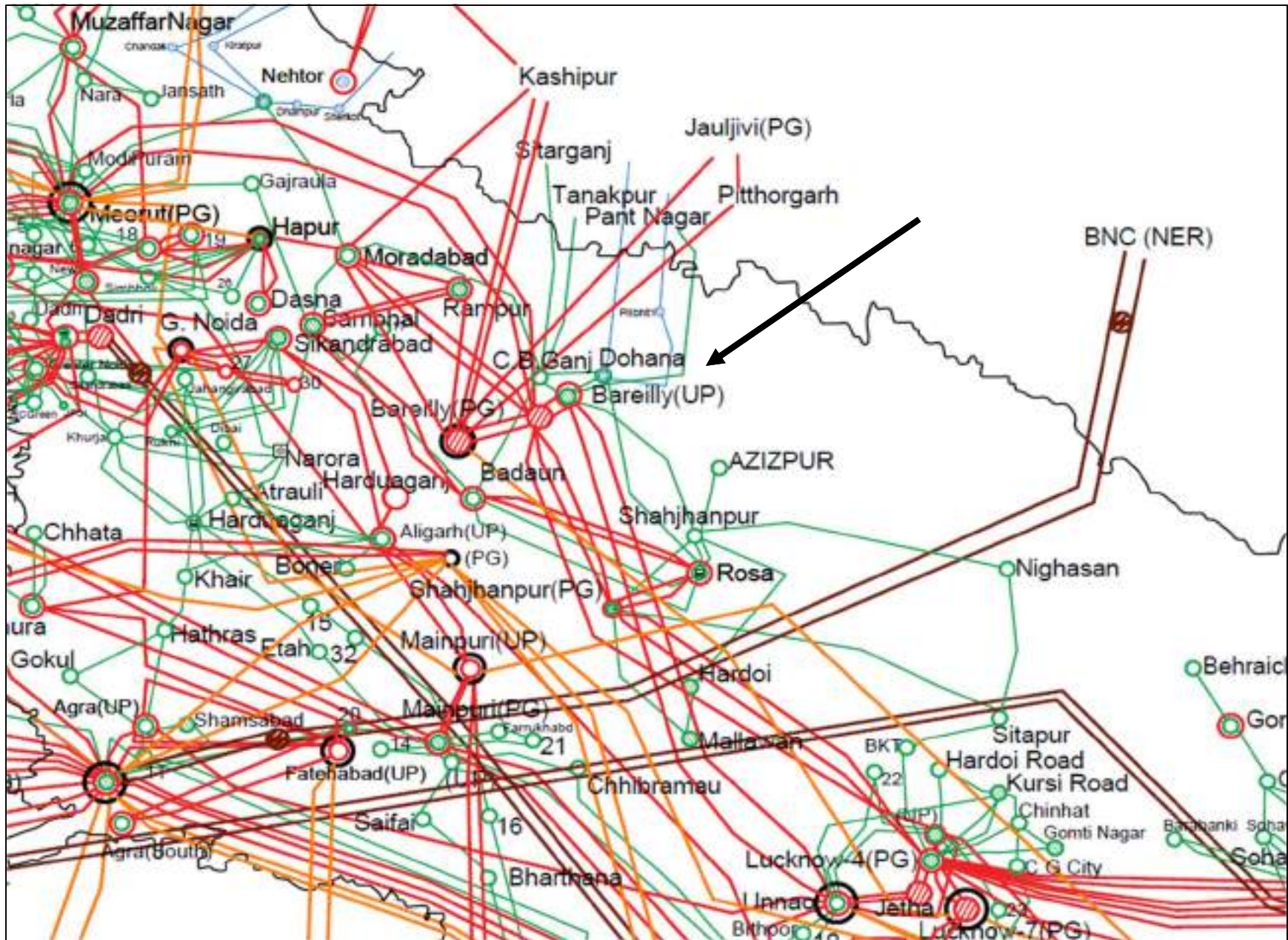
Brief of event:

- 400/220kV Bareilly(UP) has double main transfer bus scheme at both 400kV & 220kV level. During antecedent condition, 400/220 kV 315 MVA ICT 3 at Bareilly(UP), 400 KV Bareilly-Unnao (UP) Ckt-1, 400 KV Bareilly(UP)-Bareilly(PG) (PG) Ckt-1 and 80 MVAR Bus Reactor No 1 at 400KV Bareilly(UP) were connected to 400KV Bus 1 at Bareilly(UP) and rest of the elements were connected to Bus 2.
- As reported, at 06:39 hrs on 01st July, 2023, 400KV Bus 1 at Bareilly(UP) tripped due to bus bar protection mal-operation and hence all the elements connected to Bus 1 also tripped and Bus 1 became dead.

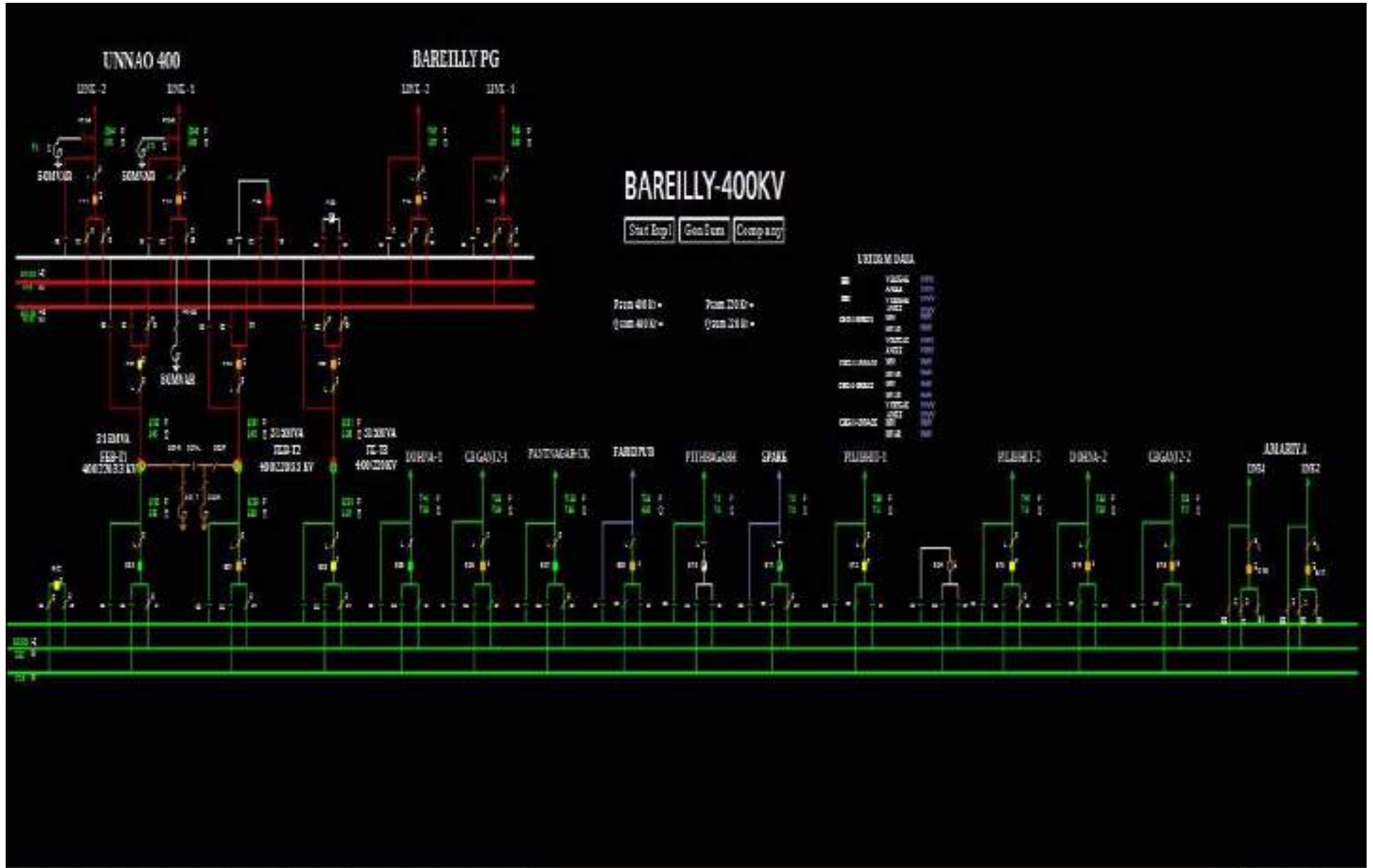
Elements tripped:

- i. 400KV Bus 1 at Bareilly(UP)
- ii. 400/220 kV 315 MVA ICT 3 at Bareilly(UP)
- iii. 400 KV Bareilly-Unnao (UP) Ckt-1
- iv. 400 KV Bareilly(UP)-Bareilly(PG) (PG) Ckt-1
- v. 80 MVAR Bus Reactor No 1 at 400KV Bareilly(UP)

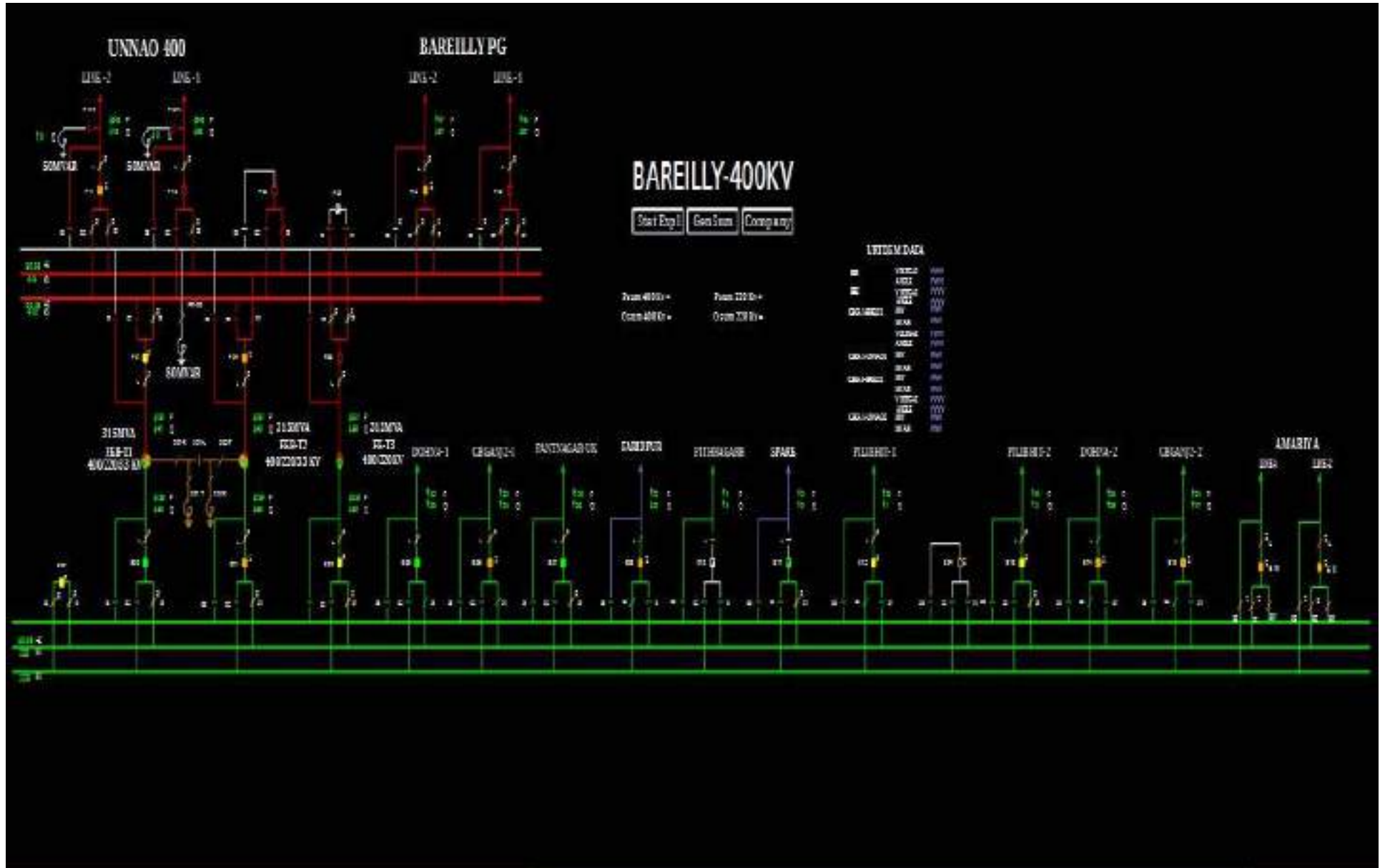
Network diagram



SLD of 400/220kV Bareilly(UP) before the tripping

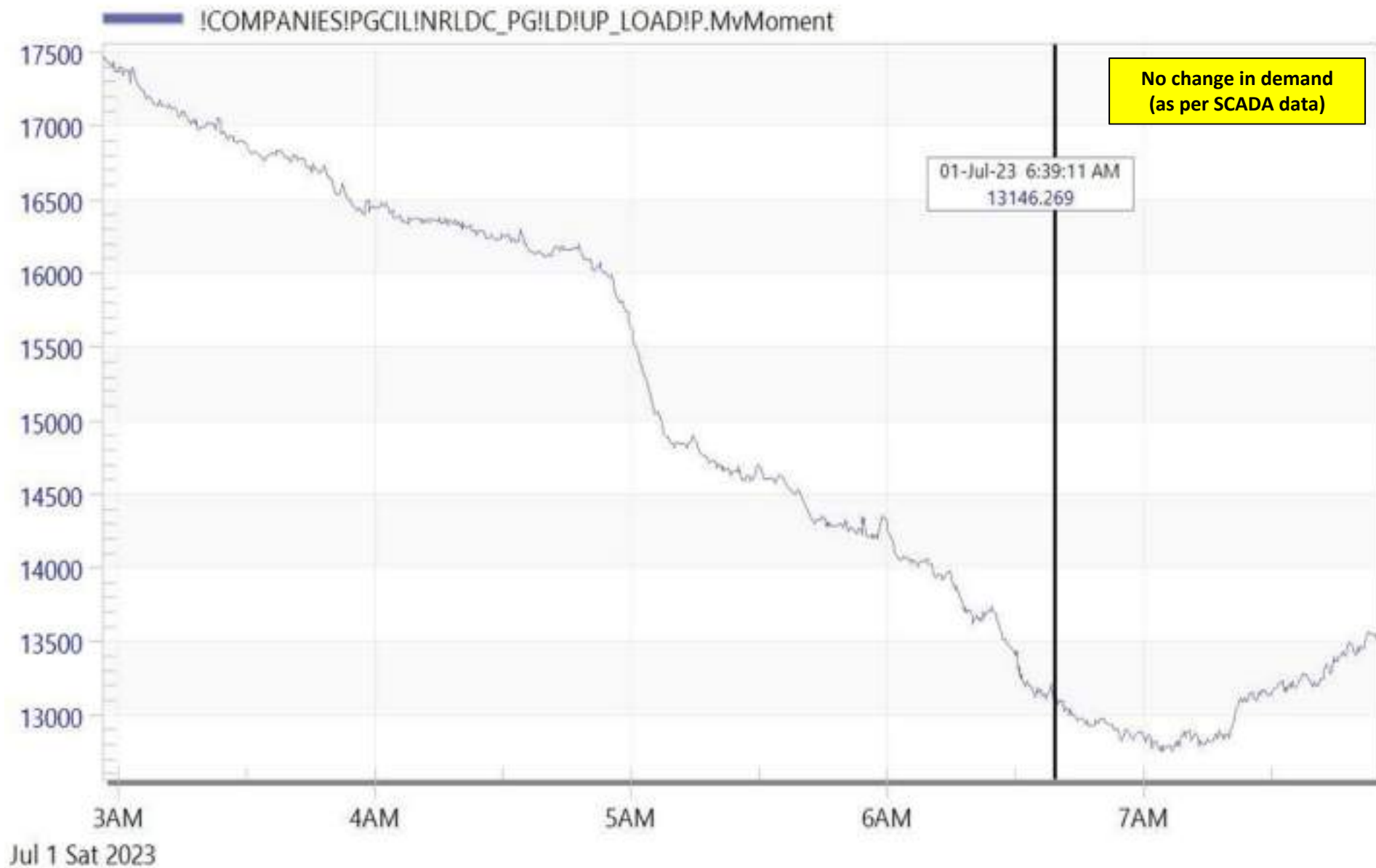


SLD of 400/220kV Bareilly(UP) after the tripping



Uttar Pradesh demand during the event

UP Demand



PMU Plot of frequency at Bareilly(PG)

06:39hrs/01-Jul-23

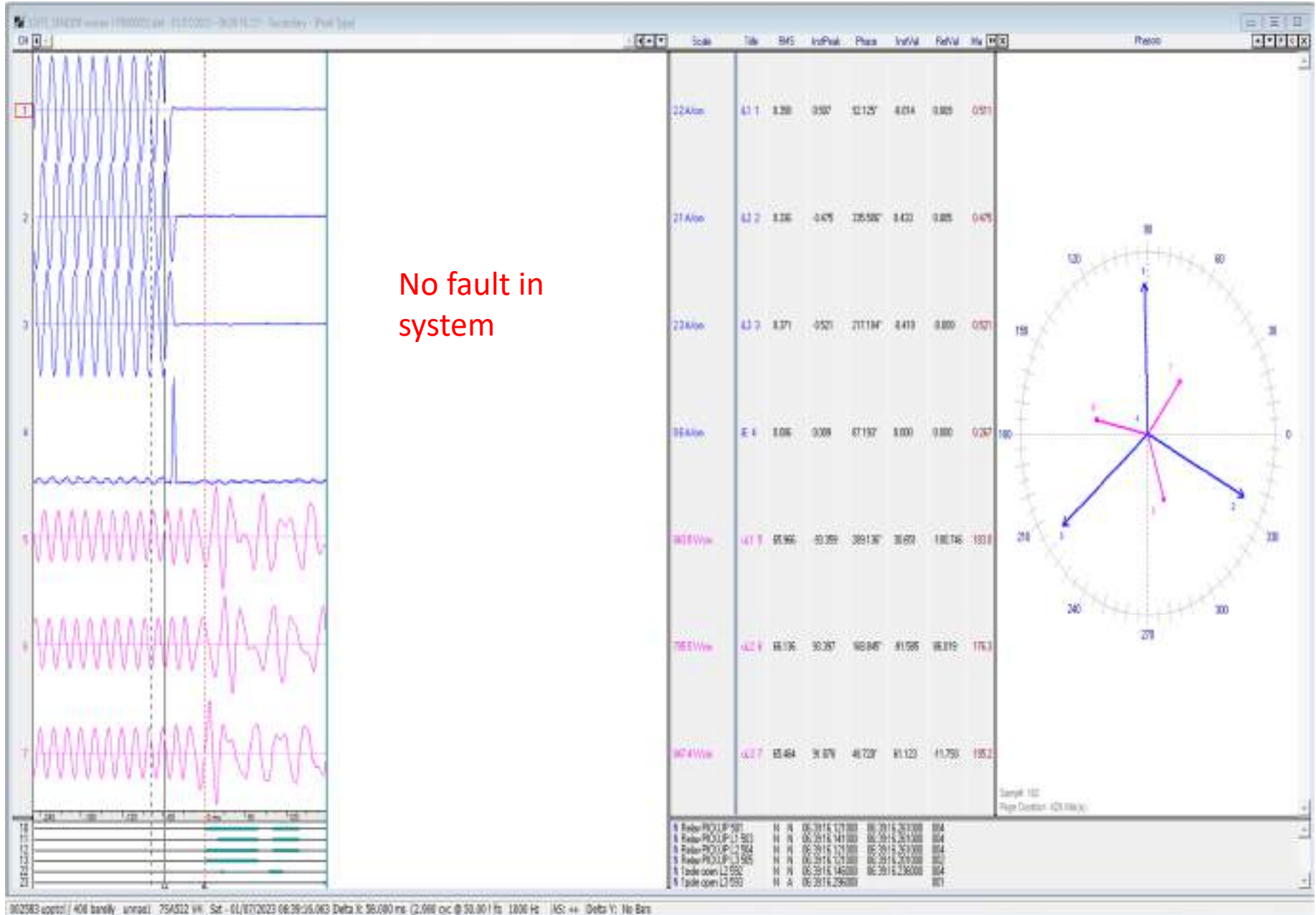


PMU Plot of phase voltage magnitude at Bareilly(PG)

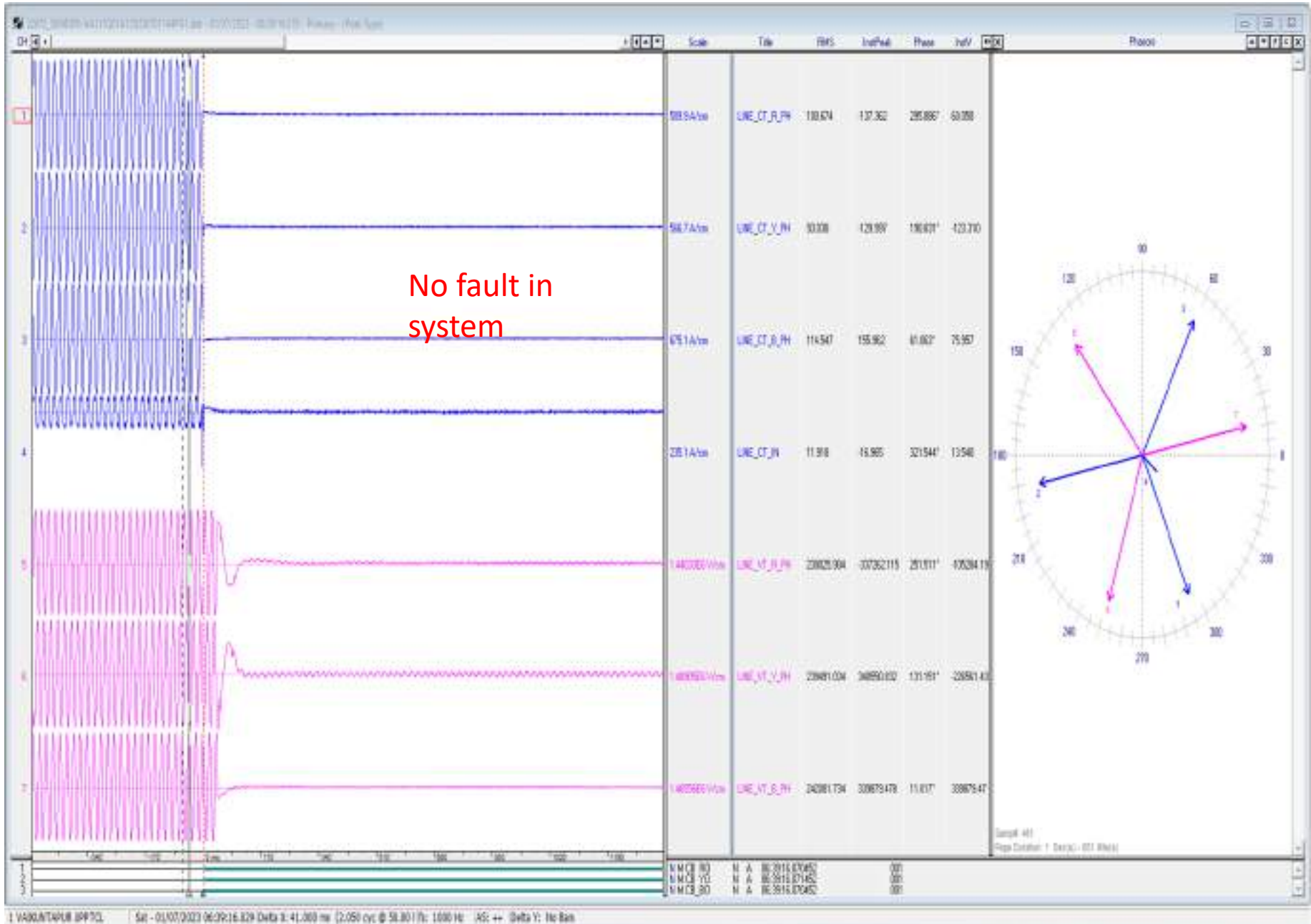
06:39hrs/01-Jul-23



DR of 400kV Bareilly(UP)(end)-Unnao ckt-1



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



SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
06:39:15,941	UNNAO_UP	400kV	02CBGA11	Circuit Breaker	Open	Line CB at Unnao(UP) end of 400 KV Bareilly-Unnao (UP) Ckt-1 opened
06:39:16,024	CBGA1_UP	400kV	10UNNAO1	Circuit Breaker	Open	Line CB at Bareilly(UP) end of 400 KV Bareilly-Unnao (UP) Ckt-1 opened
06:39:16,031	CBGA1_UP	400kV	02TBC	Circuit Breaker	Open	Transfer bus coupler CB at 400kV Bareilly(UP) opened
06:39:16,050	CBGA1_UP	400kV	13BRELY1	Circuit Breaker	Open	Line CB at Bareilly(UP) end of 400 KV Bareilly(UP)-Bareilly(PG) (PG) Ckt-1 opened
06:39:16,059	CBGA1_UP	400kV	83T3	Circuit Breaker	Open	CB at 400kV side of 400/220kV 315MVA ICT-3 at Bareilly(UP) opened
06:39:16,114	BAREILLY	400kV	5CBG1LU1	Circuit Breaker	disturbe	
06:39:16,131	BAREILLY	400kV	5CBG1LU1	Circuit Breaker	Open	Tie CB at Bareilly(PG) end of 400 KV Bareilly(UP)-Bareilly(PG) (PG) Ckt-1 opened
06:39:16,139	BAREILLY	400kV	4CBGA11	Circuit Breaker	Open	Main CB at Bareilly(PG) end of 400 KV Bareilly(UP)-Bareilly(PG) (PG) Ckt-1 opened

Event analysis detail share by UP

At 400KV Substation, Bareilly 400kV Main Bus-I operated at 06:39Hrs. dated 01.07.2023 due to which all elements of 400KV Main Bus-I tripped.

Tripped Elements

1. 400KV Bareilly-Unnao-Ckt-I.
2. 315MVA ICT-III
3. 400KV Bareilly-Bareilly(PG) Ckt-I
4. 400KV Bus Coupler.
5. 80MVAR Bus Reactor (Which is Charged through Transfer Bus)

Following are observations.

1. DR of 400KV Bareilly-Unnao Ckt-I shows no fault.
2. DR of 400KV Bareilly-Bareilly (PGCIL) Ckt-I shows no fault.
3. DR of 400KV Bus Bar couldn't extract due to Non-Numerical Relays.
4. No apparent fault observed in switchyard as well as in above relay Panels.

So, the Bus bar relay which is Non-Numeric might be mal operated, which is currently out of Ckt.

Point of discussion

- i. As reported by SLDC-UP, DR of 400kV Bus bar could not be extracted due to non-numerical relay installed at Bareilly(UP). As per the IEGC provision under clause 5.2 (r), all the Users, STU/SLDC and CTU shall send information/data including disturbance recorder/sequential event recorder output to RLDC within 24 hours for purpose of analysis of any grid disturbance/event. Hence, non-numerical relays at Bareilly(UP) S/s need to be replaced with numerical relays on priority.
- ii. As informed by UP in OCC 210, bus bar protection is kept out of service. Expeditious implementation of numerical bus bar relay was agreed during the meeting. Status of the same need to be shared.
- iii. Remedial action taken report to be shared.

**Multiple elements tripping at
400/220kV Gr. Noida(UP)**

**26th July 2023 at
04:46 hrs**

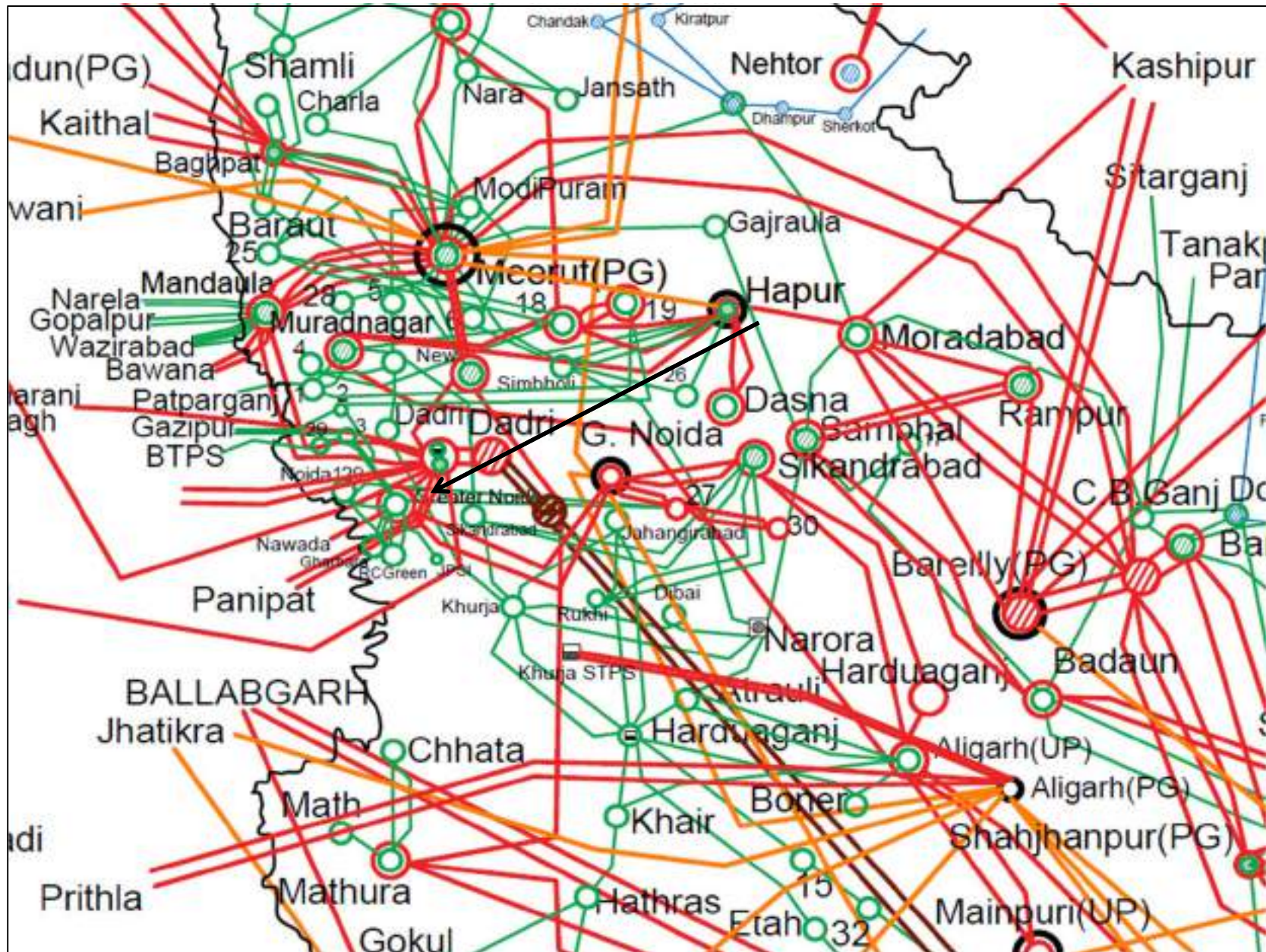
Brief of event:

- 400kV side of 400/220/132kV Gr.Noida(UP) has double main & transfer bus scheme.
- During antecedent condition, power was flowing from 400kV side to 220kV side through 400/220 kV 315 MVA ICT 1 & 2 and 400/220 kV 500 MVA ICT 5 & 6 at Gr.Noida(UPC).
- As reported, at 04:46 hrs, B-ph conductor of 400KV Bus 1 at Gr.Noida(UPC) broke and fell on Y-ph bay of 400 KV Dadri(NT)-Gr.Noida(UPC) (PG) Ckt-1 which created Y-B phase to phase fault at Bus 1. Due to this bus bar protection operated and elements on Bus 1 tripped.

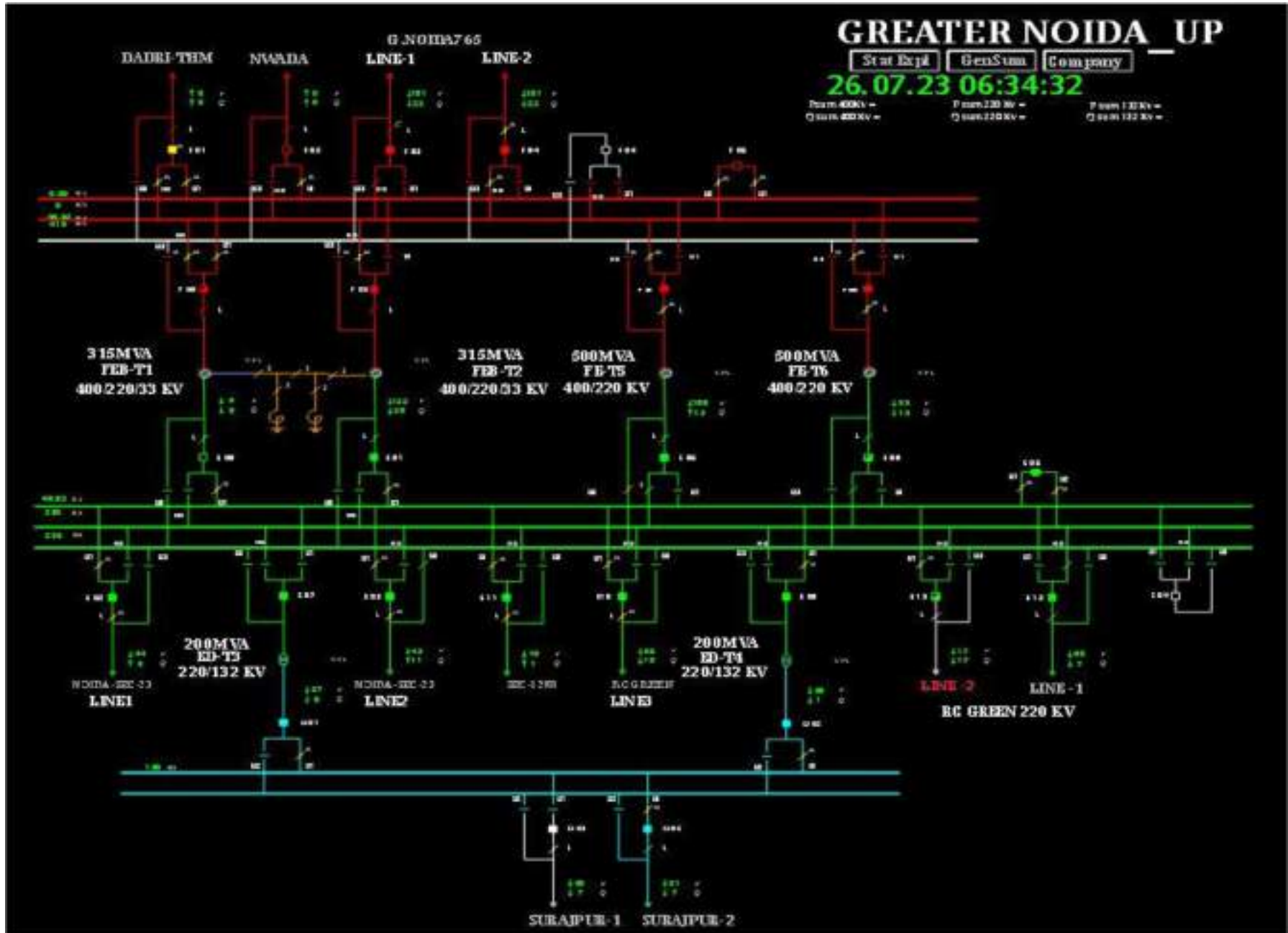
Elements tripped:

- i. 400/220 kV 315 MVA ICT 1 at Gr.Noida(UPC)
- ii. 400/220 kV 315 MVA ICT 2 at Gr.Noida(UPC)
- iii. 400KV Bus 1 at Gr.Noida(UPC)
- iv. 400 KV Dadri(NT)-Gr.Noida(UPC) (PG) Ckt-1
- v. 400 KV Gr.Noida(UPC)-Nawada(HV) (PG) Ckt-1
- vi. 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-1
- vii. 400/220 kV 500 MVA ICT 5 at Gr.Noida(UPC)
- viii. 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-2
- ix. 400/220 kV 500 MVA ICT 6 at Gr.Noida(UPC)
- x. 400KV Bus 2 at Gr.Noida(UPC)

Network Diagram

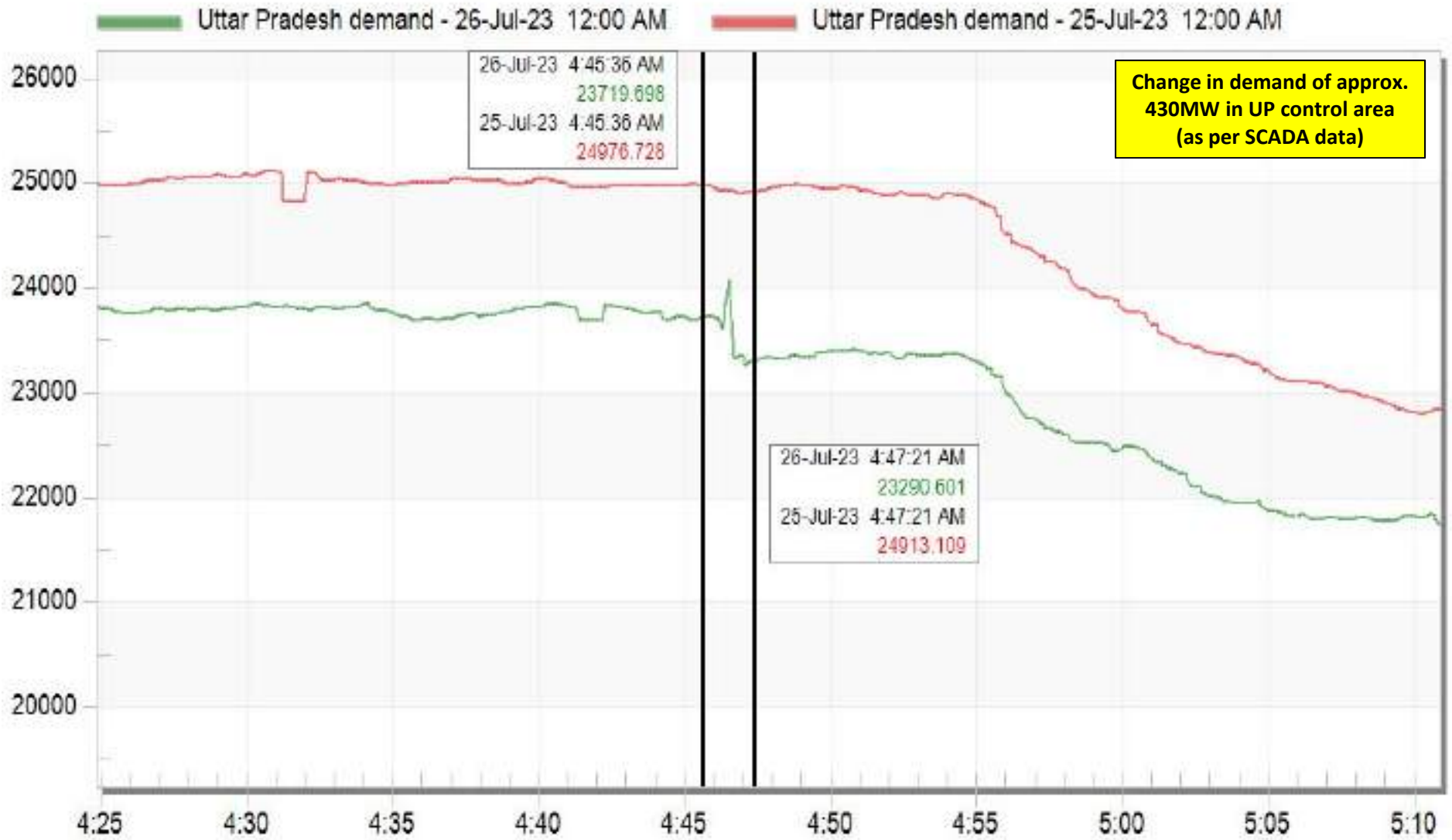


SCADA SLD of 400/220/132kV Greater Noida(UP)



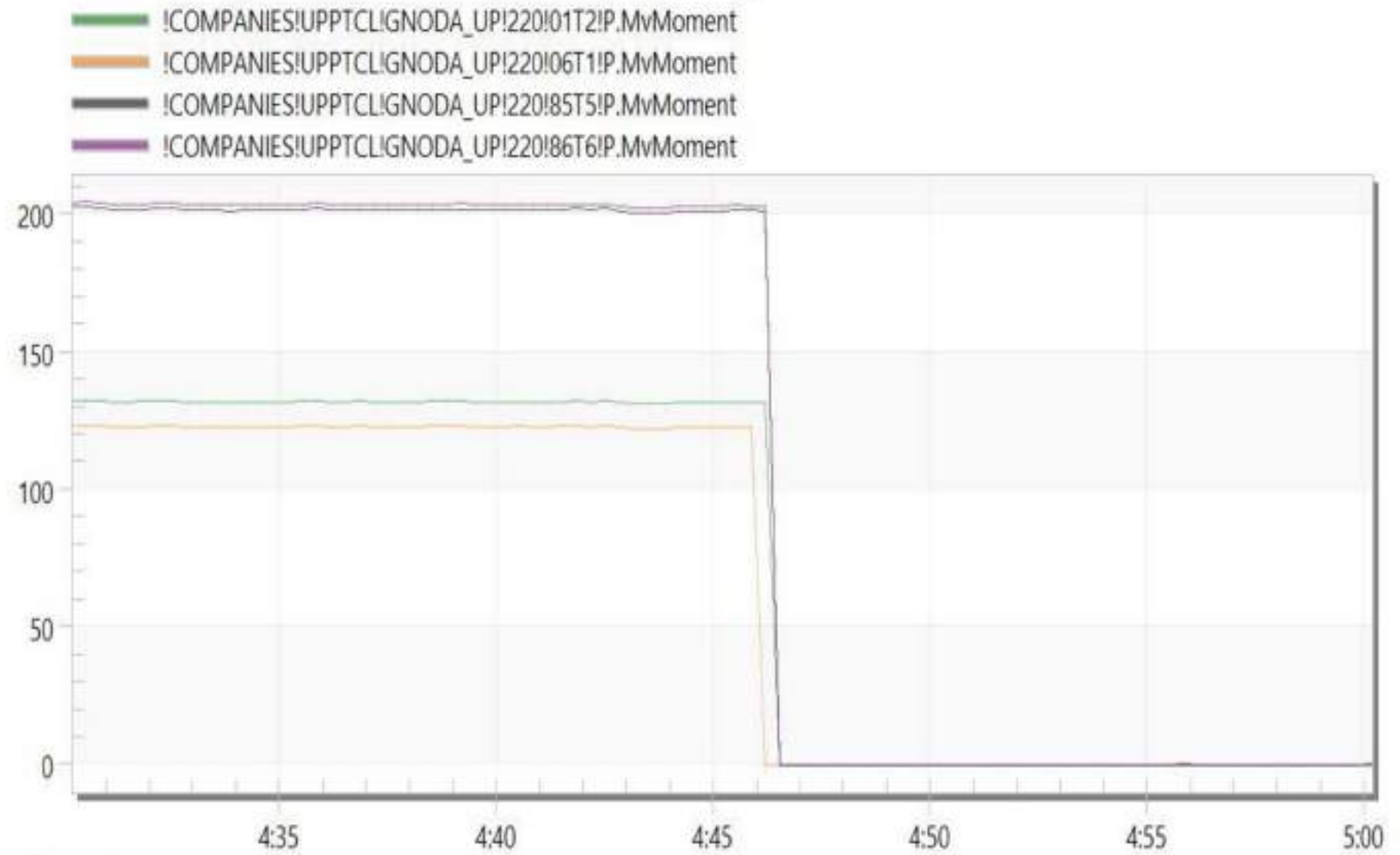
Uttar Pradesh demand during the event

Uttar Pradesh Demand



Jul 26 Wed 2023

Loading of ICTs at Gr. Noida(UP)



Jul 26 Wed 2023

PMU Plot of frequency at Agra(PG)

04:46 hrs/26-Jul-23

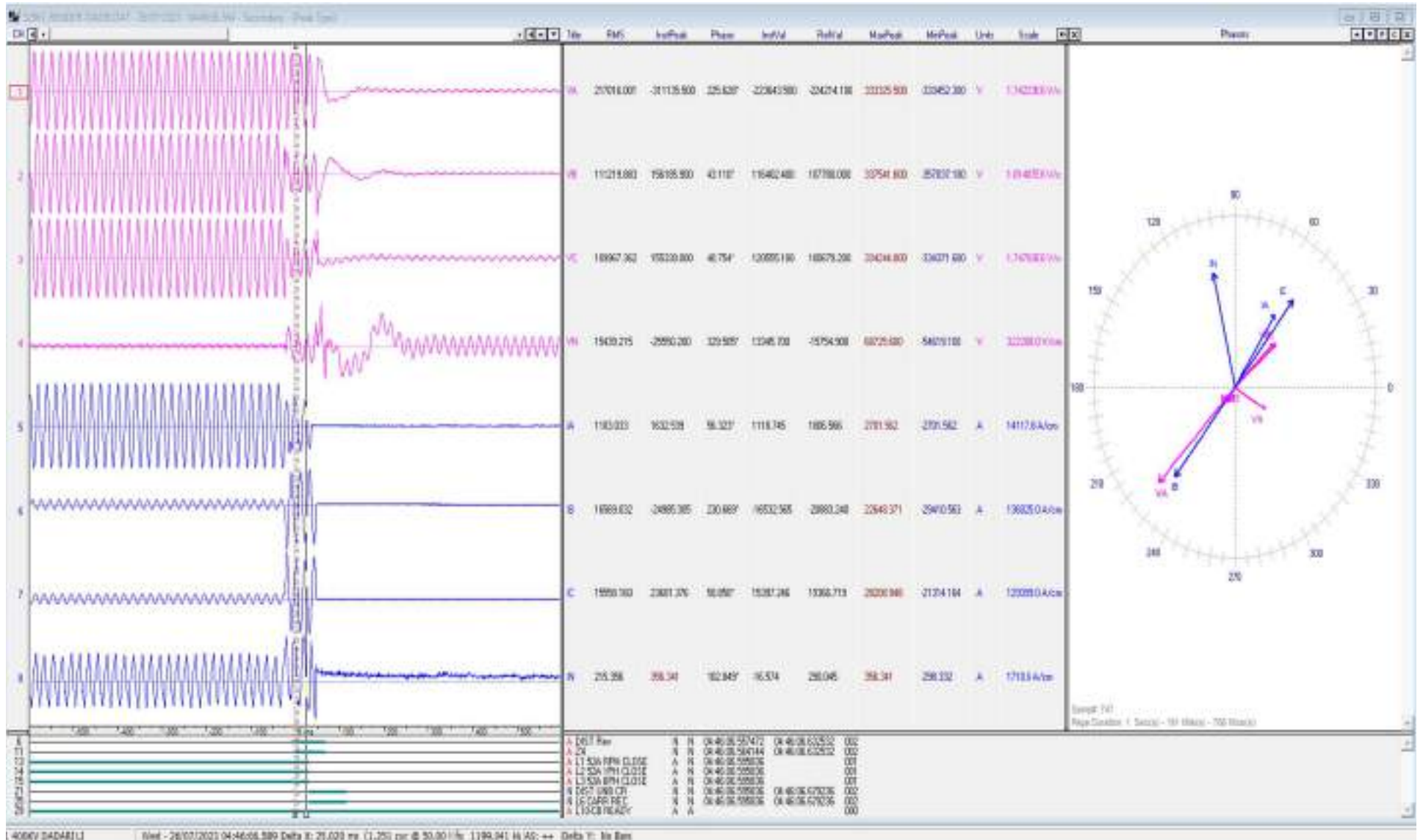


PMU Plot of phase voltage magnitude at Agra(PG)

04:46 hrs/26-Jul-23

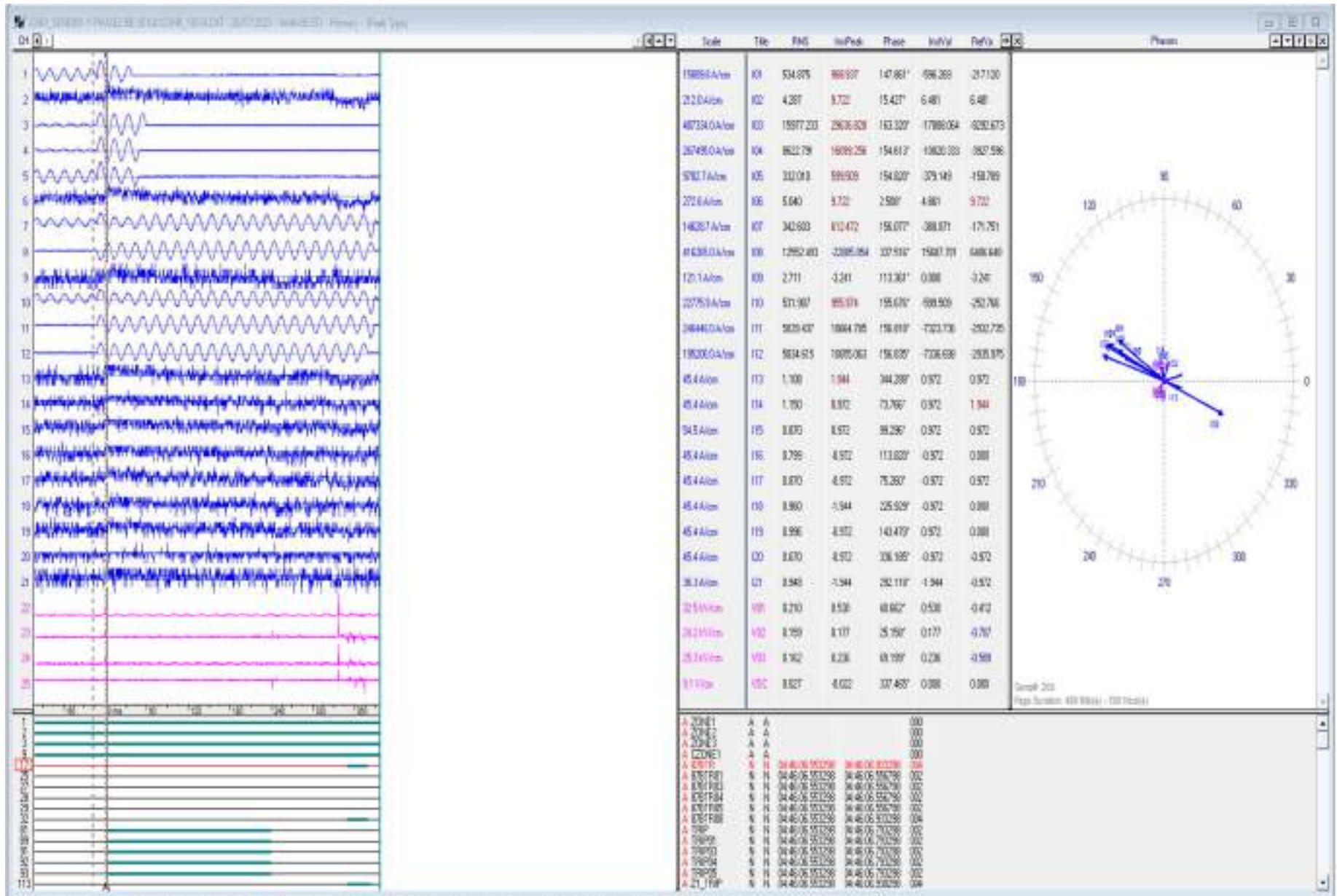


DR of 400 KV Dadri(NT)-Gr.Noida(UPC) (end) (PG) Ckt-1



- ✓ Fault sensed in zone-4
- ✓ Y-B fault, $I_y \approx 16.57\text{kA}$ and $I_b \approx 15.56\text{kA}$

DR of 400 KV Bus-1 at Gr. Noida(UPC)



SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
04:46:06,545	GNODA_UP	400kV	85T5	Circuit Breaker	disturbe	
04:46:06,555	GNODA_UP	400kV	L2NWADA1	Circuit Breaker	Open	Line CB at Gr.Noida(UP) end of 400 KV Gr.Noida(UPC)-Nawada(HV) (PG) Ckt-1 opened
04:46:06,589	GNODA_UP	400kV	06T1	Circuit Breaker	disturbe	
04:46:06,903	GNODA_UP	400kV	05MBC	Circuit Breaker	Open	Main Bus Coupler CB at 400kV Gr.Noida(UPC) opened
04:46:06,944	GNODA_UP	400kV	93GNOD71	Circuit Breaker	Open	Line CB at Gr.Noida(UP) end of 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-1 opened
04:46:06,944	GNODA_UP	400kV	94GNOD72	Circuit Breaker	Open	Line CB at Gr.Noida(UP) end of 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-2 opened
04:46:06,946	GNODA_UP	400kV	86T6	Circuit Breaker	Open	CB at 400kV side of 400/220 kV 500 MVA ICT 6 at Gr.Noida(UPC) opened
04:46:06,950	GNODA_UP	400kV	03T2	Circuit Breaker	Open	CB at 400kV side of 400/220 kV 315 MVA ICT 2 at Gr.Noida(UPC) opened
04:46:07,904	GNODA_UP	400kV	93GNOD71	Circuit Breaker	disturbe	
04:46:17,000	GNODA_UP	220kV	86T6	Circuit Breaker	disturbe	
04:47:36,922	GNOD7_UP	400kV	415GNDA2	Circuit Breaker	Open	Main CB at Gr.Noida_2(UP) end of 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-2 opened
04:47:36,922	GNOD7_UP	400kV	414SPGD2	Circuit Breaker	Open	Tie CB at Gr.Noida_2(UP) end of 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-2 opened
04:47:36,923	GNOD7_UP	400kV	417SPGD1	Circuit Breaker	Open	Tie CB at Gr.Noida_2(UP) end of 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-1 opened
04:47:36,924	GNOD7_UP	400kV	418GNDA1	Circuit Breaker	Open	Main CB at Gr.Noida_2(UP) end of 400 KV Gr.Noida_2(UPC)-Gr.Noida(UPC) (UP) Ckt-1 opened

Point of discussion

- i. Reason of delayed operation of bus coupler CB need to be identified and rectified.
- ii. Healthiness of protection system need to be ensured.
- iii. Reason of delayed clearance of fault need to be shared.
- iv. DR of bus bar relay need to be shared.
- v. Remedial action taken report need to be shared.

**Multiple elements tripping at
220kV Nara(UP)**

**26th July 2023 at
05:30 hrs**

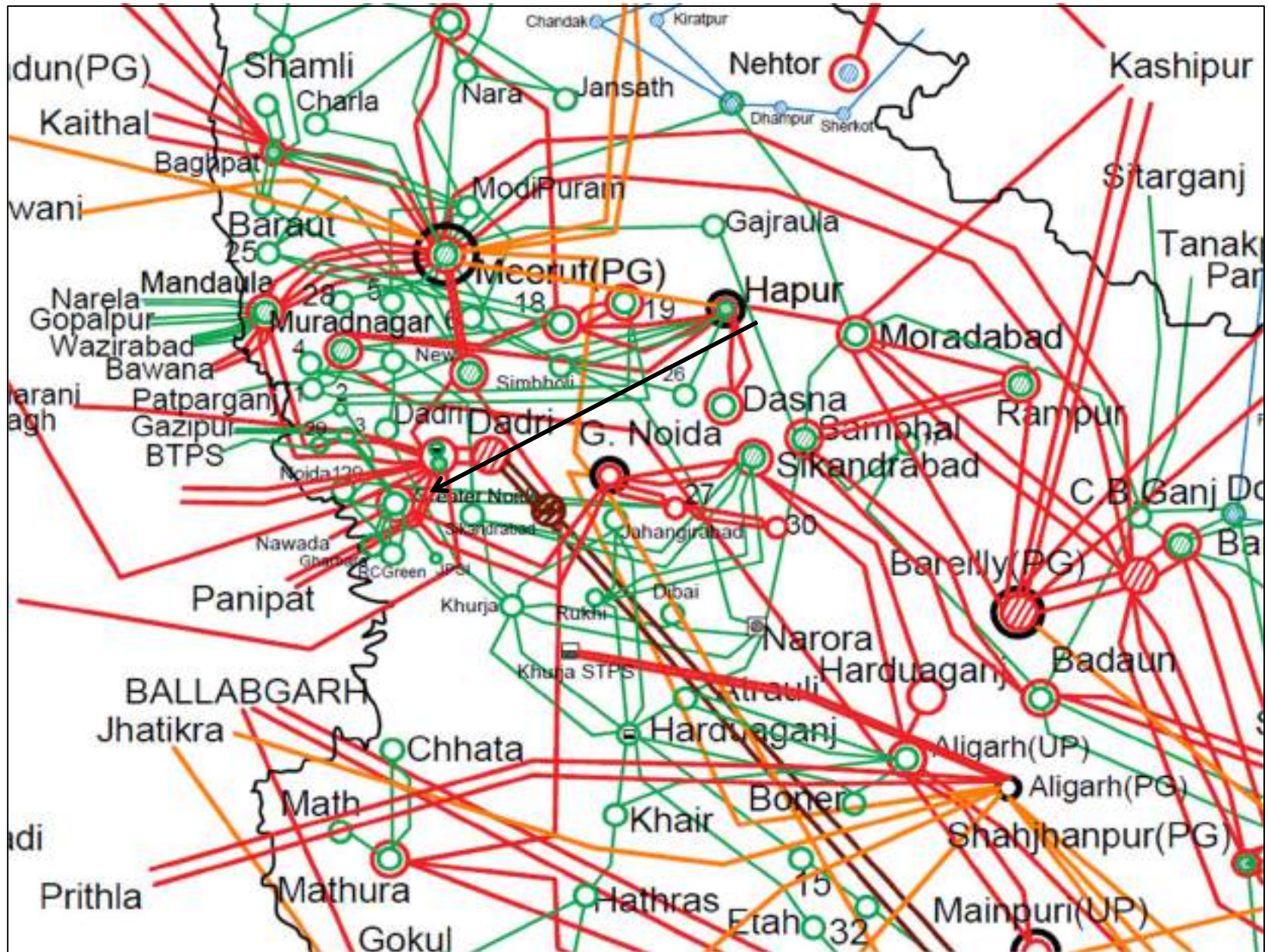
Brief of event:

- 220kV side of 220/132kV Muzaffarnagar2(Nara)(UP) has main and transfer bus scheme.
- As reported, at 05:30 hrs, 220kV Nara(UP)-Roorkee(UK) (UP) Ckt tripped from Roorkee end only on R-N fault.
- This fault was sensed by Nara(UP) end in Z-1 with fault current of approx. 4.8 kA and fault distance of 31.9 km. However, relay at Nara(UP) failed to initiate tripping command.

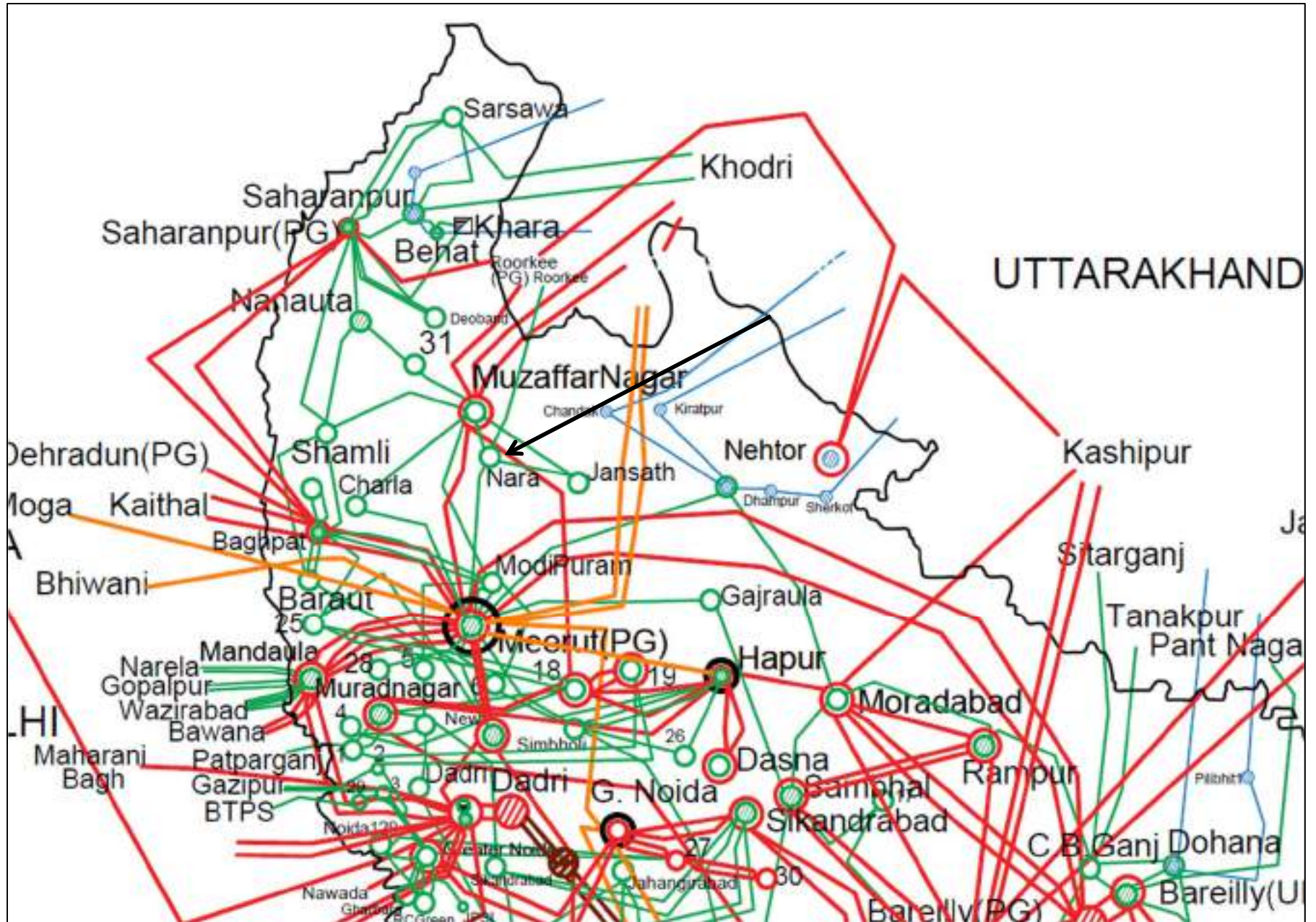
Elements tripped:

- i. 220kV Nara(UP)-Roorkee(UK) (UP) Ckt
- ii. 220 KV Meerut(PG)-Nara(UP) (PG) Ckt
- iii. 220kV Nara(UP)-Jansath(UP) Ckt
- iv. 220kV Nara(UP)-Muzaffarnagar(UP) Ckt
- v. 220/132kV 160MVA ICT-1 at Nara(UP)

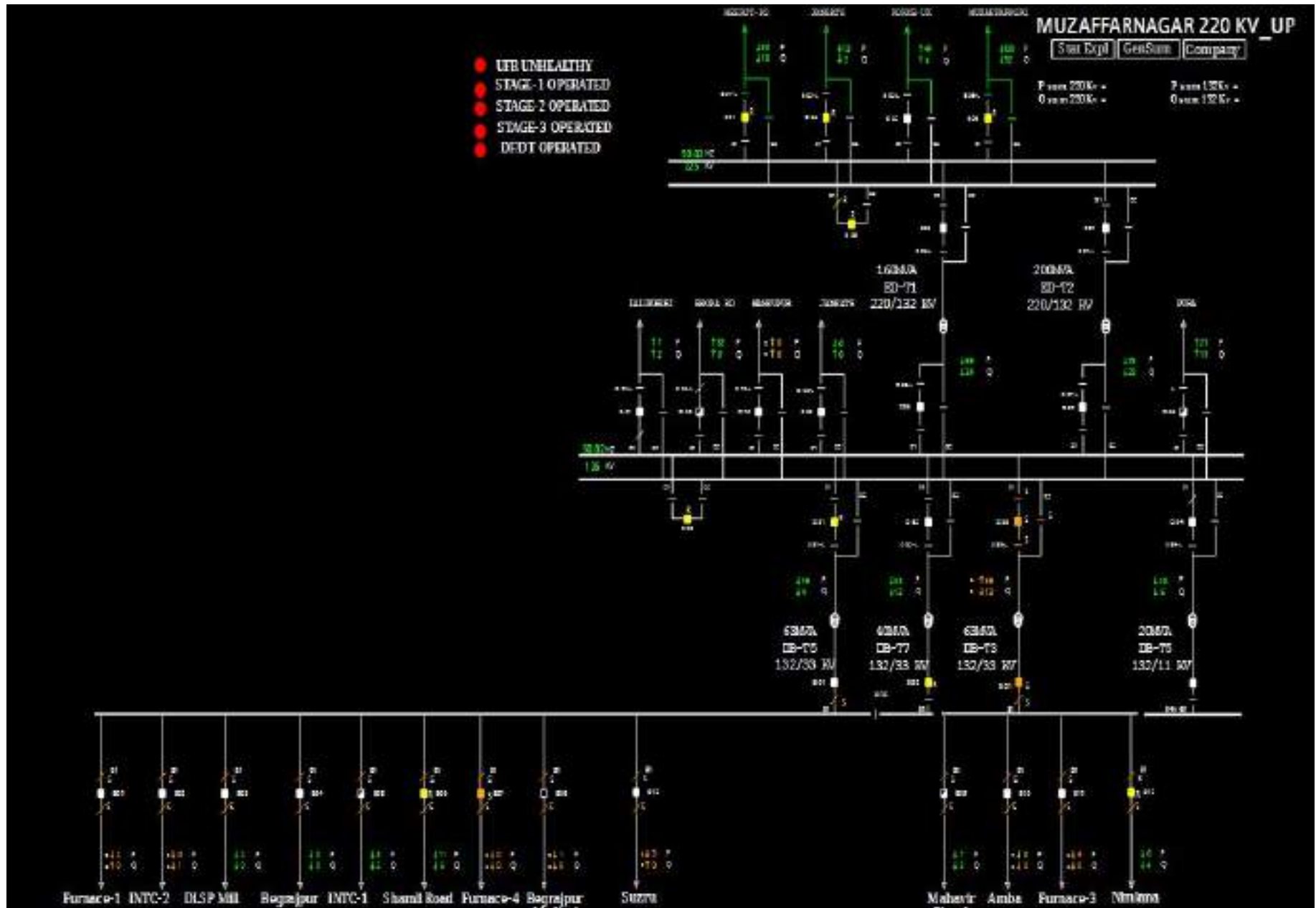
Network Diagram



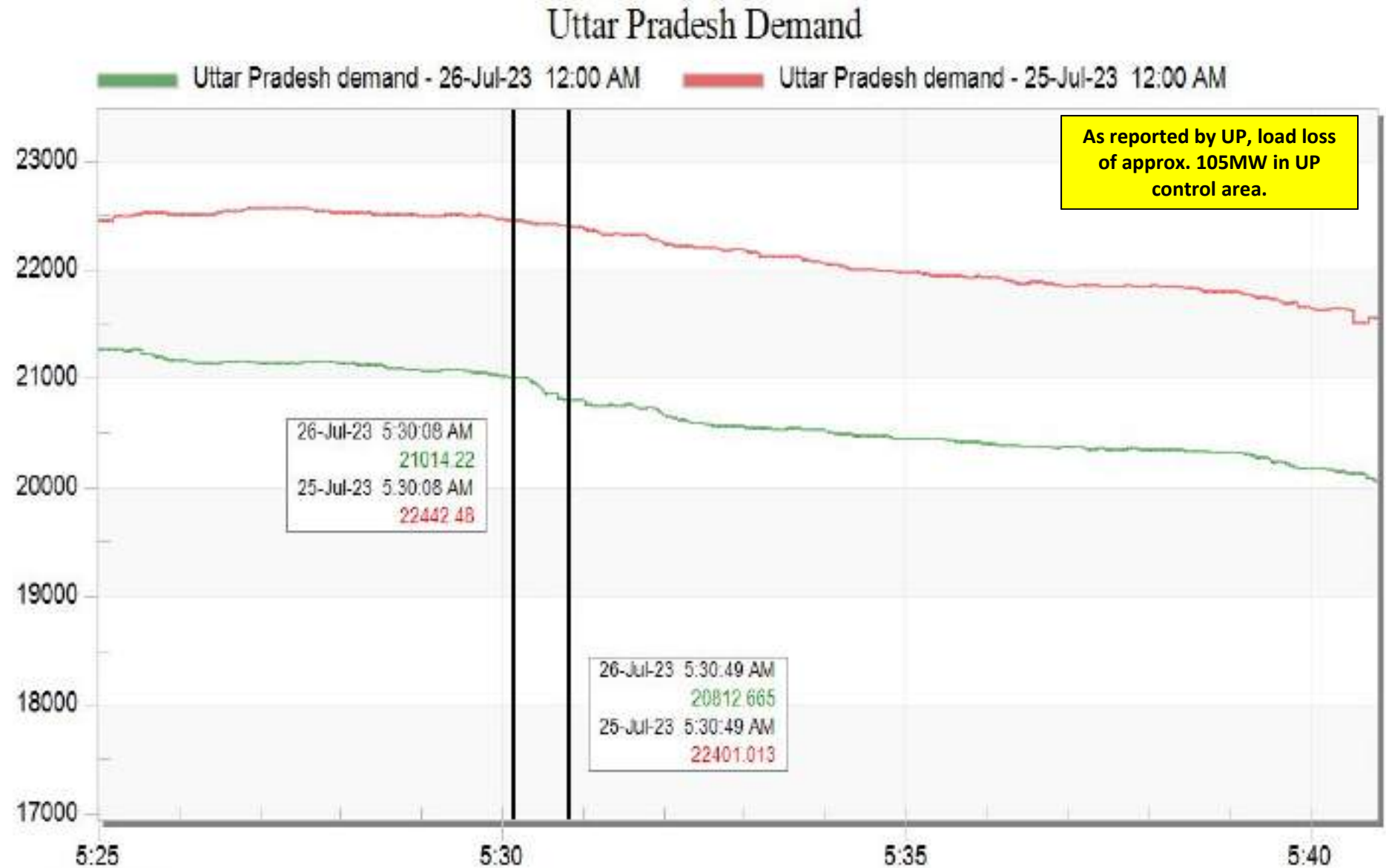
Network Diagram



SCADA SLD of 220/132kV Muzaffarnagar(Nara)(UP)



Uttar Pradesh demand during the event



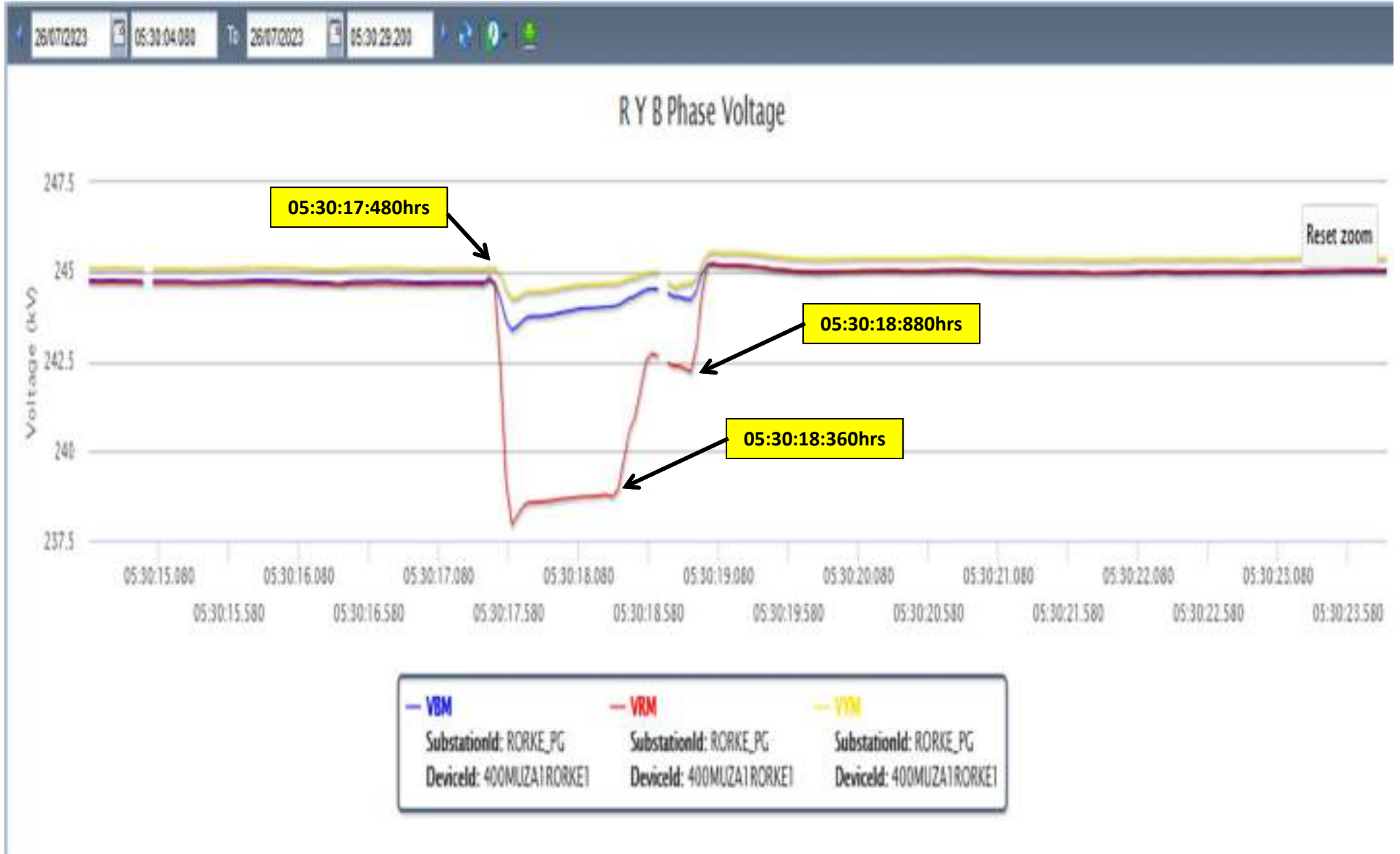
PMU Plot of frequency at Roorkee(PG)

05:30 hrs/26-Jul-23

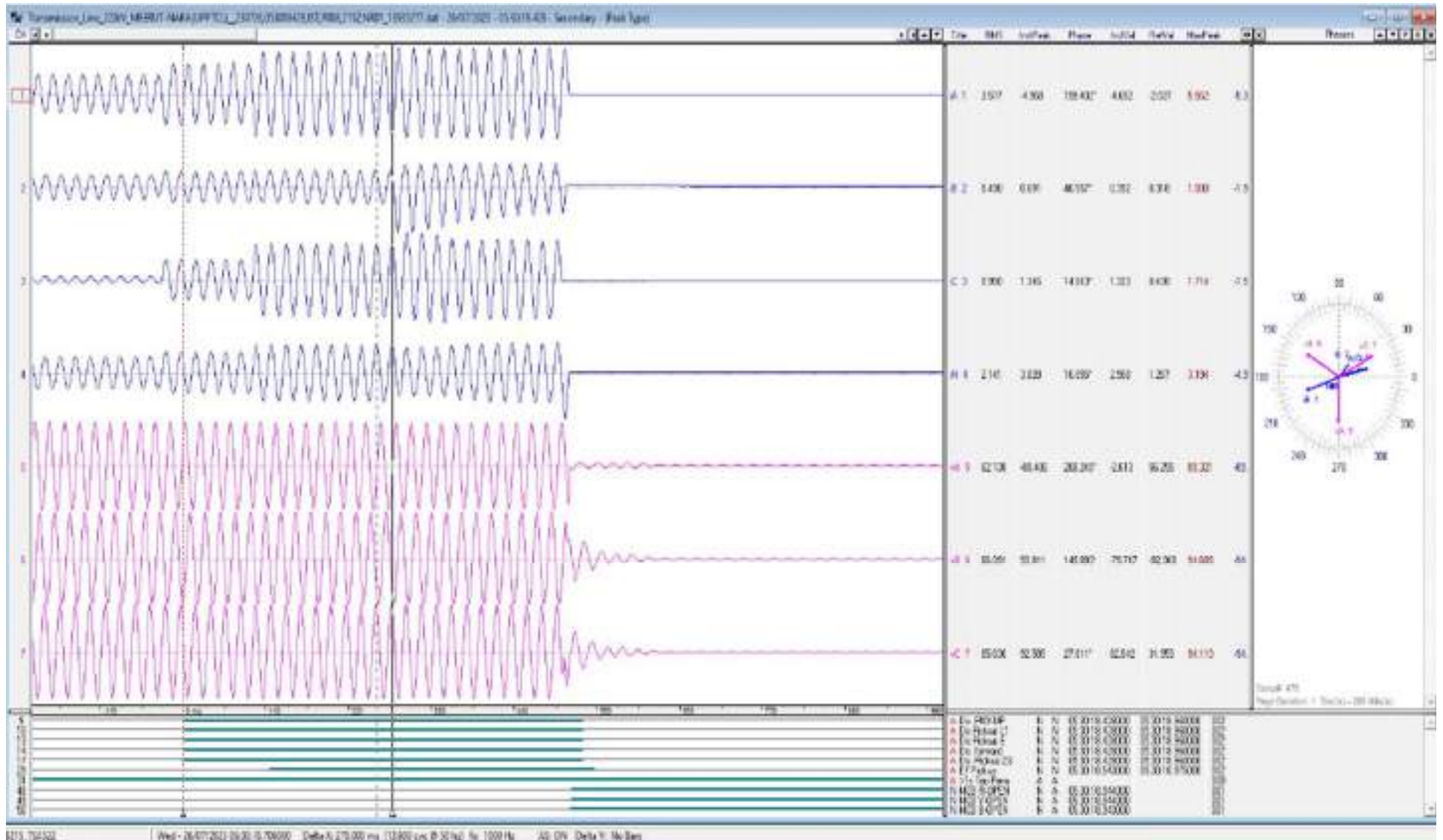


PMU Plot of phase voltage magnitude at Roorkee(PG)

05:30 hrs/26-Jul-23

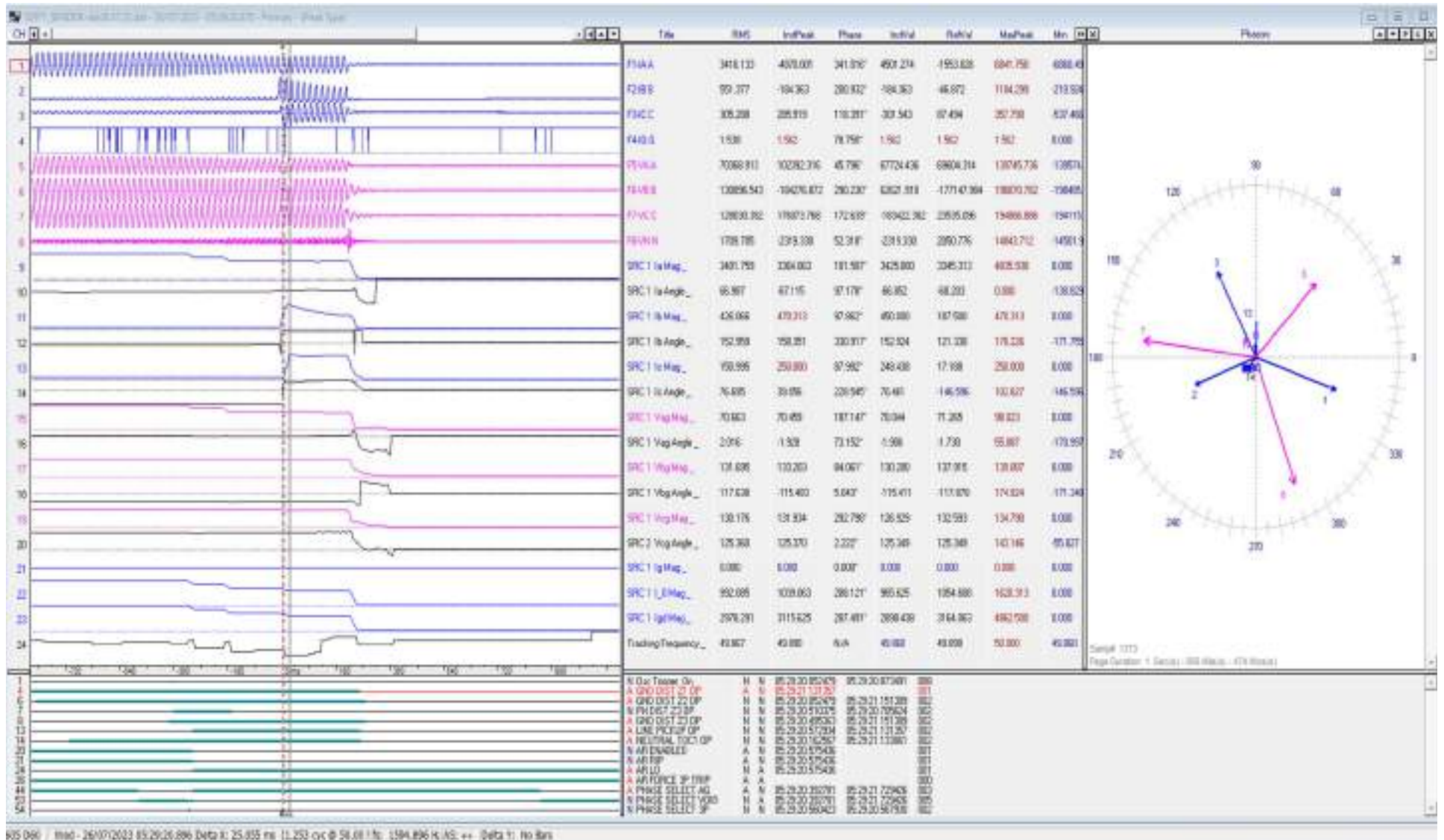


DR of 220 KV Meerut(PG) (end)-Nara(UP) (PG) Ckt-1



- ✓ Fault sensed in zone-3
- ✓ R-N fault, $I_r \approx 3.517 \text{ kA}$

DR of 220 KV Nara(UP) (end)-Roorkee(UK) (UP) Ckt-1



- ✓ Fault sensed in zone-1
- ✓ R-N fault, $I_r \approx 3.416 \text{ kA}$

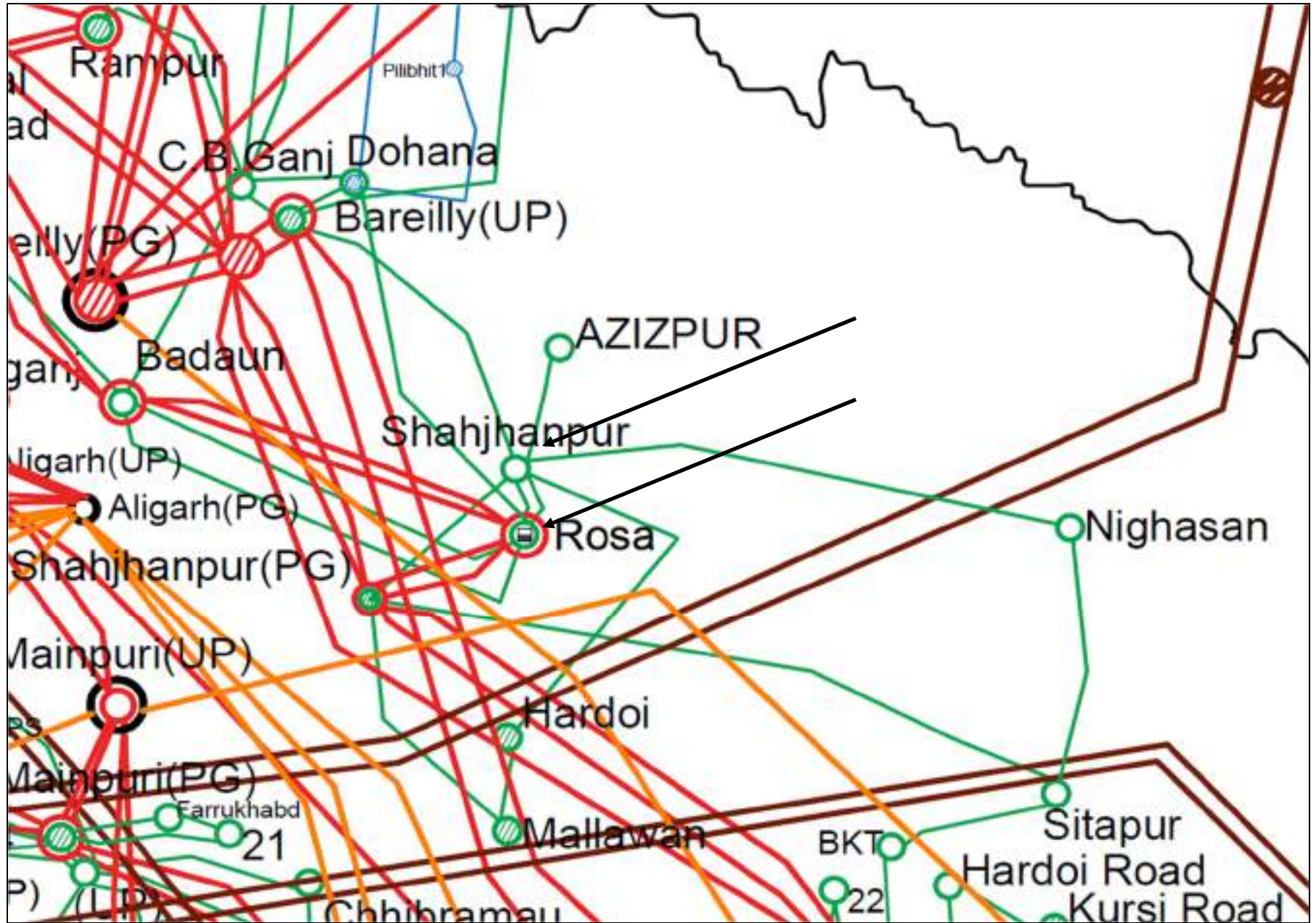
SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
05:30:18,391	MUZA1_UP	220kV	87JANSTH	Circuit Breaker	Open	Line CB at Muzaffarnagar(UP) end of 220kV Muzaffarnagar(UP)-Jansath(UP) Ckt opened
05:30:18,546	MUZA2_UP	220kV	86T1	Circuit Breaker	Open	CB at 220kV side of 220/132kV 160MVA ICT-1 at Nara(UP) opened
05:30:18,562	MUZA2_UP	132kV	86T1	Circuit Breaker	Open	CB at 132kV side of 220/132kV 160MVA ICT-1 at Nara(UP) opened
05:30:18,949	MEERT_PG	220kV	06MUZA2	Circuit Breaker	Open	Line CB at Meerut(PG) end of 220kV Nara(UP)-Meerut(PG) Ckt opened

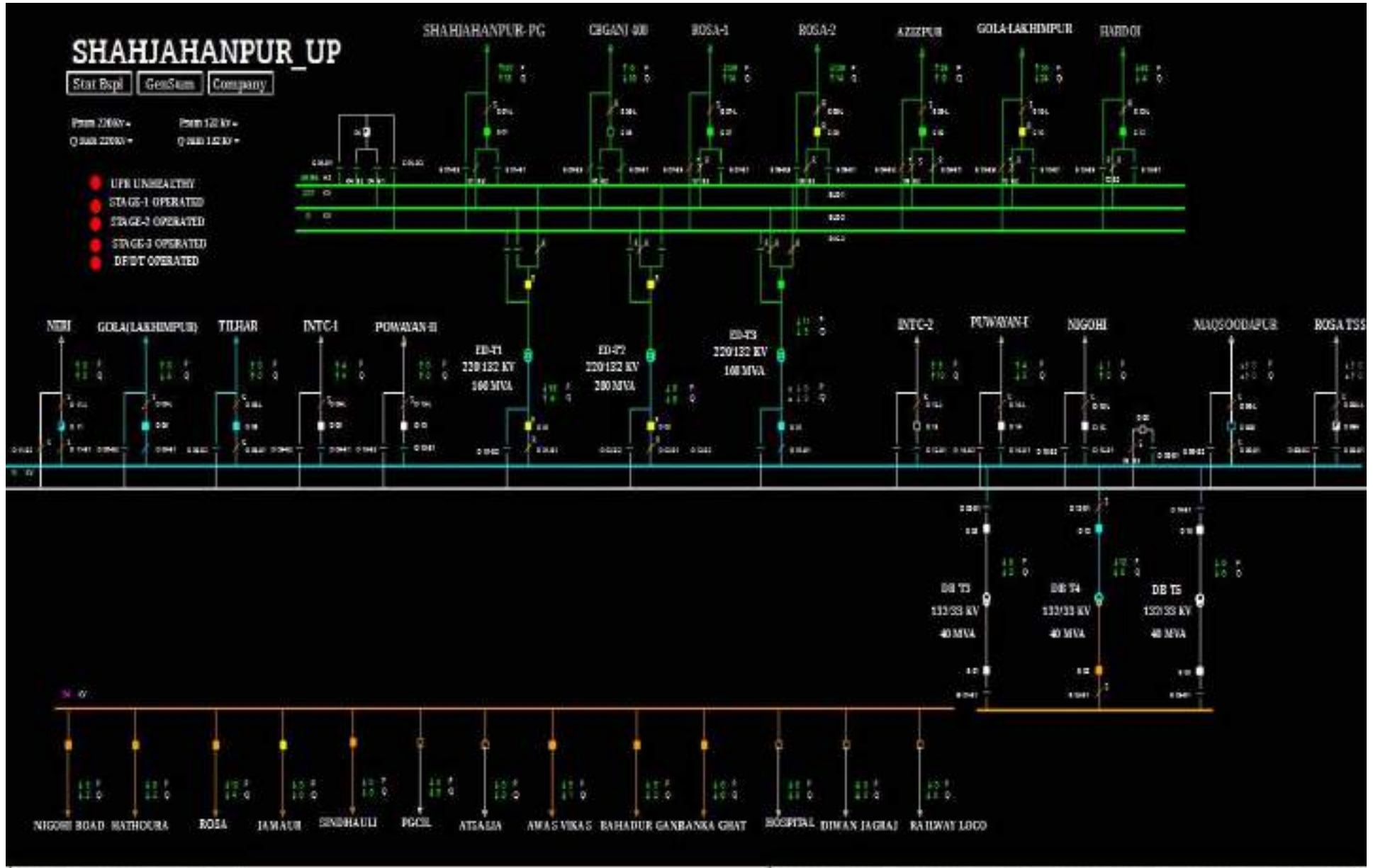
**Multiple elements tripping at
220kV Shahjhanpur(UP)**

**22nd August 2023 at
12:39 hrs**

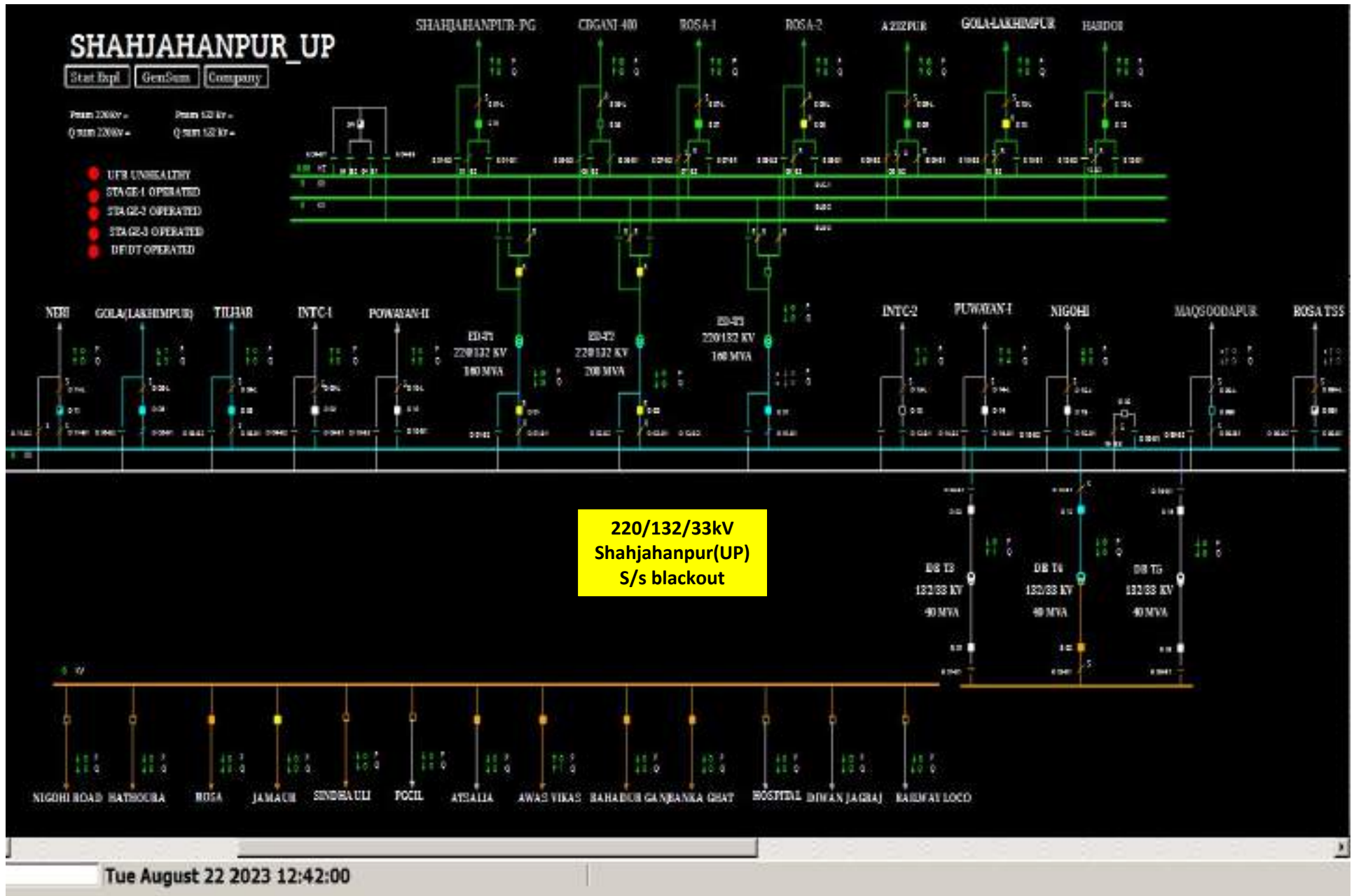
Network Diagram



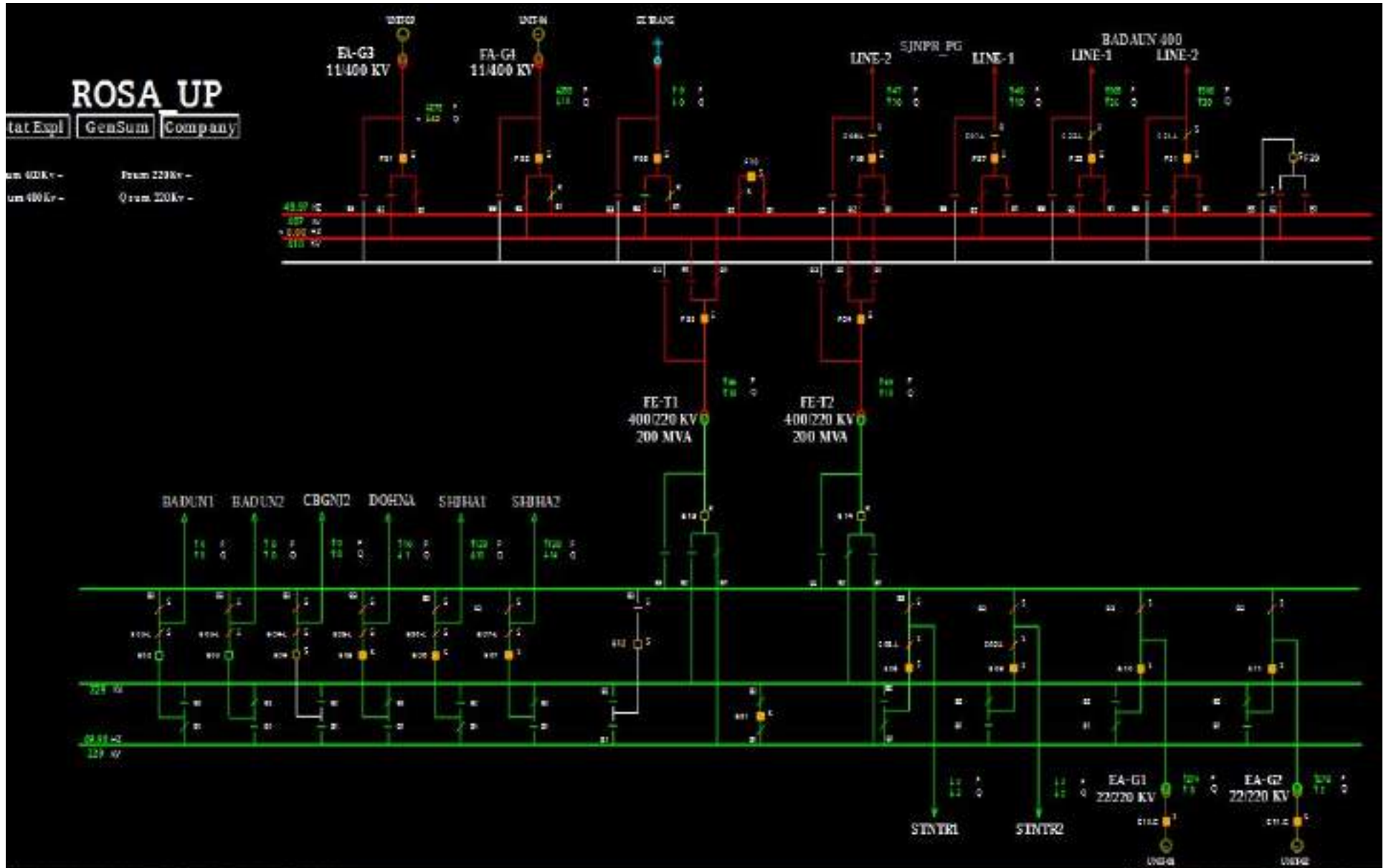
SLD of 220/132/33kV Shahjahanpur(UP) before the event



SLD of 220/132/33kV Shahjahanpur(UP) after the event

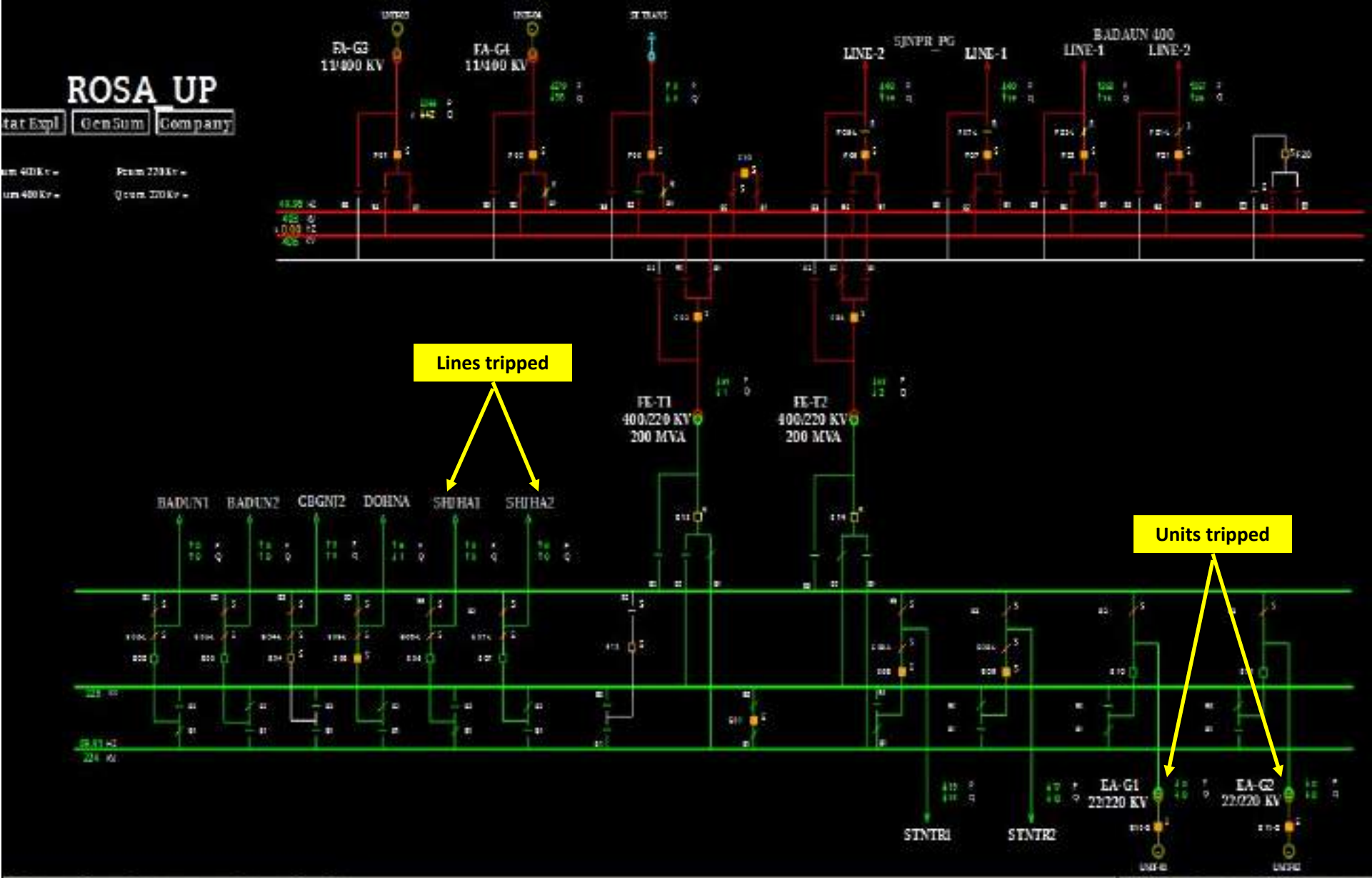


SLD of 400/220kV Rosa TPS(UP) before the event



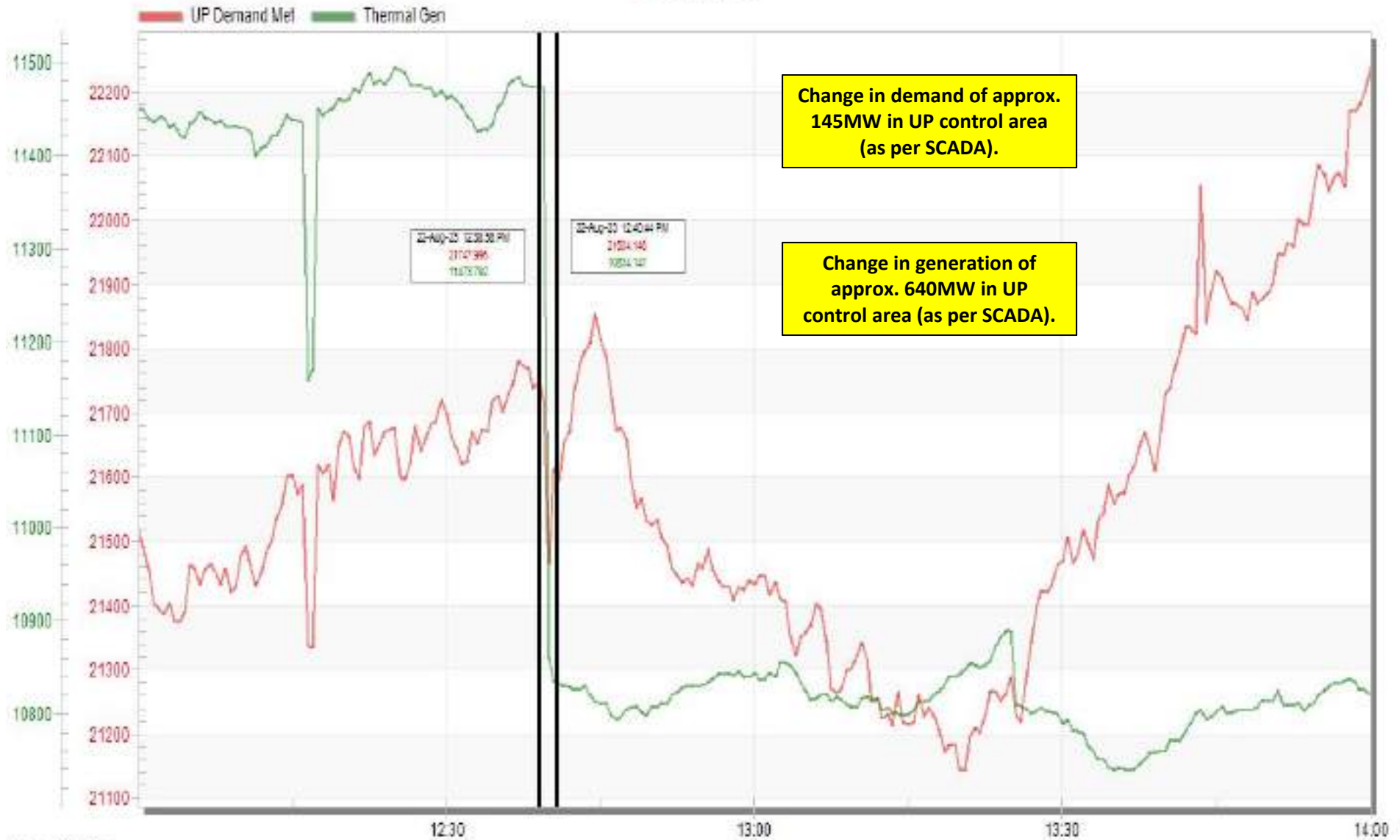
Tue August 22 2023 12:37:00

SLD of 400/220kV Rosa TPS(UP) after the event

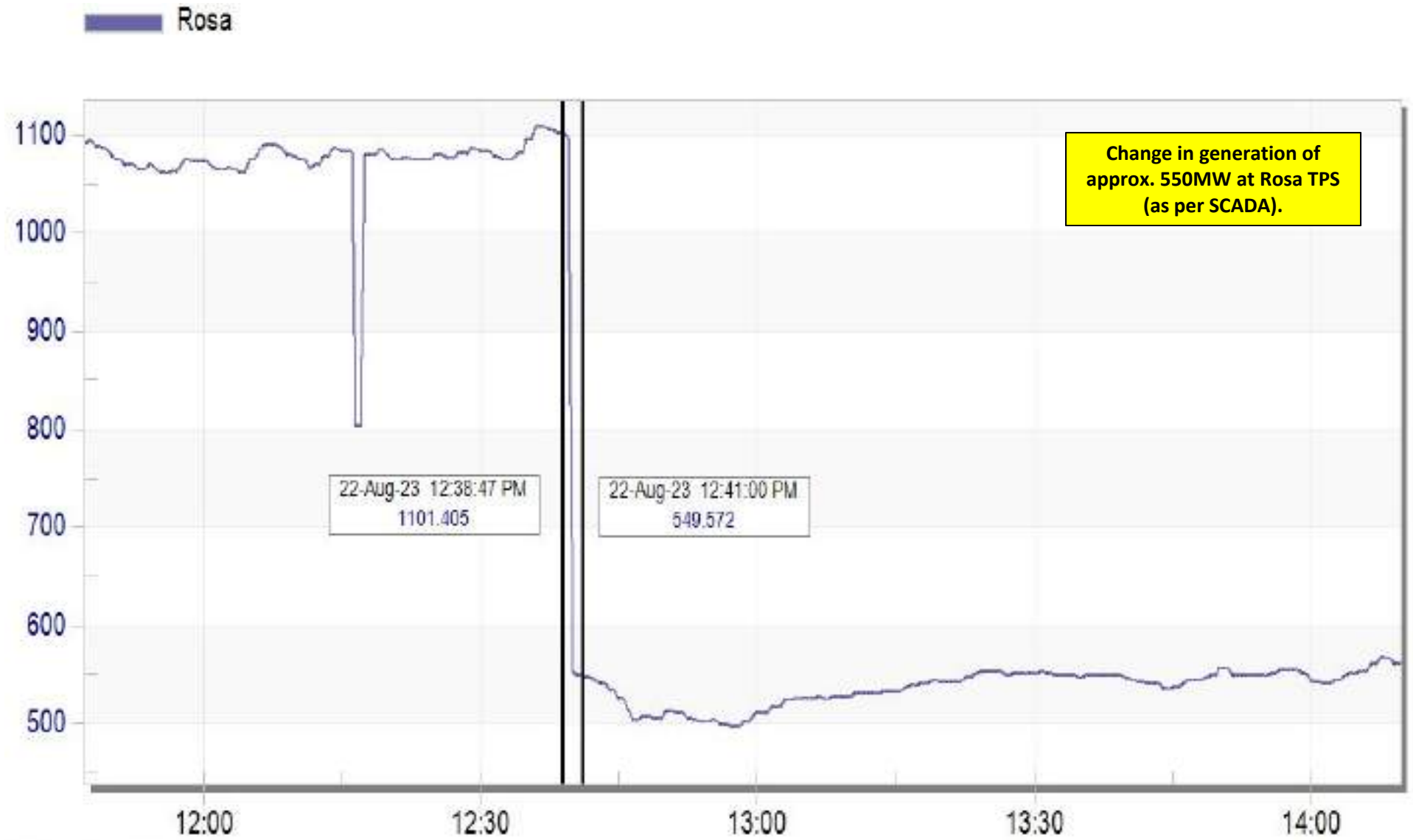


Uttar Pradesh demand vs generation during the event

UP Demand Met



Rosa TPS generation during the event



Aug 22 Tue 2023

PMU Plot of frequency at Lucknow(PG)

12:39 hrs/22-Aug-23

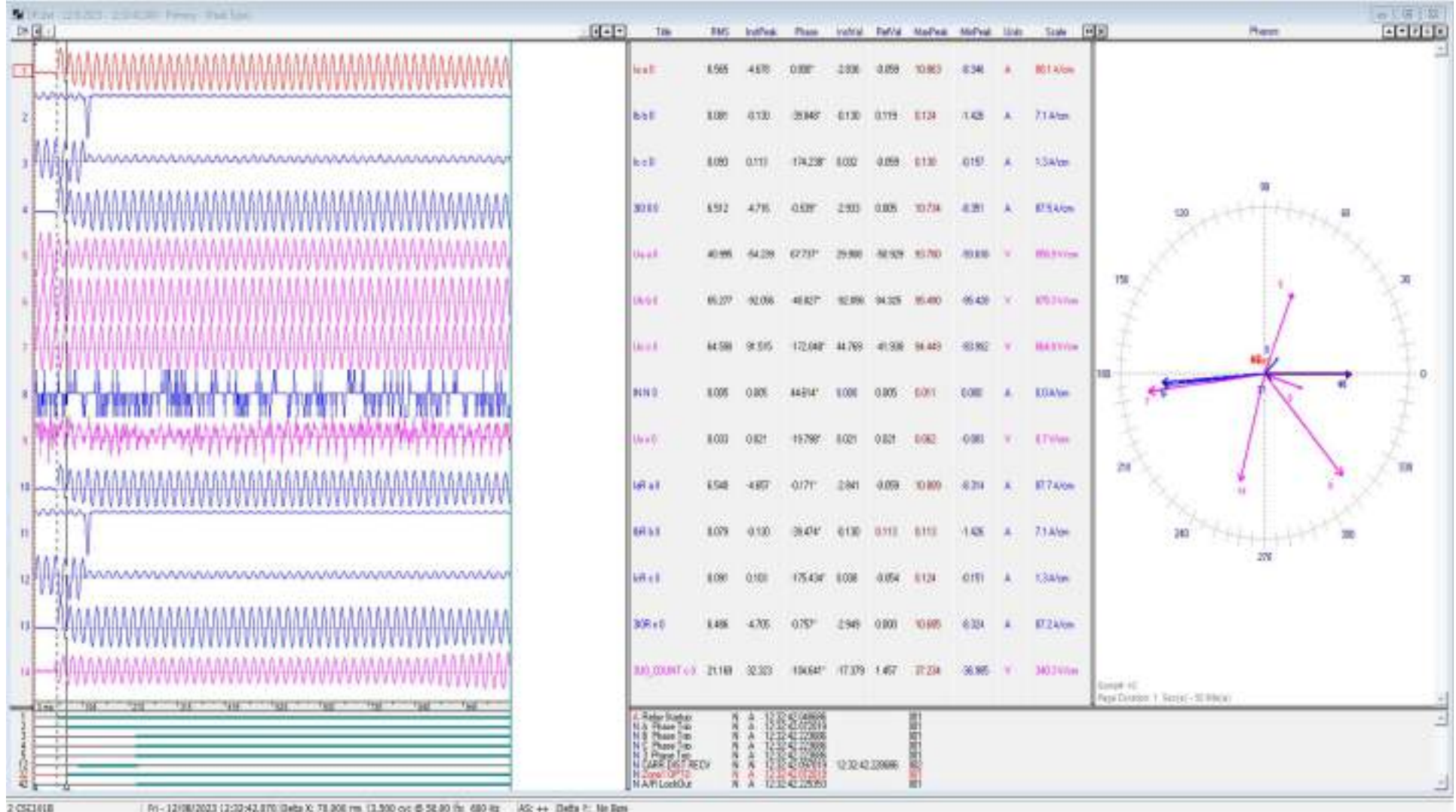


PMU Plot of phase voltage magnitude at Lucknow(PG)

12:39 hrs/22-Aug-23

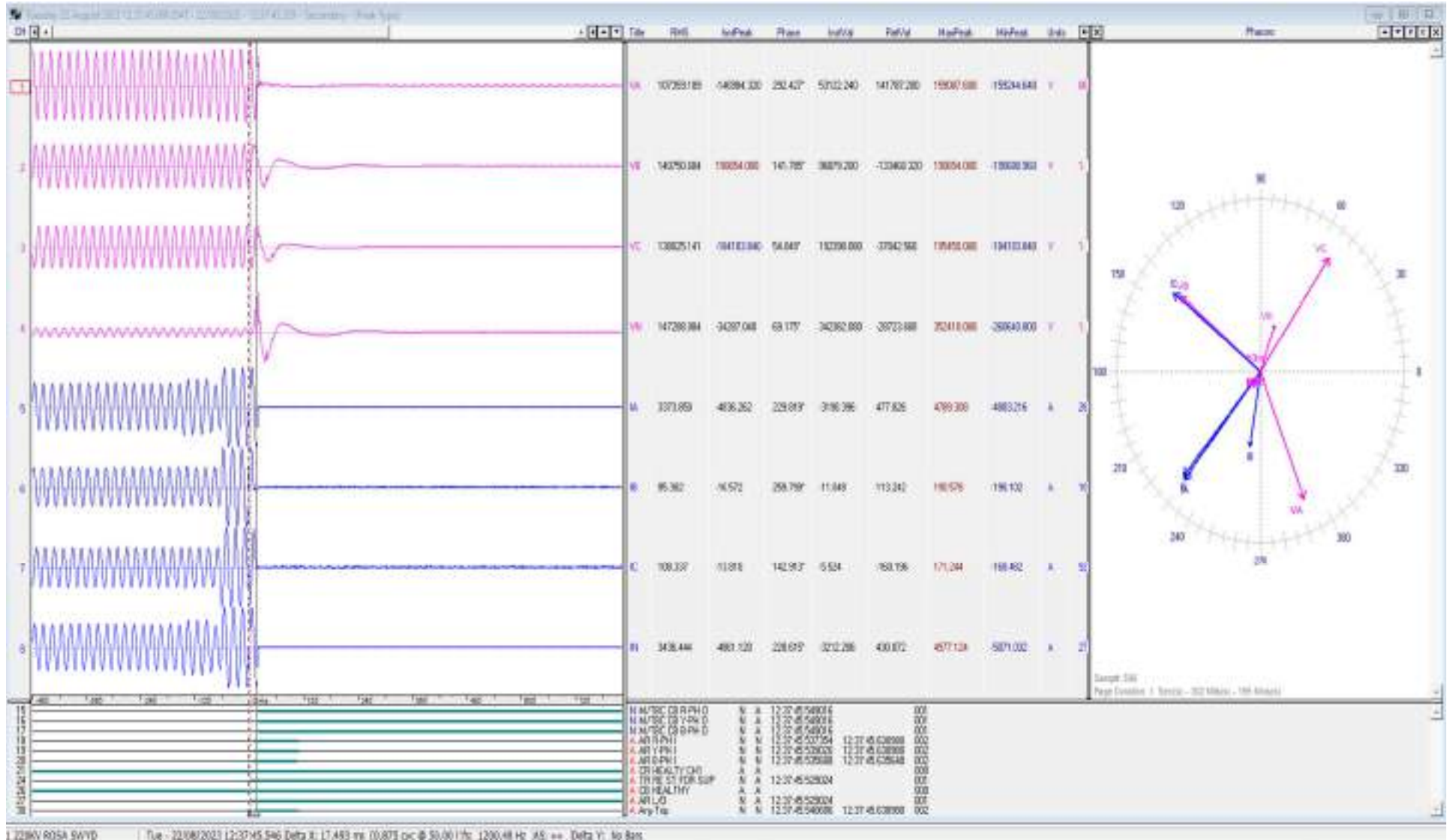


DR of 220kV Shahjahanpur(end)-Azizpur (UP) Ckt



- ✓ Fault in R-phase; Fault current= $\sim 6.56\text{kA}$
- ✓ Zone-1 distance protection operated
- ✓ No indication of master trip relay operation
- ✓ Time sync issue

DR of 300MW Rosa TPS Unit-1



- ✓ Fault in R-phase; Fault current= $\sim 3.37\text{kA}$
- ✓ Standby earth fault protection operated

SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
12:39:16,640	AZIZN_UP	220kV	06SHJHA	Circuit Breaker	Open	Line CB at Azizpur(UP) end of 220kV Shahjahanpur-Azizpur (UP) Ckt opened
12:39:17,430	HAROD_UP	220kV	02SHJHA	Circuit Breaker	Open	Line CB at Hardoi(UP) end of 220kV Shahjahanpur-Hardoi (UP) Ckt opened
12:39:17,726	AZIZN_UP	132kV	07JALAL	Circuit Breaker	Open	Line CB at Azizpur(UP) end of 132kV Jalalbad-Azizpur (UP) Ckt opened
12:39:17,869	SHJHA_UP	220kV	11T3	Circuit Breaker	Open	CB at 220kV side of 220/132kV 160MVA ICT 3 at Shahjahanpur(UP) opened
12:39:18,156	GOLAG_UP	220kV	06SJNPR	Circuit Breaker	Open	Line CB at Gola-lakhimpur(UP) end of 220kV Shahjahanpur-Gola-lakhimpur (UP) Ckt opened
12:39:19,322	CBGA1_UP	400kV	10UNNAO1	Circuit Breaker	Open	Line CB at Bareilly(UP) end of 400kV Bareilly -Unnao (UP) Ckt-1 opened
12:39:19,414	ROSA__UP	220kV	06SHJHA1	Circuit Breaker	Open	Line CB at Rosa(UP) end of 220kV Shahjahanpur-Rosa (UP) Ckt-1 opened
12:39:19,487	ROSA__UP	220kV	07SHJHA2	Circuit Breaker	Open	Line CB at Rosa(UP) end of 220kV Shahjahanpur-Rosa (UP) Ckt-2 opened
12:39:24,642	ROSA__UP	220kV	11G2	Circuit Breaker	Open	CB at 220kV side of 300MW Unit-2 at Rosa TPS(UP) opened
12:39:25,493	ROSA__UP	220kV	10G1	Circuit Breaker	Open	CB at 220kV side of 300MW Unit-1 at Rosa TPS(UP) opened

**Multiple elements tripping at
400/220kV Bhadla(RS)**

**18th July 2023 at
19:56 hrs**

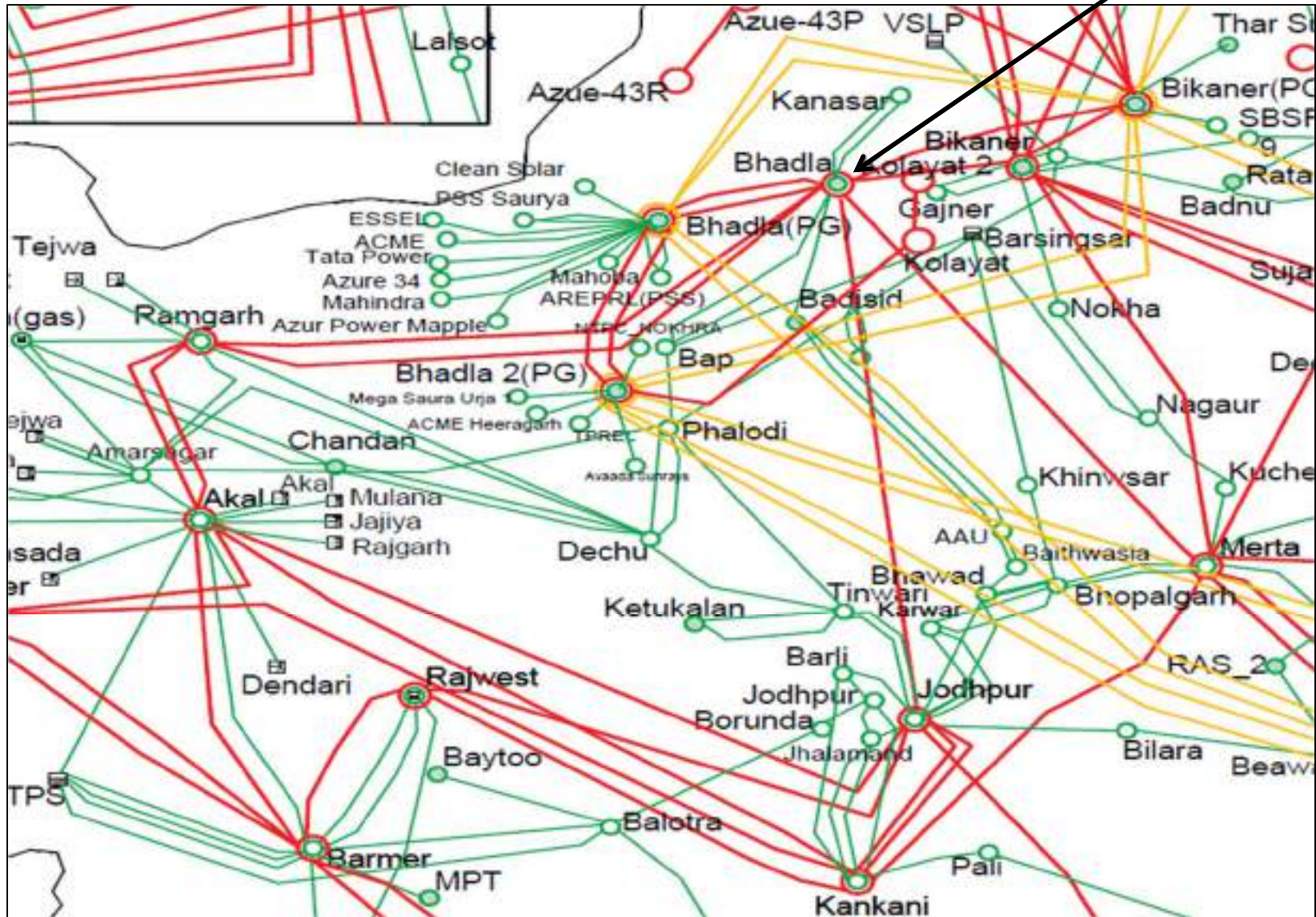
Brief of event:

- 400/220kV Bhadla(Raj) has one and half breaker scheme at 400kV side and double main & transfer bus scheme at 220kV side.
- During antecedent condition, 400/220 kV 500 MVA ICT 1&3 at Bhadla(RS) were carrying ~141MW each and 400/220 kV 500 MVA ICT 2 at Bhadla(RS) was not in service.
- As reported, at 19:56hrs, R-N phase to earth fault occurred on 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2. Fault was in Z-1 from Bhadla(RS) end and in Z-2 from Bhadla(PG) end.

Elements tripped:

- i. 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-1
- ii. 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2
- iii. 400 KV Bhadla-Ramgarh (RS) Ckt-1
- iv. 400 KV Bhadla-Ramgarh (RS) Ckt-2

Network Diagram before the event



SLD of 400/220kV Bhadla(Raj) before the event

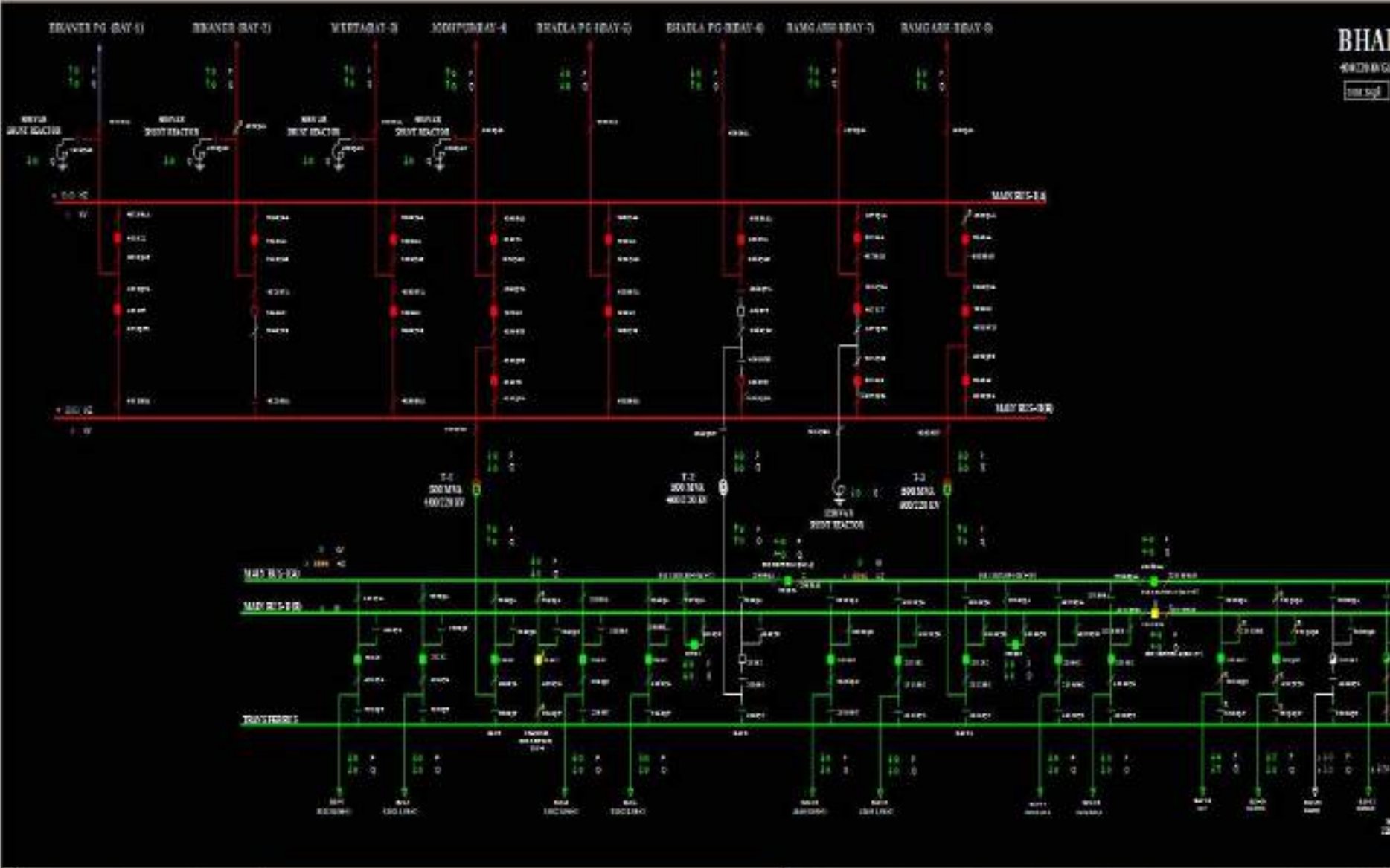


SLD of 400/220kV Bhadla(Raj) before the event



Tue July 18 2023 19:53:00

SLD of 400/220kV Bhadla(Raj) after the event



Tue July 18 2023 20:00:00

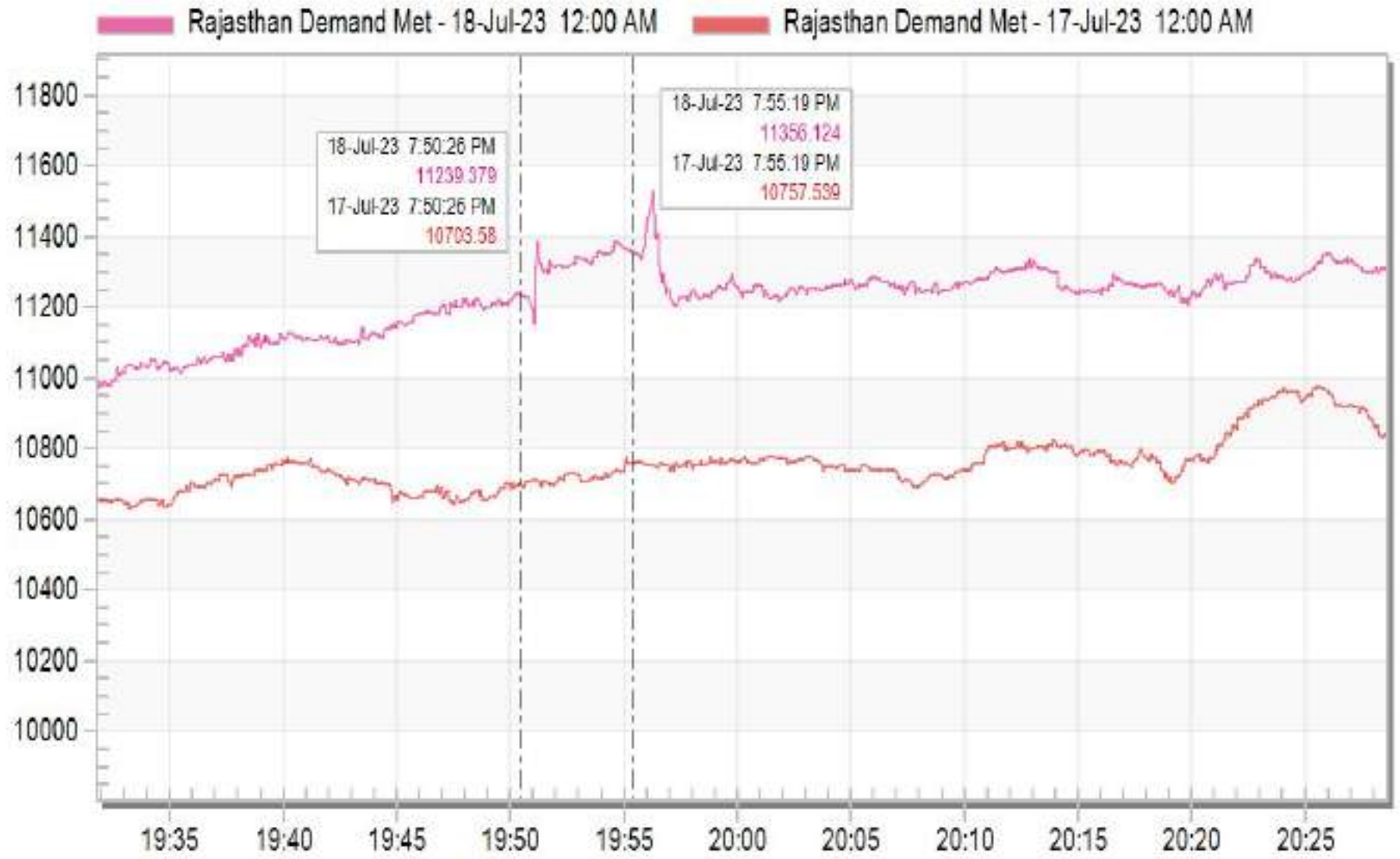
SLD of 400/220kV Bhadla(Raj) after the event



Tue July 18 2023 20:00:00

Rajasthan demand during the event

Rajasthan Demand Met



Jul 18 Tue 2023

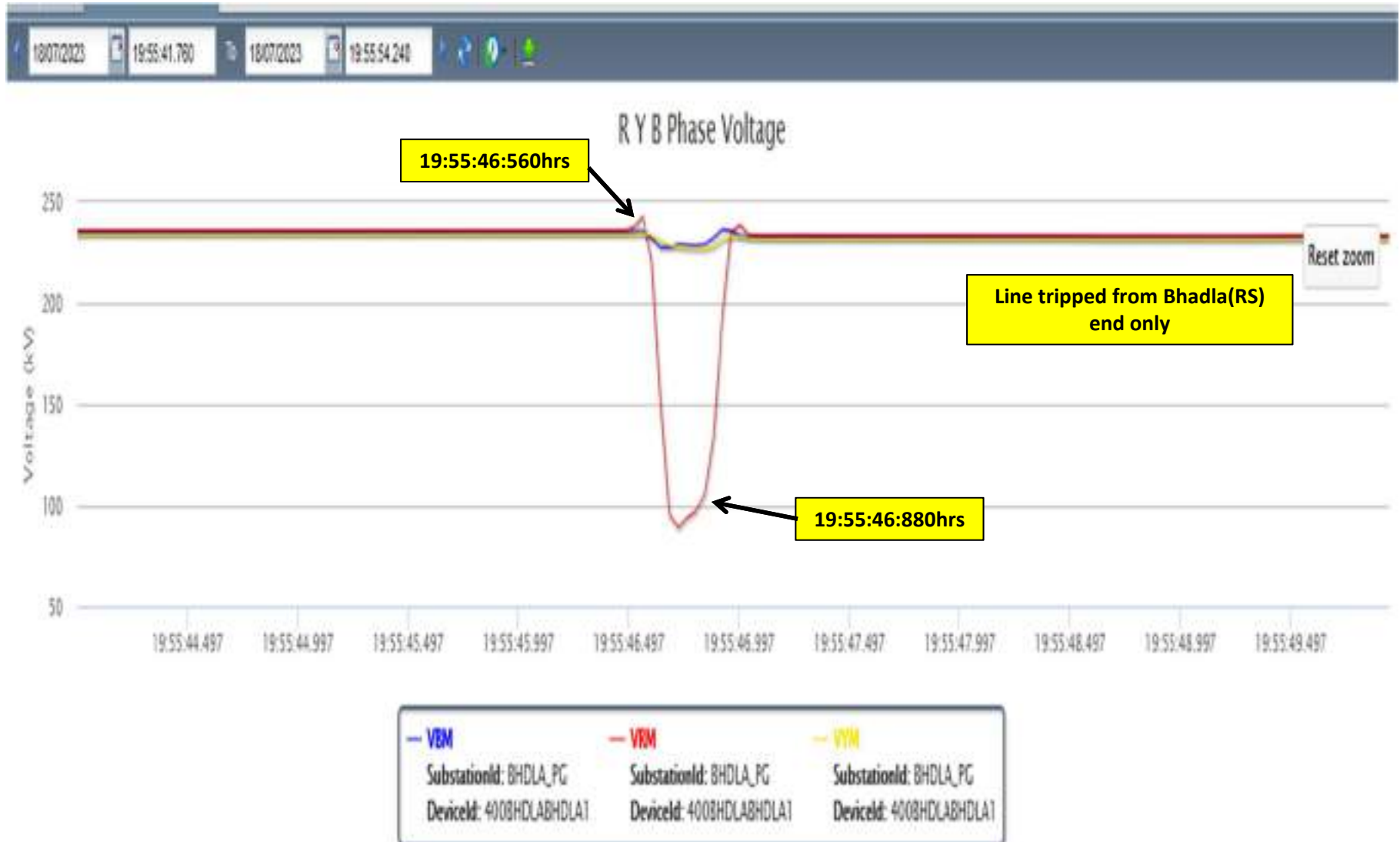
PMU Plot of frequency at Bhadla(PG)

19:56hrs/18-July-23



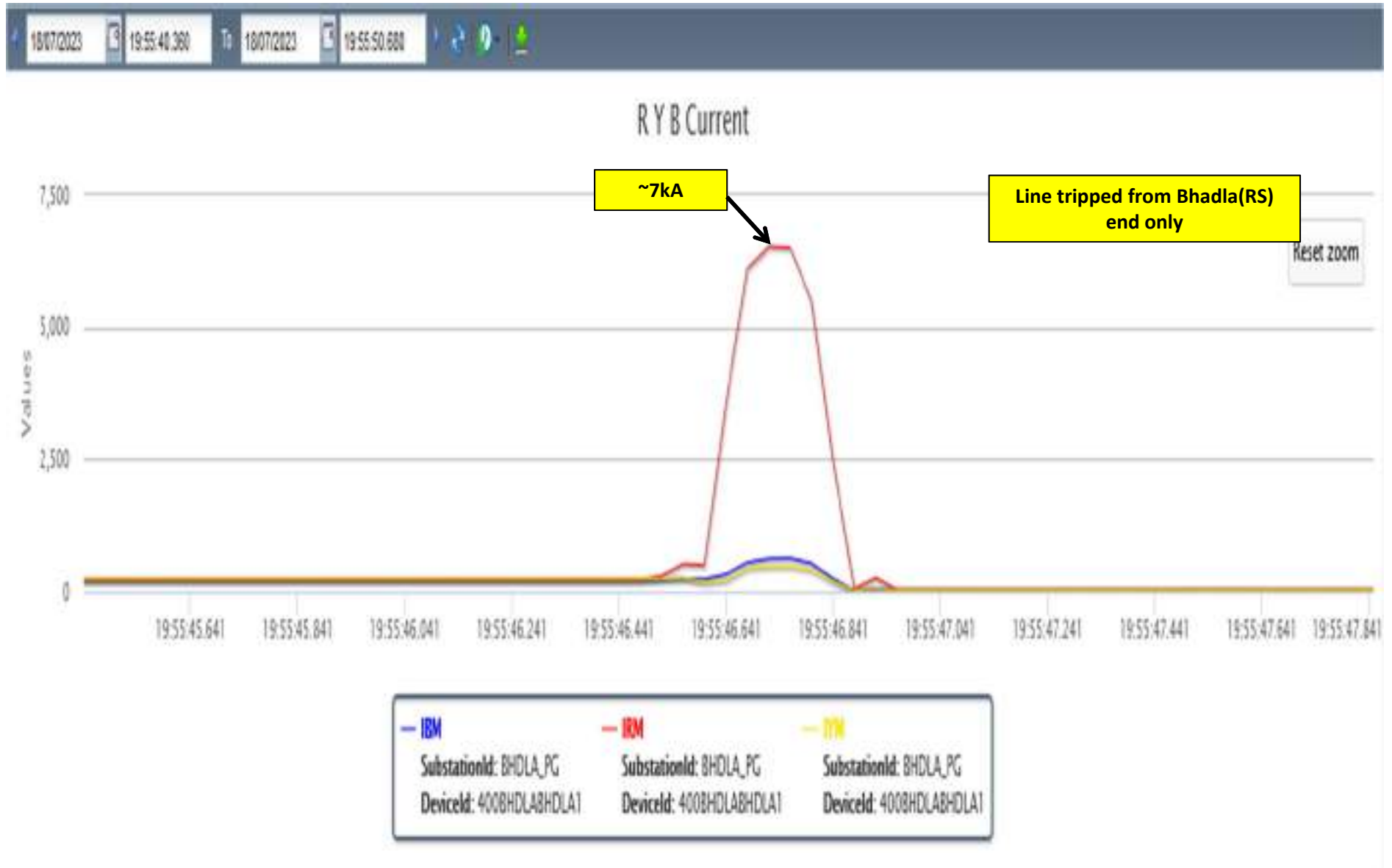
PMU Plot of phase voltage magnitude of 400kV Bhadla(PG)-Bhadla(RS) ckt-1 at Bhadla(PG)

19:56hrs/18-July-23



PMU Plot of phase current magnitude of 400kV Bhadla(PG)-Bhadla(RS) ckt-1 at Bhadla(PG)

19:56hrs/18-July-23



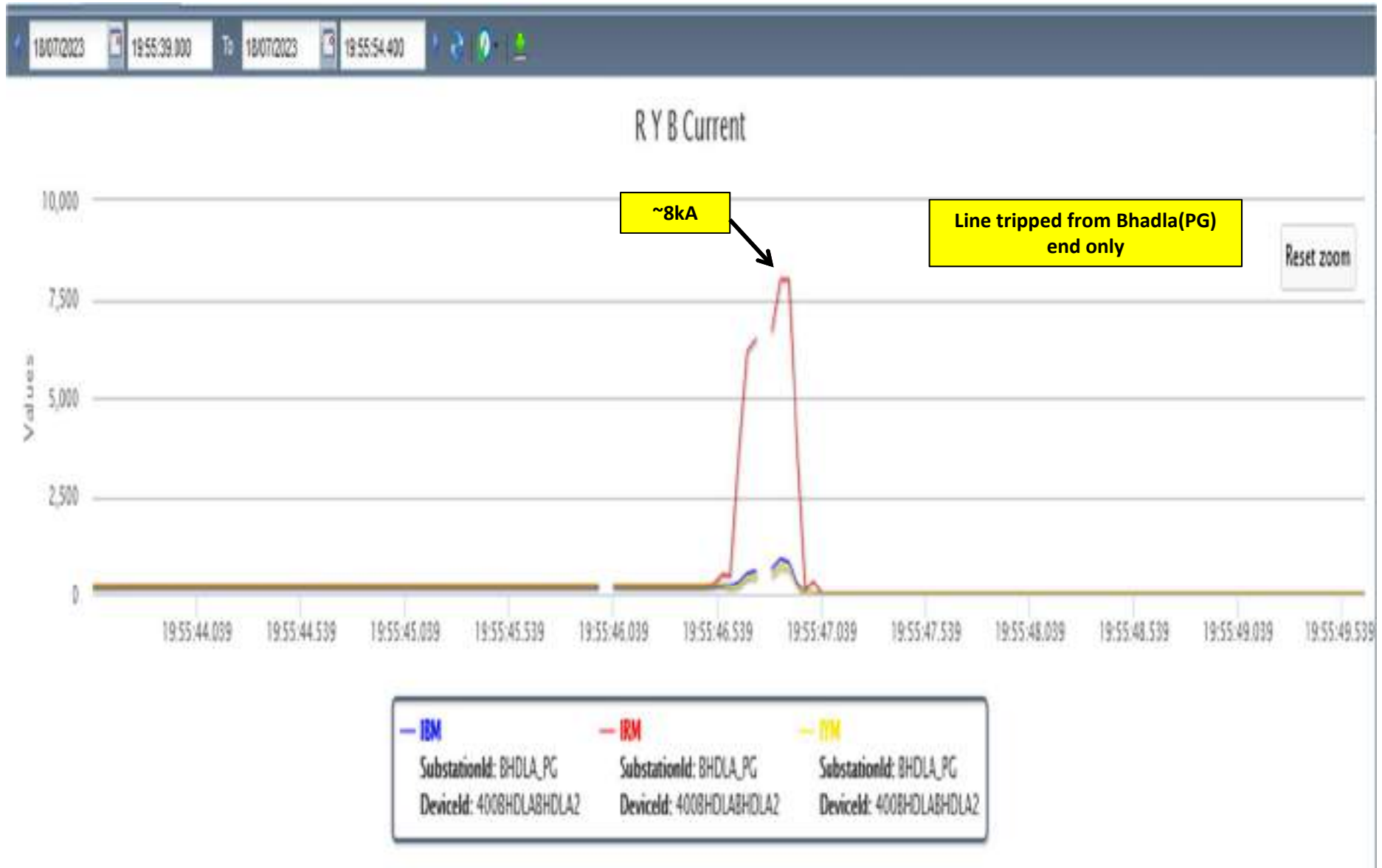
PMU Plot of phase voltage magnitude of 400kV Bhadla(PG)-Bhadla(RS) ckt-2 at Bhadla(PG)

19:56hrs/18-July-23

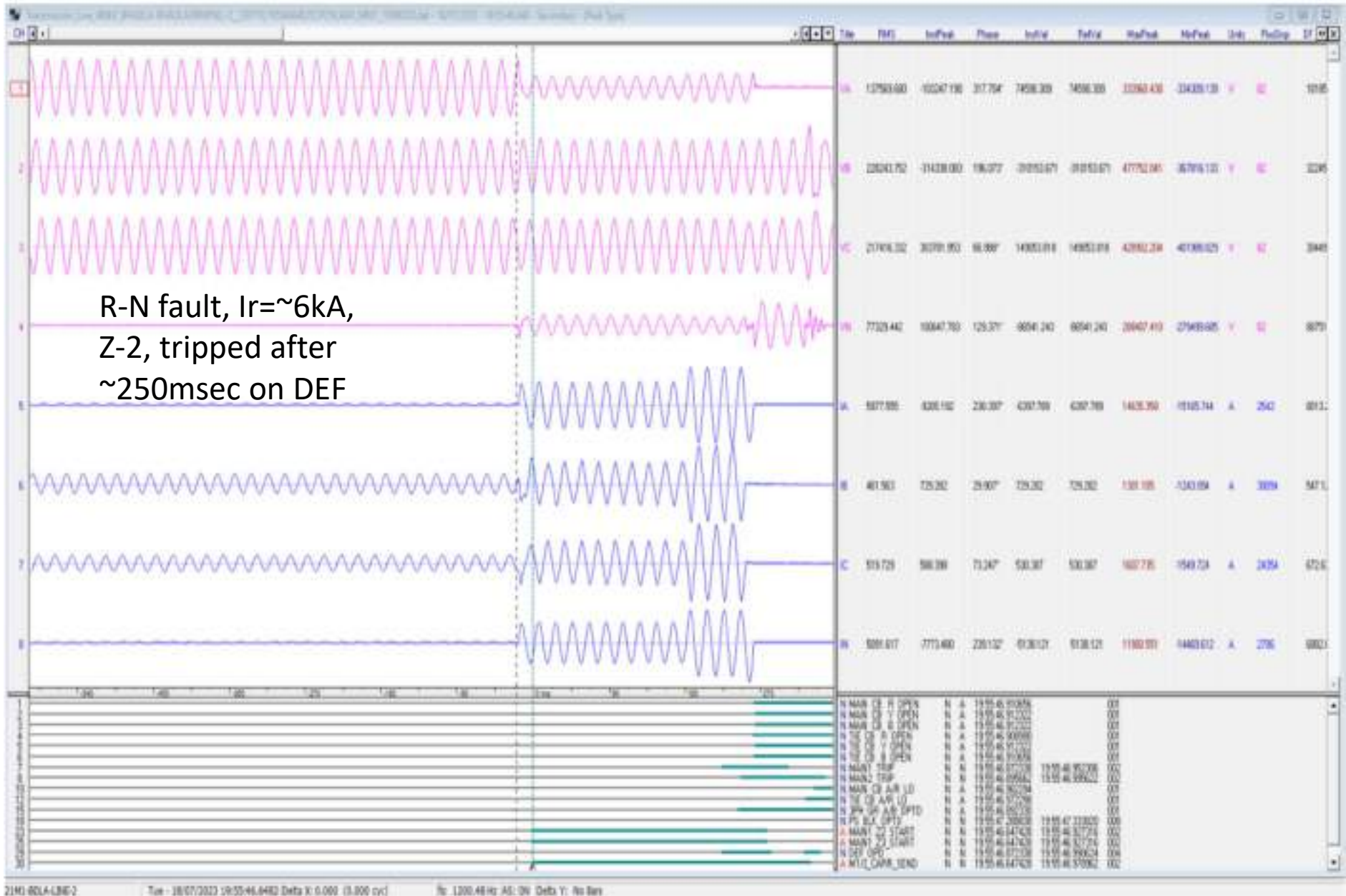


PMU Plot of phase current magnitude of 400kV Bhadla(PG)-Bhadla(RS) ckt-2 at Bhadla(PG)

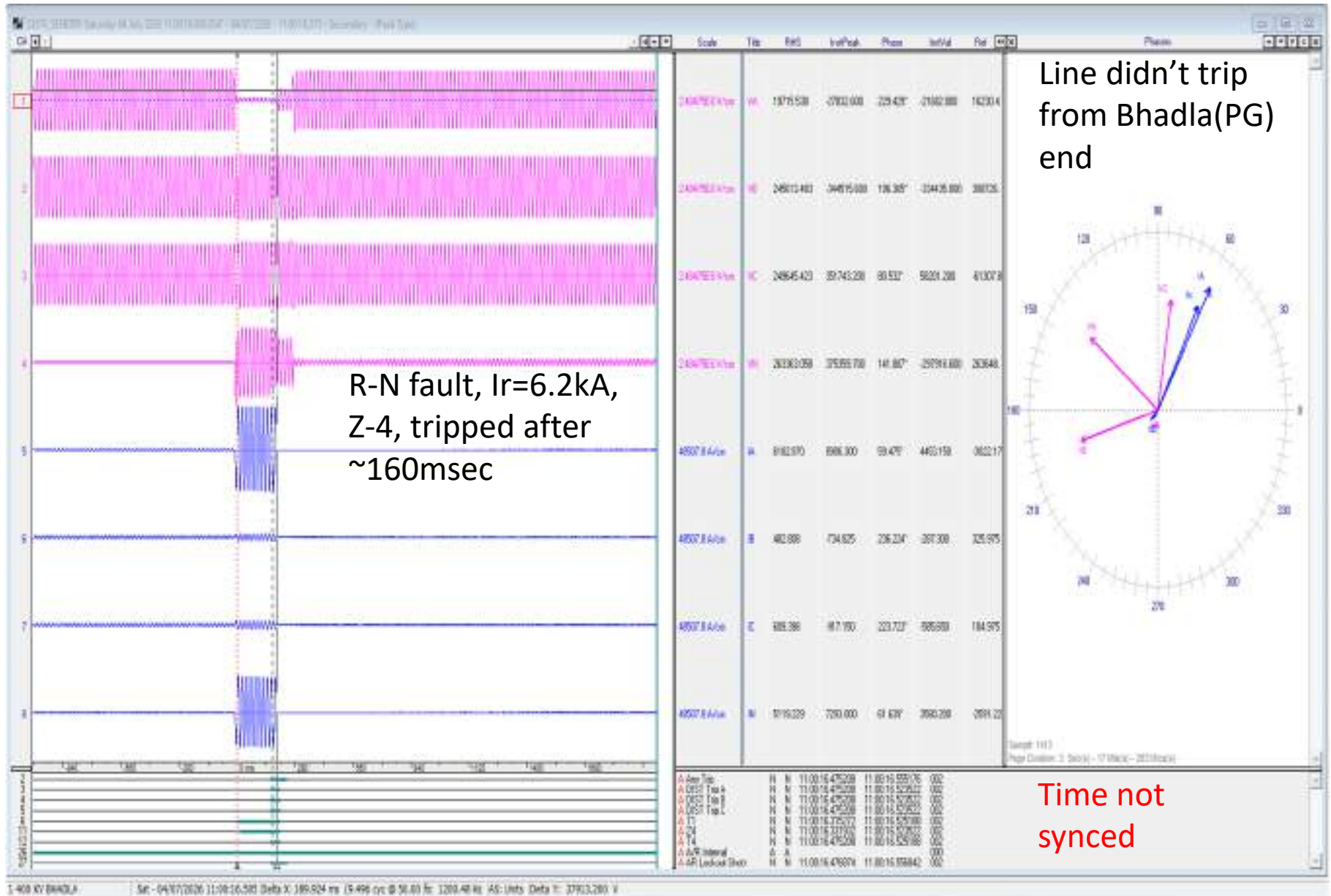
19:56hrs/18-July-23



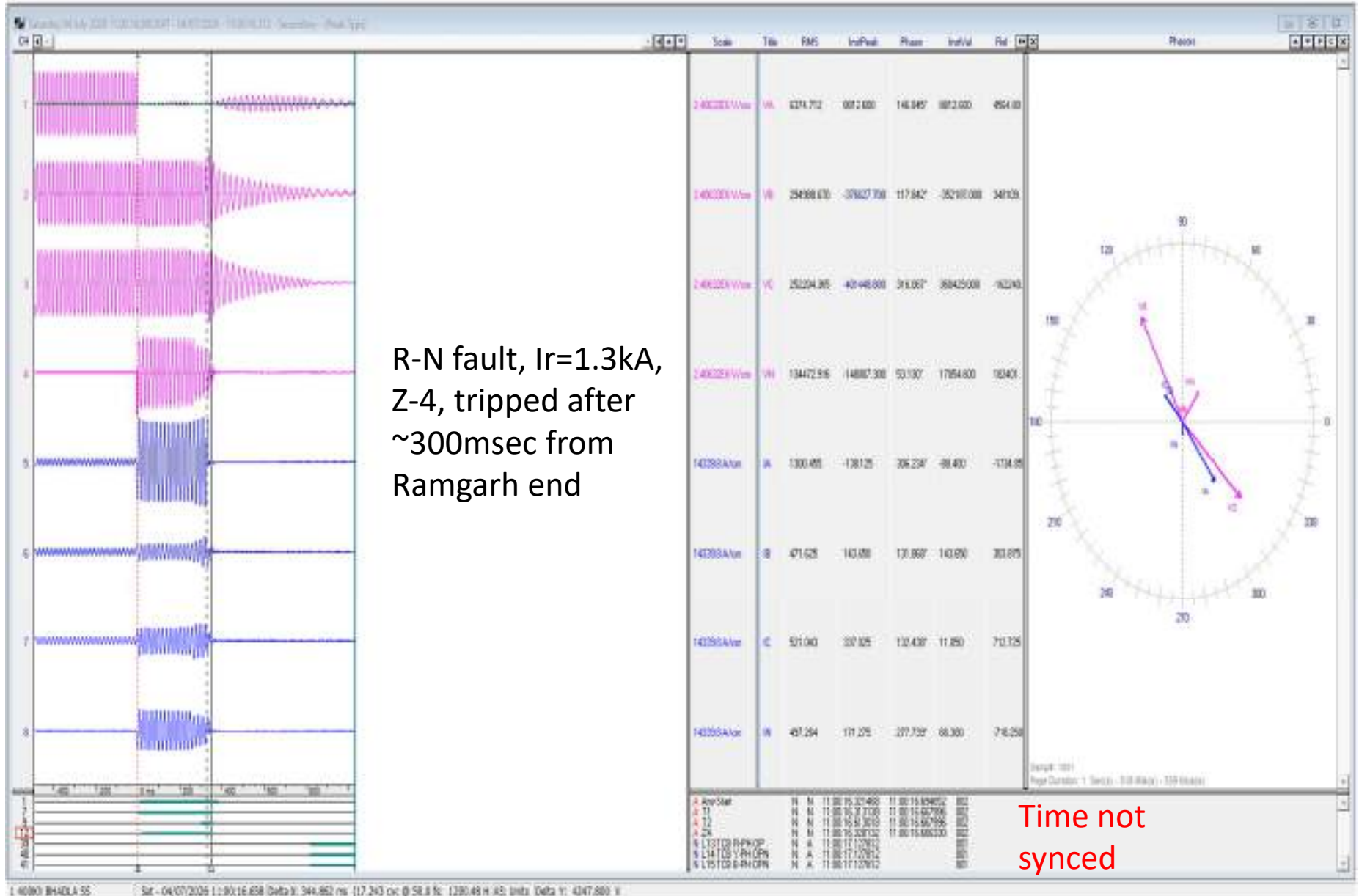
DR of 400kV Bhadla(PG)(end)-Bhadla(RS) ckt-2



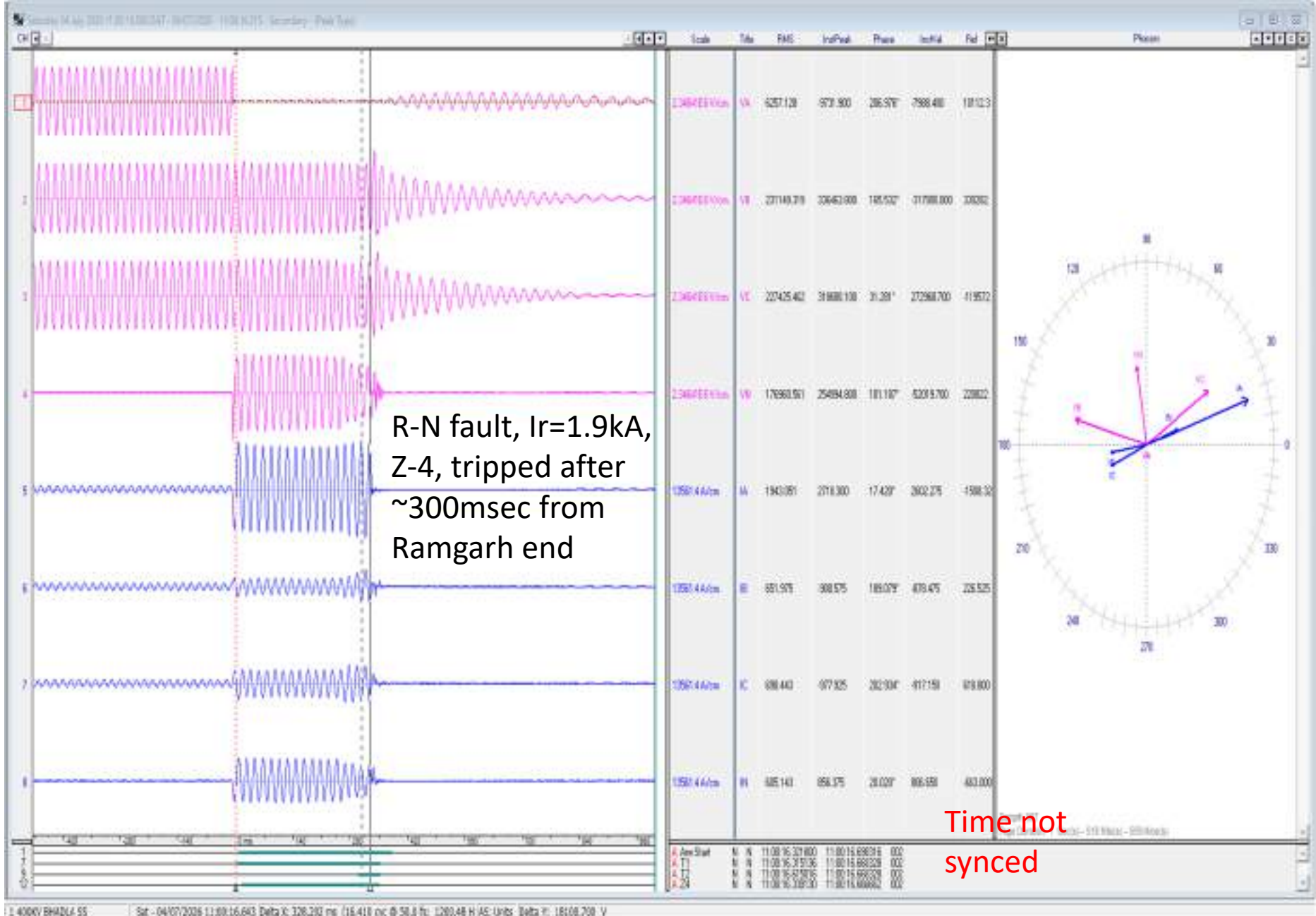
DR of 400kV Bhadla(PG)-Bhadla(RS)(end) ckt-1



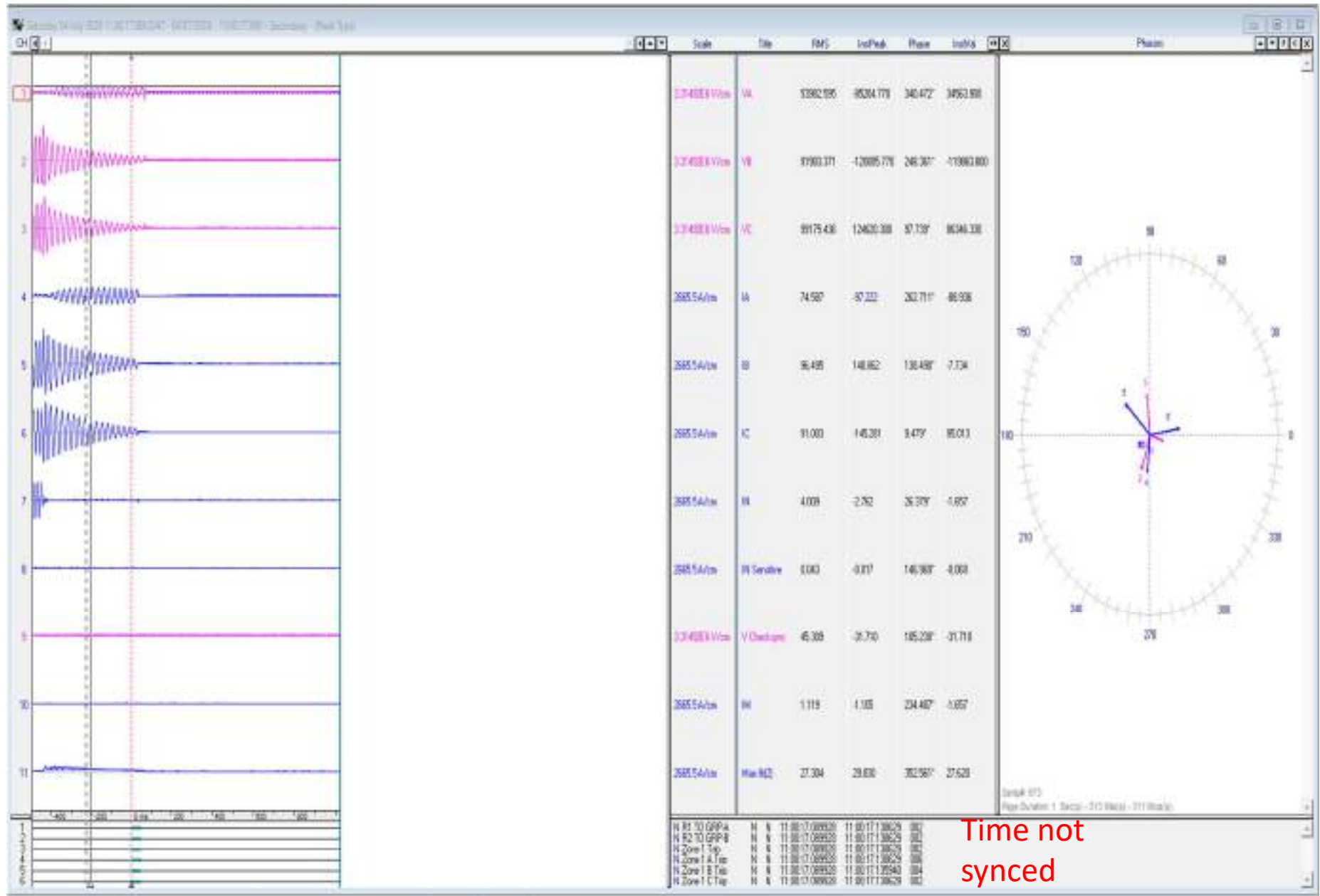
DR of 400kV Bhadla(RS)(end)-Ramgarh(RS) ckt-1



DR of 400kV Bhadla(RS)(end)-Ramgarh(RS) ckt-2

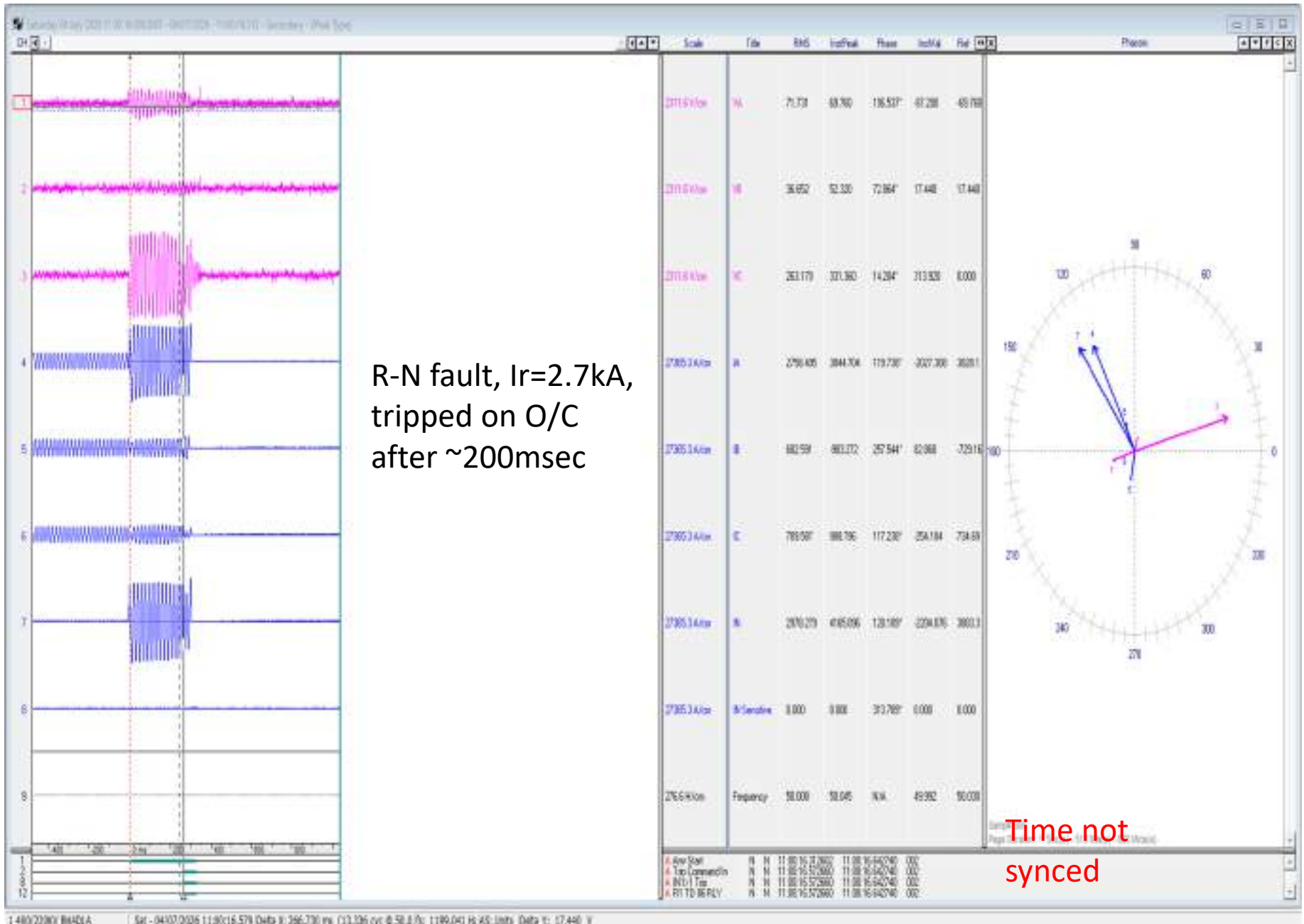


DR of 125MVA bus reactor at Bhadla(RS)



Time not synced

DR of bus sectionalizer at 220kV side at Bhadla(RS)



SCADA SOE

Time	Station Name	Voltage(kV)	Element Name	Element Type	Element Status	Remark
19:55:46,987	RMGR4_R	400	19BHDLA1	Circuit Breaker	Open	Main CB at Ramgarh end of 400kV Bhadla(RS)- Ramgarh ckt-1 opened
19:55:46,988	RMGR4_R	400	20BHDLA1	Circuit Breaker	Open	Tie CB at Ramgarh end of 400kV Bhadla(RS)-Ramgarh ckt-1 opened
19:55:46,989	RMGR4_R	400	22BHDLA2	Circuit Breaker	Open	Main CB at Ramgarh end of 400kV Bhadla(RS)- Ramgarh ckt-2 opened
19:55:46,990	RMGR4_R	400	23BHDLA2	Circuit Breaker	Open	Tie CB at Ramgarh end of 400kV Bhadla(RS)-Ramgarh ckt-2 opened
19:55:54 ***	BHDLA_P	400	4BHDLA2	Circuit Breaker	Open	Main CB at Bhadla(PG) end of 400kV Bhadla(PG)- Bhadla(RS) ckt-2 opened
19:55:55 ***	BHDLA_P	400	5BHDLA2	Circuit Breaker	Open	Tie CB at Bhadla(PG) end of 400kV Bhadla(PG)- Bhadla(RS) ckt-2 opened

Point of discussion

- i. Issues related to Main protection (Main-I&II) of 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2 at Bhadla(RS) end need to be resolved at the earliest.
- ii. Time delay setting of distance protection relay (Z-2 & Z-4) at Bhadla(RS) end need to be reviewed and to be kept in line with the NR protection philosophy.
- iii. DR of Bhadla(RS) end are not time synced. Time syncing of the same need to be ensured.
- iv. DRs of Ramgarh end not received yet, same need to be shared.
- v. Remedial action taken report to be shared.

**Multiple elements tripping at
400/220kV Bhiwadi(RS)**

**24th July 2023 at
03:29 hrs**

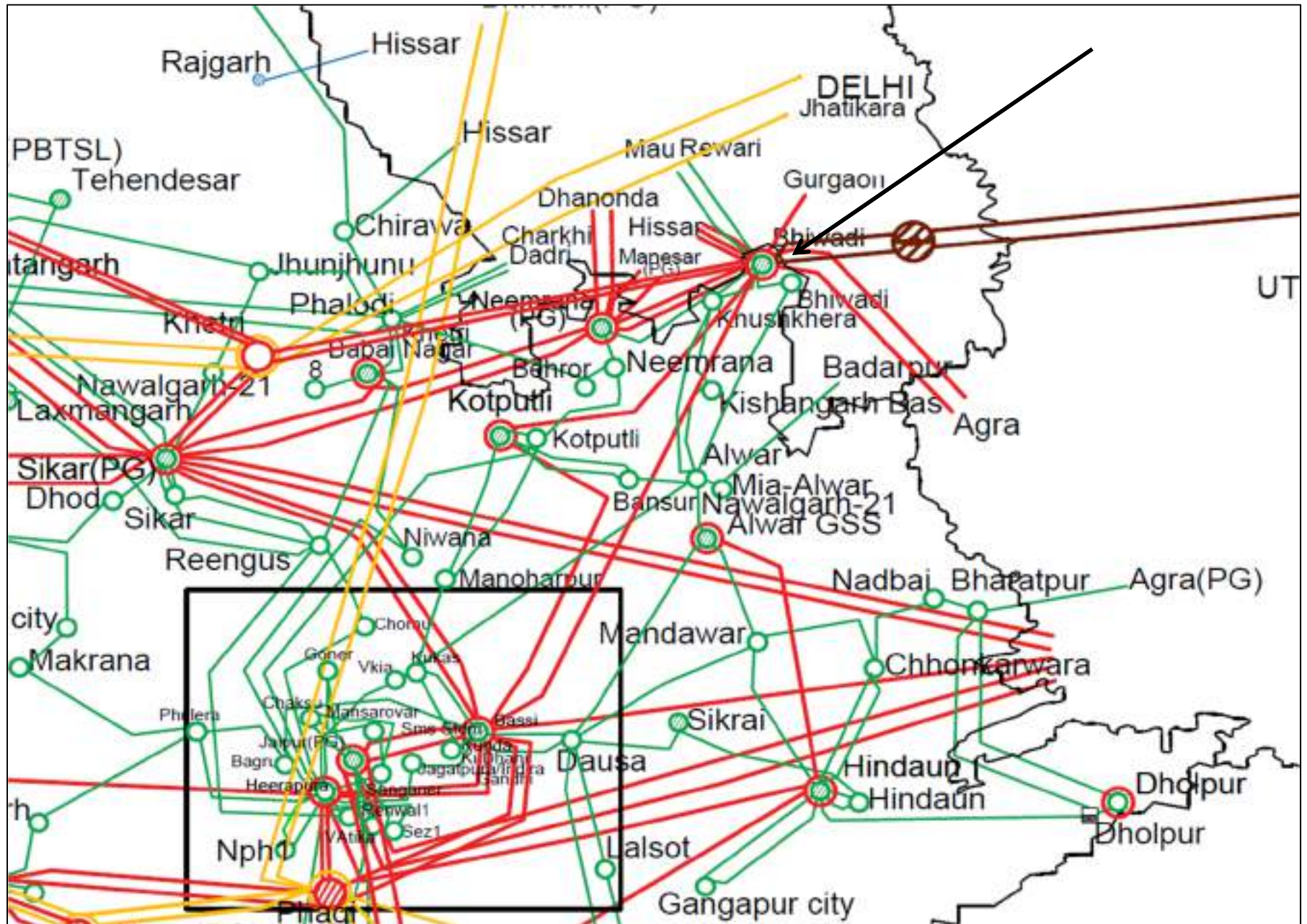
Brief of event:

- 220/132kV Bhiwadi(RS) has double main bus scheme at 220kV side.
- As reported, at 03:29hrs, 220/132kV 160MVA ICT-1 at Bhiwadi(RS) caught fire which created internal fault in the ICT and due to this LBB operated. Rajasthan has been asked to share the reason of LBB operation.
- During this time, 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-1 & 2 and 220/132kV 160MVA ICT-2 & 3 at Bhiwadi(RS) tripped which resulted in complete blackout of 220/132kV Bhiwadi(RS) S/s. Rajasthan has been asked to share the reason of tripping of all the elements at Bhiwadi(RS).

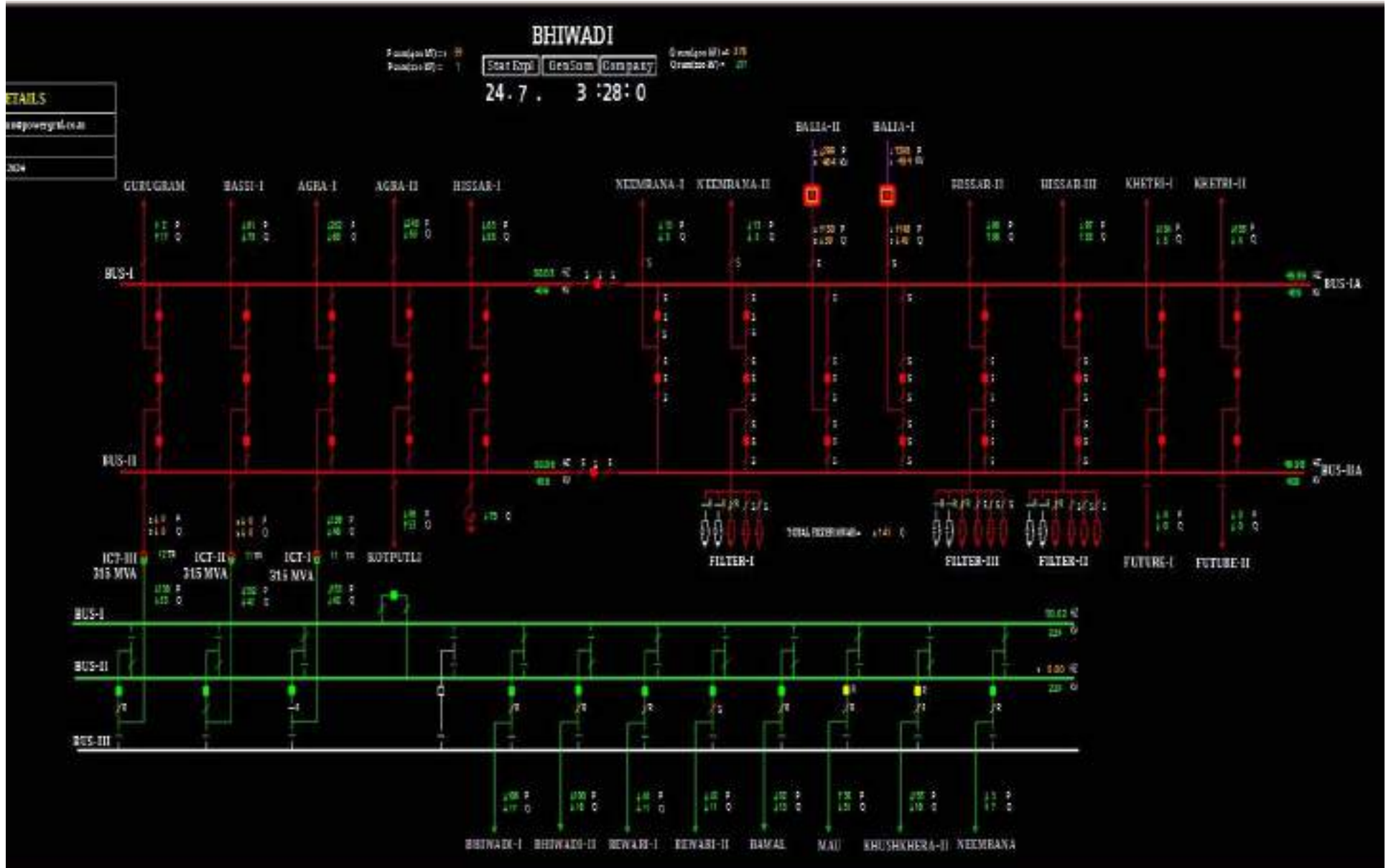
Elements tripped:

- i. 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-1
- ii. 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-2
- iii. 220/132kV 160MVA ICT-1 at Bhiwadi(RS)
- iv. 220/132kV 160MVA ICT-2 at Bhiwadi(RS)
- v. 220/132kV 100MVA ICT-3 at Bhiwadi(RS)

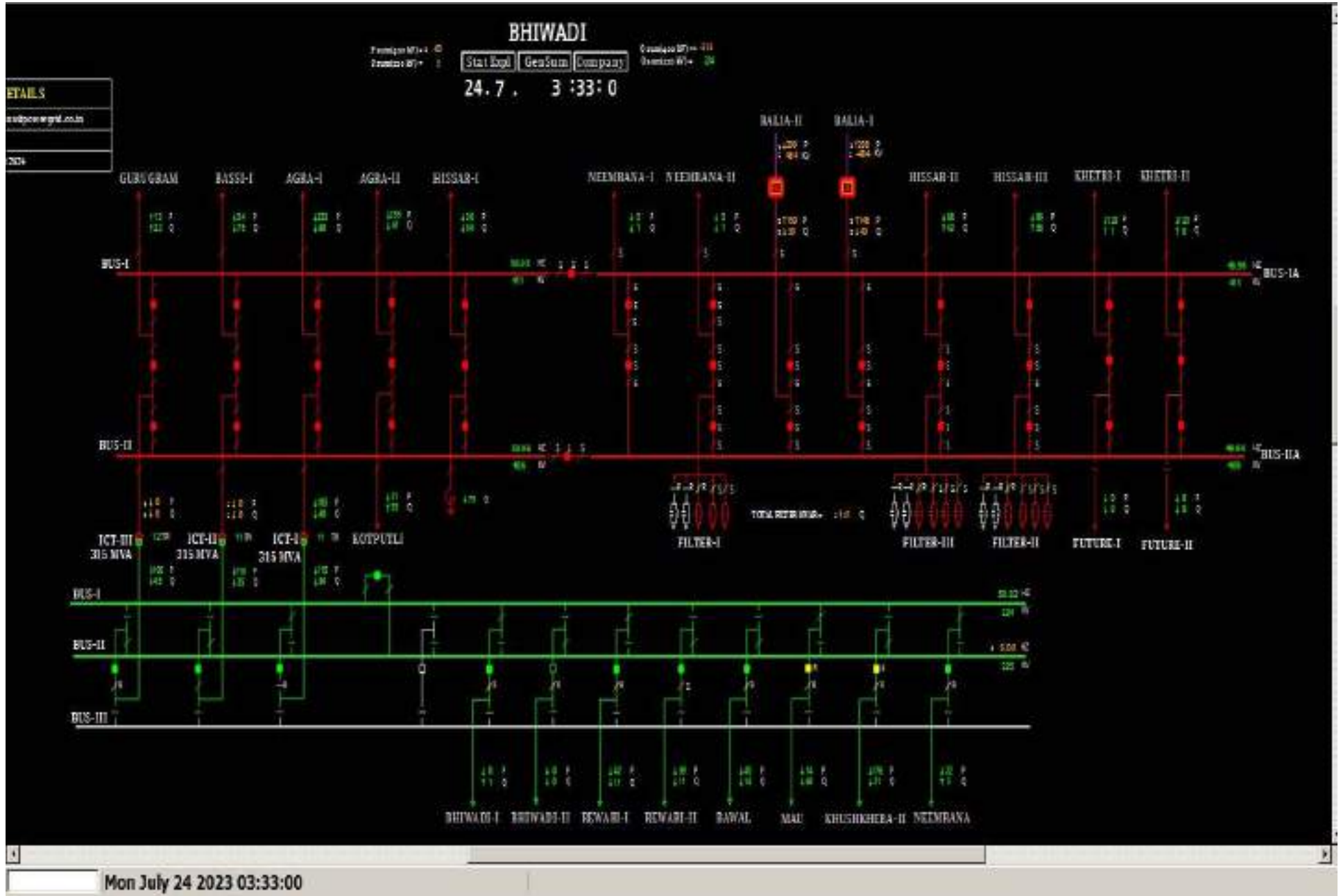
Network Diagram before the event



SLD of 400/220kV Bhiwadi(PG) before the event

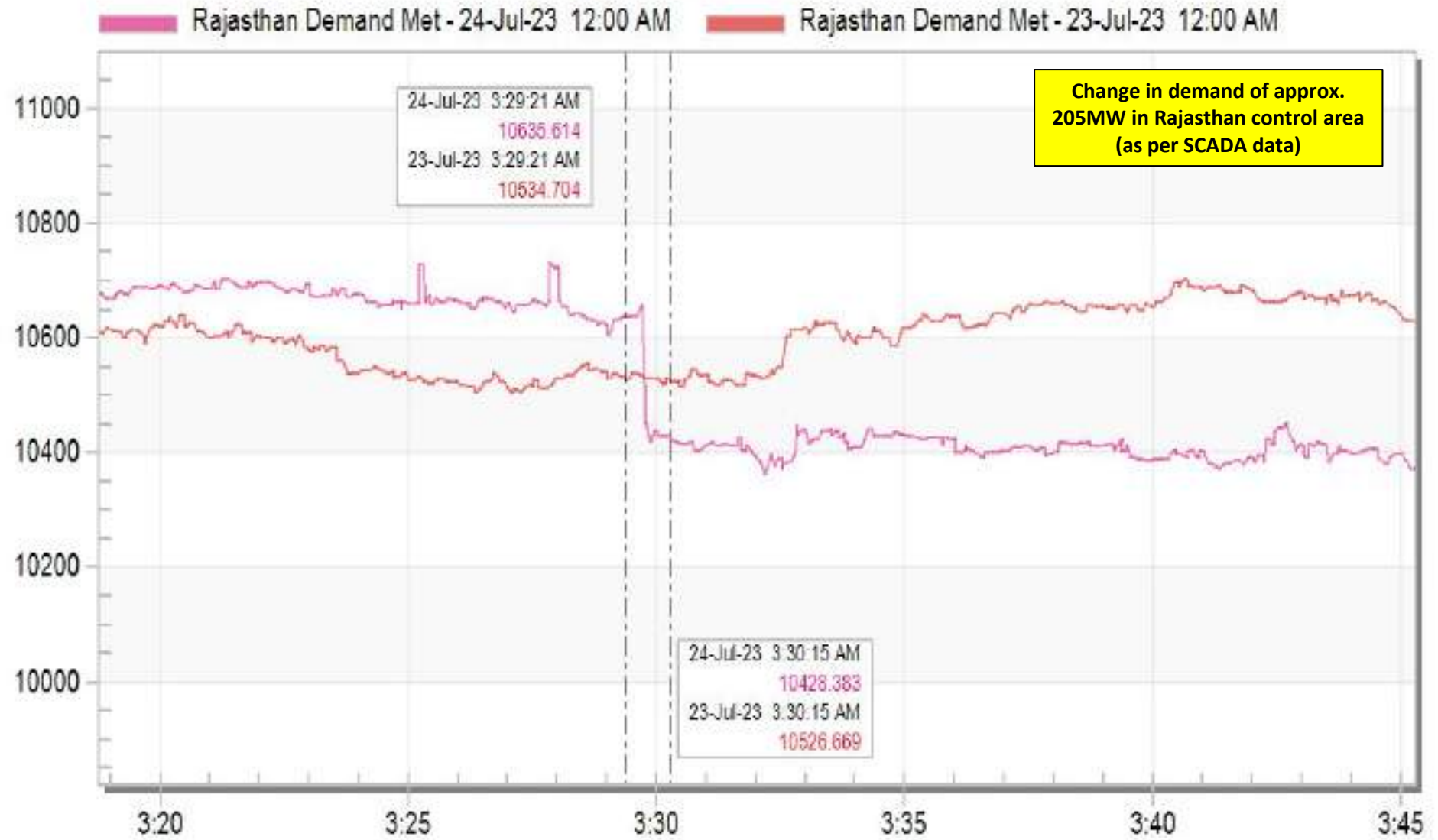


SLD of 400/220kV Bhiwadi(PG) after the event



Rajasthan demand during the event

Rajasthan Demand Met



Jul 24 Mon 2023

PMU Plot of frequency at Bhiwadi(PG)

03:29hrs/24-July-23

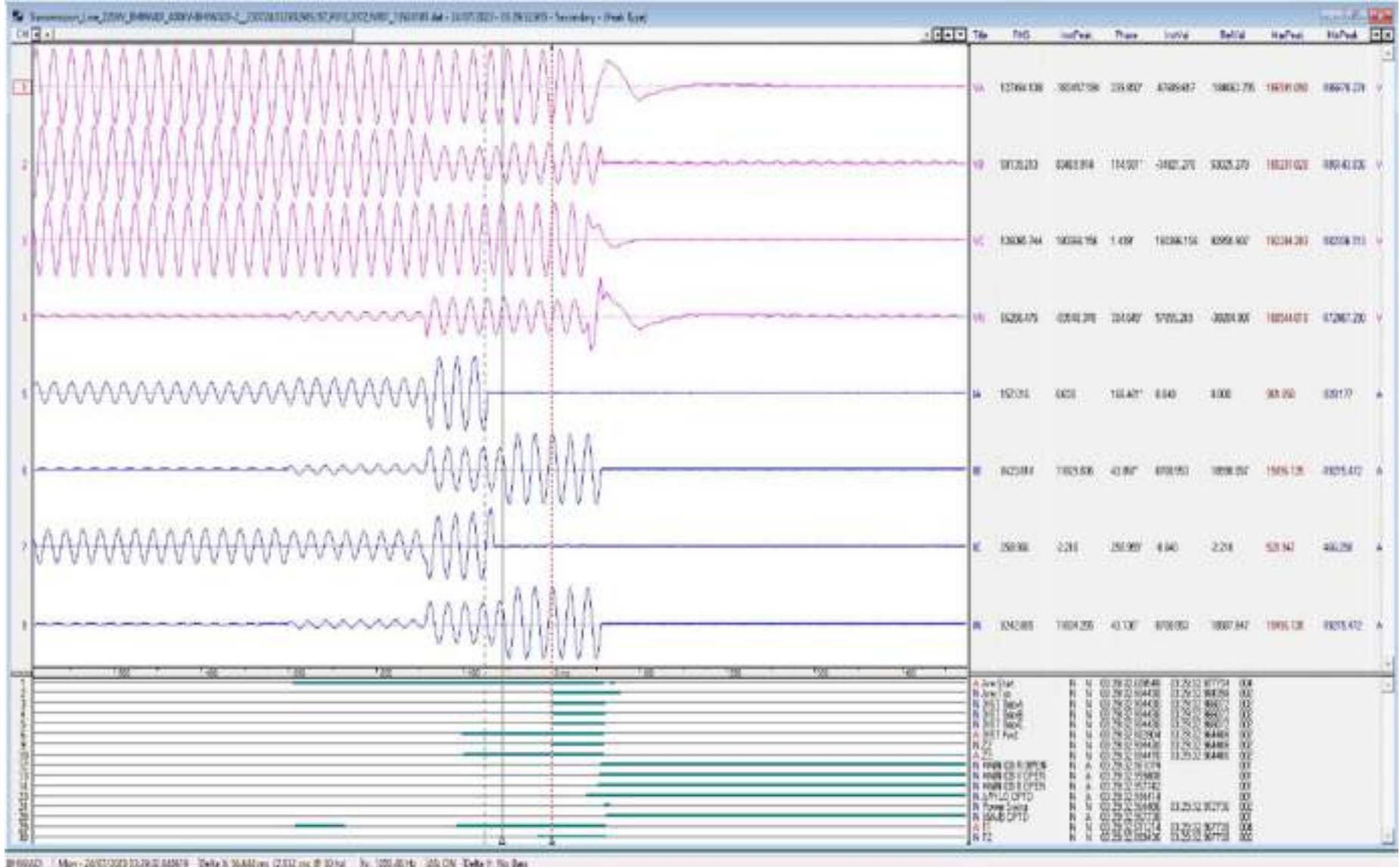


PMU Plot of phase voltage magnitude Bhiwadi(PG)

03:29hrs/24-July-23



DR of 220 KV Bhiwadi(PG) (end)-Bhiwadi(RS) (RS) Ckt-2



- ✓ Y-N phase to earth fault
- ✓ Z-2 distance protection operated

SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
03:29:32,964	BHIWA_PG	220kV	07BHIWR2	Circuit Breaker	Open	Line CB at Bhiwadi(PG) end of 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-2 opened
03:30:06,325	BHIWR_RS	132kV	10T3	Circuit Breaker	Open	CB at 132kV side of 220/132kV 100MVA ICT-3 at Bhiwadi(RS) opened
03:30:06,325	BHIWR_RS	132kV	08T2	Circuit Breaker	Open	CB at 132kV side of 220/132kV 160MVA ICT-2 at Bhiwadi(RS) opened
03:30:06,325	BHIWR_RS	220kV	07T3	Circuit Breaker	Open	CB at 220kV side of 220/132kV 100MVA ICT-3 at Bhiwadi(RS) opened
03:30:06,325	BHIWR_RS	220kV	04T1	Circuit Breaker	Open	CB at 220kV side of 220/132kV 160MVA ICT-1 at Bhiwadi(RS) opened
03:30:07,465	BHIWR_RS	220kV	02BHIWA2	Circuit Breaker	disturbe	
03:30:07,465	BHIWR_RS	220kV	01BHIWA1	Circuit Breaker	Open	Line CB at Bhiwadi(RS) end of 220 KV Bhiwadi(PG)-Bhiwadi(RS) (RS) Ckt-1 opened
03:30:07,465	BHIWR_RS	132kV	06T1	Circuit Breaker	Open	CB at 132kV side of 220/132kV 160MVA ICT-1 at Bhiwadi(RS) opened
03:31:25,793	BHIWR_RS	132kV	17BMRT	Circuit Breaker	Open	Line CB at Bhiwadi(RS) end of 132 KV Bhiwadi(RS)-BMRT Ckt opened

Point of discussion

- i. Issues related to Main protection (Main-I&II) of 400 KV Bhadla(RS)-Bhadla(PG) (PG) Ckt-2 at Bhadla(RS) end need to be resolved at the earliest.
- ii. Time delay setting of distance protection relay (Z-2 & Z-4) at Bhadla(RS) end need to be reviewed and to be kept in line with the NR protection philosophy.
- iii. DR of Bhadla(RS) end are not time synced. Time syncing of the same need to be ensured.
- iv. DRs of Ramgarh end not received yet, same need to be shared.
- v. Remedial action taken report to be shared.

**Multiple elements tripping at
400/220kV Ratangarh(RS)**

**20th June 2023 at
05:21 hrs**

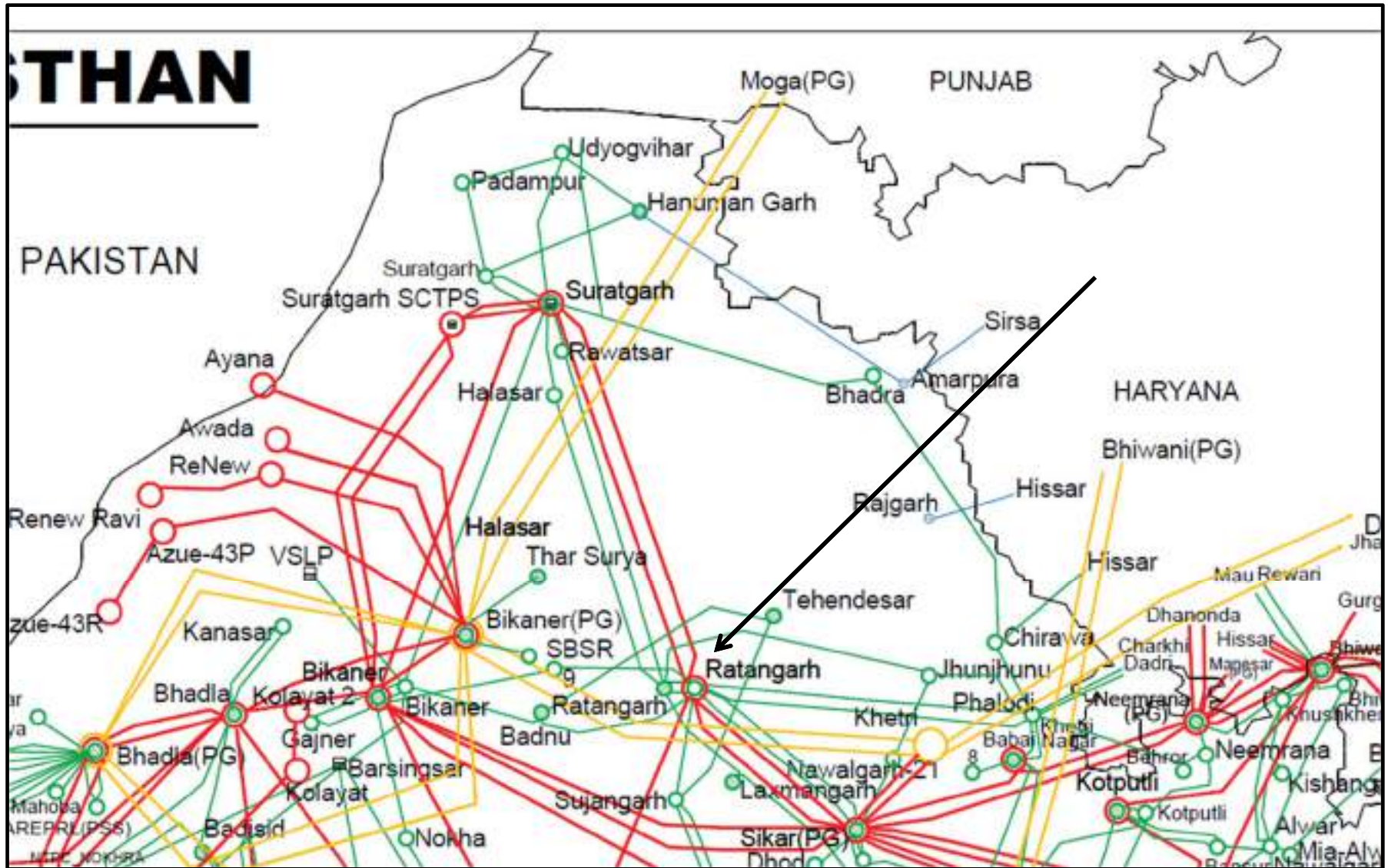
Brief of event:

- 400/220kV Ratangarh(Raj) has double main & transfer bus scheme at 220kV side.
- During antecedent condition, 400/220 kV 315 MVA ICT 2 at Ratangarh(RS) and 220kV feeders to Badnu, Sikar(PG)-II, Ratangarh-I and Khetri-I connected at 220kV Bus-B. Remaining elements were connected at 220kV Bus-A.
- As reported at 05:21 hrs, **B-ph bus jumper of 220 KV Ratangarh-Badnu (Raj) Ckt broke and created B-N phase to earth bus fault on 220kV bus-B.** 220kV Badnu ckt tripped in Z-1 from Ratangarh end (distance relay at Ratangarh end sensed fault in Z-1, forward direction due to issue of improper fault selection by relay in case of near fault).

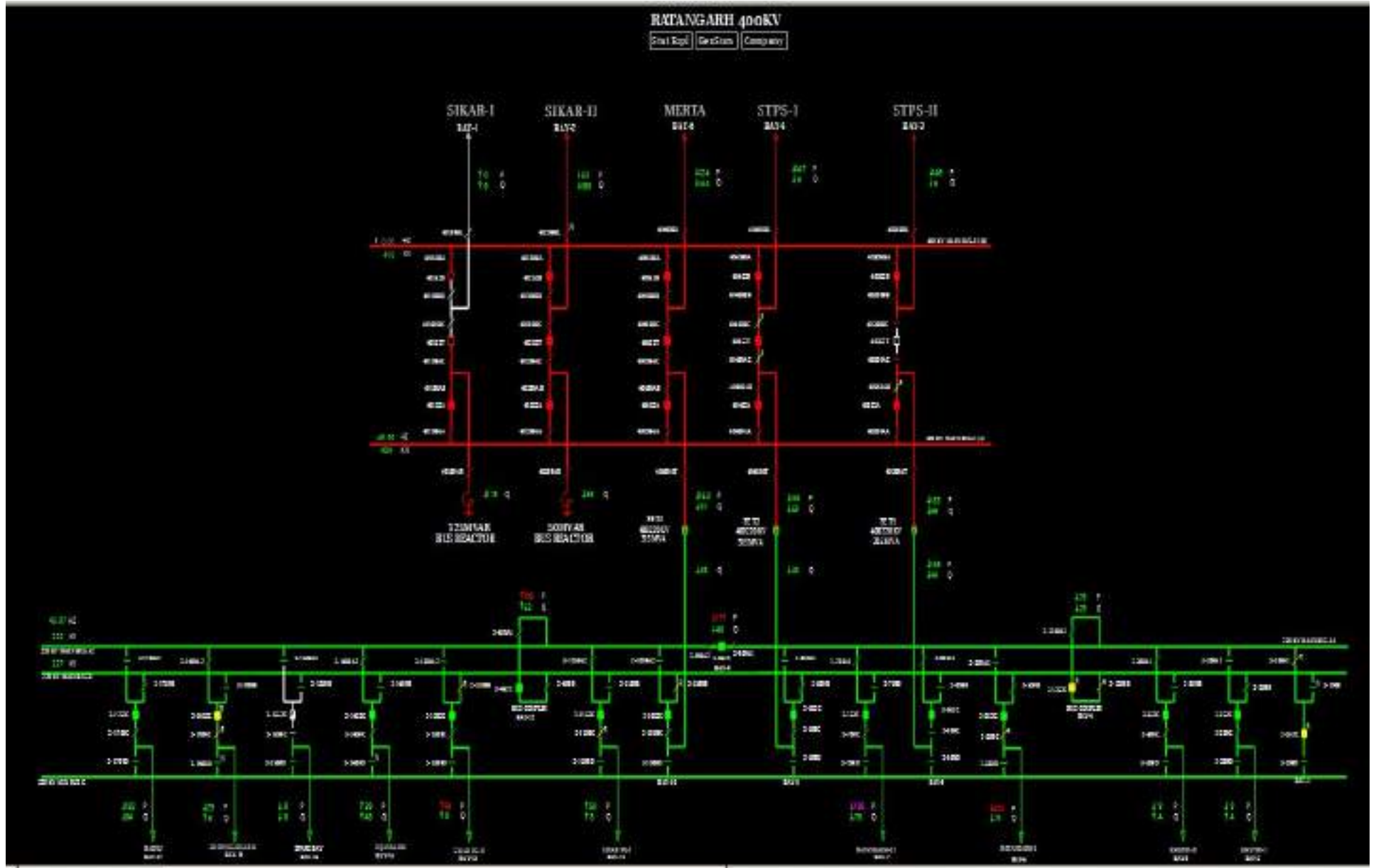
Elements tripped:

- i. 400/220 kV 315 MVA ICT 2 at Ratangarh(RS)
- ii. 220 KV Ratangarh(RS)-Sikar(PG) (PG) Ckt-1 (tripped from Ratangarh end only)
- iii. 220 KV Ratangarh(RS)-Sikar(PG) (PG) Ckt-2
- iv. 220 KV Ratangarh-Badnu (Raj) Ckt
- v. 220 KV Ratangarh-Ratangarh220 (Raj) Ckt-1
- vi. 220 KV Ratangarh-Khetri (Raj) Ckt-1

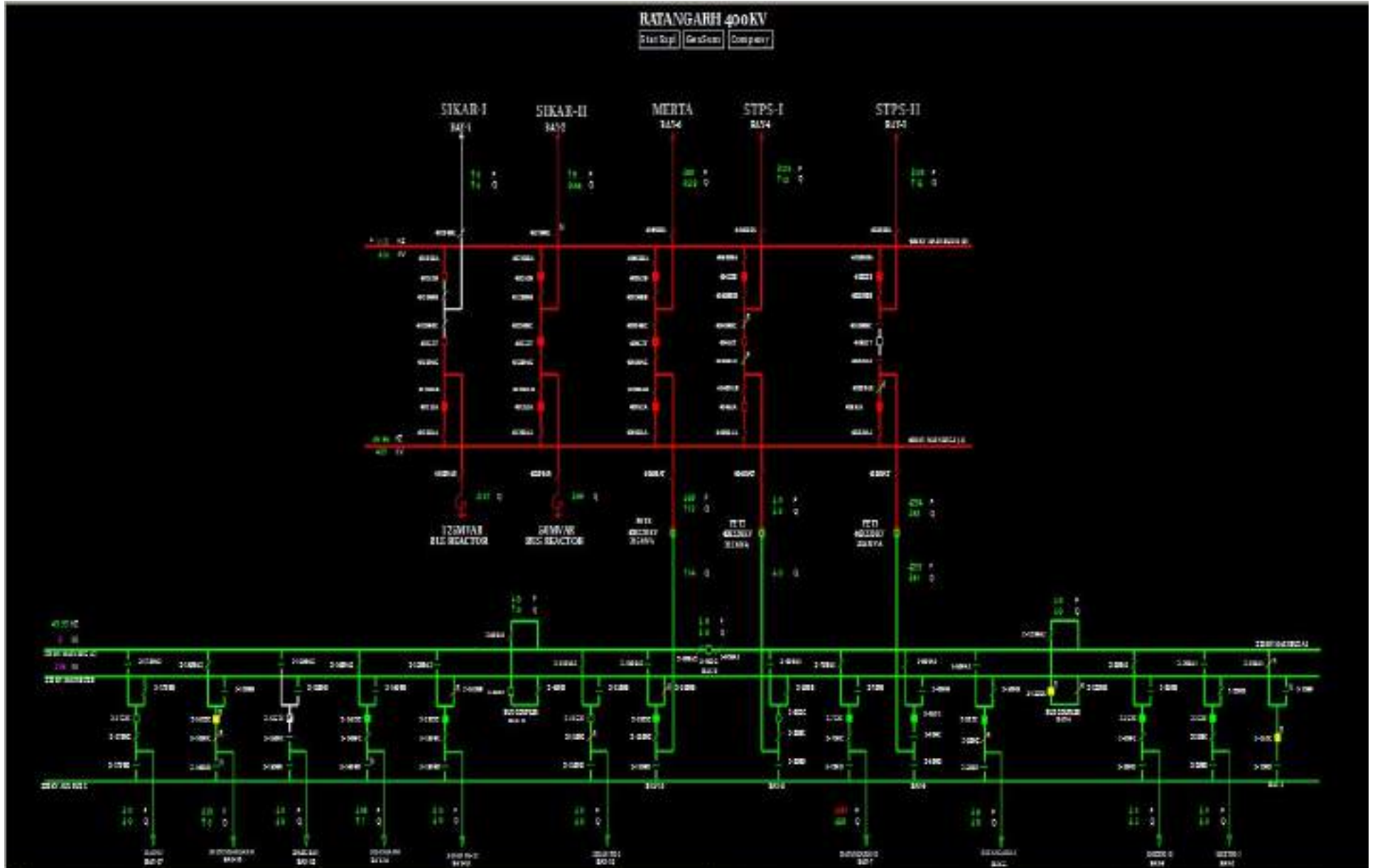
Network Diagram before the event



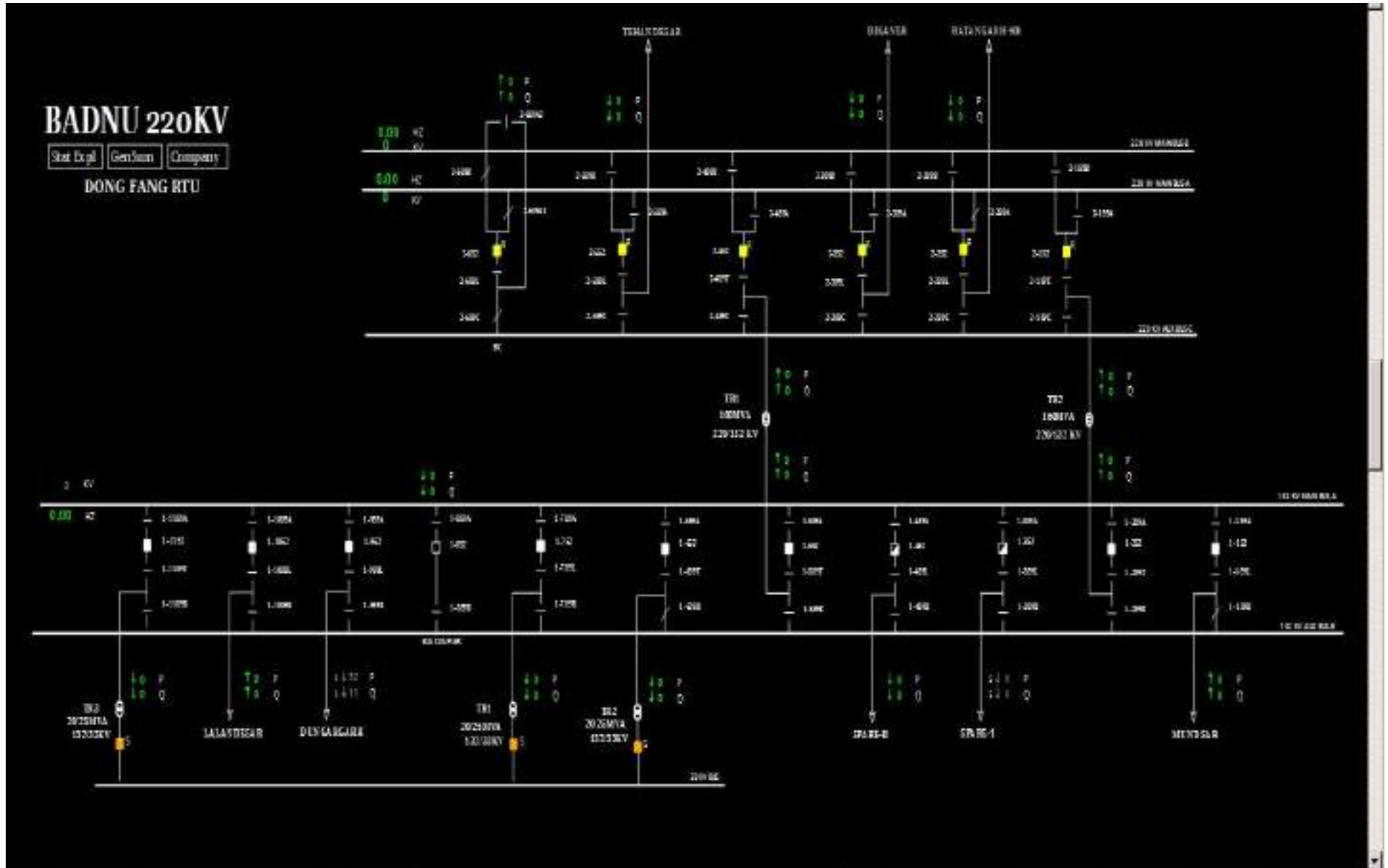
SLD of 400/220kV Ratangarh(Raj) before the event



SLD of 400/220kV Ratangarh(Raj) after the event

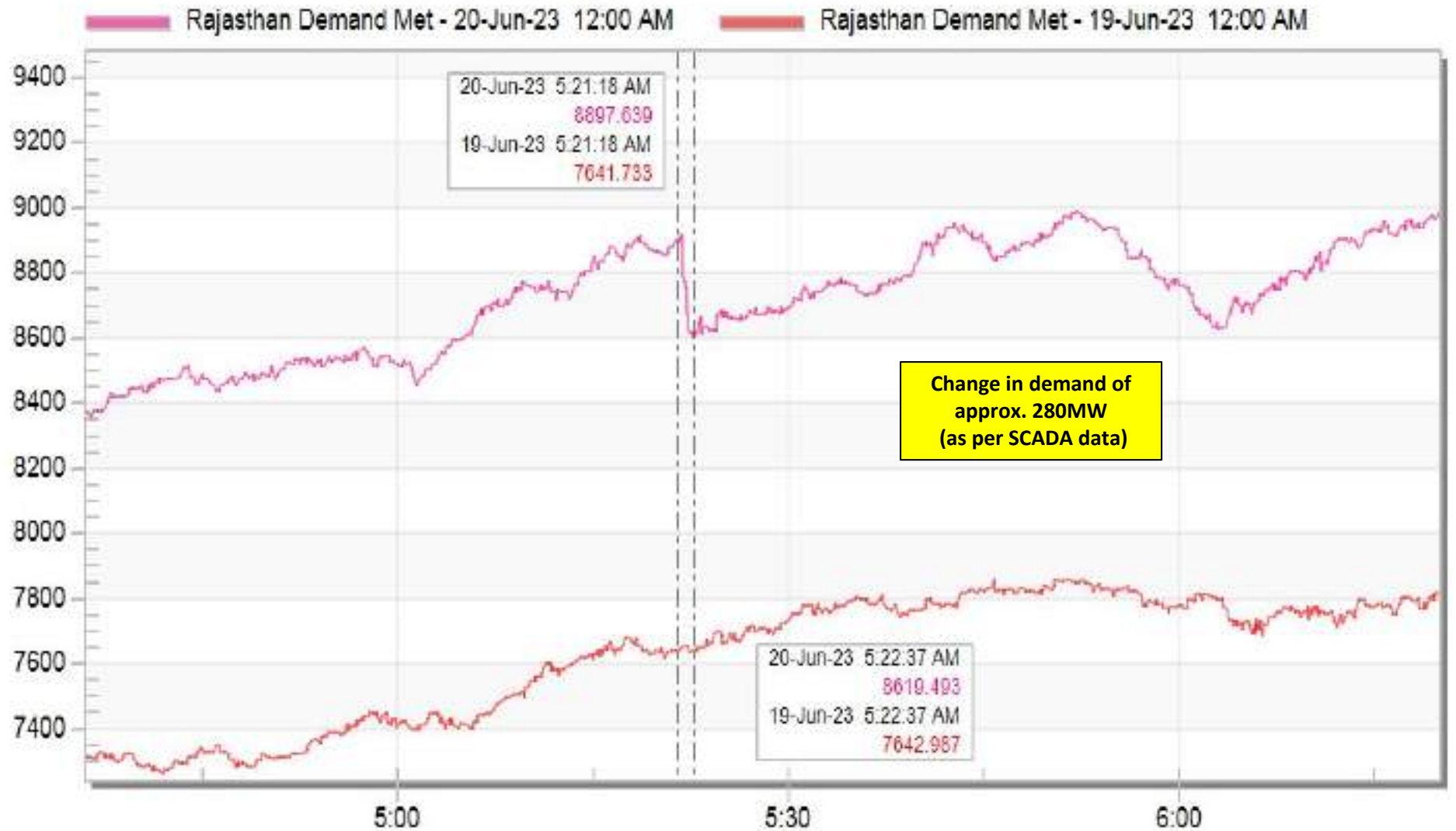


SLD of 220/132kV Badnu(Raj) after the event



Rajasthan demand during the event

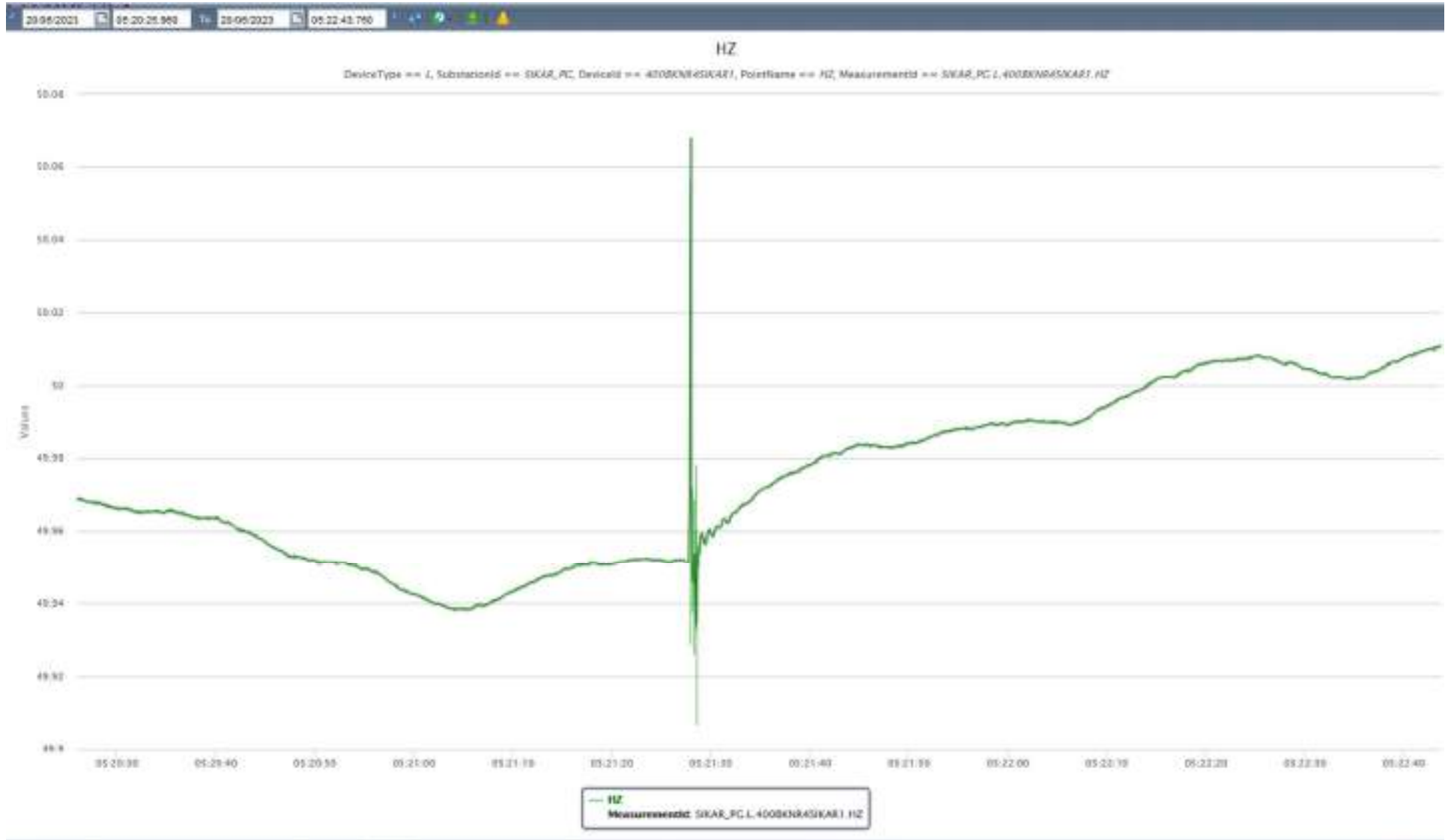
Rajasthan Demand Met



Jun 20 Tue 2023

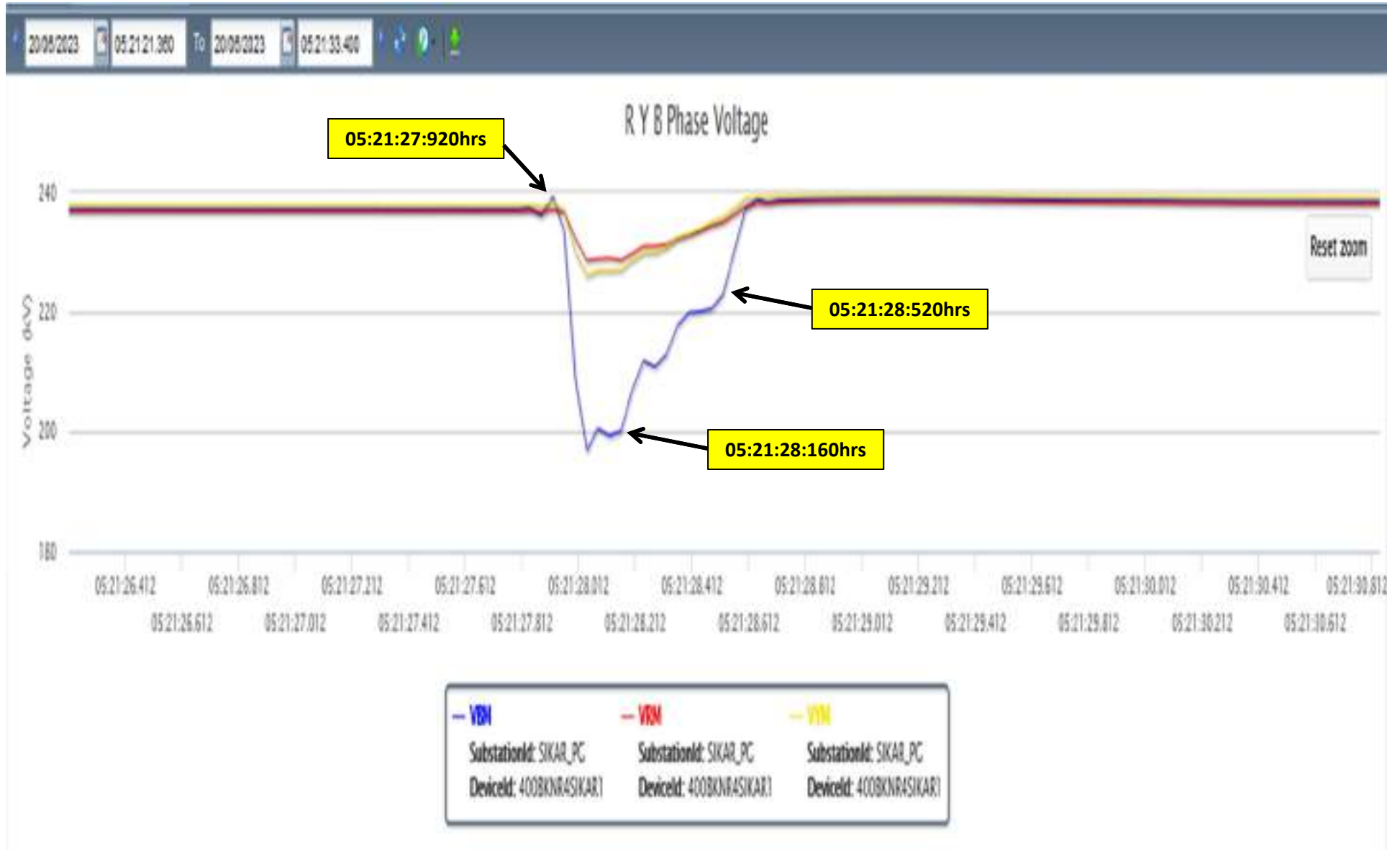
PMU Plot of frequency at Sikar(PG)

05:21hrs/20-Jun-23



PMU Plot of phase voltage magnitude at Sikar(PG)

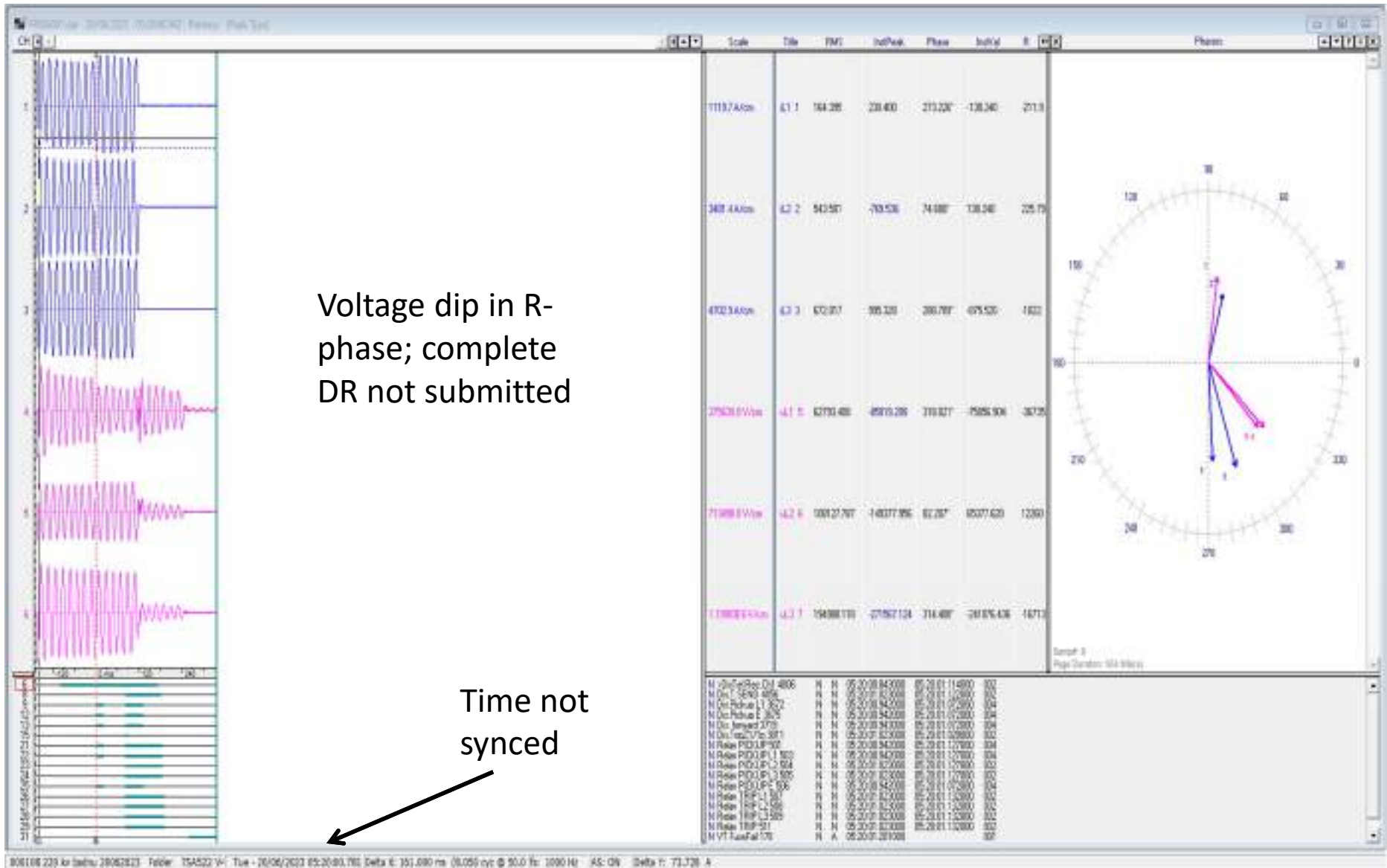
05:21hrs/20-Jun-23



SCADA SOE

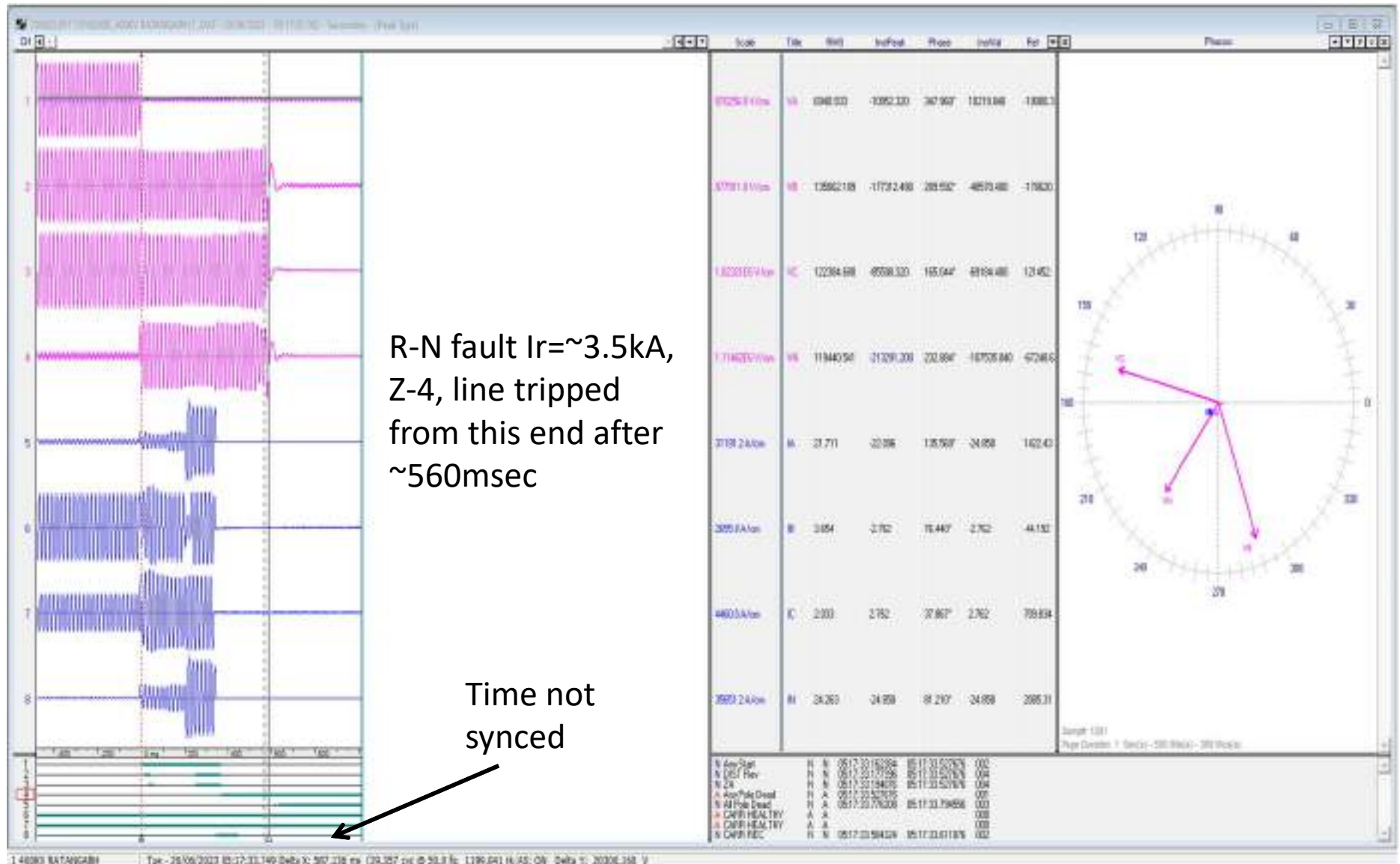
Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remarks
05:21:27,366	KHETRI	220kV	02RATN1	Circuit Breaker	disturbe	
05:21:28,064	RATAN400	220kV	04MBC	Circuit Breaker	Open	
05:21:28,127	RATAN400	220kV	11SIKAR1	Circuit Breaker	Open	Line CB at Ratangarh400 end of 220kV Ratanagr400-Sikar ckt-1 opened
05:21:28,178	RATAN400	220kV	09BS	Circuit Breaker	Open	
05:21:28,202	RATANGARH	220kV	08JHUNJ1	Circuit Breaker	Open	Line CB at Ratangarh220 end of 220kV Ratanagr220-Jhunjhunu ckt opened
05:21:28,294	RATANGARH	220kV	04RATN41	Circuit Breaker	Open	Line CB at Ratangarh220 end of 220kV Ratanagr220-Ratanagr400 ckt-1 opened
05:21:28,403	RATAN400	220kV	17BADNU	Circuit Breaker	Open	Line CB at Ratangarh400 end of 220kV Ratanagr400-Badnu ckt opened
05:21:28,522	RATAN400	400kV	8T2SU1	Circuit Breaker	Open	Tie CB at 400kV side of 400/220kV 315MVA ICT-2 at Ratanagr opened
05:21:28,527	RATAN400	400kV	9T2	Circuit Breaker	Open	Main CB at 400kV side of 400/220kV 315MVA ICT-2 at Ratanagr opened
05:21:28,530	SIKAR	220kV	5RATN41	Circuit Breaker	Open	Line CB at Sikar end of 220kV Ratanagr400-Sikar ckt-1 opened
05:21:28,532	RATAN400	220kV	08T2	Circuit Breaker	Open	CB at 220kV side of 400/220kV 315MVA ICT-2 at Ratanagr opened
05:21:32,833	KHETRI	220kV	02RATN1	Circuit Breaker	disturbe	

DR of 220kV Ratangarh(end)-Badnu (Raj) ckt



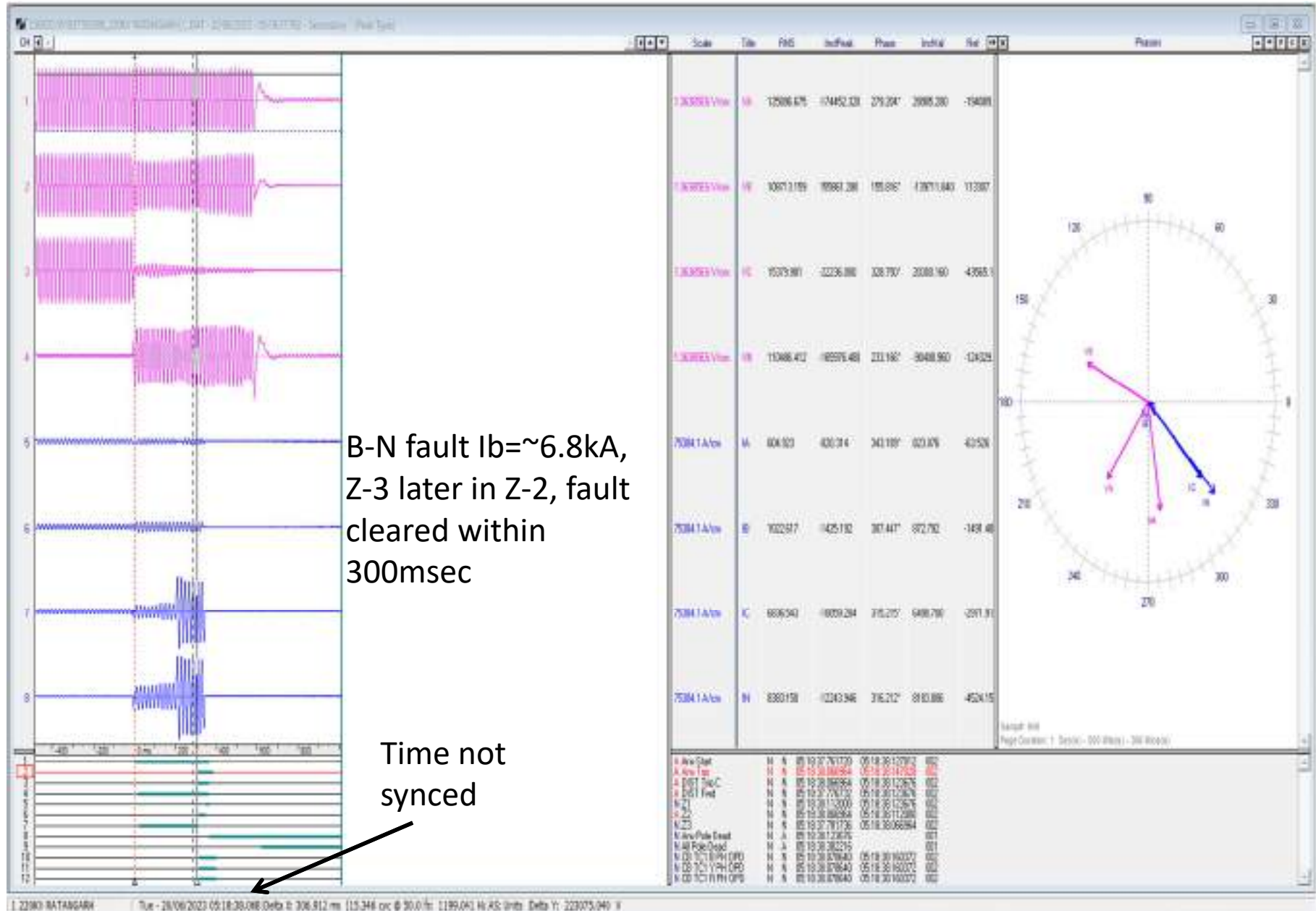
Phase sequence are not correctly configured. As per PMU & Ratangarh220 DR, fault in B-phase.

DR of 220kV Ratangarh400(end)-Ratangarh220 (Raj) ckt-1

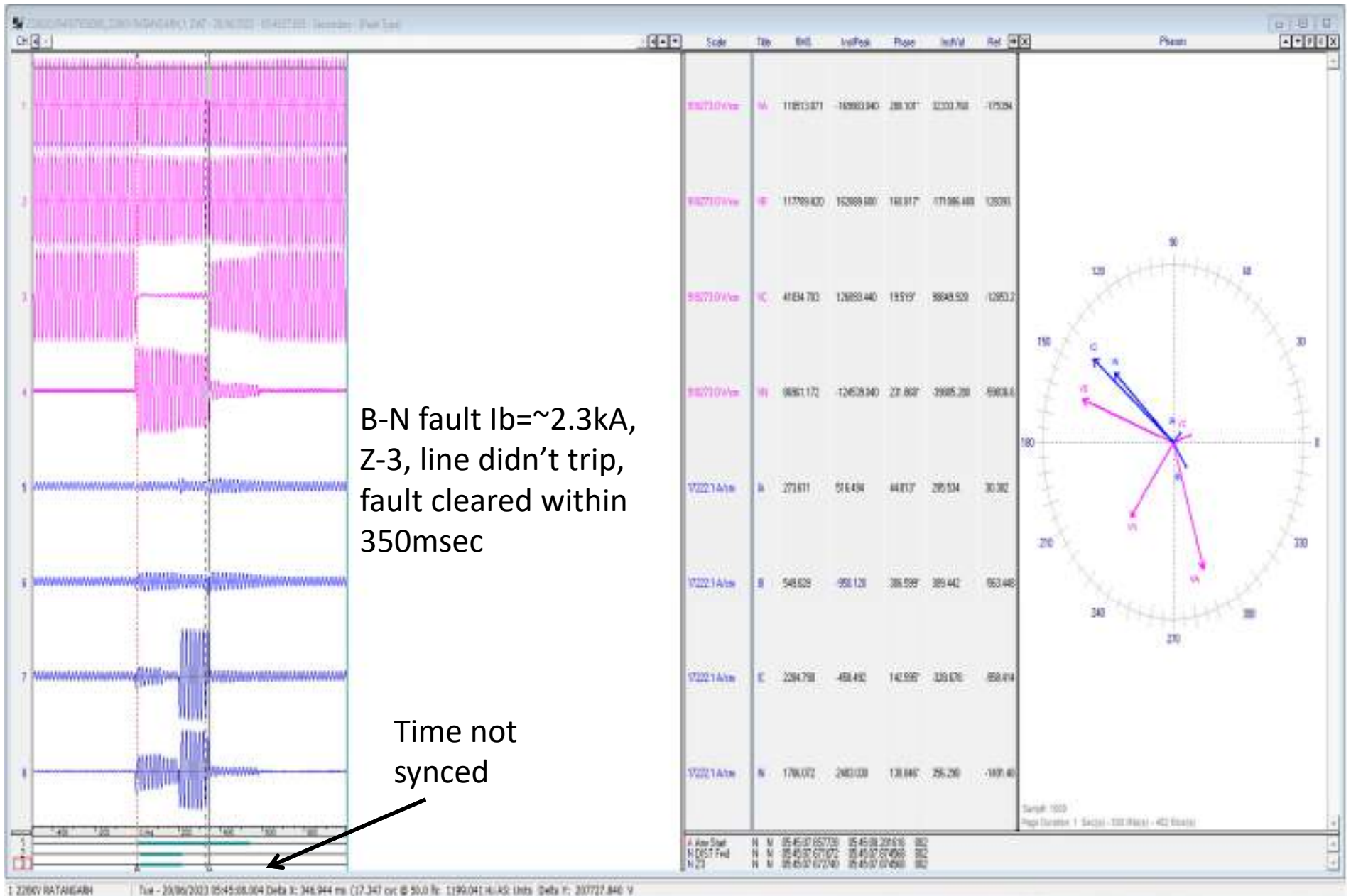


Phase sequence are not correctly configured. As per PMU & Ratangarh220 DR, fault in B-phase.

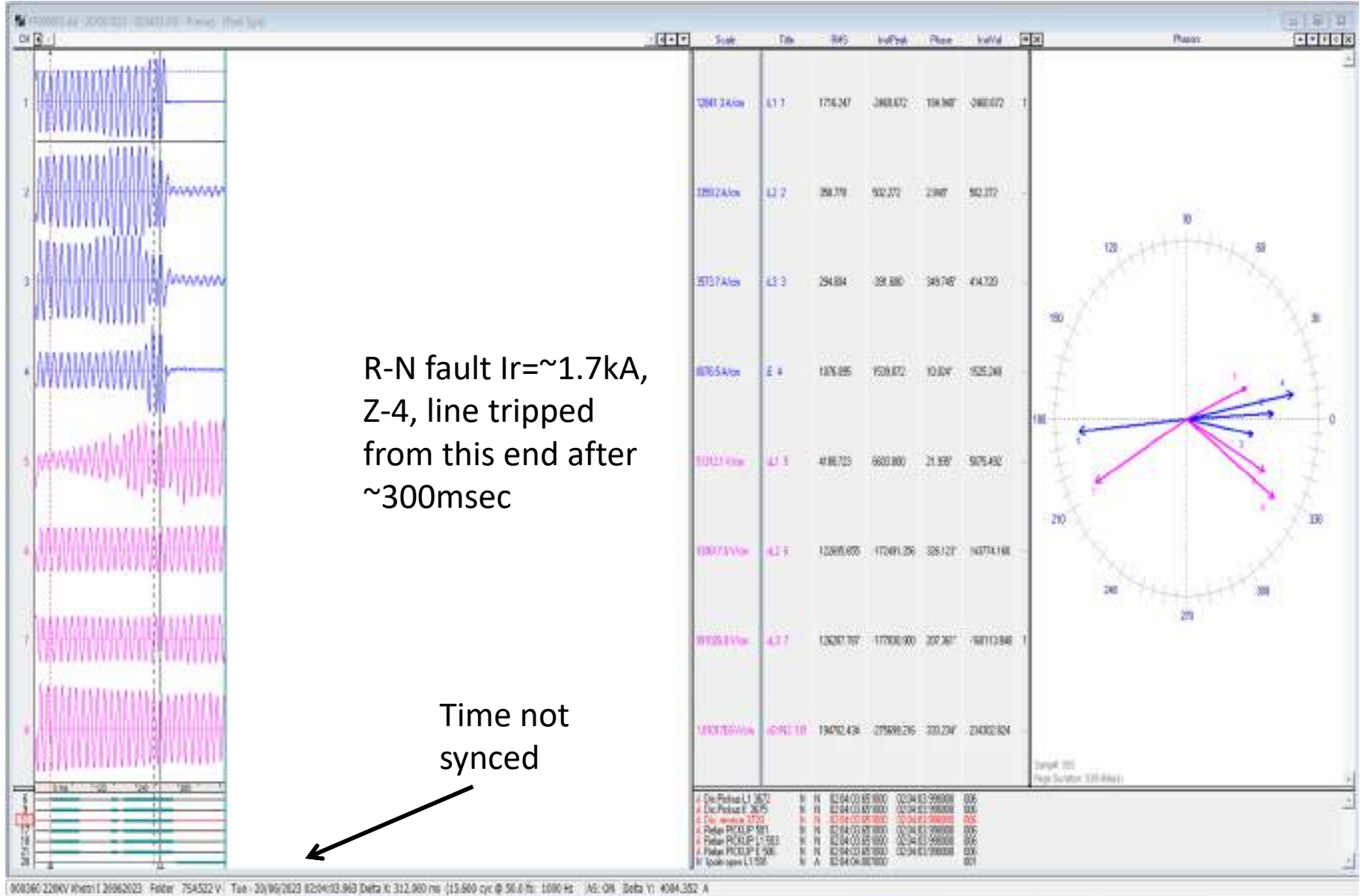
DR of 220kV Ratangarh400-Ratangarh220(end) (Raj) ckt-1



DR of 220kV Ratangarh400-Ratangarh220(end) (Raj) ckt-2

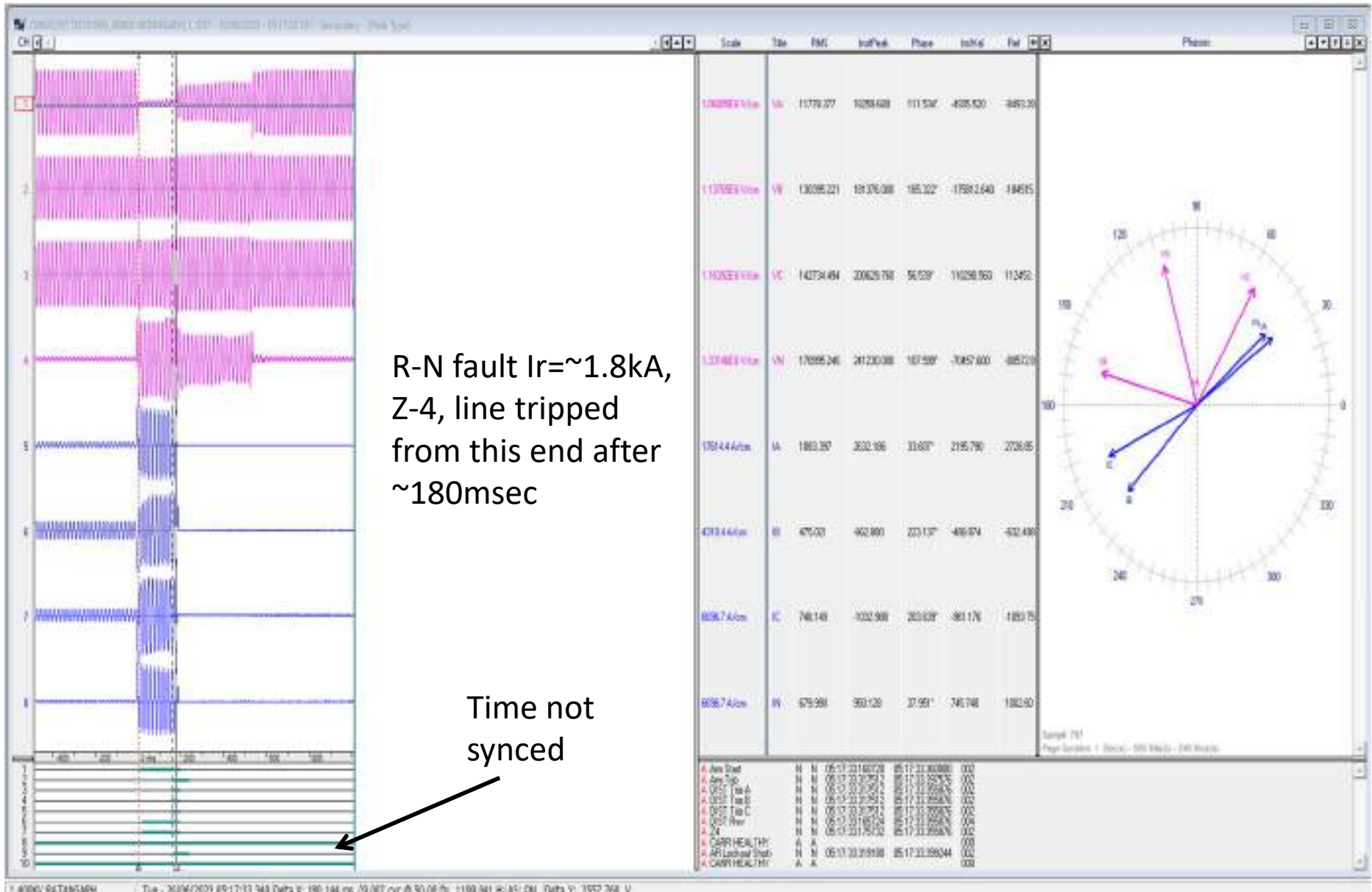


DR of 220kV Ratangarh(end)-Khetri (Raj) ckt-1



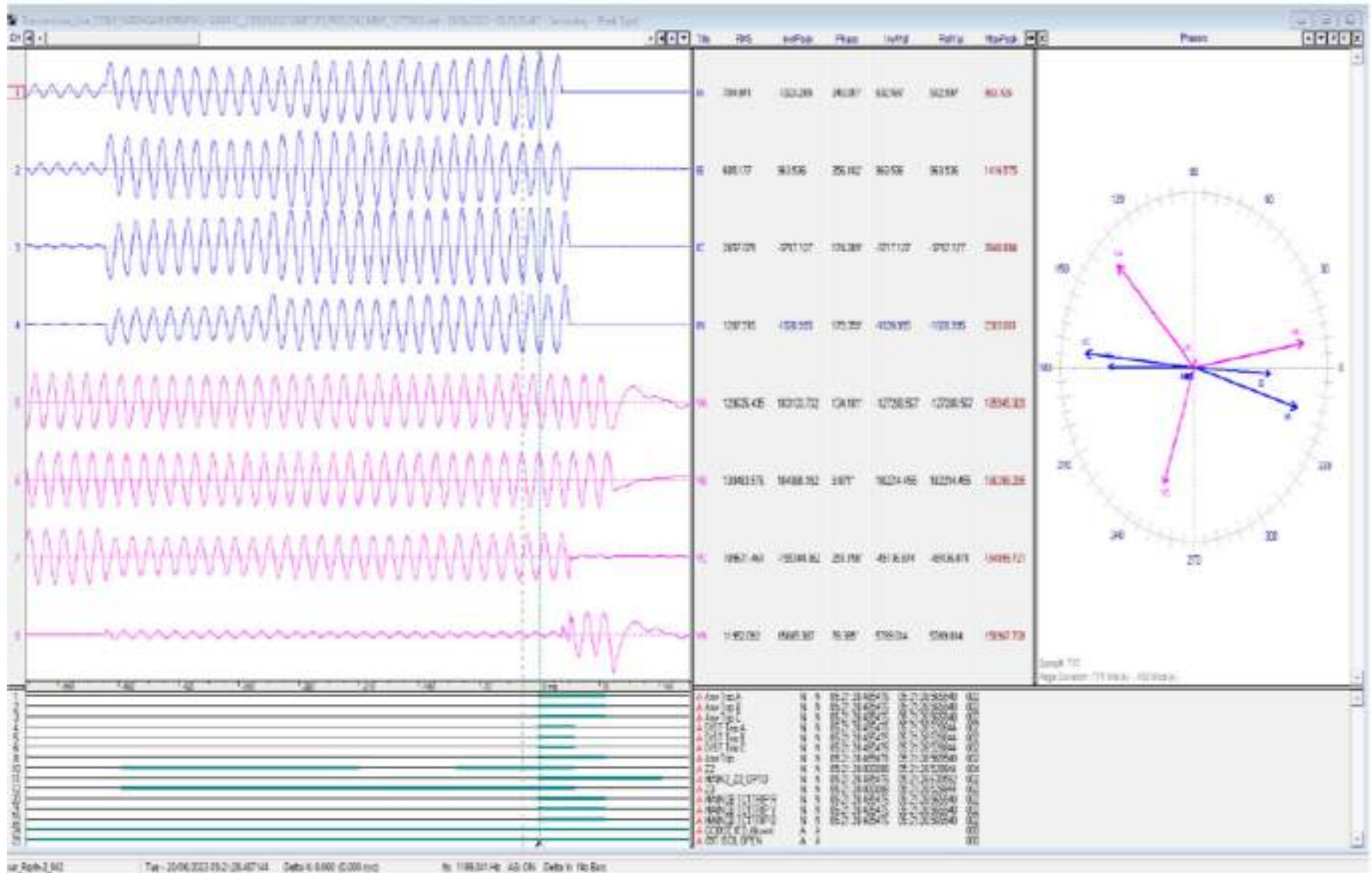
Phase sequence are not correctly configured. As per PMU & Ratangarh220 DR, fault in B-phase.

DR of 220kV Ratangarh(end)-Sikar ckt-1



Phase sequence are not correctly configured. As per PMU & Ratangarh220 DR, fault in B-phase.

DR of 220kV Ratangarh-Sikar(end) ckt-2



B-N fault $I_b \approx 2.8\text{kA}$, Z-2, line tripped from this end after $\sim 500\text{msec}$

Point of discussion

- i. Exact location and nature of fault?
- ii. Reason of delayed clearance of fault?
- iii. Periodic review of protection system and their healthiness need to be ensured.
Status of healthiness of bus bar protection?
- iv. Operation of Z-4 (distance protection) at 220kV Ratangarh end need to be reviewed.
- v. It was informed that DR of 400/220kV 315MVA ICT-2 at Ratangarh(Raj) is not available as relay is of electromechanical type. Electromechanical relay need to be replaced with numerical relay on priority.
- vi. DR of Ratangarh(Raj) end are not time synced, same has been communicated to Rajasthan to take necessary corrective action at the earliest.
- vii. Remedial action taken report to be shared.

**Multiple elements tripping at
220kV Khodri(Utt) & 220kV Majri(HP)**

**26th July 2023 at
07:07 hrs**

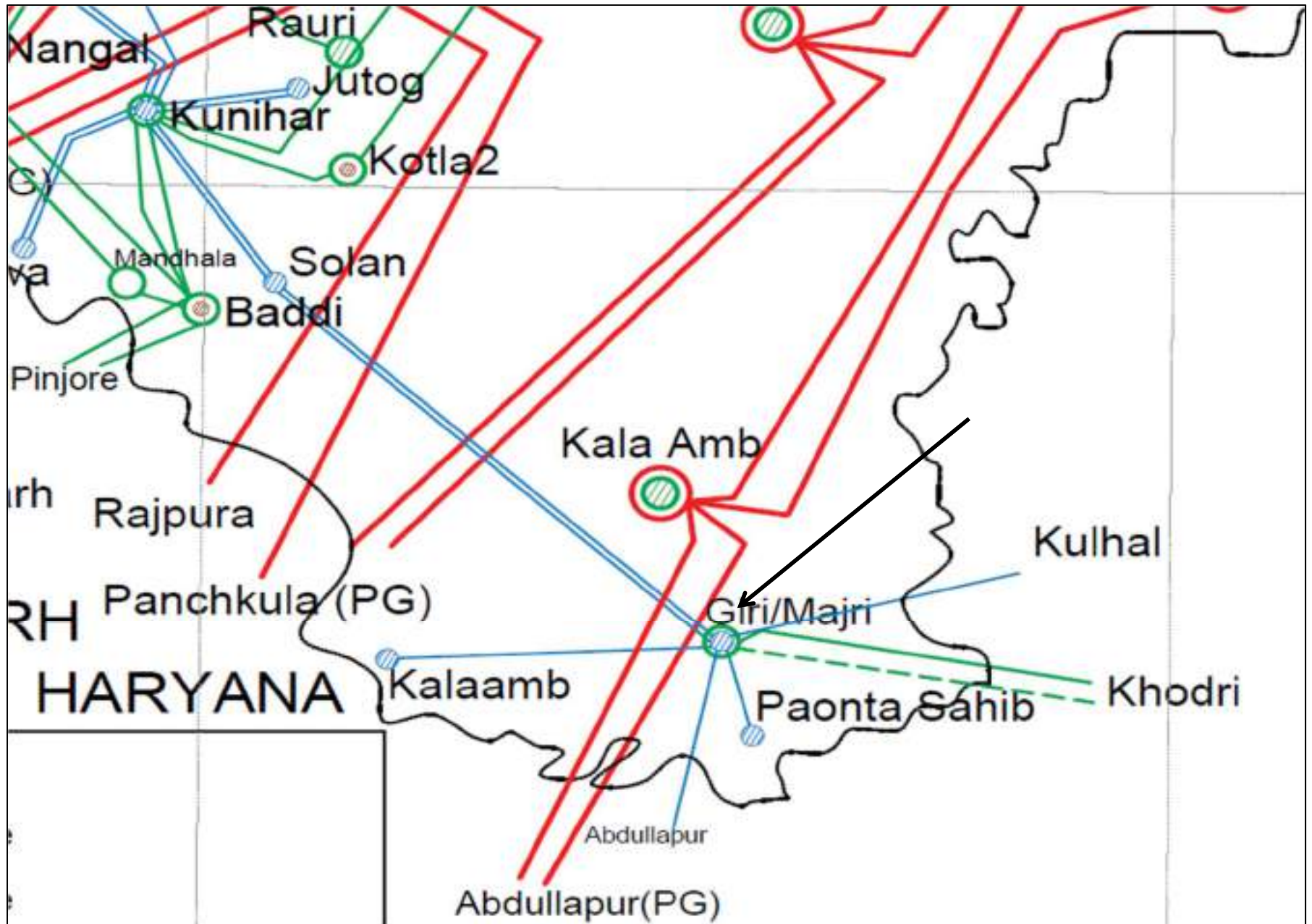
Brief of event:

- 220/132kV Majri (HP) has double main bus scheme at both 220kV & 132kV level. During antecedent condition, active power flowing through 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-1 & 2 was 72MW each respectively.
- As reported, at 07:07 hrs, 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-1 tripped on Y-B phase to phase fault. As per DR of Khodri end, Y-B phase to phase fault in Z-2 with fault current of 3.42kA each respectively in Y and B phase and fault clearance time of 384ms is observed.
- During the same time, 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-2 also tripped due to over-current protection operation ($I_y \sim 1.959\text{kA}$ and $I_b \sim 1.785\text{kA}$) from Majri end. Line tripped from Majri end only and remained charged from Khodri end.

Elements tripped:

- i. 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-1
- ii. 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-2 (tripped from Majri end only)

Network diagram



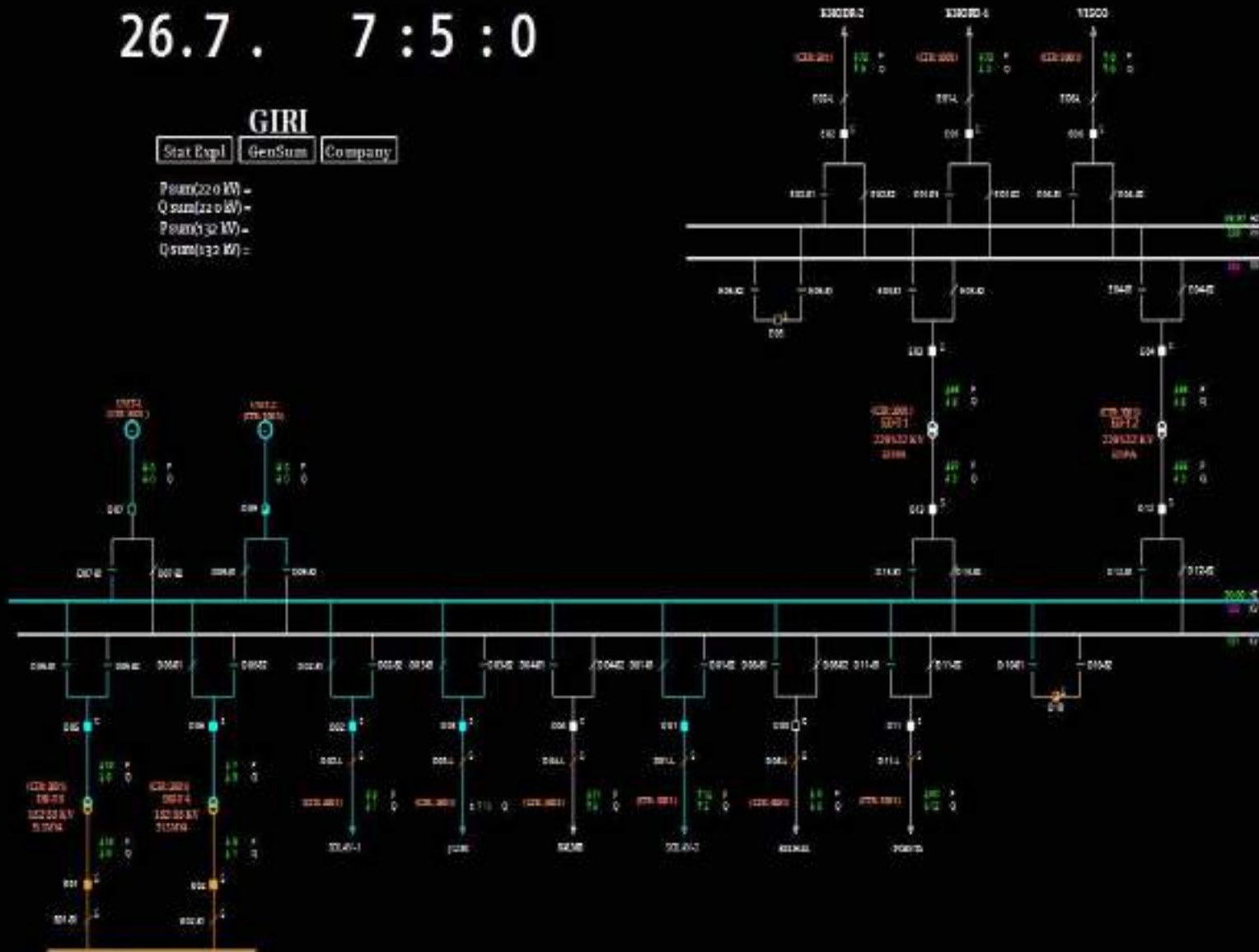
SLD of 220/132kV Giri/Majri(HP) before the tripping

26.7 . 7 : 5 : 0

GIRI

Stat Expl GeoSum Company

P sum(220 KV) =
Q sum(220 KV) =
P sum(132 KV) =
Q sum(132 KV) =



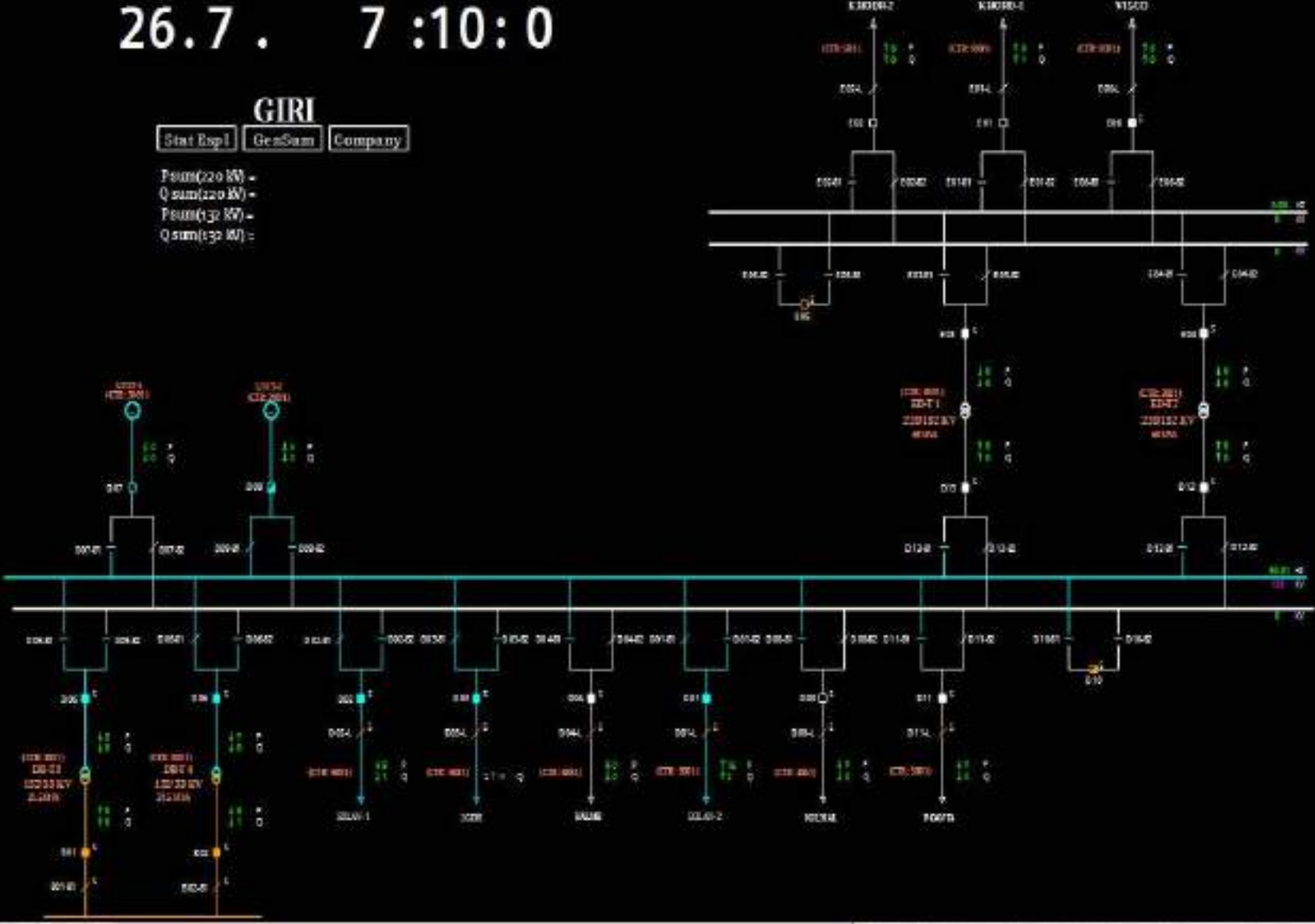
SLD of 220/132kV Giri/Majri(HP) after the tripping

26.7 . 7 :10:0

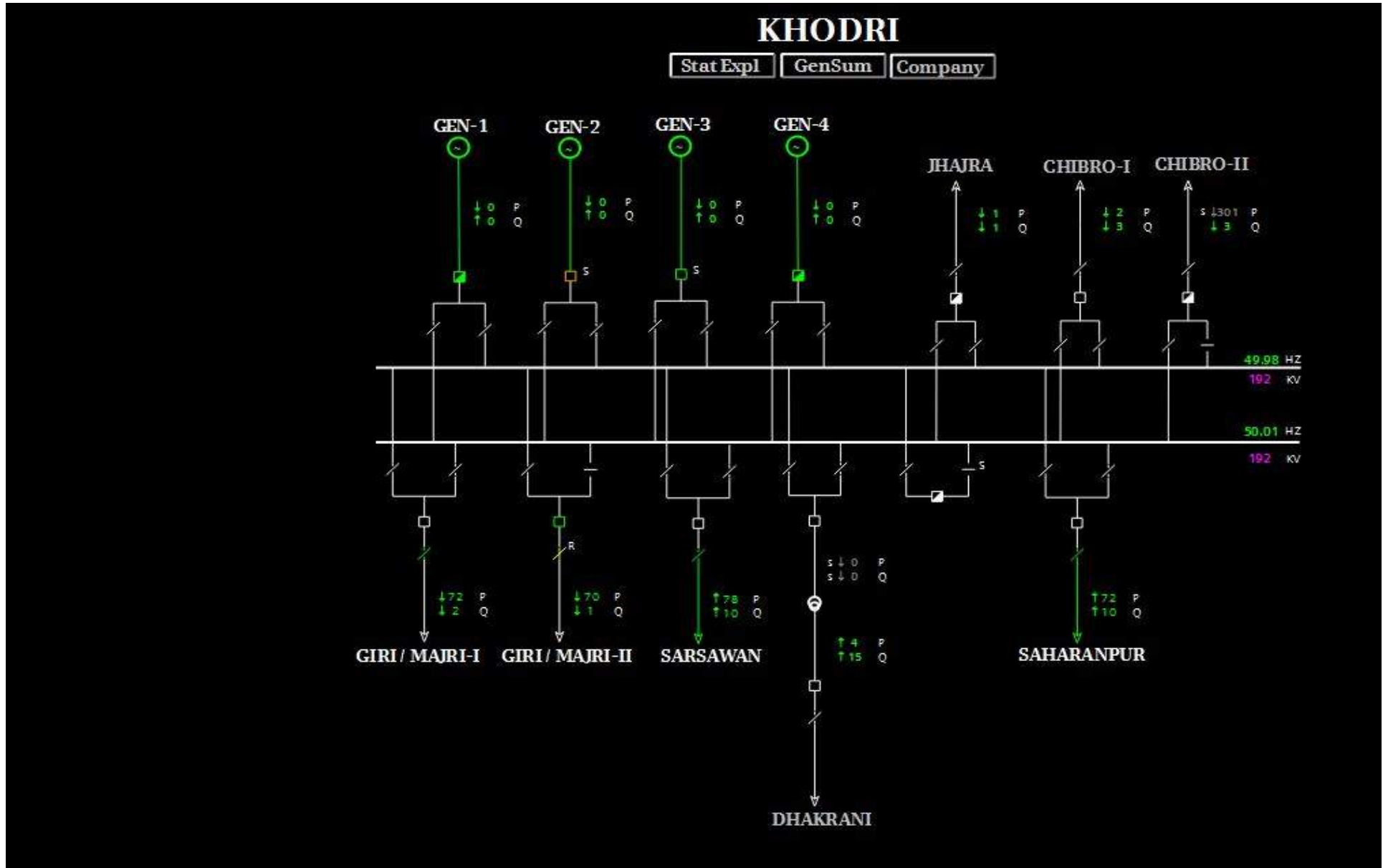
GIRI

Stat Esp1 GenSum Company

Psum(220 KV) =
Qsum(220 KV) =
Psum(132 KV) =
Qsum(132 KV) =



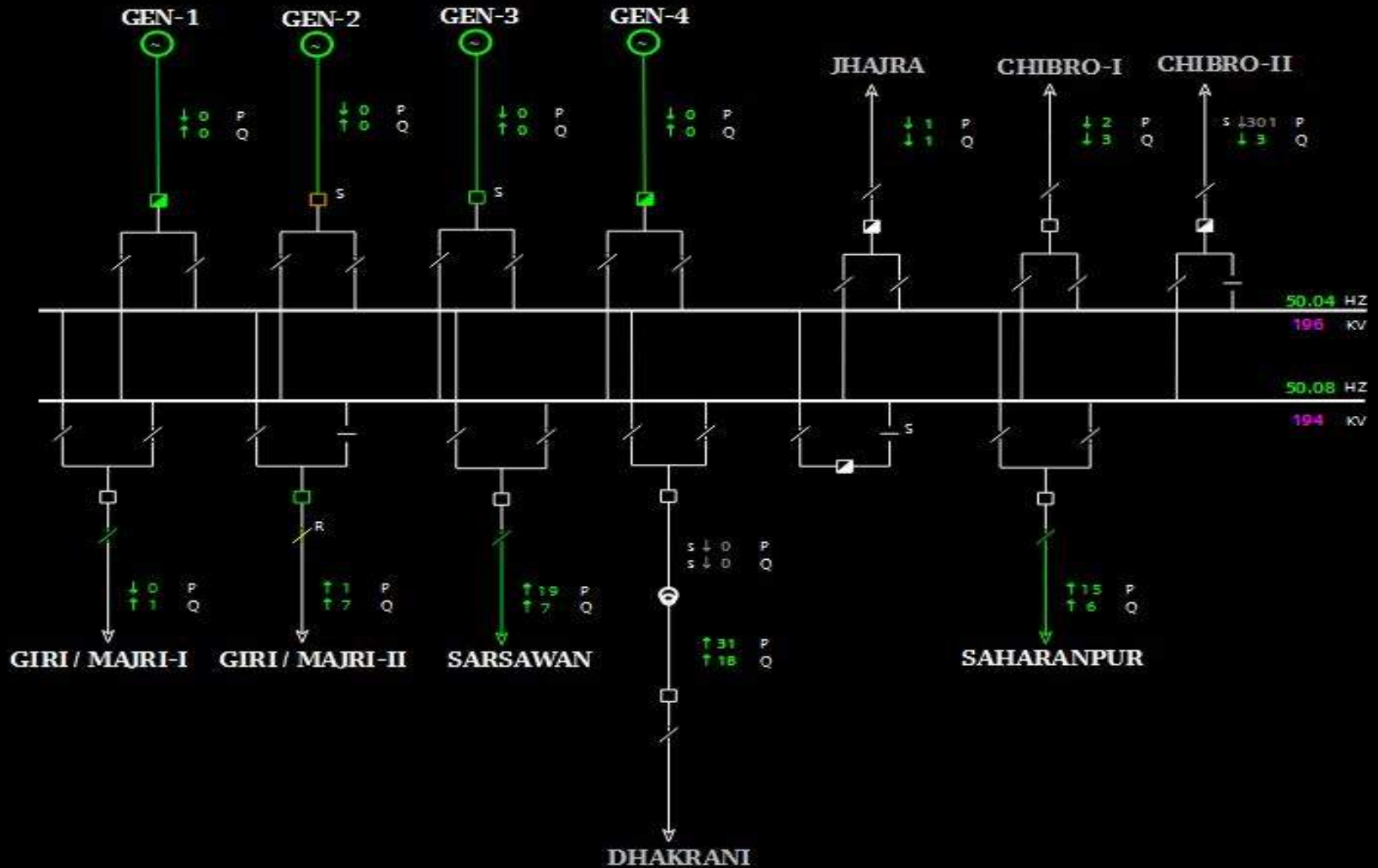
SLD of 220kV Khodri(UK) before the tripping



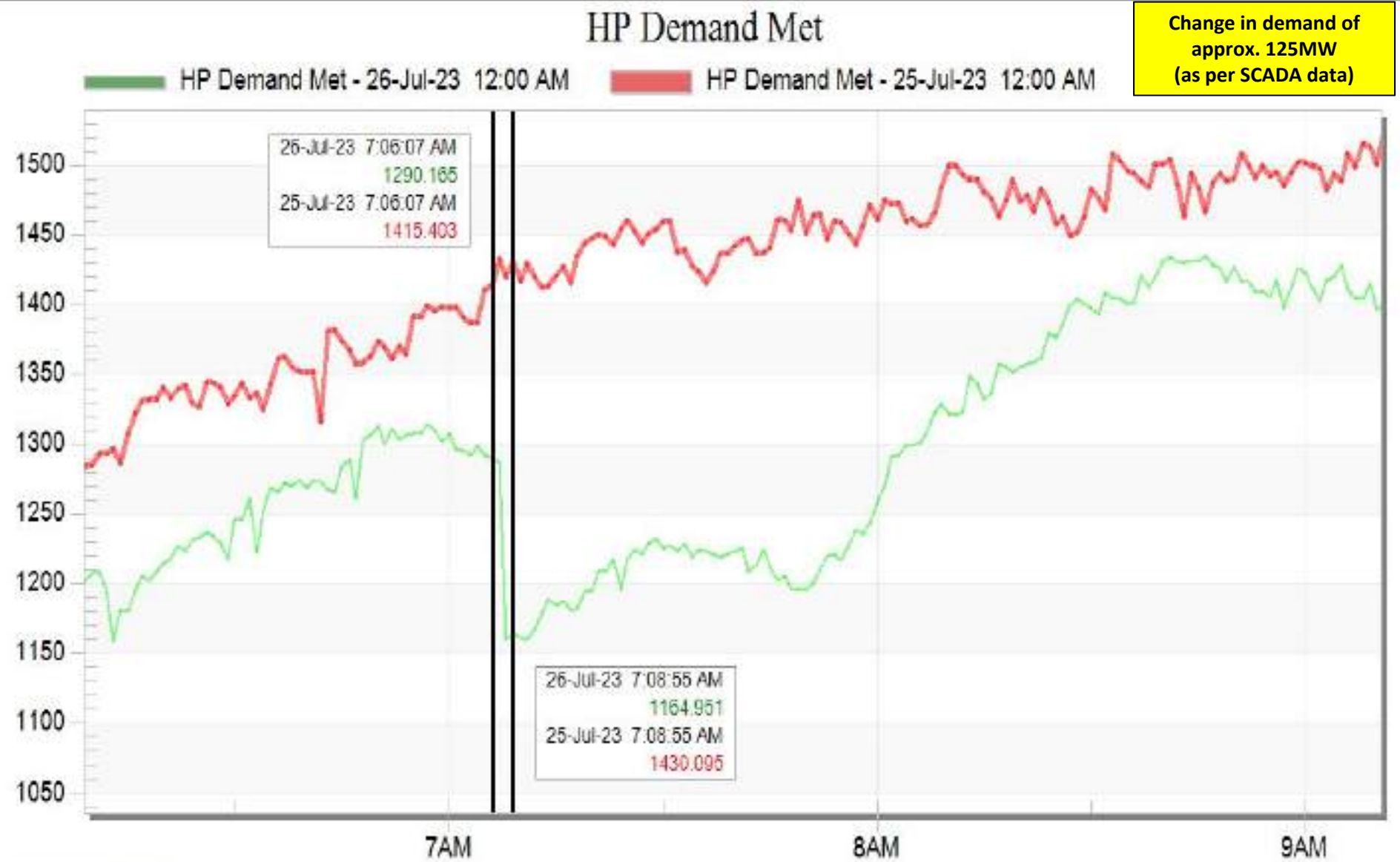
SLD of 220kV Khodri(UK) after the tripping

KHODRI

Stat Expl GenSum Company



Himachal Pradesh demand during the event



Jul 26 Wed 2023

PMU Plot of frequency at Shahrampur(PG)

07:07hrs/26-Jul-23

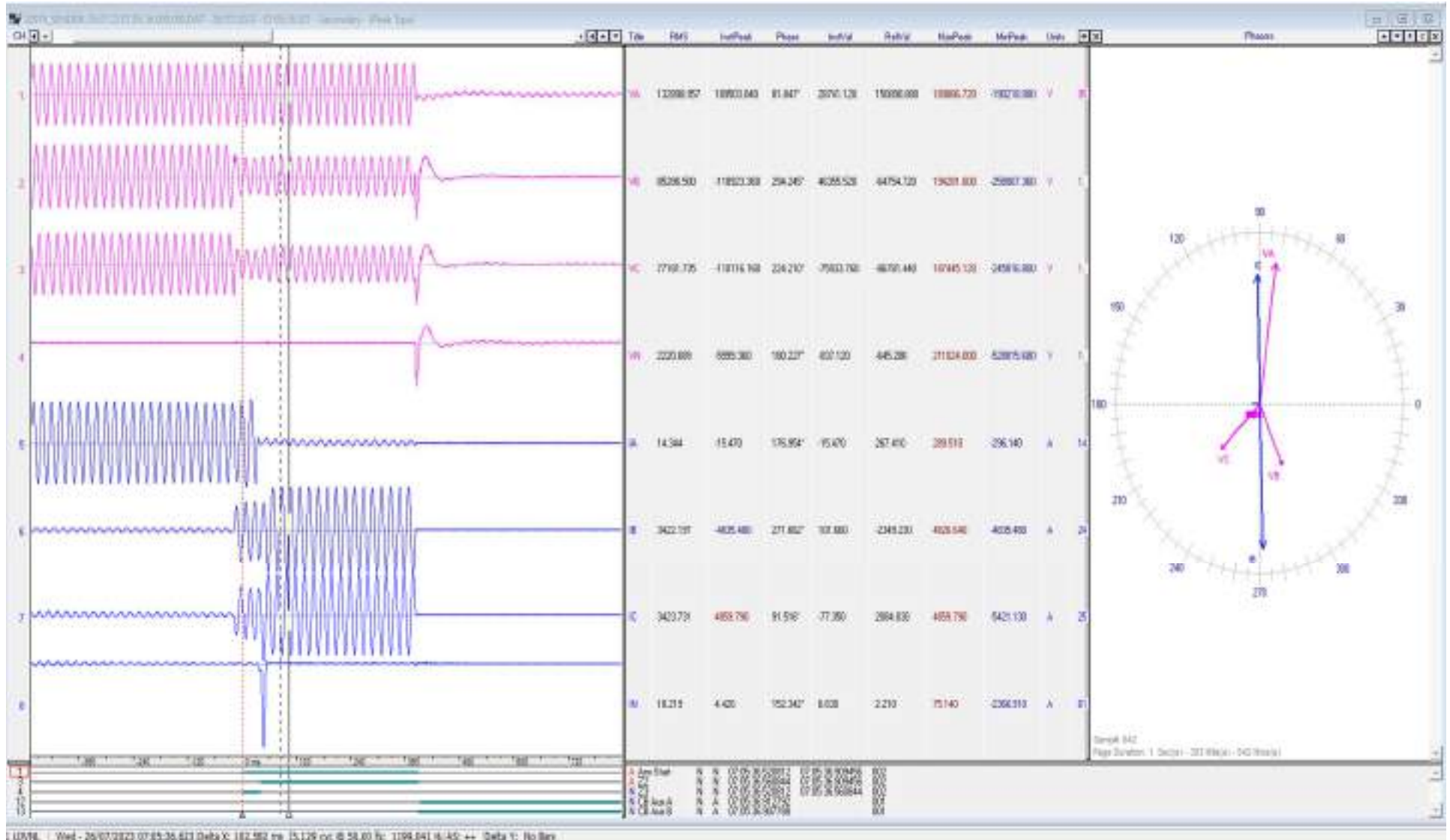


PMU Plot of phase voltage magnitude at Shahrampur(PG)

07:07hrs/26-Jul-23



DR of 220 KV Khodri(UK) (end)-Majri(HP) (UK) Ckt-1



- ✓ Y-B phase to phase fault; $I_y=I_b \approx 3.42\text{kA}$
- ✓ Fault sensed in zone-2
- ✓ Fault clearing time $\approx 384\text{ms}$

SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
07:05:50,251	GIRI__HP	220kV	01KHODR1	Circuit Breaker	Open	Line CB at Majri(HP) end of 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-1 opened
07:07:18,281	GIRI__HP	220kV	02KHODR2	Circuit Breaker	Open	Line CB at Majri(HP) end of 220 KV Khodri(UK)-Majri(HP) (UK) Ckt-2 opened

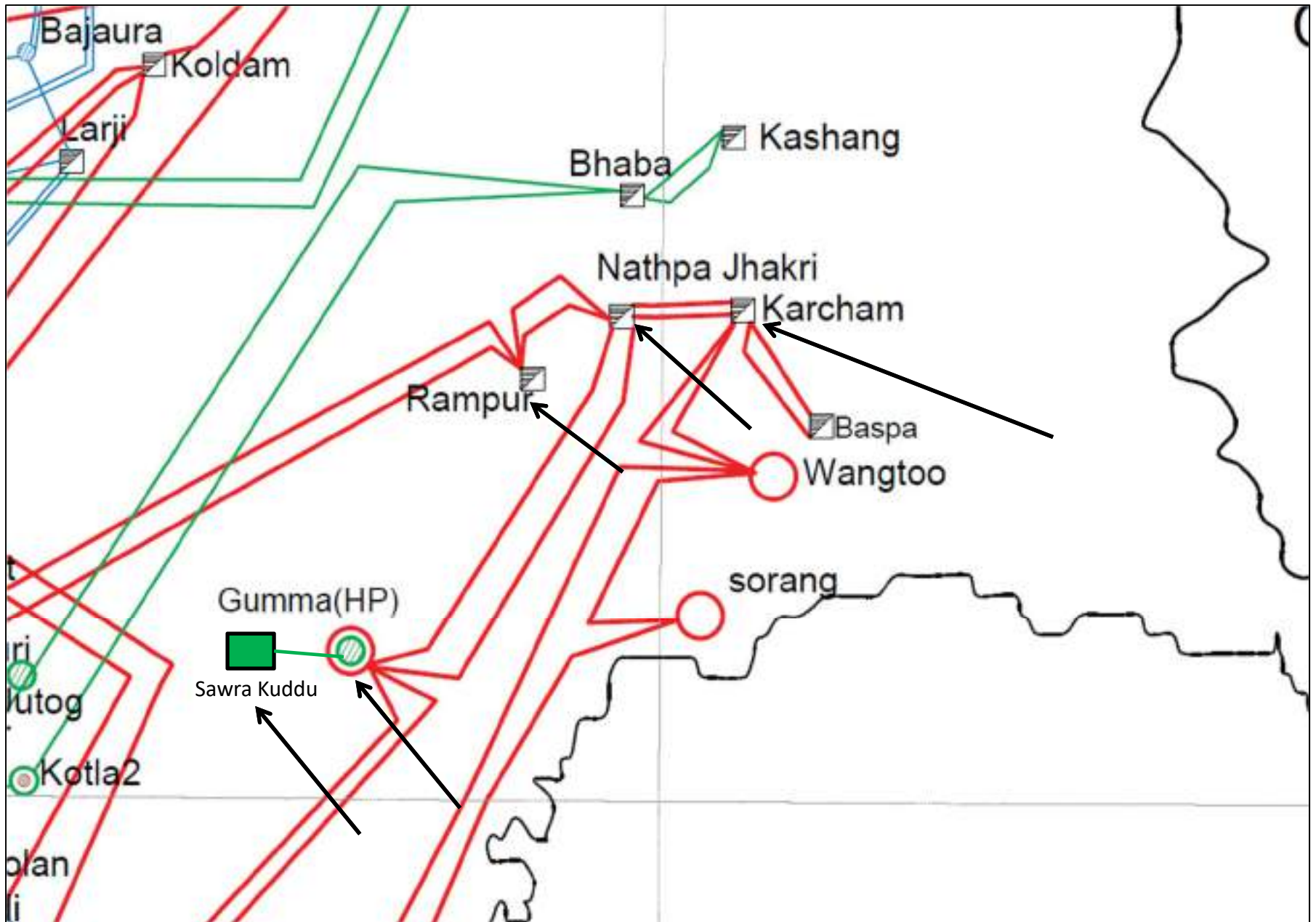
Point of discussion

- i. Exact reason of tripping need to be analysed.
- ii. Reason of delayed clearance of fault need to be shared.
- iii. Why did ckt-2 trip from Majri end?
- iv. DR/EL along with tripping report need to be shared.
- v. Remedial action taken report to be shared. In OCC 210, Uttarakhand agreed to share the analysis report of the event, however no report regarding event received yet.

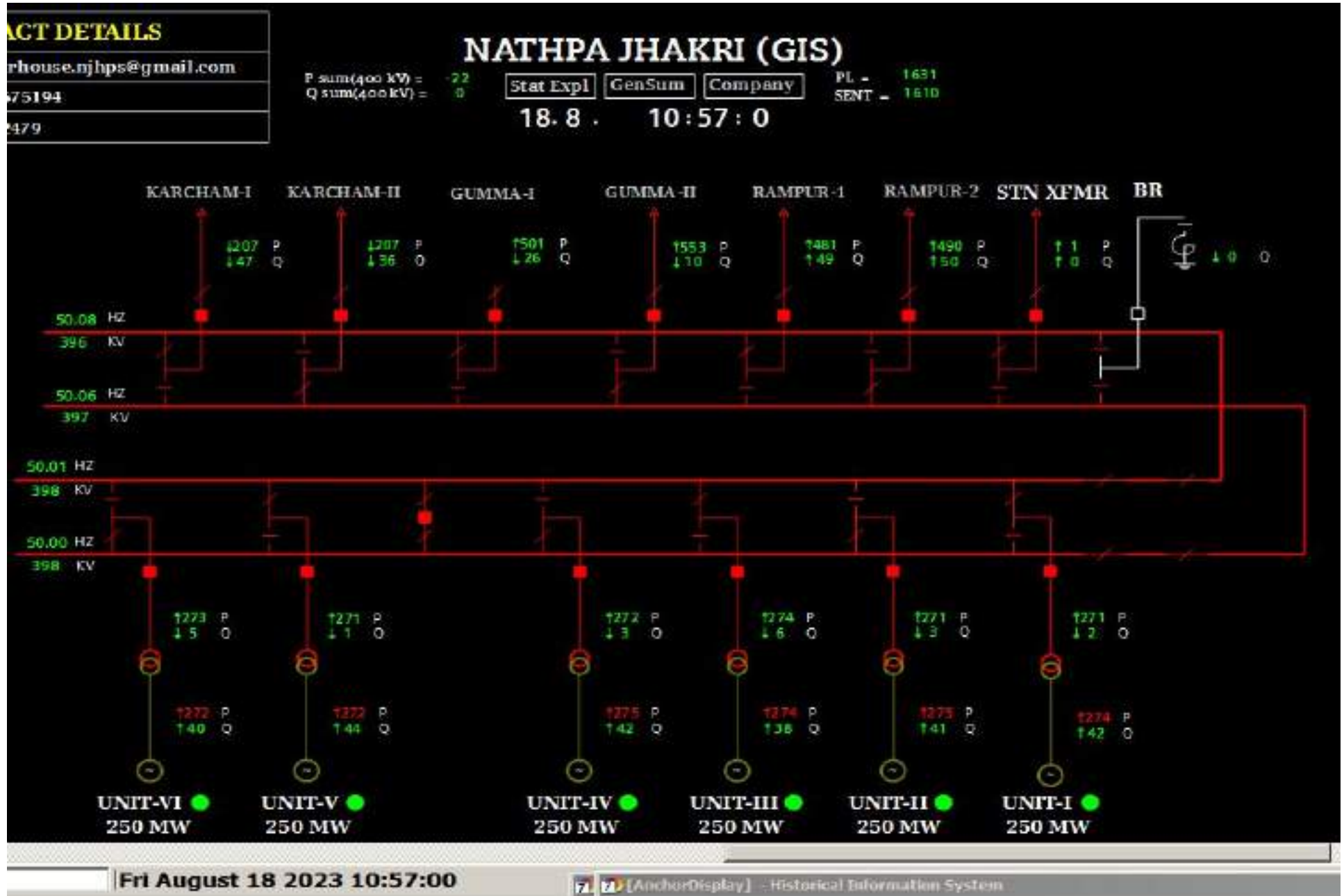
**Multiple elements tripping at
400/220kV Gumma(HP)**

**18th August 2023 at
10:59 hrs**

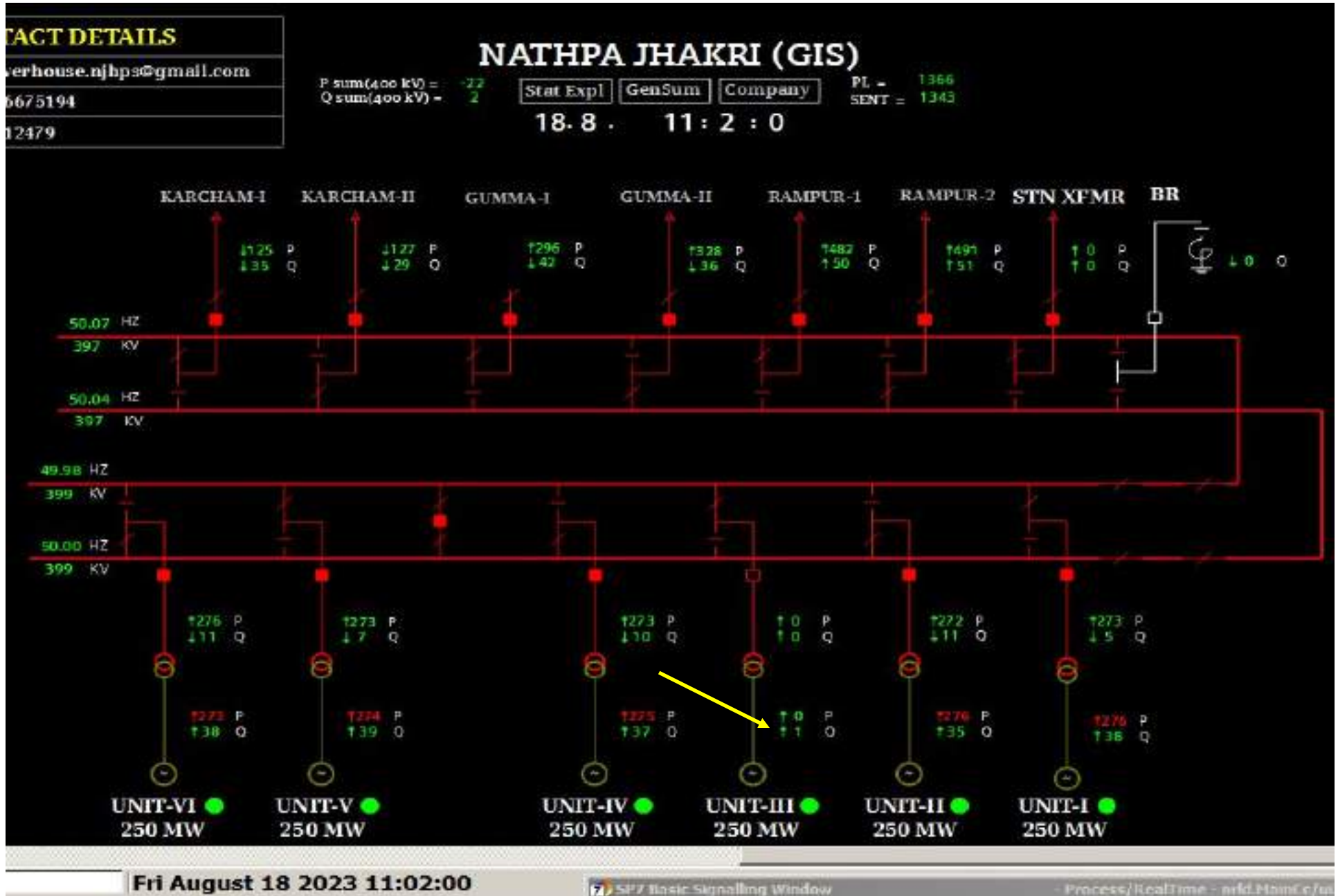
Network Diagram



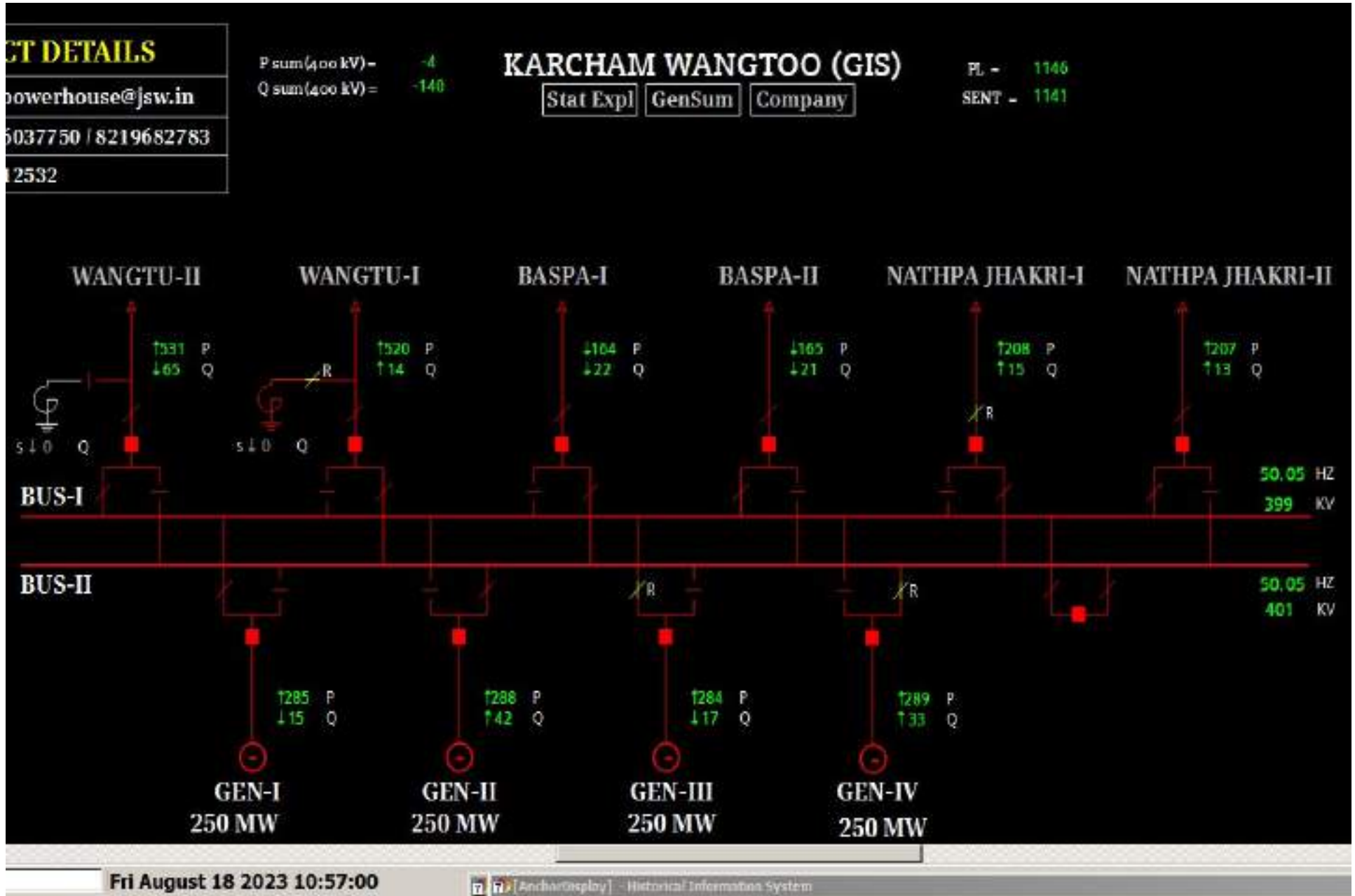
SLD of 400kV Nathpa Jhakri before the event



SLD of 400kV Nathpa Jhakri after the event



SLD of 400kV Karcham Wangtoo before the event



SLD of 400kV Karcham Wangtoo after the event

CT DETAILS

powerhouse@jsw.in

6037750 / 8219682783

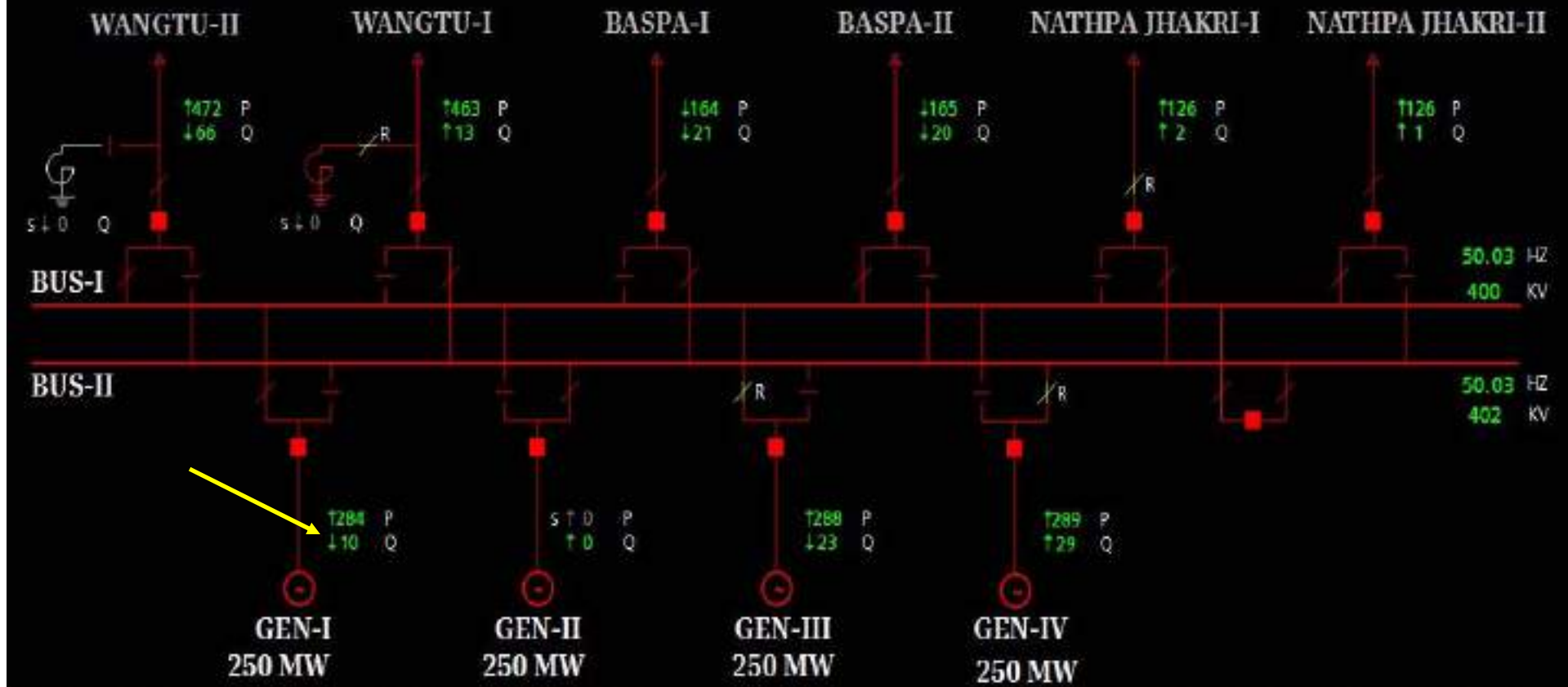
12532

P sum(400 kV) = 5 -4
Q sum(400 kV) = 5 -106

KARCHAM WANGTOO (GIS)

Stat Expl GenSum Company

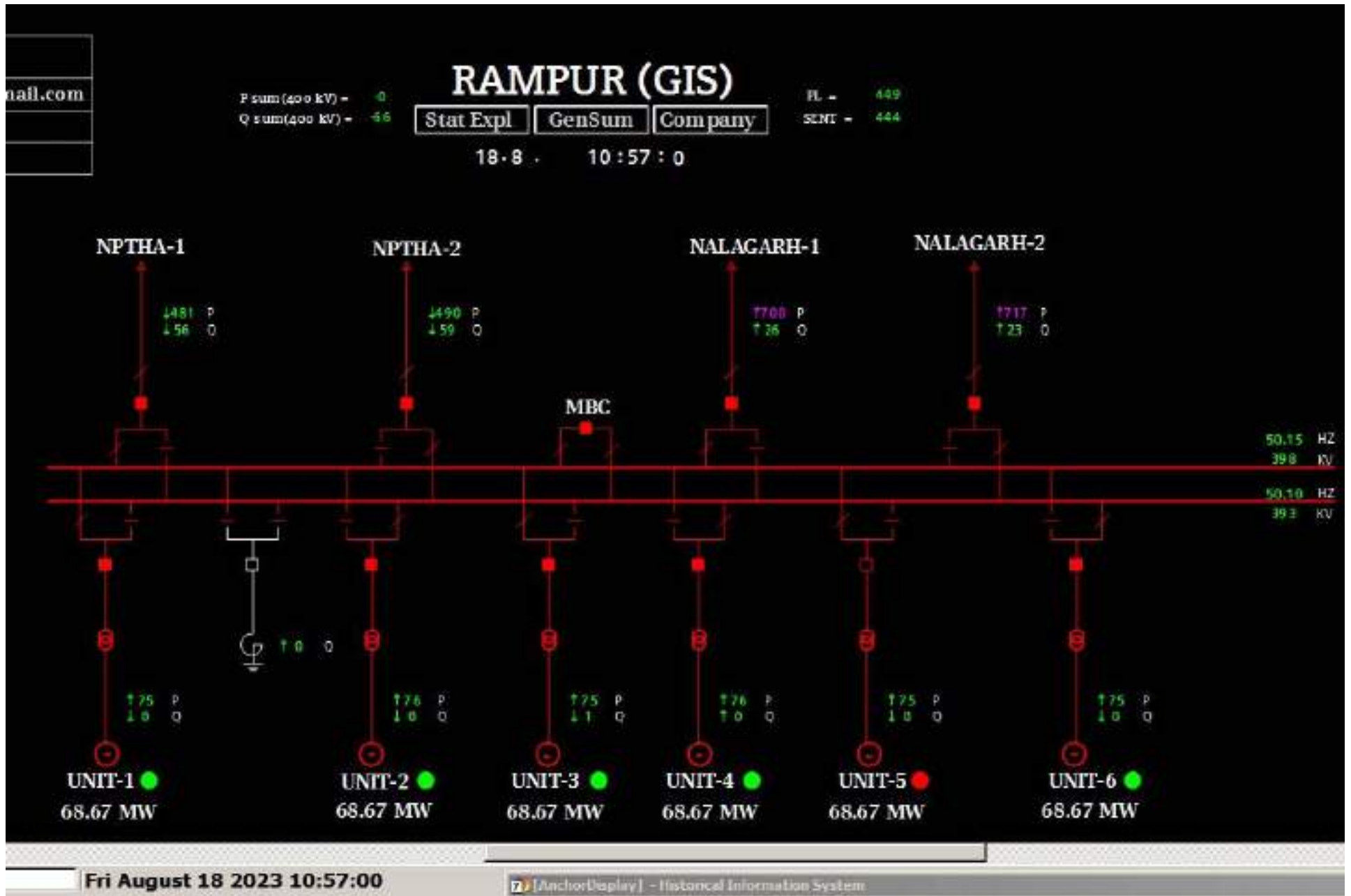
PL = 5.861
SENT = 858



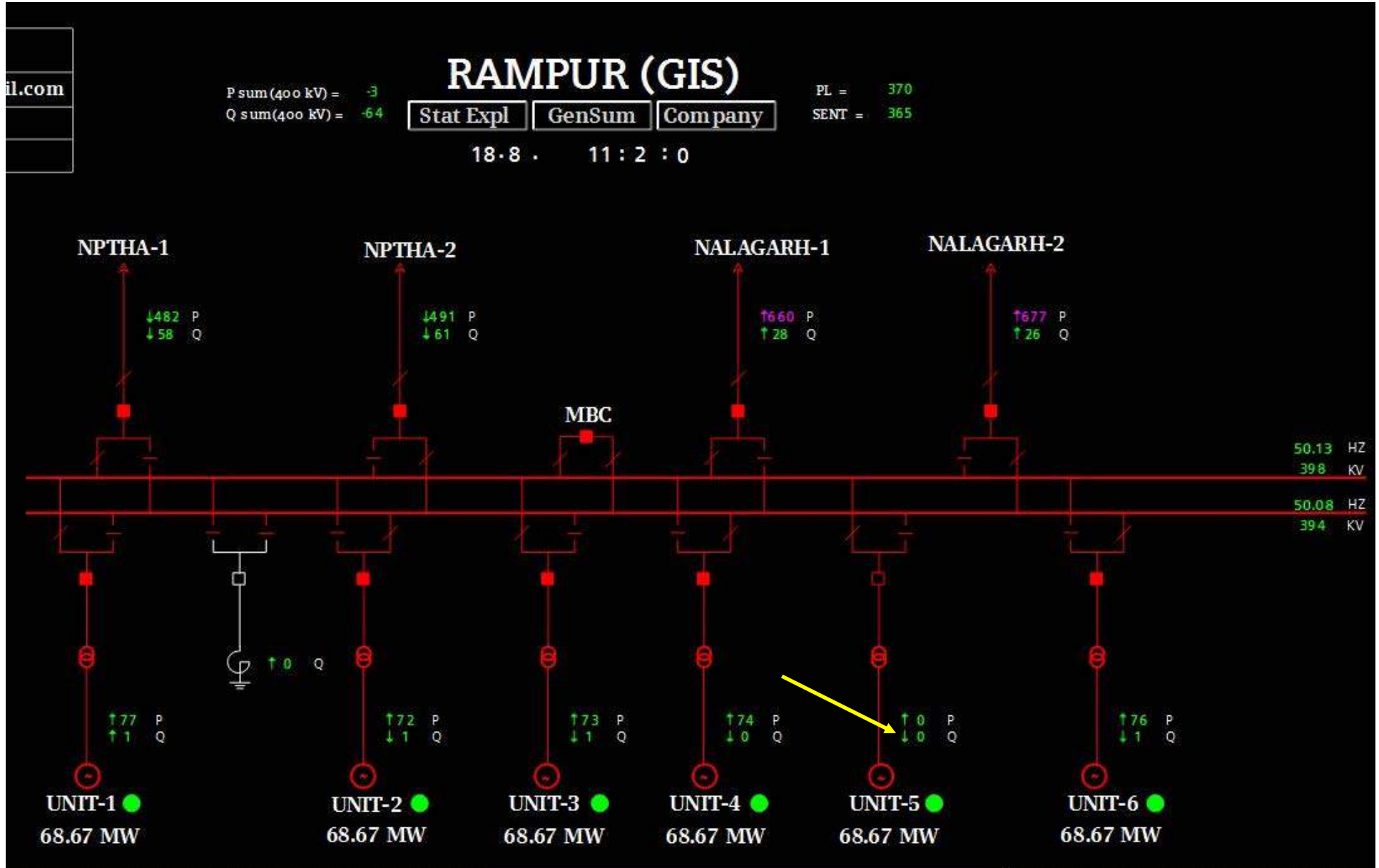
Fri August 18 2023 11:02:00

[AnchorDisplay] - Historical Information System

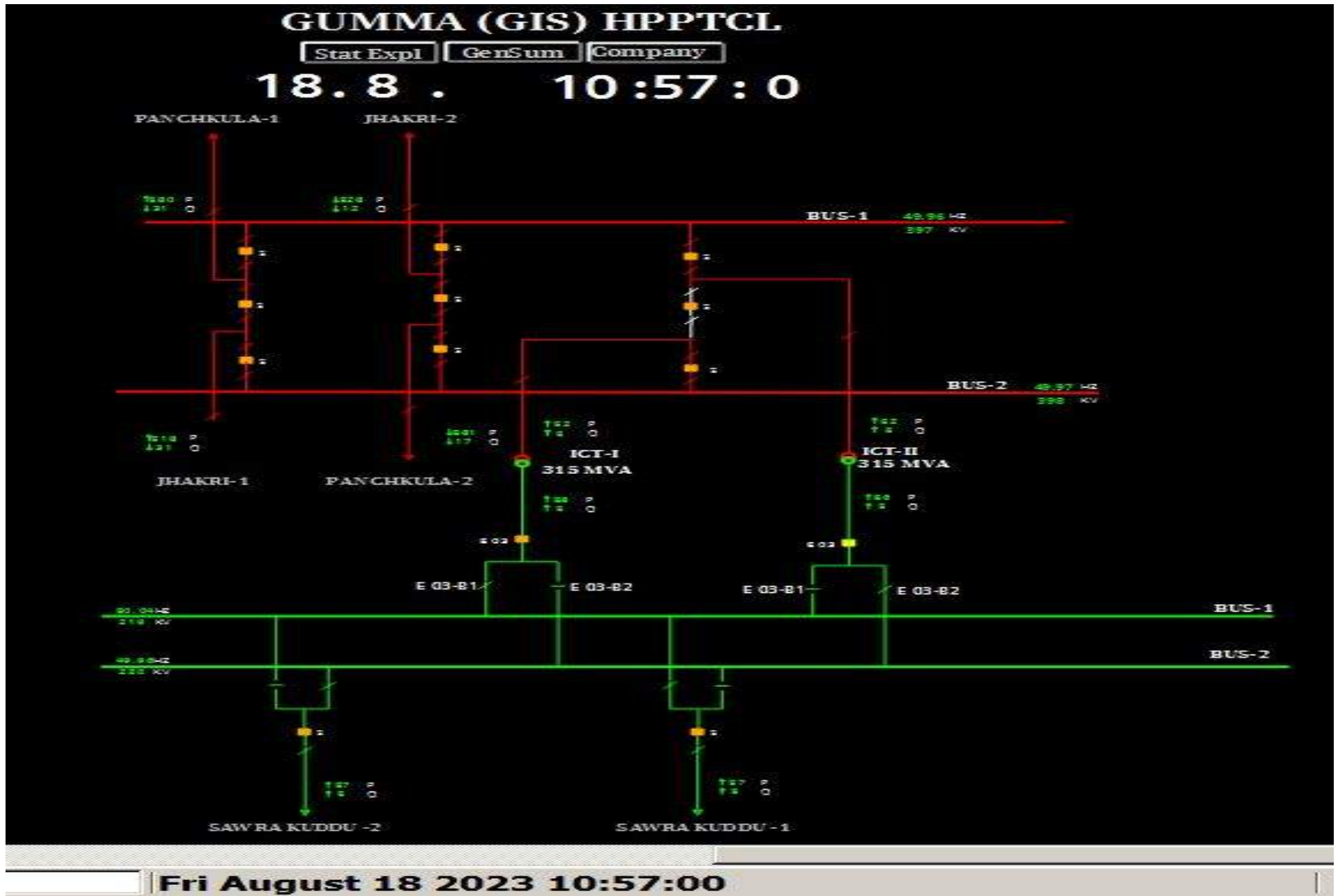
SLD of 400kV Rampur before the event



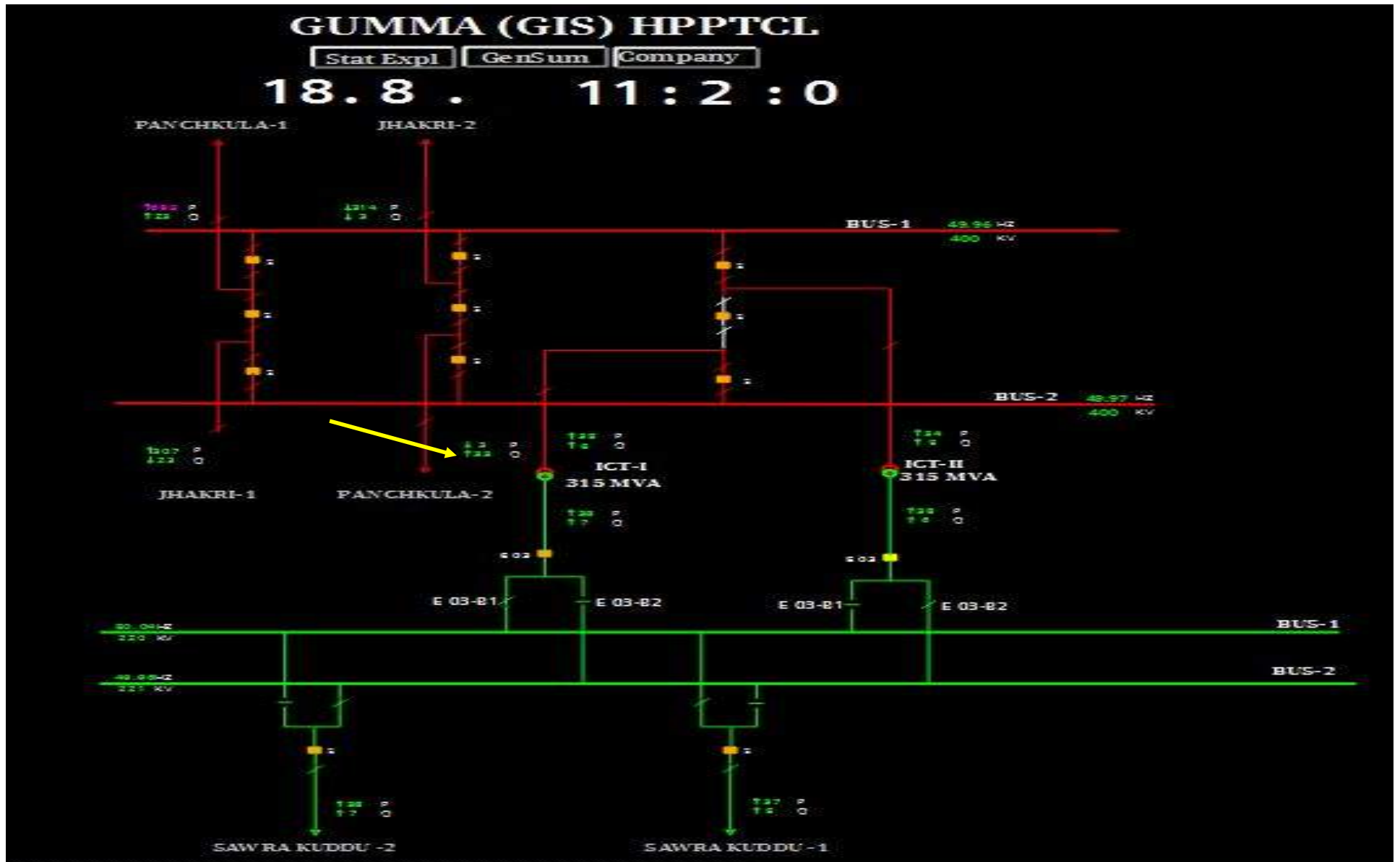
SLD of 400kV Rampur after the event



SLD of 400/220kV Gumma(HP) before the event

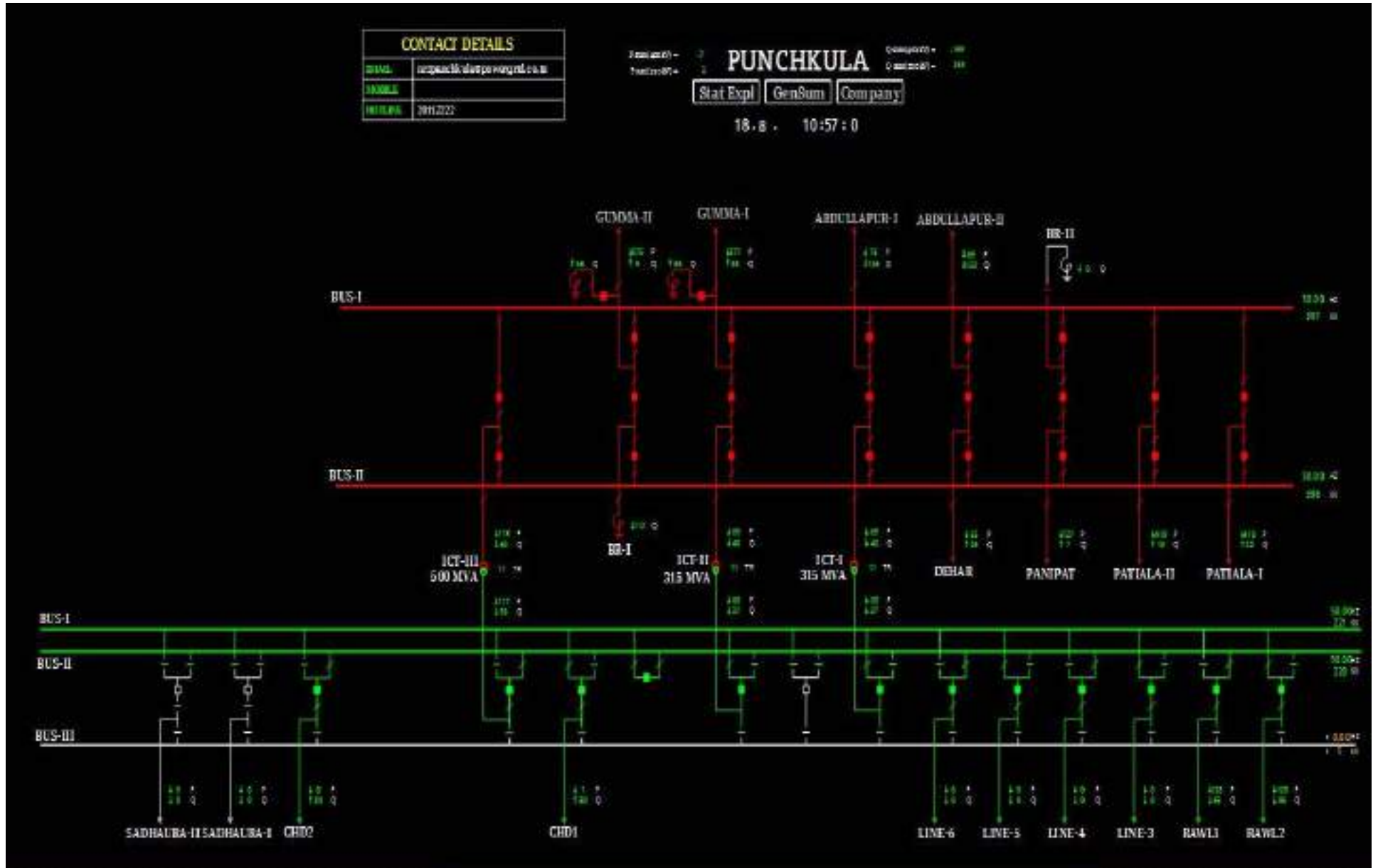


SLD of 400/220kV Gumma(HP) after the event

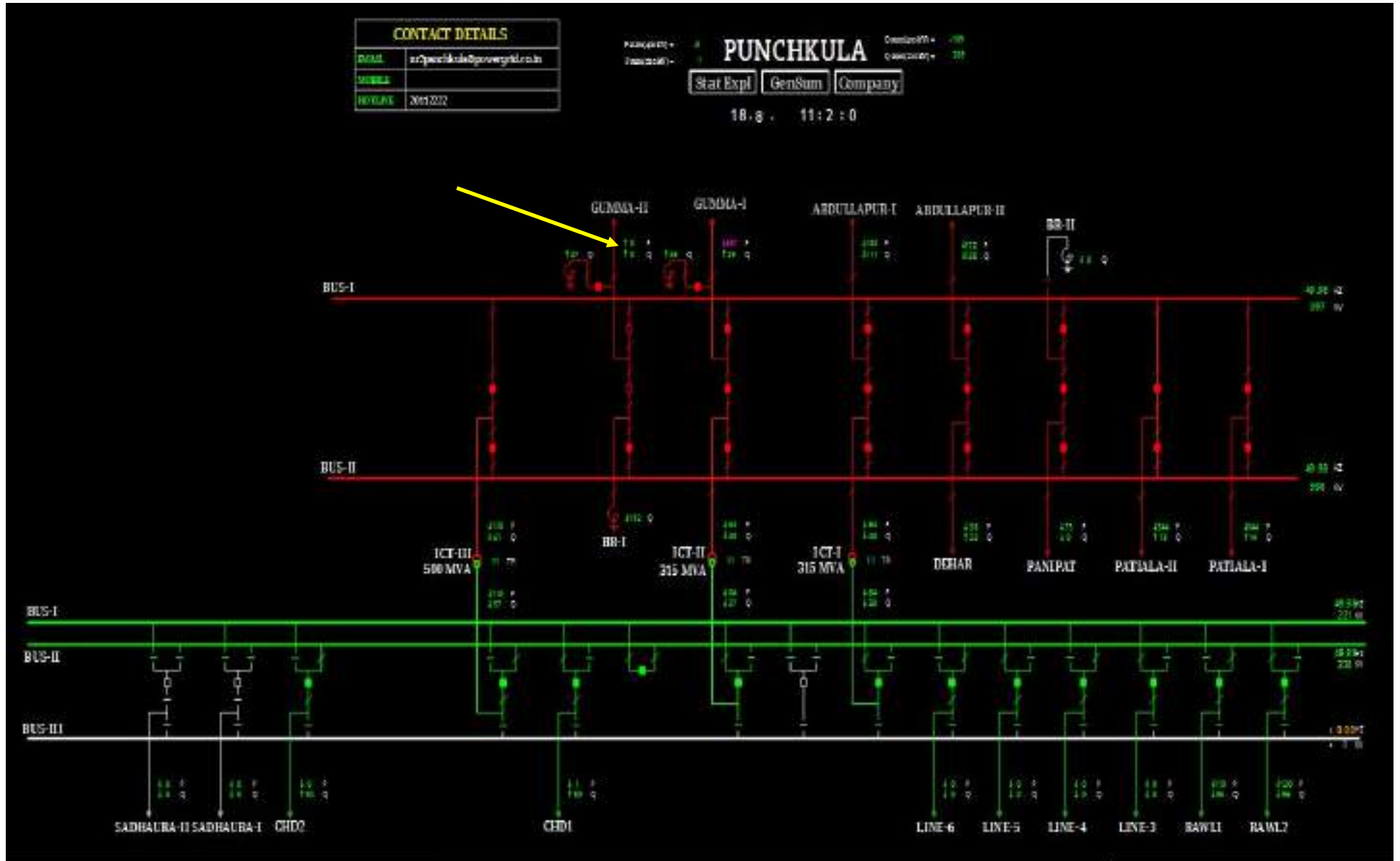


Fri August 18 2023 11:02:00

SLD of 400/220kV Panchkula(PG) before the event



SLD of 400/220kV Panchkula(PG) after the event



Fri August 18 2023 11:02:00

SPS for reliable evacuation of power from NJPS, Rampur, Sawra Kuddu, Baspa Sorang and Karcham Wangtoo HEP

Case-1: Load on any of the lines at Jhakri, Rampur or Gumma towards Nalagarh or Panchkula exceeds 850 MW

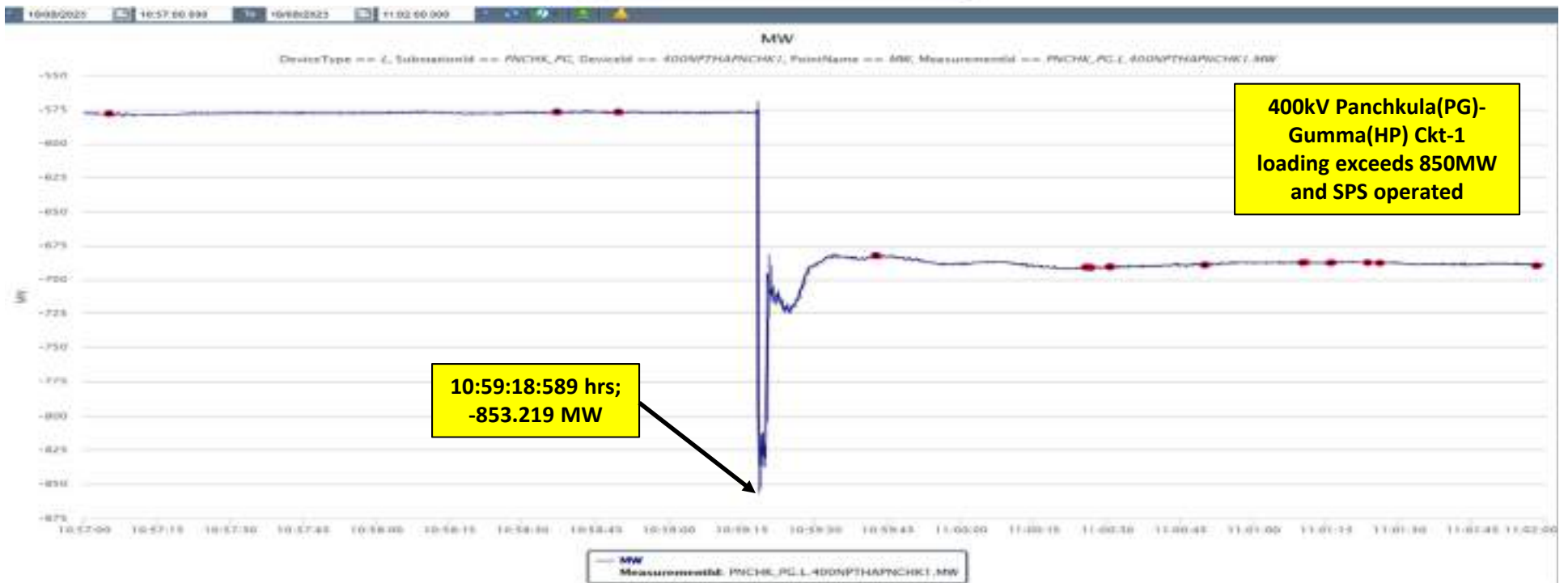
Action: Trip 1 unit of Karcham Wangtoo HPS, 1 unit of Jhakri HEP, 1 unit of Rampur HEP and 1 unit of Sawra Kuddu (Gumma) HEP

In this case,

Due to tripping of 400 KV GUMMA (HP)-PANCHKULA(PG) (PG) CKT-2, loading of 400 KV GUMMA (HP)-PANCHKULA(PG) (PG) CKT-1 exceeds 850 MW

Event: 250 MW KARCHAM WANGTOO HPS -UNIT 2 , 250 MW NATHPA-JHAKRI HPS - UNIT 3, 68.67 MW RAMPUR HEP - UNIT 5 and 40 MW SAWRA KUDDU HPS-UNIT 1 tripped due to SPS operation

Line loading of 400kV Panchkula(PG)-Gumma(HP) D/C

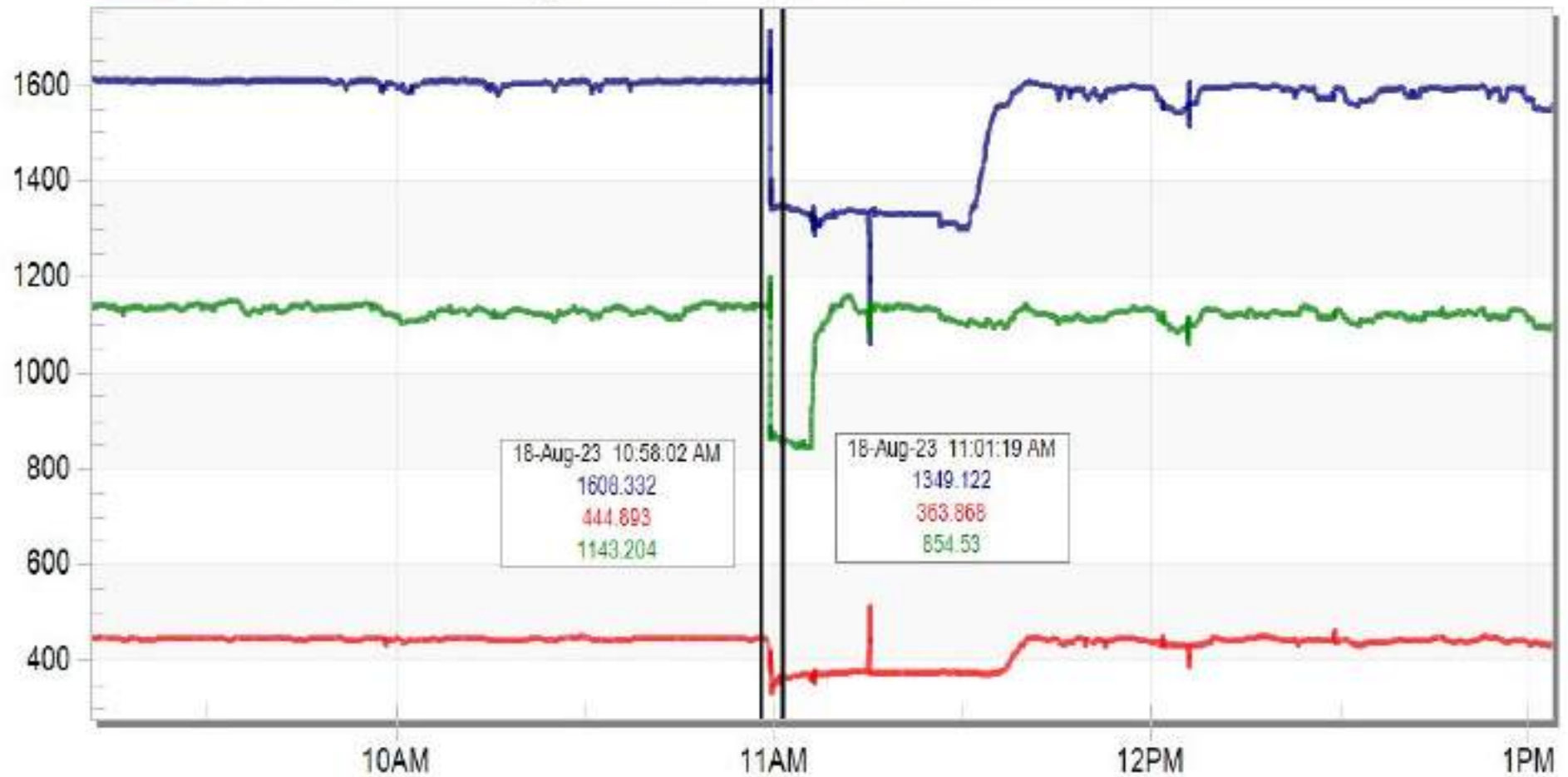


Naptha Jhakri Rampur Karcham Hydro complex generation during the event

Jhakri Rampur Karcham Hydro Complex Generation

- !COMPANIES!PGCIL!NRLDC_PGISENT!NPTHA_NJ!P.MvMoment
- !COMPANIES!PGCIL!NRLDC_PGISENT!RAMPR_NJ!P.MvMoment
- !COMPANIES!PGCIL!NRLDC_PGISENT!KRCHM_PG!P.MvMoment

Generation loss of approx.
260MW at Naptha Jhakri,
80MW at Rampur and
290MW at Karcham
(as per SCADA)



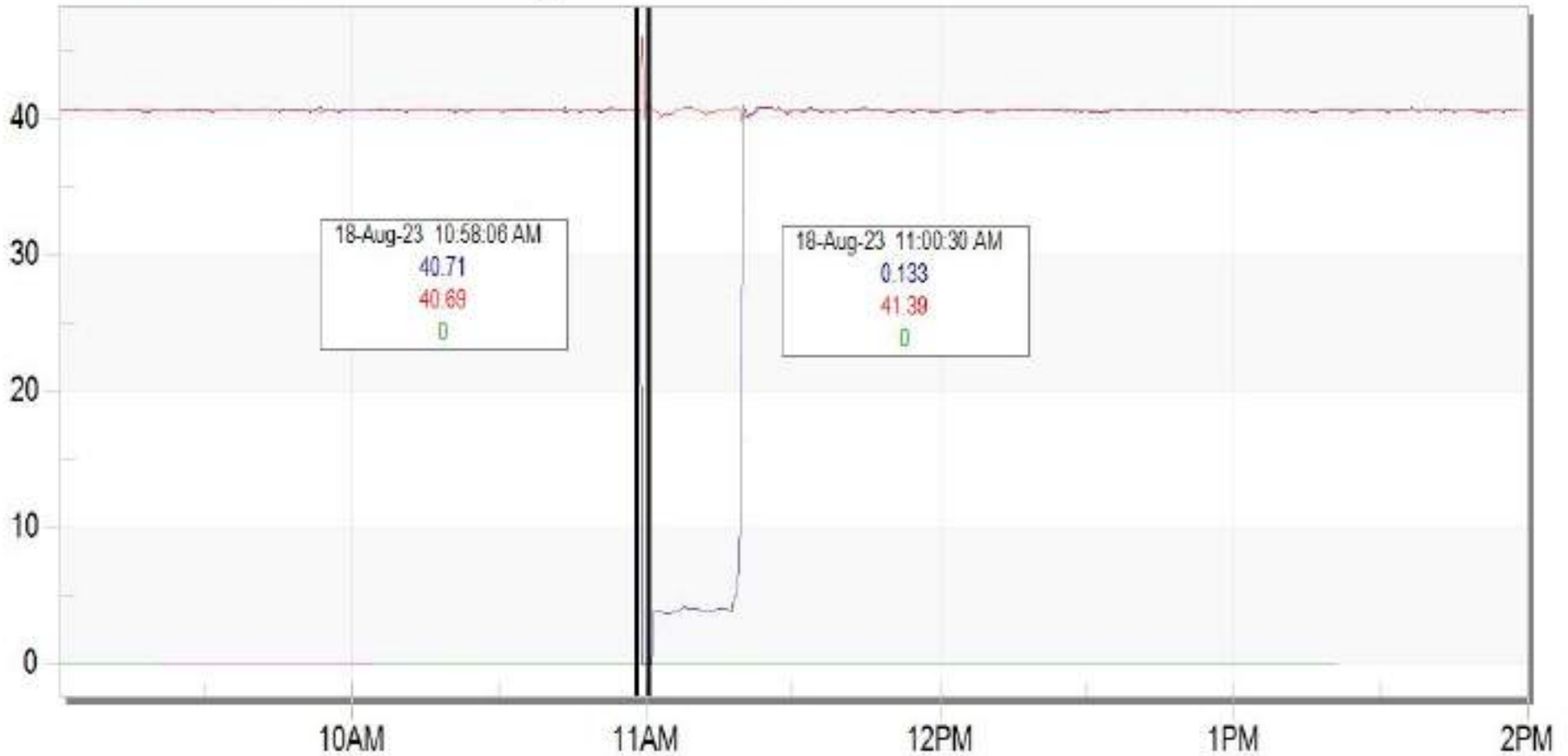
Aug 18 Fri 2023

Sawra Kuddu generation during the event

SawraKuddu Generation

- !COMPANIES!HPSEBL!SAWRA_HP!220!01H01!P.MvMoment
- !COMPANIES!HPSEBL!SAWRA_HP!220!04H02!P.MvMoment
- !COMPANIES!HPSEBL!SAWRA_HP!220!06H03!P.MvMoment

Generation loss of approx. 40MW at Sawra Kuddu (as per SCADA)



Aug 18 Fri 2023

PMU Plot of frequency at Panchkula(PG)

10:59 hrs/18-Aug-23



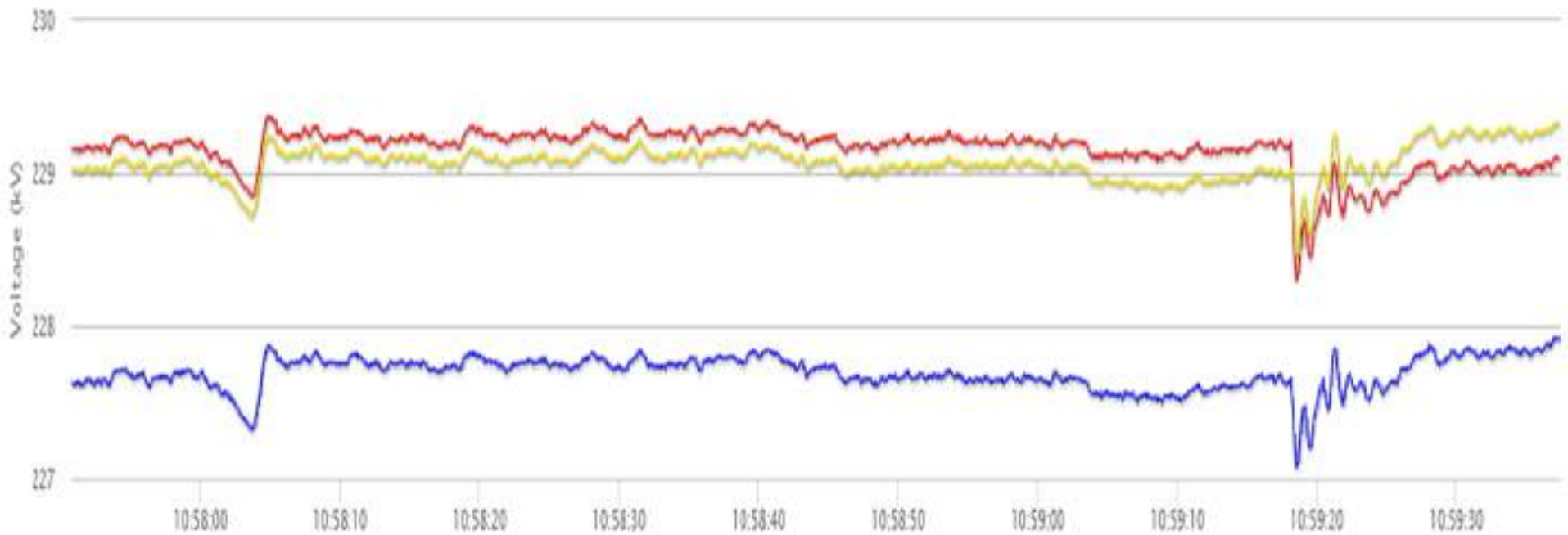
PMU Plot of phase voltage magnitude at Panchkula(PG)

10:59 hrs/18-Aug-23



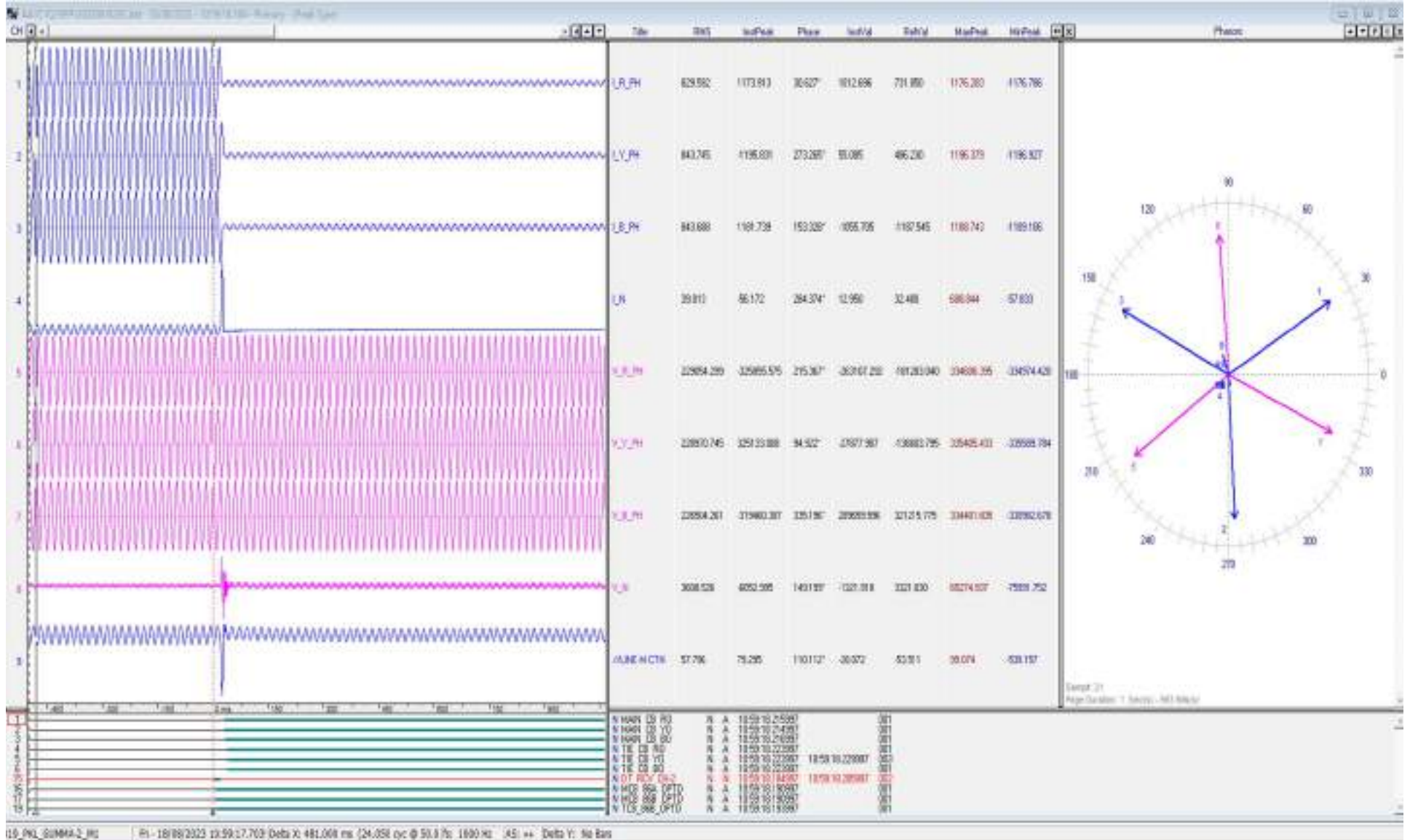
R Y B Phase Voltage

No fault is observed



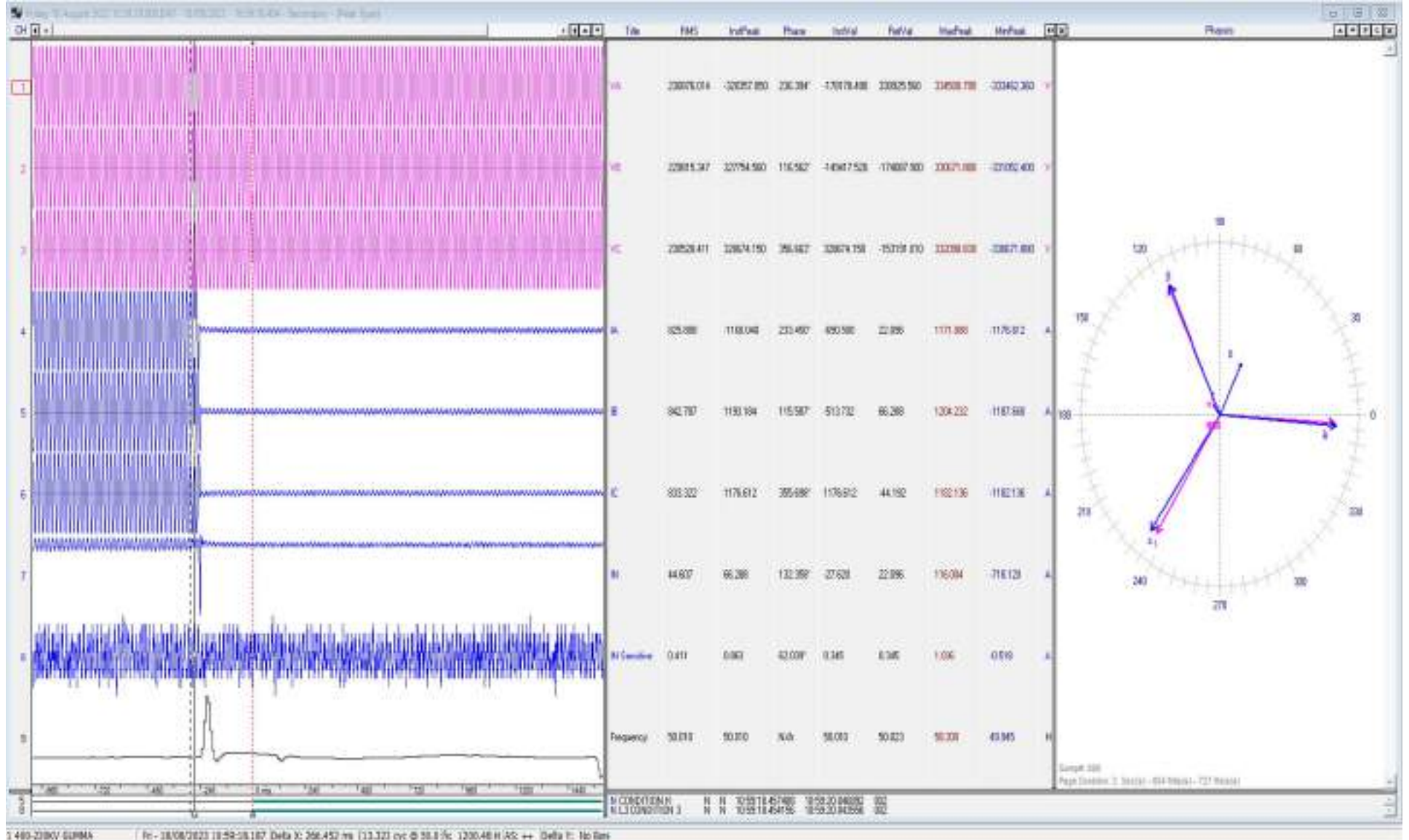
— VRM	--- VRM	— VYM
SubstationId: PNCHK_PG	SubstationId: PNCHK_PG	SubstationId: PNCHK_PG
DeviceId: 400NPTHAPNCHK1	DeviceId: 400NPTHAPNCHK1	DeviceId: 400NPTHAPNCHK1

DR of 400 KV Panchkula(PG) (end)-Gumma(HP) (PG) Ckt-2



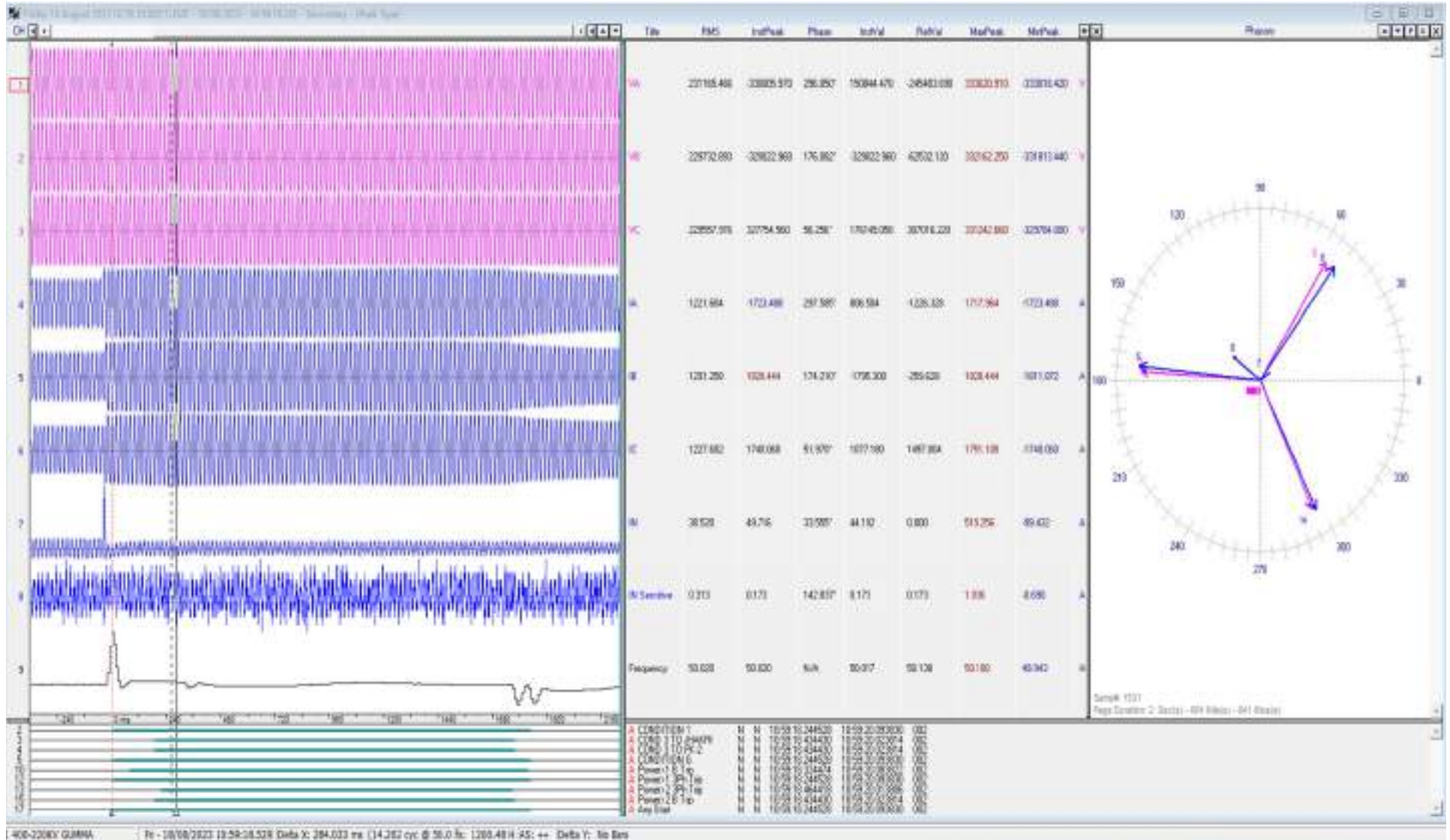
✓ DT received at Panchkula(PG) end

DR of 400 KV Panchkula(PG) -Gumma(HP) (end) (PG) Ckt-2



✓ No fault is observed

DR of 400 KV Panchkula(PG) -Gumma(HP) (end) (PG) Ckt-1



- ✓ current loading for SPS operation= $[850/(1.732*400)]=\sim 1227A$
- ✓ $I_R=\sim 1222A$, $I_Y=\sim 1291A$ and $I_B=\sim 1228A$ (correct SPS operation)

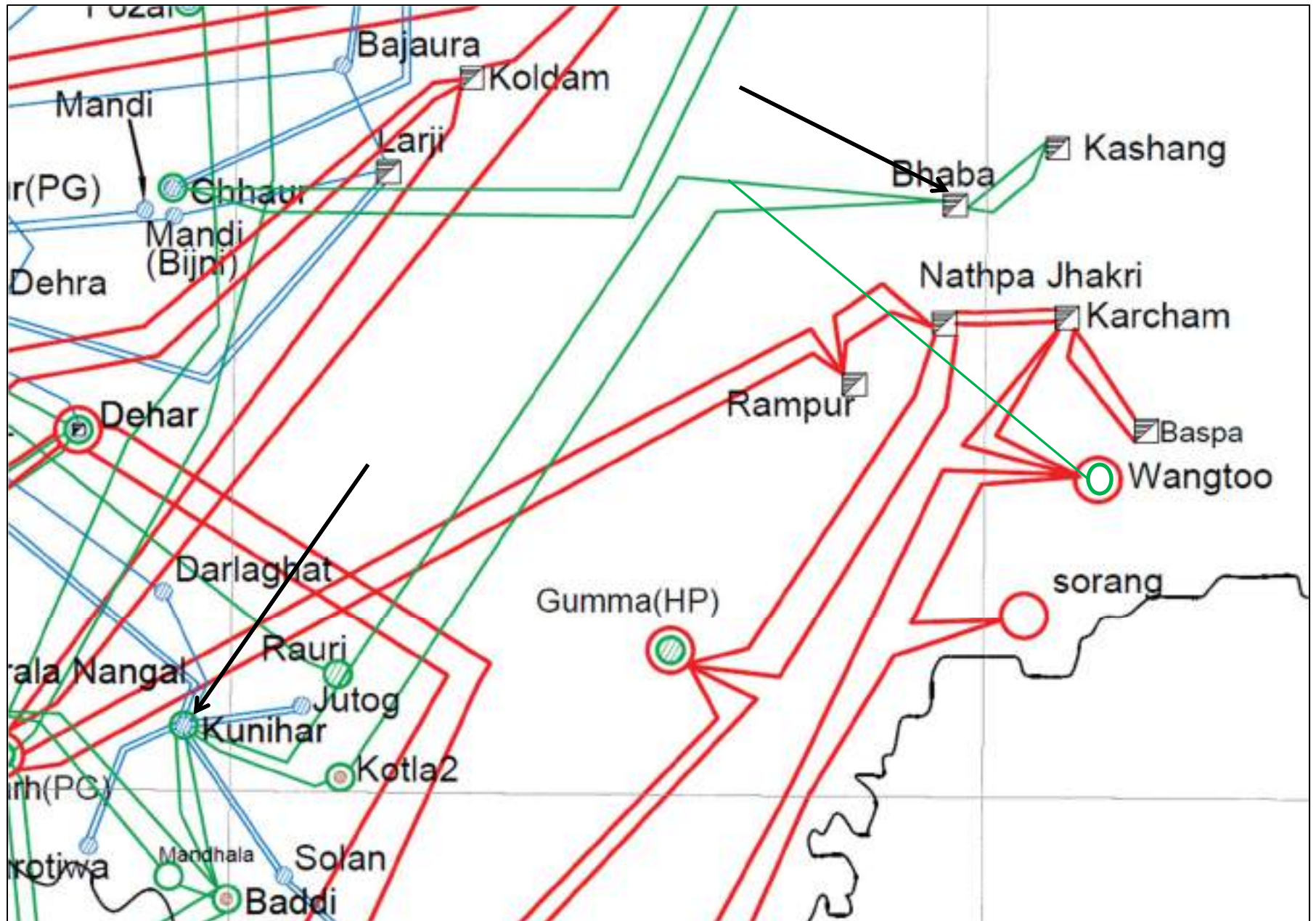
SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
10:59:18,218	PNCHK_PG	400kV	19GUMMA2	Circuit Breaker	Open	Main CB at Panchkula(PG) end of 400kV Panchkula(PG)-Gumma(HP) opened
10:59:18,220	PNCHK_PG	400kV	20TIE	Circuit Breaker	Open	Tie CB at Panchkula(PG) end of 400kV Panchkula(PG)-Gumma(HP) opened
10:59:20,001	NPTHA_NJ	400kV	04G3	Circuit Breaker	Open	CB at 400kV Nathpa Jhakri of 250 MW Nathpa-Jhakri HPS - UNIT 3 opened
11:00:00,000	KRCHM_PG	400kV	G2H02	Circuit Breaker	Open	CB at 400kV Karcham of 250 MW Karcham Wangtoo HPS - UNIT 2 opened

**Multiple elements tripping at
220kV Kunihar(HP)**

**21st August 2023 at
11:27 hrs**

Network Diagram



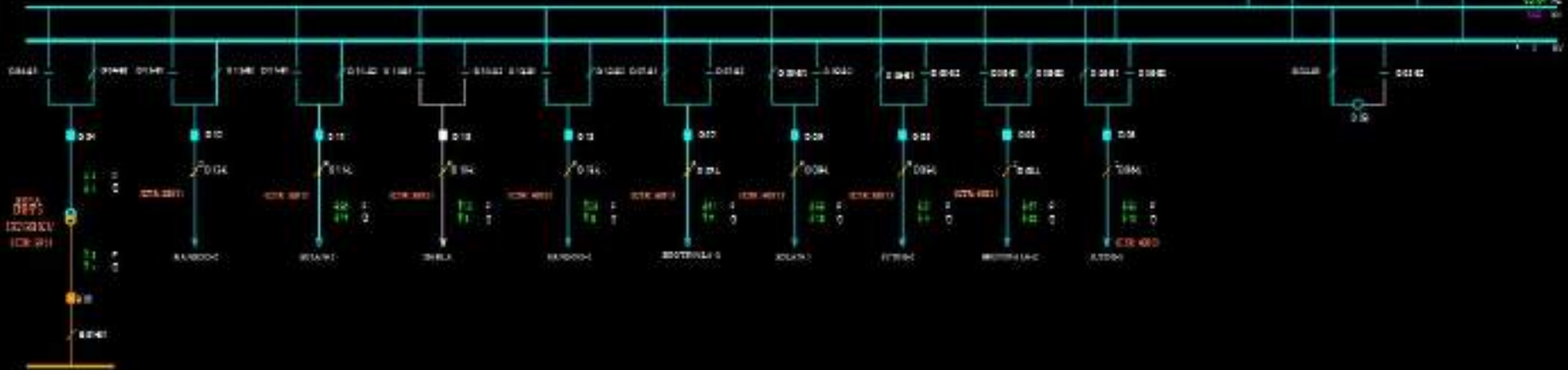
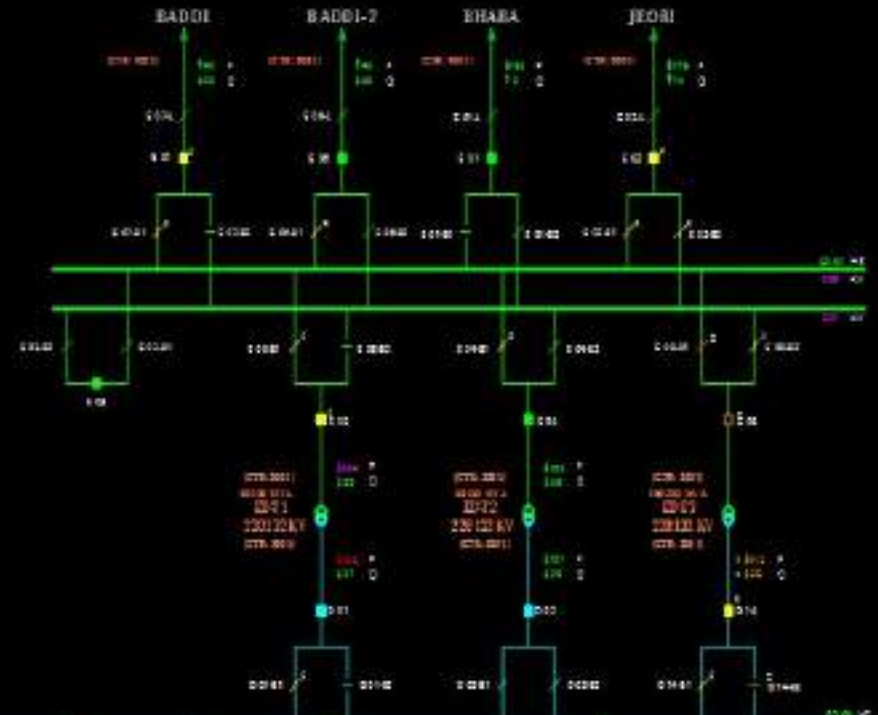
SLD of 220/132kV Kuniyar(HP) before the event

21.8 . 11:25:0

KUNIYAR

Stat Expl Gen Sum Company

Psum(220 KV) =
Psum(132 KV) =



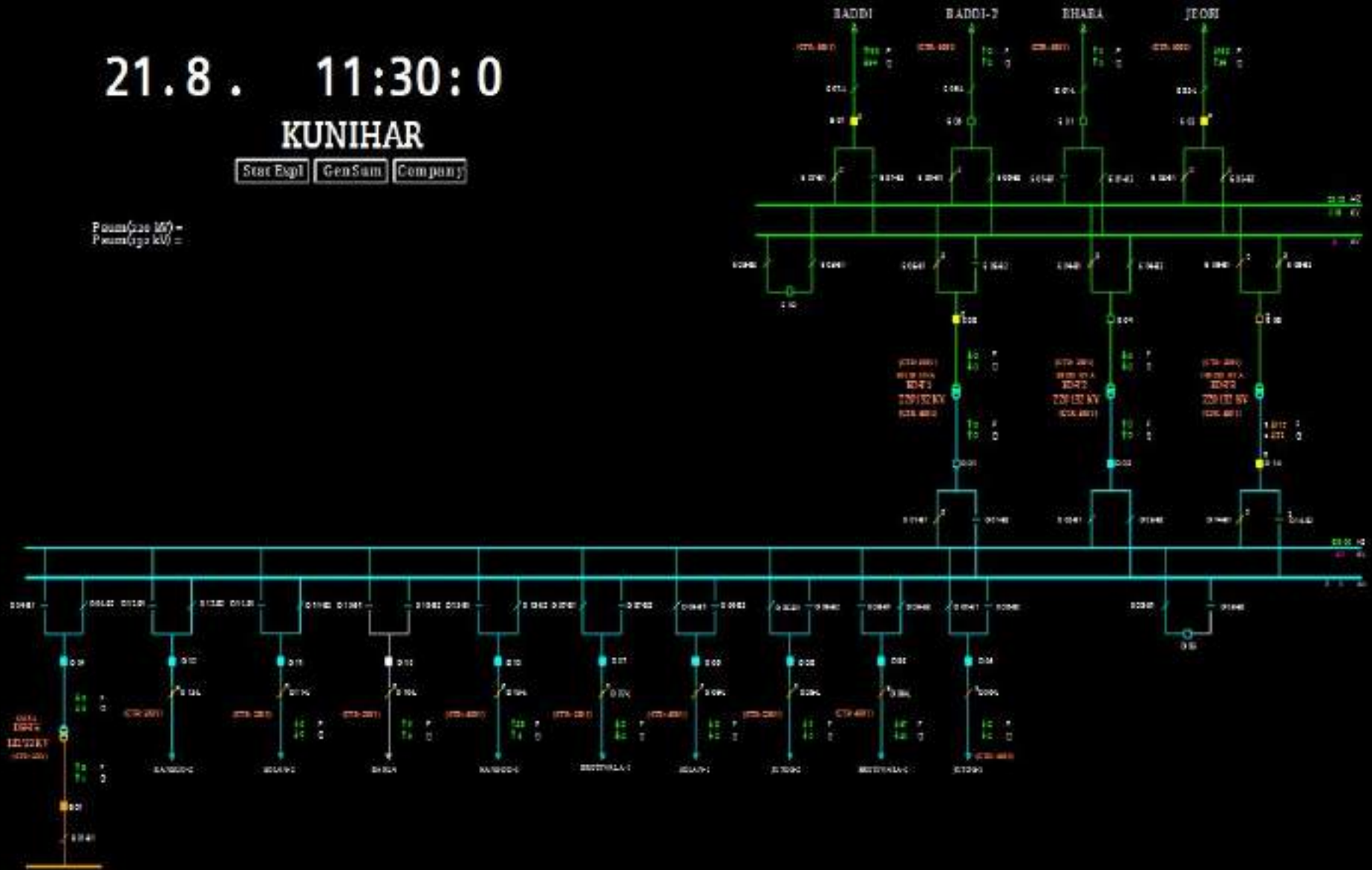
SLD of 220/132kV Kunihar(HP) after the event

21.8 . 11:30:0

KUNIHAR

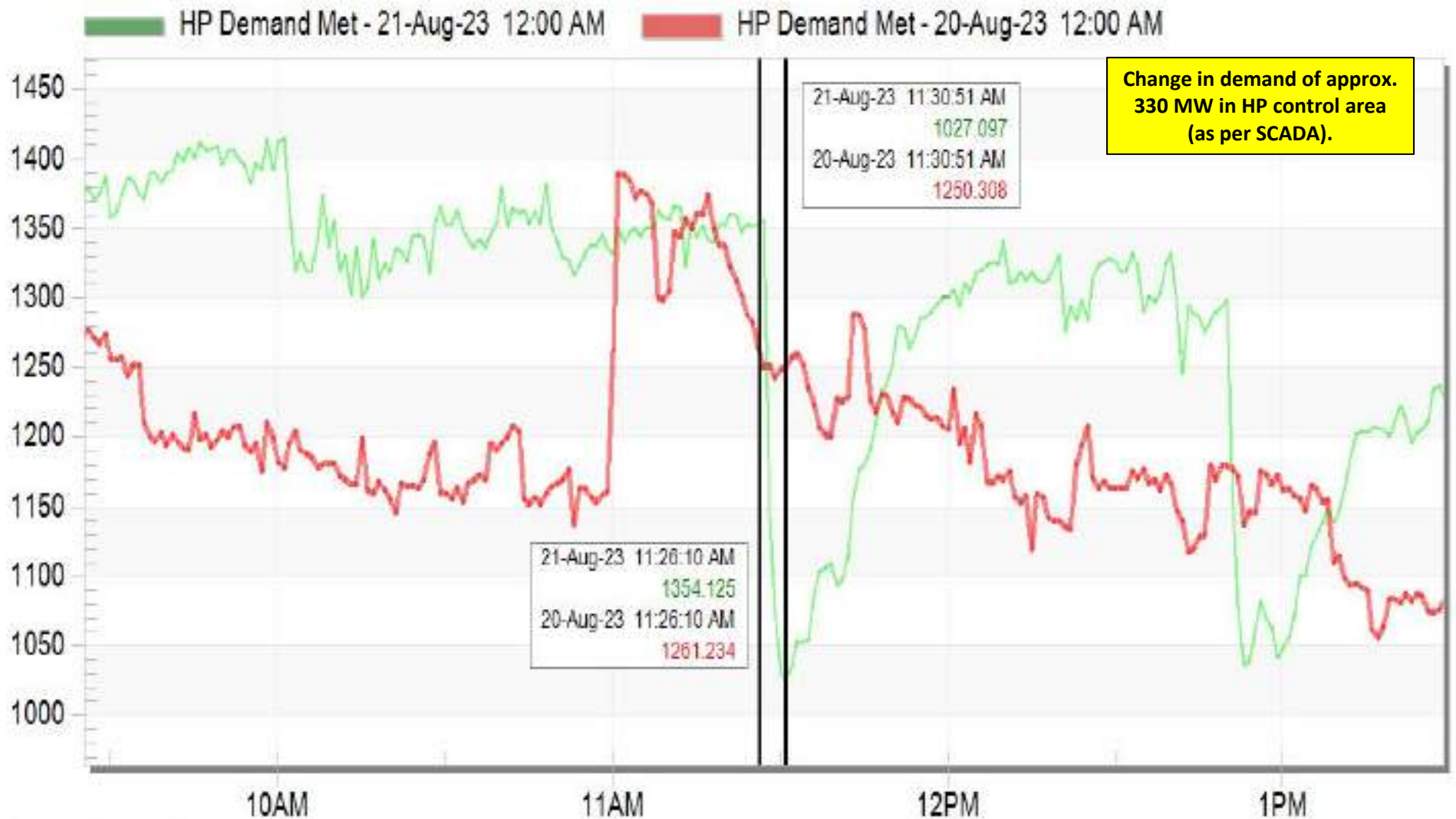
Stat Expl Gen Sam Company

P_{max}(220 kV) =
P_{max}(132 kV) =



Himachal Pradesh demand during the event

HP Demand Met

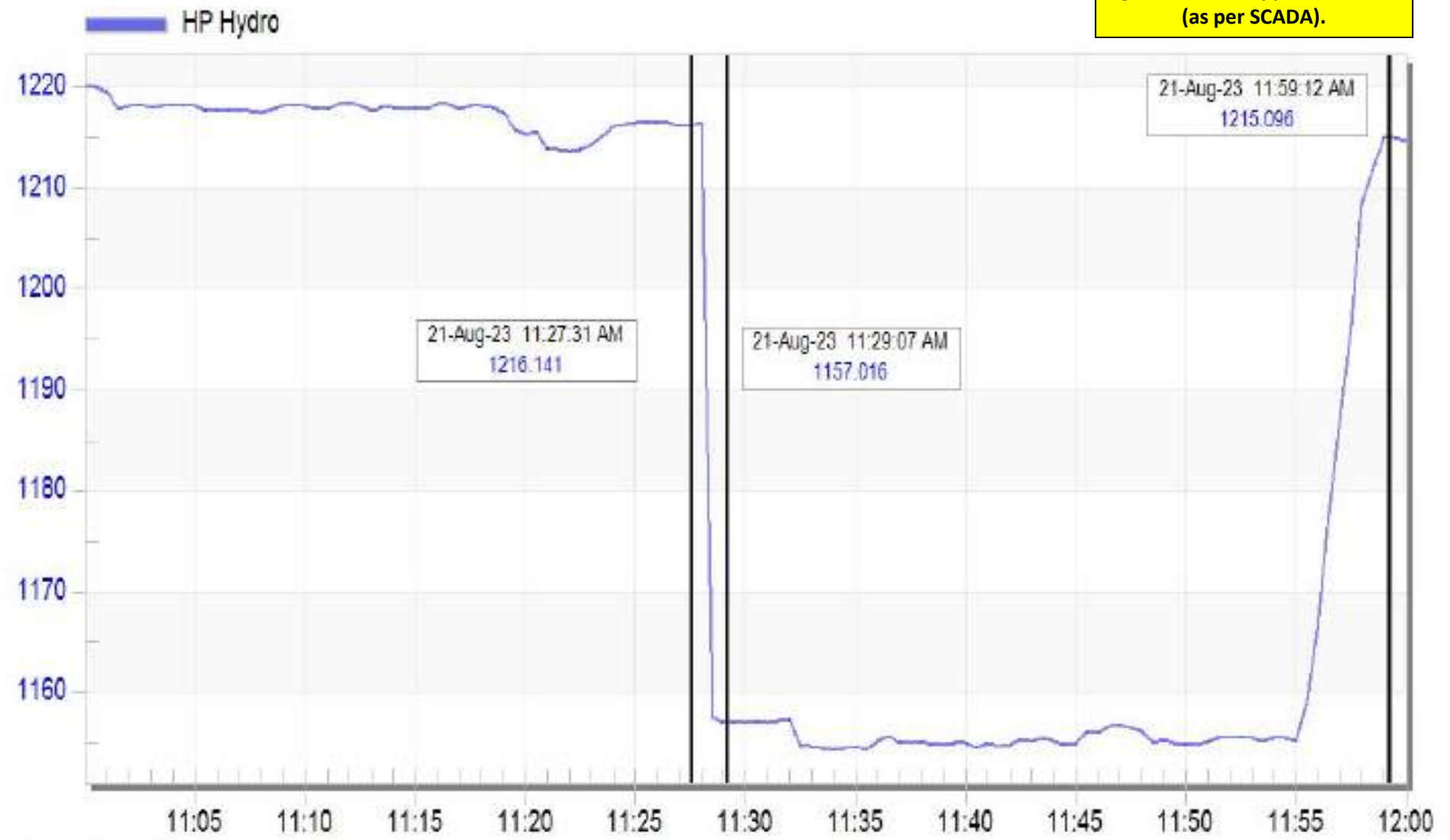


Aug 21 Mon 2023

Himachal Pradesh Hydro generation during the event

HP Hydro Generation

Change in HP Hydro generation of approx. 60MW (as per SCADA).



Aug 21 Mon 2023

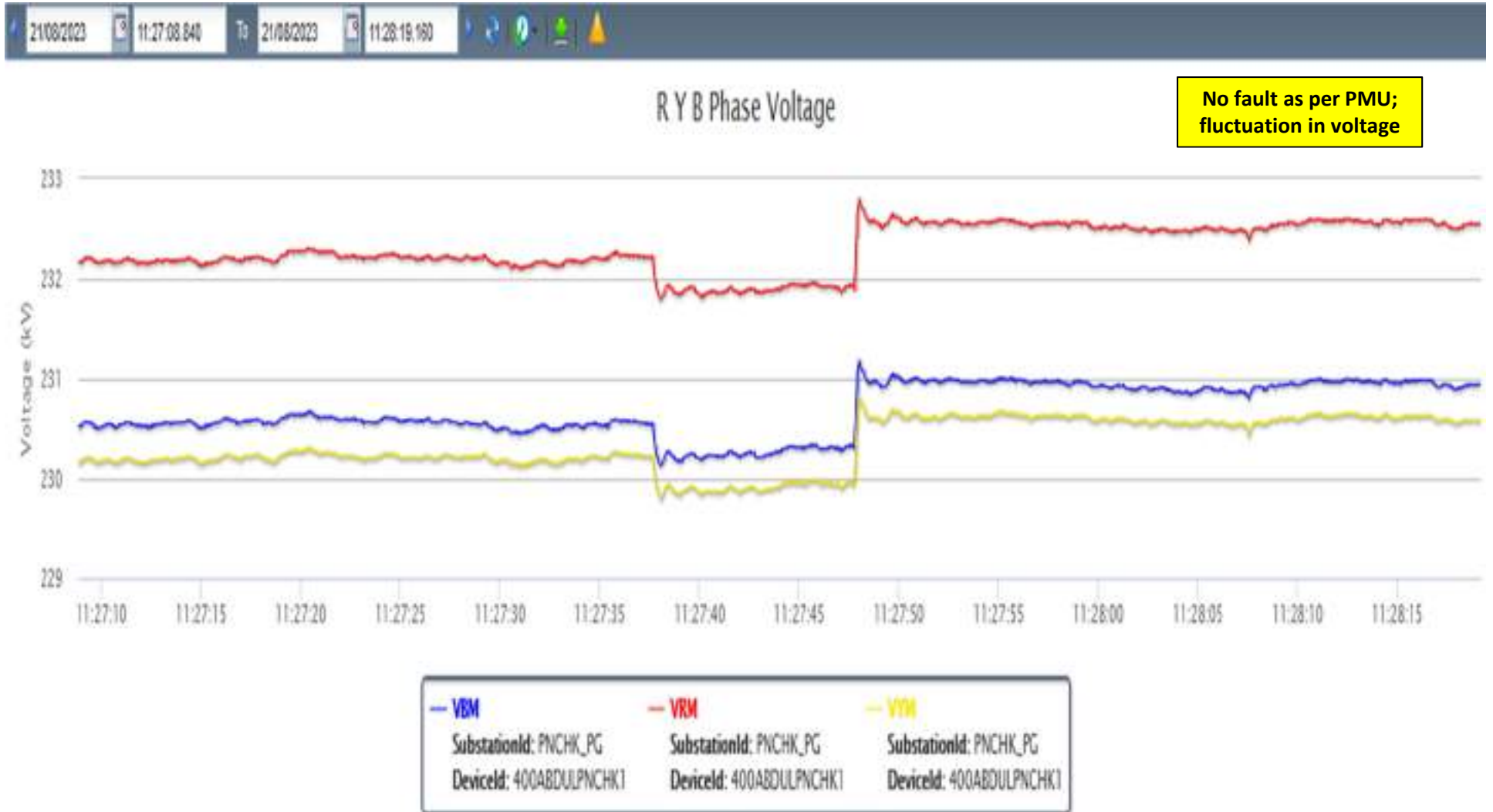
PMU Plot of frequency at Panchkula(PG)

11:27 hrs/21-Aug-23

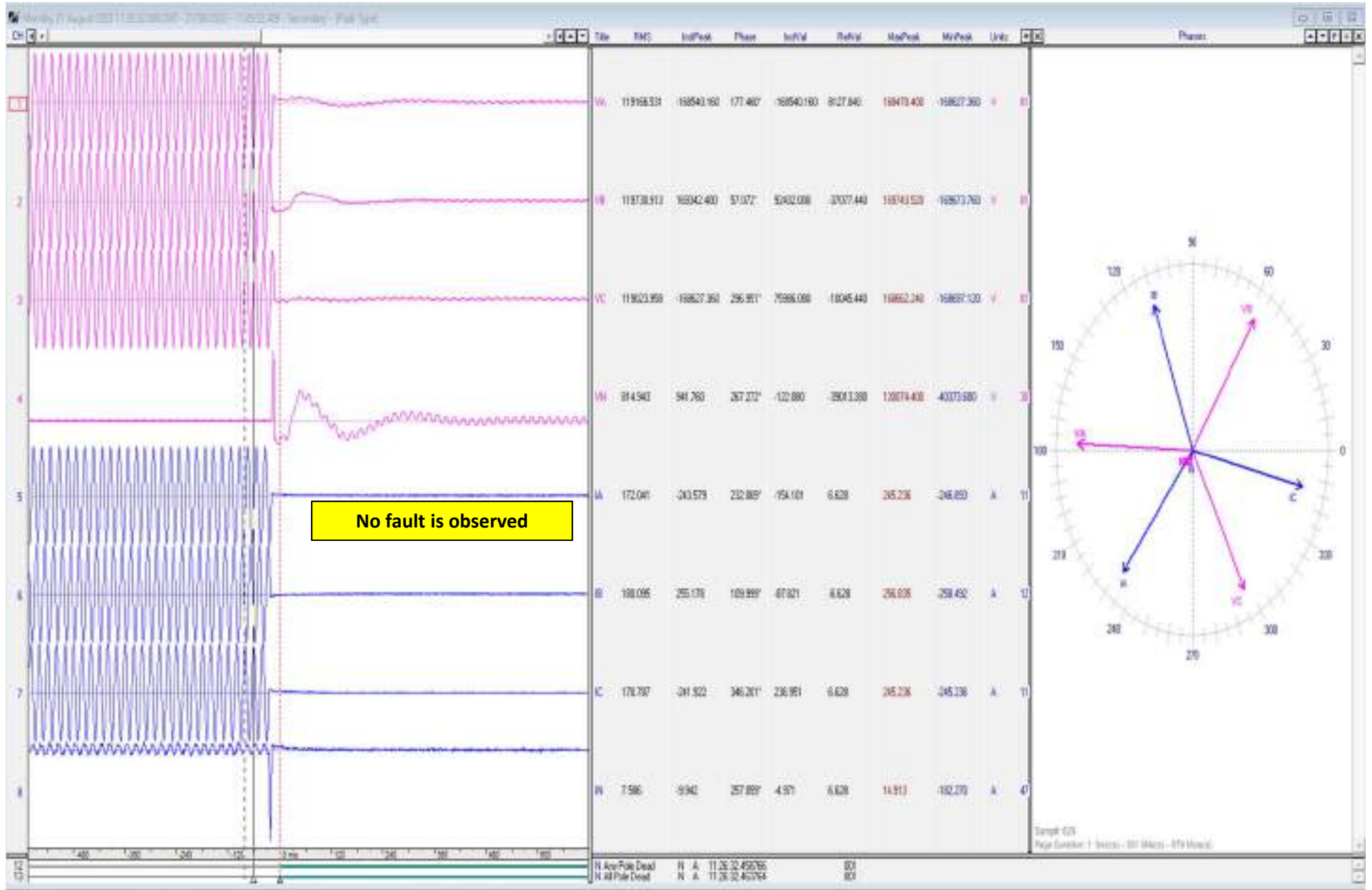


PMU Plot of phase voltage magnitude at Panchkula(PG)

11:27 hrs/21-Aug-23



DR of 220 kV Baddi-Kunihar(HP) (end) Ckt 2



SCADA SOE

Time	Station Name	Voltage	Element Name	Element Type	Element Status	Remark
11:27:37,961	KUNIH_HP	220kV	06PINJR2	Circuit Breaker	Open	Line CB at Kunihar(HP) end of 220 kV Baddi-Kunihar(HP) Ckt 2 opened
11:27:37,966	KUNIH_HP	220kV	04T2	Circuit Breaker	Open	CB at 220kV side of 220/132kV 100MVA ICT-2 at Kunihar(HP) opened
11:27:38,070	KUNIH_HP	220kV	01DUMMY	Circuit Breaker	Open	Line CB at Kunihar(HP) end of 220 kV Kunihar-Bhaba (HP) ckt opened opened
11:27:38,128	KUNIH_HP	220kV	03MBC	Circuit Breaker	Open	Main Bus Coupler CB at 220kV Kunihar(HP) opened
11:27:47,941	KUNIH_HP	132kV	01T1	Circuit Breaker	Open	CB at 132kV side of 220/132kV 100MVA ICT-1 at Kunihar(HP) opened
11:28:07,559	GIRI__HP	132kV	07U01	Circuit Breaker	Open	CB at 132kV side of 30MW Unit-1 at Giri(HP) opened
11:29:10,408	JUTOG_HP	132kV	05KUNIH2	Circuit Breaker	Open	Line CB at Jutog(HP) end of 132 kV Kunihar-Jutog (HP) ckt-2 opened