

EASTERN REGIONAL POWER COMMITTEE

MINUTES OF 22nd PROTECTION SUB-COMMITTEE MEETING HELD AT ERPC, KOLKATA ON 21.08.2014 (THURSDAY) AT 11:00 HOURS

List of participants is enclosed at **Annexure-I**

Member Secretary (I/C), ERPC chaired the meeting and welcomed the participants. He informed that as per the decision of 21st PCC meeting a team of protection engineers from ERPC forum visited 132kV Purnea, Forbesgunj (BSPTCL) and Purnea (PGCIL) S/s and done thorough checking/testing of the protection system. He appreciated the team members for their excellent contribution.

Thereafter, he requested SE (PS), ERPC to take up the agenda points in seriatim.

PART – A

ITEM NO. A.1: Confirmation of minutes of 21st Protection sub-Committee Meeting held on 17th July, 2014 at ERPC, Kolkata

The minutes of 21st Protection Sub-Committee meeting held on 17.07.14 circulated vide letter dated 01.08.14.

No comments have been received from any constituent.

The minutes of the above meeting may be confirmed.

Deliberation in the meeting

Members confirmed the minutes of the 21st Protection sub-Committee meeting.

PART – B

ANALYSIS & DISCUSSION ON GRID INCIDENCES WHICH OCCURRED IN CTU/STU SYSTEMS DURING JULY, 2014.

The grid incidences reported during July, 2014 are as given below:

(The detailed report was highlighted by ERLDC/respective constituents.)

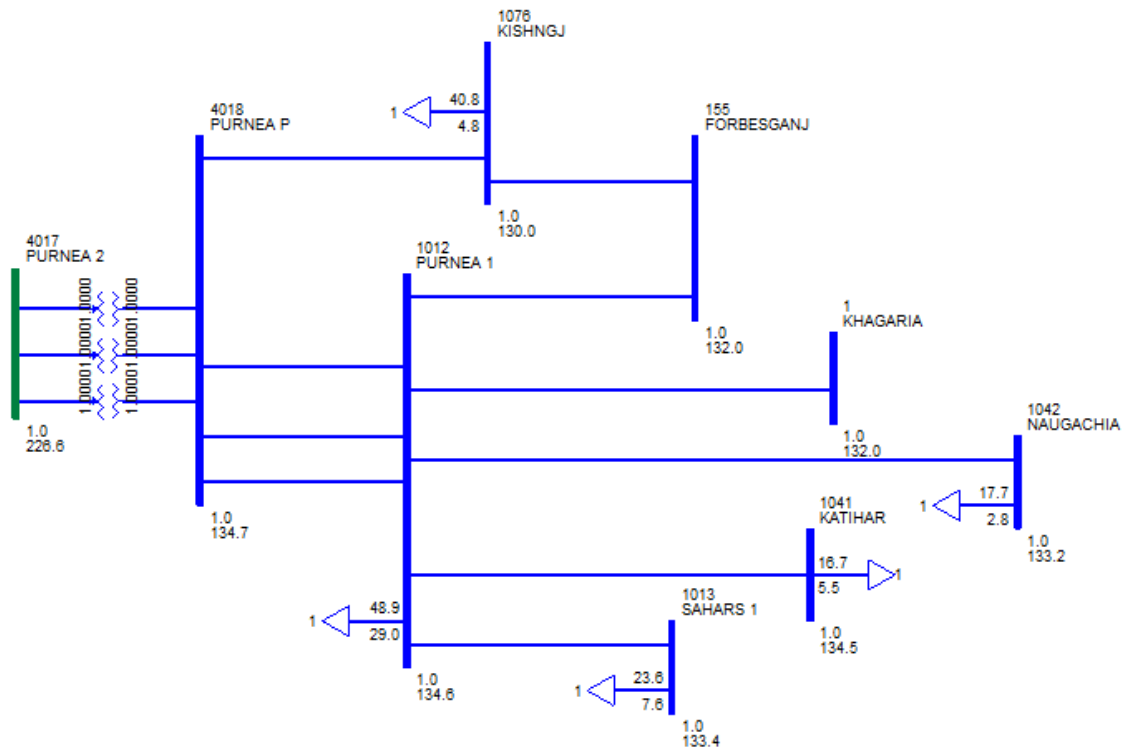
ITEM NO. B.1: BIHAR System

1. Repeated trippings at 132 kV Purnea (BSPTCL) S/S

a) Tripping at 132 kV Purnea (BSPTCL) S/S at 20:31 hrs on 19/07/14.

At 20:31hrs, total power failure occurred at 132/33kV Purnea (BSPTCL) s/s due to fault in 132kV Purnea (BSPTCL)-Saharsha line. Following lines tripped:

- i. 132kV Purnea (PG)-Purnea (BSPTCL)-I, III (tripped at BSPTCL end only)
- ii. 132kV Purnea (PG)-Purnea (BSPTCL)-II (tripped at PG end only)
- iii. 132kV Purnea (BSPTCL) - Saharsha (tripped at Purnea (BSPTCL) end only)
- iv. 132/33kV 50MVA ATR-II at Purnea (BSPTCL)
- v. 132/33kV 20MVA ATR-III at Purnea (BSPTCL)



Analysis:

It appears that the sequence of events were initiated due to fault in 132kV Purnea (BSPTCL)-Saharsa line. However, it appears that the said fault was not cleared properly from Purnea (BSPTCL) end resulting in upstream tripping of 132kV lines from Purnea(PG). As a consequence 132kV Purnea (PG)-Purnea (BSPTCL)-II tripped from Purnea (PG) on E/F. Tripping of 132kV Purnea (PG)-Purnea (BSPTCL)-I and III tripped from Purnea (BSPTCL) end due to fault in reverse zone needs to be checked. Tripping of 50MVA, 132/33kV ATR-II and 20 MVA, 132/33kV ATR-III at Purnea (BSPTCL) on E/F is also not in order. Due to the above trippings, the lines feeding radial loads viz. 132kV Purnea(B)-Katihar, 132kV Purnea(B)-Naugachhia, 132kV Purnea(B)-Khagaria and 132kV Purnea(B)- Saharsa became dead and the breakers were hand-tripped subsequently.

b) Repeated trippings at 132 kV Purnea (BSPTCL) S/S at 08:50 hrs & 09:18 hrs on 03/08/14 and 10:36 hrs on 04/08/14.

On all three occasions, total power failure occurred at 132 kV Purnea (BSPTCL) due to tripping of all outgoing lines from Purnea (old). Problem was reported due to fault in 132 kV Purnea – Saharsa line. The following lines tripped:

- i. 132kV Purnea-Purnea-I,II & III
- ii. 132kV Purnea-Saharsa
- iii. 132kV Purnea-Naugachia
- iv. 132kV Purnea-Katihar
- v. 132kV Purnea-Khagria

Preliminary Analysis:

The fault was not cleared from Purnea(BSPTCL) end leading to tripping of all incoming feeders.

c) Disturbance at 132 kV Purnea (BSPTCL) S/S at 21:18 hrs & 22:48 hrs on 07/08/14.

On both occasions, total power failure occurred at 132 kV Purnea (BSPTCL) due to tripping of all outgoing lines from Purnea(old). Reason of the incident is yet to be ascertained. The following lines tripped:

- i. 132kV Purnea-Purnea-I,II & III
- ii. 132kV Purnea-Saharsa
- iii. 132kV Purnea-Naugachia
- iv. 132kV Purnea-Khagria

Preliminary Analysis:

The fault was not cleared from Purnea(BSPTCL) end leading to tripping of all incoming feeders.

In 20th PCC Meeting, it was opined that all the three incidences the fault clearance time was much higher than the CEA standard. Therefore, the PCC advised the following actions to BSPTCL:

- 1) Proper co-ordination & grading of over current relays for 33 kV feeders
- 2) Co-ordination of over current relays timings of 132/33 kV ICTs with 33 kV feeders
- 3) Checking of operating time of all CBs at Purnea & its downstream systems and rectifying / replacing the faulty CBs, if any.

PCC advised BSPTCL to complete the above actions within 10 days and submit a report to ERPC Secretariat at the earliest. BSPTCL agreed.

Further, PCC felt that a through Protection Audit needs to be carried out again for Purnea 132/33 kV S/s, Biharshariff and Fatua 220/132/33 kV S/s of BSPTCL.

In 21st PCC, BSPTCL informed that CBs have been tested and submitted the test results & relay settings in the meeting. Most of the feeders CBs have been changed at 132 kV Purnea. Further, BSPTCL is in the process of changing the 33 kV CBs for Purnea- Forbesgunj feeders.

PCC felt that, 132 kV Purnea-Katihar line CBs is also old and taking long time to operate which needs replacement.

Powergrid opined that directional feature of CDD type directional over current relays of Purnea(BSPTCL)-Purnea(PG) line at BSPTCL end should also be checked.

PCC advised BSPTCL to test the relay and report. PCC also advised to change the PSM setting of over current & E/F relay in the interconnected lines from 0.2 to 0.1 in numerical relays.

BSPTCL agreed.

In view of repeated uncoordinated tripping from 220 kV Purnea S/s (PGCIL) due to various line faults in BSPTCL downstream system, it was decided that ERPC team comprises of ERPC, ERLDC, Powergrid, WBSETCL, DVC and BSPTCL members will visit for Audit/testing of relays in neighboring substations in around 220 kV Purnea S/s to review the protection philosophy in 1st week of August, 2014.

Accordingly, PCC advised BSPTCL & Powergrid to provide the following details within a week,

- SLD of their substations up to 11 kV level
- ICT rating
- Fault level at the substation
- Detailed relay settings (Relay settings downloaded from numerical relays wherever applicable)

- Battery maintenance record

Accordingly, ERPC team members visited the 132kV Purnea(PG), 132kV Purnea(BSPTCL) and 132kV Forbesganj S/s from 11-08-2014 to 13-08-2014.

Members may place the details.

Deliberation in the meeting

ERPC team presented the audit report of the 132 kV Purnea & adjoining sub-stations and highlighted the list of deficiencies in the protective system installed at there. The recommendation for remedial measures for those sub-stations is also presented. The report is enclosed at Annexure-B.1.

PCC expressed satisfaction for their excellent job and appraised the report in detail. After detailed deliberations PCC advised BSPTCL to comply all the recommendations at the earliest.

BSPTCL agreed to comply the recommendations as pointed by the ERPC team within a month.

BSPTCL was also advised to carry out Tan-Delta ($\tan\delta$) and thermo vision tests for all CTs.

Further, PCC referred the issue to TCC for further guidance and advised the team to present the report in the 28th TCC/ERPC meeting scheduled on 12/13.09.2014.

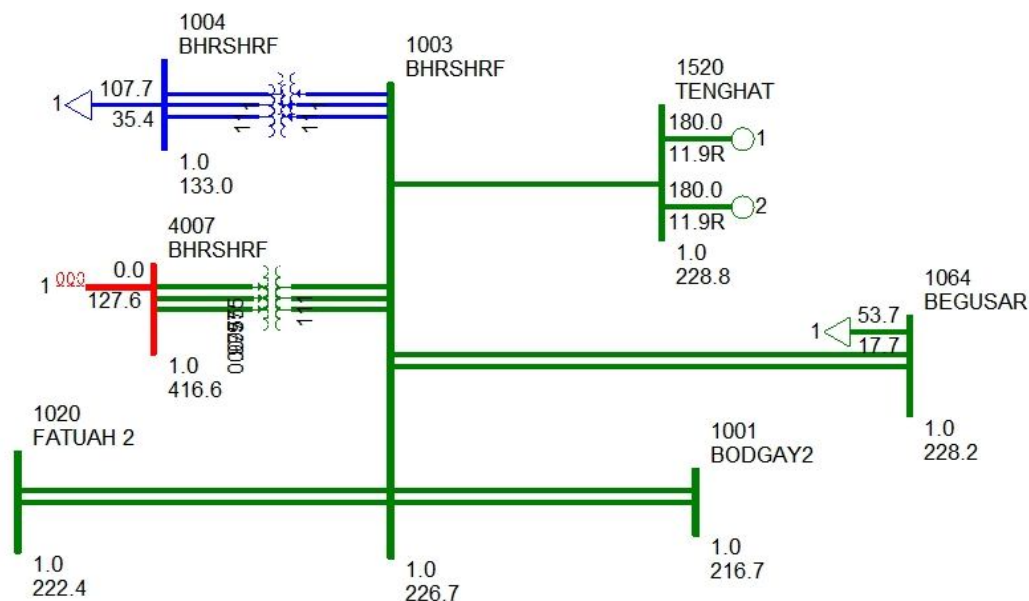
2. Disturbances at 400/220 kV Biharshariff S/S

a) Disturbance at 400/220 kV Biharshariff S/S at 23:31 hrs on 26/07/14.

All three 315 MVA, 400/220 kV ICTs tripped at Biharshariff (PG) leading to total disruption of power at 220 kV Biharshariff (BSPTCL).

Preliminary Analysis:

It was informed by BSPTCL that fault originated from 220 kV Biharshariff-Bodhgaya D/C line which was under shut down for re-conductoring work but was idle charged from Biharshariff (BSPTCL) end.



BSPTCL may update.

Minutes of 22nd PCC meeting

Members may discuss.

b) Disturbance at Biharshariff (BSPTCL), Fatuah, Begusarai, Hulasganj and Eknagarsarai at 15:03 hrs on 26/06/14

At 12:48hrs 220kV Tenughat-Biharsariff (BSPTCL) tripped from Biharshariff (BSPTCL) end only. At 15:03hrs, while trying to close the same line through transfer bus at Biharshariff (BSPTCL) end, all the three 400/220kV ICTs at Biharshariff (PG) tripped, leading to total power failure at 220kV Biharsariff (BSPTCL) S/s. Following elements tripped.

- 220kV Tenughat-Biharsariff (BSPTCL) (tripped from Biharshariff (BSPTCL) end only)
- 315MVA 400/220KV ICT –I, II and III at Biharsariff (PG) (from both the sides)

Discrepancies observed and Remedial Measures/Suggestions:

- It has been observed that 220kV Tenughat-Biharsariff has been tripping repeatedly in the past one month, due to operation of only master-trip relay, which is hence suspected to be maloperating. Accordingly, a through audit of relays at Biharsariff (BSPTCL) end needs to be done at the earliest.
- An audit of relays at Tenughat end for 220kV Tenughat-Biharsariff also needs to be done at the earliest.
- At 15:03hrs the fault persistence time of 640ms which is a violation of CEA (Grid Standards) Regulations, 2010. As per Cl.3 e) regarding 'Standards for Operation and Maintenance of Transmission Lines', maximum fault clearance time for 400/220kV Transmission system is 100ms.

In 21st PCC, ERLDC informed that detailed tripping report from Biharshariff end was not received from BSPTCL.

PCC advised BSPTCL to send the detailed tripping report as per specified format in time as and when disturbance occurred in their control area. BSPTCL agreed.

On repeated tripping of 220kV Tenughat-Biharsariff line from Biharsariff end, BSPTCL representative informed that, a cable from relay room to master trip relay was found short with 220kV Tenughat-Biharsariff line breaker. As a result, this line CB was getting frequently trip command from Master trip relay.

As a remedial measure, the defective cable had been replaced by 18 core new cable and the line was charged at 13:55 hrs on 27.06.2014. No tripping incidence has been reported thereafter. The outcome of remedial actions taken by BSPTCL will be observed for 3 months.

The reasons behind the simultaneous tripping of all the three 315 MVA, 400/220kV ICTs on 26/6/14 at 15:03 hrs from Biharshariff (PG) end, while trying to close the 220kV Tenughat-Biharsariff line from Biharsariff end through transfer bus could not be ascertained by BSPTCL.

It was felt that, there might be earth connector remained close at 220kV Biharsariff S/s during charging of the said line which led to tripping of all the three 400/220kV ICTs on backup over current relay from Biharshariff (PG) end since the fault was still persisted as reported by the Powergrid.

PCC advised BSPTCL to examine the operational procedure carried out during charging of the line at 220 kV Biharshariff S/s and report in next PCC. BSPTCL agreed.

BSPTCL may update the latest status.

Deliberation in the meeting

BSPTCL explained that on 26.07.2014 there was control cable flashing in Relay control panel and suspected short circuit in the DC cables. The DC cable needs to be checked for all lines at Biharsharif 220 kV S/s.

PCC requested Powergrid to extend their help to BSPTCL for examining the problem.

Powergrid agreed.

PCC also advised BSPTCL to carry out feeder wise tripping test under external simulation to check the healthiness of the protection system and submit a report in the next meeting.

BSPTCL agreed.

On analyzing the incident on 26/06/14, while restoring the 220kV Biharshariff-TTPS line after the tripping, on TBC at 15:03 Hrs, all the isolators related to charging the line on TBC had been closed one by one but the earth switch was kept in open condition. In the mean time, there might be a short circuit in AC and DC cable, which led to energizing the trip coil of CB of TBC.

The defective cable had been replaced by 18 core new cable and the line was charged at 13:55 hrs on 27.06.2014. No unwanted tripping incidence has been reported thereafter.

ITEM NO. B.2: Jharkhand System

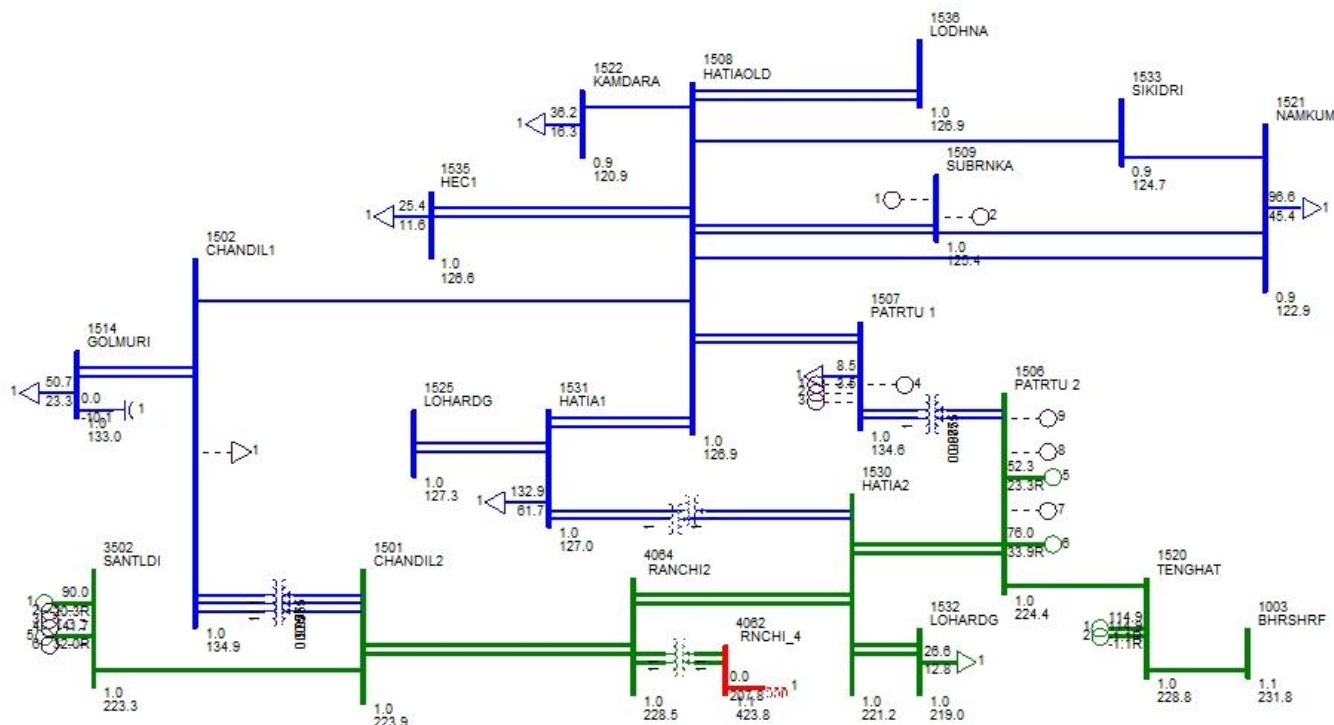
1. Disturbance at 220 kV Patratu (JSEB) S/S at 13:10 hrs on 21/07/14.

At 13:09hrs, due to bursting of R-Ø LA of 150MVA Auto transformer-1 burst in switchyard of Patratu S/s, the following lines tripped:

- i. 220kV Patratu-Tenughat (tripped at Patratu end)
- ii. 220kV Ranchi-Hatia (New) (tripped at Ranchi end)
- iii. 132kV Hatia-Patratu-D/C(tripped at Patratu end)
- iv. 132kV Hatia-Chandil(tripped at Chandil end)
- v. 132kV Hatia- Sikidari(tripped at Hatia end)

Analysis:

It was telephonically reported that the sequence of events were initiated due to bursting of R-Ø HV side LA of 150MVA Auto transformer-1 in switchyard of Patratu S/s. However, the report received from JSEB does not corroborate the same. It appears that there was a delay in clearance of the said fault from Patratu end. As a result, 132kV Hatia-Patratu-D/C tripped from Patratu end on O/C & E/F protection. As per the report, 220kV PTPS-Hatia D/c did not trip from either ends. Due to nonopening of breakers of 220kV Patratu-Hatia-D/C from both the ends, all other lines from Hatia and Hatia (new) tripped. 220kV Ranchi-Hatia (new) tripped from Ranchi end only and cleared the fault.



Discrepancies observed and Remedial Measures/Suggestions:

- Delay in fault clearance at Patratu end needs to be investigated. Non-opening of breakers of 220kV PTPS-Hatia at either ends also needs to be checked.
- Protection system at Patratu, Hatia, and Tenughat needs to be audited/tested thoroughly.

JSEB may update.

Deliberation in the meeting

JUSNL representative informed that the tripping details at Patratu end are available with newly constituted Jharkhand Urja Utpadan Nigam Ltd (JUUNL). Further, he informed that testing of protective relays by M/s Areva is in progress at all Substations in around 220 kV Chandil S/s. The relay settings wherever it is necessary would be changed.

PCC advised JUSNL to submit the detailed report after collection of tripping information from Patratu TPS and Hatia S/s at the earliest.

2. Disturbance at Tenughat/ Patratu/Hatia (JSEB) on 03/05/14 & 31/05/14.

As per preliminary report both the days due to inclement weather conditions the 220 kV Tenughat-Patratu, 220 kV Patratu- Hatia and 132 kV Patratu- Hatia were tripped along with Tenughat and PTPS units.

In 20th PCC, the issue could not be discussed in detail as JSEB representative was not present in the meeting.

PCC advised ERPC Secretariat to take up the issue with JSEB for proper representation in the meeting and also to ask the detail report of the disturbances.

However, from the ERLDC report it appeared that there was problem in Patratu end. PCC advised for testing of Patratu end relays and circuit breakers and report.

In 21st PCC, PCC observed that both the occasions (on 03/05/14 & 31/05/14), TVNL maintained around 380 MW generation when 220 kV TVNL-Biharshariff line was under outage. It was an operational problem, which led to cascade tripping of various transmission lines connected to 220/132 kV PTPS on over load after tripping of 220 kV Hatia II-PTPS line-1 from both ends on E/F.

In previous Protection Sub-committee meeting JSEB and TVNL was advised to explore the SPS implementation for inter tripping/or backing down of generation in TVNL in order to avoid above such incidences.

PCC once again advised JSEB and TVNL to restrict/backing down the TVNL generation to 280 MW in order to avoid such cascade trippings of transmission lines on over loading and advised to explore the following as and when 220 kV TVNL-Biharshariff line is outage/tripped condition,

- SPS for inter tripping of one running unit (when two units running with full generation)
- Backing down of the generation using HP and LP bypass

JSEB and TVNL agreed to review.

PCC enquired about status of 400 kV up gradation work at 220 kV TVNL and Biharshariff ends. In reply, TVNL informed that 315 MVA ICT is already available at TVNL and the erection work is in progress. TVNL reported that work will be completed by December, 2014 at TVNL end.

Powergrid informed that, up gradation related works at 400 kV Biharshariff S/s has now stalled due to some payment issues with JSEB. However, it is expected to complete the work by December, 2014, if in the mean time payment issues get settled at earliest.

PCC advised Powergrid to give the status on this and requested ERPC Secretariat to write a letter to JSEB and Powergrid to resolve the issues arising out for completion of this up gradation work.

JSEB, TVNL and Powergrid may update the status.

Deliberation in the meeting

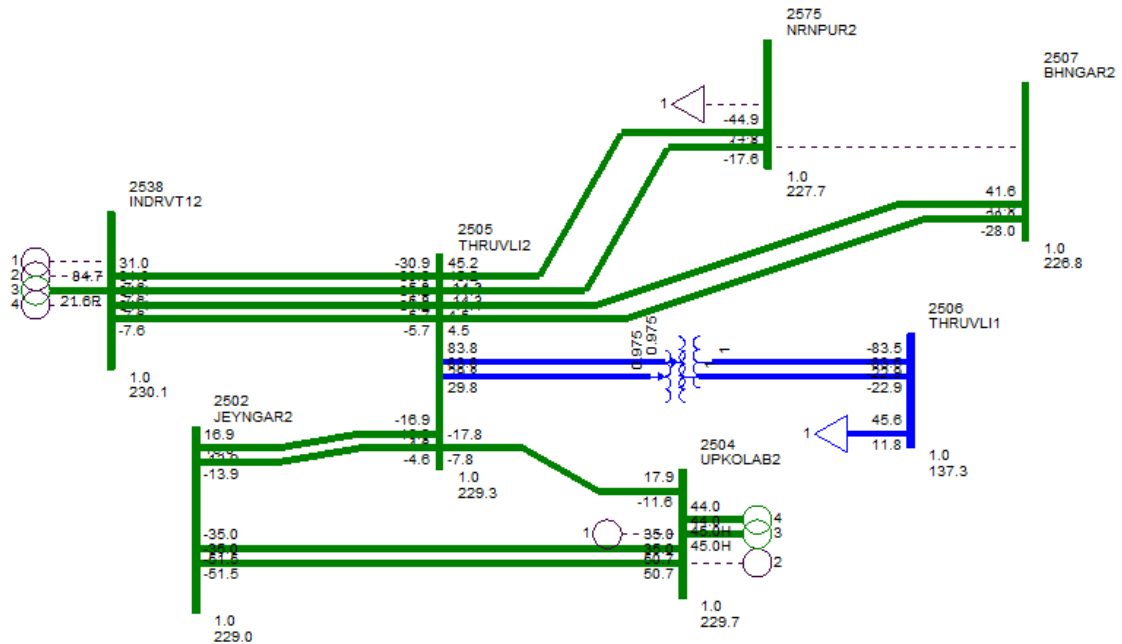
No updated status was submitted. However, JUSNL informed that relay testing of protection relays by M/s Areva is in progress at all Substations in around Chandil S/s.

ITEM NO. B.3: Odisha System

1. Disturbance at Theruvali on 21/07/14

On 21.07.14, 00:40 Hrs Bus-I side R-phase PI of 220 kV Theruvali- U. Kolab ckt burst and R-phase conductor snapped & fell on the ground. All feeders main breakers from bus-I tripped on bus bar protection due to bus fault. There was no power interruption at Theruvali S/S as 220 kV bus-II was in service. The following lines tripped:

- i. 220/132 kV, 100 MVA Auto- I main breaker tripped but was in operation on tie-breaker
- ii. 220 kV Theruvali – Narendrapur- I & II tripped from Theruvali end (E/F)
- iii. 220 kV Theruvali- Bhanjanagar- II tripped from both ends
- iv. 220 kV Theruvali- U. Indravati-I & II tripped from U.Indravati end (DP, Z-2)
- v. 220 kV Theruvali- Laxmipur- Jaynagar-I & II tripped from Laxmipur end (DP, Z-2)



In 20th PCC, replacement of defective CBs OPTCL informed that all CBs are replaced except Main and Tie CBs for 220 kV U.Kolab and Jaynagar ckt III. Action is also being taken to replace electromagnetic non-directional over current & earth fault relays with numerical relays at Theruvalli 220 kV S/s.

In 21st PCC, for frequent tripping incidences at 220 kV Theruvalli S/s it was observed by OPTCL that, old high impedance bus bar protection is not working properly at there, which was caused the tripping of transmission lines from remote end.

OPTCL reported that, new numerical bus bar protection is being installed and it will be in service by December, 2014. Further, the backup O/C relays are also being replaced with numerical relays at 220 kV Theruvalli S/s.

OPTCL may update.

Deliberation in the meeting

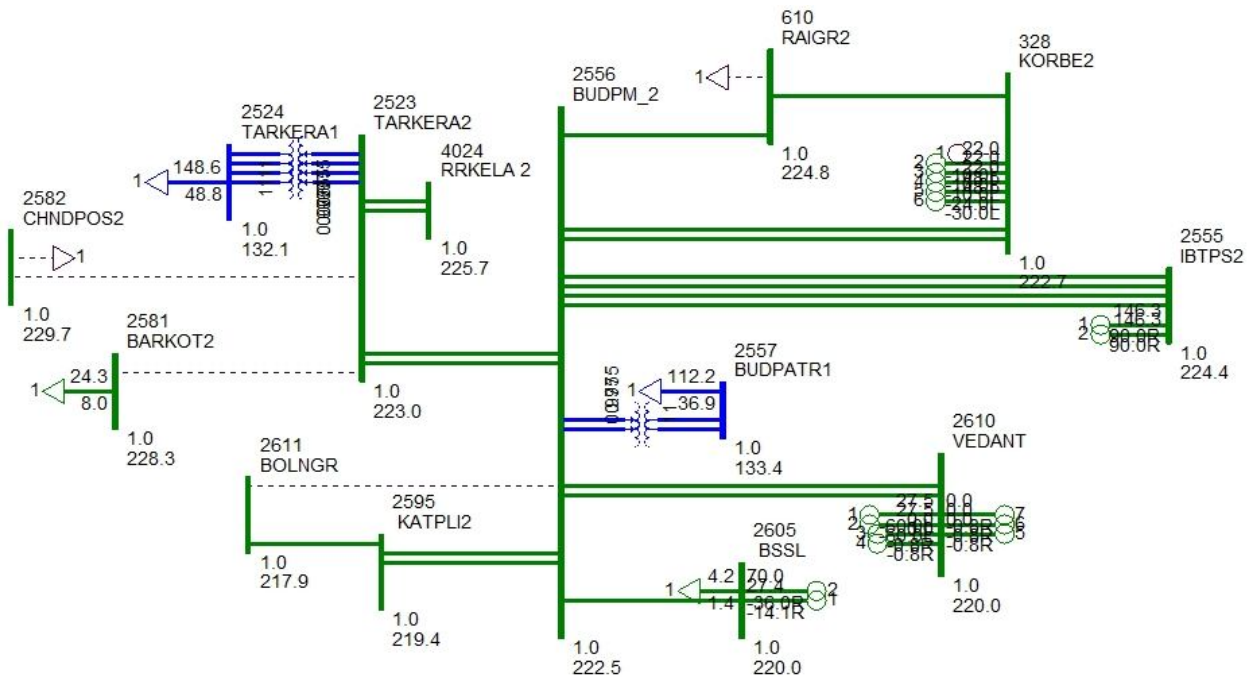
OPTCL informed that the above tripping took place due to non-operation line CB and Bus- I feeders and ATR tripped on delayed operation of Bus bar protection. The bus bar protection at Theuvalli S/s is now under replacement. However, the details of tripping of 220 kV Theruvalli-Bhanjanagar- II needs to be investigated. PCC advised OPTCL to submit a detailed report.

OPTCL also informed that some of the relays of 220 kV Theruvalli S/s were already replaced and rest will also be replaced. The installation of bus bar protection is expected to be put in service before December, 2014.

2. Disturbance at Budhipadar on 29/07/14

On 29.07.14, 20:10 Hrs while charging 220 kV Budhipadar-Tarkera ckt-II from Budhipadar, B-ph breaker limb burst at Budhipadar and all 220 kV lines/ICTs emanating from 220 kV Budhipadar S/S tripped. Running unit of SEL #1 (generating-280 MW) and IB Valley U # 1&2 (385 MW), Burla (110MW), Chiplima (40 MW) tripped due to loss of evacuation path. (Earlier at 19:10 Hrs 220 kV Budhipadar- Raigarh ckt tripped due to R-Ph LA burst at Budhipadar). Following lines were tripped:

- i. 220 kV Budhipadar- Korba D/C
- ii. 220 kV Budhipadar- Tarkera D/C
- iii. 220 kV Budhipadar- Vedanta D/C
- iv. 220 kV Budhipadar- IB Valley Q/C
- v. 220 kV Budhipadar- Katapalli D/C
- vi. 220 kV Budhipadar- Basundhhara D/C
- vii. 220 kV Budhipadar- SPS S/C
- viii. 220 kV Budhipadar- Bhusan D/C



In 21st PCC, it was observed that in view of several trippings at 220 kV Bhudipadar S/s, the evacuation path for IBTPS and Vedanta generating stations got affected. PCC advised OPTCL to explore an alternative to it.

In reply, OPTCL informed they are planning to distribute generation and loads of 220/132 kV Budhipadar S/s such that IBTPS and Vedanta generating stations can operate in islanding mode.

For implementation of bus bar protection at 220 kV Bhudipadar, OPTCL informed that panels have been installed, cabling works is in progress. It is expected that bus bar protection will be in service by December, 2014.

OPTCL may deliberate.

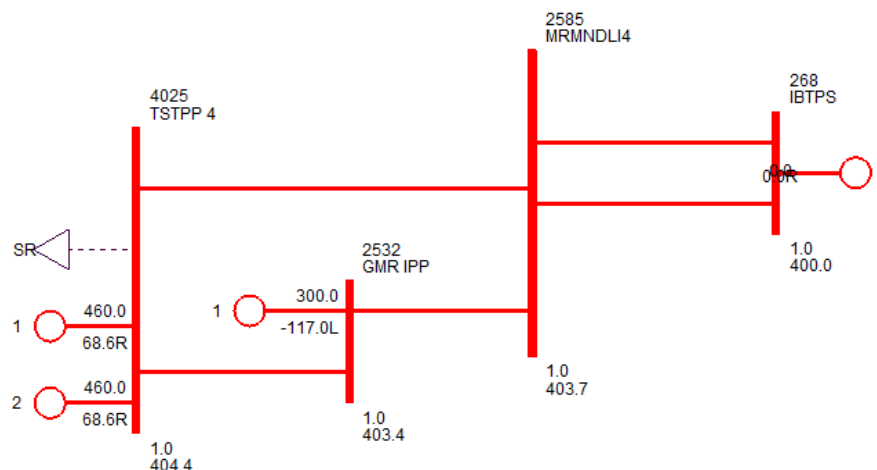
Deliberation in the meeting

OPTCL reported that on investigation it was found that B phase CB limb of the Budhipadar-Tarkera-II circuit had burst out. Since the Bus bar protection relay at Budhipadar S/s remained out of service, the bus fault caused the system disturbance.

Further he informed that new Bus bar protection system is already received and it is under installation & commissioning process .It is expected to be in service as per the schedule.

3. Disturbance at GMR system on 23/07/14

At 10:03hrs, 400kV GMR-Meeramundali line (8km) tripped on Y-Ø to earth fault, Z-2, 6.25km from GMR end only. Subsequently at 10:41hrs, 400kV Talcher-GMR line(46km) tripped on Y-Ø to earth fault again from GMR end which lead to tripping of both running units at GMR due to no evacuation path.



Analysis:

It appears that sequence of events were initiated due to Y-Ø earth fault occurred in 400kV Meeramundali-IBTPS-D/c (future line, idle charged from Meeramundali end) due to which 400kV GMR-Meeramundali line tripped from GMR end on actuation of DP, Z-2, Fd=6.25kM from GMR. From the report obtained from GMR it is found that Zone-2 setting of the said line is almost instantaneous (60ms) due to which DP relay at GMR actuated before tripping of the idle charged line from Meeramundali. However no tripping was reported at Meeramundali according to GRIDCO. At 10:43hrs, 400kV Talcher-GMR line tripped from GMR due to actuation of Back up O/C protection from GMR end only. On investigation it was found that the same ckt i.e. 400kV Meeramundali-IBTPS-D/c was again charged from Meeramundali end which caused the tripping of 400kV Talcher-GMR line on Y-Ø to earth fault. Also the relay tripping time was 58ms which depicts instantaneous timing. Both the running units of GMR hence tripped due to loss of evacuation path.

Discrepancies observed and Remedial Measures/Suggestions:

- Relay settings at GMR need to be checked/audited.

OPTCL & GMR may update.

Deliberation in the meeting

OPTCL informed that 400 kV GMR- Meeramundali line tripped from GMR end before the line CB for 400 kV Meramundali- Ib TPS tripped. The relay setting at GMR end appeared to be very fast. Subsequent tripping of 400 kV Talcher- GMR line along with GMR units tripping while charging of 400 kV Meramundalli-Ib TPS line without removing of fault by OPTCL was serious concern. The tripping of 400 kV GMR-Talcher line also showed protection coordination needed at GMR with neighbouring 400 kV S/s.

PCC felt that the existing protection coordination of relays needs to be reviewed by OPTCL, Talcher and GMR to avoid indiscriminate tripping in future. OPTCL may submit a report in the next PCC meeting.

OPTCL agreed.

4. Disturbance in OPTCL and DVC system at 17:15 hrs on 12th July, 2014.

As per report from OPTCL, due to staggered tripping of lines from TTPS end (initiated at 16:52Hrs) including both 220/132kV ICTs at TTPS, all the running units of TTPS (viz. Units #1, 2, 3, 4 running on 132kV side) tripped ultimately at 17:04Hrs. Weather was reported to be of inclement condition at the time of trippings. The Units #5 & 6 connected to 220kV Bus at TTPS were out of bar prior to the incident. Consequent to the trippings, Joda remained connected to two sources

only, viz. 220kV Joda-Ramchandrapur and 220kV Joda-Jindal-Jamshedpur. 220kV Joda-Ramchandrapur tripped at 17:15hrs on O/C which appears to be a relay mal-operation and needs to be investigated. Due to the above trippings, direction of power flow through 220kV Joda-Jindal-Jamshedpur reversed as Joda S/S became radial on DVC system resulting in heavy drawal from DVC system. Due to such heavy drawal by Joda, 132kV Barhi-Koderma D/c tripped on O/C resulting in islanding of Bokaro-B TPS. The island formed being heavily deficit in generation vis-a-vis load, suffered low voltage and collapsed on Load generation imbalance. Thus 2x210MW units at Bokaro'B' tripped consequent to tripping of 132kV Barhi-Koderma D/C. The Following elements tripped:

- i. 220kV Meramundali-TTPS-II (Tripped from Meramundali end)
- ii. 220kV Meramundali-Bhanjanagar-I (Tripped from Meramundali end)
- iii. 132kV TTPS-Duburi-I (Tripped from both ends)
- iv. 160 MVA, 220/132kV ATR-II at TTPS
- v. 160 MVA, 220/132kV ATR-I at TTPS
- vi. 220kV Meramundali-TTPS-I (Tripped from Meramundali end)
- vii. 60 MW TTPS Units-1, 2, 3 and 4
- viii. 220kV Joda-Ramchandrapur (Tripped from Ramchandrapur end)
- ix. 132kV Barhi-Koderma-D/C (Tripped from Koderma end)
- x. 2*210 MW Unit-2 and 3 at BTPS

Preliminary Analysis: Events at OPTCL side:

It appears that, multiple trippings occurred in OPTCL system due to inclement weather conditions which eventually led to tripping of all the running units of TTPS i.e.U#1, 2, 3 & 4(60MW each). Prior to the tripping, all running units were on the 132kV side, with Units#5,6 (2 x110MW) usually remaining on the 220kV side being under shutdown. The sequence of events started with staggered tripping of lines from TTPS end (initiated at 16:52Hrs) including both 220/132kV ICTs at TTPS. On tripping of the 220/132kV ATRs and 132kV TTPS-Duburi, the running units got islanded and collapsed on overspeed due to high frequency as there was less load at 132kV side of TTPS compared to the available generation. It appears that all circuits at 132kV side of TTPS also tripped to form the island but the same was not corroborated vide the reports received. 220kV TTPS-Meramundali-I which got over-loaded on tripping of circuit-II, tripped on R-N fault and directional O/C. 220kV Joda-Ramchandrapur reportedly tripped at 17:15hrs on O/C. However, SCADA plots do not corroborate the same by indicating any heavy over-loading. Immediately on tripping of 220kV Joda-Ramchandrapur, direction of power flow through 220kV Joda-Jindal-Jamshedpur got reversed as Joda S/S became radial on DVC system resulting in a heavy drawal from DVC system. Due to such heavy drawal by Joda, 132kV Barhi-Koderma D/c tripped on O/C. 132kV Barhi-Biharshariff which also remains in synchronized mode must have tripped, but the same was not mentioned in the reports. The above trippings led to islanding of Bokaro-B TPS. The island so formed being heavily deficit in generation vis-a-vis load suffered low voltage and collapsed on Load generation imbalance.

Events at DVC side:

Just before the incident, BTPS -B was generating around 340 MW with two units on bar, supplying power to the following sub-stations viz, Gola, Ramgarh Patratu, North Karanpura, Chandil Jamshedpur, Mosabani, Purulia, Kharagpur, Kolaghat, Howrah with an approximate load of 400 MW. DVC was getting 340MW from Bokaro'B' and rest of the power was being drawn through 220kV Joda-Jindal-Jamshedpur tie to the tune of 50 to 60MW. Also it was supplying 25MW power to Barhi S/s. However, due to the disturbance at Talcher TPS coupled with tripping of 220kV Ramchandrapur-Joda, the Joda loads could not be fed from TTPS & Ramchandrapur(JSEB) side anymore. Consequently, the entire Joda loads started getting sourced from DVC system resulting in the power flow through 220 KV Jamshedpur-Jindal-Joda tie line suddenly getting reversed wherein Joda started drawing power to the tune of 83 MW from DVC system. 132 KV Barhi-Koderma D/C line tripped as a result (relay back-up over-current along with lock-out 86B, 86 A) at 17:13 hrs from Koderma end and 132kv Barhi-Biharshariff also tripped leading to the BTPS-B

station along with above mentioned sub-stations becoming islanded from rest of the DVC system but remaining connected with 220 KV JSR-Joda tie radially, thus leading to formation of an island with Bokaro'B' generation and loads comprising as above. As the generation of this Island was around 340 MW and loads were more than 450 MW (including drawl by Joda in radial mode), significant low voltage occurred at BTPS B, resulting in tripping of both the running units at Bokaro'B' with low forward power relay and leaving no generation in the Island.

Discrepancies observed and Remedial Measures/Suggestions:

- Tripping of 220kV TTPS-Meramundali-II and 220kV Meramundali-Bhanjanagar-I from one end only, needs to be explained.
- O/C operation of 220kV Ramchandrapur-Joda needs to be checked.
- Over-current settings of 132kV Barhi-Koderma D/c need to be checked.
- Tripping of 132kV Barhi-Biharshariff needs to be corroborated.
- Tripping of 220kv TTPS-TSTPP, TTPS-Rengali to be cross-checked for occurrence and relay indications.
- Relays at TTPS/Meramundali need to be checked/ audited.

OPTCL & DVC may update.

Deliberation in the meeting

After detailed deliberation, PCC felt that the incidence could not be analyzed unless the detailed tripping reports are received from all the substations involved. PCC took serious note of non-submission of detailed tripping report by NTPC, TTPS end and advised NTPC to place the details in 100th OCC meeting scheduled to be held on 22nd August, 2014 for detailed deliberations. OPTCL was also advised to inquire about any tripping report from 220 kV TTPS-NALCO-Rengali line or 220 kV TSTPS for further investigation. The tripping incident will be again discussed after compiling reports received from all concerned.

ITEM NO. B.4: MPL System

MPL Both Unit Tripping on 11/06/2014 due to 400 kV Voltage dip

Maithon Unit # 1, 2 generating tripped on Class A protection as reverse power protection operated after respective Boiler Tripping on MFT due to Heavy Voltage dip in 400 kV systems.

- 1) Prior to incident Unit # 1 & 2 was generating 515 & 510 MW , power export through Maithon Line # 1, Maithon Line # 2, Ranchi Line # 1 & Ranchi Line # 2 were 440, 450, 42, 41 MW respectively.
- 2) Heavy Voltage dip was observed 2-3 times within few minutes. One of the fluctuations was of very heavy and 3 ph in nature.
- 3) Due the heavy voltage disturbances, Boiler tripped on MFT & subsequently unit tripped on reverse power protection.
- 4) DVC generating station MEJIA is connected to PGCIL Maithon S/S through 2 nos 400 KV lines. MPL 400 KV switchyard is connected with PGCIL Maithon S/S through 2 no of lines. After communication with PGCIL, it is conveyed that transmission tower which is carrying Maithon Mejia line collapsed totally & as a result major breakdown in transmission line occurred.
- 5) Due to this tower falling, 3 ph faults occurred & this fault appeared as Zone-3 fault for MPL to Maithon Lines at MPL end. Zone -3 fault disappeared within 60 m sec.
- 6) As per DR recorded from line protection relays, In 400 KV system Voltage , Phase to Neutral voltage collapsed from 239 KV to 111 KV which is around 46 % dip in 400 KV systems.

MPL may update.

Minutes of 22nd PCC meeting

Deliberation in the meeting

PCC felt that the protection settings (especially time settings) of auxiliary equipment at MPL end needs to be examined and advised MPL to contact Manufacturer for proper settings.

MPL agreed and informed that they are in contact with the manufacturers.

On enquiry from MPL to treat above units tripping under force majeure clause, it was informed that this type of incidences does not come under force majeure as per CERC regulations.

PART- C

FOLLOW-UP OF DECISIONS OF THE PREVIOUS PROTECTION SUB-COMMITTEE MEETING(S)

(The status on the follow up actions is to be furnished by respective constituents)

ITEM NO. C.1: Tripping of 400 kV Farakka-Berhampore line.

It has been observed quite sometimes that 400 kV Farakka- Berhampore line experienced repeated tripping from Berhampore end only and remained charged from FSTPP end. These incidences are cause of concern for safe grid operation. The tripping report from Powergrid has not yet been received by ERLDC in this regard for which no conclusion could be arrived at.

In reply, Powergrid informed that the fault was in one circuit of 400kV Berhampore-Bheramara D/C and the same was leading to maloperation at Berhampore end of 400kV FSTPP-Berhampore line. Powergrid indicated that prima facie the SOTF relay at Berhampore end appeared to be mal-operating and such mal-operations would be investigated and rectified shortly.

PCC advised Powergrid to submit a detailed report for discussions in next PCC meeting.

Powergrid may please update.

Deliberation in the meeting

Powergrid reported that SOTF relay at Berhampore end has been rectified.

PCC advised Powergrid to submit a report in this regard. Powergrid agreed.

ITEM NO. C.2: Disturbance at Adityapur/Chandil at 13:53 hrs on 08/07/14

Following lines tripped

- 220kV Chandil-Ranchi
- 220kV Chandil-Santaldih
- 220kV Chandil-Ramchandrapur
- 132kV Chandi-Hatia
- 132kV Chandi-Rajk'swan
- 132kV Chandi- Rajk'swan-Adityapur
- 132kV Ramchandrapur-Adityapur D/C

Total power interrupted at 220 kV Chandil S.S

- Zone setting of distance relay of 220 kV Chandil-Ramchandrapur line at Ramchandrapur end
- Zone settings of all the distance relays at 220 kV Chandil S/s

PCC advised to send the report within 7 days. JSEB agreed.

JSEB and ERLDC may update the status.

Deliberation in the meeting

JSEB informed that, zone 3 settings at Chandil end of 220kV Chandil-Ranchi (PG) and zone-1 setting of 220kV Chandil-Ramchandrapur found incorrect and the same has been rectified. JSEB informed that M/S Areva is testing all the relays at 220kV Chandil S/s.

ITEM NO. C.3: Tripping of 220 kV lines from STPS (WBPDC) on 04/04/14.

PCC enquired about over current relay settings at Chandil end. In reply, JSEB informed that the existing setting is 75% with time delay of 0.25 sec (CT ratio is 600:1).

PCC felt that O/C setting at 75% on an important interstate tie line is appeared to be at lower side and advised JSEB to increase the over current relay setting to 100%. PCC also advised WBPDC to share the O/C relay settings of STPS end with JSEB.

On enquiry, WBSETCL also informed that 4th ICT at Arambag 220/132 kV S/s will be reinstalled before Puja.

JSEB and WBSETCL may update the status.

Deliberation in the meeting

JSEB informed they have changed the O/C relay setting to 100%.

WBPDC is also advised to review the settings at their end.

WBPDC agreed.

ITEM NO. C.4: Members may update the following:

C.4.1: In 21st PCC, WBSETCL informed that 220 kV two main bus system will be made operational at Bidhannagar S/s by Aug, 2014.

WBSETCL may update the present status.

Deliberation in the meeting

WBSETCL informed that the work is under progress and expected to be completed as per the schedule.

C.4.2: In 18th PCC after deliberation on **Tripping of 132kV MTPS-Motihari line at 11:58 on 04-08-2013**, PCC advised BSHPC to take up the matter with Kanti Generating Station for replacement of their old relays with numerical relays and proper protection co-ordination may be done.

In 21st PCC, BSPTCL informed that installation of numerical relay at 132 kV Kanti (NTPC) generating station and Motihari S/s are in progress and it will be completed by July, 2014.

NTPC and BSPTCL may update the status

Deliberation in the meeting

NTPC informed that numerical relay has been installed at 132kV Kanti (NTPC) S/s.

C.4.3: In 19th PCC after deliberation on **Trippings of 220 kV lines from Hatia S/s on 24.03.14 & Disturbance in Adityapur area of JSEB on 17/03/14**, JSEB was advised to thoroughly check the relay settings and coordination of relays at 132kV and 220kV S/s for satisfactory performance and report the findings to ERPC Secretariat within 15 days.

In 21st PCC, JSEB informed that replacement of electromechanical relays of 33 kV lines is in progress and it will be completed by August, 2014.

JSEB may update.

Deliberation in the meeting

JUSNL informed that the work is under progress and expected to be completed as per the schedule.

C.4.4: In 20th PCC, OPTCL explained that old Electro Mechanical relays for distance protection were installed in 220kV Meramundali- TTPS– I &II and the backup over current directional element was inoperative. OPTCL informed that old EM relays are being replaced with numerical relays.

In 21st PCC, OPTCL informed that replacement of existing 220 kV bus bar protection at Meeramundali S/s is in progress and the new numerical relays will be in service by December, 2014 along with Theruvali, Budhipadar S/s.

OPTCL may please update.

Deliberation in the meeting

OPTCL informed that the installation work of Bus bar protection is under progress and expected to be in service as per the schedule.

ITEM NO. C.5: PLCC problem in 400 kV Sagardighi-Parulia line II

WBPDCCL reported that ABB make PLCC link repeatedly receiving carrier protection signal at Sagardighi end from 400 kV Parulia S/s without any fault in the line on following occasions:

Sl. No.	Date	Time	Relay Operated
1	09/06/14	16:16	Carrier protection,
2	11/06/14	16:25	Carrier protection
3	20/06/14	15:52	Carrier protection
4	16/06/14	16:32	Carrier protection
5	01/05/14	15:55	Carrier protection
6	07/05/14	16:19	Carrier protection
7	25/03/14	23:03	Carrier protection

MPL representative informed that ABB make PLCC system at MPL end receiving the carrier signal from 400 kV Ranchi S/s without any fault in 400 kV MPL-Ranchi line.

DVC reported that they are also experiencing the same with ABB make PLCC system in some of their lines.

PCC advised Powergrid to take up the matter with M/s ABB and resolve the problem.

Powergrid agreed.

Powergrid may update the status.

Deliberation in the meeting

Powergrid informed that ABB representative would come to rectify the problem on 25th August, 2014 for rectification.

ITEM NO. C.6: Availability of single phase auto-reclosure facility for 220KV and above lines

Single phase Auto-reclosure scheme helps to ensure Grid security by preventing unwarranted tripping of lines on short duration transient faults. However, operation of Auto-reclosure has not been in order in several cases.

In 21st PCC, PCC reiterated that as per CEA(Technical Standards for construction of Electric Plants and Electric Lines) Regulations 2010, single reclose auto-reclosure facility is to be kept in service for all lines 220kV and above.

Accordingly, PCC advised all constituents to forward the list of transmission lines for which single-phase auto-reclosure is not in service, stating the reason for the same to ERLDC with a copy to ERPC Secretariat.

PCC also advised to inform the failure of successful auto-reclosure operation to ERLDC stating the detailed relay indications along with DR/EL outputs.

Constituents agreed.

ERLDC may update the status.

Deliberation in the meeting

PCC once again advised all constituents to forward the list of transmission lines for which single-phase auto-reclosure is not in service, stating the reason for the same to ERLDC with a copy to ERPC Secretariat.

ITEM NO. C.7: PROTECTION PHILOSOPHY OF EASTERN REGION

In the Special meetings on "Protection Co-ordination of JSEB System and its neighbouring utilities" held on 12.11.13, 05.12.13 & 28.01.14 the protection philosophy for Eastern Region was agreed as given below:

Sl. No.	Zone	Direction	Protected Line Reach Settings	Time Settings
1	Zone-1	Forward	80%	Instantaneous
2	Zone-2	Forward	120%	300 milliseconds
	Zone-2 (for 220kV and below)	Forward	120 % of the protected line or 100% of the protected line + 50% of the adjacent shortest line (whichever is less)	300 milliseconds
3	Zone-3	Forward	100 % of the protected line + Za	1.0 Sec
4	Zone-4	Reverse	20%	1.2 Sec

Where, Za = Impedance of 100% of the adjacent longest line or 90 % of the Transformer impedance (whichever is less).

In 19th PCC, all the constituents were requested to adopt the same philosophy for their inter as well as intra state lines for better protection co-ordination of their systems and Eastern Regional system as a whole. Implementation of this philosophy may also be extended for BSPTCL, DVC and West Bengal systems.

A special meeting was convened to review the zone settings of BSPTCL, DVC and West Bengal systems on 06.08.14. The zone settings as updated by the constituents (till date) are circulated in the meeting. Concerned members are requested to confirm the given settings and also update the bold and blank fields.

Members may update.

Deliberation in the meeting

*The zone settings of the various lines were reviewed and enclosed at **Annexure- C.7**. PCC advised to the concerned utilities to check the settings as given in Annexure-C.7 and submit their findings (if any) to ERPC Secretariat.*

ITEM NO. C.8: Status of Disturbance Reporting- July,2014

Sl no	Disturbance	Date & Time	Agencies involved	Report in format		DR/EL/Tripping analysis		Remarks
				Y/N	DATE	Y/N	DATE	
1	Total power failure occurred at 132/33kV Purnea (BSPHCL) s/s due to fault in 132kV Purnea (BSPHCL)-Forbisgunj line	03/07/14 at 21:35hrs	ER-I	N		N		No tripping msg was received from ER-I and BSPHCL.
			BSPHCL	N		N		
2	Total power failure occurred at 220kV Purnea PG (Old) s/s due to insulator decapping at loc 41 in 220kV Purnea (Old)-Dalkhola-II.	07/07/14 at 15:19hrs	ER-I	Y	14-07-2014	Y	14-07-2014	Tripping analysis report received from ER-I with relay indication only.
3	Total power failure occurred at 132/33kV Purnea (BSPHCL) s/s due to fault in 132kV Purnea (BSPHCL)-Forbisgunj line	07/07/14 at 19:55hrs	BSPHCL	N		N		No tripping msg was received from ER-I and BSPHCL.
			ER-I	N		N		
4	Total power interrupted at 220kV Chandil Sub-Station due to busting of 33kV side Y-phase LA of 132/33kV transformer-IV at 132kV Adityapur substation	08/07/14 at 13:53hrs	ER-I	N		N		Preliminary tripping report received from JSEB with some relay indication only.
			JSEB	Y	09-07-2014	Y	09-07-2014	
5	Total power failure occurred at 220kV Budhipadar S/s due to snapping of bottom most conductor (between gantry & dead end tower) of 220 kV Budhipadar-Basundhara ckt-II	08/07/14 at 17:21hrs	GRIDCO	Y	11-07-2014	Y	11-07-2014	Tripping analysis report received from GRIDCO with relay indication only.

6	Various 220kV lines, ATRs and all the running units of TTPS tripped due to inclement weather condition. DVC system also got affected due to loss of supply from Joda S/s.	12/07/14 at 16:50hrs	DVC	N	22-07-2014	Y	22-07-2014	Preliminary tripping report received from DVC.
			GRIDCO	Y	21-07-2014	Y	21-07-2014	Tripping analysis report received from GRIDCO with relay indication only.
7	At 20:31hrs, total power failure occurred at 132/33kV Purnea (BSPHCL) s/s due to fault in 132kV Purnea (BSPHCL)-Saharsha line	19/07/14 at 20:31hrs	ER-I	N		N		No tripping msg was received from ER-I and BSPHCL.
			BSPHCL	N		N		
8	Total power failure occurred at Patratu & Hatia (I) & (II) due to bursting of R-Ø LA of 150MVA Auto transformer-1 burst in switchyard of Patratu S/s.	21/07/14 at 13:09hrs	JSEB	N	21-07-2014	Y	21-07-2014	Preliminary tripping report received from JSEB with some relay indication only.
			ER-I	N		N		
9	Total power failure occurred at GMR S/s due to tripping of all outgoing lines from GMR on E/F.	23/07/14 at 10:03 & 10:41hrs	GRIDCO	N		N		Tripping analysis report received from GMR with relay indication only.
			GMR	N	30-07-2014	Y	30-07-2014	
10	Due the fault in 220kV Biharshariff-Bodhgaya-D/C which was under shutdown for reconductoring work and kept idle charged from Biharshariff end, all the three 315 MVA, 400/220kV ICTs at Biharshariff(PG) tripped	26/07/14 at 23:31hrs	ER-I	Y	28-07-2014	Y	28-07-2014	Tripping analysis report along with DR & EL was received from ER-I.
			BSPHCL	N	26-07-2014	Y	26-07-2014	Preliminary tripping report received from BSPHCL.
11	Total power failure occurred at Budhipadar S/s due to B-Ph breaker limb of 220 kV Budhipadar-Tarkera-II burst at Budhipadar.	29/07/14 at 20:10hrs	GRIDCO	Y	04-08-2014	Y	04-08-2014	Tripping analysis report received from GRIDCO with relay indication only.

Members may note and ensure compliance.

Deliberation in the meeting

Constituents were in the opinion that the detailed analysis of the tripping incidence could not be possible within 24 hrs since it is difficult to collect the disturbance recorder data and do the analysis within a day.

PCC advised all constituents to discuss the detail analysis in monthly PCC meeting and advised SLDC of the respective utilities to submit the report within 24 hrs with a copy to respective Testing wing for investigation and report subsequently.

PCC also felt that SLDC representatives should attend PCC meeting for detailed deliberation on tripping incidences.

PCC decide to communicate same in 100th OCC meeting.

ITEM NO. C.9: ANY OTHER ITEM.

Meeting ended with vote of thanks to the chair.

Participants in 22nd PCC Meeting

Venue: ERPC Conference Room

Time: 11:00 hrs

Date: 21.08.14 (Thursday)

Sl No	Name	Designation	Organization	Contact Number	Email	Signature
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15	Bisambhadas Verma	Engineer	ERLDC	990318073		Bisambhadas Verma
16	B.B. Bhoi	Dy. Mgr.	ERLDC	943215830		B.B. Bhoi
17	RAT. P. Kundu	Engrs.	ERLDC	9903329591		R.P. Kundu
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20	S. Swain	Chief Manager	CPGC	9338715926	Sudhakar.Swain@cpge.co.in	S. Swain

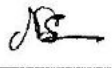
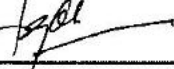
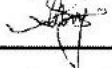
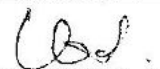
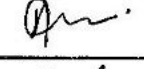
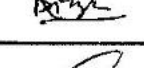
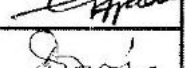
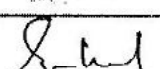
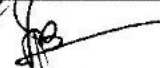


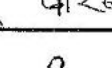
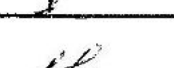
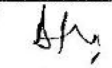

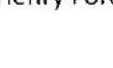
"Coming together is a beginning, staying together is progress, and working together is success." —Henry Ford

Participants in 22nd PCC Meeting

Venue: ERPC Conference Room

Time: 11:00 hrs

Date: 21.08.14 (Thursday)

Sl No	Name	Designation	Organization	Contact Number	Email	Signature
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"Coming together is a beginning, staying together is progress, and working together is success." –Henry Ford

Eastern Regional Power Committee

REPORT OF THE COMMITTEE FOR AUDIT & TESTING OF RELAYS INSTALLED AT PURNEA (BSPTCL & PGCIL) SUB-STATIONS

1. Background:

Frequent total power failure has been experienced at Purnea 132/33kV sub-station of BSPTCL [receives power directly from 220/132 kV Purnea (PGCIL) S/s] due to various types of transmission/ downstream line faults since 24.03.2014. The issue was discussed in the Protection sub-Committee meetings and BSPTCL & Powergrid ER-I was requested to attend discrepancies / deficiencies in Protection Coordination in and around Purnea 220 kV and 132 kV sub-stations and submit a status report. On 31.05.2014 BSPTCL informed that all relay settings of Purnea 132/33kV , circuit breakers timer testing were carried out in a joint meeting with Powergrid (the list is attached at **Annexure-I**). Further, BSPTCL informed that the CT polarity in respect of 132kV Purnea- Saharsa and Purnea – Naugachia lines were also corrected. In spite of above actions the indiscriminate trippings / mal-operation of relays continued to occur since May, 2014 onwards and particularly during July, 2014. In view of above, the Protection sub-Committee in its 21st meeting held on 17.07.2014 decided to constitute a team of Protection Engineers in ERPC forum for assessment / audit of existing Protection coordination and suggest revision of settings, if any after testing of existing relays installed at Purnea sub-stations.

2. Scope of Works:

The ERPC Protection Engineers constituted by the Protection sub-committee in its 21st meeting held on 17.07.2014 are as follows:

- a. **Shri J.Das, CM (OS), Powergrid, ER-I, Patna**
- b. **Shri Rambaboo Singh, EEE, CRITL, BSPTCL**
- c. **Shri S.Roy, Addl.C.E (Testing), WBSETCL, Kolkata**
- d. **Shri J.Dutta, SE, CTC, DVC, Maithon**
- e. **Shri S.Banerjee, CM, ERLDC, Kolkata**
- f. **Shri B.Sarkhel, SE (PS), ERPC, Kolkata- Convenor**

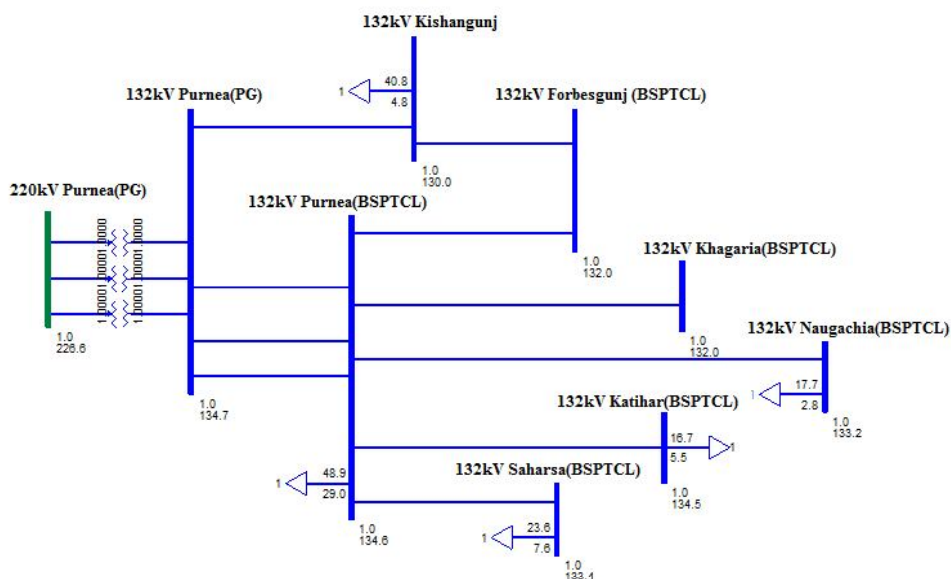
It was decided that the members shall be visiting for audit / testing of relays in Purnea 132/33kV sub-station of BSPTCL including its neighbouring sub-stations as well as Purnea 220/ 132kV PGCIL sub-station to review the Protection Coordination among them. The observation / findings of the team shall be reported in the 22nd PCC meeting to be held on 21.08.2014 and submit a status report.

Accordingly, the team visited Purnea 220/132kV (PGCIL), Purnea 132/33kV and Forbesganj 132/33kV (BSPTCL) sub-stations during 11.08.2014 to 13.08.2014 for a thorough Protection Audit with the help of engineers from CRITL , BSPTCL and Powergrid together with their testing sets /equipment.

The team initiated the discussion with BSPTCL on the recent tripping incidence of 21:18 hrs on 07-08-14, when total power failure occurred at Purnea S/s. It was reported that there was a fault in 132 kV Purnea-Forbesgunj line which was cleared from 132 kV Purnea(BSPTCL) end on directional E/F, D/P zone-1 (48 km from Purnea end) with the simultaneous operation of Incomer of PGCIL-1 and 3, which tripped at BSPTCL end and Incomer PGCIL-II tripped at Power Grid end. This caused the total Power Failure of 132KV Purnea S/Stn along with SAHARSA, NAUGACHIA, KATIHAR, KHAGARIA AND FORBESGUNJ S/STN, which receives power radially from 132 kV Purnea S/s. Since there was no reported tripping of the Line either at Forbesgunj end or Purnea (PGCIL) – Kishengunj –Forbesbgunj section, it is

presumed that, due to snapping of jumper the fault got isolated and only tripping at Purnea (BSPTCL) took place with simultaneous TPF in 132 kV Purnea (BSPTCL) S/Stn.

Existing Single Line Network Diagram of 132kV Purnea (BSPTCL) S/Stn. with neighbouring sub-stations



3. Observations:

BSPTCL explained the above incident and the relay indications as received are furnished below:

Sl. No.	Name of the line	Relay Indication at PGCIL end	Relay Indication at BSPTCL end
1.	132 kV Purnea(PG)-Purnea(B)-I	Did not tripped	O/C, E/F protection
2.	132 kV Purnea(PG)-Purnea(B)-II	Backup E/F (67N)	Hand tripped
3.	132 kV Purnea(PG)-Purnea(B)-III	Did not tripped	Directional E/F

Thereafter, physical inspection of 132 kV CTs/PTs at Purnea (BSPTCL) Switchyard and all protective relays including MICOM was carried out by ERPC team with the help of BSPTCL engineers and technical personnel. The details collected from nameplates are documented at **Annexure-II**.

The followings are the observations of ERPC team:

3.1. Purnea 132/33kV(BSPTCL) sub-station:

The single line diagram of the substation is annexed at **Exhibit- I**.

a. ABSENCE OF STANDARD SPECIFICATION OF 132kV CT

Different types of CT's were procured and installed in the bays over different period of time on replacement basis. Discrepancies were observed in proper selection of the protection core to be used as Relay Inputs, and their connections from the CT base terminals to CTJB and thereafter to Relay Panel. From the discussions with representatives of BSPTCL, it was not clear whether CT selection and their interfacing with respective Relays had been done correctly. Later on, it was found that in Power Grid Feeder # 1 at BSPTCL end, R-Phase Core – I is the protection core, and Y- and B-phase Core-I is the metering core. If as a general practice, Core -1 has been identified for protection and connections made accordingly, then actually R-Phase will be connected to the Protection Core and Y and B-Phase will be connected to the Metering core for Power Grid Feeder # 1 which in turn will lead to unnecessary mal-operation during external faults. Hence for proper connections to be completed in

Power Grid Feeder # 1 , Core -1 (R-phase) & Core 3 (Y & B Phase) should be connected to the Protection Relay. Usually Identical cores in all the phases are used for protection or metering as identified. As a Normal Practice following are the Class of CT core used for different functions:-

- Protective Relays :- Accuracy Class PS Or 5P
- Metering :- Accuracy Class 0.2s or 0.2 or 0.5 or 1.0.

Identical Discrepancy has been observed in the 132KV SAHARSA FEEDER.

b. LOWER CT RATIO OF 132KV LINE FEEDERS

It was observed that CT ratio selected for the two 132KV lines were inappropriate and CT may saturate at the time of fault. Hence, the committee recommended to increase the CT ratio as follows:

Sl. No.	Name of the line	Existing CT ratio	Revised CT ratio
1.	132 kV Purnea-Saharsa	200:1	400:1
2.	132 kV Purnea-Naugachhia	300:1	600:1

As a normal practice, minimum CT ratio of 400/1 should be used for any 132KV Line Protection.

c. ABSENCE OF MULTI –STRANDED WIRES IN CT SECONDARY SIDE CABLE

Single Stranded 2.5 Sq.mm wires have been used for CT secondary connections having poor quality terminations, i.e. from CT base terminal to CTJB and CTJB to Panel which increases the lead resistance and introduce burden to the CT. Normally Multi-Stranded wires are used which reduces the Lead Resistance and provides reliable connections and terminations.

d. WORN OUT JUNCTION BOX

- The CTJB of majority of the bays are totally rusted and broken from the bottom. The Terminal Blocks of the CTJB were automatically removed due to the pressure from the connecting cables and simply hanging in some of the cases. This has occurred due to the fact that there is **NO CABLE GLANDING** used in the CTJB for which the pressure of the cables coming through the holes has totally damaged the boxes. Similar is the case for 132KV BUS PTJB.
- None of the CTJB or the PTJB is properly earthed through earthing strips. A temporary 2.5 Sq.mm wire is connected between the CTJB earthing nut and the structure of the CT or PT. This is not the normal practice as structures are painted which in turn increases the resistance of the connection point with the structure and thus dilutes the basic purpose for which this is normally done.

e. POOR PHYSICAL CONDITION OF THE CT'S

The condition of the CT's in some of the bays was much depleted. Oil Spills were observed in the top cover and the insulating portion. This signifies that immediate TAN DELTA measurement of the CT's are to be carried out and the defective CT's should be replaced before it fails and causes damage to other equipment of the bay. THERMOVISION scanning should be carried out for identification of HOT SPOTS and immediate rectification is to be carried out.

f. WRONG WIRING IN "MICOM RELAYS" WHILE RETROFITTING

Wiring of MICOM P442 and MICOM P127 relays for most of the 132kV lines were found erroneous at relay terminals. The same was rectified for 132kV Purnea(B)-Saharsa line by the committee and BSPTCL was advised to rectify the same for the remaining 132kV lines in similar way which was subsequently completed.

g. WRONG CT CONNECTIONS

For some of the lines the input to the relay has been taken from CT metering core instead of protection core. Committee advised BSPTCL to rectify the error at the earliest.

h. REVERSE POLARITY

The committee analysed the disturbance records in numerical relays and found reversed voltage-current relationship (incorrect polarity) for 132 kV Naugachhia, Khagaria, Forbesgunj and Saharsa feeders.

3.2. Forbesganj 132/33kV (BSPTCL) sub-station

- i. The committee observed that no Voltage (potential) is available for **SEL** distance protection relay of 132kV Forbesgunj-Kataiya line-II and observed the following voltages at relay input terminals of backup Directional O/C relay:

Sl. No.	Voltage between the terminals	Voltage Difference (V)
1.	RY	63
2.	YB	110
3.	BR	63
4.	Open delta	62

From the above results it could be concluded that there was no voltage available for the R-Phase. The same was confirmed by representatives of BSPTCL that the R-Phase CVT has failed and replacement is under process. VT fuse failure annunciation is being displayed in control panel. Since no PT Potential was available, the Directional Feature of the Backup relays were disabled and the Line was charged with only Non – Directional O/C and E/F Protection available.

- ii. Directional feature is disabled in all backup directional O/C and directional E/F relays for all the 132kV incoming and outgoing lines. Under such circumstances, proper gradation of tripping cannot be maintained which will cause unnecessary indiscriminate tripping.
- iii. CT ratio of all 132kV lines is 300:1.
- iv. Differential protection of 20 MVA 132/33 kV Power Transformers 1 & 2 is out of service. The committee recommended rectifying the same at the earliest.
- v. The committee observed that air-conditioning system is non-functional at 132 kV Forbesgunj S/s which is likely to damage the sensitive numerical relays.

3.3. Purnea 220/132kV(PGCIL) sub-station

The single line diagram is annexed at **Exhibit-II**

- i. The 220/132kV transformers and 132kV inter connecting feeders between CTU and BSPTCL are protected mostly through old age electro-mechanical (UE-make)/static relays. Those feeders/transformers do not have any disturbance recording facilities for fault analysis.
- ii. Proper relay is to be selected (like line differential protection) for protecting such very short distance lines.

- iii. Over current/Earth fault relay setting need to be re-viewed after establishment of successful isolation of down stream faults from connecting sub-stations so as to accommodate zone-2 clearing time. The present directional over current relay settings at Purnea (PGCIL) end are as follows:

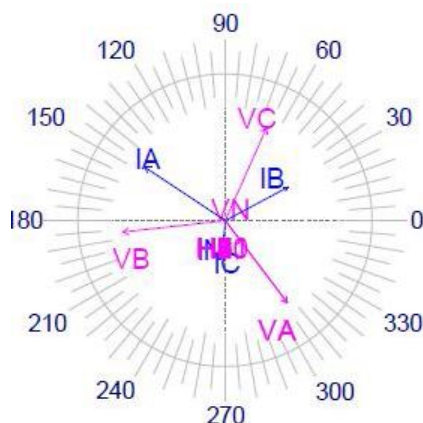
Sl. No.	Name of the bay	CT Ratio	TAP (A, B & C)	TAP (Neutral)	Dial
1.	132 kV Purnea(PG)-Purnea(B)-I	800:1	0.75	0.2	0.1
2.	132 kV Purnea(PG)-Purnea(B)-II	800:1	0.75	0.2	0.1
3.	132 kV Purnea(PG)-Purnea(B)-III	600:1	0.75	0.2	0.1
4.	132 kV Purnea(PG)-Kishanganj(B)	600:1	0.75	0.2	0.1
5.	100 MVA, 220/132kV ICT-I		0.75	0.2	0.15
6.	100 MVA, 220/132kV ICT-I		0.75	0.2	0.15

3.4. General Observations

- The members of the Committee felt that some standard test procedures should be available to the MRT team for testing and commissioning of any HT equipment like Transformers, CT, PT, CB or panel. The workforce was completely lagging in guidance for which a 3 Hrs work was taking a day to be completed. These standard procedures can be obtained in consultation with other utilities and thereby developing their own methods.
- There was literally no switchyard light available in the 132KV or the 33KV switchyard at Purnea (BSPTCL) 132KV/33KV S/Stn which made it very difficult to work in during the night. Sufficient Lights should be provided in the switchyard.

4. Analysis:

- The committee analysed the disturbance records in numerical relays and found reversed voltage-current relationship (incorrect polarity) for 132 kV Naugachhia, Khagaria, Forbesgunj and Saharsa feeders as shown in phasor diagram.



CT connections to the relays from the Panel TB to the Relay were found to be correct. Since all the outgoing 132 KV were showing the above phasor relationship, it was suspected that the 132KV CT Polarities were not proper or some modifications had been done in the Programming of the relay which was giving such results. However, after thoroughly checking the circuitry no discrepancies were found. Now suspicion arose towards the POLARITY of the

132KV BUS PT which may have been reversed. Since the Vector Group of the 132/33 kv Transformers were YNyn0, thus the secondary phase voltage of 132KV and 33KV BUS PT were simultaneously compared through phasing analysis method and results found were as below:-

Sl. No.	132kV Phase	33kV Phase	Voltage Difference (V)
1.	R	R	122
2.	R	Y	62
3.	R	B	58

The results signified that there was a 180° Phase shift between the R-Phase of 132KV and R-phase of 33KV for which the secondary voltage was adding up to 122 Volts, which the other ones were showing around the Phase to Neutral voltage of the PT. This was identical with phase comparison of the other phases also. This clearly indicated that there was a Polarity reversal of the 132KV Side PT.

- Physical Inspection of the Secondary connections also revealed the same result that the PT secondary connections were reverse from the diagram provided in the PT base Terminal of individual CVT. Subsequently the 132KV BUS PT secondary connections were corrected so that voltage of proper polarity is obtained at relay input. After completion of work, again the phasor diagrams of the Distance Protection Numerical relays were checked through analog triggering and everything was found to be in order as per the Load Flow Direction for the 132KV outgoing Lines. The Backup Relays (P127) were also checked for all lines and found to be in order.
- The star point of 132KV CT of Power Grid Line # 1 was changed towards the Line Side and the Relay Voltages and and Current Angles at P127 relay was checked and found to be in order. **Representatives of BSPTCL were advised to carry out the same procedure for Power Grid Incomer Line # 2 and 3 and 132KV Katihar Line and confirm ERPC accordingly by providing the Measurement # 1 data available from the P127 Relay (set only for Line # 2).**
- Relay settings in Micom P442 of line relays were checked and found wrong. The committee calculated the relay settings for all the feeders at 132kV Purnea (BSPTCL) S/s as per line parameters and CT ratio given in **Annexure-III**. The relay settings have been uploaded in all Micom P442 relays.
- After the change in the PT secondary Polarity, the star point of the metering cores of all the bays are to be reversed as and when required. **BSPTCL were advised do the necessary rectification work of the individual 132KV feeders so that proper registration of the meters for the individual bays could be recorded.**
- After physically inspecting the connections and terminations of the Numerical Relays the committee could conclude that the basic Philosophy of RETROFITTING has been defeated. Retrofitting does not mean only replacement of the Primary Relay and completion of the connections of that relay in a wayward way. Retrofitting actually signifies installation of new relays along with its required auxiliaries and completion of connections through new wires (as per specifications and colour coding) and proper termination and dressing. Most importantly, an approved drawing of the connections and terminations are to be obtained and accordingly the work should be carried out. None of the above was available or observed in any of the panels and in some of the panels, the mounting of the relay were also feeble. For changing a connection, the relay had to be pushed from the front so that it does not fall from the front, while changing the connections. **Thus the committee felt necessary to highlight that an approved schematic should be arranged and subsequently the wiring, termination and dressing should be completed along with proper fixing of the Relays.**

5. Recommendations:

- (i) CT Secondary cables of all the 132KV Bays are to be replaced by 2.5 sq mm 4 core Multi-stranded Armoured cables with proper terminations at CT Base Terminal Box, CTJB and Panel end.
- (ii) The CTJB of all the 132KV Bays are to be replaced by proper CTJB having approved specifications. The terminal Blocks of the CTJB should be stud type which comes along with the CTJB. The Cables should be brought inside the CTJB with proper GLANDS and dressing. The CTJB should be EARTHED through 4mm Flat Earthing strips duly connected to the earthing mesh in the switchyard .

The same is also applicable for 132KV Bus PTJB

- (iii) Earth Resistance of all the structures of the 132KV Switchyard (i.e. CT Structure, Breaker Structure, Isolator Structure, Gantry, Bus Support Structures, PT structures, etc.) should be measured and it should be brought down within 1(one) ohms wherever applicable.
- (iv) TAN DELTA Measurements of all the 132KV CT's are to be carried out. The TAN DELTA value should be within 2% (C.P.R.I recommended limit for 132 kV C.T, whereas some utilities prefers 1% also) and if any value exceeds this, or an increasing pattern is observed on subsequent measurements, and if any value exceeds this, then the particular CT has to be replaced by a healthy CT.
- (v) **132KV CT Specifications are to be standardised for 132KV Lines and transformers for the whole BSPTCL system in order to reduce human error during Installation and Commissioning. This type of varied CT's having different Core Classifications is not advisable to be used in the Protection System. This will in turn reduce the margin of error during commissioning process as well as reduce the INVENTORY for Spares.**
- (vi) Presently the CT Ratio of all the 132KV CT's are to be checked for its ratio and Polarity. Thereafter, the Protection and the Metering Cores are to be identified which will be used for Distance, Backup and Metering Purpose for all the Three Phases. Accordingly, the Connections in the CTJB and thereafter the terminations to the Panel end are to be completed. For a Guideline, the PS class Cores having a saturation of around 1400Volts may be used for Distance Protection, another PS class core or 5P cores can be used for Back-Up Directional Protection (using one PS core for one Phase and 5P core for the other 2 phases having different magnetising characteristics should always be discouraged for High impedance type protections mainly for transformer/ feeders), and the 0.2 or 1.0 Class core should be used for metering.

The Star point of the Secondary connections of all the Protection Class cores of individual 132KV Lines are to be made towards the Line side. The star point of the Metering Cores is to be made as per the metering Philosophy and the diagram of the connected meters in the Secondary Circuit for individual Bays.

- (vii) Retrofitting of Protection Relays were carried out in different 132KV Lines. There are no approved drawings available for the retrofitted panels and the Installation of some of the New Relay with the individual panel wiring along with the terminations were not done in a proper fashion. **From the quality of dressing and terminations, it clearly signifies that there was absolutely no supervision by any BSPTCL authority when the VENDOR was carrying out the work of installation and commissioning. The dressings of the wires along with the terminations are to be completed for all the panels where New Relays have been installed.**
- (viii) The committee also felt that the drawing and documentation was very poor on the Substation Side as well as the MRT side of BSPTCL. Not a single Control and Protection Drawing for 132KV bays were available at the S/Stn end by which a person can work and rectify faults in different circuits.
- (ix) The work specified in item 3 and 4 under ANALYSIS part are to be completed immediately. Till completion, the existing setting at 132 kV Purnea (PGCIL) end should continue.

Acknowledgement:

The engineers of ERPC team acknowledged with thanks to the authorities of BSPTCL & POWERGRID ER-I for extending support and cooperation in regard to audit / testing of relays installed at their sub-stations. Special thanks to the engineers of BSPTCL (Testing Wing & sub-station) and Powergrid & their support staff in carrying the above work successfully. The investigation / findings by the team would also be helpful to the fresh engineers of BSPTCL to guide their future career in this important Protection field.

-sd-

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Relay Setting at Purnea GSS 132 KV

	O/C		E/F		0.10
Feeder	PSM	TMS0.95	PSM	TMS	CT Ratio
TR-I (50MVA)	0.95	0.10	0.20	0.10	300/1
Katihar	1	0.1	0.20	0.10	300/1
Khagaria	1	0.09	0.15	0.09	300/1
Saharsa	1	0.09	0.15	0.09	200/1
PGCIL-III	1	0.10	0.20	0.10	600/1
Forbesganj	1.2	0.09	0.15	0.09	300/1
TR-III (20MVA)	0.75	0.10	0.20	0.10	100/1
Bus Coupler	1	0.10	0.20	0.10	
50MVA TR-II	0.7	0.10	0.20	0.10	300/1
Navgachhia	1	0.09	0.15	0.09	300/1
PGCIL-II	1	0.10	0.20	0.10	600/1
PGCIL-I	1	0.10	0.20	0.10	600/1

Relay Setting at Purnea GSS 33 KV

	O/C		E/F		0.10
Feeder	PSM	TMS0.95	PSM	TMS	CT Ratio
Group Control	0.95	0.10	0.20	0.10	300/5
Dalkola	0.80	0.10	0.20	0.10	300/1
Jalalgarh	0.75	0.05	0.20	0.05	300/5
Incomer-III (20MVA)	0.5	0.05	0.20	0.05	600/1
Incomer-II (50MVA)	0.60	0.095	0.20	0.095	1200/1
Zero mile	0.75	0.05	0.20	0.05	300/5
Bus Coupler	0.75	0.05	0.30	0.05	600/5
Sonouli	0.60	0.10	0.20	0.10	300/1
Incomer-I (50 MVA)	1	0.2	2	0.15	800
Madhubani	0.6	0.05	0.20	0.05	400/1
Maranga	0.80	0.10	0.20	0.10	400/1
Bus Coupler (New)	0.6	0.30	0.20	0.10	400/1

Breaker Timer Testing of 132 KV Lines at Purnea GSS

Sr.no	Name of Line	Time (ms)			Mode
		R-ph	Y-ph	B-ph	
1	PG-I	56	56	56	C
		32	32	31	O
		38	37	33	C-O
2	PG-II	57	60	57	C
		33	31	33	O
		37	36	37	C-O
3	PG-III	92	93	94	C
		25	25	25	O
		32	31	31	C-O
4	Saharsa line	58	56	58	C
		29	32	30	O
		31	35	32	C-O
5	Khagaria	91	91	93	C
		24	24	24	O
		37	38	37	C-O
6	Naugachiya	58	58	57	C
		29	30	28	O
		32	36	32	C-O
7	Katihar	137	142	141	C
		37	35	36	O

Annexure-II

(1) The Name Plate of 132KV CT are detailed as below:-

- (i) 132KV SAHARSA FEEDER :- CTR USED WAS 200/1. **CHANGED TO 400/1 ON 12.08.14. FROM THE NAME PLATES CORE – 3 OF R AND Y-PHASE HAS TO BE TAKEN ALONG WITH CORE 3 OF B PHASE FOR DISTANCE PROTECTION AND CORE-1 OF R AND Y-PHASE HAS TO BE TAKEN ALONG WITH CORE 2 OF B PHASE FOR BACK UP PROTECTION AND ACCORDINGLY THE CONNECTION HAS TO BE MADE AND PROVIDED IN THE DISTANCE AND THE BACKUP PROTECTION. A COMMON PRACTICE IS THAT IDENTICAL CORES OF ALL THE PHASES ARE TAKEN AND USED FOR RESPECTIVE PROTECTION, WHICH IN THIS CASE IS NOT POSSIBLE AND IF IDENTICAL CORES ARE TAKEN OF ALL THE THREE PHASES, THIS MAY LEAD TO MALOPERATION DURING FAULTS.**

ITEMS	R-Phase CT			Y-Phase CT			B-Phase CT		
Cores	1	2	3	1	2	3	1	2	3
Ratio	400-200-100/1	400-200-100/1	400-200-100/1	Identical Ratio as R-Phase			Identical Ratio as R-Phase		
Burden(VA)	80	30	-	80	30	-	30	40	-
Accuracy Class/ALF	<u>5P10</u>	1	PS	5P10	1	PS	<u>0.2</u>	<u>5P10</u>	PS
Knee Point Vt. (Volts)	-	-	1260/630/320	-	-	1260/630/320	-	-	<u>200</u>

- (ii) 132KV NAUGACHIA FEEDER :- CTR USED WAS 300/1. YET TO BE CHANGED TO 600/1 AS ADVISED BUT SETTING IMPLEMENTED IS AS PER THE CTR OF 600/1

ITEMS	R-Phase CT			Y-Phase CT			B-Phase CT		
Cores	1	2	3	1	2	3	1	2	3
Ratio	600-300-150/1	600-300-150/1	600-300-150/1	Identical Ratio as R-Phase			Identical Ratio as R-Phase		
Burden(VA)	-	-	10	-	-	10	-	-	10
Accuracy Class/ALF	PS	10S15	CM	-	10S15	CM	-	10S15	CM
Knee Point Vt. (Volts)	1490	-	-	-	-	-	-	-	-

- (iii) 132KV KHAGARIA FEEDER :- CTR USED WAS 400/1.

ITEMS	R-Phase CT			Y-Phase CT			B-Phase CT		
Cores	1	2	3	1	2	3	1	2	3
Ratio	400-200-100/1	400-200-100/1	400-200-100/1	NAME PLATE NOT FOUND			NAME PLATE NOT FOUND		
Burden(VA)	30	40	-						
Accuracy Class/ALF	<u>0.2</u>	<u>5P10</u>	<u>PS</u>						
Knee Point Vt. (Volts)	-	-	<u>200</u>						

- (iv) 132KV SIDE OF 50 MVA TR # 2 :- CTR USED WAS 300/1.

ITEMS	R-Phase CT				Y-Phase CT				B-Phase CT			
Cores	1	2	3	4	1	2	3	4	1	2	3	4
Ratio	600-300/1	600-300/1	600-300/1	600-300/1	Identical Name plate as R-Phase				Identical Nameplate as R-Phase			
Burden(VA)	30	40	-	-								
Accuracy Class/ALF	1.0	5P10	PS	PS								
Knee Point Vt. (Volts)	-	-	250	1490								

(v) 132KV 20MVA TR # 3 :- CTR USED WAS 100/1.

ITEMS	R-Phase CT			Y-Phase CT			B-Phase CT		
Cores	1	2	3	1	2	3	1	2	3
Ratio	200-100-50/1	200-100-50/1	200-100-50/1	Identical Ratio as R-Phase			Identical Ratio as R-Phase		
Burden(VA)	-	-	10	-	-	10	-	-	10
Accuracy Class/ALF	-	10S15	CM	-	10S15	CM	-	10S15	CM
Knee Point Vt. (Volts)	-	-	-	-	-	-	-	-	-

(vi) 132KV SIDE KATIHAR FEEDER :- CTR USED WAS 300/1.

ITEMS	R-Phase CT					Y-Phase CT					B-Phase CT				
Cores	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ratio	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	Identical Name plate as R-Phase					Identical Nameplate as R-Phase				
Burden(VA)	30	40	-	-	-										
Accuracy Class/ALF	1.0	5P10	PS	PS	PS										
Knee Point Vt. (Volts)	-	-	1490	900	1490										

(vii) 132KV POWER GRID FEEDER # 1 :- CTR USED WAS 600/1. FROM THE NAME PLATES CORE – I OF R-PHASE HAS TO BE TAKEN ALONG WITH CORE 3/4/5 OF Y & B PHASE AND ACCORDINGLY THE CONNECTION HAS TO BE MADE AND PROVIDED IN THE DISTANCE PROTECTION. A COMMON PRACTICE IS THAT IDENTICAL CORES OF ALL THE PHASES ARE TAKEN AND USED FOR RESPECTIVE PROTECTION, WHICH IN THIS CASE IS NOT POSSIBLE AND IF IDENTICAL CORES ARE TAKEN OF ALL THE THREE PHASES, THIS MAY LEAD TO MALOPERATION DURING FAULTS.

ITEMS	R-Phase CT			Y-Phase CT					B-Phase CT					
Cores	1	2	3	1	2	3	4	5	1	2	3	4	5	
Ratio	600-300-150/1	600-300-150/1	600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	Identical as Y-Phase CT					
Burden(VA)	-	-	15	30	40	-	-	-						
Accuracy Class/ALF	PS	15S15	CM	1.0	5P10	PS	PS	PS						
Knee Point Vt. (Volts)	1490	-	-	-	-	1490	1490	1490						

(viii) 132KV POWER GRID FEEDER # 2 :- CTR USED WAS 600/1

ITEMS	R-Phase CT			Y-Phase CT			B-Phase CT		
Cores	1	2	3	1	2	3	1	2	3
Ratio	600-300-150/1	600-300-150/1	600-300-150/1	Identical Name plate as R-Phase			Identical Name plate as R-Phase		
Burden(VA)	80	30	-						
Accuracy Class/ALF	5P10	1	-						
Knee Point Vt. (Volts)	-	-	1490						

(ix) 132KV SIDE FORBESGUNJ FEEDER: - CTR USED WAS 600/1.

ITEMS	R-Phase CT					Y-Phase CT					B-Phase CT				
Cores	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ratio	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	1200-600-300-150/1	Identical Name plate as R-Phase					Identical Nameplate as R-Phase				
Burden(VA)	30	40	-	-	-										
Accuracy Class/ALF	1.0	5P10	PS	PS	PS										
Knee Point Vt. (Volts)	-	-	1490	900	1490										

(x) 132KV POWER GRID FEEDER # 3:- CTR USED WAS 600/1.

ITEMS	R-Phase CT				Y-Phase CT				B-Phase CT			
Cores	1	2	3	4	1	2	3	4	1	2	3	4
Ratio	600-300-150/1	600-300-150/1	600-300-150/1	600-300-150/1	Identical Name plate as R-Phase				Identical Nameplate as R-Phase			
Burden(VA)	30	30	-	-								
Accuracy Class/ALF	1.0	5P20	PS	PS								
Knee Point Vt. (Volts)	-	-	250	1490								

(xi) 132KV SIDE TRANSFORMER # 1 :- CTR USED WAS 300/1.

ITEMS	R-Phase CT					Y-Phase CT					B-Phase CT				
Cores	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ratio	600-300-150/1	600-300-150/1	600-300-150/1	600-300-150/1	600-300-150/1	Identical Name plate as R-Phase					Identical Nameplate as R-Phase				
Burden(VA)	-	-	20	-	-										
Accuracy Class/ALF	PS	PS	0.2	PS	PS										
Knee Point Vt. (Volts)	600	600	-	600	600										

Annexure-III

Recommended settings for Relay Type **MiCOM P442** **RELAY SETTING**

Substation	400/220kV Purnea Sub Station
Line	132 kV S/C Kishanganj
Line Length	85
CT Ratio	600
PT ratio	1200
Mode	PUPZ2

LINE PARAMETERS	[line specific]
R ₁ =	0.1622
R ₀ =	0.4056
R _{OM} =	0
X ₁ =	0.3861
X ₀ =	1.622
X _{OM} =	0
Total Z =	0.2094

RELAY REACHES IN % OF LINE LENGTHS

Zone - 1 =	80
Zone - 2 =	120
Zone - 3 =	400
Zone - 4 =	20

RELAY REACHES IN OHMS

(LINE SPECIFIC)

Zone - 1 =	14.239
Zone - 2 =	21.358
Zone - 3 =	71.194
Zone - 4 =	3.560

Menu Text

Recommended settings

Line Length	85
Line Imp.	17.80
Line Angle	67.25
Zone Status	

Bit 0 : Zone- 1X Disable : Set to 0

Bit 1: Z 2 Enable Set to 1

Bit 2: Zone P Disable Set to 0

Bit 3: Zone Q Disable Set to 0

Bit 4: Zone 3 Enable Set to 1

Bit 5: Zone 4 Enable Set to 1

KZ1 Res Comp	1.003
KZ1 Angle	11.65
Z1 (Ohms)	14.239
R1-G (Ohms)	33.11
R1-Ph (Ohms)	26.48
TZ1	0

64.8 For quad & 86.4 for Twi

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	400/220kV Purnea Sub Station
Line	132 kV S/C Kishanganj
KZ2 Res Comp	1.003
KZ2 Angle	11.65
Z2	21.358
R2-G (Ohms)	34.85
R2-Ph (Ohms)	27.88
TZ2	0.5

KZ 3/4 Res Comp	1.003
KZ 3/4 Angle	11.65
Z3	71.194
R3 G- R4 G (Ohms)	43.56
R3 Ph- R4 Ph (Ohms)	34.85
TZ3	1.5
Z4	3.560
TZ4	1.6

OTHER PARAMETERS

Series Cmp. Line	Disabled
Overlap Z Mode	Enabled
Z1m Tilt Angle 0 deg	-5 deg
Z1p Tilt Angle 0 deg	-5 deg
Z2/p/q Tilt Angl	0 deg
Fwd Z Chg. Delay	30.00ms
V Mem Validity	100ms
Earth I Detect.	100mA

Distance Protection Schemes

Group 1 Distance Scheme	
Program Mode	STANDARD
Standard Mode	PUPZ2
Fault type	Both Enabled
Trip Mode	1 Pole Z1 & CR
Carrier send zone	CsZ1
Dist CR (channel receipt)	PERM Z2
(T-current reversal)	50 ms
Tp	
Current Reversal logic	OFF
Unblocking logic	None
TOR-SOFT	Dist Scheme Enabled; Zone-1 , Zone-2 enabled

SOTF TIME DELAY	110 Secs
Z1 Extension on channel fail	Disabled
Weak infeed Mode status	Disabled
Loss of load Mode status	Disabled

Power Saving Blocking (PSB)

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	400/220kV Purnea Sub Station
Line	132 kV S/C Kishanganj
Group 1 Provision	
Delta R (Ohms)	7
Delta X (ohms)	7
IN status	Disabled
IN>(% I _{max})	40
I ₂ status	Disabled
I _{max} line status	Disabled
I max Line	2.5x I _n
Unblocking time delay	2.0 Sec
Blocking zones	Bit 1: Z1 block Bit 1: Z2 block Bit 2: Z3 block Bit 3: Z4 block

Group 1 Back up 1

I> Function	Disabled
I ₂ > status	Disabled
I ₃ > status	Disabled
I ₄ > status [For Stub Protection	Enabled
<u>I₄> Current set</u>	2A [Line Specific]
<u>I₄> Time delay</u>	100 ms

Earth Fault O/C

	Enabled
IN >1 Function	IEC S Inverse
IN >1 Direction	Directional fwd
IN > VTS Block	Non Directional
IN >1 current set	0.2
IN >1 Time delay	NA
IN >1 Time delay VTS	1.5
IN >1 TMS	0.41
IN >1 RES CHAR	DEFINITE TIME(DT)
IN >1 T RESET	100 ms
IN >2 Status	Disabled
IN>3 Status	Disabled
I>3 current set	NA
I>3 Time Delay	NA
IN>4 Status	Disabled
I>4 current set	NA
I>4 Time Delay	NA
IN Char Angle	-45 deg.
Polarization	Zero sequence

Aided DEF

Aided DEF Status	Disabled
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Under Voltage Protection

Disabled

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation 400/220kV Purnea Sub Station
Line 132 kV S/C Kishanganj

Overvoltage Protection Enabled

V> Measuring Mode	Phase to Neutral
V>1 Function	DT [Line Specific]
V>1 Voltage setting (Volts)	69.9 V [Line Specific]
V > 1 Time Delay (seconds)	5 sec [Line Specific]
V > 2 Status	Enable [Line Specific]
V > 2 voltage set	95 V [Line Specific]
V>2 Time set	0.1 sec.

CB Fail & 1 status Disabled

Fault locator

kZm Mutual Comp	0.000
KZm Angle (Degrees)	-67.21
Lime Length (Km)	85
Line Impedance	17.798
Line Angle	67.25

VT Super vision

VTs time delay	3 Sec
VTs I2> & I0> inhibit	0.2 In
Detect 3p	Enabled
Threshold 3p	10 Volts
Delta I >	0.2 IN

CT Super vision

CTS status	Disabled
CTS VN< Inhibit	6.35
CTS IN > Set	0.15
CTS Time Delay	5 Seconds

Check Synchronization Disabled

Auto Reclose Disabled

Broken Conductor Enabled

I2/I1 SETTING	0.2
I2/I1 TIME DELAY	15 sec
I2/I1 TRIP	Disable

Disturbance Recorder Enabled

Duration	3.0 Sec
Trigger position	20%

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Forbesganj
Line Length	85
CT Ratio	600
PT ratio	1200
Mode	PUPZ2

LINE PARAMETRS	[line specific]
R ₁ =	0.1632
R ₀ =	0.387
R _{OM} =	0
X ₁ =	0.413
X ₀ =	1.33
X _{OM} =	0
Total Z =	0.2220

RELAY REACHES IN % OF LINE LENGTHS

Zone - 1 =	80
Zone - 2 =	120
Zone - 3 =	245
Zone - 4 =	20

RELAY REACHES IN OHMS

(LINE SPECIFIC)

Zone - 1 =	15.099
Zone - 2 =	22.648
Zone - 3 =	46.255
Zone - 4 =	3.775

Menu Text

Recommended settings

Line Length	85
Line Imp.	18.87
Line Angle	68.47
Zone Status	Bit 0 : Zone- 1X Disable : Set to 0

Bit 1: Z 2 Enable Set to 1

Bit 2: Zone P Disable Set to 0

Bit 3: Zone Q Disable Set to 0

Bit 4: Zone 3 Enable Set to 1

Bit 5: Zone 4 Enable Set to 1

KZ1 Res Comp	0.709
KZ1 Angle	7.85
Z1 (Ohms)	15.099
R1-G (Ohms)	44.35
R1-Ph (Ohms)	35.48
TZ1	0

KZ2 Res Comp	0.709
KZ2 Angle	7.85

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Forbesganj
Z2	22.648
R2-G (Ohms)	46.69
R2-Ph (Ohms)	37.35
TZ2	0.15

KZ 3/4 Res Comp	0.709
KZ 3/4 Angle	7.85
Z3	46.255
R3 G- R4 G (Ohms)	58.36
R3 Ph- R4 Ph (Ohms)	46.69
TZ3	1
Z4	3.775
TZ4	1

OTHER PARAMETERS

Series Cmp. Line	Disabled
Overlap Z Mode	Enabled
Z1m Tilt Angle 0 deg	-5 deg
Z1p Tilt Angle 0 deg	-5 deg
Z2/p/q Tilt Angl	0 deg
Fwd Z Chg. Delay	30.00ms
V Mem Validity	300ms
Earth I Detect.	100mA

Distance Protection Schemes

Group 1 Distance Scheme	
Program Mode	STANDARD
Standard Mode	PUPZ2
Fault type	Both Enabled
Trip Mode	1 Pole Z1 & CR
Carrier send zone	CsZ1
Dist CR (channel receipt)	PERM Z2
(T-current reversal)	50 ms
Tp	
Current Reversal logic	OFF
Unblocking logic	None
TOR-SOFT	Dist Scheme Enabled; Zone-1 , Zone-2 enabled

SOTF TIME DELAY	110 Secs
Z1 Extension on channel fail	Disabled
Weak infeed Mode status	Disabled
Loss of load Mode status	Disabled

Power Saving Blocking (PSB)

Group 1 Provision	
Delta R (Ohms)	9

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation

132/33 kV Purnea Sub Station

Line

132 kV S/C Forbesganj

Delta X (ohms)

9

IN status

Disabled

IN>(% I_{max})

40

I₂ status

Disabled

I_{max} line status

Enabled

I max Line

2.5x I_n

Unblocking time delay

2.0 Sec

Blocking zones

Bit 1: Z1 block

Bit 1: Z2 block

Bit 2: Z3 block

Bit 3: Z4 block

Group 1 Back up 1

I> Function

Disabled

I₂> status

Disabled

I₃> status

Disabled

I₄> status [For Stub Protection]

Enabled

I₄> Current set

2A [Line Specific]

I₄> Time delay

100 ms

Earth Fault O/C

Enabled

IN >1 Function

IEC S Inverse

IN >1 Direction

Directional fwd

IN > VTS Block

Non Directional

IN >1 current set

0.2

IN >1 Time delay

NA

IN >1 Time delay VTS

1.5

IN >1 TMS

TO BE SET

IN >1 RES CHAR

DEFINITE TIME(DT)

IN >1 T RESET

100 ms

IN >2 Status

Disabled

IN>3 Status

Disabled

I>3 current set

NA

I>3 Time Delay

NA

IN>4 Status

Disabled

I>4 current set

NA

I>4 Time Delay

NA

IN Char Angle

-45 deg.

Polarization

Zero sequence

Aided DEF

Aided DEF Status

Disabled

Under Voltage Protection

Disabled

Overvoltage Protection

Disabled

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Forbesganj
V> Measuring Mode	Phase to Neutral
V>1 Function	DT [Line Specific]
V>1 Voltage setting (Volts)	69.9 V [Line Specific]
V > 1 Time Delay (seconds)	5 sec [Line Specific]
V > 2 Status	Enable [Line Specific]
V > 2 voltage set	95 V [Line Specific]
V>2 Time set	0.1 sec.
<u>CB Fail & 1 status</u>	Disabled
<u>Fault locator</u>	
kZm Mutual Comp	0.000
KZm Angle (Degrees)	-68.44
Lime Length (Km)	85
Line Impedance	18.873
Line Angle	68.47
<u>VT Super vision</u>	
VTs time delay	3 Sec
VTs I2> & I0> inhibit	0.2 In
Detect 3p	Enabled
Threshold 3p	10 Volts
Delta I >	0.2 IN
<u>CT Super vision</u>	
CTS status	Disabled
CTS VN< Inhibit	6.35
CTS IN > Set	0.15
CTS Time Delay	5-Seconds
<u>Check Synchronization</u>	Disabled
<u>Auto Reclose</u>	Disabled
<u>Broken Conductor</u>	Enabled
I2/I1 SETTING	0.2
I2/I1 TIME DELAY	15 sec
I2/I1 TRIP	Disable
<u>Disturbance Recorder</u>	Enabled
Duration	3.0 Sec
Trigger position	20%
Trigger Mode	EXTENDED
Analog Inputs	

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Khagaria
Line Length	145
CT Ratio	400
PT ratio	1200
Mode	PUPZ2

LINE PARAMETRS	[line specific]
R ₁ =	0.1632
R ₀ =	0.387
R _{OM} =	0
X ₁ =	0.413
X ₀ =	1.33
X _{OM} =	0
Total Z =	0.1480

RELAY REACHES IN % OF LINE LENGTHS	
Zone - 1 =	80
Zone - 2 =	120
Zone - 3 =	170
Zone - 4 =	20

RELAY REACHES IN OHMS	(LINE SPECIFIC)
Zone - 1 =	17.171
Zone - 2 =	25.756
Zone - 3 =	36.414
Zone - 4 =	4.293

Menu Text	Recommended settings
Line Length	145
Line Imp.	21.46
Line Angle	68.47
Zone Status	Bit 0 : Zone- 1X Disable : Set to 0
	Bit 1: Z 2 Enable Set to 1
	Bit 2: Zone P Disable Set to 0
	Bit 3: Zone Q Disable Set to 0
	Bit 4: Zone 3 Enable Set to 1
	Bit 5: Zone 4 Enable Set to 1
KZ1 Res Comp	0.709
KZ1 Angle	7.85
Z1 (Ohms)	17.171
R1-G (Ohms)	29.57
R1-Ph (Ohms)	23.65
TZ1	0
KZ2 Res Comp	0.709
KZ2 Angle	7.85

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Khagaria
Z2	25.756
R2-G (Ohms)	31.12
R2-Ph (Ohms)	24.90
TZ2	0.15

KZ 3/4 Res Comp	0.709
KZ 3/4 Angle	7.85
Z3	36.414
R3 G- R4 G (Ohms)	38.91
R3 Ph- R4 Ph (Ohms)	31.12
TZ3	1
Z4	4.293
TZ4	1

OTHER PARAMETERS

Series Cmp. Line	Disabled
Overlap Z Mode	Enabled
Z1m Tilt Angle 0 deg	-5 deg
Z1p Tilt Angle 0 deg	-5 deg
Z2/p/q Tilt Angl	0 deg
Fwd Z Chg. Delay	30.00ms
V Mem Validity	300ms
Earth I Detect.	100mA

Distance Protection Schemes

Group 1 Distance Scheme	
Program Mode	STANDARD
Standard Mode	PUPZ2
Fault type	Both Enabled
Trip Mode	1 Pole Z1 & CR
Carrier send zone	CsZ1
Dist CR (channel receipt)	PERM Z2
(T-current reversal)	50 ms
Tp	
Current Reversal logic	OFF
Unblocking logic	None
TOR-SOFT	Dist Scheme Enabled; Zone-1 , Zone-2 enabled

SOTF TIME DELAY	110 Secs
Z1 Extension on channel fail	Disabled
Weak infeed Mode status	Disabled
Loss of load Mode status	Disabled

Power Saving Blocking (PSB)

Group 1 Provision	
Delta R (Ohms)	6

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Khagaria
Delta X (ohms)	6
IN status	Disabled
IN>(% I _{max})	40
I ₂ status	Disabled
I _{max} line status	Enabled
I max Line	2.5x I _N
Unblocking time delay	2.0 Sec
Blocking zones	Bit 1: Z1 block Bit 1: Z2 block Bit 2: Z3 block Bit 3: Z4 block
 <u>Group 1 Back up 1</u>	
I> Function	Disabled
I ₂ > status	Disabled
I ₃ > status	Disabled
I ₄ > status [For Stub Protection]	Enabled
<u>I₄> Current set</u>	2A [Line Specific]
<u>I₄> Time delay</u>	100 ms
 <u>Earth Fault O/C</u>	
IN >1 Function	Enabled
IN >1 Direction	IEC S Inverse
IN > VTS Block	Directional fwd
IN >1 current set	Non Directional
IN >1 Time delay	0.2
IN >1 Time delay VTS	NA
IN >1 TMS	1.5
IN >1 RES CHAR	TO BE SET
IN >1 T RESET	DEFINITE TIME(DT)
IN >2 Status	100 ms
IN>3 Status	Disabled
I>3 current set	Disabled
I>3 Time Delay	NA
IN>4 Status	NA
I>4 current set	Disabled
I>4 Time Delay	NA
IN Char Angle	NA
Polarization	-45 deg. Zero sequence
 <u>Aided DEF</u>	
Aided DEF Status	Disabled
 <u>Under Voltage Protection</u>	
	Disabled
 <u>Overvoltage Protection</u>	
	Disabled

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Khagaria
V> Measuring Mode	Phase to Neutral
V>1 Function	DT [Line Specific]
V>1 Voltage setting (Volts)	69.9 V [Line Specific]
V > 1 Time Delay (seconds)	5 sec [Line Specific]
V > 2 Status	Enable [Line Specific]
V > 2 voltage set	95 V [Line Specific]
V>2 Time set	0.1 sec.
<u>CB Fail & 1 status</u>	Disabled
<u>Fault locator</u>	
kZm Mutual Comp	0.000
KZm Angle (Degrees)	-68.44
Lime Length (Km)	145
Line Impedance	21.464
Line Angle	68.47
<u>VT Super vision</u>	
VTs time delay	3 Sec
VTs I2> & I0> inhibit	0.2 In
Detect 3p	Enabled
Threshold 3p	10 Volts
Delta I >	0.2 IN
<u>CT Super vision</u>	
CTS status	Disabled
CTS VN< Inhibit	6.35
CTS IN > Set	0.15
CTS Time Delay	5-Seconds
<u>Check Synchronization</u>	Disabled
<u>Auto Reclose</u>	Disabled
<u>Broken Conductor</u>	Enabled
I2/I1 SETTING	0.2
I2/I1 TIME DELAY	15 sec
I2/I1 TRIP	Disable
<u>Disturbance Recorder</u>	Enabled
Duration	3.0 Sec
Trigger position	20%
Trigger Mode	EXTENDED
Analog Inputs	

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Naugachhia
Line Length	70
CT Ratio	600
PT ratio	1200
Mode	PUPZ2

LINE PARAMETRS	[line specific]
R ₁ =	0.1632
R ₀ =	0.387
R _{OM} =	0
X ₁ =	0.413
X ₀ =	1.33
X _{OM} =	0
Total Z =	0.2220

RELAY REACHES IN % OF LINE LENGTHS

Zone - 1 =	80
Zone - 2 =	120
Zone - 3 =	353
Zone - 4 =	20

RELAY REACHES IN OHMS

(LINE SPECIFIC)

Zone - 1 =	12.434
Zone - 2 =	18.651
Zone - 3 =	54.888
Zone - 4 =	3.109

Menu Text

Recommended settings

Line Length	70
Line Imp.	15.54
Line Angle	68.47
Zone Status	Bit 0 : Zone- 1X Disable : Set to 0

Bit 1: Z 2 Enable Set to 1

Bit 2: Zone P Disable Set to 0

Bit 3: Zone Q Disable Set to 0

Bit 4: Zone 3 Enable Set to 1

Bit 5: Zone 4 Enable Set to 1

KZ1 Res Comp	0.709
KZ1 Angle	7.85
Z1 (Ohms)	12.434
R1-G (Ohms)	44.35
R1-Ph (Ohms)	35.48
TZ1	0

KZ2 Res Comp	0.709
KZ2 Angle	7.85

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Naugachhia
Z2	18.651
R2-G (Ohms)	46.69
R2-Ph (Ohms)	37.35
TZ2	0.15

KZ 3/4 Res Comp	0.709
KZ 3/4 Angle	7.85
Z3	54.888
R3 G- R4 G (Ohms)	58.36
R3 Ph- R4 Ph (Ohms)	46.69
TZ3	1
Z4	3.109
TZ4	1

OTHER PARAMETERS

Series Cmp. Line	Disabled
Overlap Z Mode	Enabled
Z1m Tilt Angle 0 deg	-5 deg
Z1p Tilt Angle 0 deg	-5 deg
Z2/p/q Tilt Angl	0 deg
Fwd Z Chg. Delay	30.00ms
V Mem Validity	300ms
Earth I Detect.	100mA

Distance Protection Schemes

Group 1 Distance Scheme	
Program Mode	STANDARD
Standard Mode	PUPZ2
Fault type	Both Enabled
Trip Mode	1 Pole Z1 & CR
Carrier send zone	CsZ1
Dist CR (channel receipt)	PERM Z2
(T-current reversal)	50 ms
Tp	
Current Reversal logic	OFF
Unblocking logic	None
TOR-SOFT	Dist Scheme Enabled; Zone-1 , Zone-2 enabled

SOTF TIME DELAY	110 Secs
Z1 Extension on channel fail	Disabled
Weak infeed Mode status	Disabled
Loss of load Mode status	Disabled

Power Saving Blocking (PSB)

Group 1 Provision	
Delta R (Ohms)	9

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Naugachhia
Delta X (ohms)	9
IN status	Disabled
IN>(% I _{max})	40
I ₂ status	Disabled
I _{max} line status	Enabled
I max Line	2.5x I _n
Unblocking time delay	2.0 Sec
Blocking zones	Bit 1: Z1 block Bit 1: Z2 block Bit 2: Z3 block Bit 3: Z4 block
 <u>Group 1 Back up 1</u>	
I> Function	Disabled
I ₂ > status	Disabled
I ₃ > status	Disabled
I ₄ > status [For Stub Protection]	Enabled
<u>I₄> Current set</u>	2A [Line Specific]
<u>I₄> Time delay</u>	100 ms
 <u>Earth Fault O/C</u>	Enabled
IN >1 Function	IEC S Inverse
IN >1 Direction	Directional fwd
IN > VTS Block	Non Directional
IN >1 current set	0.2
IN >1 Time delay	NA
IN >1 Time delay VTS	1.5
IN >1 TMS	TO BE SET
IN >1 RES CHAR	DEFINITE TIME(DT)
IN >1 T RESET	100 ms
IN >2 Status	Disabled
IN>3 Status	Disabled
I>3 current set	NA
I>3 Time Delay	NA
IN>4 Status	Disabled
I>4 current set	NA
I>4 Time Delay	NA
IN Char Angle	-45 deg.
Polarization	Zero sequence
 <u>Aided DEF</u>	
Aided DEF Status	Disabled
 <u>Under Voltage Protection</u>	Disabled
 <u>Overvoltage Protection</u>	Disabled

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Naugachhia
V> Measuring Mode	Phase to Neutral
V>1 Function	DT [Line Specific]
V>1 Voltage setting (Volts)	69.9 V [Line Specific]
V > 1 Time Delay (seconds)	5 sec [Line Specific]
V > 2 Status	Enable [Line Specific]
V > 2 voltage set	95 V [Line Specific]
V>2 Time set	0.1 sec.
<u>CB Fail & 1 status</u>	Disabled
<u>Fault locator</u>	
kZm Mutual Comp	0.000
KZm Angle (Degrees)	-68.44
Lime Length (Km)	70
Line Impedance	15.543
Line Angle	68.47
<u>VT Super vision</u>	
VTs time delay	3 Sec
VTs I2> & I0> inhibit	0.2 In
Detect 3p	Enabled
Threshold 3p	10 Volts
Delta I >	0.2 IN
<u>CT Super vision</u>	
CTS status	Disabled
CTS VN< Inhibit	6.35
CTS IN > Set	0.15
CTS Time Delay	5-Seconds
<u>Check Synchronization</u>	Disabled
<u>Auto Reclose</u>	Disabled
<u>Broken Conductor</u>	Enabled
I2/I1 SETTING	0.2
I2/I1 TIME DELAY	15 sec
I2/I1 TRIP	Disable
<u>Disturbance Recorder</u>	Enabled
Duration	3.0 Sec
Trigger position	20%
Trigger Mode	EXTENDED
Analog Inputs	

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Saharsa
Line Length	101
CT Ratio	400
PT ratio	1200
Mode	PUPZ2

LINE PARAMETRS	[line specific]
R ₁ =	0.1632
R ₀ =	0.387
R _{OM} =	0
X ₁ =	0.413
X ₀ =	1.33
X _{OM} =	0
Total Z =	0.1480

RELAY REACHES IN % OF LINE LENGTHS

Zone - 1 =	80
Zone - 2 =	120
Zone - 3 =	179
Zone - 4 =	20

RELAY REACHES IN OHMS

(LINE SPECIFIC)

Zone - 1 =	11.960
Zone - 2 =	17.941
Zone - 3 =	26.822
Zone - 4 =	2.990

Menu Text

Recommended settings

Line Length	101
Line Imp.	14.95
Line Angle	68.47
Zone Status	Bit 0 : Zone- 1X Disable : Set to 0

Bit 1: Z 2 Enable Set to 1

Bit 2: Zone P Disable Set to 0

Bit 3: Zone Q Disable Set to 0

Bit 4: Zone 3 Enable Set to 1

Bit 5: Zone 4 Enable Set to 1

KZ1 Res Comp	0.709
KZ1 Angle	7.85
Z1 (Ohms)	11.960
R1-G (Ohms)	29.57
R1-Ph (Ohms)	23.65
TZ1	0

KZ2 Res Comp	0.709
KZ2 Angle	7.85

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Saharsa
Z2	17.941
R2-G (Ohms)	31.12
R2-Ph (Ohms)	24.90
TZ2	0.15

KZ 3/4 Res Comp	0.709
KZ 3/4 Angle	7.85
Z3	26.822
R3 G- R4 G (Ohms)	38.91
R3 Ph- R4 Ph (Ohms)	31.12
TZ3	1
Z4	2.990
TZ4	1

OTHER PARAMETERS

Series Cmp. Line	Disabled
Overlap Z Mode	Enabled
Z1m Tilt Angle 0 deg	-5 deg
Z1p Tilt Angle 0 deg	-5 deg
Z2/p/q Tilt Angl	0 deg
Fwd Z Chg. Delay	30.00ms
V Mem Validity	300ms
Earth I Detect.	100mA

Distance Protection Schemes

Group 1 Distance Scheme	
Program Mode	STANDARD
Standard Mode	PUPZ2
Fault type	Both Enabled
Trip Mode	1 Pole Z1 & CR
Carrier send zone	CsZ1
Dist CR (channel receipt)	PERM Z2
(T-current reversal)	50 ms
Tp	
Current Reversal logic	OFF
Unblocking logic	None
TOR-SOFT	Dist Scheme Enabled; Zone-1 , Zone-2 enabled

SOTF TIME DELAY	110 Secs
Z1 Extension on channel fail	Disabled
Weak infeed Mode status	Disabled
Loss of load Mode status	Disabled

Power Saving Blocking (PSB)

Group 1 Provision	
Delta R (Ohms)	6

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

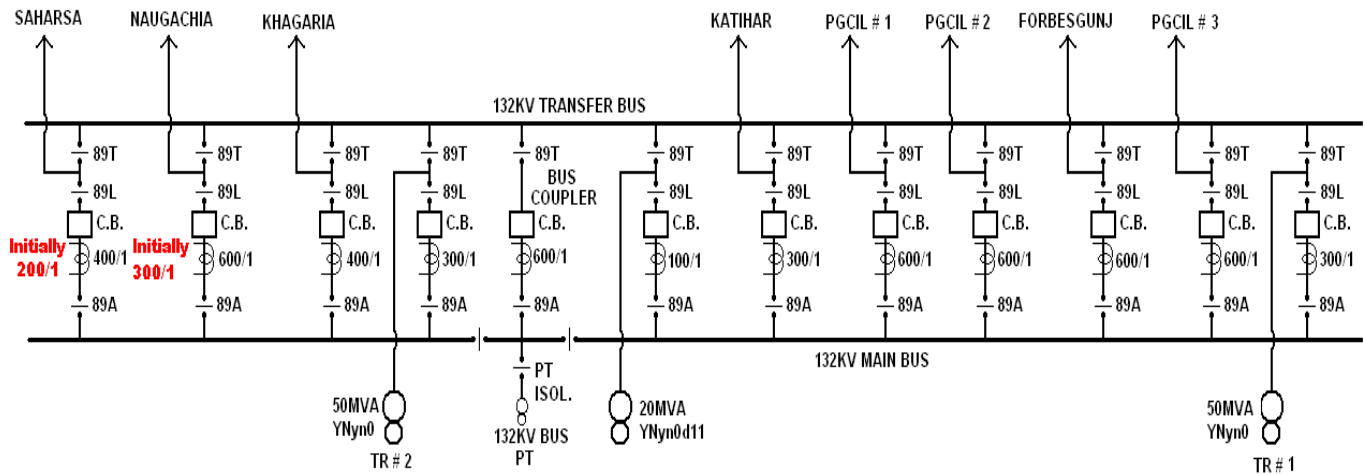
Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Saharsa
Delta X (ohms)	6
IN status	Disabled
IN>(% I _{max})	40
I ₂ status	Disabled
I _{max} line status	Enabled
I max Line	2.5x I _n
Unblocking time delay	2.0 Sec
Blocking zones	Bit 1: Z1 block Bit 1: Z2 block Bit 2: Z3 block Bit 3: Z4 block
 <u>Group 1 Back up 1</u>	
I> Function	Disabled
I ₂ > status	Disabled
I ₃ > status	Disabled
I ₄ > status [For Stub Protection]	Enabled
<u>I₄> Current set</u>	2A [Line Specific]
<u>I₄> Time delay</u>	100 ms
 <u>Earth Fault O/C</u>	Enabled
IN >1 Function	IEC S Inverse
IN >1 Direction	Directional fwd
IN > VTS Block	Non Directional
IN >1 current set	0.2
IN >1 Time delay	NA
IN >1 Time delay VTS	1.5
IN >1 TMS	TO BE SET
IN >1 RES CHAR	DEFINITE TIME(DT)
IN >1 T RESET	100 ms
IN >2 Status	Disabled
IN>3 Status	Disabled
I>3 current set	NA
I>3 Time Delay	NA
IN>4 Status	Disabled
I>4 current set	NA
I>4 Time Delay	NA
IN Char Angle	-45 deg.
Polarization	Zero sequence
 <u>Aided DEF</u>	
Aided DEF Status	Disabled
 <u>Under Voltage Protection</u>	Disabled
 <u>Overvoltage Protection</u>	Disabled

Recommended settings for Relay
Type **MiCOM P442**
RELAY SETTING

Substation	132/33 kV Purnea Sub Station
Line	132 kV S/C Saharsa
V> Measuring Mode	Phase to Neutral
V>1 Function	DT [Line Specific]
V>1 Voltage setting (Volts)	69.9 V [Line Specific]
V > 1 Time Delay (seconds)	5 sec [Line Specific]
V > 2 Status	Enable [Line Specific]
V > 2 voltage set	95 V [Line Specific]
V>2 Time set	0.1 sec.
<u>CB Fail & 1 status</u>	Disabled
<u>Fault locator</u>	
kZm Mutual Comp	0.000
KZm Angle (Degrees)	-68.44
Lime Length (Km)	101
Line Impedance	14.951
Line Angle	68.47
<u>VT Super vision</u>	
VTs time delay	3 Sec
VTs I2> & I0> inhibit	0.2 In
Detect 3p	Enabled
Threshold 3p	10 Volts
Delta I >	0.2 IN
<u>CT Super vision</u>	
CTS status	Disabled
CTS VN< Inhibit	6.35
CTS IN > Set	0.15
CTS Time Delay	5-Seconds
<u>Check Synchronization</u>	Disabled
<u>Auto Reclose</u>	Disabled
<u>Broken Conductor</u>	Enabled
I2/I1 SETTING	0.2
I2/I1 TIME DELAY	15 sec
I2/I1 TRIP	Disable
<u>Disturbance Recorder</u>	Enabled
Duration	3.0 Sec
Trigger position	20%
Trigger Mode	EXTENDED
Analog Inputs	

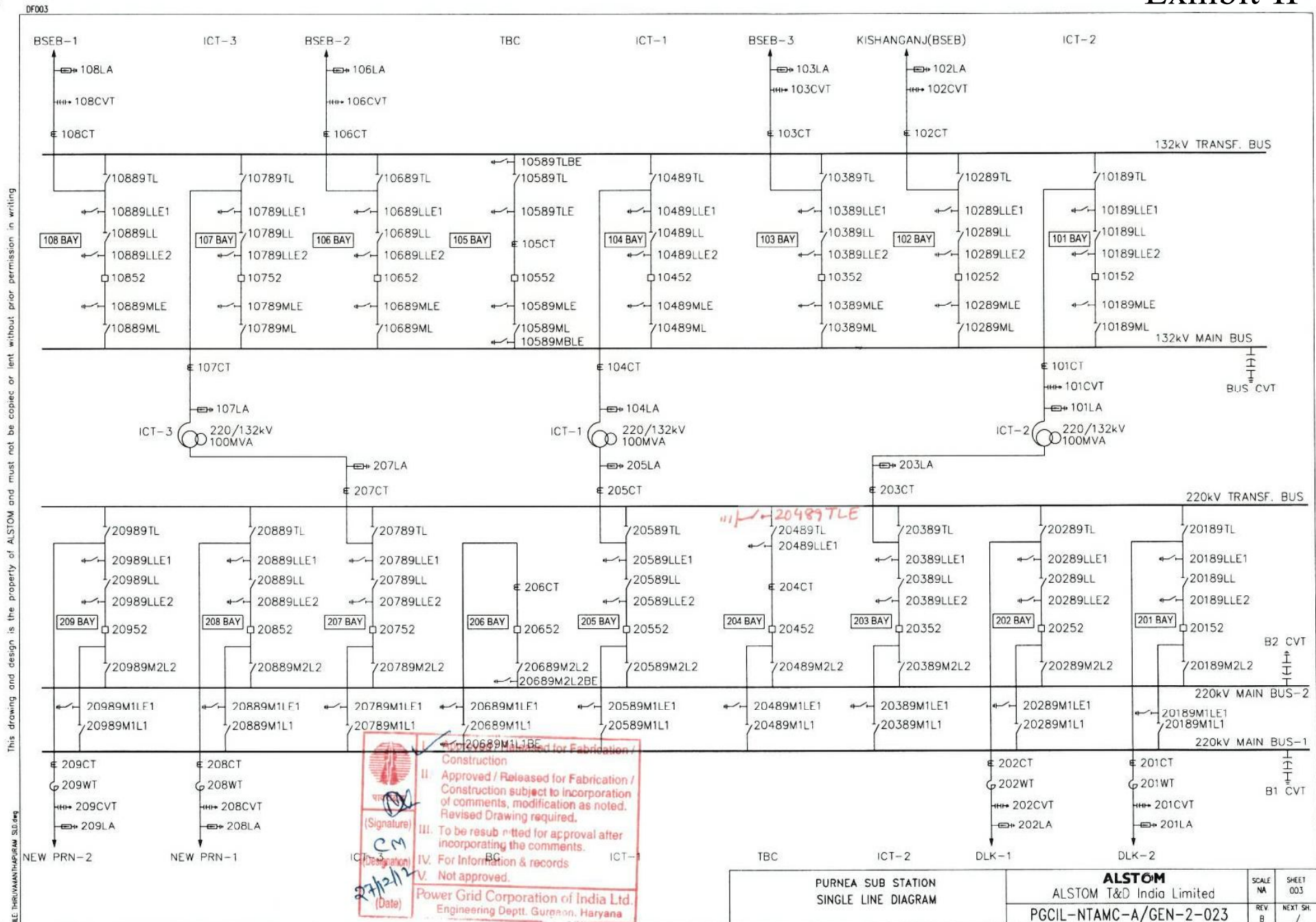
132KV PURNEA S/STN

SINGLE LINE LAYOUT DIAGRAM OF 132KV SWITCHYARD OF GSS PURNEA, BSPTCL



NOTE :- (i) 20MVA RUNS IN AN ISOLATED MANNER FEEDING PURNEA AND CERTAIN IMPORTANT LOADS. THERE IS NO 33KV PT TO MEASURE THE VOLTAGE OF THE 33KV SIDE OF THE TRANSFORMER.

(ii) IT WAS OBSERVED THAT THE LAYOUT OF THE 132KV SWITCHYARD DID NOT MATCH WITH THE MIMIC DIAGRAM OF THE CONTROL AND RELAY PANELS. THIS INHERENTLY WILL LEAD TO OPERATIONAL ERRORS FROM THE O & M PERSONNALS. THE ABOVE IS NOT AT ALL A STANDARD PRACTICE FOLLOWED IN DESIGN AND LAYOUT OF 132KV SUB STATION. SOMETIMES IT HAS BEEN ALSO OBSERVED THAT OPERATIONAL PERSONNELS IN ORDER TO HIDE THEIR MISTAKES RESORT TO PROVIDING AMBIGUOUS TRIPPING INFORMATION LEADING TO FAILURE IN ANALYSIS OF EVENTS AND THEREBY PROVIDE HINDERANCE INTO ANY DEVELOPMENT OF THE SYSTEM.



Annexure-C.7

West Bengal

SL NO.	From Bus Name	To Bus Name	Length(kms)	Type of Conductor	Resistance (R) per km	Reactance (X) per km	Z total (Ohms) (Primary)	Distance Relay Settings							
								Z1 Ohm	Z2 Ohm	Z3 Ohm	Z4 Ohm Reverse	Tz1 Sec	Tz2 Sec	Tz3 Sec	Tz4 sec
400 kV Lines															
1	Kharagpur	Baripada													
	Kharagpur						26.08	45	88.6	8.86	0	0.4	0.8	0.8	
	Baripada		100.3		0.02876	0.328744		26.38	39.57	61.33	7.56	0	0.3	1	1
	Setting as per Agreed Philosophy		98.5	D. Moose	0.033	0.329	32.57	26.06	39.08	32.57+Za	6.5138	0	0.3	1	1.2
2	Sagardighi	Durgapur													
	Sagardighi		127.9	Twin Moose.									1s for old./ 1.5s for new.		
							9.38	17.58	21.22	2.12	0	0.5		1.5	
	Durgapur		127.88	Twin moose	0.029792	0.332	11.675	9.34	17.51	28.14	2.81	0	0.3	1	1.1
	Setting as per Agreed Philosophy		127.88	Twin moose	0.029792	0.332	42.63	34.1	51.15	42.63+Za	8.5254	0	0.3	1	1.2
3	Sagardighi	Farakka													
	Sagardighi		67.3	Twin Moose.				9.87	14.81	24.68		0	0.3	1	
	Farakka							17.96	26.9	70.57	4.5	0	0.4	1	1
	Setting as per Agreed Philosophy		67.3		0.029	0.332	22.43	17.94	26.91	22.43+Za	4.4857	0	0.3	1	1.2
4	Sagardighi	Subashgram													
	Sagardighi		256.3	Twin Moose.				37.59	56.39	93.98		0	0.5	1	
	Subashgram		256.3		0.029792	0.332	85.4335	68.35	102.5	11.5335	8.5434	0	0.5	1	1
	Setting as per Agreed Philosophy		256.3		0.029792	0.332	85.43	68.35	102.5	85.43+Za	17.087	0	0.3	1	1.2
5	Bidhanagar	Durgapur													
	Bidhanagar							2.93	5.47	39.77	3.9	0	0.4	0.8	0.8
	Durgapur		11	Twin moose	0.0288	0.307	3.39182	2.713	5.088	32.6633	0.6785	0	0.3	1	1.1
	Setting as per Agreed Philosophy		11	D. Moose	0.033	0.329	3.64	2.91	4.365	3.64+Za	0.7274	0	0.3	1	1.2
6	Jeerat	Subashgram													
	Jeerat														
	Subashgram		70		0.029792	0.332	23.3334	18.67	28	4.44968	4.6667	0	0.5	1	1
	Setting as per Agreed Philosophy		70		0.029792	0.332	23.33	18.67	28	23.33+Za	4.6667	0	0.3	1	1.2
7	Jeerat	Behrampur													
	Jeerat														
	Behrampur		167	D. Moose	0.0288	0.328	54.9867	43.99	65.98	21.41	1.51	0	0.3	1	1.1
	Setting as per Agreed Philosophy		167	D. Moose	0.0288	0.328	54.99	43.99	65.98	54.99+Za	10.997	0	0.3	1	1.2

[illegible]

DVC

CT Ratio

	Setting as per Agreed Philosophy		7.613	AAAC Zebra	0.0692	0.4169	3.22	2.574	3.861	3.22+Za	0.6435	0	0.3	1	1.2	
11	Purulia	Durgapur(PG) D/C														
	Purulia		Pilot wire protection (HORM)					O/C, Curve SI 800 A 0.3 dial								
	Durgapur(PG)		1		0.06997	0.3971	0.20125	0.161	0.302	5.5241	0.0403	0	0.3	1	1.1	
	Setting as per Agreed Philosophy		0	Zebra	0	0	0.00	0	0	0	0	0	0.3	1	1.2	
12	Danbad	Maithon														
	Danbad		51	ACSR zebra	0.0827	0.4041	20.609	17.52	24.73	28.85	4.55					
	Maithon															
	Setting as per Agreed Philosophy		51	ACSR zebra	0.0827	0.4041	21.04	16.83	25.24	0	4.2073	0	0.3	1	1.2	
13	Jamshedpur	Jindal														
	Jamshedpur						54.553	46.38	81.85	109.14	13.4					
	Jindal															
	Setting as per Agreed Philosophy		135	ACSR zebra	0.0827	0.4041	55.68	44.55	66.82	55.68+Za	11.137	0	0.3	1	1.2	
14	Waria	Bidhanagar														
	Waria						6.852	5.48	10.28	14.39	2.22					
	Bidhanagar							5.8	10.32	62.77	6.2	0	0.3	1	1	
	Setting as per Agreed Philosophy		17.26	ACSR zebra	0.0827	0.4041	7.12	5.695	8.543	7.12+Za	1.4239	0	0.3	1	1.2	
	132 kV Lines															
15	Patratu	Patratu(BASL) DVC														
	Patratu JSEB data						2.71	2.17	3.25	5.92	0.54	0	0.3	1	1.2	
	Patratu (BASL)DVC data						2.71	2.40	4.23	5.92	0.54	0	0.3	1	1.2	
	Setting as per Agreed Philosophy		6.5	Panther	0.1545	0.387	2.71	2.17	3.25	2.71+Za	0.54	0	0.3	1	1.2	
16	Purulia (DVC)	Purulia (WB)														
	Purulia (DVC)		THIS LINE IS NOW DEREGISTERED													
	Purulia (WB)		Only Directional O/C relay is provided													
	Setting as per Agreed Philosophy		0		0	0	0.00	0	0	0	0	0	0.3	1	1.2	
17	Barhi	Biharshariff														
	Barhi						73.74	62.6	75.84	134.4	15.6					
	Biharshariff, LILO at Nalanda		DETAILS TO BE SUBMITTED BY BSEB REGARDING LILO AT NALANDA													
	Setting as per Agreed Philosophy		171	ACSR LARK	0.1619	0.4029	74.25	59.4	89.1	74.25+Za	14.85	0	0.3	1	1.2	
18	Barhi	Rajgir														
	Barhi						59.51	50.5	65.28	77.76	12.72					
	Rajgir															
	Setting as per Agreed Philosophy		138	ACSR LARK	0.1619	0.4029	59.92	47.94	71.91	59.92+Za	11.984	0	0.3	1	1.2	
19	Barhi	Nalanda														
	Barhi															
	Nalanda															
	Setting as per Agreed Philosophy		0	Panther	0	0	0.00	0	0	0	0	0	0.3	1	1.2	
20	Maithon	Sultangunj														
	Maithon						46.70	37.36	70.05	98.07	1.04					
	Sultangunj															
	Setting as per Agreed Philosophy		107.6	ACSR LARK	0.1619	0.4029	46.72	37.38	56.07	46.72+Za	9.3442	0	0.3	1	1.2	
21	Maithon	Sultangunj														
	Maithon		107.6	ACSR LARK	0.1619	0.4029	46.70	37.36	70.05	98.07	1.04					
			DETAILS TO BE SUBMITTED BY JSEB REGARDING LILO AT JAMTARA													
	Sultangunj															
	Setting as per Agreed Philosophy		107.6	ACSR LARK	0.1619	0.4029	46.72	37.38	56.07	0	9.3442	0	0.3	1	1.2	

1000/1

BSPTCL

SL NO.	From Bus Name	To Bus Name	Length(kms)	Type of Conductor	Resistance (R) per km	Reactance (X) per km	Z total (Ohms) (Primary)	Distance Relay Settings							
								Z1 Ohm	Z2 Ohm	Z3 Ohm	Z4 Ohm Reverse	Tz1 Sec	Tz2 Sec	Tz3 Sec	Tz4 sec
220 kV Lines															
1	Sipara	Patna													
	Sipara		Directional O/C Protection												
	Patna		Directional O/C Protection												
	Setting as per Agreed Philosophy	0.5		0	0	0.00	0	0	0	0	0	0.3	1	1.2	
2	Khagaul	Patna													
	Khagaul						7.344	11.01		1.836	0	0.3	1	1.2	
	Patna						7.345	11.02	26.9902	2.7541	0	0.2	1	1.1	
	Setting as per Agreed Philosophy	22.6	Zebra	0.074875	0.39925	9.18	7.344	11.02	9.18+Za	1.8361	0	0.3	1	1.2	
3	Fatua	Patna													
	Fatua						8.86	13.33		2.22	0	0.3	1	1.2	
	Patna					11.29	9.032	13.55	23.1445	3.387	0	0.2	1	1.1	
	Setting as per Agreed Philosophy	27.36	Zebra	0.074875	0.39925	11.11	8.891	13.34	11.11+Za	2.2228	0	0.3	1	1.2	
4	BHRSHRF	TENGHAT													
	Tenughat Data						53.75	80.63	78.27	13.44	0	0.3	1	1.2	
	Biharsariff Data						29.24	38.03	40.98	2.92	0	0.3	0.7	1	
	Setting as per Agreed Philosophy	180	T. Moose	0.0311	0.372	67.19	53.75	80.63	67.19+Za	13.44	0	0.3	1	1.2	
5	Hazipur	Muzaffarpur													
	Hazipur						17.14	25.72		4.285	0	0.3	1	1.2	
	Muzaffarpur						17.14	32.14	42.86	4.29	0	0.5	1.5	1.6	
	Setting as per Agreed Philosophy	52.75	Zebra	0.074875	0.39925	21.43	17.14	25.71	21.43+Za	4.29	0	0.3	1	1.2	
6	Dehri	Gaya													
	Dehri					39.89	31.83	42.19	46.27	7.97	0	0.3	1	1.2	
	Gaya					39.81	31.85	59.71	157.24	7.96	0	0.5	1.5	1.6	
	Setting as per Agreed Philosophy	98	Zebra	0.074875	0.39925	39.81	31.85	47.77	39.81+Za	7.96	0	0.3	1	1.2	
7	Bodgaya	Gaya													
	Bodgaya	17				2.25	1.80	8.75	21.80	0.56	0	0.4	1	1	
	Gaya	12					3.90	7.31	19.25	0.97	0	0.5	1.5	1.6	
	Setting as per Agreed Philosophy	12	Zebra	0.074875	0.39925	4.87	3.90	5.85	4.87+Za	0.97	0	0.3	1	1.2	
8	MTPS	Muzaffarpur													
	MTPS (Kanti)						7.80	14.63		1.95	0	0.5	1.5	1.6	
	Muzaffarpur						7.80	14.63	34.12	1.95	0	0.5	1.5	1.6	
	Setting as per Agreed Philosophy	24	Zebra	0.074875	0.39925	9.75	7.80	11.70	9.75+Za	1.95	0	0.3	1	1.2	
9	Dehri	Pusauli													
	Dehri						20.8	31.2		5.2	0	0.3	1	1.2	
	Pusauli	64	Zebra	0.079	0.41	26.72	21.38	34.74	39.02	5.34	0	0.5	1.5	1.6	
	Setting as per Agreed Philosophy	64	Zebra	0.074875	0.39925	26.00	20.80	31.20	26+Za	5.20	0	0.3	1	1.2	
10	Sahupuri	Pusauli													
	Sahupuri														
	Pusauli	72	Zebra	0.079	0.41	30.06	24.05	37.58	48.10	6.01	0	0.5	1.5	1.6	

	Setting as per Agreed Philosophy		72	Zebra	0.074875	0.39925	29.25	23.40	35.10	29.25+Za	5.85	0	0.3	1	1.2
11	Arrah	Khagaul													
	Arrah		49	Zebra	0.0749	0.3993	19.91	15.92	29.86	37.82	3.98	0	0.5	1.5	1.6
	Khagaul		49	Zebra	0.0749	0.3993	19.91	15.92	29.86	46.78	3.98	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		49	Zebra	0.074875	0.39925	19.90	15.92	23.89	19.9+Za	3.98	0	0.3	1	1.2
	132 kV Lines														
12	Kahalgaon(NTPC)	Kahalgaon(BSPTCL)													
	Kahalgaon(NTPC)							1.01	5.23	5.88	0.25	0	0.4	1	1
	Kahalgaon(BSPTCL)							1.664	2.498		0.416	0	0.3	1	1.2
	Setting as per Agreed Philosophy		5	Panther	0.1545	0.387	2.08	1.667	2.5	2.08+Za	0.4167	0	0.3	1	1.2
13	Kahalgaon(NTPC)	Sabour(BSPTCL)													
	Kahalgaon(NTPC)							5.23	5.88	7.69	1.31	0	0.4	1	1
	Sabour(BSPTCL)							10	15		2.5	0	0.3	1	1.2
	Setting as per Agreed Philosophy		30	Panther	0.1545	0.387	12.50	10	15	12.50+Za	2.5002	0	0.3	1	1.2
14	Kahalgaon(BSPTCL)	Lalmatia													
	Kahalgaon(BSPTCL)							15.54	23.3		3.884	0	0.3	1	1.2
	Lalmatia							15.53	23.3	58.914	3.8836	0	0.3	1	1.2
	Setting as per Agreed Philosophy		46.6	Panther	0.1545	0.387	19.42	15.53	23.3	19.42+Za	3.8836	0	0.3	1	1.2
15	Japla	Sonnegar													
	Japla Data														
	Sonnegar Data		54					22.5	18	27	4.5	0	0.3	1	1.2
	Setting as per Agreed Philosophy		49.57	Panther	0.1545	0.387	20.66	16.52	24.79	20.66+Za	4.1312	0	0.3	1	1.2
16	Deoghar	Sultanganj													
	Deoghar Data							33.34	50	57.98	8.334	0	0.3	1	1.2
	Sultanganj Data														
	Setting as per Agreed Philosophy		100	Panther	0.1545	0.387	41.67	33.34	50.00	41.67+Za	8.33	0	0.3	1	1.2
17	Kosi	Duhabi (Nepal)													
	Kosi														
	Duhabi (Nepal)														
	Setting as per Agreed Philosophy		0		0	0	0.00	0	0	0	0	0	0.3	1	1.2
18	BHPC	Gandak (Nepal)													
	BHPC														
	Gandak (Nepal)														
	Setting as per Agreed Philosophy		0		0	0	0.00	0	0	0	0	0	0.3	1	1.2
19	Dehri	Pasauli													
	Dehri														
	Pasauli							19.2	28.8	94.54	4.8	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		56.896	Panther	0.1407	0.3976	24.00	19.2	28.8	0	4.7993	0	0.3	1	1.2
20	Karmanasa	Sahupuri													
	Karmanasa		34	Panther	0.1622	0.3861	14.24	11.39	17.09		2.848	0	0.3	1	1.2
	Sahupuri														
	Setting as per Agreed Philosophy		0		0	0	0.00	0	0	0	0	0	0.3	1	1.2
21	Dalkhola (WB)	Kishangunj													
	Dalkhola (WB)		Line is not operational												
	Kishangunj		32	Panther	0.1622	0.3801	13.4	10.72	16.08		2.68	0	0.3	1	1.2
	Setting as per Agreed Philosophy		0	Panther	0	0	0.00	0	0	0	0	0	0.3	1	1.2
	Kishangunj	Purnea (PG)													

22	Kishangunj														
	Purnea (PG)							28.48	42.72	142.387	7.1194	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		85	Panther	0.1622	0.3861	35.60	28.48	42.72	35.6+Za	7.1194	0	0.3	1	1.2
23	Purnea (Bihar)	Purnea (PG)													
	Purnea (Bihar)		0.825	Panther	0.1622	0.3861	0.35	0.28	0.42		0.07	0	0.3	1	1.2
	Purnea (PG)														
	Setting as per Agreed Philosophy		0		0	0	0.00	0	0	0	0	0	0.3	1	1.2
	Barhi	Biharshariff													
	Barhi														
24	Biharshariff		153	Panther	0.1622	0.3861	64.07	51.26	76.85		12.814	0	0.3	1	1.2
	Setting as per Agreed Philosophy		0	Panther	0	0	0.00	0	0	0	0	0	0.3	1	1.2
	Barhi	Rajgir													
25	Barhi														
	Rajgir														
	Setting as per Agreed Philosophy		0	Panther	0	0	0.00	0	0	0	0	0	0.3	1	1.2
26	Arrah (BSPTCL)	Arrah (PG)													
	Arrah (BSPTCL)							0.712	1.068		0.178	0	0.3	1	1.2
	Arrah (PG)							0.708	1.062	4.56	0.1771	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		2.1	Panther	0.1402	0.3976	0.89	0.708	1.062	0.89+Za	0.1771	0	0.3	1	1.2
	Dumraoa	Arrah (PG)													
	Dumraoa														
27	Arrah (PG)														
	Setting as per Agreed Philosophy		61.5	Panther	0.1402	0.3976	25.93	20.74	31.11	59.63	5.1856	0	0.5	1.5	1.6
	Jagadishpur	Arrah (PG)													
28	Jagadishpur (BSPTCL)														
	Arrah (PG)							10.22	15.33	51.092	2.5546	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		30.5	Panther	0.1622	0.3861	12.77	10.22	15.33	12.77+Za	2.5546	0	0.3	1	1.2
29	Banka (BSPTCL)	Banka(PG)													
	Banka (BSPTCL)							4.216	6.324		1.054	0	0.3	1	1.2
	Banka(PG)							4.247	6.371	38.23	1.062	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		12.5	Panther	0.1402	0.3976	5.27	4.216	6.324	5.27+Za	1.054	0	0.3	1	1.2
	Sulthanganj (BSPTCL)	Banka(PG)													
	Sulthanganj (BSPTCL), Sabour							24.52	36.78		6.13	0	0.3	1	1.2
30	Banka(PG)							24.71	37.07	69.487	6.176	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		72.7	Panther	0.1402	0.3976	30.65	24.52	36.78	30.65+Za	6.13	0	0.3	1	1.2
	Dehri	Pusauli(PG)													
31	Dehri		Maintained by PGCIL					19.19	28.78						
	Pusauli(PG)							19.19	28.78	94.5	4.797	0	0.5	1.5	1.6
	Setting as per Agreed Philosophy		56.89	Panther	0.1402	0.3976	23.98	19.19	28.78	23.98+Za	4.7969	0	0.3	1	1.2
32	Mohania (BSPTCL)	Pusauli(PG)													
	Mohania (BSPTCL)														
	Pusauli(PG)							3.71	5.565	18.272	0.9275	0	0.3	1	1.1
	Setting as per Agreed Philosophy		11	Panther	0.1402	0.3976	4.64	3.71	5.565	4.64+Za	0.9275	0	0.3	1	1.2

NTPC

SL NO.	From Bus Name	To Bus Name	Length(kms)	Type of Conductor	Resistance (R) per km	Reactance (X) per km	Z total (Ohms) (Primary)	Distance Relay Settings							
								Z1 Ohm	Z2 Ohm	Z3 Ohm	Z4 Ohm Reverse	Tz1 Sec	Tz2 Sec	Tz3 Sec	Tz4 sec
400 kV Lines															
1	Farakka	Behrampur													
	Farakka						6.72	5.37	11.35	23.37	1.34	0	0.4	1	1
	Behrampur														
	Setting as per Agreed Philosophy		73.3		0	0	0.00	0	0	0	0	0	0.3	1	1.2
2	Sagardighi	Farakka													
	Sagardighi							9.87	14.81	24.68		0	0.3	1	
	Farakka							17.96	26.9	70.57	4.5	0	0.4	1	1
	Setting as per Agreed Philosophy		67.3		0.029	0.332	22.43	17.94	26.91	22.43+Za	4.4857	0	0.3	1	1.2
3	Farakka	Durgapur I													
	Farakka						14.25	11.4	17.1	21.79	2.85	0	0.5	1	1
	Durgapur		150.239	Twin moose	0.029792	0.332	13.775	11.02	20.66	22.31	1.38	0	0.3	1	1.1
	Setting as per Agreed Philosophy		156		0	0	0.00	0	0	0	0	0	0.3	1	1.2
4	Farakka	Durgapur II													
	Farakka						14.58	11.66	17.49	22.12	2.92	0	0.5	1	1
	Durgapur		145	Twin moose	0.029792	0.332	13.2918	10.63	19.94	21.5326	1.3292	0	0.3	1	1.1
	Setting as per Agreed Philosophy		161		0	0	0.00	0	0	0	0	0	0.3	1	1.2
5	Farakka	Khahalgaon I													
	Farakka						9.5	7.6	16.37	20.5	0.76	0	0.4	1	1
	Khahalgaon		94.7	Twin Moose		0.0845	8	6.4	9.602	21.355	1.61	0	0.4	1	1
	Setting as per Agreed Philosophy		104		0	0	0.00	0	0	0	0	0	0.3	1	1.2
6	Farakka	Khahalgaon II													
	Farakka						9.5	7.6	16.37	20.5	0.76	0	0.4	1	1
	Khahalgaon		94.7	Twin Moose		0.0845	8	6.4	9.602	21.355	1.61	0	0.4	1	1
	Setting as per Agreed Philosophy		104		0	0	0.00	0	0	0	0	0	0.3	1	1.2
7	Farakka	Khahalgaon III													
	Farakka						8.77	7.02	15.65	19.77	0.7	0	0.4	1	1
	Khahalgaon		96	Twin Moose		0.0845	8.8	7.04	10.56	22.15	1.77	0	0.4	1	1

	Setting as per Agreed Philosophy	96		0	0	0.00	0	0	0	0	0	0.3	1	1.2
8	Farakka	Khahalgaon IV												
	Farakka					8.77	7.02	15.65	19.77	0.7	0	0.4	1	1
	Khahalgaon	96	Twin Moose		0.0845	8.8	7.04	10.56	22.15	1.77	0	0.4	1	1
	Setting as per Agreed Philosophy	96		0	0	0.00	0	0	0	0	0	0.3	1	1.2
9	Farakka	Malda I & II												
	Farakka					3.52	2.822	7.705	11.86	1.06	0	0.4	1	1
	Malda	40		0.0287	0.3187	12.7996	10.24	19.2	76.79752	2.5599	0	0.5	1.5	2
	Setting as per Agreed Philosophy	40		0	0	0.00	0	0	0	0	0	0.3	1	1.2
10	Kahalgaon	Lakhisarai												
	Kahalgaon	145	Twin Moose		0.0845	12.25	9.8	18.5	23.31	0.98	0	0.4	1	1
	Lakhisarai													
	Setting as per Agreed Philosophy													
11	Kahalgaon	Biharshariff												
	Kahalgaon	234	Twin Moose		0.0845	19.77	15.89	22.77	24.52	1.59	0	0.4	1	1
	Biharshariff													
	Setting as per Agreed Philosophy													
12	Kahalgaon	Banka#1												
	Kahalgaon	47.703	Twin Moose			X1=4.03 ,R1=0.380,X 0=14.06,R0= 3.62	For P-P fault X1PP= 3.224ohm , R1PP= 0.304ohm RFPP=19 .34ohm, For P-E fault	For P-P fault X1PP= 4.835ohm , R1PP= 0.456ohm RFPP=55 .4ohm, For P-E fault	For P-P fault X1PP= 15.027ohm, R1PP= 0.600ohm, RFPP=55.4ohm, For P-E fault X1PE=15.027 ohm, R1PE=0.600ohm,	For P-P fault X1PP= 0.806ohm, R1PP= 0.076ohm, RFPP=55.4 ohm, For P-E fault X1PE=0.806ohm,	0	0.4	1	1
	Banka#1													
	Setting as per Agreed Philosophy													
	Kahalgaon	Banka#2												

13	Kahalgaon		47.703	Twin Moose				X1=4.03 ,R1=0.380,X 0=14.06,R0=3.62	For P-P fault X1PP= 3.224ohm , R1PP= 0.304ohm RFPP=19 .34ohm, For P-E fault X1PE=3.2 24ohm, R1PE=0.3 04ohm ,X0PE=11 .245ohm, R0PE=2.8 93ohm, RFPE=12 .14 ohm	For P-P fault X1PP= 4.835ohm , R1PP= 0.456ohm RFPP=55 .4ohm, For P-E fault X1PE=4.8 35ohm, R1PE=0.4 56ohm ,X0PE=16 .868ohm, R0PE=4.3 39ohm, RFPE=36 .96ohm	For P-P fault X1PP= 15.027ohm, R1PP= 0.600ohm, RFPP=55.4oh m, For P-E fault X1PE=15.027 ohm, R1PE=0.600o hm ,X0PE=25.05 4ohm, R0PE=3.836o hm, RFPE=36.96o hm	For P-P fault X1PP= 0.806ohm, R1PP= 0.076ohm, RFPP=55.4 ohm, For P-E fault X1PE=0.80 6ohm, R1PE=0.07 6ohm ,X0PE=2.8 11ohm, R0PE=0.72 3ohm, RFPE=36.9 6ohm	0	0.4	1	1
	Banka#2															
	Setting as per Agreed Philosophy															
14	Kahalgaon	Maithon#1														
	Kahalgaon		171.9	Twin Moose		0.0845	14.53	11.61	17.42	21.5	1.16	0	0.4	1	1	
	Maithon#1															
	Setting as per Agreed Philosophy															
15	Kahalgaon	Maithon#2														
	Kahalgaon		171.9	Twin Moose		0.0845	14.53	11.61	17.42	21.5	1.16	0	0.4	1	1	
	Maithon#2															
	Setting as per Agreed Philosophy															
16	Kahalgaon	Barh#1														
	Kahalgaon		217	Quad . Moose				X1=29.94 ,R1=1.740, X0=99.420, R0=22.620	For P-P fault X1PP= 23.956 ohm, R1PP= 1.394 ohm, RFPP=25 .117 ohm, For P-E fault X1PE=36	For P-P fault X1PP= 36.431 ohm, R1PP= 2.12 ohm RFPP=38 .2 ohm, For P-E fault X1PE=36	For P-P fault X1PP= 42.916 ohm, R1PP= 2.497 ohm RFPP=44.916 ohm, For P-E fault X1PE=42.916 ohm, R1PE=2.497 ohm	For P-P fault X1PP= 1.3 ohm, R1PP= 0.1ohm RFPP=7.78 ohm, For P-E fault X1PE=1.3 ohm	0	0.4	1	1

17	Barh#1													
	Setting as per Agreed Philosophy													
	Kahalgaon	Barh#2												
	Kahalgaon	217	Quad . Moose			X1=29.94 ,R1=1.740, X0=99.420, R0=22.620	For P-P fault X1PP= 23.956 ohm, R1PP= 1.394 ohm, RFPP=25 .117 ohm, For P-E fault X1PE= 23.956 ohm, R1PE=1.3	For P-P fault X1PP= 36.431 ohm, R1PP= 2.12 ohm RFPP=38 .2 ohm, For P-E fault X1PE=36. 431 ohm, R1PE=2.1 2 ohm , X0PE=18	For P-P fault X1PP= 42.916 ohm, R1PP= 2.497 ohm RFPP=44.916 ohm, For P-E fault X1PE=42.916 ohm, R1PE=2.497 ohm ,X0PE=142.4 8 ohm, R0PE=32.414 ohm.	For P-P fault X1PP= 1.3 ohm, R1PP= 0.1ohm RFPP=7.78 ohm, For P-E fault X1PE=1.3 ohm, R1PE=0.1 ohm, X0PE=4.31 ohm.	0	0.4	1	1
	Barh#2													
Setting as per Agreed Philosophy														
220 kV Lines														
18	Farakka	Lalmatia(JSEB)												
	Farakka					17.27	13.8	22.84	26.19	3.45	0	0.4	1	1
	Lalmatia(JSEB)													
	Setting as per Agreed Philosophy	85	Zebra	0	0	0.00	0	0	0	0	0	0.3	1	1.2
	132 kV Lines													
19	Kahalgaon(NTPC)	Kahalgaon(BSPTCL)												
	Kahalgaon(NTPC)						1.01	5.23	5.88	0.25	0	0.4	1	1
	Kahalgaon(BSPTCL)													
	Setting as per Agreed Philosophy	5	Panther	0.1545	0.387	2.08	1.667	2.5	2.08+Za	0.4167	0	0.3	1	1.2
20	Kahalgaon(NTPC)	Sabour(BSPTCL)												
	Kahalgaon(NTPC)						5.23	5.88	7.69	1.31	0	0.4	1	1
	Sabour(BSPTCL)													
	Setting as per Agreed Philosophy	30	Panther	0.1545	0.387	12.50	10	15	12.50+Za	2.5002	0	0.3	1	1.2
21	Kahalgaon(NTPC)	Lalmatia(JSEB)												
	Kahalgaon(NTPC)		40.3				16.86	20.2	47.6289	3.366	0	0.4	1	1
	Lalmatia(JSEB)						15.53	23.3	58.914	3.8836	0	0.3	1	1.2
	Setting as per Agreed Philosophy	40.3	Panther	0.1545	0.387	16.79	13.43	20.15	19.42+Za	3.3586	0	0.3	1	1.2