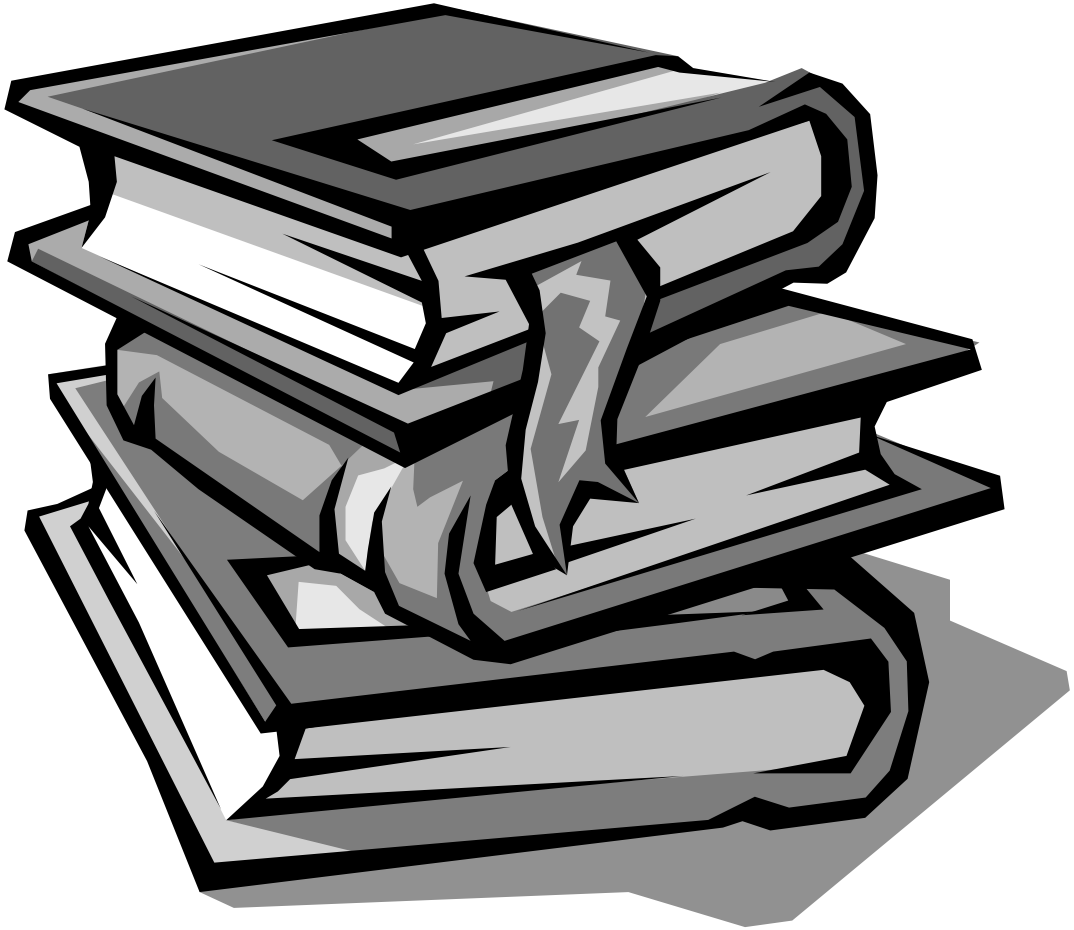
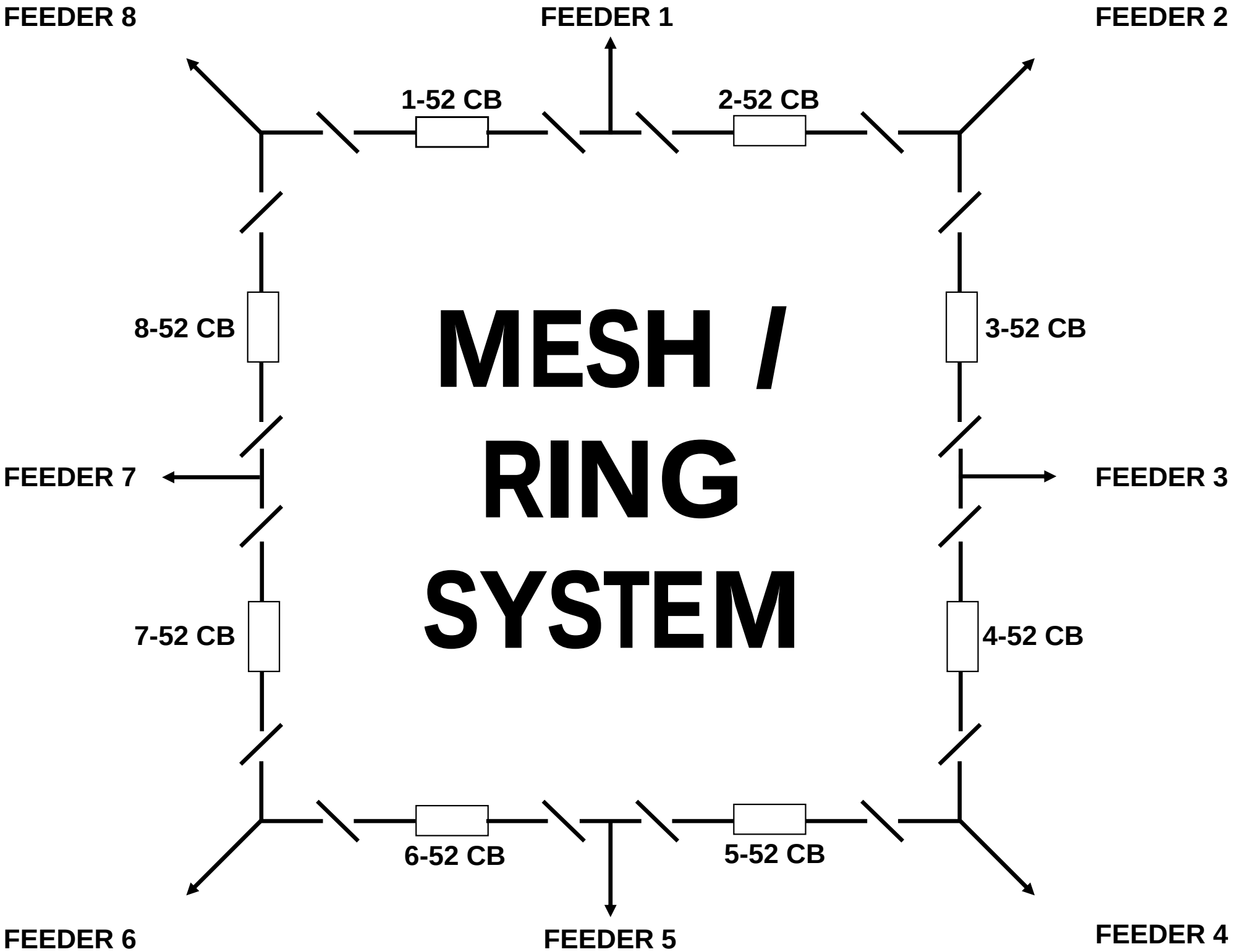
APTRANSCO

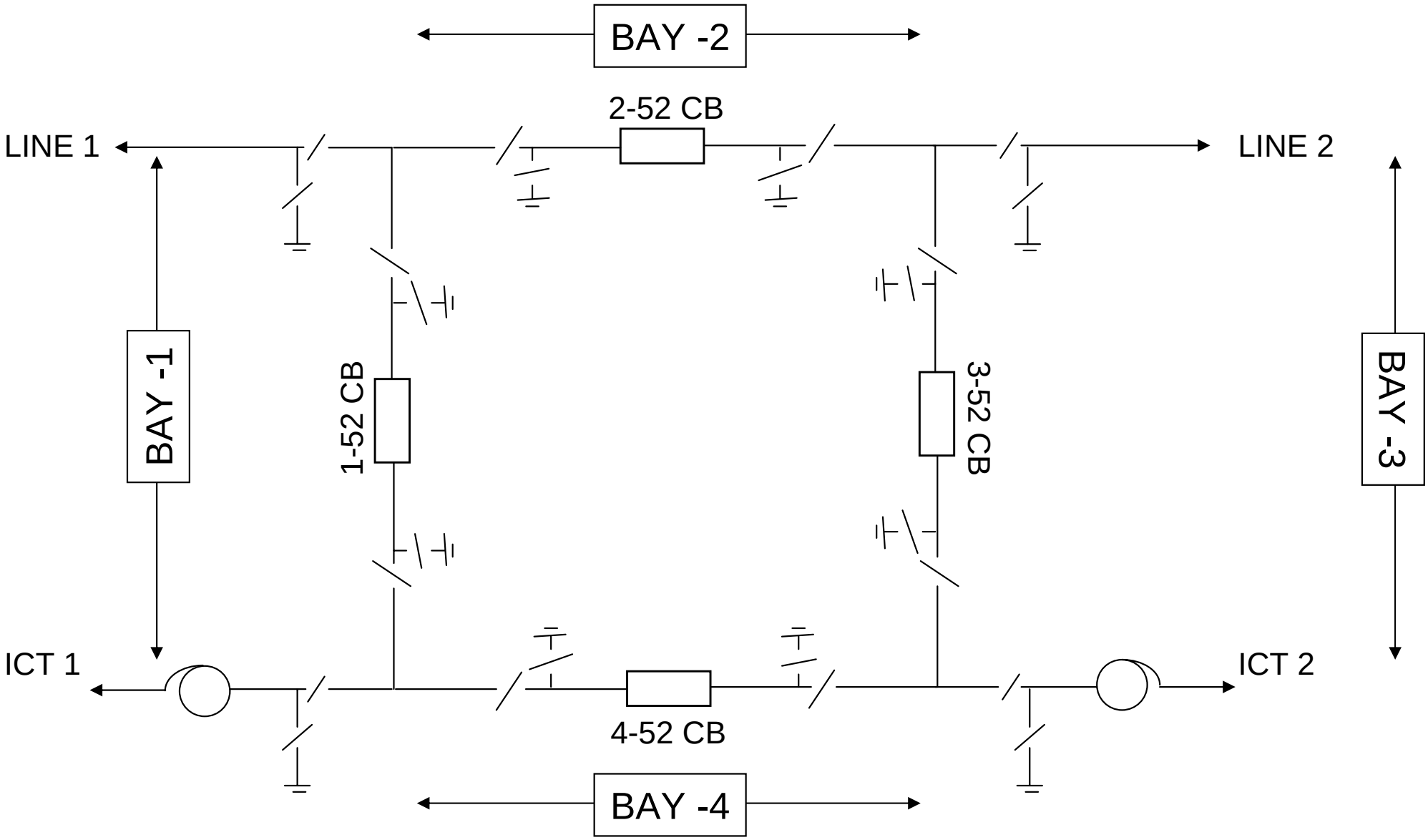


RING / MESH SYSTEM

PREPARED BY
GOPALA KRISHNA PALEPU
ADE/MRT(PROTECTION)
gk_aptransco@yahoo.co.in,
Mobile:9440336984, 9440619093

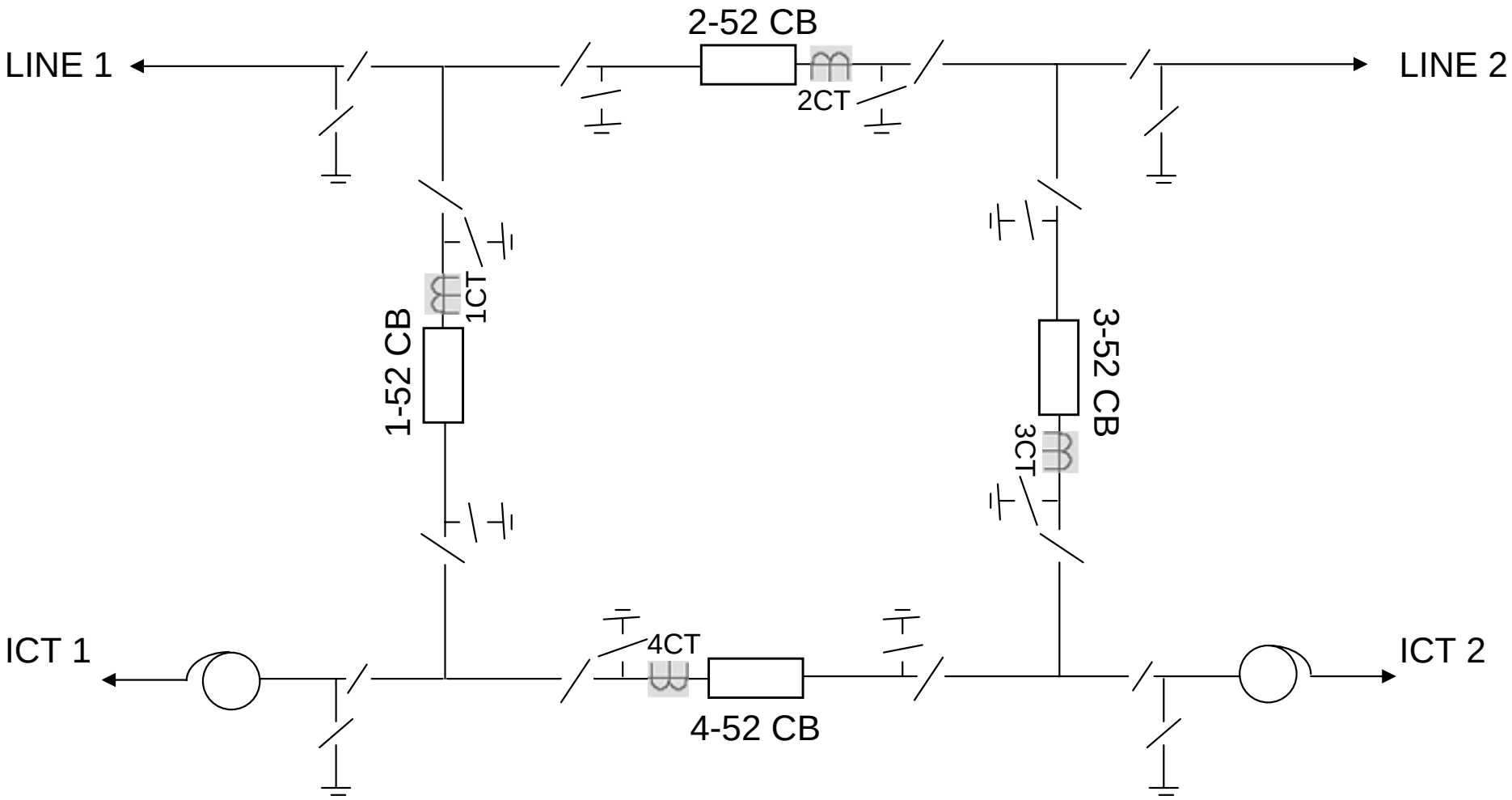

FEEDER 8
FEEDER 1
FEEDER 2
1-52 CB
2-52 CB
8-52 CB
3-52 CB
MESH / RING SYSTEM
FEEDER 7
FEEDER 3
7-52 CB
4-52 CB
6-52 CB
5-52 CB
FEEDER 6
FEEDER 5
FEEDER 4

MESH / RING SYSTEM



MESH / RING SYSTEM

(ONE CT FOR CB SYSTEM)



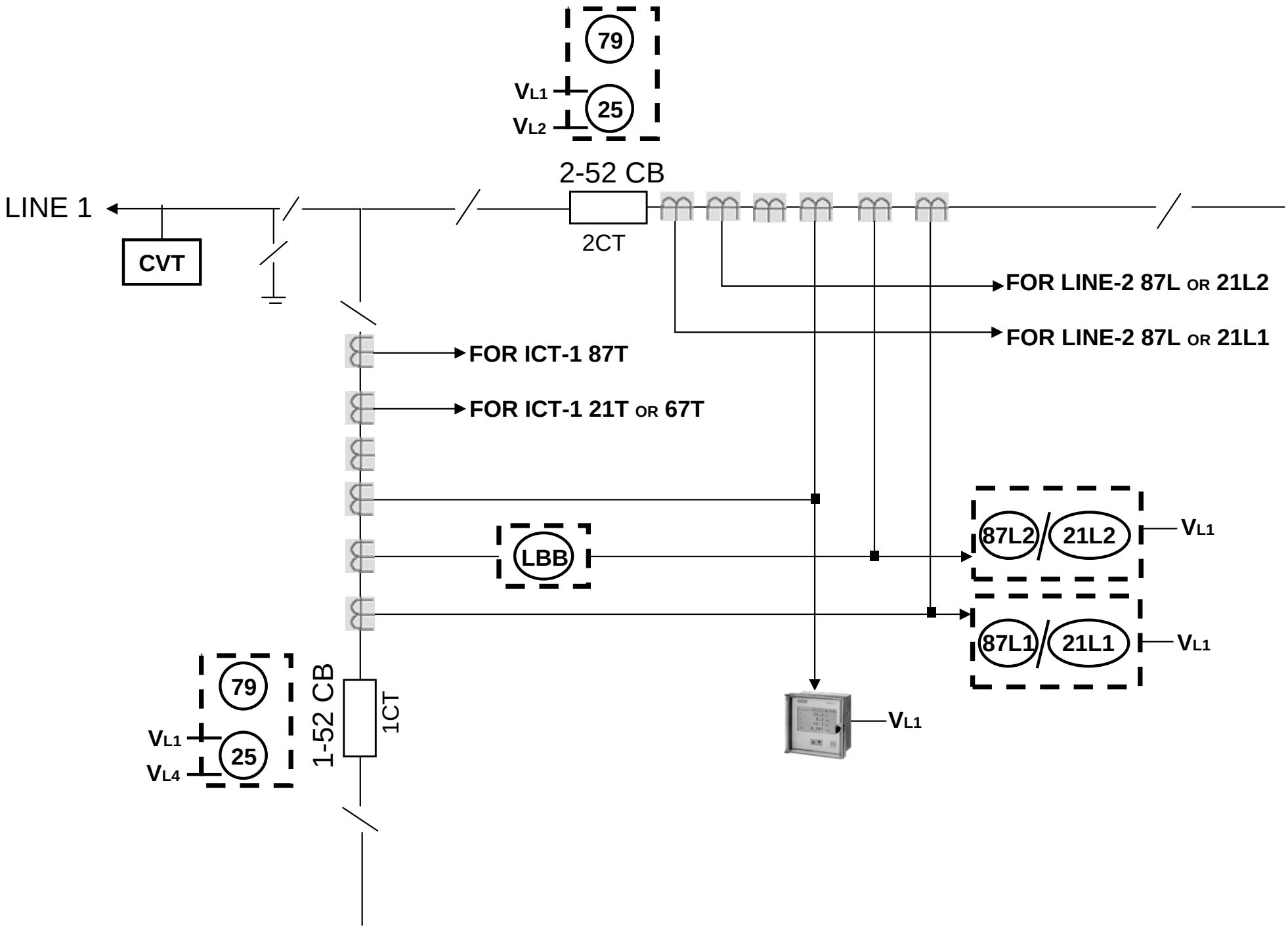
CURRENT TRANSFORMER CONNECTIONS

	1- CT	2-CT	3-CT	4-CT
CORE-1 (PS)	LINE – 1 MAIN-1 PROTECTION (21 L1 OR 87L)		ICT – 2 MAIN-1 PROTECTION (87T)	
CORE-2 (PS)	LINE – 1 MAIN-2 PROTECTION (21 L2 OR 87L)		ICT – 2 MAIN-2 PROTECTION (21T OR 67T)	
CORE-3 (0.2)	LINE-1 METERING		ICT-2 METERING	
CORE-4 (0.2)	ICT-1 METERING	LINE-2 METERING		ICT-1 METERING
CORE-5 (PS)	ICT – 1 MAIN-1 PROTECTION (87T)	LINE – 2 MAIN-1 PROTECTION (21 L1 OR 87L)		ICT – 1 MAIN-1 PROTECTION (87T)
CORE-6 (PS)	ICT – 1 MAIN-2 PROTECTION (21T OR 67T)	LINE – 2 MAIN-2 PROTECTION (21 L2 OR 87L)		ICT – 1 MAIN-2 PROTECTION (21T OR 67T)

ADDITIONAL PROTECTIONS

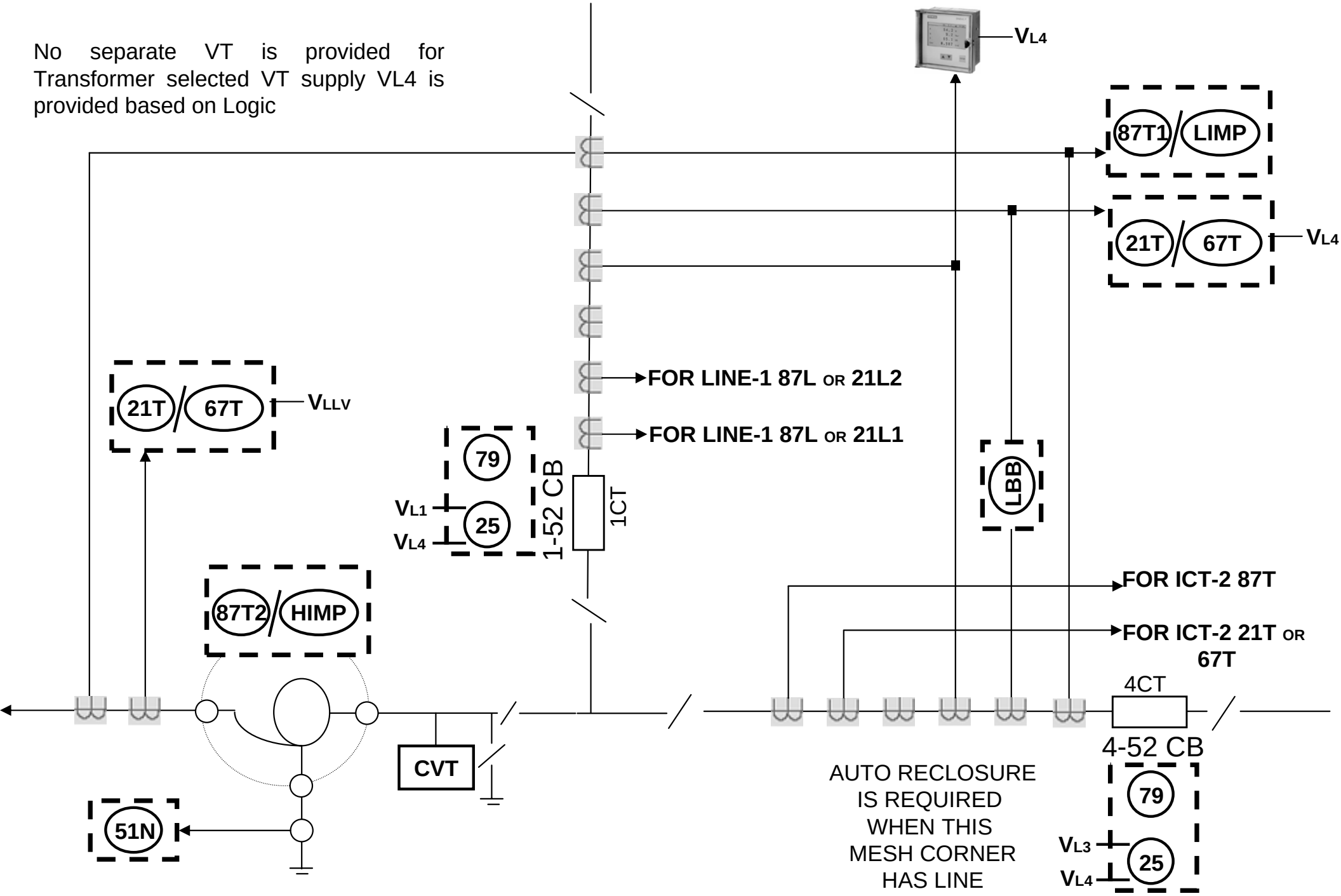
1. STUB Protection : In built feature in Main Protections of Line / ICT
2. LBB Protection : either extra relay connected in series with any one of the protection or in built function of any one of the protection.
3. TRANSFORMER 87T2 : USING Bushing CTs
4. BLIND ZONE: In this blind zone will not cover.

LINE PROTECTION



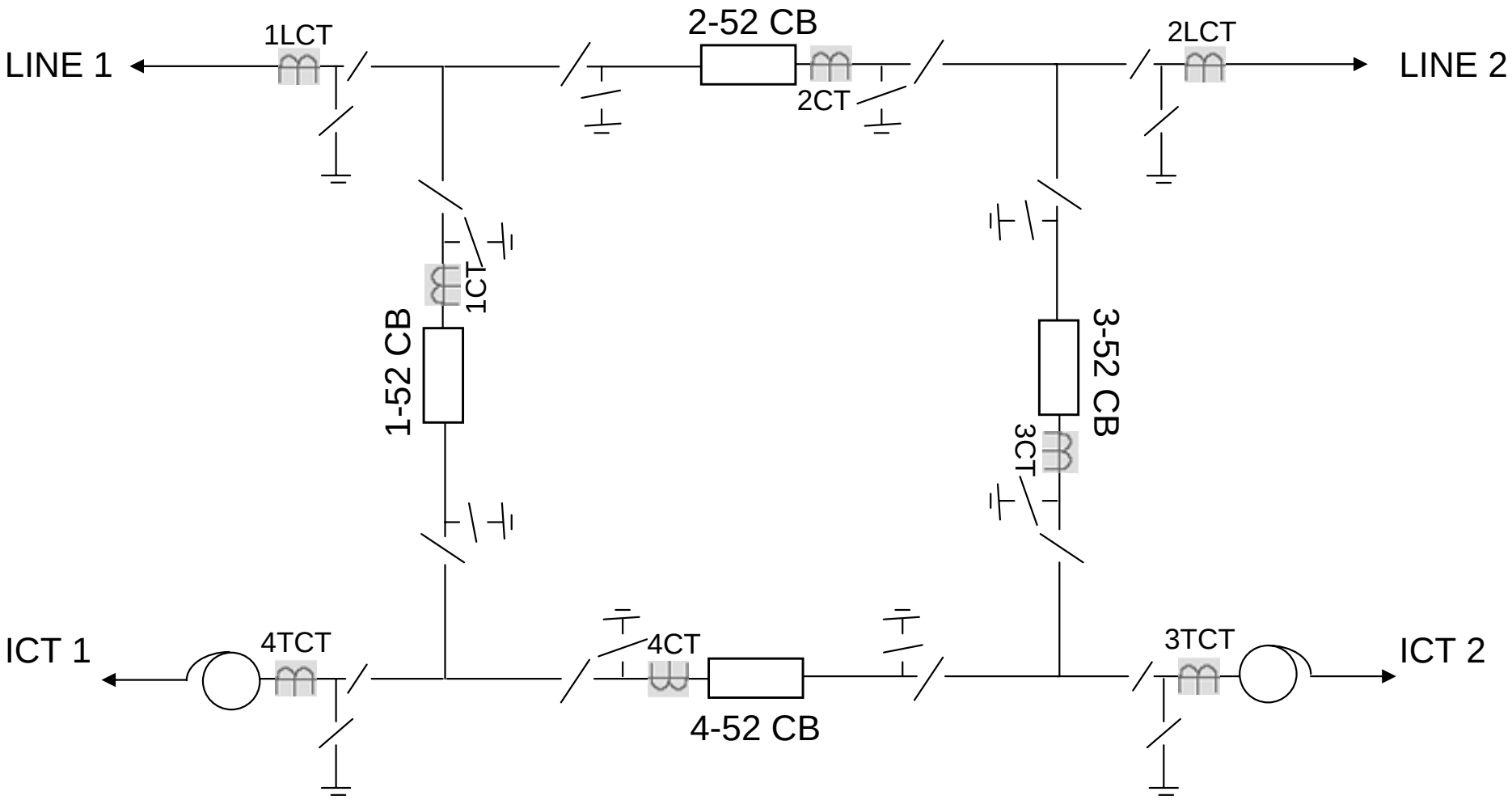
TRANSFORMER PROTECTION

No separate VT is provided for Transformer selected VT supply VL4 is provided based on Logic



MESH / RING SYSTEM

(ONE CT FOR CB SYSTEM & ONE CT AT OUTGOING)



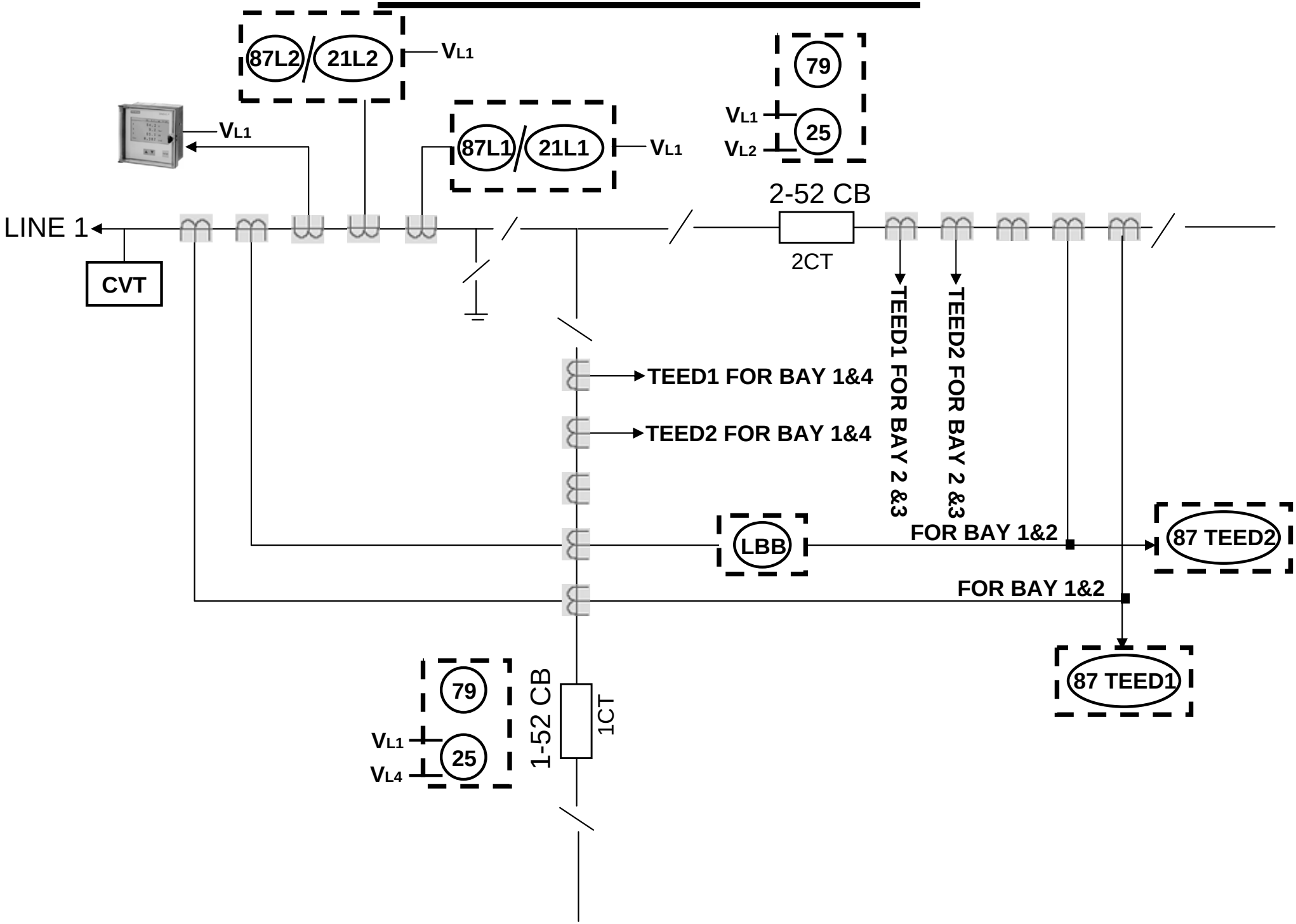
CURRENT TRANSFORMER CONNECTIONS

	1 CT	1LCT	2CT	2LCT	3CT	3T CT	4CT	4TCT
CORE-1 (PS)	TEED -1 PROTN (4&1)	LINE1 21 LI OR 87 L	TEED -1 PROTN (2 &3)	LINE2 21 LI OR 87 L	TEED -1 PROTN (2 &3)	ICT2 87 T	TEED -1 PROTN (4&1)	ICT1 87 T
CORE-2 (PS)	TEED -2 PROTN (4 &1)	LINE1 21 L2 OR 87 L	TEED -2 PROTN (2&3)	LINE2 21 L2 OR 87 L	TEED -2 PROTN (2&3)	ICT2 21 T OR 67 T	TEED -2 PROTN (4 &1)	ICT2 21 T OR 67 T
CORE-3 (0.2)	SPARE	METERI NG	SPARE	METERI NG	SPARE	METERI NG	SPARE	METERI NG
CORE-4 (PS)	TEED -2 PROTECTION (1&2)			TEED -2 PROTN (2&3)	TEED -2 PROTECTION (3&4)			TEED -2 PROTN (4&1)
CORE-5 (PS)	TEED -1 PROTECTION (1&2)			TEED -1 PROTN (2 &3)	TEED -1 PROTECTION (3&4)			TEED -1 PROTN (4 &1)

ADDITIONAL PROTECTIONS

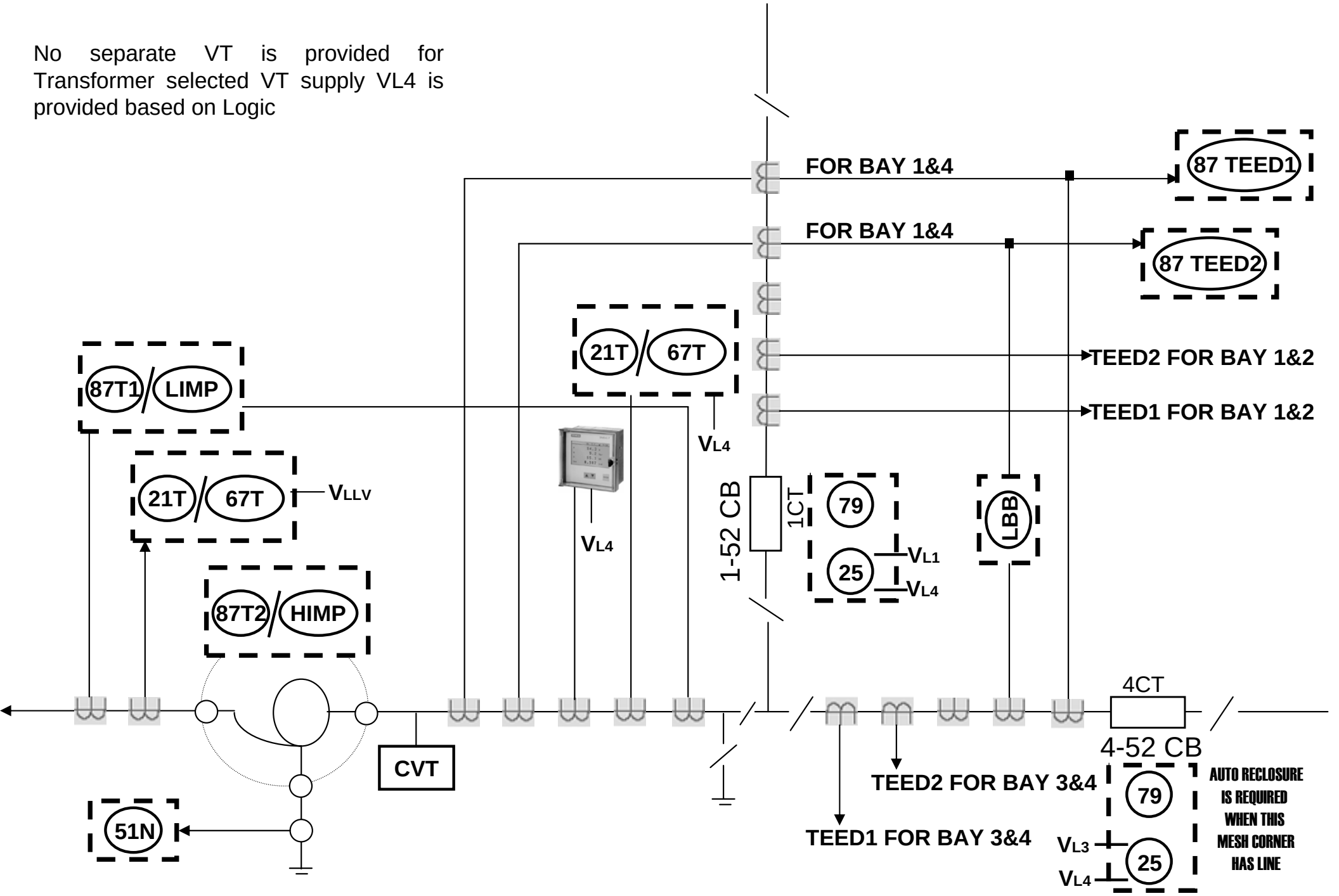
1. TEED Protection : Duplicate TEED Protection with TEED-1 High Impedance Type & TEED-2 Low Impedance Type.
2. LBB Protection : either extra relay connected in series with any one of the protection or in built function of any one of the protection.
3. TRANSFORMER 87T2 : USING Bushing CTs
4. BLIND ZONE: In this blind zone will not cover.

LINE PROTECTION



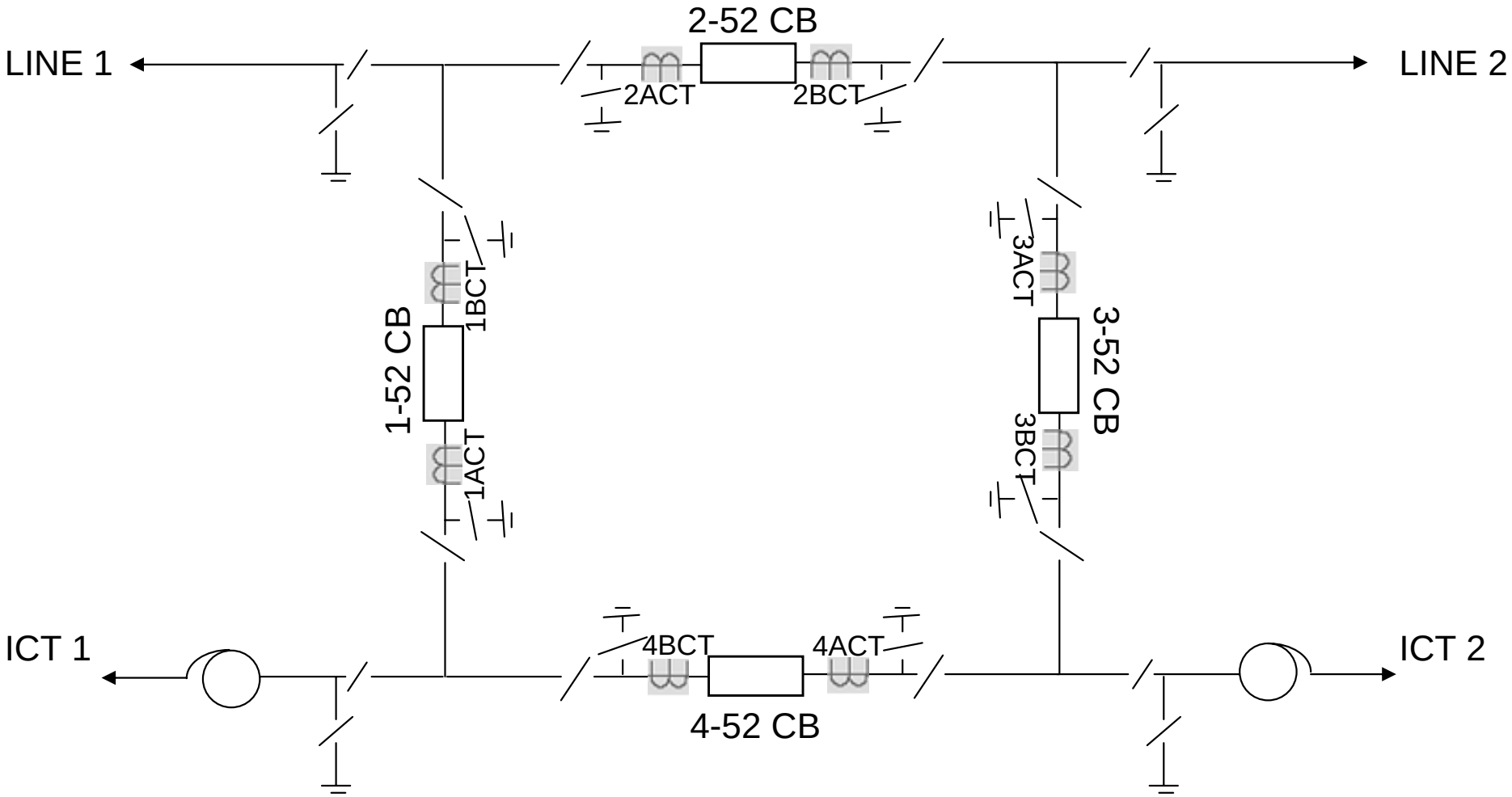
TRANSFORMER PROTECTION

No separate VT is provided for Transformer selected VT supply VL4 is provided based on Logic



MESH / RING SYSTEM

(TWO CTs FOR CB SYSTEM)



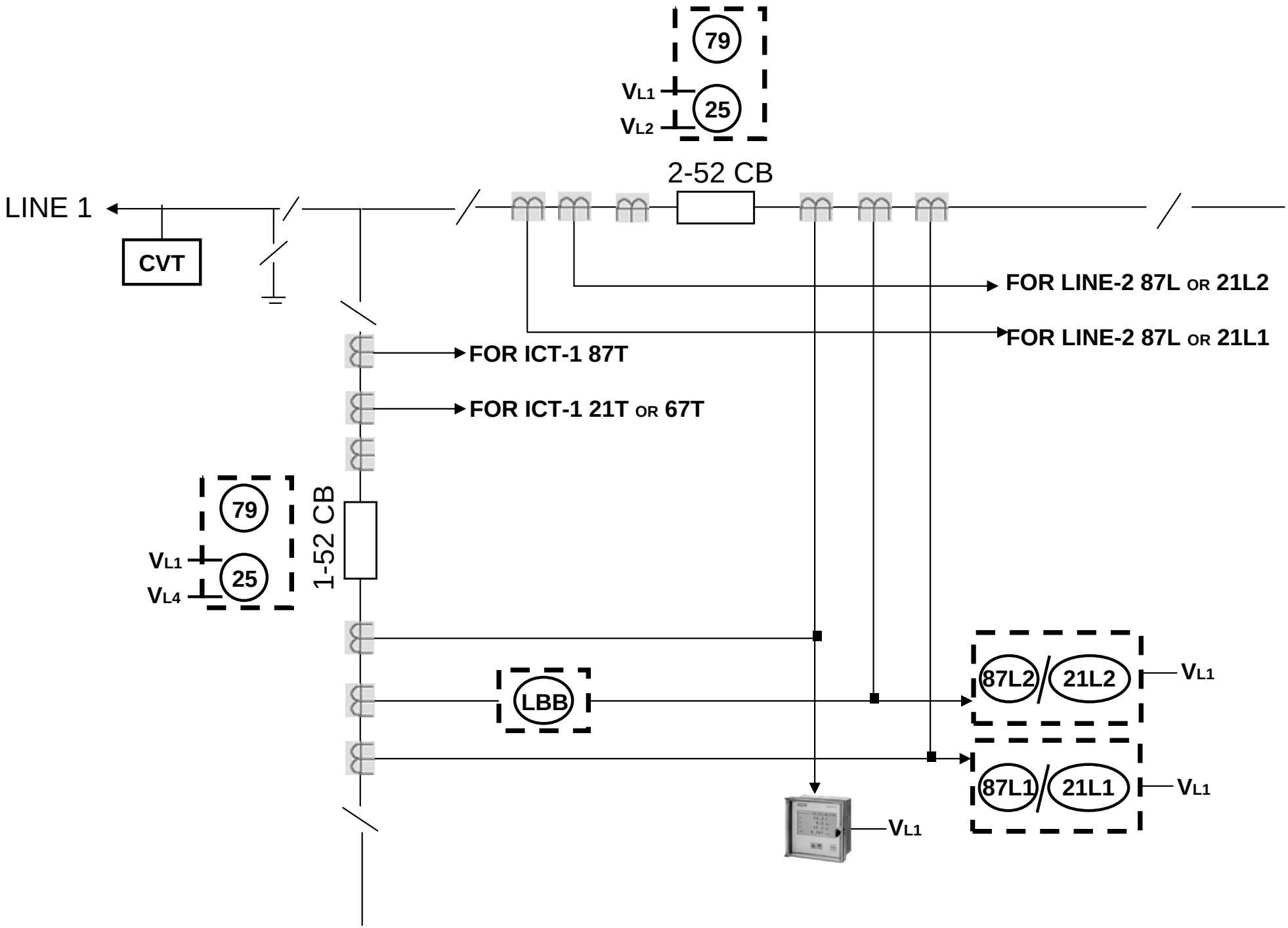
CURRENT TRANSFORMER CONNECTIONS

	1ACT	1BCT	2ACT	2BCT	3ACT	3BCT	4ACT	4BCT
CORE-1 (PS)	LINE-1 21L1 OR 87L	ICT-1 87T	LINE-2 21L1 OR 87L	LINE-1 21L1 OR 87L	ICT-2 87T	LINE-2 21L1 OR 87L	ICT-1 87T	ICT-1 87T
CORE-2 (PS)	LINE-1 21L2 OR 87L	ICT-1 21T OR 67T	LINE-2 21L2 OR 87L	LINE-1 21L2 OR 87L	ICT-2 21T OR 67T	LINE-2 21L2 OR 87L	ICT-1 21T OR 67T	ICT-1 21T OR 67T
CORE-3 (0.2)	LINE-1 METERI NG	ICT-1 METERI NG	LINE-2 METERI NG	LINE-1 METERI NG	ICT-2 METERI NG	LINE-2METERI NG	ICT-1 METERI NG	ICT-1 METER ING

ADDITIONAL PROTECTIONS

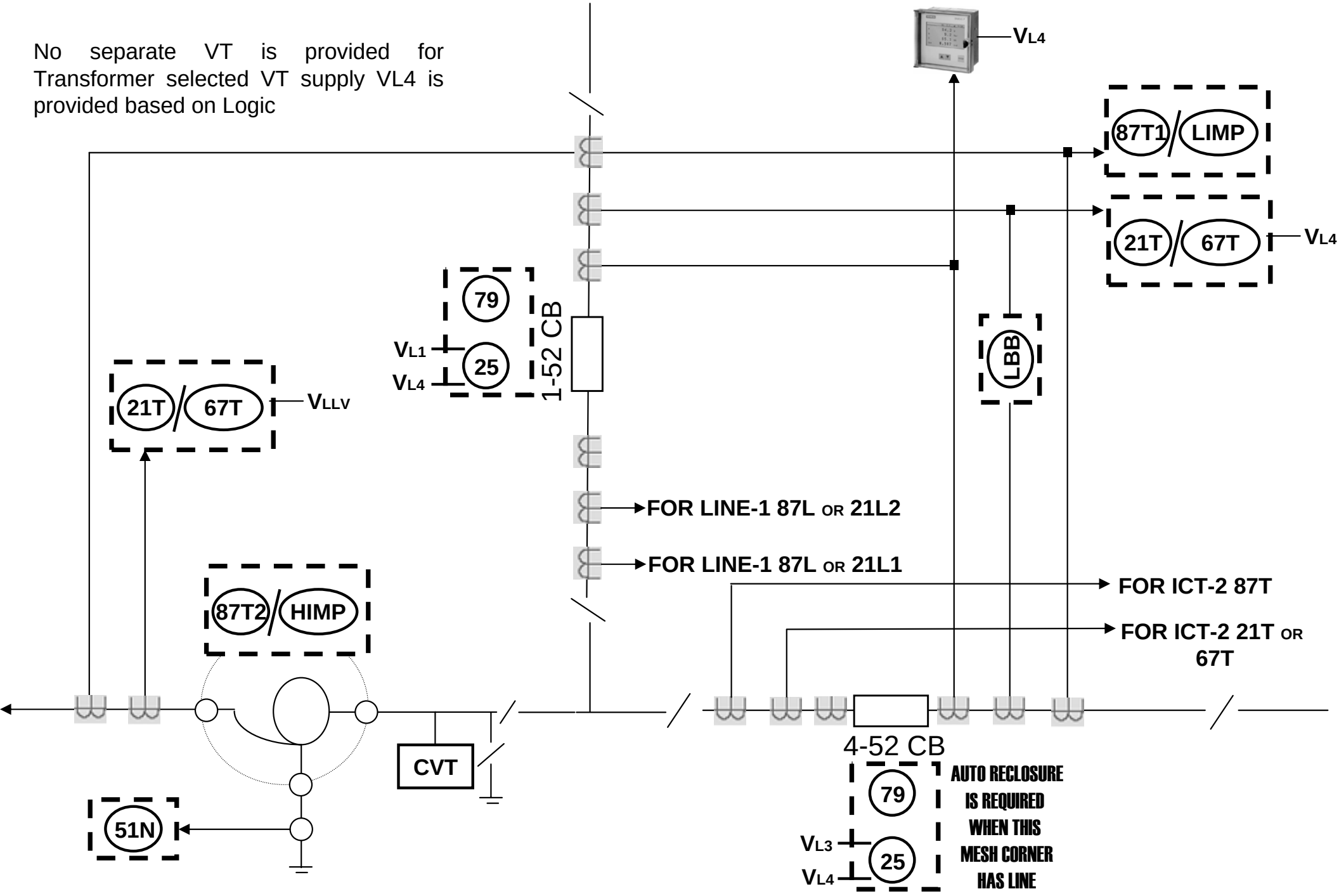
1. STUB Protection : In built feature in Main Protections of Line / ICT
2. LBB Protection : either extra relay connected in series with any one of the protection or in built function of any one of the protection.
3. TRANSFORMER 87T2 : USING Bushing CTs
4. BLIND ZONE: In this No Blind zone.

LINE PROTECTION



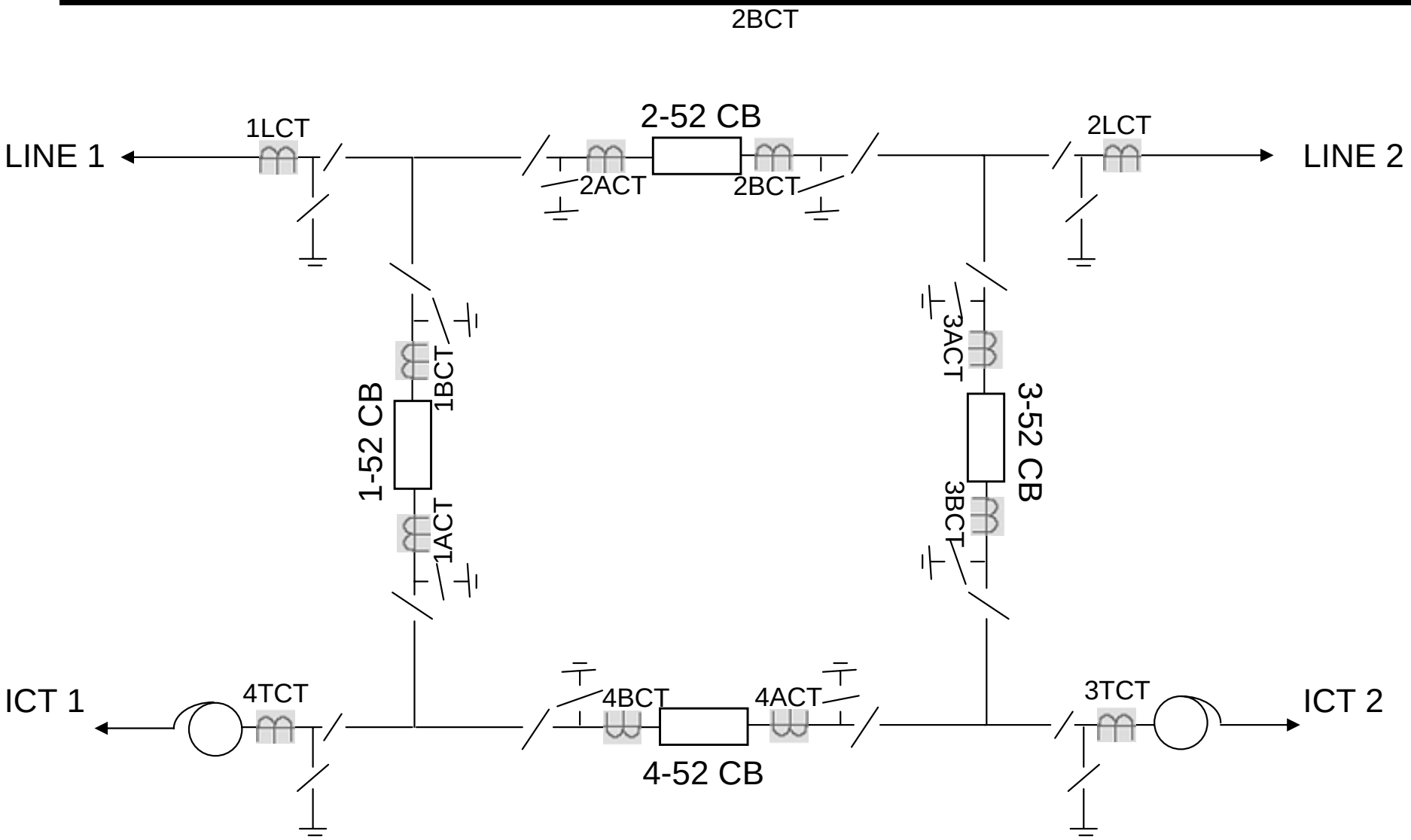
TRANSFORMER PROTECTION

No separate VT is provided for Transformer selected VT supply VL4 is provided based on Logic



MESH / RING SYSTEM

(TWO CTs FOR CB SYSTEM & ONE CT AT OUTGOING)



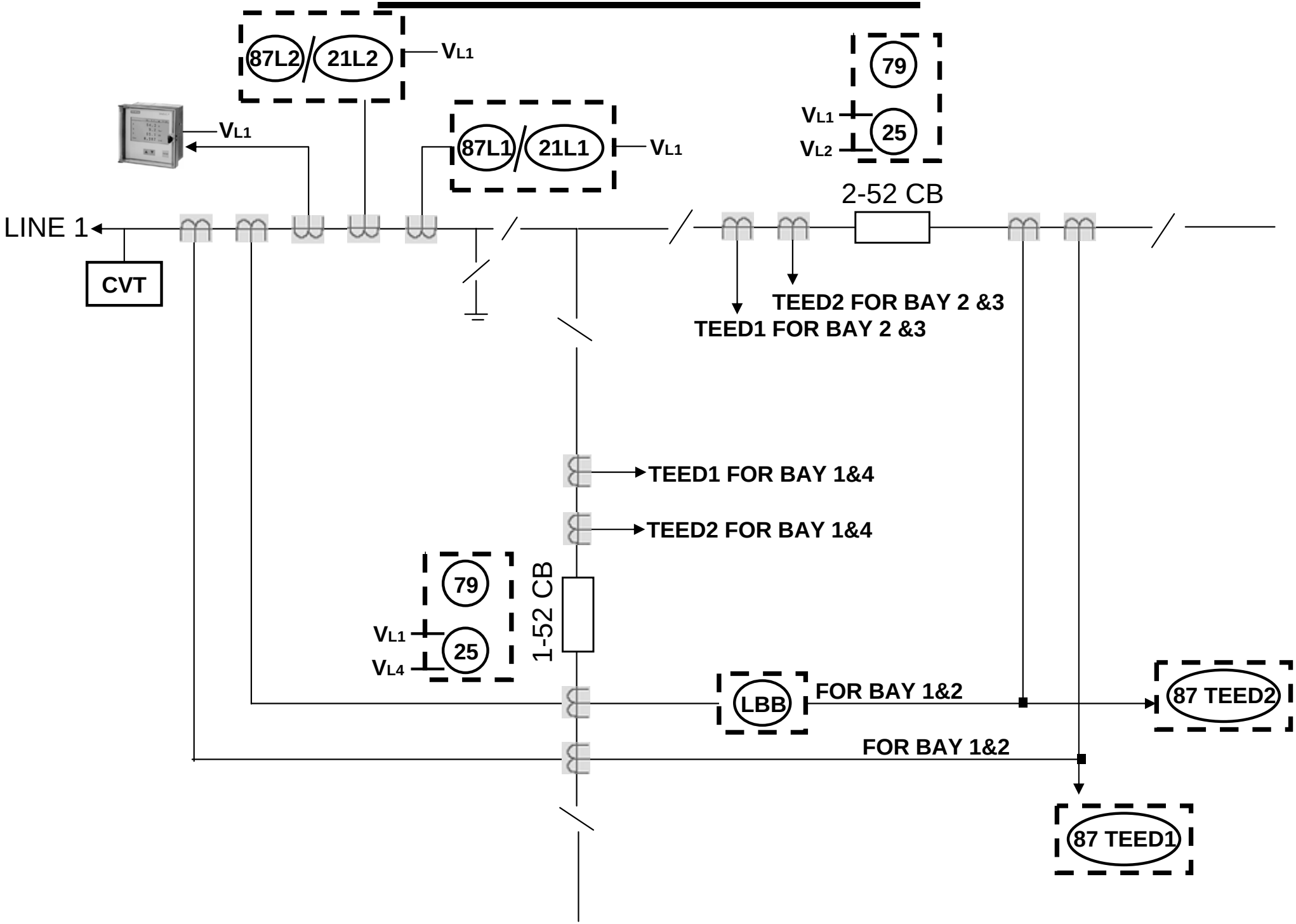
CURRENT TRANSFORMER CONNECTIONS

	1A CT	1B CT	1L CT	2A CT	2B CT	2L CT	3A CT	3B CT	3T CT	4A CT	4B CT	4T CT
CORE-1 (PS)	**TEED -1 PROTN (1&2)**	**TEED -1 PROTN (4&1)**	LINE-1 21L1 OR 87L	**TEED -1 PROTN (2 &3)**	**TEED -1 PROTN (1&2)**	LINE-2 21L1 OR 87L	**TEED -1 PROTN (3&4)**	**TEED -1 PROTN (2 &3)**	ICT-2 87T	**TEED -1 PROTN (4&1)**	**TEED -1 PROTN (3&4)**	ICT-1 87T
CORE-2 (PS)	**TEED -2 PROTN (1&2)**	**TEED -2 PROTN (4 &1)**	LINE-1 21L2 OR 87L	**TEED -2 PROTN (2&3)**	**TEED -2 PROTN (1&2)**	LINE-2 21L2 OR 87L	**TEED -2 PROTN (3&4)**	**TEED -2 PROTN (2&3)**	ICT-2 21T OR 67T	**TEED -2 PROTN (4 &1)**	**TEED -2 PROTN (3&4)**	ICT-1 21T OR 67L
CORE-3 (0.2)			LINE-1 METE RING			LINE 2 METE RING			ICT-2 METE RING			ICT-1 METE RING
CORE-4 (PS)			**TEED -2 PROTN (1&2)**			**TEED -2 PROTN (2&3)**			**TEED -2 PROTN (3&4)**			**TEED -2 PROTN (4 &1)**
CORE-5 (PS)			**TEED -1 PROTN (1&2)**			**TEED -1 PROTN (2 &3)**			**TEED -1 PROTN (3&4)**			**TEED -1 PROTN (4&1)**

ADDITIONAL PROTECTIONS

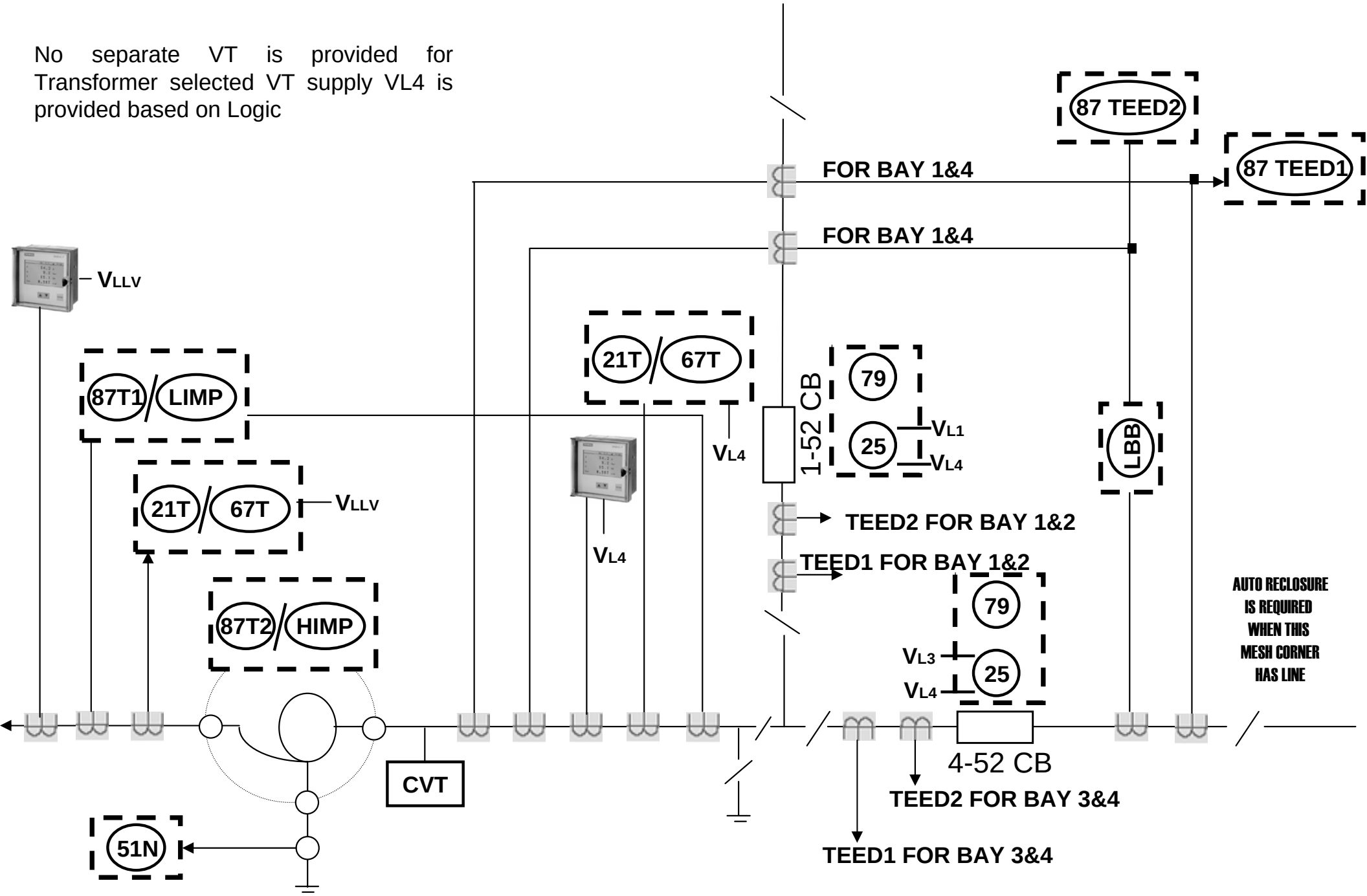
1. TEED Protection : Duplicate TEED Protection with TEED-1 High Impedance Type & TEED-2 Low Impedance Type.
2. LBB Protection : either extra relay connected in series with any one of the protection or in built function of any one of the protection.
3. TRANSFORMER 87T2 : USING Bushing CTs
4. BLIND ZONE: In this No Blind zone.

LINE PROTECTION

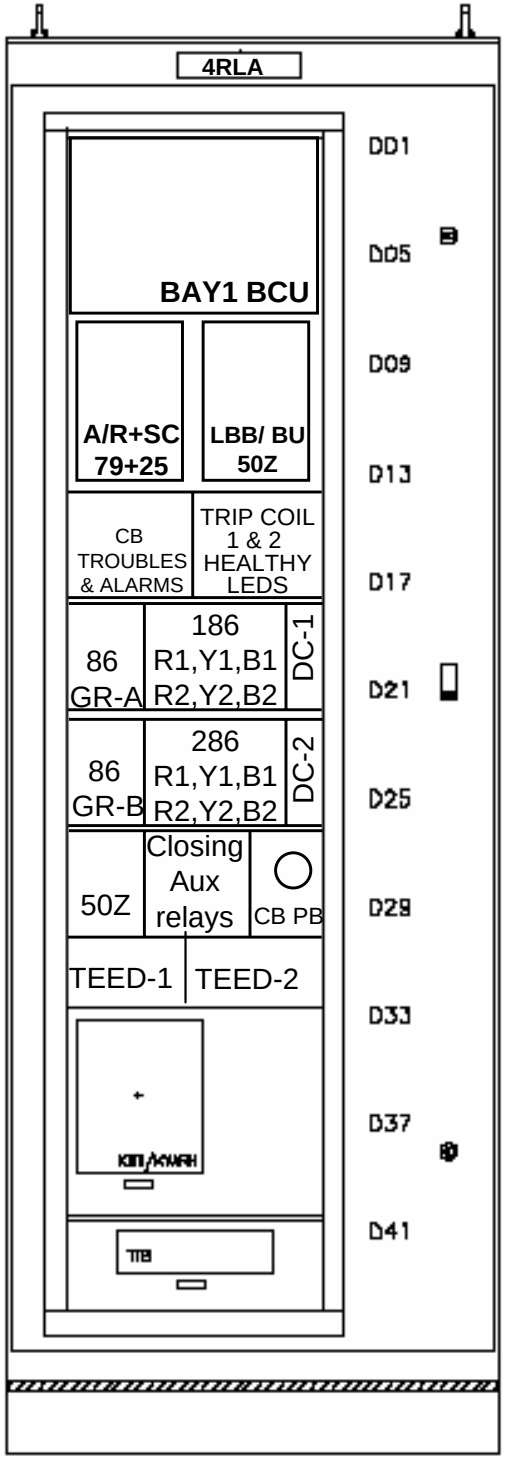


TRANSFORMER PROTECTION

No separate VT is provided for Transformer selected VT supply VL4 is provided based on Logic



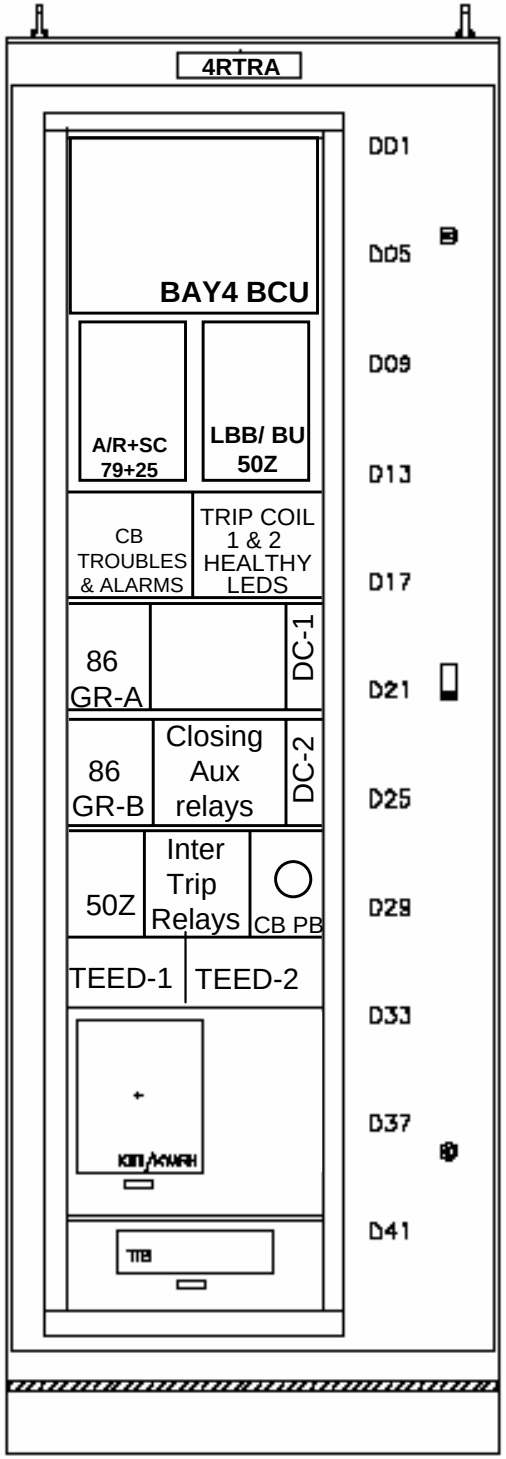
400 KV LINE MAIN CB CONTROL & RELAY PANEL



1. BAY1 BCU is for Bay1 CB & Isolators Control & Operation, Bay1 Earth Switches Status, associated interlocks.
2. Auto Reclosure & Check Synchronising Relay (79+25). This can be inbuilt function of BCU Unit is acceptable. Then Uniformity of Panel we can achieve.
3. LBB / CBF/ BFR / Stuck Breaker Failure Relay
4. CB Troubles and Alarms, Trip Coil-1 & Trip Coil-2 Healthy Relays, DC-1 & DC-2 Healthy Relays and output of these aux relays are brought to Bay1 BCU for Event Recorder and Alarms.
5. 86 GA, 86GB, 50Z, 186R1,Y1,B1, R2,Y2,B2 & 286R1,Y1,B1, R2,Y2,B2 are Three Phase & Single Phase Trip Relays. Output of these relays are brought to Bay1 BCU and Resetting of High Speed Master Trip Latch Relays (86 GA, 86GB, 50Z) from BCU. These are to be configured for Event Recorder function and Alarm Function.
6. Emergency CB Open Push Button/ TNC switch is to be Provided. One output is brought to BCU for Event recorder & Alarm.
7. The CT & CVT Metering Core Brought to Energy Meter with TTB & BCU for view & Data Transfer to SAS
8. The BCU should have Trip Counter Table of Circuit Breakers, SF6 Pressures, Operating Mechanism Pressures, PLCC Carrier Trip Counter Table for Permissive Trips and Direct Trips of Send and receive.
9. Closing Auxiliary Relays to Close Circuit breaker & Isolators from BCU.
10. TEED-1 Protection Relay. (if Required)
11. TEED-2 Protection Relay. (if Required)

This is similar to Bay 1 & Bay 2 & Bay 3

400 KV ICT MAIN CB CONTROL & RELAY PANEL



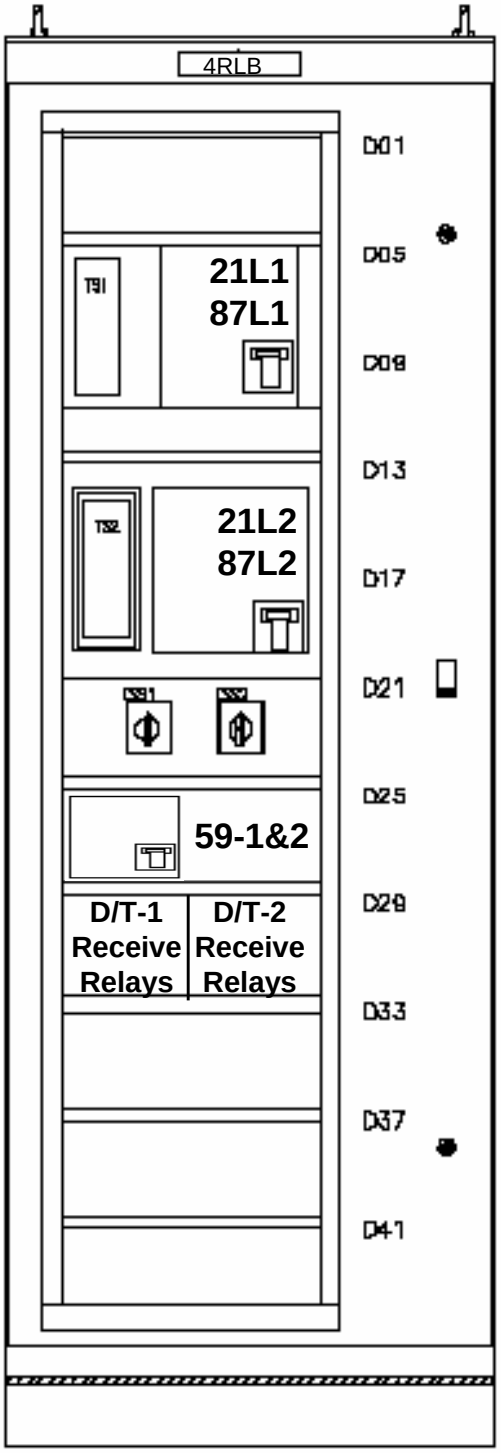
1. BAY4 BCU is for Bay4 CB & Isolators Control & Operation, Bay4 Earth Switches Status, associated interlocks.
2. Auto Reclosure & Check Synchronising Relay (79+25). This can be inbuilt function of BCU Unit is acceptable. This is not required in case of ICT.
3. LBB / CBF/ BFR / Stuck Breaker Failure Relay 50Z Relay
4. CB Troubles and Alarms, Trip Coil-1 & Trip Coil-2 Healthy Indications, DC-1 & DC-2 Healthy Indications and output of these aux relays can brought to Bay3 BCU for Event Recorder and Alarms.
5. 86 GA, 86GB, 50Z are Three Phase Trip Relays & Inter trip Auxiliary Relays are available. Output of these relays can brought to Bay3 BCU and Resetting of High Speed Master Trip Latch Relays (86 GA, 86GB, 50Z) from BCU. These are to be configured for Event Recorder function and Alarm Function.
6. Emergency CB Open Push Button/TNC Switch. One output is brought to BCU for Event recorder.
7. The CT & CVT Metering Core Brought to Energy Meter with TTB & BCU for view & Data Transfer to SAS & ALDC/SLDC/RLDC/NLDC.
8. The BCU should have Trip Counter Table of Circuit Breakers, SF6 Pressures, Operating Mechanism Pressures, OLTC Tap Position, OLTC Tap Changer Control, WTI of HV, IV, LV, OTI and Hydran Info and trend.
9. Inter Trip Relays for HV to IV & IV to HV.
10. Closing Auxiliary Relays to Close Circuit breaker & Isolators from BCU.
11. TEED-1 Protection Relay. (if Required)
12. TEED-2 Protection Relay. (if Required)

DIFFERENCE BETWEEN LINE CB RELAY PANEL & ICT CB RELAY PANEL

	LINE CB RELAY PANEL	ICT CB RELAY PANEL	Remarks
Auto Reclosure (79+25)	Required	Not required	If it is inbuilt function of BCU, then Panel appearance is same
Single Phase Trip Relays	Required	Not Required	This is Extra in Line CB Panel
Other end Trip Relays	Carrier Direct Trip relays for Channel-1 &2	Physical Wiring Inter trip relays for Gr-A & Gr-B	This is Minor Modification

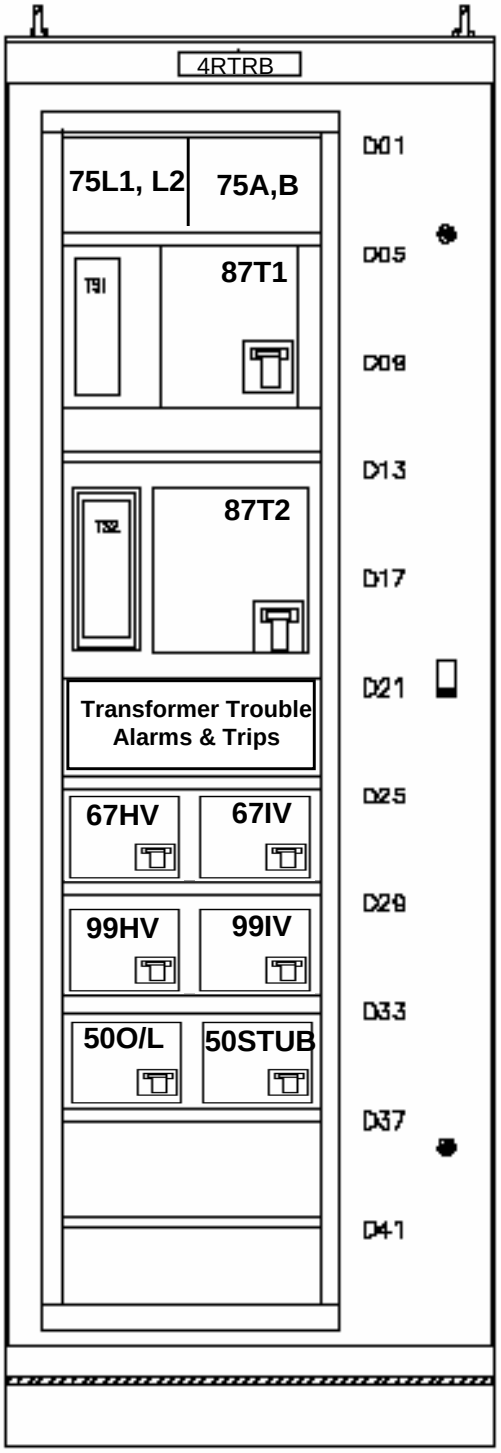
From the above it is conclude that the CB Relay Panels for Line & Transformer is same except some slight Modifications i.e Single Phase trip Relays & other end trip relays.

400 KV LINE PROTECTION PANEL(4RLB)



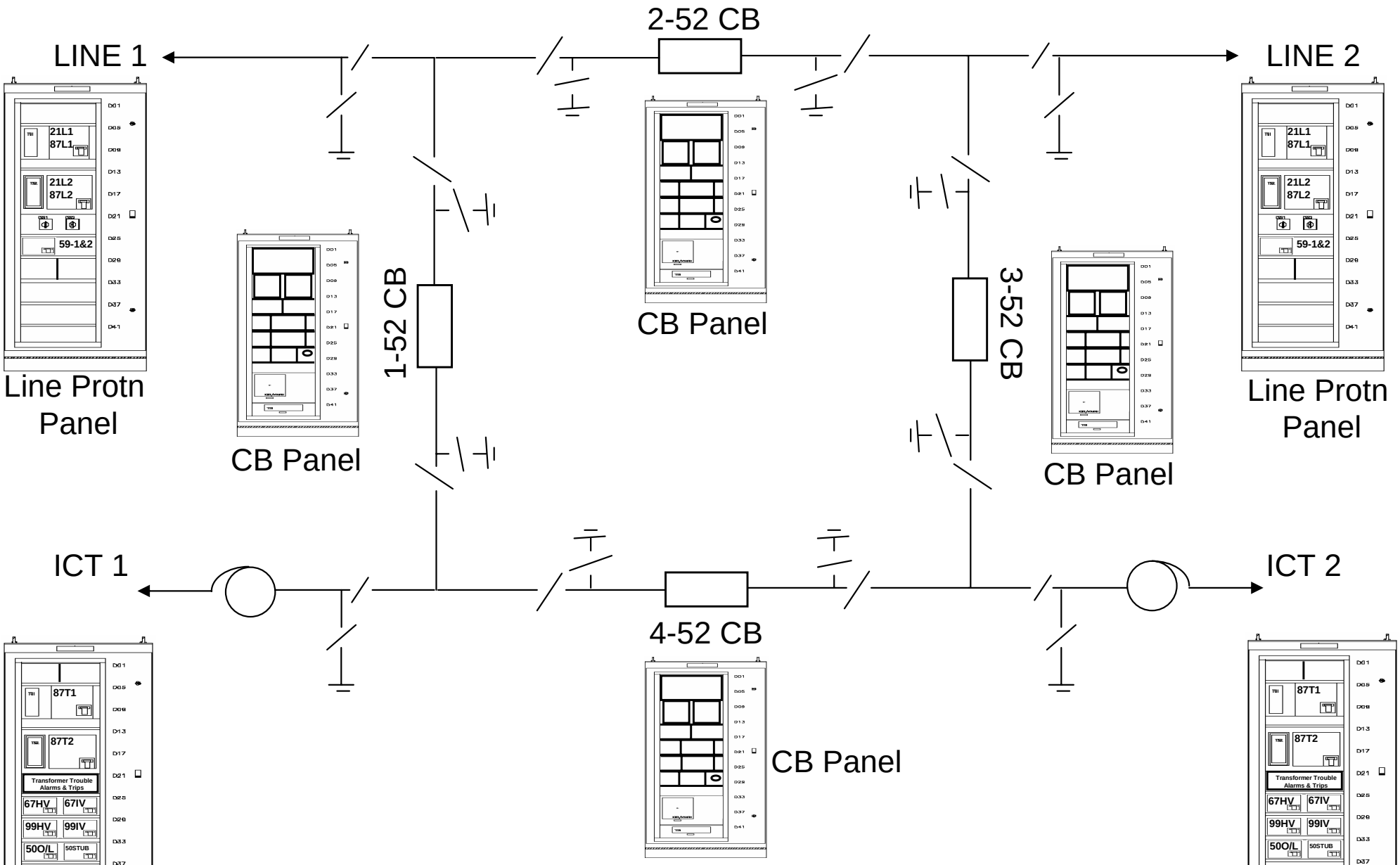
1. 21L1 Main1 Distance Scheme for Line.
2. 21L2 Main 2 Distance Scheme for Line.
3. Carrier Selector Switches CSS1 & CSS2. These should be Latch Relays and can be ON & OFF from BCU1. The Operation of These Latch relays should appear in Event Recorder and Alarm.
4. Over Voltage Stage-1 & Over Voltage Stage-2 and Under Voltage Relay Separate Numerical Over and Under Voltage Relay is required. Under Voltage Relay is required for Inter lock for Operation of Line Earth Switch. Inbuilt function is accepted in case of Over Voltage protections available in Main 1 & Main 2 and Activated in Both Relays. Under Voltage protection can be accepted in BCU.
5. Disturbance recorder is Inbuilt Function of Both Distance Schemes is acceptable and 100% redundancy required.
6. Event recorder is in built function in all Numerical Relays and All Events and Alarms should Transfer to Station Unit.
7. Direct Transfer Trip Receive Relays. The output of these relays can be configured in BCU for Event Recorder & Alarms.

400 KV ICT PROTECTION PANEL



1. 75 A,B,L is 400KV Voltage Selection Latch Relays & 75 A,B is 220KV Voltage Selection Latch Relays and can be ON & OFF from BCU3 & IV BCU after satisfying the Logic. The Operation & Output of These Latch relays can be Configure to BCU3 for 400KV & IV BCU for 220KV for Event Recorder and Alarm.
2. 87T1 Main1Transformer Protection - 3 Winding Low Imp % Biased Differential Scheme for Transformer (Merz Price Principle) (Ampere Turn Balance Method).
3. 87T2 Main2 Transformer Protection - 3Ph 3 Pole High Imp Differential Scheme for Transformer (Circulating Current Principle) (kirchoff's Law).
4. Transformer Troubles Alarm and Trip Aux Relays. The outputs are connected to 87T1&87T2 for Disturbance recorder, Event recorder and Alarm and for tripping also.
5. 67HV / 21T is Back up O/L & E/F Relay or Transformer Impedance Relay for HV & 67IV/ 21T is Back up O/L & E/F Relay or Transformer Impedance Relay for IV.
6. 50 O/L ICT Over load Alarm/ Trip Protection. This can be accepted & offered in built protection of either 67HV or 87T1.
7. 50 O/L ICT Over load Alarm/ Trip Protection. This can be accepted & offered in built protection of either 67HV or 87T1.
8. 99HV is HV Over Flux relay. This can be accepted & offered as inbuilt function of either 87T1 or 67HV & 99IV is IV Over Flux relay. This can be accepted & offered as inbuilt function of either 87T2 or 67IV and FFR is inbuilt function of 67HV & 67IV and Over load Alarm can be accepted & offered as inbuilt function of either in 67HV or 87T1.
9. Disturbance recorder is Inbuilt Function of Both 87 T1 & 87 T2 Schemes is acceptable and 100% redundancy required.
10. Event recorder is in built function in all Numerical Relays and All Events and Alarms should Transfer to Station Unit.

PANEL ARRANGEMENT

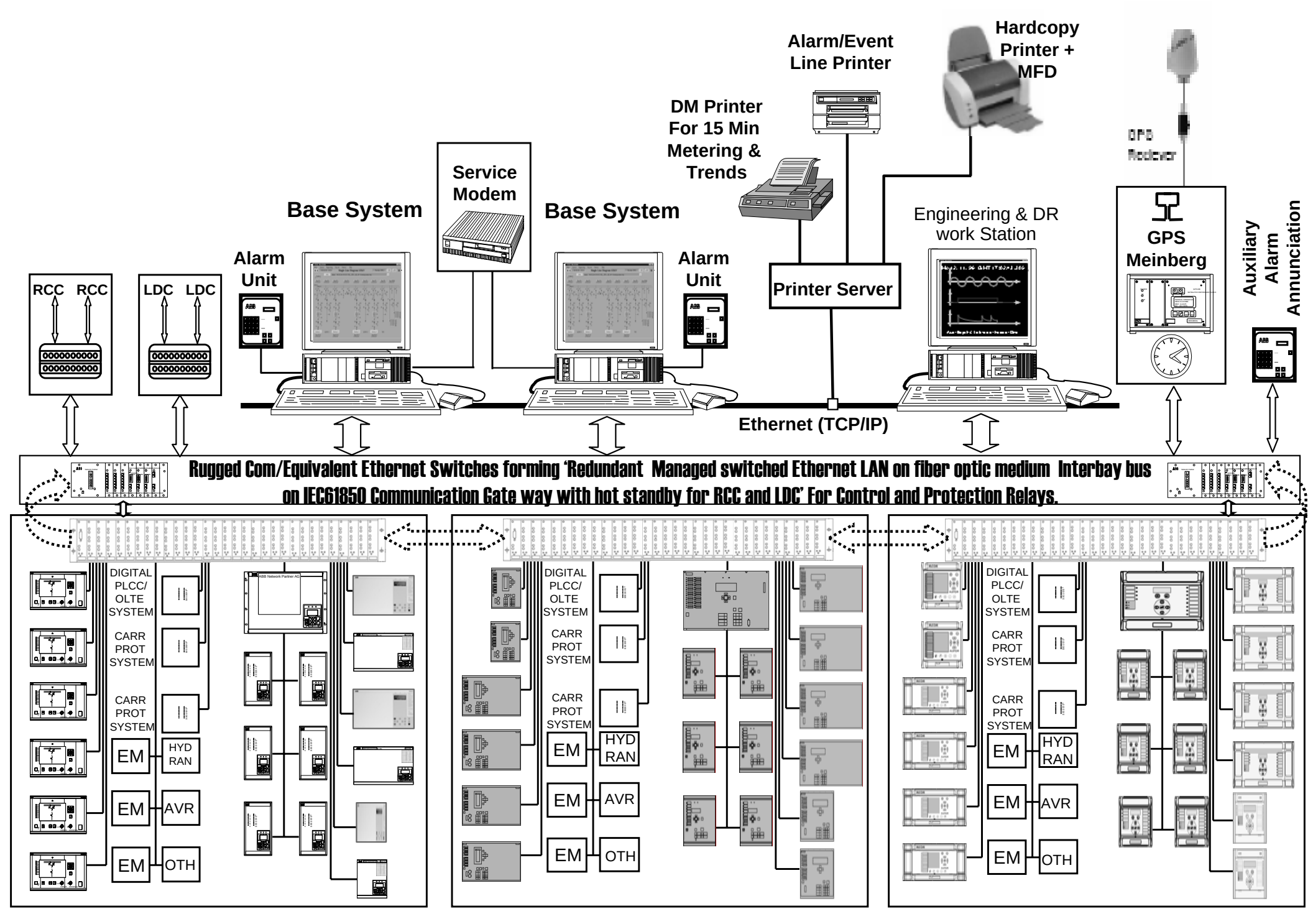


PANEL ARRANGEMENT IN A CONTROL ROOM							
BAY1 CB PANEL	LINE1 PROTN PANEL	BAY2 CB PANEL	LINE2 PROTN PANEL	BAY3 CB PANEL	ICT2 PROTN PANEL	BAY4 CB PANEL	ICT1 PROTN PANEL

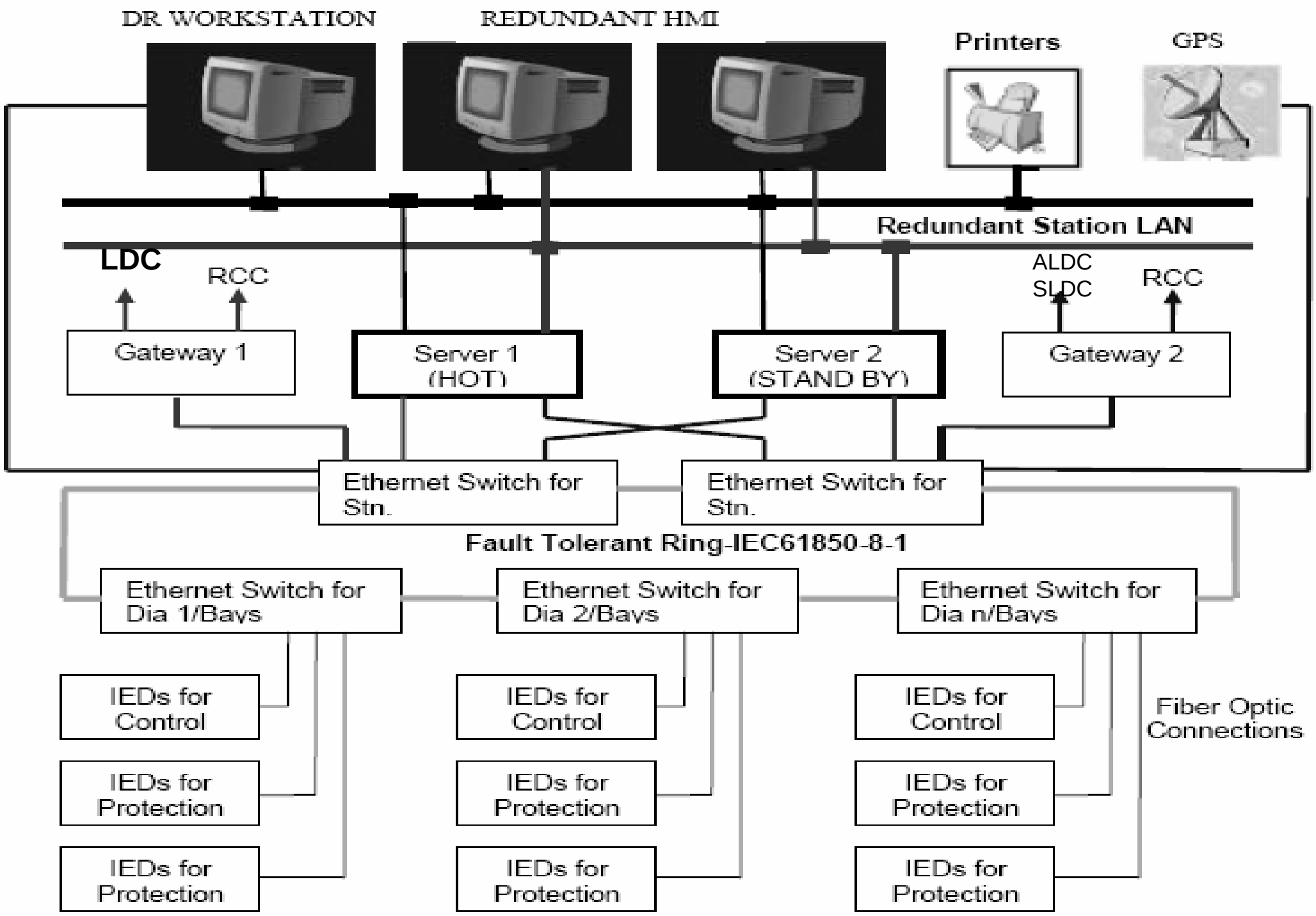
IEC 61850 RELAY MODELS OF DIFFERENT MANUFACTURERS

MANUFACTURERS	BCU CB CONTROL	FEEDER 67	DISTANCE 21	LINE DIFFERENTIAL 87 L	DIFFERENTIAL 87 T	BUSBAR 87 BB
ABB	REC 670	REX 610 REX 510	REL 670	RED 670	RET 670	REB 670 REB 500
AREVA	MICOM C264	MICOM P141	MICOM P44 2/3/4	MICOM P543/547	MICOM P633/P643	MICOM P74 1/3/6
GE MULTILIN	D 25	F 60	D 60, D 90	L 60, L 90	T 60	B 90, B 30
SIEMENS (SIPROTEC)	SIPROTEC 6MD66/3	SIPROTEC 7SJ 62/3/4	SIPROTEC 7SA 522/6..	SIPROTEC 7SD 522/61_	SIPROTEC 7UT 633/13/2	SIPROTEC 7 SS 52
SEL	SEL 451-4	SEL 451	SEL 421/321	SEL 387L	SEL 487E	SEL 487B
TOSHIBA	GRD 150	GRD 140	GRZ 100	GRL 100 / 150	GRT 100	GRB 100/150

SUBSTATION AUTOMATION



SUBSTATION AUTOMATION



TRIPPING LOGICS

GROUP-A & GROUP-B TRIPPINGS

FOR 400KV STATIONS THERE SHALL BE TWO SEPARATE BATTERY SYSTEMS AVAILABLE FOR PROTECTION, CONTROL & TRIPPING/CLOSING OPERATIONS. TO OBTAIN REDUNDENCY AND TO BE ABLE TO TAKE PROTECTION OUT FOR MAINTANENCE, WHILE EQUIPMENT IS IN SERVICE, THE RELAYS ARE ELECTRICALLY AND PHYSICALLY SEGREGATED IN TO TWO GROUPS. GROUPING IS DONE TO THE EXTENT POSSIBLE IN SUCH A WAY THAT EACH GROUP CAN INDEPENDENTLY CARRYOUT PROTECTIVE FUNCTIONS WITH NEAR EQUAL REDUNDENCY. INTER CONNECTION OF THESE TWO GROUPS SHALL NOT BE GENERALLY BE ATTEMPTED.

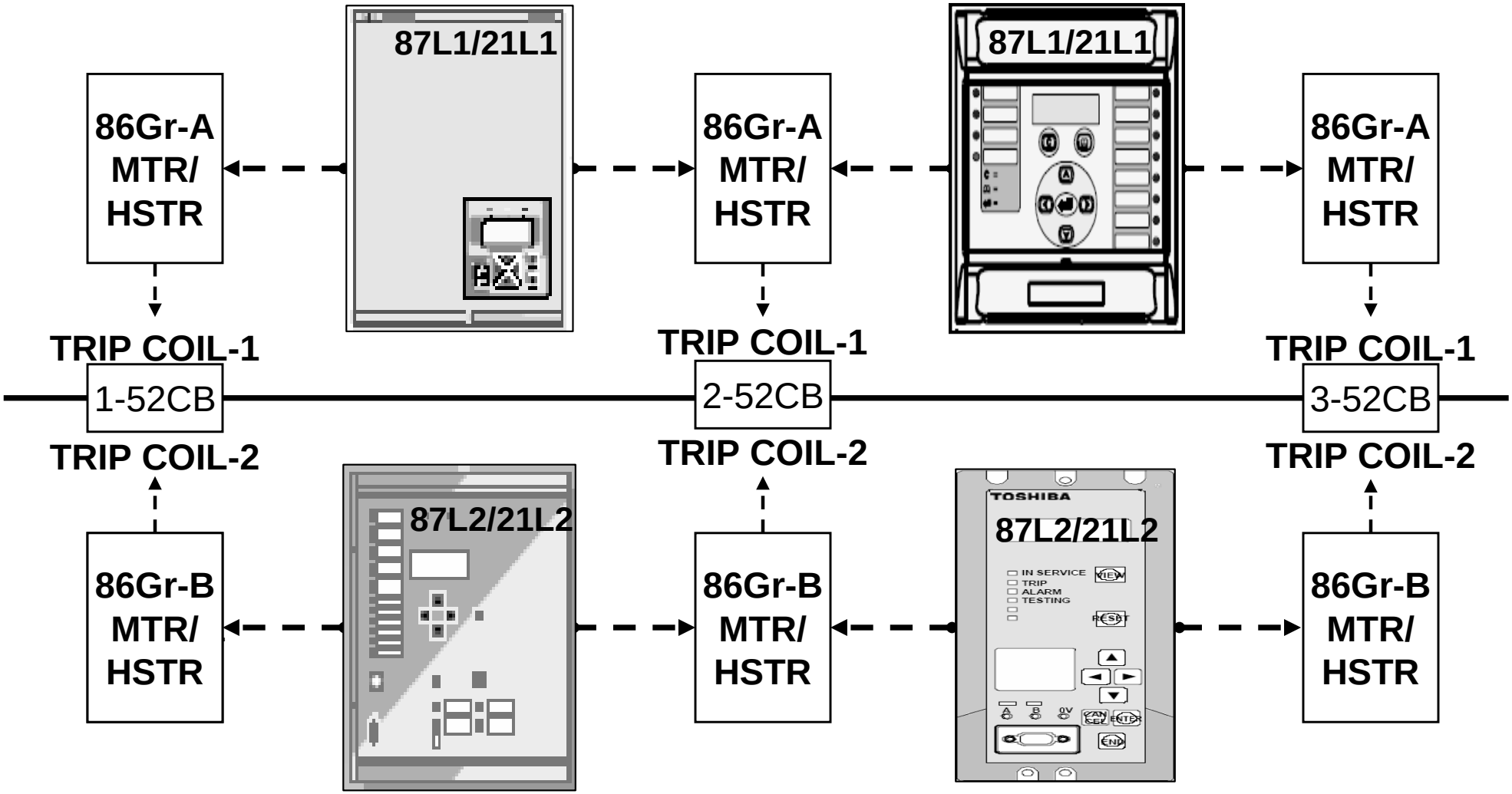
DISTRIBUTION OF DC SUPPLY SHALL BE DONE BAY WISE TO FEED THE FOLLOWING

1. **PROTECTION**
2. **CB CONTROL**
3. **ISOLATOR / EARTH SWITCH CONTROL**
4. **ANNUNCIATION / INDICATION**

LINE PROTECTION	TRANSFORMER PROTECTION	REACTOR PROTECTION
GROUP-A MAIN-1 PROTECTION M1 BUILT IN FUNCTIONS TEED-1 PROTECTION OVER VOLTAGE STAGE-1 PROT DIRECT TRIP CHANNEL-1 RECEIVED **GROUP-B** MAIN-2 PROTCTION M2 BUILT IN FUNCTIONS TEED-2 PROTECTION OVER VOLTAGE STAGE-2 PROT LBB/BFR RELAY DIRECT TRIP CHANNEL-2 RECEIVED	**GROUP-A** T/F DIFFERENTIAL RELAY T/F HV BACKUP RELAY T/F IMP / 21T RELAY T/F HV OVERFLUX RELAY OIL TEMP HIGH TRIP PRESURE RELIEF TRIP TERITIARY DELTA WNDG NDR PROT **GROUP-B** T/F REF / HIGH Z DIFF RELAY BUCHHOLZ TRIP T/F LV BACKUP RELAY T/F NEUTRAL CURRENT / 51 O/C RLY T/F LV OVERFLUX RELAY OVER LOAD PROT (ALARM ONLY) OLTC BUCHHOLZ TRIP WINDING TEMP HIGH TRIP LOW/ HIGH OIL LEVEL TRIP	**GROUP-A** REACTOR DIFFERENTIAL RELAY REACTOR BACKUP / 21R RELAY OIL TEMP HIGH TRIP PRESURE RELIEF TRIP **GROUP-B** REACTOR REF RELAY BUCHHOLZ TRIP WINDING TEMP HIGH TRIP LOW/ HIGH OIL LEVEL TRIP FIRE PROTECTION TRIP

PROTECTION TRIP SCHEME

(LINE-1 & LINE-2)

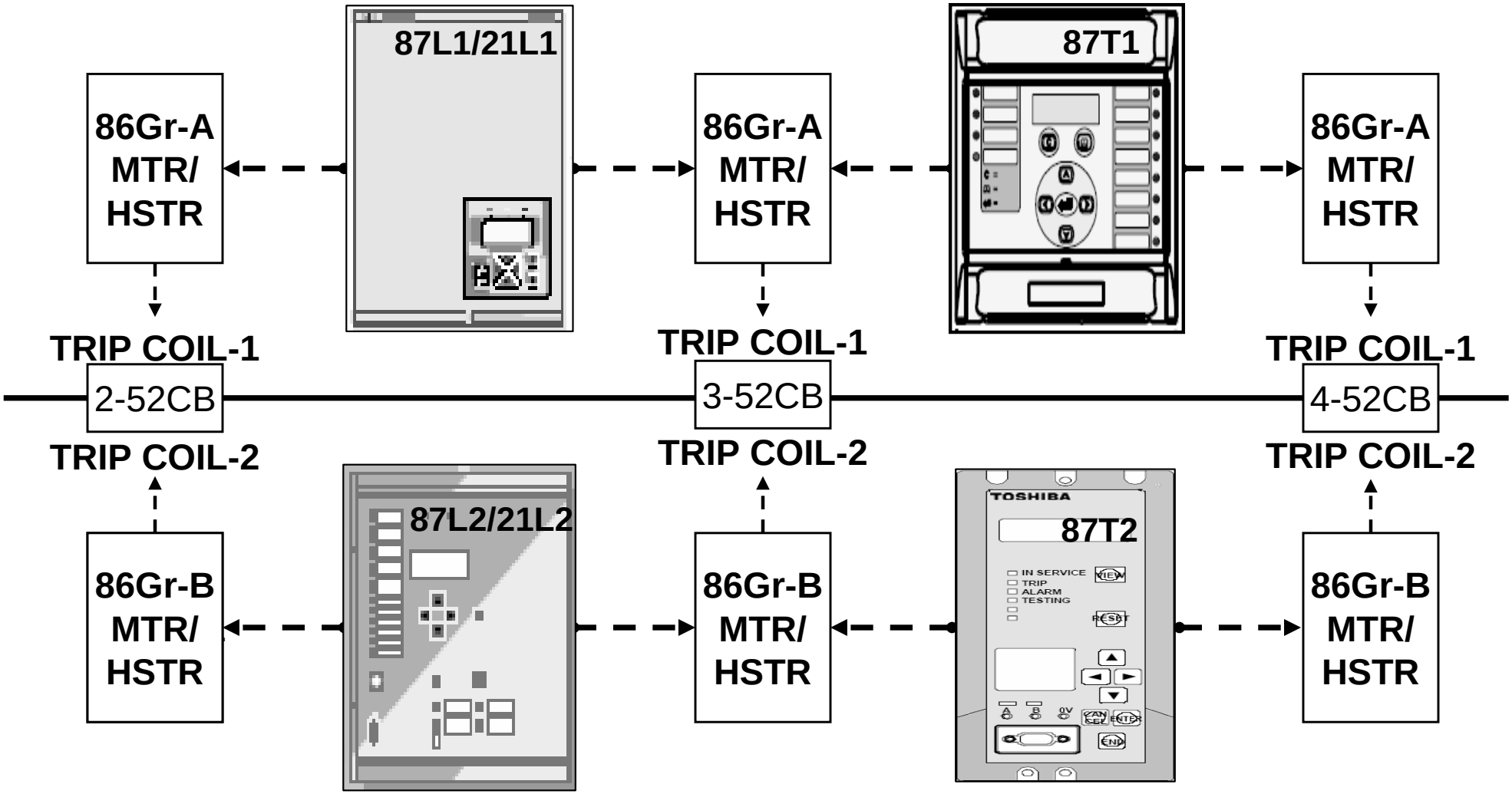


86-A : GROUP-A MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

86-B : GROUP-B MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

PROTECTION TRIP SCHEME

(LINE-2 & ICT-2)

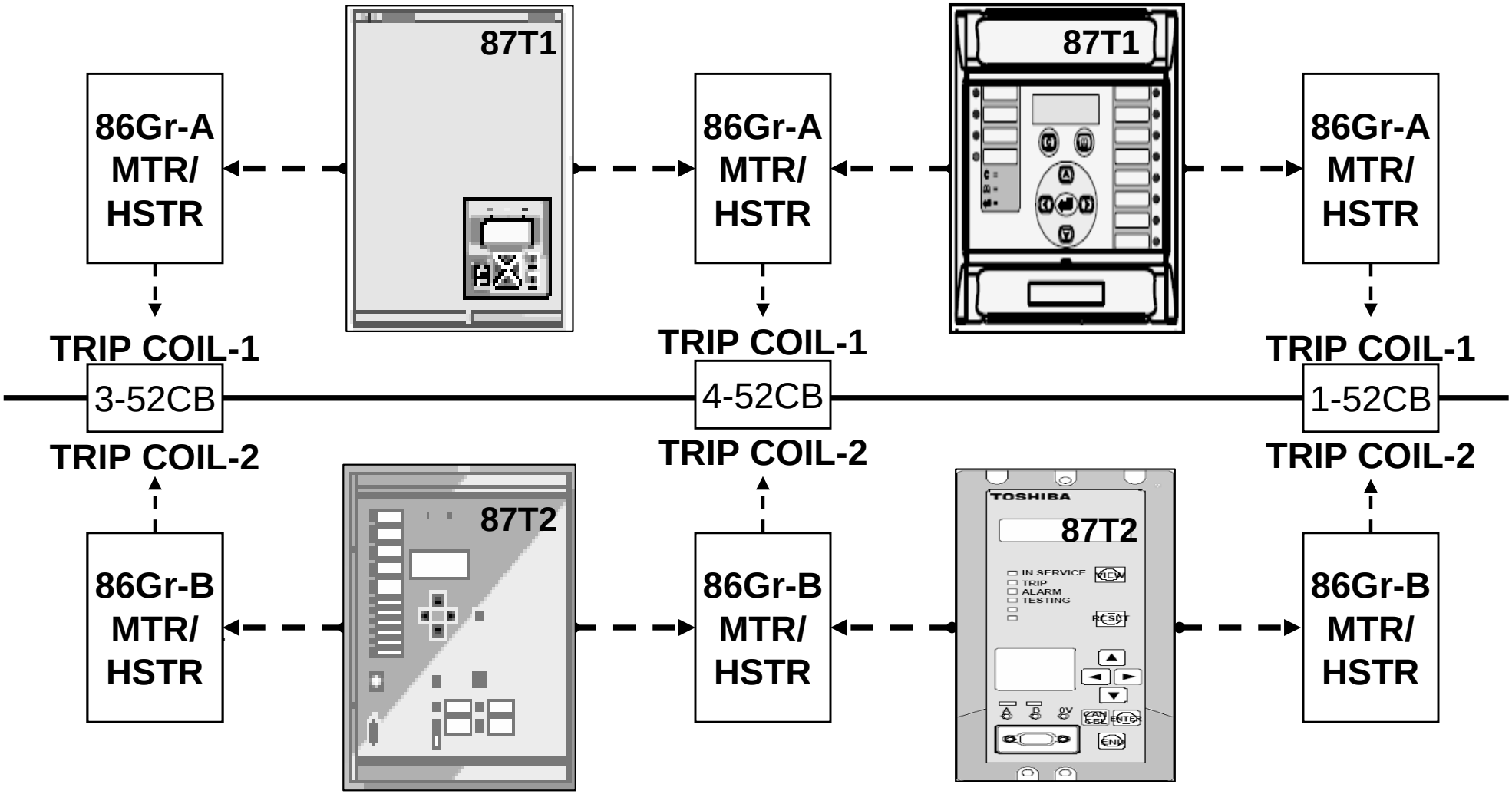


86-A : GROUP-A MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

86-B : GROUP-B MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

PROTECTION TRIP SCHEME

(ICT-2 & ICT-1)

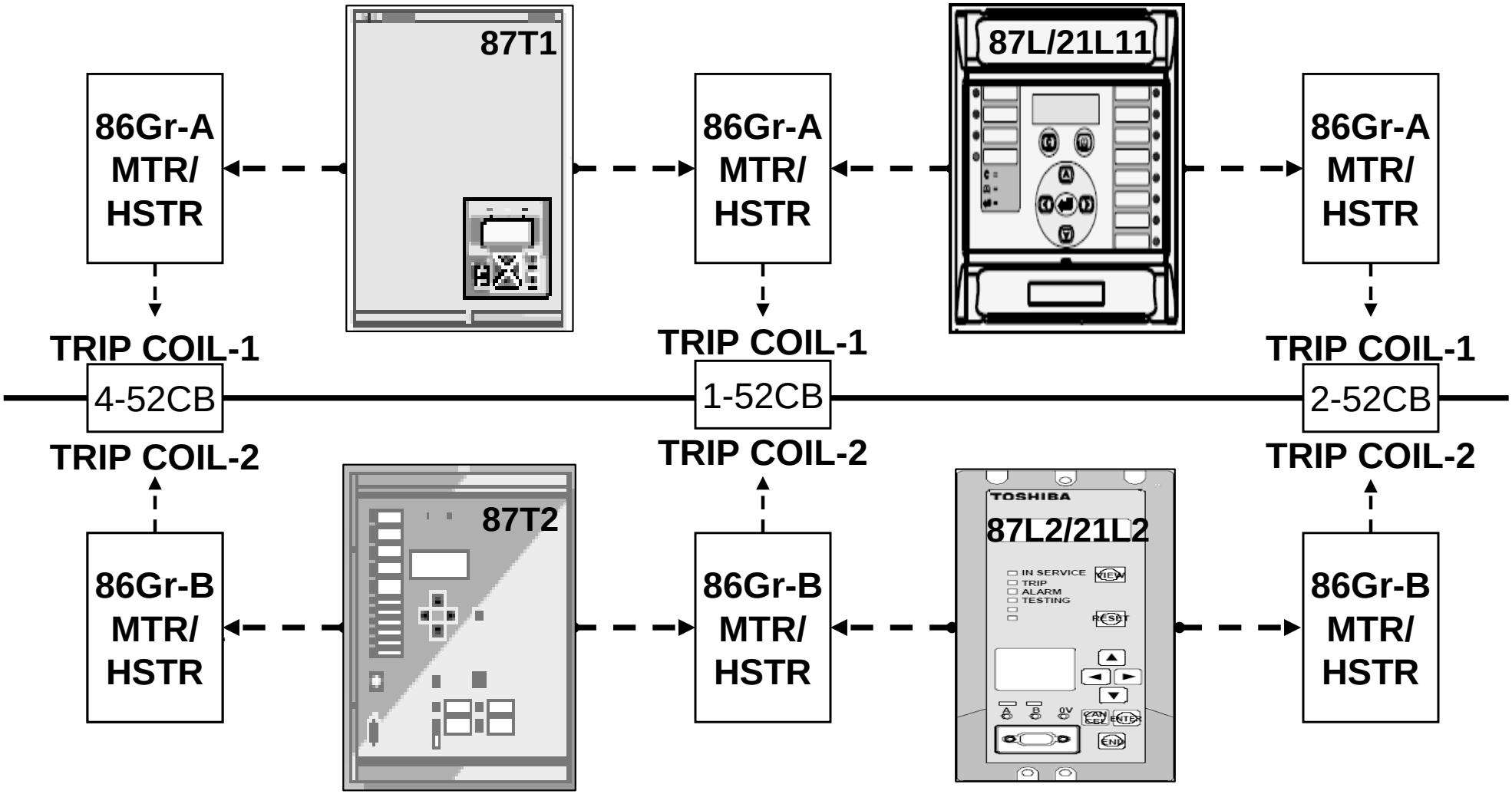


86-A : GROUP-A MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

86-B : GROUP-B MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

PROTECTION TRIP SCHEME

(ICT-1 & LINE-1)

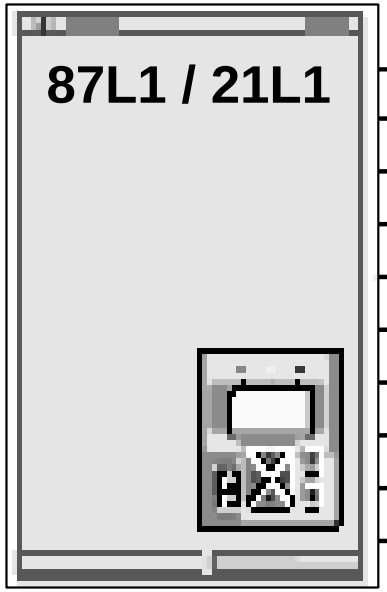


86-A : GROUP-A MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

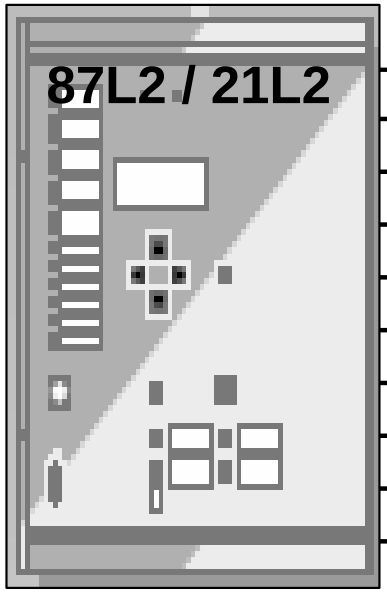
86-B : GROUP-B MASTER TRIP RELAY / HIGH SPEED TRIP RELAY

MAIN-1/ MAIN-2

ZONE-1 & SINGLE PHASE FAULT



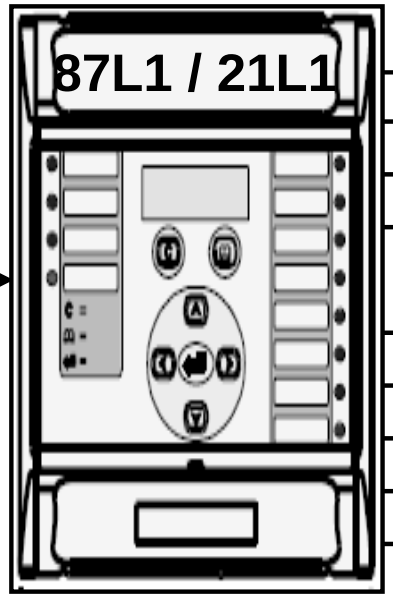
- INITIATE MAIN CB GR-A 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- INITIATE OTHER CB GR-A 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- START MAIN CB AUTO RECLOSURE
- START OTHER CB AUTO RECLOSURE
- CARRIER SEND TO REMOTE END(LINE OTHER END)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE / FAULT RECORDER
- TO EVENT RECORDER (SOE/ SCADA)
- TO LBB/BFR INITIATION



- INITIATE MAIN CB GR-B 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- INITIATE OTHER CB GR-B 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- START MAIN CB AUTO RECLOSURE
- START OTHER CB AUTO RECLOSURE
- CARRIER SEND RO REMOTE END (LINE OTHER END)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)
- TO LBB/BFR INITIATION

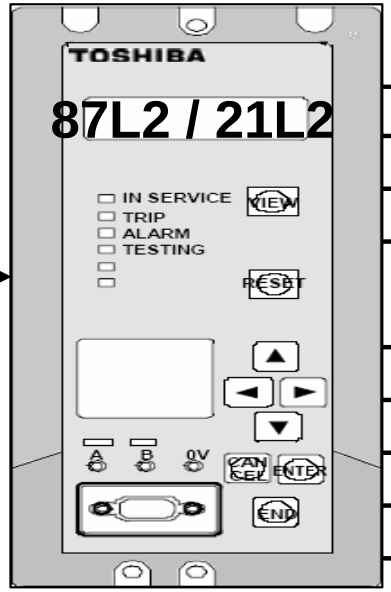
MAIN-1/ MAIN-2

ZONE-2(WITH IN 100% OF LINE) & SINGLE PHASE FAULT



CARRIER RECEIVE FROM OTHER END & RELAY ZONE -2 STARTER PICKUP

- INITIATE MAIN CB GR-A 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- INITIATE OTHER CB GR-A 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- START MAIN CB AUTO RECLOSURE
- START OTHER CB AUTO RECLOSURE
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)
- TO LBB/BFR INITIATION

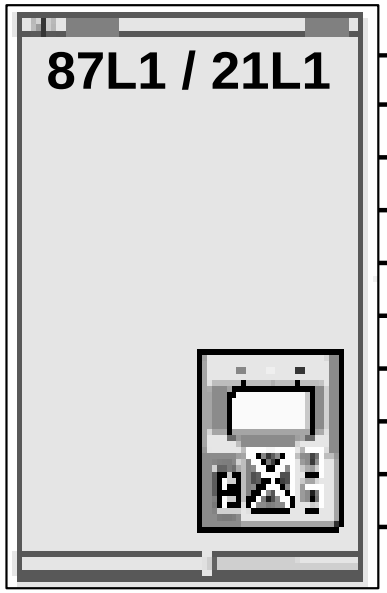


CARRIER RECEIVE FROM OTHER END & RELAY ZONE -2 STARTER PICKUP

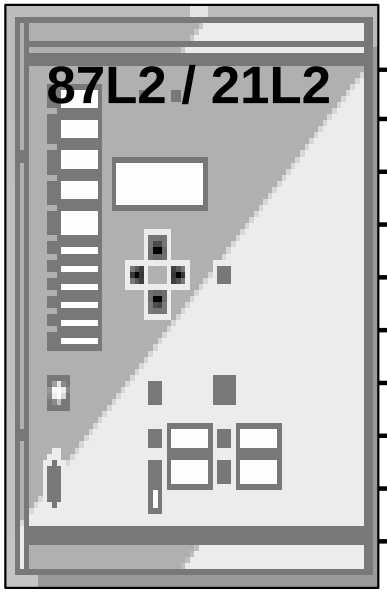
- INITIATE MAIN CB GR-B 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- INITIATE OTHER CB GR-B 1-PH TRIP UNIT (INTURN IT WILL TRIP 1-POLE)
- START MAIN CB AUTO RECLOSURE
- START OTHER CB AUTO RECLOSURE
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)
- TO LBB/BFR INITIATION

MAIN-1/ MAIN-2

ZONE-1 & 2Ph / 3Ph FAULT



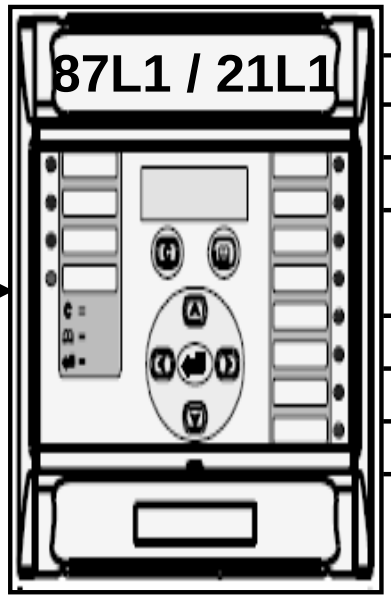
- INITIATE MAIN CB GR-A 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB GR-A 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CARRIER SEND TO LINE REMOTE END
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)
- TO LBB/BFR INITIATION



- INITIATE MAIN CB GR-B 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB GR-B 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CARRIER SEND TO LINE REMOTE END
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)
- TO LBB/BFR INITIATION

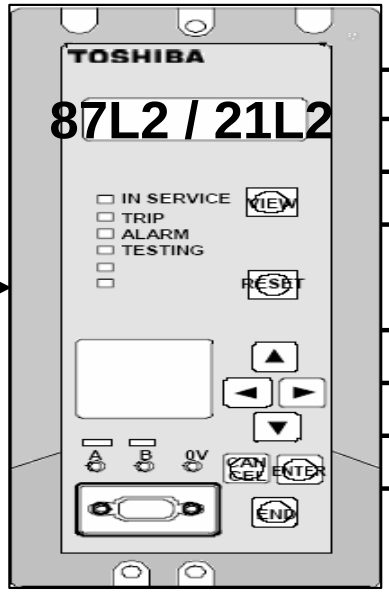
MAIN-1/ MAIN-2

ZONE-2 & 1Ph/2Ph/3Ph FAULT



CARRIER SIGNAL RECEIVED & ZONE-2 STARTER IS PICKUP CONDITION

- INITIATE MAIN CB GR-A 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB GR-A 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION CAME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

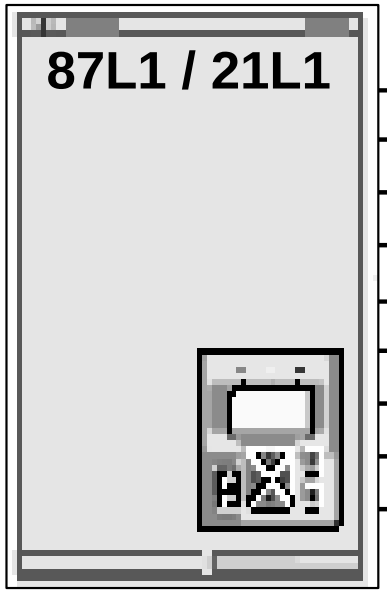


CARRIER SIGNAL RECEIVED & ZONE-2 STARTER IS PICKUP CONDITION

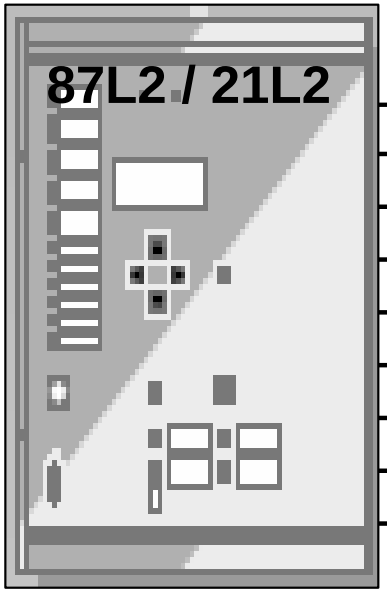
- INITIATE MAIN CB GR-B 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB GR-B 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

MAIN-1/ MAIN-2

ZONE- 3/4/5 & 1Ph/2Ph/3Ph FAULT

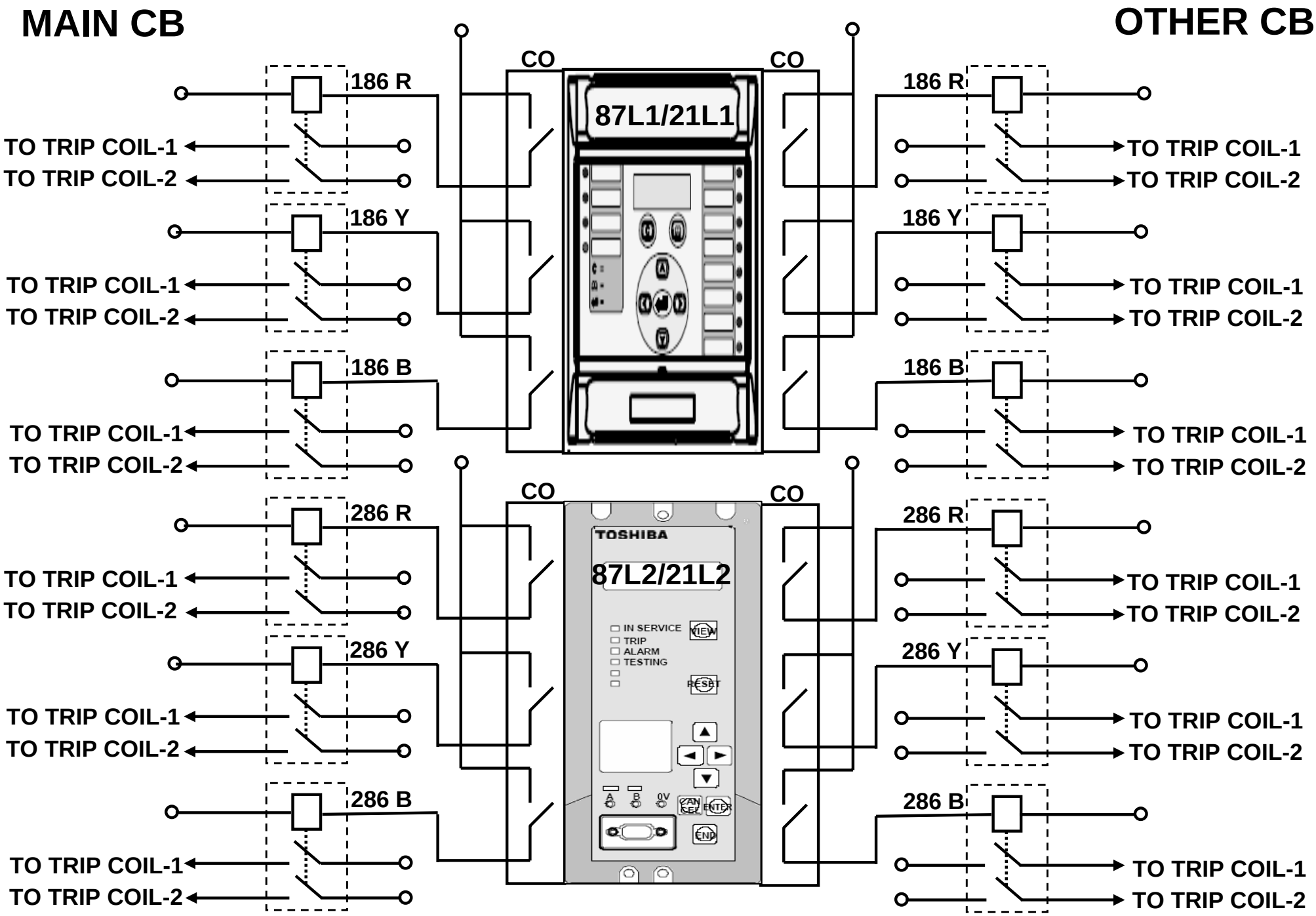


- INITIATE MAIN CB GR-A 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB GR-A 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- TO LBB/BFR INITIATION
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION CAME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)



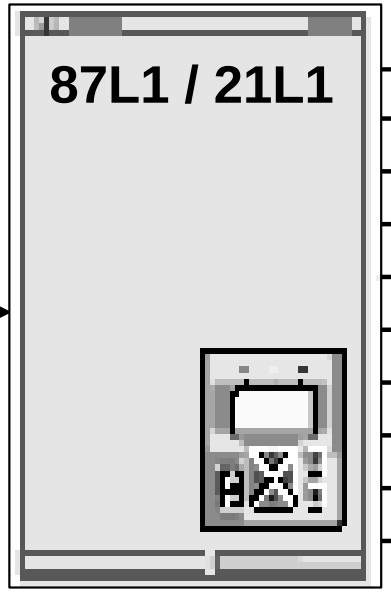
- INITIATE MAIN CB GR-B 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB GR-B 1-PH TRIP UNITS (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- TO LBB/BFR INITIATION
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

DISTANCE SCHEME TRIPPING OUTPUTS



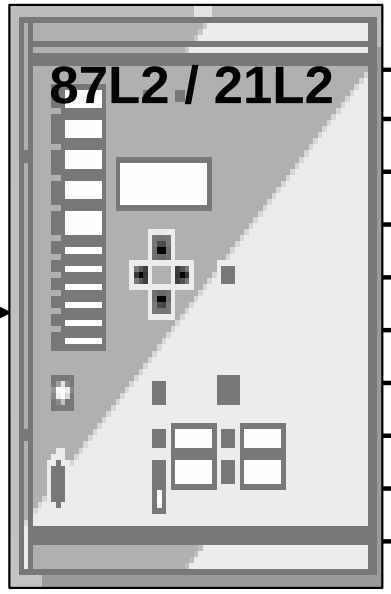
MAIN-1/ MAIN-2

OVER VOLTAGE STAGE-1



110% OF V
4 SECS FOR FEEDER-1
5 SECS FOR FEEDER-2

- INITIATE MAIN CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB & OTHER CB AUTO RECLOSURE
- DIRECT TRANSFER TRIP-1 CARRIER SEND TO OTHER END
- DIRECT TRANSFER TRIP-2 CARRIER SEND TO OTHER END
- CLOSE INTERLOCK OF MAIN CB & OTHER CB THROUGH 86Gr-A
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

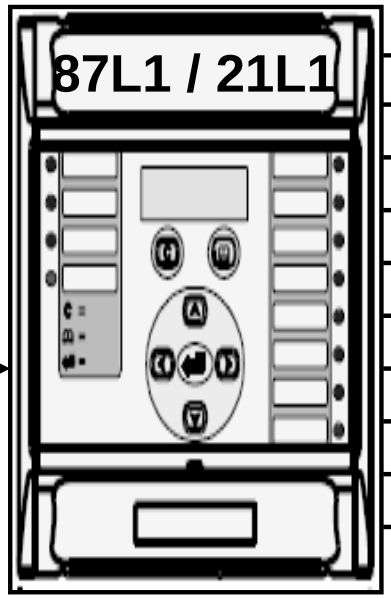


110% OF V
4 SECS FOR FEEDER-1
5 SECS FOR FEEDER-2

- INITIATE MAIN CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB & OTHER CB AUTO RECLOSURE
- DIRECT TRANSFER TRIP-1 CARRIER SEND TO OTHER END
- DIRECT TRANSFER TRIP-2 CARRIER SEND TO OTHER END
- CLOSE INTERLOCK OF MAIN CB & OTHER CB THORUGH 86Gr-B
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

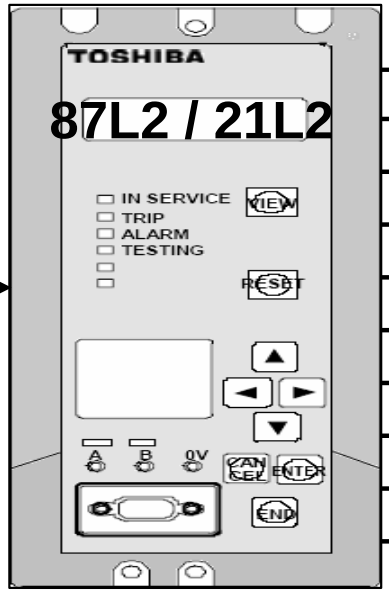
MAIN-1/ MAIN-2

OVER VOLTAGE STAGE-2



120% OF V
20m SECS

- INITIATE MAIN CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB & OTHER CB AUTO RECLOSURE
- DIRECT TRANSFER TRIP-1 CARRIER SEND TO OTHER END
- DIRECT TRANSFER TRIP-2 CARRIER SEND TO OTHER END
- CLOSE INTERLOCK OF MAIN CB & OTHER CB THORUGH 86Gr-A
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)



120% OF V
20m SECS

- INITIATE MAIN CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB & OTHER CB AUTO RECLOSURE
- DIRECT TRANSFER TRIP-1 CARRIER SEND TO OTHER END
- DIRECT TRANSFER TRIP-2 CARRIER SEND TO OTHER END
- CLOSE INTERLOCK OF MAIN CB & OTHER CB THORUGH 86Gr-A
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

AUTO RECLOSURE BASICS

➢ METHOD OF ADOPTION IN MESH / RING SYSTEM:

The Auto-Reclosure Functions used for the Line Circuit Breakers 1-52CB, 2-52 CB, 3-52CB & 4-52CB are set as Masters for Particular Bay of Line and other bay is follower. Co-ordination is required between the Auto-Reclosure Functions. A Synchrocheck function is also loaded in each Relay to permit 3 pole Auto-Reclosing.

Each Line Protection relays starts both MAIN & other connected Circuit Breakers to trip for the Concerned line. After a Successful reclosure of the Main Breaker, The Tie Breaker will be reclosed after a supplementary time delay. Should the Main CB Auto- Reclosure relay not be successful in its reclosing attempts, the other CB Auto- Reclosure is blocked. If the Main CB is Open or its Auto-Reclosure Relay is not ready or Out of service, The other CB Auto-Reclosure will reclose this Circuit Breaker after its own dead time without any supplementary time delay.

FEEDER	MAIN AUTO RECLOSURE	FOLLOWER AUTO RECLOSURE
LINE-1	1-52 CB	2-52 CB
LINE-2	2-52 CB	3-52 CB
LINE-3	3-52 CB	4-52 CB
LINE-4	4-52 CB	1-52 CB

AUTO RECLOSURE

➢ CONDITIONS REQUIRED FOR A/R OPERATION

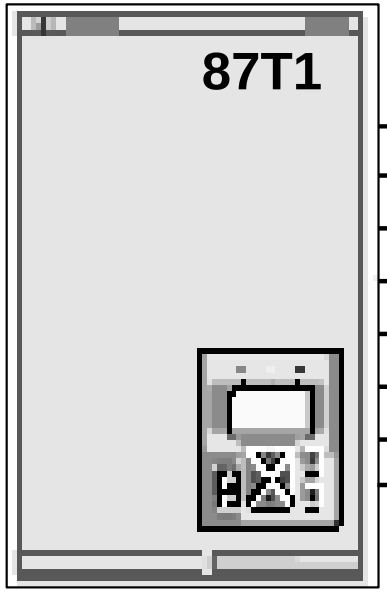
1. CB CLOSE CONDITION.
2. TIME LAPSED MORE THAN RECLAIM TIME.
3. OPERATING PRESSURE OF CB SUITABLE FOR AUTORECLOSURE OPERATION. i.e. CB READY FOR AUTO RECLOSURE SIGNAL FROM CB IS TO BE READY.
4. DC SUPPLY TO AUTORECLOSURE SHOULD BE AVAILABLE.
5. PREPARE 3-PH TRIP RELAY SHOULD BE RELEASED CONDITION.
6. NO BLOCKING SIGNAL TO AUTORECLOSURE RELAY.
7. POLE DISTURBANCE RELAY TIME SHOULD BE MORE THAN TWICE OF DEAD TIME OF AUTO RECLOSURE.
7. CARRIER FAIL SIGNAL SHOULD NOT COME AT BOTH ENDS.
8. CARRIER SWITCH SHOULD BE IN SERVICE CONDITION.
9. SINGLE PHASE & ZONE-1 FAULT ONLY.

➢ AUTO RECLOSURE OPERATION

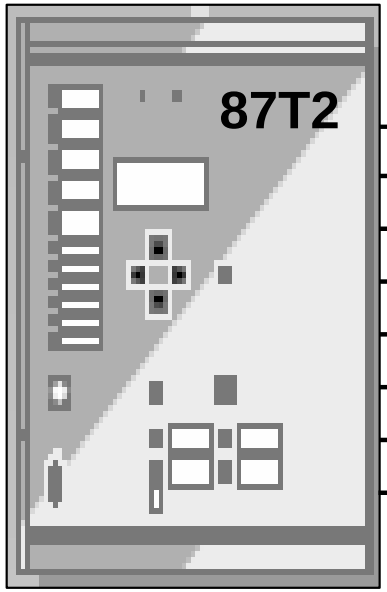
1. TRIP MAIN CB SINGLE POLE.
2. TRIP OTHER CB SINGLE POLE.
3. CLOSE MAIN CB AFTER DEAD TIME.
4. IF A/R SUCCESS FOR MAIN CB THEN AFTER SUPPLEMENTARY TIME DELAY CLOSE OTHER CB.(NORMALLY SUPPLEMENTARY TIME DELAY IS DEAD TIME)
5. IF A/R UNSUCCESS THEN TRIP MAIN & OTHER CBs.
6. IF MAIN CB OPEN CONDITION, THEN NO SUPPLEMENTARY DELAY TIME FOR OTHER CB A/R. IT WILL OPERATE ITs OWN DEAD TIME.

TRANSFORMER PROTECTION

(DIFFERENCIAL PROTECTION 87T1 & 87T2)



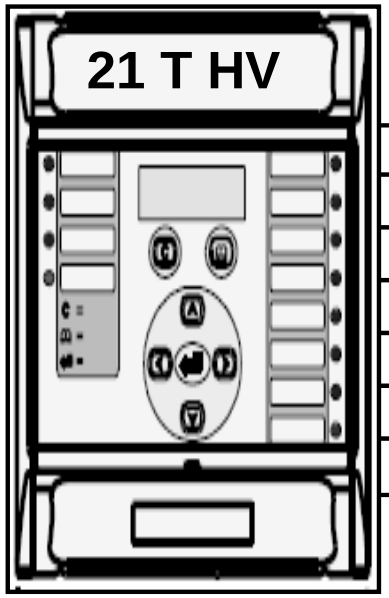
- INITIATE 400KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC(IF AVILABLE) CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)
- TO DISTURBANCE RECORDER



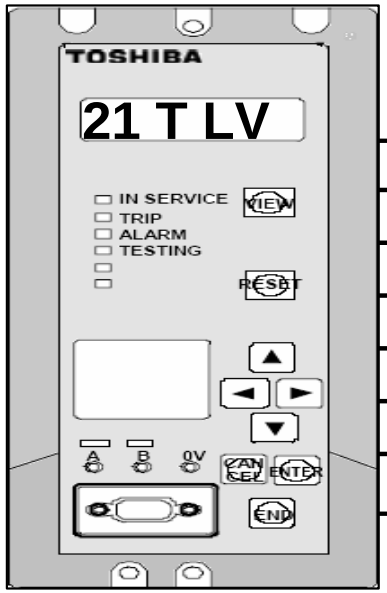
- INITIATE 400KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC(IF AVAILABLE) CB GR-B 3-PH TRIP UNIT(INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)
- TO DISTURBANCE RECORDER

TRANSFORMER PROTECTION

(BACKUP IMPEDANCE PROTECTION FOR HV & LV)



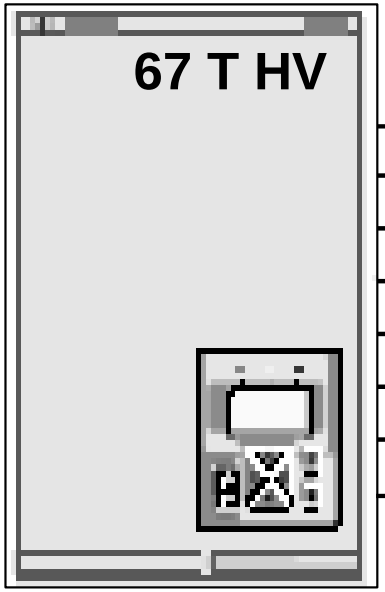
- INITIATE 400KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB (IF AVAILABLE)GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)
- TO DISTURBANCE RECORDER



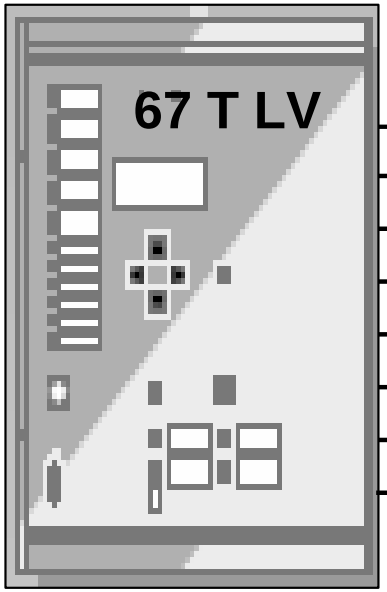
- INITIATE 400KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV TIE CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB (IF AVAILABLE)GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)
- TO DISTURBANCE RECORDER

TRANSFORMER PROTECTION

(BACKUP DIRECTIONAL O/L & E/F PROTECTION FOR HV & LV)



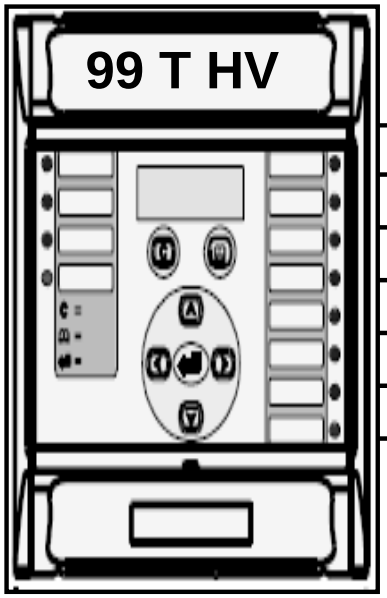
- INITIATE 400KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB(IF AVAILABLE) GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)
- TO DISTURBANCE RECORDER



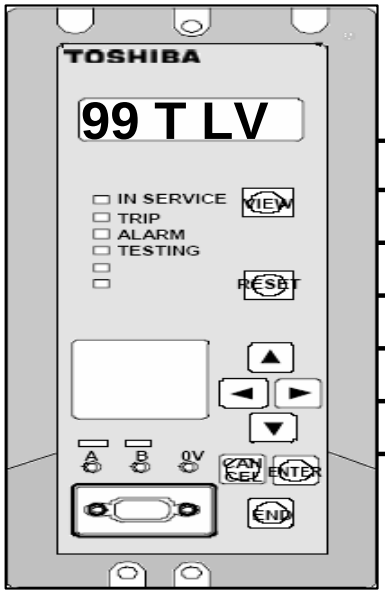
- INITIATE 400KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB(IF AVAILABLE) GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)
- TO DISTURBANCE RECORDER

TRANSFORMER PROTECTION

(OVER FLUX PROTECTION FOR HV & LV)

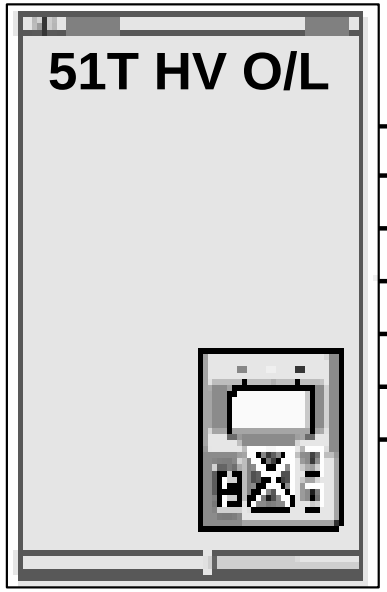


- INITIATE 400KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB (IF AVAIALABLE)GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)

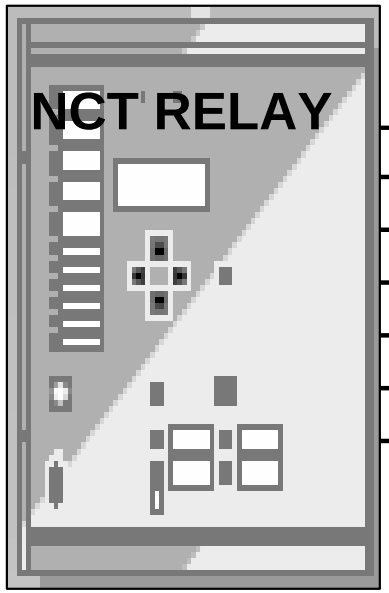


- INITIATE 400KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB(IF AVAIALABLE) GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)

TRANSFORMER PROTECTION

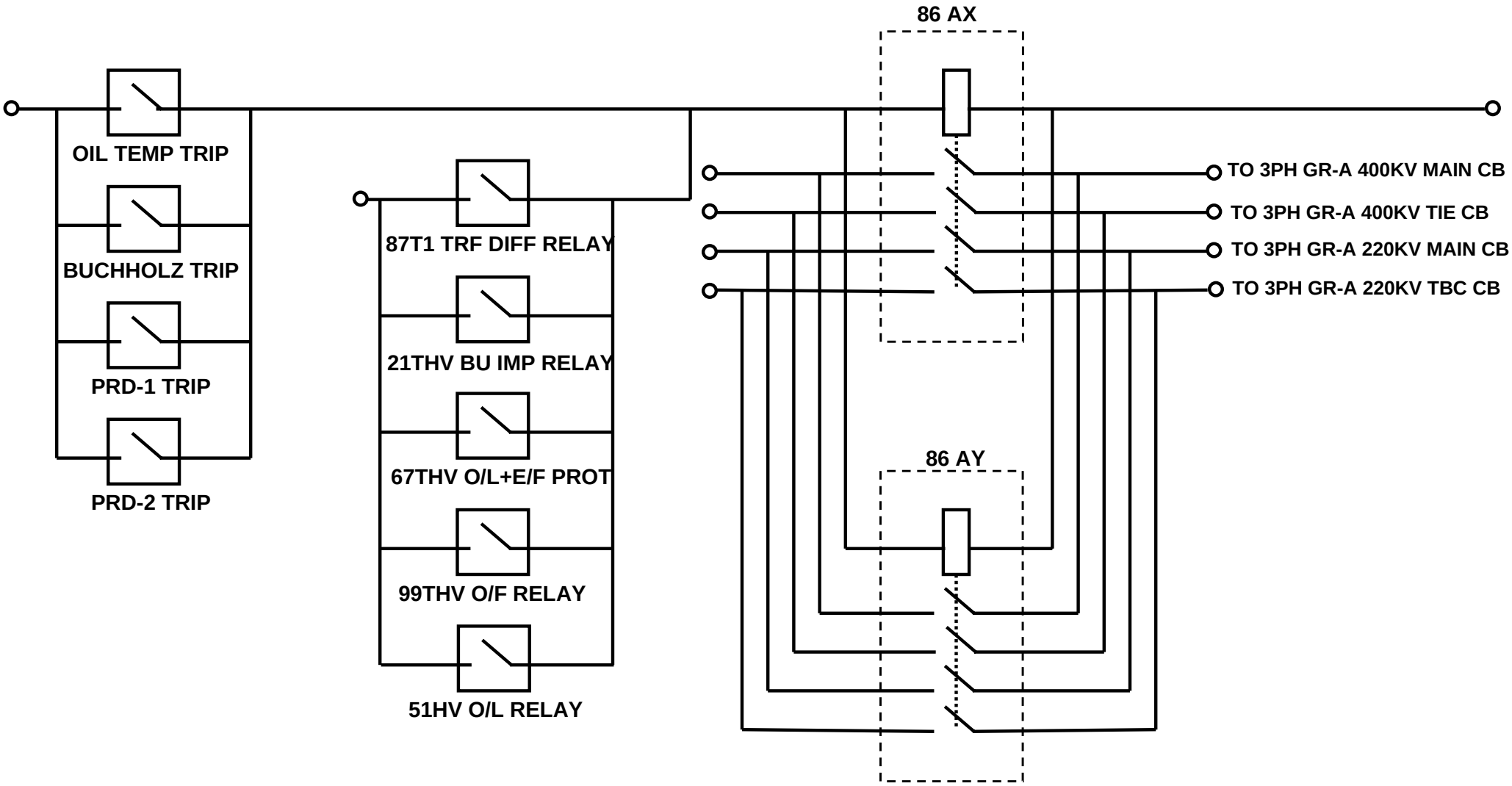


- INITIATE 400KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB(IF AVAILABLE) GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)

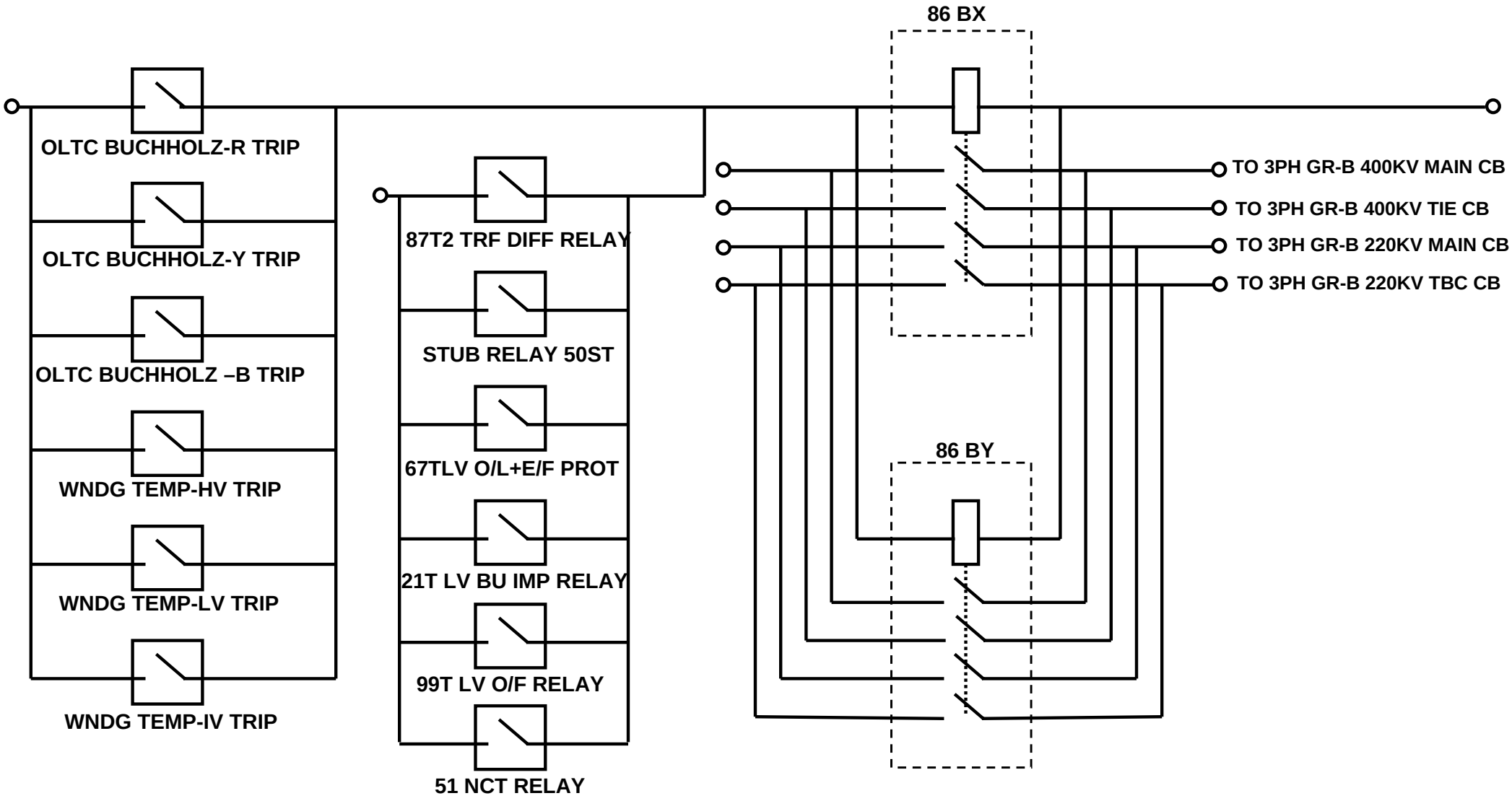


- INITIATE 400KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 400KV OTHER CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV MAIN CB GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE 220KV TBC CB (IF AVAIALABLE)GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO EVENT RECORDER (SOE/ SCADA)

TRANSFORMER TROUBLES TRIPPING GR-A



TRANSFORMER TROUBLES TRIPPING GR-B



STUB-1/ STUB-2 PROTECTION

WHEN A LINE IS SUPPLIED VIA TWO CIRCUIT BREAKERS IN A MESH / RING SYSTEM ARRANGEMENT, THE LINE PROTECTION INCLUDES THE AREA BETWEEN THE TWO CT's.

HOWEVER, WHEN THE LINE ISOLATOR IS OPEN, THE LINE CVT's FOR THE DISTANCE PROTECTION, ARE CONNECTED TO THE LINE AND CANNOT PROVIDE THE CORRECT VOLTAGE FOR THE STUB END.(i.e THE AREA BETWEEN THE LINE ISOLATOR AND CT's) (STUB = DEAD END)

TO PROVIDE PROTECTION FOR A FAULT IN THIS AREA, LINE / TRANSFORMER MAIN PROTECTIONS 87L / 21L / 87T / 21T / 67T IS PROVIDED WITH A STUB PROTECTION WHICH GIVES AN BUS OVER CURRENT TRIP IF THE LINE ISOLATOR IS OPEN AND THE CURRENT EXCEEDS THE SET VALUE IN ANY PHASE.

IN CASE OF RING / MESH SYSTEM ONE CT FOR BREAKER SYSTEM / TWO CTs FOR BREAKER SYSTEM THIS IS APPLICABLE.

Out going isolator opens	MAIN PROTECTIONS	WHEN FAULT OCCURS
LINE-1 ISO 1-89L OPENS	87L1/21L1 CONVERTS TO STUB-1 87L2/21L2 CONVERTS TO STUB-2	1-52 CB TRIPS 2-52 CB TRIPS
LINE-2 ISO 2-89L OPENS	87L1/21L1 CONVERTS TO STUB-1 87L2/21L2 CONVERTS TO STUB-2	2-52 CB TRIPS 3-52 CB TRIPS
ICT-1 ISO 4-89T OPENS	87T1 CONVERTS TO STUB-1 21T/67T CONVERTS TO STUB-2	4-52 CB TRIPS 1-52 CB TRIPS
ICT-2 ISO 3-89T OPENS	87T1 CONVERTS TO STUB-1 21T/67T CONVERTS TO STUB-2	4-52 CB TRIPS 3-52 CB TRIPS

TEED-1/ TEED-2 PROTECTION

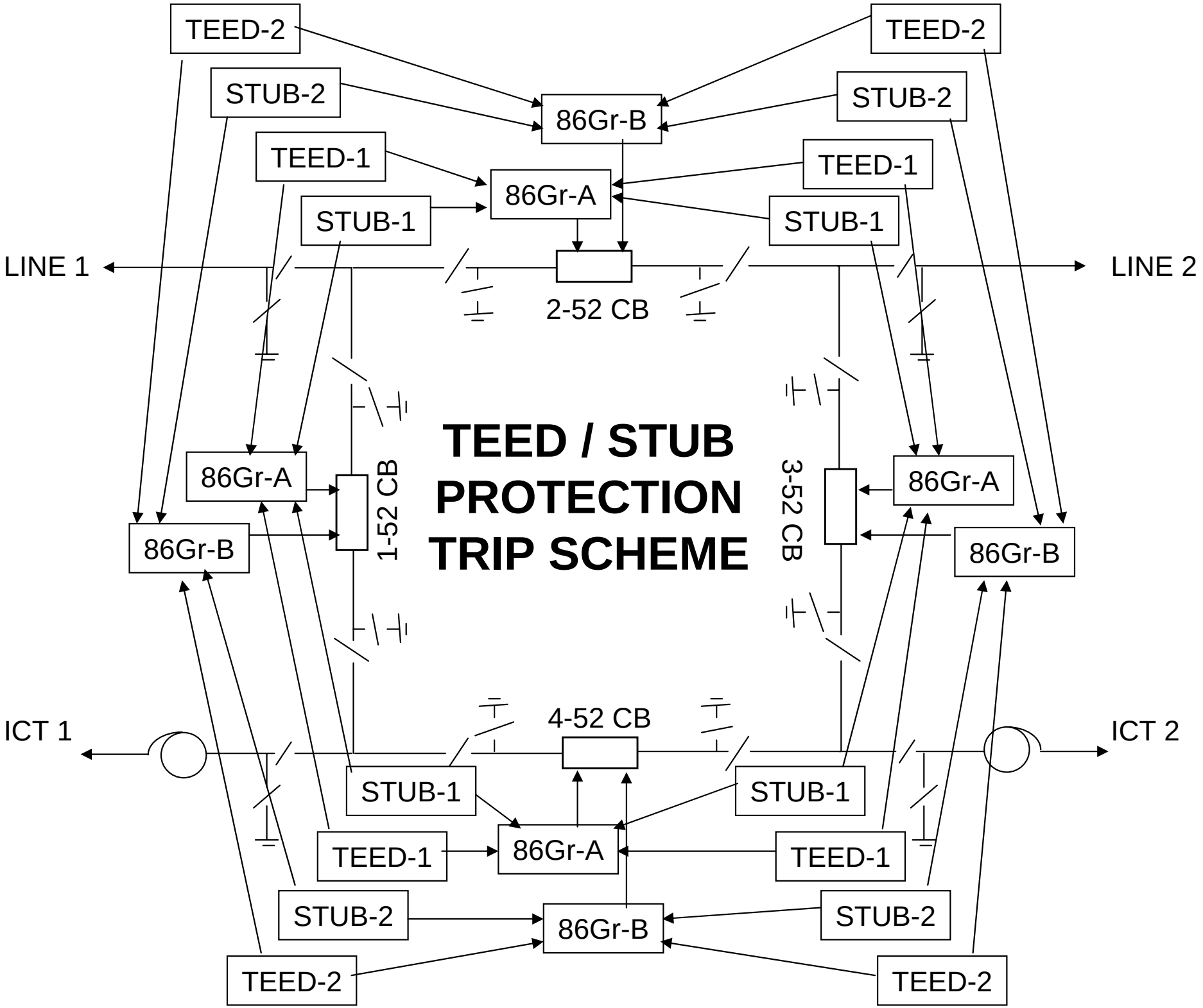
TEED PROTECTION IS BASED ON KIRCHOFF'S CURRENT LAW. THREE SETS OF CTs AT LINE & AT CBs PHYSICALLY PLACED IN A T-SHAPE AND ARE CONNECTED TO DIFFERENTIAL RELAY. THE FAULT OCCURRED IN BETWEEN THESE THREE CTs IS DETECTED BY TEED DIFFERENTIAL RELAYS. IN TEED PROTECTION SUM OF THE CURRENTS MUST BE ZERO. IF ANY UNBALANCE CURRENTS ARE NOTICED THEN IMMEDIATELY TEED PROTECTION OPERATES.

IN CASE OF RING / MESH SYSTEM, CT IS PROVIDED AFTER LINE / TRANSFORMER ISOLATOR, THIS IS APPLICABLE.

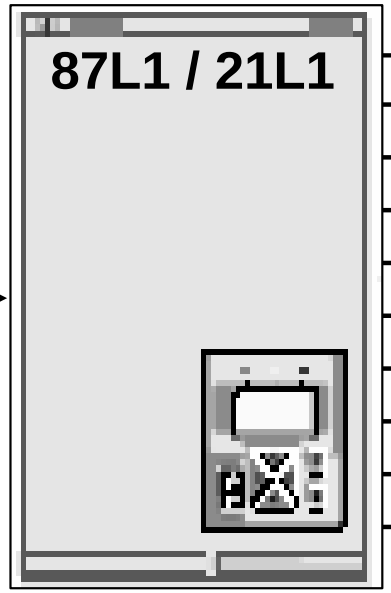
TEED-1 PROTECTION IS HIGH IMPEDANCE CIRCULATING CURRENT PROTECTION.

TEED-2 PROTECTION IS LOW IMPEDANCE %BIASED DIFFERENTIAL CURRENT PROTECTION.

TEED PROTECTIONS	WHEN FAULT OCCURS
TEED – 1 PROTECTION (BAY1 & BAY2 & LINE-1)	1-52 CB TRIPS
TEED – 2 PROTECTION (BAY1 & BAY2 & LINE-1)	2-52 CB TRIPS
TEED – 1 PROTECTION (BAY2 & BAY3 & LINE-2)	2-52 CB TRIPS
TEED – 2 PROTECTION (BAY2 & BAY3 & LINE-2)	3-52 CB TRIPS
TEED – 1 PROTECTION (BAY3 & BAY4 & ICT-2)	3-52 CB TRIPS
TEED – 2 PROTECTION (BAY3 & BAY4 & ICT-2)	4-52 CB TRIPS
TEED – 1 PROTECTION (BAY4 & BAY1 & ICT-1)	4-52 CB TRIPS
TEED – 2 PROTECTION (BAY4 & BAY1 & ICT-1)	1-52 CB TRIPS

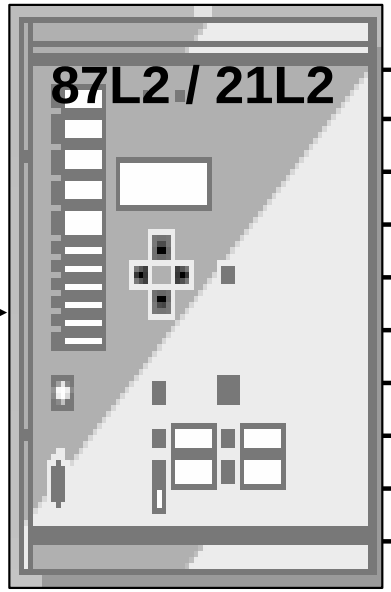

TEED-2
TEED-2
STUB-2
STUB-2
86Gr-B
TEED-1
TEED-1
86Gr-A
STUB-1
STUB-1
LINE 1
LINE 2
2-52 CB
TEED / STUB
PROTECTION
TRIP SCHEME
86Gr-A
1-52 CB
3-52 CB
86Gr-A
86Gr-B
86Gr-B
4-52 CB
ICT 1
ICT 2
STUB-1
STUB-1
TEED-1
86Gr-A
TEED-1
STUB-2
86Gr-B
STUB-2
TEED-2
TEED-2

STUB PROTECTION



LINE /AT/F ISOLATOR OPENS

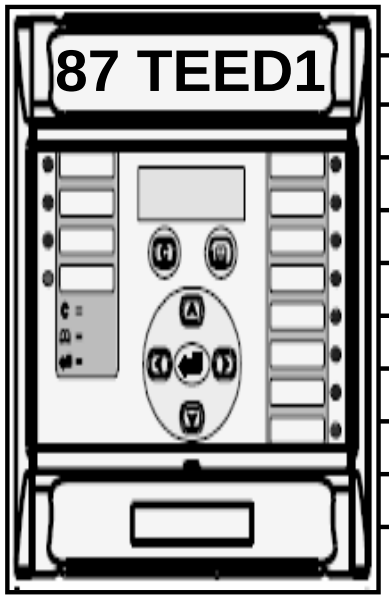
- INITIATE MAIN CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CLOSE INTERLOCK OF MAIN CB THROUGH 86Gr-A
- CLOSE INTERLOCK OF OTHER CB THROUGH 86Gr-A
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)



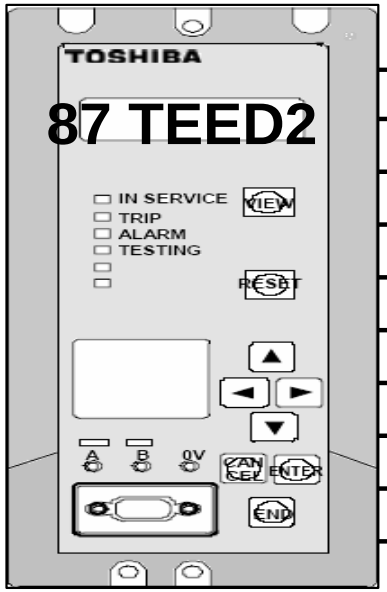
LINE /AT/F ISOLATOR OPENS

- INITIATE MAIN CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CLOSE INTERLOCK OF MAIN CB THROUGH 86Gr-B
- CLOSE INTERLOCK OF OTHER CB THROUGH 86Gr-B
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

TEED PROTECTION

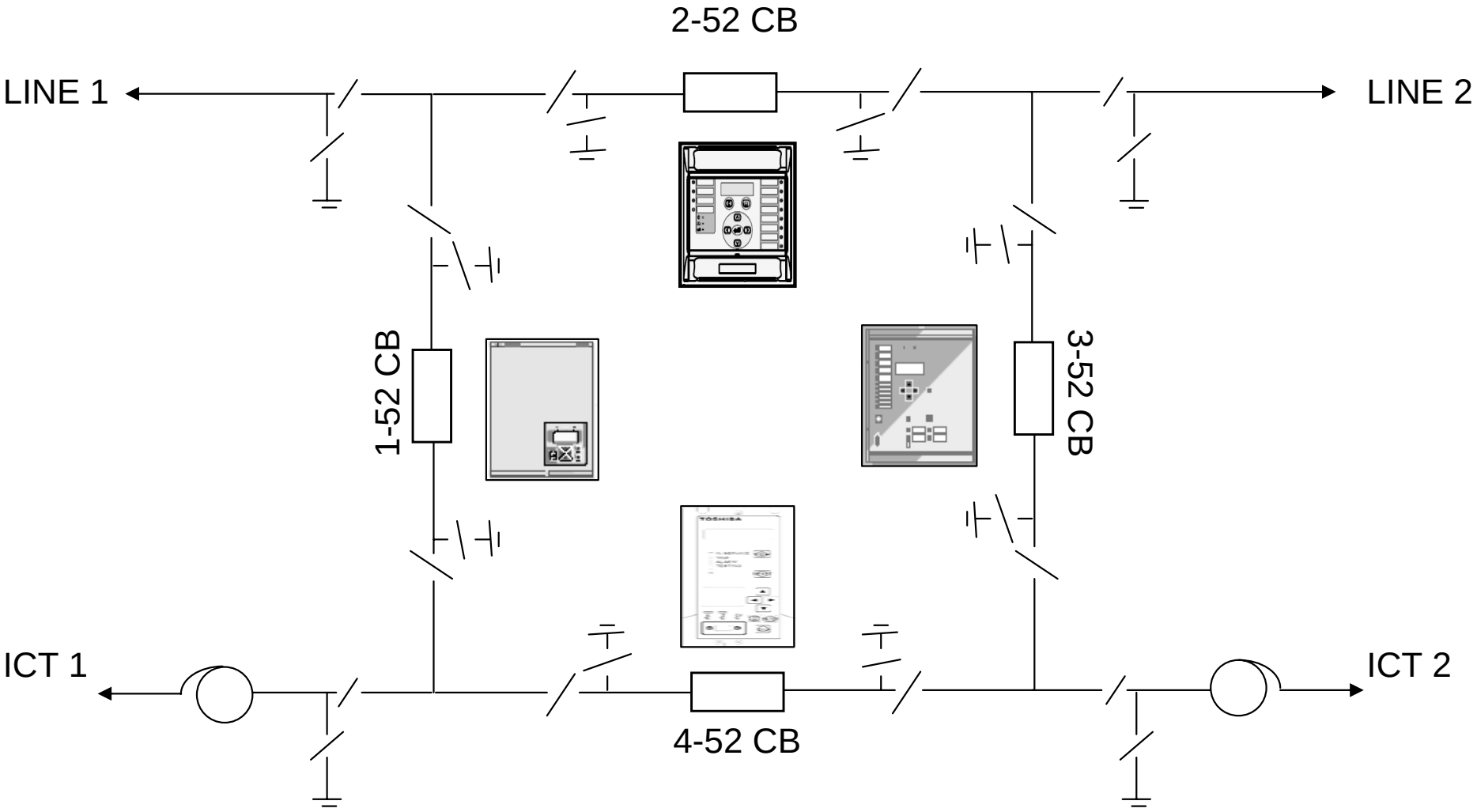


- INITIATE MAIN CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CLOSE INTERLOCK OF MAIN CB THROUGH 86Gr-A
- CLOSE INTERLOCK OF OTHER CB THROUGH 86Gr-A
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)



- INITIATE MAIN CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CLOSE INTERLOCK OF MAIN CB THROUGH 86Gr-B
- CLOSE INTERLOCK OF OTHER CB THROUGH 86Gr-B
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

LBB/BFR LOGIC



LBB/BFR PROTECTION

- **LBB/BFR IS LOCAL BREAKER BACKUP PROTECTION/ BREAKER FAILURE RELAY.**
- **1No RELAY IS PROVIDED FOR EACH BREAKER.**
- **THIS IS CURRENT OPERATED RELAY.**
- **THIS RELAY INITIALISES WHEN**

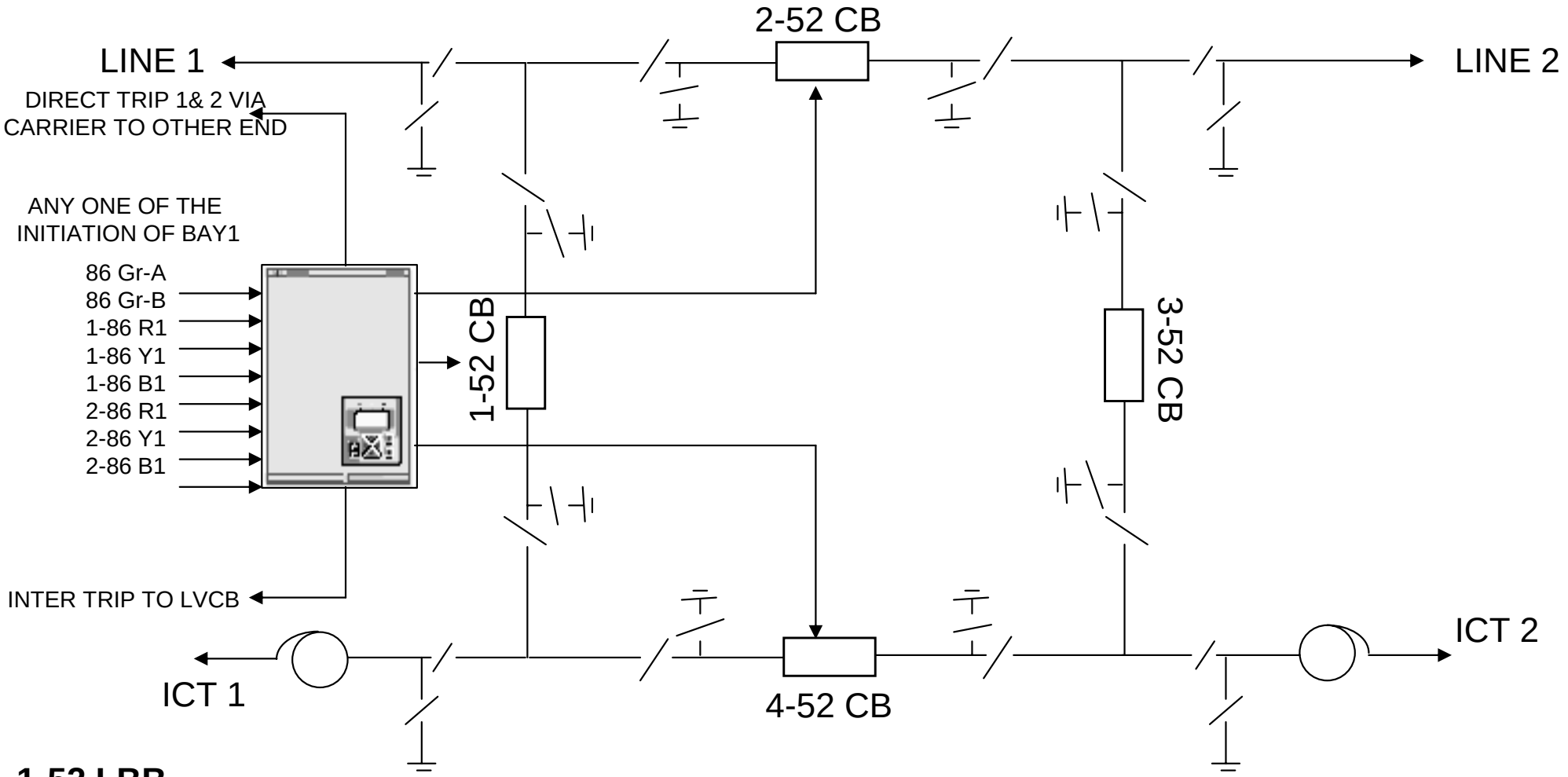
  1. HIGH SPEED MASTER TRIP RELAY 86Gr-A OPERATED.

  2. HIGH SPEED MASTER TRIP RELAY 86Gr-B OPERATED.

  3. HIGH SPEED Gr-A SINGLE PHASE TRIP RELAYS OPERATED. 1-86R1,Y1,B1,R2,Y2,B2.

  4. HIGH SPEED Gr-B SINGLE PHASE TRIP RELAYS OPERATED. 2-86R1,Y1,B1,R2,Y2,B2.
- **IN THIS RELAY TIME DELAY IS PROVIDED.**
- **THIS RELAY OPERATES WHEN THE BREAKER IS UNDER TROUBLE/ FAILS TO OPERATE.**
- **AFTER INITIALISATION TO THE RELAY IMMEDIATELY RELAY TIMER STARTS AND TIME DELAY COMPLETES, THEN STILL INITILISATION IS THERE AND SPECIFIED CURRENT IS THERE, THEN THE RELAY THINKS BREAKER FAIL TO OPERATE AND GIVEN SIGNAL AS PER SCHEME DESCRIBED NEXT PRESENTATION.**
- LBB is not having Separate Trip Relay. In First Attempt it will trip Gr-B Trip Relay of Particular Bay and next it will proceeded accordingly like above. If Separate Trip relay Provides, This initiation also is to be taken to LBB.

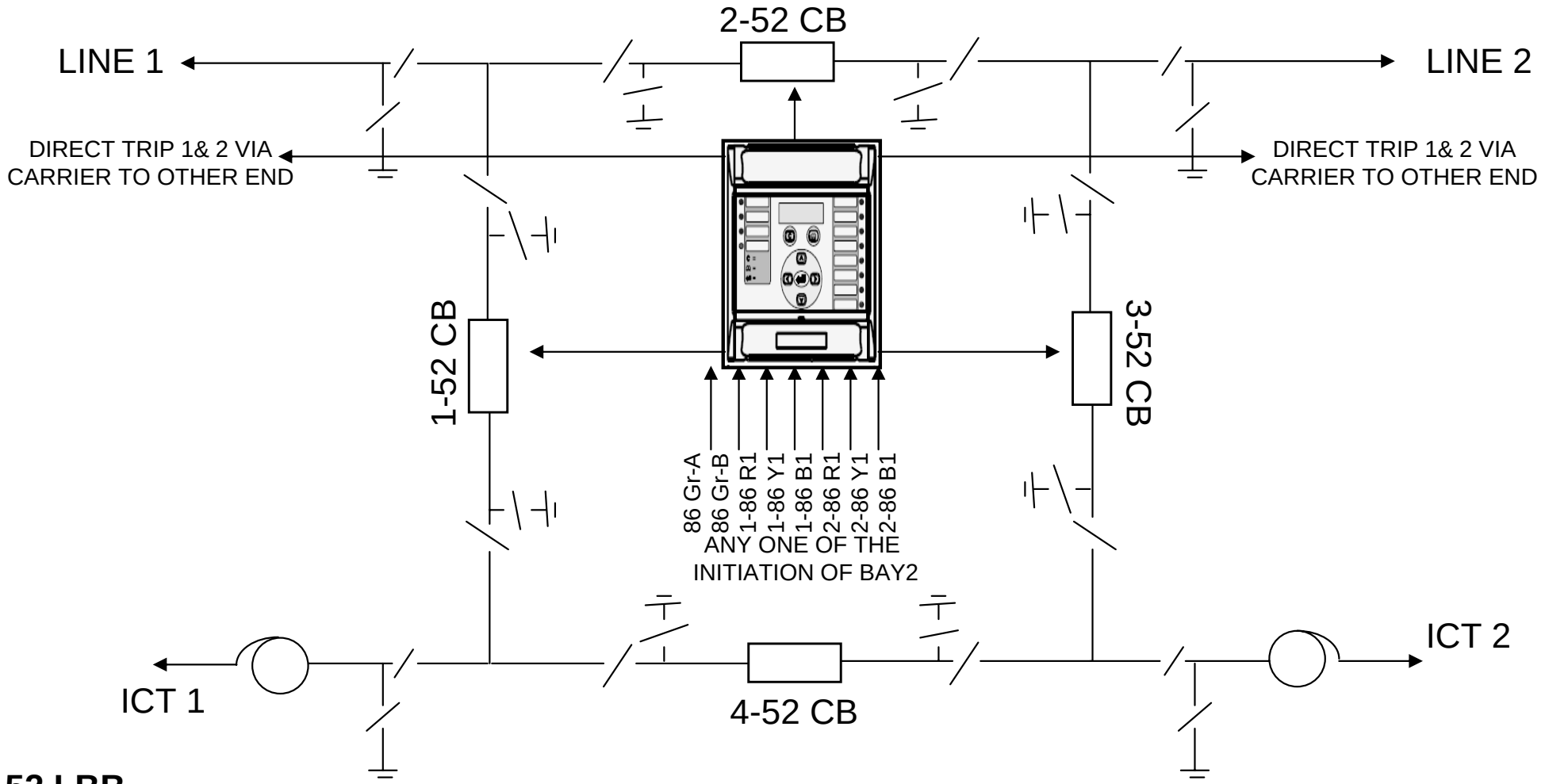
1-52 CB LBB/BFR OPERATION



1-52 LBB

1. First Attempt it is again trying to trip 1-52 CB. Still it is not successful?
2. Second Attempt it trips
    1. 2-52 CB
    2. 4-52 CB
    3. Line1 remote end CB Through Carrier Direct Trip.
    4. ICT 1 LV end CB Through Inter Trip Relay.

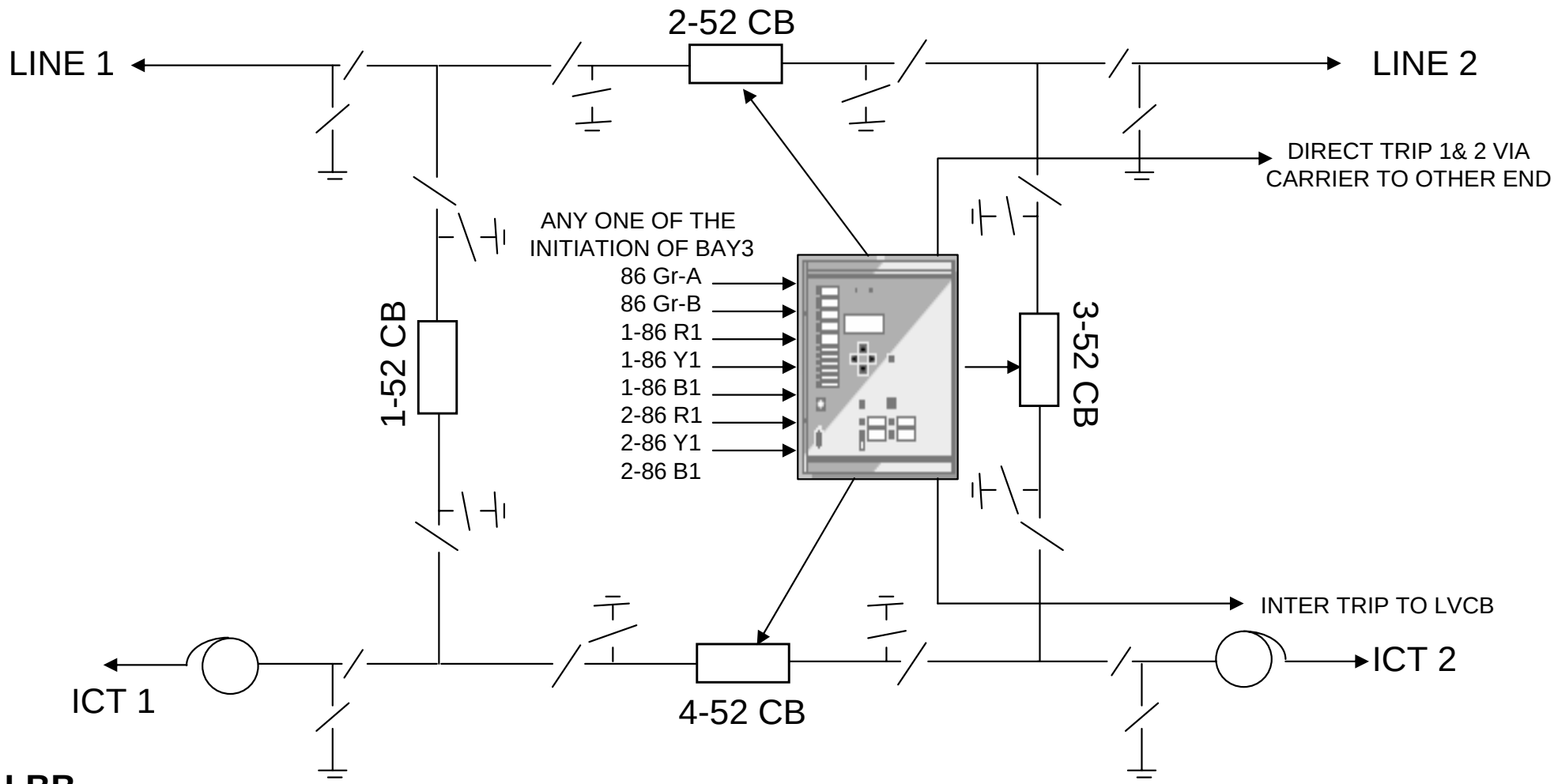
2-52 CB LBB/BFR OPERATION



2-52 LBB

1. First Attempt it is again trying to trip 2-52 CB. Still it is not successful?
2. Second Attempt it trips
    1. 1-52 CB
    2. 3-52 CB
    3. Line1 remote end CB Through Carrier Direct Trip.
    4. Line2 remote end CB Through Carrier Direct Trip..

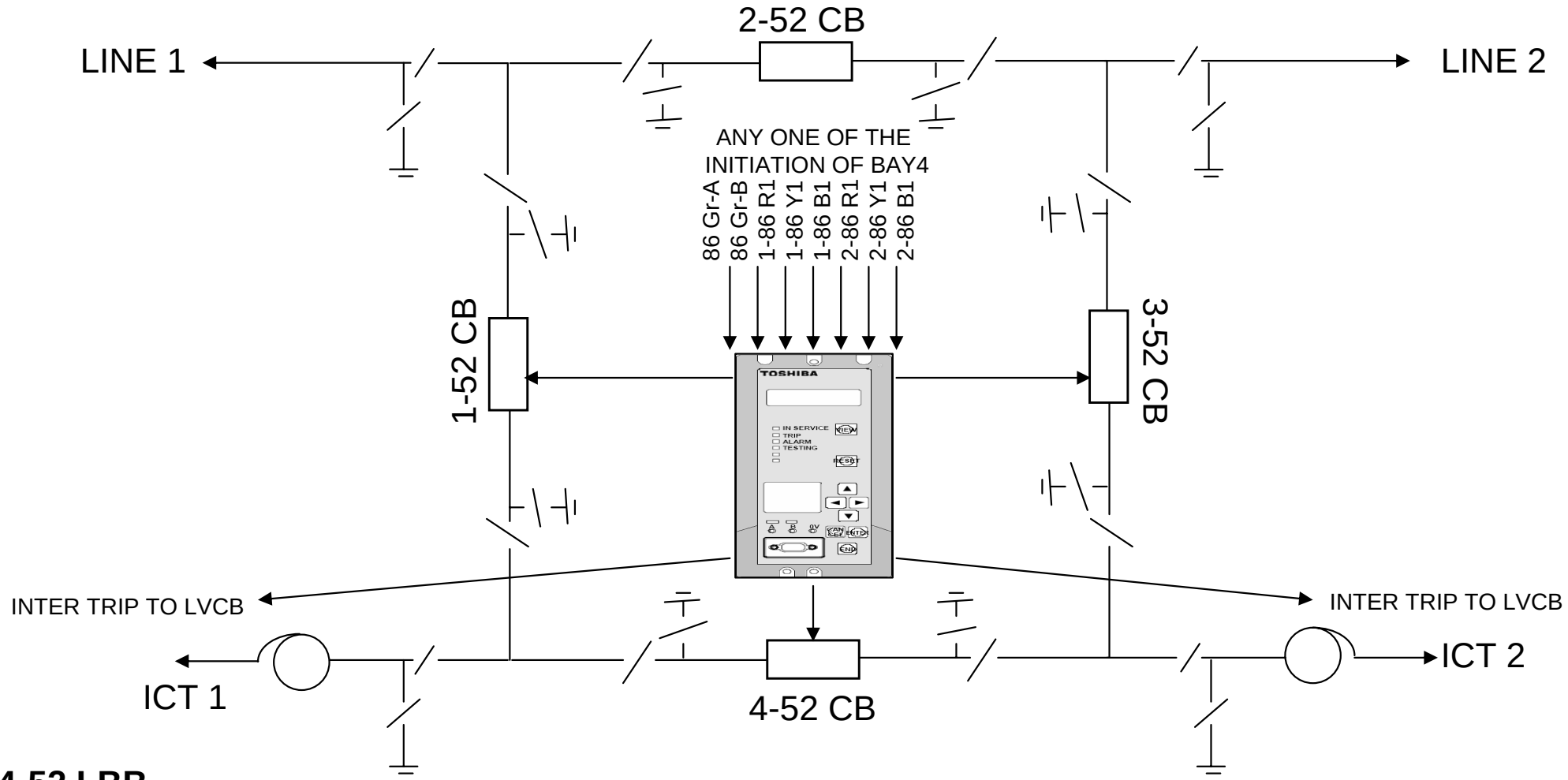
3-52 CB LBB/BFR OPERATION



3-52 LBB

1. First Attempt it is again trying to trip 3-52 CB. Still it is not successful?
2. Second Attempt it trips
    1. 2-52 CB
    2. 4-52 CB
    3. Line2 remote end CB Through Carrier Direct Trip.
    4. ICT 2 LV end CB Through Inter Trip Relay.

4-52 CB LBB/BFR OPERATION



4-52 LBB

1. First Attempt it is again trying to trip 4-52 CB. Still it is not successful?
2. Second Attempt it trips
    1. 3-52 CB
    2. 1-52 CB
    3. ICT 1 LV end CB Through Inter Trip Relay.
    4. ICT 2 LV end CB Through Inter Trip Relay.

LBB / BFR / CBF PROTECTION

INITIATION

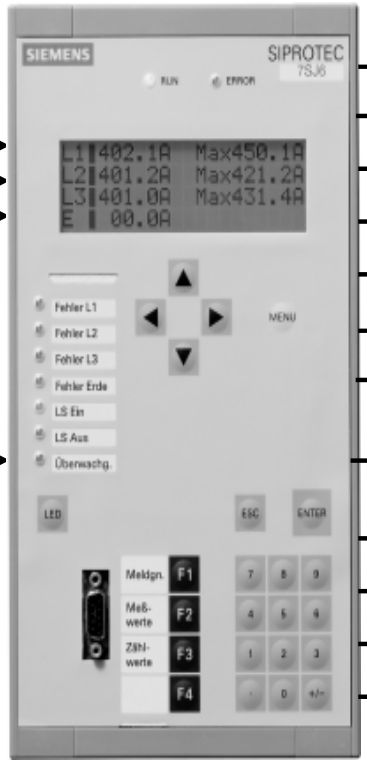
1-PH TRIP RELAYS OF MAIN-1 PROTECTION

1-PH TRIP RELAYS OF MAIN-2 PROTECTION

86-GR-A MASTER TRIP RELAY

86-GR-B MASTER TRIP RELAY

50 Z LBB TRIP RELAY



INITIATE LEFT CB 50Z 3-PH TRIP UNIT (TRIP LEFT CB 3-POLES)

INITIATE RIGHT CB 50Z 3-PH TRIP UNIT (TRIP RIGHT CB 3-POLES)

BLOCK LEFT & RIGHT CBs AUTO RECLOSURE

BLOCK THIS BAY CB AUTO RECLOSURE

CLOSE INTERLOCK OF LEFT & RIGHT CB THROUGH 50Z OPTD

CLOSE INTERLOCK OF THIS BAY CB THROUGH 50Z OPTD

DIRECT TRANSFER TRIP-1 CARRIER SEND TO LEFT & RIGHT TO THIS CB LINES

DIRECT TRANSFER TRIP-2 CARRIER SEND TO LEFT & RIGHT TO THIS CB LINES

INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)

INITIATE ALARM (ANNUNCIATION COME)

TO DISTURBANCE RECORDER (BAY1 & BAY3)

TO EVENT RECORDER (SOE/ SCADA)

DIRECT TRIP SEND CHANNEL-1 & 2

CONDITIONS FOR DIRECT TRIP

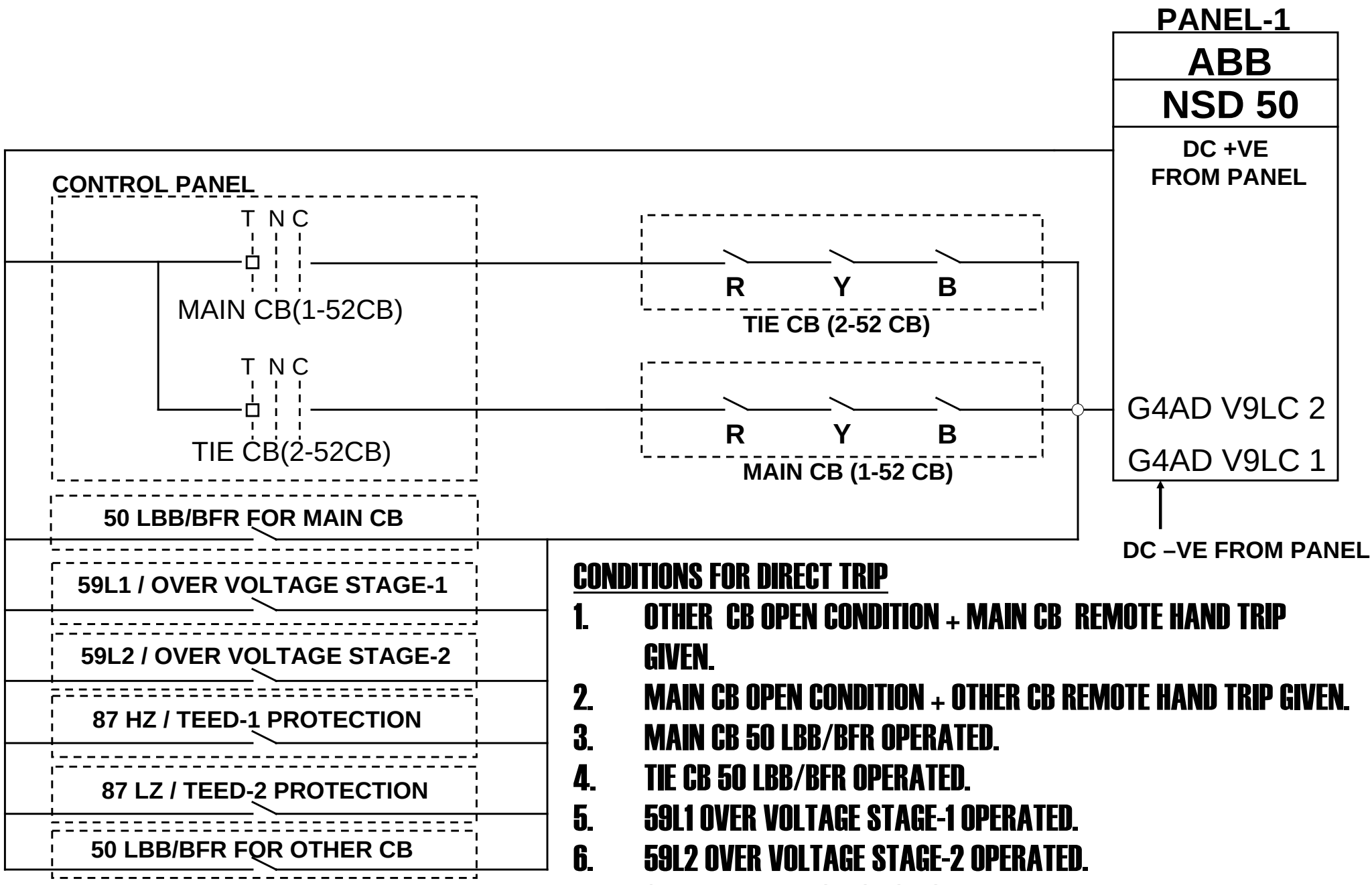
1. OTHER CB OPEN CONDITION + MAIN CB REMOTE HAND TRIP GIVEN.
2. MAIN CB OPEN CONDITION + OTHER CB REMOTE HAND TRIP GIVEN.
3. MAIN CB 50 LBB/BFR OPERATED.
4. OTHER CB 50 LBB/BFR OPERATED.
5. 59L1 OVER VOLTAGE STAGE-1 OPERATED.
6. 59L2 OVER VOLTAGE STAGE-2 OPERATED.
7. 87 HZ TEED-1 PROTECTION OPERATED
8. 87 LZ TEED-2 PROTECTION OPERATED.

IN CASE OF LINE OTHER END TRIPPING THROUGH CARRIER.

IN CASE OF TRANSFORMER OTHER END MEANS LV BREAKER. SO TRIPPINGS ARE DONE PHYSICAL WIRING THROUGH INTER-TRIP RELAYS.

FEEDER	MAIN CB	OTHER CB
LINE-1	1-52 CB	2-52 CB
LINE-2	2-52 CB	3-52 CB
LINE-3	3-52 CB	4-52 CB
LINE-4	4-52 CB	1-52 CB

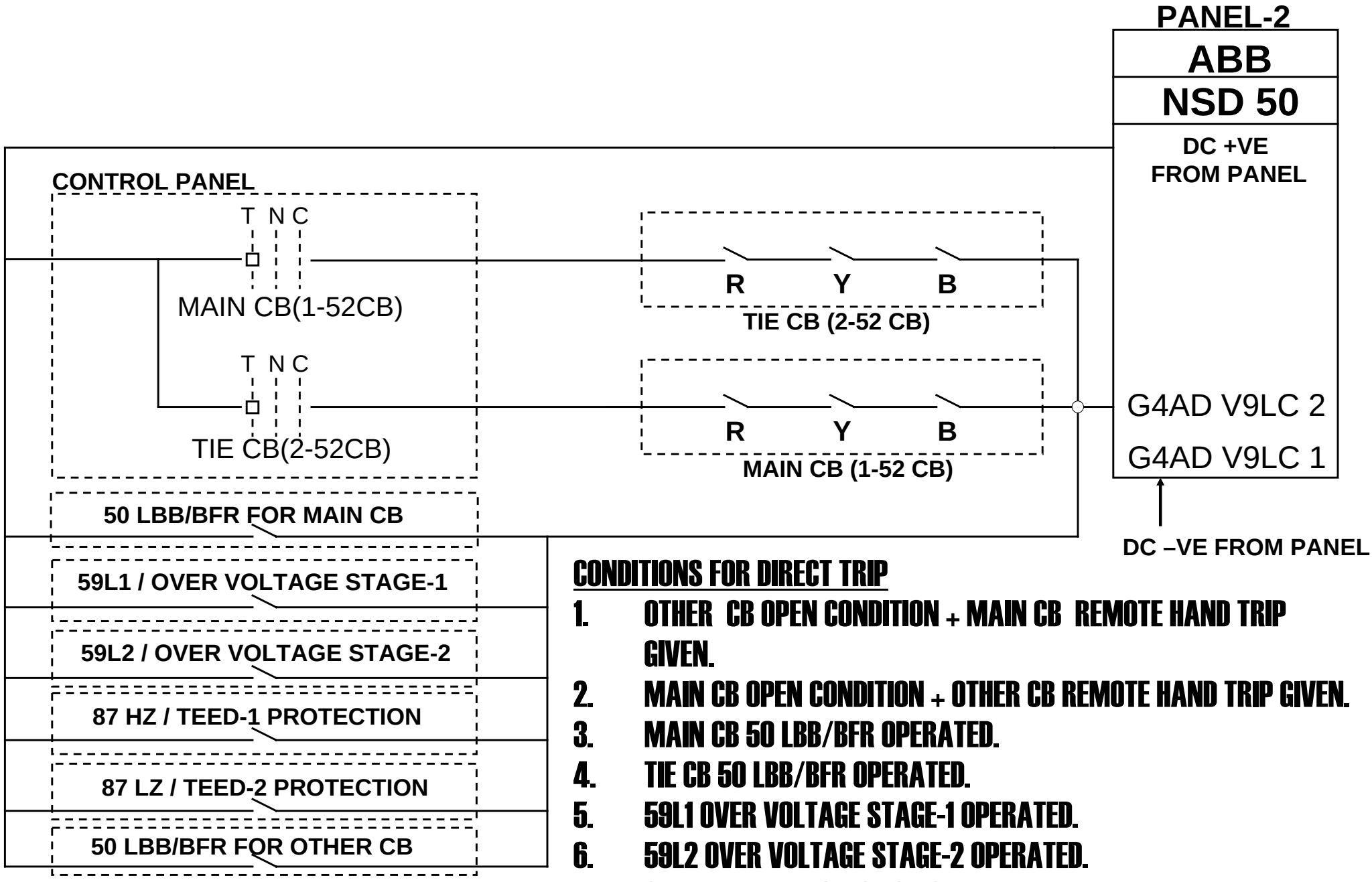
DIRECT TRIP SEND CARRIER CHANNEL-1



CONDITIONS FOR DIRECT TRIP

1. OTHER CB OPEN CONDITION + MAIN CB REMOTE HAND TRIP GIVEN.
2. MAIN CB OPEN CONDITION + OTHER CB REMOTE HAND TRIP GIVEN.
3. MAIN CB 50 LBB/BFR OPERATED.
4. TIE CB 50 LBB/BFR OPERATED.
5. 59L1 OVER VOLTAGE STAGE-1 OPERATED.
6. 59L2 OVER VOLTAGE STAGE-2 OPERATED.
7. 87 HZ TEED-1 PROTECTION OPERATED
8. 87 LZ TEED-2 PROTECTION OPERATED.

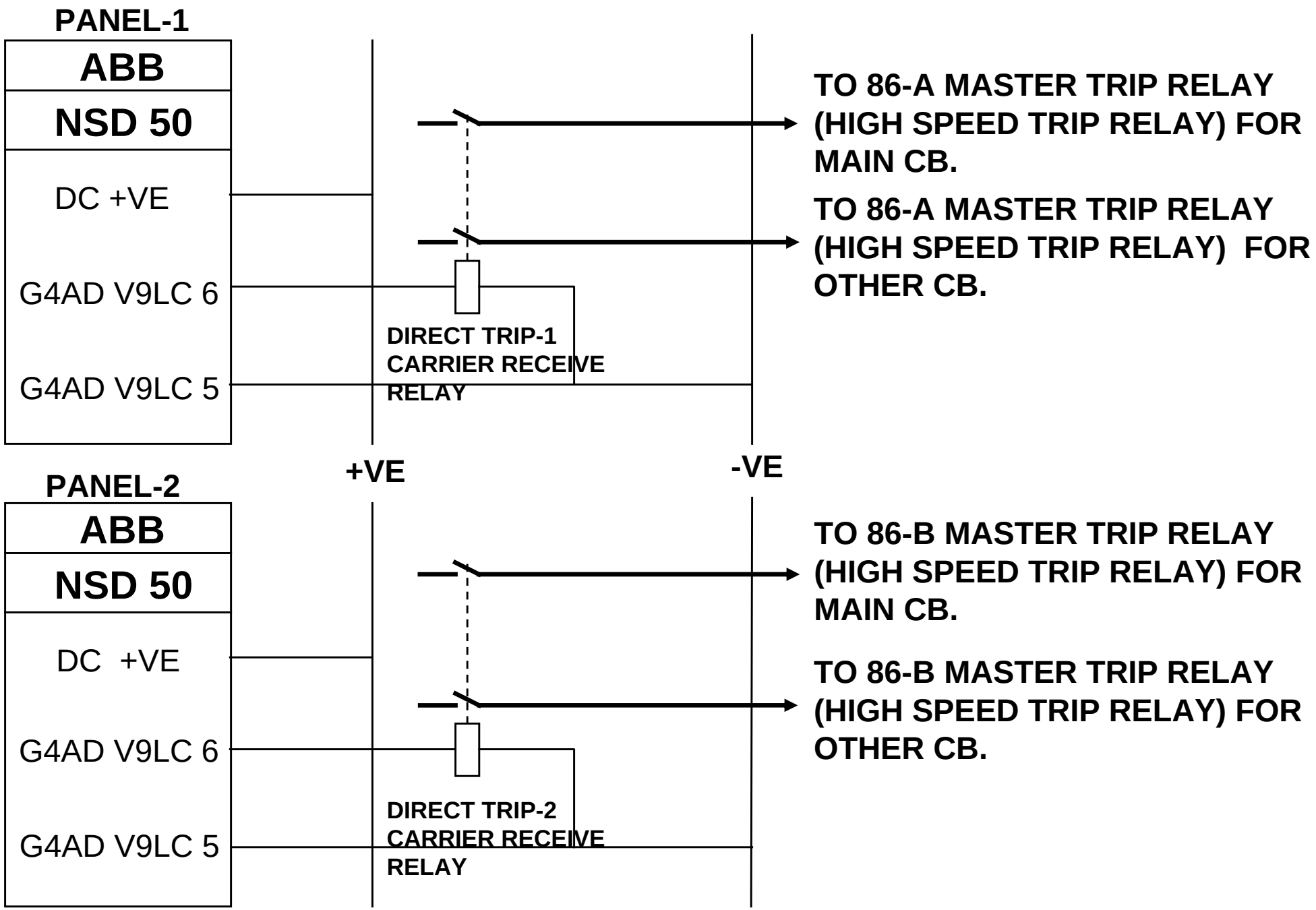
DIRECT TRIP SEND CARRIER CHANNEL-2



CONDITIONS FOR DIRECT TRIP

1. OTHER CB OPEN CONDITION + MAIN CB REMOTE HAND TRIP GIVEN.
2. MAIN CB OPEN CONDITION + OTHER CB REMOTE HAND TRIP GIVEN.
3. MAIN CB 50 LBB/BFR OPERATED.
4. TIE CB 50 LBB/BFR OPERATED.
5. 59L1 OVER VOLTAGE STAGE-1 OPERATED.
6. 59L2 OVER VOLTAGE STAGE-2 OPERATED.
7. 87 HZ TEED-1 PROTECTION OPERATED
8. 87 LZ TEED-2 PROTECTION OPERATED.

DIRECT TRIP RECEIVE CHANNEL-1&2



DIRECT TRANSFER TRIP CHANNEL – 1/2 RECD

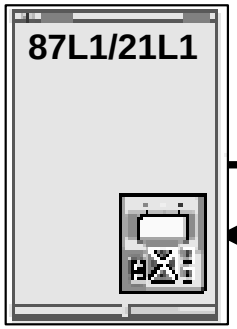
DIRECT TRIP CHANNEL-1 RECEIVED

- INITIATE MAIN CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-A 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CLOSE INTERLOCK OF MAIN CB
- CLOSE INTERLOCK OF OTHER CB
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

DIRECT TRIP CHANNEL-2 RECEIVED.

- INITIATE MAIN CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- INITIATE OTHER CB 86-GR-B 3-PH TRIP UNIT (INTURN IT WILL TRIP 3-POLES)
- BLOCK MAIN CB AUTO RECLOSURE
- BLOCK OTHER CB AUTO RECLOSURE
- CLOSE INTERLOCK OF MAIN CB
- CLOSE INTERLOCK OF OTHER CB
- INITIATE FLAG RELAY (INTURN FLAG RELAY OPERATES)
- INITIATE ALARM (ANNUNCIATION COME)
- TO DISTURBANCE RECORDER
- TO EVENT RECORDER (SOE/ SCADA)

CARRIER TRIPPING SCHEMES(TELEPROTECTION)



CARRIER PROTECTION PANEL-1

PT SEND

PT RECEIVE

PT SEND

PT RECEIVE

DT SEND

DT RECEIVE

DIRECT TRIP SEND CH-1

MAIN CB 86-A

TIE CB 86-A

ONE END

CARRIER PROTECTION PANEL-1

PT SEND

PT RECEIVE

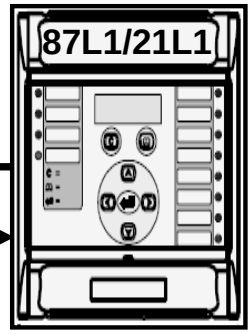
PT SEND

PT RECEIVE

DT SEND

DT RECEIVE

OTHER END

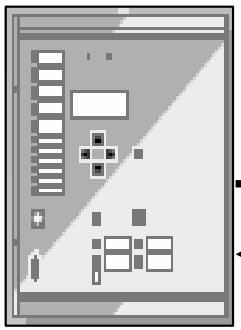


DIRECT TRIP SEND CH-1

MAIN CB 86-A

TIE CB 86-A

87L2/21L2



CARRIER PROTECTION PANEL-2

PT SEND

PT RECEIVE

PT SEND

PT RECEIVE

DT SEND

DT RECEIVE

DIRECT TRIP SEND CH-2

MAIN CB 86-B

TIE CB 86-B

CARRIER PROTECTION PANEL-2

PT SEND

PT RECEIVE

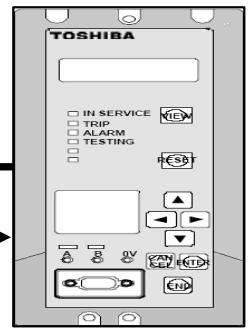
PT SEND

PT RECEIVE

DT SEND

DT RECEIVE

87L2/21L2



DIRECT TRIP SEND CH-2

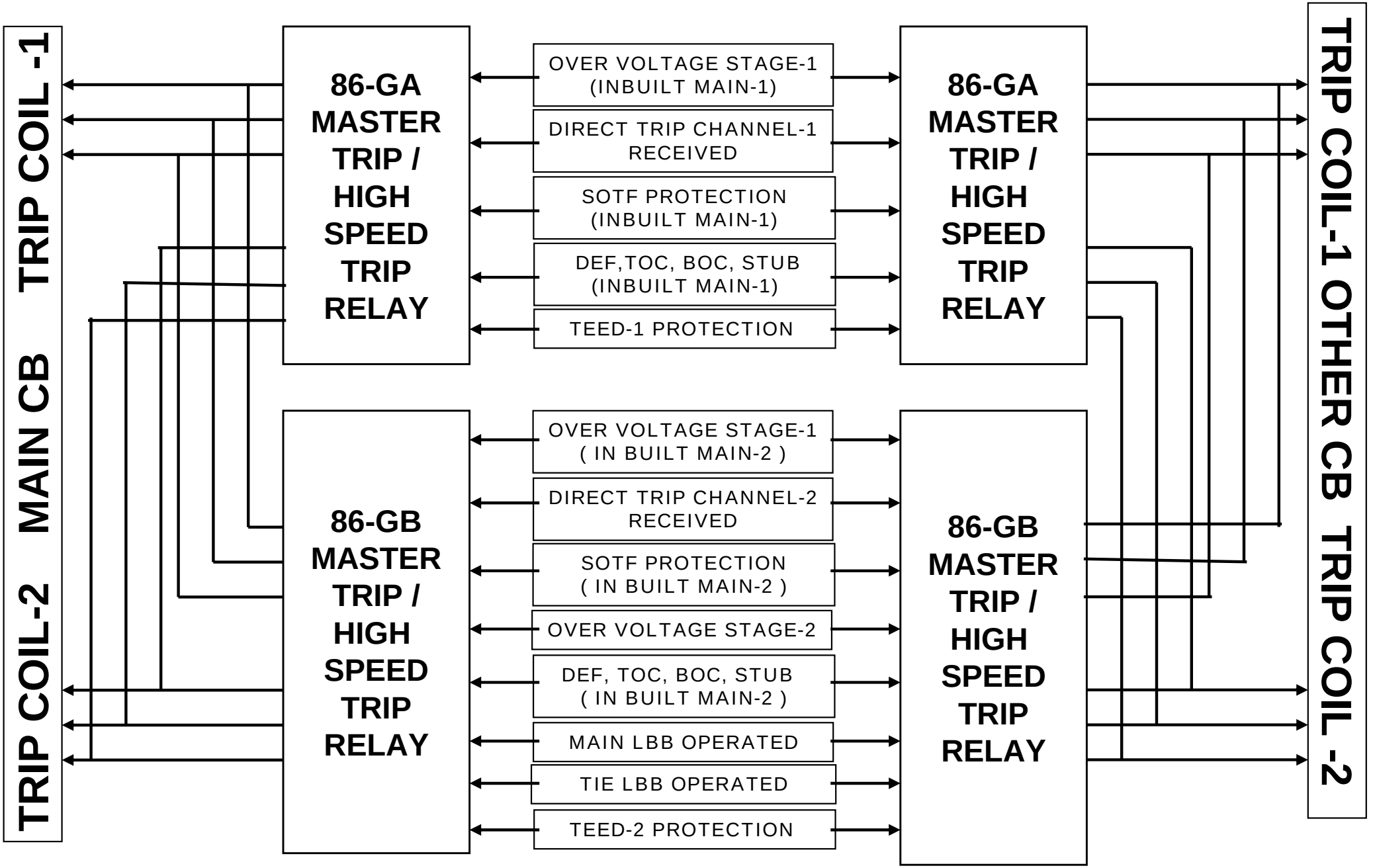
MAIN CB 86-B

TIE CB 86-B

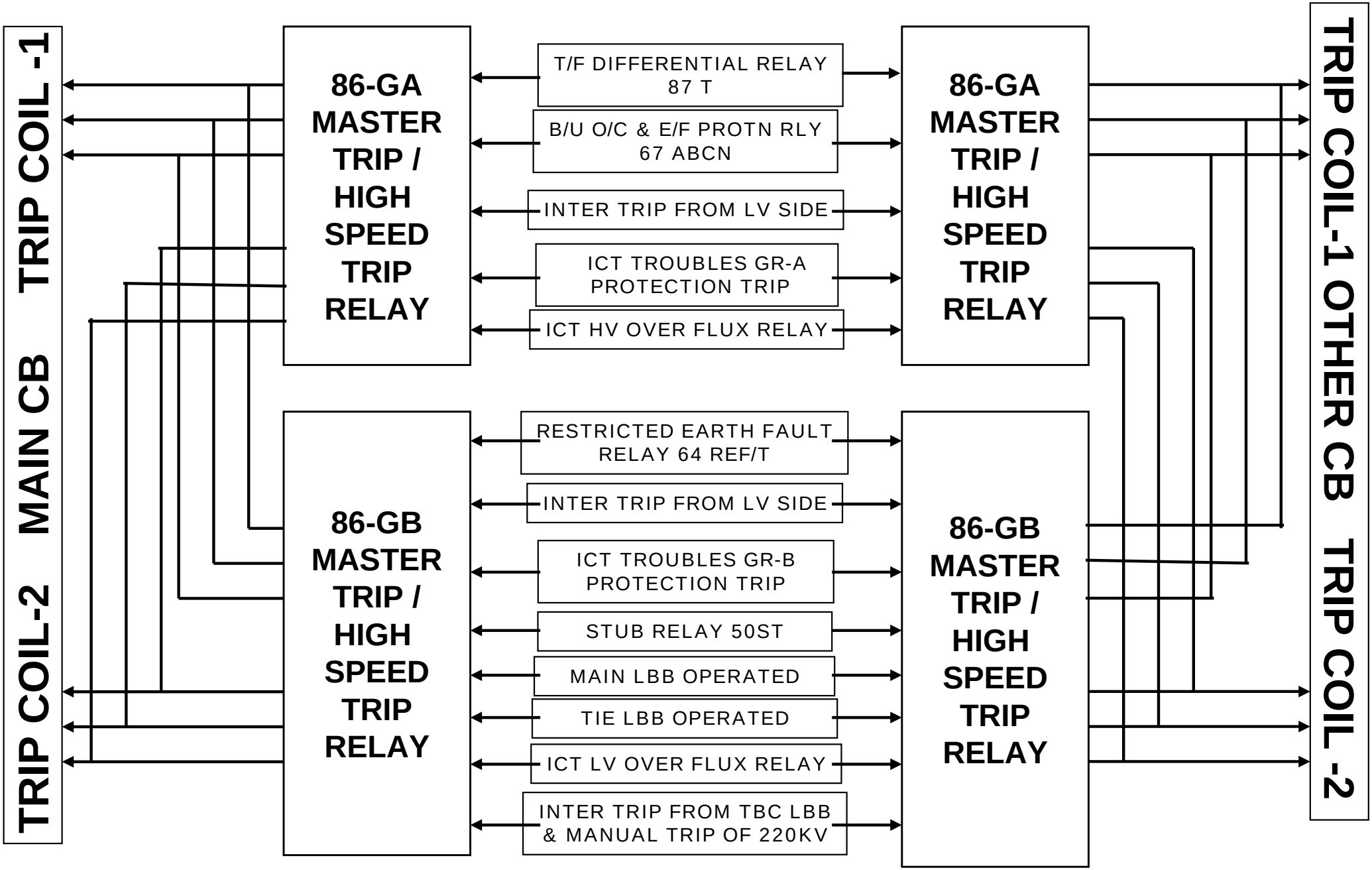
PT : PERMISSIVE PROTECTION TRANSFER TRIP

DT : DIRECT TRANSFER TRIP

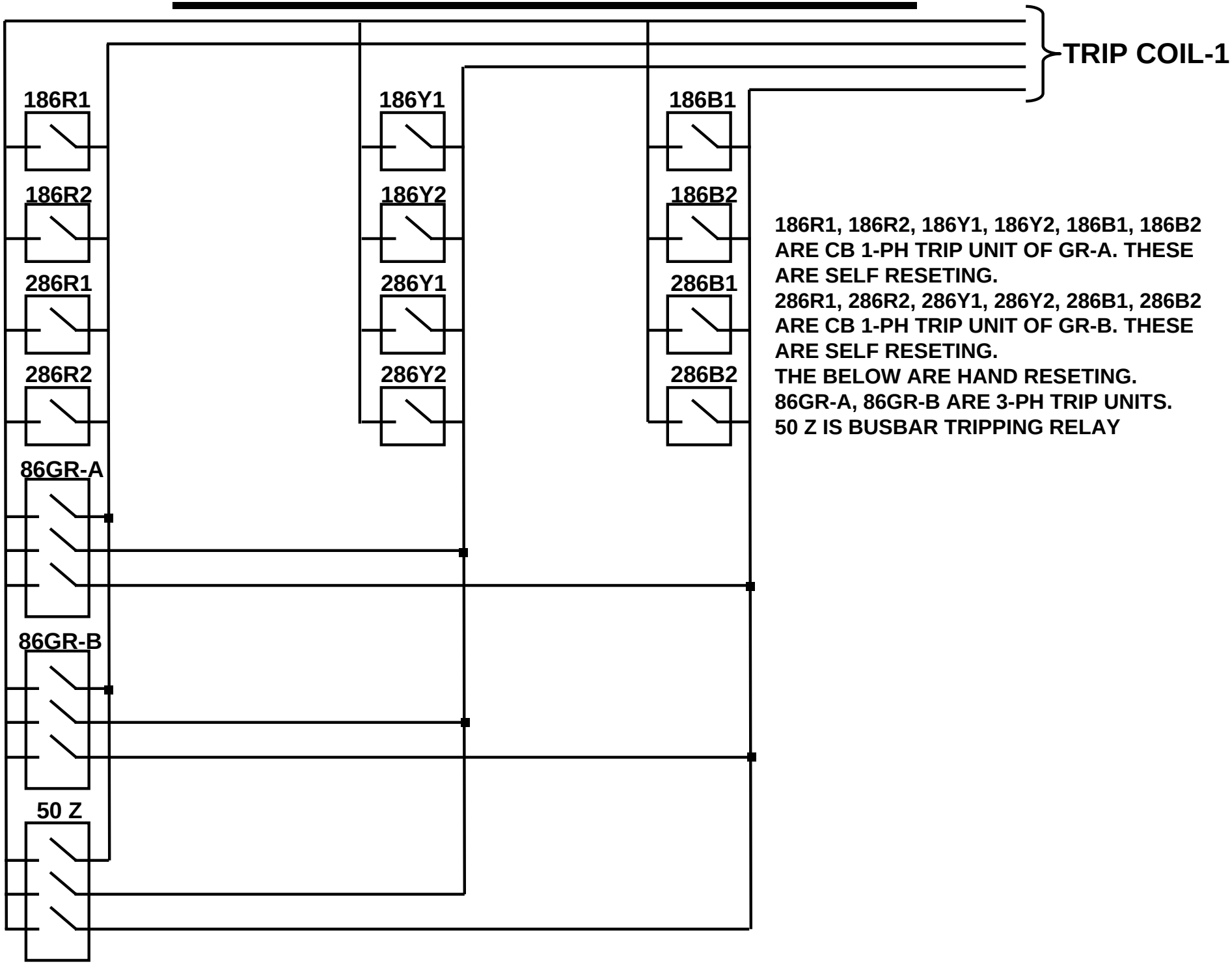
86-GA & 86 GB MASTER TRIP / HIGH SPEED TRIP LOCKOUT RELAY OPERATION



86-GA & 86 GB MASTER TRIP / HIGH SPEED TRIP LOCKOUT RELAY OPERATION



TRIP COIL-1 CIRCUITS



186R1, 186R2, 186Y1, 186Y2, 186B1, 186B2 ARE CB 1-PH TRIP UNIT OF GR-A. THESE ARE SELF RESETING.

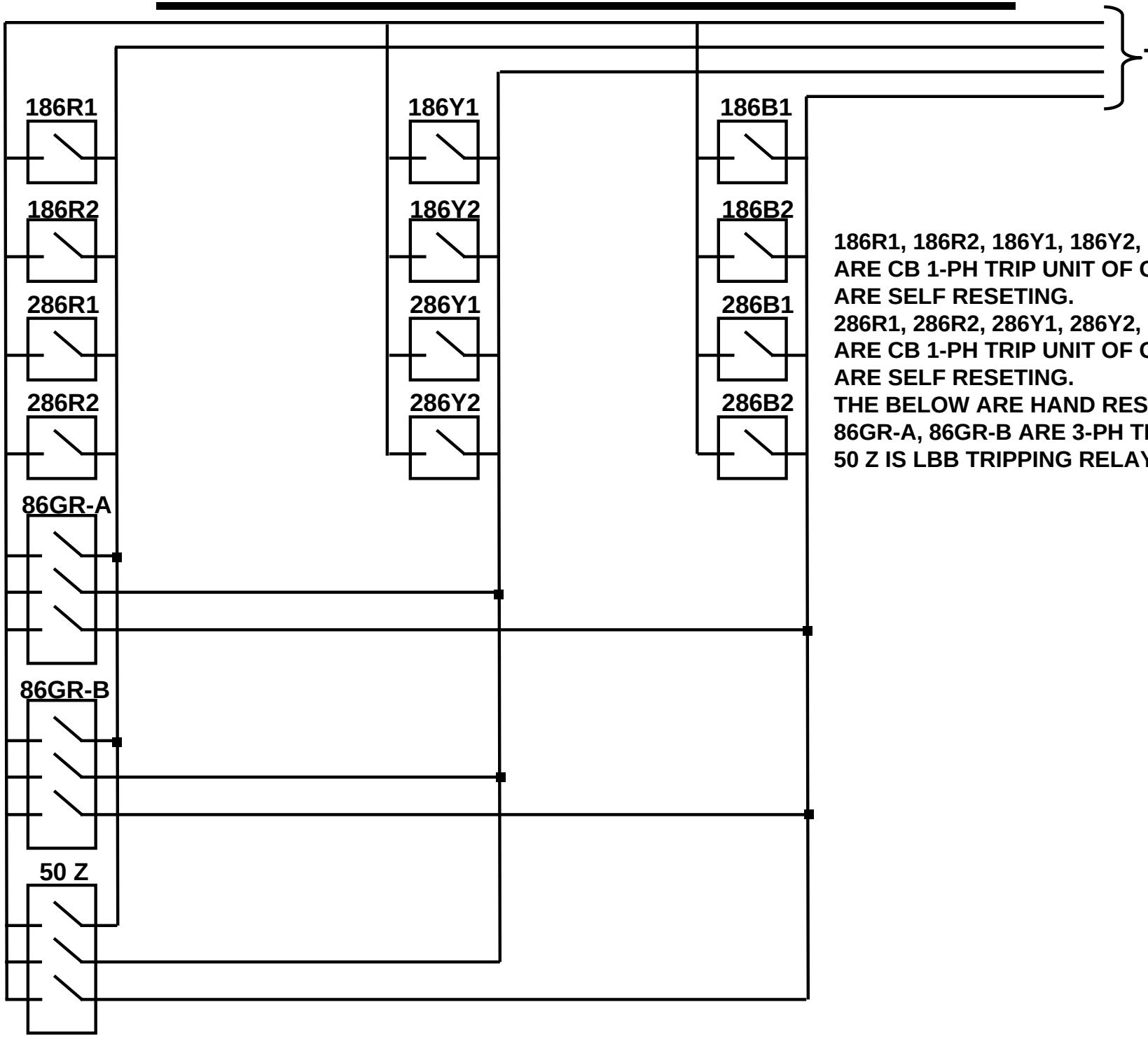
286R1, 286R2, 286Y1, 286Y2, 286B1, 286B2 ARE CB 1-PH TRIP UNIT OF GR-B. THESE ARE SELF RESETING.

THE BELOW ARE HAND RESETING.

86GR-A, 86GR-B ARE 3-PH TRIP UNITS.

50 Z IS BUSBAR TRIPPING RELAY

TRIP COIL – 2 CIRCUITS



186R1, 186R2, 186Y1, 186Y2, 186B1, 186B2 ARE CB 1-PH TRIP UNIT OF GR-A. THESE ARE SELF RESETING.

286R1, 286R2, 286Y1, 286Y2, 286B1, 286B2 ARE CB 1-PH TRIP UNIT OF GR-B. THESE ARE SELF RESETING.

THE BELOW ARE HAND RESETING.

86GR-A, 86GR-B ARE 3-PH TRIP UNITS.

50 Z IS LBB TRIPPING RELAY

INTERLOCKS

WHY INTERLOCKS ARE REQUIRED

1. **PREVENTS HUMAN MISTAKES**

2. **INDEPENDENCY OF REQUIREMENT BETWEEN OPERATION OF CIRCUITS AND INTERLOCKING SHOULD BE KEPT IN MIND TO ACHIEVE HIGHEST POSSIBLE RELIABULITY.**

INTERLOCKS

STANDARD PRACTICE

1. **FOR CB ISOLATION:** CIRCUIT BREAKER HAVING BOTH SIDES ISOLATORS.
2. **FOR LINE/ICT ISOLATION:** LINE / ICT HAVING LINE ISOLATOR.
3. **FOR CB MAINTANENCE:** EACH ISOLATOR HAVING EARTH SWITCH TOWARDS CB SIDE.
4. **FOR LINE / ICT MAINTANENCE:** EACH LINE / ICT HAVING LINE/ICT EARTH SWITCH.

INTERLOCKS

ISOLATORS

1. ISOLATORS ARE NO LOAD SWITCHES. THEY ARE NOT PERMITTED TO BREAK POWER CURRENT OR TO CONNECT DIFFERENT VOLTAGE SYSTEM.
2. MAKING OR BREAKING OF PARALLEL CIRCUITS IS PERMITTED.
3. AN ISOLATOR CONNECTED IN SERIES WITH A CB MAY BE OPERATED WHEN CB IS OPEN AND IF NONE OF ADJACENT EARTH SWITCHES IS CLOSED. EVEN IF ANOTHER ISOLATOR CONNECTED IN SERIES TO THE CB IS OPEN THE ISOLATOR IS NOT ALLOWED TO OPERATED UNLESS THE CB IS OPEN.
4. AN ISOLATOR CONNECTED TO A DUPLICATE BUSBAR OR AUXILIARY BUS MAY BE OPERATED IF

   i) NO LOAD IS CONNECTED AND NON OF THE EARTH SWITCH IS CLOSED.

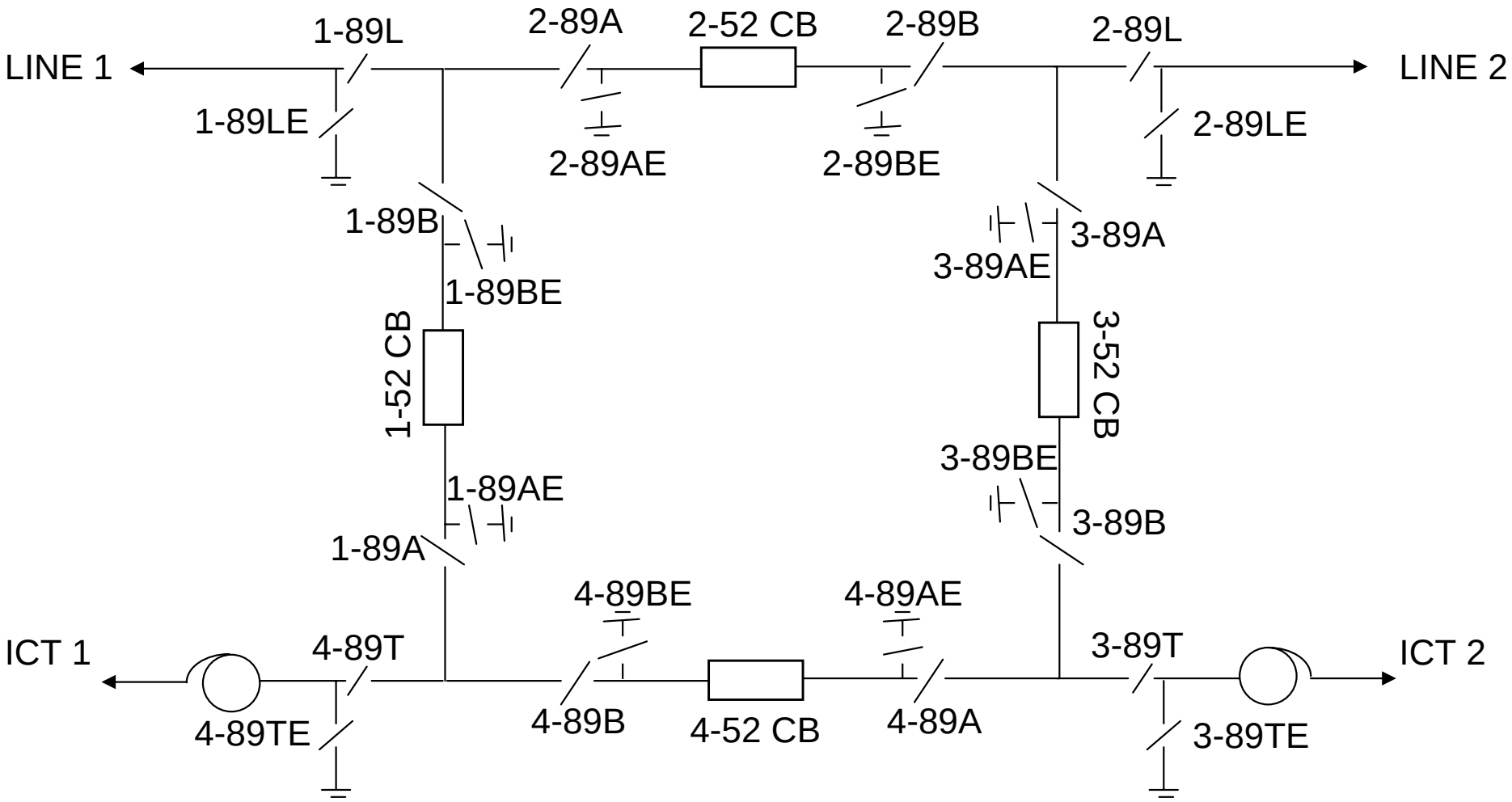
   ii) A PARALLELING CIRCUIT TO THE ISOLATOR IS PRESENT. (ONLY THROUGH THE BUSCOUPLER FOR THE ISOLATORS THAT ARE CONNECTED TO THE TRANSFER BUS.

EARTH SWITCH

1. OPERATED ONLY IF THE ISOLATORS ON BOTH THE SIDES ARE OPEN.
2. EARTH SWITCHES WHICH CAN EARTH AN INCOMING LINE DIRECTLY OR THROUGH A CB CAN BE OPERATED IF AND ONLY IF THE LINE IS DEAD.

MESH / RING SYSTEM

INTERLOCKS

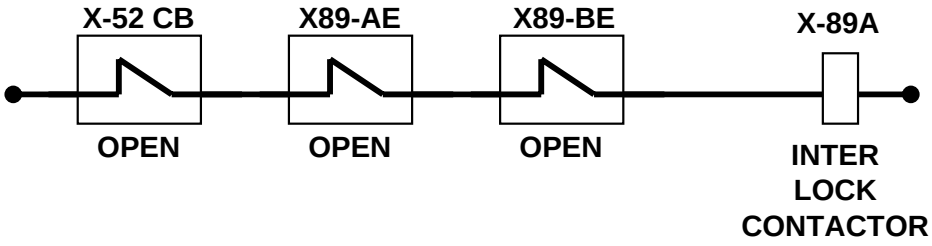


INTERLOCKS

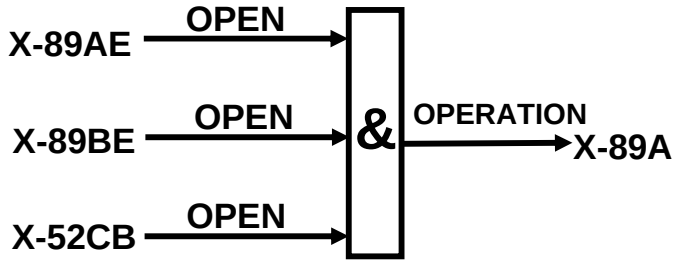
89-A ISOLATOR OPERATION

FOR X-89A ISOLATOR OPERATION:

1. X-52 CB IN OPEN CONDITION.
2. X-89AE EARTH SWITCH OPEN CONDITION.
3. X-89BE EARTH SWITCH OPEN CONDITION.



FOR X-89A ISOLATOR OPERATION:

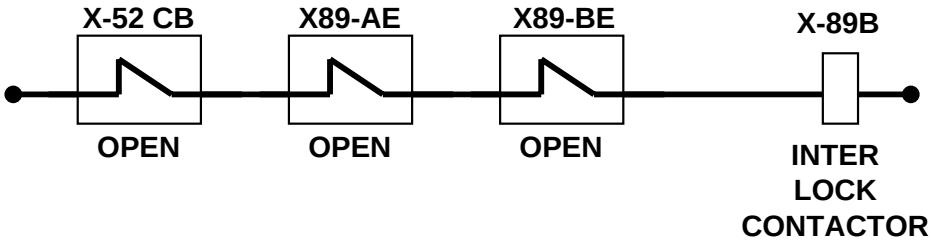


S.No	ISOLATOR OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2		EQUIPMENT-3	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE					
1	1-89 A	ISOLATOR	1-89 AE	OPEN	1-89 BE	OPEN	1-52 CB	OPEN
2	2-89 A	ISOLATOR	2-89 AE	OPEN	2-89 BE	OPEN	2-52 CB	OPEN
3	3-89 A	ISOLATOR	3-89 AE	OPEN	3-89 BE	OPEN	3-52 CB	OPEN
4	4-89 A	ISOLATOR	4-89 AE	OPEN	4-89 BE	OPEN	4-52 CB	OPEN

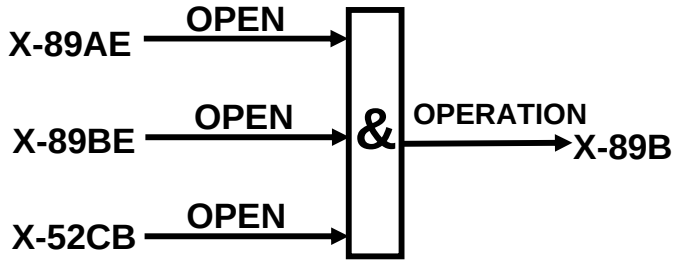
INTERLOCKS 89-B ISOLATOR OPERATION

FOR X-89B ISOLATOR OPERATION:

1. X-52 CB IN OPEN CONDITION.
2. X-89AE EARTH SWITCH OPEN CONDITION.
3. X-89BE EARTH SWITCH OPEN CONDITION.



FOR X-89B ISOLATOR OPERATION:



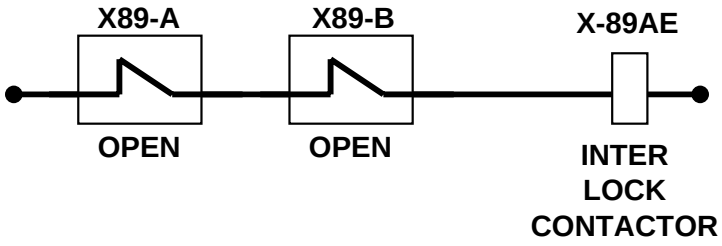
S.No	ISOLATOR OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2		EQUIPMENT-3	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE					
1	1-89 B	ISOLATOR	1-89 AE	OPEN	1-89 BE	OPEN	1-52 CB	OPEN
2	2-89 B	ISOLATOR	2-89 AE	OPEN	2-89 BE	OPEN	2-52 CB	OPEN
3	3-89 B	ISOLATOR	3-89 AE	OPEN	3-89 BE	OPEN	3-52 CB	OPEN
4	4-89 B	ISOLATOR	4-89 AE	OPEN	4-89 BE	OPEN	4-52 CB	OPEN

INTERLOCKS

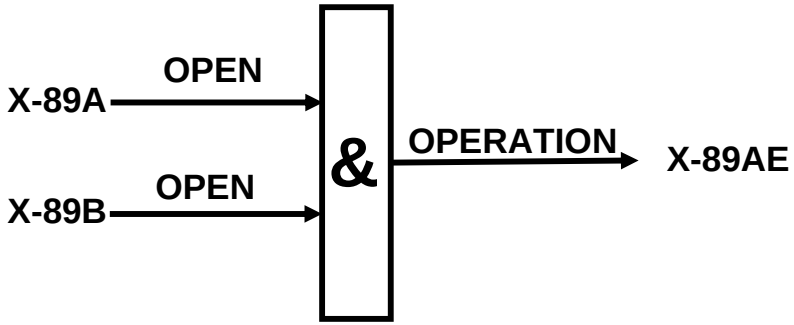
89-AE EARTH SWITCH OPERATION

FOR X-89AE EARTH SWITCH OPERATION:

1. X-89A ISOLATOR OPEN CONDITION.
2. X-89B ISOLATOR OPEN CONDITION.



FOR X-89AE EARTH SWITCH OPERATION:



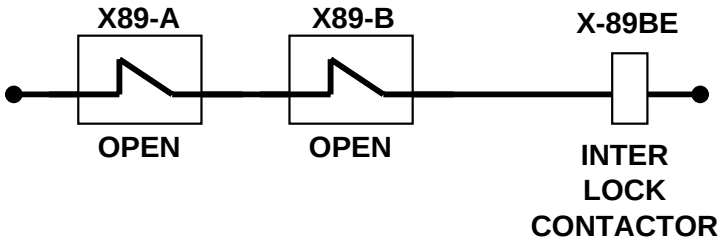
S.No	EARTH SWITCH OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE			
1	1-89 AE	EARTH SWITCH	1-89 A	OPEN	1-89 B	OPEN
2	2-89 AE	EARTH SWITCH	2-89 A	OPEN	2-89 B	OPEN
3	3-89 AE	EARTH SWITCH	3-89 A	OPEN	3-89 B	OPEN
4	4-89 AE	EARTH SWITCH	4-89 A	OPEN	4-89 B	OPEN

INTERLOCKS

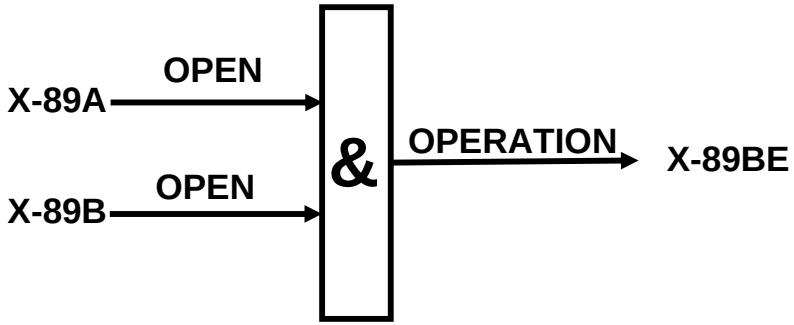
89-BE EARTH SWITCH OPERATION

FOR X-89BE EARTH SWITCH OPERATION:

1. X-89A ISOLATOR OPEN CONDITION.
2. X-89B ISOLATOR OPEN CONDITION.



FOR X-89BE EARTH SWITCH OPERATION:

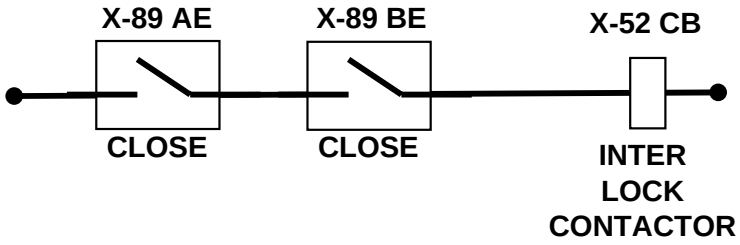


S.No	EARTH SWITCH OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE			
1	1-89 BE	EARTH SWITCH	1-89 A	OPEN	1-89 B	OPEN
2	2-89 BE	EARTH SWITCH	2-89 A	OPEN	2-89 B	OPEN
3	3-89 BE	EARTH SWITCH	3-89 A	OPEN	3-89 B	OPEN
4	4-89 BE	EARTH SWITCH	4-89 A	OPEN	4-89 B	OPEN

INTERLOCKS

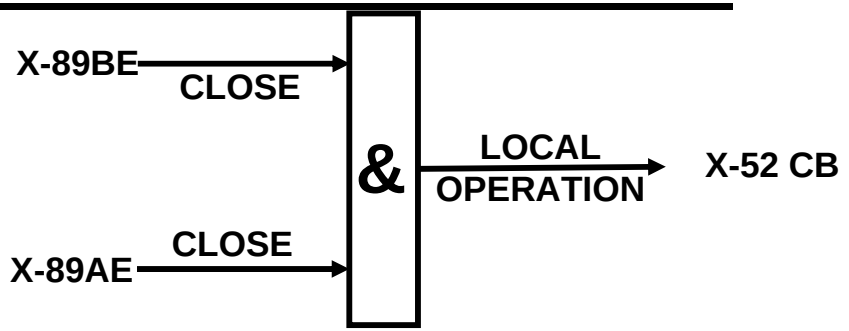
FOR X-52 CB LOCAL OPERATION:

1. X-89 AE EARTH SWITCH CLOSE CONDITION.
2. X-89 BE EARTH SWITCH CLOSE CONDITION.



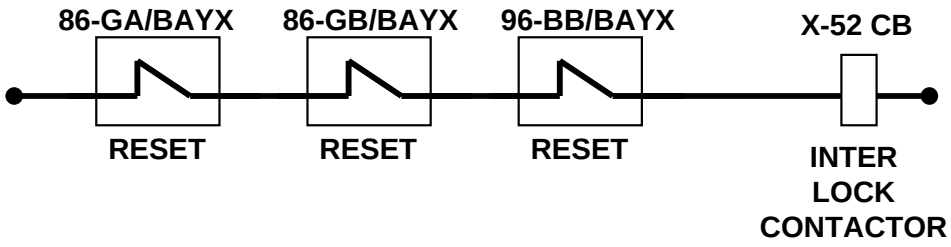
CLOSING INTERLOCK OF CIRCUIT BREAKER

FOR X-52 CB LOCAL OPERATION:

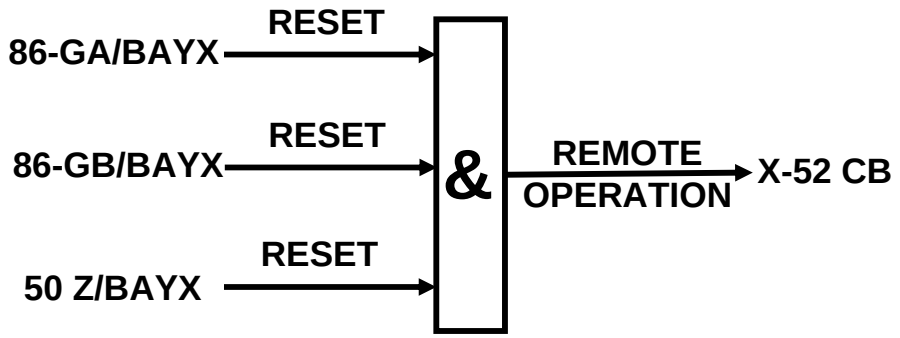


FOR X-52 CB REMOTE OPERATION:

1. BAYX-86 Gr-A RESET CONDITION.
2. BAYX-86 Gr-B RESET CONDITION.
3. BAYX-50 Z RESET CONDITION.

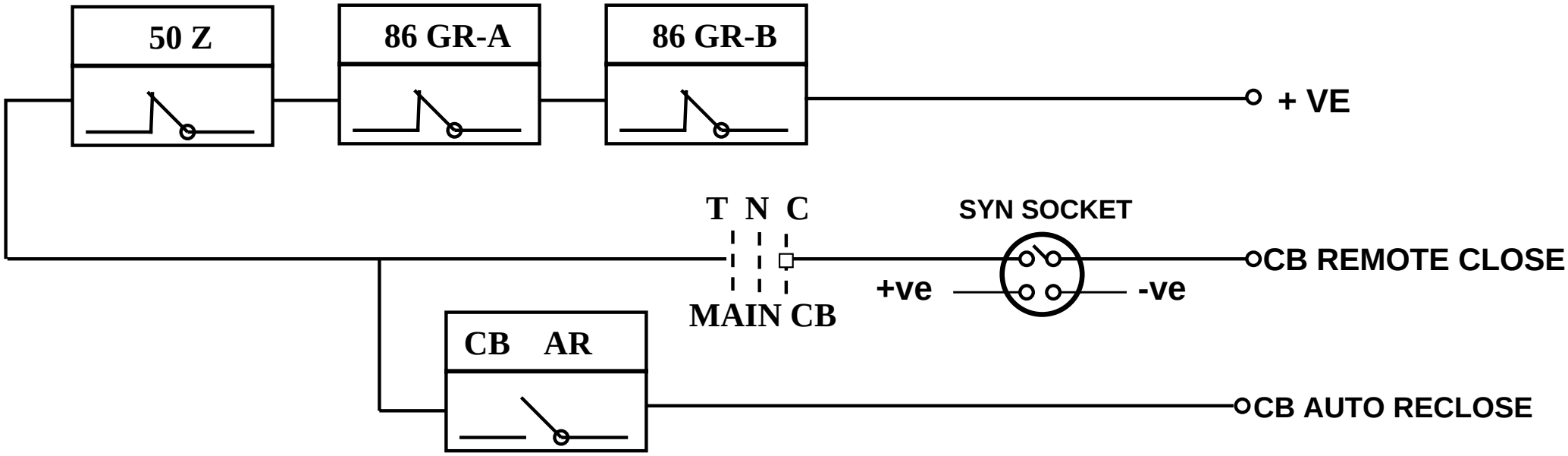


FOR X-52 CB REMOTE OPERATION:



INTERLOCKS

CLOSING INTERLOCK OF CIRCUIT BREAKER



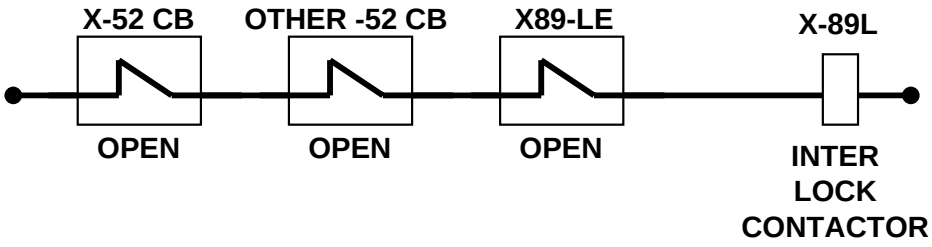
S. No	CIRCUIT BREAKER OPERATION OPEN / CLOSE		LOCAL OPERATION				REMOTE OPERATION						
			EQUIPMENT-1		EQUIPMENT-2		BAY	EQUIPMENT-1		EQUIPMENT-2		EQUIPMENT-3	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE										
1	1-52 CB	CIRCUIT BREAKER	1-89 AE	CLOSE	1-89 BE	CLOSE	BAY 1	86 Gr-A	RESET	86 Gr-B	RESET	50 Z	RESET
2	2-52 CB	CIRCUIT BREAKER	2-89 AE	CLOSE	2-89 BE	CLOSE	BAY 2	86 Gr-A	RESET	86 Gr-B	RESET	50 Z	RESET
3	3-52 CB	CIRCUIT BREAKER	3-89 AE	CLOSE	3-89 BE	CLOSE	BAY 3	86 Gr-A	RESET	86 Gr-B	RESET	50 Z	RESET
4	4-52 CB	CIRCUIT BREAKER	4-89 AE	CLOSE	4-89 BE	CLOSE	BAY 4	86 Gr-A	RESET	86 Gr-B	RESET	50 Z	RESET

INTERLOCKS

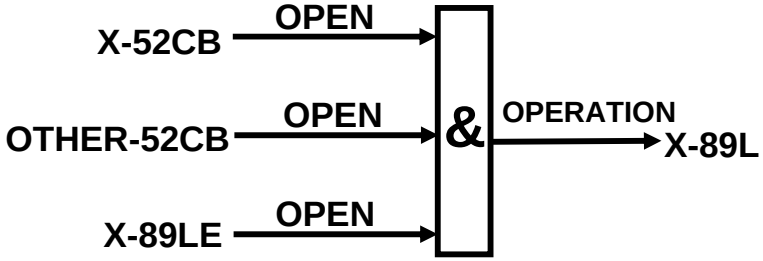
89-L ISOLATOR OPERATION

FOR X-89L ISOLATOR OPERATION:

1. X-52 CB IN OPEN CONDITION.
2. OTHER-52 CB IN OPEN CONDITION..
3. X-89 LE EARTH SWITCH OPEN CONDITION.



FOR X-89L ISOLATOR OPERATION:



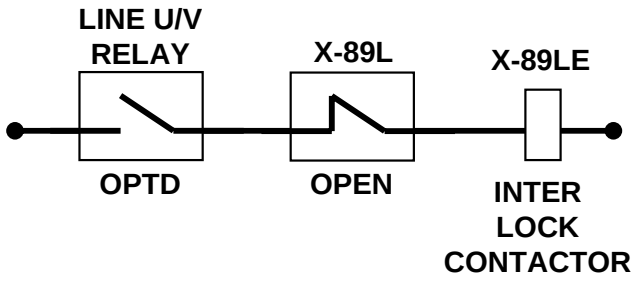
S.No	ISOLATOR OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2		EQUIPMENT-3	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE					
1	1-89 L	ISOLATOR	1-52 CB	OPEN	2-52 CB	OPEN	1-89 LE	OPEN
2	2-89 L	ISOLATOR	2-52 CB	OPEN	3-52 CB	OPEN	2-89 LE	OPEN

INTERLOCKS

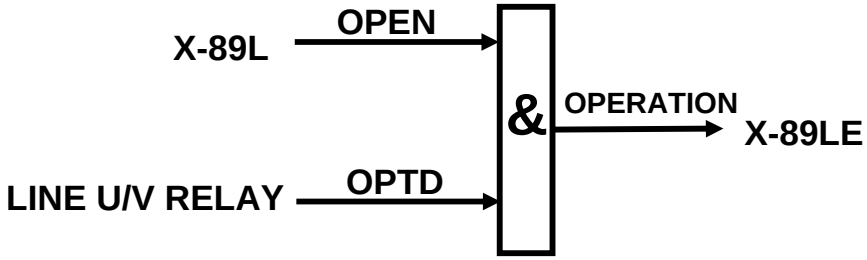
89-LE EARTH SWITCH OPERATION

FOR X-89LE EARTH SWITCH OPERATION:

1. X-89 L LINE ISOLATOR OPEN CONDITION.
2. LINE UNDER VOLTAGE RELAY OPTD.



FOR X-89LE EARTH SWITCH OPERATION:



S.No	EARTH SWITCH OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE			
1	1-89 LE	EARTH SWITCH	LINE-1 U/V RELAY	OPTD	1-89 L	OPEN
2	2-89 LE	EARTH SWITCH	LINE-2 U/V RELAY	OPTD	2-89 L	OPEN

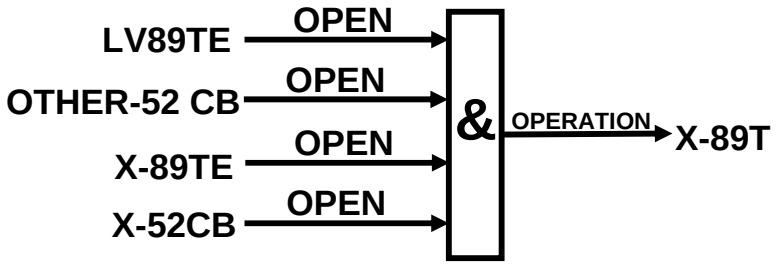
INTERLOCKS

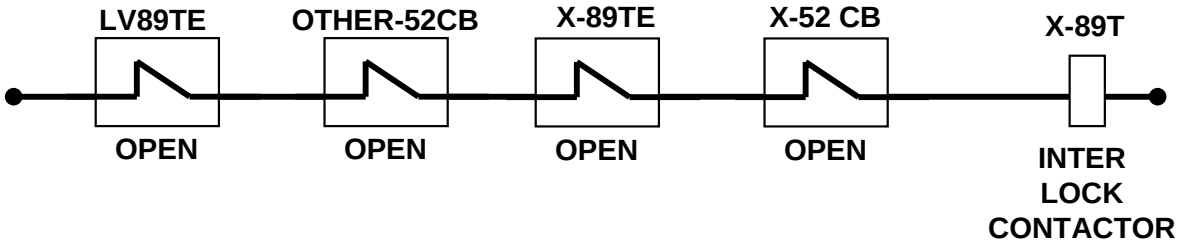
89-T ISOLATOR OPERATION

FOR X-89T ISOLATOR OPERATION:

1. X-52 CB IN OPEN CONDITION.
2. OTHER-52 CB IN OPEN CONDITION.
3. X-89 TE EARTH SWITCH OPEN CONDITION.
4. LV X-89 TE EARTH SWITCH OPEN CONDITION. (TOWARDS TRANSFORMER)

FOR X-89T ISOLATOR OPERATION:





S. No	ISOLATOR OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2		EQUIPMENT-3		EQUIPMENT-4	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE							
1	3-89 T	ISOLATOR	3-52 CB	OPEN	4-52 CB	OPEN	3-89 TE	OPEN	LV2-89 TE	OPEN
2	4-89 T	ISOLATOR	4-52 CB	OPEN	1-52 CB	OPEN	4-89 TE	OPEN	LV1-89 TE	OPEN

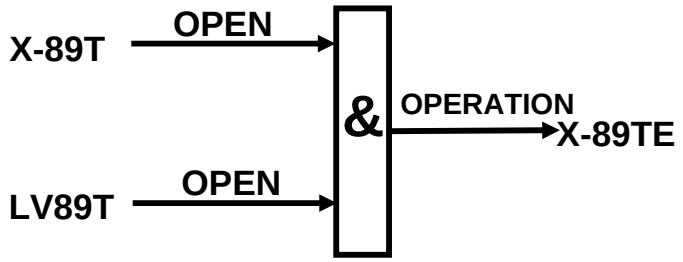
INTERLOCKS

89-TE EARTH SWITCH OPERATION

FOR X-89TE EARTH SWITCH OPERATION:

1. HV X-89 T TRANSFORMER HV ISOLATOR OPEN CONDITION.
2. LV X-89 T TRANSFORMER LV ISOLATOR OPEN CONDITION.

FOR X-89TE EARTH SWITCH OPERATION:



S.No	EARTH SWITCH OPERATION OPEN / CLOSE		EQUIPMENT-1		EQUIPMENT-2	
			INTERLOCKS REQUIRED FOR CONCERNED ISOLATOR / EARTH SWITCH OPEN OR CLOSE			
1	3-89 TE	EARTH SWITCH	3-89 T HV	OPEN	LV 2-89 T	OPEN
2	4-89 TE	EARTH SWITCH	4-89 T HV	OPEN	LV 1-89 T	OPEN

ANY DOUBTS

THANK YOU