2X500 kVA Electric Hotel Load Converter

(MCN504V2)

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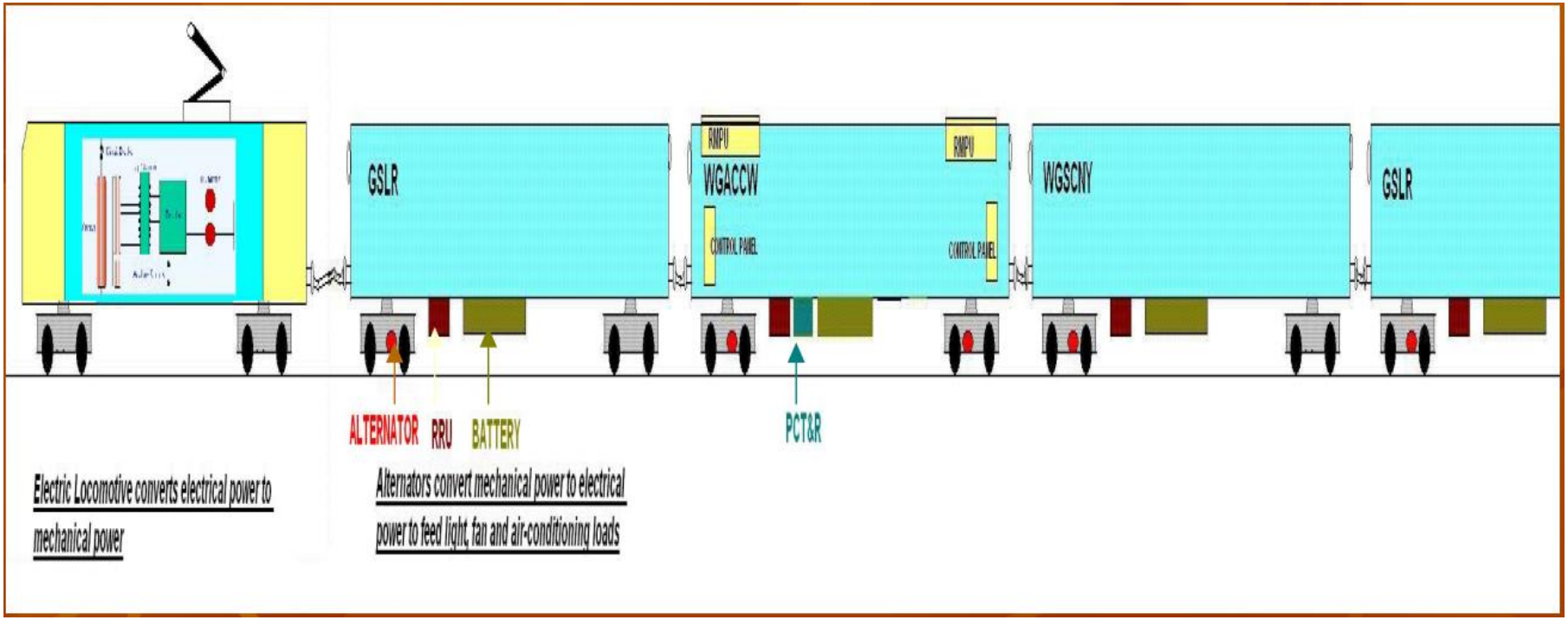
Introduction

- Hotel Load ?
  - Passenger comfort loads such as coach lighting, fans, mobile and laptop charger, air conditioning equipment, pumps, heaters, Pantry loads such as bottle coolers, water boiler, refrigerators & other equipment such as battery charger for emergency light etc loads are collectively described as Hotel Load.

Introduction

- The electrical energy for hotel load in passenger coaches over railways is currently being supplied by three different systems namely
  - Self Generation System
  - End on Generation System (E.O.G)
  - Head on Generation System (H.O.G)

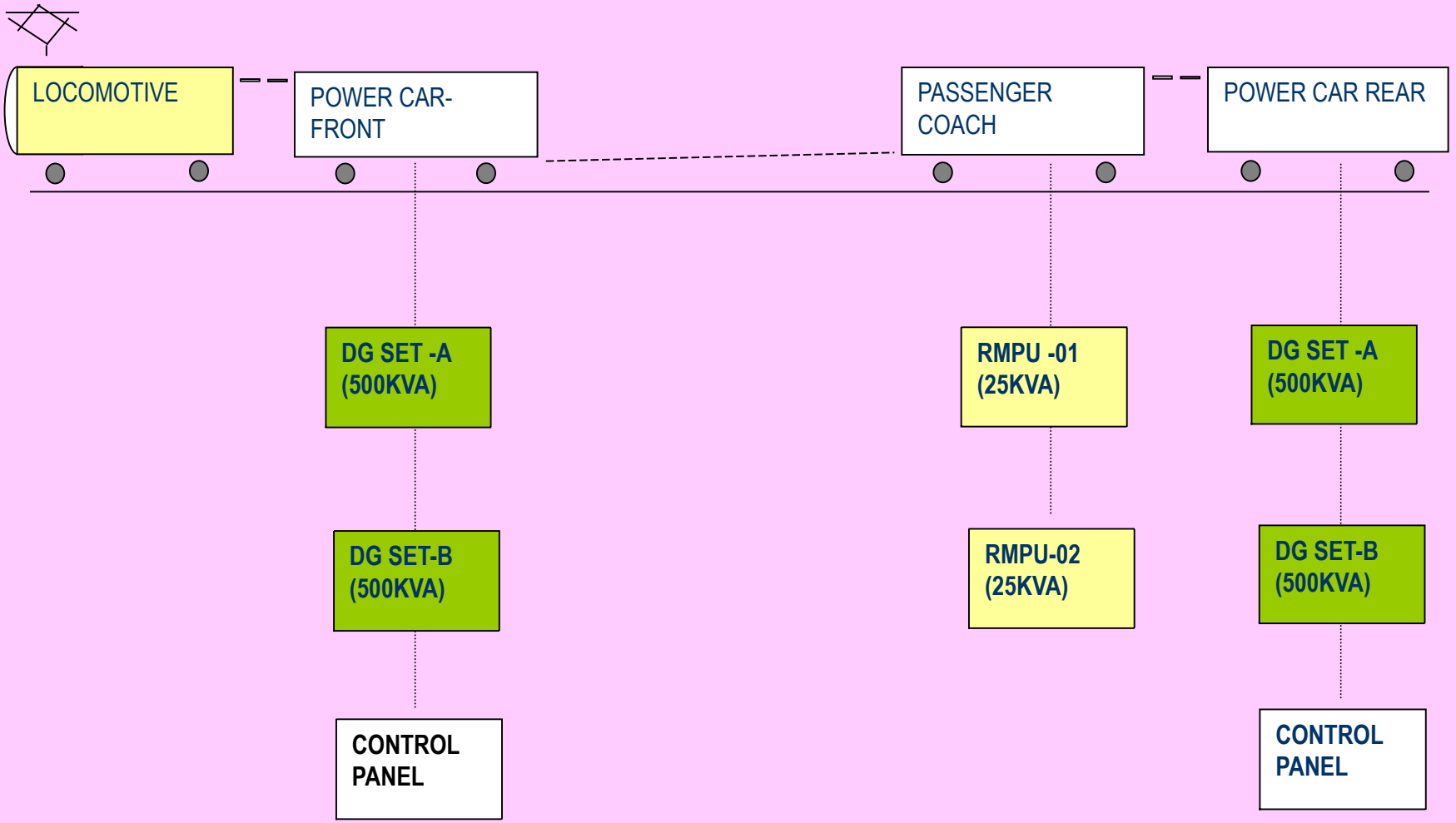
Self Generation System



Self Generation System

- The Self Generating System consists of
  - An under slung alternator that charges a 110 V battery and
  - A 25 kVA under slung inverter to convert 110 V DC to 415 V, 3 Phase AC supply.
- In this method, the efficiency of generation is very low since traction power driving the coaches is regenerated back using an inefficient alternator while using a bulky battery.

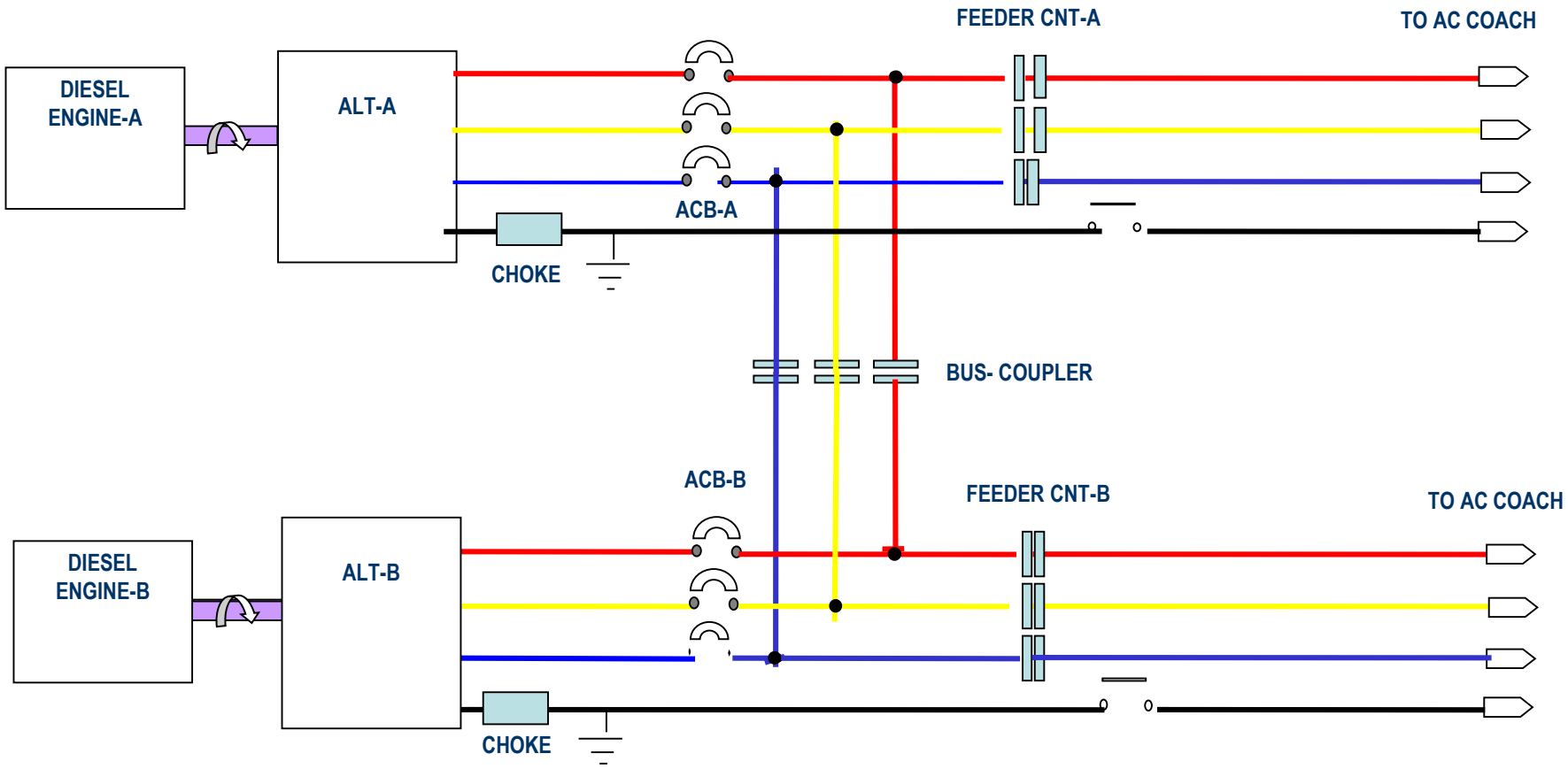
End On Generation System



End On Generation System

- It consists of two power cars, one on the front and other on the rear.
- Each power car is installed with 2 nos of Diesel Generator sets generating 3-phase (4 wires) power supply of 750 V and 50 Hz.
- This Voltage(750V, 3Ph) is transmitted to entire rake through two parallel feeders termed as Feeder – A and Feeder – B, running along the rake and coupled in between with the help of Inter Vehicle (IV) couplers.

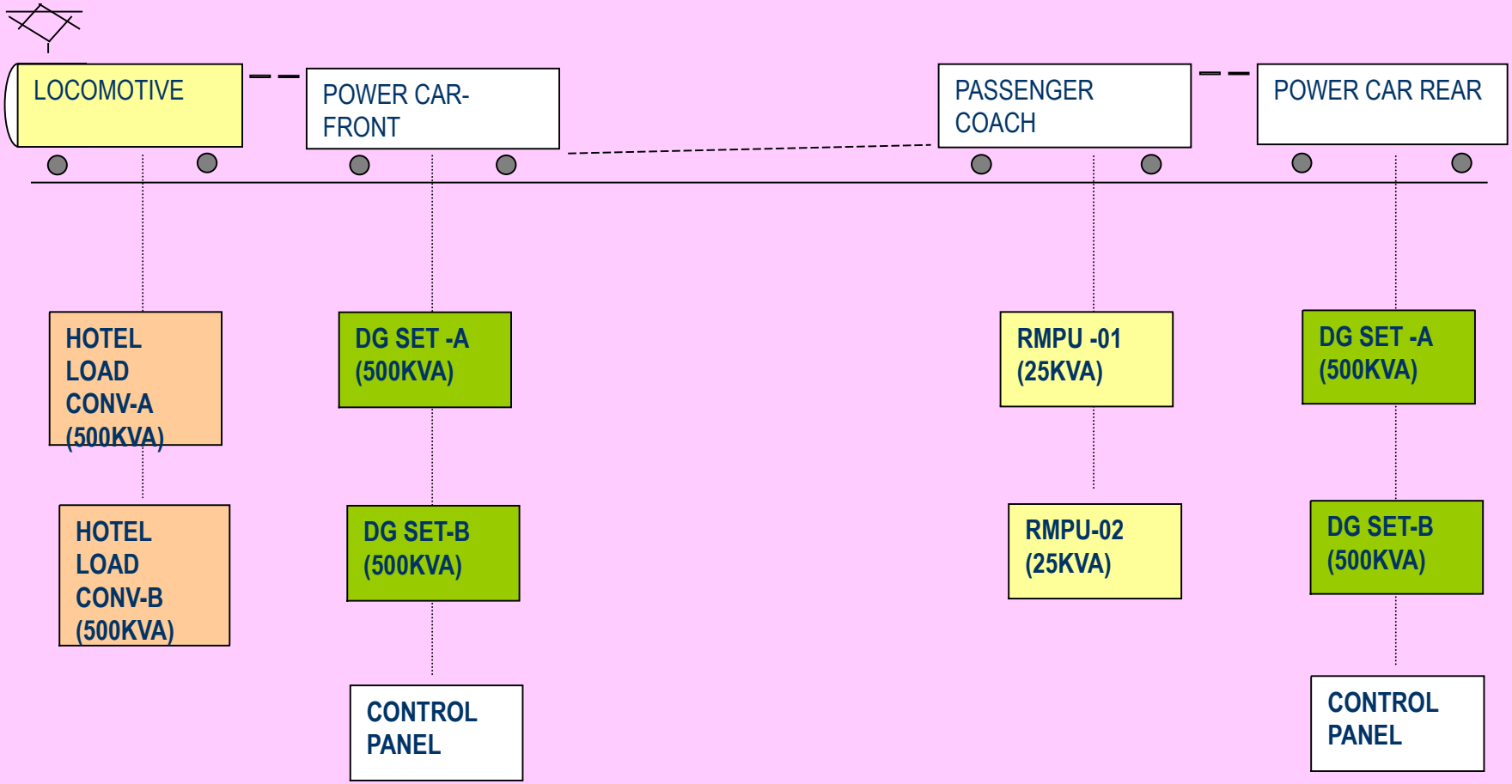
Power Car Block Diagram with EOG Supply



End On Generation System

- Each Coach gets supply through two feeder lines and has a step down transformer(60 kVA) for converting 750 V AC to 415 V / 110 V AC supply to feed the air conditioning equipment and other loads on the coaches.
- The EOG System is independent of mode of traction and has high reliability due to cent percent stand by system.
- Drawbacks of this type of system are
  - higher Fuel Cost
  - Noise and Smoke Pollution
  - Reduction in Commercial Space
  - Requirement of more staff to operate and maintain

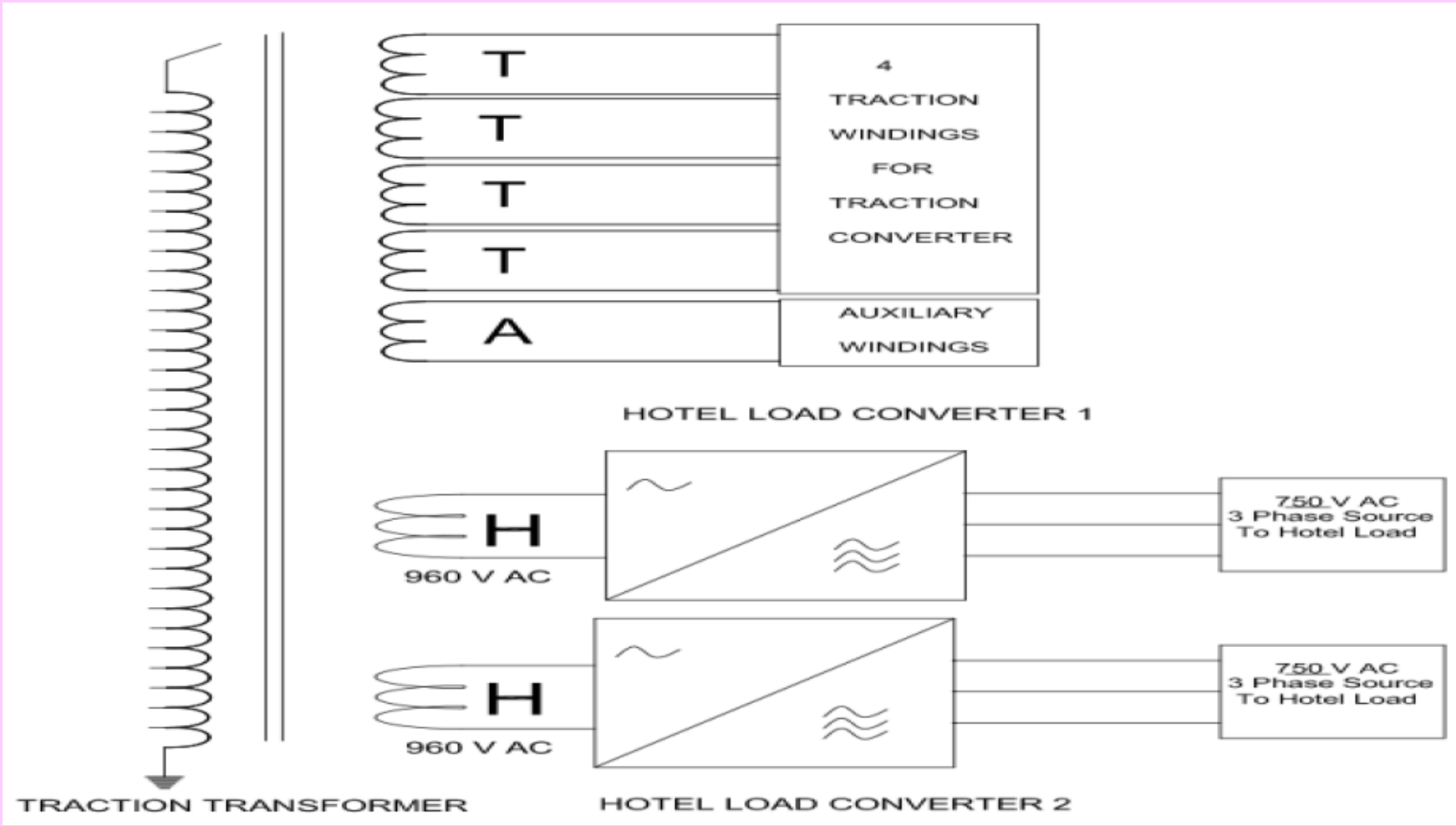
Head On Generation System



Head On Generation System

- In HOG scheme, Power is Fed from the the electric locomotive to the entire train to cater for hotel load of the train.
- In electric locomotives power is taken from the OHE through pantograph to traction transformer of the locomotive which is provided with two separate hotel load winding of 622.5 kVA each, at nominal voltage of 960 V single-phase, which varies with the OHE voltage variations.
- This 960 V single phase supply is fed to the Hotel load converter, which gives 750 V, 3-Phase 50 Hz supply as output, for feeding the hotel load of the train.

Head On Generation System



Head On Generation System

- The locomotive consists of 2 nos of 500 kVA Hotel Load Converters and each gets supply from the hotel load winding of the transformer independently.
- The three phase output supply of the hotel load converter is fed to the IV couplers, which are being connected on both ends of the locomotive through the junction box.
- The hotel load supply from the locomotive is transmitted to both the feeder of the existing EOG train through IV couplers.

INTERFACE OF HOTEL LOAD CONVERTERS WITH POWER CAR DG – SETS

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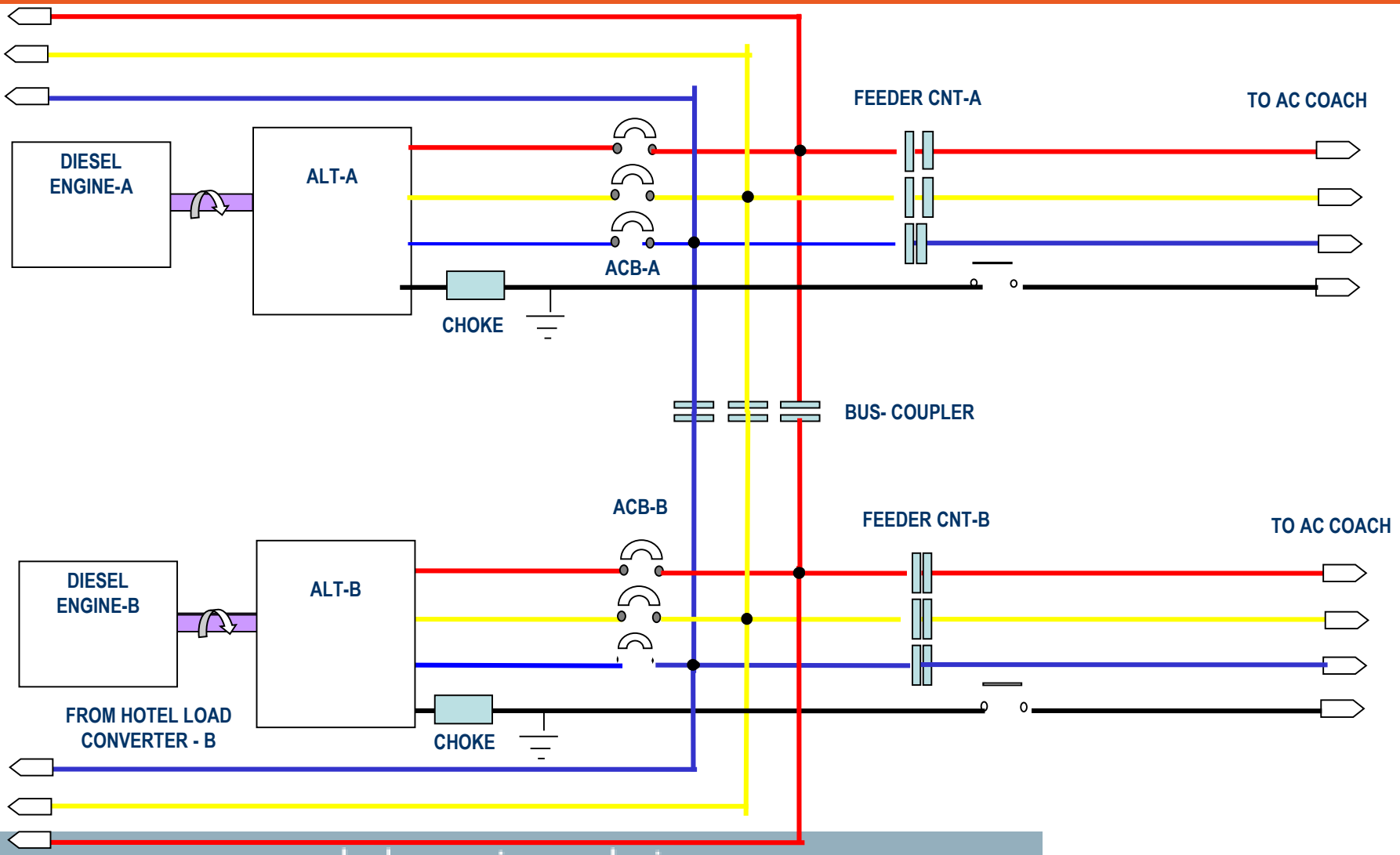

Interface With EOG Power Car System

- Interlocking Control Panel:
  - To operate the converters, a control panel is developed and installed in the Power Car.
  - It provides interlock between Hotel Load output and the existing Diesel Generator System.
  - This control panel enables the operator sitting in the Power Car to switch ON either the D-A sets in the power car or the converters in the locomotive. At a time, either the Converters are operable or D-A sets.

INTERLOCKING CONTROL PANEL

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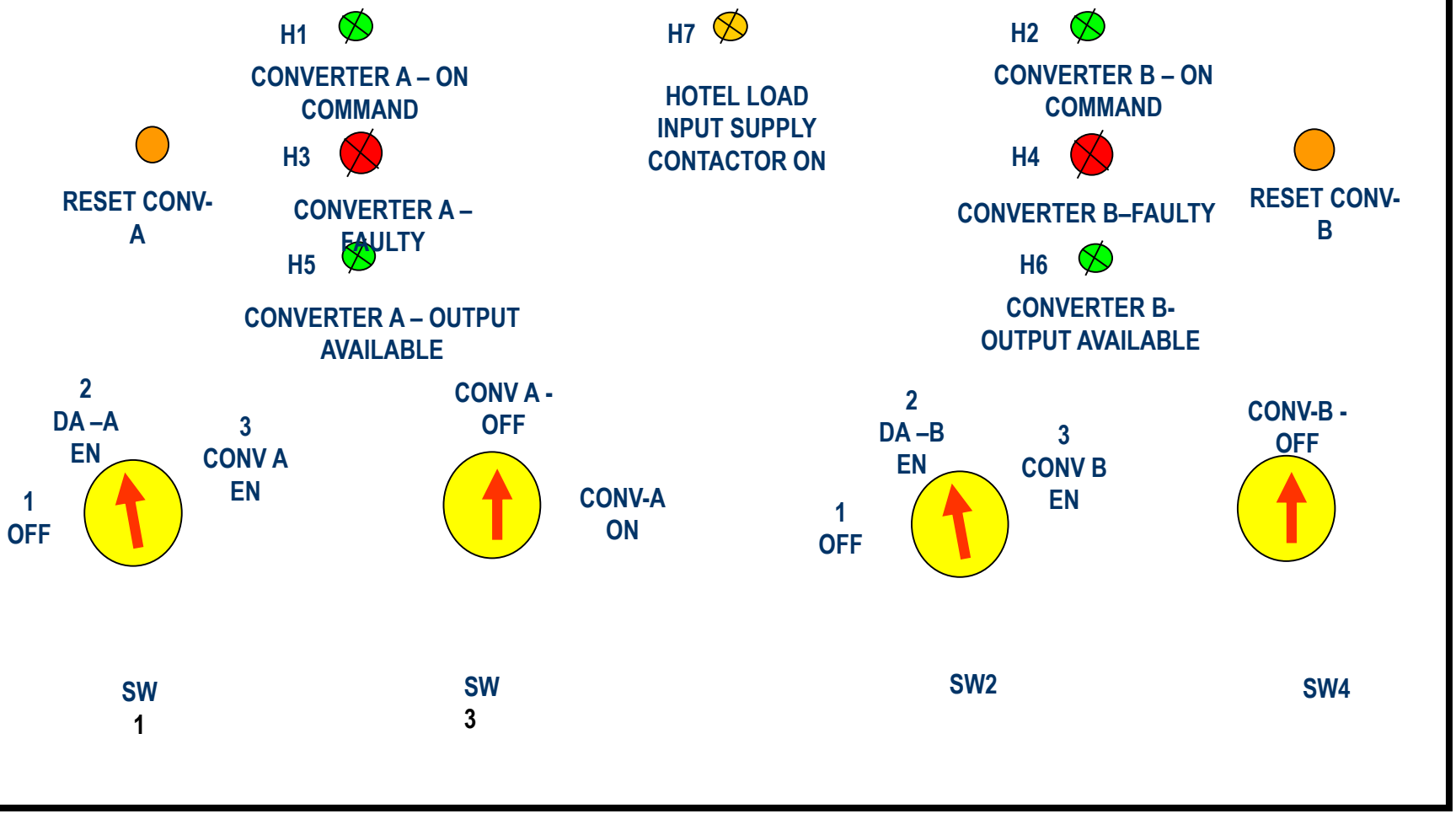

Interface With EOG Power Car System

- Functions of Interlocking Control Panel:
  - Hotel load converter tripping (or not operated) while moving the supply selector switch (SW1/SW2) position from Converter Enable to DA Enable.
  - DG set tripping (or not operated) while moving the supply selector switch (SW1/SW2) position from DA Enable to Converter Enable.
  - Provides the Bus coupler interlocking during Hotel load Converter operation also.
  - Hotel load converter is enabled from Power Car by moving the Converter enable switch (SW3/SW4) from OFF to ON after BLHO contactor is turned on by the loco pilot.
  - Reset push buttons (PB1/PB2) for Fault acknowledgment by the power car operator.

Interface With EOG Power Car System

- LED Indications on Interlocking Control Panel:
  - Hotel load BLHO Contactor ON LED (H7) indication.
  - Hotel load Converter ON LED (H1/H2) indication.
  - Hotel load Converter Output Available LED (H5/H6) indication.
  - Hotel Load Converter Fault LED (H3/H4) indication.

- IV Couplers:
  - The output of the converters is fed to the Power Car through the use of couplers. These are standard couplers used by the Railways.

Interface With EOG Power Car System

- UIC Couplers:
  - The control cables are wired between the converters and the power car through UIC couplers.
  - There are two such UIC couplers on each side of the locomotive.
  - The connections between the converters and the power car have been duplicated for redundancy in case if one set is lost due to a fault in the wiring during service.
  - If one UIC coupler is not fitted or is defective, the converter will continue to function normally.
  - Both the UIC couplers must be connected before starting of the service.

INTERCONNECTION BETWEEN LOCO & POWER CAR

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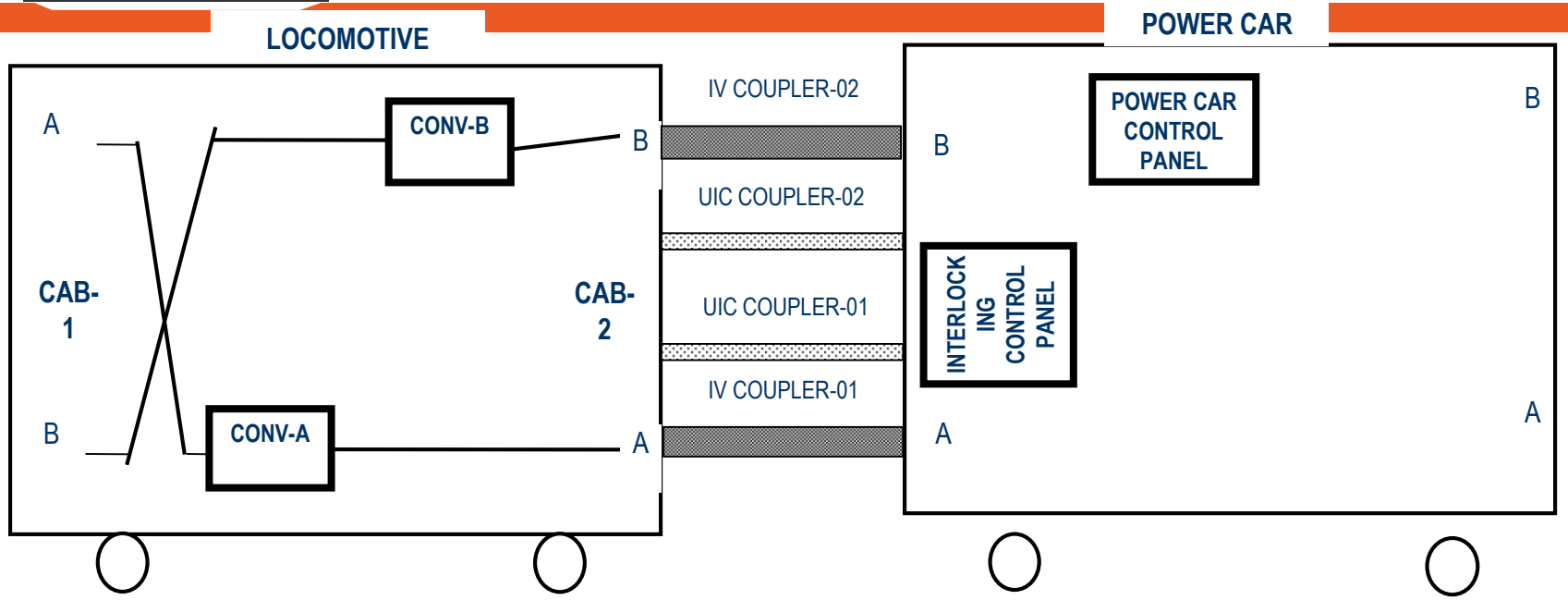

IV Coupler-01: CONV-A

R, Y,B, E, C1

IV Coupler-02: CONV-B

R, Y,B, E, C1

UIC Coupler- 01& 02:

Control signals to and from the Converter and Loco to the Power Car.

Redundant system. If one UIC fails the other will ensure the Converter and train is healthy.

Hotel Load Converter Electrical Specifications

S. No	Description	Value
1	**Input Voltage**	
	Nominal Operating Voltage	25 kV OHE Voltage
	Minimum Operating Voltage	17.5 kV OHE Voltage
	Maximum Operating Voltage	30 kV OHE Voltage
	Occasional Minimum Voltage	16.5 kV OHE Voltage
	Occasional Maximum Voltage	31 kV OHE Voltage

Hotel Load Converter Electrical Specifications

S. No	Description	Value
2	Input Frequency	50 Hz (± 8%)
3	Input Power Factor	> 0.9 (Near to 1.0)
4	THD of Input Current at Full Load	< 5% up to 20th Harmonic
5	Efficiency at Full Load	> 93% at Rated Input Voltage
6	Control Supply Voltage	110 V DC (75 to 138 V)

Hotel Load Converter Electrical Specifications

S. No	Description	Value
7	Rated Output	
	Voltage	750 V ±5%, 50 Hz ±2%,3-Ph 3 wire AC
	Capacity	500 kVA Continuous, 0.8 P.F Load
8	Direct on Load Starting of Converter	750 A for 3 Sec.
9	Output Voltage Unbalance	< 3%
10		

Hotel Load Converter Electrical Specifications

S. No	Description	Value
12	Acoustic Noise	< 80 dB (A) at 1m from the equipment
13	Type of Cooling	Forced Air Cooling
14	Enclosure Material	Stainless Steel SST grade 304
15	Ambient Temperature	Inside Locomotive : -5 to 55 ˚C (Max.60˚C) Inside DG Set : 65 ˚C

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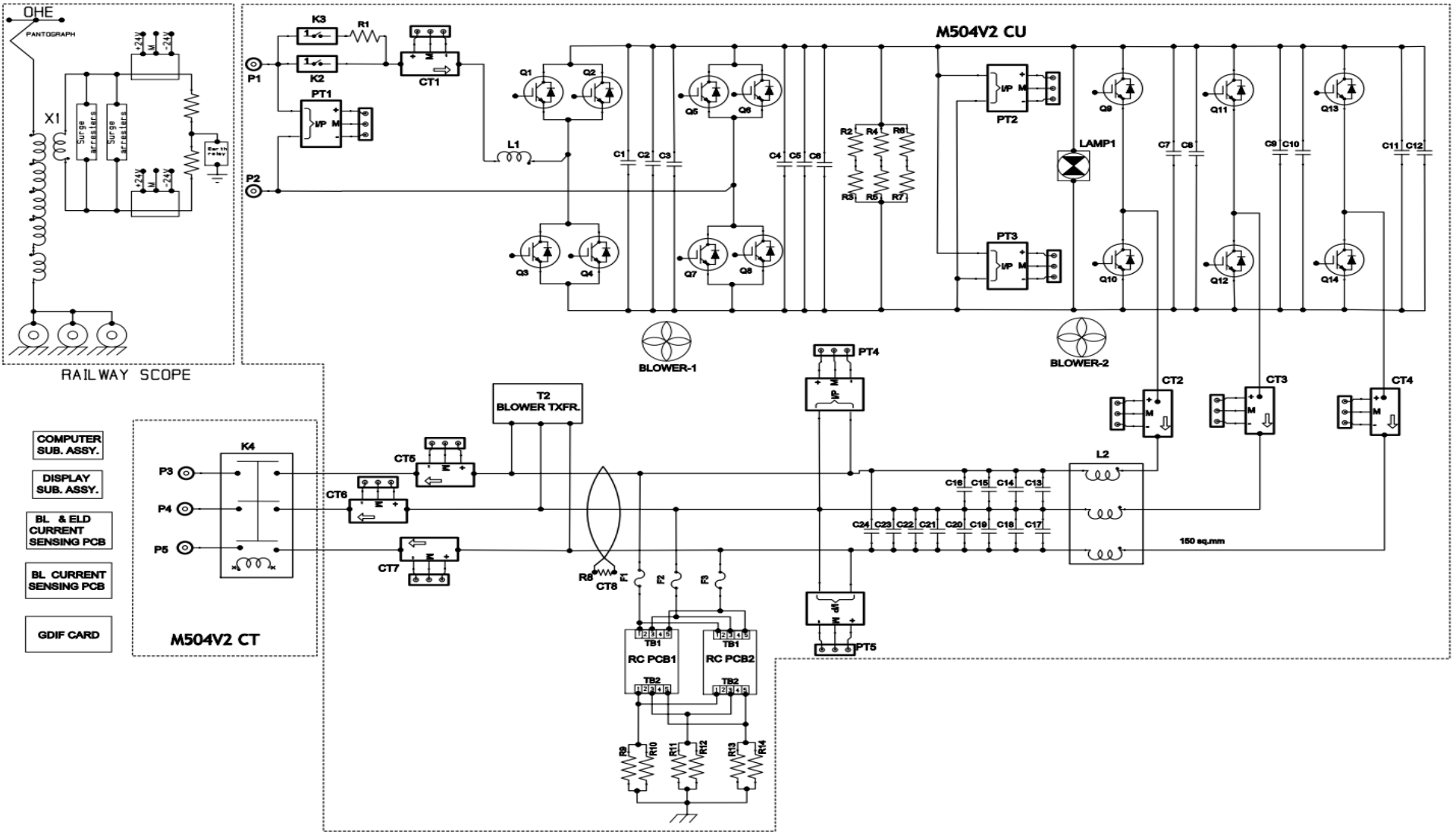
Schematic Block Diagram



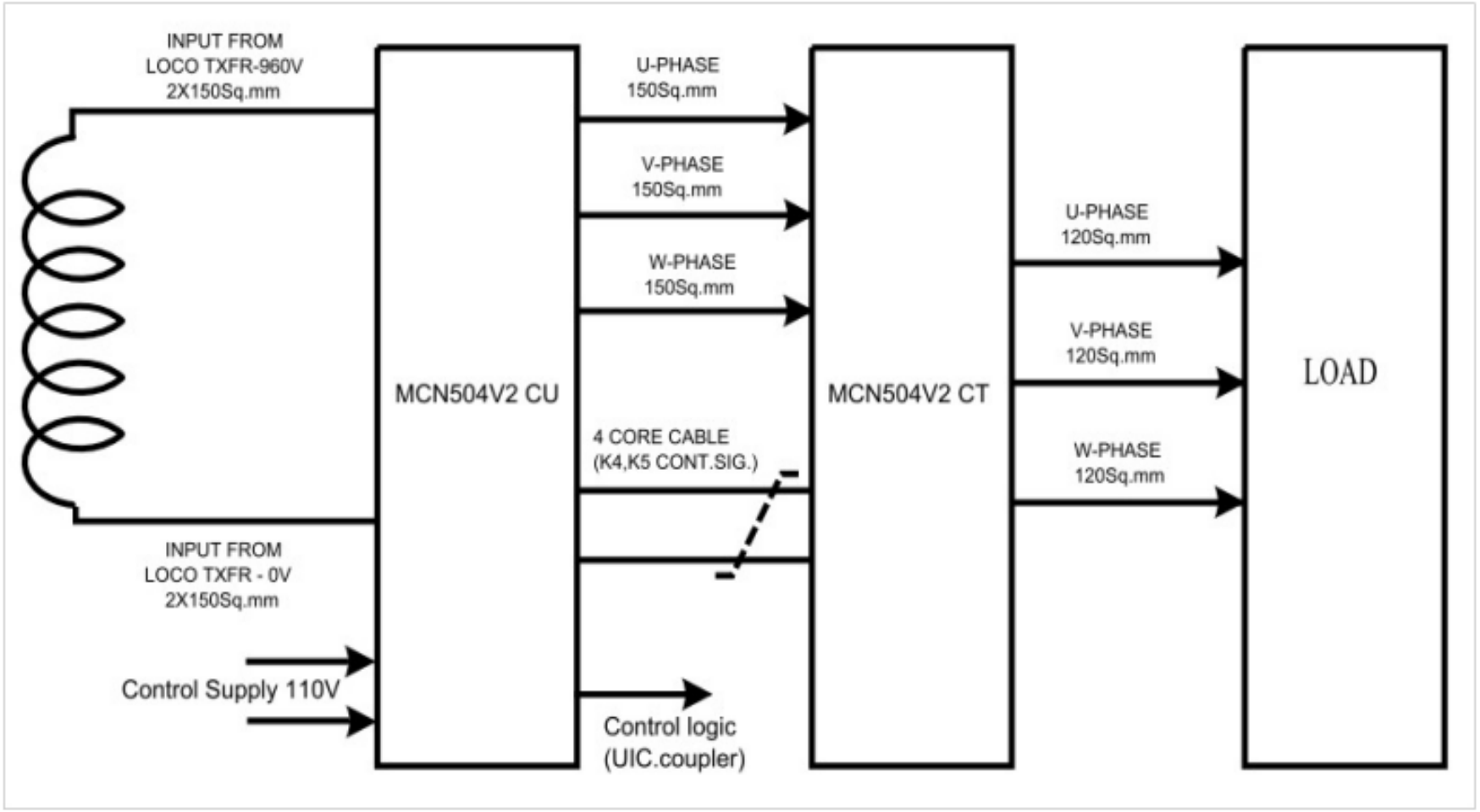
Interface with Locomotive

- Power to the converter is obtained from Hotel load winding of the Loco Transformer through a contactor.
- This contactor is switched ON manually by the loco pilot using the switch BLHO, which is located on the driver desk.
- Each time the train moves through the neutral section, power is lost to the converter. To restore the power to the loco and the converter, loco pilot has to switch ON the DJ and the input contactor for the Converter.

Interface with Locomotive

- The input current to the converter is sensed by the locomotive CT and is fed to Vehicle Control Electronics (VCE) of the locomotive. In case if the input current exceeds a set limit, then VCE trips the contactor.

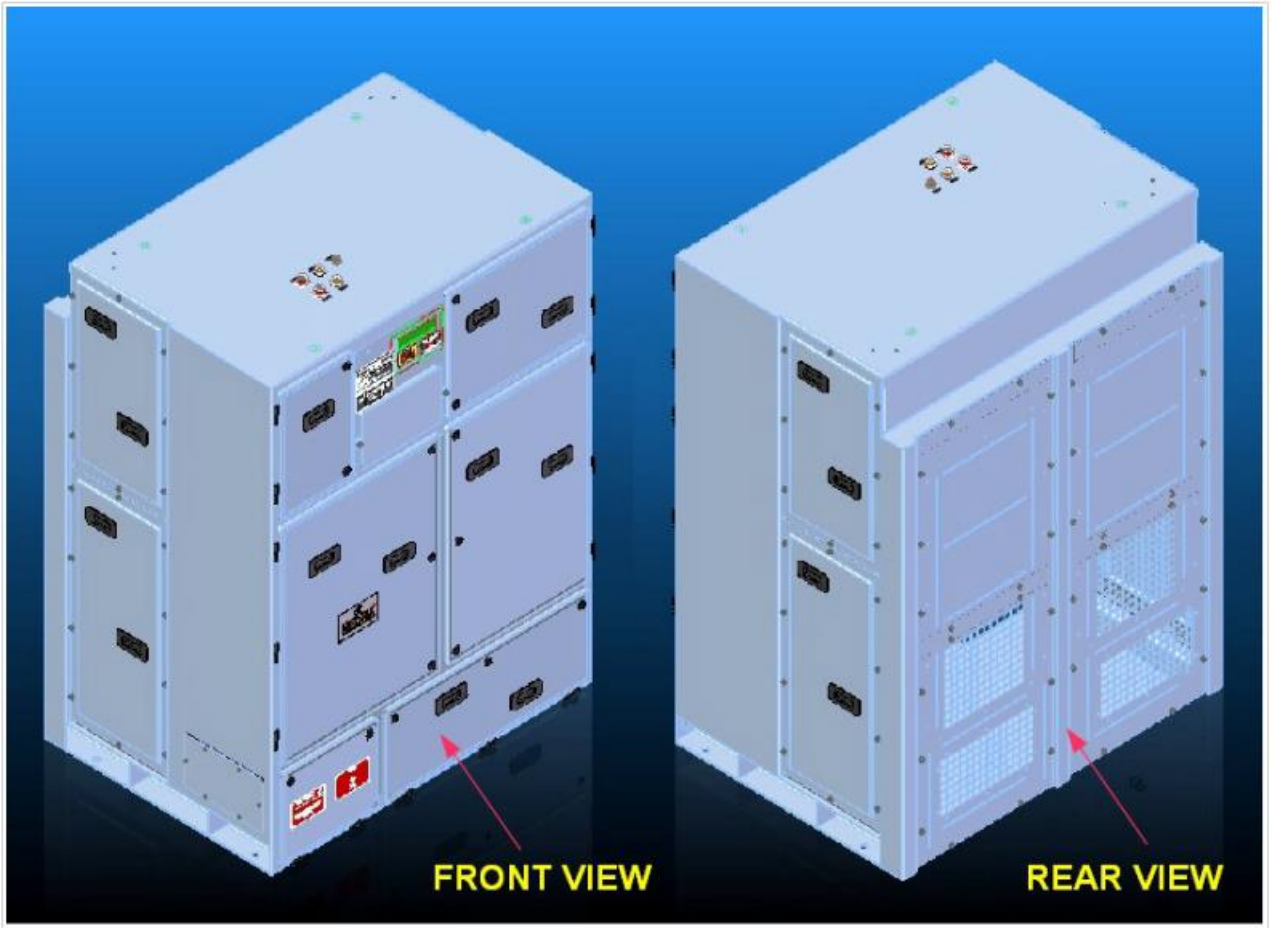
System Overview



Major sub-assemblies

- Hotel Load Converter mainly consist of two cubicles
  - Converter Unit (MCN504V2 CU)
  - Contactor Unit ((MCN504V2 CT)

Converter Unit (MCN504V2 CU)



3-D image of Converter Unit

Converter Unit (MCN504V2 CU)

- Converter Unit consists of
  - Input Contactor
  - Precharging Contactor
  - Precharging Resistor
  - Input Inductor
  - Line Converter (AC-DC Converter)
  - DC LINK
  - Voltage Indicator Lamp
  - Inverter (DC-AC Converter)
  - Sine Filter
  - RC Filter
  - Control Computer
  - Display Unit

Input Contactor

- Input Main contactor placed in the Phase of Hotel Load winding. The Input contactor isolates the line converter from Hotel Load winding of transformer.
- During Precharging Precharging contactor closed, after the precharging action completes main contactor is closed and precharging contactor is opened.
- If any short circuit occurs, then input contactor will open. It is electromagnetically controlled.

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Input Contactor

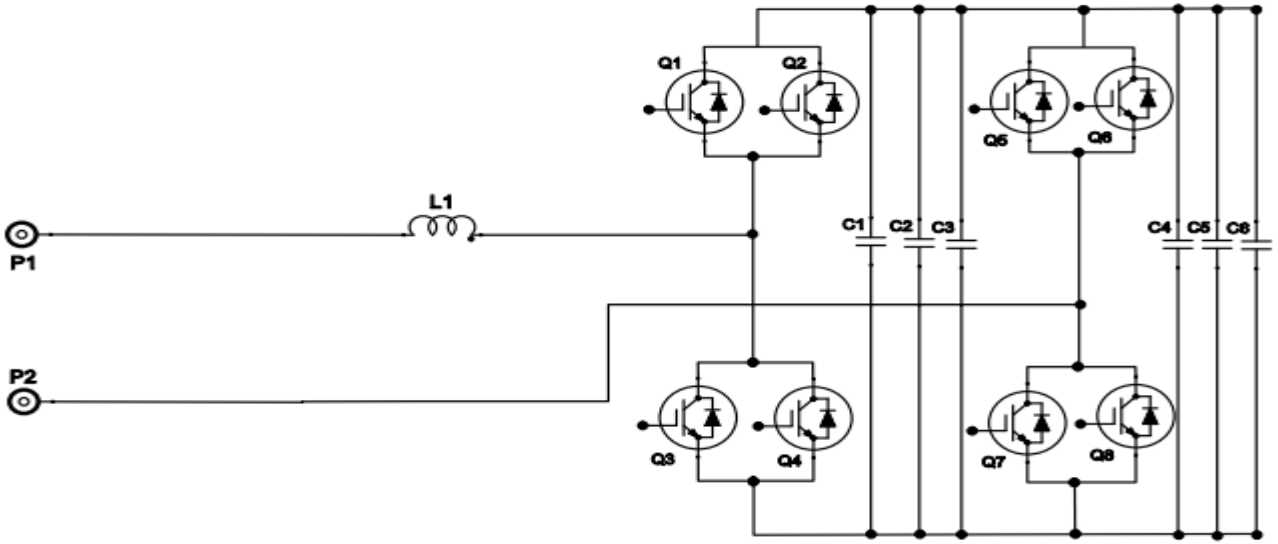
Precharging Contactor & Resistor

- The pre-charge resistor, pre-charge contactor together are called as pre-charge circuit.
- The pre-charge circuit is used to avoid sudden inrush currents through DC Link capacitors during initial start up condition.
- The pre-charge resistor is switched in series with the input to the line converter by the pre-charge contactor.
- The pre-charge resistor is used to limit the current through DC Link capacitors and IGBTs (diodes).

Precharging Contactor & Resistor

- Initially the main contactor is in open position, and the pre-charge contactor is in closed position, so that the capacitors gets charged through a pre-charge resistor through diodes of Line converter.
- Once the DC Link capacitors gets charged to sufficient DC voltage, then main contactor is closed and pre-charge contactor is opened.

Input Inductor



- Front end line converter draws fundamental current with some switching frequency.
- To minimize the higher order harmonics in the input current, an inductor is used to reduce the switching ripple on the AC side.

Line Converter

- Line converter is responsible for conversion of single phase AC into constant DC.
- The Line Converter is connected to transformer secondary winding on the AC side, and to the DC Link capacitors on the other side.
- Line Converter will maintain the DC link Voltage to fixed value(1600 V) irrespective of input voltage variations with nearly Unity Power Factor and with minimized harmonics in the input current.
- Line Converter Control card protects all phase modules by sensing the input voltage, input current, DC Link voltage and temperature using various sensors.
- Firing signals to Line Converter IGBTs are given by Hotel load computer through OFC.

Line Converter Phase Module

- Line Converter is implemented as two phase modules. Each phase module is of modular design and has the following components:
  - Four IGBTs of each phase (Two IGBTs used in parallel for each switch)
  - Two gate drive cards and Four gate drive child cards. All gate drive child cards are mounted directly on the IGBTs.
  - One gate drive power supply per Switch fitted within Gate Drive Card. Input voltage to these power supplies is taken from Phase module power supply.

Line Converter Phase Module

- The Phase module power supply is common for one phase module. The input to the Phase module power supply is 110VDC taken from Auxiliary Power source.
- Heat sink temperature sensor (PT-100) is used for monitoring the IGBT temperatures.
- Temperature switch for each IGBT heat sink as a backup monitoring mechanism in case temperature sensor fails.
- Busbar connections between the phase module and DC link capacitors.

DC LINK

- DC link Capacitor has following functions:
  - DC Link Capacitor is used to buffer the energy differences between line-side and Inverter-side of the converter.
  - DC Link Capacitor absorbs the harmonic currents produced by line side and Inverter-side of the converter, thus reducing the ripple voltage.
  - DC Link capacitor is used to limit the switching over voltages of IGBTs. These over voltages occur due to loop inductance.

Voltage Indicator Lamp

- Voltage indicator is provided on the DC Link. It indicates presence of the DC Link voltage in case of monitoring and maintenance operations.
- An LED flashes at voltages above 45V (independent of DC link polarity).
- The voltage indicator lamp flashes rapidly when DC-Link voltage is high as its flashing frequency is directly proportional to the DC-Link voltage. Voltage Indicator is accommodated in the Converter Cubicle.

Inverter

- Inverter input is connected to controlled DC Link.
- Inverter is controlled by Inverter Control Card.
- Output Line to Line voltage will be maintained to 750V L-L irrespective of load side variations with minimized harmonics in the voltage.
- Inverter Control protects all phase modules by sensing the Output Line to Line voltage sensor, Output phase currents, Output earth leakage current and temperature using various sensors.
- Firing signals to Inverter IGBTs are given by Hotel load computer through OFC.

Inverter Phase Module packages

- Inverter is implemented in two phase module packages. One package consists of 4 IGBTs for two inverter phases and other consists of 2 IGBTs for the other phase. Each package consists of the following components
  - Two IGBTs per phase.
  - One gate drive card and One gate drive child card per IGBT mounted directly on the IGBTs.
  - One isolated gate drive power supply per IGBT. Input voltage to these power supplies is taken from Inverter power supply. The input to the Inverter power supply shall be 110VDC (Auxiliary Power voltage).

Inverter Phase Module packages

- Heat sink temperature sensor (PT-100) is used for monitoring the IGBT temperatures.
- Temperature switch for each IGBT heat sink as a backup monitoring mechanism in case temperature sensor fails.
- Busbar connections between the phase modules and DC link capacitors.

Sine Filter

- The output line-line voltage of inverter consists of fundamental component, switching frequency and its integral multiple components.
- Presence of switching frequency and its multiple components increases the output Voltage THD. To reduce the output voltage THD, a low pass LC filter is used.

RC Filter

- The common mode switching ripple in the hotel load converter output Phase to Earth voltage is filtered with a RC filter.
- The resulting waveform at the RC filter output is sinusoidal with voltage peak below 800 V.
- The RC filter is connected between hotel load converter output phase and earth.

Hotel Load Control Computer

- Electric Hotel Load Control Computer unit consists of Control Computer Cards, related Analog, Digital input, Digital Output cards and Power Supply cards. Required LED indications provided on Card front facia which indicates the status of the cards.
- Hotel Load control has been divided into Line Side Converter Control with Power Car interfacing and Inverter Control with Data Management Activities.
- Control Computer cards inter connection details are shown in the below figure.

Hotel Load Control Computer

S. No	Type	Name	Functional Description	Qty.
1	M504 DI	Digital Input Card	Digital Inputs monitoring	1
2	M504 DO	Digital Output Card	Digital Outputs driving	1
3	M504 CC	Main Control Cards	Controls and protect the Line Converter and Inverter	2

Hotel Load Control Computer

S. No	Type	Name	Functional Description	Qty.
4	M504V2 AIP	Analog Input Card	Measurement of Analog Inputs	3
5	M504 OFC	Fiber Optical Card	Interface for Fiber optic links	1
6	M504 PS	Control Power Supply	+/- 7 V,+5 V Control Supply	1
7	M504V2 SPS	Sensor Power Supply	+/- 24 V for Sensors	1

M504CC - LC

- M504CC LC Line Converter Control card consists of a 32-bit Digital Signal Processor (DSP) and one 16-bit Micro Controller (μC). Both communicates with each other the control, status and protection information.
- Line Converter Control card interfaces with the interlocking panel, and performs various functions like input pre-charging and direct contactors control using Digital Outputs (DOP) and feedbacks are read by Digital Inputs (DIP).

- Input over voltage, Input under voltage, Input over current, DC Link over voltage, DC Link under voltage, Overload protections (IGBT GD), IGBT phase module over temperature, Pre-charging circuit failures, Input frequency Under or over frequency, and Cooling blower fail detection protections are provided. Protection limits are configurable and these limits can be changed using Laptop.
- Dual redundant CAN communication is used between the Line Converter Control and the Inverter Control. Additional CAN communication is used between Line Converter Control and Inverter Control for high speed communication.

M504CC - IC

- M504CC IC Inverter Control card consists of a 32-bit Digital Signal Processor (DSP) and one 16-bit Micro Controller (µC). Both communicates with each other the control, status and protection information.
- Inverter Control card controls Inverter and performs Data Management activities.

- Output Over Voltage, Output Under Voltage, Output Overload, Output short circuit protections, Output Imbalance, Earth leakage at Output, Output contactor faults and cooling blower fail detection protections are provided. Protection limits are configurable and these limits can be changed using Laptop.
- Optionally one vehicle Interface card is provided that manages the communication required from the loco control. Inverter control card communicates with vehicle interface card using CAN communication.

- Data Management Features :
  - Fault data and Event data are recorded in Flash with real time clock time stamps(Date & Time), which can store more than 5000 Faults.
  - RTC for Data & Time.
  - NVRAM: Stores the active faults data, cumulative data and data counters.
  - USB Host and Slave controller.
  - RS232 and RS485 Interface.
  - Energy monitoring and recording of Trip Wise, Day Wise and Month Wise Data.

M504V2AIP

- There are Three Analog Input Cards in Hotel Load Control Computer Unit.
- All the analog signals are processed to control sensing voltage levels using Analog Input Cards.

M504OFC

- M504OFC module consists of 7 channels which convert electrical signal to optical light signal and vice versa.
- Each channel has Optical isolation and are used for driving and monitoring the Inverter IGBTs.

M504DI

- M504DI card consists of the hardware required for converting the high voltage signals of nominal 110 V DC from the Converter circuits to the low voltage signals of 5 V DC required for the M504CC LC card.
- All Inputs are reverse polarity protected and surge protected.
- The Green color LEDs provided on this card fascia indicates presence of 110VDC input voltage on that particular channel.
- The yellow LEDs indicate the status of the signal read by Microprocessor after isolation and signal conditioning.
- Both the LEDs of a particular channel should be either OFF or ON to indicate the correct functioning of card.

M504DI

M504DO

- M504DO card consists of the hardware required for converting the low voltage signal of 5 V DC from M504CC LC card to high voltage signals of nominal 110 V DC.
- 110V DC power signals required for driving relays, contactors, indication lamp etc.
- All outputs are reverse polarity protected, surge, overload and short circuit protected.
- The yellow LEDs indicate the status of the signal given by Micro processor.
- The Green colour LEDs provided on this card fascia indicates presence of 110V DC voltage on that paticular channel.
- Both the LEDs of a particular channel should be either OFF or ON to indicate the correct functioning of card.

M504DO

- The following voltages are generated in power supply card for control computer:

  +/- 7 V, + 5 V – for Interal circuit

  +/- 15V – for External circuit

- These regulated power supplies are generated from nominal 110 V DC input power from the battery or battery charger.
- It is basically a switch mode power supply, which can accept wide variation in the input voltage.
- The Power supply card is protected from reverse polarity, surges, RFI and EMI through suitable devices.

M504PS

- The Sensor power supply voltages are generated in this power supply card

  +/- 24 V – for Sensor Power Supply

- It is basically a switch mode power supply, which can accept wide variation in the input voltage (77 V -138 V) with nominal 110 V DC.
- The Power supply card is protected from reverse polarity, surges, RFI and EMI through suitable devices.

M504V2 SPS

Display Unit

- Display has following features:
  - Four line LCD text display with 20 characters per line.
  - Parameters display Screen: In parameters display screens all the parameters such as I/P voltages,O/P voltage, I/P current and O/P currents related to converter will displayed.
  - Fault Messages Screen: This will give the active fault message information with time stamp.
  - Test Modes: Here test modes activation and deactivation can be done and after completion of test, the results will be displayed.

Contactor Unit (MCN504V2 CT)

3-D image of Contactor Unit

Contactor Unit (MCN504V2 CT)

- The Contactor Unit consist Output Contactor with its Control Circuit.
  - The Output contactor isolates the Load from Hotel Load supply. The Output contactor is a 3-pole switch, connected to sine filter output.
  - Initially the Output contactor is in open position, when the output voltage is reached to rated value 750 V line to line the output contactor is closed.
  - If any severe fault occurs, then Output contactor is opened. The Output contactor is electromagnetically controlled.

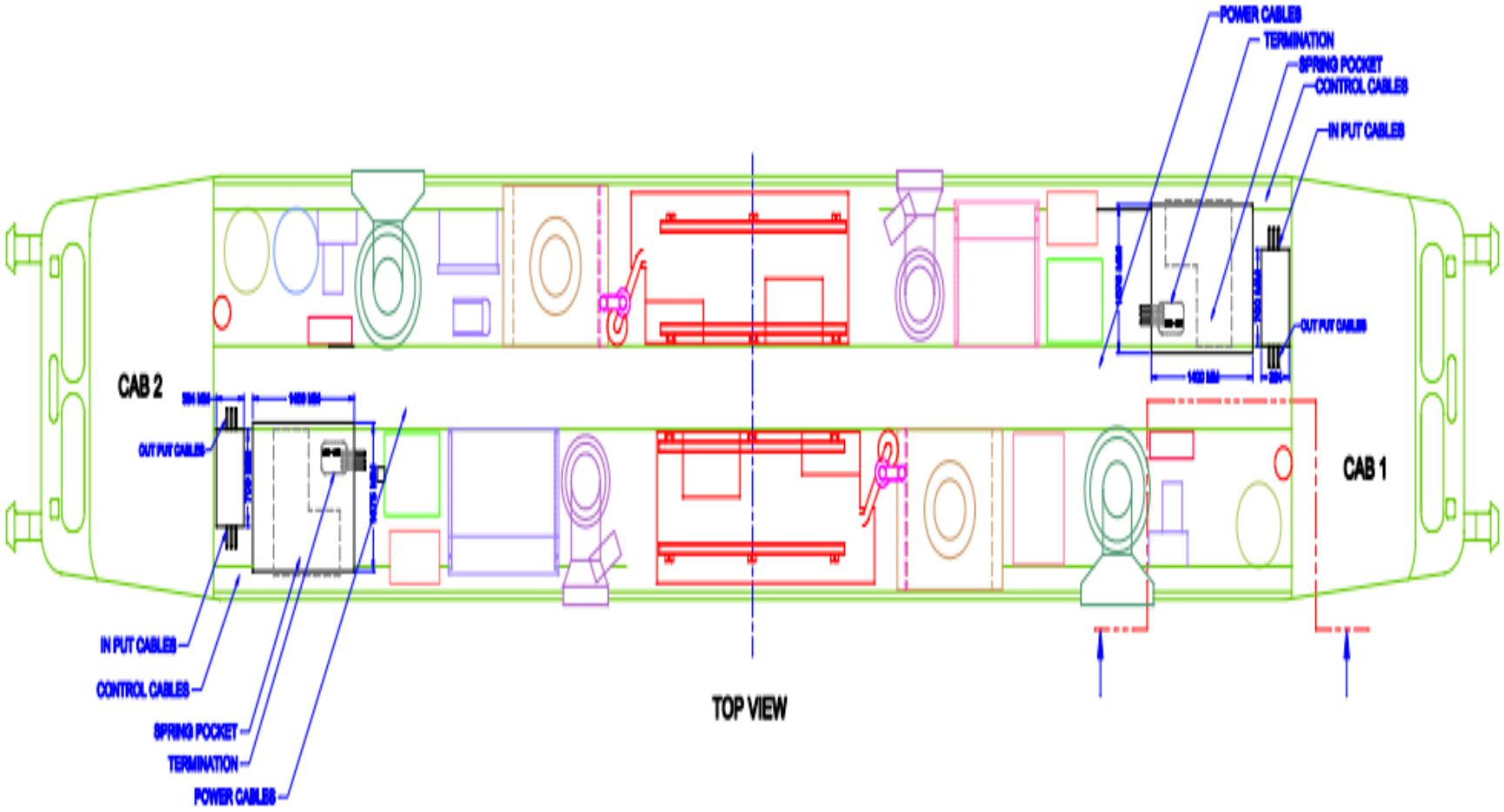
Hotel Load Converter Protections

Sl. No	Protection	Limits	Type (HW/SW)
1	Input contactor malfunction	Through Auxiliary contactor	Software
2	Pre-charging contactor malfunction	Through Auxiliary contactor	Software
3	Input Under Voltage	< 495V Vrms for 2 sec	Software
4	Input Over Voltage	> 1190V Vrms for 1 sec	Software
5	Input Over Current	> 750 A rms for 50 msec, > 1700 A peak for 200 usec	Software
6	Input out of frequency	< 46 Hz for 100 msec, > 54 Hz for 100 msec	Software
7	4QC Heat sink Temperature	> 90°C 2 sec	Software
8	4QC IGBT saturation (Vce)	Vce exceeded	Software
9	DC Link Over Voltage	> 1800 V instantaneous	Software
10	DC Link Under Voltage	< 1000 V for 100 msec	Software
11	Cooling Blower Failure	Based on the blower current value	Software
12	Inverter Heat sink Temperature	> 85°C 2 sec	Software

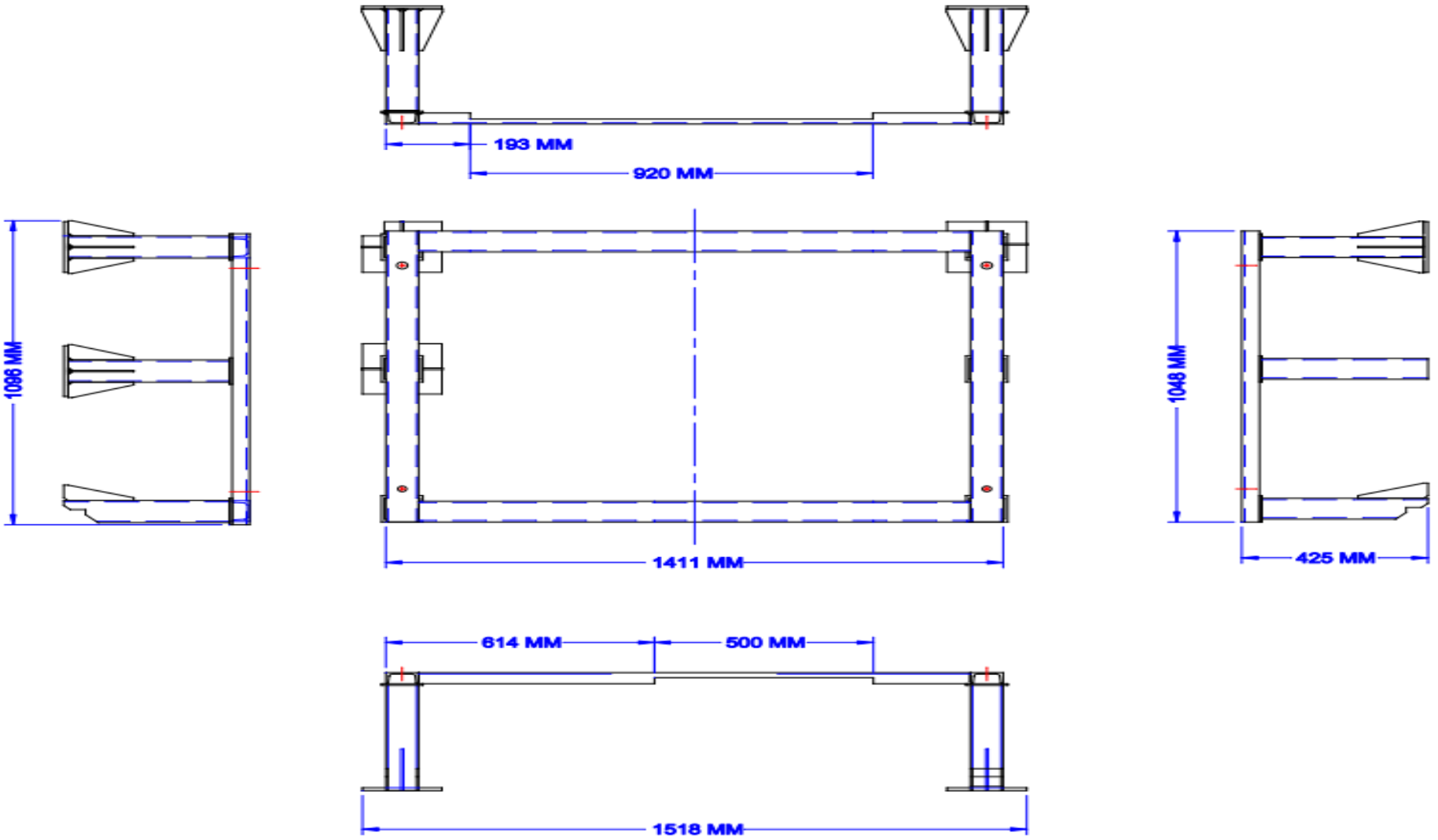
Hotel Load Converter Protections

13	Inverter IGBT saturation (Vce)	Vce exceeded	Software
14	Output Under Voltage	< 710 V rms for 5 sec	Software
15	Output Over Voltage	> 790 V rms for 1 sec, > 850 V rms for 100 msec	Software
16	Output Over Load	User Configurable	Software
17	Output Over Current	User Configurable	Software
18	Output short circuit	User Configurable	Software
19	Output Single phasing	Current difference > 50 A for 1 sec	Software
20	Earth Fault on AC output side	User Configurable	Software
21	Output contactor malfunction	Through Auxiliary contactor	Software

Placement of Hotel Load Converter in Locomotive

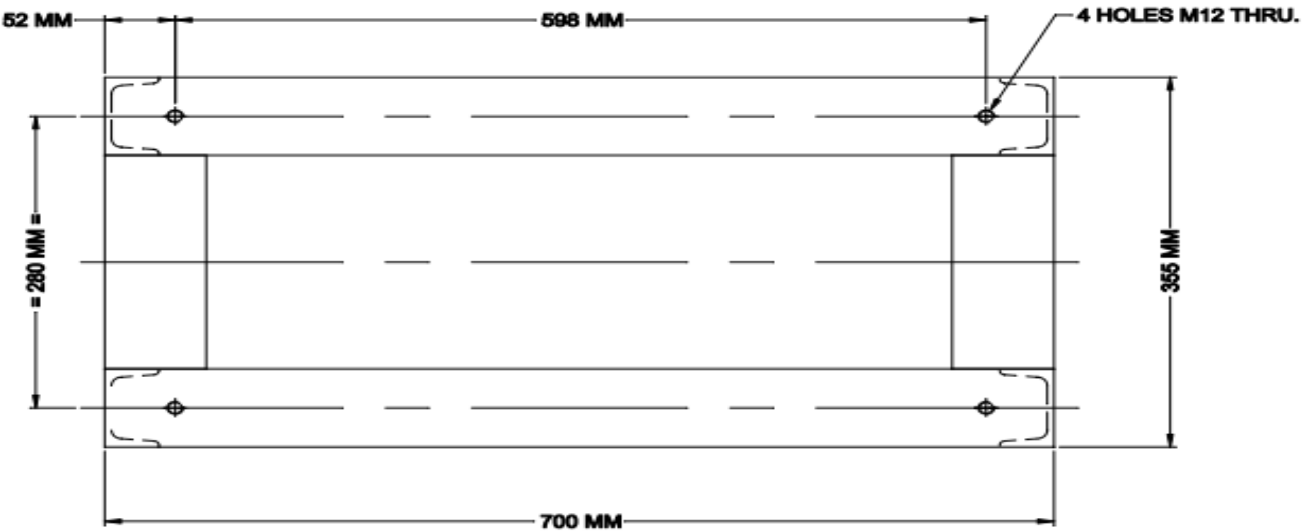


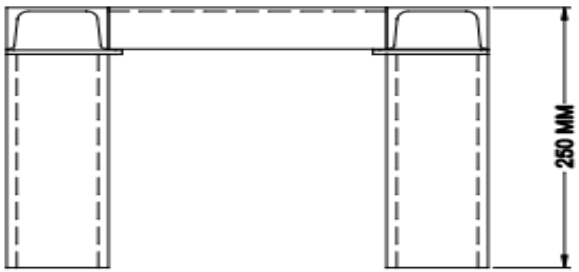
Mounting Base For Converter Unit



MOUNTING BASE FOR HOTEL LOAD CONVERTER

Mounting Base For Contactor Unit





MOUNTING BASE FOR
ADDITIONAL EQUIPMENTS B

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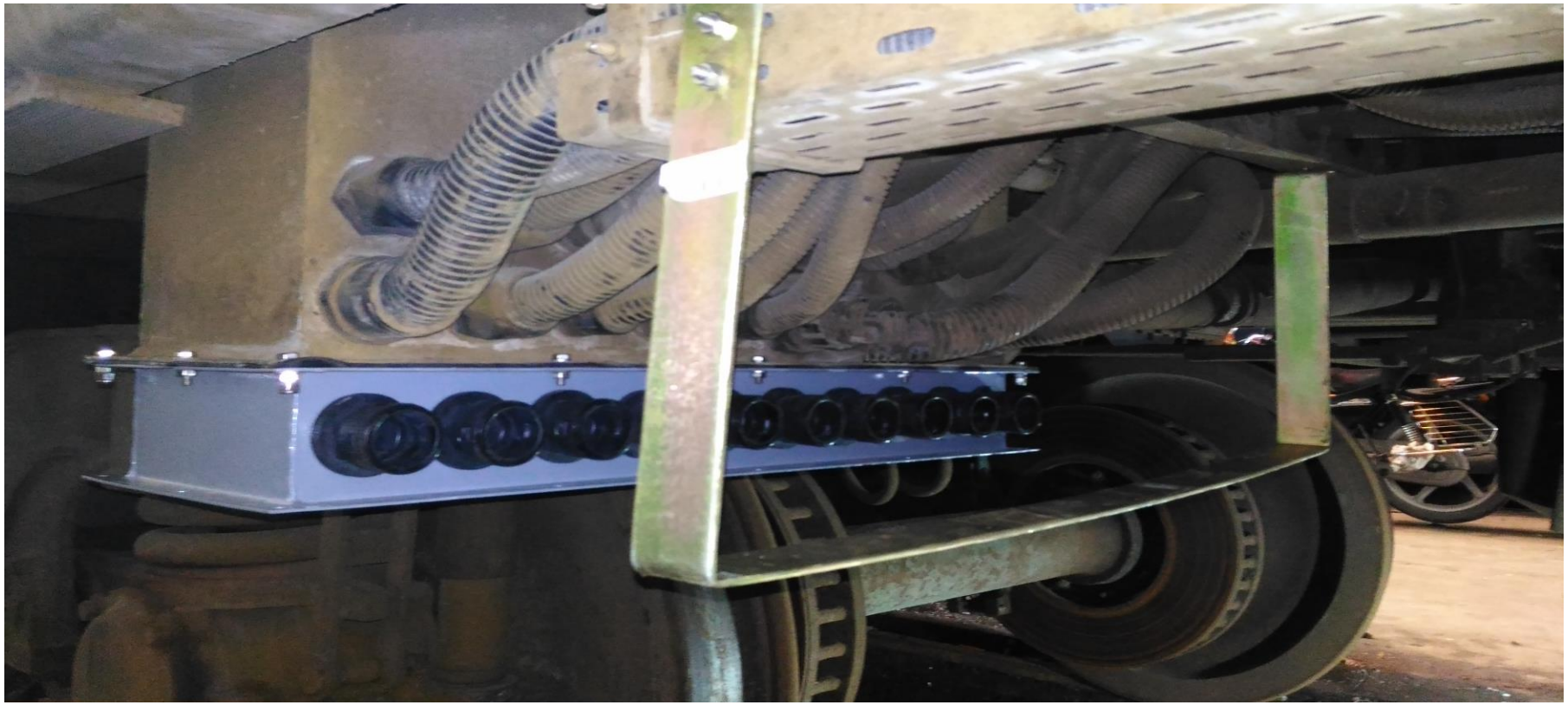
Power car with coach modification

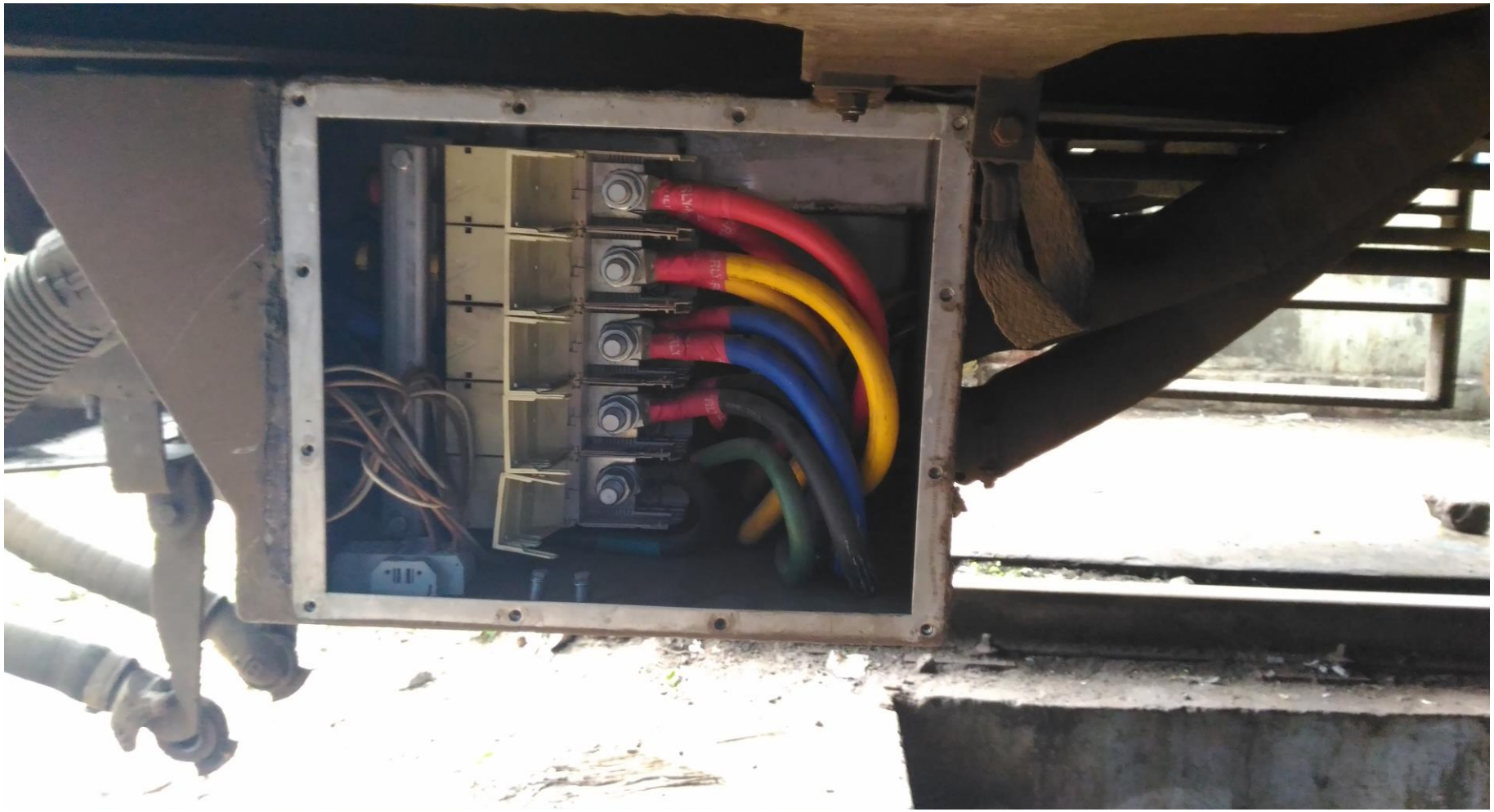
- Cable Routing and Laying : Under slung Power cables, Control cables and UIC coupler 19 core cables routing through extended junction box as per below figure.

Power car with coach modification

Remove the Power cables at vestibule side Feeder A and Feeder B Junction Box. (this cables are came to non vestibule end Feeder-A and B Junction Box). See the below figure.



Power car with coach modification



Power car with coach modification

Power car with coach modification

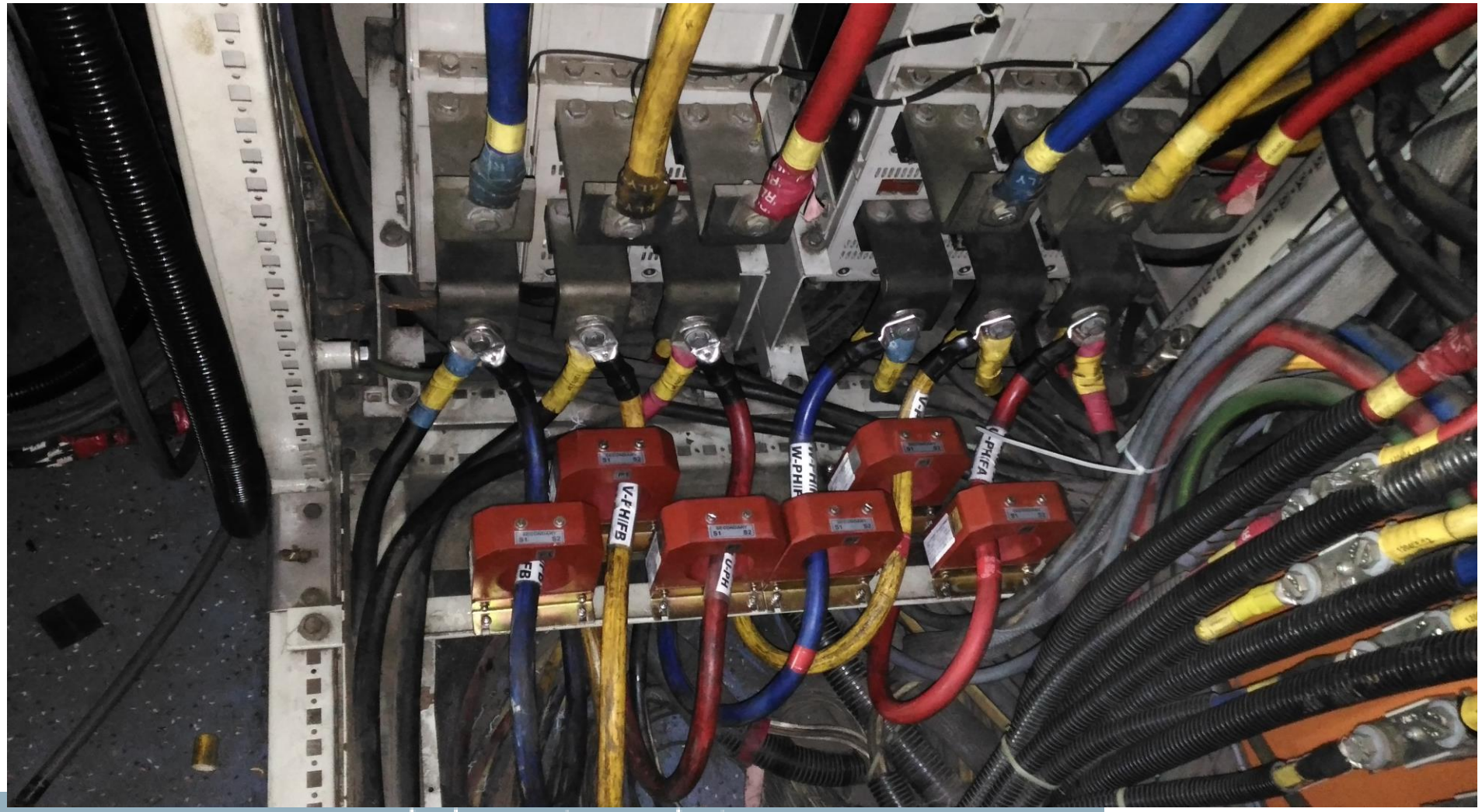
Power car with coach modification

Power car with coach modification

- Remove the Power cables at vestibule side Feeder A and Feeder B Junction Box. (this cables are came to non vestibule end Feeder-A and B Junction Box) See the above figures.

Removed power cables are Connected to ACB-A and ACB-B Output terminals through extended Power Panel junction Box. See the below figures.

Power car with coach modification

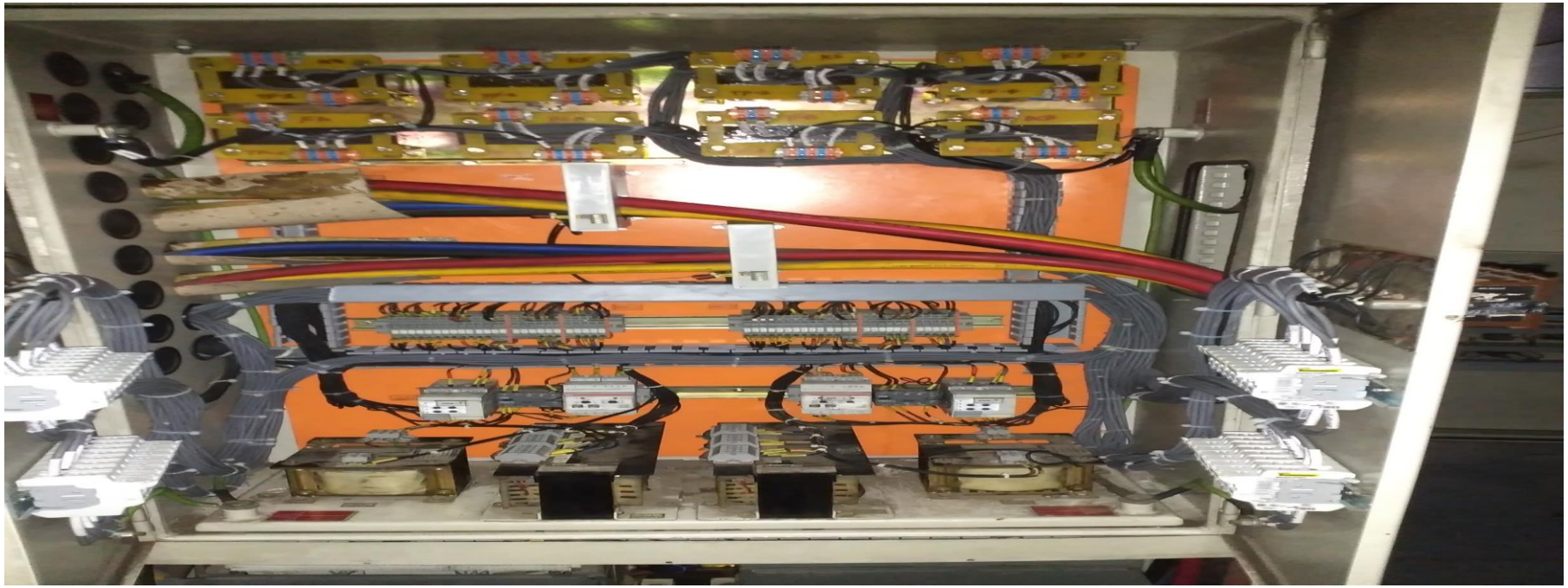


Power car with coach modification

- Remove the IV coupler socket at Feeder-B Junction Box non vestibule end and Mounting the IV coupler Dummy Socket at Feeder-B Junction Box non vestibule end.
- Connect the New IV coupler plug cables at Feeder-B Junction Box Power Terminals as per below figure.

Power car with coach modification

- **100VA TRANSFORMER WIRING:**
- **Mounting the TXFR Bracket with 750V/415V,100VA Transformers 8no.s and Fuse holders 32no.s and connect the TXFR input and out connections through fuse as per WF. See the below figure.**

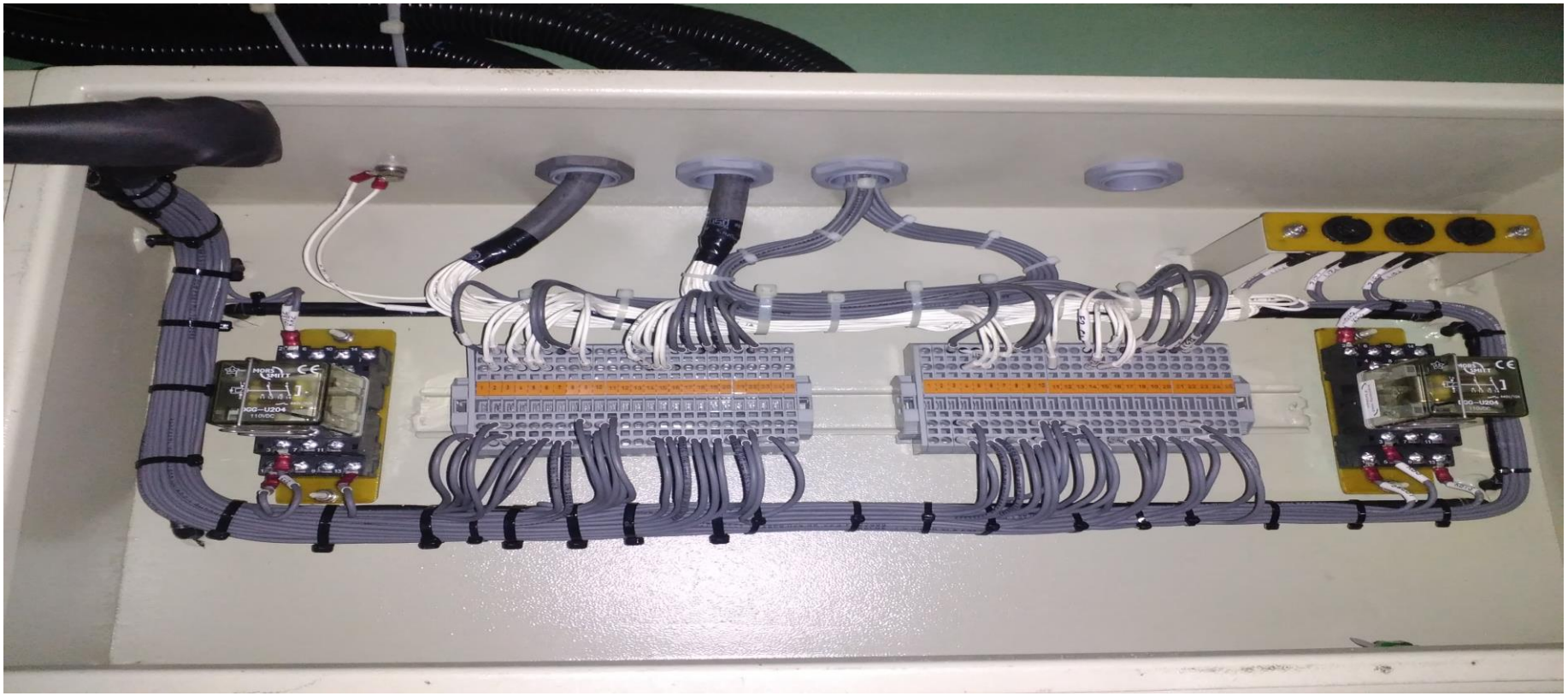


Power car with coach modification

- **INTER LOCKING PANEL WIRING :-**
- Mounting the interlocking panel. This panel functioning is is electrical hotel load to generator set interference as per WF. See the below figure.

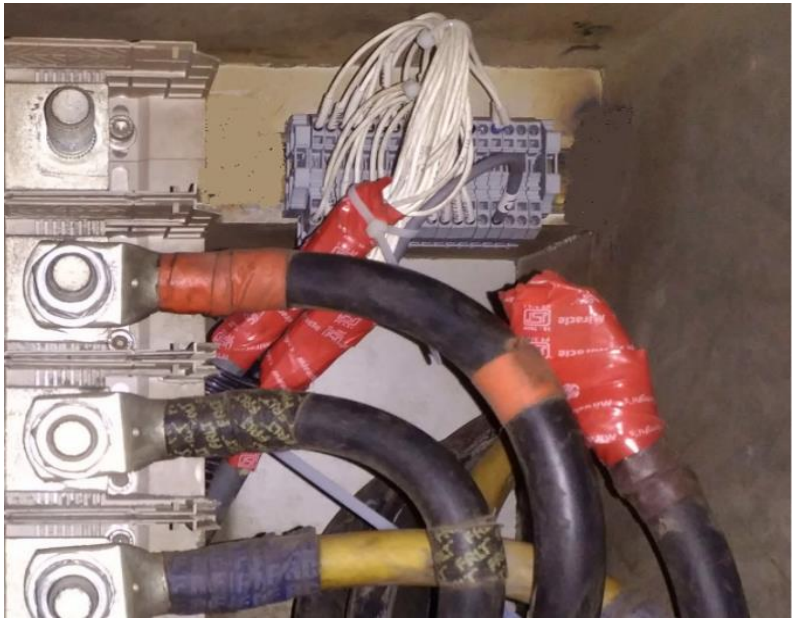
Power car with coach modification

- **Control wiring:-**
- **Connect the 19 core cable connections from feeder-A & B junction boxes to interlocking panel. Connect the interlocking panel CON-A cables to Power car control panel Feeder-A section and CON-B cables to Power car control panel Feeder-B.**



Power car with coach modification

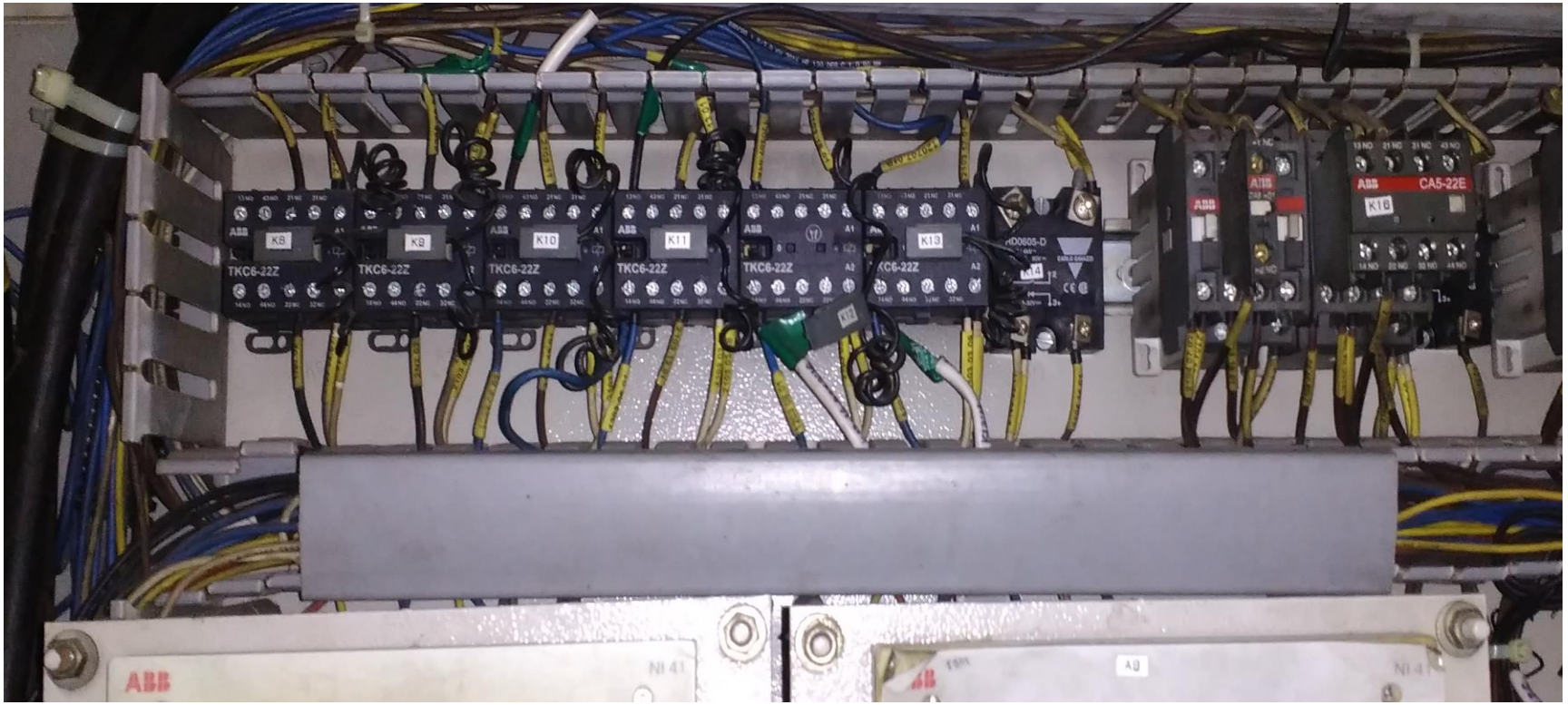
- **UIC COUPLER SOCKET WIRING :-**
- **Connect the 19 core cable Connections from Feeder-A side UIC coupler socket to Wago connectors of Feeder-A junction box Non Vestibule End and Feeder-B side UIC coupler socket to Wago connectors of Feeder-B junction box Non Vestibule End as per WF. See the below figure.**



Power car with coach modification

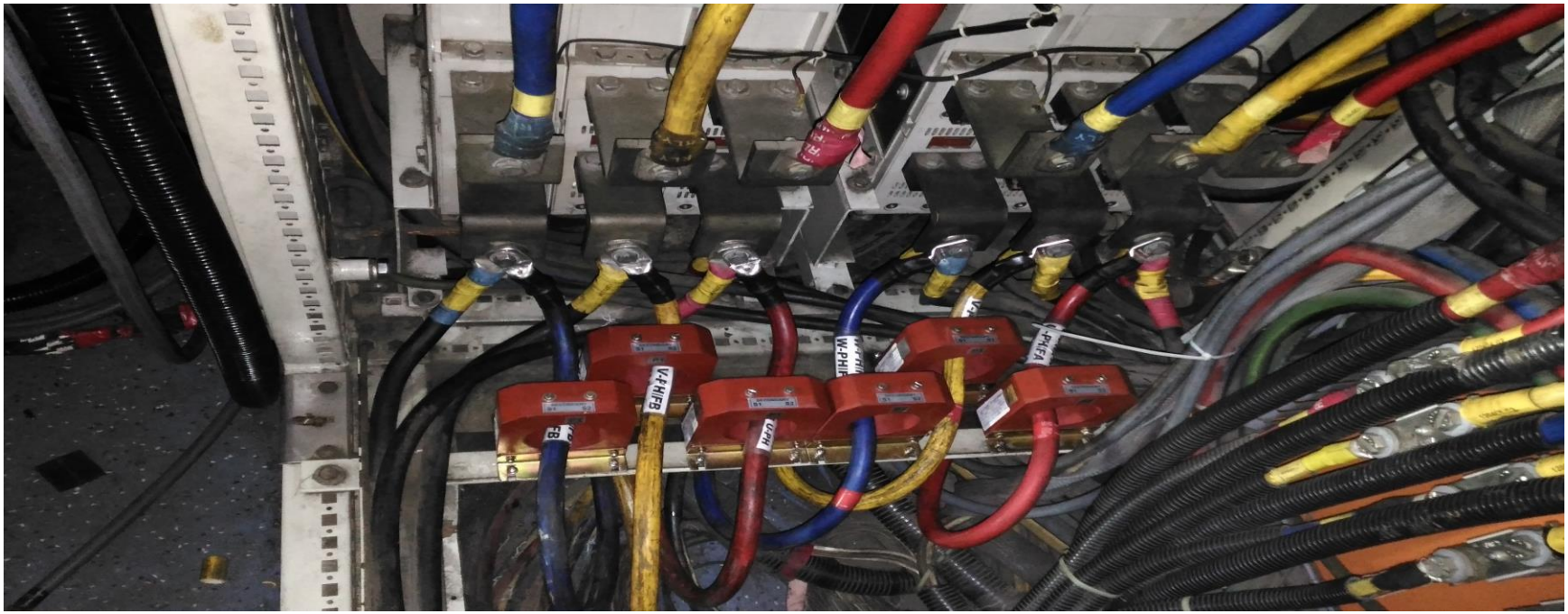
NEUTRAL SECTION WIRING :-

Replace the existing contactors with new one (with add-om block) and modify the wiring of K10,K11,K12 & K13. See the below figure for reference.



Power car with coach modification

- **Measurements of HOG Converter currents:-**
- **Add the 6pole, 3way Rotary Switch 2no.s at Power car Control panel Front Door and Add the 400/5A Current Transformer 6 no.s at ACB-A & ACB-B O/P terminals through CT as per below figure.**



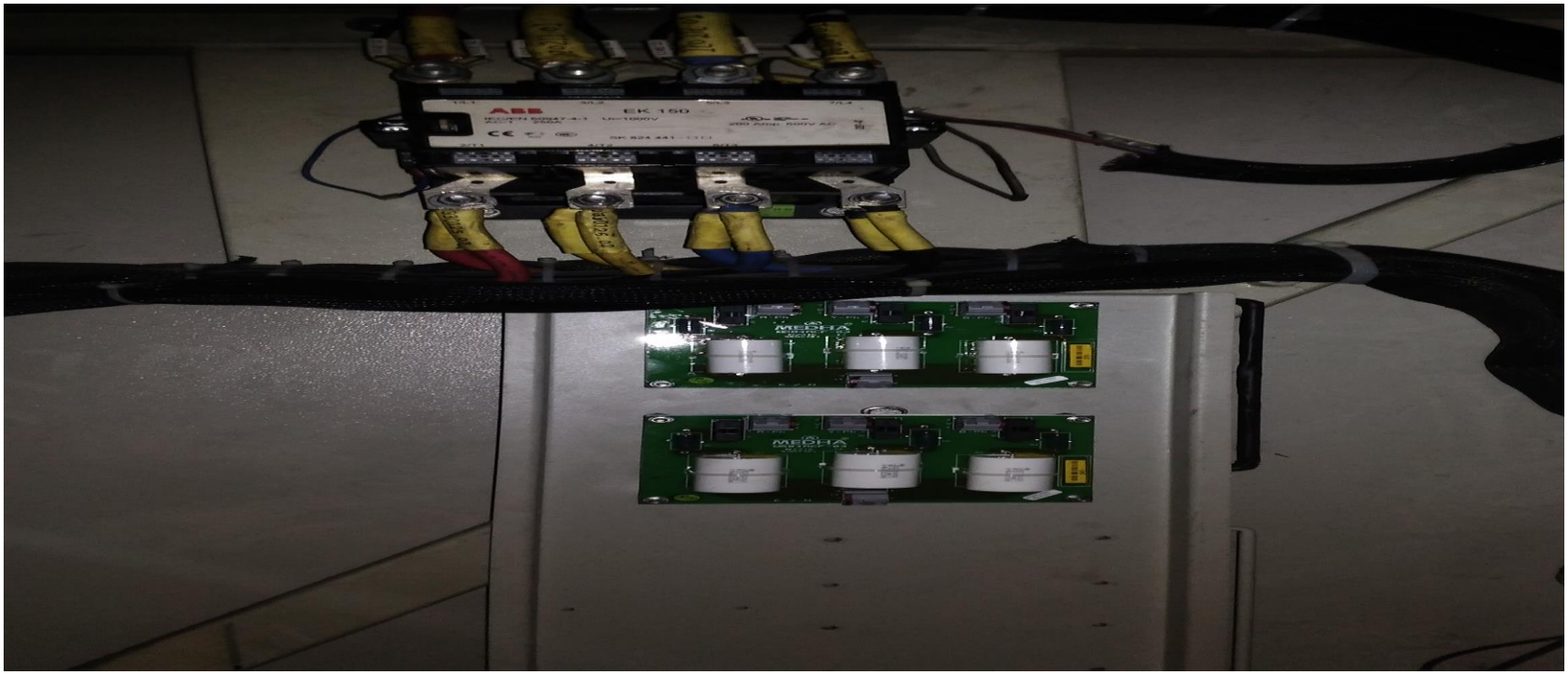
Power car with coach modification

- Connect the 1.5Sq.mm cable Connections from Rotary Switch (Feeder-A SW) to 1F18,1F19,1F20 & ACB-A O/P terminals for Voltage measurement and Rotary Switch (Feeder-A SW) to HOG Current Transformers at ACB-A O/P terminals for Current measurement.
- Connect the 1.5Sq.mm cable Connections from Rotary Switch (Feeder-B SW) to 2F18,2F19,2F20 & ACB-B O/P terminals for Voltage measurement and Rotary Switch (Feeder-B SW) to HOG Current Transformers at ACB-B O/P terminals for Current measurement.

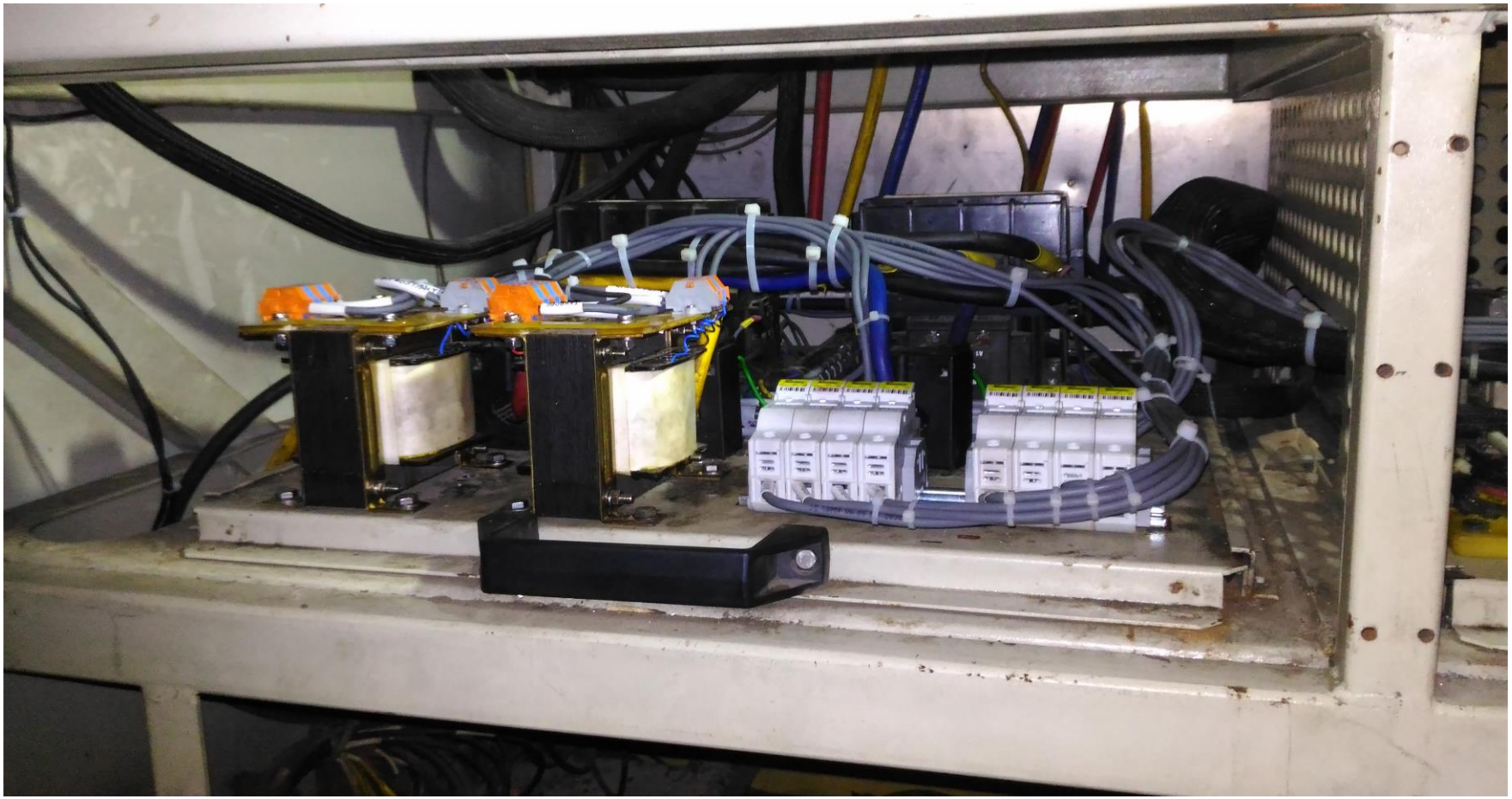
Power car with coach modification

Power car with coach modification

- **Coach Control panel Modification :-**
- **Mounting the RCF & TXFR Mounting Bracket with Components in Coach Control Panel. See the below figure.**



Power car with coach modification



Power car with coach modification

- Mounting the Glass Epoxy sheet 200mmx150mm4mm for MMR and Maintain the distance 100mm between MMR1 & MMR2. Connect the 1.5Sqmm/4KV cable Connections Feeder-A Transformer & Feeder-B Transformer I/P to NET1,NET2 Contactors I/P terminals through Fuse holders as per W.F. The Feeder-A Transformer & Feeder-B Transformer O/P Connections are connected to Feeder-A coil wago fuse, Feeder-B coil wago fuse and MMR1 Relay & MMR 2Relay. Connect the 2.5sqmm cable connections are K44 Contactor I/P terminals to RCF PCB1 & RCF PCB2 as per WF. See the below figure.

Power car with coach modification

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