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भारत सरकार – रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ – 226011
Govt. of India - Ministry of Railways
Research, Designs & Standards Organization,
LUCKNOW - 226011

No. EL/11.5.5/6

Date: 06.02.2018

Chief Electrical Engineer,

- Central Railway, HQs Office, 2nd floor, Parcel Office Bldg., Mumbai-400 001
- East Central Railway, Hajipur (Bihar)-844 101
- Eastern Railway, Fairlie Place, Kolkata – 700 001
- East Coast Railway, Railway Complex, Bhubneshwar – 751 023
- Northern Railway, Baroda House, New Delhi-110 001
- North Central Railway, Allahabad – 211 001
- South East Central Railway, Bilaspur-495 004
- South Central Railway, HQs Office, Rail Nilayam, Secunderabad-500 071
- South Eastern Railway, Garden Reach, Kolkata- 700 043
- Southern Railway, Park Town, Chennai – 600 003
- West Central Railway, HQs Office, Opp. Indira Market, Jabalpur-482 001
- Western Railway, Churchgate, Mumbai – 4000 020

Sub: Modification Sheet No. RDSO/2018/EL/MS/0468 (Rev. '0') dtd. 06.02.2018 for modification in existing hotel load scheme by removing irrelevant protections provided in WAP-7 locomotives.

Please find enclosed herewith a copy of Modification Sheet No. RDSO/2018/EL/MS/0468 (Rev.'0') dtd. 06.02.2018 for modification in existing hotel load scheme by removing irrelevant protections provided in WAP-7 locomotives.

(Suresh Kumar)

For Director General (Elect.)

Encl: As above.

Copy to:

1. **Secretary (Electrical), Railway Board, Rail Bhawan, New Delhi-110 001.** For kind information. (Kind Attn.: Shri A.K. Goswami, DEE/RS)
2. **CEE, Chittaranjan Locomotive Works, Chittaranjan – 713 331(WB)**
3. **Sr. Divisional Electrical Engineer (TRS), Electric Loco Shed,**
 - Central Railway, Ajni (Nagpur)-440008.
 - Central Railway, Kalyan-421304 (Maharashtra)
 - East Central Railway, Gomoh-828 401
 - Eastern Railway, Howrah-711 106
 - Northern Railway, Ghaziabad (UP)-201 0L01.

For information &
necessary action
please.

- North Central Railway, Fazalganj, Kanpur – 208 003
- South East Central Railway, BMY Complex, Bhilai, Durg-490 025.
- South Central Railway, Lallaguda, Secunderabad – 500 017.
- South Eastern Railway, Tatanagar-831 002.
- Southern Railway, Royapuram, Chennai-600 013.
- West Central Railway, Tughlakabad, New Delhi-110 044.
- Western Railway, Vadodara-390 002.
- East Coast Railway, Vishakhapatnam – 530 001.
- Northern Railway, Ludhiana.

Suresh
6/2/18

(Suresh Kumar)
For Director General (Elect.)

Encl: as above.

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भारत सरकार – रेल मंत्रालय
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लखनऊ – 226011
Government of India - Ministry of Railways
Research, Designs & Standards Organization,
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No. EL/11.5.5/6

Dated: 06.02.2018

Chief Electrical Engineers;

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- Western Railway, Churchgate, Mumbai – 4000 020

MODIFICATION SHEET NO. RDSO/2018/EL/MS/0468 (REV. '0') dtd. 06.02.2018

1.0 Title:

Modification in existing hotel load scheme by removing irrelevant protections provided in WAP-7 locomotives.

2.0 Brief History:

- 2.1 At present, Indian Railways is producing WAP5, WAP7 and WAG9-H class of three phase locomotives. These locomotives take power from OHE through pantograph to traction transformer. Traction transformer of WAP5 and WAP7 are provided with a hotel load winding to cater for the power supply to coaches (also referred to as Hotel Load).
- 2.2 In original design of WAP5 loco as received from ABB/Switzerland, there was provision of Head On Generation (HOG). Accordingly, single Hotel Load (HL) winding in the main transformer was provided. In WAP5 locomotive, there was no provision of Hotel Load Converter (HLC) inside machine room, instead single phase output of the Hotel Load (HL) winding was directly routed to coaches through arrangement of Inter Vehicle Coupler (IVC). Thus, the output of transformer was directly provided to coaches where it was utilized as per load demand of the coach. The scheme could never be put in service as the coach requires three phase supply instead of single phase. In the original design there was

some essential protection were provided for HL winding through the under mentioned components. The scheme is shown in Figure – 1.

Item. No.	Description	Purpose
32	Contactor for hotel load	Main input Contactor
33	Current Sensor for Hotel Load Supply	Over Current Protection during short circuit condition
35	Socket Hotel Load Supply	Supply for connecting HLC in Power Car
37.1	Resistor for Earth Fault Detection Hotel Load	Earth fault detection on input side
38.1	Earth Fault Relay for Hotel Load	
38.2	Surge Arrestor for Hotel Load	Surge Protection

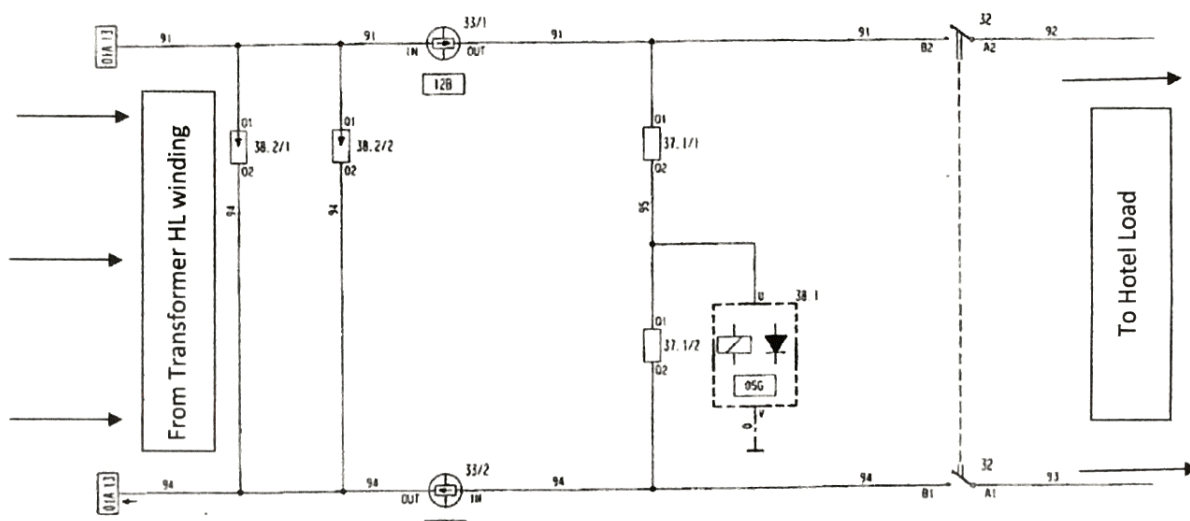


Figure – 1

2.3 With the technological up-gradation and continuous advancements in the field of power electronics, control system and power supply systems, Indian Railways decided to develop 2x500 kVA Hotel Load Converter (HLC) for WAP7 locomotives. The scheme which was originally provided for WAP5 locomotive in which a HOG winding was provided in transformer was adopted for WAP7 locomotive also. However, supply to the coaches has to be given through HLC instead of direct from Hotel Load Winding of the main transformer as the train load requires 3-phase supply. So IR deviates from original design of WAP5 and successfully incorporated HLC inside the WAP7 locomotive itself.

3.0 Existing Schematic for HLC in WAP7 Locomotive

3.1 In July'2010, CLW turned out first hotel load converter equipped electric loco No. 30277 (WAP7) having single hotel load winding of 945KVA (LOT 7500). In the locomotive, the Hotel Load protection scheme as shown in Figure-1 was kept unaltered. The schematic for single winding hotel is attached in figure-2.

W. S. 6/2/16

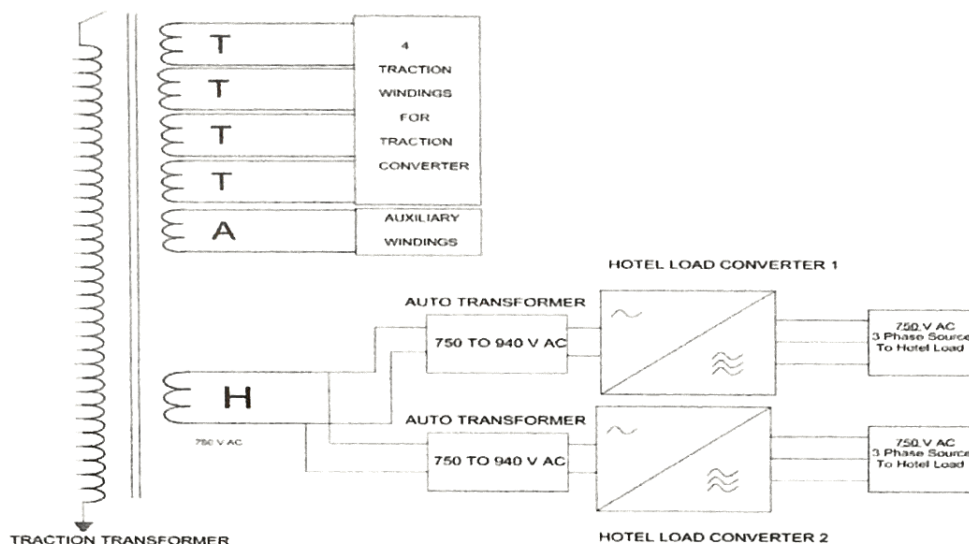


Figure – 2

- 3.2 Due to single HL winding of the main transformer, the two HLCs were connected in parallel. The parallel connection leads to circulating current due to which the reliable operation of both the HLCs simultaneously was difficult. Later on, modified main transformer, i.e., LOT 7775 was introduced in WAP7 locomotives which was provided with two secondary hotel load windings of 2x622.5 kVA rating. The schematic of Hotel Load Converter with dual hotel load winding is shown in figure-3 below.

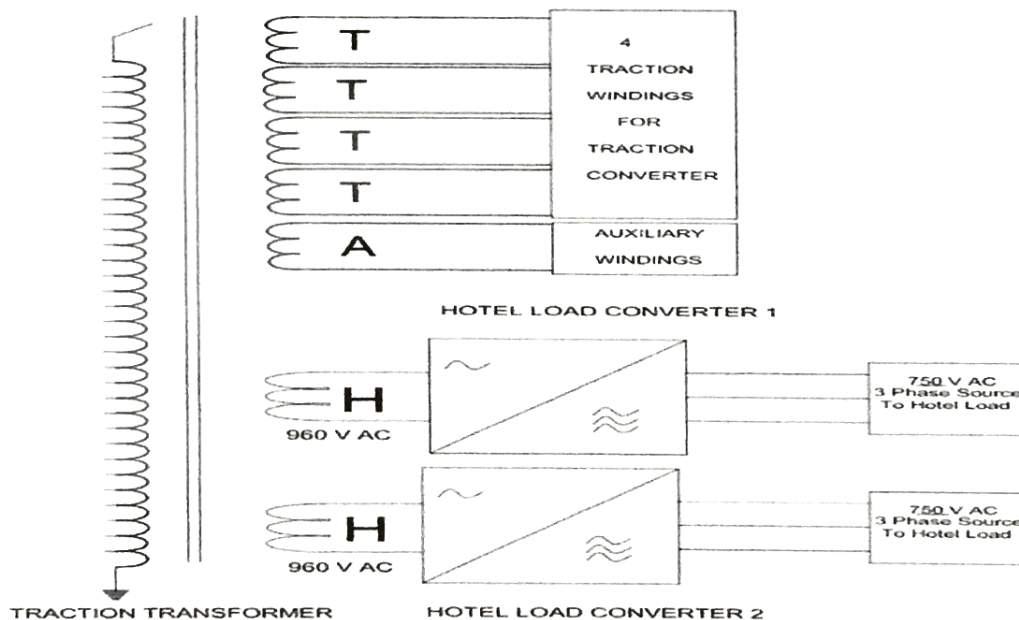


Figure – 3

WAP7

- 4.0 The entire protection scheme as followed in previous single HOG winding was also provided in each of dual HOG windings also. However in this arrangement, only one phase of each HL winding was provided with contactor (32) as shown in figure-4 below.

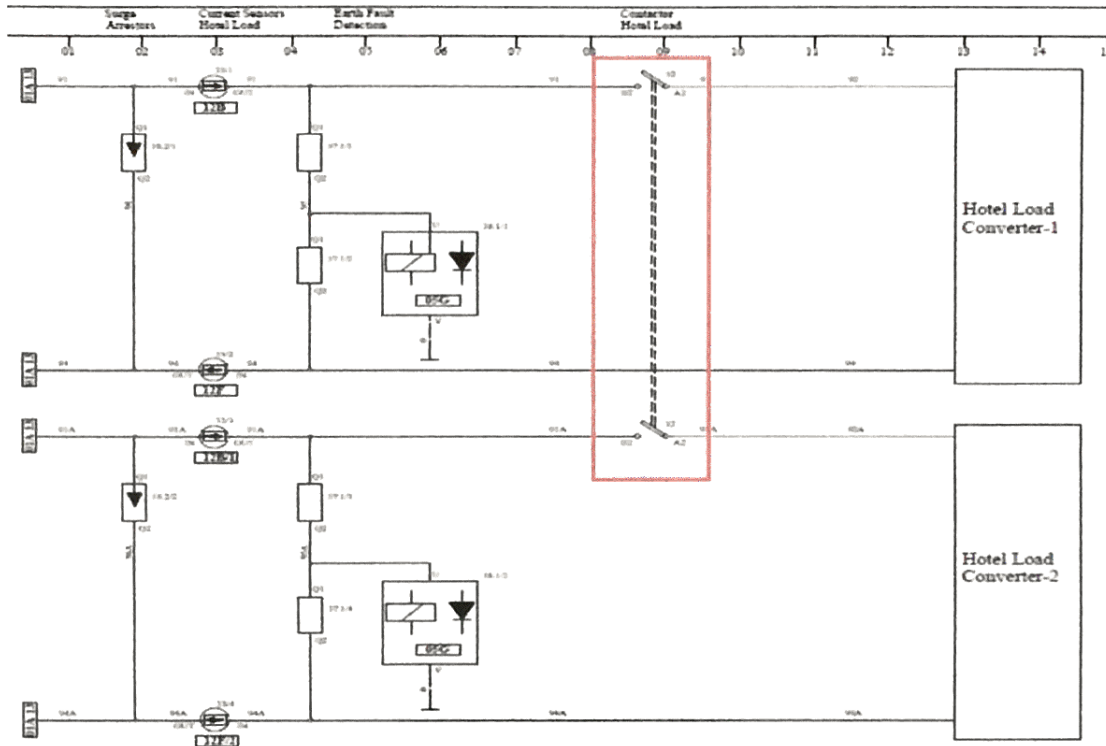


Figure – 4

5.0 Object:

Due to the implementation of original protection scheme for the two HL windings, the entire circuitry provided in filter block (FB) becomes very cramped which leads to overheating of the components and even sometimes incidents of fire have happened. Thus, the HLC manufacturers incorporated these protection schemes in Hotel Load Converter itself. Therefore, the objective of this modification sheet to reconsider the existing hotel load protection scheme in the changed scenario and remove the irrelevant equipments from the circuit.

6.0 Existing Hotel Load Control Scheme of WAP7 Locomotive:

- 6.1 **BLHO key:** BLHO key has been provided in A-panel of both the cabs in the locomotive. It is used for controlling the main contactor (32) located in Filter Block (FB). Once this contactor is closed the input supply from HOG winding is available to the HLC and indication for "input supply available to HLC" glows. Now the converters can be started from Power Car through Pacco Switch.

Wires
6/2/16

- 6.2 **Pacco Switch:** Control panel for switching OFF/ON control of the Hotel Load Converter has been provided in power cars where it can be controlled through Pacco switches connected through UIC as shown in Figure – 5. Thus, the ON/OFF command is under control of power car.

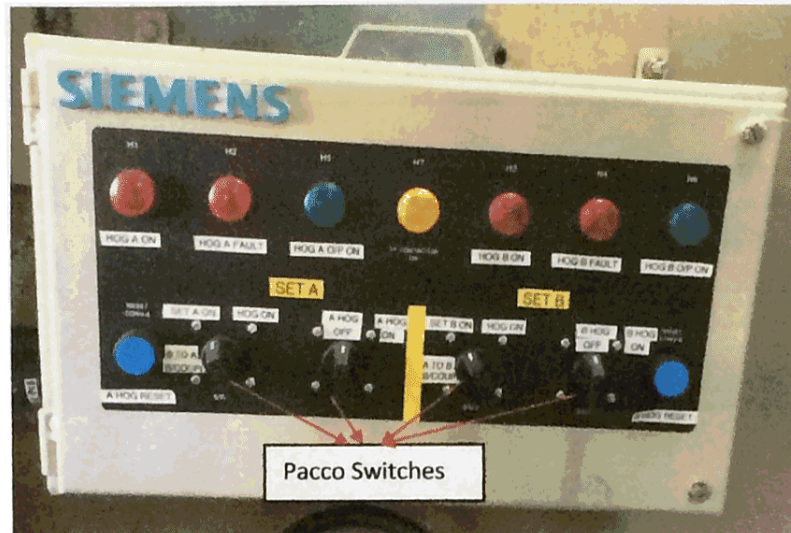


Figure – 5: Control Panel provided in Power Car

- 6.3 **33 no. Relay:** This relay is provided inside SB-1 panel. This relay was introduced in WAP7 locomotives (not originally in WAP5) for overcoming the problem of arcing/flashing in main contactors (32) whenever the off command is generated through BLHO or Pacco Switch. This 33-no. relay comes in picture while turning OFF the HLC. This introduced a mechanism which first generates OFF command for HLC which opens the main contactor provided inside the HLC. After delay of 3 seconds the Open command is generated for main contactor (32). This ensures the opening of main contactor in OFF load condition of HLC. Thus, ensuring no arcing/flashing in main contactor (32). This clearly indicate that after introducing this 33 no. relay the role of main contactor (32) is to just make/break the circuit in Off-load Conditions only.

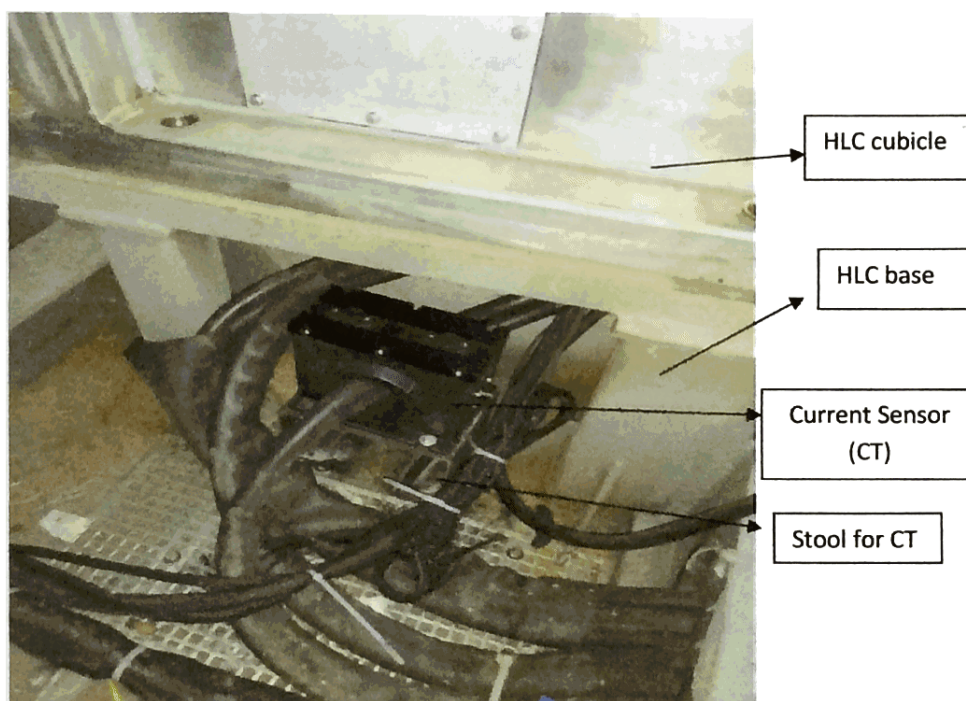
7.0 Work to be done for modified new HOG Scheme for WAP7 Locomotive

- 7.1 The modified new HOG scheme for WAP7 loco has been finalized after study of different components of Filter Block, protection scheme provided in WAP7 locomotive. As the existing scheme of WAP7 locomotive is quite different from the original scheme of WAP5 locomotive. The function of various equipment provided in filter block for HLC have been studied and their relevance in the present scheme has been reviewed. The protection scheme in this proposed architecture shall be as follows:

- 7.1.1 **Main Contactor (32):** As discussed above, the main function of making and breaking of the circuit is through contactor provided in HLC itself. Therefore, it becomes irrelevant to use additional main contactor (32) in filter block (FB). Hence, in the proposed scheme this contactor shall be eliminated from the circuit.

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- 7.1.2 **Earth Fault Protection:** As per specification, the HLC supplied at present by different manufacturer, has been provided with Earth Fault Protection on both (input and output) side of HLC. Hence, Earth Fault Relay for Hotel Load (38.1) provided in filter block (FB) shall be removed from the HL circuit.
- 7.1.3 **Surge arrestor:** This has already been provided by HLC manufactures inside both the HLC. Hence Surge Arrestor for Hotel Load (38.2) provided in filter block (FB) shall be removed from the HL circuit.
- 7.1.4 **Input Over-current Protection:** The manufacturers of HLC are providing CT for current monitoring of input and output current inside both the HLC. Apart from this protection which is inherent in HLC, separate current monitoring of input current has been ensured. This is achieved by providing current sensor at the bottom of each HLC which is being monitored by SR electronics as per the original scheme. But only single phase current monitoring has been provided instead of providing CT in both the phase (original scheme). The photograph and drawing of current sensor stool is enclosed as Annexure – 1.



- 7.2 The detailed drawings for Hotel Load connection circuit without 32 no. contactor and 33 no. relay provided in HB panel (CLW drawing No. 3EHP281101 01H & 3EHP281105 05D) have been enclosed as Annexure – 2. Modified UIC-Line Hotel Load 1&2 (CLW drawing No. 3EHP281113 13B) has been enclosed as Annexure – 3.
- 7.3 Modified cable index along with details of cables removed/modified for Hotel Load Converter is enclosed as Annexure – 4.

Wages

7.4 Suitable modification in the Vehicle Control Software for its status feedback has been done by CLW. The detailed changes which comprises two hotel load converters and no hotel load contactor "32" or HLC ON command relay "33", controls and monitors the hotel load supply is enclosed as Annexure – 5. Modified software is available on CLW website.

8.0 Material required:

- (i) Two nos. 150 mm² cables of 9.0 m length each (cable no. 91 & 94). The two removed 150 mm² cables of length 15 m (cable no. 92 & 93) as mentioned in Annexure – 4/1 may be re-used for the same.
- (ii) Two nos. 150 mm² cables of 8.5 m length each (Cable no. 91A & 94A).

9.0 Material surplus:

- (i) Two nos. Contactor for Hotel Load (32).
- (ii) Earth Fault Relay for Hotel Load (38.1).
- (iii) Surge Arrestor for Hotel Load (38.2).
- (iv) Four nos. 150 mm² cables of 7.0 m length each by removing cable nos. 91, 94, 91A & 94A (TFR bushing – FB).
- (v) Two nos. 150 mm² cables of 5.0 m length each by removing of cable nos. 92 & 93 (FB – HLC1).
- (vi) Two nos. 150 mm² cables of 6.0 m length each by removing cable nos. 92 & 93 (FB – HLC2) and after re-using of cables as per Para – 8.0 (ii) above.

10.0 Application to the Class of Locomotives:

WAP-7 locomotives fitted with 2x500 kVA, hotel load converters.

11.0 Agency of Implementation:

All Electric Loco Sheds Holding 3-Phase Electric Locomotives (WAP-7) fitted with 2x500 kVA, hotel load converters.

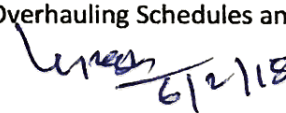
12.0 Periodicity of Implementation:

Minor Schedule Inspections (IA/IB/IC), MOH, IOH, POH Overhauling Schedules and any other unscheduled maintenance.


Encl: Nil

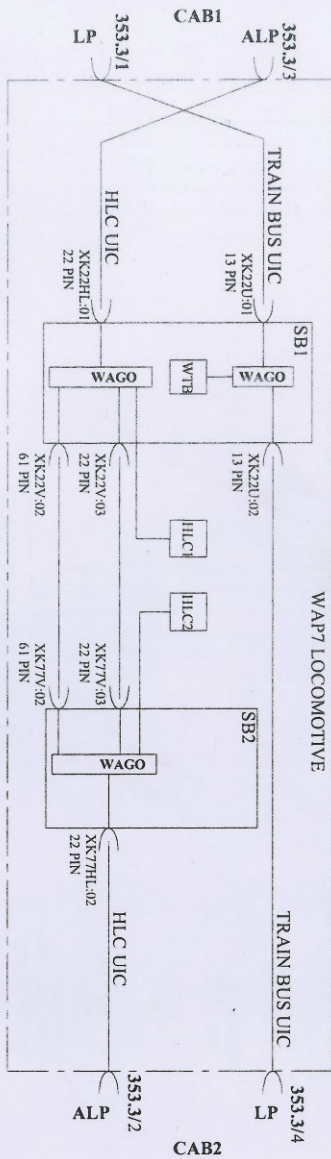
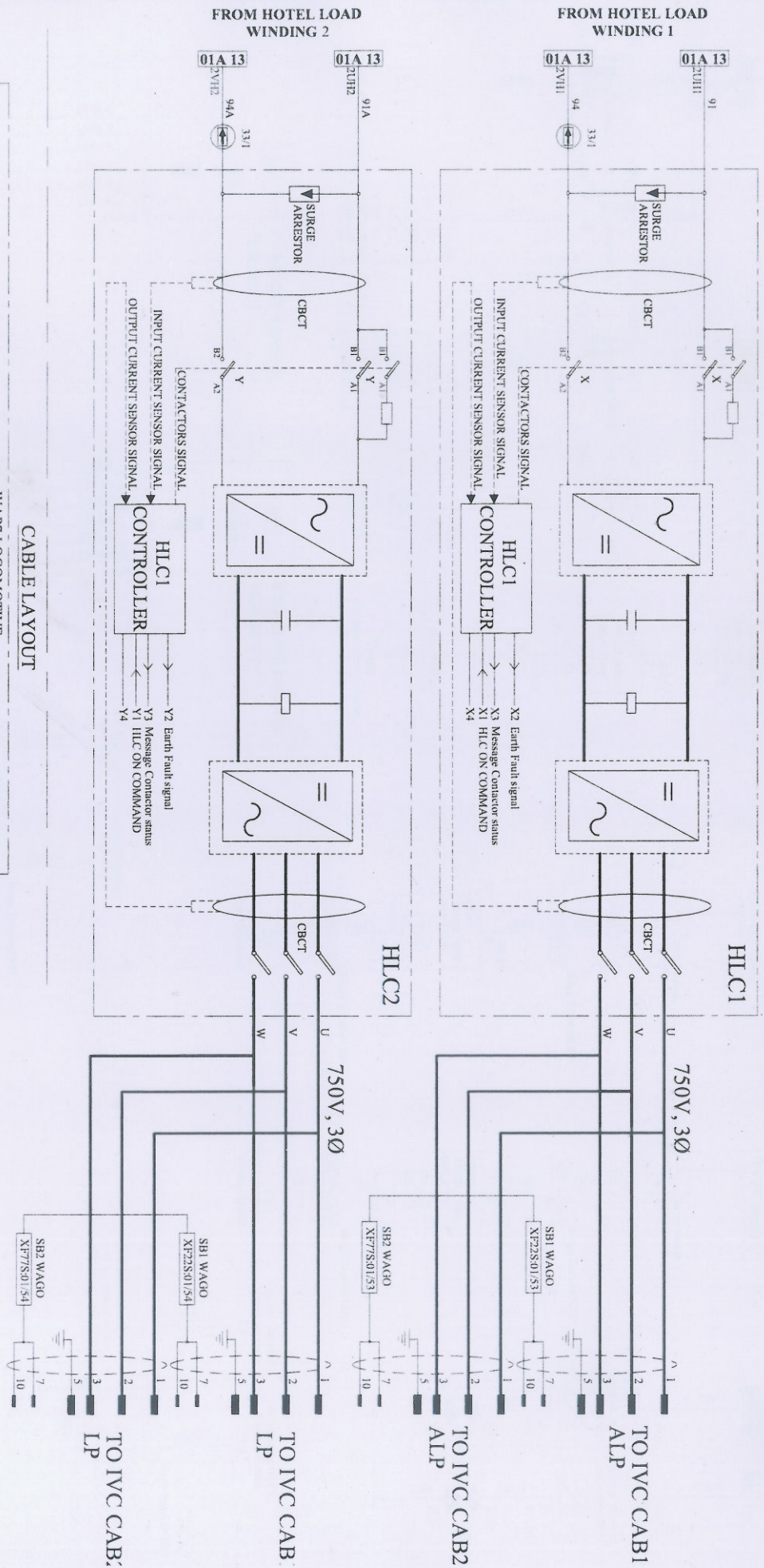
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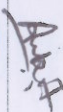


Secretary (Electrical),
Railway Board, Rail Bhawan,
New Delhi – 110 001


(Suresh Kumar)
for Director General (Elect.)

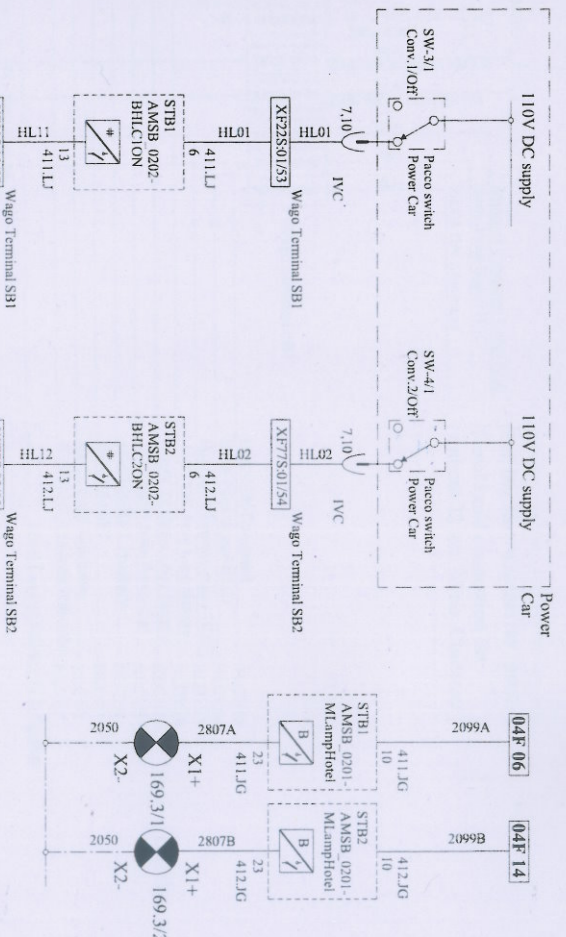
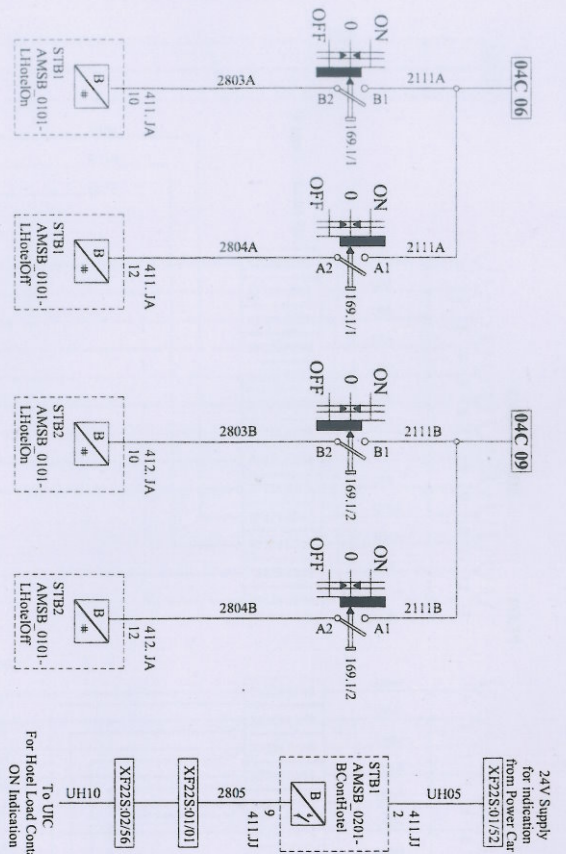
Encl: Nil


(Suresh Kumar)
for Director General (Elect.)



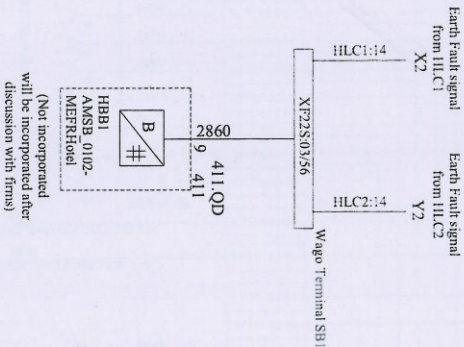
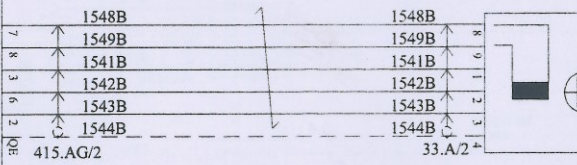
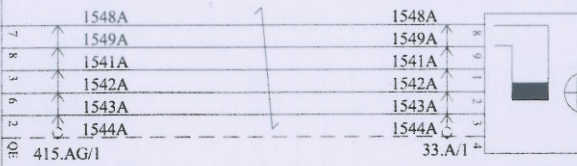
Ref. Drg No.: 3EHP281101 (01H)			
Hotel Load connection ckt. without 32 and 33 no. Contactor			
DRAWN BY SSE/D&D			
CHECKED BY AEE/D&D			
APPROVED BY Dy.CEE/D&D			

CHITTARANJAN LOCOMOTIVE WORKS
Chittaranjan : 713331
CENTRE FOR DESIGN & DEVELOPMENT

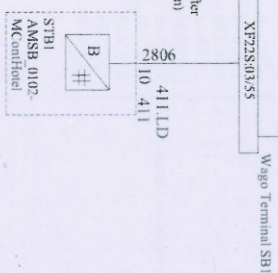


33/1 CURRENT SENSOR FOR HLC1

33/2 CURRENT SENSOR FOR HLC2



(Not Applicable will be applicable after discussion with firm)



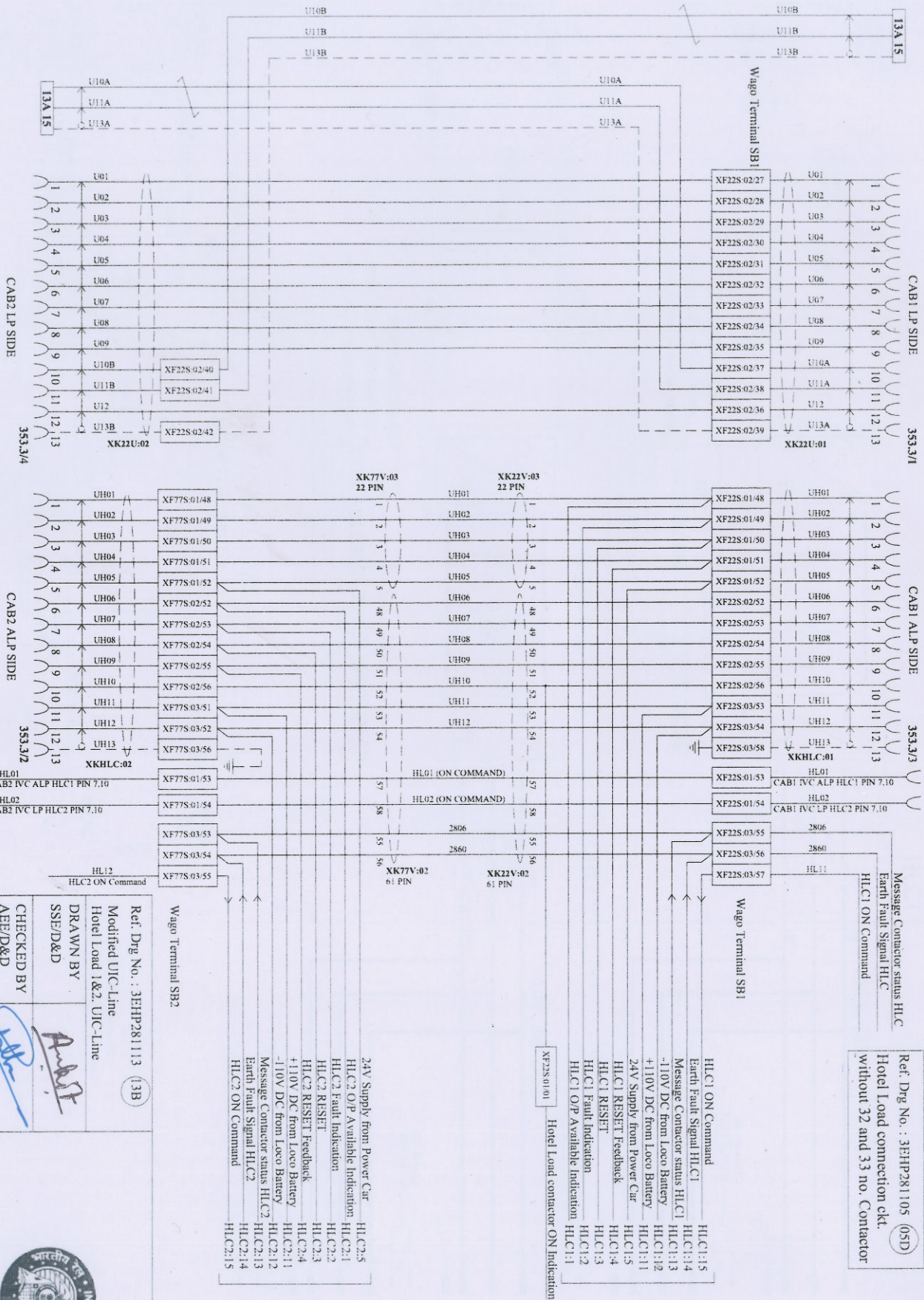
TRACTION CONVERTER-1 CONTROL ELECTRONICS

TRACTION CONVERTER-2 CONTROL ELECTRONICS

Ref. Drg No. : 3EHP281105 (OSD)
Hotel Load connection ckt. without 32 and 33 no. Contactor
DRAWN BY SSE/D&D
CHECKED BY AEE/D&D
APPROVED BY Dy.CEE/D&D



CHITTARANJAN LOCOMOTIVE WORKS
Chittaranjan : 713331
CENTRE FOR DESIGN & DEVELOPMENT



Ref. Drg No. : 3EHP281105 (05D)
Hotel Load connection ckt.
without 32 and 33 no. Contactor

Wago Terminal SB1

HL C1 ON Command
Earth Fault Signal HL C1
Message Contactor status HL C1
+110V DC from Loco Battery
+110V DC from Loco Battery
24V Supply from Power Car
HL C1 RESET
HL C1 Fault Indication
HL C1 O/P Available Indication
HL C1:1
HL C1:2
HL C1:3
HL C1:4
HL C1:5

Wago Terminal SB2

24V Supply from Power Car
HL C2 O/P Available Indication
HL C2:1
HL C2:2
HL C2:3
HL C2:4
+110V DC from Loco Battery
+110V DC from Loco Battery
Message Contactor status HL C2
Earth Fault Signal HL C2
HL C2 ON Command
HL C2:1
HL C2:2
HL C2:3
HL C2:4
HL C2:11
HL C2:12
HL C2:13
HL C2:14
HL C2:15

To Hotel Load Converter-

To Hotel Load Converter-

NOTE:
This drawing is applicable for WAP-7 Loco equipped with Hotel load converter. Else follow Schematic 13B for WAG-9/9H and WAP-5.
Hotel Load Wago terminals and ferrules for SB1 & SB2 shall be provided by HLC Supplier.

Ref. Drg No. : 3EHP281113 (13B)
Modified UIC-Line
Hotel Load 1&2. UIC-Line

Wago Terminal SB2

APPROVED BY
Dy.CE/D&D

CHECKED BY
AEE/D&D

DRAWN BY
SSE/D&D



CHITTARANJAN LOCOMOTIVE WORKS
Chittaranjan : 713331
CENTRE FOR DESIGN & DEVELOPMENT

Modified Cable Index for HLC

HOTEL LOAD POWER CABLE DETAILS

SN	From	To	Cable No.	Cable Run	Cable Size	Cable Length
1	TFR BUSHING 2UH1	HLC1	91	2	150 SQ.MM	9 M
2	TFR BUSHING 2VH1	HLC1	94	2	150 SQ.MM	9M
3	TFR BUSHING 2UH2	HLC2	91A	2	150 SQ.MM	8.5 M
4	TFR BUSHING 2VH2	HLC2	94A	2	150 SQ.MM	8.5M
5	HLC1	CONT BOX 1/1	HL-15-1	1	120 SQ.MM	5.5M
6	HLC1	CONT BOX 1/3	HL-15-2	1	120 SQ.MM	5.5M
7	HLC1	CONT BOX 1/5	HL-15-3	1	120 SQ.MM	5.5M
8	HLC2	CONT BOX 2/1	HL-25-1	1	120 SQ.MM	5.5M
9	HLC2	CONT BOX 2/3	HL-25-2	1	120 SQ.MM	5.5M
10	HLC2	CONT BOX 2/5	HL-25-3	1	120 SQ.MM	5.5M
11	CONT BOX 1/2	CAB1 IVC ALP/1	HL-18-1	1	120 SQ.MM	5.5M
12	CONT BOX 1/4	CAB1 IVC ALP/2	HL-18-2	1	120 SQ.MM	5.5M
13	CONT BOX 1/6	CAB1 IVC ALP/3	HL-18-3	1	120 SQ.MM	5.5M
14		CAB1 IVC ALP/5	EARTHING			
15	CONT BOX 1/2	CAB2 IVC ALP/1	HL-18-4	1	120 SQ.MM	20M
16	CONT BOX 1/4	CAB2 IVC ALP/2	HL-18-5	1	120 SQ.MM	20M
17	CONT BOX 1/6	CAB2 IVC ALP/3	HL-18-6	1	120 SQ.MM	20M
18		CAB2 IVC ALP/5	EARTHING			
19	CONT BOX 2/2	CAB1 IVC LP/1	HL-28-1	1	120 SQ.MM	20M
20	CONT BOX 2/4	CAB1 IVC LP/2	HL-28-2	1	120 SQ.MM	20M
21	CONT BOX 2/6	CAB1 IVC LP/3	HL-28-3	1	120 SQ.MM	20M
22		CAB1 IVC LP/5	EARTHING			
23	CONT BOX 2/2	CAB2 IVC LP/1	HL-28-4	1	120 SQ.MM	5.5M
24	CONT BOX 2/4	CAB2 IVC LP/2	HL-28-5	1	120 SQ.MM	5.5M
25	CONT BOX 2/6	CAB2 IVC LP/3	HL-28-6	1	120 SQ.MM	5.5M
26		CAB2 IVC LP/5	EARTHING			

Note:

All Power cables shall run through centre sill.

The cables marked in yellow colour are newly added in New scheme of HLC

Cables Removed/Modified

1	TFR BUSHING 2UH1	FB	91	2	150 SQ.MM	7M	Cable Modified	These cables are removed and replaced by cables as per Sr. No. 1 to 4 above table.
2	TFR BUSHING 2VH1	FB	94	2	150 SQ.MM	7M	Cable Modified	
3	TFR BUSHING 2UH2	FB	91A	2	150 SQ.MM	7M	Cable Modified	
4	TFR BUSHING 2VH2	FB	94A	2	150 SQ.MM	7M	Cable Modified	
5	FB	HLC1	92	2	150 SQ.MM	5M	Cable Removed	
6	FB	HLC1	93	2	150 SQ.MM	5M	Cable Removed	
7	FB	HLC2	92	2	150 SQ.MM	15M	Cable Removed	
8	FB	HLC2	93	2	150 SQ.MM	15M	Cable Removed	

The above cables marked in green colour are not being used in new scheme of Hotel Load Converter.

HOTEL LOAD CONTROL CABLE DETAILS

From	To	Cable No.	Cable Size(sq. mm)	Cable Length (m)	Loom No.	REMARKS
XK22V:03/1	XK77V:03/1	UH01	2.5	17.7	359	SB1 TO SB2 THROUGH 22 PIN CIRCULAR COUPLER
XK22V:03/2	XK77V:03/2	UH02	2.5			
XK22V:03/3	XK77V:03/3	UH03	2.5			
XK22V:03/4	XK77V:03/4	UH04	2.5			
XK22V:03/5	XK77V:03/5	UH05	2.5			
XK22V:02/48	XK77V:02/48	UH06	2.5	17.7	331	SB1 TO SB2 THROUGH 61 PIN CIRCULAR COUPLER
XK22V:02/49	XK77V:02/49	UH07	2.5			
XK22V:02/50	XK77V:02/50	UH08	2.5			
XK22V:02/51	XK77V:02/51	UH09	2.5			
XK22V:02/52	XK77V:02/52	UH10	2.5			
XK22V:02/53	XK77V:02/53	UH11	2.5			
XK22V:02/54	XK77V:02/54	UH12	2.5			
XK22V:02/55	XK77V:02/55	2806	2.5			
XK22V:02/56	XK77V:02/56	2860	2.5			
XK22V:02/57	XK77V:02/57	HL01	2.5			
XK22V:02/58	XK77V:02/58	HL02	2.5			
XK22V:03/1	XF22S:01/48	UH01	1.5	1.5	NIL	SB1 CIRCULAR COUPLER TO SB1 WAGO
XK22V:03/2	XF22S:01/49	UH02	1.5	1.5		
XK22V:03/3	XF22S:01/50	UH03	1.5	1.5		
XK22V:03/4	XF22S:01/51	UH04	1.5	1.5		
XK22V:03/5	XF22S:01/52	UH05	1.5	1.5		
XK22V:02/48	XF22S:02/52	UH06	1.5	1.5	NIL	SB1 CIRCULAR COUPLER TO SB1 WAGO
XK22V:02/49	XF22S:02/53	UH07	1.5	1.5		
XK22V:02/50	XF22S:02/54	UH08	1.5	1.5		
XK22V:02/51	XF22S:02/55	UH09	1.5	1.5		
XK22V:02/52	XF22S:02/56	UH10	1.5	1.5		
XK22V:02/53	XF22S:03/53	UH11	1.5	1.5		
XK22V:02/54	XF22S:03/54	UH12	1.5	1.5		
XK22V:02/55	XF22S:03/55	2806	1.5	1.5		
XK22V:02/56	XF22S:03/56	2860	1.5	1.5		
XK22V:02/57	XF22S:01/53	HL01	1.5	1.5		
XK22V:02/58	XF22S:01/54	HL02	1.5	1.5		
XK77V:03/1	XF77S:01/48	UH01	1.5	1.5	NIL	SB2 CIRCULAR COUPLER TO SB2 WAGO
XK77V:03/2	XF77S:01/49	UH02	1.5	1.5		
XK77V:03/3	XF77S:01/50	UH03	1.5	1.5		
XK77V:03/4	XF77S:01/51	UH04	1.5	1.5		
XK77V:03/5	XF77S:01/52	UH05	1.5	1.5		
XK77V:02/48	XF77S:02/52	UH06	1.5	1.5	NIL	SB2 CIRCULAR COUPLER TO SB2 WAGO
XK77V:02/49	XF77S:02/53	UH07	1.5	1.5		
XK77V:02/50	XF77S:02/54	UH08	1.5	1.5		
XK77V:02/51	XF77S:02/55	UH09	1.5	1.5		
XK77V:02/52	XF77S:02/56	UH10	1.5	1.5		
XK77V:02/53	XF77S:03/51	UH11	1.5	1.5		
XK77V:02/54	XF77S:03/52	UH12	1.5	1.5		
XK77V:02/55	XF77S:03/53	2806	1.5	1.5		
XK77V:02/56	XF77S:03/54	2860	1.5	1.5		
XK77V:02/57	XF77S:01/53	HL01	1.5	1.5		
XK77V:02/58	XF77S:01/54	HL02	1.5	1.5		

From	To	Cable No.	Cable Size(sq. mm)	Cable Length (m)	Loom No.	REMARKS
XF22S:01/48	XK22HL:01/1	UH01	1.5	1.5	NIL	SB1 WAGO TO HL CIRCULAR COUPLER
XF22S:01/49	XK22HL:01/2	UH02	1.5	1.5		
XF22S:01/50	XK22HL:01/3	UH03	1.5	1.5		
XF22S:01/51	XK22HL:01/4	UH04	1.5	1.5		
XF22S:01/52	XK22HL:01/5	UH05	1.5	1.5		
XF22S:02/52	XK22HL:01/6	UH06	1.5	1.5		
XF22S:02/53	XK22HL:01/7	UH07	1.5	1.5		
XF22S:02/54	XK22HL:01/8	UH08	1.5	1.5		
XF22S:02/55	XK22HL:01/9	UH09	1.5	1.5		
XF22S:02/56	XK22HL:01/10	UH10	1.5	1.5		
XF22S:03/53	XK22HL:01/11	UH11	1.5	1.5		
XF22S:03/54	XK22HL:01/12	UH12	1.5	1.5		
XF22S:03/58	XK22HL:01/13	UH13	1.5	1.5		

XK22HL:01/	353.3/3 (1)	UH01	1.5	10.5	311	SB1 CIRCULAR COUPLER TO HL UIC CAB1 ALP SIDE
XK22HL:01/	353.3/3 (2)	UH02	1.5			
XK22HL:01/	353.3/3 (3)	UH03	1.5			
XK22HL:01/	353.3/3 (4)	UH04	1.5			
XK22HL:01/	353.3/3 (5)	UH05	1.5			
XK22HL:01/	353.3/3 (6)	UH06	1.5			
XK22HL:01/	353.3/3 (7)	UH07	1.5			
XK22HL:01/	353.3/3 (8)	UH08	1.5			
XK22HL:01/	353.3/3 (9)	UH09	1.5			
XK22HL:01/	353.3/3 (10)	UH10	1.5			
XK22HL:01/	353.3/3 (11)	UH11	1.5			
XK22HL:01/	353.3/3 (12)	UH12	1.5			
XK22HL:01/	353.3/3 (13)	UH13	1.5			

XF77S:01/48	XK77HL:02/1	UH01	1.5	1.5	NIL	SB2 WAGO TO HL CIRCULAR COUPLER
XF77S:01/49	XK77HL:02/2	UH02	1.5	1.5		
XF77S:01/50	XK77HL:02/3	UH03	1.5	1.5		
XF77S:01/51	XK77HL:02/4	UH04	1.5	1.5		
XF77S:01/52	XK77HL:02/5	UH05	1.5	1.5		
XF77S:02/52	XK77HL:02/6	UH06	1.5	1.5		
XF77S:02/53	XK77HL:02/7	UH07	1.5	1.5		
XF77S:02/54	XK77HL:02/8	UH08	1.5	1.5		
XF77S:02/55	XK77HL:02/9	UH09	1.5	1.5		
XF77S:02/56	XK77HL:02/10	UH10	1.5	1.5		
XF77S:03/51	XK77HL:02/11	UH11	1.5	1.5		
XF77S:03/52	XK77HL:02/12	UH12	1.5	1.5		
XB77S:03/56	XK77HL:02/13	UH13	1.5	1.5		

XK77HL:02/	353.3/2 (1)	UH01	1.5	10.5	311	SB2 CIRCULAR COUPLER TO HL UIC CAB2 ALP SIDE
XK77HL:02/	353.3/2 (2)	UH02	1.5			
XK77HL:02/	353.3/2 (3)	UH03	1.5			
XK77HL:02/	353.3/2 (4)	UH04	1.5			
XK77HL:02/	353.3/2 (5)	UH05	1.5			
XK77HL:02/	353.3/2 (6)	UH06	1.5			
XK77HL:02/	353.3/2 (7)	UH07	1.5			
XK77HL:02/	353.3/2 (8)	UH08	1.5			
XK77HL:02/	353.3/2 (9)	UH09	1.5			
XK77HL:02/	353.3/2 (10)	UH10	1.5			
XK77HL:02/	353.3/2 (11)	UH11	1.5			
XK77HL:02/	353.3/2 (12)	UH12	1.5			
XK77HL:02/	353.3/2 (13)	UH13	1.5			

From	To	Cable No.	Cable Size(sq. mm)	Cable Length (m)	Loom No.	REMARKS
XF22S:01/48	HLC1:1	UH01	1.5	7.5	TO BE CONNECTED BY HOTEL LOAD SUPPLIER	SB1 WAGO TO HLC1
XF22S:01/49	HLC1:2	UH02	1.5	7.5		
XF22S:01/50	HLC1:3	UH03	1.5	7.5		
XF22S:01/51	HLC1:4	UH04	1.5	7.5		
XF22S:01/52	HLC1:5	UH05	1.5	7.5		
XF22S:03/53	HLC1:11	UH11	1.5	7.5		
XF22S:03/54	HLC1:12	UH12	1.5	7.5		
XF22S:03/55	HLC1:13	2806	1.5	7.5		
XF22S:03/56	HLC1:14	2860	1.5	7.5		
XF22S:03/57	HLC1:15	HL11	1.5	7.5		


XF77S:01/52	HLC2:5	UH05	1.5	7.5	TO BE CONNECTED BY HOTEL LOAD SUPPLIER	SB2 WAGO TO HLC2
XF77S:02/52	HLC2:1	UH06	1.5	7.5		
XF77S:02/53	HLC2:2	UH07	1.5	7.5		
XF77S:02/54	HLC2:3	UH08	1.5	7.5		
XF77S:02/55	HLC2:4	UH09	1.5	7.5		
XF77S:03/51	HLC2:11	UH11	1.5	7.5		
XF77S:03/52	HLC2:12	UH12	1.5	7.5		
XF77S:03/53	HLC2:13	2806	1.5	7.5		
XF77S:03/54	HLC2:14	2860	1.5	7.5		
XF77S:03/55	HLC2:15	HL12	1.5	7.5		

XF22S:03/56	411.QD 9	2860	0.5	3.6	NIL	SB TO VCU
XF22S:03/55	411.LD 10	2806	0.5	3.6		
XF22S:01/52	411.JJ 2	UH05	0.5	3.6		
XF22S:01/01	411.JJ 9	2805	0.5	3.6		
XF22S:01/53	411.LJ 6	HL01	0.5	3.6		
XF22S:03/57	411.LJ 13	HL11	0.5	3.6		
XF77S:01/54	412.LJ 6	HL02	0.5	3.6		
XF77S:03/55	412.LJ 13	HL12	0.5	3.6		
XF22S:01/01	XF22S:02/56	UH10	0.5	1		

33.A/1 (8)	415.AG/1 (7)	1548A	0.5	10.5	336	HLC1 LEM SENSOR TO SR1
33.A/1 (9)	415.AG/1 (8)	1549A	0.5			
33.A/1 (1)	415.AG/1 (3)	1541A	0.5			
33.A/1 (2)	415.AG/1 (6)	1542A	0.5			
33.A/1 (3)	415.AG/1 (2)	1543A	0.5			
33.A/1 (4)	415.AG/1 (QE)	1544A	EARTHING			

33.A/2 (8)	415.AG/2 (7)	1548B	0.5	10.5	339	HLC2 LEM SENSOR TO SR2
33.A/2 (9)	415.AG/2 (8)	1549B	0.5			
33.A/2 (1)	415.AG/2 (3)	1541B	0.5			
33.A/2 (2)	415.AG/2 (6)	1542B	0.5			
33.A/2 (3)	415.AG/2 (2)	1543B	0.5			
33.A/2 (4)	415.AG/2 (QE)	1544B	EARTHING			

XF22S:01/53	CAB1 IVC ALP HLC1 PIN 7,10	HL01	2.5	11	NIL	SB1 WAGO TO IVC CAB1 ALP
XF22S:01/54	CAB1 IVC LP HLC2 PIN 7,10	HL02	2.5	11		SB1 WAGO TO IVC CAB1 LP
XF77S:01/53	CAB2 IVC ALP HLC1 PIN 7 & 10	HL01	2.5	11		SB2 WAGO TO IVC CAB2 ALP
XF77S:01/54	CAB2 IVC LP HLC2 PIN 7 & 10	HL02	2.5	11		SB2 WAGO TO IVC CAB2 LP

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Vehicle Control Software

IR WAP-7 (without 32 no. Contactor & 33 no. Relay)

Design FG 52 - Hotel Load Converter/Monitor

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52.1. Purpose

This FG, which is only valid for the IR WAP-7 loco which comprises of two hotel load converters and no hotel load contactor “32” or HLC ON command relay “33”, controls and monitors the hotel load supply.

52.2. Reference Documents

- | | | |
|-----|--------------|--|
| [1] | 3EHP 541 681 | Vehicle Control System Software-Specification |
| | 2.5.1 | Hotel load (Train supply) |
| | 2.8.7 | Hotel load (Multiple operation) |
| [2] | 3EHP 541 526 | Specification of ABB Protective Functions |
| | 5.4 | Hotel load current |
| | 5.16 | Earth fault hotel load supply |
| [3] | 3EHP 281 105 | Control main apparatus |
| | 01G | Hotel Load Power Circuit (Newly added and Modified version of) |
| | 05D | Hotel load control and monitoring (Modified) |
| | 13C | Hotel Load control supply through UIC (Newly added) |

52.3. Processors and Clusters

All processors containing this function group are listed below.

Processor	Description
STB1	Hotel Load Converter Control/Monitor

52.4. Normal Functionality

52.4.1. General Information

The task of this FG is to control and monitor the operation and protection of the two hotel load converters (HLC) installed in locomotive. The two HLCs could be switched on from any driving cab just after pressing BLHO switch. But the conditions for switching on the two HLCs is that the power supply for the HLCs should be ON in the power car and BLHO switch should be pressed ON. As there is only one LSHO switch for indication of the status of the hotel load converter, therefore the status of HLC (any one/both) is indicated by the hotel load indication lamp in the active cab. Earlier this indication was shown when hotel load contractor “32” was closed.

52.4.2. Redundancy

This FG is only implemented in STB1. No redundancy is provided.

52.4.3. Hotel load contactor switch on handing

In order to close the hotel load converters 1 & 2 ([3], {05D}) following conditions must be fulfilled:

- The VCB must be closed ([1], n 2512.01 f)
- and the input side earth fault relay of the hotel load converter circuit ([3], {05G, 38.1}) is not be energised (which is presently monitored by HLC controller itself else earlier this was monitored in HBB1; see 52.6.2)
- and the driver pushes the 'Hotel load supply' switch ([3], {05D, 169.1/1 or 169.1/2}) to the "On" position



52.4.4. Hotel load Converter normal switch off handling

In order to open the hotel load converters one of the following conditions must be fulfilled:

- The driver pushes the 'Hotel load supply' switch ([3], {05D, 169.1/1 or 169.1/2}) to the "Off" position
- or the driver switches the VCB off
- or the technical attendant of Power/Generator Car switch the supply OFF from Pacco switch of Both/Any.
 - If Any one power supply is switched OFF then HOG supply could be obtained from another HLC but that particular HLC will turn OFF. But in this condition LSHO will keep glowing in Drivers Cab
 - If both the power supply is switched OFF then HOG supply would be cut off from both HLC. But in this condition also LSHO will keep glowing in Driver Cab. This is because of the reason that HLC is switched OFF from power/generator car and not by driver who is sitting in the Loco.
- or the driver lowers the pan (the VCB will be opened first)

52.4.5. Hotel load contactor error switch off reasons

In the following cases, the hotel load converters will be switched off:

- Disturbance with VCB off (the two HLCs will **always be switched off 500ms** after the VCB)
- or the VCB sticks in the on position
- Pressure in main reservoir is low
- Transformer oil pressure is not okay

52.4.6. Hotel load monitoring

The hotel load indication lamp ([3], 169.3/1 or 169.3/2) of the activated cab is directly connected to the BLHO switch and not to previous auxiliary contact of the hotel load contactor ([3], {05D, 32}). Hence, LSHO switch will start glowing once driver wishes to switch on any/both HLCs converters and it's independent to any other action. TO physically switch on the HLC converter the primary criteria is that the Pacco switches of both/any HLC converter located in the power/generator car should be switched ON and also the VCB should be closed normally without any fault related to VCB status or MR pressure or Transformer oil pressure. After that once driver wishes to switch on HLC then BLHO should be pressed to ON position.

52.5. Multiple Control

In multiple operation (two IR WAP-7 locos) the hotel load is supplied from the slave loco the hotel load converters on the master loco is disabled ([1], 2.8.7). The hotel load switch "On"/"Off" command will be transmitted over the Trainbus from the master to the slave loco. The status of the hotel load converters (Both/any one HLC switched ON) on the slave loco is monitored with the 'Hotel load indication' lamp on the master loco.

52.6. Disturbances

52.6.1. Stuck on/off monitoring

There is no monitoring of hotel load contactor as it has been removed. As the VCU is just giving output command for switching ON any-one/both HLC. Therefore the monitoring of contactors located inside HLC are being monitored by HLC itself and isolates automatically that particular HLC. In case of a stuck off, the wish to close the hotel load contactor will be reset once driver opens the VCB and try to close the VCB.

52.6.2. Protective hotel load switch off

In the following cases, the hotel load contactor will be switched off:



- Overcurrent in the hotel load circuit (750A longer than 300ms) leads to a disturbance with VCB off and a priority 1 fault message ([2], 5.4). The VCB must be switched off **500ms before** to avoid from switching off high currents. One renewed switch on attempt is permitted. If this attempt fails as well, the Subsystem 05 will be isolated. This limit monitoring is implemented in FG09 of both SLGs
- Earth fault is presently being monitored by HLC itself. If any earth fault occurs in input or output side of hotel load circuit then automatically that part (line/drive side) will get automatically isolated for that particular HLC and there would be no disturbance with VCB off and no priority 1 fault message or isolation of Subsystem 05 will happen as in earlier case. Hence as this protection is incorporated inside the individual HLC. Thus, this logic has been removed. Although this protection for Earth fault may be integrated as the limit monitoring is implemented in FG09 of HBB1. But after implementation it will affect the train operation in case of any earth fault in hotel load circuit it will not allow to close VCB.
- In case of Transformer Oil pressure not OK (one pump is not working) the traction power is reduced to 70%. To prevent the transformer of overload in this case, the hotel load will be inhibited.

52.6.3. Isolation of Subsystem 01

In no case the subsystem 01 will be isolated as the status of main/pre-charging contactors of any HLC is monitored by HLC controller itself. If any of the contactor is malfunctioning then that particular HLC will get isolated automatically without any message and at the same time power would be supplied by the other HLC converter. Incase if both HLC converter are having problem then also both HLC would get isolated. The same phenomenon will be replicated if there is any earth fault in hotel load circuit. If any hotel load overcurrent problem occurs in the hotel load circuit then OCR will trip the VCB and will not allow to close VCB and then only Subsystem 01 may get isolated. This logic is implemented in FG06 of STB1. Hence it can be seen that due to any fault in Hotel load circuit the normal operation of train wouldn't be affected except in case of over current which will not allow to close VCB.

52.7. Interface

Below is a complete list of all input and output signals of this function group.

52.7.1. FG52 implemented in STB1

Cluster Task: 100 ms

Name	Type	I/O	Bustype	From / To	Description
24-LHotelOn	BIT	I	INT	FG24	Both/Any HLC "On" from cab 1
13-LHotelOn (M->S)			MVB	STB2, FG24	Both/Any HLC "On" from cab 2
24-LHotelOff	BIT	I	TB	STB1, FG24	Both/Any HLC "On" from the TB
13-LHotelOff (M->S)				STB2, FG24	
24-LHotelOff	BIT	I	INT	FG24	Both/Any HLC "Off" from cab 1
13-LHotelOff (M->S)			MVB	STB2, FG24	Both/Any HLC "Off" from cab 2
12-MTbSlA1Actv	BIT	I	TB	STB1, FG24	Both/Any HLC "Off" from the TB
12-MTbSlA1Actv	BIT	I	MVB	FLGM,FG12	TB slave is active
01-MPrSwLowMR	BIT	I	MVB	HBB2,FG01	Pressure in main reservoir is low
32-MVCB-On	BIT	I	INT	FG32	VCB is on
32-MVCBStuckOn	BIT	I	MVB	HBB1, FG32	VCB stuck on
09-MTrPrNotOK	BIT	I	MVB	FLG1, FG09	Message: Transformer Oil pressure not OK
54-BSubS05-Off	BIT	I	MVB	FLGM, FG54	Subsystem 05 off
01-BDetCoCo	BIT	I	INT	{17B}	Detection Co'Co' (IR WAG-9)
01-MContHotel	BIT	I	AMS	{05D,32}	Auxiliary contact of the hotel load contactor
52-LHotelOn	BIT	O	INT	FG04	Driver wishes to switch on Both/Any HLC
5201-BContHotel	BIT	O	AMS	{05D}	Contactore hotel load
5201-BHLC1ON	BIT	O	AMS	{05D}	HLC 1 On Command for switching on HLC1



5201-BHLC2ON	BIT	O	AMS	{05D}	HLC 1 On Command for switching on HLC1
5201-MCHotelSON	BIT	0	INT	FG06	Disturbance signal: Contactor hotel load stuck-on (priority 2 message)
5201-MCHotelSOff	BIT	0	INT	FG06	Disturbance signal: Contactor hotel load stuck-off (priority 2 message)

52.8. Appendix Principle-Schemes

The following pages contain the principle schemes of this FG.

52.9. Change in MVB Descriptive

The following pages contain the MVB descriptive changes in STB telegram.

;=====				
\$TELEGRAM	STB1-1105	STB1	1105	64
;=====				
;				
\$SRC	SIG 29-MLampTest	BIT	2	3
\$SINKMEMB	FLG1			
\$SINKMEMB	FLG2			
\$SINKMEMB	HBB1			
; Lamp test active				
;-----				
\$SRC	SIG 01-MContHotel	BIT	2	4
\$SINKMEMB	FLG1			
\$SINKMEMB	FLG2			
\$SINKMEMB	STB2			
; Contactor hotel load				
;-----				
\$SRC	SIG 01-BHLC2ON	BIT	2	5
\$SINKMEMB	STB2			
; hotel load 2 ON COMmand				
;-----				
;				