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

No. EL/3.1.35.17 Dated: As signed

Principal Chief Electrical Engineer,

- Central Railway, HQs Office, 2nd floor, Parcel Office Bldg., Mumbai – 400 001.
- East Central Railway, Hajipur (Bihar) – 844 101.
- East Coast Railway, Railway Complex, Bhubaneswar – 751 023.
- Eastern Railway, Fairlie Place, Kolkata – 700 001.
- North Central Railway, Prayagraj – 211 001.
- North Eastern Railway, Gorakhpur –273 001.
- North Western Railway, near Jawahar Circle, Jaipur–302 017.
- Northeast Frontier Railways, Maligaon, Guwahati – 781 011
- Northern Railway, Baroda House, New Delhi – 110 001.
- Southern Railway, Park Town, Chennai – 600 003.
- South Central Railway, HQs Office, Rail Nilayam, Secunderabad – 500 071.
- South Eastern Railway, Garden Reach, Kolkata – 700 043.
- South East Central Railway, Bilaspur – 495 004.
- South Western Railway, Hubli – 580020.
- West Central Railway, HQs Office, Opp. Indira Market, Jabalpur – 482 001.
- Western Railway, Church gate, Mumbai – 400 020.
- Banaras Locomotive Works, Varanasi – 221 004.
- Chittaranjan Locomotive Works, Chittaranjan – 713 331 (WB).
- Patiala Locomotive Works, Patiala – 147 003.

MODIFICATION SHEET NO. RDSO/2020/EL/MS/0482 (Rev. '1')

1.0 Title:

Scheme for Energy Saving in 3-phase freight electric locomotives.

2.0 Brief History:

2.1 Presently, 3-phase electric locomotives i.e. WAP5, WAP7 and WAG9HC is being manufactured by Production Units. WAP5 and WAP7 class of locomotives are passenger locomotives whereas WAG9HC class of locomotive is a freight locomotive. There are three variants of 3-phase freight electric locomotives produced by IR i.e. WAG9, WAG9H and WAG9HC however, only WAG9HC class of locomotives are being manufactured by Production Units i.e. CLW & BLW. Three nos. of auxiliary converters namely BUR1, BUR2 & BUR3 are provided in 3-phase locomotives to feed auxiliary machines. Presently, 13 Nos. of auxiliary machines are fed by

these converters for various functions. The distribution of loads of all these machines is detailed in following table.

Auxiliary Converter	**Auxiliary loads**	**Frequency (Normal Mode)**
BUR 1 supply	• Oil Cooler Blower – 1&2 (OCB – 1&2)	44 Hz, 50 Hz
BUR 2 supply	• Traction Motor Blower –1&2 (TMB – 1&2) • Transformer Oil Pump – 1&2 (TFP MPH – 1&2) • Traction Converter Oil Pump – 1&2 (SR MPH – 1&2)	50 Hz
BUR 3 supply	• Scavenge blowers – 1&2 (ScTMB – 1&2) • Main compressor – 1&2 (MCP – 1&2) • Battery charger (CHBA)	50 Hz

2.2 The most energy consuming blowers are OCB – 1&2 and TMB – 1&2 (rating of OCB is 30 KW and TMB is 25 KW). The rating of GTO based auxiliary converter is 100 KVA and IGBT based auxiliary converter is 130 KVA.

2.3 OCB – 1&2 is connected with BUR1. OCB motor runs on ventilation demand which depends on temperature level of transformer oil as per CLW manual. Below 47 deg. Celsius, there is no ventilation demand and OCB does not work. There are three ventilation levels depending upon the transformer oil temperature – Level-1 (47-50 Deg. C), Level-2 (52-55 Deg. C) and Level-3 (57-60 Deg. C and above). OCB starts running whenever the oil temperature exceeds 47 deg. irrespective of working of locomotive i.e. whether locomotive remains idle or in running [idle means locomotive is in standing condition, throttle (Tractive effort/braking effort) is Zero].

2.4 In the present system as per design configuration, TMB – 1&2 (25KW each) and ScTMB – 1&2 (3 KW each) is connected with BUR2 and BUR3 respectively. As soon as loco energies, BUR2 and BUR3 start working, therefore, TMB & ScTMB start working irrespective of ventilation demand. The ventilation demand in 3-phase locomotive totally depends upon temperature level of traction motor, converter oil & transformer oil. But in the present case, the traction motor blower and its scavenger blowers are running continuously irrespective of ventilation demand.

2.5 Machine Room Blower (MRB) and its Scavenge have been shifted to BUR-2 in order to implement the recommendations of 39th MSG meeting by CLW and Zonal Railways. CLW has further shifted MRB and its ScMRB to BUR-3 for WAG9H class of locomotive in order to implement energy saving scheme as mentioned in Annexure-1 of CLW letter No. C-D&D/T/42, Vol-I/Medha dtd. 07.11.2023. As per initial design, these MRBs and its Scavenge takes power directly from Auxiliary Winding of Main Transformer (1000V) through an auxiliary transformer having output of single phase 415V & 110V.

3.0 Objective:

To save Electrical Energy in 3-phase freight locomotives (WAG9/WAG9H/WAG9HC) by modification in existing scheme of load distribution and adding 'Energy Saving Mode' in software to put OCBs, coolant pumps, TMBs and ScTMBs in OFF condition when there is no requirement of cooling in the corresponding equipment for which these blowers are provided.

4.0 Modified scheme:

4.1 Load Distribution among the Auxiliary Converters

Auxiliary loads have been re-distributed among auxiliary converters in which ScTMB and Cab AC Unit has been removed from BUR-3 and added to BUR-2. Further, MRB and its Scavenge have been added to BUR-3 as mentioned in Para-2.5 above. Rest of the load distributions remains same. The distribution of load among the auxiliary converters in normal condition are detailed below:

Auxiliary Converter	Existing Load Distribution	Modified Load Distribution
BUR 1 supply	OCB – 1&2	OCB – 1&2
BUR 2 supply	TMB – 1&2 TFP MPH – 1&2 SR Pump – 1&2 Cab AC Unit - 1&2	TMB – 1&2 ScTMB – 1&2 TFP MPH – 1&2 SR Pump – 1&2
BUR 3 supply	CP – 1&2 ScTMB – 1&2 Battery charger	CP – 1&2 Battery charger MR Blower – 1&2 Scavenge to MRB – 1&2 Cab AC Unit – 1&2

4.2 Procedure for shifting of MRB-1&2 to BUR-3

To achieve shifting of MRB-1&2 to BUR-3, modifications in HB1 and HB2 Panels are required to be carried out as per following tables:

(i) Modification in HB1 Panel

WIRES TO BE REMOVED					
SN	WIRE DETAILS				Remarks
	Cable No.	Size	From	To	
1.	1121A	2.5 mm^2	MCB 53.1/1	MCB 54.1/1	If MRB is being fed by BUR-2.
2.	1122A	2.5 mm^2			
3.	1123A	2.5 mm^2			
4.	1201A	2.5 mm^2	MRB-1 Terminal Box	To tie with Dummy	If MRB is being fed by 1000/415V Auxiliary Transformer.
5.	1202A	2.5 mm^2			
6.	1218A	2.5 mm^2			

WIRES TO BE CONNECTED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
1.	1131	2.5 mm^2	XH 32A(2) 4	MCB 54.1/1-1	To connect BUR-3 supply to MCB of MRB-1.
2.	1132	2.5 mm^2	XH 32A(2) 5	MCB 54.1/1-3	
3.	1133	2.5 mm^2	XH 32A(2) 6	MCB 54.1/1-5	

(ii) Modification in HB2 Panel

WIRES TO BE REMOVED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
1.	1121B	2.5 mm^2	MCB 53.1/2	MCB 54.1/2	If MRB is being fed by BUR-2.
2.	1122B	2.5 mm^2			
3.	1123B	2.5 mm^2			
4.	1201B	2.5 mm^2	MRB-2 Terminal Box	To tie with Dummy	If MRB is being fed by 1000/415V Auxiliary Transformer.
5.	1202B	2.5 mm^2			
6.	1218B	2.5 mm^2			
WIRES TO BE ADDED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
1.	1131	2.5 mm^2	XH 67A(2) 4	MCB 54.1/2 (1)	To connect BUR-3 supply to MCB of MRB-2.
2.	1132	2.5 mm^2	XH 67A(2) 5	MCB 54.1/2 (3)	
3.	1133	2.5 mm^2	XH 67A(2) 6	MCB 54.1/2 (5)	

4.3 Shifting of ScMRB-1&2 to BUR-3

To achieve shifting of ScMRB-1&2 to BUR-3, modification in HB1 panel and HB2 Panel is required to be carried out as detailed below:

(i) Modification in HB1 Panel

WIRES TO BE REMOVED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
1.	1211A	2.5 mm^2	ScMRB-1 Terminal Box	To tie with Dummy	This is to be done where ScMRB is being supplied by 1000/415V Auxiliary Transformer.
2.	1212A	2.5 mm^2			
3.	1218A	2.5 mm^2			
WIRES TO BE CONNECTED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
4.	1131	2.5 mm^2	XH 32A(2) 4	MCB 56.1/1(1)	Existing 1-pole MCB denoted as 56.1/1 (HB-1) and 56.1/2 (HB-2) shall be replaced by 3-pole, 5 Amps MCB.
5.	1132	2.5 mm^2	XH 32A(2) 5	MCB 56.1/1(3)	
6.	1133	2.5 mm^2	XH 32A(2) 6	MCB 56.1/1(5)	

(ii) Modification in HB2 Panel

WIRES TO BE REMOVED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
1.	1211B	2.5 mm^2	ScMRB-2 Terminal Box	To tie with Dummy	This is to be done where ScMRB is being supplied by 1000/415V Auxiliary Transformer.
2.	1212B	2.5 mm^2			
3.	1218B	2.5 mm^2			
WIRES TO BE ADDED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
1.	1131	2.5 mm^2	XH 67A(2) 4	MCB 56.1/2(1)	Existing 1-pole MCB denoted as 56.1/1 (HB-1) and 56.1/2 (HB-2) shall be replaced by 3-pole, 5 Amps MCB.
2.	1132	2.5 mm^2	XH 67A(2) 5	MCB 56.1/2(3)	
3.	1133	2.5 mm^2	XH 67A(2) 6	MCB 56.1/2(5)	

4.4 Modification in HB2 Panel for shifting of CAB AC to BUR-3

Presently, power feed to CAB AC is given by BUR-2. To shift the same on BUR-3, modification is required to be carried out as per following table:

WIRES TO BE REMOVED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size**	**From**	**To**	
4.	1121B	2.5 mm^2	MCB 52.5/1	MCB 64.1	---
5.	1122B	2.5 mm^2			
6.	1123B	2.5 mm^2			
WIRES TO BE ADDED					
SN	**WIRE DETAILS**				**Remarks**
	Cable No.	**Size of wire**	**From**	**To**	
4.	1131	2.5 mm^2	XH 67A(2) 4	MCB 64.1/1(1)	Refer Para 4.2 (ii), cable no. 1131, 1132 & 1133 may be obtained from XH67A(2) TBs.
5.	1132	2.5 mm^2	XH 67A(2) 5	MCB 64.1/1(3)	
6.	1133	2.5 mm^2	XH 67A(2) 6	MCB 64.1/1(5)	

4.5 Shifting of ScTMB-1&2 to BUR-2

1. Check the cable continuity between Contactor 52.4/2 terminal 1, 3, 5 to contactor 52.5/2 terminal no. 1, 3, 5. Remove cable no. 1131, 1132 and 1133 from contactor 52.5/2 terminal no. 1, 3, 5 respectively.

2. Rename cable no. 1131 to 1121B, 1132 to 1122B and 1133 to 1123B.
3. Connect the cable 1121B, 1122B and 1123B to contactor 52.5/1 terminal no. 1, 3, 5 respectively.

4.6 Activation of Energy Saving Mode through Software Modification:

(i) In Energy Saving Mode, power supply of BUR-1 & BUR-2 shall be switched OFF by ramping down the frequency through software logics. Conditions for loco to go in Energy Saving Mode are cited below:
   a) All BURs are in service;
   b) Tractive/braking effort is Zero (Reverser in neutral position or Node ≤ 570);
   c) Loco remains idle (i.e. speed=0) and BC in applied condition;
   d) Temperature of transformer oil, traction converter coolant and traction motor ≤ 55^0 Celsius.

(ii) If the aforesaid condition prevails for ≥ 5 minutes, then frequency of BUR-1 & 2 shall be ramped down to Zero and Energy Saving Mode shall be activated with a pop-up message on driver display screen that "**Energy Saving Mode Activated**" along with calling the push button lamp of BPFA. Loco Pilot has to only acknowledge by pressing this illuminated push button BPFA.

(iii) As and when Loco Pilot moves throttle for traction (Node > 570) or BC is released, Energy Saving Mode will be DE-ACTIVATED.

5.0 Material required

To implement the scheme following materials are required:

(i) Wire of 2.5 mm^2 (4GKW/1.8kV): Approx. 30 meters.

(ii) MCB (3-pole, 10 Amps): 02 nos. to be placed at 56.2/1 (HB-1) & 56.2/2 (HB-2)

(iii) MCB (3-pole, 10 Amps): 02 nos. to be placed at 54.2/1 (HB-1) & 54.2/2 (HB-2)

6.0 Material Rendered Surplus:

(i) 1-pole MCBs (54.1/1 & 54.2/2) – 02 Nos.
(ii) Capacitor (54.5/1 & 54.5/2) – 02 Nos.
(iii) Capacitor (54.8/1 & 54.8/2) – 02 Nos.
(iv) Timer (54.2/1 & 54.2/2) – 02 Nos.

7.0 Application to the Class of Locomotives:

WAG9/WAG9H/WAG9HC class of locomotives.

8.0 Agency of Implementation:

Electric Loco Sheds Holding WAG9/WAG9H/WAG9HC class of locomotives and PUs/Workshops.

9.0 Periodicity of Implementation:

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

Encl: Nil.

-sd-
For Director General (Traction)

Copy to:

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

Digitally Signed by Amit Kumar Saraf
Date: 10-04-2024 18:06:25
Reason: Approved

For Director General (Traction)