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सत्यमेव जयते

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/11.5.5/21 Date: 29-03-2019

Principal 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, Bhuvneshwar – 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 – 400 020

Sub: Minutes of the Meeting on reliability of M/s BHEL make IGBT based Propulsion system of 3-phase locomotives.

A meeting to review the performance of M/s BHEL make propulsion equipments, i.e., IGBT based Traction Converter, Auxiliary Converter and VCU was held at RDSO, Lucknow on 19.03.2019. M/s BHEL and ELS/LGD participated in this meeting.

Based on the deliberations/discussion, Minutes of the Meeting has been prepared and the same is enclosed herewith for kind information and necessary action please.

29/03/19

(Suresh Kumar)
For Director General/Elect.

Encl: As above

Copy to:

1. **Secretary (Elec. Engg./RS), 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):** for kind information and necessary action please
3. M/s. BHEL, Electronic Division, PB No. 2606, Mysore Road Bangalore-560 026

29/03/19

(Suresh Kumar)
For Director General/Elect.

Encl: As above

Minutes of performance review meeting held in chamber of PEDSE/RDSO on 19.03.2019 regarding issues of M/s BHEL propulsion equipment of IGBT based 3 Phase locomotives

Members Present:

RDSO	1.	Shri O. P. Kesari, PEDSE.
	2.	" Suresh Kumar, DSE/TPS
	3.	" Shailendra K. Deo, SSE/TPS.
SCR	4.	" T. Nagraj , Sr. DEE/ELS/LGD
M/s BHEL	5.	" Shekar R., AGM/PES/EDN

The meeting was convened to review the issues raised in last reliability meeting held in ELS/HWH on 14/15.02.2019. The detailed deliberations done during the meeting are as under:
Following issues were discussed during the meeting:

1. **Failure statistics of M/s BHEL make Traction Converter**

Detailed failure – type wise and shed wise are indicated in table – 1 and 2 respectively.

Table – 1: Failure type wise details

SN.	Cause of Failure	No. of Failures					
		2015-16	2016-17	2017-18	2018-19 (Apr-Jun)	2018-19 (Jul-Sep)	2018-19 (Oct-Dec)
1	Power Module/PMI/USID	57	90	140	66	136	105
2	VIU/DCU Card	17	26	55	20	31	26
3	Coolant Pump	1	3	8	4	2	3
4	Software Malfunctioning (Harmonic filter stuck, ASC pulsing stopped, TFP oil pressure not OK, etc)	10	14	36	20	17	12
5	Pressure Switch	42	15	29	13	6	6
6	Misc. (Transient /random faults)	16	26	56	50	40	31
	Total Failures	143	174	324	173	232	183
	Total Population (loco)	140	176	329	348	361	417
	FRPCPY	102	99	98	199	257	176

Table – 2: Shed wise failures

SN	Cause of Failure	2018-19 (Oct-Dec)												
		AQ	BIA	BRC	GMO	GZB	HWH	KYN	LGD	RPM	TATA	TKD	VSKP	Total
1	Power Module/PMI/USID	6	0	2	2	12	7	4	13	2	49	5	3	105
2	VIU/DCU Card	4	0	2	1	5	1	0	3	1	8	1	0	26
3	Coolant Pump	0	0	0	0	1	0	0	0	0	0	0	2	3
4	Software Malfunctioning (Harmonic filter stuck, ASC pulsing stopped, TFP oil pressure not OK,etc)	0	0	0	0	10	1	0	1	0	0	0	0	12
5	Pressure Switch	0	2	0	0	0	0	0	2	0	2	0	0	6
6	Misc. (Transient /random faults)	0	2	2	1	12	0	8	2	0	3	0	1	31
7	Total Failures	10	4	6	4	40	9	12	21	3	62	6	6	183
8	Total Population (loco set)	9	19	18	8	48	9	35	21	17	63	32	45	324
9	FRPCPY	**444**	**84**	**133**	**200**	**333**	**400**	**137**	**400**	**71**	**394**	**75**	**53**	**226**

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2. **Issues of Traction Converter discussed during the meeting are as below:**

SN	Item	Action Plan	Remarks
1.	Power Module Failures	BHEL informed that higher rated MOSFET driver introduced from Oct 2017 and higher rated MOSFET introduced in gate drivers from June 2018 in regular production to improve the reliability of gate driver after usage in converters at Kazipet. • Software ver. 774 with increased timing parameter for SEPL max detection introduced loaded in all 347 Locos. BHEL should look into the problem afresh.	Measures taken by BHEL to reduce the failure of power module are found to be insufficient and there is no considerable reduction in failure rate of the same. The power modules are repeatedly failing due to SEPL status & USID low error. The problem is continuously faced for last four years without any respite. M/s BHEL may look into the problem afresh and submit the new action plan to RDSO/CLW.
2.	Failure of Pressure Switch	The pressure switch needs to be replaced by Honeywell make in all the locomotives in phased manner. Replaced in 263 locos till date. Remaining 50 Locos of ELS/LGD, KZJ, TATA	Replaced in 263 locos till date. Material of remaining 50 Locos of ELS/LGD, KZJ, TATA have been supplied. Concern Railways are requested to take necessary action and confirm the compliance.
3.	Reduction of TE/BE with no DDS at higher speed.	M/s BHEL stated that this is occurring due to loss of Panto contact with OHE for more than 45ms. This is noted after analyzing the data of loco 30129 of ELS/GZB where this problem occurred.	BHEL was requested to explore the feasibility of increasing the DC link capacitance to the extent possible so as to reduce such problems by higher energy storage capacity. Existing rating 6.75 mF (9x750 uF). M/s BHEL stated that they are in process to increase the DC link capacitance after making space in Traction Converter cabinet. PDC – 30.04.2019. Thereafter, 10 nos. passenger locos having M/s BHEL make traction converter shall be modified with higher DC link capacitance and extensive field trial shall be conducted.
4.	Failure of Electronic Cards (VIU/DCU)	77 cards failed in 2018-19 (Apr-Dec) whereas 55 cards were failed in year 2017-18.	In spite of taking various steps, the rate of failure is increasing. It seems that the steps are not effective and the problem needs to be taken afresh. M/s BHEL may

			draw detailed action plan and submit to RDSO/CLW.
5.	Reappearing of "Harmonic Filter contactor (8.1 /8.2) stuck on"	Reappearing of "Harmonic Filter contactor (8.1 /8.2) stuck on" problem.	M/s BHEL shall investigate the issue at ELS/LGD and submit the detailed to RDSO/CLW.
6.	Harmonic filter current high.	In M/s. BHEL IGBT Traction Converter, Harmonic Filter current is current 300 to 325 amp. Whereas in other make Traction Converter it is 150 to 180 amp.	BHEL shall study the logic of filter operation of other make and submit detailed report to RDSO/CLW for improvement of filter operation. PDC – 30.04.19.
7.	Issue of "**flashing of power cable**" at gland area inside converter.	This issue has been reported by ELS/BRC. M/s BHEL to take corrective action at the earliest.	M/s BHEL has informed the issue is with quality of cable lot supplied from M/s Seichem. BHEL to identify the converter nos. with defective lot and arrange for replacement of cables.
8.	Power module Stucchi coupling failure	Power module Stucchi spindle found jam due to spring inside got defective in some locos where coolant replacement was done.	M/s BHEL has informed that they have attended the locos. However, if there are still such reports form Railways, the same may be intimated to m/s BHEL for early replacement.
9.	Sludge formation in coolant circuit	Sludge formation in coolant circuit of BHEL make Traction converter even after flushing and changing the coolant causing pressure switch chocked.	It appears this is due to improper cleaning. Railways are requested to identify such locos and get them attended by M/s BHEL.

3. M/s BHEL make Auxiliary Converter

Detailed failure – type wise and shed wise are indicated in table – 3 and 4 respectively.

Table – 3: Failure type wise details

SN	Cause of Failure	No. of Failures					
		2015-16	2016-17	2017-18	2018-19 (Apr-Jun)	2018-19 (Jul-Sep)	2018-19 (Oct-Dec)
1	Inverter module	21	35	40	13	13	14
2	Controlled rectifier module	9	7	22	2	10	10
3	ACI card	11	17	12	11	4	6
4	AMC card	0	8	4	2	1	0
5	MVB Fibre interface (MFI card)	3	4	3	2	2	0
6	Battery Charger	12	11	13	4	1	1
7	Software malfunctioning	7	7	8	4	1	2
8	Misc.	9	11	20	13	4	33
	Total Failures	72	100	122	51	36	66
	Total Population (loco)	93	180	328	347	360	406
	FRPCPY	77	56	37	59	40	65

Table – 4: Failure type wise details

SN	Cause of Failure	2018-19 (Oct-Dec)														
		AQ	BIA	BRC	GMO	GZB	HWH	KYN	LDH	LGD	NKJ	RPM	TATA	TKD	VSKP	Total
1	Inverter module	1	0	0	0	2	1	1	0	2	0	0	2	2	3	14
2	Controlled rectifier module	0	0	0	0	1	1	0	0	1	0	1	2	3	1	10
3	ACI card	1	0	0	0	1	2	0	0	0	0	1	1	0	0	6
4	AMC card	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MVBFibreinterface (MFI card)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Battery Charger	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
7	Software malfunctioning	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
8	Misc	2	0	0	0	0	0	0	0	0	1	0	0	5	1	33
9	Total Failures	4	0	0	0	7	4	1	0	3	1	2	5	10	5	66
10	Total Population (loco set)	20	28	23	11	37	13	32	8	40	4	18	60	32	48	374
11	FRPCPY	**80**	**0**	**0**	**0**	**76**	**123**	**13**	**0**	**30**	**100**	**44**	**33**	**125**	**42**	**71**

4. Issues of Auxiliary Converter discussed during the meeting are as below:

SN	Item	Action Plan	Remarks
1.	Inverter module failure	SW ver. 188.1 with less sensitive di/dt monitoring (2 to 3 µs) has been uploaded and regular cut-in since Jan'2018. Power up issue in AMC module: Resistor value modified to optimize the initializing current and same implemented from May 2016. No improvement in the performance.	In spite of taking various steps, the rate of failure is increasing. It seems that the steps are not effective and the problem needs to be taken afresh. M/s BHEL may draw detailed action plan and submit to RDSO/CLW.
2.	Control rectifier module failure		
3.	No DDS of BUR with BT make traction converter.	No DDS of BUR is being recorded other than life sign missing in Locos equipped with BT make Traction Converters. • Compatibility issue with BT make SR. • BT and BHEL has modified the software to address the issue. • Tested in loco no. 31943 at ELS/Katni. • Firmware was updated and message getting logged. • However, BHEL has not still started downloading the updated firmware.	There are 61 locomotives having M/s BTIPL make SR with M/s BHEL make BUR. The problem can be attended by downloading the upgraded firmware. M/s BHEL stated that port for downloading of firmware is not accessible. EMI/EMC sheet is to be open to reload the modified software which is not desirable. In view of above, M/s BHEL shall submit the proposal for accessing the downloading port from outside by 15.04.2019.
4.	Low BUR-2 frequency	• Firm has indicated they have addressed the issue in software version -188.1. • Railways to indicate if the problem is resolved in software version – 188.1.	Resolved. Railways are requested to keep a close watch.
5.	Main power off	Isolation of BUR1, 2 & 3 due to Low/No OHE followed by Main power off as compared to other make Auxiliary converter.	BHEL has to take corrective action and inform RDSO/CLW.

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6.	Overheating of power cable terminal lug supporting stud	• Firm has stated that Brass studs have been made available to loco sheds. • Very poor response of firm in BRC. Only 03 nos. locos out of 22 locos.	BHEL has intimated that BUR manufactured in 2012 and before have MS studs. Railways to identify such converters and if not modified, detailed may be shared with M/s BHEL and RDSO for replacement.
7.	Mismatch of Ramp up time	Mismatch of Ramp up time (16 sec) of BHEL make auxiliary converter with monitoring time (15 Sec) of BT make Traction Converter even in latest software version R-1240 causing several time message of 'TFP oil pressure not OK' and after 3 times this leads to " Main Power Off". BHEL to solve the issue at the earliest.	BHEL stated that the modified software 889.1 having less ramp up time (8-10 sec.) has been downloaded in one loco of ELS/HWH on 09.02.19. The modified software need to be downloaded in 4 more locos of ELS/HWH. Based on the field trial report, further decision will be taken.
8.	Contactor logic neither recorded in DDS nor in Aux. ACI card.	Isolation of Aux. Converter due to contactor logic neither recorded in DDS nor in Aux. ACI card. Only pop up message shown, so isolation of Aux. converter due to contactor mal operation could not be identified at shed.	M/s BHEL shall check the same at ELS/LGD and joint note with LGD shall be intimated to RDSO/CLW.
9.	BUR 3 input current is having a variation of upto 20A between phases when Battery charger is in service.	M/s BHEL to investigate the cause and take corrective action at the earliest.	
10.	There is power supply breaker to battery charger processor card and when it fails loco shut down with message battery voltage less than 82 V.	M/s BHEL to investigate the cause and take corrective action at the earliest.	M/s BHEL has stated that software patch has been given to ELS/LGD. ELS/LGD informed that the same has not worked. The issue shall be jointly checked by M/s BHEL & ELS/LGD. Joint note shall be submitted to RDSO/CLW in this regard.

5. **Performance of M/s. BHEL make VCU:** Issues of traction converter discussed during the meeting are as below.

SN	Item	Action plan	Remarks
1.	TM isolation from DDU is possible only from CAB-1	• In BHEL TCN Locos, TM isolation from DDU is possible only from CAB-1. From CAB-2 TM isolation not possible from DDU.	BHEL has stated that they will study the issue and revert back by 10.04.2019.

2.	Frequent failure of train bus communication in MU operation	• Frequent failure of train bus communication in MU operation of MICAS based system with IGBT BHEL traction converter. The failures are transient but repetitive in nature. • MU operation with C-DAC & BHEL make VCU has not been done yet.	BHEL has to give action plan for MU operation with C-DAC & BHEL make VCU.
3.	Multi operation failure	• Multi operation failure in BHEL C-DAC VCU loco due to reasons like tripping of slave loco & panto lowered, traction not allowed in master & slave loco.	BHEL state that trials in different combinations of MU gateway successful in ELS/VSKP.
4.	Harmonic current high.	• Trial has been conducted at ELS/VSKP in loco no. 31967 with C-DAC VCU on 24.01.19.	Performance under watch.

29/03/19
(DSE/TRS)

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