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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/11.5.5/5

Date: 21.06.2018

M/s. BHEL Limited,
Electronics Division, PB.No.2606,
Mysore Road, Bangalore-560 026

Sub: Minutes of the Meeting held at RDSO, Lucknow on 20.06.2018 on Reliability of M/s BHEL make IGBT based converters fitted in three phase electric locomotives.

Please find enclosed herewith a copy of Minutes of the Meeting held at RDSO, Lucknow on 20.06.2018 on Reliability of M/s BHEL make IGBT based converters fitted in three phase electric locomotives for information and necessary action.

21/06/2018

(Aseem Kumar)

For Director General (Elect.)

Encl: As above.

Copy to:

1. **Secretary (Electrical), Railway Board, Rail Bhawan, New Delhi-110 001.** For kind information.
2. **Chief Electrical Engineer, (For information and necessary action)**
 - 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 - 751 017
 - 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
 - Chittaranjan Locomotive Works, Chittaranjan - 713 331(WB)

21/06/2018

(Aseem Kumar)

For Director General (Elect.)

Encl: As above.

**Reliability meeting of M/s BHEL make IGBT based converters fitted in 3-ph loco
held at RDSO on 20.06.2018**

Member Present

| RDSO | M/s BHEL |
|----------------------------|------------------------------|
| 1. Shri O.P. Kesari, PEDSE | 1. Shri Subhasis Biswas, AGM |
| 2. Shri Ran Vijay, JE/TPL | 2. Shri R. Shekhar, Sr. DGM |

In this meeting, issues related to M/s BHEL make IGBT based Traction Converter, Auxiliary Converter and Hotel Load Converter have been discussed. The detailed deliberations done during the meeting are appended below:

1.0 M/s BHEL make Traction Converter

1.1 Failure trend of BHEL make traction converter:

| SN. | Cause of Failure | No. of Failures | | | |
|-----|--|-----------------|---------|---------|---|
| | | 2015-16 | 2016-17 | 2017-18 | 2018-19 (Apr-May) reported by BHEL |
| 1 | Power Module/PMI/USID | 57 | 90 | 140 | 16 |
| 2 | VIU/DCU Card | 17 | 26 | 55 | 8 |
| 3 | Coolant Pump | 1 | 3 | 8 | 2 |
| 4 | Software Malfunctioning (Harmonic filter stuck, ASC pulsing stopped, TFP oil pressure not OK, etc) | 10 | 14 | 36 | Information not available |
| 5 | Pressure Switch | 42 | 15 | 29 | 4 |
| 6 | Misc. (Transient /random faults) | 16 | 26 | 56 | Information not available |
| | Total Failures | 143 | 174 | 324 | 30 |
| | Total Population (loco) | 140 | 176 | 329 | 346 |
| | FRPCPY | 112 | 99 | 98.5 | - |

1.2 Following issues are with BHEL make traction converter:

| SN | Item | Action plan | Remark |
|----|-----------------------|--|---|
| 1. | Power Module Failures | Protection level of monitoring time has been modified for from existing 750ns to 1000ns. | <p>(i) Trial software ver. 774 with increased Timing parameter for addressing generation of SEPL_MAX error.</p> <p>(ii) This modified software has been loaded in 124 locos as under:</p> <p>RPM-10, GZB-26, LGD-46, BIA-11, AQ-4 and KYN-24.</p> |

R. G. Kesari

R. Shekhar

| SN | Item | Action plan | Remark |
|----|---|---|--|
| | | | <p>(iii) 18 nos. of IGBT Power Modules (02 locos) with upgraded components have been fitted in loco no. 31970 & 31975 of ELS/KAZIPET. Upgraded components include MOSFET, MOSFET Driver, Capacitor and Resistor. Details enclosed as annexure-1:</p> <p>(iv) M/s BHEL confirmed that all the loco commissioned after Apr'18 with converter sr. no. starting from 625 (TC order) and 823 (Propulsion Order) are being supplied to CLW with upgraded components.</p> |
| 2. | Reduction of TE/BE with no DDS at higher speed. | <p>(i) M/s BHEL stated that this is occurring due to loss of Panto contact with OHE for more than 45ms. This has come to light after analyzing the data of loco 30129 of ELS/GZB where this problem occurred.</p> <p>(ii) DC link capacitor in M/s BHEL make traction converter is 6.75 mF (9x750 uF) whereas it is about 10 to 12 mF in other makes traction converters. 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.</p> | <p>(i) Simulation with increase capacitance shall be completed by 31.07.18.</p> <p>(ii) BHEL will submit the proposal for development of traction converter with increased capacitance based on simulation results.</p> |
| 3. | Failure of Electronic Cards | VIU: BHEL has provided snubber circuit across the relay contacts. | M/s BHEL confirmed that all the loco commissioned after Apr'18 with converter sr. no. starting from |

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| SN | Item | Action plan | Remark |
|----|--|---|--|
| | (VIU/DCU/ACI) | <p>DCU: Board was getting corrupted when access with diagnostic s/w version 2.7.</p> <p>ACI: It was incidental failure because of AMC card.</p> | <p>625 (TC order) and 823 (Propulsion Order) are being supplied to CLW with upgraded components.</p> <p>DCU: Diagnostic software version changed from 2.7 to 2.9 that are used for accessing DCU board for programming and downloading.</p> <p>ACI: After improved power-up circuit in AMC card the failures have reduced.</p> <p>Performance to be watched.</p> |
| 4. | Failure of Pressure Switch | The pressure switch needs to be replaced by Honeywell make in all the locomotives in phased manner. | <p>1. Position of Honeywell make pressure switch as given by BHEL is as below:</p> <p>Shed locos modified/spares available at sheds</p> <p>a) ELS/TATA – 28/20 Nos. b) ELS/LGD – 19/10 Nos. c) ELS/BIA – 05/17 Nos. d) ELS/KYN – 05/14 Nos. e) ELS/BRC – 10/15 Nos. f) ELS/TKD – 19/00 Nos. g) ELS/WAT – 15/03 Nos. h) ELS/HWH – 02/28 Nos. i) ELS/GMO – 01/00 Nos. j) ELS/GZB – 09/14 Nos. k) ELS/AQ – 08/14 Nos. l) ELS/RPM – 03/36 Nos. m) ELS/KZJ – 07/04 Nos.</p> <p>Total locos modified: 131 (145 locos) Spares available: 175locos</p> <p>2. BHEL requested RDSO/CLW to accord approval for additional vendors for pressure switch namely M/s Suco & M/s Orion.</p> |
| 5. | Harmonic Filter contactor stuck on/off | Modified software (ver. 373) by increasing the feedback time of the auxiliary signal to 2.0 sec. Downloaded in 5 locos each at ELS/LGD, ELS/KYN | <p>(i) Software version 373 addresses this problem.</p> <p>(ii) RDSO approval has been given for regular use of software version 373 in all BHEL make SR vide letter No. EL/3.1.35.17</p> |

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| SN | Item | Action plan | Remark |
|----|----------------------|---|--|
| | | and ELS/BIA and two locos at ELS/RPM. | (BHEL) dtd: 25.09.17. |
| 6. | Coolant pump failure | <p>(i) The pump failure rate is on rise. firm to submit the failure investigation report.</p> <p>(ii) Approval for alternate make of Flowell has been given. Firm has been advised to install the same for early trial.</p> <p>(iii) M/s BHEL stated that Pump motors are burning probably due to higher harmonics in the supplies of auxiliary converters.</p> | <p>(i) Firm has given a target of 31.07.18 for installation of Flowell make pump for field trial. It is once again reiterated that flowell make pump for field trial shall not be installed in new converters to be supplied to CLW. M/s BHEL shall supply TC as per approved BOM. Vide letter no. EL/3.1.35/17/BHEL dated: 17.10.2017 trial to be conducted in 5 loco sets (2- ELS/KYN and 3-ELS/LGD).</p> <p>(ii) Output harmonics contents shall be jointly measured by RDSO & BHEL in all makes of auxiliary converters on 9th-10th July/2018 at ELS/GZB and TKD without fail.</p> |

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RDSO

2.0 Failure trend of BHEL make auxiliary converter:

| SN | Cause of Failure | No. of Failures | | | |
|----|--------------------------------|-----------------|---------|---------|------------------------------------|
| | | 2015-16 | 2016-17 | 2017-18 | 2018-19 (Apr-May) reported by BHEL |
| 1 | Inverter module | 21 | 35 | 40 | 5 |
| 2 | Controlled rectifier module | 9 | 7 | 22 | 2 |
| 3 | ACI card | 11 | 17 | 12 | 2 |
| 4 | AMC card | 0 | 8 | 4 | 0 |
| 5 | MVB Fibre interface (MFI card) | 3 | 4 | 3 | 1 |
| 6 | Battery Charger | 12 | 11 | 13 | 2 |
| 7 | Software malfunctioning | 7 | 7 | 8 | 0 |
| 8 | Misc | 9 | 11 | 20 | Information not available |
| | Total Failures | 94 | 100 | 122 | 12 |
| | Total Population (loco) | 93 | 180 | 328 | 345 |
| | FRPCPY | 102 | 61 | 37 | - |

2.1 Following issues are with M/s BHEL make auxiliary converter

| SN | Item | Action plan | Remark |
|----|--|---|---|
| 1 | Inverter module failure of Auxiliary converter including control rectifier module. | <ul style="list-style-type: none"> • Assembly process reviewed to prevent damage of IGBT terminals in the module. • Further, power-up issue in the AMC module has been addressed with increased initializing current. Refer Annexure-1. | SW ver. 188 with less sensitive di/dt monitoring (2 to 3 μ s) has been uploaded and regular cut-in since Jan'2018. Performance under watch. |
| 2 | 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. | Issue with the compatibility with BT make SR. BT and BHEL has modified the software to address the issue. It has to be tested in loco at ELS/LDH by 30.06.18. |
| 3 | Low BUR-2 frequency | Frequency of message TR-1 & 2 oil pressure not OK & Converter-1 & 2 Coolant pressure not OK is abnormally high. BUR-2 frequency at that moment is found 15 to 20 Hz. whereas, frequency of BUR-3 is 50 Hz in the back ground data. | Firm has indicated they have addressed the issue in software version - 188.1. Railways may give the performance feedback to RDSO. |

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Handwritten signature: *[Signature]*

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| SN | Item | Action plan | Remark |
|----|---|--|---|
| 4 | Overheating of power cable terminal lug supporting stud | Overheating of power cable terminal lug supporting stud inside the BUR Box-1 & 2 due to bad conductivity between stud and hexagonal socket reported by ELS/GMO and ELS/BRC | <p>Firm has stated that Brass studs have been made available to loco sheds. The details are as below:</p> <p>GMO-30, BRC-30, LGD-60, WAT-20, LDH-30, GZB-80, TATA-30</p> <p>There are 27 studs (3x9) per locomotive. Therefore above quantity is very small as about 136 locos need replacement.</p> <p>Railways are requested to undertake replacement of studs available with them.</p> |

2.2 During the meeting held at RDSO on 20.06.2018, BHEL has confirmed about keeping adequate spares at different locations. However, the spares availability was very poor and locomotives keep waiting for spares. The position of spares was given below. Current position of spares as on 12.06.18 is as under.

| Spare Items | CLW | | BIA | | LGD | | KYN | | DLI/TKD | |
|----------------------|---------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-----------------|
| | Decided spare | Actual position | Decided spare | Actual position | Decided spare | Actual position | Decided spare | Actual position | Decided spare | Actual position |
| Power Module | 10 | 04 | 5 | 0 | 8 | 2 | 8 | 0 | 5 | 0 |
| DCU | 6 | 01 | 3 | 3 | 5 | 0 | 5 | 0 | 3 | 0 |
| VIU | 4 | 0 | 2 | 1 | 3 | 1 | 3 | 0 | 2 | 0 |
| Pressure Switch | 10 | 40 | 5 | 21 | 8 | 66 | 8 | 35 | 5 | 21 |
| MFI | 4 | 0 | 2 | 0 | 3 | 0 | 3 | 0 | 2 | 0 |
| Inverter | 6 | 0 | 3 | 1 | 5 | 0 | 5 | 0 | 3 | 1 |
| ACI | 6 | 01 | 3 | 0 | 5 | 0 | 5 | 1 | 3 | 0 |
| Battery Charger | 4 | 0 | 2 | 1 | 3 | 0 | 3 | 0 | 2 | 1 |
| Controlled Rectifier | 4 | 0 | 2 | 01 | 3 | 0 | 3 | 1 | 2 | 0 |
| Buffer Module | 4 | 01 | 2 | 0 | 3 | 0 | 3 | 0 | 2 | 0 |

BHEL has been requested to take immediate action to ensure availability of spares as above.

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Date

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20/06/2018

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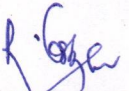
3.0 Hotel Load Converter:

- 3.1 Two WAP-7 locomotives – 30426 & 30644 fitted with M/s BHEL make 2x500 kVA hotel load converter are homed at ELS/RPM/SR.
- 3.2 As per report submitted by Southern Railway, major concern with BHEL make HLCs fitted in loco no. 30426 is 'Spuriously trip on line due to converter output voltage fluctuation'. SR further informed that M/s BHEL is investigating this problem for chalking out action plan.
- 3.3 In this connection, M/s BHEL requested to make loco no. 30426 along with full coach load available at Chennai platform for 4-6 hours to tune the output parameters.
- 3.4 Southern Railway also informed that converter-B Input Panel of loco no. 30644 burnt and they are waiting for spares/materials from BHEL.
- 3.5 BHEL confirmed that required material of converter-B input panel will be made available by 06.07.2018 and Input Panel will be ready by 10.07.2018 without fail. BHEL further requested to make loco no. 30644 available at ELS/RPM from 12.07.18 to 14.07.18 for mounting of Input Panel and commissioning of HLC.
- 3.6 It was advised that full testing of HLC should be done while turning out loco at CLW.


4.0 Other points:

- 4.1 M/s BHEL was requested to update the position of action plan every month along with other details as discussed today and send the compliance every month on email dsetplgroup@gmail.com.

For M/s BHEL


(R. Shekar)
Sr. DGM

For RDSO


(Ran Vijay)
JE/TPL

Upgraded component list of Power Module of Traction Converter

| Sl.No | Existing / Approved component | Proposed Component/Change | Implementation date for serial production | Qty | Remarks |
|-------|-------------------------------|---------------------------|---|-----|--------------------------|
| 1 | MOSFET: 30 V | MOSFET: 40 V | Apr-18 | 2 | Higher rated |
| 2 | MOSFET DRIVER: 85 Deg C | MOSFET DRIVER: 125 Deg.C | Nov-17 | 1 | Higher temperature rated |
| 3 | Capacitor: 68 uF, 20 V | Capacitor: 68 uF,25V | Apr-18 | 1 | Higher voltage |
| 4 | Resistor : 10R, 0.25 W | Resistor: 10 R, 0.5 W | Nov-16 | 2 | Higher rated |

Upgraded component list of Power Module of Auxiliary Converter

| Sl.No | Existing / Approved component | Proposed Component/Change | Implementation date for serial production | Qty | Remarks |
|-------|-------------------------------|---------------------------|---|-----|-----------------|
| 1 | Resistor: 33K, 0.25 W | Resistor 18K, 0.25 W | May-16 | 3 | Optimised value |
| 2 | Capacitor: 10 uF, 35V | Capacitor, 10uf, 50 V | Nov-15 | 6 | Higher rated |

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