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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/11.5.5/5

Date: 19.01.2017

1. M/s ABB Limited, Survey No. 88/3-4, Nelamangala Taluk, Bangalore – 562 123
2. M/s. BHEL Limited, Electronics Division, PB.No.2606, Mysore Road, Bangalore-560 026
3. M/s. BTIPL, ERDA Road, Maneja, Vadodara-390 013
4. M/s. BHEL, CEE Division, Piplani, Bhopal – 462 022
5. M/s. CGL, Plot No. 9, MPAKVN Phase-2, New Industrial Area, Mandideep – 462 046.
6. M/s Medha Servo Drives Pvt. Ltd., P-4/5 B, I.D.A., Nacharam, Hyderabad – 500076

Sub: Minutes of the Meeting held at RDSO, Lucknow on 06.01.2017 on Reliability of GTO & IGBT based three phase electric locomotives.

Ref: This office letter of even no. dtd. 14 & 16.12.16.

Please find enclosed herewith a copy of Minutes of the Meeting held at held at RDSO, Lucknow on 06.01.2017 on 'Reliability of GTO & IGBT based three phase electric locomotives' for information and necessary action.

19/01/17

(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.
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 – 751 023
   - 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
   - Chittaranjan Locomotive Works, Chittaranjan – 713 331(WB)

19/01/17

(Suresh Kumar)
For Director General (Elect.)

Encl: As above.

Minutes of the Meeting held at RDSO, Lucknow on 06.01.2017 on Reliability of GTO & IGBT based three phase electric locomotives

Members Present: (S./Sri)

RDSO

1. O.P. Kesari, EDSE (Co-ord)
2. Suresh Kumar, DSE/TPL
3. S.K. Deo, SSE/TPL

CLW

1. Vipin Kumar, Dy. CEE/D&D

Industry

1. S. Chandrakumar, Head Traction/ABB
2. C. Ramanujam, Head Business/BTIPL
3. Manjunathan, AGM/BHEL
4. S.S. Ostwal, DGM/CGL
5. A.N.V. Rao, Asst. Manager/Medha

Zonal Railways

1. A.A. Phadke, CELE/SCR
2. S.K. Natarajan, Sr. DEE/ELS/RPM
3. Arjit Saxena, DEE/ELS/BIA
4. Hemant Jindal, DEE/ELS/KYN
5. Kunwar Singh Yadav, DEE/ELS/CNB
6. Chetan Gulwani, DEE/ELS/WAT
7. Puneet Jeth, DEE/ELS/TKD
8. Harikesh Meena, DEE/ELS/BRC
9. Gaurav Goel, ADEE/ELS/LGD
10. D.K. Meena, ADEE/ELS/TATA
11. Rachit Khanna, ADEE/ELS/LDH
12. Sachin Goel, ADEE/ELS/GZB
13. J.P. Pal, ADEE/ELS/HWH
14. Dinesh Thakur, JE/ELS/AQ

****

The meeting was held in accordance with the agenda circulated vide RDSO letter no. EL/11.5.5/5 dtd. 28.12.2016. At the outset EDSE (Co-ord) welcomed all the delegates for the meeting from Zonal Railways, CLW and industries for the review of reliability performance of GTO/IGBT based converter of three phase locomotives.

DSE/TPL/RDSO made a presentation on reliability of GTO & IGBT based three phase locomotives highlighting trend of failures of various modules, cards, their analysis, action plan already finalized by RDSO, essential infrastructure required in Electric Loco Sheds, new action plan identified and all other agenda items. Presentations of Electric Loco Sheds were also discussed according to the agenda.

Brief of the detailed deliberations and action plan as discussed and decided during meeting are as under:

1.0 GTO based converters and its electronics:

Performance of Traction Converter, Auxiliary Converter and VCU of GTO based locomotives has been deliberated in detail. It is noted that FRPCPYs of these equipments are very high. The detailed failures of modules of Traction Converter and Auxiliary Converter are enclosed as annexure-1. The break-up of electronic cards failure are given in Annexure-2. Based on the deliberations, following action plans have been decided for the GTO based converters and its electronics.

1.1 Valve Set

Make wise failures are tabulated below:

S.No.	Types of failure	BT/Swiss			BT/India			BHEL			CGL		
		14-15	15-16	16-17 (April-Sep.)	14-15	15-16	16-17 (April-Sep.)	14-15	15-16	16-17 (April-Sep.)	14-15	15-16	16-17 (April-Sep.)
1	Valve Set GTO without TM	3	1	0	58	67	25	44	39	23	76	97	47
2	Valve Set GTO due to TM	2	1	0	14	9	4	11	9	9	4	6	10
3	Valve Set Leakage	3	0	0	14	6	8	5	5	3	8	26	21
4	Total	8	2	0	86	82	37	60	53	35	88	129	78
5	Population (Loco)	63	63	63	267	266	267	303	303.5	304.5	226.5	262	263.5
6	FRPCPY	12.7	3.2	0.0	32.2	30.8	27.7	19.8	17.5	23.0	38.9	49.3	59.2

19/01/17

(i) It was opined that capacitors of valve sets having life 18 years or more may be the cause of GTO failures. Similarly old insulating rod of the valve sets also need replacement to avoid GTO failures.

(ii) Therefore, it has been decided that following action plan will be followed during repair of failed valve sets:

(a) GTO shall be replaced in pairs;

(b) Capacitors and Insulating rods shall be replaced with new one in limited quantity of valve set. Performance of such valve set shall be compared with repaired valve sets in which capacitor & insulating rods were not replaced during repair. Once the efficacy of such repair mode is established, necessary instructions will issue by RDSO.

(c) Cases of Valve set leakage in CGL make are very high as compared to other makes. M/s CGL shall improve the same and measures for improvements shall be discussed in next meeting.

1.2 PPA988B02 card (SR)

Make wise failures are tabulated below:

SN	Name of PCB	BT/Swiss			BT/India			BHEL			CGL		
		2014-15	2015-16	2016-17 (April-Sep)	2014-15	2015-16	2016-17 (April-Sep)	2014-15	2015-16	2016-17 (April-Sep)	2014-15	2015-16	2016-17 (April-Sep)
1	NS/AS Controller (PPA988)	5	3	2	33	50	16	15	19	14	43	51	13
2	Population(SR)	71	78	99	306	308	308	300	310	339	258	293	233
3	**FRPCPY**	**7.0**	**3.8**	**4.0**	**10.8**	**16.2**	**10.4**	**5.0**	**6.1**	**8.2**	**16.7**	**17.4**	**11.2**

(i) The maximum failure cases of Valve Sets are of CGL & BT make. The reasons of failures of both make cards were discussed. Measures have already been taken to improve the reliability of this card in past.

(ii) It was opined that most of the failure cases are due to malfunctioning of software. Therefore, it has been decided that software shall be downloaded by Windows based LDS.

1.3 Gate Unit (GVA 587) (SR)

Make wise failures are tabulated below:

SN	Name of PCB	BT/Swiss			BT/India			BHEL			CGL		
		2014-15	2015-16	2016-17 (April-Sep)	2014-15	2015-16	2016-17 (April-Sep)	2014-15	2015-16	2016-17 (April-Sep)	2014-15	2015-16	2016-17 (April-Sep)
1	Gate Unit (GVA587)	13	13	2	179	78	26	18	13	7	54	76	23
2	Population(SR)	71	78	99	306	308	308	300	310	339	258	293	233
3	**FRPCPY**	**18.3**	**16.7**	**4.0**	**58.5**	**25.3**	**16.9**	**6.0**	**4.2**	**4.1**	**20.9**	**26.0**	**19.8**

(i) ELS/RPM has stated that failure rate of M/s CGL make is high as compared to other makes.

(ii) ELS/RPM has been nominated for complete investigation of M/s CGL make Gate Units vis-à-vis other makes to find out the problem. After complete investigation, M/s CGL & ELS/RPM shall submit their joint report by 15 Feb'17 in this regard.

1.4 PPB622B01 (VCU)

Make wise failures are tabulated below:

SN	Name of PCB	BT/Swiss			BT/India			BHEL			CGL		
		2014-15	2015-16	2016-17 (April-	2014-15	2015-16	2016-17 (April-	2014-15	2015-16	2016-17 (April-	2014-15	2015-16	2016-17 (April-
1	Single board computer (PPB622B01)	4	3	1	12	35	16	11	11	13	22	26	18
2	Population (VCU)	52	50	62	308	361	408	432	496	573	295	371	419
3	**FRPCPY**	**7.7**	**6.0**	**3.2**	**3.9**	**9.7**	**7.8**	**2.5**	**2.2**	**4.5**	**7.5**	**7.0**	**8.6**

(i) It was opined that most of the failure cases are due to malfunctioning of software. Therefore, it has been decided that software shall be downloaded by Windows based LDS.

(ii) Performance of the same shall be monitored separately and submitted to RDSO.

1.5 URB512D15 (VCU)

Make wise failures are tabulated below:

SN	Name of PCB	BT/Swiss			BT/India			BHEL			CGL		
		2014-15	2015-16	2016-17 (April-	2014-15	2015-16	2016-17 (April-	2014-15	2015-16	2016-17 (April-	2014-15	2015-16	2016-17 (April-
1	Digital I/O board (URB512D15)	0	0	1	13	25	11	17	14	8	10	26	11
2	Population (VCU)	52	50	62	308	361	408	432	496	573	295	371	419
3	**FRPCPY**	**0.0**	**0.0**	**3.2**	**4.2**	**6.9**	**5.4**	**3.9**	**2.8**	**2.8**	**3.4**	**7.0**	**5.3**

It has been decided that Electric Loco Sheds shall ensure to implement RAPs issued in past for this card.

1.6 WRE module

Make wise failures are tabulated below:

SN	Type of failure	BT/Swiss			BT/India			BHEL			CGL		
		14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)
1	**WRE Module**	29	14	5	54	46	23	35	45	18	51	36	23
2	**Population**	75	75	75	542	547	550	432	452	454	533	527	524
3	**FRPCPY**	**38.7**	**18.7**	**13.3**	**10.0**	**8.4**	**8.4**	**8.1**	**10.0**	**7.9**	**9.6**	**6.8**	**8.8**

(i) M/s CGL will carry out complete investigation of WRE module failures in GTO based Auxiliary Converters duly checking the opto-isolators.

(ii) Make wise failure of CTs should also be recorded to take suitable decision in this regard.

1.7 Back plane power supply card (KUC153A02) (BUR)

Make wise failures are tabulated below:

SN	Name of PCB	BT/Swiss			BT/India			BHEL			CGL		
		2014-15	2015-16	2016-17 (Apr-Sept)	2014-15	2015-16	2016-17 (Apr-Sept)	2014-15	2015-16	2016-17 (Apr-Sept)	2014-15	2015-16	2016-17 (Apr-Sept)
1	Power Supply (KUC153A02)	6	7	1	50	52	10	48	52	16	30	38	21
2	Population(BUR)	76	76	76	395	396	397	419	438	450	498	504	514
3	**FRPCPY**	**7.9**	**9.2**	**2.6**	**12.7**	**13.1**	**5.0**	**11.5**	**11.9**	**7.1**	**6.0**	**7.5**	**8.2**

(i) Failures of power supply cards (KUC153A02) shall be investigated by M/s BT for remedial action. Necessary modification may be done in one loco of ELS/BRC on trial basis by M/s BT.

(ii) M/s CGL has modified KUB921B02 card (VCU) in place of KUC153A02 card. Same modified cards were placed in one loco of ELS/AQ. The modified card is running in field satisfactorily for more than 2 months. It has been decided that M/s CGL shall provide modified KUB921B02 card of VCU in 5 loco sets auxiliary converter of ELS/GZB & ELS/LGD each. ELS/GZB & ELS/LGD shall facilitate M/s CGL and provide KUB921 card for the same.

19/1/17

1.8 Speed Sensor

Make wise failures are tabulated below:

Description	ARC			Laxven			AAL			Total		
	2014-15	2015-16	2016-17 (Apr-Sept)	2014-15	2015-16	2016-17 (Apr-Sept)	2014-15	2015-16	2016-17 (Apr-Sept)	2014-16	2015-17	2016-17 (Apr-Sept)
No. of Failures	166	203	78	6	7	4	5	12	4	177	222	86
Population	2190	2256	2289	17	17	41	92	221	242	2299	2494	2572
FRPCPY	**7.6**	**9.0**	**6.8**	**35.3**	**41.2**	**19.5**	**5.4**	**5.4**	**3.3**	**7.7**	**8.9**	**6.7**

(i) Speed sensors used in IGBT locos are very reliable. One loco no. 31127 of ELS/LGD was modified for use of speed sensor of IGBT converters in place of speed sensors used in GTO converters. ELS/LGD has reported its satisfactory working. It was decided in the meeting to carry out suitable modification so that power supply to speed sensors is made available from outside to avoid inbuilt arrangement of power supply for the speed sensor. This will help in improving the reliability to a great extent. This modification will enable the flexibility in using either speed sensors of GTO or IGBT converters in GTO based converters with power supply taken from electronic card.

(ii) For this purpose, modification shall be issued by RDSO.

(iii) Modified speed sensor shall be provided for GTO converters as per the modification discussed, in following loco sheds:

ELS/RPM - 5 locos,
ELS/GZB - 5 locos,
ELS/TKD - 5 locos, and
ELS/LGD - 5 locos

(iv) ToT partners shall study the feasibility of modification and shall submit their proposal to RDSO by Feb'17.

2.0 IGBT based converters and its electronics:

Performance of Traction Converter, Auxiliary Converter and VCU of IGBT based locomotives has also been deliberated in detail. Following action plans for different manufacturers have been decided for the IGBT based Traction Converter and Auxiliary Converter.

2.1 M/s ABB make Traction Converter

Major types of failures are tabulated as below:

SN	Cause of Failure	No. of Failures	
		2015-16	2016-17 (Nov'16)
1	Duagon Card defective	10	4
2	Software Malfunctioning (Time out initialization, harmonic filter current high, etc)	44	21
3	PEC (controller card) defective	11	4
4	Gate Driver Unit (GDU) cards	14	8
5	Pump Failure / Fan Failure	2	2
6	Loose connector/OFC/ Cable defective	6	2
7	PEBB (Power Module) Failure	12	13
8	Others (transient, contactor stuck up, MCB trip etc)	52	21
9	Total	151	75
10	Total Population	115	142
11	FRPCPY	131	79

(i) Software issue:

(a) Modified software version-37 will be provided on trial basis in 6 locos (TKD-2, GZB-2 & AQ-2). M/s ABB stated that this modified software will address following problems in –

- Harmonic high current,
- Loco creeping DC link over voltage message
- Earth fault in converters & bogie locked
- D.C. link overvoltage
- Time out shut down

(b) Joint note between Loco Sheds & ABB shall be submitted to RDSO after providing the modified software version;

(c) Performance will be monitored by loco sheds closely and feedback to be given to RDSO/CLW.

(ii) PEC (Controller card):

Booting time of PEC-2 card need to be reduced. M/s ABB shall study that how much time can be reduced and revert back by 20th Feb'17.

(iii) GDU cards:

M/s ABB shall investigate the cause of failure and submit the report to RDSO by 20th Feb'17.

(iv) PEBB Modules:

M/s ABB shall submit detailed investigation report to RDSO by Feb'17 end.

2.2 M/s BHEL make Traction Converter

Major types of failures are tabulated as below:

SN.	Cause of Failure	No. of Failures	
		2015-16	2016-17 (25th Dec'16)
1	Power Module/PMI	57	65
2	VIU/DCU Card	17	24
3	Coolant Pump	1	5
4	Software Malfunctioning (Harmonic filter stuck, ASC pulsing stopped, TFP oil pressure not OK, etc)	10	13
5	Pressure Switch	42	11
6	Misc. (Transient /random faults)	16	21
7	Total Failures	143	139
8	Total Population (loco)	140	194
9	FRPCPY	112	95

(i) Failure of Power Module/PMI

(a) Filter in PMI card was introduced to address Usid_low error since Apr'16. No improvement in reliability of PMI card has been noticed.

(b) ELS will inform RDSO about the number of card in which filter has been introduced and submit the performance.

(c) BHEL agreed to make available the spares of PMI card in Sheds for replacement of failed module by modified one.

(d) M/s BHEL stated that all failed modules will be replaced by March'17.

19/1/17

(ii) Failure of VIU/Drive Control Unit (DCU) cards:

(a) Precaution shall be taken for uploading the software with laptop dedicated for this purpose to avoid software corruption.

(b) Track burnt/resistor burnt found in failed card. BHEL shall improve the manufacturing quality.

(iii) Coolant leakage/fluctuation:

(a) Overflow of coolant and air trap in pipe line are being noticed.

(b) M/s BHEL shall modify the cooling circuit by additional connection between conservator and pipe line to solve these problems.

(c) RDSO has issued Modification Sheet (MS No. RDSO/2017/EL/MS/0457) on this modification.

(d) All the Traction Converter henceforth shall be modified and implemented in new supplies by M/s BHEL per RDSO Modification Sheet No. RDSO/2017/EL/MS/0457.

(e) Existing Traction converters shall be modified as per modification sheet prepared by RDSO in Electric Loco Sheds as when problem of coolant leakage/fluctuation is noticed.

(iv) Repeated earth fault messages are observed in 7 locomotives of ELS/LGD. M/s BHEL shall investigate jointly with ELS/LGD and submit report to RDSO by Jan'17 end.

(v) Problem is being faced by sheds in identifying failed traction motor. M/s BHEL shall implement proper DDS message so that failed traction motor can be located easily.

(vi) Time delay for closing of 8.1 contactor may be increased from 1000 ms to 1500 ms on trial basis by M/s BHEL in 02 locos of ELS/LGD. Based on the feedback decision will be taken for its regular implementation.

2.3 M/s CGL make Auxiliary Converter

Major types of failures are tabulated as below:

SN	Cause of failure	2015-16	2016-17 (Nov'2016)
1	Power supply card (KUC153 A02)	74	60
2	BUR processor card (CCPU card)	9	23
3	INVCC-01 electronic card	21	36
4	Total	104	119
5	Total Population (Loco)	182	227
6	FRPCPY	57	78

(i) Failure of KUC153A02 card

(a) Failure of Power supply card (KUC153A02) is a serious cause of concern. M/s CGL has stated that they have modified the card by regulating -24V output supply.

(b) This modified power supply card (KUC153A02) shall be replaced by M/s CGL in 25 locomotives as per following breakup:

ELS/RPM - 5 locos,
ELS/AQ - 5 locos,
ELS/BRC - 5 locos,
ELS/LGD - 5 locos,
ELS/WAT - 5 locos.

(c) Performance of modified card shall be monitored and based on that, further action will be taken.

(ii) Failure of CCPU card:

Sensitivity of CCPU card shall be increased by M/s CGL and provided in same locomotive mentioned above. Performance of the same will be monitored and submitted to RDSO.

(iii) Failure of INVCC card:

M/s CGL will study the problem and revert back with the solution by Feb'17 end.

(iv) Issue of BUR current > max:

Modification in hardware and software shall be done in 3 locos of ELS/BRC & ELS/LGD each. Modification details may be collected from M/s CGL. Performance will be monitored and submitted for further action.

2.4 M/s BTIL make Auxiliary Converter

Major types of failures are tabulated as below:

SN	Cause of Failure	No. of failures 16-17 (Nov.'16)
1	Power Module	13
2	Software Malfunctioning	5
4	Total Failures	18
5	Total Population	126
6	**FRPCPY**	**21**

(i) Failures of Power Modules

- It has been observed that IGBTs (Mitsubishi make) failed mostly on line side. M/s BT has stated that report from Mitsubishi is inconclusive due to heavy damage of the IGBT.
- M/s BT has sent the data-logger data to BT/Zurich for investigation. The investigation report will be submitted to RDSO for further action.

(ii) Software issue:

- *Time out DC link circuit charge B1 & B2 message* leads to bogie isolation and main power off. M/s BTIL has installed data logger in two locomotives one each at GMO and BRC for capturing the environmental data during the fault. Detailed analysis of the same shall be submitted to RDSO.

2.5 M/s Medha make Traction Converter

Major types of failures are tabulated as below:

SN	Cause of Failure	No. of failures	
		2015-16	16-17 (Sept.'16)
1	Card failure	0	2
2	VCU problem	1	1
3	Software Malfunctioning (Time out initialization, Time mis-match etc)	1	0
4	Converter contactor	2	1
5	Power Module	3	0
6	TM speed sensors	0	4
7	Loose connector / OFC/ Cable defective	0	1
8	Others / Misc.	5	1
9	Total	12	10
10	FRPCPY	150	91

29/1/17

(i) Jaquet make speed sensor supplied by M/s Medha is not compatible with other make speed sensor gear wheel at higher speed i.e. >80 kmph. M/s Medha will study and revert back by Jan'17 end so that speed sensors are interchangeable.

(ii) M/s Medha shall standardize the DDU messages with MICAS and remove extra background messages as it creates confusion to Loco Pilots. M/s Medha will submit action plan by Jan'17 end.

(iii) Driver needs to configure the driving cab every time when any change done in loco combination during multi-loco operation with M/s Medha make propulsion system. M/s Medha shall study the issue and revert back by Jan'17 end to ensure smooth multi-loco operation.

3.0 Other action plans:

3.1 Multi-loco operation issue:

(i) All the OEMs & suppliers of converters is advised to ensure that there should be provision of multi-loco operation with different make without any problem.

(ii) RDSO & CLW will jointly work and define necessary changes in specification for multi-loco operation with different makes.

3.2 Nomenclature of software version

Modified nomenclature of software version shall be followed in all future software versions by OEMs as discussed during meeting. This will help in better understanding and standardization of software.

Proposed nomenclature of software of IGBT Converters shall be in eight alphanumeric code as below:

A YY B RR MM

A – loco type (1 for WAP5, 2 for WAP7, 3 for WAG9/9H & 4 for all loco)

YY – For Year of release 2016

B – Types of Equipments (A for Auxiliary Converter, T for Traction Converter, V for VCU & W for all equipments)

RR – Release number (00 to 99)

MM – Manufacturer (AL for M/s ALL, AB for M/s ABB, BH for M/s BHEL, BT for M/s BT, CG for M/s CGL, HR for M/s HIRECT & MD for M/s MEDHA)

3.3 Development of bilingual Driver Display message:

Effort shall be made by converter manufacturers to develop Bilingual (Hindi/English) Driver display messages so that staff/loco pilots can understand it without problem. This has been also pointed out by Railway Board's letter no. 2008/Elect(TRS)/113/5 dtd. 26.12.16.

3.4 Warranty obligation by firms:

Railway has reported that there are a number of cases of warranty obligations with different manufacturers. Manufacturers were advised to tackle the warranty obligations immediately. The list of the same is enclosed as Annexure-3.

3.5 AMC of GTO based converters by ToT partners:

BT informed that budgetary quotation for AMC has been submitted to Railways. Other ToT partners are advised to submit their quotation at the earliest. However, Zonal Railways may make the proposal for AMC based on the offer submitted by on ToT partner, i.e., M/s BT.

3.6 Basic infrastructure facility:

All Electric Loco Sheds holding 3-phase locomotives shall develop all the basic infrastructure facilities as discussed in the meeting. Loco sheds confirmed that they will ensure all the facilities in place by March'17 end.

3.7 Development of functionally equivalent cards:

Development of functionally equivalent cards for GTO locomotives has been deliberated. ToT partners shall make efforts to develop the same and shall inform RDSO by 15th Feb'17. RDSO will also float EOI to find out other available option in open market.

3.8 M/s BHEL has been advised that Service Engineer at Delhi may also be posted and intimate the contact details of their service engineers to concerned Shed with a copy to CLW & RDSO.

3.9 M/s BT has informed that 40 nos. of Window based LDS were provided to CLW which have been handed over to Electric Loco Sheds. All electric locos sheds must ensure proper training to staff and updated software to exploit its full utilization.

3.10 It has been observed that some loco sheds have not updated RAPs position in e-locos website. Electric Loco Shed shall regular update their RAPs position in e-locos website.

Annexure-1

Power Converter (SR)

SN	Type of Failure	AQ			GMO			LGD			TKD			SIA			BRC			RPM			VIAT			NMH			Total		
		14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)
1	Valve Set GTO without TM	44	55	26	41	39	17	22	21	18	22	18	17	15	31	6	19	16	3	16	24	6	0	0	0	0	0	0	179	204	68
2	Valve Set GTO due to TM	3	2	0	6	6	1	0	0	0	0	4	1	7	4	7	0	0	0	0	1	2	0	0	0	13	8	11	29	25	22
3	Valve set leakage	3	1	1	2	1	0	1	0	0	6	4	3	0	6	3	15	10	8	1	15	18	0	0	0	0	0	0	28	37	33
4	Gate Unit	24	15	3	70	47	27	18	21	7	1	2	1	4	3	0	82	29	10	78	75	16	0	0	0	10	8	2	287	200	66
5	GUSP	13	6	8	9	6	3	3	1	0	1	6	1	0	0	0	2	4	3	1	2	2	0	0	0	0	0	0	29	25	17
6	PCB / Electronics	52	43	13	29	30	16	13	28	16	71	57	20	20	11	2	22	28	9	36	38	13	3	3	6	40	38	8	286	276	105
7	Dc-link voltage sensor/EF sensor / voltage transducer	0	0	0	6	3	3	0	0	0	2	0	0	11	1	0	9	3	0	1	1	0	0	0	0	0	1	0	29	9	3
8	MUB	0	0	0	1	0	0	0	2	0	1	1	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	3	3
9	DC-link & series resonance capacitor	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
10	Main Contactor & 'O' ring	0	0	0	2	0	0	0	0	1	0	2	0	0	2	2	4	0	1	0	0	0	0	0	0	0	0	0	6	4	4
11	Other	4	0	1	15	11	2	8	5	4	10	15	3	2	13	0	0	0	0	0	1	0	6	17	31	4	0	0	49	62	41
12	Total	143	123	62	181	144	71	65	78	46	114	109	47	59	72	22	153	90	34	133	157	69	9	20	37	67	55	21	924	848	369
13	Population	215	220	220	204	208	208	236	246	250	121	130	134	81	81	81	74	82	82	66	80	80	8	25	49	38	38	38	1043	1110	1142
14	FRPCPY	66.6%	56%	47%	88.73	69.23	66.27	27.54	31.71	36.80	94.21	83.85	70.15	72.84	88.89	64.32	206.76	109.76	82.93	201.52	196.25	147.60	112.50	80.00	151.02	176.32	144.74	110.83	88.59	76.40	66.13

Auxiliary Converter (BUR)

SN	Type of Failure	AQ			GMO			LGD			TKD			SIA			BRC			RPM			VIAT			NMH			Total		
		14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)	14-15	15-16	16-17 (Apr-Sept)
1	WRE Module	36	43	15	73	48	25	11	25	16	18	16	9	13	8	7	10	4	1	4	4	1				7	0	1	172	148	75
2	GG Module	11	10	7	7	3	4	4	20	11	7	13	7	0	5	2	2	1	3	1	1	0				3	2	1	35	55	35
3	PCB / Electronics	49	58	22	56	37	16	18	41	24	60	47	20	13	12	7	10	18	4	18	13	11	8	10	17	5	7	3	237	243	124
4	DC-link Capacitor	0	0	0	8	2	1	2	1	0	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0	1	4	0	13	8	2
5	Surge Arrestor	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0
6	3-phase Choke	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
7	Other	3	4	0	9	3	1	0	0	1	3	0	3	14	20	3	0	0	0	11	3	0	5	6	9	2	2	0	47	38	17
8	Total	100	115	44	154	94	47	35	87	52	88	78	40	27	33	12	22	23	8	36	21	12	13	16	26	19	15	5	494	482	246
9	Population	355	366	366	321	320	320	351	363	366	217	217	220	138	138	138	103	108	108	72	72	72	8	25	38	52	52	52	1617	1661	1677
10	FRPCPY	28.2%	31%	24%	47.98	29.38	29.38	9.97	23.97	28.42	41%	36%	36%	19.57	23.91	17.39	21.36	21.30	14.81	50.00	29.17	33.33	162.50	64.00	148.57	36.54	28.85	19.23	30.55	29.02	29.34

Annexure-2

Power Converter (SR)

SN	Name of PCB	Type of PCB	Slot Name	2014-15	2015-16	2016-17 (Apr-Sept)
1	Signal conditioning board-SLG	UAB630A36	A slot	7	5	9
2	Signal conditioning board-NSC	UAB630A91	B slot	6	10	4
3	Signal conditioning board-ASC	UAB630A93	C slot	23	7	5
4	Signal routine board	ARB705B01	D slot	2	1	0
5	AS peripheral board	XVA987C22	H slot	15	5	2
6	NS peripheral board	XVA986B22	L slot	13	9	3
7	NS Controller/AS Controller	PPA988B02	MN/IJ slot	84	146	50
10	GTO optical pulse card	AFB635B08	12/34 slot	10	17	3
11	Single board computer	PPB622B01	U slot	58	21	7
9	Single bus coupler	UFB701A01	R slot	1	2	0
8	Analog I/O board	UAB514B33	S slot	21	13	5
12	Digital I/O board computer	URB177D15	W slot	26	25	11
13	Power Supply	KUA915B01	XYZ slot	9	16	10
14	Gate Unit	GVA 587		260	185	67
15	GUSP	KYA 924		30	25	17
16	Rack			6	6	1
17	Unknown			14	5	1
18	**Total**			**585**	**498**	**195**
19	**Population**			**1043**	**1106**	**1142**
20	**FRPCPY(EQPT)**			**56.09**	**45.03**	**34.15**

AUXILIARY CONVERTER (BUR)

SN	Name of PCB	Type of PCB	Slot Name	2014-15	2015-16	2016-17 (Apr-Sept)
1	Signal Bus Coupler	UFB 701A01	B slot	0	1	1
2	Controller board	PPB471A02	CD slot	51	42	16
3	Chopper Controller/GG/WRE Controller	RDB472A01	F slot	19	15	10
4	Inver Controller/Aux. Interface	UAB476A01	G slot	12	6	16
5	Power Supply	KUC153A01	Back plane	147	164	71
6	Rack			7	15	8
7	Unknown			1	0	2
8	**Total**			**237**	**243**	**124**
9	**Population**			**1617**	**1661**	**1687**
10	**FRPCPY**			**14.66**	**14.63**	**14.70**

Control Electronics (VCU)

SN	Name of PCB	Type of PCB	Slot Name	2014-15	2015-16	2016-17 (Apr-Sept)
1	Power Supply	KUB921A01	AB/CD slot	21	21	6
2	Diagnostic computer	PPB624A01	U slot	12	11	15
3	Signal routine board	ARB705B01	E slot	2	3	2
4	Single board computer	PPB622B01	G/N/S slot	59	75	52
5	Analog I/O board	UAB514B33	F slot	3	2	5
6	Display computer (DDA)	PPB908A01	HI slot	18	31	6
7	Digital I/O board	URB512D15	J/L/O/Q slot	42	69	34
8	Bus administrator	PPB626B01	T slot	8	8	13
9	Multiple redundant bus coupler	UFB660A01	W slot	31	42	24
10	Train bus administrator	PPA425B01	YZ slot	15	18	6
11	Rack		Rack	4	7	3
12	Unknown			1	12	4
13	**Total**			**216**	**299**	**170**
14	**Population**			**1194**	**1419**	**1621**
15	**FRPCPY**			**18.09**	**21.07**	**20.97**

Annexure-3

Warranty obligations with different makes

SN	Shed	Equipment under warranty obligation					
		ABB	BHEL	BTIL	CGL	Medha	**Total**
1.	ELS/RPM	Nil	13	25	16	Nil	**54**
2.	ELS/BRC	Nil	19	13	19	Nil	**51**
3.	ELS/LGD	Nil	7	15	15	Nil	**37**
4.	ELS/WAT	9	23	Nil	Nil	Nil	**32**
5.	ELS/AQ	Nil	4	Nil	2	Nil	**6**
6.	ELS/HWH	Nil	37	8	7	Nil	**52**
7.	ELS/GZB	2	1	6	Nil	Nil	**9**
8.	**Total**	**11**	**104**	**67**	**59**	**Nil**	**241**