सत्यमेव जयते

Government of India
Ministry of Railways

Technical Investigation Report of Axle seizure due to Bearing failure of Traction Motor type 6FRA6068 fitted in Locomotive No. 30549/WAP-7/SRC on 24.04.2019 between Bhusawal –Badnera section on Bhusawal division.

No. RDSO/2019/EL/IR/0186 Rev. '0'

June-2019

Approved by	Signature
PEDSE	10.6.19

ELECTRICAL DIRECTORATE
RESEARCH DESIGNS & STANDARDS ORGANIZATION
MANAK NAGAR, LUCKNOW-226011

Prepared by	Checked by	Issued by

Status of Revision

SN	Date of Revision	Page No.	Revision	Reason for Revision
1.	10.06.2019	All	0	First Issue

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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS
(रेलवे बोर्ड RAILWAY BOARD)

No. 2002/Elect(TRS)/440/18/9 Pt. New Delhi, dated : 24.04.2019

General Manager (Elect)
Chittaranjan Locomotive Works, Chittaranjan
Central Railway, Mumbai
South Eastern Railway, Kolkata

Director General (Elect)
RDSO, Lucknow

Sub : Axle seizure in loco no. 30549/WAP-7 of ELS/SRC

Loco no. 30549/WAP7, SRC while working train no. 12661 on 24.04.19 failed at Takli station ('C' class) between Bhusawal – Badnera section on Bhusawal division of CR due to seizure of axle no. 5. Though assisting engine was arranged, block section remained blocked for more than four hours.

It is therefore, advised that a committee comprising of DSE/TM/RDSO (convener), Dy.CEE/TM/CLW, Sr.DEE/TRS/SRC & Sr.DEE/TRS/AQ should investigate the case and submit report through PED/SE/RDSO fixing responsibility and preventive measures to avoid such recurrence.

The committee shall be advised to submit Report by 30.04.2019.

(A.K. Goswami)
Dir. Elect. Engg. (RS)
Railway Board
e-mail: dir.rsrb@gmail.com

Copy for information and necessary action to:

(i) Sr.DEE/TRS, ELS/AQ, Central Railway
(ii) Sr.DEE/TRS, ELS/SRC, South Eastern Railway

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS
(रेलवे बोर्ड RAILWAY BOARD)

No. 2002/Elect(TRS)/440/18/9 Pt. New Delhi, dated : 26.04.2019

Director General (Elect)
RDSO,
Manak Nagar,
LUCKNOW

Sub : Axle seizure in loco no. 30549/WAP-7 of ELS/SRC

Loco no. 30549/WAP7, SRC while working train no. 12661 on 24.04.19 failed at Takli station ('C' class) between Bhusawal – Badnera section on Bhusawal division of CR due to seizure of axle no. 5. Assisting engine was arranged from rear for clearing the block section. However, block section remained blocked for more than four hours.

Preliminary investigation revealed that Traction Bogie-2 and concerned traction motor were isolated initially on account of earth fault and temperature greater than limit but the same were recovered (cut-in back in service) automatically without any intervention of Loco Pilot resulting in extensive damage to Traction Motor and further led to fire. It indicates malfunctioning of software logic/ protection system of propulsion equipment. Copy of Diagnostic data is enclosed. It is an issue of serious concern related with safety.

It is, therefore, advised that case be investigated thoroughly involving CLW & propulsion equipment manufacturer and concerned officers of RDSO & CLW should be directed to attend Railway Board along with detailed investigation report at the earliest.

(A.K. Goswami)
Dir. Elect. Engg. (RS)
Railway Board
e-mail: dir.rsrb@gmail.com

Copy to:
PCEE/CLW/CRJ : For information and necessary action please.

Investigation Report of Loco No. 30549 WAP-7, SRC failed due to wheel set-5 locked on 23/24.04.2019

1) Rly. Board vide letter no 2002/ Elect (TRS)/ 440/18/9Pt dated 24.04.2019 had nominated following officers for investigation of the incidence-
   Shri P. K. Saraswat (DSE/TM/RDSO) – Convener
   Shri S. P. Patra (Dy.CEE/TMM/CLW) – Member
   Shri Jeet Ram (Sr.DEE/TRS/ELS/SRC) – Member
   Shri S. C. Chaudhari (Sr.DEE/TRS/ELS/AQ) – Member

2) **Brief history of the incidence** :- Loco No. 30549 WAP-7 SRC while working Train No. 12261 Mumbai Howrah Duronto Express failed in Bhusawal-Badnera section of BSL division. Train departed from BSL at 23:39 on 23.04.2019 and at 00:59 Hrs on 24.04.2019, after passing Jalamb (JM) station Loco Pilot observed message F0301P2, F0301P1 and Bogie-2 isolated without any MCB tripping. Further between Kurum (KUM) and Takli (TKL) station, Loco pilot noticed smoke from under truck and he stopped train at Takli station at 02:12 Hrs. The fire extinguishers were used. After that wheel set-5 found locked. Assisting engine was given from rear side & train arrived at Badnera station in pushing mode & loco was detached there.

   The section was blocked from 02:11 Hrs till 07:00 Hrs i.e. for 04'49".

   Loco was attended at Badnera & pinion of TM-5 was cut. Loco arrived in dead condition with speed restriction of 50 kmph from Badnera to ELS/AQ. The joint report of SSE/TRS/ELS/AQ & CLI/BD is enclosed as **Annexure-I** (02 pages).

   Gear case of TM-5 was found intact & spy glass was found in the gear case. As per the SSE/TRS/ELS/AQ, who attended loco at Badnera, spy glass was not in its position and loco movement from Badnera to ELS/AQ was done by applying M-seal and RTV. Loco was jointly checked at Badnera at 10:00 Hrs on 24.04.2019 by CLI/Badnera and SSE/TRS/Ajni

3) **Train and Loco particulars**

1)	Train No.	:	12261 Mumbai Howrah Duronto Express
2)	Load	:	17 Bogies

3)	Loco No.	:	30549 WAP-7 SRC (Medha propulsion)
4)	Loco Comm. Date	:	06.08.2017 (Commissioned at ELS/TATA)
5)	ELS SRC Comm.	:	02.12.2017
6)	IC schedule	:	28.02.2019
7)	Last visit to ELS/SRC	:	05.04.2019
8)	TI	:	20.04.2019 at Pune (PA)
9)	Name of Loco Pilot	:	K W Naidu/NGP
10)	Name of ALP	:	A K Pandit/NGP

4) Observations made at ELS/AQ :-

4.1) TM-5 which was without pinion, was dismantled. Motor was found in seized condition. The traces of use of fire extinguisher on TM-5 noticed, power cables & TM temperature sensor cables found damaged due to burning. Driving side end shield was removed & thereafter bearing. Bearing was found seized but not to that extent which is generally noticed in case of bearing seizure. Bearing cage & rollers were found intact. Driving side overhang portion insulation damaged & coil conductors came out in broken condition.

4.2) NDE end shield bolts were opened but end shield was not coming out. NDE side bearing was also found in seized condition & its rollers were dislocated. Rollers had jammed with inner racer & outer racer due to which end shield can't be taken out even after removal of end shield bolts. Rollers were taken out one by one by gas cutter & end shield removed thereafter. Inner racer was also removed by gas cutter. The NDE bearing was in much more damaged condition compared to DE bearing. NDE side stator overhang portion insulation found burnt & damaged. The rotor could not be taken out from the stator & rotor is physically locked & entangled with stator. The photographs of damaged TM parts are attached at **Annexure-II** (05 pages).

4.3) As per record of ELS/SRC TM-5 of CLW make is already identified for gear case oil ingress & shed has written to CLW on 15.11.2018 regarding the issue. As per ELS/SRC last greasing details are as below-

Date	DE side	NDE side
28.02.2019 (IC schedule)	1091 gm	285 gm
05.04.2019 (Unschedule for oil ingress)	Till grease came out from outlet	--

4.4) During IC schedule on 28.02.2019, grease metal content was checked & no metal content found.
Documents submitted by ELS/SRC are attached as **Annexure-III** (10 pages).

4.5) Measurements were carried out jointly by supervisors of CLW, RDSO, ELS/AQ & ELS/SRC and joint report is attached as **Annexure-IV**(05 pages). From the measurements it is observed that diameter of NDE side end shield bearing seating area is 214.914/ 214.920/ 214.951mm which is less than the prescribed limit of 214.948 to 214.960mm.

4.6) ELS/AQ had given suggestion for issues related to oil ingress & mating component dimensions of traction motor type 6FRA6068, attached at **Annexure-V** (02 pages).

4.7) CLW had confirmed that physical measurement of dimensions of mating components is being measured from Feb'2018 onwards. However radial clearance & axial clearances are being measured from the beginning & for this TM-5 radial clearance & axial clearances are within the limit, as per records at **Annexure VI** (01 page).

4.8) The major events logged in & their meaning are as below :-

i. At 00:48:03 Hrs :- Earth fault in BG-2 is logged.
ii. At 00:49:50 Hrs :- BG-2 isolated.
iii. Between 00:54:19 till 00:56:29 Hrs :-There are faults logged of TM-5 temperature more than limit-1 & more than limit-2 & TM-5 temperature sensor-2 faulty.
iv. At 01:00:10 Hrs :- BG-2 is recovered even though TM-5 temperature logged is 282°C.
v. At 01:00:11 Hrs :- There is earth fault in BG-2 again.
vi. At 01:00:17 Hrs :- Over current drawn by TM-5 (more than 800Amp) & hence firing to motor converter-5 stopped. Again same thing repeated twice at 01:03:11 Hrs & 01:04:51 Hrs & finally TM-5 isolated at 01:04:51 Hrs.
vii. Loco &Train continued to work in same condition till approximately 02:12:00 Hrs.

4.9) The analysis of fault data logged submitted by M/s Medha is enclosed herewith as **Annexure-VII** (04 pages).

5) Deliberations on the observations for probable causes of incidences :-

i. There is earth fault in the TM-5 as per fault data logged. This earth fault cannot be considered as cause of bearing seizure rather in our opinion earth fault is caused by bearing seizure of TM-5 due to misalignment and rubbing of rotor with stator after bearing seizure.

ii. The heavy electrical damage to windings is most probably due to TM-5 coming into service in earth fault & heavy transient current in TM-5 as evident from fault message of "WBOT V_{CE}Sat Fault".

iii. Seizure of DE bearing :- The driving end bearing is found in seized condition, however its rollers & cage were intact. The problem of oil ingress was reported in this traction motor. However the DE bearing seizure can't be attributed to starvation of grease as last greasing was done on 05.04.2019. From the observations, it appears that DE bearing seizure is after effect of NDE bearing seizure as damage of NDE bearing is much more than DE bearing.

iv. Seizure of NDE bearing :- NDE bearing also found in seized condition, its rollers were dislocated & cage had broken. From the observation it appears that NDE bearing seizure is root cause of the incidence. From the measurements carried out, it is evident that diameter of NDE bearing main seating area found 214.914/ 214.920/ 214.951mm at different locations compared to prescribed diameter of 214.948 to 214.960mm. The less diameter of end shield will result into higher interference than prescribed. It is suspected that high interference of NDE bearing is probable cause of seizure of NDE bearing. CLW had started measurements of mating components from February'2018 & this traction motor was manufactured in January'2017.

6) There are cases of bearing seizure and cases of NDE side bearing seizure are less. However in either case damage to stator & rotor is not to the extent observed in this case. Locomotive is having Medha propulsion & two deviations with other propulsion system noticed in this case are-

i. In case of isolation of traction converter due to earth fault same is put into service automatically without any positive action manually.

ii. It appears that, even if TM temperature is more than 230°C, TM is taken into service.

7) **Conclusion** :- From all the above observations most probable cause of incidence is NDE bearing seizure due to less diameter of end shield which resulted into higher interference than prescribed. The extent of damage to the traction motor is more due to deviations in logic of Medha propulsion system.

8) **Responsibility** :- As admitted by CLW, Traction motor assembly was done without measuring the dimensions of mating components, which resulted in failure. Hence CLW is responsible.

9) **Preventive measures to avoid recurrence:-**

i. Proper measurement of mating components must be carried out during traction motor assembly. CLW informed that they had started measurements from Feb'2018.
ii. It is suggested to revert back to original dimensions of labyrinths to eliminate the problem of oil ingress in traction motor.
iii. Review of deviations in logic of Medha propulsion.

26.4.19
P. K. Saraswat
DSE/TM/RDSO
Convener

26/4/19
Jeet Ram
Sr.DEE/TRS/ELS/SRC
Member

26/4/19
S. C. Chaudhari
Sr.DEE/TRS/ELS/AQ
Member

26/4/19
S. P. Patra
Dy.CEE/TMM/CLW
Member

Prepared by	Checked by	Issued by

ANNEXURE-I

JOINT REPORT

Subject: Failure report of Loco No. 30549(SRC), working train no. 12261 on dated 23/24.4.19.

Brief History: Loco No 30549/WAP7/SER working with T. No. 12261, BSL dep 23.39 on 23.04.19. At 00:59 after passing JM LP get message F0301P2, F0301P1 and Bogie 2 isolated and no MCB tripped. Between KUM andTKI LP noticed having smoke and fire form undertruck so he stopped his train at TKI at 02.12hrs..

Train Particular:
T. No. 12261
Load: 17 bogies
Schedule: IC Done 28.02.19
TI done 20.04.19 at PA
QI done on 22.04.19 at SRC
Name of LP: Shri K.W.Naidu/NGP
Name of Co LP: Shri A.K.Pandit/NGP

Observation: Loco was checked at BD DN Yd. at 10:00 hrs. Found*

1. The fire extinguisher was used on TM 5
2. Burring small is coming from TM5
3. Speed sensor earth shunt cable was found burned
4. MCB 62.1/2 (Pump transformer), 53.1/2(motor blower), 59.1/2(vent oil cooler) was triped and switch no. 154 on 1.
5. On checking DDS found following messages:

Fault No.	Message	Time		Code
F0309P2	TC5 TOW PHASE CURRENT SEMSOR FAULT	02:09:32		4245
F0309P2	TC5 TM5 SPEED SENSOR CONNECTION OPEN	02:07:04	02:07:11	4165
F0301P2	TC5 TM5 SPEED SENSOR CONNECTION OPEN	02:01:04	02:06:54	4165
F0309P2	MCC ISOLATIN OF PROCESSOR TC5	01:04:51	10:08:00	30745
F0309P2	TC5 PWMBCESAT DETECTION FAULT	01:04:51	10:08:00	4240
F0309P2	TC5 PWMBCESAT DETECTION FAULT	01:03:11	10:08:00	4240
F0309P2	TC5 PWMBCESAT DETECTION FAULT	01:00:17	10:08:00	4240
NO DISP	TC5 STARTOR TEMP SENSOR 2 FAULTY	00:56:24	10:08:00	4100
F0307P1	MCC BOGIE 2 MOTOR 2 TEMP > LIMIT 2	00:56:03	00:56:25	18645
F0305P2	MCC BOGIE 2 MOTOR E TEMP > LIMIT 1	00:55:40	00:56:25	18645
NO DISP	TC5 STARTOR TMEP SENSOR FAULTY	00:55:14	10:08:00	4093
F0307P1	MCC BOGIE 2 MOTOR 2 TEMP > LIMIT 2	00:54:15	00:55:15	18631
F0305P2	MCC BOGIE 2 MOTOR 2 TEMP > LIMIT 1	00:54:26	00:55:15	18645
F0304P2	TC5 TM TEMP SENSOR FAULTY	00:54:19	10:08:00	4101
	MCC ISOLATION BOGIE 2	00:49:15	01:00:00	30722
F0301P1	LIC 3 EARTH FAULT LEVEL1 AT T/F OR TM SIDE	00:48:42	01:00:01	10428
F0309P2	TC5 CURRENT CROSSED MAX LIMIT	00:48:42	00:48:47	4242
NO DISP	LIC4 EARTHFAULT LEVEL 2 BCL POSITIVE SIDE	00:48:41	00:48:43	13312
F0309P2	TC5 CURRENT CROSSED MAX LIMIT	00:48:33	00:48:38	4242
NO DISP	LIC4 EARTH FAULT LEVE 2 DCL POSITIVE SIDE	00:48:07	00:48:14	13312
F0301P1	LIC 3 EARTH FAULT LIVEL 1 AT T/F OR TM SIDE	00:48:03	00:48:04	10428
F0301P1	LIC4 EARTH FAULT LEVEL 1 AT T/F OR TM SIDE	00:48:03	00:4804	12476

Other observationsare

1. Both side TM5 bearing (DE and NDE end) seized
2. Speed sensor earthing shunt cable burned
3. Gare case oil burned form the heating of bearing seized

4. Deflector dislocated. Deflector come out, DE side pinion labyrinth come out and MSU both bearing checked found normal but it was found dry.
5. TM 5 below burned.
6. Skid mark is found on the wheel no. 9 and 10 app. 30mm. Speed is allowed 50 kmph with shed staff. Speed may be reduce or increases as per the shed staff.

Restoration: Loco arrived at BD Yd. 07:00hrs.. AQ Loco Shed Brake down staff arrival at spot at 11:45hrs. work starts at11.55 hrs. Gare case drop at 13:10hrs. Pinion drop at 14:45 and Gare case fit at 16:15.

Conclusion: We the under signed Sr. Supervisor concluded that the incidence took place due to TM5 bearing seized due to bearing problem, causing heat generation and burn the Gare case oil and causes fire in TM5.

Reasonability:SRC locoshed.

(Prashant Pali)
CLI/BD

(Shrinarayan Choudhary)
SSE/TRS (bogie)/AQ

ANNEXURE - II

Fig 1 : DE side winding badly melted on overhang filling stator and rotor gap

Fig No. 2&3 :Molten copper stuck on coils of winding on DE overhang

Fig. No. 4 : Badly overheated temperature sensor assembly

Fig. No. 5 : Molten copper and ash on NDE overhang

Fig. No. 6 : DE Bearing with inner racer stuck inside

Fig. No. 7 : Broken front ring of NDE bearing brass cage and NDE grease cover

Fig. No. 8 : Badly overheated TM junction box

Fig. No. 9 : DE end of TM before dismantle

Fig. No. 10 : NDE side of TM before dismantle

Fig. No. 11 : NDE bearing after dismantle

Annexure - III

विद्युत लोको शेड/सातंरागाछी/द.पू.रेलवे

ELECTRIC LOCO SHED / SANTRAGACHHI / S.E.Rly.

व.मं.वि.इंजी./क.प.स्टॉ./सांतरागाछी का कार्यालय, Office of the Sr. DEE/TRS/Santragachhi

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सं.No. TRS/SRC/713/3-Ph. TM/2338

दिनांक Date- November 15, 2018

Chief Electrical Engineer (TMM)
Chittaranjan Locomotive Works (CLW)
Chittaranjan
Pin- 713331

विषय Sub.: Premature failure of 3-phase TM in ELS/SRC's locomotives

At present 3-phase loco (WAP7) holding of ELS/SRC is 19. Premature failure of Traction Motors for ingress of Gear Case oil has occurred in different locomotives.

Detail is mentioned below:

Sl. No.	TM No. & Make	Loco No. & TM position	Comm. Date	Nature of failure	Remarks
1	7387 (CLW)	30584/3	15.11.2017	Oil ingress	Loco in service with oil insert in TM. This may lead to failure any time
2	7375 (CLW)	30584/4	15.11.2017		
3	7118 (CLW)	30564/3	05.08.2017	Oil ingress	
4	6985 (CLW)	30564/6	05.08.2017		
5	6728 (CLW)	30549/5	06.08.2017	Oil ingress	
6	6528 (CLW)	30549/6	06.08.2017		
7	8008 (CLW)	30633/2	02.01.2018	Oil ingress	Modification done on 24.07.2018 as per RDSO's modification no. MS/439 Dtd. 23.11.2016 Again oil ingress in TMs after modification
8	7947 (CLW)	30633/3	02.01.2018		
9	7999 (CLW)	30633/4	02.01.2018		

Hence, 09 Traction Motors have developed oil ingress but are **still in service due to non availability of spare TM.**

This is for your kind information and necessary action please.

15/11/18

Sr.DEE/TRS/SRC

प्रतिलिपि Copy to CELE/SER for kind information please.

30549

ANNEXURE - III

25/8/18 (TA).

1) A-B Grease (1-12) — OK.

2) TM Grease (1-6) for both PE/CE — NIL / NIL

3) But all PE Side (1-6) grease sample are dirty & Sand Contaminated.

3) MSU Grease (1-6) NDE Side — NIL

9/11/18 (NC)

1) TM 5, 6 DE Side (both Sides) — NIL.

25/11/18 (TA)

TM Grease (1-6) — OK.

09/12/18 (NC)

1) T/M No. 5 — DE Side — OK } NDE Side not given

2) T/M No 6 — DE Side — OK } NDE Side not given

29/02/19

1) TM 5 & 6 — DE Side — OK/OK. } NDE Side not given

28/2/19

1. Axle box grease from ① to ⑫ → OK
   A.B-2 → 20mg
2. TM grease from ① to ⑥ CE/PE = Metal content = NIL/NIL
3. MSU grease from ① to 6 → " → NIL OK (5mg)

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(4)

LOCO No. 30549

Srl no	Axle Testing	Testing technique		Observation	Remarks	M/c NO	Sig
		FE	NELA				
1.	TPP - 59 - 52	FE	NELA	No indication of any flaw.	OK	Einstein -IIR	Ke.
2.	TPP - 45 - 49	"	"				
3.	TPP - 12 - 49	"	"				
.	TPP - 02 - 52	"	"				
.	TPP - 26 - 49	"	"				
	TPP - 41 - 49	"	"				
1.	TPP 59 52	FE	NELA	no indication of flaw	OK.	Einstein ER	
2.	TPP 45 49	,	,				
3	TPP 12 49	,	,				
4.	TPP 02 52	,	,				
5.	TPP 26 49	,	,				
6.	TPP 41 49	,	,				
1.	TPP 59 52	FE	NELA	no indication of flaw.	OK.	Einstein ER	
2.	TPP 45 49	,	,				
3.	TPP 12 49	,	,				
4.	TPP 02 52	,	,				
5.	TPP 626 49	,	,				
6.	TPP 4149	,	,				

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30247

29/8/18 (IA).

1) A-B Grease. (1 – 12) — ok.

2) TM Grease. (1 – 6) for both PE/CE — NIL/NIL

But All PE Side (1-6) grease sample are dirty & Sand Contaminated.

3) MSU Grease. (1 – 6) NDE Side — NIL

9/11/18 (NC)

1) TM 5, 6 DE Side (both ...) — NIL.

25/11/18 (IB)

TM Grease (1 – 6) — ok.

29/12/18 (NC)

1) T/M No. 5 — DE Side — ok
2) T/M No 6 — DE Side — ok
} NDE Side are given

29/02/19

1) TM 5 & 6 — DE Side — ok/ok. } NDE Side are given

28/2/19

1. Axle box grease from ① to ⑫ → OK; A.B-2 → 20mg
2. TM grease from ① to ⑥ $\frac{CE}{PE}$ = Metal content = $\frac{NIL}{NIL}$
3. MSU grease from ① to 6 → " → NIL OK (5mg)

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05-04-2019

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1) Sri J.P. NARAYAN – 422
2) " B.S.P. Patra 306
3) " S.K. Ghosh – ~~413~~ 913.
~~4) " S.K. Ghosh~~
4) " R. Dasgupta – 315.
5) " Ranjan Kr. Pal – 446
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Champering/ATH drop – S.K. Maity
Store – D. Ghosh
Record – S. Ranjan
Welding – R.K. Pal.
A/c turning – S.K. Patra ~~R.K. Das~~
Misc – P.K. Das.

(B. Adhikary)
SSE (E/TM)/BIS/SEL

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L/N-272 IC
All TM blowing, top checking, greasing & movement + B/box with size to note. | J.P. Narayan / R.S.P. Patra

L/N-272 IC
Bg1 TM inspection — R. Dasgupta / Anita Singh
Bg2 TM inspection — P.S. Chatterjee / Madhu Samanta

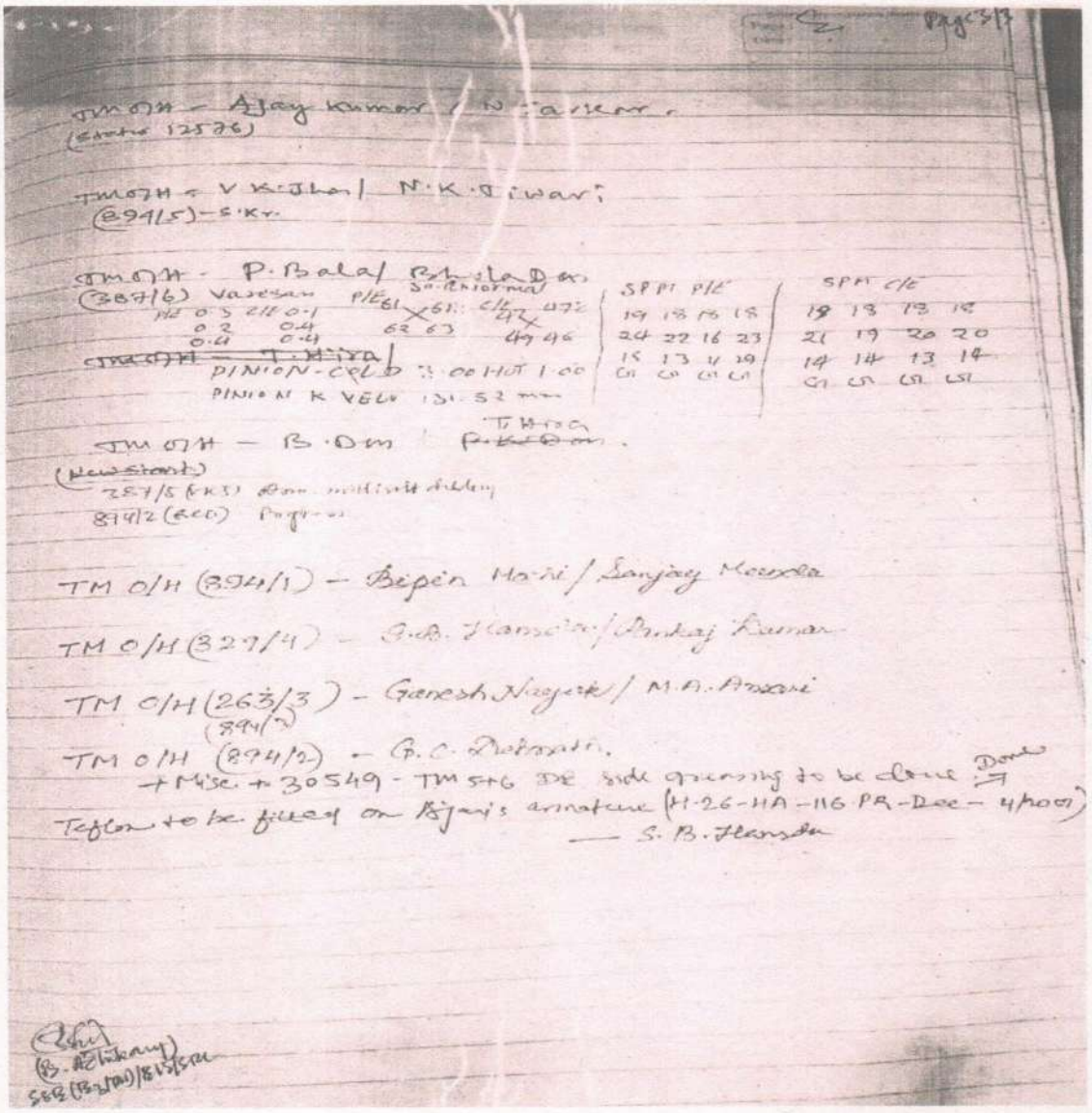
L/N-879 IA
All TM blowing & inspection — S.K. Ghosh / S. Dutta.

~~R.P. Singh~~ / S.K. Das	R.P. Singh / S.K. Patra
① 22501 / NC + 22387 / NC	① 27272 / 2C - CF cover opening, setting for grease sample collection
② 30549 / NC	② 22645 / NC + TMC CB shearing (CB only)
③ 22879 / IA - CE side greasing (140g).	③ 30672 / NC
~~4) ... + 22500 - C/ ... fitted~~	4) ... + 32064 / TM iso (ET) checked.
(1) 22501 Bg NC all TM checked, checked TM 1+2 movement and Pakistani insulation done, TM Insulation changing	5) 30549 - TM 5+6 PE side greasing.
	6) 22645 TM one bottom bolt head broken and abnormal sound from TM5 bellow — to attend.

(2) 22387 NC all TM normal
(3) 879 IA greasing 140 gm done
(4) 30549 — Work not done due to loco is on doc fit.

L/272 CF G/Case open and fit & sample sent to lab.
L/645 N/C done, TS S/B shearing, Pakistani arm some S/B replaced by good S/B
L/30672 + 30549 N/C Done
L/32064 not placed in pit
L/30549, L/22645 TS portion not placed in pit

(B. Adhikary) 16.05.2019
SSE (Bg/TM)



Prepared by	Checked by	Issued by

IC/ICo	CHECK SHEET FOR IA/IB/TRIP SCHEDULE OF WAP-7 LOCO SECTION E3 (TM)	Doc. No.: ELS/SRC/INSP/WAP-7/E3(TM)/IC/ICo dt: 06.12.17 Ref: ELS/VSKP

Page No. 1 of 1

LOCO NO. DATE

Sl. No.	Schedule Activity	Standard	Actual / Action taken
A)	TRACTION MOTOR		
1	Examine all Traction Motors for signs of damage, dents or other defects caused by ballast. Check oil falling on TM and air outlet are not obstructed in any way, replace if any mesh is broken	Abnormality/ No Abnormality	
2	Open TM terminal box and check the tightness of connections. Also check for water ingress in junction box	Abnormality/ No Abnormality	
3	Check the tightness of Allen bolt of NDE & DE end frame	Demand	
4	Check traction power cables, speed sensor and temperature sensor cables are not chaffed or damaged in any way	Abnormality/ No Abnormality	
5	Check the coupler tightness of Temperature and speed sensors	Loose or /Tight	
6	Check the difference in resistance between AB and CD terminal of the temperature sensor	≤ 0.3 ohms	
7	Check for proper tightness of cable with din rail for cable connection and tie up with cable tie for additional protection. Check rubber grommets	Abnormality/ No Abnormality	
8	Ensure the healthy condition and proper connection of all TM earth shunts **(SMI/248)**	Loose/Tight	
9	Open speed sensor units and covers for metal content checking and clean the grease and provide back. Ensure the tightness of bolts of speed ring and clamp plates	Abnormality/ No Abnormality	
10	Send the grease samples for lab testing and ensure metal content is within limits at NDE end i.e. less than 0.25%**(SMI-273)**	<0.25%	
11	Check for grease nipple on NDE & DE end frame	Connected/ Not connected	
12	Note and record the temperature sticker readings**(SMI-278)**	Record	
13	Check the ohmic value of AB & CD of the temperature sensor and E to body value (difference between AB & CD is ≤ 0.4Ω & E to body value is ≤ 0.2Ω)	Abnormal/ Normal	
14	Individual TM inductance values at TM terminals with disconnection of TM cables if difference of inductance between any two phase is ≤ 0.005mH, allow the motor for next schedule (For IGBT based locos) **(as per SMI-262)** Check inductance whenever any three fault messages – (i) PS fault storage CGP, (ii) Motor temperature above limit, (iii) Temperature difference motor bearing > limit.	(see below)	
15	Do greasing of TM after opening grease nipple. Regressing of bearing of TM to carry out every alternative inspection (1^{st} IB, 2^{nd} IA, 2^{nd} IC).	DE-400 grams NDE-150 grams (SMI-307)	
16	Visual checking of holder plate lug and lab testing by DPT	Crack/ No Crack	
17	Checking the grease metal content during schedule, whenever grease available	Checked	

Std	TM 1	TM 2	TM 3	TM 4	TM 5	TM 6
U-V						
V-W						
W-U						

B)	UNDER FRAME & BRAKE RIGGING SCHEDULE		
	TRACTION MOTOR		
i)	Check the condition of bellow and replace, if required.	Checked	
ii)	Check the condition of bellow frame tightness	Checked	
C)	TM JUNCTION BOX & BATTERY BOX SCHEDULE		
	TRACTION MOTOR		
I.	Open TM junction box at body side and check the tightness of connections.	Tightened	
(D)	Check DE side any oil ingress. If found greasing to be done in DE side only after set cleaning to be done	Oil ingress/ Normal.	

Name Of Staff	Signature Of Staff	Name & Signature Of Supervisor With Remarks If Any

– W.e.f. 22.9.19

Prepared by	Checked by	Issued by
[signature]	[signature]	[signature]

J. P. NARAYAN
S. Ku. DAS

L/30549 K.

28-02-2019

1> No Abnormality
2> Checked Torck wrench with (40 Nm)
3> Checked
4> Checked
5> Checked
6> Not checked for Instruction
7> Checked
8> ensured
9> TM 1+2+3 No Grease found
10> Sent to LAB. Kept Record.
11> TM 1 PE & TM 2 Both End Grease nipple & TM 3 not difecant
12> TM 1 2 3 steker difecant TM 2 PE file 72°C
13> Not Checked
14> Not checked ass per Instruction.
15> TM 1+2+3 DE & NDE full. Greasing done

TM 1 NDE	318 gm	DE	1023 gm
TM 2 NDE	295 gm	DE	1149 gm
TM 3 NDE	39 gm	DE	1088 gm.

16> DPT Done by Lab.
17> No Grease found
B> I → Checked
II → Checked
C> Checked.

Grease Report

TM grease for TM (1)–(3)
for BUG BF/CF = OK/OK

[signature] [signature: Narayan]

Prepared by	Checked by	Issued by
[signature]	[signature]	[signature]

Dt. 28.02.2019

430549
(IC)

S. K. Ghosh,
S. Dutta.

1. No abnormality.
2. Checked.
3. Checked.
4. Checked
5. Checked
6. Checked
7. Checked
8. Checked.
9. TM4+5+6 no grease found
10. Grease sample sent to LAB.
11. Checked the grease nipple, ~~TM4 to RS & CE side deficient.~~ TM4 to 6 no grease nipple found
12. TM4+5 retainer deficient. TM6. ... 71. ...
13. Not checked.
14. Not checked.
15. Greasing done on both side ~~PE~~ DE - 1191 TM4; NDE - 308 TM4; DE - 1091 TM5; NDE - 285 TM5; NDE - 318 TM6; DE - 1195 TM6
16. DPT done by LAB.
17. NO Grease found
   b) I → No grease found (check)
   → Checked.
   c) Checked.

(signature)

(signature)

Prepared by	Checked by	Issued by
(signature)	(signature)	(signature)

(97)

30540

loco comm: 6.8.17

17.02.18 => Loco commissioning done. And also IB inspection done.
21.04.18 => NC done, All TMs breather cleaning done. GREASING
21.05.18 => IC 1st done. Greasing not done (Grease Not Available). 1. 07.02.18/IB
23.5.18 => Additional greasing done. Both PE & CE side full greasing. (2) 23.5.18 (IC)
21.6.18 => TM6 PE side full greasing done on G/C oil inserting into the TM (At. PP – attended by P.S.Chatterjee). 2. TM-5+6 PE greasing done full.

17.06.18 => NC Done.
11.06.18 => NC, Done, All TM Cleaning done.

26.07.18 => NC Done, checking visually
13.07.18 => NC done checking visually.
29.08.18 => BA-2 done.

30.08.18 => TM3 – Temp Sensor changed
29.11.18 → BA done
21/1/19 – TM3 temp. sensor faulty – checked – ok
28/02/19 → IC done
15/4/19 => N/C done

TM5+6 Greasing done.
TM5+6 greasing done on 13.07.18.
29.08.18 – BA-2 full greasing done.
28.02.19 IC full greasing done –
22.??.19 TM 5+6 greasing & oil greasing during lifting.
05.4.19 NC TM5+6 greasing done.

(signature)
(B. Adhikary)
SSE(BS/TM)/BSL/SRE

Prepared by	Checked by	Issued by
(signature)	(signature)	(signature)

ANNEXURE IV

OBSERVATIONS OF TRACTION MOTOR-5 sr. No. TMTG 6728 OF LOCO NO. 30549 OF ELS/SRC

Traction Motor Sr. No. TMTG-6728 CLW make Mfg Feb-2017 commissioned on 06.08.2017 at ELS/ TATA in Loco No. 30549. Loco transferred to ELS/SRC on 02.12.2017.

DE bearing make: FAG 17 roller design, Sr. No. 2409816-032 NDE bearing make: FAG

DE end shield : KMRI make Sr. No. 417-01-17

NDE end shield : KMRI make Sr. No. 417-01-17

Type of Rotor : Scheme-I (Sr. no. CLW-RTG Z843, CLW E 289, GIU401)

Common observations for DE and NDE side :-

1) Both DE and NDE bearings found seized.
2) No grease found inside DE as well as NDE bearing since burnt.
3) DE & NDE side winding badly melted at overhang portion and molten copper deposited on the bottom portion of overhang along with fire extinguisher powder and ash. Copper coils of winding were visible due to burning of insulation.
4) Molten metal found stick to copper coils on DE as well as NDE overhang.
5) Induction brazing material of rotor bars with end ring found melted on both ends.

Molten metal on DE overhang

Molten metal on NDE overhang

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Observations on DE Side

1) Driving end outer labyrinth shifted out. Overheated signs observed in outer labyrinth.

2) DE outer labyrinth found rubbed with DE outer grease cover. All the rollers of DE bearing were intact in place. No damages noticed on DE brass cage. No crack on DE Outer racer and found intact.

3) DE inner racer found loose on shaft due to increased inner diameter of inner racer. DE Inner racer and inner labyrinth badly rotated on shaft. Hence dimensions of shaft as well as inner diameter of inner racer could not be measured.

4) DE side end shield came out easily along with complete bearing and inner racer during dismantling of motor. DE Inner racer trapped inside the bearing due to deep grooves on raceway & hence could not be removed out from bearing

5) Stator IR found zero MΩ.

6) Tried to remove rotor from stator but could not be removed out due to burnt material and molten metal trapped between stator and rotor.

7) RDSO MS 439 Rev. 0 found implemented on outer labyrinth to drain out ingressed oil.

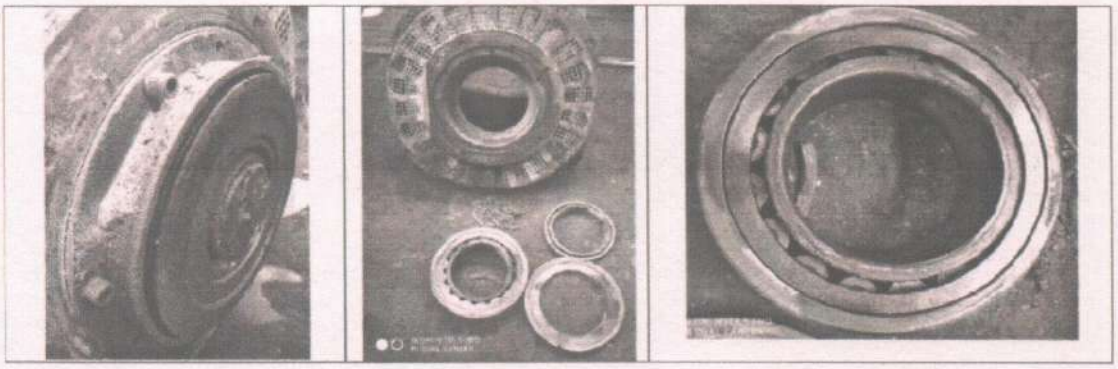
8) Dimensions of DE end shield & outer racer were jointly measured by representative of ELS/AQ, CLW, RDSO, ELS/SRC & M/s Schaffler and are as below-

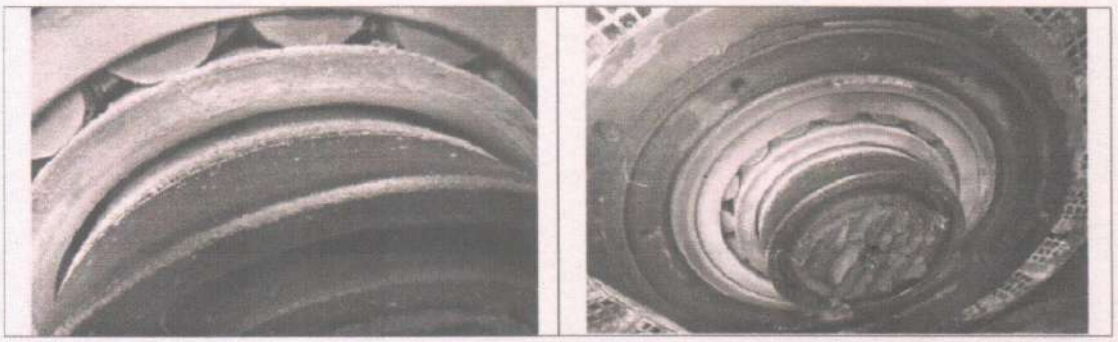
SN	Description	Standard dimension as per MS 0415 (in mm)	Measured dimension on 26.04.2019 (in mm)
1	DE end shield ID at bearing seat	319.950 to 319.990	319.851/319.902/319.998
2	DE bearing outer racer OD	319.960 to 320.00	319.028 & 318.969
3	Shaft OD for DE inner racer seat	180.043 to 180.068	Could not be measured

Since outer racer of DE bearing found rotated inside DE end shield distorting dimensions of both OD and ID.

Shaft OD could not be measured due to scoring caused by rotation of inner racer and inner labyrinth.

26.04.19 26/4/19. 26/4/19 26/4/19





NDE side:

1) NDE end frame has overheating signs on its complete periphery.
2) NDE side 3 Nos. lock plate bolts found intact (size M16 X 45) with proper tightness . Same removed for dismantling the rotor. (One no. bolt broken during dismantling)
3) Tried to remove NDE end shield along with rotor from NDE side but could not be removed out since burnt material and molten metal trapped between stator and rotor and NDE side bearing stuck up with inner racer on shaft and labyrinth.
4) NDE grease cover removed out. Angle ring (Annular ring) found badly rubbed with rollers.
5) NDE Brass cage all rivets found broken & front ring came out, rollers de-shaped and accumulated at one place.

26.04.19 26/04/19 26/4/19 26/4/19

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6) NDE inner racer has groove on race way. Both labyrinths (shaft & end shield) rubbed and locked with each other hence NDE end shield & bearing could not removed out from shaft.

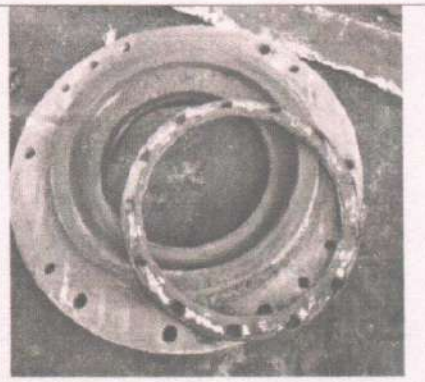
7) For removing NDE end shield, bearing cut by gas to remove all rollers. Then inner labyrinth cut by gas and removed the end shield.

8) NDE inner racer and its labyrinth on shaft were cut by gas into two pieces and removed out. Hence dimensions could not be measured.

9) Dimensions of NDE end shield & outer racer were jointly measured by ELS/AQ, ELS/SRC, CLW, RDSO & M/s Schaffler and are as below-

SN	Description	Standard dimension as per MS 0415 (in mm)	Measured dimension on 26.04.2019 (in mm)
1	NDE end shield ID at bearing seat	214.948 to 214.960	214.914 /214.920 / 214.951
2	NDE bearing outer racer OD	214.970 to 215.000	214.185 & 214.047
3	Shaft OD for NDE inner racer seat	100.023 to 100.045	99.920 /99.980

NDE end shield bore for outer racer seat found undersize despite rotation of outer racer. OD of outer racer drastically reduced due to wearing of ceramic coating due to its rotation. Considering the standard OD of NDE outer racer (214.990 mm), the interference seems to be in the order of 49 to 76 micron.



Other observations :-

1) Temperature sensor Florican make, values checked and found AB-109 Ω and CD-154.4 ohms. Lead insulation of both elements completely melted. Silicon rubber gasket burnt to ash. Element and fixing bolts badly overheated.
2) Speed sensor badly rubbed with PG ring & damaged. (Speed sensor make Medha)
3) Terminal box of traction motor found badly overheated & green coloured RTV found melted & spread inside the junction box.
4) Some portion of speed & temperature sensor cables, which were touching to stator body found burnt.
5) All the measurements of DE and NDE side will be jointly checked by CLW and KMRI, HWH representatives afterwards as desired by CEE/TM/CLW.

Conclusion : From the above observations it is suspected that the DE bearing seizure is the after effect of NDE bearing failure. Whereas the probable cause of failure is suspected as NDE side bearing seizure due to very high interference between NDE outer racer and end shield bore.

M.R. Ghooi
SSE/ELS/Ajni

26/4/19
Biswanath Biswas
SSE/TM21/CLW/CRJ

26/4/19
Bimal Adhikary
SSE/E3TM/ELS/SRC

26.04.19
Mohd. Azeem
SSE/Elect/RDSO/LKO

26/04/19.
Pulkit Sharma
Dy. Manager M/s Schaffler

Since the failure is in a very advanced stage, it is difficult to ascertain the root cause of failure

26.09.19
(G. C. GHOSH)
SSE/TM20/CLW/CRJ.

26/4/19
(T. Mallik).
CCE/TM21/CLW/CRJ

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ANNEXURE -V

OBSERVATIONS OF ELS AJNI REGARDING THREE PHASE TM 6FRA6068

During the year 2018 and 2019 (upto April) 05 bearing seizures of new locos Ex. CLW were occurred at ELS/Ajni.

Sr. No.	Loco No.	TM Sr. No.	Bearing Comm. Dt.	Bearing Make	Failure Dt.	End shield ID	DE Bearing outer Racer OD
1	32035/5	TMTG-7679	Dec-17	FAGG	19-Feb-18	319.944/950/960 mm	319.416 mm to 319.576 mm
2	32035/3	TMTG-7695	Dec-17	FAGG	01-Mar-18	319.920/930/955 mm	318.440 mm to 318.700 mm
3	30499/6	TMTG-6154	Dec-16	FAGG	14-Sep-18	319.973/975 mm	319.499/695 mm
4	32006/5	TMTG-8384	Mar-18	FAGG	04-Dec-18	319.935/940/955 mm	Not measure as racer crack.
5	32296/4	TMTG-9778	Feb-19	FAGG	17-Feb-19	319.638/649/715 mm	Could not be taken.

In all the above cases DE bearing was seized and axle locked. Bore dia of DE end shield for bearing seat in all the above cases found under size which was the suspected root cause of bearing seizure, due to excessive interference of DE outer racer with end shield bore.

1) ELS/AQ has removed several healthy TM's from new locos Ex. CLW to measure the DE side end shield bore, which was measured in the range of 319.920 to 319.950 mm. This is already informed to CLW.

2) ELS AQ is repeatedly requesting for removing the remark most preferred dimension of 319.950 (For DE) and 214.955 (For NDE). We are of the opinion to modify these dimensions to 319.970 (for DE) and 214.965 (For NDE). These are the mid points of the respective tolerance limit.

3) We are also requesting to replace the Table No. C4 of RDSO Ms 415 Amendment-2 regarding ID of NDE end shield 214.949 to 214.960 mm by the previous table B4 of RDSO MS 415 Amendment-1 which was having dimensions similar to OEM M/s ABB 214.949 to 214.978 mm. With most preferred dimension as 214.965 mm.

4) As per observations of ELS/AQ the cases of gear case oil ingress are regularly observed in new locos Ex. CLW. Many times oil ingress is observed at the moment loco arrives from CLW for commissioning. As per ELS/SRC the same problem is

25-4-19
(M. R. Ghosh)
SSE/TM/ELS/AQ

26/4/19
SSE/TRS/Ajni.

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observed within six months of commissioning. (Letter has been sent to CLW by ELS/SRC on 15.11.2018 copy enclosed).

5) ELS AQ also requested to change the back side inner dia of DE and NDE end shield. (As shown in the photograph) to OEM's dimensions.

Reduce ID from 255.5 mm to 254.5 DE

181 to 180 mm NDE

End Shield	CLW Drg. No.	Existing Dia	OEM's Dia
DE	1TWD.096.005	255.5 mm	254.5 mm
NDE	0TWD.096.003	181.0 mm	180.0 mm

Due to increased existing diameters grease is getting thrown on both DE and NDE windings irrespective of gear case oil ingress. These dimensions has no role in the cases of bearing seizures.

6) To prevent gear case oil ingress inside DE bearing, ELS/AQ is adding approximately 1.5 Kg RR3 grease with 5 litres of gear case oil. This increases the viscosity of gear case oil. (Approximate 1100 CS at room temperature).

7) As per observations of ELS/AQ the wear rate of K value of pinion is improved due to increased viscosity of gear case oil.

8) It was agreed by CLW to shift stator junction box away from NDE side by approximately 30 mm to avoid damages to leather bellow, but it is yet to be implemented.

9) It was also agreed by CLW to develop NDE end shield with bellow plate as its integral part like Hitachi TM. But it is yet to be implemented.

Dated : 26th April 2019.

26.4.19
(M. R. Ghosh)
SSE/TM/ELS/AQ

26/4/19
SSE/TM/RS/Agni.

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Annexure-VI

CHITTARANJAN LOCOMOTIVE WORKS

42

CHITTARANJAN

FORMAT FOR TEST AND INSPECTION OF 3-PHASE MOTOR

DATE OF TEST : 24.01.17

REF. WI NO. W21412
VER. : 01
REGISTER NO. : R-3PHASE
PAGE : 010F01

KM-59

STG. NO.: ~~4584~~ RTG. NO. : Z-843 MOTOR NO. :

A. PHYSICAL INSPECTION FOR ABNORMALLY IN VARIOUS PARTS	OBSERVATION & REMARKS
STG. NO.	KM-59
RTG. NO.	Z-843
ROTOR SHAFT NO.	510 401/E 289
D E BEARING NO.	CLW- X- FAG
N D E BEARING NO.	CLW- XX- FAG
D E FRAME NO.	417-1-17 KM
N D E FRAME NO.	417-1-17 KM
B. MEASUREMENT OF BEARING	
SWELL AT D.E.	214.82 - 214.87 mm = 0.05 mm
SWELL AT N.D.E	127.40 - 127.43 mm = 0.03 mm
C. RADIAL PLAY OF BEARINGS :	
a) 0.130 to 0.220 mm AT 4 PLACES OF RADIAL PLAY AT D.E.	0.15 mm
b) 0.060 TO 0.110mm AT 4 PLACES OF RADIAL PLAY AT N.D.E.	0.08 mm
ROTOR ROTATION BEFORE PINION FITMENT -	FREE /JAM
D. STAGE INSPECTION	
GAP BETWEEN D.E. FRAME TO STATOR	OK
GAP BETWEEN N.D.E. FRAME TO STATOR	OK
LABYRINTH GAP & SETTING CHECKED	OK
INSULATION RESISTANCE AT U1V1W1	SPECIFIED 2.18 M OBTAINED X
CONTINUITY	OK / NOT OK OK 24/1/17

E. PINION FITMENT			
PINION NO- KPC16K16603	NO. OF TEETH- 20		TEETH LENGTH 130.0
COLLAR LENGTH - 7.0	INITIAL READING- 153.0		FINAL READING- 141.0
DRAW	SPECIFIED VALUE	12mm	OBSERVED VALUE 12.0
GAP	4.00 ± 1.00mm		4.0

F. RADIAL & AXIAL PLAY AFTER PENION FITMENT		
	SPECIFIED	OBSERVED
R/PLAY	0.110 TO 0.190 mm	0.16
A/PLAY	0.180 TO 0.30 mm	0.30

ROTOR ROTATION AFTER PINION FITMENT - FREE / JAM free 27/01/17

L.T. REPORT :
DATE :

Annexure - VII

Medha Electrical Loco - Type MEC628 - Loco Type : WAP7

File Name INPDFM5 30549
User Name WAP7
Data Displa Ascending Order

DATE	TIME	FAULT MESSAGE
24/04/19	00:48:03	[F0301P1] LIC3 :Earth Fault Level -1 at T/F or TM Side
24/04/19	00:48:04	[F0301P1] LIC4 :Earth Fault Level -1 at T/F or TM Side Recovered
24/04/19	00:48:04	[F0301P1] LIC3 :Earth Fault Level -1 at T/F or TM Side Recovered
24/04/19	00:48:06	[F0301P1] LIC3 :Earth Fault Level -1 at T/F or TM Side
24/04/19	00:48:07	[NODISP] LIC4 :Earth fault Level 2 DCL positive side
24/04/19	00:48:14	[NODISP] LIC4 :Earth fault Level 2 DCL positive side Recovered
24/04/19	00:48:14	[F0301P1] LIC3 :Earth Fault Level -1 at T/F or TM Side Recovered
24/04/19	00:48:41	[NODISP] LIC4 :Earth fault Level 2 DCL positive side
24/04/19	00:48:43	[NODISP] LIC4 :Earth fault Level 2 DCL positive side Recovered
24/04/19	00:48:48	[F0301P1] LIC3 :Earth Fault Level -1 at T/F or TM Side
24/04/19	00:49:15	MCC :Isolation Bogie2
24/04/19	00:54:19	[NODISP] TC5 : TM5 Stator Temperature Sensors Faulty
24/04/19	00:54:26	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1
24/04/19	00:54:51	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2
24/04/19	00:55:14	[NODISP] TC5 : TM5 Stator temperature sensor1 faulty
24/04/19	00:55:15	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2 Recovered
24/04/19	00:55:15	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1 Recovered
24/04/19	00:55:40	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1
24/04/19	00:56:03	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2
24/04/19	00:56:24	[NODISP] TC5 : TM5 Stator temperature sensor2 faulty
24/04/19	00:56:25	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2 Recovered
24/04/19	00:56:25	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1 Recovered
24/04/19	01:00:10	MCC :Isolation Bogie2 Recovered
24/04/19	01:00:11	[F0301P1] LIC3 :Earth Fault Level -1 at T/F or TM Side Recovered
24/04/19	01:00:17	[NODISP] TC5 :WBOT VceSat Fault
24/04/19	01:02:02	[NODISP] TC5 :WBOT VceSat Fault Recovered
24/04/19	01:03:11	[NODISP] TC5 :WBOT VceSat Fault
24/04/19	01:03:33	[NODISP] TC5 :WBOT VceSat Fault Recovered
24/04/19	01:04:51	[NODISP] TC5 :WBOT VceSat Fault
24/04/19	01:04:51	[F0309P2] MCC :Isolation of Processor TC5
24/04/19	02:06:04	[F0309P2] TC5 :TM5 Speed sensor connectors open
24/04/19	02:06:54	[F0309P2] TC5 :TM5 Speed sensor connectors open Recovered
24/04/19	02:07:05	[F0309P2] TC5 :TM5 Speed sensor connectors open
24/04/19	02:07:10	[NODISP] TC5 :UV phase Temperature sensor faulty
24/04/19	02:07:10	[NODISP] TC5 :W phase Temperature sensor faulty
24/04/19	02:07:11	[F0309P2] TC5 :TM5 Speed sensor connectors open Recovered
24/04/19	02:09:32	[F0309P2] TC5 : TM5 Two phase current sensors faulty
24/04/19	02:09:32	[NODISP] TC5 :R-Phase Current Sensor Faulty
24/04/19	02:09:32	[NODISP] TC5 :B-Phase Current Sensor Faulty
24/04/19	02:10:58	[NODISP] MCC : MCE Power Off Fault
24/04/19	10:08:01	[NODISP] MCC :Power On fault
24/04/19	10:08:03	[NODISP] TC5 :UV phase Temperature sensor faulty
24/04/19	10:08:03	[NODISP] TC5 : TM5 Stator temperature sensor1 faulty
24/04/19	10:08:03	[NODISP] TC5 : TM5 Stator temperature sensor2 faulty

24/04/19	10:08:03	[NODISP] TC5 :W phase Temperature sensor faulty
24/04/19	10:08:03	[NODISP] TC5 : TM5 Stator Temperature Sensors Faulty
24/04/19	10:08:03	[F0309P2] TC5 : TM5 Two phase current sensors faulty
24/04/19	10:08:03	[NODISP] TC5 :R-Phase Current Sensor Faulty
24/04/19	10:08:03	[NODISP] TC5 :B-Phase Current Sensor Faulty
24/04/19	10:08:03	[F1010P1] MCC :S/R Interlock - Emg Brk Out
24/04/19	10:08:04	MCC :Bogie 1 Cutout switch active
24/04/19	10:08:04	MCC :Isolation Bogie1
24/04/19	10:08:07	[F1201P2] MCC :Oil cooler blower2 mcb open
24/04/19	10:08:07	[F1201P2] MCC :Tm2 blower2 mcb open
24/04/19	10:08:07	[F1201P2] MCC :Converter2 pump2 mcb open
24/04/19	10:08:07	[F1201P2] MCC :Transformer pump2 mcb open
24/04/19	10:17:31	[F0903P1] MCC :MCE Off - Pan Down 10 Min
24/04/19	10:18:01	[NODISP] MCC : MCE Power Off Fault
24/04/19	10:18:24	[NODISP] MCC :Power On fault
24/04/19	10:18:25	[NODISP] TC5 :UV phase Temperature sensor faulty
24/04/19	10:18:25	[NODISP] TC5 : TM5 Stator temperature sensor1 faulty
24/04/19	10:18:25	[NODISP] TC5 : TM5 Stator temperature sensor2 faulty
24/04/19	10:18:25	[NODISP] TC5 :W phase Temperature sensor faulty
24/04/19	10:18:25	[NODISP] TC5 : TM5 Stator Temperature Sensors Faulty
24/04/19	10:18:25	[F0309P2] TC5 : TM5 Two phase current sensors faulty
24/04/19	10:18:25	[NODISP] TC5 :R-Phase Current Sensor Faulty
24/04/19	10:18:25	[NODISP] TC5 :B-Phase Current Sensor Faulty
24/04/19	10:18:25	[F1010P1] MCC :S/R Interlock - Emg Brk Out
24/04/19	10:18:26	MCC :Bogie 1 Cutout switch active
24/04/19	10:18:26	MCC :Isolation Bogie1
24/04/19	10:18:29	[F1201P2] MCC :Oil cooler blower2 mcb open
24/04/19	10:18:29	[F1201P2] MCC :Tm2 blower2 mcb open
24/04/19	10:18:29	[F1201P2] MCC :Converter2 pump2 mcb open
24/04/19	10:18:29	[F1201P2] MCC :Transformer pump2 mcb open
24/04/19	10:27:54	[F0903P1] MCC :MCE Off - Pan Down 10 Min
24/04/19	10:28:24	[NODISP] MCC : MCE Power Off Fault
24/04/19	10:29:18	[NODISP] MCC :Power On fault
24/04/19	10:29:19	[NODISP] TC5 :UV phase Temperature sensor faulty
24/04/19	10:29:19	[NODISP] TC5 : TM5 Stator temperature sensor1 faulty
24/04/19	10:29:19	[NODISP] TC5 : TM5 Stator temperature sensor2 faulty
24/04/19	10:29:19	[NODISP] TC5 :W phase Temperature sensor faulty
24/04/19	10:29:19	[NODISP] TC5 : TM5 Stator Temperature Sensors Faulty
24/04/19	10:29:19	[F0309P2] TC5 : TM5 Two phase current sensors faulty
24/04/19	10:29:19	[NODISP] TC5 :R-Phase Current Sensor Faulty
24/04/19	10:29:19	[NODISP] TC5 :B-Phase Current Sensor Faulty
24/04/19	10:29:19	[F1010P1] MCC :S/R Interlock - Emg Brk Out
24/04/19	10:29:20	MCC :Bogie 1 Cutout switch active
24/04/19	10:29:20	MCC :Isolation Bogie1
24/04/19	10:29:23	[F1201P2] MCC :Oil cooler blower2 mcb open
24/04/19	10:29:23	[F1201P2] MCC :Tm2 blower2 mcb open
24/04/19	10:29:23	[F1201P2] MCC :Converter2 pump2 mcb open
24/04/19	10:29:23	[F1201P2] MCC :Transformer pump2 mcb open
24/04/19	10:38:48	[F0903P1] MCC :MCE Off - Pan Down 10 Min
24/04/19	10:38:54	[NODISP] MCC : MCE Power Off Fault

30549 Data analysis for TM5 Fire issue

Date	Time	Fault Message	Explanation
24/04/19	00:48:03	[F0301P1]LIC4 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LC4. So LC4 pulsing is disabled
24/04/19	00:48:03	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LC3. So LC3 pulsing is disabled
24/04/19	00:48:04	[F0301P1]LIC4 :Earth Fault Level -1at T/F or TM Side RECOVERED	After disabling of pulsing of Bogie2, Earth fault voltage ratios are normal, So fault is recovered
24/04/19	00:48:04	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side RECOVERED	After disabling of pulsing of Bogie2, Earth fault voltage ratios are normal, So fault is recovered
24/04/19	00:48:06	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LC3. So LC3 pulsing is disabled
24/04/19	00:48:07	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side	Earth fault detected by LC4,as earth fault voltage ratio is less than 0.5
24/04/19	00:48:14	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side RECOVERED	As Throttle kept at IDLE position, Bogie2 pulsing is disabled, Hence fault got recovered
24/04/19	00:48:14	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side RECOVERED	As Throttle kept at IDLE position, Bogie2 pulsing is disabled, Hence fault got recovered
24/04/19	00:48:41	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side	Earth fault detected by LC4,as earth fault voltage ratio is less than 0.5
24/04/19	00:48:43	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side RECOVERED	As earth fault voltage ratio is between 0.65 to 0.85, Hence fault got recovered
24/04/19	00:48:48	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LTC2
24/04/19	00:49:15	MCC :Isolation Bogie2	Earth fault detected by LTC2 logged 3times with in 15minutes, hence system isolated Bogie2
24/04/19	00:54:19	[F0304P2] TC5 :TM Temperature Sensors Faulty	Difference between the two temperature sensors is more than 25degC
24/04/19	00:54:26	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1	TM5 Temperature is more than 160degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	00:54:51	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2	TM5 Temperature is more than 190degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	00:55:14	[NODISP] TC5 :Stator temperature sensor1 faulty	TM5 Temperature sensor2 reading is more than 240degC, Hence declared as sensor faulty (After 190 degC, TM pulsing will be disabled and So Temperature shall not increase further. To identify faulty sensor, temperature limit is kept at 240degC)
24/04/19	00:55:15	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2 RECOVERED	TM5 Temperature sensor1 is faulty and sensor2 is healthy which has reading of less than 160degC. Hence fault got recovered
24/04/19	00:55:15	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1 RECOVERED	TM5 Temperature sensor1 is faulty and sensor2 is healthy which has reading of less than 160degC. Hence fault got recovered
24/04/19	00:55:40	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1	TM5 Temperature is more than 160degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	00:56:03	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2	TM5 Temperature is more than 190degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	00:56:24	[NODISP] TC5 :Stator temperature sensor2 faulty	TM5 Temperature sensor2 reading is more than 240degC, Hence declared as sensor faulty (After 190 degC, TM pulsing will be disabled and So Temperature shall not increase further. To identify faulty sensor, temperature limit is kept at 240degC)
24/04/19	00:56:25	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2 RECOVERED	TM5 both temperature sensors are faulty, So recovered message is logged
24/04/19	00:56:25	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1 RECOVERED	TM5 both temperature sensors are faulty, So recovered message is logged

Date	Time	Fault Message	Explanation
24/04/19	01:00:10	MCC :Isolation Bogie2 RECOVERED	Earth fault recovered in LTC2, hence system recovered Isolation fault of Bogie2
24/04/19	01:00:11	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side RECOVERED	Earth fault recovered in LTC2
24/04/19	01:00:17	[NODISP] TC5 :WBOT VceSat Fault	Gate Drive detected Desaturation (IGBT Collector to Emitter voltage is more than 5V apprx.) of IGBT when pulsing is enabled to TM5 and immediately shutdown of TM5
24/04/19	01:02:02	[NODISP] TC5 :WBOT VceSat Fault RECOVERED	Auto recovery at Throttle IDLE
24/04/19	01:03:11	[NODISP] TC5 :WBOT VceSat Fault	Gate Drive detected Desaturation (IGBT Collector to Emitter voltage is more than 5V apprx.) of IGBT when pulsing is enabled to TM5 and immediately shutdown of TM5
24/04/19	01:03:33	[NODISP] TC5 :WBOT VceSat Fault RECOVERED	Auto recovery at Throttle IDLE
24/04/19	01:04:51	[NODISP] TC5 :WBOT VceSat Fault	Gate Drive detected Desaturation (IGBT Collector to Emitter voltage is more than 5V apprx.) of IGBT when pulsing is enabled to TM5 and immediately shutdown of TM5
24/04/19	01:04:51	[F0309P2] MCC :Isolation of Processor TC5	TM5 isolated due to WBOT Vcesat Fault is occurred 3times
24/04/19	02:06:04	[F0309P2] TC5 :TM5 Speed sensor connectors open	Seems to be speed sensor is open circuited
24/04/19	02:06:54	[F0309P2] TC5 :TM5 Speed sensor connectors open RECOVERED	Seems to be speed sensor connections are becoming Make&Brake
24/04/19	02:07:05	[F0309P2] TC5 :TM5 Speed sensor connectors open	Seems to be speed sensor is open circuited
24/04/19	02:07:10	[NODISP] TC5 :UV phase Temperature sensor faulty	May be due to short of speed sensor +15V&GND wires at TM5, Phase module temperature sensor supply disturbed
24/04/19	02:07:10	[NODISP] TC5 :W phase Temperature sensor faulty	May be due to short of speed sensor +15V&GND wires at TM5, Phase module temperature sensor supply disturbed
24/04/19	02:07:11	[F0309P2] TC5 :TM5 Speed sensor connectors open RECOVERED	Seems to be speed sensor connections are becoming Make&Brake
24/04/19	02:09:32	[F0309P2] TC5 :Two phase current sensors faulty	May be due to short of speed sensor +15V&GND wires at TM5, Current sensor supply disturbed
24/04/19	02:09:32	[NODISP] TC5 :R-Phase Current Sensor Faulty	May be due to short of speed sensor +15V&GND wires at TM5, Current sensor supply disturbed
24/04/19	02:09:32	[NODISP] TC5 :B-Phase Current Sensor Faulty	May be due to short of speed sensor +15V&GND wires at TM5, Current sensor supply disturbed
24/04/19	02:10:58	[NODISP] MCC : MCE Power Off	

Conclusion:

From the instant '00:49:15Hrs, Effectively TM5 is in disabled condition electrically till fire was noticed by IR Staff at 02:12Hrs (even though some times pulsing is enabled momentarily, but due to faults TM5 is getting disabled). Even TM5 is electrically disconnected its temperatures are keep on increasing, so it indicates that there is NO abnormality from electrical point of view but suspecting that there may be a physical rubbing of rotating part to stationary part with in the TM, so local heating is developed and subsequently TM insulation may caught fire.

Investigation Report of Loco No. 30549 WAP-7, SRC failed due to wheel set-5 locked on 23/24.04.2019

1. Rly. Board vide letter no 2002/ Elect (TRS)/ 440/18/9Pt dated 26.04.2019 had directed RDSO to thoroughly investigate the failure of axle seizure in locomotive involving CLW & propulsion equipment manufacturer. For this purpose a meeting was conducted on 02.05.2019 at RDSO. Following members attended the meeting:

   a. Suresh Kumar, DSE/TPS, RDSO
   b. Pankaj Kumar, SEE/D&D, CLW
   c. S.K. Deo, SSE/RDSO
   d. Koteshwara Rao, Manager/Medha
   e. Venu, Engg./Marketing, Medha

2. **Brief history of the incidence**

   Loco No. 30549 WAP-7 SRC while working Train No. 12261 Mumbai Howrah Duronto Express failed in Bhusawal-Badnera section of BSL division. Train departed from BSL at 23:39 on 23.04.2019 and at 00:59 Hrs on 24.04.2019, after passing Jalamb (JM) station Loco Pilot observed message F0301P2, F0301P1 and Bogie-2 isolated without any MCB tripping. Further between Kurum (KUM) and Takli (TKL) station, Loco pilot noticed smoke from under truck and he stopped train at Takli station at 02:12 Hrs. The fire extinguishers were used. After that wheel set-5 found locked. Assisting engine was given from rear side & train arrived at Badnera station in pushing mode & loco was detached there.

   The section was blocked from 02:11 Hrs till 07:00 Hrs, i.e., for 04'49".

3. **Mode of analysis**

   Following data have been considered:

   a. DDS of the loco
   b. Background data of the loco
   c. Event recorded in loco (recorded @ 1 event/second)

   In a 3-ph locomotive, whenever any event occurs (alarm situation is generated) the associated diagnostic data set (DDS) is generated and is stored in locomotive. In MEDHA Propulsion system ten samples of the background data of DDS got registered which contains environment data of the locomotive at the instance of registration. These samples of DDS are taken @ 1 sample/sec. Six samples of DDS are before the occurrence of event and three samples of DDS are after occurrence of event. In addition to the above, continuous recording of operating parameters are @ 1 event/second which are also stored in loco memory. Using these data, analysis of the events persisting at the time of failure has been done.

4. **Investigation**

4.1 **Earth fault detection**

In the traction converter the discrimination between the earth fault at AC side (transformer and motor) and DC link side is done by measuring the voltage across the balancing resistors provided across the DC link. As per M/s Medha Engineers, the

control electronics of the traction converter monitors the voltage ratio across the balancing resistor. Whenever the voltage ratio varies from its nominal value the location of the earth fault is decided from the drift of voltage ratio on either side based on the measurement across the balancing resistor.
As per M/s Medha the protection logic of the locomotive is programmed to trigger the protective action of isolation of the bogie in the event of detection of earth fault three time in 15 minutes.

4.2 The DDS have been analysed in four parts, namely

a. From time 00:48:03 to 00:49:15.
b. From time 00:54:19 to 00:56:25.
c. From time 01:00:10 to 01:04:51.
d. From time 02:06:04 to 02:10:58.

a. From time 00:48:03 to 00:49:15.

Date	Time	Fault Message	Explanation by firm
24/04/19	00:48:03	[F0301P1]LIC4 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LC4, So LC4 pulsing is disabled
24/04/19	00:48:03	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LC3, So LC3 pulsing is disabled
24/04/19	00:48:04	[F0301P1]LIC4 :Earth Fault Level -1at T/F or TM Side RECOVERED	After disabling of pulsing of Bogie2, Earth fault voltage ratios are normal, So fault is recovered
24/04/19	00:48:04	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side RECOVERED	After disabling of pulsing of Bogie2, Earth fault voltage ratios are normal, So fault is recovered
24/04/19	00:48:06	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LC3, So LC3 pulsing is disabled
24/04/19	00:48:07	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side	Earth fault detected by LC4,as earth fault voltage ratio is less than 0.5
24/04/19	00:48:14	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side RECOVERED	As Throttle kept at IDLE position, Bogie2 pulsing is disabled, Hence fault got recovered
24/04/19	00:48:14	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side RECOVERED	As Throttle kept at IDLE position, Bogie2 pulsing is disabled, Hence fault got recovered
24/04/19	00:48:41	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side	Earth fault detected by LC4,as earth fault voltage ratio is less than 0.5
24/04/19	00:48:43	[NODISP]LIC4 :Earth fault Level 2 DCL Positive side RECOVERED	As earth fault voltage ratio is between 0.65 to 0.85, Hence fault got recovered
24/04/19	00:48:48	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side	Earth fault detected by LTC2
24/04/19	00:49:15	MCC :Isolation Bogie2	Earth fault detected by LTC2 logged 3times with in 15minutes, hence system isolated Bogie2

From the above, it is observed that the bogie isolated only after a particular type of earth fault (F0301P1] LIC3: Earth Fault Level -1at T/F or TM Side) occurred 3 times. As the logic of identification of location of earth fault is built on the measurement of voltage across the balancing resistance which also depends on the earth resistance therefore, the exact location of earth fault may not be correctly predicted. Therefore, the bogie should have been isolated after occurrence of any type of earth fault three times in 15 minutes.

In locos with the MICAS logic when the any subsystem like bogie get isolated with priority one fault and due to any reason, the VCB got opened, message is displayed to the driver, LSFI blink and BPFA illuminated push button glows. When the LP presses the BPFA it gets extinguished and LSFI permanently glows. Thus, the reclosing of the VCB is possible only when the LP presses the BPFA push button. In this way it duly ensures LP's intervention in the process of isolation of a subsystem and he get aware that some issue is there in the subsystem. This proven and tested logic of MICAS has been implemented by all the propulsion manufacturers except Medha.

The graph Tractive Effort vs Time is shown in Annexure – 1.

b. From time 00:54:19 to 00:56:25.

Date	Time	Fault Message	Explanation by firm
24/04/19	00:54:19	[F0304P2] TC5 :TM Temperature Sensors Faulty	Difference between the two temperature sensors is more than 25degC
24/04/19	00:54:26	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1	TM5 Temperature is more than 160degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	00:54:51	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2	TM5 Temperature is more than 190degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	**00:55:14**	**[NODISP] TC5 :Stator temperature sensor1 faulty**	**TM5 Temperature sensor2 reading is more than 240degC, Hence declared as sensor faulty (After 190 degC, TM pulsing will be disabled and So Temperature shall not increase further. To identify faulty sensor, temperature limit is kept at 240degC)**
24/04/19	00:55:15	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2 RECOVERED	TM5 Temperature sensor1 is faulty and sensor2 is healthy which has reading of less than 160degC. Hence fault got recovered
24/04/19	00:55:15	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1 RECOVERED	TM5 Temperature sensor1 is faulty and sensor2 is healthy which has reading of less than 160degC. Hence fault got recovered
24/04/19	00:55:40	[F0305P2] MCC :Bogie2 Motor2 Temperature > Limit1	TM5 Temperature is more than 160degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	00:56:03	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2	TM5 Temperature is more than 190degC (Temperature will be considered maximum of healthy sensor readings of TM5)
24/04/19	**00:56:24**	**[NODISP] TC5 :Stator temperature sensor2 faulty**	**TM5 Temperature sensor2 reading is more than 240degC, Hence declared as sensor faulty (After 190 degC, TM pulsing will be disabled and So Temperature shall not increase further. To identify faulty sensor, temperature limit is kept at 240 degC)**
24/04/19	00:56:25	[F0307P1] MCC :Bogie2 Motor2 Temperature > Limit2 RECOVERED	TM5 both temperature sensors are faulty, So recovered message is logged
24/04/19	00:56:25	[F0305P2] MCC :Bogie2 Motor2 Temperature >	TM5 both temperature sensors are faulty, So recovered message is logged

		Limit1 RECOVERED	

After the isolation of the bogie the electronics of the traction converter keeps on monitoring the temperature and speed and the fault messages continue to get logged.

From the above it is observed that even when the bogie is electrically isolated the temperature of the TM increases beyond 160°C (Limit-1) and prioiry2 fault is generated at 00:54:26. The temperature further keeps on increasing leading to logging of the temperature beyond 190°C (Limit-2) at 00:54:51. The temperature of the TM further kept on increasing and at 00:55:14 the 'Stator temperature sensor1 faulty' is recorded which, as per Medha, indicates the temperature sensed by sensor1 is beyond 240°C (in the temperature sensor assembly there are two elements namely sensor1 and sensor2). Thus, at this point onwards the readings of sensor1 are discarded and readings of sensor2 which are less than 160C are taken into consideration.
At 00:56:24 the sensor2 was also declared faulty, i.e., the temperature measured by sensor2 increases beyond 240°C. In Medha SR logic, whenever the temperature of any element of temperature sensor increases beyond 240°C, SR considers the sensor element to be faulty. It is further observed that even when temperature recorded by both the temperature sensor element is more than 240°C there are signals of recovery of sensors limits - limit-2 & limit-1. While discussing with M/s Medha, it has been intimated that in their software logic whenever both the sensor elements sensor1 and sensor2 of a traction motor are declared faulty, i.e., read values more than 240°C, their values are ignored and the values of other traction motors Temperature are considered which again is not logical. If the traction motor temperature increases even when it is electrically isolated, it clearly indicates a mechanical failure which should have been implemented through a software logic.

The graph Tractive Effort vs Time is shown in Annexure – 2.

c. From time 01:00:10 to 01:04:51.

Date	Time	Fault Message	Explanation by firm
24/04/19	01:00:10	MCC :Isolation Bogie2 RECOVERED	Earth fault recovered in LTC2, hence system recovered Isolation fault of Bogie2
24/04/19	01:00:11	[F0301P1]LIC3 :Earth Fault Level -1at T/F or TM Side RECOVERED	Earth fault recovered in LTC2
24/04/19	01:00:17	[NODISP] TC5 :WBOT VceSat Fault	Gate Drive detected Desaturation (IGBT Collector to Emitter voltage is more than 5V apprx.) of IGBT when pulsing is enabled to TM5 and immediately shutdown of TM5
24/04/19	01:02:02	[NODISP] TC5 :WBOT VceSat Fault RECOVERED	Auto recovery at Throttle IDLE
24/04/19	01:03:11	[NODISP] TC5 :WBOT VceSat Fault	Gate Drive detected Desaturation (IGBT Collector to Emitter voltage is more than 5V apprx.) of IGBT when pulsing is enabled to TM5 and immediately shutdown of TM5
24/04/19	01:03:33	[NODISP] TC5 :WBOT VceSat Fault RECOVERED	Auto recovery at Throttle IDLE

24/04/19	01:04:51	[NODISP] TC5 :WBOT VceSat Fault	Gate Drive detected Desaturation (IGBT Collector to Emitter voltage is more than 5V apprx.) of IGBT when pulsing is enabled to TM5 and immediately shutdown of TM5
24/04/19	01:04:51	[F0309P2] MCC :Isolation of Processor TC5	TM5 isolated due to WBOT Vcesat Fault is occurred 3times

There is a provision in the Medha software logic that if the system has experienced the isolation due to earth fault then after every hour the earth fault message is artificially eliminated and system is operated as normal. Again, there is no logic of this provision. There is no message to LP about the recovery of the bogie and there was no intervention by LP.

GTO TOT doc No. 3EHP541682 clearly indicates that "A system which is isolated will remain isolated as long as the MCE is supplied." In the MICAS logic once the subsystem is isolated it cannot be recovered automatically unless the loco is restarted. Idea is that in case of isolation of any electrical system it is not recommended to charge it again without manual inspection and due analysis of the isolation. The repetitive attempt of charging the faulty system may increase the severity of fault and can lead to unsafe condition such as fire etc.

It is observed that bogie came into service at 01:00:10 as the earth fault was artificially eliminated. At this time the TE demand was already persisting. At 01:00:17 there is message of TC5: WBOT VceSat Fault. As per Medha, this message is generated when the current through IGBT is abnormally high typically 800 Amp) MEDHA explained that the sampling time of this current is high and this high current shall be detected and control action of turning off the IGBT shall be done within 10 microseconds. Therefore, current flows through the TM5 only for time up to 10 microseconds and the control system goes in to protection mode and stops pulsing. Consequently, only TM4 & TM6 generated TE and the total TE generated by bogie is only 2/3rd of the TE generated by bogie1. Again, when the throttle brought to '0' this message disappears at 01:02:02 and when the throttle was again moved at 01:03:11 the same message appears and IGBT goes into protection mode once again. As per Medha protection logic, this condition is allowed upto 3 times within 15 minutes and consequently the pulsing of TM5 permanently stopped at 01:04:51 with logging of message MCC: Isolation of Processor TC5.

From the logs above, it is observed that the traction motor – 5 remained isolated from 01:04:51 onwards except three attempts to charge it as mentioned in the above paragraph

The graph Tractive Effort vs Time is shown in Annexure – 3.

d. From time 02:06:04 to 02:10:58

24/04/19	02:06:04	[F0309P2] TC5: TM5 Speed sensor connectors open	Seems to be speed sensor is open circuited
24/04/19	02:06:54	[F0309P2] TC5: TM5 Speed sensor connectors open RECOVERED	Seems to be speed sensor connections are becoming Make & Break
24/04/19	02:07:05	[F0309P2] TC5: TM5 Speed sensor connectors open	Seems to be speed sensor is open circuited

24/04/19	02:07:10	[NODISP] TC5 :UV phase Temperature sensor faulty	May be due to short of speed sensor +15V&GND wires at TM5, Phase module temperature sensor supply disturbed
24/04/19	02:07:10	[NODISP] TC5 :W phase Temperature sensor faulty	May be due to short of speed sensor +15V&GND wires at TM5, Phase module temperature sensor supply disturbed
24/04/19	02:07:11	[F0309P2] TC5 :TM5 Speed sensor connectors open RECOVERED	Seems to be speed sensor connections are becoming Make&Brake
24/04/19	02:09:32	[F0309P2] TC5 :Two phase current sensors faulty	May be due to short of speed sensor +15V&GND wires at TM5, Current sensor supply disturbed
24/04/19	02:09:32	[NODISP] TC5 :R-Phase Current Sensor Faulty	May be due to short of speed sensor +15V&GND wires at TM5, Current sensor supply disturbed
24/04/19	02:09:32	[NODISP] TC5 :B-Phase Current Sensor Faulty	May be due to short of speed sensor +15V&GND wires at TM5, Current sensor supply disturbed
24/04/19	02:10:58	[NODISP] MCC : MCE Power Off	

It appears from 02:06:04 onwards there was fire in the TM5 and the electrical connection of speed sensor and temperature sensor started burning. The power to temperature sensors and speed sensors is supplied by power supply unit installed in traction converter. As per Medha, due to burning and shorting of these control wires the power supply unit got overloaded and generated consequent DDS.

It is observed that from 01:04:51 to 02:06:04, no fault was generated. For entire duration from 00:48:03 when the first message of earth fault is logged to 02:10:58 when the MCE was switched OFF the current through TM-5 has passed only for 24 seconds.

The graph Tractive Effort vs Time is shown in Annexure – 4.

The graph Speed vs Time is shown in Annexure – 5 for the entire duration.

5. Conclusion

Different propulsion system manufacturers have developed their control software in line with the MICAS software logic. This is important as the LP needs to have a common operating experience while operating locomotives with different makes of propulsion system. The logging and popping of messages and registration of DDS should also be in line with the MICAS system to have common troubleshooting and fault identification practice at sheds. From the foregoing, it is observed that there are several deviations in the Medha propulsion system logic vis-à-vis MICAS software logic. These deviations need to be addressed so that a uniform software logic can be ensured across different makes of propulsion systems for uniform operational behavior of the locomotive.

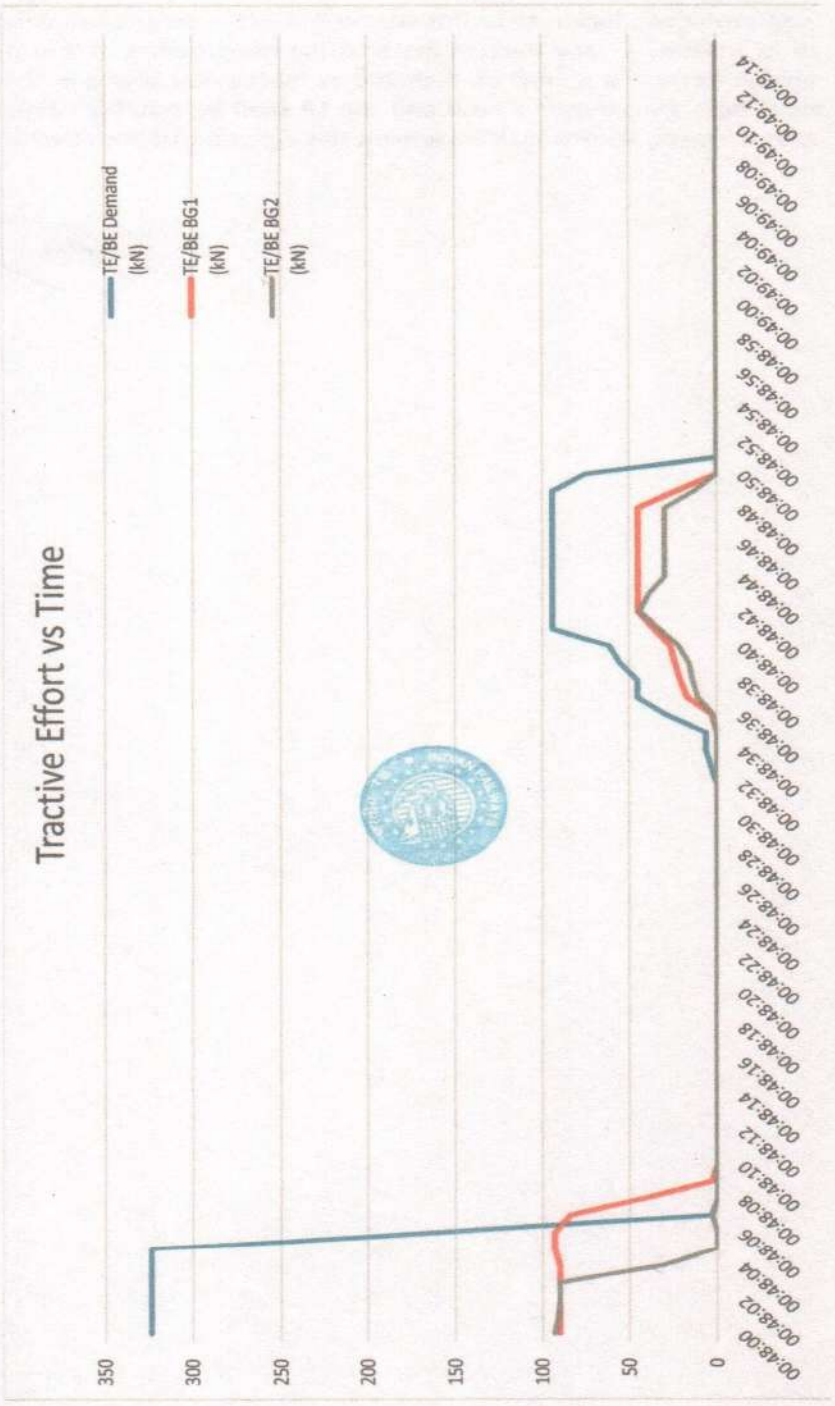
6. Action Plan

a. M/s Medha has been asked to implement the software control logic in line with MICAS. The procedure of message popup on DDU screen for loco pilot for the events and subsequent steps of acknowledgement by loco pilot to be made as per MICAS logic. The software shall be made ready by 20.06.19 and shall be put in locomotives on trial basis.

b. A new protection logic may be introduced in the loco control software such that in case of isolation of any traction motor if the temperature of that particular TM keeps on increasing it shall be detected as mechanical failure in the motor. The control logic shall trigger a fault and the LP shall be suitably intimated through display message. Medha shall implement this logic on trial basis by 20.06.19.

10/06/19

Annexure-1



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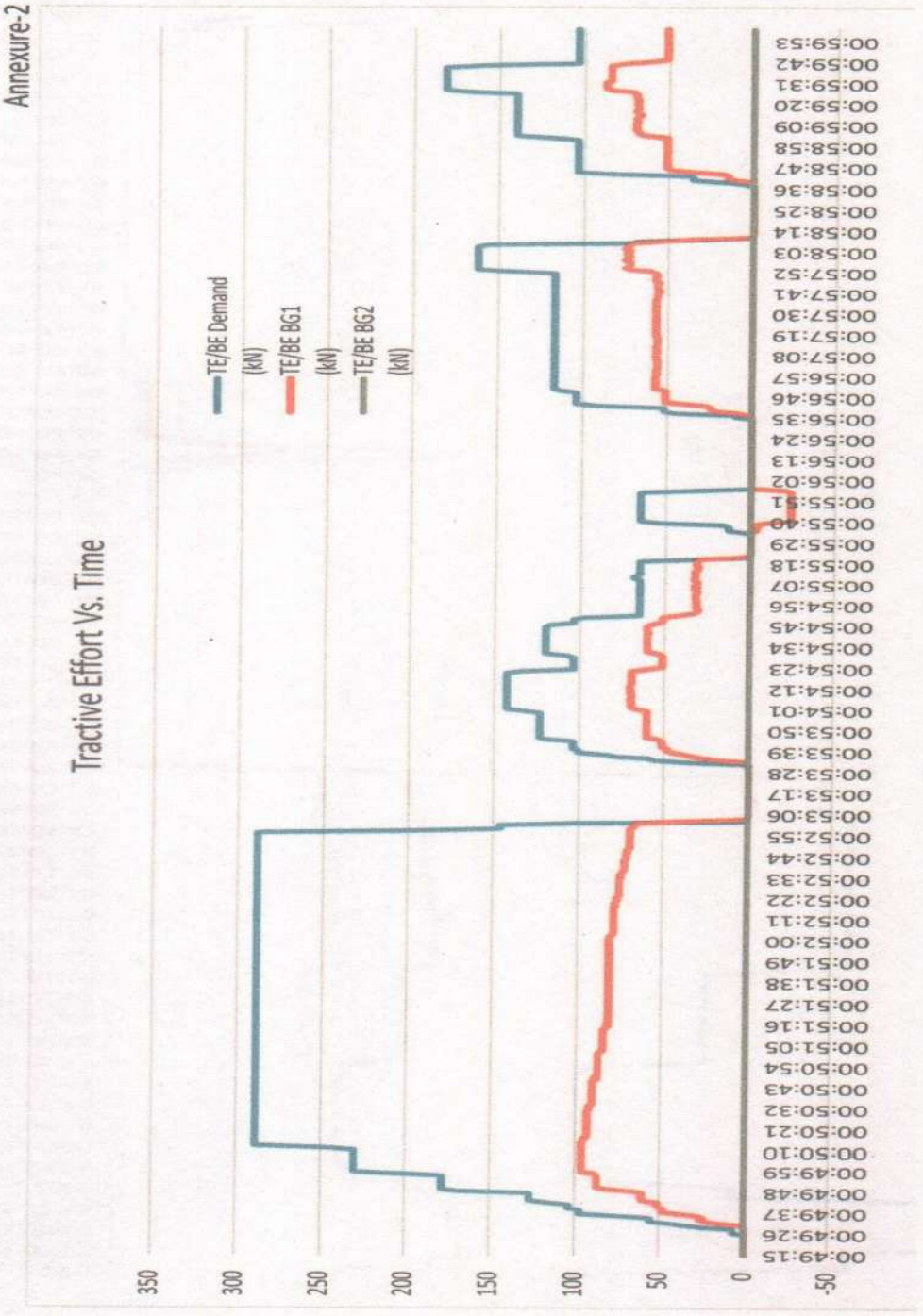
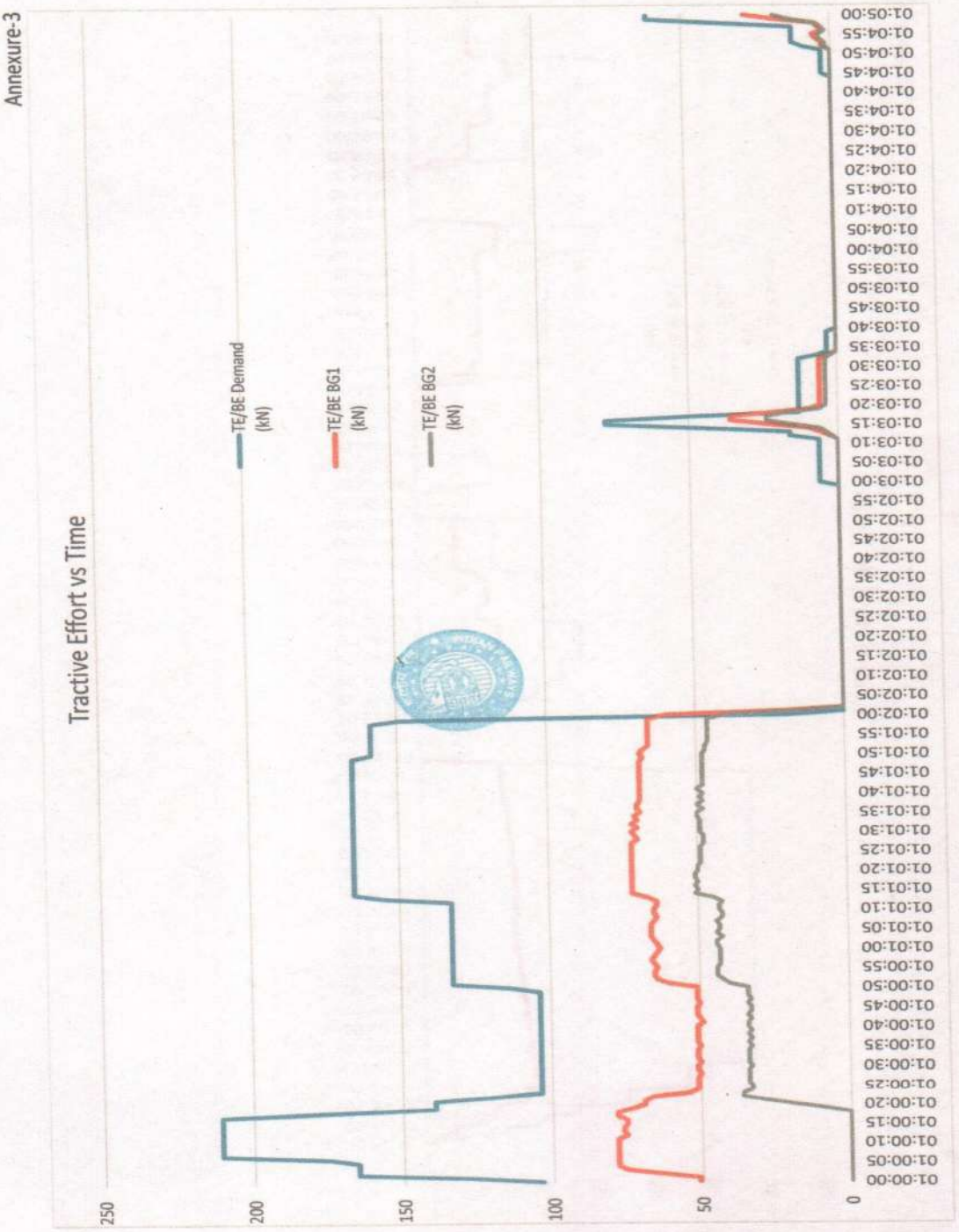
Annexure-2



Prepared by	Checked by	Issued by
MK		

Annexure-3



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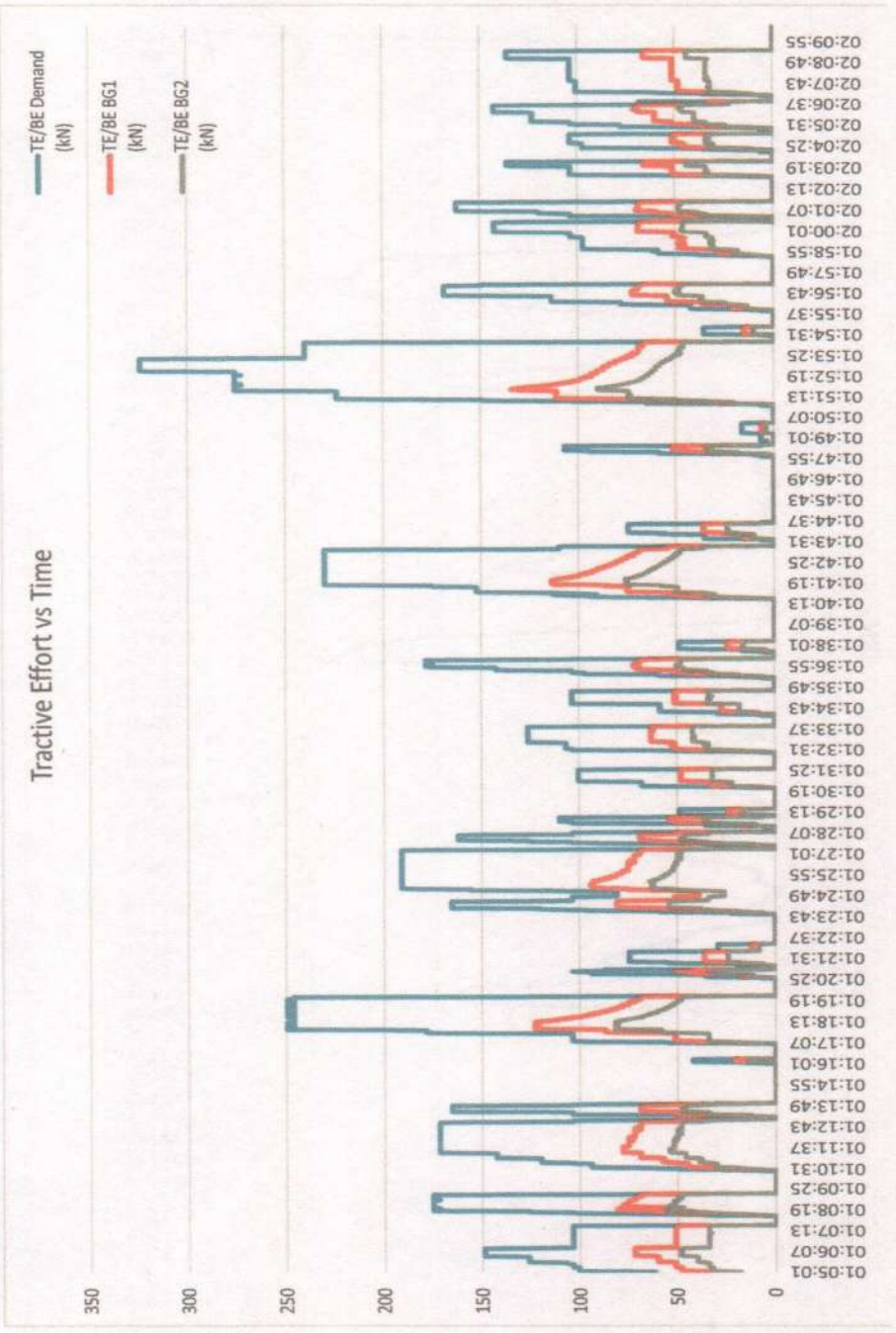
Annexure-4



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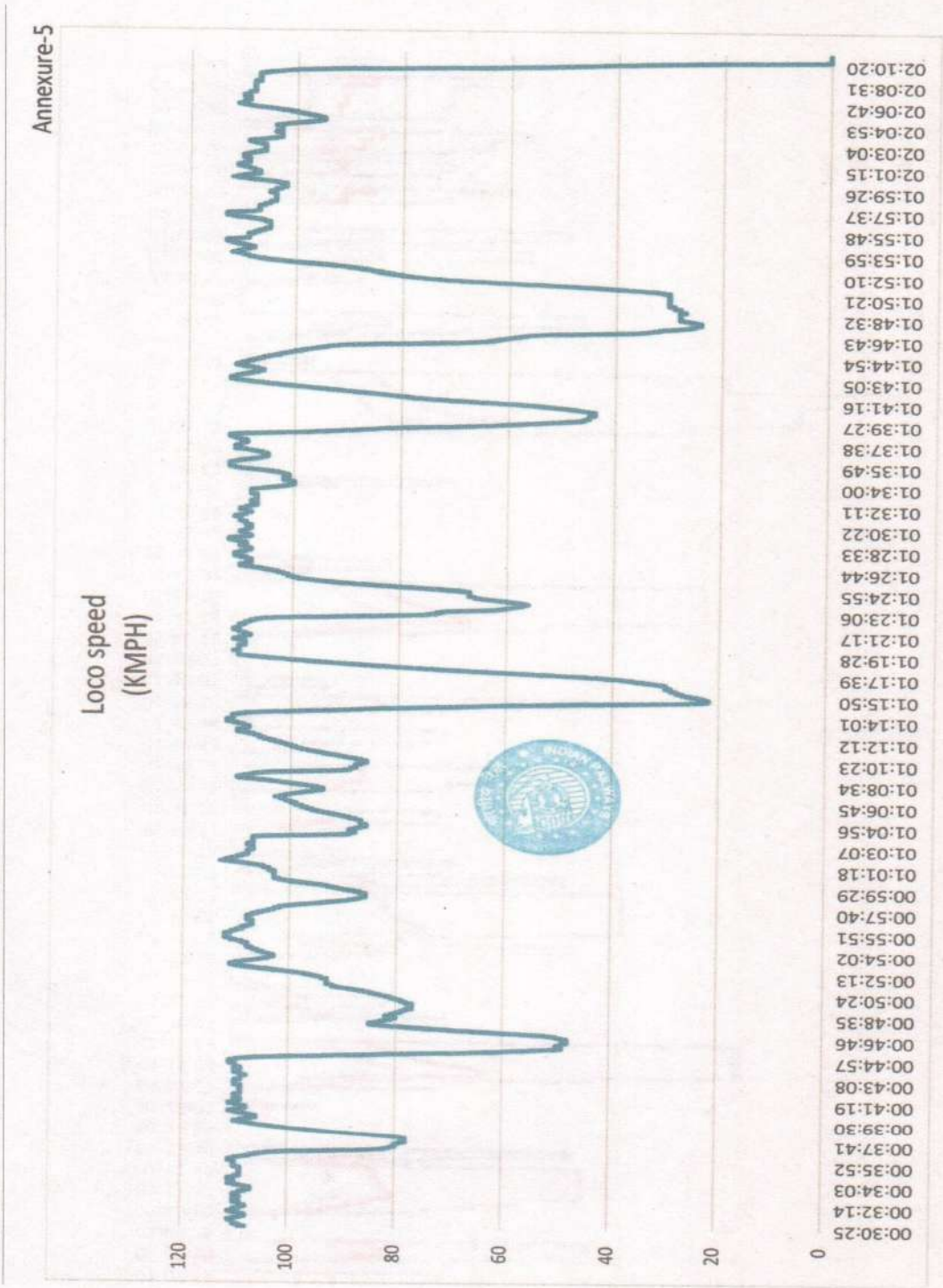
Annexure-5



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