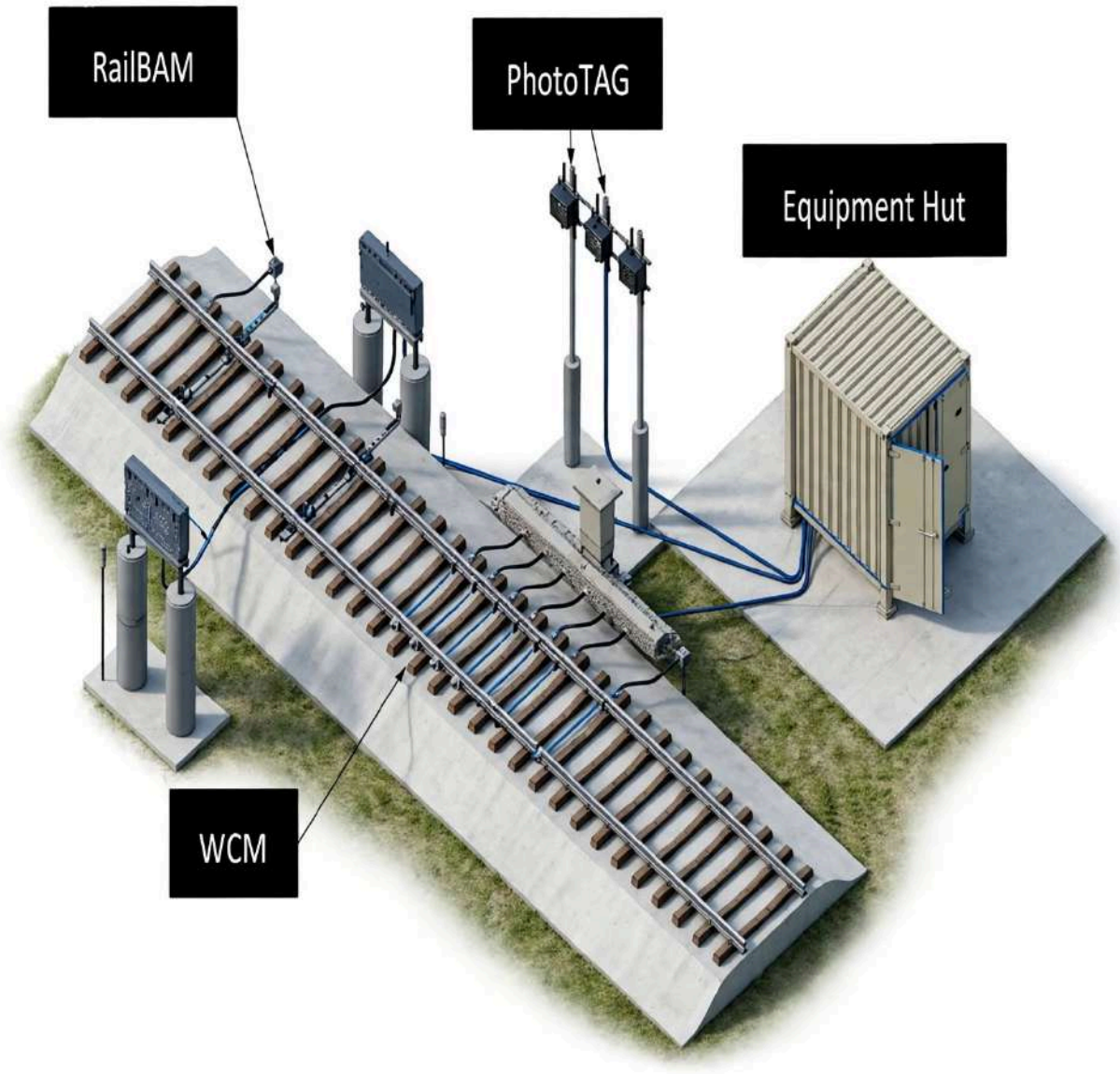
FUNCTIONALITY OF RAILBAM

& MEASURES TO IMPROVE ITS FUNCTION

Schematic of an OMRS single-track site



BEARING ACOUSTIC MONITORING

A technical review of RailBAM alert functionality, analysis,
and
Measures to improve reliability and maintenance response.

AUGUST 2024

Technical Paper & Report

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North Central Railway

Report
on
Functionality of RAILBAM & Measures to improve its function

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1. Overview of Incident

Train no. 20501 passed through OMRS/SSL [UP direction] at 05:21:53 Hrs. on 20.03.2024. The Coach WR 211059/C LWCBAC had **non-actionable** alert viz **FBS (RS1)** & Noisy (RS1) respectively in **North & South** side of **trailing trolley leading wheel**.

On its return on same date as train no 20502 at CMR (Chamrola), HBD alert in the coach no WR 211059/C LWCBAC was noticed (temperature of leading end trolley trailing end wheel north side 82.46^0 C). Subsequently, the coach was examined at TDL & Axle Box temperature was found 76.10^0 & grease seal **temperature 80.9^0 C**. Also **grease oozing** was found. Coach was **detached at TDL (Tundla).**

Post incidence, Railway Board at the level of MTRS, instructed to carry out detailed analysis of above incident and suggest improvement to enhance working of RailBAM and to make its alert more realistic.

Detailed report on above is presented below.

1.1. Brief History

1. On date 20.03.24 train no. 20502 (ANVT-AGTL) passed JLS (Jalesar) at 21:48 Hrs, passed CMR (Chamraula) at 21:52 hrs.
2. HBD machine/CMR reported excessive axle box temperature in the Coach 15th from EP. Leading end trolley trailing end wheel north side temperature was reported **82.46^0C.**
3. Train passed MTI (Mitawali) at 22:04 hrs. and controlled at TDL (Tundla) at 22:12 Hrs.
4. Train arrived TDL (Tundla) PF No. 06 at 22:12 hrs. and after stoppage of the train SSE/C&W/TDL checked Coach No. WR 211059/C LWCBAC Pantry Car 15th from EP found axle box temperature 76.10^0C at 22:20 Hrs. in leading end trolley trailing end wheel north side.
5. On opening of axle box cover at 22:25 hrs. grease seal temperature was found 80.9^0C and grease oozing was noticed.
6. Other axle boxes temperatures of the same coach were found 29-40 degree centigrade.
7. Coach was detached at Tundla.

1.2 Coach Details

Coach No.	:	NFR 211059 LWCBAC	, Mfg.	:	MCF 01/2021
Position	:	15th from EP	, SS-I	:	AGTL 28.10.22
Primary Base Depot	:	AGTL (Agartala)/NFR	, Extd. Ret. Date	:	04/2024

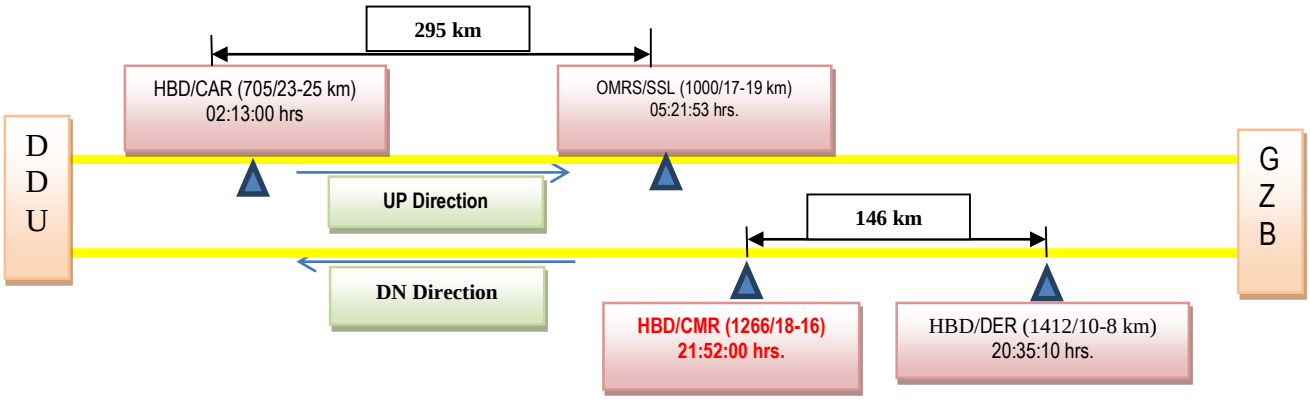
1.3 RailBAM alerts generated

Details of alerts generated by Way side Equipments

On date 20.03.2024, same rake passed through HBD/CAR (UP), OMRS/SSL (UP) and HBD/DER (DN). Details of generated alerts by enroute installed way side equipment's are as under:

Way side Equipment	Passing time	Trolley	North side	South Side
HBD/CAR (UP direction)	02:13:00 hrs.	Trailing trolley leading wheel	22.8 ^{0}C	23.88 ^{0}C
OMRS/SSL (UP direction)	05:21:53 hrs.	Trailing trolley leading wheel	FBS(RS1)	NOISY(RS1)
HBD/DER (DN Direction)	20:35:10 hrs.	Leading trolley trailing wheel	26.10 ^{0}C	28.51 ^{0}C
HBD/CMR (DN Direction)	21:52:00 hrs.	Leading trolley trailing wheel	82.46 ^{0}C	36.01 ^{0}C

FBS: Flanging, Braking, Slamming noise, NOISY-Unknown (extraneous) noise.



2. Analysis

2.1. Analysis of Incident

1. On date 20.03.2024 during its journey towards Delhi in up direction, it passed through HBD/Chunar, OMRS/Sirsual. The temperatures of the affected axle of the train 20502 was found well within the limit and there was no sign of high temperature (all axle boxes found less than 30^0C) by HBD/CAR.
2. The train was examined at ANVT on date 20.03.2024 and while on return journey in down direction, it passed through HBD/DER, 150kms before HBD/CMR. The temperatures of the axle boxes of the train 20502 were well within the limit and there was no sign of high temperature (all axle boxes found less than 30^0C) by HBD/DER.
3. Similarly, while passing through the OMRS/SSL, **no critical alert was given by OMRS/SSL**. The affected axle of trailing trolley leading wheel (right side) has RailBAM alert of FBS (RS1) and left side NOISY (RS1), which are not the actionable alerts vide Railway Board's letter no. 2020/Dev. Cell/IGRI/9 dated 08.06.2021. (List of alerts: actionable and non-actionable is enclosed as **Annexure 1)**
4. The OMRS history of this coach was extracted for the period Sep'23 to Mar'24 and found that OMRS Sirsaul had noticed critical alert of **high wheel impact ratio** (5.114) generated in the **same coach** on date **24.01.2024**. It was checked at CNB and minor wheel shelling marks was found hence it was allowed in same condition. Control message was conveyed to Secondary Maintenance point (Delhi Division) and Primary Maintenance (LMDG division) for proper examination at their end. Later, it was detached at AGTL/LMDG division for examination on date 29.01.2024 during sick line attention. No fault was noticed.
5. No critical alert was generated by OMRS Kanchausi for the same coach during Sep'23 to Mar'24.

2.2 Non-Actionable alerts by OMRS/SSL

Details of OMRS/SSL alerts of different categories for Coaching / Freight stock for the period Jan'24 to Mar'24 are as under: -

	FBS(RS1)	NOISY(RS1)	RS1	SHRK(RS1)	Total
No of alerts/%	16948	15316	7740	1067	41070
	41.30%	37.3%	18.84%	2.6%	100%

(FBS (RS1)-FLANGING, BRAKING, SLAMMING, (RS-BEARING RUNNING SURFACE LIMIT) 1-HIGH DYNAMIC FORCES ON BEARING STRUCTURE, 3-LOW DYNAMIC FORCE ON BEARING STRUCTURE, NOISY-UNKNOWN (extraneous) NOISE, SHRK-Tonal Noise)

The number of non- actionable alerts having prefix FBS (16948) and NOISY (15316) are very high and as per present protocol not to be attended. The alerts not having suffix or prefix and non- actionable also i.e. RS1 (7740) are also quite high.

2.3 Actionable alerts by OMRS/SSL

Total 52 nos. (44 – Freight stock, 08- Coaching stock) of actionable alerts were generated by OMRS/SSL during the period Jan '24 to Mar'24. Details of actionable alerts for FY 2022-23 and 2023-24 is provided at **Annexure-2**.

Summarized details of alerts generated by OMRS/SSL during the period Jan '24 to Mar'24 are as under: [Details enclosed as **Annexure-2A**]

Type of Alerts	Coaching Stock	Freight Stock
RS1_p	7	38
RS1_n	1	6
Total	**8**	**44**

p: clear cup fault

n: clear cone fault

3. Findings and recommendation:

These may be grouped under these categories:

3.1) Findings and Recommendations for Railways:

a) **Finding: Non detection during D2 & D3 schedule of LHB Coaches:**
Actionable alerts of OMRS/SSL during Jan'24-Mar'24 in coaching stock is attached as **Annexure-2**. Reporting of alerts after last schedule has been attached as **Annexure-3**. From Annexure-2A, it is evident that these defects are not being detected in D2 & D3 schedule because one particular case happened just after one day of D2.

b) **Finding: Disproportionately high contribution of LWSCN Coaches:**
At present LWSCN contributes to disproportionality high % of alerts as can be seen from **Annexure-4**. Against 24.24% of coaches in rake composition, the alerts generated are as high as 50%. All 8 cases involving 6 coaches are either LWSCN or LWS.
Recommendation: This aspect of disproportionally high alerts in same variants of coaches needs to be looked into

c) **Disproportionate high contribution of LHB Coaches:**
Finding: The alerts have been analyzed stock wise LHB vs. ICF and it is seen that the number of alerts are very high in LHB coaches [**Annexure - 4(A)**].
Recommendation: These aspects need to be investigated by RDSO and OEM.

d) **Insignificant correlation of alerts of 02 RailBAM in UP & DN direction between TDL and FTP section**:
Finding: N. C. Railway has two OMRS Equipment; one at Sirsaul in UP direction and another at Kanchausi in down direction. Total alerts generated in coaching stock for both the OMRS have been analyzed [**Annexure-4(B)**] and it has been noticed that there is a significant variation in number of alerts generated during Jan'24-Mar'24 [**Annexure-4(C)**] (OMRS/KNS-34 alerts, OMRS/SSL-8 alerts).

Recommendation: There should be a similarity in the total alerts generated. The variation of such data needs a thorough investigation by RDSO and OEM and disparity should be rectified.

e) **No uniform protocol post RailBAM alert and adherence to WILD Format for RailBAM:**
Finding: Flaws in investigations at primary/secondary depot by RDSO:

i. There are no legislated guidelines regarding analysis or sequence of activities for culprit wheel to be carried out in case RailBAM alerts are generated. For RAILBAM alerts Zonal Railway are still following the format which is being used for investigation of WCM alerts. Investigation reports of NFR is attached at **Annexure-5(A)** which does not conform to RAILBAM investigations. NCR has developed a RAILBAM specific proforma attached

at **Annexure 5(B)**. ECR has additional sheet for RailBAM at **Annexure 5(C)**. ER and SER proforma too were obtained and placed at **Annexure 5(D)** and **Annexure 5(E)** respectively.

ii. During investigation many Zonal Railways are not mentioning the type of OMRS alerts.

Recommendation: The practice should be same for all Zonal Railways and RDSO may issue guidelines alongside format.

f) **No guideline regarding Timeframe for reckoning 03 alerts for detachment and investigation:**

Finding: In respect to the coach and wagons, no uniform practice is being followed. Some Zonal Railways are detaching the wagon after single OMRS alert and some are detaching the wagon when 03 alerts are generated by RAILBAM.

Recommendation: Nos of actionable alerts and time frame over which these are to be received needs to be defined by RDSO for automatic messaging for coaches and wagons.

g) **Investigation at Jhansi Workshop:**

Finding: Total 74 nos. CTRB of freight cars which having RAILBAM alerts was investigated by JHSW. Details of findings of investigation are as under:

Type of actionable alerts	No of cases	No. of cases conformed to RAILBAM alerts	No. of cases not conformed to RAILBAM alerts
RS1_p (cup)	59	14 (24%)	45 (76%)
RS1_n (cone)	15	2 (13%)	13 (87%)
Total	**74**	**16 (22%)**	**58 (78%)**

From above finding, it is clear that only 22% of CTRB are conforming with RAILBAM alerts.

Recommendations:

i. Workshops which are investigating the defective CTRB should have the detailed analysis of type of OMRS (RailBAM) alerts and its results.

ii. They should match its result with OMRS (RailBAM) alerts generated and develop data to ascertain the performance of OMRS equipment. Such detection of fault should be analyzed by RDSO and OEM for further improving the reliability of OMRS equipment.

iii. This has to be gone into further details by RDSO & OEM with reference to Bid document part-II, Section V, clause 1.4.3.1 regarding repeatability test which specifies greater than 50% conformance for smallest i.e. small size defects after opening in workshops and complied by OEM vide Annexure-1 (plan for type validation / prove-out of RailBAM system) Para 3.2. Relevant pages enclosed as **Annexure - 6**.

3.2) Recommendations for OEM:

3.2.1. **Disproportionately high RS1 Alert:** RS1 type of alert without (descriptor/suffix) despite being high and comprising nearly 18.84% of total alerts as well as being in the severe (Highest category) may continue as non-actionable alert and may not be shown in the system to obviate the confusion to the field staff. However, their accuracy needs to be improved so that a part of them are without descriptor and become actionable alerts in future.

3.2.2. **Post failure action details:** The details of post failure actions taken on CTRB/wheel should also be included in the database of OMRS so that its failure signature can be correlated with OMRS indications.

3.2.3. **Cancellation of noises attributed to Environment:** The type of alerts like FBS (RS1), NOISY (RS1) are noise level attributed to environment other than CTRB. The relation of these indications may be further analyzed for their relevance to CTRB failure.

3.2.4. The reliability and confidence level of these systems to be enhanced.

3.2.5. If, however, there is any relevance of these signals the conclusive logic should be provided by the OEM.

3.2.6. **Drawback in Systems:**

Detailed analysis of OMRS alert history of actionable alerts has been done for the 06 nos. of coaches (of 08 cases) in which actionable alerts were generated by OMRS/SSL during Jan'24-Mar'24 (**Annexure-4B**). Following points is concluded regrading generation of actionably alerts by OMRS system:

i. **No alert in reverse direction:**
In significant number of cases, actionable alerts generated by OMRS/SSL in the rolling stock when the train passed through the system in UP direction, but no actionable alerts were generated in the same rolling stock by OMRS/KNS when the train passed through it in DN direction. There is no uniformity in alert generation.

ii. **Different alert in reverse direction:**
In some cases, actionable alerts are generated by OMRS system in rolling stock when passed through the system in UP direction, but different type of actionable alerts are generated in the same rolling stock by other OMRS/KNS while passing in DN direction.

iii. **Non recording of alerts in System:**
Details of actionable alerts generated by OMRS system are not available in server for some incidences

3.2.7. **Acoustic signature database**: Right now, all these data are transmitted to control server and running software provided by WabTech, and fed into trending (FleetOne) data base. However, no significant gain is expected by comparison with Global bearing signature as BG rolling stock in operation of only in Spain, Portugal and some South American countries besides Indian subcontinent.

As the name suggest the purpose of feeding data on trending software (FleetOne) is to fine tune the trend over a period of time with increased data base alongside feedback on diagnostic and action taken. However, this purpose is not served due to not feeding the investigation report on any actionable alert and correlating with the system alerts which intrinsically is an iterative process.

3.2.8. **Data interchange:** Data interchange between CRIS and RAILBAM server should be secured through API or web services.

3.2.9. **Expanding the queries for RailBAM database**:
At present any Railway user has access to limited number of queries predefined by OEM. Railway users should hence have the ability to build an independent query after incorporating such changes and subsequent training by OEM. Alternatively, the range of predefined queries need to be increased after consultation with railway users at various levels who have gained significant experience.

3.2.10. **Various Sensing technologies for condition-based monitoring:**
The efficacy of various sensing technologies to monitor condition of axle box bearings have been discussed in **Annexure-7**. OEM may take a call in consultation with RDSO to analyze & fine tune its RailBAM system and related process & procedures to have greater precision & accuracy in results.

3.3 Recommendations regarding existing alert:

a. Severe alerts without any suffix/descriptor – These alerts should remain actionable and their correlation needs to be improved by OEM.

b. Repeatability of alerts generated by RailBAM should be improved by OEM.

c. Severe alerts without suffix/descriptor – These are too high a percentage and therefore should continue as non-actionable alerts.

d. Defining time frame for coaches and wagons for reckoning specific number of active severe alerts (RS1_p, RS1_n, RS1_r, RS1_m, RS1_e) and auto messaging to base depot through SMS and CMM.

3.4 Other Recommendations and Technical Overview

3.4.1. **Development of make in India bearing acoustic monitor and bearing vibration analyzer**

Development of make in India, bearing acoustic monitor may be undertaken. Undersigned, while working as CWM/JMP had developed Bearing vibration analyzer using MEMS triaxis vibration sensor, micro controller-based hall effect sensor, USB OTG cable for connecting laptop, C Driver SIMPLOT & MATLAB as software for CTRB of loose wheel set. A proof of concept (POC) equipment was also developed.

Vibration signature is captured from which noise signature is removed to obtain bearing vibration signature which is compared with the signature library of good acceptable bearing's signature as well as defective bearing signature subdivided into various type. In bearing acoustic monitoring, the

vibration sensor is replaced by acoustic sensor however, the noise is very high and the bearing acoustic signal is low which requires amplification and a vast library is required which should fine tune the system in an iterative manner.

The schematic diagrams of OMRS for single track and double track site are enclosed in **Annexure-8** and **Annexure-9** respectively**.**

3.4.2. Bearing damage causes interaction between the damaged area and components such as the races and rollers within the rolling element that generates additional noise and vibration. A number of signal processing methods can be applied to the measurements to detect and/or identify the type and severity of axle bearing defects. Signals can be analyzed in time, frequency or time–frequency domains. The geometry of the bearing can lead to certain frequencies being important, dependent on the type of fault. The following characteristic frequencies are generated in a bearing due to fault:

a. Fundamental train frequency (FTF) fault on the cage or mechanical looseness
b. Roller passing frequency outer race (RPFO) local fault on outer race
c. Roller passing frequency inner race (RPFI) local fault on inner race
d. Roller fault frequency

These fault frequencies are dependent on

i. Shaft rotation rate (Hz)
ii. The roller diameter (m)
iii. The mean roller race diameter
iv. The contact angle (rad)
v. The number of rollers

3.4.3. **Installation of a few RailBAM in low-speed locations**:

Due to presence of high noise, it is desirable that RAILBAM are installed where noise signature is less i.e. at low-speed locations. Empirical formula exists to arrive at indicative value which can be further fine-tuned with acoustics signature library.

It appears that RailBAM systems have been installed on the norms of WILD. But WILD alerts are immediately actionable alerts and therefore WILD locations are before major yards but RAILBAM alerts are maintenance alerts typically 1,00,000 Kms before failing. Hence, there should be different norms for RAILBAM detectors preferably for entire speed range 30-160 Kmph specific (vide leading parameters in section IV of COFMOW Bid document part 2) de linking from major yard.

The signature of the sound generated by WCM System is well known for wheel flats and in absence of identification of wheel flats bearing acoustic signal may be greatly masked and hence is needed to be separated to improve the accuracy of the alerts generated by RailBAM. Thus, WCM system in RailBAM is a concomitant tool for identification of wheel flat and thus its acoustic signature to get pure bearing acoustic signature and its assistive role should not guide the location based on WCH Norms.

Annexure – 1

Alerts naming Protocol for RailBAM Bearing Faults:

A. Actionable alerts:

Vide railway Board letter no. 2020/Dev Cell/IGRI/9 dated 08.06.2021, alert protocol for RAILBAL of OMRS system was issued to Zonal Railways. In accordance with the alert protocol, only Clear Level 1 running surface bearing faults, such as RS1_e, RS1_m, RS1_r, RS1_p, and RS1_n have been configured as 'actionable bearing alerts'.
(RS LEVEL DESCRIPTOR)
RS: Bearing Running surface fault; Level (impact severity of fault): 1/2/3: – Severe impact/ Moderate impact / Minor impact; DESCRIPTOR (detail about fault) r – clear roller fault, p – clear cup fault, n – clear cone fault, m – multiple faults, e – extended fault.

- RS1_r: Bearing Running surface fault clear roller fault
- RS1_p: Bearing Running surface fault clear cup fault
- RS1_n: Bearing Running surface fault clear cone fault
- RS1_m: Bearing Running surface fault clear multiple fault
- RS1_e: Bearing Running surface fault clear extended fault

The description of the Running Surface (RS) fault is determined by the roller pass frequency – the rate at which the rollers move over the cup and cone raceways.
When a description of the fault is clearly identifiable from the acoustic signal, the descriptor is appended to the severity classification.
For example, a severe cup fault would be classified as RS1_p.

The approximate roller pass frequencies and descriptors for different RS faults are given in the following table:

Fault Description	Roller Pass Frequency	Descriptor
Cone	12.5 to 14	_n
Cup	10 to 11.5	_p
Roller	3.5 to 4.8	_r
Multiple	Faults of similar severity on cup and cone.	_m
Extended	Any of the above with additional indication of an extended fault	_e

B. Non-actionable alerts:

PREFIX (RS LEVEL DESCRIPTOR)
e.g. NOISY(RS1)

PREFIX – noise that may interfere with bearing or wheel fault detection.

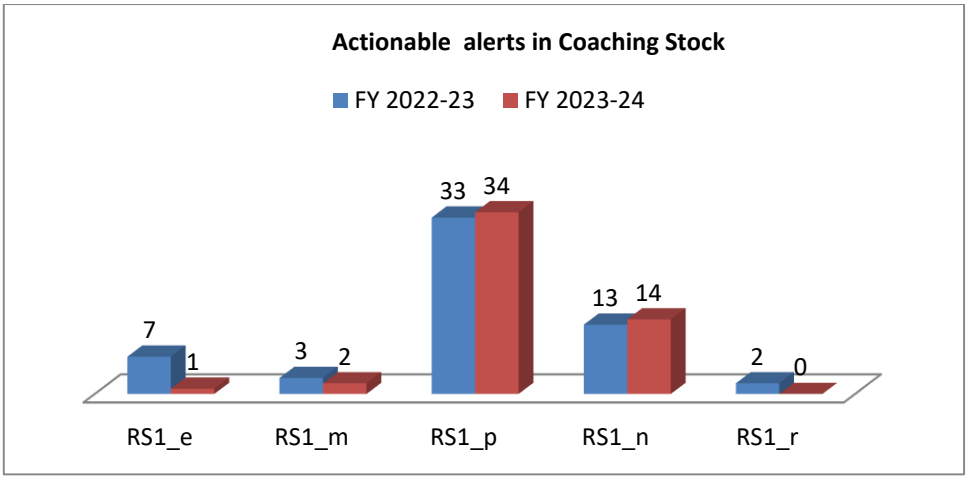
There are 04 types of prefix which are being used in non-actionable alerts, details of which are as under:

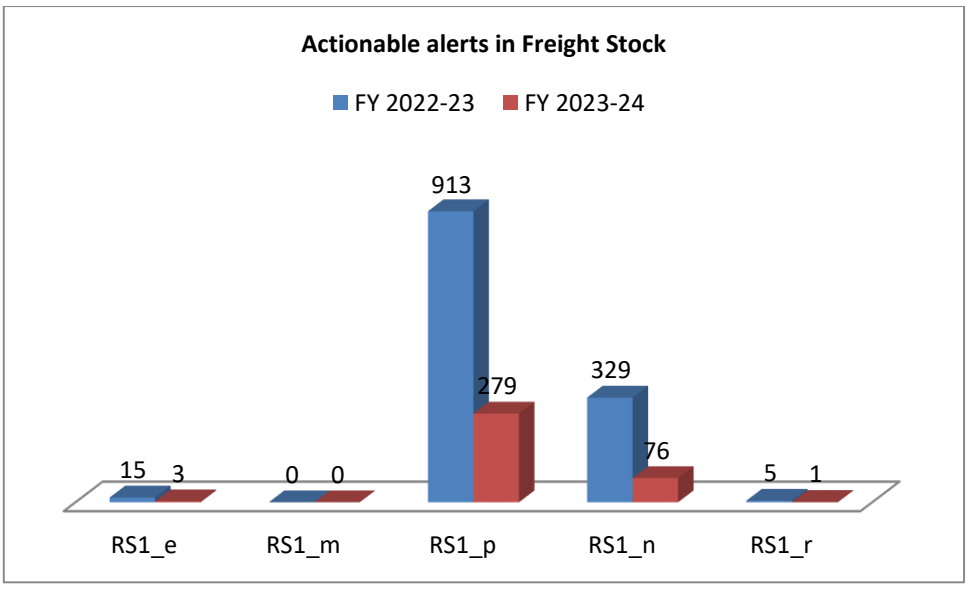
- **Clpd –** Data acquisition equipment saturated
- **Shrk –** Tonal noise (removed before bearing analysis
- **FBS –** Flanging, Braking, Slamming noise
- **NOISY –** Unknown (extraneous) noise.

Annexure-2

Actionable alerts of OMRS/SSL RAILBAM for FY 2022-23 & FY 2023-24

	FY 2022-23				FY 2023-24		
	Coaching	Freight	Total		Coaching	Freight	Total
Actionable Alert							
RS1_e	7	15	22	**RS1_e**	1	3	4
RS1_m	3	0	3	**RS1_m**	2	0	2
RS1_p	33	913	946	**RS1_p**	34	279	313
RS1_n	13	329	342	**RS1_n**	14	76	90
RS1_r	2	5	7	**RS1_r**	0	1	1
Total	58	1262	1320	**Total**	51	359	410



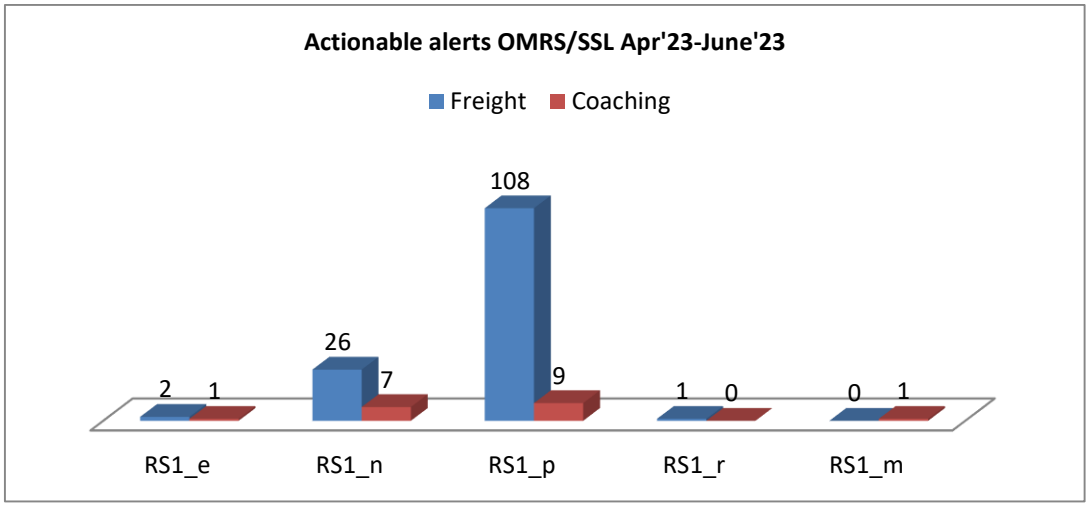


Actionable alerts of OMRS/SSL RAILBAM for quarterly period FY 2023-24

FY 2023-24 (Apr'23-June'23)

SSL (actionable alerts)

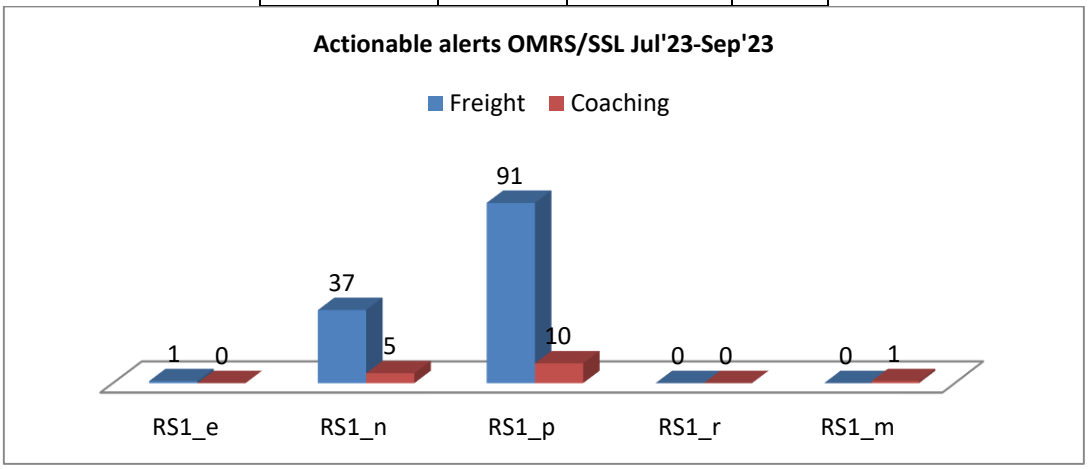
Alert type	Freight	Coaching	Total
RS1_e	2	1	3
RS1_n	26	7	33
RS1_p	108	9	117
RS1_r	1	0	1
RS1_m	0	1	1
Total	137	18	155



FY 2023-24 (Jul'23-Sep'23)

SSL (actionable alerts)

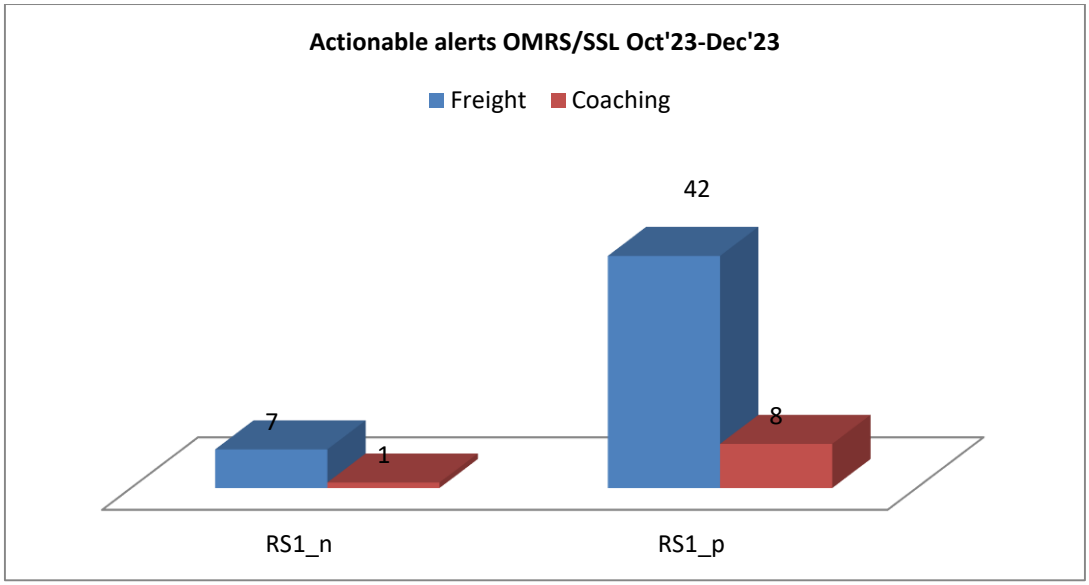
Alert type	Freight	Coaching	Total
RS1_e	1	0	1
RS1_n	37	5	42
RS1_p	91	10	101
RS1_r	0	0	0
RS1_m	0	1	1
Total	129	16	145



FY 2023-24 (Oct'23-Dec'23)

SSL (actionable alerts)

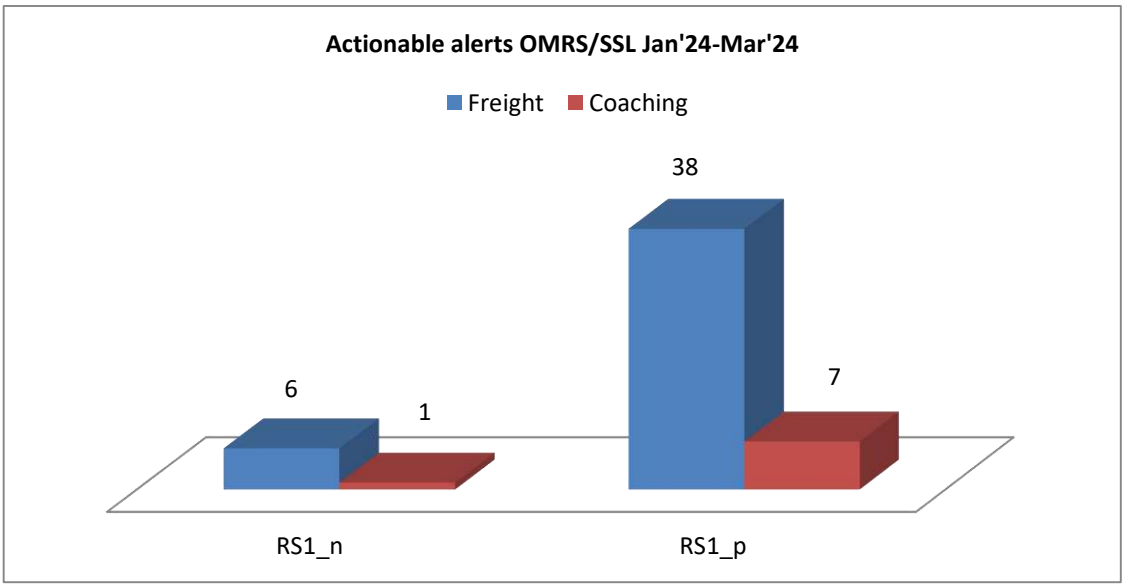
Alert type	Freight	Coaching	Total
RS1_n	7	1	8
RS1_p	42	8	50
Total	49	9	58



FY 2023-24 (Jan'24-Mar'24)

SSL (actionable alerts)

Alert type	Freight	Coaching	Total
RS1_n	6	1	7
RS1_p	38	7	45
Total	44	8	52



Annexure-2A

Sirsaul (SSL) OMRS /RAILBAM RS1 (Prefix) reported for Coaching Stock During Jan'24-Mar'24																
Sr. No.	Actual attending report															
	Date	Train passed SSL (as per machine)	Actual Alarm Time	Train No	Rolling Stock Position from Train Engine	Axle Position in rolling stock	Sensor type (Wheel impact force, Wheel impact ratio, Railbam)		Train checked at (station & time)	Coach No	Zone	Primary Depot / Division	DOC/ POH/ SS-1/ SS-2	IOH/ D-3/ D-2	Ret	Checked and found at primary depot	Advice to primary / secondary depot through Sms No
1	11.01.2024	04.44	04:57	12393	4	LT,LW S/Side	RAILBAM	RS1_p	CNB PF 02, 05.36-41	EC 195861 LWS	ECR	RJPB/ ECR	POH 03.11.2022	D2 RNCC 11.12.2023	Dec-25	wheel changed due to Abnormal sound from bearing	SSL/C/149
2	13.01.2024	10:45	10:55	12379	3	TT,TW S/S	RAILBAM	RS1_p	CNB PF 01 11.45-57	ER 172416 LWS	ER	SDAH/ ER	POH LLHM 23.06.21	D-2 SDAH 29.12.2023	Jul-24	Coach detachde for wheel turning	SSL/C/164
3	19.01.2024	06:12	06:22	12313	4	TT,LW N/SIDE	RAILBAM	RS1_p	CNB PF 03 06.50-55	ER 112113 LWACCN	ER	SDAH/ ER	POH LLHM 05.08.21	D-2 SADH 02.12.23	Sep-24	Nothing found, allowed to run	SSL/C/252
4	19.01.2024	07:45	07:57	12873	17	LT, LW S/SIDE	RAILBAM	RS1_n	CNB PF 02 08.21-38	SE 193680 LWSCN	SER	HTE/ SER	SS-2 14.11.22	D-2 HTE 18.01.24	Oct-25	wheel changed due to grease oozing	SSL/C/255
5	29.01.2024	18:35	18:52	15483	6	TT, TW N/SIDE	RAILBAM	RS1_p	CNB PF01, 19.13-30	NFR 217996 LWSCN	NFR	APDJ/ NFR	DOC/APDJ 27.07.23	D3/APDJ 09.01.24	Feb-25	Nothing found, allowed to run	SSL/C/359
6	09.02.2024	12:21	12:35	15483	6	LT LW N/S	RAILBAM	RS1_P	CNB PF 01 13.15-25	NF 217996 LWSCN	NFR	APDJ/ NFR	SS-1 APDJ 23.07.23,	D3- APDJ 09.01.24	Feb-25	Nothing found, allowed to run	SSL/C/512
7	16.03.2024	13:19	13:30	12561	3	LT,TW S/S	RAILBAM	RS1_p	CNB PF 02	EC 195794 LWS	ECR	JYG/ECR	SS-2 GKPS 23.01.23	D-3 JYG 23.02.24	Feb-26	Report not submitted	SSL/C/972
8	30.03.2024	11:53	12:12	15483	18	LTLW N/SIDE	RAILBAM	RS1_p	CNB PF 01, 12.30	NFR 217996 LWSCN	NFR	APDJ/ NFR	SS1 APDJ 23.07.2023	D2 APDJ 09.03.2024	Feb-25	Nothing found, allowed to run	SSL/C/1208

Annexure-3

Actionable alerts in Coaching Stock vs. Last Schedule Maintenance

Date of incidence	Level of actionable alert	Actionable alerts reported after last Schedule	Time elapsed from last schedule
11.01.2024	RS1_p	D2	30 days
13.01.2024	RS1_p	D2	15 days
19.01.2024	RS1_p	D2	48 days
19.01.2024	RS1_n	D2	1 days
29.01.2024	RS1_p	D3	20 days
09.02.2024	RS1_p	D3	31 days
16.03.2024	RS1_p	D3	22 days
30.03.2024	RS1_p	D2	21 days

Annexure-4

Coach Type-wise % of trains figured in actionable OMRS alerts at Sirsaul

SN	Train no	LWS	LWACCN	LWSCN	Others	Total Coaches
1	12393	3	6	6	7	22
2	12379	3	5	9	5	22
3	12313	0	14	0	8	22
4	12873	2	5	7	8	22
5	15483	2	5	4	11	22
6	12561	3	6	6	7	22
	Total	13	41	32	46	132
	%	9.8	31	24.24	34.8	100

LWSCN - Coach are 24% in population in the trains reflected in actionable OMRS alerts but the alerts generated are 50% of all actionable alerts.

Annexure – 4A

Details of Actionable Alerts for FY 2023-24 for different Coaching Stocks of OMRS/SSL

Duration	ICF	LHB	Total
Apr'23-Jun'23	3	15	18
Jul'23-Sep'23	4	12	16
Oct'23-Dec'23	3	6	9
Jan'24-Mar'24	0	8	8
Total	**10**	**41**	**51**
%	**20**	**80**	**100**

Annexure – 4B

Details of actionable alerts by OMRS SSL and KNS for 06 Different Coaches

SN 1	Coach no.	Train Time	Site	Vehicle Number	Train Axle Number	Vehicle Axle Number	Side of Train	Bearing Fault
1	ECR195861	12.01.2024	Kanchausi	21	86	4	R	RS1_e
		11.01.2024	Sirsaul	5	19	1	L	RS1_p
2	ER 172416	no data						
3	ER 112113	no data						
4	SER193680	19.01.2024	Sirsaul	18	71	1	L	RS1_n
5	ECR195794	16.03.2024	Sirsaul	4	16	2	R	RS1_p
6	NFR217996	13.01.2024	Kanchausi	18	73	3	L	RS1_p
		13.01.2024	Kanchausi	18	74	4	L	RS1_e
		18.01.2024	Kanchausi	18	72	4	L	RS1_e
		29.01.2024	Sirsaul	7	25	1	R	RS1_p
		09.02.2024	Sirsaul	7	27	1	R	RS1_p
		03.03.2024	Sirsaul	19	75	4	R	RS1_p

Analysis of actionable RAILBAM alerts of 08 nos. of cases by OMRS/SSL during Jan'24 to Mar'24

Case 1:- Coach no. EC 195861 LWS

a. On date 11.01.2024, actionable RAILBAM alerts (RS1_p) was generated by OMRS/SSL in leading trolley leading end south side.
b. On date 12.01.2024, actionable RAILBAM alerts (RS1_e) was generated by OMRS/KNS in trailing trolley trailing end South side.
c. Different type of actionable alerts was generated in same axle of a coach by two different OMRS system.

Case 2:- Coach no. ER 172416 LWS

a. On date 13.01.2024, actionable RAILBAM alerts (RS1_p) was generated by OMRS/SSL in trailing trolley trailing wheel (South side), but this case is not being reflected in fetched details from WabTech server.
b. Besides this, there was no actionable alert generated by OMRS/KNS in the same coach.

Case 3:- Coach no. ER 112113 LWACCN

c. On date 19.01.2024, actionable RAILBAM alerts (RS1_p) was generated by OMRS/SSL in trailing trolley leading wheel (north side), but this case is not being reflected in fetched details from WabTech server.

a. Besides this, there was no actionable alert generated by OMRS/KNS in the same coach.

Case 4: - Coach no. SER 193680 LWSCN

a. On date 19.01.2024, actionable RAILBAM alerts (RS1_n) was generated by OMRS/SSL in leading trolley leading wheel (south side), but no actionable alert generated by OMRS/KNS in the same coach.

Case 5: - Coach no. EC 195794 LWS

a. On date 16.03.2024, actionable RAILBAM alerts (RS1_p) was generated by OMRS/SSL in leading trolley trailing wheel (south side), but there was no actionable alert generated by OMRS/KNS in the same coach.

Case 6: - Coach no. NFR 217996 LWSCN

a. Following actionable RAILBAM alerts were generated by OMRS/KNS and OMRS/SSL in coach no. NF 217966:

OMRS/KNS			OMRS/SSL		
Date	Axle position	Alert	Date	Axle position	Alert
13.01.2024	Trailing trolley trailing wheel (north side)	RS1_e	29.01.2024	Trailing trolley trailing wheel (north side)	RS1_P
13.01.2024	Trailing trolley leading wheel (north side)	RS1_p	09.02.2024	Leading trolley leading wheel (north side)	RS1_p
18.01.2024	Leading trolley trailing wheel (north side)	RS1_e	03.03.2024	Leading trolley leading wheel (north side)	RS1_p

The data and type of actionable alerts for the same coach are different.

From above analysis following points have been concluded regrading generation of actionably alerts by OMRS system:

i. In few cases, actionable alerts generated by OMRS/SSL in the rolling stock when the train passed through the system in UP direction, but no actionable alerts were generated in the same rolling stock by OMRS /KNS when the train passed through it in DN direction. There is no uniformity in alert generation.

ii. In some cases, actionable alerts are generated by OMRS system in rolling stock when passed through the system in UP direction, but different type of actionable alerts are generated in the same rolling stock by other OMRS/KNS while passing in DN direction.

iii. Details of actionable alerts generated by OMRS system are not available in server for some incidences

Annexure – 4C

Comparison of Actionable alerts generated at OMRS/SSL and OMRS/KNS for FY 2023-24 for different Coaching Stocks for OMRS/SSL

	FY 2023-24		Jan'24-Mar'24	
	OMRS/SSL	OMRS/KNS	OMRS/SSL	OMRS/KNS
No. of Alerts	51	98	8	34

ANNEXURE-5A

Check List To Be Filled For LHB Coaches With OMRS Alert			
Type of Failure	OMRS Reported		
Coach No	217996 - NF/LHBCN.		
Train No.	15483 DN		
SS2/SS3 Date	DOC AMJ 23122		
RL Date	09-25		
SS1 Date	AMJ 23123		
Date of Detection			
Date of Placement	02.04.24		
Alert Details			
OMRS Alerts generated in last 01 year			
Values of OMRS Alerts generated in last 01 year			
Primary spring failures in last 01 year			
Observations	Items to be checked as per OMRS protocol issued by RDSO CONDITION ACTION TAKEN Lt. No. - RZ/171/WILD/Rlys/Vol.-XII	Condition Found	Action Taken
	1. Wheel defects as per IRCA Part IV & CMIK 003.	No wheel defects	
	2. Inner/outer axle spring broken.	No	
	a. Inner spring condition	OK	
	b. Outer spring condition	OK	
	3. Oil leakage from Lateral/vertical/Yaw dampers.	No oil leakage	
	a. Lateral damper condition	OK	
	b. Primary Vertical damper condition	OK	
	c. Secondary vertical damper	OK	
	d. Yaw damper condition	OK	
	4. Defect in secondary suspension system (Inner/outer)	NO	
	a. Inner spring condition	-	
	b. Outer spring condition	-	
	5. Air spring should not in deflated condition.	Not deflated	
	6. Control arm should be intact properly	OK	
	7. All components of primary suspension (Rubber pad, rubber spring and ring) should be in intact position.	OK	
	8. Defect in steel coil spring and rubber spring of secondary suspension system.	-	
	9. Abnormal sound from axle box/ hot axle.		
	10. Wheel Shelling observed.	NO - Shelling Mark	
Action Taken	Allowed to Run.		
Bearing Details	N/A.		
Remarks	OK.		

OMRS Alert Ref:- Message BSL/C/1208

Wheel observation image

SSE-CUM-CDO (NOVAPOL) N.F. RLY.

Check List To Be Filled For LHB Coaches With OMRS Alert

Type of Failure	OMRS Reported 217996 NEELWSCN
Coach No	15483
Train No.	Doc: APDJ 23.01.21
SS2/SS3 Date	2/25
Rt. Date	APDJ. 23.07.23
SS1 Date	10.02.24
Date of Detection	12.02.24
Date of Placement	
Alert Details	
OMRS Alerts generated in last 01 year	
Values of OMRS Alerts generated in last 01 year	
Primary spring failures in last 01 year	

Observations	Items to be checked as per OMRS protocol issued by RDSO CONDITION ACTION TAKEN Lt. No. - R2/171/WILD/Rlys/Vol.-XII	Condition Found	Action Taken
	1. Wheel defects as per IRCA Part IV & CMIK 003.	No coheel defects found	
	2. Inner/outer axle spring broken.	NO	
	a. Inner spring condition	OK	
	b. Outer spring condition	OK	
	3. Oil leakage from Lateral/vertical/Yaw dampers.	Oil leakage not found	
	a. Lateral damper condition	OK	
	b. Primary Vertical damper condition	OK	
	c. Secondary vertical damper	OK	
	d. Yaw damper condition	OK	
	4. Defect in secondary suspension system (Inner/outer)	N/A	
	a. Inner spring condition	N/A	
	b. Outer spring condition	N/A	
	5. Air spring should not in deflated condition.	No deflated Found Intact	
	6. Control arm should be intact properly	All components found intact.	
	7. All components of primary suspension (Rubber pad, rubber spring and ring) should be in intact position.	N/A	
	8. Defect in steel coil spring and rubber spring of secondary suspension system.	Not reported Minor wheel Skelly.	
	9. Abnormal sound from axle box/ hot axle.		
	10. Wheel Shelling observed.		
Action Taken	Allowed to run.		
Bearing Details			
Remarks			

OMRS Alert Reff:- Message SSL/C/1208

Wheel observation Image.

A.K. Barman
12.02.24

A/B - KBL.

Check List To Be Filled For LHB Coaches With OMRS Alert

Type of Failure	OMRS Reported.
Coach No	21799 C1 NF/LWSCN
Train No.	15483 DN
SS2/SS3 Date	DOC APDJ 23.01.22.
Rt. Date	02/25
SS1 Date	APDJ 25/07/23.
Date of Detection	29.01.2024
Date of Placement	01.02.2024
Alert Details	
OMRS Alerts generated in last 01 year	
Values of OMRS Alerts generated in last 01 year	
Primary spring failures in last 01 year	

Observations

Items to be checked as per OMRS protocol issued by RDSO CONDITION ACTION TAKEN Lt. No. - R2/171/WILD/Rlys/Vol.-XII	Condition Found	Action Taken
1. Wheel defects as per IRCA Part IV & CMIX 003.	No wheel defects detected.	
2. Inner/outer axle spring broken.	NO.	
a. Inner spring condition	OK	
b. Outer spring condition	OK.	
3. Oil leakage from Lateral/vertical/Yaw dampers.	No oil leakage.	
a. Lateral damper condition	OK	
b. Primary Vertical damper condition	OK	
c. Secondary vertical damper	OK	
d. Yaw damper condition	OK	
4. Defect in secondary suspension system (Inner/outer)	N/A	
a. Inner spring condition	N/A	
b. Outer spring condition	N/A	
5. Air spring should not in deflated condition.	No deflated	
6. Control arm should be intact properly	Intact properly.	
7. All components of primary suspension (Rubber pad, rubber spring and ring) should be in intact position.	All are found intact condition.	
8. Defect in steel coil spring and rubber spring of secondary suspension system.	N/A.	
9. Abnormal sound from axle box/ hot axle.	Not reported.	
10. Wheel Shelling observed.	Minor.	

Action Taken	Allow to run.
Bearing Details	—
Remarks	—

OMRS Alert Ref> Message NO: SSL/C/359 on date 29.01.2024

Wheel observation Image.

Visually checked all wheels. No wheel defects found. Minor shelling mark within permissible limit found on wheel tread.

01/02/24

ANNEXURE-5B

NORTH CENTRAL RAILWAY

Headquarter Office
Mechanical Branch
Prayagraj

File No. NCR/MECH./826/part-12/WILD

Dated: 17.05.2024

Sr.DME/C&W
North Central Railway
PRYJ, AGC & JHS

Sub: Investigation Format for RAILBAM Actionable Alerts.

Vide above referred subject matter, please find enclosed herewith format for investigation of RAILBAM alert in LHB coach and freight stock.

It is advised to ensure the thorough investigation of the RAILBAM alert of LHB and Freight stock should be done according to the issued format.

These formats have been issued with approval of competent authority.

DA: Format for LHB coach (03 pages)
Format for freight stock (03 pages)

17.5.24

(Pramod Kumar Pandey)
CRSE/Freight/NCR

RAILBAM Alert Investigation in LHB Coaches

General particulars			
OMRS location/Division		RailBam Alert type	
Date		Time	
Coach Position from engine		Axle no.	

Train particulars		Date	
Train no.		Ex-to	
Engine no.		Load	
BPC no. station date		LP	
Primary depot		TM	
Sch. Arr. and dept.		Actual arr./Dept. and line no.	

1.1 Coach Details

Coach number	Primary Depot	Owning Railway	Production Unit	Date of commissioning	Return date

1.2 Maintenance Particulars

Any Shop Schedule done (Yes/No)	Last shop schedule particulars (SSI, SSII, SSIII)	Date of Shop Schedule	Workshop	Last D1 schedule date	Last D3 schedule date

Action to be taken by depot on Receiving RAILBAM alerts

Item	Observation
1. Affected axle no.	
2. Abnormal sound from axle box during rolling in examination	

3. Affected end axle temperature along with other axles	Location of wheel	Temperature of axle box (Bearings)
	L-1	
	L-2	
	L-3	
	L-4	
	R-5	
	R-6	
	R-7	
	R-8	
4. Condition of bearing (affected axle)		
5. Axle box grease oozing		
6. Any visual symptoms of bearing failure		
7. Condition of control arm fittings		
8. Condition of primary vertical damper		
9. Condition of coil spring		
10. Condition of secondary suspension		
11. Condition of wheel tread		
12. Any other observation		
13. Action taken		
14. Conclusion		

1.3 Whether coach was detached -

Additional details to be furnished

1. All RAILBAM Alerts for the Coach during last 01 year:-

SN	Date of alarm	#Location of alarm	Type of alerts	Issue identified for the alarm	Action taken
1.					
2.					
3.					
4.					
5.					

#As per figure A/Figure B under para 1.6.2 in In chapter 1 (introduction) of CAMTECH Maintenance Manual for LHB Coaches, Volume-II (copy enclosed). Details of each alarm should be listed in separate rows.

2. Sick Marking History (Including damper change) of the coach during last six month:-

SN	Date of sick marking	Issue identified	Location of failure	Action taken
1.				
2.				
3.				
4.				
5.				
6.				

RAILBAM Alert Investigation of Freight Stock

General particulars			
OMRS location/Division		RailBam Alert type	
Date		Time	
Wagon Position from engine		Axle no.	

Train particulars		Loaded/empty	
Train no.		Ex-to	
Engine no.		Load	
BPC no./date /yard name/Type of BPC		LP	
GDR details		TM	

1.1 Wagon Details

Wagon number	Type of wagon	POH	ROH	Return date

Action to be taken by depot on Receiving RAILBAM alerts

Item	Observation		
1. Affected axle no.			
2. Abnormal sound from CTRB during rolling in examination			
3. Affected end axle temperature along with other axles	Location of wheel	Temperature of axle box (Bearings)	
	LTLW	LHS	
		RHS	
	LTTW	LHS	
		RHS	

	TTLW	LHS	
		RHS	
	TTTW	LHS	
		RHS	
4. Condition of bearing (affected axle)			
5. Grease oozing			
6. Any visual symptoms of bearing failure			
7. Condition of EM pad(shifted/perished)			
8. Condition of CCSB (gap, wear plate worn out, any other abnormality noticed etc.)			
9. Condition of Adaptor (canted/any other abnormality)			
10. Condition of coil spring			
11. Condition of wheel tread			
12. Any other observation			
13. Action taken			
14. Conclusion			

Additional details to be furnished

1. All RAILBAM Alerts for the Wagon during last one year:-

SN	Date of alarm	#Location of alarm	Type of alerts	Issue identified for the alarm	Action taken
1.					
2.					
3.					
4.					
5.					

2. Sick Marking History of the wagon during last six month:-

SN	Date of sick marking	Issue identified	Location of failure	Action taken
1.				
2.				
3.				
4.				
5.				

Annexure – 5C

East Central Railway

DATE: - 14/01/2024 5C

SSE/C&W/RNCC
Danapur

Rajendra Nagar Coaching Complex, Patna Report

Check List To Be Filled For LHB Coaches With OMRS Alert			
Type of Failure	On-line Monitoring of Rolling stock System		
Coach No	EC LWS 195861		
Train No.	12355		
SS2/SS3 Date	HRT 03/11/2022		
Rt. Date	12/25		
SS1 Date	------		
D1,D2 & D3	D2 RNCC 11/12/2023, D3 RNCC 05/11/2023		
Date of Detection	11/01/2024 & 12/01/2024 respectively.		
Date of Placement	14/01/2024		
Alert Details	OMRS machine at SSL reported RAILBAM RS1_p in D/D S/S wheel & KNS reported RAILBAM RS1-E in D/D S/S wheel.		
Observations	**Items to be checked as per OMRS protocol issued by RDSO CONDITIONACTION TAKEN Lt. No. - R2/171/WILD/Rlys/Vol.-XII**	**Condition Found**	**Action Taken**
	1. Wheel defects as per IRCA Part IV & CMIK 003.	OK	
	2. Inner/outer axle spring broken.	Ok	
	a. Inner spring condition	Ok	
	b. Outer spring condition	Ok	
	3. Oil leakage from Lateral/vertical/Yaw dampers.	Ok	
	a. Lateral damper condition	Ok	
	b. Primary Vertical damper condition	OK	
	c. Secondary vertical damper	OK	
	d. Yaw damper condition	Ok	
	4. Defect in secondary suspension system (Inner/outer)		
	a. Inner spring condition	N/A	
	b. Outer spring condition	N/A	
	5. Air spring should not in deflated condition.	OK	
	a. Air Spring height	OK	
	b. Isolating cocks of pneumatic system (air spg. /FIBA) set for proper functioning.	OK	
	c. Leakage test of pipe line & joints of pneumatic suspension with soap solution.	OK	
	d. Visual condition of levelling valve & installation lever	OK	
	6. Control arm should be intact properly	Ok	
	7. All components of primary suspension (Rubber pad, rubber spring and ring) should be in intact position.	Ok	
	8. Abnormal sound from axle box/ hot axle.	**D/D S/S wheel bearing abnormal sound dia. 913 mm.**	Coach detain for wheel change.
	9. Wheel Shelling observed. Refer TSO- 04 if wheel shelling found and format is attached (Anex.1)	No	
	10. Antiroll bar	Ok	
Action Taken	**D/D S/S wheel bearing abnormal sound dia. 913 mm.** Coach detain for wheel change.		
Bearing Details	D/D N/S- SKF OR V 06 18 16714 JQ 116 18/07/22 S/S- SKF OR V 05 14 38663 JQ 02115 18/07/22		
Remarks			

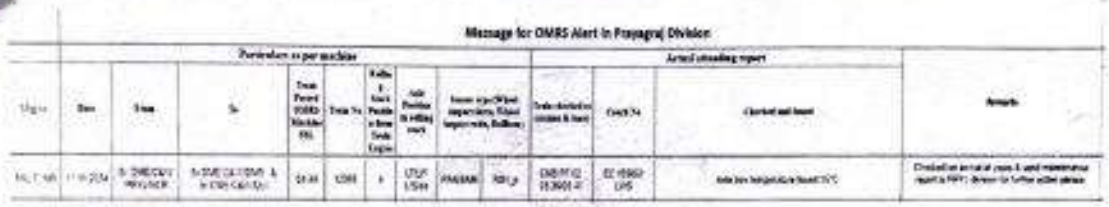
Rajendra Nagar Coaching Complex, Patna

OMRS (WCM) / WILD Alert / Alarm Feedback and Action Taken format

1. Details of present case of alarm:-

1.1 Following details to be provided:

Train no.	Coach No. and Transportation code	Critical / Maintenance Alarm with date	#Location of alarm	Impact Load of alarm	Impact Load Factor of alarm	En-route Observation	Location where alert noticed (OMRS/ WILD Site)
12393 & 12394	EC LWS 195861	11/01/2024 & 12/01/2024	D/D S/S		------	Axle box temperature 15 degree C	SSL & KNS





As per 'Figure A/Figure B' under Para 1.6.2 in chapter 1 (introduction) of CAMTECH Maintenance Manual for LHB Coaches, Volume-II

1.2 Details of Alarm:

(i) Whether alarm / alert received for one wheel or more than one wheel inpresent case of alarm (Provide details). ---- ONE WHEEL

(ii) Details of all alarms should be listed in separate rows & feedback and actiontaken should be filled for each alarm in following format. ---form Attached

1.3 Coach Details

Primary Depot	Owning Railway	Production Unit	Date of commissioning
RNCC	EC	MCF	-----

1.4 Maintenance Particulars

Any Shop Schedule done (Yes / No)	Last shop schedule particulars (SSI, SSII, SSIII)	Date of Shop Schedule	Workshop	Last D1 schedule date	Last D2 D3 schedule date
YES	SSII	03/11/2022	HRT	-----	D2 RNCC 11/12/2023, D3 RNCC 05/11/2023

2. All OMRS (WCM)/WILD Alerts/Alarms for the Coach during last 30 days:-

S. No.	Date of Alarm	Critical/ Maintenance Alarm	#Location of Alarm	Impact Load of alarm	Impact load factor of alarm	Issue identified for the Alarm	Action taken
				NIL			

As per 'Figure A/Figure B' under Para 1.6.2 in chapter 1 (Introduction) of CAMTECH Maintenance Manual for LHB Coaches, Volume-II (copy enclosed). Details of each alarm should be listed in separate rows.

3. Sick Marking History (Including damper change) of the coach during last one year:-

S. No.	Date of Sick Marking	Issues Identified	Location of Failure as per 'Figure A/Figure B' under Para 1.6.2 of CAMTECH Maintenance Manual for LHB Coaches, if sick marking due to coil spring failure or bearing failure or wheel defects or any other axle box level defect	Actiontaken
1	10/05/2023	D.V DEFECTIVE (MAKE-F)		REPAIRED
2	26/01/2023	WSP DEFECTIVE		REPAIRED

4. Condition / investigation of concerned Primary Suspension System:-

4.1 Investigation for Axle Box involved in the alarm / alert- Ok

4.1.1 Condition of Wheel Tread: Wheel tread condition shall be thoroughlyexamined for shelling, flat or any other issue **D/D S/S wheel bearing abnormal sound dia. 913 mm.** Coach detain for wheel change.

Note: Corresponding other wheel of same axle should also be checked for above Parameters.

4.1.2 Bearing: Temperature of axle box and visual condition of Bearing.

Temperature –N/A

Visual condition of bearing- Ok

Note: *Corresponding other bearing & axle box of the same axle should also be checked for above parameters*

4.1.3 Brake System: Health of brake system shall be checked as per Annexure -1 to this format.

1	Bogie BC flexible hose washer condition (hole through /perished / shrinkage dia less)	OK
2	Brake cylinder hose ID (through/blocked).	Through
3	BC pressure in coach also any fluctuation in BC pressure noticed w.r.t last schedule pressure reading.	OK (03 KG/CM^2)
4	Check the bogie body BC flexible hose pipe is of Ermeto type or std design.	Std design
5	Check the size of BC flexible hose pipe bogie to body whether fitted correct size. (700m m ICF hose should not be provided in LHB coaches as id is less.	Correct size(500 MM,ID -15.8 MM)
6	Whether correct size (id 14mm of male stud connector fitted in bogie	14 mm
7	Check the BC flexible hose pipe for any Twist, bent etc.	Found ok
8	Check the fitment of Bite joints in Body bogie flexible pipe line as per drawing. (More no. of bite joints are not allowed).	OK (ALL READY MODIFIED)
9	Condition of BP filters (leakage/blockage)	Ok
10	Functioning of PEABP box and check for any leakages.	Ok

4.1.4 Control Arm:

S. No.	Check	Observation
1.	Visual condition of Control Arm	OK

Note: *Corresponding other control arm of same axle should also be checked for above parameters.*

4.1.5Coil Spring:

S. No.	Check	Observation
1.	Condition of involved coil spring	OK
2.	Condition of coil springs at other axle boxes.	OK

Note: *In case of broken coil spring, action should be taken as per extant guidelines. Investigation as per format for coil spring failure shall also be done.*

4.1.6 Primary Vertical Dampers:

S. No.	Check	Observation
1.	Visual	OK
2.	Leakage	OK

Note: 1) *If condition of primary vertical damper is not OK, it shall be changed.*

2) *Corresponding other damper of same axle should also be checked for above parameters.*

4.1.7 Inspection of Primary Bump Stop:

S. No.	Check	Observation
1.	Visual	OK

4.2 Visual inspection of Bogie Frame:

S. No.	Check	Observation
1.	Visual	OK

5. Condition / investigation of Secondary Suspension of same bogie:-

5.1 Secondary Coil Spring:

S. No.	Check	Observation
1.	Condition of coil spring.	N/A
2.	Condition of other coil spring nest of same bogie.	N/A

5.2 Air Suspension System:

S. No.	Check	Observation
1.	Visual condition of air spring	OK
2.	If inflated , Installed height of air spring (289 – 294) mm	OK
3.	Isolating cocks of pneumatic system (air spring/ air spring control equipment/FIBA) set for proper functioning	OK
4.	Leakage test of pipe line and joints of pneumatic suspension with soap solution.	OK
5.	Visual condition of leveling valve and Installation lever	OK

Note: *Corresponding other air spring, leveling valve & installation lever of same bogie should Also be checked for above parameters*

5.3 Dampers:

S. No.	Type of damper	Inspection	Observation
1.	Secondary Vertical Damper	Visual	OK
2.	Secondary Lateral Damper	Visual	OK
3.	Yaw Damper	Visual	OK

Note: 1) *If condition of dampers is not OK, it shall be changed.*

2) *Corresponding other Secondary Vertical damper and Yaw damper of same bogieshould also be checked for above parameters.*

5.4 Antiroll Bar:

S. No.	Item	Observation
1.	Visual Check	OK

Note: *If condition of antiroll bar is not OK, it shall be rectified for observed defect.*

5.5 Lateral and longitudinal bump stop:

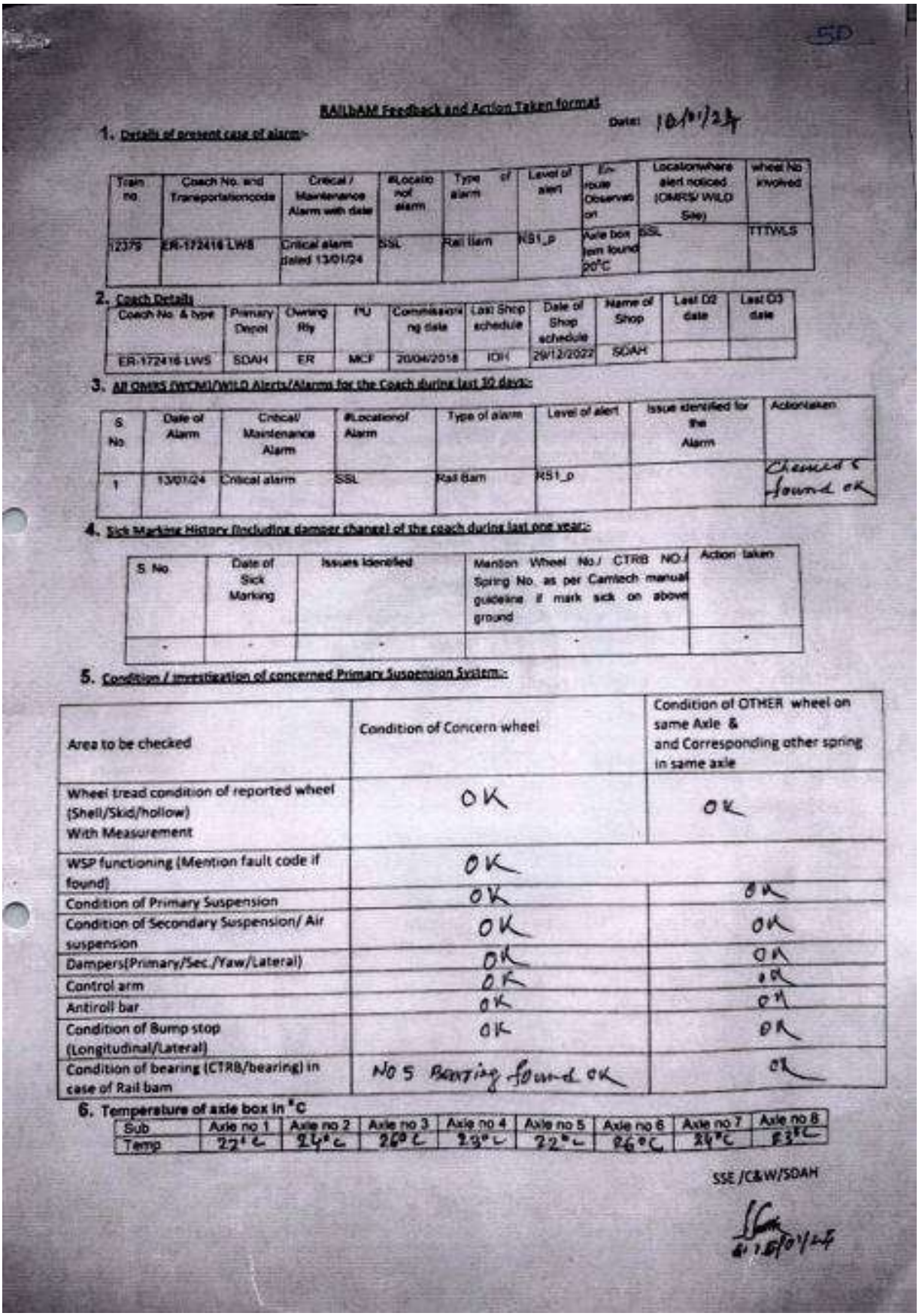
S. No.		Item	Observation
1.		Visual Check	OK

6. If wheel set is changed or coach is lifted for any other reason, details ofwheel set:-

S. No.	Condition	Details sought / Check
1.	Bearing failed (Reported wheel bearing detail)	D/D N/S- SKF OR V 06 18 16714 JQ 116 18/07/22 S/S- SKF OR V 05 14 38663 JQ 02115 18/07/22
2.	Wheel tread defect	Depth of cut to make wheel good **D/D S/S wheel bearing abnormal sound dia. 913 mm.** Coach detain for wheel change.
3.	If coach lifted for any other reason	Movement of bearing should be checked. **NO**

14/02/22
SSE/SL/RNCC

Annexure – 5D



5D

BA\|bAM Feedback and Action Taken format

Date: 10/01/24

1. Details of present case of alarm:-

Train no	Coach No. and Trainportationcode	Critical / Maintenance Alarm with date	#Locatio nof alarm	Type of alarm	Level of alert	En-route Observati on	Locationwhere alert noticed (OMRS/ WILD Site)	wheel No involved
12379	ER-172416 LWS	Critical alarm dated 13/01/24	SSL	Rail bam	RS1_P	Axle box tem found 20°C	SSL	TTTWLS

2. Coach Details

Coach No. & type	Primary Depot	Owning Rly	PU	Commissioni ng date	Last Shop schedule	Date of Shop schedule	Name of Shop	Last D2 date	Last D3 date
ER-172416 LWS	SDAH	ER	MCF	20/04/2018	IOH	29/12/2022	SDAH		

3. All OMRS (WCM)/WILD Alerts/Alarms for the Coach during last 30 days:-

S No	Date of Alarm	Critical/ Maintenance Alarm	#Locationof Alarm	Type of alarm	Level of alert	Issue identified for the Alarm	Actiontaken
1	13/01/24	Critical alarm	SSL	Rail Bam	RS1_P		Checked & found ok

4. Sick Marking History (Including damper change) of the coach during last one year:-

S No	Date of Sick Marking	Issues identified	Mention Wheel No./ CTRB NO./ Spring No. as per Camtech manual guideline if mark sick on above ground	Action taken
-	-	-	-	-

5. Condition / investigation of concerned Primary Suspension System:-

Area to be checked	Condition of Concern wheel	Condition of OTHER wheel on same Axle & and Corresponding other spring in same axle
Wheel tread condition of reported wheel (Shell/Skid/hollow) With Measurement	OK	OK
WSP functioning (Mention fault code if found)	OK	
Condition of Primary Suspension	OK	OK
Condition of Secondary Suspension/ Air suspension	OK	OK
Dampers(Primary/Sec./Yaw/Lateral)	OK	OK
Control arm	OK	OK
Antiroll bar	OK	OK
Condition of Bump stop (Longitudinal/Lateral)	OK	OK
Condition of bearing (CTRB/bearing) in case of Rail bam	No 5 Bearing found OK	OK

6. Temperature of axle box in °C

Sub	Axle no 1	Axle no 2	Axle no 3	Axle no 4	Axle no 5	Axle no 6	Axle no 7	Axle no 8
Temp	27°C	24°C	26°C	23°C	22°C	26°C	24°C	23°C

SSE /C&W/SDAH

10.50/01/24

No :NCC/SPL/04/2024 Date: 18.04.2024

Divisional Mechanical Engineer(C&W)
Eastern Railway ,Sealdah

Sub: **Queries from HQ regarding OMRS alert of two coaches 112113 LWACCN & 172416 LWS dtd 19.01.2024 & 13.01.2024.**

Vide subject above the details report of OMRS alert of the above mentioned coaches are as under :

1. Te detail report of the OMRS alert is furnished below for 172416 LWS dtd 13-01-2024 . The coach was detached for wheel turning on account of no 3 wheel RTS on 22.01.2024.

2. There was no information of OMRS alert regarding coach 112113 LWACCN on 19.01.2024 neither from any division nor in CMM. The last OMRS shown in CMM is 21.11.2023 . But from sick history is found that the coach was detached for wheel turning on 02.01.2024 (all wheel skidded) and on 27.01.2024 (wheel 1,2,3,5,6 wheel skidded & shelled) in this period WSP was in working condition and code was 99

Details OMRS report and action taken of coach 172416 LWS

Sl. No	Data feeding Division	Alert Msg received Date	Detect by TBMS/ WILD/ OMRS/ OBCMS	Train details		Coach Particulars								Detection Date /Time	
				Train No	PM Depot	Rly	Type	Coach No	POH/DOC		IOH		R/Dt	Date	Time
									Shop	Date	Depo	Date			
1327	SDAH	13-01-2024	OMRS	12379	SDAH	ER	LWS	172416	LLHW	23-06-2021	SDAH	29-12-2022	Jul-24	13-01-2024	NA

Fault Category (RailBAM/WCM/ThermalCAM)	Detail Fault Type	WCM Impact value	Thermal CAM Temperature	Axle No	Axle Box (Near , Far)	Remarks				
						Coach detached/Allowed after Investigation	Date of coach Detachment or Allowed	Wheel/Bogie Changed on	Date Sent to LLH/KPA for investigation	Recvd by LLH/KPA
RailBAM	RS1_p			TTTWLS		Allowed	16-01-2024			

Inspection/Investigation Report					
			By Shop		
Date of Investigation	Details report	Action Taken	Date of Investigation	Details report	Action Taken
16-01-2024	Nothing abnormal found	Allowed			

SSE/C&W/SDAH

SER

Report in connection with defect detected by OMRS

Ref:- OMRS/SSL-PRJ Msg no 245

Train No:- 12893

Detected Coach no:- SE 193680 - LWSCN Date:- 2.11.24

SL no	Items to be checked	Observation
1	Coil Spring weak	Nil
2	Shell Tread/Wheel defect	All wheel profile found ok
3	Control arm condition/paint on control arm bolts	Ok found tightened
4	Lateral bump Stop gap	Found within permissible limit
5	Defects in Suspension	Nil
6	Broken Spring	Nil
7	Skid mark on wheel skid	No Skid mark
8	Axle Box bolt/paint condition on bolt & control arm bolts	Found intact
9	Phonic wheel condition/MS bolt condition	Found intact
10	Oiler Ring/Slip Assembly	Found intact.
11	Secondary Bump Stop Clearance	Found within permissible limit
12	Control arm drain holes/grease around bearing	Grease oozing & bearing
13	Minor pad condition	More play in LH wheel
14	Condition of all the dampers	Found ok.
15	WSP	All dampers found ok
16	Condition of air spring	Found ok Cake 99
17	Condition of rubber spring, rubber pad	Nil
18	Anti-Roll bar bush, traction rod bush	Found ok
		All bushes found ok & intact

Remarks:- Due to Red Box alert & Grease oozing from LH wheel. Now overhaul wheel set failed alot wheel send to Khpw.

SSE/C&W/TATE
TC/Cow
Rajesh Kumar
Jr Sr. SE 2/11/24

1.2.35. When Track or Rail is renewed, it shall be possible for the track mounted sensors to be reinstalled on the renewed track.

1.3. **Drawings & Documentation:**

After the award of contract, the tenderer shall supply five sets of documents in hard copy along with the soft copy in English language and covering the following:

- All System requirements in details, including system configuration, hardware, software, connectivity, network, web-access, dataflow, site plans, and signage plan etc.
- Detailed Inspection, Testing, Transportation, Installation and commissioning plan
- Manuals of operating instructions, repair procedures, periodical maintenance checks, Overhauling, Inspection, Testing and trouble shooting and calibration frequency for the complete system. Different manuals for Divisional C & W control office and the Central Control should be made.
- Comprehensive Bill of materials and list of spares including drawings of any specific tooling.
- A detailed Resource deployment plan, including details of deployment of key project personnel.
- Back up of software used, in executable files, on CD's along with installation instructions.
- Details design and drawings, layout of central data control cum training centre building including architecture of network connectivity infrastructure.
- Details of heat load calculations for Centralized Air conditioning of the building.

System should have searchable, online technical documentation which can be bookmarked by different user, with training modules for different categories of users. It should also have extensive troubleshooting guide.

1.4. **Inspection and Testing**

The tenderer must submit details of test-plan for the proposed system along with the offer. It should prima facie include the following details.

1.4.1. Factory Sub-System Level Test

Factory acceptance test is carried out to check the full functionality of the systems including sub-systems and components integrated to a fully functional level at a factory. This is the QA test done at the factory either by the Tenderer or through third party testing. These tests will not be witnessed by the IR representatives. All documentation for this stage of testing is to be submitted to the IR team nominated for the System Proving-Out test at the factory.

1.4.2. System Proving-Out Test at Factory

This is the test at the factory for the full proving out of the System. All individually tested sub-systems, as outlined in the clause 1.4.1, are to be integrated in a fully functional manner and offered for inspection. The test will be witnessed by the IR team at the premises of the Tenderer. The system rigged up should be accessible on-line over the Web in India to the Indian Railway (IR) officials for review at this stage.

1.4.3. Site tests/Proving Out Tests: Validation scheme for proving out test of first OMRS system shall be furnished by system suppliers / designer along-with their offer however the same shall be decided jointly between COFMOW, RDSO & respective consignee and the successful tenderer after issue of LOA. After installation & initial commissioning of the first OMRS system will be done by the contractor in presence of RDSO along with concerned Railway(s) / consignee as per validation scheme on the basis of which commissioning can be completed by the consignee. Balance quantity of OMRS will be inspected by RITES before dispatch. The commissioning of balance OMRS systems will be done by the contractor in presence of consignee as per approved documentation.

1.4.3.1 Acoustic Bearing Detector (ABD):

Validation Scheme to Prove-Out the ABD as per RDSO Letter No. R2/327/OMRS dated 23.02.2018, & R2/327/OMRS dated 16.06.2020 & TST.3/GI./OMRS Vol.I, dated 25.06.2020

1. Steps Involved in ABD prove-out:

Proving of the Acoustic Bearing Monitoring System of OMRS for consistency, calibration & repeatability as per RDSO specification is to be done in following three steps:

a) Using data captured by the system for existing pass-by trains - for proving-out consistency.
b) Running "Test Special" with known bearing defects for proving-out repeatability.
c) Using Calibrator or Sound Level Meter (SLM) - for Calibration.

1.1 Consistency Tests

Data logged by the system for all vehicles of running trains through equipment site for a period of 10 days shall be obtained from the available OMRS processing software and will be cross-checked with the actual no. of passenger trains passed from the site as per record of divisional section control as per following format.

For freight trains: To check consistency for freight stocks, data recorded from trial runs conducted with test train formed for repeatability test will be used.

1.2 Repeatability Test

i) For Coaches and Locomotives:

S.No.	Details as per divisional sectional control				Details as logged by OMRS system			Remarks regarding photographs captured by Photo TAG system or RFID as available
1.	Date/ Time	Train No.	No. of Vehicle passed	No. of axle bearing passed	Date/ Time	No. of Vehicle passed	No. of bearing for which acoustic record taken	

Reliability of the system with respect to coaches and locomotives can be checked by extracting total data from OMRS processing software. All alerts during the period will be analyzed to verify repeatability. Twenty (20) % or minimum of 4 cases of bearings alerted by the system for clear level 1 fault will have to be crosschecked in workshop/Depot. If axles having defective bearings are changed during the period by the Railway, such bearings will not be considered for inspection.

ii) For Freight stock:

For validating reliability of the system, the test train shall run at different speeds, i.e., 30, 40, 50, 60, 70, and 80 K.m/h with six runs at each speed and at 90 and 100 Km/h with 3runs at each speed. Therefore, a total number of 42 runs will be conducted. Repeatability shall be established by evaluating the test results of 3 runs at each speed in same direction.

The 06 wagons will be fitted with twelve (12) defective CTRB type bearings two (02) in each wagon. Re-assembled defective bearings will be packed with old (used) grease with operation amount to replicate actual service conditions.

For validating the system, if alert have been generated in other than twelve (12) nominated defective bearings, these will be opened in workshop for crosschecking. Accuracy of defect detection will be analyzed and compared as per following criteria:

a. Large size defects - greater than 90%
b. Medium size defects - greater than 80%
c. Small size defects - greater than approximately 50%

Where large, medium small size defect means:

a. Large size defects - these are typically greater than 15 mm wide across the full raceway and 0.5 to 1 mm deep
b. Medium size defects - these are typically between 5 mm and 15 mm wide across the full raceway and 0.5 to 1 mm deep
c. Small size defects - these are typically around 5 mm wide across the full or half raceway and 0.5 to 1 mm deep

1.3 Calibration Test

In ABD system the only component to calibrate is the sensitivity of the microphone installed in Near (Master) and Far (Slave) cabinets. A calibration unit is used to position a random noise source at the axle height on both the tracks in front of the ABD system (microphone array). The methodology as proposed by OEM in the contract placed by Railway Board was followed for Calibration. During the final acceptance stage of the installation, the calibration of the system was demonstrated by the firm to ensure that the system is providing data.

The details of calibration protocol followed during installation of existing OMRS systems at IR sites is as below:

<table>
<tr><th>S.No.</th><th>Description</th><th>Expected results/ Comments</th></tr>
<tr><td>1.</td><td>For Calibration Unit Record
Model.....
Record Serial Number .....
Record Calibration Date .....</td><td></td></tr>
<tr><td>2.</td><td>If a SLM is required (e.g. the calibrator is out of calibration)
Record Model.....
Record Serial Number .....
Record Calibration Date .....</td><td></td></tr>
<tr><td>3.</td><td>Position calibration unit on track, approximately 5 meters to one side of the cabinets and activate as described in the specification sheet (Packed with calibration unit)
Point the sound level meter (SLM) directly at the calibration unit from a distance of 2.5 meters. SLM should be level with calibration unit. Measure sound pressure level (SPL) for 6.3, 8, 10 and 12.5 kHz 3rd Octave Bands
Repeat this check after calibration. (If using calibration unit, record values from calibration unit User manual - Calibration data. In this case the overall value is not required and the use of a SLM and the repeated check is optional)</td><td>Sound pressure levels

Note: The calibration unit shall emit levels within the limits stated in brackets

<table><tr><th>Before Calibration</th><th>After Calibration</th></tr><tr><td>6.3 kHz.....dB</td><td>(60-80)..... dB</td></tr><tr><td>8 kHz.....dB</td><td>(60-80)..... dB</td></tr><tr><td>10 kHz.....dB</td><td>(60-80)..... dB</td></tr><tr><td>12.5 kHz.....dB</td><td>(60-80)..... dB</td></tr><tr><td>Overall .....dB</td><td>(<90).....dB</td></tr></table></td></tr>
</table>

1.4.3.2Wheel Impact Load Detector (WILD /WCM)

Site Test/Proving out Test at Indian Railways site, to demonstrate consistent and accurate data measurement and associated defect reports, and data storage for each axle of representative trains including train consist preparation. For this, the system will be tested in different conditions of the train formation and operating conditions. This test will also include measurement system calibration.

Proving out scheme shall be decided jointly in consultation with contractor duly incorporating specific technology based feature of the offered system and the technology platform on the system is based. Sample test scheme for proving-out test shall be furnished by the tenderer along with their offer.

1. **System Commissioning Test (SCT)** at the Indian Railways Central Data control cum Training Centre, demonstrating consistent and accurate data transfer from site to database & display subsystem on the System Server with adequate response time: this will provide cross-checks of data from site storage and demonstrate all data retrieval and display functions. Issuing of alarms will be demonstrated.

The Contractor shall demonstrate/conduct the following tests to the consignee during Commissioning. Detail plans for the same should be submitted within 30 days of the order.

i. **Consistency Tests with regard to data capture functionality:** -

a) All the trains should be perfectly recorded with regard to direction of motion, date and time of passing, speed, no. of axles no. of locomotives and reports should be generated for at least 98% of the trains.The system should be able to generate trains drop list to record this requirement.

b) The complete data report (without missing any axle) including Maximum Dynamic Impact Wheel Load, Average Normal Dynamic Wheel Load, Impact Load Factor & speed of a wheel-set of the trains passed shall be generated.

ii. **Impact Load measurement capability**: The contractor should demonstrate the impact load measurement capability using suitable jigs, fixtures, impact hammers or other calibration equipment duly calibrated with certificate issued from a Govt. certified agency. The calibration equipment will have to be provided by firm's representatives and should have valid calibration certificate issued from a Govt. certified agency. The calibration of the system should be demonstrated by the supplier at the time of commissioning of the system."

iii. **Weighing accuracy at crawling speed:** System should have weighing accuracy in range of ±4% of the known/stamped weight (calibrated) of wagon/coach/loco at crawling speed.

2. **Repeatability Test:** The reliability of the system should be observed with the repeatability of axle load recorded. If the same rolling stock passes with the same speed, the axle load recorded by the system should be approximately same or within the range of ±5%.

Acceptance Certificates: Records of all tests and conformity checks shall be provided by the Tenderer and be made part of the system documentation.

1.4.4. Statutory Certification

The System must meet all the International and Indian statutory requirements as applicable for the System and its component.

1.5. Training

The tender should submit its training plan along with the offer and it should include the following.

1.5.1. Pre commissioning

In order to have an insight into the technical details, method of operation, and fault detection and rectification, the contractor should impart training to IR Personnel for 260 man-days at the manufacturer's site as well as locations where this technology is in use. IR will bear the cost for traveling and stay during training. Tentative training plans and modules should be indicated along with the offer.

1.5.2. User Training

The contractor will also arrange one-week training at his cost to IR personnel at each of the site and at the Control Center and should cover following essential aspects.

- Operating procedure for system at site office.
- Preventive and corrective maintenance procedure for the installed system.
- Training on repair, replacement and calibration jigs instrumentation used including the use of calibration jigs.
- Acquisition and interpretation of the measured data.

1.5.3. Online Training at Contractor's cost

Web base self-learning tutorials about the various aspect of the user interaction with trainee management capability should be available. It should be possible to give controlled access to different type of content to different users.

1.6. Packaging & Transportation

The Contractor will transport the completed system in such a manner that minimum dismantling of the system takes place post proving-out Inspection at the factory. The packaging and transportation should be designed to avoid any transit damage. The Contractor shall carry out a system check at the consignee end along with the consignee before unpacking to avoid subsequent complaints regarding short shipment or transit damage. This check should be done immediately on receipt of consignment at the consignee's place.

1.7. Installation and Commissioning

The complete installation and commissioning of the system will be carried out by the Contractor, including foundation and civil work at sites to be decided by negotiation with Indian Railways. The Contractor will advise details of the installation plan indicating interruption/speed restriction to traffic (if any), in terms of hours/days during installation and commissioning of each site.

1.8. Preventive maintenance and Comprehensive Annual Maintenance & Operations Contract: As per Annexure E of Section-V of Bid Document part-II.

1.9. Warranty

1.9.1. The Warranty shall be governed by clause 3400 of Section-II of Bid Document part –I except that the period shall be 36 months (3 years).

1.9.2. Foreign Suppliers who do not have registered office/maintenance facilities in India may authorize an Indian Agent, who shall be responsible for maintenance and break down support. In such case, Indian agent should have experience of maintaining any type of wayside equipment after commissioning. The tenderer should submit documentary evidence towards the experience of the Indian Agent in maintaining the **wayside equipment** in India, along the offer. The Indian Agent should submit details of infrastructure and man power available with them in the bid.

1.10. List of Documents to be submitted

ANNEX I

PLAN FOR 'TYPE' VALIDATION/ PROVE-OUT OF THE RAILBAM SYSTEM

(In accordance with Clause 1.14.3, Bid Document Part – II)

1 INTRODUCTION

1.1 Document Purpose

This document is submitted in accordance with Bid Document Part-II, Section V, Clause 1.4.3: Site tests/ prove-out tests.

This document describes the 'type' validation/ prove-out plan for the RailBAM system using our standard site test procedures. The test procedures include:

i. Site Installation Test (51R-16-0054-TPR-870867-1)
ii. Full Acceptance Test (51R-16-0054-TPR-873617-1)

2 Site Tests

2.1 Site Installation Test

As a standard practice, post installation of the systems, Site Installation Test (SIT) procedures are conducted. These test procedures verify that the systems are configured correctly and operate as 'designed' without errors.

A copy of the SIT procedure for the RailBAM system is included at Annex D. The SIT procedure also includes the calibration of the RailBAM system as per Appendix B.7 and B.8 of Annex D of Inspection and Testing Plan.

2.2 Full Acceptance Tests

Satisfactory completion of the SIT procedures including calibration is followed by conducting the Full System Acceptance Test (FSAT). The FSAT verifies the data flow from a wayside site to a data server, and availability of data through FleetONE to users is configured correctly and operating as 'designed' without errors. In other words, the FSAT confirms validity of data measured by wayside systems, validates data transfer to the Control Centre and correct data presentation in the FleetONE software.

Satisfactory completion of the SIT and FSAT demonstrates that a wayside site including all the wayside systems (RailBAM, WCM, and PhotoTAG) and associated sub-systems (Equipment Hut) is fully validated/ commissioned for operational use, and ready for acceptance by the client.

The commissioning of the site and systems is indicated by our standard Certificate of Conformance (CoC) document.

Copies of our Full System Acceptance Test and Certificate of Conformance are enclosed at Annexes G and H, respectively, of Inspection and Testing Plan.

3 Compliance with Site Test Requirements

Following the Site Tests, compliance with the type testing requirements can be demonstrated as described below.

3.1 Consistency

Data recorded over time for a certain period, say 10 days will be used to demonstrate consistency compliance.

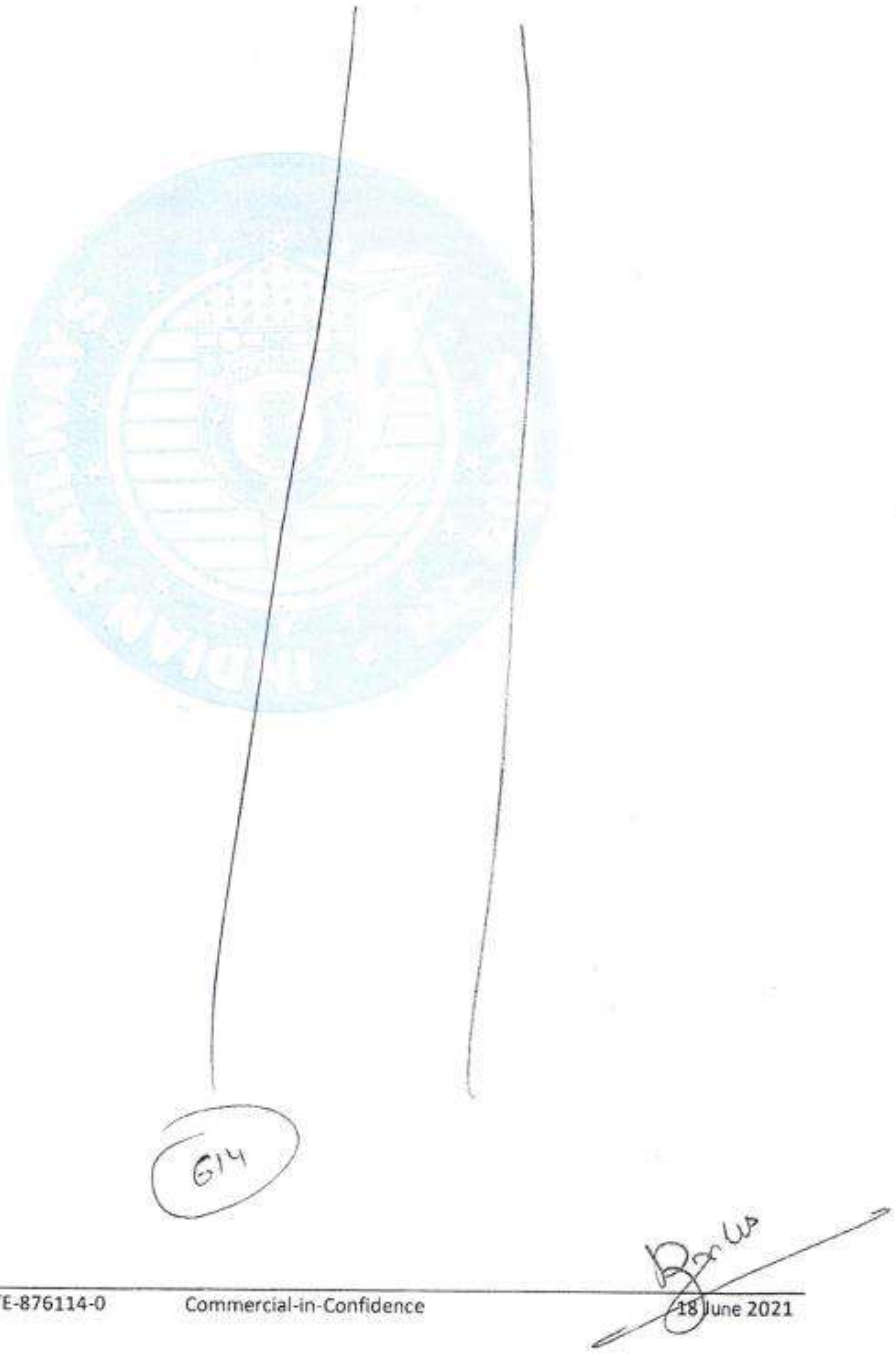
3.2 Repeatability

Repeatability will be demonstrated by monitoring through the FleetONE software multiple passes of defective bearings identified by the RailBAM system as per clause 1.4.3.1. These can be further verified by examination in a workshop.

3.3 Calibration

Results from the SIT calibration will be used to demonstrate calibration compliance.

Note: Following the type (or first article) testing that is concerned with the first equipment set, the standard production testing that includes conducting SIT and FSAT will be applicable to all the subsequent equipment sets.



ANNEX J

PLAN FOR 'TYPE' VALIDATION/ PROVE-OUT OF THE WHEEL CONDITION MONITOR (WCM) SYSTEM

(In accordance with Clause 1.14.3, Bid Document Part – II)

1 INTRODUCTION

1.1 Document Purpose

This document is submitted in accordance with Bid Document Part-II, Section V, Clause 1.4.3: Site tests/ prove-out tests.

This document describes the 'type' validation/ prove-out plan for the Wheel Condition Monitor (WCM) System using our standard site test procedures. The test procedures include:

i. Site Installation Test (51R-16-0054-TPR-870681-1)
ii. Full Acceptance Test (51R-16-0054-TPR-873617-1)

In addition, a test train comprising wagons having known calibrated weights will be required to run through the WCM systems for dynamic calibration.

2 Site Tests

2.1 Site Installation Test

As a standard practice, post installation of the systems, Site Installation Test (SIT) procedures are conducted. These test procedures verify that the systems are configured correctly and operate as 'designed' without errors. A copy of the SIT procedure for the WCM is included at Annex E of Inspection and Testing Plan.

2.1.1 Calibration Test

For the calibration of the WCM system, a test train comprising vehicles of known weights is usually required to run through the system at a range of speeds. Both test wagon weights and test speeds should be representative of the conditions that rolling stock would operate at the site. Such a dynamic calibration method accounting for actual train operating conditions ensures accurate weighing measurements.

The test train should comprise at least 5 vehicles of known weights ranging from 20 (representing an empty wagon) to 90 tonnes (representing a loaded wagon) is required to travel through the WCM sensor array at various train speeds, typically 20, 40, 60 and 80 km/h with 2 runs at each speed in forward and reverse directions.

2.2 Full Acceptance Tests

Satisfactory completion of the SIT procedures including calibration is followed by conducting the Full System Acceptance Test (FSAT). The FSAT verifies the data flow from a wayside site to a data server, and availability of data through FleetONE to users is configured correctly and operating as 'designed' without errors. In other words, the FSAT confirms validity of data measured by wayside systems, validates data transfer to the Control Centre and correct data presentation in the FleetONE software.

Satisfactory completion of the SIT and FSAT demonstrates that a wayside site including all the wayside systems (RailBAM, WCM, and PhotoTAG) and associated sub-systems (Equipment Hut) is fully validated/ commissioned for operational use, and ready for acceptance by the client.

The commissioning of the site and systems is indicated by our standard Certificate of Conformance (CoC) document. Copies of our Full System Acceptance Test and Certificate of Conformance are enclosed at Annexes G and H, respectively, of Inspection and Testing Plan.

Annexure – 7

Various Sensing Technologies

Sound measurement based predictive fault system is a type of condition monitoring system and ***Condition monitoring systems are data collection systems with intelligent algorithms that can detect faults prior to failures, identify faults and assess the severity of a fault.***

The potential-to-functional failure curve (p–f curve) can be used to represent the performance of condition monitoring technologies. Functional failure is the point at which the bearing does not perform, such as a seized bearing, and will require replacement.

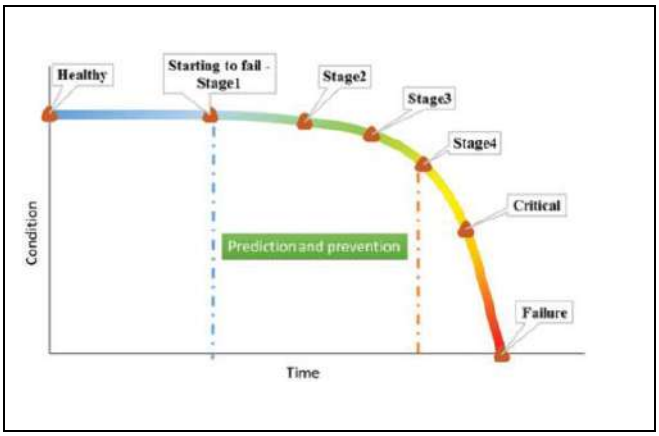


Figure above is an example of a p–f curve that can illustrate the stages in bearing degradation. The general overview of a p–f curve is to quantify and allow an appropriate reaction to be defined over time. The p–f curve demonstrates the time between the potential failure and the event of failure. Condition-based maintenance and condition monitoring allow strategic scheduling of corrective maintenance, and hence cost savings.

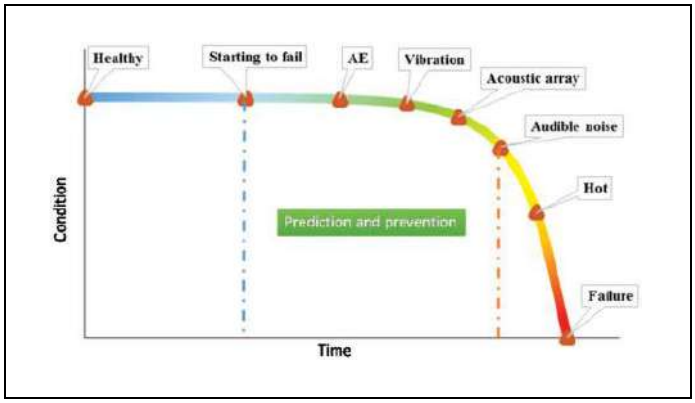
Ideally the best Condition Maintenance System (CMC) should be near stage 1 of the above curve. However, where a failure can be deducted on p–f curve is basically dependent on technologies being used. There are 4 types of important sensing technologies.

Sensing technologies

Various sensing techniques can be used to monitor the condition of axle box bearings:
(1) Acoustic emissions (AEs)/ultrasound
(2) Vibration/acceleration
(3) Microphone/sound measurement
(4) Thermal

The first three technologies are used to detect early-stage defects. When bearing defects become severe, they generate heat that can be detected by thermal sensors.

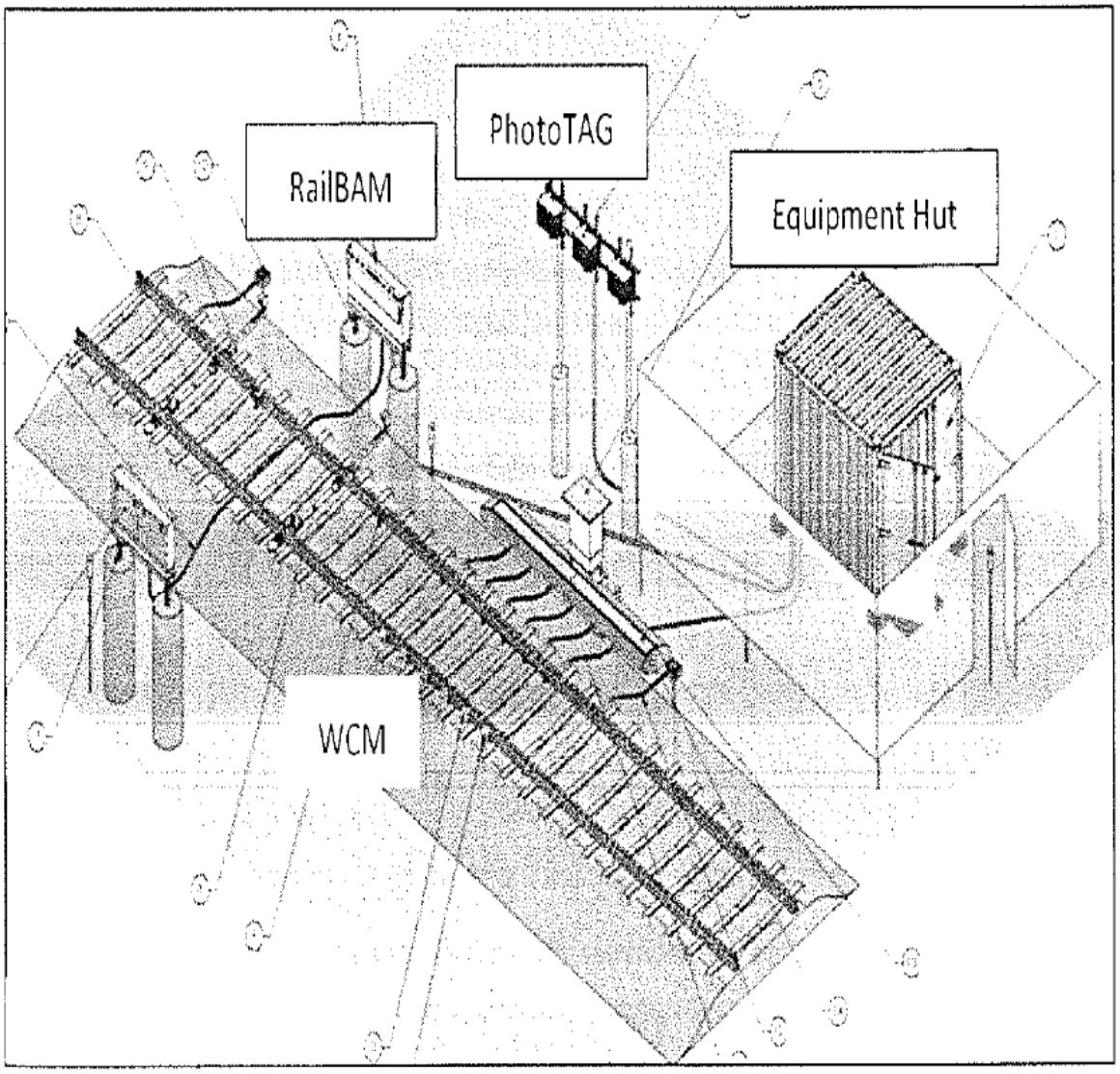
Sensing technologies comparison can be seen in the following graph



Ref: Proceeding of IMechE (perspective on railway axle that is bearing condition monitoring.

Annexure – 8

Schematic of an OMRS single-track site



Annexure – 9

Schematic of an OMRS double-track site

