

WELCOME

TO

Shri G. R. Agarwal

Addl. Member (Electrical)

&

Shri Sudheer Kumar

ED/RS

Railway Board

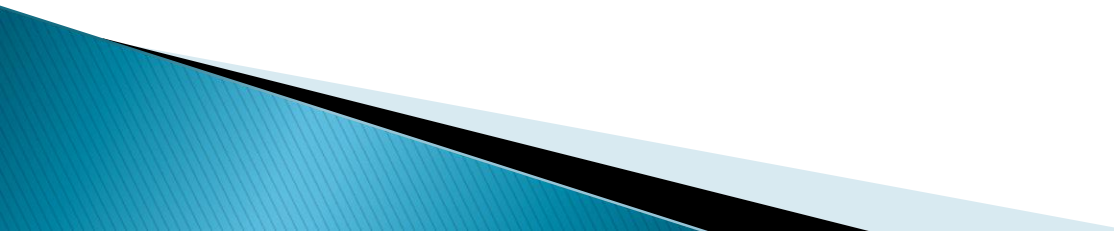


Items Included For Presentation

- Developmental Items
- Modification Sheets
- Special Maintenance Instructions
- Technical Circulars
- Reliability Studies and Technical Audits

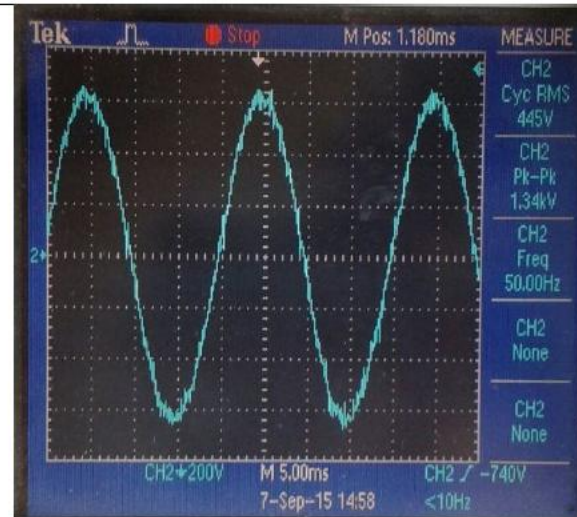
Developmental Items

Development of Twin winding LOT 7775

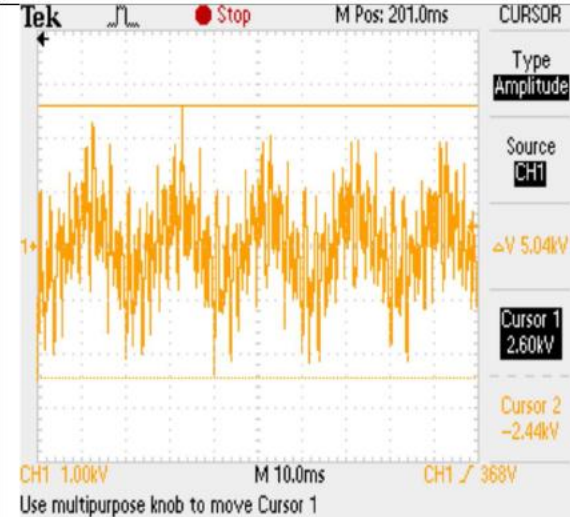
- The existing LOT-7500 has single Hotel Load winding.
 - There were problems in smooth operation of Hotel Load Converter (HLC) due to circulating current as the two HLC were connected in parallel.
 - LOT-7775 has been developed with dual hotel load winding with encouraging results.
 - Successful operation on HOG in Kalka/Chandigarh Shatabdi and further in Mumbai Rajdhani Express with dual winding transformer LOT-7775.
- 

Comparison of Voltage waveforms – Dual winding Vs Single winding transformer

L-E voltage waveform with dual winding transformer (with external RC filter)



L-E voltage waveform with single winding transformer





**HOG operation in Rajdhani Express (NDLS-BCT) flagged off
by Hon'ble MR on 30.12.2015
With loco no. 30365**

Commissioning Status of HLC in WAP-7

Make	Order Qty.	Fitted in Loco	Remarks
M/s SIEMENS	28	22	<ul style="list-style-type: none"> • Jul'10 on 30277 • Nov'13 on 30365 <i>(Presently working in Mumbai Raj. wef 30.12.2015)</i> • Jan.15 on 30406 • Dec 15 on 30445 • Jan 16 on 30446 • Feb 16 on 30454 • Mar 30457, 30453, 30455 • April – 5 locos, May – 8 Locos
M/s MEDHA	21	01	Feb'14 on 30375 <i>(Working in Kalka Shatabdi as well in Mumbai Rajdhani)</i>
M/s BHEL	04	01	Commissioning in progres in Loco no. 30426 for ELS/RPM. <i>Rake modification completed.</i> Trial in progress.
M/s ABB	04	00	Prototype test completed.
M/s AAL	03	00	1 no. supplied to CLW

Action Plan for HOG operation

Trains & Rakes identified for Phase-I

SN	Train No.	Name of Train	Primary maint. depot	No of rake to be modify	Modification to be done by	No. of Locos	Loco link (shed)
1.	12951/52	Mumbai Rajdhani	BCT	5	Siemens & WR	3	ELS/GZB
2.	12953/54	AG Kranti Rajdhani	BCT			3	ELS/GZB
3.	12301/02	HWH Rajdhani	HWH	3	Siemens & ER	3	ELS/HWH
4.	12313/14	SDAH Rajdhani	SDAH	3		3	ELS/GZB
5.	12425/26	Ranchi Rajdhani	NDLS	2	Siemens & NR	2	ELS/GZB
6.	12309/10	RJPB Rajdhani	RJPB	2	Siemens & ECR	2	ELS/GZB
Total no. of rake to be modified in Phase-1 = 15							

Planning for HOG operation Phase-2

- Following trains have been identified for operation on HOG for Phase-2 after completion of Phase-I

Railway	Train No.	Train Name	From	To	Primary Maint. Depot	No. of rakes to be modified	Agency for modification
Western Railway	12909/10	Garibrath	BDTS	NZM	BCT	1	All these rakes shall be modified by Siemens.
	22209/10	Duronto	BDTS	NDLS	BCT	1	
	12227/28	Duronto	BCT	INDB	BCT	1	
	12009/10	Shatabdi	BCT	ADI	BCT	1	
	12267/68	Duronto/ICF rake	ADI	BCT	ADI	2	
	12931/32	Double Decker	ADI	BCT	ADI	1	
	12933/34	Karnavati	ADI	BCT	ADI	1	
Total rakes to be modified						8	
Eastern Railway	12303/04	Poorva Express	NDLS	HWH	HWH	3	All these rakes shall be modified by Siemens.
	12381/82						
	12323/24	HWH-NDLS	NDLS	HWH	HWH	1	
	12259/60	SDAH-NDLS	SDAH	NDLS	SDAH	2	
	12019/20	RNC Shatabdi	HWH	RNC	HWH	1	
Total rakes to be modified						7	

Planning for HOG operation Phase-2

Railway	Train No.	Train Name	From	To	Primary Maint. Depot	No. of rakes to be modified	Agency for modification
EC Railway	12393/94	Sampoorna Kranti	PNBE	NDLS	PNBE	2	All these rakes shall be modified by Siemens
	12397/98	Mahabodhi	Gaya	NDLS	Gaya	2	
	Total rakes to be modified					4	
N. Railway	12003/04	Lucknow Shatabdi	NDLS	LKO	NDLS	6	All these rakes shall be modified by Northern Railway
	12011/12	Kalka Shatabdi	NDLS	KLK	NDLS		
	12013/14	Amritsar Shatabdi	NDLS	ASR	NDLS		
	Total rakes to be modified					6	

Planning for HOG operation Phase-2

Railway	Train No.	Train Name	From	To	Primary Maint. Depot	No. of rakes to be modified	Agency for modification
S. Railway	12007/08	MAS-MYS Shatabdi	MAS	MYS	MAS	1	All these rakes shall be modified by Medha.
	22625/26	Double Decker	MAS	SBC	MAS	1	
	22269/70	Duronto	MAS	SBC	MAS	1	
SW Railway	12027/28	Shatabdi	MAS	SBC	SBC	1	
	Total rakes to be modified					4	
Total rakes to be modified in Phase-2						29	

Other points to be taken care of

- Railways shall provide training and counseling to the staff associated with attaching/detaching of Inter-Vehicular (IV) and UIC coupler of the power car to the loco to minimize the time taken for this activity as well as safety of train operation.
- JPO shall be issued regarding attachment/detachment of IV & UIC coupler at the Railway stations/yards by Zonal Railways as has been done by Northern Railway.
- Coach/Power Car modification included in the Hotel Load procurement by CLW to ensure smooth and quality work of coach and power car modification.

Benefits of HOG supply system as compared to EOG

Operational fuel/energy cost saving

Table-1: Annual Saving of 101 lac will be obtained in NDLS-KLK Shatabdi Exp. (14 coaches) on energy cost basis only.

SN	Scheme	Energy cost per unit (Rs.)	Total hotel load (KW)	Total hotel load Considering duty cycle 70% of the load	Total time (Run time + pre-departure time+ Post arrival time)	Units spend in a trip of 5.0 hrs (kWH)	Total energy cost of hotel load in one trip	Total energy cost of hotel load in one round trip i.e. daily (Rs.)	Total annual energy cost of hotel load (Lacs Rs.)
1	EOG	13	636.4	445.48	5.0 hrs	2004.66	26060.58	52121.16	190.24
2	HOG	7.1	545.4	381.78	5.0 hrs	1718.01	12197.871	24395.742	89.04
Saving									101.20

Table-2: Annual Saving of 590 lac will be obtained in Mumbai Rajdhani Exp. (21 coaches) on energy cost basis only.

SN	Scheme	Energy cost per unit (Rs.)	Total hotel load (KW)	Total connected electrical load @ 0.8 diversity factor	Total time (Run time + pre-departure time+ Post arrival time)	Units spend in a trip of 17.5 hrs (kWH)	Total energy cost of hotel load in one trip	Total energy cost of hotel load in one round trip i.e. daily (Rs.)	Total annual energy cost of hotel load (Lacs Rs.)
1	EOG	13.0	886.6	709.3	17.5 hrs.	12412.4	161361	322722	1178
2	HOG	7.1	806.6	645.3	17.5 hrs.	11292.4	80515	161030	588
Saving									590

Reliability issues of Hotel Load Converter

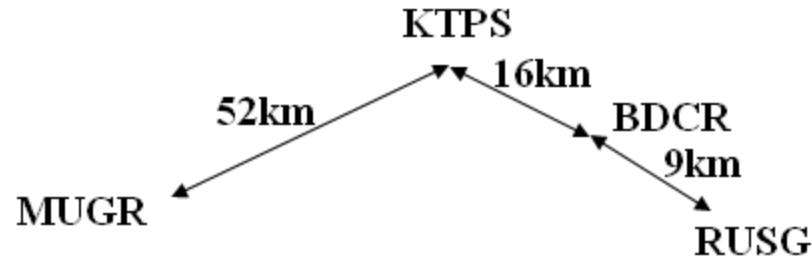
- ▶ To avoid frequent tripping particularly following neutral section following modifications are being done by M/s Siemens:
 - Change in location and rating of cooling fan MCB.
 - Pressure switch modification of DC link capacitor.

DPWCS

Distributed Power Wireless Control Systems (DPWCS) in freight locos over IR.

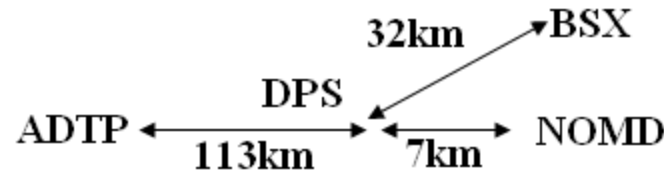
Present Status:

SCR- 5 Pairs(WAG7)



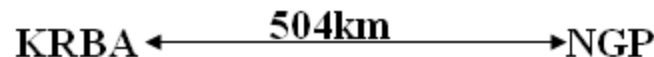
(i) Rudrapur siding (RUSG)-
Bhadrachalam Road (BDCR)-
(Kothagudam Thermal Power
Station)
(ii) KTPS-Manuguru (MUGR)

**SER- 1 Pair (WAG7)
2 Pair (WAG9)**



(i) Adityapur (ADTP)- Dangoaposi
(DPS)-Banspani (BSPX)
(ii) Adityapur (ADTP)
Dangoaposi (DPS)-Noamundi
(NOMD)

SECR- 1 Pair(WAG7)



Korba-Nagpur

ECOR- 3 Pairs(WAG7)



Talchar- Paradeep

Present Status of DPWCS In Electric Locos

Rly	Loco Pair No.	Average Kms Earned/month	Remarks
SCR	28480+28481	1380	Working in Push-pull mode Section MUGR-KTPS & KTPS-BDCR-RUSG
	27426+27428		
	27516+27827		
	27432+27863		
	27588+27386		
SECR	27909+27913	6480	Working in Push-pull mode in Korba-Nagpur

Present Status of DPWCS In Electric Locos

Rly	Loco Pair No.	Average Kms Earned/month	Remarks
SER	31282+31284	4500	Working in Push-pull mode in section ADTP-DPS-BSX-NOMD
	31525+31526		
	28583+28589		
ECoR	27255+27770	8730	Working in Wireless Multi in Talchar-Paradeep
	27774+27795		
	27813+27838		

Status of DPWCS In Diesel Locos

S. No.	No. of Locos	Shed	Make	Section
1	10 (05 pairs)	VSKP	M/s Lotus	Talcher - Paradeep
2	04(02 pairs)	KZJ	M/s Lotus	Isolated Condition
3	12 (06 pairs)	TKD	M/s Lotus	Isolated Condition
4	16 (08 pairs)	VATVA	M/s Lotus	Ahemdabad-Mundraport
5	02 (01 pairs)	HUBLI	M/s Medha	Isolated Condition
6	04 (02 pairs)	ERODE	M/s GE	Isolated Condition
7	04 (02 pairs)	SABARMATI	M/s GE	Isolated Condition
Total	52(26 Pairs)			

Status of DPWCS In Diesel Locos

- ❖ **Instruction given to DLW for regular cut in freight locos vide Railway Board letter dated 8.04.2015.**
- ❖ **42 Nos. of M/s Lotus Make.**
- ❖ **8 Nos. of M/s GE Make**
- ❖ **2 Nos. of M/s Medha Make**
- ❖ **At present DPWCS fitted in Diesel Locos of VSKP and Vatva are only working and others are in isolated condition.**

**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)**

No.2007/M(L)/466/19(84) VoLIV

New Delhi, dated 8th April 2015

General Manager
DLW
Varanasi

Sub: Cut-in of DPCS on freight locomotives manufactured by DLW for IR.

Board (MT) vide his note dated 25-03-14 desired that all freight locomotives turned out by DLW and CLW should be provided with Locotrol (brand name of GE DPCS and in common parlance, is generally synonymous with the generic term DPCS).

2. In his Budget Speech for 2015-16, the Hon'ble Minister for Railways has announced the following:

"60. Long haul freight operations, where two or more freight trains are combined into a single train formation, will be used extensively. Towards this end, the construction of long loop lines will be expedited. Further, the pace at which distributed power systems are to be provided on locomotives deployed on long haul trains will be speeded up."

3. For implementation of the above it has been decided that all freight locomotives turned out by DLW from 2016-17 onwards should be fitted with DPCS.

4. This issues with the approval of Board (MM).

A. G. MIL
8.4.15
(Vivek Kumar)
Exec.Dir.Mech.Engg.(Traction)
Railway Board

Procurement Plan of DPWCS

S N	Type of Loco	Sanctioned RSP	Quantity (Loco set)	Procurement by
1	Conventional Freight	1169/2013-14 389/2015-16	56	CR
		1193/2014-15 357/2015-16	80	SCR
2	Three Phase Freight	1060/2011-12 308/2015-16	25	CLW
		1122/2012-13 351/2015-16	50	

Procurement Cost of DPWCS

For Conventional Freight Locos	Rs. 39.62 lac for one set
For Three Phase Freight Locos	Rs. 44.00 lac for one set

Specification and Procurement of DPWCS

- ❖ RDSO has finalized Specification No RDSO/2008/EL/SPEC/0074 Rev.1 & amendment 1 dated 27-7-15 for conventional Locomotives .
- ❖ CLW has finalized and issued specification No. CLW/C-D&D/ES/3/0540, Alt A, Aug 2015 for three phase Locos.
- ❖ Zonal Railways may procure DPWCS as per sanctioned RSP.
- ❖ Eligibility Criteria has already been circulated to Zonal Railways for procurement which is as under

"Firm should have supplied and commissioned successfully Distributed Power Wireless Control System (DPWCS) in electric/Diesel locomotives"

Issues For Further Development

Interoperability:

- ❖ Meetings held at RDSO on 04.11.15, 07.12.15 & 29.03.16 with prospective vendors to finalize common Communication protocol.

Safety Integrity level (SIL) Certification:

- ❖ Prospective vendors have been advised by RDSO to ensure SIL certification which may be required for CRS sanction.
- ❖ OEMs have approached to different certification agencies:
 - M/s TUV/Bangalore and
 - M/s TUV/Mumbai.
- ❖ OEMs have been advised to submit a time schedule for getting SIL Certification

Issues For Further Development

Leaky Cable for tunnels/cuttings:

- ❖ Since there are tunnels of length more than 50 meters in electrified sections of I.R. (as given below) leaky cable can be provided to achieve the seamless communication in these tunnels.
- ❖ No. of tunnels of length more than 50 meters are as under:

SN	Railway	No. of tunnels
1.	South Central Railway	NIL
2.	South Eastern Railway	04
3.	South East Central Railway	03
4.	East Coast Railway	56(in KK line)
5.	Eastern Railway	01
6.	East Central Railway	03
7.	Central Railway	83
8.	Western Railway	02
9.	South Western Railway	18(under electrification) 55 (Non electrified)
10.	West Central Railway	06
11.	Southern Railway	09
12.	North Eastern Railway	NIL

Issues For Further Development

Radio Finalization:

- ❖ Different makes of radio system with different data encoding and encryption schemes are usually proprietary item.
- ❖ All the OEMs except GE have accepted to use a common radio of SATEL make however M/s GE use the radio of MDS & GREYHILL make.
- ❖ Use of Standard Radio System is to be decided.

Standard Operation Screen of Driver Interface Unit:

- ❖ RDSO has prepared a standard operation screen of Driver Interface Unit (DIU) of DPWCS incorporating the additional requirements after discussion with OEMs.

Interface with E-70/CCB Brake System:

- ❖ Interface requirement of E-70/CCB Brake system with DPWCS has been incorporated in Specification of Brake System.

► Development of High Reach Pantograph

- Specification of High Reach Pantograph was revised as Rev 2 for development of high reach pantograph for speed up to 200kmph.
- Provisional approval of General Assembly drawing is accorded to M/s FTRTIL, M/s Schunk, M/s SIL and M/s Contransys for development of prototype unit for testing.

► Load cell for measurement of lateral forces in WAP5

- Measuring wheel not fit for use and hence load cell is being developed for measurement of lateral forces for oscillation trial with consultation with ED testing.
- Oscillation trials of WAP5 with Talgo coaches shall be carried out by measuring riding index as per the provision of policy circular no. 6.
- Amendment to speed certificate has been issued.

Modification Sheets

Modification Sheets

- **Indication of notch position of rear loco in MU operation (MS-442).**
- **Increase in the gap between resistance ring and end ring of Scheme-II rotor of traction motor FRA 6068 of WAG-9/WAP-7 (MS-438).**
- **Simplification of VCD control circuit (MS – 444)**
 - **BL key control modified for non-working cab.**
 - **Acknowledge by horn deactivated in line with 3-Phase loco.**
- **Provision of roof bar similar to 3-Phase loco (MS – 446).**
- **Provision of high capacity on-board compressors in WAP-4 loco (MS-445).**

Modification Sheets

- **Modified blower for SIV (MS-449)**
- **Noise Reduction in Loco Cabs (MS-448)**
 - **A study was undertaken to measure the noise level in the cabs of electric locomotives during run by Electric Loco directorate of RDSO. The noise level recorded for three phase locomotive was found to be 80 dB for WAP-5 and 83 dB for WAP-7 locomotives. For conventional locomotives, the measurements were found to be 90 dB for WAP-4 and 89 dB for WAG-7 locomotives.**
 - **As per Code of Federal Regulation (CFR-49) Pt. 229.121(a) locomotive cab noise shall average less than or equal to 85 dB (A).**

- **Noise Reduction in Loco Cabs (MS-448)**

- **Suitable sound insulation on roof, machine room doors, walls and floors were provided.**
- **This resulted in noise level reduction.**
- **After modification trials done and cab noise reduced to 82 dB.**

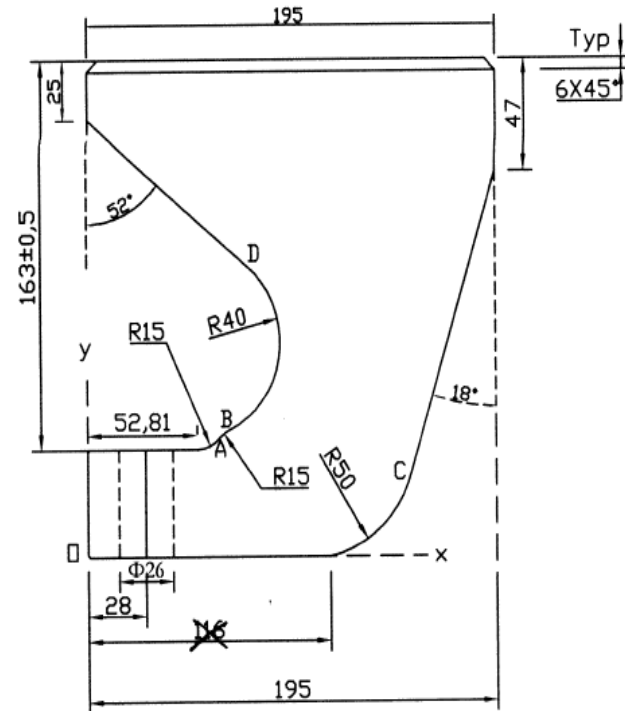


Loco No-22622



Strengthening of Motor Support (MS-443)

- ▶ Railways reported breakage of motor support in WAG9/WAP7 locomotives.
- ▶ It was observed that the cracks initiated from motor support lug portion in fatigue manner near the curvature portion
- ▶ Development of crack and subsequent failure of bogie mounting nose is due to stress concentration at the lug portion due to sudden change of machining



Upper surface with 15R

SN	Radius on Upper & Lower surfaces of motor support nose respectively	Min. Safety factor
1	0R & 8R	1.666
2	8R & 8R	1.728
3	15R & 8R	4.988
4	15R & 15 R	5.050
5	15R & ∞ R	6.50

Top operated CBC arrangement (MS-454)

- To avoid damage of operating rod due to cattle run-over and
- To prevent detention of locomotives on account of difficulty in operation from platform side.



Specifications and SMLs

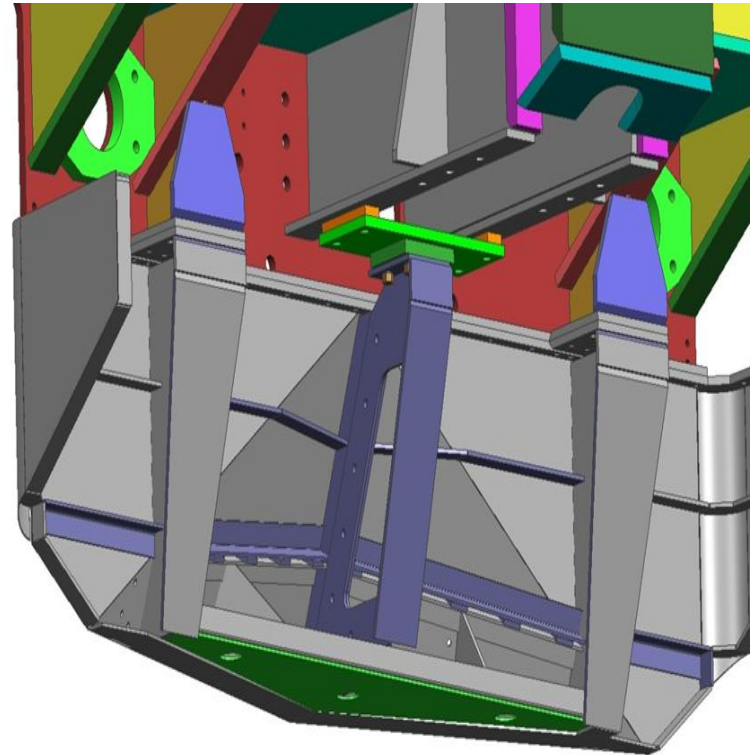
Water closet for electric locomotives

- A specification for water closet module with vacuum evacuation system and anaerobic bio-dischargeable system has been prepared for on board digestion of waste for WAP-7/WAG9/9H.



Modified Cattle Guard

- ▶ Design of cattle guard modified to prevent damage to cattle guard during cattle run-over in high speed locomotives.
- ▶ Modified design of cattle guard for WAP5 locos has been developed as per drawing no. SKDL-4759 Alt 'A' suitable for high speed up to 160 kmph.



SMI and Technical Circulars

- **Technical Circular no 47 (Rev 02) was issued to standardize Ultrasonic Testing of Axles**
 - **Near end low angle (NELA) and high angle probe defined for various types of locos**
 - **Periodicity – Six months for > 120kmph
– Yearly for < 120kmph**
- **Special Maintenance Instructions no 246 (Rev 01) was issued regarding maintenance of axle box bearings for WAP7 and WAG9 locomotives – Greasing methods and Schedules defined**
- **Standardization of safety slings of compressor (SMI-242 Rev - 1). Length, location and specification of slings defined**

SMI and Technical Circulars

- **Fuel Cell based breath alcohol analyser**

can be interfaced with CMS

10000 test result storage

- **Crew Voice & Video Recording system**

4 nos camera/cab

Analog/digital recording (Min. 12.5 frame/sec)

90 days data storage

- **Drawing for construction of zero level pit issued to zonal railways (Drg No/07/16)**

Zero level adjustment is feasible during maintenance.

Strengthening of traction rod of 3-Phase loco

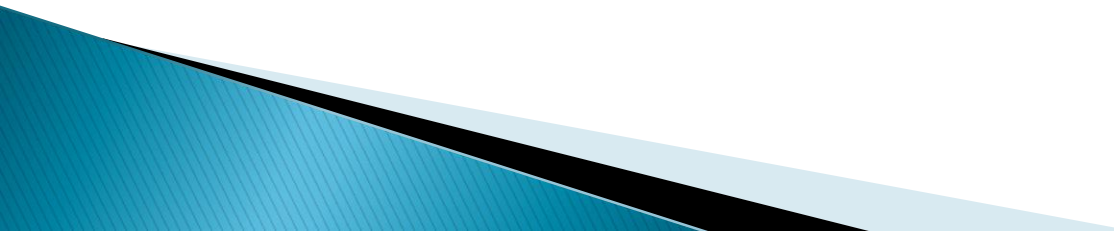
- Traction rod diameter increased from 135 mm to 137 mm.
- The angle of welding between flange and tube increased from 30 to 45 deg



Reliability Studies and Technical Audits

Audit of wheel pressing activities

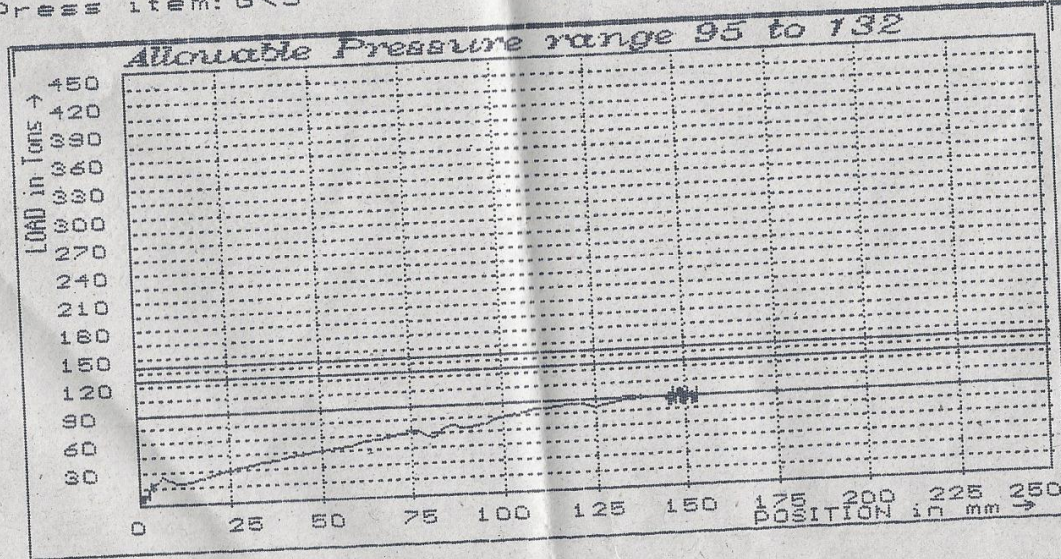
► Important findings

- **Surface Finish of wheel seat not being maintained**
 - **Use of non-standard Lubricants**
 - **The pressure graph is not being examined and wheels are declared passed based on machine print out**
- 

Audit of wheel pressing activities

KANCHRAPARA WORK SHOP WHEEL PRESS RECORD

Date: 11/6/2016 Time: 8:52:18 Prog no: 9 Manufact.: KANCHRAPARA Page: 6
Axle No: A\HH-2066EK Bore Dia: 251.55 mm Interference: -0.4 mm
Axle Type: WAG7 Seat Dia: 251.95mm DISC No:
Press item: G\S Wheel Type: WAG7-LOCO Operator: R.T.RAO



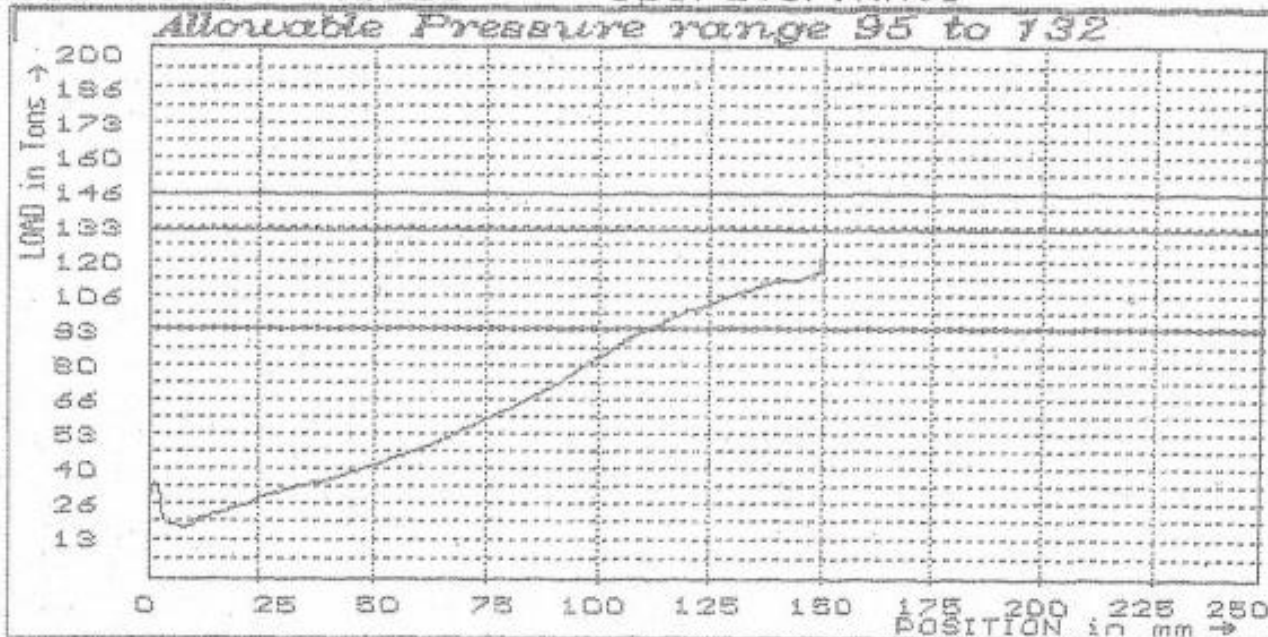
Normal Pressing
Ton.Max.Lmt: 132 T
Ton.Min.Lmt: 95 T
Max.Tonnage: 103.8 T
Displacement: 153.8mm

Pressing Status
PASS

Inspected by
Checked by

Audit of wheel pressing activities

Date: 31/3/2016 Time: 11:25:44 Prog no: 7 Manufact.: LW-PER Page: 6
Axle No: H-01862 Bore Dia: 246.37 mm Tot.mount shft1: 6
Axle Type: AC-SHA-RBEI Seat Dia: 246.67mm Tot.mount shft2: 0
Press item: DISC Wheel Type: AC Tot.mount shft3: 0
DISC No: DPP-41926 Operator: RAUI Interference: 0.3 mm



Normal Pressing

Ton.Max.Lmt: 132 T
Ton.Min.Lmt: 95 T
Max.Tonnage: 124.9 T
Axle Length: 1852mm
Displacement: 150.4mm
Tot.mount/day: 6
Tot.mount/month: 384

Pressing Status

PASS

Inspected by
Checked by

Audit of Pantograph maintenance

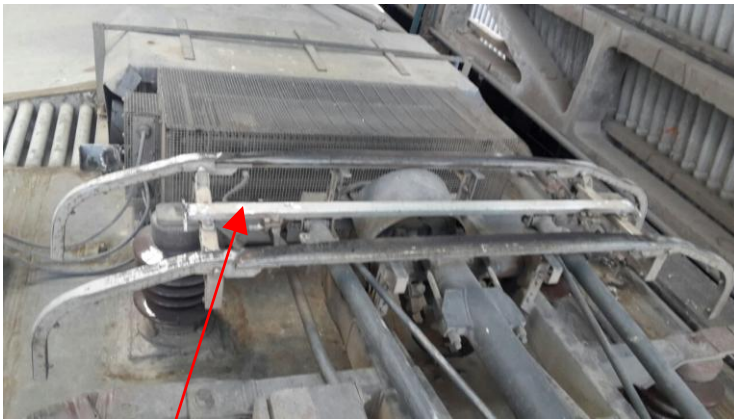
- ▶ Important findings:
 - Pantographs are found working beyond codal life
 - Record of deflection of plunger spring is not being maintained
 - Transverse flexibility is not measured during inspection schedule
 - Swivel angle is not measured and recorded

Recommendations

- ▶ **TC I23 modified to include upper arm assembly as a must change item for different types of pantograph during POH schedule.**
- ▶ **A scheme to measure transverse flexibility during IC inspection schedule recommended in Technical Audit report 0006.**
- ▶ **Scheme and location of RDPT of upper arm assembly of pantograph defined**
- ▶ **Lubricants and its substitute for the use of pantograph clarified**

Reliability study of Schunk make pantograph of EMU rakes in WR

- ▶ **Following action plans:**
- ▶ **Tapered Apex Tube and leaf spring of 2.0mm to be provided in phase I MUTP rake (Siemens make).**
- ▶ **Modified bucket of the horn in Bombardier rake to be provided to avoid crack/breakage of horns.**



Apex Tube



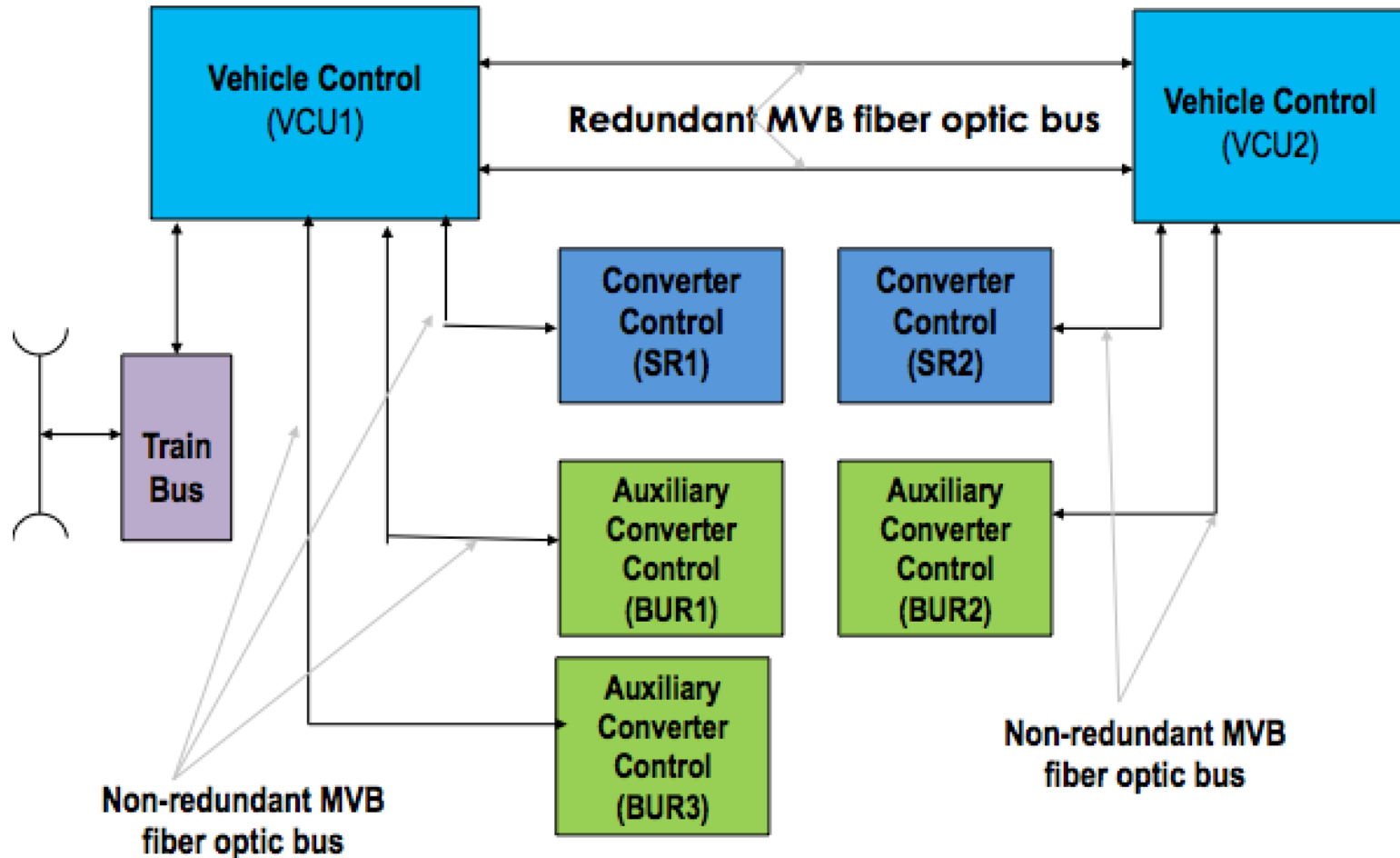
Location of horn breakage in BT rake

New Initiatives

New Initiatives

- **Improvement of adhesion in WAP-7 locomotives.**
 - **Slip/slide control in WAG-9/WAG-9H already fine tuned with the help of M/s BT/SWZ in 2013.**
 - **In-house software modification done for WAP-7 locomotive for improving adhesion in Loco no. 30371 of ELS/HWH. Trial underway since April, 2016.**
- **Change in OHE voltage setting of FLG from 29 kV to 31 kV**
- **Temperature difference of TM sensors increased from 10 to 25 degree C.**
- **Technical Circular for Multiple operation of WAP-7.**
- **Revised TSD for 3-Phase locomotives issued in Mar, 2016.**
- **Technical Circular for Interconnected bus station for offline testing of sensors, PCB cards, Master controller, etc, of 3-Phase loco.**

Interconnected Bus Station Network



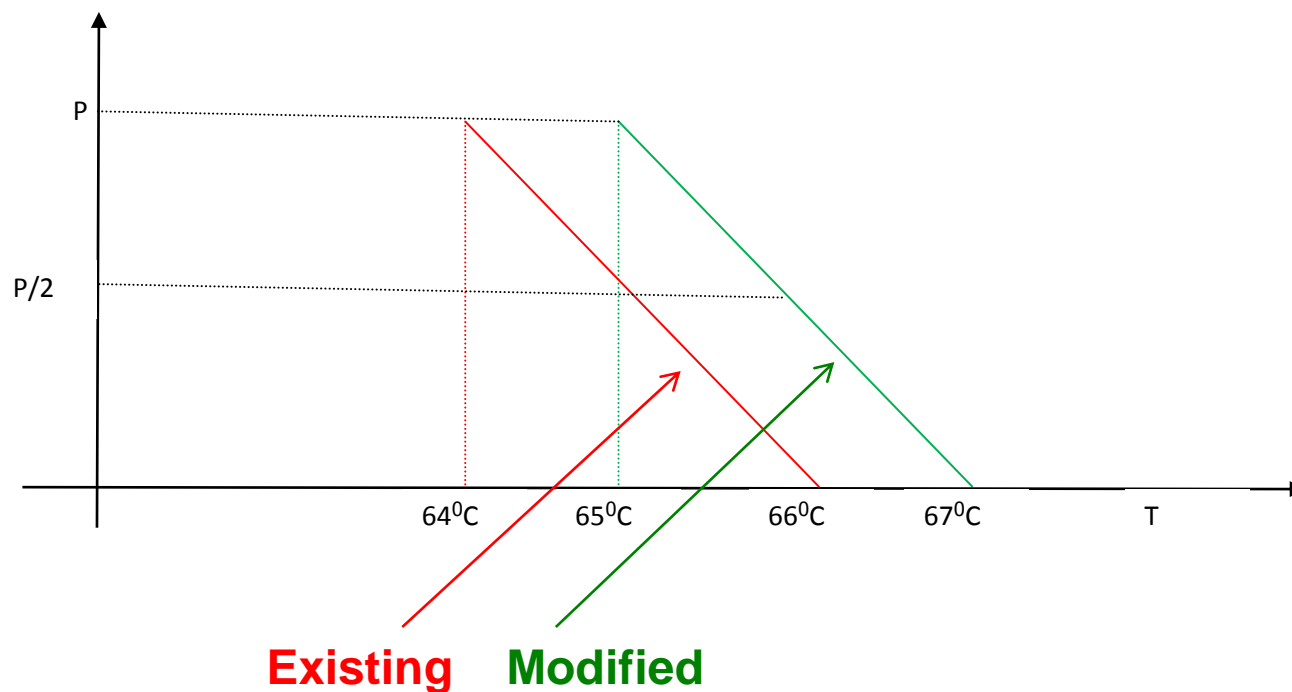
New Initiatives

- **SMI for cleaning cyclonic filters of OCB, TMB and MRB.**
- **Technical scope of work for AMC of following**
 - **SIV**
 - **VCD**
 - **ESMON**
 - **MPCS**
- **Standardization of Specification of brake system to ensure interchangeability and common interface.**
- **Development of energy efficient head light for locomotive.**

New Initiatives

- **Modification in SR oil temperature setting.**
 - **Lower limit – 64 to 65 deg C**
 - **Upper limit – 66 to 67 deg C**

SR Oil Temperature vs Output Power



Development of LED Head light

- 02 nos. LED based head light fitted on ELS/MGS based loco no. 27008 (WAG-7) in March 2016 for field trial.
- During test followings are observed:
 - Lux at 8 Meter (Main operation)= 8530 Lux
 - Lux at 8 Meter (Dim operation)= 5030 Lux
 - Working voltage= 110 V DC
 - Power consumption= 65 Watt



THANKS