Dated: 24.03.2025

Sub: Commissioning inspection of Loco No. 38856 equipped with M/S Hind Rectifiers limited make prototype IGBT based 3-phase drive Propulsion Equipment

Ref:

i.   CLW PO No. 70211134D01496 dated 28.10.2021
ii. CLW letter no. C-D&D/T/24(Part-IV)/Hirect dated 21.09.2024
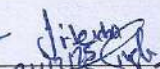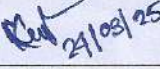
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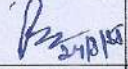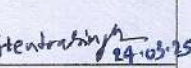
CLW Representatives	BLEE Shed Representatives	M/S HIRECT Representatives
Mr. Ankit Kumar Verma SSE/D&D/CLW	Mr. Ashish Kumar Rathore SSE/TRS/BLEE	Mr. Kshaunish Kayal Manager/Hirect
Mr. Jitendra Singh JE/D&D/CLW	Mr. Pravin Panchal JE/TRS/BLEE	Mr. Jitendra Singh Manager/Hirect

Vide reference to the above, Loco No. 38856 has been fitted with prototype Propulsion Equipment of M/S Hind Rectifiers Limited Make and same is under commissioning at CLW/CRJ.

The Locomotive functionality has been tested jointly with CLW/C-D&D, BLEE Shed representatives & firm representatives and all functionality tests report have been appended in attached annexures below:

Annexures:
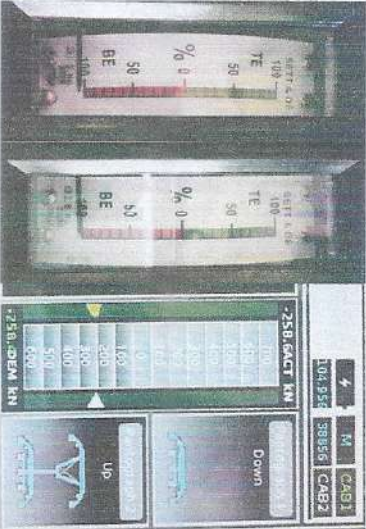
Annexure 1	:	Analogue Signal Checking
Annexure 2	:	Functional Test in Simulation Mode
Annexure 3	:	Protective Functions in WAG9 locomotive
Annexure 4	:	Performance Test

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Joint Inspection Test Report for Protection Test of HIRECT make IGBT Based Three Phase Drive Propulsion Unit in Loco 38856

Annexure: 1

Analogue Signal Checking (Testing & Commissioning Format for 3-Phase Locomotive fitted with IGBT based Traction Converter, Auxiliary Converter and VCU Format No. F60.305.01, Version:06)
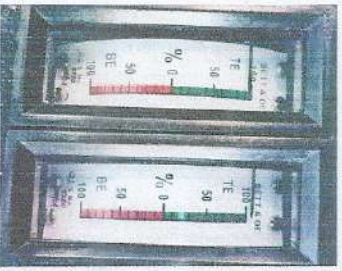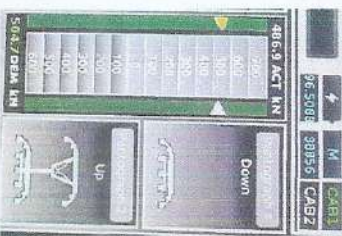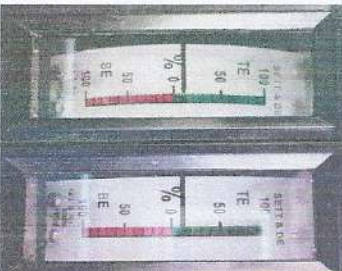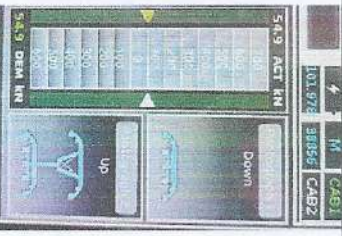
Check for the following analogue signals with the help of DDU/firm's laptop and same to be Verified OK by the testing supervisor connected with loco.

Description	Prescribed value	Functional Requirement	Observations and Value displayed on DDU	Remark	Photo
Brake pipe pressure	100% (= 5 Kg/cm2)	Displayed value of BP on DDU should be changed after application of A9 brake according to Analog BP Gauge reading	Checked in both simulation and in Power mode		
			In loco running condition at 596 node when A9 brake handle was at RUN position, 5 Kg/cm² BP was observed	Verified OK	
			(Also mapped with other values of BP pressure gauge reading)		

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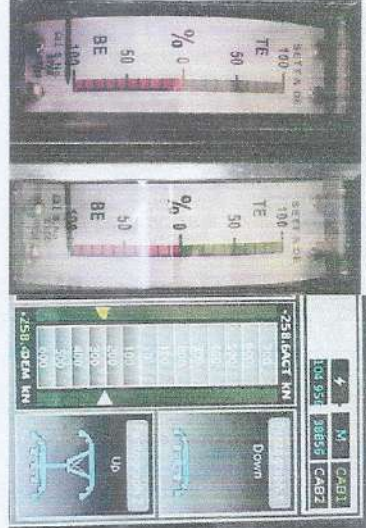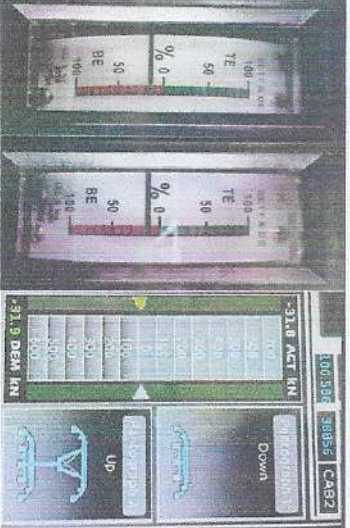| Parameter	Specification	Observation / Result	Verified	
	Checked in simulation mode		Verified OK	
Displayed value of BE on DDU should be changed according to Analog BE Gauge reading.	In this condition at 596 node when regenerative braking was taken by moving throttle in BE side		Verified OK	
Actual BE electric	100% (= 10V)	BE Calculated by formula = (actual BE of both bogie x 100) /260kN	258.6 kN BE, (130 kN per bogie) was observed. (also mapped with other values of BE Gauge reading)	
TE/BE at '0' position from both cab	Between 0% and 10% of Max kN	Observed values should be within prescribed range	0%	Verified OK
TE/BE at 'TE maximal'	Between 95% and 105% of Max kN	TE Calculated by formula =	100%	Verified OK

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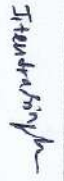
position from both cab		(actual TE of both bogie x 100) /504kN	(504kN value is observed in simulation mode.)		
TE/BE at 'TE minimal' position from both cab	Between 10% and 33% of Max kN	10.8% (54.9 kN observed in simulation mode)	Verified OK		

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| TE/BE at 'BE maximal' position from both cab | Between 95% and 105% of Max kN | | 99.5% (258.7 KN observed in simulation mode) | Verified OK | |
| TE/BE at 'BE Minimal' position from both cab | Between 10% and 33% of Max kN | | 12.26% (31.9 KN observed in simulation mode) | Verified OK | |

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TE/BE at '1/3 position' in TE and BE mode in both cab	Between 33% and 50% of Max kN	36.38% of BE (94.1 KN observed in simulation mode) 33.15% (167 KN observed in Simulation mode)	Verified OK	

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TE/BE at '2/3 position' in TE and BE mode in both cab	Between 51% and 75% of Max kN	75% of TE (381 KN observed in simulation mode) 71% of BE (184.3 KN observed in simulation mode)	Verified OK
Both temperature sensor of TM1	Between 10% to 14.33% depending upon ambient	Observed values should be within / Checked in traction mode / When loco was stand still at 570 node	Verified OK

BOGIE 1   BOGIE 2

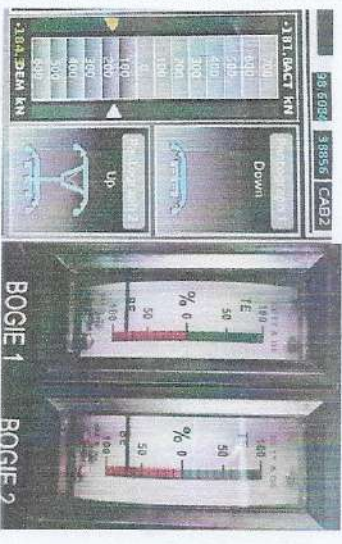|					
Mr. Ankit Verma SSE/D&D/CLW/CRJ	Mr. Mendra Singh Manager/R&D Hind Rectifiers Ltd.	Mr. Ashish Kumar Rathore SSE/TRS/BLEE	Mr. Kshaunish Kayal Manager/R&D Hind Rectifiers Ltd.	Mr. Pravin Panchal JE/TRS/BLEE	Mr. Jitendra Singh JE/D&D/CLW/CRJ

	Prescribed range	Observed values	Verified
temperature 0°C to 50°C	prescribed range	23.57 °C @ 23 °C amb	
Both temperature sensor of TM2 — Between 10% to 14.33% depending upon ambient temperature 0°C to 50°C	Checked in traction mode When loco was stand still at 570 node	19.83 °C @ 23 °C amb	Verified OK
Both temperature sensor of TM3 — Between 10% to 14.33% depending upon ambient temperature 0°C to 50°C	Observed values should be within prescribed range — When loco was stand still at 570 node	20.55 °C @ 23 °C amb	Verified OK
Both temperature sensor of TM4 — Between 10% to 14.33% depending upon ambient temperature 0°C to 50°C	Checked in traction mode When loco was stand still at 570 node	23.16 °C @ 23 °C amb	Verified OK
Both temperature — Between 10% to 14.33% depending upon ambient	Checked in traction mode	Checked in traction mode	Verified OK

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sensor of TM5	temperature 0°C to50°C	When loco was stand still at 570 node	
		21.55 °C @ 23 °C amb	
Both temperature sensor of TM6	Between 10% to 14.33% depending upon ambient temperature 0°C to 50°C	Checked in traction mode	
		When loco was stand still at 570 node	Verified OK
		21.4 °C @ 23 °C amb	

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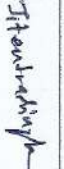
Annexure: 2

Functional Test in Simulation Mode
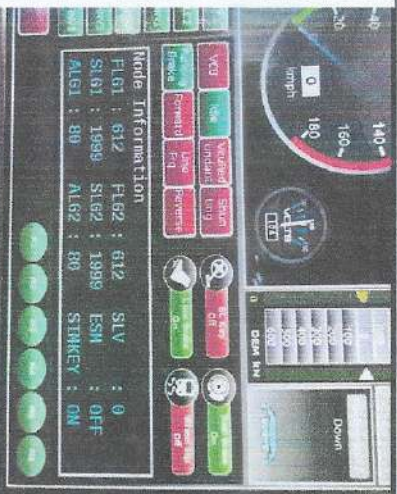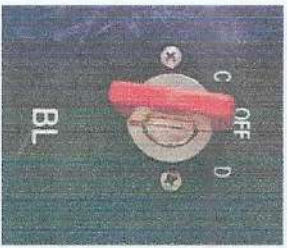
Conduct the following functional tests in simulation mode as per Para 5.5 of document no.3EHX 610 281 through the laptop/DDU:

Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
Emergency shutdown through emergency stop switch 244	An Emergency braking operation can be initiated by actuation of the Emergency stop push button on A panel VCB must open. Pantograph must lower. Flasher light should glow TE should be zero	Push Emergency Shutdown button located on A panel in both active and inactive CAB	Checked for both in loco energized condition and in simulation mode • Push emergency stop button in loco running condition at 596 mode • VCB opened • Panto lowered • Traction effort became zero • BP pressure dropped • BC applied • In inactive CAB emergency stop button on A	Verified OK	

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
			panel was pressed in loco running condition at 596 node then emergency stop was not activated		
			Checked for both in loco energized condition and in simulation mode	Verified OK.	In simulation mode
Shut Down through cab activation switch to "OFF" position	Move BL key from drive position to off position	Moved BL key from drive position to off position	Moved BL key from D to Off position • VCB opened • Pantograph lowered • Final node reached to 612 • Loco has gone in hold mode for 10 minute		
	VCB must open. Panto must lower.				

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
			Moved BL key from D to off position and off to C and then moved from C to off position and removed at off position from A panel • VCB opened node reached to 550 • Pantograph lowered node reached to 504 • Main control electronics shut downed		In energized condition

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
			Checked in simulation mode from both CAB and Verified OK the status of contactor on DDU has been verified.		
		DDU/HMI/Laptop was connected with VCU		Verified OK	
Converter and filter contactor operation with both Power Converters during Start Up.	FB contactor 8.41 is closed. By moving reverser handle or node ≥ 570(in case of M/s Siemens): • Converter pre-charging contactor must close after few seconds. • Converter main contactor must close.	• Activate the CAB by moving BL key from 'O' to 'D' After self-test when node reached to 504 then discharging contactor 8.41 was closed After closing VCB, when reverser was moved in reverse/forward direction at 570 node			
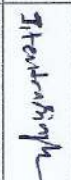
| Mr. Ankit Verma
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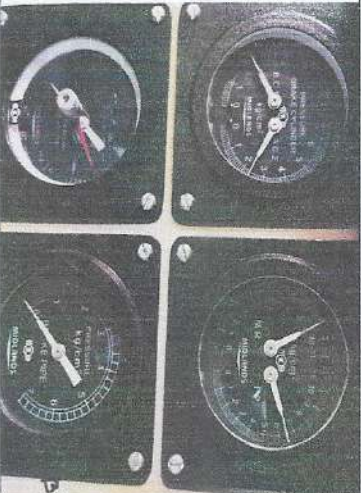| Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	• Converter pre-charging contactor must open. By increasing TE/BE throttle: • FB contactor 8.41 must open. • FB contactor 8.2 must close. FB contactor 8.1 must close.		then Precharge contactor 12.1 was closed and DC link was charged		
			After few second converter main contactor 12.2 was closed and and Precharge contactor was opened		
			After moving throttle node reached to 596 and FB contactor 8.41 was opened and 8.2 was opened and 8.1 was closed		
Converter and filter contactor operation with both Power Converters during Shut Down.	Bring TE/BE to '0'. Bring the cab activation key to '0'. • VCB must open. • Panto must lower. • Converter main contactor must open. • FB contactor 8.1 must open.	DDU/HMI/Laptop was connected with VCU Move BL key from 'D' to 'O'	Checked in simulation mode from both CAB and Verified OK the status of contactor on DDU has been verified. • VCB opened. • Panto lowered.	Verified OK	

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	• FB contactors 8.41 must close. • FB contactor 8.2 must remain closed.		FB discharging contactor 8.41 is closed, Verified OK on DDU		
			FB main contactor 8.1 opened and 8.2 had closed, Verified OK on DDU		
	Isolate any one bogie through bogie cut out switch. Wait for self-test of the loco.	DDU/HMI/Laptop was connected with VCU	Checked in simulation mode from both CABs and Verified OK the status of contactor on DDU has been verified		
Contactor filter adaptation by isolating any bogie	• Check that FB contactor 8.1 is open.	One by one bogie1 and 2 isolated through 154/SB1 bogie cut out switch I1	When loco was in run condition at 596 node	Verified OK	
	• Check that FB contactor 8.2 is open.		VCB was opened and one bogie was cut through 154 rotary switch		
	After raising panto, closing VCB, and setting TE/BE		FB contactor 8.1 & 8.2 was opened		
	• FB contactor 8.1 closes.				

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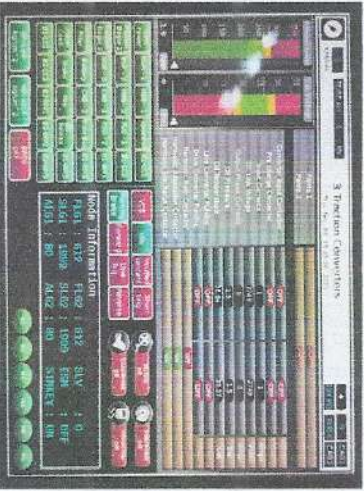| Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	• FB contactor 8.2 remains open.		After closing VCB and taking traction 8.1 contactor had closed and 8.2 remained open		
Test earth fault detection battery circuit positive & negative	Wire 2050 to earth, create earth fault negative potential. • message for earth fault By connecting wire 2095 to earth, create earth fault positive potential. message for earth fault.	Wire 2050 is earthed to the body for simulating negative earth fault Wire 2095 is earthed to the body for simulating positive earth fault	Earth fault battery circuit pop-up message appeared on DDU screen	Verified OK	

WARNING!

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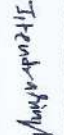
Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
Test fire system. Create a smoke in the machine room near the FDU. Watch for activation of alarm.	When smoke sensor-1 gets activated then • Alarm triggers and fault message priority 2 appears on screen. When both smoke sensor 1+2 gets activated then • A fault message priority 1 appears on screen and lamp LSF1 glow. • Start/Running interlock occurs and TE/BE becomes to 0.	for simulating this test smoke was created by burning a paper in machine room after setting a loco speed through throttle	Checked in simulation mode from Both CAB. Alarm triggered and warning smoke in machine room priority 1 fault message appeared on DDU screen. TE became zero	Verified OK	
Angle Transmitter Failure Mode	Failure mode should work when difference between auxiliary contacts and the absolute value of angle transmitter became greater	Disconnect EA connector of angle transmitter from VCU	Checked in simulation and traction mode from Both CAB. Disconnected EA connector from VCU 1 when CAB 1 was	Verified Ok	At 0< TE< 1/3TEmax

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	than 62% of the full range because of a defective master controller		active at 504 node state		
	Pop-Up message Fault in angle transmitter should be appeared on DDU		Disconnected EA connector from VCU 2 when CAB 2 was active		
	Activate failure mode by moving the rotary switch 152 to position '1'		After taking traction node was reached to 596. **A pop-up message fault in angle transmitter** was appeared on both DDU 1 (when CAB 1 is active) & DDU 2(when CAB 2 is active)		
	Move reverser in forward/reverse direction				
	Take Traction Angle transmitter must work at 3 steps i.e 1/3, 2/3 and max. values		Angle transmitter moved at 3 steps i.e 1/3, 2/3 and max. values • With application of throttle, gradual increase in TE		At 1/3TEmax< TE <2/3TEmax

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
			• Step change in values of TE/BE observed at position 1/3, 2/3, and maximum • For TE minimal position from 0 to 1/3TEmax, TE observed is 138.3 KN • For 1/3 TE_max up to 2/3 TE_max is 289.3 KN • For 2/3TEmax up to full is 398.2kN Regenerative braking in failure mode is working		At TE>2/3TEmax or TEmax

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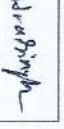
Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
					AT 1/3BE max>BE> 0 AT 2/3BE max>BE> 1/3BEmax

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
Bogie Cut Out Mode	Single bogie isolation;	Firstly, VCB opened then one by one Bogie 1 & 2 isolated	Checked in both traction and simulation mode from both CAB	Verified OK	BE>2/3BEmax or Full

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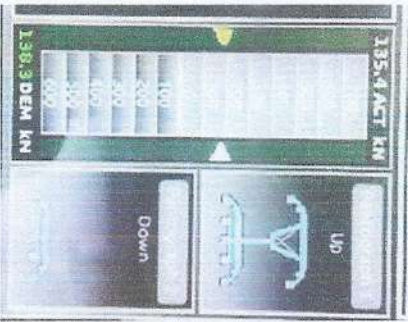| Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	Isolate any one bogie by rotary switch(154/SB1) to be kept in I/II(for isolation of SR1/SR2 position should be I/II) position and then isolation message should pop up on the DDU	through bogie cut out rotary switch	After taking traction Priority 1 fault with Pop-Up message "Disturbance in converter" appeared on DDU		
		For isolating SR1 through MCB, Firstly VCB opened then Tripped MCBs of control electronics of SR1 127.1/1 in SB1 panel	LSFI and BPFA glowed in all cases After acknowledging BPFA faulty SR got isolated and LSFI lamp permanently glowed		
	Both bogie isolation: Rotary switch to be kept at I+II position. Both bogie should be isolated with pop up message of main power off.	For isolating SR2 through MCB, Firstly VCB opened then Tripped MCBs of control electronics of SR2 127.1/2 & 127.11/2 in SB2 panel	To do the faulty SR normal, MCE was reset.		

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo

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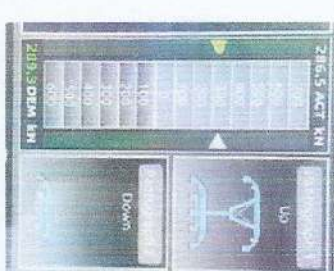| Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
Configuration Mode		Loco was stand still with applied SA9 brake		Verified OK	

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	Rotary switch 160 to be moved at position 0	Throttle and reverser were in neutral position	Checked in both simulation and power mode		
	Speed should be restricted to 15kmph	When node was 504 then shunting mode switch located in SB 1 moved from normal to active position	At 590 node throttle was taken		
	Pop up message "Loco in shunting mode" should appear during every throttle movement		After application of throttle loco is in shunting mode activated Pop-Up message is appeared.		
			Maximum loco speed was reached up to 14.9 KMPH		
			And Loco speed was restricted to 15 KMPH		
			BPCS push button was pressed at 7.3 KMPH speed and loco speed became constant at 7.4 KMPH.		

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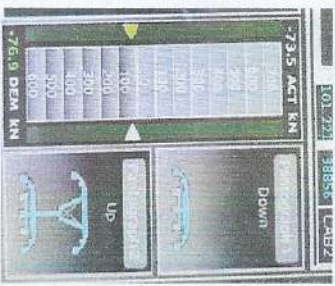| Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
	Rotary Switch 237 to be kept at 0 position	Checked in simulation mode from both CAB 1 and CAB 2			
	Speed to be increased and apply BPCS above 5kmph, no action to be taken for 1 minute	When loco was in 504 node and SA9 596 nodes, traction and speed appeared.	At 590 node throttle was taken and node reached to 596. After 596 nodes, traction and speed appeared.		
	VCD should not operate after 1 min	Moved VCD switch 237 located in SB 1 panel to 0 position	When speed reached 11 KMPH BPCS push button was pressed and no action was taken for 1 minute.	Verified OK	
Vigilance Cut Out Mode	Further rotary switch to be moved to original position '1' and check operation of VCD Pop up message of vigilance emergency applied should appear		After 1-minute vigilance warning appeared.		
			After 76 second vigilance emergency brakes were applied with popup on DDU.		

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Test Function	Test Procedure/ Functional Requirement	Test Procedure Followed	Observation	Result	Photo
Time, date & loco number	Ensure correct date time and loco number	Checked on DDU	Loco type WAG9 and loco number 38856 is displaying on DDU Time and date setting OS based. It is also suggested to add an indication for Hotel load converter in the DDU. . .	Verified OK	

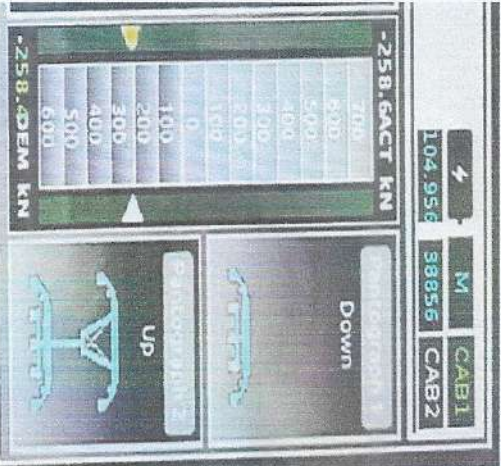|				
Mr. Ankit Verma SSE/D&D/CLW/CRJ	Mr. Jitendra Singh Manager/R&D Hind Rectifiers Ltd.	Mr. Ashish Kumar Rathore SSE/TRS/BLEE	Mr. Kshaunish Kayal Manager/R&D Hind Rectifiers Ltd.	Mr. Pravin Panchal JE/TRS/BLEE	Mr. Jitendra Singh JE/D&D/CLW/CRJ

Annexure: 3

Protective Functions in WAG9 locomotive as per Document Vehicle Control System Software Specification F:3EHP 541 526

Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
AC Primary Voltage (Cooling mode)	Trigger level 17,5 kV(RMS) (+/- 0.5 kV, no hysteresis) : VCB off	The trip setting was initiated by operating the MVR relay.	BL key was in C position, MCE was off	Verified OK	NA

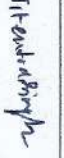|			
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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
AC Primary Voltage (Driving mode)	Protective actions: 1) Minimum-voltage monitoring: U <= 17 kV(RMS) : VCB off closing of VCB inhibited if U <= 17.5 kV 2) Maximum-voltage monitoring: U >= 30 kV(RMS) : VCB off closing of VCB inhibited if U >= 29 kV	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	Values of OHE at which VCB tripped 1) VCB tripped for U<= 25 kV. (Actual value is 25 KV, forced value is 26 KV, Default value will be 17kV) 2) VCB tripped at U>=31.5kV, (Actual value is 25 KV Forced value is 24 KV. Default value will be 30kV) "Catenary voltage out of limit" Pop-Up message appeared on DDU	Verified OK	

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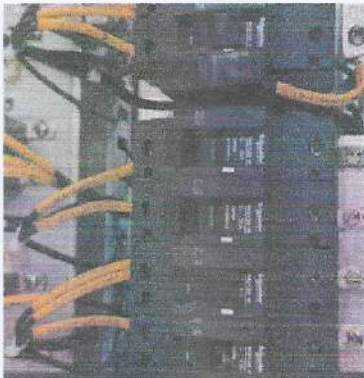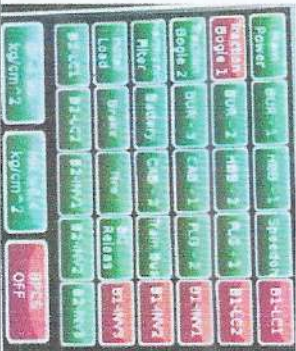| Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
AC Primary Current (Hardware Function)	Protective actions: 1)Trigger level 990 Apeak (+ 0 A / - 100 A): VCB off 2) Maximum-current monitoring during normal operation: Trigger level 360 ARMS (+ 0 A / - 20 A): VCB off		In cooling mode, MCE stays off due to which AC over current protection cannot be simulated through software logic		
			Ac over current protection in cooling mode is actuated by over current relay	Verified Ok	AC over current protection in cooling mode is actuated by over current relay.

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
AC Primary Return Current	Protective actions: 1) Maximum-current monitoring within 1.25 sec after switch-on of VCB (inrush current of transformer): I >= 800 A(RMS) : VCB off 2) Maximum-current monitoring during normal operation: I >= 330 A(RMS) : VCB off	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	Values of AC Primary Return Current at which VCB tripped 1) VCB tripped for I≥810A To simulate the condition, the level has been changed in forced value. (Actual value –10A Forced value- 8A Default value – 810A 2) VCB tripped for I≥338A (Actual value –10A Forced value- 5A Default value – 338A) **"Primary overcurrent"** Pop-Up message appeared on DDU.	Verified Ok	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Harmonic Filter Current	Protective actions: 1) Maximum-current monitoring within 1 sec after switch-on of harmonic-filter: I >= 600 A(RMS) : VCB off, contactor harmonic filter off 2) Maximum-current monitoring during normal operation: I >= 410 A(RMS) : VCB off, contactor harmonic filter off	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	Values of Harmonic Filter Current at which VCB tripped To simulate the condition, the level has been changed in forced value. 1) VCB tripped for I≥600A (Actual value – 168A Forced value- 150A Default value – 600A) 2) VCB tripped for I≥410A (Actual value – 190A Forced value- 130A Default value – 410A) Harmonic filter current too high Pop-Up message appeared on DDU.	Verified OK.	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Auxiliary Current	Protective actions: 1) Maximum-current monitoring: I >= 400 A(RMS) : VCB off	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	Values of Auxiliary Current at which VCB tripped To simulate the condition, the level has been changed in forced value. VCB tripped at I≥402A (Actual value – 117A Forced value- 100A Default value – 400A) **Auxiliary winding overcurrent** Pop up message appeared on DDU	Verified OK.	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Vehicle Speed, Motor Speed	Protective actions: 1) 100 <V <=110 KMPH TE linear reduction from 100 % to 0 % in VCU 2) v > 112 km/h : IGBT-pulsing inhibited		In simulation mode, when speed exceeded to 100 KMPH, buzzer alarm activated, VCU start reducing TE demand with a linear reduction from 100 % to 0 % in VCU. When speed v>113 km/h motor pulsing stopped.	Verified OK	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Traction Motor Temperature	Protective actions: 1) IGBT-pulsing inhibited: 230°C	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	VCB tripped for motor temperature T >= 230 °C (Actual value – 21.8 °C Forced value- 20 °C Default value – 230 °C) "Traction motor temperature too high" Pop-Up message appeared on DDU The motor got isolated.	Verified Ok	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Transformer Oil Pressure	Protective actions: 1) If signal < 7 mA (0.75 bar) : VCB off or signal > 14 mA (2.5 bar) : VCB off	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	When transformer oil pressure drops and exceeds the following values 1) VCB tripped at TOP<0.75 Bar (Actual value – 1.5bar Forced value– 1.6 bar Default value – 0.75 bar) 2) VCB tripped at TOP>2.6 Bar (Actual value – 1.5 bar Forced value– 1 bar Default value – 2.5 bar) **Transformer oil temperature or pressure not ok** Pop-Up message appeared on DDU Converter got isolated Main power isolated.	Verified OK	

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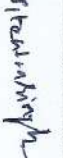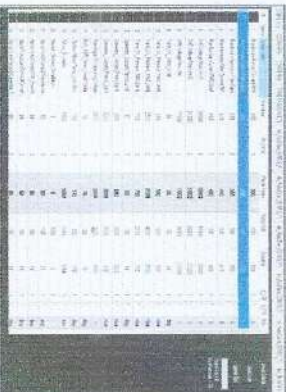| Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Transformer Temperature	Protective actions: 1) VCB Off: T 84°C longer than 10 sec	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	When transformer oil temperature exceeds the following values VCB tripped at T≥84 °C (Actual value – 31.58°C Forced value- 25°C Default value – 84°C) Transformer oil temperature or pressure not ok Pop-Up message appeared on DDU and VCB will be tripped and after two iterations Main power will be isolated.	Verified OK	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Converter Oil Pressure	Protective actions: 1) Oil-pressure monitoring: Converter oil temperature > 50°C pressure < 1.5 bar : VCB off	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	When converter oil pressure dropped below the following value VCB tripped at P<1.45 Bar, actual value is 1.45 Set value is 1 Bar after two iterations that converter & bogie got isolated. **Converter oil pressure not ok** pop-Up message appeared on DDU	Verified Ok	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Converter Oil Temperature	Protective actions: 1) VCB Off: T 80°C longer than 10 sec	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	When converter oil temperature exceeded the following results. VCB tripped at T≥81°C. Actual temp was 29.45°C, limit changed to 25°C. After One iteration particular bogie got isolated. "Converter oil temperature too high" Pop-Up message appeared on DDU.	 Verified Ok	

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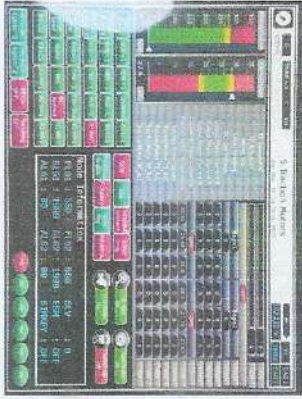| Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
DC Link Voltage Main Converter	Protective actions: Udc < 2500 V : DC-link Under Voltage Udc > 3200 V : DC Link Over Voltage	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	When DC link voltage dropped below and exceeded above the following values VCB tripped at V≤2450V. limit change 2500-volt actual value is 2000 volt. 2) VCB tripped at V≥3199V, limit change 1500 volt, actual value is 1950.volt. Disturbance in Converter, **Line Converter-1 Bogie-1 Isolated** Pop-Up message appeared on DDU	Verified OK	

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Earth Fault Detection Main Converter	'Earth fault in converter 1/2' Ie > 1A: DDS 'Earth fault in converter 1/2' (Ie: Earth fault leakage current)	For testing the protective action for the upper and lower limit of locomotive parameters Simulated forced signal was given to the controller of processor cards of the traction converter through software tool and GUI.	Earth fault in Traction Converter Pop-Up message appeared on DDU		WARNING!
			As we have used the current based Earth fault sensing logic	Verified Ok	
Earth Fault Battery Circuit	Protective actions: Binary signal 0 : normal operation Binary signal 1 : diagnostic data set (DDS) 'earth fault battery circuit'	To simulated the battery Earth fault, at PCLH connector +ve and –ve terminal of the D panel is connected to the loco body individually.	Earth Fault Battery Circuit Pop-Up message appeared on DDU.		
			As per shed, the E/F indication need to be incorporated in DDU.	Verified Ok	WARNING!

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Description	Prescribed Value	Test Procedure Followed	Observation (Checked in Simulation/Traction Mode from Both CAB)	Remark	Photo
Earth Fault Auxiliary Circuit	Protective actions: Binary signal 0: normal operation Binary signal 1 : diagnostic data set (DDS) 'earth fault auxiliary circuit'	To simulate this, in HB2 panel relay 89.2 A & B are shorted.	**Earth Fault Auxiliary Circuit** Pop-Up message appeared on DDU. As per shed, the E/F indication need to be incorporated in DDU.	Verified Ok	
Earth Fault 415V/110V Circuit	Protective actions: Binary signal 0 : normal operation Binary signal 1 : diagnostic data set (DDS) 'earth fault 415V/110V circuit'	To simulate this, in HB1 panel, relay 89.5 A & B points are shorted.	**Earth Fault 415V/110V Circuit** Pop-Up message appeared on DDU. As per shed, the E/F indication need to be incorporated in DDU.	Verified Ok	
Earth Fault Filter Circuit	Protective actions: Binary signal 0 : normal operation Binary signal 1 : diagnostic data set (DDS) 'earth fault filter circuit'	To simulate this, in FB Cubicle, relay 89.6 A & B points are shorted.	**Earth fault harmonic filter circuit** Pop-Up message appeared on DDU. As per shed, the E/F indication need to be incorporated in DDU.	Verified Ok	

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Performance Testing & Commissioning Format For 3-Phase Locomotive fitted with IGBT based Traction Converter, Auxiliary Converter and VCU Format No. F60.305.01, Version:06

Description	Process followed to simulate the test	Observations	Result
Emergency stop in cooling mode	Raise panto in cooling mode. Put the brake controller into RUN position. Close the VCB. Push emergency stop button 244.	VCB got open Panto was lowered Emergency brake was applied	Verified OK
Emergency stop in driving mode	Raise panto in driving mode in. Put the brake controller into RUN position. Close the VCB. Push emergency stop button 244.	VCB got open Panto was lowered Emergency brake was applied	Verified OK
Shut down in cooling mode	Raise panto in cooling mode. Close the VCB. Bring the BL-key in 'O' position.	VCB got open Panto was lowered	Verified OK
Shutdown in driving mode	Raise panto in driving mode. Close the VCB. Bring the BL-key in 'O' position.	VCB got open Panto was lowered	Verified OK
Interlocking pantograph-VCB in cooling mode	Raise panto in cooling mode. Close the VCB. Lower the pantograph by ZPT	VCB got open	Verified OK
Interlocking pantograph-VCB in driving mode	Raise panto in driving mode. Close the VCB. Lower the pantograph by ZPT	VCB got open	Verified OK

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Description	Process followed to simulate the test	Observations	Result
Measurement of protective shutdown by Converter 1 electronics	Start up the loco with both the converter. Raise panto. Close VCB. Move Reverser handle to forward or reverse. Remove one of the fiber optic/EMD/ESD/Communication media feedback cable from converter 1 Check that converter 1 electronics produces a protective shut down. • VCB goes off • Priority 1 fault msg. on DDU appears "Disturbance in Converter 1"	After removing the MVB cable from the Traction Converter 1 VCB goes OFF and fault msg popped up on DDU screen "Life sign from Line Converter 1 is missing"	Verified OK
Measurement of protective shutdown by Converter 2 electronics	Start up the loco with both the converter. Raise panto. Close VCB. Move Reverser handle to forward or reverse. Remove one of the fiber optic/EMD/ESD/Communication media feedback cable from converter 2. Check that converter 2 electronics produces a protective shut down. • VCB goes off • Priority 1 fault msg. on diagnostic display appears "Disturbance in Converter 2"	After removing the MVB cable from the Traction Converter 1 VCB was OFF and fault msg popped up on DDU screen "Life sign from Line Converter 2 is missing"	Verified OK
Cab activation in driving mode	No fault message should appear on the DDU of the loco.	No fault msg appeared on DDU screen	Verified OK
Check regenerative braking	Bring the TE/BE throttle to BE side. Loco speed should start reducing	Regenerative braking was checked during loco running in trial and found working satisfactory	Verified OK
Check for BUR redundancy test at ventilation level 1 & 3 of loco operation	In the event of failure of one BUR, rest of the two BURs can take the load of all the auxiliaries. For this switch off one BUR. Auxiliaries should be catered by rest of two BURs. Switch off the 2 BURs; loco should trip in this case.	BUR redundancy test was conducted with isolation of 1, 2 & 3 BUR individually. When 2 BURs were got isolated, main power SS01 also got isolated.	Verified OK

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Description	Process followed to simulate the test	Observations	Result
Check the power converter isolation test	Create disturbance in power converter by switching off the electronics. VCB should open and converter should get isolated and traction is possible with another power converter.	"Disturbance in BUR Processor 1/2/3" pop-up message appeared.	
		Power Supply of Traction Converter was isolated from SB1 & SB2 and VCB turned OFF	
		Bogie 1 isolated only half traction available.	Verified Ok
Loco charging.	Loco to be charged and all auxiliaries should run. No fault message to appear on the diagnostic panel of the loco. Raise MR pressure to 10 Kg/cm², BP to 5 Kg/cm², FP to 6 Kg/cm².	Moved BL key from off to drive position	
		After self-test node reached to 504, after raising panto node reached to 550, and after closing VCB node reached to 570 all auxiliaries start working	
		MR, BP and FP are charged accordingly.	Verified OK
Check operation of compressors in "AUTO" Mode.	• BLCP off mode • Manual mode • Auto mode • At the starting of compressors un-loader valve should operate. • If MR pressure is less than 8 Kg/cm² both compressor will run till MR pressure reaches at 10 Kg/cm².	1-BLCP off mode verified compressor not operate. 2-Auto & Manual verified 3-Un-loader valve operated during ON of compressor 4-When MR pressure drops below 8 Kg/cm² both compressor runs till MR pressure reached at 10 Kg/cm².	Verified OK

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Description	Process followed to simulate the test	Observations	Result
Check function of emergency push stop.	Emergency stop push button was pressed	5-Low MR pressure verified	
		It is working only in activated cab. By pressing Emergency stop push button, VCB opens & pantograph lowers	Verified OK
		Checked in both simulation and traction mode	
Check function of BPCS.	Beyond 5 kmph, press BPCS, the speed of loco should be constant.	Below 5 KMPH it is not working. And beyond 5kmph it works as stated.	
		At loco speed 9 KMPH BPCS Push button pressed and speed became constant.	Verified OK
	BPCS action should be cancelled by moving TE/BE throttle, by dropping BP below 4.75 Kg/cm², by pressing BPCS again.	By moving throttle BPCS action got disabled	
		LSAF glowed	
Check train parting operation of the locomotive.	Emergency RS cock at ALP side operated to drop the BP pressure LSAF should glow.	BP pressure dropped, AFL gauge needle shoot up, and Buzzer sounds, auto flasher starts glowing, on DDU screen "Alarm chain pulling" message appeared, BC & BP pressure was decreased, after 1 minute P2 fault Pop-Up Message	Verified OK

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Description	Process followed to simulate the test	Observations	Result
		Alarm Chain Pulling was appeared on DDU.	
		As per shed remark, AFL logic with logging has been implemented in the software but the necessary wiring as pert MS needs to be done by CLW.	
Check vigilance operation of the locomotive.	Set the speed more than 1.5 kmph and ensure that brakes are released. For 60 seconds do not press vigilance foot switch or sanding foots switch or TE/BE throttle then Buzzer should start buzzing. LSVW should glow continuously.	Buzzer sounds after 1 minute	Verified OK
Check start/run interlock	At low pressure of MR (< 5.6 kg/cm²). With direct loco brake applied. With automatic train brake applied (BP < 4.75 kg/cm²). With emergency cock (BP < 4.75 Kg/cm²).	LSVW glows	Verified OK
Check traction interlock	Switch off the brake electronics MCB 127.7 in SB2. The tractive/braking effort should ramp down, and BP reduces rapidly.	Start/run interlock was simulated with all the four combinations	Verified OK
Brake Blending Test	During the Regeneration failure the loco brakes will be applied in proportion to throttle position in BE mode	After MCB 127.7 in SB2 was switched off TE/BE & BP reduced to zero	Verified OK
		Checked in simulation and traction mode	Verified OK
		To simulate the test condition VCB was intentionally opened after taking the throttle in BE in loco running condition.	Verified OK

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Description	Process followed to simulate the test	Observations	Result
ZTEL to be switched on at 596 node	TE should be limited to 300kN after applying the brakes (applicable only to WAG-9H)	loco brake was automatically applied without application of SA 9 brake.	
		Checked in simulation mode at 596 node, after taking traction TE not exceeded to 298 KN	Verified OK
Transformer Oil Pressure Sensor Failure Test	Remove the sensor to detect the failure message on DDU screen. VCB turns OFF	Transformer oil pressure sensor cable (214.C/1) was disconnected from amplifier	
		"Transformer oil temperature is not ok" Pop-Up message appeared on DDU and VCB tripped	Verified OK
Transformer Oil Temperature Sensor Failure Test	Remove the sensor to detect the failure message on DDU screen. VCB turns OFF	Transformer temperature sensor cable (210.5A) was disconnected from amplifier	
		"Transformer oil temperature is not ok" Pop-Up message appeared on DDU and VCB tripped	Verified OK
Motor Temperature Sensor Failure Test	Remove 1,2,3 temperature sensor cable from TC1/TC2 and check whether that motor is isolated. Again, in case of three motor the Bogie gets isolated.	VCB Tripped, "Traction motor temperature too high" Pop-Up message appeared on DDU and respective motor got isolated.	
		When all temperature sensor connectors of SR1/SR2 were disconnected from MCU processor card then that bogie got isolated.	Verified OK

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Description	Process followed to simulate the test	Observations	Result
VCU Reset	Press the VCU reset switch at 504 node, BP should not drop more than 4.65kg/cm2. Control Electronics will get off and restart. 504 node should be reached.	VCU reset push button was pressed BP does not drop MCE reset occurred	Verified OK
Inching mode	Reverser to be kept at forward/reverse mode. Inching mode to be selected from DDU. Speed limit to be set at 0.5-1.5kmph Press ZTEL switch.	Checked in forward reverse direction, after configuring through DDU screen, ZTEL switch was set to on position After moving ZTEL switch in off position ZTEL operation got deactivated	Verified OK
Motor Speed Sensor Failure Test	Speed sensor connectors of Bogie 1 & 2 was disconnected from motor sensor units (MSUs processor cards) from TC1/TC2 and checked whether that motor is isolated. When 3 speed sensors of Bogie1 and Bogie 2 was isolated one by one then that Bogie got isolated.	After disconnecting motor speed sensor connectors, "Fault in speed sensor" pop-up message was appeared with VCB tripped, BPFA and LSFI glowed, after acknowledging BPFA that motor got isolated. When 3 speed sensors of Bogie1 and Bogie 2 was isolated one by one then that Bogie got isolated.	Verified OK
Traction Converter Coolant Oil	Remove the sensor to detect the failure message on DDU screen. VCB turns OFF	TC Coolant MCB was turned off from HB panel to simulate the result	Verified OK

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Description	Process followed to simulate the test	Observations	Result
Pressure Sensor Failure Test			
Speed restricted to 100 KMPH when harmonic filter got isolated	Cas-1 In simulation mode, harmonic filter isolation has created by simulating the condition of harmonic filter over current by giving the forced command to the controller of processor card through software tool and HMI. Case-2 Harmonic filter isolated fault was created by harmonic filter contactor stuck off fault. By releasing pressure of EPC contactor (8.1 & 8.2) through FB cock on pneumatic panel	In simulation mode, for the first case, VCB was tripped and "Harmonic filter current too high" pop-up message appeared. After closing the VCB and taking traction speed was restricted to 100 kmph In second case, harmonic filter was isolated, again VCB closed and when traction taken speed restricted to 100 kmph. 	Verified OK
Banking mode operation	The brake pipe of rolling stock will not be charged by the banking loco, but it will be possible for the banking	Banking mode was tested in power mode. Throttle was applied to check the TE demand	Verified OK

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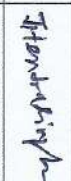| Description	Process followed to simulate the test	Observations	Result
	loco's driver to apply train brakes from banking loco in case of emergency. Throttle can be applied		
VCB Stuck ON	VCB Stuck OFF/ON by continually ON/OFF of BLDJ	No VCB stuck ON/OFF message observed	Verified OK
BPFA operation	Fault should acknowledge by pressing BPFA in any fault pop switch.	Fault get acknowledge by pressuring BPFA switch.	Verified OK
AD-BLDJ operation	Raise panto in driving mode. Close the VCB by AD-BLDJ.	VCB got open/close by AD-BLDJ switch	Verified OK
Performance of BURs during energy saving mode	To check the operation of Energy saving mode, the following steps to be followed: 1. First keep the BL in 'D' position, raise the panto and switch on VCB. 2. Ensured all BUR are in service, TE/BE is zero, BC applied and loco speed is zero. 3. Ensured Temperature of Transformer oil, Traction converter coolant and traction motor is less than 55 deg.C 4. Wait for 5 min, if all the above condition prevails, then loco should go to energy saving mode by switching OFF BUR-2 converter. 5. By moving TE/BE throttle, Energy saving mode will be deactivated.	Energy saving mode getting activated & deactivated. As per described condition.	Verified OK
Auxiliary load - isolation test	1-tripped any one Compressor MCB 2-tripped any one Scavenge Blower	Performed by tripping MCB form HB-2 panel and only popup message observed no performance issue was observed.	Verified OK
Check sanding operation.	1-Reversal in forward 1,3, sanding valves should be activated.	Operated from CAB-2 found 1-Reversal in forward 1,3, sanding valves is activated.	Verified OK

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Description	Process followed to simulate the test	Observations	Result
	2-Reversal in reverse 2,4 sanding valves should be activated.	2-Reversal in reverse 2,4 sanding valves is activated.	
PVEF Operation	Break pressure should release fast.	PVEF pressed and break get release fast	Verified OK
VCU redundancy test	Removed VCU main processor card	VCU-1 main processor removed in control and verified FLG-1 status high and system working ok .	Verified OK
Check Harmonic current	By removing AFE-2 gate pulse optical cable.	Reduction of 1/4 th of AFE & checked 190 Amps harmonic current.	Verified Ok

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Description	Process followed to simulate the test	Observations	Result
Inching Mode	In inching mode speed of locomotive verified at 0.5 KMPH to 1.5 KMPH.	Inching mode at 0.5 KMPH & 1.5KMPH verified ok	Verified ok
Constant Speed	Speed should maintain constant speed by pressing BPCS at above 5 KMPH	BPCS pressed at 5KMPH speed & observed speed maintain 5 KMPH.	Verified ok

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Joint Note

In compliance to CLW letter no. C-D&D/T/24(Part-IV)/Hirect, dated 21.09.2024 functionality and performance testing was done on 19.03.2025 and the observations are as follows:

1. The snapshot of software version which has been uploaded in the loco no. 38856 is as follow and the versions are -

Description		Software version
SR 1 software version	:	1006
SR 2 software version	:	2006
BUR1 software version	:	103
BUR2 software version	:	203
BUR3 software version	:	303
VCU 1 software version	:	1036
VCU 2 software version	:	2036
DDU1 software version	:	DDU_CAB11703.11
DDU2 software version	:	DDU_CAB11703.11

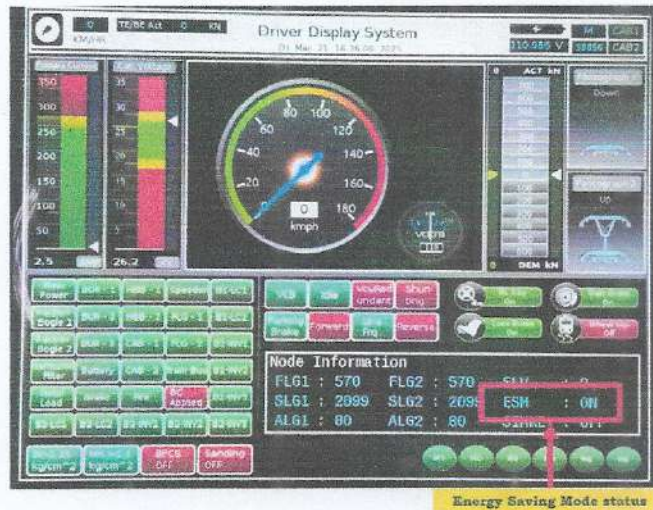| Mr. Ankit Verma SSE/D&D/CLW/CRJ	Mr. Jitendra Singh Manager/R&D Hind Rectifiers Ltd.	Mr. Ashish Kumar Rathore SSE/TRS/BLEE	Mr. Kshaunish Kayal Manager/R&D Hind Rectifiers Ltd.	Mr. Pravin Panchal JE/TRS/BLEE	Mr. Jitendra Singh JE/D&D/CLW/CRJ

2. Graphical user interface (GUI) to monitor the healthiness of each motor has been implemented in DDU and same has been verified. Also Screen shot of same is attached below for reference

Status of AFE and INV modules   Status of TM motor

3. Recordings of 43 critical signals as per RDSO letter no. EL/3.1.35/17 dated 28.04.2023 has been implemented. The storing is being done for 72 hours and it is being downloaded through Ethernet cable and the data displayed in Excel format which is provided as Annexure-AA. Further it is to be noted that there are 62 parameters altogether which is being recorded.

4. Logic for energy-saving scheme, based on RDSO Modification Sheet no. 0482, rev 1, has been provided. Further whenever energy saving mode gets activated, in pixy window of DDU the status of the ESM will be ON indicating "ESM (Energy Saving mode): ON" showing a pop up message of "Energy Saving Mode Activated".

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Energy Saving Mode status

5. Against implementation of DPWCS ICD firm confirmed that they have MVB ports ready for integration. However, due to unavailability of DPWCS in the locomotive the logic can't be verified.

6. Against implementation of WTB ICD firm mentioned that they are using standard WTB gateway unit of M/S HaslerRail which is already been used by other propulsion manufacturer. Same has been verified in loco. It can't be verified because similar propulsion system of M/S Hind Rectifiers Limited propulsion is not available.

7. Firm has provided Trouble shooting and Maintenance manual with Fault diagnostic list and mentioned that Compliance with the protection scheme is in already include in the manual and design documents. Thus, firm intimated to refer the same. Also firm has provided a joint test report which has been witnessed by CLW.

8. On 19.03.2025, a testing was conducted with two locomotives placed back-to-back in regeneration mode. The trail was done in both up and down gradient available inside CLW. In the testing following was observed
    a. On the day of testing it was fair and sunny and no rain was there.
    b. In the up gradient the maximum tractive effort which was reached was 508kN and the maximum speed was 9.2kmph. Wheel Slip appeared sometime but no tripping of Traction converter had been observed.

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c. In down gradient the maximum tractive effort which was reached was 520 KN and the maximum speed observed was 12 kmph. Wheel slip in down gradient was not observed and snapshot for the same is attached for reference.

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In addition to this the TE curve for complete testing period is attached for reference.
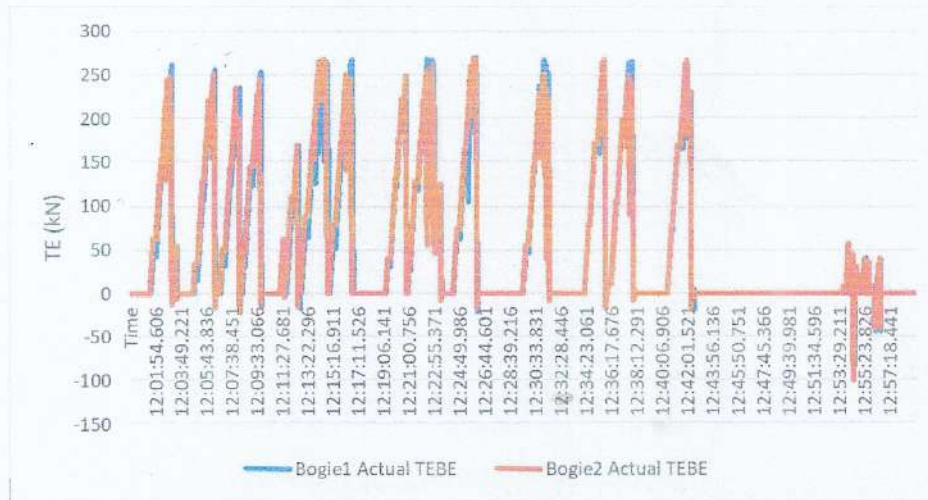
In view of above of it can be observed that slip slide control has been found satisfactory. Currently, the test is being conducted with two locomotives connected back-to-back in regeneration mode, with the loads being simulated. However, more precise tuning may be required to match actual service conditions during field trials.

Additionally, it is to be noted that due to speed and track limitations at CLW, the complete performance could not be assessed at higher speeds. Therefore, firm may be advised to conduct foot plating of the locomotive when it is dispatched from CLW. Furthermore, ELS/Shop-19/CLW may be instructed to carry out pre-dispatch tests as per the testing and commissioning format along with the modifications with the necessary MS issued by RDSO.

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