Report of Committee

On

Finalization of Location / Fitment

Of

KAVACH DMI

In Various Types of Locomotives

Report No. : RDSO/2021/EL/RM/0197(Rev.0)

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Committee and Terms of Reference

Committee

Vide letter no. 2021/Elec(TRS)/138/3(KAVACH) dated 03.11.2021, Board (Member/Infra and Member/T&RS) has constituted interdepartmental committee as under to deliberate upon the issue of Finalization of Location/ fitment of KAVACH DMI in various types of locomotives and amalgamation of multiple displays inside Locomotive cabs.

1.	Shri Kishore Kumar	PED/EE/RS	Convenor
2.	Shri G. Pavan Kumar	ED/Tele-II/RDSO	Member
3.	Shri R. K. Tewari	CELE/SER	Member
4.	Shri S. K. Tiwari	ED/SE/RDSO	Member
5.	Shri P. P. Raju	CEE/Inspection/BLW	Member

Terms of Reference (TOR)

To finalize the location/fitting of KAVACH DMIs for different types of Locomotives duly prioritizing the same keeping in view residual running life etc. which needs to be amalgamated with other display/fittings provided in the Loco cab keeping in view drivers' functionality requirement and ergonomics etc.

1. Objective

To reduce multiple numbers of dynamic displays and integrate functionality and finalization of their fitment location inside locomotive cabs.

2. Background Information

There are various projects/systems are under various stages of induction over IR which have their own display interface for the driver in addition to already existing Driver Display Unit (DDU) provided in the locomotive i.e.

- Distributed Power Wireless Control System (DPWCS)
- End of Train Telemetry (EOTT)
- Real Time Train Information System (RTIS)
- Fog Safe Device (FSD)
- KAVACH

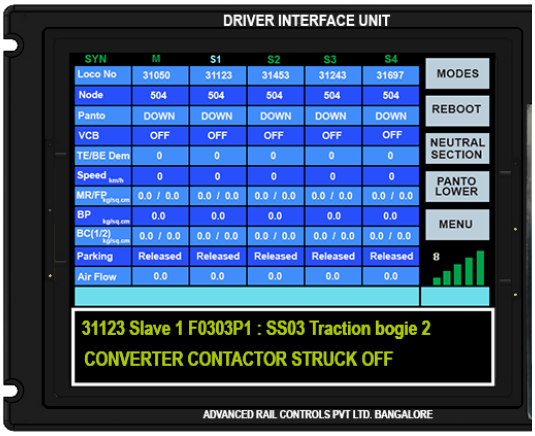
The 3rd party equipment has been added over a period of time either for performance improvement or for safety enhancement and has independent display units. Due to space constraints in the locomotive cab; it is difficult to provide multiple displays in the cab. Multiple displays not only impose problems on their fitment but also put undue stress on LP in working of trains. The details of 3rd party equipment are described below:

(i) Distributed Power Wireless Control System (DPWCS) in 3-phase Locos

This equipment permits operation of the rear locomotives configured in slave mode from the lead (master) locomotive on RF communication. It has two displays, one in each cab of Locomotive. DPWCS has basically five components viz. CCU (Communication Control Unit), BIU (Brake Interface Unit), DIU (Driver Interface Unit), Radio and Antenna which are all supplied by the same vendor. The CCU has to communicate with VCU for data sharing, whereas, the BIU has to communicate with Brake System (either E70 of M/s Faiveley or CCB of M/s KBIL). Initially, a design was tested successfully wherein DIU communicated directly with the VCU and the display could be switched as a propulsion system display or DIU. However, some of the vendors expressed reservations for this arrangement on technical reasons and hence, later it was permitted to have a separate display independent of the propulsion display, in which case, the DIU is connected only with CCU.

DIU OF M/s Lotus Wireless DPWCS (Fig.-1)

DIU OF M/s ARC DPWCS (Fig.-2)



DIU OF M/s MEDHA DPWCS (Fig.-3)

(ii) EoTT

End of Train Telemetry aims at improving the freight trains' operations. It has two units, one in the locomotive (HoT) and another in the last vehicle (EoT). Both these devices use UHF radio and wireless communication. The HoT has a display unit in each cab for visualization and data feeding. The main function of EoTT is as under:

- Display BP pressure of last vehicle in Loco cab.
- Apply emergency brake from the last vehicle by LP from the cab.
- Monitoring of Train integrity/train parting, fouling mark clearance, GPS location of EoT/HoT over map on website
- Broadcast location of EOT device to other train equipped with EoTT
- Switching ON of HVML and DTWL.

HOT of M/s Siemens make EOTT

HOT of M/s Signotron make EOTT

HOT of M/s Tata make EOTT

HOT of M/s PPS make EOTT

HOT of M/s Hirect make EOTT

(Fig.-4)

(iii) Real-time Train Information System (RTIS)

This device is being provided in loco to get the real-time geographical location of the locomotive. The objectives of RTIS :

- Automatic acquisition of train movement data & feed to COA for automatic control chart plotting and improved train control functions.
- Emergency messaging from loco pilot to control room and vice-versa.
- Accurate information to passengers regarding train movement delivered as a by-product since COA is already integrated with National Train Enquiry System (NTES).

RTIS (Fig.-5)

(iv) Fog Pass:

This is a safety enhancement device provided for informing the driver in advance about the approaching signal (location, not the aspect of signal) during poor visibility conditions. It is a GPS based navigation device which helps LP to navigate during dense foggy conditions. It provides on-

board real-time information (display as well as voice guidance) to LP/ALP regarding location of fixed landmarks i.e. signal, LC, PSR, Neutral Section etc. However, LP/ALP has to observe signal aspects (Red, Green, Yellow) from the physical track.

(Fig.-6)

(v) Remote Monitoring and Analysis for Electric Locomotives (REMAN_EL)

This equipment is provided in Conventional electric locomotives (tap-changer based). Vital Data monitored through REMAN_EL are as under:

- Speed in kmph, Brake application status, TM Isolation Status, GPS Locations, VCD Status, Vigilance Penalty Brake Application, Fault messages and SMS & Email alerts.

- Functionality of REMAN_EL has been incorporated in Microprocessor based Control and Fault Diagnostic System (MPFDCS version-3), used in Conventional electric locomotives.

(Fig.-7)

(vi) Remote Monitoring System

Remote monitoring System enables viewing and analysing the live condition of locomotives over the internet by bringing the live data to a base server through GSM network. The location of the locomotive is also captured through the GPS receiver and sent to the base server, which enables geo tracking of the locomotive.

(Fig.-8)

3. Purpose of the new product:

The proposed Integrated Display(s) will reduce the requirement of multiple displays and interfaces. It is also expected to provide additional interfaces to connect possible futuristic devices as and when it is proposed. As per TOR, committee has to finalize the location/fitting of KAVACH DMIs for different types of Locomotives duly prioritizing the same keeping in view residual running life etc. which needs to be amalgamated with other display/fitments provided in the Loco cab keeping in view drivers' functionality requirement and ergonomics etc. However, as per discussion held during meetings held on 11.10.2021 at RB, 29.10.2021 at CNB, VC held on 18.11.2021 & 20.11.2021, the integration of displays has been further extended to driver cabs of all other Rolling stocks.

4. Proposed scheme:

The implementation of KAVACH in Electric Locomotive by integrating various display units has been considered based on various constraints like space, similar/overlapping functionalities, Ergonomics, driver's convenience etc.

4.1 Short term Proposal for Electric locomotive:

To expedite the implementation of KAVACH, as a short-term measure, integration of multiple displays has not been considered; instead the existing displays have been relocated at suitable places with minor modification on driver desk inside Cab to facilitate obstruction and stress-free environment to crew in their normal working of Locomotive.

4.1.1 Three-Phase Electric Locomotive (WAP-5, WAP-7, WAG-9H, WAG-9HC, WAG-9HH):

Existing 3-Phase Loco Cab View (Fig.-9)

Proposed 3-Phase Loco Cab View (Fig.-10)

In this proposal, the 'Panel C' has to be extended/ modified to accommodate DPWCS besides shifting of dual tone horn valves on the ALP side. RTIS may be relocated away from the driver desk subsequently. The speedometer can be shifted upward to accommodate the HoT Unit of EoTT. KAVACH DMI is to be fitted in space above 'Panel-B'.

4.1.2 Conventional Electric locomotives (WAP-4, WAG-7):

Existing Conventional Loco Cab View (Fig.-11)

Proposed Conventional Loco Cab View (Fig.-12)

The proposed layout will be implemented in conventional electric locomotives with requisite modification in Loco cab and relocating RTIS from driver desk.

4.2 Long term (2 years to 5 years) Proposal for Electric locomotive:

There should be two driver display units designated as Primary (DDU-1) and Secondary (DDU-2) display in each cab based upon the required information, interaction with display system and the safety critical information to the loco pilot. The information to be displayed, switches and push buttons on each display unit should cover all the requirements stipulated in RDSO/CLW/BLW specifications of particular device/system.

Primary Display Unit (DDU-1)	Secondary Display Unit (DDU-2_
Locomotive Driver Display Unit information as per the CLW Specification CLW/ES/3/0487/ALT-C or latest .	KAVACH
DPWCS information as per the RDSO Specification RDSO/2019/EL/SPEC/0142 or latest	Real-time Information System (RTIS): - will be either incorporated in KAVACH or removed or placed on rear wall of LP Cab
EoTT's HoT Device information as per specification RDSO/2021/EL/SPEC/0144 or latest	Fog Pass
	Caution order

4.2.1 Primary Display Unit (DDU-1):

DDU-1 will display the information about Distributed Power Wireless Control System (DPWCS) and End of Train Telemetry (EoTT) along with an operational screen of loco DDU. It displays the operational status of the locomotive including all pneumatic & electrical gauges. The functionalities are required in primary display (DDU-1) shall be as per CLW spec. No. CLW/ES/3/0487 Alt 'C' or latest. The features like provision of context sensitive troubleshooting assistance to the driver, viewing of process variables on graphic mimic, display status of various sub-system (SS-01 to SS-19) healthy/isolated due to fault or isolated but healthy and equipment internal status including TM's isolation status to be displayed in this main DDU. DDU shall display fault messages along with troubleshooting context (pop-up). The pop up screen will vanish after once the driver acknowledges and exits from such a function. From the default screen, it shall be possible to navigate to any other predefined screen and vice-versa. The screen will display the normal DDU of loco along with EoTT if DPWCS mode is not selected, otherwise if DPWCS is selected, it will display the parameters of DDU, DPWCS & EoTT altogether. The required Switches and interface keys shall be available on this display to comply with the respective specification requirements.

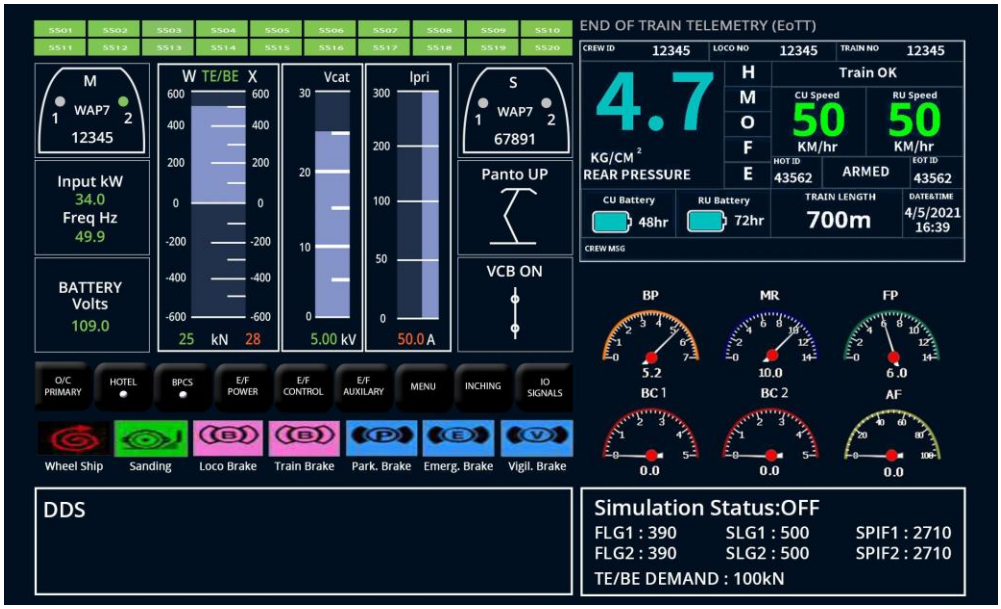
4.2.2 Secondary Display Unit (DDU-2):

It displays the information about KAVACH and any other train safety system information. The required Switches and keys shall be available on this display to comply with the specification requirements of the particular device. The Fog pass device also integrated to the same display as this information is continuously required by the loco pilot. The information about the next upcoming signal or level crossing information shall be continuously displayed at the bottom of this display. Features of the Real Time Information System (RTIS) should be integrated with KAVACH.

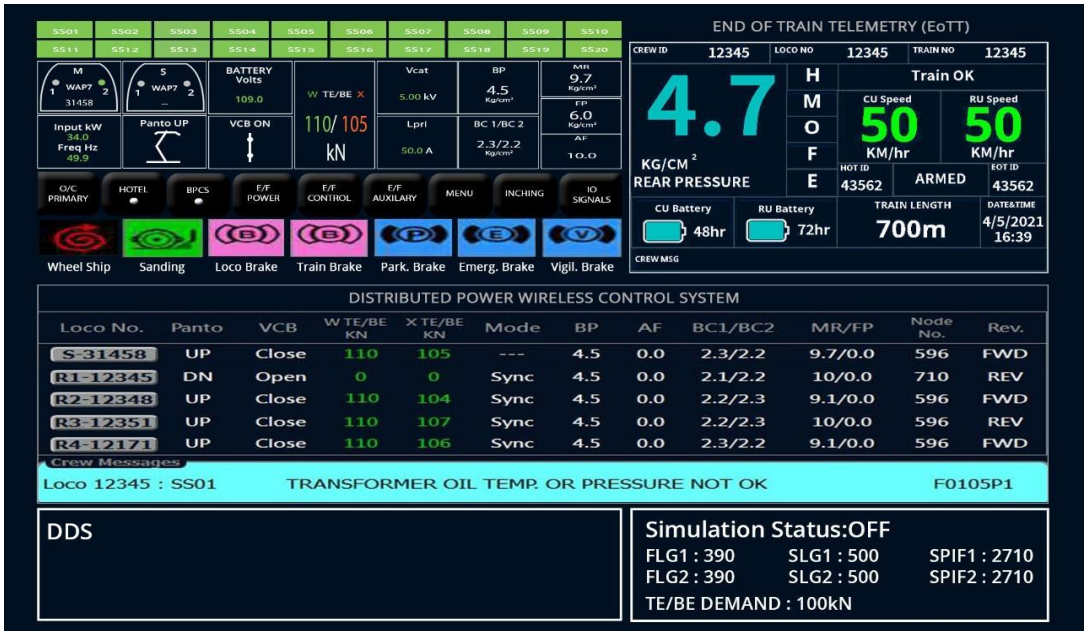
These two displays (DDU-1 & DDU-2) should be connected on the TCP/IP/ethernet network. Any system installed in the locomotive can plug into this network and can access these displays to display the required information. Existing analog gauges can be eliminated and all required gauge information will be displayed in the primary display. These displays should be arranged on the driver desk in such a way that the visibility and accessibility of the these displays are at ease. However, the committee is of view that analog pneumatic gauges shall be retained at their original position or shifted above the DDU-2.

A) Proposed DDU-1 for 3-Phase Locomotive:

Primary Default Display for 3-Phase Locomotive (DDU-1) (Fig.-13)

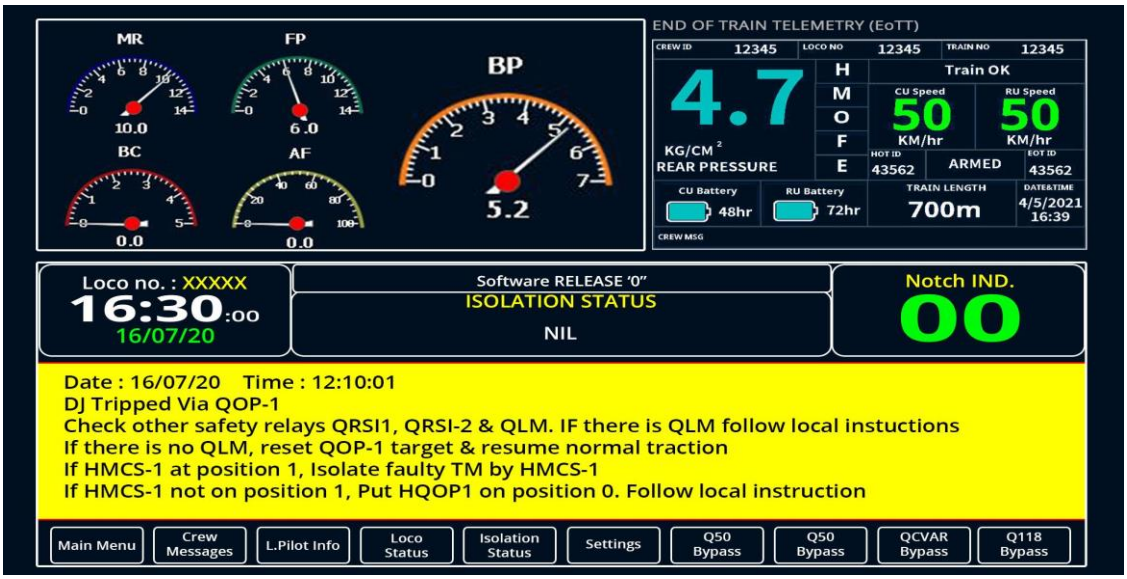


Primary Display with DPWCS Enabled for 3-Phase Locomotive (DDU-1) (Fig.-14)

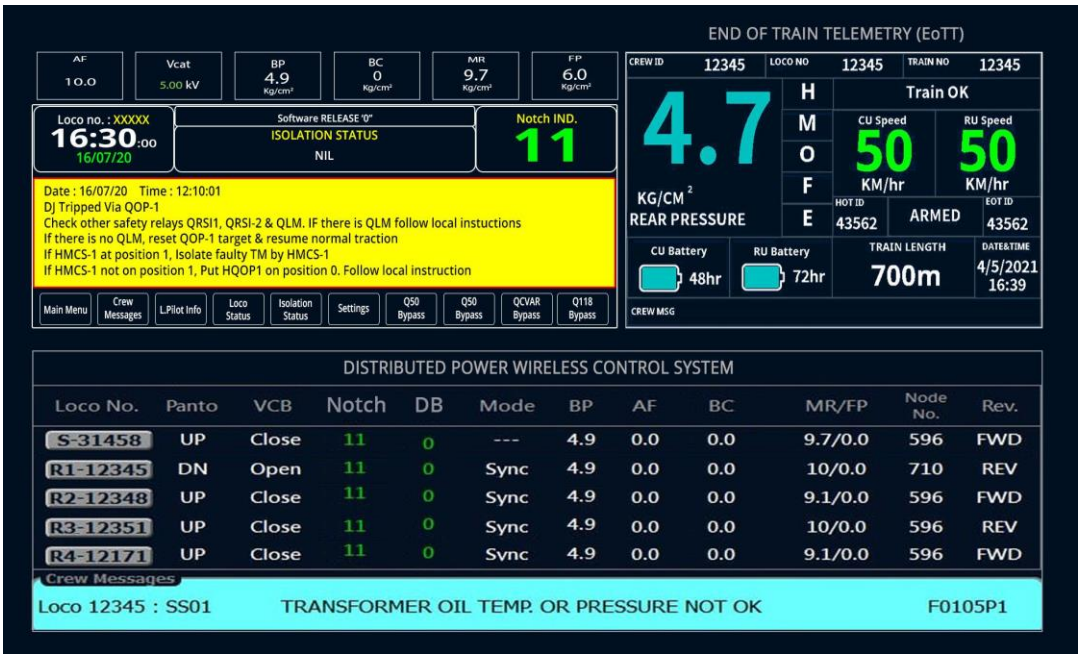


B) Proposed DDU-1 for Conventional Electric Locomotive:

Primary default Display for Conventional Locomotive (DDU-1) (Fig.-15)

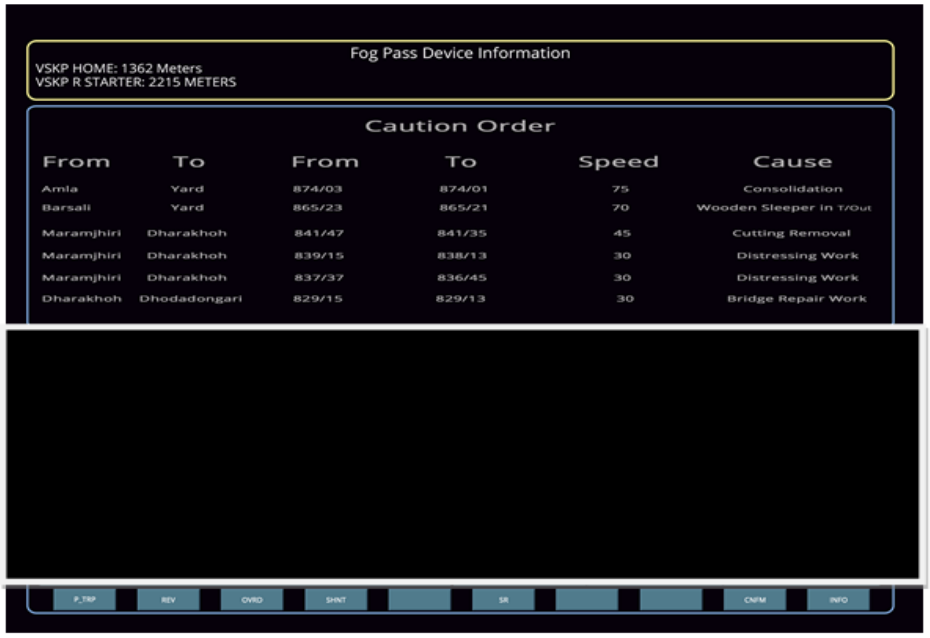


Primary default Display with DPWCS Enabled for Conventional Locomotive (DDU-1) (Fig.-16)

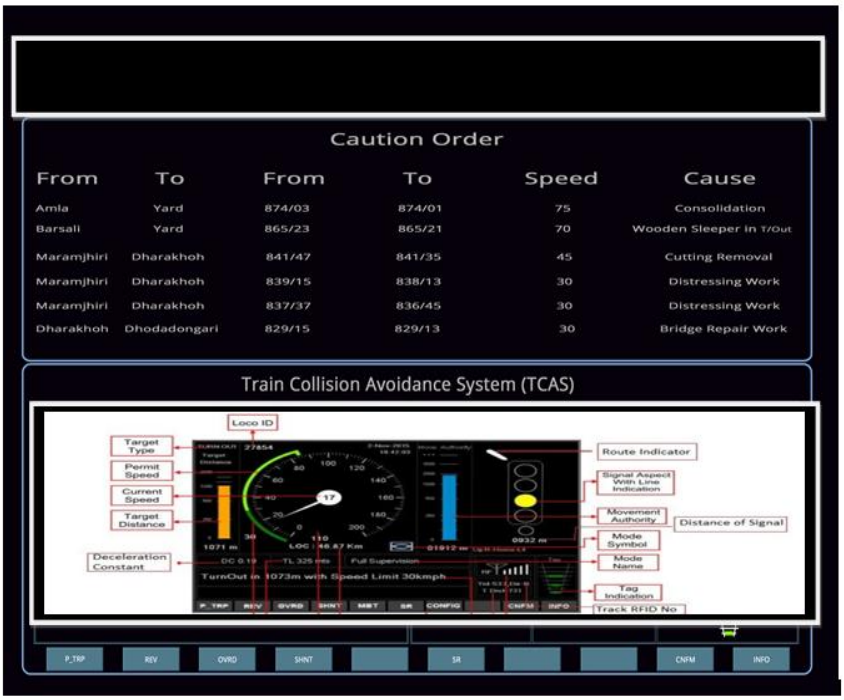


C) **Proposed DDU-2 for 3-Phase & Conventional Electric Locomotive**

Default display of Secondary (DDU-2) in NON-KAVACH territory (Fig.-17)



Display of Secondary (DDU-2) in KAVACH territory (Fig.-18)



5. Fitment location of proposed displays (DDU-1 & DDU-2):

- Primary Display (DDU-1): At existing DDU location
- Secondary Display (DDU-2):
  - Scheme-I: At the location of BP/BC/MR/AFI gauges. The pneumatic gauges will be installed above the DDU-2.
  - Scheme-II: Above Pneumatic gauge (Panel-B)

The proposed location of DDU-1 & 2 will appear as under (Fig.-19):

Scheme-I	
Scheme-II	

The survey was conducted among Loco Pilots to give their suggestions on the above proposed schemes. Scheme-I suggested by 48.8% and Scheme-II suggested by 50.6% drivers from total feedback of about 4000 drivers. Hence the committee suggested implementing Scheme-II.

6. Proposal for existing and new rakes of *Vande Bharat*:

(Fig.-20)

Cab Lay-out for incoming Vande Bharat Express (Fig.-21)

3.1 Driver Desk, Driver Panel Description

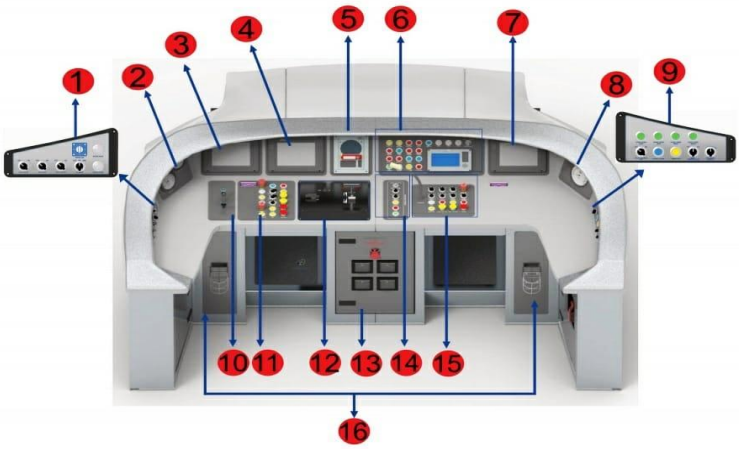


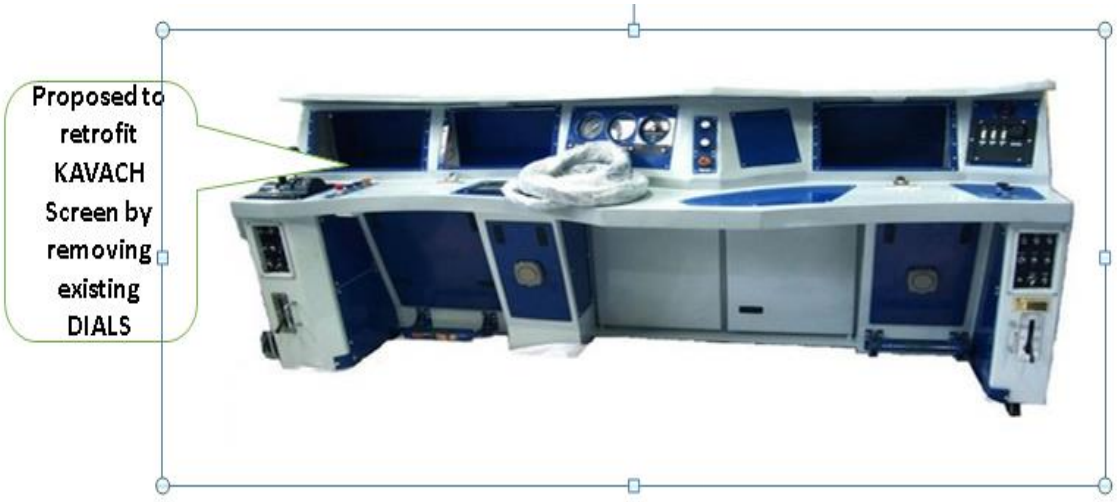
Figure 4: Driver Desk Overview Front View

CAPTION	DESCRIPTION	MAKE	PART NO
1	DRIVER SWITCH PANEL 1	MEDHA	Referred in the below sections
2	MR/BP GAUGES-4 INCH-DRIVER BC-AR GAUGE -4 INCH-DRIVER	ICF SCOPE	--
3	TCMS DISPLAY	MEDHA	90108018401
4	TPWS DISPLAY	TPWS	--
5	SPEED RECORDER CUM INDICATOR	MEDHA	90006402001
6	PIS MCP & INDICATION PANEL	MEDHA	Referred in the below sections
7	CCTV DISPLAY	MEDHA	90108018401

(Fig.-22)

7. Proposed Location of KAVACH in Dual Cab HHP Diesel Loco:

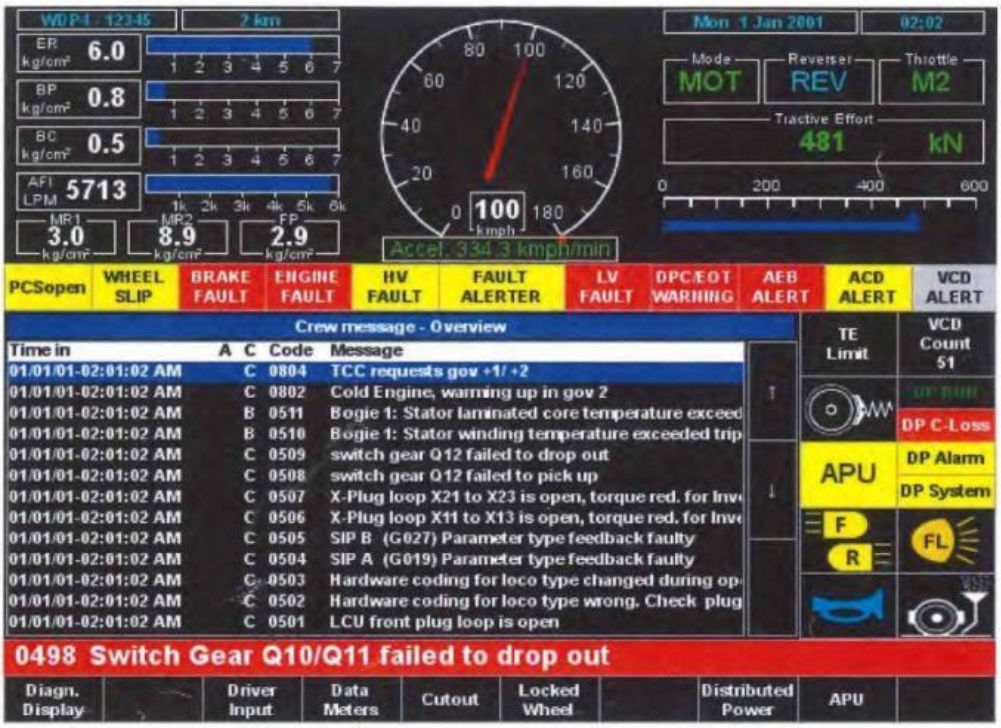
In Dual Cab HHP Loco, Two Displays are provided for Loco Pilot side (Primary Screen & Secondary Screen) and One for Assistant Loco Pilot side. One Screen can be removed from LP side Control Desk and KAVACH Display may be retrofitted as under-



(Fig.-23)

(Fig.-24)

Primary Default-Screen of DDU in Dual Cab HHP Loco (Fig.-25)

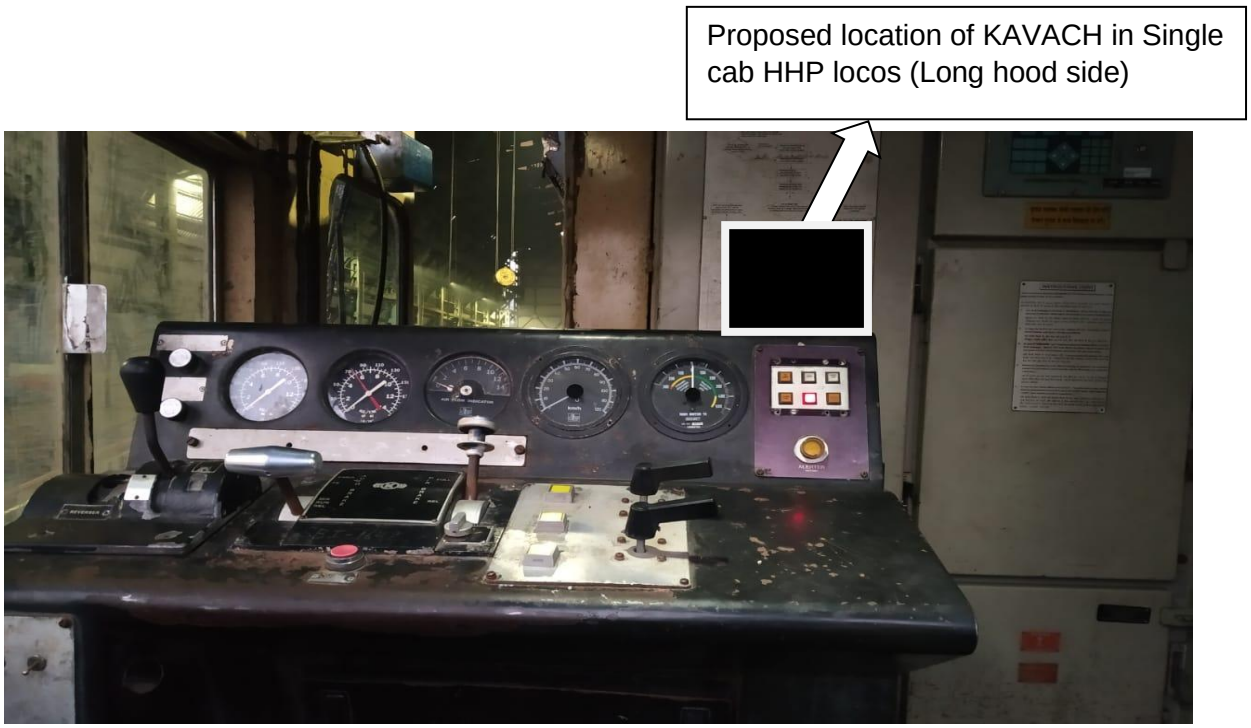


8. Proposed Location of KAVACH in single Cab HHP/ALCO Diesel Loco:

No provision of DDU in Single Cab HHP Loco on the driver desk and ALCO Loco exists at present. The KAVACH Display is to be located in front of Loco Pilot without obstructing the track

view ahead. The existing location for KAVACH Display fitted in ALCO Loco may be considered for fitment of additional Display (KAVACH Display) near Control Stand.

Proposed location of KAVACH in single cab HHP Locos (Long-Hood side) (Fig. 26)

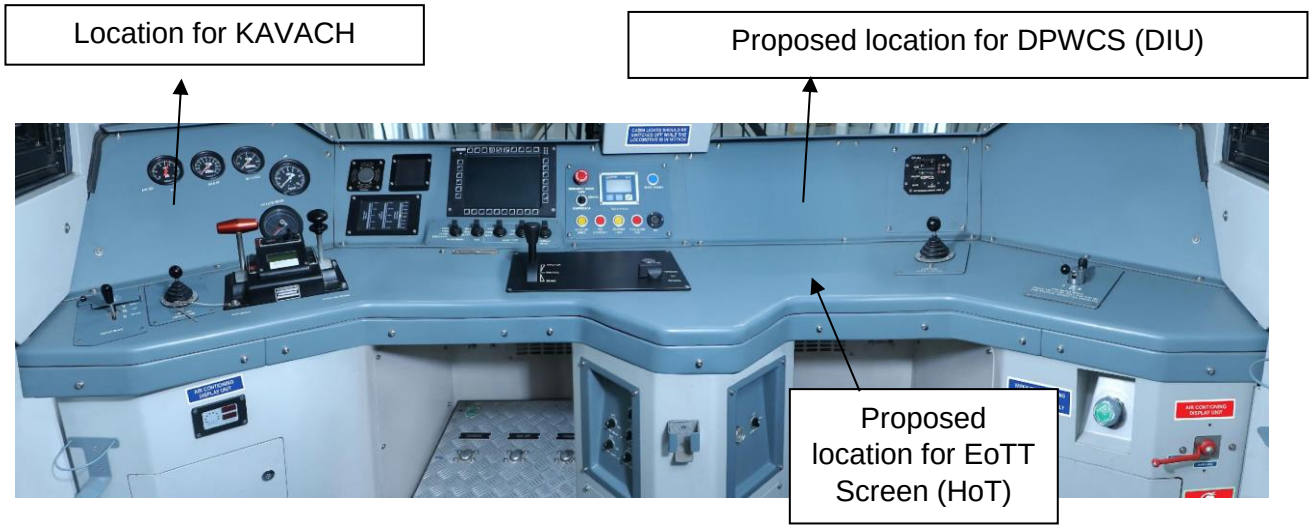


Proposed location of KAVACH in single cab HHP Loco (Short-Hood side) (Fig.-27)

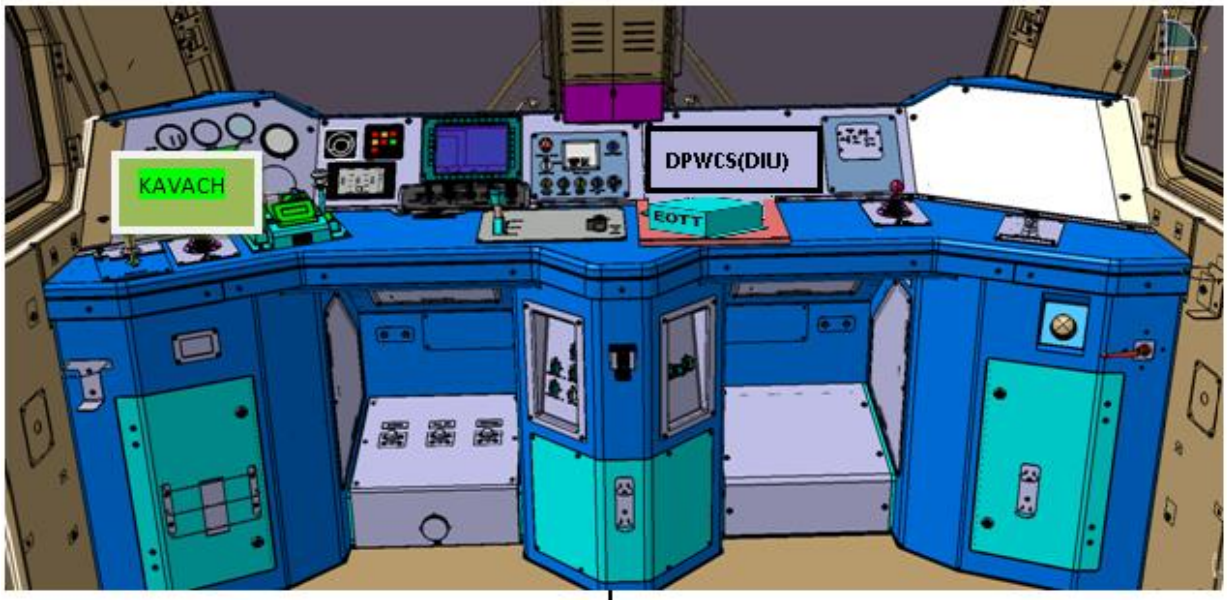
Location of KAVACH in ALCO Loco (Fig.-28)

9. Proposed Location of KAVACH in WAG-12B Loco:

(Fig.-29)

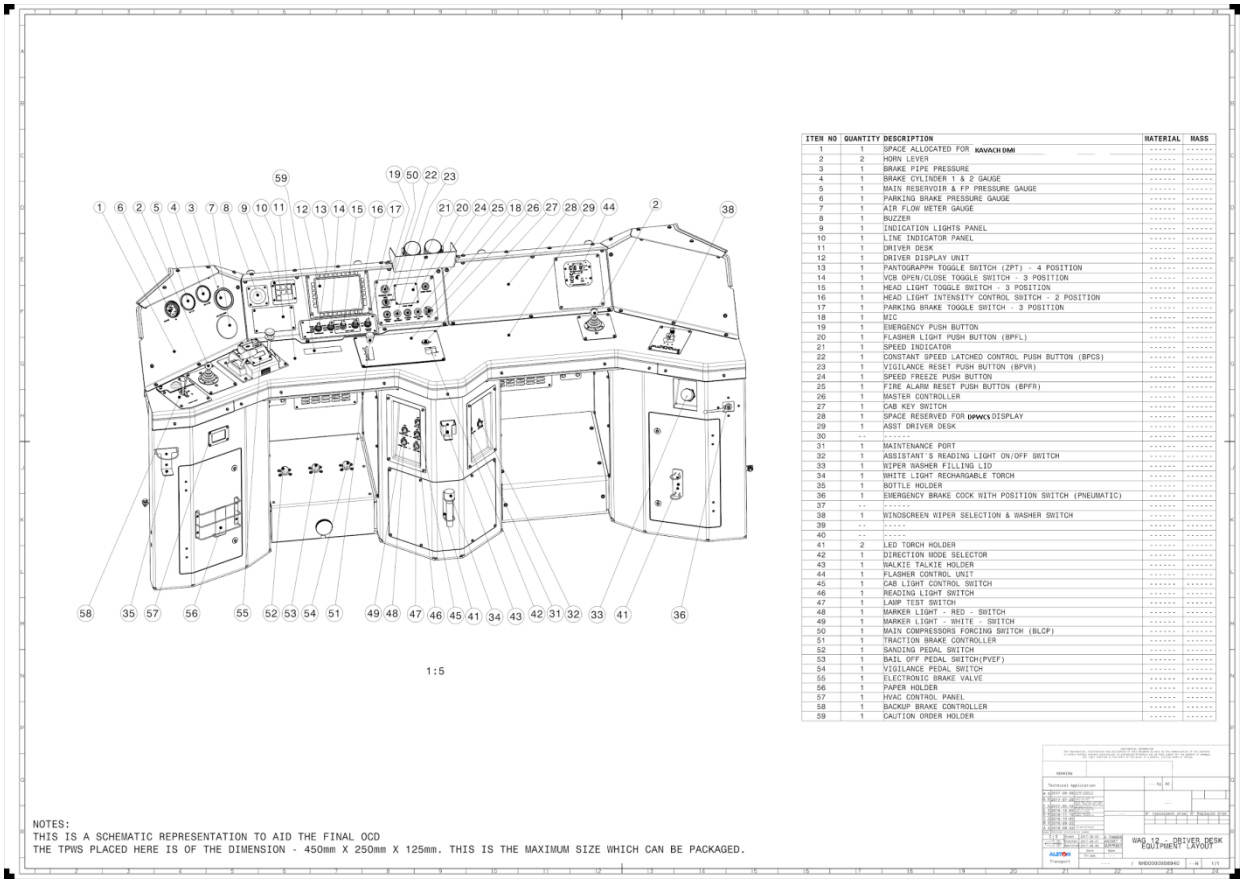


(Fig.-30)



(Fig.-31)

Driver Desk Equipment Layout for WAG-12B with provision of KAVACH Screen 310 (W) x 214 (H) X 70(D) mm) as Item No.1 & DPWCS Display as Item No. 28 (Fig.-32)

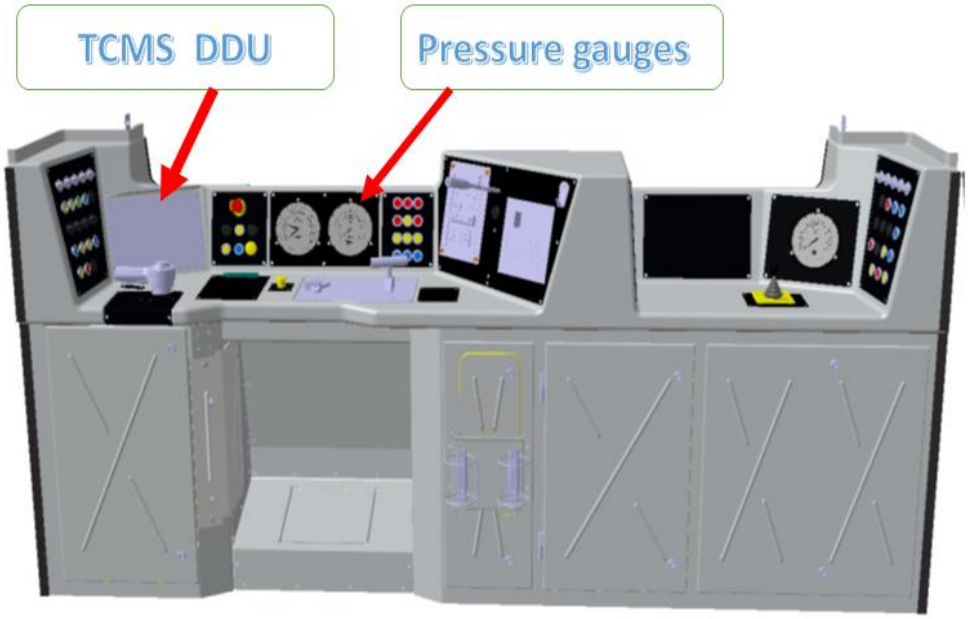


ITEM NO	QUANTITY	DESCRIPTION	MATERIAL	MASS
1	1	SPACE ALLOCATED FOR KAVACH DMI	------	------
2	2	HORN LEVER	------	------
3	1	BRAKE PIPE PRESSURE	------	------
4	1	BRAKE CYLINDER 1 & 2 GAUGE	------	------
5	1	MAIN RESERVOIR & FP PRESSURE GAUGE	------	------
6	1	PARKING BRAKE PRESSURE GAUGE	------	------
7	1	AIR FLOW METER GAUGE	------	------
8	1	BUZZER	------	------
9	1	INDICATION LIGHTS PANEL	------	------
10	1	LINE INDICATOR PANEL	------	------
11	1	DRIVER DESK	------	------
12	1	DRIVER DISPLAY UNIT	------	------
13	1	PANTOGRAPH TOGGLE SWITCH (ZPT) - 4 POSITION	------	------
14	1	VCB OPEN/CLOSE TOGGLE SWITCH - 3 POSITION	------	------
15	1	HEAD LIGHT TOGGLE SWITCH - 3 POSITION	------	------
16	1	HEAD LIGHT INTENSITY CONTROL SWITCH - 2 POSITION	------	------
17	1	PARKING BRAKE TOGGLE SWITCH - 3 POSITION	------	------
18	1	MIC	------	------
19	1	EMERGENCY PUSH BUTTON	------	------
20	1	FLASHER LIGHT PUSH BUTTON (BPFL)	------	------
21	1	SPEED INDICATOR	------	------
22	1	CONSTANT SPEED LATCHED CONTROL PUSH BUTTON (BPCS)	------	------
23	1	VIGILANCE RESET PUSH BUTTON (BPVR)	------	------
24	1	SPEED FREEZE PUSH BUTTON	------	------
25	1	FIRE ALARM RESET PUSH BUTTON (BPFR)	------	------
26	1	MASTER CONTROLLER	------	------
27	1	CAB KEY SWITCH	------	------
28	1	SPACE RESERVED FOR DPWCS DISPLAY	------	------
29	1	ASST DRIVER DESK	------	------
30	--	------	------	------
31	1	MAINTENANCE PORT	------	------
32	1	ASSISTANT'S READING LIGHT ON/OFF SWITCH	------	------
33	1	WIPER WASHER FILLING LID	------	------
34	1	WHITE LIGHT RECHARGABLE TORCH	------	------
35	1	BOTTLE HOLDER	------	------
36	1	EMERGENCY BRAKE COCK WITH POSITION SWITCH (PNEUMATIC)	------	------
37	--	------	------	------
38	1	WINDSCREEN WIPER SELECTION & WASHER SWITCH	------	------
39	--	------	------	------
40	--	------	------	------
41	2	LED TORCH HOLDER	------	------
42	1	DIRECTION MODE SELECTOR	------	------
43	1	WALKIE TALKIE HOLDER	------	------
44	1	FLASHER CONTROL UNIT	------	------
45	1	CAB LIGHT CONTROL SWITCH	------	------
46	1	READING LIGHT SWITCH	------	------
47	1	LAMP TEST SWITCH	------	------
48	1	MARKER LIGHT - RED - SWITCH	------	------
49	1	MARKER LIGHT - WHITE - SWITCH	------	------
50	1	MAIN COMPRESSORS FORCING SWITCH (BLCP)	------	------
51	1	TRACTION BRAKE CONTROLLER	------	------
52	1	SANDING PEDAL SWITCH	------	------
53	1	BAIL OFF PEDAL SWITCH(PVEF)	------	------
54	1	VIGILANCE PEDAL SWITCH	------	------
55	1	ELECTRONIC BRAKE VALVE	------	------
56	1	PAPER HOLDER	------	------
57	1	HVAC CONTROL PANEL	------	------
58	1	BACKUP BRAKE CONTROLLER	------	------
59	1	CAUTION ORDER HOLDER	------	------

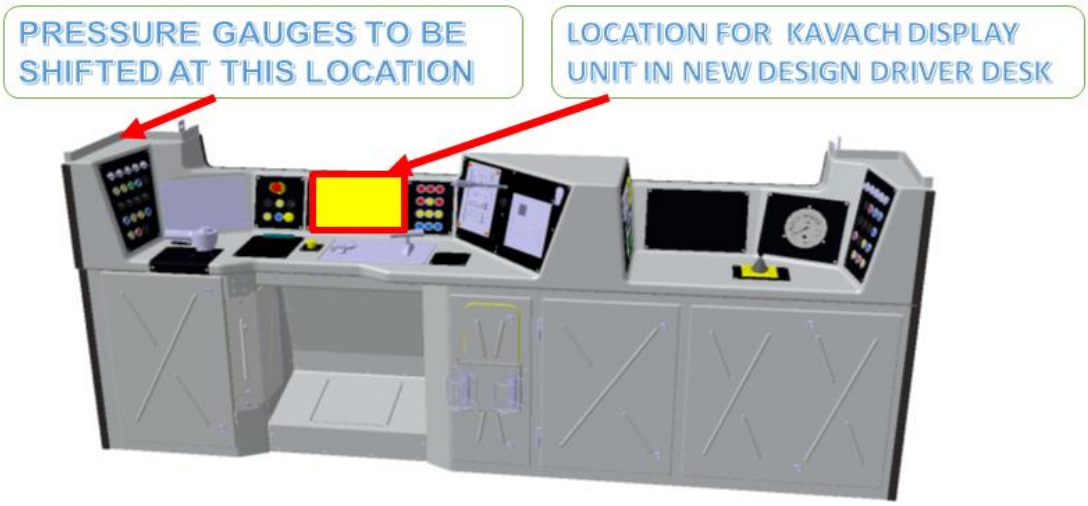
WAG-12 DRIVER DESK EQUIPMENT LAYOUT

10. Proposed Location for KAVACH in 3-Phase EMU:

EXISTING DRIVER DESK OF 3-PHASE EMU (Fig.-33)



PROPOSED MODIFICATION IN DRIVER DESK OF 3-PHASE EMU FOR PROVISION OF KAVACH



(Fig.-34)

Recommendations

In order to achieve the purpose of integration of multiple displays and interfaces, committee recommends following short term (1 year to 2 years) and long term (2 years to 5 years) action plan:

A. Short Term (1 year to 2 years) recommendations for Electric Locomotive:

To expedite the implementation of KAVACH, the existing displays have to be relocated at suitable places with minor modification on driver desk inside Cab to facilitate obstruction-free and stress-free environment to Loco Pilot in their normal working of Locomotive.

(i) In Three Phase Locomotive, KAVACH DMI to be provided above Panel-B, HoT unit of EoTT to be provided below speedometer, DPWCS (DIU) to be provided besides Panel-C and RTIS unit to be relocated away from driver desk. It required extension/modification of Panel-C to accommodate DPWCS (DIU) and upward shifting of speedometer to accommodate HoT of EoTT unit. Refer Fig.-10 for details.

(ii) In Conventional Electric Locomotive, KAVACH DMI, HoT unit of EoTT & RTIS shall be provided in similar manner as recommended for 3-Phase Locomotive i.e. KAVACH DMI above pneumatic gauges, HoT unit of EoTT below speedometer & RTIS unit to be relocated away from driver desk. DPWCS (DIU) shall be kept in front of ALP as shown in Fig.-12. The recommended layout shall be implemented with requisite modification in Loco-Cab.

B. Long Term (2 years to 5 years) recommendations for Electric Locomotive:

The integration of multiple displays shall be carried out to have only two driver display units designated as Primary (DDU-1) and Secondary (DDU-2) display in each cab. The Primary (DDU-1) display unit should have the functionalities of Loco DDS along with functionalities of DPWCS & EoTT's HoT. The Secondary (DDU-2) display unit should have the functionalities of KAVACH, Real-time Information System (RTIS), Fog Pass & caution order details. Refer Fig.-19 for details.

These two displays (DDU-1 & DDU-2) should be connected on the common standard network protocol. The primary display (DDU-1) shall include the existing Analog Pneumatic & Electrical gauges also and once the reliability of these digital gauges are established, the decision on elimination of analog gauges (Electrical and pneumatic) shall be taken.

C. Recommendations for Vande Bharat Express:

i. The location for KAVACH DMI has been identified between indication panel and switch panel in already running two rake of Vande Bharat. Refer Fig.-22 for details.
ii. The location for KAVACH DMI has been identified and marked (3 & 4) on driver desk of incoming Vande Bharat. Refer Fig.-21 for details.

D. Recommendations for Dual Cab HHP Diesel Loco:

In Dual Cab HHP diesel Loco KAVACH DMI to be retrofitted by removing one existing display screen on LP side control desk. Refer Fig.-23 & 24 for details.

E. Recommendations for single Cab HHP / ALCO Diesel Loco:

The KAVACH DMI is to be located on left hand side (short-hood) and on right hand side (long-hood) of Loco Pilot control desk of single cab HHP Loco. Refer Fig.-26 & 27 for details.

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The existing location for KAVACH DMI in ALCO Loco to be followed. Refer Fig.-28 for details.

F. Recommendations for WAG-12B Loco:

The KAVACH DMI to be provided in front of Loco Pilot. Refer Fig.-30 & 31 for details.

G. Recommendations for 3-Phase EMU:

The KAVACH DMI to be fitted at existing location of pneumatic gauges and pneumatic gauges to be shifted on left hand side of LP above switch panel. Refer Fig.-34 for details.

Implementation of Recommendations

i. The short term recommendations shall be executed by Zonal Railways/Production Units of Railways and manufacturing units of other rolling stock discussed above.

ii. To expedite the long term action plan for Electric Locomotives, Production Unit(s) of Railways and manufacturing units of other rolling stocks discussed above shall explore the possibilities for development of recommended primary and secondary displays with the support of industries and one set of prototype having all the desirable features shall be developed for trial. RDSO will associate in the exercise and development of standard specification of recommended scheme.

iii. Railway Board shall assign the responsibility for placement of trial order for recommended scheme for further proliferation in all locomotives.

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