



Association of Train Operating Companies

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Guidance Note – ETCS Cab Human
Factors Design Guidance

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Guidance Note - ETCS Cab Human Factors Design Guidance

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Synopsis

This Guidance Note (GN) defines a set of guidelines and rules that can be applied when introducing European Train Control System (ETCS) into train cab design.

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Part A

Issue record

This Guidance Note will be updated when necessary by distribution of a complete replacement.

Issue	Date	Comments
One	October 2015	Original document

Responsibilities

The Association of Train Operating Companies (ATOC) will be responsible for issuing the document. Copies of this Guidance Note should be distributed by ATOC members and Network Rail, under the guidance of National Joint RoSCo Project (NJRP), to persons responsible for ensuring compliance with the appropriate Railway Group Standards.

Explanatory note

ATOC have produced this Guidance Note for the information of and use by all Industry Stakeholders. ATOC is not a regulatory body and compliance with ATOC Guidance Notes is not mandatory.

This Guidance Note is intended to reflect good practice. All Industry Stakeholders are recommended to evaluate against their own arrangements in a structured and systematic way. Some parts of the guidance may not be appropriate to their operations/circumstances. It is recommended that this process of evaluation and any subsequent decision to adopt (or not to adopt) elements of the guidance should be documented.

Guidance Note status

This document is not intended to create legally binding obligations between train or freight operating companies, their suppliers, the Department for Transport (DfT) or the Office for Rail Regulation (ORR).

Supply

The Controlled version of this document can be found on the RSSB website <http://www.rssb.co.uk/railway-group-standards>.

Uncontrolled copies of this Guidance Note may be obtained from the ATOC Director - Major Projects, Operations & Engineering.

Part B

1 Purpose

Wherever possible and reasonably practicable the design of a driving cab should remain unchanged, unless the introduction of European Train Control System (ETCS) makes it absolutely necessary to make changes to the layout to robustly integrate equipment. Any such changes shall be kept to the absolute minimum.

The purpose of this document is therefore to provide guidance on a consistent set of Human Factors (HF) guidelines, and other generally accepted industry principles, that can be applied when introducing changes associated with the ETCS Driver Machine Interface (DMI) and Train Protection Warning System (TPWS) system into existing train driving cabs, in the event that design change has been identified. The document aims to provide a consistent approach in the event of redesign of cab desk layouts, controls and indicators with respect to retro-fitting the ETCS DMI, and TPWS DMI with both existing and new associated controls and displays.

Each design shall be approved via a collaborative approach with the owners and operators of the fleets undergoing any change related to ETCS integration and as such this document has been provided to inform that process by providing a guide to assist the design activities.

2 Scope

This document is applicable to all UK train operators, train manufacturers and other organisations who undertake the design and fitment of ETCS to existing or new trains. It can be used to assist Train Operating Companies (TOCs) and other organisations so that they can be an informed customer during the design process.

While this Guidance Note will outline a set of HF guidelines and principles for the fitment of ETCS, it still remains the responsibility of the Supplier to conduct HF studies and user assessments during the design process. It is expected that detailed assessments such as task and error analyses, Computer Aided Design assessments, low and high fidelity mock-ups, environmental assessments and user trials will be completed to ensure that the design meets HF standards and best practice.

The guidance only considers the placement of the facia interface of controls and displays, and not the housing of electronic equipment for the whole system. These are wider design constraints that will need to be managed by ETCS suppliers within the whole system design.

The document considers the choice of ETCS DMI technology and its placement, but excludes consideration of the ETCS interface design as this is mandated by European Standards (Ref 1).

3 Background

3.1 Details

National Projects to undertake the procurement of ETCS First in Class (FiC) train designs are underway. The National Joint RoSCo Project (NJRP) and Voyager Leasing ETCS Project (VLEP) are two examples of projects under which FiC procurement can be achieved for passenger trains. The projects will lead to contracts being awarded for FiC design, fitment, test and authorisation to put into use for each class of train.

The Train Operating Companies (TOCs) have a desire to develop a consistent cab design across train fleets, where practical. Given the number of ETCS suppliers involved, there is the potential for varied cab design approaches, and it is therefore advantageous that the same set of guidance and rules are applied by all suppliers. Some key reasoning behind this includes:

- To minimise the potential for human error arising from ‘wrong side’ operation of safety and other controls
- To assist driver training programmes by ensuring the same design rules are applied
- To provide familiarity across fleets for drivers that sign different classes of rolling stock
- To provide familiarity across fleets when drivers change employment from TOC to TOC.

With consistency of approach from suppliers it is anticipated that the cost of training and need for re-training will be reduced, and that drivers will be more familiar with cab layouts from class to class.

3.2 Guidance Limitations

In developing guidance that is applicable to all rolling stock, there were a number of challenges and considerations that were taken into account:

- The review considered a large number of train classes during the development of the guidance, and associated cab desk layouts
- Due to the varying age and type of train classes, the design and layout of control equipment on driver desks is inconsistent. This variance has meant that newer rolling stock have more recent controls integrated into the driver desk, while on older desks they have been ‘bolted on’, for example TPWS, Automatic Warning System (AWS) and Drivers Reminder Appliance (DRA)
- The space available for the fitment of ETCS controls and indications varies between the cab types as some are very cluttered, and therefore the level of some cab re-designs may be more extensive than others
- RSSB T1079 research project (Ref. 2) aims to clarify the operational, safety and functional requirements for the co-existent operation of ETCS and AWS/TPWS, including the form and functionality requirements for the Class B safety system indications when presented to the train driver via the ETCS driver/machine interface (DMI). Outcomes of the project shall be included in a Rail Industry Standard and will be taken into consideration by ETCS DMI suppliers. It is suggested that this document may require revision following the conclusion of the project.

The challenges posed mean that interpretation of the guidance should be applied to the design of each train class for fitment.

3.3 Assumptions

A number of assumptions have been made when developing this guidance that requires consideration for cab desk redesign:

- It is expected that where a TPWS unit currently features on a class of train, it will be upgraded to equipment compliant with Railway Group Standard (RGS) GE/RT8075 - AWS and TPWS Interface Requirements (33) as part of the cab re-fit. The new TPWS DMI panel tends to be larger in size than the previous panel
- The DRA is to be retained on the driver's desk panel. Although it is not required for ETCS Levels 1 and 2, it is required for conventionally signalled track
- It is assumed that all existing Automatic Train Protection (ATP) interfaces, including all train protection systems such as tripcocks, shall be retained within driver's cabs until ERTMS/ETCS is fitted on all applicable routes. For this reason, it is expected that cabs will be fitted with both ATP and TPWS. It is expected that only classes 43, 165/166 and 180 are applicable. When introducing ETCS to these cabs, additional assessments shall be carried out to ensure integration of the three signalling systems are incorporated effectively.
- While a standard industry approach to the integration of the AWS, TPWS and speedometer into the ETCS DMI has not been made, a speedometer shall always be integral to the DMI. A secondary speedometer, if required, shall only be operational if ETCS is isolated (while remaining operational in level National Train Control (NTC)). This guidance has been written with consideration of both integrated and separate fitment of AWS, TPWS and speedometer into the cab desk. It is anticipated that the level of integration offered for these items will vary between suppliers.

3.4 Relevance to Standards

The following documents include content that is relevant to the design of the train cabs or locations of controls within a train cab. Where appropriate, specific cross-references are provided within the text of this guidance note. The guidance note is intended to support achieving compliance with the following relevant documents:

- Railway Group Standards and other rail industry standards associated with train cab controls (See Section 7:5.4 Ref. 3, Ref. 4, Ref. 5, Ref. 6 and Ref. 7)
- European Standards (Ref. 1 and Ref.8)
- Industry related research programme (Ref.2, Ref. 9 and Ref. 10).

4 Design Guidance

4.1 Human Factors Approach to Cab Re-Design

For most cabs, it is inevitable that the driver desk panel will need to be re-designed to accommodate the DMI. However, in order to maintain familiarity and consistency within the current layouts, unless there is necessary reason for change, minimal changes to the layout of controls are recommended. TOCs have expressed a desire to retain the look and feel of current cabs and the flow of interaction with controls and indications. This stems from the following TOC aspirations:

- to minimise the level of driver re-training required
- to reduce the potential for confusion between cab layouts
- to minimise the potential for human error due to incorrect selection of controls or inadvertent operation.

In all cases, stakeholders must be involved in the design process and design reviews to assess if the changes are acceptable and to highlight any operational or engineering issues arising from the design.

This Guidance Note provides HF guidelines for application during the initial stages of cab re-design to support suppliers. It is essential that HF is considered during the entire design process. The approach should include, but not be limited to, the following activities:

- Human Factors Analysis

Task and error analyses, frequency and link analysis of controls to define the most acceptable location for each control on the driver's desk panel. This will also relate to functional grouping of controls and placement of most frequently used controls in central locations, where practicable.

- User Testing and Stakeholder Engagement

Low to high fidelity mock-ups, user and/or driver representative trials. Following the re-design of the cab layout, these activities will allow for stakeholder engagement and opportunities for issues to be addressed and mitigated prior to the finished design.

- Selection of ETCS DMI technology

The selection of ETCS DMI screen technology should be considered in relation to the type of train, the space available for fitment, the type of service and the cab environment.

Research has been completed into the use of soft key vs touch screen technology for the DMI and both types of technology have advantages and disadvantages. The screen technology is an important consideration in minimising the potential for glare and achieving an optimal solution. While consideration of technology is required, the final decision of DMI is with the supplier following tender evaluation and when installation is required.

The DMI technology is discussed further in section 5.3.1.

- Cab environment

Assessments of the cab environment are essential to the successful introduction of the DMI. Determining any environmental issues that currently exist through discussions with drivers would help to ensure they can be addressed at an early stage and mitigated during the design process. The cab environment includes a number of areas:

- glare (direct and indirect)
- luminosity of controls
- angle of driver desk panel and any associated issues with control activation

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- previous mitigations put in place (uniform changes, blinds, window tints, and self-covered controls/displays).

The cab environment is discussed further in section 5.3.2.

5 Cab Design Principles

When developing the revised cab layout design, the following guiding principles shall be considered when assessing control or display relocation:

Principle 1 – Anthropometric Design Constraints (reach envelopes, visual fields, display characteristics such as luminosity using guidance from existing standards)

Principle 2 - Existing control locations and the train driving task (Guidance based on familiarity of design and work flow)

Principle 3 – Integration of the ETCS DMI within the existing train cab (selection of appropriate DMI technology and testing for glare)

Principle 4 – Specific Control Design Guidance (positioning and how they are used)

In addition to each set of guiding principles for each control, guidance on how to overcome the issues will be provided.

5.1 Principle 1 – Anthropometric Design Constraints

A number of design constraints require accommodating within the design of train cabs which will directly influence the location of individual, or grouping, of controls. The design shall take into consideration the reach distances and visual sightlines for the intended user population (Ref. 10).

Reach Distances to Controls

All controls positioned on a driver's desk that are required while driving, in a sitting or if applicable, standing position, shall be positioned within the following reach envelopes (Ref. 8):

- Normal reach area
- Extended reach area
- Maximum reach area

Viewing Zones to Controls and Displays

Controls needed for driving or in cases of danger should be positioned within either the optimum or preferred fields of vision, for a 95th percentile male in a seated driving position (Ref. 8).

5.2 Principle 2 - Existing Control Locations and the Train Driving Task

During the fitment of ETCS, the following fundamental principles shall be considered when developing and evaluating the design of the driver desk for each train class:

1. During the introduction of the ETCS DMI on the driver desk , the existing layout of controls shall be maintained where possible, or as a minimum the same functional grouping

2. Controls shall only be relocated if required to ensure the ETCS DMI can be positioned in a central position on the driver desk
3. Any controls or displays on a drivers desk that are obsolete shall be considered for removal if space is required to position the DMI
4. If any control or display requires relocation then the revised cab desk design shall be subject to a detailed HF assessment prior to acceptance
5. The impact of the design on the driver task and the potential for human error due to inadvertent operation of controls shall be evaluated during the design process.

5.3 Principle 3 – Integration of the ETCS DMI within the Existing Train Cab

5.3.1 DMI Technology

Given the train environment, the technology that will be used in the ETCS DMI will have a significant impact on the utility of the whole system. Factors such as the positioning of the DMI in the cab, display angle, the location of windows in the cab and viewing distance from the driver's seat should be considered to identify the potential for glare and reflectance. The selected design solution should be tested in all lighting conditions that accurately reflect the cab environment, to provide assurance that the DMI will provide adequate performance levels. The objective should be to choose a DMI screen that is appropriate to the train cab type and to minimise the potential for glare, rather than choose a solution that needs to be managed with a number of glare mitigation measures.

When selecting the type of technology to be used when fitting the ETCS DMI into the driver's desk panel, there are a number of key parameters that need to be taken into consideration:

1. Contrast Ratio

Contrast ratio is the difference between the 'whitest' white and the 'blackest' black on the display. Screens with a high contrast ratio will be perceived as displaying more crisp and sharper images and perform better in bright conditions. High contrast ratios can be achieved in factory settings and they may not directly translate into adequate performance within the driver cab, as the contrast ratio can be significantly reduced by ambient light.

2. Screen Luminance

Screen luminance (or brightness) should be considered when selecting suitable display technology. A balance should be struck when selecting a DMI with a 'higher' luminance (which normally provides greater quality) as this may be sub-optimal for night-time performance, as seen in the Cambrian trials. The appropriate screen luminance for the DMI display will need to be considered in the context of the environment in which the display is used to develop an optimum solution.

3. Dimming

When considering screen luminance, a suitable dimming range is required. Understanding the dimming range of the backlight is important as the minimum luminance is a percentage of the maximum luminance, so the brighter the display the wider dynamic backlight dimming range needed. A dimming range should be chosen that ensures a good performance in all lighting conditions.

4. Reflectance

In a real life environment where glare can be a significant issue the reflectance value of a screen may play the most important role. This characteristic may impact on real-life performance in terms of brightness and contrast. A screen with a high reflectance value can diminish the performance of a very bright screen.

This will also impact on the contrast ratio, as the difference in range between the whitest white and the blackest black will be much smaller. Moreover, high reflectance screens are likely to reflect objects, further reducing screen readability (e.g. driver wearing white shirt on a bright day may see the reflection of his shirt on the display). This single factor (reflectance) can affect the performance of a display that claims to have a high brightness and contrast level.

5. Touch Screen vs Soft Key

There are two types of ETCS DMI interaction design solutions available, Touch Screen and Soft Key. There are advantages and disadvantages of both solutions, these are summarised below. This section provides an overview to the considerations that should be taken into account when procuring ETCS DMI technology. As mentioned previously, RSSB T1079 research project (Ref. 2) aims to clarify the operational, safety and functional requirements for the co-existent operation of ETCS and AWS/TPWS, including the form and functionality requirements for the Class B safety system indications when presented to the train driver via the ETCS driver/machine interface (DMI).

a. Touch Screen

The touch screen solution tends to be intuitive to use, i.e. the operator presses an area that requires their attention. For example, to acknowledge an alarm the user presses the flashing icon alarm. Only active 'buttons' are displayed when they are required thereby reducing clutter on the display area, and directing attention (Ref. 9).

As the touch screen has no physical buttons, generally the DMI area is smaller than the soft key solution (Ref. 10). However, the touch screen has a surrounding bezel that will increase the overall unit size. As individual suppliers may vary with regard to unit size, a detailed assessment for each train cab and its proposed DMI units should be carried out.

Touch screens, in their simplest form, do not provide tactile feedback to the operator. This is especially important as users are accustomed to a tactile response when pressing keys. The ETCS DMI design standard (Ref 1) recommends the provision of an auditory 'click' tone on a button press, and a visual change of the button presentation to provide feedback. However noisy cab conditions may mean that the auditory feedback could be difficult to detect, leaving just one form of feedback available to the user i.e. the visual change of button.

Touch screens are more susceptible to wear and damage than physical buttons due to the frequency and type of operation required, and the potential for input using other objects, e.g. keys. To mitigate this issue a touch screen can be provided with a robust protective screen to shield the main screen from misuse or vandalism. However, protective films have been known to produce the effect of blurring the screen and reducing its readability. The option of a protective screen shall be considered during the detailed assessment of screen technology usage. Where applicable, a separate ETCS acknowledge button could also be considered to reduce wear and tear on the screen.

b. Soft Key

The soft key option eliminates some issues found with the touch screen. For example, the screen area is not subject to contamination by fingerprints and the keys can be designed to provide the user with tactile feedback during press and release actions. However, limitations include reduced options for locations of buttons and indications, while the flexibility of the screen is limited as the functions must be displayed close to the physical buttons.

The soft key solutions include a narrow bezel that includes the buttons. As previously mentioned, an assessment is recommended when the choice of screen is confirmed and size of DMI unit is known.

The soft key option can provide some error recovery as the user can locate a button by touch, then visually confirm that it is the correct key before pressing. The touch screen does not provide recovery from a misplaced press, but the size of the touch screen buttons can reduce the risk of mis-selection. An advantage of the soft key over the touch screen is that it allows for simultaneous operation of multiple buttons (a key requirement if the TPWS functions are integrated into the DMI), while the touch screen can only respond to a single button press at a time. The RSSB research project T1079 will investigate the functionality of both the soft key and touch screen options when responding to a TPWS activation, where a simultaneous button press is required.

However, soft key technology can limit options for the location of buttons and indications as the soft key location, size, colour and their number is limited in comparison to the touch screen option which offers greater flexibility in presentation (within the constraints of the ERTMS DMI standard, Ref. 1). The flexibility of the screen is also limited as the functions must be displayed close to the physical buttons. Customisation of the display screen, depending on the mode of the system is restricted due to the need to ensure that all active areas will be displayed close to their respective 'soft keys' (Ref. 9).

6. Dual / Split Screen DMI

Some ETCS suppliers offer a dual / split screen DMI, and it is expected that this will be adopted in some UK cabs, although the extent of application is unknown at this time. When installation of DMI for all types of rolling stock is confirmed, a detailed assessment regarding use of dual / split screen DMI shall be required on an individual cab basis.

5.3.2 Cab Environment

Glare is the environmental factor that can affect the DMI to the greatest level and is the most difficult factor to manage.

Glare is described in ISO standard 9241-6 (Ref.11), as a:

'condition of vision in which there is discomfort or a reduction in the ability to see details or objects caused by an unsuitable distribution or range of luminance, or to extreme contrasts'

Two types of glare should be considered in the context of driver cab environment: direct glare and glare caused by reflection.

Direct glare refers to glare from light emitting sources e.g. the sun, bright luminaries, and displays. This type of glare is caused by excessive simultaneous difference in luminance in the field of vision. The severity of direct glare depends on the size, intensity and position of the source of glare. Ambient light and the state of adaptation of the viewer will also influence the visibility of the screen. For instance, in the late afternoon the sun may directly face the front of a train making it difficult for a driver to read the information displayed on the DMI. Similarly, as demonstrated during Cambrian early deployment, a bright display inside the train cab can cause glare at night, making it more difficult for the driver to see objects outside the cab and causing discomfort.

Glare by reflection is caused by reflected light onto surfaces. A bright object can be reflected on the screen partially obscuring displayed information. For instance a driver's white shirt or a high-visibility vest can be 'reflected' on the screen, masking some important information and making it more difficult to read. In addition, the contrast ratio of the screen may be reduced to the level that the information displayed on the screen is no longer readable.

It is suggested that a glare assessment should consist of investigating glare caused by internal lighting as well as assessing glare caused by external light sources. A wide-range of external light sources could be simulated by illuminating a cab mock-up with a single light source located in a sequence of positions and

orientations and assessing the resulting glare impacts. Subjective results could be gathered by asking end-users and stakeholders to comment on the conditions. This approach was used for the evaluation of the Hitachi Intercity Express Programme Drivers Cab (Ref. 12).

5.4 Principle 4 – Specific Control Design Guidance

The following section details the specific guidance for each individual control and display found on a driver's desk panel. The guidance should be interpreted when considering individual train classes and the impact of the inclusion of the ETCS DMI on the overall train cab layout.

This guidance has been developed from a review of industry standards and guidance, and consultation with the rail industry¹.

The list of controls and displays presented have been generated from those cited in industry standards and stakeholder input. An extensive review of all train cab controls has not been performed and therefore, this list is not exhaustive. This section is also presented in a tabular format in Appendix A. As mentioned previously, unless there is necessary reason for change, minimal changes to the layout of controls are recommended.

This list does not provide information regarding the option of replacing old controls or displays with newer and more reliable controls. While it is understood that should the possibility arise, it is the responsibility of the suppliers to take this into consideration when assessing the inclusion of the ETCS DMI.

Speed Related Controls and Displays

5.4.1 Primary Speedometer- integrated into the DMI

- a) The primary speedometer shall be integrated into the DMI and thus will be positioned within the optimum field of vision when seated in the train driver's normal position (see section 5.4.12).

Additional guidance:

- b) As the primary speedometer is integrated into the DMI the traditional analogue speedometer can be removed from the driver's desk.

5.4.2 Secondary Speedometer

- a) Where a secondary speedometer is currently positioned on a driver's desk and is being maintained following the introduction of the ETCS DMI, it should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- b) Where fitted, the secondary speedometer is un-illuminated and not operational unless ETCS is isolated.

5.4.3 Automatic Speed Control

1 An industry workshop held on 1st June 2015, facilitated by ATOC.

- a) The automatic speed control should be located within the extended reach area.
- b) The automatic speed control should be located close to the power / brake controller.

Additional guidance:

Not used

Train Protection and Warning System Displays and Controls

Onboard AWS/TPWS equipment is to be retained in the driver's cab when the train is required to operate using National Train Control (NTC), including where operation will be required on diversionary routes.

5.4.4 AWS Indicator

- a) Where the AWS Indicator is maintained on the driver's desk, it should be positioned within the optimum field of vision when seated in the train driver's normal position.

Integration guidance:

- b) Where the AWS Indicator is integrated into the ETCS DMI, it should be positioned so that it is visible from the train driver's normal seated position.
- c) Where the AWS indicator is integrated into the ETCS DMI, it should maintain its existing design appearance. However, consideration should be made of the presentation of the AWS 'sunflower' design and the potential for glare. These issues are under consideration by the RSSB T1079 research project and specific guidance for presentation of the AWS indicator will be developed.

5.4.5 AWS Reset Button

- a) The AWS Reset Button should be positioned within the normal reach when in the primary seated position.
- b) The AWS Reset Button should be positioned within the optimum field of vision when seated in the train driver's normal position.
- c) Where possible, the AWS Reset Button should be maintained in its existing position. If the current position is considered sub-optimal due to inclusion of the ETCS DMI (especially with regard to smaller cabs) an option to move it to a more beneficial position for the driver shall be considered.
- d) If the AWS Reset Button is to be relocated on the driver's desk, it shall be reviewed as part of the detailed HF Assessment to ensure it is positioned in an ergonomically acceptable location.

Additional guidance:

- e) Where an AWS Reset Button is currently positioned at a less than acceptable location, the introduction of the ETCS DMI and possible re-design of the driver's desk shall allow consideration of relocation to an improved position. The position and angle of activation should be considered when placing this control.

5.4.6 TPWS Panel

- a) The TPWS panel should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- b) Where fitment of the RGS GE/RT8075 compliant TPWS is required as an upgrade to the driver desk, consideration should be given to accommodating any change in size of the DMI panel.
- c) If a driver desk re-design is required, optimising the location of the TPWS DMI panel if there is an opportunity to do so shall be considered.
- d) Consideration should be made to locate the TPWS controls and indicators on the ETCS DMI.

5.4.7 ATP- Override

- a) ATP controls and displays should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, ATP controls and displays are to be retained as close as possible to their current locations or if the opportunity arises, to move them to a more beneficial position for the driver.

5.4.8 Drivers Reminder Appliance

- a) The DRA should be positioned within the extended reach area when in the normal seated position.
- b) The DRA should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- c) The DRA is to be retained on the driver's desk and maintained as a separate control following the introduction of ERTMS/ETCS.
- d) The DRA is to be retained in its existing location unless a required re-design of the driver's desk provides an opportunity to optimise its location.
- e) Where a driver desk re-design is required, caution shall be applied to ensure the DRA is not positioned adjacent to any other controls where inadvertent operation could occur.
- f) The location of the DRA during a driver desk re-design shall be subject to a detailed HF assessment to validate the suitability of its position.

5.4.9 Transmission Voie-Machine (TVM430)

- a) Controls associated with the existing TVM430 shall be positioned within the normal reach area when seated in the normal seated position.

Additional guidance:

Not used

5.4.10 EM2000 (Diesel engine control system)

- a) Controls associated with the existing EM2000 Train Management System shall be positioned within the extended reach area when seated in the normal seated position.

Additional guidance:

Not used

5.4.11 Radio Electronic Token Block (RETB) Controls

- a) The Cab Display Unit for RETB should be within the normal reach of drivers when seated in the normal position.

Additional guidance:

Not used

ETCS Controls

Any ETCS related controls, displays or switches shall be located based on guidance from existing standards and where possible integrated with existing controls and displays. As mentioned previously, the level of integration is the decision of the individual system suppliers. Any introduction of ETCS controls or displays will be subject to a full HF assessment.

5.4.12 ETCS DMI

- a) The ETCS DMI should be positioned within the optimum field of vision when seated in the train driver's normal position.
- b) THE ETCS DMI should be positioned within the normal reach area when in the normal seated position.
- c) The driver shall be able to interact with the DMI display area without impediment by other cab equipment, controls or structure (Ref. 7).

Additional guidance:

Where the DMI cannot be viewed easily from the 'second man's side' it is recommended that a facility to put a temporary repeater DMI is included so that the Traction Inspector or assessor can view what is displayed on the DMI. This recommendation should be assessed on an individual cab design basis.

5.4.13 ETCS Reset Switch

- a) The ETCS reset facility shall be placed in each train cab (Ref. 7).
- b) The ETCS reset facility shall be located beyond the reach of the driver when in the normal seated position (Ref. 7).

Additional guidance:

Not used

ETCS Isolation

In light of the desire to maintain familiarity and consistency within the existing cab layouts, it is recommended that the type and location of the ETCS Isolation controls and displays should be the same as the existing isolation switches. If changes are necessary, any re-location should adhere to current guidance and standards (Ref. 7).

5.4.14 ETCS Isolation Switch

- a) The ETCS Isolation Switch should be positioned within each train cab, but located beyond the reach of the driver when in the normal driving position (Ref. 7).
- b) The Isolation switch must only isolate the ETCS and must not affect the normal operation of the vehicle in a non ETCS mode.

Additional guidance:

- c) The ETCS isolation switch shall not be operable while the train is moving.

5.4.15 ETCS Isolation Switch Indicator

- a) The ETCS Isolation Switch Indicator should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

Not used

Service Braking Displays and Controls

With regard to all braking controls or displays, none of the following instruments are to be removed and all current locations must be retained wherever possible. However, if the spatial constraints of the cab desk are such that controls or indications need to be reconfigured to accommodate the ETCS DMI, the removal or re-location must be subject to a detailed HF assessment and must ensure that the safety of the train is not compromised.

5.4.16 Emergency Brake Plunger

- a) The Emergency Brake Plunger should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Where possible, the Emergency Brake Plunger is to be retained as close as possible to its current location.

5.4.17 Combined Power/Brake Controller

- a) The Combined Power / Brake Controller should be positioned within the normal reach area when in the normal seated position.
- b) The Combined Power / Brake Controller should be located at the left hand side in a locomotive configuration.

Additional guidance:

- c) Where possible, the Combined Power / Brake Controller is to be retained as close as possible to its current location.

5.4.18 Brake Controller

- a) The Brake Controller should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Brake Controller is to be retained as close as possible to its current location.

5.4.19 Straight Air Brake

- a) The Straight Air Brake should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Straight Air Brake is to be retained as close as possible to its current location.

5.4.20 Parking Brake Controls/Displays

- a) Controls associated with the Parking Brake should be positioned within the extended reach area when in the normal seated position.
- b) Displays associated with the Parking Brake should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- c) Where possible, the Parking Brake controls and displays are to be retained as close as possible to their current locations.

5.4.21 Overcharge

- a) The Overcharge control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Overcharge control is to be retained as close as possible to its current location.

5.4.22 Traction Control

- a) The Traction Control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Traction Control is to be retained as close as possible to its current location.

5.4.23 Hill Start Control

- a) The Hill Start Control should be positioned within the normal reach area when in the normal seated position.
- b) The Hill Start control should be positioned within the envelope of the Combined Power / Brake Controller.

Additional guidance:

- c) Where possible, the Hill Start Control is to be retained as close as possible to its current location.

5.4.24 Main Reservoir Gauge

- a) The Main Reservoir Gauge should be positioned within the preferred field of vision when seated in the train driver's normal position.

Additional guidance:

- b) Where possible, the Main Reservoir Gauge is to be retained as close as possible to its current location.

If the Main Reservoir Gauge requires re-location, it is permissible to position the display outside of the normal viewing zone when the driver is in the normal seated position.

5.4.25 Main Reservoir Pipe Gauge

- a) The Main Reservoir Pipe Gauge should be positioned within the preferred field of vision when seated in the train driver's normal position.

Additional guidance:

- b) Where possible, the Main Reservoir Pipe Gauge is to be retained as close as possible to its current location.
- c) If space on the cab desk is limited, an option to combine the Main Reservoir Pipe Gauge with the Main Reservoir Gauge could be considered.

5.4.26 Brake Cylinder Gauge

- a) The Brake Cylinder Gauge should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- b) For selected class of train, an option to combine the Brake Cylinder Gauge with the Main Reservoir Gauge is to be considered should space be required on the driver's desk for the ETCS DMI.
 - i) Where combination of displays is considered, research into technology upgrades or instances where this practice is already in use should be completed within the design process to identify suitable options.

5.4.27 Brake Pipe Gauge

- a) The Brake Pipe Gauge should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- b) If a re-design of a driver's desk is required, it should be considered that the Brake Pipe Gauge takes precedence over the Main Reservoir Gauge with regard to primary locations of the displays.

5.4.28 Brake Rate

- a) The Brake Rate should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- b) Where possible, the Brake Rate is to be retained as close as possible to its current location.

5.4.29 Air Flow Gauge

- a) The Air Flow Gauge should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

- b) Where possible, the Air Flow Gauge is to be retained as close as possible to its current location.

5.4.30 Brake Test Switch

- a) The Brake Test Switch can be positioned outside of the maximum reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Brake Test Switch is to be retained as close as possible to its current location.

Power Device Controls and Displays**5.4.31 Diesel Engine Control**

- a) The Diesel Engine Control (for transition between diesel and electric) should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.32 Diesel Controls

- a) The Diesel Controls can be positioned within the extended reach area when in the normal seated position.

Additional guidance:

Not used

5.4.33 EMU (Pantograph Down)

- a) The EMU (Pantograph Down) should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.34 EMU (Pantograph Up)

- a) The EMU (Pantograph Up) should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.35 Fire Override

- a) The Fire Override control should be positioned within the normal reach area when in the normal seated position.
- b) The Fire Override display should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

Not used

5.4.36 Pan Selector Dial

- a) The Pan Selector Dial should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.37 Changeover Control (VCB)

- a) The Changeover Control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.38 Main Circuit Breaker / Power Transmission

- a) The Main Circuit Breaker / Power Transmission control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.39 Electric Train Supply (ETS) - Train Power Switch

- a) The ETS control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

Not used

5.4.40 Line Light

- a) The Line Light should be positioned within the optimum field of vision when seated in the train driver's normal position.

Additional guidance:

Not used

5.4.41 Direction of Travel

- a) The Direction of Travel control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Direction of Travel control is to be retained in its current location.

Door Controls and Indicators

For all door related controls, it is suggested that there should be no relocation unless space constraints on the driver desk due to the inclusion of the ETCS DMI require them to be re-positioned. If any controls are to be moved, they shall be subject to a detailed HF assessment to ensure that the risk of inadvertent activation is limited.

5.4.42 Doors Release and Cancel Release (Left)

- a) The Door Release and Cancel Release (Left) should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Door Release and Cancel Release (Left) should be retained as close as possible to its current location.
- c) During the driver desk re-design, it is recommended that in any instance that the Door Release and Cancel Release (Left) are grouped together with the Door Release and Cancel Release (Right), consideration should be taken to separating the controls.
 - i) If this option is considered, the final location of the controls shall be subject to a detailed HF assessment.

5.4.43 Door Close (Left)

For some classes of train, the Door Close (Left) control is combined with Door / Close Interlock. Where the controls are combined, any re-location due to the driver desk re-design shall take into consideration the impact of moving multiple controls.

- a) The Door Close (Left) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) If the position is considered to be good, the Door Close (Left) control should be retained as close as possible to its current location.

5.4.44 Driver/Guard Signal (Left) Control

- a) The Driver/Guard Signal (Left) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

Not used

5.4.45 SDO (Left)

- a) The SDO (Left) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

Not used

5.4.46 Doors Release and Cancel Release (Right)

- a) The Door Release and Cancel Release (Right) should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Door Release and Cancel Release (Right) should be retained as close as possible to its current location.
- c) During the driver desk re-design, it is recommended that in any instance that the Door Release and Cancel Release (Right) are grouped together with the Door Release and Cancel Release (Left), consideration should be taken to separating the controls.
 - i) If this option is considered, the final location of the controls shall be subject to a detailed HF assessment.

5.4.47 Door Close (Right)

For some classes of train, the Door Close (Right) control is combined with Door / Close Interlock. Where the controls are combined, any re-location due to the driver desk re-design shall take into consideration the impact of moving multiple controls.

- a) The Door Close (Right) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Door Close (Right) control should be retained as close as possible to its current location.

5.4.48 Driver/Guard Signal (Right) Control

- a) The Driver / Guard Signal (Right) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

Not used

5.4.49 SDO (Right)

- a) The SDO (Right) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

Not used

5.4.50 Door / Close Interlock (Left)

Some train classes have a control that has Door Close and Door Interlock combined.

- a) The Door / Close Interlock (Left) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Door / Close Interlock (Left) control should be retained as close as possible to its current location.
- c) Where this control is positioned on a driver's desk, it should not be separated into two controls so to ensure space saving and maintain familiarity for the driver.

5.4.51 Door / Close Interlock (Right)

Some train classes have a control that has Door Close and Door Interlock combined.

- a) The Door / Close Interlock (Right) control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Door / Close Interlock (Right) control should be retained as close as possible to its current location.
- c) Where this control is positioned on a driver's desk, it should not be separated into two controls so to ensure space saving and maintain familiarity for the driver.

5.4.52 Doors Forced Close

A Forced Door Close control can be found on some train classes, where it is separate to the Door Close control. However, the action of forced closure of doors can also be completed by holding down the Door Close control on some classes. Guidance is provided for both scenarios.

- a) Where a driver desk has a separate Door Forced Close control it should be positioned outside of the normal reach area when in the normal seated position.

- b) Where a driver desk has a combined Door Forced Close and Door Close control, it should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

Not used

Train Lights Controls and Displays

In the instance that a lighting panel has to be re-located as a result of the introduction of the ETCS DMI, a mimic panel may be required.

5.4.53 External Front Light

- a) The External Front Light control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the External Front Light control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the External Front Light control shall be subject to a detailed HF assessment.

5.4.54 Train Lighting

- a) The Train Lighting control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Train Lighting control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Train Lighting control shall be subject to a detailed HF assessment.

5.4.55 Instrument Lighting

- a) The Instrument Lighting control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, the Instrument Lighting control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Instrument Lighting control shall be subject to a detailed HF assessment.

5.4.56 Hazard Light

- a) The Hazard Light control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Hazard Light control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Hazard Light control shall be subject to a detailed HF assessment.

5.4.57 Cab Light

- a) The Cab Light control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Cab Light control should be retained in its current location.
- c) Any re-location of the Cab Light control shall be subject to a detailed HF assessment.

5.4.58 Task and Driver Desk Lighting

- a) The Task and Driver Desk Lighting control should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Task and Driver Desk Lighting control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Task and Driver Desk Lighting control shall be subject to a detailed HF assessment.

Coupling Controls**5.4.59 Couple Button**

- a) The Couple Button should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) If a driver desk requires a re-design due to the introduction of the ETCS DMI, re-locating the Couple Button to create space for other controls should be considered.
- c) If the Couple Button is to be re-located, a detailed HF assessment shall be completed.

5.4.60 Uncouple Button

- a) The Uncouple Button should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) If a driver desk requires a re-design due to the introduction of the ETCS DMI, re-locating the Uncouple Button to create space for other controls should be considered.
- c) If the Uncouple Button is to be re-located, a detailed HF assessment shall be completed.

Windscreen Controls

5.4.61 Windscreen Wiper

- a) The Windscreen Wiper control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Windscreen Wiper control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Windscreen Wiper control shall be subject to a detailed HF assessment.

5.4.62 Windscreen Washer

- a) The Windscreen Washer control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Windscreen Washer control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Windscreen Washer control shall be subject to a detailed HF assessment.

5.4.63 Windscreen Heater

- a) The Windscreen Heater control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Windscreen Heater control should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) Any re-location of the Windscreen Heater control shall be subject to a detailed HF assessment.

Additional Controls or Displays

5.4.64 Train Management System

- a) Controls associated with the existing Train Management System shall be positioned within the extended reach area when seated in the normal seated position.

Additional guidance:

Not used

5.4.65 Sanding Button

- a) The Sanding Button should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, Sanding Button should be retained as close as possible to its current location or if the opportunity arises, to move it to a more beneficial position for the driver.
- c) If the Sanding Button is to be re-located, it should be subjected to a detailed HF assessment.

5.4.66 External Warning Horn

- a) The External Warning Horn should be positioned within the extended reach area when in the normal seated position.

Additional guidance:

- b) Where possible, External Warning Horn should be retained in its current location.
- c) If the External Warning Horn is to be re-located due to the introduction of the ETCS DMI, it should be subjected to a detailed HF assessment.

5.4.67 Cab Environmental Controls (heating and ventilation)

- a) Controls associated with Cab Environment (heating and ventilation) should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) Where possible, controls associated with Cab Environment (heating and ventilation) should be retained as close as possible to their current location.
- c) If the controls associated with Cab Environment (heating and ventilation) are to be re-located, they should be subjected to a detailed HF assessment.

5.4.68 Train Lengthen (switches and indicators)

- a) Controls associated with Train Lengthening should be positioned should be retained as close as possible to their current location.

Additional guidance:

Not used

5.4.69 GSM-R Voice DMI

- a) The GSM-R Drivers Control Panel should be retained in its current location.

Additional guidance:

Not used

5.4.70 Driver Advisory System

- a) The DAS unit should be retained in its current location.

Additional guidance:

- b) As the DAS is an advisory system it had lower importance than in-cab signalling display. Therefore, if required, it shall be moved to allow space for the ETCS DMI.
- c) If a re-location of the DAS unit is required, it shall be subject to a detailed HF assessment.

5.4.71 Public Address Controls

- a) The PA controls should be positioned within normal reach when in the primary driving position.

Additional guidance:

Not used

5.4.72 Tilt Authorisation and Speed Supervision (TASS) Controls and Indicators (where applicable)

There is no guidance provided for the TASS controls and indicators as it is expected that the indicators, controls and EVC are to be removed during the fitment of ETCS.

5.4.73 CCTV Capture Control (forward facing)

- a) The CCTV Capture controls should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) The CCTV Capture control should be positioned should be retained as close as possible to their current location.

5.4.74 Wash Mode Control

- a) The Wash Mode control should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) The Wash Mode control should be retained in their current locations.

5.4.75 Tablet / Peripheral Device Control

- a) The Tablet / Peripheral Device interface should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) There should be an area in the cab to rest the Tablet or peripheral device that is outside of the primary reach zone but within the extended reach zone to reduce any possible glare reflections.

5.4.76 Cup Holder

- a) The Cup Holder should be positioned within the normal reach area when in the normal seated position.

Additional guidance:

- b) The Cup Holder should be retained in their current locations if possible.

5.4.77 Driver Clipboard

- a) The Driver Clipboard area should be positioned within the normal viewing area when in the normal seated position.

Additional guidance:

Not used

6 Glossary

ATP	Automatic Train Protection
AWS	Automatic Warning System
CCTV	Closed Circuit Television System
DAS	Driver Advisory System
DfT	Department for Transport
DMI	Driver Machine Interface
DRA	Driver Reminder Appliance
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EVC	European Vital Computer
NJRP	National Joint Rolling Stock Programme
NTC	National Train Control
HF	Human Factors
PA	Public Address
RETB	Radio Electronic Token Block
ROSCO	Rolling Stock Operating Company
RSSB	Railway Safety and Standards Board
TASS	Tilt Authorisation and Speed Supervision
TOC	Train Operating Company
TPWS	Train Protection Warning System
TVM430	Transmission Voie-Machine 430
VLEP	Voyager Leasing ETCS Project

7 References

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5. GM/RT2473- 1: 2003 Power Operated External Doors on Passenger Carrying Rail Vehicles
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7. NEPT/ERTMS/REQ/0007 ETCS Onboard System – Baseline 3 – National Onboard Subsystem Requirements Specification
8. prEN 16186-2: 2015 Railway applications- Driver’s cab – Part 2: Integration of displays, controls and indicators
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Guidance Note
ETCS Cab Human Factors Design Guidance

ATOC/EC/GN/004
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Appendix A – Train Cab Controls Table

**Guidance Note –
 ETCS Cab Human Factors Design Guidance**

Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?	
Display Control	Service braking instruments Any brake controller shall not be moved and no controls shall be placed within the proximity of for accidental activation/injury	Main reservoir gauge	Where required and fitted as essential for the safe driving of a train or vehicle, shall be viewable by the driver whilst at the main driving position				-	Yes	Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments	Will this be retained on ETCS fitted rolling stock?	Hitachi retained. Siemens retained (some doubt, checking). SSL retained.		
		Main reservoir pipe					-				One gauge		
	Controls- not to be moved	Brake cylinder gauge	Option to be integrated into the Technical and Diagnostic Display (TDD)					Yes		prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators Table B. 1- List of elements and their locations including function codes	Will this be retained on ETCS fitted rolling stock?	Hitachi retained. Siemens retained (some doubt, checking). SSL retained. More important that main res Can be combined with main reservoir. Upgrade in technology to allow this- used as a recommendation (create space)	
		Brake controller	Where required and fitted as essential for the safe driving of a train or vehicle, shall be operable by the driver whilst at the main driving position	Yes						Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments		Not moving	
		Straight air										Not moving	

Guidance Note – ETCS Cab Human Factors Design Guidance

Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		brake										
		Emergency Brake Plunger									Not moving	
		Brake Pipe Gauge					Yes				More important for air brake units More important than main res gauge	
		Brake rate								Included in Speedo on Pendolinos 220-2 separate gauge		
		Air Flow gauge					Yes				Not removed critical on freight, not so much passenger	
		Brake test switch				Yes					As existing	
		Parking brake controls/indicator	Priority of movement secondary use-	Yes	Yes						As existing	
		Overcharge (button)										
		Traction control									Not moving	
		Hill start control-within proximity of power brake									Not moving	

**Guidance Note –
ETCS Cab Human Factors Design Guidance**

Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		controller-										
		Combined Power / brake controller	All controls having high importance and/or a high frequency and/or prolonged periods of use in sitting and, if applicable, standing position shall be located within the normal reach envelope in line with the anthropometric requirements of this standard.	Yes					prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Not moving	
Display Control	Speed	Speedometer	Where required and fitted as essential for the safe driving of a train or vehicle, shall be viewable by the driver whilst at the main driving position				Yes		Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments	Will the speedometer be integrated into the ETCS DMI- as a general rule? Will this be retained on ETCS fitted rolling stock?	Hitachi retained. Siemens integrated into DMI. SSL integrated into DMI.	
		Back-up (specific to fleet)										

Guidance Note – ETCS Cab Human Factors Design Guidance

Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		Automatic Speed Control	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust.	Yes	Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk	Will these controls be needed with the introduction of the DMI? Assumption: Retained	Retained by all manufacturers.	
			The automatic speed control shall be close to the traction/dynamic braking lever. This may not apply in case of a single combined traction/brake controller. It should be position dependent.	Yes					prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.7 Position of specific control		Both relevant	
Control	DRA	Drivers Reminder Appliance	Old models- positioned on top of the driver panel Newer models- positioned close to the Speedometer						Ergonomics best practice General cab layouts	Will all DRA's be removed with the introduction of ETCS? Assumption: Not required on ETCS fitted rolling stock	Retained by all manufacturers. Function still required when using AWS/TPWS.	
			The Driver Reminder Appliance (DRA) is a system that was implemented to mitigate SPAD (Signal Passed at Danger) risk. It is recommended that DRA is not used when operating in ERTMS Levels 1 and 2. Questionable-						RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.15 Driver Reminder Appliance		Positioned so it can be seen (as lit) and not compromising safety related controls need further investigation at detailed design (T.A.?)	

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			Where required and fitted as essential for the safe driving of a train or vehicle, shall be operable by the driver whilst at the main driving position	Yes					Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments			
Display Control	AWS		Onboard AWS/TPWS equipment need only be provided if the train is required to operate using the national train control system, including where operation might be required on diversionary routes.						RSSB- Operational Concept for ERTMS Issue 2: 2014 20.2.1 AWS / TPWS		Integration- as long as maintained within existing sightline. Maintain current position where possible-	
		AWS indicator / alarm	The indicator shall be in the field of vision of the driver when looking at the track ahead from the driving position(s) to which it applies.				Yes		Railway Group Standard GE/RT8075- 2: 2015 AWS and TPWS Interface Requirements Part 4: Driver / Machine Interface (DMI) for AWS and TPWS, 4.1.1.3		Hitachi New hardwired controls. Siemens integrated into DMI. SSL retained.	
		AWS reset button	The AWS caution acknowledgement device shall be in the form of a physical button, located where the driver can easily operate it when seated at the active driving position.	Yes					Railway Group Standard GE/RT8075- 2: 2015 AWS and TPWS Interface Requirements Part 4- Driver / Machine Interface (DMI) for AWS and TPWS, 4.1.2.2	Will AWS / TPWS be integrated within the ETCS DMI? Assumption: Retained	Maintained- Not operable from any other driving position	

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
			Often positioned off the main panel and to the side of the driver, within normal reaching position	Yes					Ergonomics best practice General cab layouts		Retained wherever possible (last resort). If moved, detailed HF assessment and task analysis/sequence required to ensure misuse is avoided, angle of activation is acceptable etc. (end users).	
			Where AWS and TPWS are integrated with the ERTMS DMI, the train stop override control and indicator must be accommodated by the ERTMS DMI to allow the passing of a single signal at danger without getting tripped by TPWS.						RSSB- Operational Concept for ERTMS Issue 2: 2014 20.2.4 AWS / TPWS			
			Where AWS and TPWS are integrated with the ERTMS DMI, the AWS acknowledgement device must be separate						RSSB- Operational Concept for ERTMS Issue 2: 2014 20.2.7 AWS / TPWS			

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Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
Control	TPWS	TPWS Panel	The visual indication (of TPWS) shall be a primary instrument, the design and positioning of which shall be in accordance with the requirements set out in GM/RT2161	Yes					Railway Group Standard GE/RT8075- 2: 2015 AWS and TPWS Interface Requirements Part 4- Driver / Machine Interface (DMI) for AWS and TPWS, 4.1.3.4	Will the TPWS DMI be integrated within the ETCS DMI? Assumption: Retained	Hitachi New hardwired controls. Siemens integrated into DMI. (Not sure if the buttons of the TPWS are done by the DMI) SSL new hardwired panel. Primary location- Current position of TPWS panel might not be optimised so opportunity to introduce it in an optimised location	
Control	Doors (right)	Door release and cancel release	Location of operating element should enable convenient operation by the left or right hand i.e. be located in the intersection of the reach envelopes.	Yes					prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators Table B. 1- List of elements and their locations including function codes	If there is an opportunity to spatially separate the controls should this be a priority?		Risk of opening incorrect side if right and left controls are too close together

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
			Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust.		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk			
		Driver/guard signal button		Yes	Yes							
		SDO (many variations)	Same principles as above									
		Door control: forced closing	Location of operating element should enable convenient operation by the left or right hand i.e. be located in the intersection of the reach envelopes.	-	-	Yes			prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators Table B. 1- List of elements and their locations including function codes	1. Separate control- away from desk 2. existing controls- as per current design	Separate control (of release) for obstacles required for forced closing.	
		Door close button (both)-	Ideally the controls should be separate from the controls for the left side doors (on the right side of panel within the reach envelope)	-	Yes				Ergonomics best practice General cab layouts			

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Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
Control	Doors (left) AS ABOVE (RIGHT)-	Door release and cancel release	Location of operating element should enable convenient operation by the left or right hand i.e. be located in the intersection of the reach envelopes.	Yes	Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators Table B. 1- List of elements and their locations including function codes	If there is an opportunity to spatially separate the controls should this be a priority?		Risk of opening incorrect side if right and left controls are too close together
			Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust.						prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk			
		Door control: forced closing	Location of operating element should enable convenient operation by the left or right hand i.e. be located in the intersection of the reach envelopes.	Yes	Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators Table B. 1- List of elements and their locations including function codes			
			Ideally the controls should be separate from the controls for the right side doors (on the left side of panel within the reach envelope)						Ergonomics best practice General cab layouts			

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Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
Control	Doors (both)	Door (close) interlock Can be separate-	(From Class 377) Control positioned beneath grouping of above controls	Yes	Yes				Ergonomics best practice General cab layouts		Keep in existing position or betterment-	
			Controls provided for the driver shall be positioned for operation from the normal seated position. They shall be designed using ergonomic principles, with the specific aim of minimising the risk of wrong side or inadvertent operation.	Yes					Railway Group Standard GM/RT 2473-1: 2003 Power Operated External Doors on Passenger Carrying Rail Vehicles B8 Provision of door controls, B 8.2.1			
			The controls on the desk related to doors shall be grouped together or be integrated into one combined element. The position of these elements shall reflect the associated side of the unit.						prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.2 Grouping of controls, 7.3.2.2	The European standard contradicts UK standards. Assumption: UK standard to be applied		
			Relative to the forward direction of motion of the cab, controls for the left-hand side doors shall be mounted on the left of the driver, and controls for the right-hand side doors mounted on the right of the driver.						Railway Group Standard GM/RT 2473-1: 2003 Power Operated External Doors on Passenger Carrying Rail Vehicles B8 Provision of door controls, B 8.2.2			

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Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
Control	Sand	Sanding button	Location of operating element should enable convenient operation by the left or right hand i.e. be located in the intersection of the reach envelopes.	Yes	Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators Table B. 1- List of elements and their locations including function codes		DVT outside of normal- existing or betterment.	
			Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust.		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Normal reach	
			Centrally located on the drivers panel						General cab layouts			
Control	Direction of travel		The ETCS shall not require specific actions from the driver in order to provide the 'cab active' signal to the ETCS. The ETCS shall use appropriate existing controls (cab open switch, direction controller , etc) such that the correct train orientation is determined.						NEPT-ERTMS-REQ-0007 ETCS Onboard System-Baseline 3- Subsystem Requirements Specification 3.10 Cab Detection		Not moving	

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		Forward Neutral Reverse	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk			
			The controls related to the direction of travel shall be grouped together on the desk or be integrated into one combined element. The position of these elements shall reflect the associated direction of travel.						prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.2 Grouping of controls, 7.3.2.3			
Control	Power device	Diesel engine- Transitions between diesel and electric	Control button Located in grouping with Main Circuit Breaker / Power Transmission and Train Power Supply	Yes					prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 b) Reachability of controls on the driver's desk			
		Diesel controls			Yes							

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Categorisation of train cab controls/indicators/displays

Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		EMU- Pantograph down	Control button Located in grouping with Main Circuit Breaker / Power Transmission and Train Power Supply	Yes								
		EMU- Pantograph up	Control button Located in grouping with Main Circuit Breaker / Power Transmission and Train Power Supply	Yes								
		Fire override (separate control)		Yes			Yes					
		Pan selector		Yes								
		line light					Yes					
		Changeover control (identified as VCB).										
		Main Circuit Breaker / Power Transmission	Control button Located in grouping with Pantograph / Diesel engine control and Train Power Supply	Yes					prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 b) Reachability of controls on the driver's desk	If these can't be identified on existing cab designs, I will assume they will not need adding to the panels.		

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		Electric Train Supply (ETS) Train Power Supply	Control button Located in grouping with Main Circuit Breaker / Power Transmission and Pantograph / Diesel engine control	Yes					prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 b) Reachability of controls on the driver's desk			
Display Control	Protection System	ATP- Override		Yes			Yes		Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators	Would ATP protection systems be required with the introduction of ETCS and if so, any displays/controls linked to ATP be needed on the panel?		
								Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators				
								Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators				
		Train Management system			Yes							
		TVM430	Other in-cab signalling	Yes								

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		EM2000 (Diesel engine control system)	Train management system for freight trains		Yes							
		On-train data recorder plus (all types)									Might be removed when ETCS introduced	
Control	Warning	External Warning Horn	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Not moving If in positioning in front of where DMI will go- specific assessment required (HF). Design review	
Controls	Lights	External Front Light	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Existing or betterment opportunity of introduction of mimic panel where possible if switch removed, mimic panel should be included.	
		Train Lighting	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Existing or betterment opportunity of introduction of mimic panel where possible if switch removed, mimic panel should be included.	

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		Instrument Lighting	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Existing or betterment opportunity of introduction of mimic panel where possible if switch removed, mimic panel should be included.	
		Hazard Light		Yes							Consistency of design	
		TASS indicators		Yes							Consistency of design	
		Forward facing CCTV capture button		Yes							Consistency of design	
		Cab light Engine room etc.		Yes							Not moving Where currently centrally located-detailed design review	
		Brake timing selector time indication									Consistency of design	
		iPad / peripheral device		Yes							Reachable but not in primary (glare issues)-	
		Train lengthen indicator	Freight- combination of switches and indicators								Consistency of design	

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		Task and Drivers Desk Lighting	Should be located within the extended reach envelope which encompasses those areas when the upper arm has to move away from the normal conditions and which can include shoulder thrust		Yes				prEN 16186-2:2015 Railway applications — Driver's cab — Part 2: Integration of displays, controls and indicators 7.3.1 a) Reachability of controls on the driver's desk		Existing or betterment opportunity of introduction of mimic panel where possible if switch removed, mimic panel should be included.	
	Heating controls										As per lighting controls	
Control	Coupling	Couple button	Automatic coupling- Control shall be operable and/or viewable by the driver whilst at the main driving position		Yes				Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments		Possible to re-locate if required. (space creation).	
			Bottom left of a number of driver panels (Classes 313 / 375 / 377)					Various cab layouts				
			Close to the uncouple control: Corridor- Classes 153 / 158 / 172 / 315 / 455 Full-left- Classes 168 / 170 / 390 /					Various cab layouts				
		Uncouple button	Automatic uncoupling- Control shall be operable and/or viewable by the driver whilst at the main driving position		Yes				Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments		Possible to re-locate if required. (space creation)	
			Furthest edge of the drivers desk (Classes 172 / 313 / 375 / 377 / 455)						Various cab layouts			

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
			Close to the couple control: Corridor- Classes 153 / 158 / 172 / 315 / 455 Full-left- Classes 168 / 170 / 390 /						Various cab layouts			
Control	Engine	Start control	Close to stop button		Yes				Class 153 / 156 / 158	Assumption: Retained	will need moving	
		Stop control	Close to start button		Yes				Class 153 / 156 / 159		will need moving	
Control	Windscreen controls	Windscreen Wiper	Depending on the size and/or location of the desk, preferred location is on the right side of the desk	Yes			Yes		Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments		Existing or better (were possible)	
		Windscreen Washer	Depending on the size and/or location of the desk, preferred location is on the right side of the desk						Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments		Existing or better (were possible)	
		Windscreen Heater	Depending on the size and/or location of the desk, preferred location is on the right side of the desk						Railway Group Standard GM/RT2161- 1: 1995 Requirements for Driving Cabs of Railway Vehicles 7.2.1 Primary Controls and Instruments		Existing or better (were possible)	
		Combined controls	Edges of driver desks						Various cab layouts		Existing or better (were possible)	
	Additional controls	Fault indicators (generic)	Primary and secondary- fault and status indicators								Existing or better (if in middle, move to left or right). Keep in categories.	

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
		PA equipment									Leave where is	
		GSM-R									Leave where is	
		RETB									Leave where is	
		Wash mode (default mode)		Yes							Existing	
		Cup holder	Very important								Existing	
		Drivers clipboard									Existing	
Control	ETCS	ERTMS Isolation Switch	<p>The ERTMS onboard equipment must incorporate a control that enables it to be physically isolated from the traction unit's braking system and, where required, other onboard systems.</p> <p><i>This control should be physically separate from the ERTMS onboard equipment so that the train is not totally immobilised by failure/removal of ERTMS.</i></p>						RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.12 ERTMS isolation switch	Assumption: Not located on the drivers desk and will be located elsewhere in the cab. Should the location of this be considered as part of the design guidance?	Ideally, it's worth putting a recommendation in.	
			Operation of the ERTMS isolation switch must be clearly indicated in affected driving cabs.						RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.12 ERTMS isolation switch			

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
			The ERTMS isolation switch must be located outside the reach zone of the train driver's normal seated position			Yes			RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.12 ERTMS isolation switch			
Display		ERTMS Isolation Switch Indicator	The indication must be visible from the train driver's normal seated position.				Yes		RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.12 ERTMS isolation switch, 3.3.12.2			
		ERTMS Reset switch	The ERTMS onboard equipment must incorporate a control (ERTMS reset) that enables an authorised user to temporarily interrupt the power supply to the ERTMS onboard equipment (that is, invoke a transition to and out of No Power mode (NP)) without interrupting the power supply to other onboard systems.						RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.12 ERTMS reset	To be accommodated on the drivers desk	Ideally, it's worth putting a recommendation in.	
			The ERTMS reset must be located within each driving cab, but outside the reach zone of the train driver's normal seated position.			Yes			RSSB- Operational Concept for ERTMS Issue 2: 2014 3.3.12 ERTMS reset	Assumption: Not located on the drivers desk and will be located elsewhere in the cab. Should the location of this be considered as part of the design		

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Instrument	Grouping	Control / display	Comment	Normal Reach	Extended Reach	Outside Normal Reach	Normal Viewing	Outside Normal Viewing	Source	Questions / Assumptions	Comment	Error?
										guidance?		
	DMI		The minimum size of the total image display area shall be 180 mm x 135 mm (w x h).						ERA_ERTMS_015560 European Railway Agency- ETCS Driver Machine Interface 5.2.1.1.1			