Paper to support Paddington 0-12m Exemption

Class 387/1: ETCS GW-ATP Case

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Title: Class 387/1: ETCS GW-ATP Case

Subject: Justification for non-fitment of GW-ATP to the HEx ETCS fitted class 387s.

Authors: Nick Wright, Trainborne Systems Manager, FirstGroup

Andy Moore, Senior Project Operations Manager, Great Western Railway

John Batty, Engineering Lead – EMU Introduction, Great Western Railway

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1.0 Introduction

This paper supports the case for the ORR to grant an exemption to facilitate service operation of the new HEx ETCS fitted Class 387s between Paddington and Stockley Bridge Junction (milepost 0-12) on ETCS non-fitted infrastructure.

This paper recognises that the existing HEx class 332s are fitted and operating with GW-ATP from Paddington to the Heathrow Terminals. The scope of the ETCS programme was that these routes and the replacement for the class 332s would be equipped with and operating under ETCS. Network Rail's programme slippage of the application of ETCS to the infrastructure has meant that the main and relief lines will not be fitted in time for the class 387 to commence HEx service operation by June 2019. However, between Stockley Bridge Junction and the Heathrow Terminals the class 387s will be able to operate in Level 2 ETCS.

To mitigate the delay in ETCS infrastructure fitment, GWR, Crossrail and Network Rail are submitting separate documentation which sets out mitigating this risk by applying enhanced TPWS to every signal between Paddington and Stockley Bridge Junction.

This paper is concerned with justifying why it is not feasible to apply GW-ATP to the HEx class 387s that are being delivered with ETCS.

2.0 Background

The HEx class 387 “Electrostar” units manufactured by Bombardier are to an existing design and will be fitted with ETCS at build and can operate with a maximum speed of 110mph.

GWR have entered into a Management Contract with HEx. HEx wishes to outsource to GWR the provision of train crew and certain management services in relation to the HEx Services. HEx also wish to sub-contract to GWR the provision of the class 387 Units which will be modified for Airport use for HEx Services in substitution for the class 332 Units.

The replacement of rolling stock is due to be completed by December 2019 to allow Siemen’s HEx Old Oak Common maintenance facility to be closed and enable work on HS2 to commence.

The original intention was for the infrastructure from Paddington to the Heathrow Terminals to be fitted and operating with ETCS to support service operation of the HEx class 387s by June 2019. Between Paddington and Stockley Bridge Junction the ETCS would have been in an overlay configuration. This would have facilitated withdrawal of the GW-ATP fitted class 332s and 360s units and decommissioning the GW-ATP infrastructure between Stockley Bridge Junction and the Heathrow Terminals. The GW-ATP fitted mainline infrastructure between Paddington and Stockley Bridge Junction is required to be retained to support GW-ATP service operation of the GWR class 43 and class 80x (IET) units.

Application of ETCS infrastructure, including GSM-R data coverage, between Stockley Bridge Junction and Heathrow Terminals has taken place and is currently undergoing testing prior to acceptance for service operation. Application of ETCS between Stockley Bridge Junction and Paddington is ongoing and indications are that it will not be available for service operation in time for the service introduction of the HEx class 387s and also the Crossrail class 345s.

Should this be the case, Network Rail, GWR and Crossrail have produced separate documentation which demonstrates the safety issues associated with operating the class 345s and class 387s under ETCS level NTC between Paddington and Stockley Bridge Junction.

As the class 332s are already fitted with GW-ATP and will be replaced by the ETCS fitted HEx class 387s, this paper justifies why it is not considered to be feasible to fit GW-ATP to the HEx class 387s in order to maintain the safety benefits provided by the GW-ATP should the lines between Paddington and Stockley Bridge Junction not be fitted with ETCS in time for their introduction into service.

3.0 Purpose

This paper outlines the strategy for assessing the capability of HEx class 387 units to operate safely on the route between Paddington and Stockley Bridge Junction without ETCS infrastructure fitment. It also seeks to demonstrate why fitting GW-ATP equipment is not cost effective and thus considered not viable.

Confidence in the ability of Network Rail to deliver this ETCS infrastructure between Paddington and Stockley Bridge Junction in the required timescales is now very low in order to achieve the June 2019 HEx class 387s service introduction.

The current proposed GWR ETCS on-board implementation programme is to complete ETCS fitment of the HEx class 387 units in 2019, and to use ETCS L2 in the 0-12 miles section between “Paddington and Stockley Bridge Junction” when it becomes operationally available for use by Crossrail services during 2019.

However, this depends on NR delivering the necessary ETCS operational infrastructure in line with the current ETCS delivery programme, and sufficient GSM-R data capacity being available to enable GWR to operate these units in Level 2 ETCS in addition to the Crossrail services.

If NR cannot achieve full fitment of ETCS equipment in the 0-12 mile area by June 2019 class 387 units will have to operate on the route in one of the following states:

- ETCS Level NTC – National Train Control (TPWS and AWS) only,
- Or, be fitted with the GW-ATP.

It is noted that the fitment of GW-ATP to the HEx class 387s operating over the GW-ATP system’s remaining anticipated life would be costly and provide benefit over a limited area and for a relatively short period of time. It will significantly complicate the timely introduction of these units and will potentially lead to an over complicated and unusable cab layout. In addition, the operation of ETCS and GW-ATP would introduce additional burden to the Driver and require complicated transitions between each system, which in the absence of a GW-ATP Specific Transmission Module (STM), would not be achievable on the move and hence be unable to support the service pattern timetable.

4.0 Options

Following a review two options were considered available in the event that ETCS infrastructure does not extend beyond Heathrow Stockley Bridge Junction by June 2019, these are:

- Undertake the fitment of GW-ATP to the class 387 fleet, options as to how this could be achieved are detailed in Section 4.1
- Carry out a detailed assessment of the risks associated with the operation of class 387 as permitted in the Sectional Appendix under the existing national safety system with the application of enhanced TPWS to every signal. This is the subject of a separate document.

Each of these options will be assessed in turn in the following sections.

4.1 Fitting GW-ATP to Class 387s

This is an exceptionally expensive option and is both technically and commercially extremely challenging. Nevertheless, its assessment as an option is necessary.

The option of dual fitting GW-ATP with ETCS, depending on the option adopted, appears highly unlikely to be physically achievable as the cab desk is very limited in size due to the on-board DOO and other essential equipment, together with central gangway provision. Furthermore, dual fitment would also well exceed the current space provision for the ETCS European Vital Computer (EVC) and peripheral equipment and, if adopted, would result in a loss of either luggage space or seating. Furthermore, as the GW-ATP equipment would be provided by a different supplier its application and integration with ETCS provided by the train builder would be technically complex and likely to compromise the agreed overall reliability and performance of the train.

It is considered that dual fitment of GW-ATP and ETCS is therefore not a viable option This may leave no alternative to the fitment of only GW-ATP equipment, resulting in an inability to use ETCS protection between Stockley Bridge Junction and the Heathrow Terminals. Earlier work undertaken by GWR for the introduction of the class 387s, for service operation on the GWML, identified that there is no current design for the application of GW-ATP to the "Electrostar" (class 387) fleet. The application design timescales and lead time to manufacture the equipment from the placement of order is such that, even if undertaken, the equipment would not be deliverable in time for HEx class 387 service introduction.

4.1.1 GW-ATP fitment in parallel to HEx ETCS programme.

GWR has engaged with the class 387s leasing company -Porterbrook, to explore the feasibility of GW-ATP fitment in parallel to the HEx. ETCS programme

4.1.1.1 Installation of GW-ATP by ETCS supplier

The GW-ATP equipment is currently installed in a single cubicle that would be difficult to install in the interior of a class 387 e.g. the cubicle would not fit into the luggage stack currently proposed for the installation of ETCS equipment and would probably necessitate the removal of at least one or more seats, including the development of a fire proof cubicle suitable for mounting in a passenger environment; as the GW-ATP cubicle and its contents would not meet modern fire safety requirements.

The critical path in the Bombardier programme is the design and installation activities. The time taken to design the GW-ATP installation, then install the equipment, undertake vehicle testing and commissioning would be significantly longer than the current ETCS programme, so there are no time advantages to be gained.

4.1.1.2 Re - use of HST GW-ATP equipment

The GWR HST fleet is currently fitted with GW-ATP equipment that could be re-used. However, this equipment could not be removed until April 2019 and the equipment would then need to be returned to Alstom for a complete overhaul and testing, before it could be fitted to the Class 387s and hence would not be available for installation until late summer 2019, several months after Bombardier ETCS equipment is planned to be available. Furthermore, vehicle characterisation testing would need to be undertaken to optimise the system performance for the class 387.

4.1.2.1 GW-ATP fitment by GW-ATP Provider SSL - Technical information

As part of earlier detailed dialogue with the ATP Design Authority, GWR sought technical and indicative pricing information from Alstom (through SSL) to inform the risk assessment process and subsequent value management assessment, as to the feasibility and cost of installing ATP on Class 387s. This enabled an evaluation to be conducted on GW-ATP fitment as either a standalone installation, or a dual fit with ETCS.

SSL has indicated that the following basic options could be developed further if required:

1. Fit GW-ATP as a stand-alone system, without ETCS
2. Fit GW-ATP as a stand-alone system, but with a bespoke SSL interface to ETCS
3. Integrate GW-ATP into the ETCS system using a Specific Transmission Module (STM)

Options 2 & 3 both assume displaying GW-ATP information on the ETCS DMI i.e. accepting that fitting both displays in the cab is not possible due to the lack of space. This would be difficult to achieve within the tight timescales with the 2 complex systems being provided by 2 different organisations, and the fact that currently there is no approved GW ATP STM.

If a dual fit with a physical changeover switch was provided (as per Class 800/801/802 IEP units), similar constraints to the IEP would apply and transition between the 2 systems would have to be undertaken when stationary and this would compromise the service pattern and cause the timetable to be unachievable.

In addition, with dual fitment as described above for the class 800/01/02 two separate speedometers would be required, as each system must be capable of operating independently of the other.

The additional costs and complexities of this ruled it out in the discussions that led to the three options described above.

The three options are summarised for indicative costs as follows:

Option	Total cost	Comment
1). GW-ATP only (and retain existing TPWS /AWS).	**£3.6m**	Further est. £3.6m cost when change to ETCS is required
2). ETCS+GW-ATP functionality via SSL's 'USSB' interface to ETCS.	**£5.5m** (+ETCS development cost - unknown)	Costs exclude any ETCS equipment. This option will incur an additional cost because as a minimum an ETCS DMI and limited EVC functionality. Total cost of Option 2 is likely to exceed the cost of Option 3 due to ETCS suppliers' development costs and the need for an ETCS set of equipment in each cab end.
3). ETCS + GW-ATP using STM integrated solution	**£10.3m**	Fully SSL integrated solution would also require ETCS to be fitted at both cab ends but the development implication are significantly less than those for Option 2.

4.1.2.2 GW-ATP fitment by GW-ATP Provider SSL - Option detail

Option 1:

Option 1 requires fitment of the existing GW-ATP speedometer into the cab desk and an application design of the system to the unit. The space restrictions in the Class 387 driving cab (shown in the photo, right) demonstrate the difficulty of fitting a GW-ATP speedometer and GW-ATP data entry panel.

Physically, this would be unrealistic unless dual fitment was implemented with a combined ETCS & GW-ATP DMI – SSL have already indicated that, even for a standalone GW-ATP fitment, the data entry panel would need to be located on the back wall of the cab rather than on the desk.

Option 1 also precludes the use of a Specific Transmission Module (STM) for the GW-ATP system which means that running transitions between the GW-ATP and ETCS systems would not be possible. This is evidenced by the constraint on the IEP fleet of Class 800/801 units, where a transition between the two systems must be made with the train at a stand and is expected to take in the order of 2 minutes to complete.

Standalone GW-ATP fitment would mean that use of ETCS on Class 387 units could not take place until all routes currently equipped with GW-ATP, over which the units would run, had migrated to ETCS, currently estimated by NR to not happen for at least two decades.

- **Note:** This limitation would be removed under the STM solution.

Based on earlier indicative prices provided by SSL the current cost for GW-ATP equipment (excluding design, approval or performance loss costs) is circa **£150k** per cab (or **£300k** per unit).

This equates to an estimated fleet fitment cost of **£3.6m** across the 12 units intended for HEx operation for GW-ATP alone. A further cost estimated as another **£3.6m,** would then be required later for ETCS fitment to meet the dates when signals are planned to be removed; currently estimated by NR to be 2024 – 2025.

Options 2 & 3

Considering Option 2 & 3, this would be for the procurement of GW-ATP with an ETCS interface (STM) from SSL.

- **Note:** the ETCS costs are not included – the ETCS could also be provided by other suppliers.

This option would also incur the same GW-ATP equipment costs, plus the cost of the STM (not yet developed or proven).

The STM hardware cost is estimated to be a further **£80k** per cab by SSL (circa **£1.9m** for 12 Hex Units, using their "USSB" interface, which effectively acts as a second EVC on board the train. Thus, the equipment costs for Option 2, excluding any ETCS equipment, DMI / EVC etc would be circa **£5.5m.**

The application design costs are likely to be high due to there being no current application design for GW-ATP on these vehicles.

In addition to the **£5.5m** GW-ATP and STM costs identified, both options 2 & 3 would also require the fitment of ETCS equipment at an additional cost. It is envisaged that 2 sets of ETCS EVC equipment will be required per unit and therefore, the ETCS costs could rise from **£150k** per cab to an estimated **£200k** per cab (based on the DA2 costs anticipated for the original 387 fitment with one EVC against the HST, where an EVC was required for each cab). Total cost for this option is **~£3.6m** GW-ATP, plus **£4.8m** ETCS = total ~**£10.3m.**

Using a different supplier of the ETCS, to that of the supplier of the STM and GW-ATP, would result in significant development work for the ETCS supplier and incur a high cost and development timescale.

4.1.3 GW-ATP system discussion.

For all GW-ATP options, the age of the technology used for GW-ATP results in significant space being required for the computer rack and peripheral components, which would be likely to result in the loss of seating or luggage space within these vehicles. It would also be necessary to enhance or replace the existing OTMR on the units, as this would not currently record GW-ATP data.

GW-ATP equipment is already difficult to source, with a 12-18 month lead time from order placement to delivery and subsequent fitment. GW-ATP fitment would also require the relevant approvals and comprehensive vehicle testing to optimise the variable system parameters (e.g. acceleration, braking etc.) for a particular vehicle class.

It should also be noted that the presence of an additional protection system will compromise train reliability and availability as more equipment (and therefore more potential points of failure) is being added, with nothing being taken away. This will introduce contractual and commercial issues in relation to the contracted train reliability and performance requirements placed on the train builder and maintainer.

The estimated lifespan of all the obsolete GW-ATP equipment is short – December 2025 being the current design life under the existing maintenance regime. Under the current published

plans, ETCS will replace it by December 2019 although, given likely programme slippage for ETCS, a life-extension of GW-ATP to around 2025 is now being considered.

It should also be noted that the fitment of the Alstom / SSL GW-ATP System to an existing train design, manufactured by a different supplier, may present commercial obstacles. Based on historical GW-ATP reliability data this is likely to lead to a significant degradation in the class 387 performance and availability over both GW-ATP fitted and unfitted routes.

This degradation in the train performance will provide an opportunity for the train manufacturer to seek, and probably justify, an easing of the train's current contracted reliability target.

Furthermore, based on the GSM-R experience, the fitment of a competitor's system to an existing trains design comes at an extremely high cost.

Therefore, the whole-life cost of the GW-ATP equipment would be extremely high for the arguably limited incremental increase in protection offered.

Assuming a 2020 GW-ATP introduction (based upon the indicative estimates provided by SSL), it would be in service for a maximum of five years under current proposals for the GW-ATP life extension to 2025.

4.1.4 Impact on NJRP

It should also be noted that the fitment of GW-ATP to the class 387 will introduce complications to the ETCS National Joint RoSCo Project (NJRP). The NJRP has already started the ETCS tender evaluation process for the First in Class (FiC) Class 387 design and GWR has been identified as the lead TOC. The current contractual agreement will see two separate ETCS cab designs for GWR's class 387 fleet and the project is currently managing the associated human factors and driver workload risk. Installation of GW-ATP into the HEx class 387s cab will provide additional variation and greater differences between the two cabs. This has the potential to increase the number of familiarisation and confusion issues across the common pool of GWR drivers.

To change this position would mean contractual changes between the GWR, Network Rail and NJRP, and has the potential for significant cost increase and to further delay the contract signature and subsequent commencement of the considerable development work required to provide an GW-ATP solution for ETCS-equipped vehicles.

5.0 Conclusion

Installation of GW-ATP on the HEx class 387s would require significant modifications to the cab layout, the train management control and ETCS system. Interfacing between these systems has not previously been achieve and therefore these risks have not been quantified. Furthermore, substantial equipment placement and relocation will be required. This will impact the cab and passenger environment, resulting in a reduction of seats.

There is currently no design for GW-ATP on the Electrostar platform and its interaction with the train has not been proven. Combined with commercial, procurement, design and installation lead times, the fitment of GW-ATP would not be achievable prior to HEx class 387 service launch in 2019. Additionally, there is no funding for these extremely expensive activities.

GWR concludes that fitment of GW-ATP on HEx class 387 trains produces high levels of programme risk that could delay their introduction onto HEx services in 2019.

Nick Wright
Train-Borne Systems Manager
First Group Rail Division

Andy Moore
Senior Project Operations Manager
Great Western Railway

John Batty
Engineering Lead – EMU introduction
Great Western Railway

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