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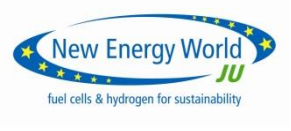

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Author:

Dr Peter Speers (Cenex[1])

With contributions from:

Dennis Hayter (intelligent Energy)

Dave Mossop (Intelligent Energy)

Andy Walker (London Taxi Company)

[1]Cenex, Holywell Park, Loughborough LE11 3TU, UK

peter.speers@cenex.co.uk

Author printed in bold is the contact person for this document.

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Executive summary

This document summarises the processes involved with and lessons learned from the certification of the TX4 fuel cell electric taxis (TX4 FCEV) for UK Individual Approval in 2011-12 during the HyTEC project.

At the outset of HyTEC, the aim was to achieve European Community Whole Vehicle Type Approval (ECWVTA) of the TX4 FCEV, as a prerequisite for wider commercial roll-out of hydrogen taxis across the European Community. After reviewing the appropriate EU regulations, it was clear that the TX4 FCEV was classified as a 'new type', for reasons including its use of a new fuel compared to the base TX4. The primary issue resulting from this was that EU regulations for electronic stability control, gear shift indication, tyre pressure monitoring (General Safety) and air conditioning would have to be applied to the TX4 FCEV and, ultimately, to the base TX4 itself. This meant that ECWVTA was not possible within the project time and budget constraints.

The potential of European Community Small Series Type Approval (ECSSTA), aimed at producers of less than 1,000 vehicles per year, was also investigated. However, review of Conformity of Production requirements necessary for this approval revealed issues, primarily due to the fact that the TX4 FCEV was being converted at a third party facility that was not ISO9001 certified.

Since ECWVTA and CoP issues were not solvable within project time and budget constraints, a decision was made in January 2012 to seek UK Individual Approval (IVA) for the TX4 FCEV. IVA is a UK national scheme aimed at small manufacturers which would allow the vehicle to operate on UK roads. The IVA was obtained and the five taxis registered for road use on 25th July 2012.

A consequence of the lack of ECWVTA was the TX4 FCEV could not be certified as a taxi for hire and reward by the London Taxi and Private Hire office, and therefore cannot carry fare paying passengers. The TX4 FCEV was accepted for use in London to carry non-fare paying passengers on 25th June 2012.

Review of this and other UK hydrogen vehicle certification activities, revealed a number of issues specific to hydrogen vehicles, including: the fact that there are no documented procedures for hydrogen vehicle certification; compliance with recently-introduced hydrogen safety Directive 79/2009/EC is taking time to work its way down the hydrogen vehicle supply chain; and that no specific directives apply for automotive fuel cells. This project, along with other UK certification case studies reviewed here, form a basis for future vehicle type approval activities during the early market deployment of hydrogen vehicles prior to the establishment of appropriate documentation such as exists for conventional vehicle type approval.

A number of issues that are not specific to hydrogen vehicles also came to light, including: difficulties for low volume manufacturers to deal with technical problems arising from certification requirements due to time and budget constraints; and the current mismatch of UK national requirements versus European requirements, specifically the fact that under Regulation 94 of the UK's Road Vehicles (Construction and Use) Regulations (C&U Regulations, 1986) prohibits the use of any gaseous fuel other than LPG to fuel a road vehicle. The consequence of the latter issue is that that in the UK all hydrogen-propelled vehicles need to

obtain a Vehicle Special Order (VSO), which are issued for periods of up to five years to vehicles that do not meet the Construction and Use Regulations provided suitable information is presented to ensure that appropriate care has been taken to address safety issues and requirements. The C&U Regulations issue is currently being addressed by Government and industry as part of the UK H2Mobility project.

Abbreviations

C&U	Construction and Use regulations
CoF	Conditions of Fitness
CoP	Conformity of Production
DfT	Department for Transport
ECSSTA	European Community Small Series Type Approval
ECWVTA	European Community Whole Vehicle Type Approval
EMC	Electromagnetic compatibility
ENV	Intelligent Energy fuel cell hybrid motorcycle development platform launched in 2005
EV	Electric vehicle
FC	Fuel cell
FCEV	Fuel cell electric vehicle
IE	Intelligent Energy
IVA	Individual Vehicle Approval
LTPH	London Taxi and Private Hire office
LTC	London Taxi Company (formerly LTI)
NSSTA	National Small Series Type Approval
TfL	Transport for London
TX4	London Taxi Company diesel-fuelled TX4 taxi
TX4 FCEV	London Taxi Company fuel cell hybrid TX4 taxi built for the HyTEC project
UN GTR	UN Global Technical Regulations
VCA	Vehicle Certification Agency
VOSA	Vehicle and Operator Services Agency
VSO	Vehicle Special Order

Contents

1 Purpose

This document summarises the processes involved with and lessons learned from the certification of the TX4 fuel cell electric taxis for UK Individual Approval in 2011-12 during the HyTEC project. Where appropriate, this process is compared and contrasted with the certification of 'conventionally' fuelled vehicles, and the experience of other early hydrogen vehicle certification activities in the UK.

2 Introduction

Certifying that vehicles meet relevant regulations and standards is a crucial part of their deployment on the road, and ultimately towards their successful commercial rollout. Certification processes for conventionally-fuelled vehicles are well established, with the majority being based on a type approval system. Type approval is the confirmation that production samples of a design or 'type' meets specified performance standards. If the vehicle tested complies then all others of the same design or type are also certified as compliant.

For alternatively-fuelled vehicles, such as electric vehicles (EVs) and fuel cell electric vehicles (FCEVs) to reach fully commercial status, they must also go through appropriate certification processes. However, there is far less precedent for this process than for conventionally fuelled vehicles, and the appropriate standards and legislation is still evolving.

This document discusses the issues involved in certifying a hydrogen vehicle on UK roads for use as a taxi using the example of the certification of the TX4 fuel cell hybrid taxis for use in the HyTEC project. The report is not intended as a comprehensive overview of the evolution of hydrogen vehicle certification legislation or the process of obtaining UK type approval as this information is provided elsewhere (e.g., see TRL, 2011 and VCA, 2013). Issues in certifying hydrogen vehicles and infrastructure in Scandinavia were addressed in the H2MovesScandinavia project (SP, 2012).

3 Vehicle type approval options in the UK

The information below is taken largely from the UK Vehicle Certification Agency website (VCA, 2013). VCA is the designated UK Approval Authority and a Technical Service for all type approvals to automotive EC Directives and most UN Regulations.

A number of type approvals options are available in the EU and UK dependent on intended vehicle production numbers and target markets as shown below:

European Community Whole Vehicle Type Approval (ECWVTA) is the preferred route for vehicles in the EU. The approval is based around Framework Directive 2007/46/EC (as amended), which applies to passenger vehicles, goods vehicles and trailers, specifies aspects of the vehicle that must be approved to around 50 separate technical Directives; Figure 1 below (VCA, 2011) illustrates the key areas where these Directives apply in the case of cars (M1 category vehicles):

Figure 1. ECWVTA standards for M1 category vehicles (source: VCA, 2011)

Hence, in order to gain EC whole vehicle approval, a vehicle first will have to be approved for various systems, e.g. brakes, emissions, noise, etc. Issuing of the approval does not itself involve testing, but a production sample of the complete vehicle is inspected to ensure that its specifications match those in separate Directive approvals. A key aspect of ECWVTA is the Conformity of Production requirement (see below), which can be based on established quality standards such as ISO9001. Full details of the ECWVTA process can be found on the VCA website (VCA, 2013a).

European Community Small Series Type Approval (ECSSTA) is an adaptation of ECWVTA with reduced technical and administrative requirements for small businesses and is aimed at production runs of fewer than 1,000 M1 vehicles per year.

National Small Series Type Approval (NSSTA) is for manufacturers that intend to sell only in the UK. The advantages of NSSTA are relaxed technical requirements in some areas, a more pragmatic approach to the Conformity of Production (CoP) requirements compared to ECWVTA, and reduction in administration.

Individual Vehicle Approval (IVA) is a UK national scheme suited to individual/very low volume vehicles. IVA does not require CoP as it is based on inspection of each vehicle. Under IVA, vehicles must be inspected by the Vehicle and Operator Services Agency.

4 Legislation, codes and standards for certification of hydrogen vehicles

This report is not intended as a comprehensive overview of the evolution of hydrogen vehicle certification legislation as this information is provided elsewhere (e.g., see TRL, 2011), but a brief review of current applicable legislation is provided below.

Within the EC, two systems of type approval are relevant (VCA, 2013a). One is based around EC Directives and Regulations, and provides for the approval of whole vehicles, systems and separate components. The other is based around UN Global Technical Regulations (UN GTR) and provides for approval of vehicle systems and separate components, but not whole vehicles. In an effort to simplify EU type approval, EU Directives are being replaced by fewer EU Regulations, which may in turn refer to UN Regulation. Regulations (including EC Directives) are typically legally binding, and often refer to compliance with specific technical codes and standards.

As stated previously, the most important directive for ECWVTA is 2007/46/EC. For hydrogen vehicles, regulation EC 79/2009 of 14th January 2009 amends 2007/46/EC. This was implemented as EU 406/2010 on 26th April 2010 (EC, 2010). The regulation applies to all new vehicle type as of 24th February 2011 and therefore to the TX4 FCEVs of HyTEC as discussed in Section 0 below.

The technical requirements of EU 406/201 are set out in a series of Annexes which address:

- Documentation with respect to EC type approval of hydrogen propulsion , components and systems
- On-board liquid and gaseous hydrogen storage
- Vehicle identification
- Complex electronic systems

Also during the certification project, a draft UN GTR on hydrogen vehicles was available, which covers similar areas to 2007/46/EC. This has since been adopted as ECE/TRANS/WP.29/2013/41 on 27th June 2013 (UNECE, 2013). While UN GTRs are not legislation, contracting parties that vote in favour of establishing a UN GTR (the EU in this case) are obliged to begin the process of transposing the global requirements into their local legislation.

5 Previous UK hydrogen vehicle certification activities

5.1 Cenex Stornoway Hydrogen Vehicle Trial

In July-August 2010 Cenex deployed and managed the trial of a demonstration Ford Transit converted by Revolve Technologies to a bi-fuel petrol/hydrogen internal combustion engine mode in Stornoway, Outer Hebrides, Scotland (Cenex, 2011). The trial involved the use of a vehicle by Royal Mail on two delivery routes out of its Stornoway delivery office over a six week period.

At the time of the trial, hydrogen vehicles were not certified to carry loads on UK public UK roads. In order to operate the vehicle in Stornoway a test and trials Vehicle Special Order (VSO) was obtained from the UK VCA under Section 44 of the UK Road Traffic Act 1988 (VCA, 2013c). VSOs are issued for periods of up to five years to vehicles that do not meet the construction and use regulations (C&U Regs), provided reasons for non-compliance can be justified and suitable information is presented to the VCA to ensure that appropriate care has been taken to address safety issues and requirements.

In order to obtain the VSO for the trial Revolve Technologies certified the vehicle's compliance with regulation 2007/46/EC (EU framework for type approval of motor vehicles and trailers) and UNECE GRPE 2004/3 (Draft United Nations Economic Commission for Europe Working Party on Pollution and Energy Uniform Provisions concerning the approval of (a) Specific components of motor vehicles using compressed gaseous hydrogen (b) Vehicles with regard to the installation of specific components for the use of compressed gaseous hydrogen). The VSO only applied for vehicle operation on the routes specified for the trial period.

5.2 Intelligent Energy Hydrogen Fuel Cell Motorcycle Certification

The content below is a summary of a presentation by Dennis Hayter of Intelligent Energy (IE, 2012). Full details are available in the presentation.

In 2007, Intelligent Energy began a process funded by Cenex to certify to ECWVTA its ENV fuel cell hybrid motorcycle development platform. At that time no EC directives, ECE regulations or standards were in place relating to vehicle fuel cell systems, vehicle hydrogen systems, or fuel cell hybrid cars or bikes. Where such regulations were in development, they were aimed specifically at cars – as remains the case at the time of writing (October 2013).

Investigation of the certification possibilities by IE, in conjunction with Dutch-based type approval agency RDW which has experience of hydrogen vehicle certification, revealed that the ENV was not a suitable vehicle platform for certification against the then current or anticipated directive and standards:

- The vehicle running gear and frame were not compliant due to the prototype nature of the 'base' (non-fuel cell) ENV platform
- In terms of the hydrogen and fuel cell systems, the principle issue was the lack of a certified (or certifiable) hydrogen storage cylinder

Following the decision to cease work on the ENV, a second certification pathway was chosen in conjunction with Suzuki, based on the Burgman fuel cell hybrid scooter. This offered the considerable advantage that the

Burgman is based on a standard production motor scooter platform which already has ECWVTA. This means that full conformity testing would not be needed as the fuel cell hybrid was viewed as an adaptation of the base vehicle, and that:

- Testing would be required to cover changes in weight balance and handling
- A certifiable hydrogen storage system would be needed as the fuel cell system represented a new power train which would need to be type approved by independent testing

Review of the appropriate certification pathways and legislation meant that the approach below was adopted for the Burgman fuel cell hybrid (as described in more detail in IE, 2012):

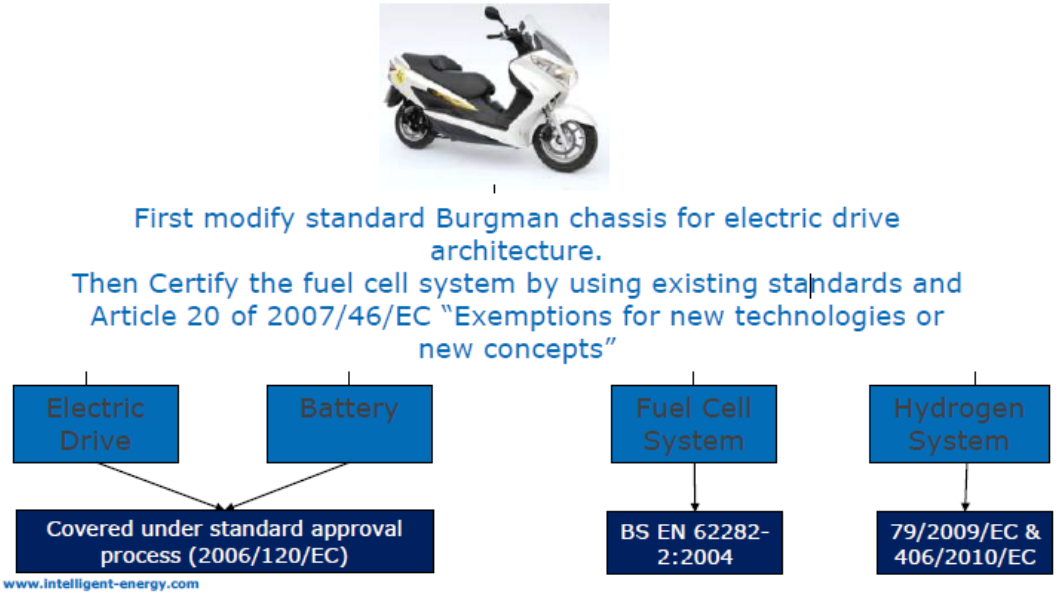

Figure 2. Overview of Burgman ECWVTA process (source: IE, 2012)

Following the testing and certification steps process outlined in the Figure, RDW made the submission for ECWVTA to the EC's Technical Committee – Motor Vehicles on May 2010. Final ECWVTA was granted on 9th March 2011.

ECWVTA for the fuel cell hybrid Burgman was the first time any fuel cell vehicle was certified safe for public roads and approved for production and sale in Europe. Among the issues identified during the type approval process were:

- Lack of defined requirements for automotive fuel cells. For the Burgman, the fuel cell system was certified to IEC 62282-2 which is not intended for motive power fuel cell systems
- Recent EC Directives for hydrogen vehicles (including EC/406/2010) only apply to cars, not fuel cell or hydrogen powered motorcycles (category L)

6 The TX4 fuel cell electric hybrid (TX4 FCEV)

The TX4 fuel cell electric hybrid (TX4 FCEV) is a conversion of the base London Taxi Company (LTC) diesel TX4 (hereafter the base TX4). The TX1, ancestor of the TX4, was awarded ECWVTA on 5th September 1997; this was extended to cover the TX4 on 6th October 2006. The TX4 FCEV is a series plug-in hybrid with rear-wheel drive; its architecture is shown schematically in Figure 3.

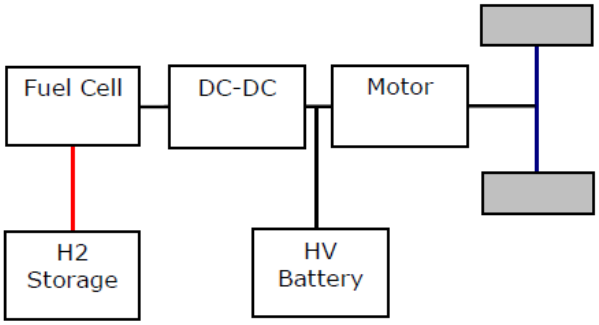

Figure 3. TX4 FCEV architecture (source: Intelligent Energy)

Compared to the base TX4, the TX4 FCEV obviously no longer has the diesel internal combustion engine, but has additional:

- Compressed hydrogen storage
- Fuel cell system and 400V traction battery pack with on-board charger
- Electric drive motor with fixed ratio gearbox (4.186:1)

The characteristics of the TX4 FCEV are compared to the base TX4 in Table 1.

Table 1. TX4 FCEV and TX4 technical characteristics

Characteristic	TX4 FCEV	Diesel TX4
Overall Length	4,580 mm	
Overall Width	2,036 mm (including mirrors)	
Overall Height	1,834 mm	
Weight	2,180 kg	1,815-1,975 kg
Engine	Electric motor	2,499cc diesel
Power	100 kW	75 kW
Fuel Cell	30 kW air-cooled PEM (Intelligent Energy)	-
Fuel Storage	350 bar, 3.73 kg H2	50 l Diesel
Battery	Li-Polymer battery, 14kW with plug-in capability, plus 12v lead-acid battery	12v lead-acid battery
Range	400 km (250 miles)	>500 km (>310 miles)
Top Speed	81 mph (limited)	81 mph (limited)

The engineering layout of the TX4 FCEV is shown in Figure 4.

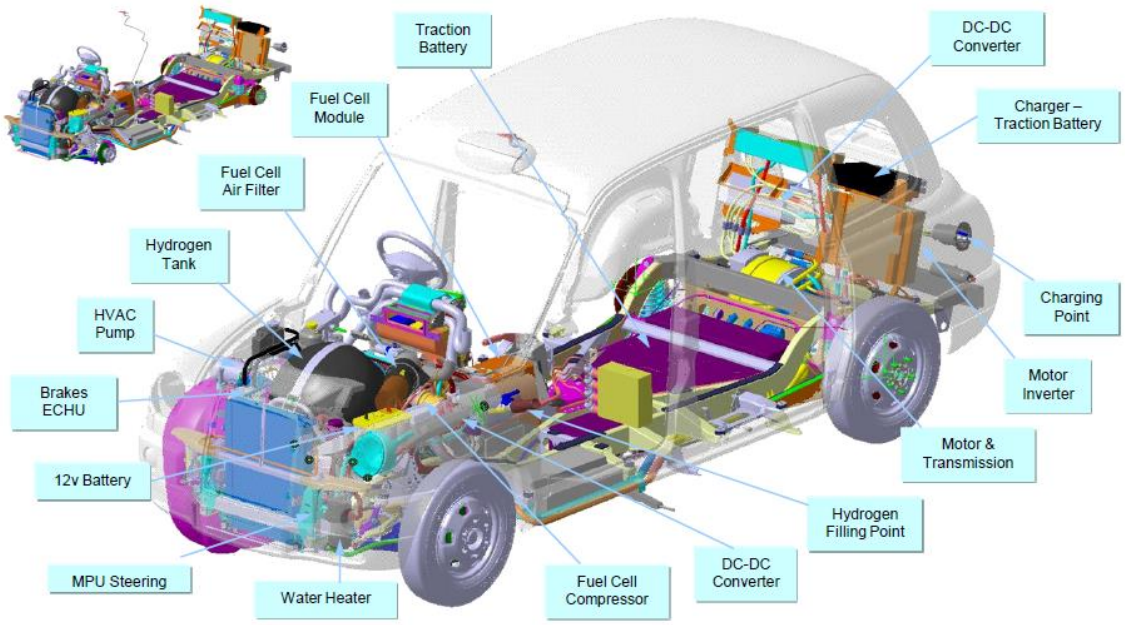

Figure 4. Engineering layout of TX4 FCEV (source: Intelligent Energy, Lotus Engineering)

7 TX4 FCEV type approval process

The work described below was carried out by Andy Walker of London Taxi Company from September 2011-July 2012. Andy also provided much of the content used in this section.

At the outset of HyTEC, the aim was to achieve ECWVTA of the TX4 FCEV. ECWVTA is preferred as it based around EC Directives and is accepted throughout the EU. The base (diesel) TX4 was awarded ECWVTA in 2006, and, as discussed further below, possession of ECWVTA is generally a precondition of compliance with the 'Condition of Fitness' rules issued by taxi licensing authorities such as Transport for London (TfL) for operating taxis in the UK. Achieving ECWVTA would therefore be a crucial milestone in the wider commercial rollout of the TX4 FCEV variant, particularly outside the UK, and for its use as a taxi for hire and reward.

Four steps are involved in the process of seeking vehicle type approval:

(i) Legislation review
(ii) Certification status
(iii) Inspection and test
(iv) Registration

The outcomes of each of these steps in the case of the TX4 FCEV are discussed further below.

7.1 Legislation review

This step, which involves researching and reviewing all appropriate legislation for the given approval or vehicle use, was started at the beginning of the HyTEC project in September 2011. The documents that were reviewed, outputs, expected results and issues and barriers encountered during this process are summarised in Table 2 and discussed further below.

Table 2. Legislation review

Documentation/process reviewed	Output	Result	Issues	Barriers
1. EU Legislation including: - 2007/46/EC - Whole vehicle approval - EC 79/2009 - Hydrogen directive - EC 661/2009 General Safety - 2005/64/EC - Recyclability - 92/21/EC Masses & Dimensions - 78/317/EC - Demist / Defrost - 78/316/EC - ID of Controls - 76/114/EC - Statutory Plates - 74/297/EC - Protective Steering - 74/61/EC - Anti-theft - 95/54/EC - EMC - 71/320/EC - Braking - 70/311/EC - Steering Effort - 70/221/EC - Fuel tanks - EC 715/2007 Emissions - 200/40/EC Air Conditioning - 92/23/EC Tyres - 80/1269/EC Engine Power - 70/157/EC Noise	1. Legislation profile (applicability) 2. Technical difficulty rating (priority & resource) 3. Provisional costs 4. Technical direction (design inputs) 5. Worst-case / exemption basis **6.** Future legislation profile	Provisional EU legislation work-scope	**1. Vehicle classified as new type** 2. Many issues apply to base TX4 as well as FCEV variant	1. Technically unsolvable during project 2. Cost Availability of external resource
2. EU Conformity of Production (CoP) including: - Control plans - Homologation audits - Major unit inspection & control	Agreed CoP work-scope	Agreed CoP work-scope	1. Non-audited manufacturing facilities **2.** Split plant manufacture	
3. London Taxi Conditions of Fitness (CoF) including: - Whole vehicle licensing requirements - Advertising limitations - EMC Requirements - Additional equipment approval	1. Technical difficulty rating (priority & resource) 2. Provisional costs 3. Technical direction (design inputs) 4. Worst-case / exemption basis	Provisional work-scope	1. Lack of possibility of ECWVTA meant vehicle could not be certified for use by fare paying passengers 2. Internal display screen in back of taxi used to display vehicle operating information took the vehicle outside of CoF compliance	1. Technically unsolvable during project 2. Cost
4. **UK National Construction & Use Regulations including:** - Whole vehicle licensing requirements - EMC Requirements - Hydrogen systems - CO2 Emissions - Vehicle taxation - Vehicle registration process's	1. Technical difficulty rating (priority & resource) 2. Provisional costs 3. Technical direction (design inputs) 4. Worst-case / exemption basis 5. Taxation target 6. Preferred registration route	1. Agreed taxation category 2. Agreed registration route	'New' Technology registration outside of normal process	

7.1.1 EU legislation review

ECWVTA

Clearly, review of applicable current and forthcoming EU regulations is a crucial aspect of securing ECWVTA. After reviewing the appropriate EU regulations, it was clear at the time of this study that the TX4 FCEV was classified as a 'new type', for reasons including its use of a new fuel compared to the base TX4. The primary issue resulting from this was that EU regulations for electronic stability control, gear shift indication, tyre pressure monitoring (General Safety) and air conditioning would have to be applied to the TX4 FCEV and, ultimately, to the base TX4 itself. The application dates for these regulations as applied to 'new types' of vehicles are three, two and seven years prior to 'existing types' of vehicle respectively. Therefore, as well as the need to certify the hydrogen vehicle, the base TX4 components did not meet ECWVTA requirements in these areas.

ECSSTA

Potential of ECSSTA was also investigated. As stated above, under ECSSTA registrations are restricted within the EU to 1,000 M1 vehicles per year. However, it does offer the advantage to small manufacturers that derogations are in-place within ECWVTA small series legislation which exclude certain elements of general safety and air conditioning regulations. A key aspect of ECSSTA however remains Conformity of Production (CoP) requirements, which are discussed next.

7.1.2 Conformity of Production (CoP) requirements

The CoP requirements are intended to give the certifying authority (in this case the VCA) confidence in the manufacturer's control plan and quality systems (such as ISO9001 accreditation, but this is not mandatory). Review of CoP requirements revealed issues for the TX4 FCEV. Although the LTC facility Coventry is ISO9001 certified and is fully EU CoP-compliant, the TX4 FCEV was being converted at a third party facility that was not ISO9001 certified. Additionally, there was the possibility that some components would be sourced from outside the LTC Coventry facility, which would require additional auditing. These issues were not considered solvable within project time and resource constraints.

7.1.3 London Taxi Conditions of Fitness (CoF) requirements

No vehicle can be licensed as a London taxi unless it is fit for public service and conforms to the CoF requirements (TfL, 2007, last updated 2011), unless the London Taxi and Private Hire office (LTPH) elects to exempt the vehicle after a request by the applicant.

Each new type of taxi must comply in all respects with British and European vehicle regulations and be type approved to the requirements of the M1 category of European Whole Type Approval Directive 2007/46/EC as amended, including the Road Vehicles (Construction and Use) Regulations 1986 (C & U). The presence of a screen in the passenger compartment, which provides feedback on the vehicle operation mode for the TX4 FCEV, was also found to be non-compliant with CoF requirements on advertising.

The lack of possibility of ECWVTA provided a considerable barrier to acceptance of the TX4 FCEV as a London Taxi. Discussions with the TfL London Taxi and Private Hire office (LTPH) indicated that they would be

prepared to accept the vehicle to be driven on the road with a taxi plate, but not used to pick up passengers for hire and reward, if it could achieve ECSSTA.

7.1.4 Road Vehicles (Construction and Use) Regulations 1986 (C & U) requirements

As stated above, C&U Regulation compliance is generally essential to securing CoF compliance. The C&U Regulations are administered by VOSA, which is the UK Agency responsible for roadworthiness standards, including licensing vehicles for road use via the MOT test. It is also the body responsible for establishing the registration of the vehicle into a designated category (e.g., M1 etc.)

Investigation of the C&U regulations and discussions with VOSA revealed that because the vehicle used a fuel cell hybrid powertrain for which no specific directives applied, the TX4 FCEV would have to be treated as a 'new' technology registration outside of the 'normal' C&U process.

7.2 Certification status

Ruling out achieving ECWVTA and ECSSTA meant that only UK national type approval would be possible. Review of the CoP requirements for NSSTA, plus consideration of project timescales and budget, meant that a decision was made in January 2012 to focus on securing Individual Vehicle Approval (IVA) for the taxis.

7.3 Inspection and test

Engagement with the UK Vehicle Certification Agency (VCA) became crucial once the decision was taken to seek IVA. The process for securing IVA is described in detail elsewhere (VOSA, 2012), but the most important aspect in this case is that vehicles submitted for IVA inspections need to demonstrate that they generally comply with the technical provisions of Directive 2007/46/EC. For any areas outside of compliance, provision of a robust safety case – which provides evidence that a system is acceptably safe to operate in a particular environment – is crucial in securing IVA. In the case of the TX4 FCEV, the main vehicle systems that required safety cases were:

- Steering,
- Braking
- Electrical drive
- Hydrogen conversion

The TX4 FCEV IVA application was based on existing 'unaffected' TX4 taxi approvals, plus tests and assessment carried out by VOSA. Although IVA is not a type approval process, following discussions with the VCA it was decided that one vehicle would be tested and inspected with the others assumed to be of the same type. Vehicle inspection work was finished on 26th June 2012, and the final safety case for the vehicle completed on 23th July 2012.

7.4 Certification

IVA

The IVA was obtained and the five taxis registered for road use on 25th July 2012.

LTPH

London Taxi and Private Hire office accepted the TX4 FCEV for use in London to carry non-fare paying passengers (due to lack of ECWVTA) on 25th June 2012.

8 Lessons learned from the TX4 FCEV certification process

8.1 Hydrogen-vehicle specific lessons learned

8.1.1 There are no documented procedures for hydrogen vehicle certification

Discussions with the VCA facilitated a workable, pragmatic path to achieving IVA for the TX4 FCEV. As reported in Section 7.3, this was based on existing 'unaffected' TX4 taxi approvals, plus specific VOSA testing. In terms of the aspects of the IVA that were specific to the vehicle hydrogen subsystems, the previous experience provided by the certification of the Burgman scooters (see Section 5.2) was particularly helpful by providing 'read across' compliance of components that were identical to the two vehicles. The aim of the work described in this report, and the certification of the IE Burgman scooters, is to provide the 'case study' basis for future vehicle type approval activities during the early market deployment of hydrogen vehicles prior to the establishment of appropriate documentation such as exists for conventional vehicle type approval.

8.1.2 Hydrogen directive 79/2009/EC compliance is taking time to take full effect

Directive 79/2009/EC came into force early in the certification process, providing documented tests and procedures for ensuring compliance to manufacturers of hydrogen vehicles for the first time. In practice, particularly in relatively low-volume manufacturing as is currently the case for fuel cell vehicles, compliance has passed down the supply chain to the suppliers of the individual components. Currently, given the low volumes required of suppliers, seeking the required approval to comply with EC 79/2009 has proven expensive, and a number of suppliers are yet to obtain the required approvals.

8.1.3 No specific directives apply for automotive fuel cells, and standards are still evolving

As highlighted by Intelligent Energy's fuel cell hybrid scooter ECWVTA case study (Section 5.2), there are still no specific directives or standards for automotive fuel cells, with the current EU and UNECE regulations instead focusing on on-board safety of hydrogen. The IVA of the fuel cell drive train of the FCEV TX4 was essentially 'read across' from the ECWVTA of the Burgman, which certified :

- The electric drive train to ECE R100 (electric power train) and ECE R12/94/95 (steering and frontal/rear impact)
- The fuel cell to IEC 62282-2 which is not intended for motive power fuel cell systems.

Rollout of appropriate standards for motive power fuel cells will be needed prior to mass market deployment.

8.2 Non-hydrogen vehicle specific

8.2.1 It is difficult for low volume manufacturers to deal with technical problems arising from certification requirements

ECWVTA requirements for new types, and CoP requirement conformance, were the principle reasons that the TX4 FCEV did not achieve ECWVTA and is not licensed by the London Taxi and Private Hire office to carry fare-paying passengers. Given time and budget, these problems could have been resolved. Clearly, for smaller manufacturers, resource and budget constraints can present a significant barrier to achieving type approval.

8.2.2 Personal relationships were important in securing rapid turnaround of IVA after decision taken not to proceed with ECWVTA

Once the decision was made in January 2012 to seek IVA for the five taxis, the domain expertise of Andy Walker of LTC, and his existing relationship with the VCA, was crucial in facilitating the certification process which allowed the vehicles to be deployed in London during the Olympic Games period from July-September 2012. This is likely to remain the case until hydrogen vehicle certification becomes the norm rather than an exception for the vehicle certification authorities.

8.2.3 National requirements versus European requirements

Regulation 94 of the UK's Road Vehicles (Construction and Use) Regulations (1986) prohibits the use of any gaseous fuel other than LPG to fuel a road vehicle (UKGov, 1986). As discussed in Section 5.1, Vehicle Special Orders (VSOs) are issued for periods of up to five years by the VCA to vehicles that do not meet the C&U Regs, provided reasons for non-compliance can be justified and suitable information is presented to ensure that appropriate care has been taken to address safety issues and requirements. It is the understanding of the author of this report at the time of writing (October 2013) that in the UK all hydrogen-propelled vehicles need to obtain a VSO before submitting an application for IVA, and that a VSO will still be needed to operate in the UK hydrogen vehicles that have achieved ECWVTA. This issue is currently being addressed by Government and industry as part of the UK H2Mobility project.

9 References

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