elementenergy

HyTEC

HyTEC London station deployment

Lessons learned from planning and safety process

Final report

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Contents

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Glossary

AP	Air Products
CCTV	Closed-circuit television
CPDA	Crime Prevention Design Advisor
CTSA	Counter Terrorism Security Adviser
DNO	Distribution Network Operator
EC	European Commission
GSM	Global system for mobile communications
HAL	Heathrow Airport Limited
HRS	Hydrogen Refuelling Station
HSE	Health and Safety Executive
HyTEC	Hydrogen Transport in European Cities
ISO	International Organization for Standardization
NaCTSO	National Counter Terrorism Security Office
VIP	Very important person
WP	Work package

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1 Summary

1.1 Overview

Hydrogen Transport in European Cities (HyTEC) is a hydrogen vehicle and infrastructure demonstration project with activities in London and Copenhagen. The overarching aims of the project are to:

- **Demonstrate** new hydrogen vehicles (three vehicle classes) and hydrogen refuelling facilities.
- **Analyse** the results of the project with an expert pan-European research team, considering the full well to wheels life cycle impact of the vehicles and fuelling networks, demonstrate the technical performance and uncover the non-technical barriers to wider implementation.
- **Plan** for future commercialisation of the vehicles, and provide an approach for the rollout of vehicles and infrastructure.
- **Disseminate** the results of the project to improve hydrogen awareness, including targeted dissemination to other regions, key industrial stakeholders and policy makers.

The UK activities include the installation of a new hydrogen refuelling station in London and deployment of fuel cell taxis and passenger cars. An early task involved the selection of a suitable site for the infrastructure, and preparation of materials to secure planning permission and demonstrate the safety case.

This summary report records lessons learned in the planning and safety process for hydrogen refuelling infrastructure installation, and is intended to provide useful information for future infrastructure deployments.

1.2 Lessons learned: planning

Details of the overall process for installing a hydrogen refuelling station (HRS) are given in section 3, and the planning process is summarised in section 4. Although installation of the London HRS under HyTEC did not involve a full planning application, a number of lessons have been learnt from the process:

- Do not underestimate the time required to prepare documentation for a planning application, which may include site plans, layout drawings, safety distance plans, design and access statement etc. (see section 4.1).
- Include budget for the planning application fee and any expert support required in preparing the application.
- To avoid risks to the programme, start the process early. Initial discussions with all stakeholders (planners, local businesses / residents, fire service, police, HSE etc.) should be held at an early stage to collect input into the design process.
- Where appropriate, seek input from security specialists (e.g. the local police (Crime Prevention Design Advisor (CPDA)), and the landlord's security staff) early in the design process. This allows security measures to be designed in rather than added as an afterthought, potentially providing cost and aesthetic benefits.
- Maintain close contact with the planners to ensure that any queries are answered promptly.

1.3 Lessons learned: safety and security

The safety of the HRS equipment installed remains the responsibility of the equipment provider, in this case Air Products. While stations can be designed to meet or exceed European safety standards, one challenge is communicating the safety features effectively to the relevant stakeholders (planners, police, fire service etc.). There is currently in general a low level of knowledge and understanding of hydrogen in the UK. As a result, an *introduction to hydrogen* document was produced to inform individuals with limited knowledge of hydrogen as a fuel. This document will be a useful resource for future installations.

Specific lessons learned in relation to site security and safety considerations include:

- Where installations are close to existing strategic infrastructure the project team should engage with the police early in the process, including the local CPDA, and representatives from the Counter Terrorism Security Office as required (see section 6.1). The police should be informed of the plans and consulted for advice on design features to minimise threats.
- Inform the local fire service of the plans to install a hydrogen refuelling station and provide any information required. If the station includes storage of more than two tonnes of hydrogen, the Health and Safety Executive must also be informed (see section 5.1).
- Appropriate and proportionate security measures will be site-specific, for example depending on the location and layout of the site, mass of hydrogen stored, proximity to buildings, infrastructure etc.
- Delivery of hydrogen to the HRS is a critical issue from a safety / security perspective. Consideration should be given to implementing adequate protection and processes to minimise risks associated with fuel delivery.
- Installing an unmanned HRS in a publicly accessible location leads to a number of challenges. For example, minimising the risk of tampering / vandalism, and preventing unauthorised parking. The solution installed at the Hatton Cross HRS includes a remote monitoring system. With such an approach, arrangements must be put in place to remotely monitor the site, along with a process for acting on the information collected.

1.4 Lessons learned: installation

The installation of the HRS at Hatton Cross involved various organisations: Element Energy (as overall project managers for HyTEC's UK activities), Air Products (HRS provider), HAL (oversaw HRS installation as landlord), Dyer & Butler (sub-contractors who carried out the works on site), and UKPN (the local DNO responsible for providing electricity to the site). Key lessons from completing the installation process include:

- Assigning responsibility to one individual in each organisation is crucial. In multiple-stakeholder projects such as this a single point of contact (project manager) within each organisation is required. This person must be responsible for taking actions, including following up with their colleagues as appropriate, to drive the project forward.
- Identify any long lead time processes early. Some activities required for HRS installation will have longer lead times than others. In the case of the Hatton Cross

HRS, providing a power supply took a significant amount of time and posed a significant risk to the programme.

- The process for appointing any sub-contractors required should be discussed and understood by all parties. In this case, the civil engineering sub-contractors were appointed by the landlord (HAL), and the process was expedited by the existing relationship. On future sites the issue of who appoints the sub-contractors to carry out civil engineering works, and the process to be followed (including allowing adequate time for a tender exercise if required) should be established at an early stage.

2 Introduction

2.1 Overview

The UK activities under HyTEC (an EC-funded hydrogen transport demonstration project) include deployment of a number of hydrogen vehicles to London, and the installation of a hydrogen refuelling station. The project began in September 2011, and early tasks under WP3 (Infrastructure Deployment) included site selection, station design, and safety and planning activities. The latter task involved preparing the planning application for submission to the local council and demonstrating the safety case for installing the station. This report captures the key lessons learned in relation to the planning and safety activities specific to hydrogen refuelling infrastructure and provides a useful reference for future installations.

2.2 Site selection

2.2.1 Context

Although a specific site had not been chosen for the London HRS prior to the start of the project, the original intention was to identify a central London location (given that the majority of vehicles were expected to operate in and around central London). Efforts to identify such a site began early in the project and consideration to the safety and planning implications was given from the outset. However, it became clear that securing a high profile central London site and completing the planning and safety processes (allowing time for station design work) would not be possible within the timescales of the project.

One of the project partners (HAL) was able to offer land to site the HRS in west London, near Heathrow Airport. This site offered numerous advantages, including:

- **Supportive landlord** – HAL was a project partner and offered the land for the duration of the project on favourable commercial terms. Furthermore, HAL contributed significant resources to securing planning consent and towards station installation.
- **Favourable site characteristics** – the land available was a relatively unconstrained site (large land area, undeveloped, away from buildings) and close to a number of major roads.
- **Streamlined planning process** – the site is within a permitted development zone, which means that planning applications are approved by default within a set period provided that no objections are raised.

2.2.2 UK HyTEC refuelling site and infrastructure

Site characteristics

The land available for the HyTEC hydrogen refuelling station (HRS) is adjacent to the Jurys Inn hotel, near Hatton Cross tube station, as shown below.

Figure 1: HyTEC HRS site location[1]

The piece of land in question (between the Jurys Inn hotel and the Envoy Roundabout) was unused and undeveloped prior to the HyTEC project. An aerial view of the site before development is given below.

[1] Source: Google maps.

Figure 2: Aerial view of the land made available for the HyTEC HRS in London[2]

Vehicular access to the site is via the entrance road to the Jurys Inn hotel (off Eastern Perimeter Road).

Hydrogen refuelling station

The original HRS installed at the site was an Air Products S125 station, offering 350 bar fuelling. During the project further funding was secured to upgrade the infrastructure to allow both 350 bar and 700 bar fast fill refuelling.[3]

The S125 station (a containerised solution) was installed in summer 2012 and used to refuel a fleet of five hydrogen taxis during the Olympic and Paralympic Games (London 2012). The station continued to operate until spring 2014, when an upgrade was carried out by Air Products.[4] This involved replacement of the S125 station with new equipment that offers 350 bar and 700 bar fast fill refuelling, and storage of hydrogen at 500 bar on site. The upgrade followed the first deployment of high pressure (500 bar) tube trailer logistics in the UK by Air Products.

[2] Source: Google maps.
[3] Funding under HyTEC covered the installation of a 700 bar HRS. Additional funding from a TSB-supported project allowed the upgrade to fast fill capability.
[4] The upgraded was completed in the first half of June 2014.

Figure 3: The HyTEC HRS (Air Products S125 refueller), summer 2012

Figure 4: The upgraded HRS at Hatton Cross, summer 2014

2.3 Report structure

The following sections give an overview of the process followed to install the infrastructure, details of the planning process and safety case. Key lessons learnt are highlighted throughout and summarised in section 1.

3 Process for HRS installation

3.1 Overall process – summary

The overall process for installing the HRS at Heathrow is summarised below.

Table 1: Overall process for HRS installation

Activity	Duration (approx.)	Notes
Select site	c.6 months	A site with appropriate characteristics to accommodate a HRS was required. This includes: level ground, adequate space to accommodate the equipment (allowing for exclusion zones from buildings, and access for fuel delivery), a three phase power supply, telephone line, and adequate road links.
Arrange lease	c.6 months	A lease between the landlord (in this case HAL) and equipment provider (AP) was required to legally agree the terms under which the site would be operated. An MOU between HAL and AP, setting out the basic terms of the agreement, was arranged before the lease was put in place. An extended period was required to agree the lease due to the novel nature of the project and difficulties with eliciting response from HAL's legal department.
Design work (civils & HRS)	c.3 months	The level of civil engineering required is likely to vary by site. Station designs (including any civil engineering work that will affect the appearance of the station) are required as part of the application to the planners. Risks to budget and programme are increased for sites where significant groundworks are required.
Safety case	c. 2 months	The safety case of the HRS had to be demonstrated to AP's own safety team, HAL, and the planning authority. In particular, evidence of sufficient exclusion zones around the station was required. The London Fire Brigade was informed of the plans for the station (although the mass of hydrogen stored on site is below the 2t limit at which the HSE must be notified (see section 5)).
Agree security arrangements	c.2 months	Security features of the HyTEC station include a security fence and CCTV (a watchman system with motion detectors and night vision). The Met Police were informed of the arrangements and provided recommendations regarding security arrangements.
Gain planning permission	8–12 weeks	The process at Heathrow was simplified due to the fact that the land was within a permitted development area. The station did not need to be granted full planning consent, but was instead classified as permitted development. Permission was automatically granted provided that no objections were raised within 8 weeks of the application being acknowledged by the council. Time must also be allowed for collating all necessary information and submitting documents to the local planners.

Appoint contractor	c.1 month	A contractor to carry out the civil engineering works (including levelling the site, constructing a solid base, constructing firewalls, erecting fencing, and laying tarmac) was appointed. The contractor worked closely with AP engineers and contributed to the design work to ensure that the site was adequately prepared.
Site preparation & civil engineering	c.2 months	The civil engineering work ran closely to schedule (although the total costs greatly exceeded the initial budget). However, an issue related to working above buried services arose towards the end of the works (see below).
HRS installation & commissioning	c.2 weeks	The final stage of installation was relatively straightforward and involved craning the station into position, delivering the hydrogen, making all necessary connections and commissioning the system.

3.2 Timescales

The first refuelling event at the HyTEC London HRS occurred on 2nd August 2012, eleven months after the project began. A number of activities listed in the table above were carried out in parallel; however, the start of station operation was delayed relative to the original plan. The intention had been for the station to be ready for refuelling training and a first refuel on 23rd July 2012 (in time for the taxis to begin VIP transfer duties from the start of the Olympics on 27th July 2012). There were multiple reasons for this delay, which are listed below:

- **Submission of planning application** – the planning application was submitted in May 2012, following a period of months during which the relevant documentation was created and collated. Earlier initiation of the planning process would have reduced the risk of delay to gaining planning permission.
- **Planning permission** – given the permitted development status, the planning process was simplified. This meant that permission was granted by default eight weeks after the planning application had been accepted (provided that no objections were raised). However, there was a misunderstanding related to the dates. While the planning application was submitted (along with the appropriate fee) on 21st May 2012, it was not formally acknowledged by Hillingdon Council until 7th June 2012. The eight week period began from the date of acknowledgement (rather than the date of submission), which meant that the date on which approval would be granted by default (provided no objections were raised) was 2nd August 2012 (eight weeks after 7th June). Since planning permission was a prerequisite to other tasks (such as signing the lease and installing the equipment), this had the potential to delay station installation. To expedite the process close contact was maintained with the planners and permission was granted on 23rd July 2012 (although this process was also linked to interventions from the Metropolitan Police – see below).
- **Security concerns raised by the police** – a representative from the Metropolitan Police Counter Terrorism Protective Security Command contacted HAL at the end of June 2012 and raised a number of concerns related to the proximity of the site to the Envoy Roundabout and the Jurys Inn hotel, and the “physical security for the site”. Meetings and discussions were held with the police to address the concerns and consider mitigation strategies. The concerns were raised partly

since experience with HRS is limited in London (this was the first publicly accessible unmanned HRS in the UK), but also due to the timing. The heightened security arrangements in the lead up to London 2012 were widely reported in the UK media. This intervention from the police had the potential to delay the installation since the planners were willing to grant permission subject to the police confirming security arrangements were to their satisfaction. Through close communication and rapid response to queries the police were satisfied with the security arrangements and confirmed this fact to the planners on 20th July 2012.

- **Lease** – the lease between the landowner (HAL) and site operator (AP) was agreed and signed following a period of negotiations. HAL did not have a lease agreement suitable for a project of this nature, and the document was based on a modified version of HAL's standard lease (which is more typically used to cover the operation of retail units within the terminals). This approach necessitated some changes to the lease and hence negotiation between HAL and AP lawyers was required. This process was protracted due to difficulties in communications with HAL's legal team. The lease required a number of supporting documents such as a list of equipment on site and schedule of condition (describing the state of the site at the date of handover to AP), which also had the potential to impact when the lease could be formally agreed.
- **Civil engineering work** – the contractors appointed were very flexible, responsive and accommodating; and most of the work ran to schedule. However, part of the HRS site lay above buried services and an issue arose towards the end of the civil engineering work related to a fire main (water supply serving hydrants for the Jurys Inn hotel), which had the potential to cause delays.[5] This issue was eventually resolved and all civil engineering works were completed by the beginning of August 2012.
- **Power supply to site** – there was an existing source of power in the area (via an electricity sub-station located on the edge of the site), but a new cable had to be run to the newly constructed HRS compound. UKPN is responsible for electricity supply in the area and the engineers are required to follow a set procedure to provide a new power connection. A risk assessment (by UKPN) was required for approval by HAL before work could start on site. The tight timescales meant that work to complete the risk assessment delayed the provision of power to the site.

A number of the issues described above stemmed from the fact that the initial application to the planners was delayed, which in turn was a result of delays in collating the required documentation, in particular the station design. A key lesson to take from this is the need to produce plans and designs early in the process and to allow a time contingency in the programme.

Despite the delays outlined above, the station was installed and commissioned within around eleven months of the project start date. The principal factors affecting lead time for future hydrogen refuelling stations include: time required to identify a site, negotiations to agree commercial terms with the landlord, time taken to collate all documentation for full planning application, application determination period, lead times for station components, period for appointing sub-contractors, and time for site preparation activities.

[5] The issue was that the fire main ran under the entrance to the site, where new tarmac had to be laid. Works over fire mains are not permitted in the area without isolating the water supply. The full process involves drawing up an isolation plan (HAL Water Services) in conjunction with the London Fire Brigade.

3.3 Risks

There are multiple risks to the timely installation and operation of new hydrogen refuelling stations that future projects should consider. Based on the experience gained through the HyTEC project, the principal risks are as follows:

- **Site selection** – finding a suitable site with sufficient space to accommodate the station (including safety distances) and with a supportive landlord is not straightforward, particularly in dense urban environments. Given that hydrogen fuelling stations are likely to be under-utilised (and therefore loss-making) in the early years of hydrogen transport rollout, there will be limited capacity to pay market rents.
- **Lease arrangements** – if equipment is to be installed on land owned by a third party, a lease will be required. The HyTEC experience suggests that landlords may not have an existing standard lease agreement suitable for such projects. Sufficient time (and budget) should be allocated to the task of arranging a lease.
- **Gaining planning permission** – local planners should be engaged at an early stage to maximise the chances of planning applications being approved. Projects to install new HRS should include budget to cover the time of any expert support needed and the planning application fee (which is likely to be site-specific). Adequate programme time is also required as a full planning application involves collating all information required (see section 4.1), submitting the application, waiting for the local authority to consider and consult on the application, and awaiting a decision. However, the HRS provides a good template for future stations and site visits can be arranged for local planners to demonstrate the design and use of an HRS.
- **Security issues** – the police may recommend security measures that could have significant budget and / or timescale implications. The police should be consulted early in the design process so that any recommendations to be adopted can be included in the designs (rather than added as afterthoughts). Recommended security measures are likely to be site-specific.
- **Groundworks** – as with any building project, if civil engineering works are required, there is a risk (to programme and budget) associated with the groundworks phase. Contractors can never be sure what will be found in the ground, or the actual depths of buried services, until work commences.
- **Performance of sub-contractors / third parties** – where aspects of the installation work are the responsibility of third party organisations, there is a risk that they will not deliver as expected. E.g. at the HyTEC site, the power supply was the responsibility of the local distribution network operator, who could not carry out the risk assessments and complete the connection work in line with the desired (very tight) timescales.

4 Planning process

4.1 HyTEC planning process: permitted development

As mentioned above, the London HRS installed under HyTEC is on land owned by HAL, and within a permitted development area. This means that the planning application process is streamlined, and permission is granted by default if no objections are raised within eight weeks of the application being acknowledged by the council.

The following documents were submitted to the local planning authority (within the London borough of Hillingdon):

- **Covering letter** written by HAL's Town Planning Manager outlining the proposed development, together with a cheque for the application fee.
- **Introduction to hydrogen** and the HyTEC project – a brief document with some basic information about hydrogen, hydrogen activities in the UK and the HyTEC project (prepared by Element Energy).
- **Site plan** – a map of the site showing the proposed location of the HRS in the context of the surrounding area (by Air Products).
- **Station layout drawing** – including a plan and two elevations of the HRS compound (by Air Products)
- **Safety distance plan** – a plan of the site with exclusion zones marked (by Air Products).
- **Design and Access Statement** – a document prepared by HAL providing a written description of the proposed development (including layout, scale and appearance), the context of the project, references to the relevant policies of the local authority's UDP, and a statement on how vehicles will access the site and the HRS.
- **Photograph** of an existing HRS to provide an indication of the expected visual appearance of the developed site.

The overall process is shown on the timeline below.

Preparation of planning application	To May 2012
Application (and fee) submitted	21st May 2012
Application acknowledged by planners	7th June 2012
Concerns raised by Met Police	29th June 2012
Planning approval granted	23rd July 2012
Eight weeks following application acknowledgement	2nd August 2012

The key lessons from this process are:

- If the HRS is to be located close to strategic infrastructure and of interest to the Police, they should be informed of the plans early in the process (at design stage, before planning application is made).
- In the case of permitted development, the eight week period begins from acknowledgement of the application by the local planning department (not from the date of planning application submission). The same is true for full planning applications – the determination period begins following registration of a complete application by the council (not from the date of submission).

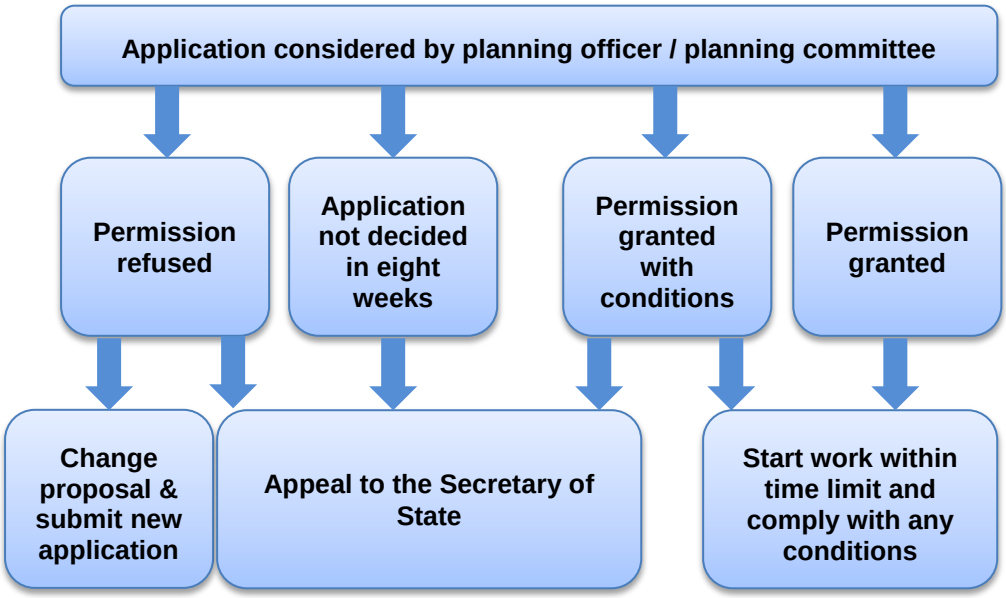
4.2 Planning process – general

While a full planning application process was not followed for the London HyTEC HRS, completing the process provided a number of lessons for future installations. The HRS at Hatton Cross is the first fully publicly accessible hydrogen fuelling station in the UK. One issue currently being faced is a general lack of knowledge of hydrogen as a fuel and myths around its use. Although hydrogen has been used as an industrial gas for many decades, awareness of hydrogen amongst decision-makers in the planning process (including the Police and planning officers) is low. It is therefore important to communicate clearly and concisely all relevant facts, in particular the measures taken to address safety and security concerns.

A typical process for gaining planning permission for a new HRS in the UK is given below.

1. Select site and contact local planning authority for initial discussions of feasibility and to understand documentation required and details of the local planning process.
2. Undertake outline design work.
3. Contact the local Police, Fire Service, and HSE representative (as appropriate – see section 5.1.1) to inform them of the outline plans and seek input to be considered in detailed design.
4. If required, engage sub-contractor to undertake the building work, including any civil engineering required, provision of a power supply, installation of safety and security measures.
5. Undertake detailed design work, with the HRS equipment provider working closely with the sub-contractor. Civil engineering sub-contractors will generally require a detailed specification before being able to provide a quotation for carrying out the work. This means that the project's civils budget remains an estimate until the HRS design work is finalised.
6. Collate all documentation required for planning application (e.g. see section 4.1).
7. Submit application to local planning authority, including appropriate application fee and all supporting documentation.
8. Receive acknowledgement of application.

Following acknowledgement of a valid planning application, the local planning authority will publicise and consult on the application, before it is considered by a planning officer or planning committee. At this stage there are a number of possibilities, as shown below.



The full process of site selection, station design, planning application submission and gaining approval will in general take many months. Risks of delay can be mitigated by engaging with all relevant parties at an early stage and maintaining good communications throughout the process.

5 HRS safety case and site security issues

5.1 Safety case

5.1.1 Process

Demonstration of the safety case for HRS installation involved safety experts from the equipment supplier (AP) and the site landlord (HAL), including the Airport Fire Service. The local fire brigade was also informed of the plans, in accordance with recommended best practice. The UK's Health and Safety Executive has published guidance on the permitting of hydrogen and fuel cells for stationary applications, many aspects of which are relevant in the context of HRS installation. The guidance recommends that "*the complexity of the permitting route required for a particular installation should be proportionate to the scale, intended use and location of the installation*".[6] The following five steps are recommended for any permitting route:

1. **Undertake a risk assessment** – to identify hazards and measures to eliminate risks or mitigate impacts.
2. **Check compliance of equipment** with health and safety requirements of applicable EU Directives – for example, ATEX Directives, Pressure Equipment Directive, Machinery Directive, Gas Appliances Directive, Low Voltage Directive and Electromagnetic Compatibility Directive.
3. **Check compliance with national legislation** – i.e. ensure that the installation meets legislation related to planning approval, building regulations and fire regulations.
4. Ensure that a **competent person** is employed to install and maintain the equipment.
5. **Inform the local fire brigade** of the location and type of installation – the fire brigade will be particularly interested in the quantity and location of hydrogen stored on site.

Although not applicable for the London HyTEC HRS (due to the limited mass of hydrogen to be stored on site), there is also a requirement to inform the HSE if an installation involves the storage of more than two tonnes of hydrogen, as set out in the *Notification of Installations Handling Hazardous Substances Regulations 1982*.[7]

5.1.2 Safety measures

The HRS at Hatton Cross includes the following safety features:

- Hydrogen storage positioned such that all exclusion zone requirements are satisfied.
- Fire walls on two sides of the compound.
- Integral safety features of station, including sensor-controlled automatic shutdown with leak detection and standard operator earthing.
- PIN system to prevent unauthorised use of HRS.

[6] *Installation permitting guidance for hydrogen and fuel cell stationary applications: UK version*, Health and Safety Laboratory for the HSE (2009). This document contains a list of "Useful Codes and Standards" (Appendix 1). www.hse.gov.uk/research/rrhtm/rr715.htm.
[7] A comprehensive list of UK regulations relating to handling (liquid) hydrogen is provided in chapter 3 of the document: *Hazards of liquid hydrogen: Position paper*, Health and Safety Laboratory for the HSE (2010). www.hse.gov.uk/research/rrpdf/rr769.pdf.

5.2 Site security

Various security measures were included in the London HyTEC HRS design, the main features of which are described below. The fact that the station is installed in a publicly accessible area, and is unmanned, presents particular challenges from a security point of view. For example, there remained a desire to retain public accessibility, whilst also guarding against risks of unauthorised use of the station, vandalism, and unauthorised parking on the site.

5.2.1 Restricting access to the site

The filling station site consists of two areas: the publicly accessible refuelling area and the HRS compound. The compound is bounded on two sides by 3m high firewalls and enclosed on the remaining two sides by 2.3m high pointed steel palisade fencing. A short section of barbed wire was installed above the ISO container that housed the dispensers to guard against intruders gaining access by climbing.

The overall site (including the publicly accessible areas) is bounded by a low fence and hedge, with road access provided off the entrance to the Jurys Inn hotel.

5.2.2 Intrusion identification

The primary protection against unauthorised access to the hydrogen refuelling station compound is based on a CCTV system known as the *Watchman*. This wireless system consists of four cameras with motion detectors and night vision, which allows identification and remote verification of any intrusion. Any movement within the compound (bounded by the palisade fencing) triggers one or several of the motion detectors and activates the corresponding cameras. Images are then recorded and transmitted automatically to the monitoring centre that will receive an alarm. An operator then assesses whether there is an intruder and if confirmed, will follow the escalation procedure (which includes calling the local police).

The system is fully independent, running on its own batteries without external power supply and uses the GSM network to transmit data. This guarantees that the monitoring system cannot be deactivated by disconnection of utilities. Even though the site is illuminated at night, cameras are equipped with night vision in case of interruption of the site lighting. In order to verify the station operation, an automated timer test is sent every 24 hours.

6 Appendix

6.1 Contacts

The main points of contact for the police, fire service, and Health and Safety Executive in relation to the HRS installation at Hatton Cross are given below.

Table 2: Contacts

Name	Role	Contact
Brian Reardon	Group Manager, Operation Contingency Planning, LFB	02085 551200 x 31020, brian.reardon@london-fire.gov.uk
Geoff Bigby	CTSA | SO20 Counter Terrorism Protective Security Command. Met Police.	07867 500994 Geoff.Bigby@met.police.uk
Richard Barnes	Centre for the Protection of National Infrastructure, Met Police	Richard.Barnes@met.police.uk
Mike Smooker	Crime Prevention Design Advisor, Met Police	Mike.Smooker1@met.police.uk

Geoff Bigby from the Met Police provided recommendations on security measures for the site. His role exists throughout the UK and the relevant contact for security advice can be found via the National Counter Terrorism Security Office (NaCTSO) website: http://www.nactso.gov.uk/contact.

6.2 Questions raised by the Metropolitan Police

Questions raised by the Police are recorded below for reference. An awareness of the types of concerns that may be raised by the Police should benefit any future installations, however it should be noted that these queries were raised during June/July 2012 (i.e. at a time of heightened security during the run-up to the Olympic and Paralympic Games (London 2012)). Furthermore, the questions were raised based on the Hatton Cross site, which is adjacent to Heathrow Airport (an important piece of strategic infrastructure).

Accident consequences

What is the blast radius of the site if a terrorist was successful in breaching the safety mechanisms?

Perimeter security – ease of breaching the perimeter with a moving vehicle

What is the crash / impact standard for the bollards?

What is the crash / impact standard for the fencing?

What is the crash / impact standard for the fire wall?

What locking mechanism will be used for the gates?

Can the gates be shut when the tanker is delivering hydrogen?

Infrastructure

What quantity of hydrogen will be carried by the tanker? What form will it be in?

Are the shipping containers vented to prevent the build-up of hydrogen if there is a leak?

Site of filling station

Do we know the depth of the foul water drain?

What does the on-site transformer serve?

What is the distance between the filling site and the Jury's Inn hotel?

London Fire Brigade contact

Have you talked to anyone specifically in London Fire Brigade about the site?

6.3 Recommended security measures

Responses to the questions listed above were provided to the Metropolitan Police, who then provided a series of recommendations for additional security measures for the site, summarised below. Ultimately, the implementation of further security measures was a decision for HAL and AP to take; balancing the security risks against costs and practicalities of installation.

Fencing

Use secure nuts that cannot easily be undone to attach the support posts to the concrete base.

Add protective sheathing to all welded bolts securing the uprights of the palisade fencing (to guard against shearing).

Increase the height of the fence around the compound and add a security topping on top of the fire wall.[8]

CCTV / Alarm Intruder Monitoring

The system currently employed on site to identify intruders is a remotely monitored CCTV sensor operated system. When activated the system immediately starts recording and alerts the monitoring centre. Ideally an intruder should be identified prior to them actually accessing the compound. This could be achieved by the installation of a perimeter intruder detection system (PID) on the fence and the wall.

The standard of intruder alarm should conform to PD6662 security rating 3 which in addition to tamper protection incorporates an anti-masking capability.

Some CCTV monitoring systems have the capability to record and capture pre-event images which could be beneficial to this site.

Install CCTV covering the publicly accessible area of the site to deter crime and reassure any users of the site.

Consider instigating either a system whereby the monitoring of the site is continuous during fuel deliveries or the provision of a remote panic button collected by the driver upon entering the site and then returned on leaving the site.

[8] This recommendation arose in part due to the "climbing aids" located near the perimeter of the compound. These included the yellow bollards installed around the dispenser and a utilities box near the fire wall.

Vehicle Mitigation

Consider installing a double line of gabions around three sides of the site to provide a visual deterrent and a level of protection to a vehicle incursion.

The inclusion of 'jersey' barriers adjacent to the vehicle refuelling area would provide additional vehicle mitigation from a direct vehicle incursion via the main entrance of the site.