

Report

Aberdeen City Hydrogen Energy and Supply (ACHES) Facility HAZID

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Aberdeen City Council

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EXECUTIVE SUMMARY

Aberdeen City Council have requested that Risktec facilitate a Hazard Identification (HAZID) study to identify the Health, Safety, Security and Environmental hazards associated with the new build Aberdeen City Hydrogen Supply and Energy (ACHES) refuelling facility on Langdykes Road, Cove.

The HAZID was carried out at Marischal College, Aberdeen on the 29th of June 2016 during which the HAZID team reviewed the hazards associated with the facility and assessed the adequacy of the controls planned to be in place to mitigate these.

Where it was identified that further action is required, or a control measure needed to be confirmed, an action was placed on the appropriate party. A total of 36 actions were generated at the HAZID workshop; with 5 actions identified as high priority and 31 identified as medium priority.

ISSUE RECORD

Issue	Date	Author Initials	Reviewer Initials	Approver Initials	Revision History
0.1	01-07-2016	■	■	■	Issued for client comment

DISTRIBUTION

■	Aberdeen City Council, Aberdeen
File	Risktec Solutions Limited, Aberdeen

ABBREVIATIONS

ACC	Aberdeen City Council
ACHES	Aberdeen City Hydrogen Energy and Supply
ATEX	<i>Atmosphères Explosibles</i> (Explosive atmosphere directive)
CCTV	Closed Circuit Television
DSEAR	Dangerous Substances and Explosive Atmospheres
ER	Emergency Response
FAT	Factory Acceptance Testing
HAZID	Hazard Identification (Assessment)
ISO	International Standards Organisation
MOC	Management of Change
NFPA	National Fire Protection Association
P&ID	Process and Instrumentation Diagram
RCC	Regional Communication Centre
SUDS	Sustainable Drainage System
WSE	Written Scheme of Examination

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1 INTRODUCTION

1.1 Background

The Aberdeen Hydrogen Energy and Supply (ACHES) project is constructing a new hydrogen production, storage and refuelling facility in the south of the city (Langdykes Road, Cove, Aberdeen).

The station is designed to produce up to 130kg of hydrogen per day at 10 barg. Compression is provided to allow the facility to dispense hydrogen at either 350 bar or 700 bar. Hydrogen will be produced on site using a HySTAT™-60 Electrolyser manufactured by Hydrogenics. This unit has a capacity of 130 kg of high purity hydrogen per day.

Hydrogen storage will be provided at 536 bar and 1034 bar.

1.2 Objective

Aberdeen City Council have requested that Risktec support the ACHES project by carrying out a set of safety related studies involving:

1. Facilitation/Reporting of a Hazard Identification (HAZID) workshop;
2. Facilitation/Reporting of a Hazard and Operability (HAZOP) workshop;
3. DSEAR (Dangerous Substances and Explosive Atmospheres Regulations) Assessment;
4. Development of Emergency Response Procedures.

This Report covers the first of these studies, the Hazard Identification (HAZID) study to identify the Health, Safety, Security and Environmental hazards associated with the new build ACHES refuelling facility and to assess the adequacy of the planned controls.

1.3 Scope

The scope of the HAZID incorporates the full ACHES site as shown within the General Arrangement Drawing [Ref. 1], an extract from which is shown in Figure 1.

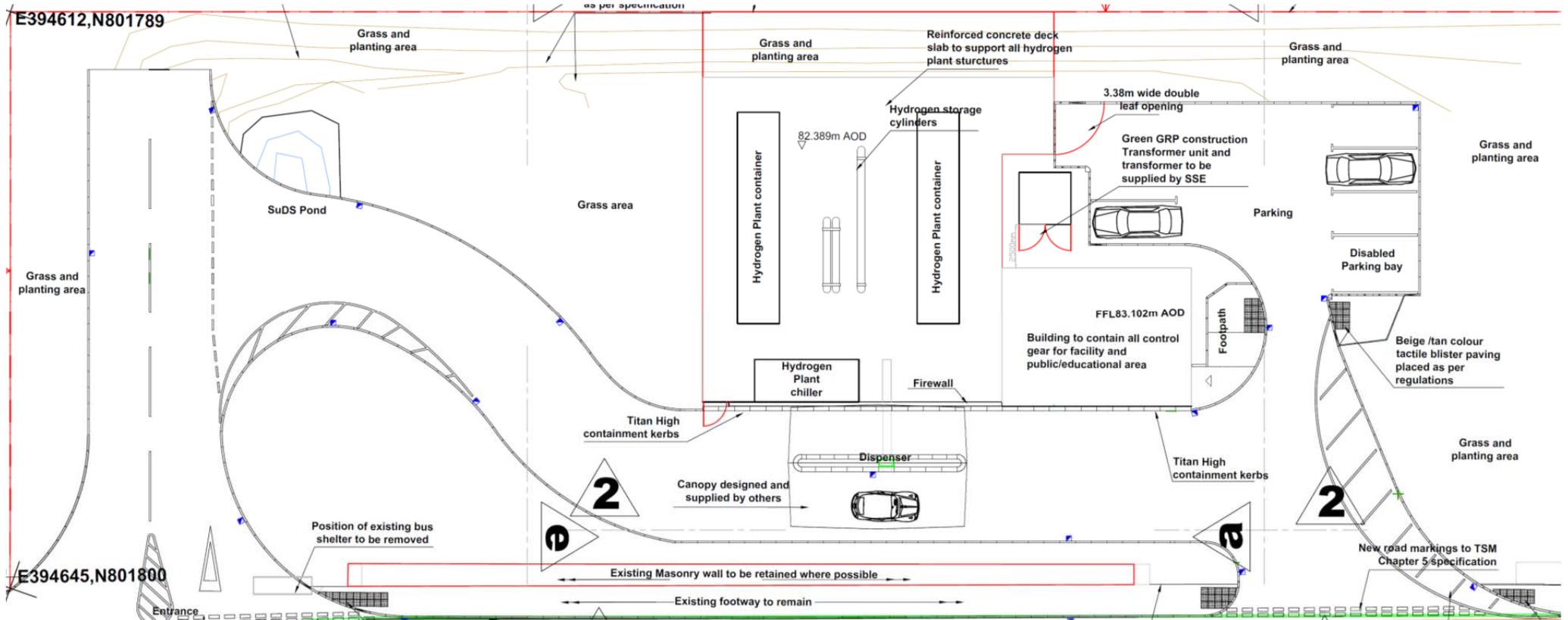


Figure 1 – Overall Layout of ACHES Facility

2 Review Methodology

2.1 Overview

A HAZID study is a systematic evaluation performed to identify and gain an understanding of potential hazards and threats, and to assess adequacy of the planned controls.

The HAZID was carried out by review against a set of structured guidewords, as described in Section 2.2. Where it was deemed necessary, actions were recorded – see Section **Error! Reference source not found.**

2.2 HAZID Guidewords

The HAZID guidewords covered the following key topics associated with the ACHES facility:

- 1 Organisational Issues
- 2 Facility Operations and Maintenance
- 3 Process Safety Management
- 4 Communication and Training
- 5 Emergency Preparedness and Response

Each topic had a list of associated guidewords, presented in Table 1, which were reviewed in turn by the HAZID team.

Table 1: HAZID Guidewords

Organisational Issues			
Operational Responsibility	Housekeeping and regular equipment check visits	Work authorisation	Management of Change
Operating timetable	Procedures and Documentation	Factory acceptance testing	Commissioning process
Approval to enter service			
Facility Operations and Maintenance			
Operating envelope	Prevention of vehicle impact with refuelling facilities	Grounding of vehicle being fuelled	Drive-away prevention
Control of remote operation	Vehicle movement control and collision prevention	Filling process control	Equipment Certification
Control over use of facility	Hose handling / management	Defects on vehicles being filled	Maintenance arrangements
Written Scheme of Examination (WSE) for Pressure Systems	CCTV coverage	Lighting	Ice and snow
Management of life limited items – e.g. hoses	Prevention of vandalism	Surface water management/ flood prevention	Low ambient temperatures
Trading Standards access	Management of Chemicals	Lightning protection	

Process Safety Management			
Prevention of hydrogen accumulation (canopies, containers etc.)	Zone rated equipment	Mobile phones	Fire detection
Separation distances and code used for these	Earth bonding	Electrical equipment outside hazardous zones (Site electrics or adjacent electrical substation)	Emergency shutdown
Blast protection	Smoking controls	Leak detection	Venting on blowdown of H ₂ inventory
Site building risk			
Communication and Training			
Training of facility operators	Emergency services awareness	Safety Signage – Usage restrictions	Capability of communication by Operators with personnel onsite
Training of site users	Arrangements for site educational use	Safety Signage – Emergency action	
Emergency Preparedness and Response			
Emergency Response Philosophy	Emergency Drills / Exercises	Fire in the hydrogen generation and pressurisation plant	Vehicle fire at the hydrogen dispensing point
Emergency Response Plan	Hydrogen leak	Fire in the hydrogen dispensing plant	Flammable liquid spill at the facility (e.g. from conventionally fuelled vehicles at the site)
Person in SUDS pond			

2.3 Arrangements

The HAZID was carried out at Marischal College, Aberdeen on the 29th June 2016. Table 2 shows the attendees at the HAZID.

Table 2: HAZID Attendees

Name	Company
[REDACTED]	Aberdeen City Council
[REDACTED]	Hydrogen Office - Fife
[REDACTED]	Hydrogenics
[REDACTED]	Hydrogenics
[REDACTED]	Police Scotland
[REDACTED]	Police Scotland
[REDACTED] - Facilitator	Risktec
[REDACTED] – Scribe	Risktec

3 HAZID Output

The completed HAZID worksheet is presented in Appendix A.

During the HAZID, where it was identified that further action needed to be taken, or a control measure needed to be confirmed, an action was placed on the appropriate party.

A total of 36 actions were generated, these being summarised in Table 3. Each of the actions was assigned as either medium or high priority. Of these, 5 actions were identified as high priority and 31 identified as medium priority.

Table 3: Actions Raised

No.	Action	Action Party	Priority
1	ACC to provide a 24hr contact number for the emergency services in the event of an incident at the site.	[REDACTED]	Medium
2	Daily timetable for hydrogen generation to be agreed to minimise energy costs whilst meeting demand requirement.	[REDACTED] / Hydrogenics	Medium
3	Check with Asset Management in Aberdeen City Council whether an authorisation / permit to work is required for Hydrogenics (and other contractors) to carry out work on site.	[REDACTED]	High
4	Confirm whether changes can be managed through an existing ACC Management of Change procedure or if a specific procedure needs to be developed.	[REDACTED]	High
5	Hydrogenics to provide a complete pack of FAT testing and certification documentation to ACC following commissioning.	Hydrogenics	Medium
6	Develop a procedure for communications between ACC and Hydrogenics and ACC and users of the refuelling facility, in the event of plant shutdown.	[REDACTED]	Medium
7	Determine whether the protocol to fill vehicles not having infra-red connections will need to be activated.	[REDACTED]	Medium
8	Produce a procedure for safe disconnection of a pressurised hose from a vehicle following drive-away.	Hydrogenics	Medium
9	Define how independent inspection and examination of pressure systems will be carried out and who will be the Competent Person required by the Pressure Systems Safety Regulations.	[REDACTED]	High
10	Produce a written scheme of examination for the ACHES facilities.	[REDACTED]	High
11	The user agreement will need to include a clause identifying the terms under which fuel quantity is delivered.	[REDACTED]	Medium
12	Determine whether there is a requirement for ACC to acquire an operator's licence for fuel delivery (similar to petrol station licensing by the Local Petroleum Enforcement Authority).	[REDACTED]	High
13	Check with trading standards whether they have any input into the control of the fuelling and payment process.	[REDACTED]	Medium
14	Check the CCTV coverage of the site for blind spots, following installation of canopy.	[REDACTED]	Medium
15	Consider what signage is required on the fences to warn / deter vandals.	[REDACTED]	Medium
16	Provide details of the standard used to define separation distances and provide the Explosion Protection Document to ACC.	Hydrogenics	Medium

No.	Action	Action Party	Priority
17	Provide ACC with the length of time to blowdown the hydrogen facility in an emergency.	Hydrogenics	Medium
18	Include in the DSEAR review an assessment of the safety range required for Emergency Services radios in an emergency.	Risktec	Medium
19	ACC to arrange for visitors to site (other than for refuelling) to leave mobile phones in a safe location.	[REDACTED]	Medium
20	Ensure that the site attendants leave mobile phones within the building and do not take these within the fenced area.	[REDACTED]	Medium
21	Define the clothing safety requirements for personnel opening equipment for taking readings / carrying out maintenance.	[REDACTED]	Medium
22	ACC and Hydrogenics to agree what alarm signals should be sent from the Hydrogenics panel to the site Fire panel.	[REDACTED] / Hydrogenics	Medium
23	Following agreement of signal handshaking, (action 22) Hydrogenics incorporate inhibit actions within the maintenance procedures to prevent spurious signals being sent to the Fire Service.	Hydrogenics	Medium
24	Define whether signals from the site Fire / Building Intruder Panel should be sent direct to the emergency service or via the ACC Regional Communication Centre (RCC).	[REDACTED] /	Medium
25	Identify the optimum location and type of manual emergency shutdown switch for the site and how operation of this will be monitored.	[REDACTED]	Medium
26	Ensure the site attendants are included in the communication process with the emergency services.	[REDACTED]	Medium
27	Provide ACC with appropriate hazard cards for communication of site hazards to the emergency services.	Hydrogenics	Medium
28	ACC to provide police at the Cove office with a contact details for minor incidents (e.g. vandalism).	[REDACTED]	Medium
29	Provide information for residents about the site to the Cove Chronicle.	[REDACTED]	Medium
30	Define the signs required to provide information on prohibited activities and safe practices.	[REDACTED]	Medium
31	Define what restrictions will be applied to the areas where visitors can be allowed, and any restrictions (mobile phones, clothing etc.) that apply in these areas.	[REDACTED]	Medium
32	Define the signs required to provide information on emergency actions.	[REDACTED]	Medium
33	Emergency response plan to be developed	Risktec	Medium
34	Fire extinguishing equipment to be provided for building on site.	[REDACTED]	Medium
35	Discuss with the fire service what the response would be to a vehicle on fire within the facility.	Risktec / [REDACTED]	Medium
36	ACC to consider training of locally available person to be at the facility for simple plant restarts.	[REDACTED]	Medium

4 REFERENCES

<u>Ref</u>	<u>Title</u>
1.	Aberdeen City Council, <i>Construction General Arrangements Drawing</i> Drawing C/101, September 2015

APPENDIX A HAZID WORKSHEETS

Appendix A includes the final worksheets from the HAZID Workshop held on the 29th June 2016.

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Organisational Issues						
Operations Management						
Operational responsibility	Organisational responsibilities when facility is in operation.	Aberdeen City Council (ACC) retain overall responsibility for the site and plan to provide 2x part time attendants. CCTV cameras covering the site will be linked to the council's 24hr security network. Technical operation of the hydrogen systems will be monitored by Hydrogenics in Belgium, under contract from ACC. Operations do not required to be monitored continuously, but the control system will maintain full operating records.	Site is not continuously manned. There may be a requirements for the emergency services to contact ACC if an abnormal situation is found at the site.	1. ACC to provide a 24hr contact number for the emergency services in the event of an incident at the site.	Emma Watt	Medium
Operational Monitoring						
Operating timetable	Is facility to be available for refuelling on a 24/7 basis? Is monitoring 24/7, even if facility is not operating?	Site not planned for 24 hour operation, although premises are not gated to prevent access. Timetable for use to be agreed with users. All users will be registered and provided with fobs for refuelling. Technical monitoring by Hydrogenics does not need to be 24/7 – the equipment is fully safeguarded and will fully or partially shut down automatically on detection of unsafe situations. CCTV linked to the council's 24hr security network.	Possibility identified to set daily timetable for refilling of storage to minimise energy costs.	2. Daily timetable for hydrogen generation to be agreed to minimise energy costs whilst meeting demand requirement.	██████████ / Hydrogenics	Medium
Housekeeping and regular equipment check visits	Arrangements for personnel to visit site for equipment condition monitoring and site housekeeping purposes	Attendants will be provided with a daily checklist for house keeping and safety checks of site.				
Work Management and Design Control						
Work authorisation	Authorisation of work at the facility	Hydrogenics will provide Aberdeen City Council with notification prior to carrying out work at the facility.	ACC have responsibility for the Asset. As the facility is a hazardous site, ACC may need to provide written authorisation for work to be carried out.	3. Check with Asset Management in Aberdeen City Council whether an authorisation / permit to work is required for Hydrogenics (and other contractors) to carry out work on site.	██████████	High
Management of Change	Process for authorisation of any changes required for the facility	Management of Change process not currently clear.	A documented Management of Change process needs to be applied.	4. Confirm whether changes can be managed through an existing ACC Management of Change procedure or if a specific procedure needs to be developed.	██████████	High

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Procedures and Documentation	Completeness of operating procedures and documentation for the facility.	Hydrogenics will provide a suite of procedures and documentation including operations and maintenance manuals and checklists, P&IDs, etc. Copy of documentation will be available on site and electronically.				
System commissioning						
Factory acceptance testing	Arrangements for factory acceptance testing prior to shipping of plant to site.	FAT testing has been carried out on Hydrogenics equipment (hydrogen generator, compressors). Equipment is CE marked.	Documentation needs to be completed by Hydrogenics and then provided to ACC.	5. Hydrogenics to provide a complete pack of FAT testing and certification documentation to ACC following commissioning.	Hydrogenics	Medium
Commissioning process	Responsibility and arrangements for safe and effective facility commissioning	Formal commissioning process will be carried out by Hydrogenics against defined documentation and with final commissioning process witnessed by ACC.				
Approval to enter service	Process for approval for facility use	Defined site acceptance test programme developed by Hydrogenics, including formal handover to ACC after test fills have been carried out. Acceptance includes certification of purity of hydrogen.				
Facility Operations and Maintenance						
Hydrogen Plant Operation						
Operating envelope	Is there a defined operating envelope – e.g. throughput limits, etc.	The contract defined filling and availability targets can be sustained on a perpetual basis provided appropriate maintenance is carried out, as per the maintenance schedule.				
Control of remote operation	Integrity of remote operation controls – software and network integrity	Equipment and control system design is for stand-alone operation, with safeguards to ensure automatic full or partial shutdown, as appropriate, on detection of unsafe situations. Loss of network connection to Belgium poses no safety risk – connection is required for monitoring only. Hydrogenics in Belgium will monitor plant operation, and can make minor adjustments. No remote starts and stops would be carried out without someone present on site.				
Management of Vehicle Refuelling						
Control over use of facility	Controls over site users for vehicle refuelling	Authorised users will be given fobs to allow operation of filling facilities.				
Prevention of vehicle impact with refuelling facilities	Prevention of vehicle impact with fuel dispensers	Containment kerb in place to protect dispensing facilities from impact from approaching vehicle. The dispenser is depressurised when not dispensing hydrogen. There is a tilt sensor within the dispensing unit which, if an impact is registered, would result in facility shutdown. Hydrogen detector provided within dispensing unit.	Protocol for communication between ACC and Hydrogenics in the event of plant shutdown has not yet been developed	6. Develop a procedure for communications between ACC and Hydrogenics and ACC and users of the refuelling facility, in the event of plant shutdown.		Medium

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Vehicle movement control and collision prevention	Control of vehicle flow at facility	Chicane road design on entry to reduce vehicle speed. Containment kerbs in place to prevent impact damage to dispensing unit.				
Hose handling / management	Arrangements for safe hose handling (e.g. self reeling arrangements)	The hose cannot be disconnected from the vehicle until the stop button on the dispenser is activated to release the pressure.	Hose handle does not have to be held continuously during refuelling. This could increase risk of driveaway with hose connected – see "Drive-away prevention" below			
Grounding of vehicle being fuelled	Arrangements to ensure grounding of vehicle during refuelling	Grounding integrated into hose connection.				
Filling process control	Controls in place for safe starting and stopping of vehicle fuelling process What refuelling protocol is applied? (e.g. SAE J 2601)	Start / stop buttons provided on dispenser. Registration on site requires selection of appropriate fill pressure; it is not possible then to select the incorrect hose and refuel with it. The 700 bar hose cannot be fitted to a 350 bar vehicle connection. Refuelling system carries out connectivity and leak tests before starting fuel transfer. Delivery system and vehicle communicate via infra-red communications ports on the hose end and vehicle fuelling connection. Refuelling process is automatically managed; it is not possible to 'overfill' vehicle – pressure protection provided in the filling process. SAE J 2601 protocol is applied to refuelling.				
Defects on vehicles being filled	Arrangements to prevent fuelling of vehicles with defects in their hydrogen filling or storage equipment	For older vehicles without infra-red connection, it is technically possible to carry out lower rate filling of vehicles. Pressure test carried out prior to fuelling will identify any defects. No refuelling will be carried out if defects identified as part of protocol.	Filling of vehicles without infra-red connection should not be implemented unless it is necessary for the vehicle fleet planned to be used.	7. Determine whether the protocol to fill vehicles not having infra-red connections will need to be activated.		Medium
Drive-away prevention	Arrangements to prevent hose damage on drive-away	Breakaway coupling provided at dispenser end of the hose. When activated, breakaway coupling on dispenser would shutdown plant. Non-return valves provided in filling hose to prevent release of hydrogen.	In a driveaway without hose disconnection, the full hose length will remain attached to the vehicle. Unless the dispensing process had been stopped prior to drive-away, the hose will be at filling pressure.	8. Produce a procedure for safe disconnection of a pressurised hose from a vehicle following drive-away.		Medium
Plant Integrity						
Equipment Certification	What is Certification status of the plant?	All equipment within the hydrogen production, storage and dispensing system is covered under Machinery Directive and comes with CE mark.				

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Maintenance arrangements	What arrangements are in place for facility maintenance? – e.g. maintenance schedule, any requirements for plant shutdown, etc.	<p>Hydrogenics have a defined maintenance schedule for equipment supplied by Hydrogenics and their sub-contractors.</p> <p>Daily / weekly checks will be carried out by ACC. Attendants will have a checklist of items to be verified to allow the facility to be operated.</p> <p>Hydrogenics will carry out maintenance visits approximately 3 times per year.</p>				
Written Scheme of Examination (WSE) for Pressure Systems	Has WSE been prepared?	ACC will be responsible for the Written Scheme of Examination.	Written Scheme of Examination has not yet been prepared	<p>9. Define how independent inspection and examination of pressure systems will be carried out, and who will be the Competent Person required by the Pressure Systems Safety Regulations.</p> <p>10. Produce a written scheme of examination for the ACHES facilities.</p>	██████████	High
	Who is nominated as the Competent Person responsible for integrity of pressure systems?				██████████	High

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Management of life limited items – e.g. hoses	How is the life of life-limited equipment determined and managed	Life limited items (on a time basis e.g. hoses) will be changed out at the periods defined in the maintenance schedules. Other limited items that are cycle-based (e.g. pressure vessel) will be monitored by Hydrogenics and the number of cycles will be trended. The facility is designed against the contractual filling frequency over a 25 year lifetime.				
Trading Standards access	Any requirements for access by Trading Standards to monitor fuel dispensing? If so, how is this managed?	Hydrogen dispensing units fuel vehicles against a defined protocol (SAE J 2601 is used by Hydrogenics). This gives good assurance of the mass of gas delivered, but not to the level of certainty that can be provided for liquid fuelling. The agreement with the users will need to include a definition of the terms under which the hydrogen is delivered.	Terms of fuel delivery and any requirement for Trading Standards verification, need to be determined.	11. The user agreement will need to include a clause identifying the terms under which fuel quantity is delivered. 12. Determine whether there is a requirement for ACC to acquire an operator's licence for fuel delivery. (similar to petrol station licensing by the Local Petroleum Enforcement Authority) 13. Check with trading standards whether they have any input into the control of the fuelling and payment process.	██████████ ██████████ ██████████	Medium High Medium
Hazardous Substance Management						
Management of Chemicals (e.g. Electrolyte (KOH))	Arrangements for safe handling (and any requirement of storage) of chemicals	Additional electrolyte is not normally stored on site. Leak tray will collect any leakage of electrolyte. Electrolyte waste will be managed during maintenance programme. No normal requirement for topping up of electrolyte. Refrigerant is not hazardous. Standard hydraulic oil used in compressors – any drips are contained by drip trays in containers, or spraying leaks by the container walls and then drip trays. Small amounts of nitrogen provided onsite (2 bottles) for purging before re-start after system depressurisation. Produced oxygen vented to atmosphere at safe location.				
Security						
CCTV coverage	Adequacy of CCTV coverage, and how is this monitored? Any detection facilities incorporated into the CCTV?	Six CCTV cameras are provided on site. The cameras cover the hydrogen compound, the site entrances, the building and substation next door.	Coverage is currently adequate, but may be obstructed by the dispensing unit canopy	14. Check the CCTV coverage of the site for blind spots, following installation of canopy.	██████████	Medium
Prevention of vandalism	Suitability of fencing. Adequacy of areas open to public access to withstand vandalism	Robust fencing is provided around the hydrogen generation facility.	No current definition of warning signs for the site	15. Consider what signage is required on the fences to warn / deter vandals.	██████████	Medium

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Lighting	Adequacy of site lighting for vehicle movement and security purposes	Daylight sensor-operated high-powered lighting covering the dispensing area and the hydrogen generation areas. Hazardous zones have been identified and extend vertically above the hydrogen production and storage equipment. Site lighting is outside the hazardous zones and is not required to be zone rated.				
Noise	Adequacy of Noise suppression	Silencing arrangements provided on site to minimise noise production such that noise is suitable for residential area.				
Adverse weather						
Surface water management/ flood prevention	Ability of surface water treatment systems to manage heavy rainfall and prevent flooding	SUDS pond will act as interceptor for water run off from site.				
Lightning protection	Arrangements for lightning protection	Lightning protection for containers and dispensing system is incorporated into the site lightning protection as part of the slab design.				
Ice and snow	Arrangements for winter snow and ice clearance	Grit bin will be provided on site. Roads team can be asked to clear the site.				
Low ambient temperatures	Any vulnerability of the units to low ambient temperatures (freezing, seal embrittlement etc.)	Hydrogen facilities are designed for operation down to -20°C. Heating elements and heat tracing are provided.				
Process Safety Management						
Fire and Explosion Risk Mitigation						
Prevention of hydrogen accumulation (canopies, containers etc.)	Area all containers and canopies designed to prevent accumulation of escaped hydrogen	Canopies are curved to allow hydrogen to escape. Equipment containers are equipped with natural and forced ventilation to prevent hydrogen accumulation. Hydrogen detectors are located at highest points within hydrogen containers.				
Separation distances and code used for these	How have required separation distances between the equipment and other hazards been established? What Code has been applied, and are distances adequate?	Separation distances have been established in accordance with NFPA Code and ISO standard. Explosion risk assessed in Explosion Protection Document	NFPA/ISO Codes used to be clarified	16. Provide details of the standards used to define separation distances and provide the Explosion Protection Document to ACC.	Hydrogenics	Medium
Fire Protection	Protection of people and plant against hydrogen fires	Fire wall between hydrogen production and storage and dispensing areas, rated for jet fires				
Blast protection	Suitability of blast protection	Explosion venting panels provided on the closed hydrogen production containers. Explosion risk assessed by Hydrogenics in Explosion Protection Document (see "Separation Distances" above). No requirement for explosion overpressure rating for the buildings (very low hydrogen explosion probability in unconfined areas). Vessels stored in open rack with sheltered roof for weather protection.		17. Provide ACC with the length of time to blowdown the hydrogen facility in an emergency.	Hydrogenics	Medium

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Detection and Shutdown Systems						
Leak detection	Are suitable arrangements in place for hydrogen leak detection?	Hydrogen detectors are provided within the hydrogen generation and compression containers, within the dispensing unit and in the fuel cell room within the educational building. The fuel cell room is separated from the educational area by block walls and double glazed windows. The room has forced ventilation.				
Fire detection	Are suitable arrangements in place for fire detection?	Storage vessels have passive fire detection which initiates shutdown and blowdown of the cylinders at a controlled rate to remain within the manufacturer's specification for storage vessel depressurisation. This rate has been confirmed as being faster than the time to vessel failure under flame impingement. Smoke detectors are provided within the containers, and will initiate a shutdown and blowdown of the facilities. Fire detection provided in the site building which initiates an alarm, thought to be direct to the fire service (to be verified).	Protocol for where alarm signals are routed to be defined	22. ACC and Hydrogenics to agree what alarm signals should be sent from the Hydrogenics panel to the site Fire panel. 23. Following agreement of signal handshaking (action 22), Hydrogenics incorporate inhibit actions within the maintenance procedures to prevent spurious signals being sent to the Fire Service. 24. Define whether signals from the site Fire / Building Intruder Panel should be sent direct to the emergency service or via the ACC Regional Communication Centre (RCC).	██████████ / Hydrogenics	Medium
					Hydrogenics	Medium
					██████████	Medium
Emergency shutdown	Are suitable arrangements in place for emergency shutdown?	Emergency shutdown switch provided on site to shutdown facility in an emergency.	Emergency shutdown switch needs to be located in a position where it is accessible for appropriate personnel, e.g. emergency services, but reasonably secure against improper use.	25. Identify the optimum location and type of manual emergency shutdown switch for the site and how operation of this will be monitored.	██████████	Medium
Venting on blowdown of H ₂ inventory	Are suitable arrangements in place for safe venting of the site inventory in an emergency?	Venting arrangements in place to provide for controlled rate blowdown of cylinders to high level vents. Vent rate set to be within manufacturer's specification for storage vessel depressurisation. Venting can be carried out on all vessels at the same time, if required e.g. in a fire scenario.	Total time for blowdown to be included in information passed to emergency services.	17. Provide ACC with the length of time to blowdown the hydrogen facility in an emergency.	Hydrogenics	Medium
Communication and Training						
Training and Awareness						
Training of facility operators	What arrangements are there in place for training and competence assurance for site operators?	Hydrogenics to provide training for operators on the hydrogen plant. ACC attendants will be provided with initial basic training for plant without ability to intervene with plant. ACC to review the level of training in future to determine if further training required for attendants. ACC would provide on site training for attendants to allow them to interface with emergency services.		26. Ensure the site attendants are included in the communication process with the emergency services.	██████████	Medium

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Training of Hydrogenics personnel		Hydrogenics has a defined training and competence programme (including a competence matrix) that covers the skills required for the operation and maintenance of customers facilities.				
Training of site users	What arrangements are there in place for training of site users?	ACC will provide induction training including how to use the dispenser to new site users prior to being allowed to use the site.				
Emergency services awareness	What arrangements will be in place for ensuring emergency service awareness of the site and hazards involved?	Emergency services will be invited to the site for familiarisation prior to site opening. ACC to provide police at the Cove office with a contact details for minor incidents (vandalism etc.).	Simple hazard and emergency action cards required to inform emergency services	27. Provide ACC with appropriate hazard cards for communication of site hazards to the emergency services. 28. ACC to provide police at the Cove office with a contact details for minor incidents (e.g. vandalism)	Hydrogenics [REDACTED]	Medium Medium
Interfaces with the Public						
Communication with local residents	What arrangements will be in to communicate with local residents over the site and the hazards involved?	ACC provides updates to the community council on progress with the site. ACC plans to hold an open day for residents.	The community council circulates a magazine – the Cove Chronicle – to all residents. Useful as a means of distributing information to local residents.	29. Provide information for residents about the site to the Cove Chronicle.	[REDACTED]	Medium
Arrangements for site educational use	What controls will be applied to ensure risks are controlled during any educational uses for the site?	Restrictions to be in place on visitor's ability to enter the hydrogen compound. Maximum of 10 people within the building at any one time. Entry to the building is controlled by the site attendants / ACC.	Restrictions on areas that can be visited to be defined.	30. Define what restrictions will be applied to the areas where visitors can be allowed, and any restrictions (mobile phones, clothing etc.) that apply in these areas	[REDACTED]	Medium
Signs and Warnings						
Safety Signage – Usage restrictions	Will sufficient suitable signs be provided to inform users of prohibited activities at the site, and of safe refuelling practices?	Signage will be provided at the site.	Information sign requirement not yet defined	31. Define the signs required to provide information on prohibited activities and safe practices.	[REDACTED]	Medium
Safety Signage – Emergency action	Will sufficient suitable signs be provided to inform users of actions to be taken in the event of an emergency at the site?	Signage will be provided at the site.	Emergency sign requirement not yet defined	32. Define the signs required to provide information on emergency actions.	[REDACTED]	Medium
Capability of communication by Operators with personnel onsite	Will remote operators have the ability to communicate with personnel at the site, to deal with questions, issue warnings over unsafe behaviour and receive/deliver information in an emergency?	Not required.				
Emergency Preparedness and Response						
Emergency Response Philosophy						
Emergency Response Philosophy	What is the fundamental philosophy for response to an emergency at the site?	Technical failure of plant results in a fail-safe action, in most instances full shutdown. Site attendants will be trained in basic emergency response. Emergency response actions to be detailed in emergency response plans.				

Prompt / Guideword	Description / Context	Controls	Issues	Action Required	Action Party	Priority
Emergency Preparedness						
Emergency Response Plan	Status of Emergency Response Plans/Procedures	Emergency Response Plan will be developed.	ER Plan to be developed for ACC by Risktec – no specific ACC requirements for format.	33. Emergency response plan to be developed.	Risktec	Medium
				34. Fire extinguishing equipment to be provided for building on site.	██████████	Medium
Emergency Drills / Exercises	Is it planned to carry out any Emergency Response drills or exercises for the site?	No defined drills / emergency response exercises are considered necessary for the facility. Emergency services response can be covered adequately in the planned communication activities listed above.				
Emergency Scenario Response						
Hydrogen leak	What is the planned response?	When a hydrogen leak is detected within a hydrogen generator or compressor container, the system is shutdown with storage pressure locked in. Hydrogen leaks from the vessels will be detected if a lower pressure than expected is detected in the trend monitoring. Unexpected low pressure will initiate automatic isolation. An individual vessel can be isolated automatically if required.				
Fire in the hydrogen generation and pressurisation plant	What is the planned response?	If a fire is detected, the plant will shut down. The hydrogen vessels will remain at pressure unless there is fire impingement on a vessel.				
Fire in the hydrogen dispensing plant	What is the planned response?	Hydrogen fire is only possible during dispensing operations. Would be detected by user who will have been briefed to raise the alarm in this situation				
Vehicle fire at the hydrogen dispensing point	What is the planned response?	User will be advised in fuelling safety briefing to push stop button to shut down dispensing unit in the event of any abnormal event.	Fire service response to a vehicle fire within the facility to be agreed.	35. Discuss with the fire service what the response would be to a vehicle on fire within the facility.	Risktec / ██████████	Medium
Flammable liquid spill at the facility (e.g. from conventionally fuelled vehicles at the site)	What is the planned response?	Two spill kits on site provided within hydrogen compound e.g. to deal with oil spill within plant.				
Person in SuDS pond	What is the planned response?	SUDS pond only expected to be few inches in depth.	SUDS pond is located outside CCTV area, but risk to individual entering the pond is considered low, and additional CCTV is not required.			
Other Issues						
Any other issues identified as not covered above						
Restart of Plant		If a spurious alarm or a minor incident shuts down the plant, and the plant condition is checked and found to be satisfactory, the plant can be restarted. For detailed technical plant shut downs where the systems have been depressurised and a system purge is required, trained personnel will have to be present at the facility to carry out purging and plant restart. ACC will need to request Hydrogenics to provide these personnel.	Simple plant re-starts after a trip (where no purging is required) require someone onsite during the start-up. It could be expensive and cause loss of availability if personnel had to be requested from Hydrogenics to respond to simple plant shutdowns.	36. ACC to consider training of locally available person to be at the facility for simple plant restarts.	██████████	Medium