Station Name	Address	Safety Plan Document #:	Revision
Santa Nella Hydrogen Station	12860 S. Highway 33, Santa Nella, CA, 95322	H065-SAF-001	A – August 12th 2016

THIS DOCUMENT IS MEANT AS AN OVERARCHING SAFETY DOCUMENT AND MUST BE POSTED IN CLEAR VIEW AT SITE.

Brief Station Description:

The Santa Nella Station is located on a large Rotten Robbie Gas station site which services both vehicles and trucks. The station has a dispensing capacity of 200 kg/day. Hydrogen is supplied to the station via a 200 kg/day McPhy electrolyzer and a backup PowerCube hydrogen delivery system. A Compression, Storage, and Dispensing (CSD) system supplied by Powertech labs increases the pressure and stores the hydrogen at 12,750 psig. Using the J2601 protocol the CSD system can deliver approximately 5kg of hydrogen to a vehicle at the dispenser.

Scope of Hydrogen Safety Plan

The purpose of this plan is to provide a guide that will ensure the safe conduct of all project work with an emphasis on aspects involving hydrogen and hazardous materials handling. HTEC is building a network of hydrogen stations in California with the same safety mindset for all stations. Certain elements of this safety plan will be the same for all of HTEC stations while others will be specific to this station.

A complete safety plan for this station is the amalgamation of all the documents listed below:

No.	Document Name	Document Number	Revision
1.	HTEC Safety Policy and Processes	HSP-P-10	A – August 10th 2016
2.	HTEC Hydrogen Station Design B	HSP-P-12	A – August 17th 2016
3.	Santa Nella Site Specific Details	H065-SAF-002	A – August 18th 2016

Brief Document description:

HTEC Safety Policy and Processes:
includes HTEC safety policies and procedures including training, site orientations, change management, HTEC hydrogen and fuel cell experiences, general hydrogen characteristics and emergency response procedures.

HTEC Hydrogen Station Design B:
includes a description of the station design and equipment, hazard analysis, and safety design to mitigate potential risks

Santa Nella Site Specific Details:
includes site specific information including: a general layout of the station, process flow diagrams, site access, site required safety systems above the station design requirements.

Santa Nella Hydrogen Fuelling Station
Emergency Response & Safety Guide Quick Reference

12860 S. Highway 33,
Santa Nella, CA, 95322

This quick reference is intended for technical personnel and equipment operators who have completed all mandatory hydrogen safety and equipment training.

1. Emergency Contact Information:

First Responders	**911**	(Fire / Ambulance / Police)

2. HTEC Emergency Contact Information:

Colin Armstrong	(604) 998-4147 or	(604) 351-0298
Ashley Perry	(778) 229-8059	
Bob Boyd	(510) 922-9613	

3. McPhy Energy

Prabhu Rao	(617) 899-1980

4. Land Owner

Robinson Oil Corp.	(209) 826-4418

Critical Emergency

During a critical emergency, an issue has been identified that is likely to affect the safety, health, and welfare of personnel, or damage the environment or equipment.

The following procedure shall be followed if a critical emergency has occurred:

1. **Push the nearest Red Emergency Shutdown button (ESD).**
2. As an immediate measure, isolate the area for at least 100 meters (330 ft) in all directions, keeping people upwind of the incident if possible.
3. Call 911 to report the emergency, and notify the dispatcher that the emergency involves hydrogen fuel;
4. Follow instructions provided by Emergency Services personnel, giving first aid as appropriate to injured persons.
5. Contact one of the Emergency contacts listed above.

Fires: Use dry chemical or carbon dioxide (CO_2) fire extinguisher – a fire extinguisher is located at in the Control Room (south door of station). Do not attempt to extinguish a fire if the fire is being fed from a hydrogen leak – the source of the leak must be eliminated prior to extinguishing the fire, allow the hydrogen to burn until all the fuel is consumed. The extinguisher can be used to prevent the fire from spreading to adjacent structures.

During a station fire, it is likely that the thermal pressure relief devices (TPRD's) will activate. When activated, the TPRD's release hydrogen through the relief vents located on top of the station. Note that release of the TPRD's may be very loud. The PowerCubes each have their own relief vents, located along the top edge.

Minor Emergency Procedures

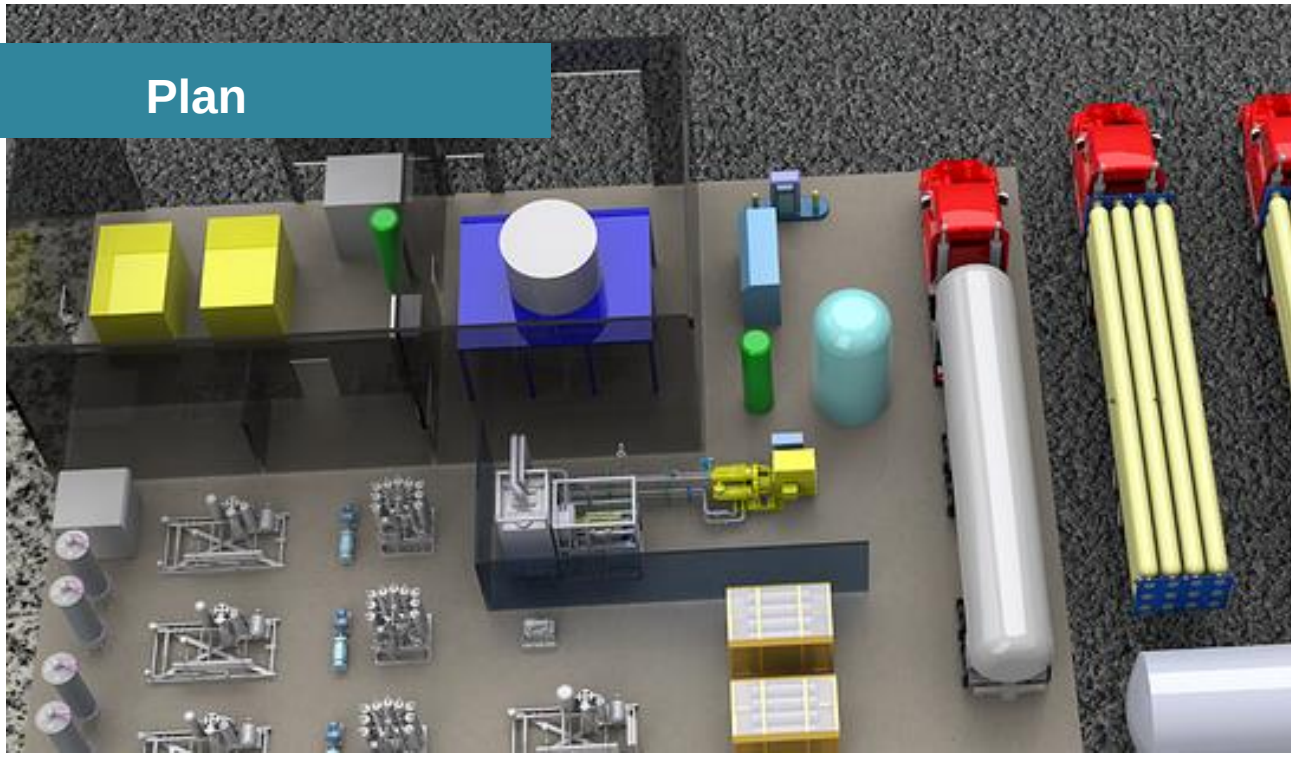
1. Operator shall manage the scene, assess the severity of the emergency, and determine the initial course of action.
2. Take appropriate action to contain and eliminate the emergency. If it is safe to do so, close the Bank Isolation Valves on the PowerCube control panel (on the side of the PowerCube) and/or the station isolation valves inside the high pressure storage area (inside the doors on the station).
3. If required, push the nearest Emergency Shutdown button (ESD). ESD's are located on the Electrical Room and the side of the Fuelling Station.
4. Keep bystanders at least 75m (250 feet) away from the station and PowerCube.
5. Contact one of the Emergency contacts listed above.

HTEC
Hydrogen Technology & Energy Corporation

HYDROGEN SAFETY PLAN

SAFETY POLICY & PROCESSES

Plan



Identification of the document: HSP-P-010

Revision: A

10-Aug-2016

Number of pages: 26

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(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	HTEC Station Safety Policy and Processes
REFERENCE	HSP-P-010

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	10-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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9. Attachment – Locking Out Procedure (HSP-P-003)
10. Attachment - Contractor Orientation Questionnaire (HSP-P-021)

1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California. Its purpose is to provide general safety policy and methodologies for all HTEC stations and where applicable to direct the reader to specific company safety policies that are not controlled by this document.

It is expected that this is a document that will evolve over time as stations mature and new policies and techniques are improved or required.

2. Preserving Health, Safety, and the Environment (HSE)

2.1. Introduction

HTEC has embarked on building hydrogen infrastructure in California to capitalize on the role out fuel cell vehicles (FCV). The success of this program, which involves key station developer stakeholders, the government of California, and the public, depends on HTEC’s ability to provide stations that perform to and exceed CEC standards while preserving the health and safety of HTEC employees, contractors, visitors, the general public as well as the environment in which HTEC operates.

2.2. HTEC Safety Program Policy

HTEC operates all its facilities, distribution systems, and engineering design under a unified umbrella Safety program, (HIP-005 - HTEC Safety Program – Definition & Mgment Commitment”). An uncontrolled copy of this document is attached to this safety document as a reference only. For the most recent version of this document please contact HTEC document control.

The HIP-005 document details HTEC’s commitment in following areas:

- Management Commitment And Program Manager Designation
- Purpose of Health and Safety Program
- Rules And Procedures
- Instruction And Supervision
- Personal Protection Equipment
- Worksite Inspections And Follow-Up
- Incident Reports
- Incident Investigations
- Safety Committee & Safety Meetings
- Workplace Hazardous Material Information System (WHMIS)
- First-Aid

- Documents, Records And Statistics
- Responsibilities & Authority

2.3. HTEC Hydrogen and Fuel Cell Experience

HTEC has extensive experience in designing, building, and operating hydrogen facilities of all pressures, for both liquid and gaseous hydrogen. The key lesson learned in previous hydrogen projects is that communication is paramount with all stakeholders in this type of project.

The following tables provide a summary of relevant projects HTEC and their partners have worked and partnered on:

Facility Name	Location / Purpose / Dates	Station/ Facility Details	Consortium Member Roles (Lead in Brackets)
Skyline Hydrogen Energy and Education Center	Woodside, CA Provide low carbon intensity hydrogen production facility, advanced high pressure distribution and public engagement/education programs Operational Oct 2016	Pressure – 450 Bar Capactiy – two x 7kg sequential fill and 140 kg/day. Hydrogen – delivered in 450 Bar PowerCube modules, and generated on site with electrolyzer	(HTEC) HTEC – site design, build, permitting, operation maintenance, hydrogen supply Powertech – CSD module and support MyPhy – Electrolzyer module and support
Northland H2 Station	Port of Vancouver lot in North Vancouver, BC IWHUP station providing fuel to the fleet of 8 HICE GM trucks and 2 HICE Ford Shuttle buses (2005 – 2010)	*Pressure - 350 Bar* *Capacity - 2 x 7.5kg sequential fill and 75 kg/day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(SDE) Powertech – module build SDE – site design, build, permitting, operation HTEC – maintenance, hydrogen supply
By-product H2 Processing Facility	Located in North Vancouver BC, built to purify and compress hydrogen to 450 Bar for delivery in PowerCubes	*Pressure – up to 450 Bar* *Capacity – 480 kg/day* *Hydrogen – by-product from chlor-*	(HTEC) HTEC – own, operate SDE – design, build.

	to IWHUP facilities and fill tube trailers for industrial gas companies. (2005 – 2012)	*alkali plant*	
Hemlock H2 Station	City of Surrey works yard in Surrey BC to support fleet of 4 H2ICE trucks and 4 FCEV's. (2011 – current)	*Relocated Northland Station*	(HTEC) HTEC - installation, permitting, own, operate, hydrogen supply
Central Works H2 Station	City of Surrey works yard in Surrey BC to support fleet of 4 H2ICE trucks and 4 FCEV's (2011 – current)	*Pressure - 350 Bar* *Capacity - 1 x 5kg sequential fill and 50 kg/day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(Powertech) HTEC – operate, maintain, hydrogen supply. Powertech – module build and installation
Pacific Spirit H2 Station	National Research Council facility at the University of British Columbia in Vancouver, BC installed to support the local fleet of Ford Focus fuel cell vehicles. (2008 – current)	*Pressure - 350 Bar* *Capacity - 2 x 5kg sequential fill and 75 kg/day.* *Hydrogen – delivered in tube trailers or 450 Bar PowerCube modules.*	(Linde/HTEC) Bob Boyd (Linde) – design, approvals. HTEC – took over and continues to operate and supply hydrogen.
Whistler Fuel Cell Bus H2 Station	BC Transit Facility in Whistler, BC installed to provide fuel for 20 revenue service fuel cell bus. (2010 – current)	*Pressure - 350 Bar* *Capacity - 20 x 35kg sequential fill and 1,000 kg/day.* *Hydrogen – delivered as liquid.*	(Air Liquide/BC Transit) SDE – site design and engineering, process and electrical support, permitting, construction management HTEC – maintenance
Victoria Fuel Cell Bus H2 Station	BC Transit Facility in Victoria, BC installed to fuel a demonstration fleet of 5 fuel cell bus fleets. (2009)	*Pressure - 350 Bar* *Capacity - 5 x 35kg sequential fill and 250 kg/day.*	(Air Liquide/BC Transit) SDE – site design and engineering, process

		Hydrogen – onsite electrolysis and tube trailer. (Project cancelled 75% of way through construction)	and electrical support, permitting, construction management.
BC Transit Mobile Fueling Station	Designed to be installed in various locations in BC to support bus demonstrations and special servicing. (2009 – 2012)	*Pressure - 350 Bar* *Capacity - 2 x 35kg sequential fill and 100 kg/day.* *Hydrogen – tube trailer & PowerCube*	(Air Liquide/BC Transit) SDE – design, build HTEC – operate, hydrogen
Vancouver Airport H2 Station	Vancouver International Airport grounds installed to fill HICE truck, shuttle buses and TUGs. (2010-2012)	*Pressure - 350 Bar* *Capacity - 2 x 35kg sequential fill and 100 kg/day.* *Hydrogen – tube trailer & PowerCube*	SDE – site design and engineering, process and electrical support, permitting, construction management. HTEC – operate, hydrogen
Translink HCNG Bus Station	Translink facility in Coquitlam BC installed to provide HCNG for the 4 HCNG revenue service transit buses under the IWHUP. (2006 – 2010)	*Pressure - 200 Bar* *Capacity – 4 HCNG bus fills sequential twice per day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(Clean Energy) SDE – Emergency response planning, hydrogen delivery HTEC – hydrogen supply
IWHUP Outreach Program	Public Open houses Promotional Video	*See IWHUP Video in youtube.* *Http://www.htec.ca/#!resources/cq4t*	SDE/HTEC/Powertech
H2 Vehicle Fleet Program	8 H2-ICE Trucks in IWHUP	*Development and management of users of 8 H2 powered trucks over a 4 year period*	SDE/HTEC/Powertech

2.4. Safety Management – Roles and Responsibilities

For companywide safety roles and responsibilities please refer to HTEC policy document HIP-005.

2.4.1. HTEC Leadership and Administration

As per HIP-005, HTEC leadership and administration have the following responsibilities:

- Senior Personnel will actively be involved in safety meetings, investigating incidents, attending safety meetings, conducting safety audits and follow up to ensure corrective action is taken. Senior personnel include the Leads, Construction Supervisor, Project Manager, President and Safety Program Manager.
- Senior Personnel will ensure that all HTEC's contractors or subcontractors are contractually held to all HTEC's safety requirements, attend safety meetings as required, and have received a safety orientation before commencing work.
- Senior personnel will ensure full compliance with all HTEC, Client, Workers' Compensation Board requirements and regulations.

2.4.2. Station Development Phase

Key people (from a Safety Perspective) that will be involved in the development of each station:

1. Project Manager – will be the Primary Point of Contact from the Project Team
2. Safety Specialist – see below description
3. HTEC consortium technology experts for all components of Project deliverables, namely,
    a. Renewable Energy
    b. Generation and Transportation of supply Hydrogen
    c. Compression, Storage and Dispensing of hydrogen
4. HTEC will employ 3rd party reviewers to provide feedback on all technical and safety aspects of this project.

<u>Safety Specialist</u>

HTEC will assign or employ a Safety Specialist to take responsibility for the overall Safety aspects of the project from an end-to-end perspective. He/She will interface with various stakeholders involved in the project and ensure that we comply with all applicable safety norms and guidelines applicable during the design, shipping, installation, commissioning phase of the project. He/She will also be the primary point of contact for the HTEC Safety Committee, as described in HIP-005.

The Safety Specialist shall also carry out a detailed Safety-Audit jointly if needed with an external agency to check and ensure compliance with the design norms laid out at the project kickoff stage.

Post the commissioning of the Project, the Safety Specialist shall design and roll out a train-trainer program for the 'Safety-Supervisor' who in turn shall train the O&M team members, the First Responders (if applicable) and others as and when needed during the O&M phase of the project.

2.4.3. Station Operation Phase

Key people (from a safety perspective) that will be involved in the operation phase of each station:

1. Project Manager – will be the Primary Point of Contact from the Project Team
2. Safety Supervisor – will be responsible to managing all safety aspects of station and reporting to the HTEC safety committee
3. Maintenance personnel – will perform station maintenance and operational support
4. Equipment and process specialists (internal or external) – will consulted or hired when necessary

Please note that all specific names, contact details, and resumes will be shared post NOPA.

2.5. Safety Management Tools

Please refer to HTEC policy document HIP-005 for direction on safety management tools.

2.6. Management of Change (MOC)

At the time of writing this document, HTEC's management of change policy and procedure has not been approved as a part of HTEC Quality manual.

This station safety policy document (HSP-P-010) will be updated and will reference HTEC's companywide MOC policy once it has been approved. Until this quality policy has been approved, the following MOC procedure will apply to all stations.

Station MOC Policy

Changes to the HTEC HSE systems shall be reviewed and approved according to the protocol outlined below. All changes shall be made in writing dated upon Program Manager approval and added as addenda to the appropriate document in the station Hydrogen Safety Plan. In case of disagreement, the HTEC Safety Committee will consider the reviewers' comments and the Program Manager will make a decision based on the best available information.

Changes to facility HSE systems, such as facility ventilation, hydrogen detection and alarm protocols and other facility design-related issues shall be reviewed and approved by the following, in order:

1. Facility maintenance contractor.
2. A team of partner safety experts composed of one representative from each of the following groups:
   a) Powertech Labs (if applicable)
   b) McPhy Industries (if applicable)
   c) HTEC Hydrogen distribution
   d) HTEC project engineer familiar with Hydrogen Stations
3. The HTEC Safety Committee
4. The Program Manager (in consultation with the Safety Supervisor)

Changes to the HTEC Safety Plan shall be reviewed and approved by the following, in order:

1. A team of partner safety experts composed of one representative from each of the following groups:
   a) HTEC Safety Committee
   b) HTEC Hydrogen distribution
   c) HTEC Project Engineer familiar with Hydrogen Stations
2. The HTEC Safety Program Manager
3. The Program Manager (in consultation with the Safety Supervisor)

3. Safety Procedures

The following safety procedures will be followed at each station. This section provides overall safety requirements as well as direction to other controlled HTEC safety documents.

3.1. Safety Equipment Requirements and Recommendations:

- Protective eyewear must be worn when working around and/or with power tools, caustic liquids or compressed gases, heated materials, and other hazardous situations.
- All personnel who work at the station must wear footwear that provides appropriate protection. No open-toe footwear is allowed in the work areas.
- The use of gloves is required when working with chemicals, heat, and sharp objects, and/or working in cramped spaces. Note that most medical cases involve the hand.
- A minimum level of PPE to be required will be determined by the Project Manager.

3.2. General Work Rules:

3.2.1. Drugs and Alcohol

HTEC has a no tolerance policy for drugs and alcohol while either present at the station or operating the station remotely. If an employee or contractor requires the use of medical drugs or prescriptions which inhibit work practice in any form, the station safety supervisor, via written consent, must authorize and clearly provide modified responsibilities (if necessary) before the employee/contractor commences work of any form at the station.

Once the drug no longer inhibits the employee/contractor, the station safety supervisor, via written consent, will reinstate the worker to their full responsibilities as prior to consuming the medical drug.

3.2.2. Working Alone

If working alone, the HTEC work alone procedure must be followed (HSP-P-002). An uncontrolled version of this document is attached.

3.2.3. Maintenance on equipment

Maintenance on station equipment is not allowed if sources of energy have not been locked out.

Work on equipment or piping must follow the HTEC Lock-out procedure (HSP-P-003). An uncontrolled version of this document is attached. By virtue of following this lock out procedure, personnel injury risks from sources of energy will be significantly reduced. Please note that only employees/contractors that have been trained and certified in HTEC's lock out procedure may lock out equipment for further maintenance.

3.2.4. Confined Spaces

The definition of a confined space is:

> A place where the means of entry or exit are restricted because of location, design, construction or contents. The main hazards encountered in confined spaces are fire or explosion, asphyxiation, toxicity, drowning in liquids or free flowing solids and injury or death if mechanical equipment within the confined space is inadvertently turned on while someone is still inside. These hazards are due to the presence of hazardous gases, vapours, fumes, dusts or the creation of an oxygen-deficient or oxygen-rich atmosphere.

At HTEC stations, certain areas of the containers used to house equipment might be considered confined spaces. Design of these areas will include warning mechanisms, fail safe valves and other risk reducing mechanisms, but this does not eliminate the risk associated with working in one of these confined spaces. HTEC's orientation procedure ensures that workers are aware of areas that could be classified as confined spaces and HTEC's 'Confined Space Policy' ensures that all workers are trained and certified to work in confined spaces.

3.2.5. Hazardous Materials

All personnel working with hazardous materials at the HTEC station must have their 'Workplace Hazardous Materials Information System (WHMIS) training completed. Confirmation and date of complete of WHMIS training must be included in HTEC's Master Log List. All Material Safety Datasheets (MSDS) for hazardous materials will be provided in a binder where the station first aid supplies are stored.

3.2.6. Operation of heavy machinery (forklift)

Only those persons who are trained, certified, and licensed to operate a forklift or other heavy machinery and have met these requirements within the last two years, are allowed to operate these machines. These certifications and licenses must be logged on the HTEC's master list.

3.2.7. Access to Station

Access to HTEC's stations is restricted to authorized personnel only. All authorized personnel must be listed in the Station Access log file. This log file will keep a record of when personnel passed orientation training, the level of their responsibility, and any certification applicable records. For a better description of what training is required, please refer to the training section below.

3.3. Contractor/Subcontractor Hiring and Training

For hiring and training contractors/subcontractors the following must be followed:

- All HTEC contractors and subcontractors must receive training and be knowledgeable of HTEC's HSE requirements and procedures. All contractors or subcontractors hired by HTEC will be trained, supervised and closely monitored to ensure the proper procedures are being followed.
- A pre-construction qualification check will be done to ensure each new contractor/subcontractor is capable of performing all aspects of his/her job safely.
- HTEC will conduct a new contractor/subcontractor orientation for new persons coming onto a station for the first time.
- All contractors/subcontractors will receive a tour of the project site and familiarize themselves with the work environment.
- Leads will be responsible for conducting a familiarization tour of the immediate work area for all new contractors/subcontractors reporting to them. Included in this familiarization tour will be area specific safety procedures, instructions and hazards.
- HTEC will identify safety training required as shown on the Safety Training Checklist.

3.3.1. Required Training

As per the HTEC Safety Program HIP-005, persons who are working with and around hydrogen must be trained on proper hydrogen handling procedures and practices. All contractors/subcontractors assigned field responsibilities will complete the safety orientation from HTEC before starting work on the project site.

The orientation will highlight the following topics:

Site and Hazard Orientation

- Site Rules and Regulations –General
- Site/Project Specific Safety Orientation
- Tour of the Project Site

Safety Policies and Program

- HTEC's Safety Policy
- HTEC's General Safety Orientation

Each contractor/subcontractor will receive a copy of the above, and a copy will be retained in the North Vancouver office.

Additional Site Specific Programs include:

- Construction Safety Rules and Responsibilities (if applicable)
- Emergency Evacuation Procedures
- Safety Equipment
- Personal Protective Equipment
- First Aid
- Protection and Response
- Confined Areas
- Hazardous Goods
- Sign Off Sheets – acknowledge a contractor/subcontractor has completed the HTEC's site safety orientation.
- Safety Recognition Program

3.3.2. Contractor/Subcontractor Orientation Questionnaire

Each contractor/subcontractor must complete the HTEC Orientation Questionnaire before work at the HTEC site can be commenced. The purpose of the questionnaire is to ensure that the subcontractor has been fully informed about the job and safety procedures. The contractor must complete the questionnaire and return it to the HTEC; a uncontrolled copy of this questionnaire is attached.

3.4. First Aid

HTEC is committed to providing and maintaining a first aid program for the purpose of minimizing the effects of job-related injuries and illnesses, increasing productivity, reducing absenteeism and meeting WCB regulations. The company will provide and maintain first aid services, supplies and equipment.

First Aid services, supplies and equipment will be made available to all workers during working hours. The company will ensure that workers receive instructions in the procedure for summoning first aid and reporting injuries.

Workers who sustain a job-related injury or illness, regardless of seriousness, must immediately report it to the first aid attendant for treatment or recording, and where practicable, must also report it to their immediate supervisor. If medical treatment is required the injured worker will be transported to the nearest medical aid facility at the expense of the company.

The first aid attendant will be in complete charge of all first aid treatment of injured worker until medical aid is available. Supervisory personnel will not attempt to over-rule the attendant's decisions relating to first aid or emergency transportation.

Pertinent injury information will be entered in the First Aid Treatment Log Book by the first aid attendant and verified by the injured worker's supervisor.

All personnel assigned to field project sites shall ensure they are familiar with the site procedure to summon first aid, the reporting of injuries and the location of the first aid room.

4. Compressed Hydrogen Fuel Characteristics

This section summarizes the general characteristics of hydrogen and identifies potential hazards.

Hydrogen possesses several unique characteristics and hazards compared to other, more common fuels currently available on the market. Some of these general characteristics and hazards include the following;

- Hydrogen is a colorless, odorless, tasteless, non-corrosive, and flammable gas;
- The amount of energy required to initiate hydrogen combustion is much less than other common fuels;
- Hydrogen/air mixtures can be easely ignited by small energy sources such as sparks;
- Hydrogen is considerably lighter than air: it rises very quickly and does not pool near the ground like gasoline, diesel, or propane fuel vapors;
- Hydrogen rapidly diffuses into the atmosphere;
- Hydrogen fires burn at high temperatures, but are **less** likely to spread to adjacent structures than fires fuelled by other fuel types, because hydrogen is highly buoyant and radiates little heat energy;
- Hydrogen contains a lower amount of explosive energy per volume than most other fuels;
- Hydrogen gas is not toxic but may induce suffocation (asphyxiation) if it displaces oxygen in a confined space.



All combustible fuels are hazardous. Hydrogen is not inherently more dangerous than other fuels, but its properties are unique and it must be handled appropriately.

The low ignition energy of hydrogen presents an increased probability of ignition. However, hydrogen's high buoyancy and high diffusivity in air tend to reduce the duration over which the hydrogen gas-air mixture is in the flammable concentration range.

Additional safety related information and information on hydrogen characteristics can be found from the following sources:

- General Compressed Hydrogen Safety Training Program (Sacré-Davey Innovations)
- http://www.hydrogenandfuelcellsafety.info/
- www.hydrogensociety.net
- www.hydrogen.energy.gov

5. Emergency Response Procedures

THIS SECTION MEANT TO BE REVIEWED FOR TRAINING AND NON-EMERGENCY SITUATIONS ONLY.

REFER TO THE STATION ONE PAGE EMERGENCY GUIDE IN THE EVENT OF A EMERGENGY SITUATION, WHICH WILL INCLUDE ALL UPTO DATE CONTACT DETAILS.

This section details the recommended safety and emergency response procedures that should be followed by technical personnel and equipment operators, and serves as a guide for emergency responders.

If the incident occurs at HTEC fueling station this Emergency Response Procedure should be followed to ensure that equipment is shut down and the proper personnel are informed.

In general, any red emergency shut-down (ESD) button should be pressed during any emergency situation at the HTEC Station.

5.1. Hydrogen Fuel Hose Breakaway

The fuelling hose at the station is equipped with a breakaway coupling. In the event that a vehicle is driven away while the fueling hose is still connected, a small amount of hydrogen will be vented when the breakaway decouples, but the event is not considered an emergency situation. The ends of the hose will seal automatically and no sustained release of hydrogen will occur. In this event facility operators (either onsite or remotely) should press or activate the station ESD button and remain 10m (30 feet) from the vehicle and station, then contact HTEC personnel for instructions. Do not operate the vehicle until it is inspected by qualified personnel.

5.2. Emergency Response Levels

During any emergency situation, operators must assess the incident and identify the appropriate emergency response according to the severity of the incident. Emergencies are divided into the following two levels:

1. **Minor Emergency**
2. **Critical Emergency**

When responding to emergencies of either level, the following equipment is recommended for emergency services personnel:

- full protective clothing including turnout pants, turnout jacket, boots, helmet and face shield; and

For any incident involving fire, a positive pressure self-contained breathing apparatus (SCBA) is recommended.

During the initial stages of an emergency incident, technical personnel and equipment operators are the most qualified personnel to take the command role, until more qualified personnel arrive on scene. The Fire Department will always take the command role when they arrive on scene.

5.3. Minor Emergency

During a minor emergency, an issue has been identified that is unlikely to affect the safety, health, and welfare of personnel, or damage the environment or equipment.

During this emergency level, the equipment operator will generally be capable of managing the scene. A minor emergency may include the following:

- small amount of hydrogen leakage found during PowerCube exchange or otherwise normal station operations;

The following procedure shall be followed if a minor emergency has occurred:

1. Operator shall manage the scene, assess the severity of the emergency, and determine the initial course of action.
2. Take appropriate action to contain and eliminate the emergency. If it is safe to do so, close the PowerCube Isolation Valves on the PowerCube control panel and/or the station isolation valves inside the high pressure storage area.
3. If required, push the nearest Emergency Shutdown button (ESD). ESD's are located on the compressor container module and near the exits of the site.
4. Keep bystanders at least 75m (250 feet) away from the station.
5. Contact the HTEC emergency phone number who will then be responsible for assessing the severity of the incident and taking the appropriate action:
6. Record the emergency details and forward the information to the HTEC Safety Committee and program manager.

5.4. Critical Emergency

During a critical emergency, an issue has been identified that is **likely to affect the safety, health, and welfare of personnel, or damage the environment or equipment**.

Some examples of critical emergencies include the following:

- line rupture, fitting failure, or other significant escape of hydrogen from the station, such as from the relief vents on top of the station;

Note: A release of hydrogen through the station vents will be very loud – the station ESD should be pressed immediately in this event.

- fire in or near the station;
- pressure explosion of any kind;

Small Fires: Use dry chemical or carbon dioxide (CO_2) fire extinguisher – a fire extinguisher is located in the Control Room. Do not attempt to extinguish a fire if the fire is being fed from a hydrogen leak – the source of the leak must be eliminated prior to extinguishing the fire. If the leak cannot be stopped, press the station ESD and allow the hydrogen to burn until all the fuel is consumed. The extinguisher can be used to prevent the fire from spreading to adjacent structures.

During a station fire, it is likely that the thermal pressure relief devices (TPRD's) will activate. When activated, the TPRD's release hydrogen through several relief vents located either on top of the station or through the main station vent stack. Note that release of the TPRD's may be very loud. The PowerCubes each have their own relief vents, located along the top edge of each PowerCube.

During the initial stages of an emergency, the operator is generally the most qualified person on scene, and shall manage the site until more qualified personnel arrive. The Fire Department will always take the command role when they arrive on scene.

The following procedure shall be followed if a critical emergency has occurred:

1. Push the nearest Emergency Shutdown button (ESD). ESD's are located on the south wall of the Electrical Room and the west wall of the Fuelling Station.
2. As an immediate measure, isolate the area for at least 100 meters (330 ft) in all directions, keeping people upwind of the incident if possible.
3. In the event of a fire or explosion, call 911 to report the emergency, and notify the dispatcher that the emergency involves hydrogen fuel;
4. Follow instructions provided by Emergency Services personnel, giving first aid as appropriate to injured persons.
5. Contact at least one of the HTEC individuals listed on the one page emergency guide.
6. If a significant amount of hydrogen has been released (10 kg or more) during the incident, then the following agencies must also be contacted:
    a. the State Emergency Program;
    b. the operator's employer, if not already contacted.

7. Before the station is returned to service, the area must be checked with a methane detector.
8. Record the emergency details and forward the information to the Station Safety Supervisor .

5.5. Hydrogen Release Detection

Hydrogen is not odorized. The only way to detect a leak is typically to hear a hissing sound or use one of the following detection methods:

- Thermal Conductivity Sensor (functions well in stable air environment with minimal temperature variations),
- Catalytic Combustion Sensor (functions well for detecting 0 to 4% hydrogen content in air, but not hydrogen specific, typically used by HAZMAT teams).

5.6. Fire Detection

Hydrogen fires can be nearly invisible in daylight. The following methods should be used to detect a hydrogen fire:

- Long handled broom – the bristles should be made of corn straw, as it will easily ignite but does not release toxic fumes. Hold the broom in front of you as you slowly approach the vehicle and it will ignite when passed through a hydrogen fire.
- Ultra Violet (UV) Sensor (functions better than Infra Red (IR) sensors that are better suited to a brighter fire).

5.7. Reporting Incidents

All emergencies and incidents regardless of their severity must be documented and brought to the attention of the HTEC Safety Committee.

5.8. Dealing with News Media

If there is a significant incident involving the HTEC Fueling Station, the news media may arrive on-site and request information. HTEC is responsible for handling all media inquiries.

At the accident scene;

- Do not give the names of injured persons;
- Do not give any personal opinions; and
- Do not take photographs of the scene; however do not attempt to prevent any press photographer from taking pictures.

If HTEC is not available, remember these additional guidelines when dealing with the news media:

- Direct persons asking questions to the authorized spokesperson and don't say "no comment";
- Remember that there is no such thing as "off the record"; and
- Be courteous at all times.

6. Attachment – HTEC's Safety Program – Definition and Management Commitment (HIP-005)

PROJECT NAME / TITLE	CLIENT / INTERNAL	DOCUMENT
HTEC Safety Program	Internal	HIP-005

Revision	Issue Date	Description / Summary of Changes	Issued By	Approved By
A	2015-Oct-16	Initial	AP	

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1. MANAGEMENT COMMITMENT AND PROGRAM MANAGER DESIGNATION

The management of Hydrogen Technology and Energy Corporation (HTEC) will provide a safe and healthy workplace for all employees, contractors, and others that may visit or enter our facilities. Our firm will establish and maintain a Health and Safety Program designed to prevent safety incidences, injuries and disease, and hold it equal to other business values. We are responsible for providing the necessary instruction in health and safety and for addressing unsafe situations in a timely manner. All workers and service contractors are required to work safely and to know and follow our company rules for safe work.

Signature of Management

Colin Armstrong, President

OCT 16, 2015

Date

The Safety Program Manager (SPM) is: ASHLEY PERRY and by way of the following signature accepts the role and responsibilities determined in this document.

Signature of SPM

Oct 22/2015

Date

2. PURPOSE OF HEALTH AND SAFETY PROGRAM

The purposes of the Health and Safety Program defined in this document are to:

a. determine the activities and strategies to ensure management safety commitments are met;
b. eliminate accidents and control potential hazards in the workplace;
c. provide the foundations for ensuring that safety is a fundamentally integrated part of the culture of the company;
d. co-ordinate the provision of the knowledge and tools required for accident prevention.

3. RULES AND PROCEDURES

Safety rules and procedures will be created and made available to employees and posted as appropriate in facilities.

Documents will be created as required for each facility or section of the program and will be revision and issue controlled. A master Document Log will be kept by the SPM who will be the owner of all rules and procedure documents.

If HTEC employees are on a client's facility, the higher level of safety rules and procedures will apply. It is the expectation that HTEC employees visiting or working on a client's site will ask for a safety induction if one is not provided.

4. INSTRUCTION AND SUPERVISION

Employer/Supervisors will:

a. Orientation - Give general orientation to new workers, visitors and contractors prior to entering the workplace.

b. Instruction - Instruct workers in General Site Rules, Safe Work Procedures and Job Rules (e.g. safety headgear, eyewear and footwear, guardrails/fall protection, WHMIS).

c. Training - Provide training and/or ensure required certification is in place for jobs requiring extra skill or knowledge as well as those with demonstrated higher risk of injury (e.g. manual handling) such that equipment & machinery operators can demonstrate that they can do the job safely before being allowed to operate without direct supervision.

d. Supervision - Observe workers, work practices and equipment operation and initiate corrective action when necessary to ensure safety to personnel.

e. Documentation - Keep records of instruction, training, facility inductions, employee and contractor certifications, safety incidents, investigations, and corrective measures taken.

f. Safety Training - Ensure that the SPM receives the required 8 hours of WCB approved training per year.

5. PERSONAL PROTECTION EQUIPMENT

Personnel Protection Equipment (PPE) will be issued and used by all employees, visitors, and contractors as determined by specific procedures for specific areas and activities. In general PPE refers to safety glasses, hearing protection, high visibility clothing, and protective headwear and footwear.

It is recognized that noise levels above 85 decibels combined with long exposure can permanently damage hearing, so the SPM shall ensure that:

a. Noise is reduced or controlled at the source, where practical.
b. Workers are informed about the noise hazard and the risk of hearing loss.
c. Noise hazard signs are posted in areas, which require hearing protection.
d. Hearing protective devices are provided to and used by all workers exposed to excess noise levels.

6. WORKSITE INSPECTIONS AND FOLLOW-UP

Safety inspections of the work site will be done on a regular basis by the SMP or by a person assigned by the SMP. Inspectors must be knowledgeable with the work process. Employees found to be working in an unsafe manner or in unsafe conditions will be asked immediately to stop work and correct the situation. If an immediate solution cannot be found to remedy the unsafe situation, the matter must be immediately referred to the SMP for action.

All work site safety inspections will be recorded using an Inspection Report form and will include: employees involved in the inspection, potential unsafe working conditions or methods that were observed and/or corrected, and suggestions for corrective action (if possible).

All Inspection Reports will be discussed at safety meetings and corrective actions are to be recorded and addressed in a timely fashion.

Inspection Reports will be reviewed prior to new worksite inspection to ensure follow-up is done.

7. INCIDENT REPORTS

An employee involved in a safety incident as described below will be required to complete a safety 'Incident Report'. An incident report will be a standardized form which will include at minimum the employees involved as well as an incident description. Incident reports may or may not be specifically discussed at a safety committee meeting but will be included in a summarized monthly report. Applicable incidents include:

a. All incidents that result in injury requiring first aid or other medical treatment,
b. Any incidents of violence,
c. Incidents that could cause serious injury or death,
d. Incidents involving 'near misses' that could have resulted in serious injury
e. Incidents involving 'near misses' (serious or minor) that could have been prevented via a procedure,
f. Observations of unsafe acts that could lead to a future incident (does not include observations during an work site inspection)

8. INCIDENT INVESTIGATIONS

All incidents that result in injury requiring medical treatment, any incidents of violence, incidents that could cause serious injury or death, or near misses that could have resulted in serious injury shall be investigated.

Investigations shall be carried out by a person knowledgeable with the work process, but not involved with the incident, as well as a senior staff member to determine the root cause of the incident and identify corrective measures to be taken. Information shall be recorded on an Incident Investigation form and supervisors or worker representatives shall review the reports with all workers. Investigation reports will be presented and discussed at monthly safety committee meetings or special safety meetings as required.

The worker safety authority have jurisdiction (AHJ) shall be notified of any accident resulting in life threatening injury, death or any accident resulting from a major structural failure.

9. SAFETY COMMITTEE & SAFETY MEETINGS

The SPM will create and chair a Safety Committee that has between 3 and 5 personnel. Members will be documented in a separate form. The Safety Committee shall conduct safety meetings, at least once per month, with supervisors and workers to review safety plan implementation, accident investigation reports, inspection reports, corrective action, unsafe work practices, work conditions of concern and any specific safety concerns of management and/or workers.

When practical, short "Tool Box" chats will be conducted at the beginning of each shift to review special operating conditions, hazards that may be encountered during the shift, or any factors that might have changed since the last shift.

Special Safety Meetings will be held as needed prior to initiation of major initiatives such as new operations start-up or long extended hours on customer sites.

Management will review and take action on all items discussed at safety meetings. Minutes of the monthly and special safety meetings will be recorded and kept to document actions taken and items discussed. A copy of the safety meeting minutes shall be posted for reference by workers.

Minutes of monthly and special safety meetings will be taken, held on record and posted for reference by workers. Management will review and take action on all items required.

The shorter "Tool Box" meetings do not need to be recorded unless substantive items are determined during the meeting.

All safety meetings shall be considered teaching moments and are to be recorded on daily timesheets.

10. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

Management will ensure that WHMIS regulations are followed by ensuring the following:

1. All controlled products on site are identified with supplier or workplace labels.
2. Material Safety Data Sheets (MSDS) for products are up to date and made available to workers and the First Aid Attendant.
3. All workers receive education and training to safely store, handle, use, or dispose of products.

11. FIRST-AID

Management shall ensure that first-aid services, supplies and equipment as required by the Occupational Health and Safety Regulation, are available to workers on all shifts. Workers shall be instructed on how to summon first-aid. Workers shall promptly report all injuries to the first-aid attendant. A treatment record shall be maintained.

In the event of a more severe incident requiring external medical services while on a client's site, site representatives will be informed in accordance with their first aid protocols.

12. DOCUMENTS, RECORDS AND STATISTICS

All documentation associated with the Safety Program including procedures, rules, records, meeting minutes, reports and logs shall be maintained in an organized and controlled manner.

The SMP and one member from the Safety Committee shall sign all rules and procedures developed under the Safety Program.

Statistical information shall be provided to employees, managers, and as required by Workers Compensation Board (WCB) to communicate accident, incident and success trends such as number of accident free days.

13. RESPONSIBILITIES & AUTHORITY

Management shall:

a. Lead by setting a good example, wearing PPE and following all safety policies and procedures.
b. Interact with workers regularly to hear first-hand any safety concerns and show workers the importance and top priority a safe workplace is within the organization.
c. Participate in safety meetings and the safety committee (when applicable).
d. Hold supervisors and workers accountable to maintain the Safety Program.
e. Set reasonable health and safety goals and objectives.
f. Provide resources required to implement and maintain the Safety Program.

The SMP shall:

a. Lead by setting a good example, wearing PPE and following all safety policies and procedures.
b. Interact with workers regularly to hear first-hand any safety concerns and show workers the importance and top priority a safe workplace is within the organization.
c. Chair safety meetings and the safety committee.
d. Hold supervisors and workers accountable to maintain the Safety Program.
e. Be responsible for developing, maintaining and issuing all documents, records and informational required by the Safety Program.
f. Be responsible for compiling and providing statistical information.
g. Prepare a program, future activity plan and request for resources to management on a quarterly basis.

If the SPM feels that resources are not available for Safety Program implementation or rules and procedures are not being followed, the SPM is empowered to curtail operations until the issue is resolved.

Personnel are responsible for their own actions and thus must cooperate with program personnel and initiative and never overlook unsafe acts or conditions.

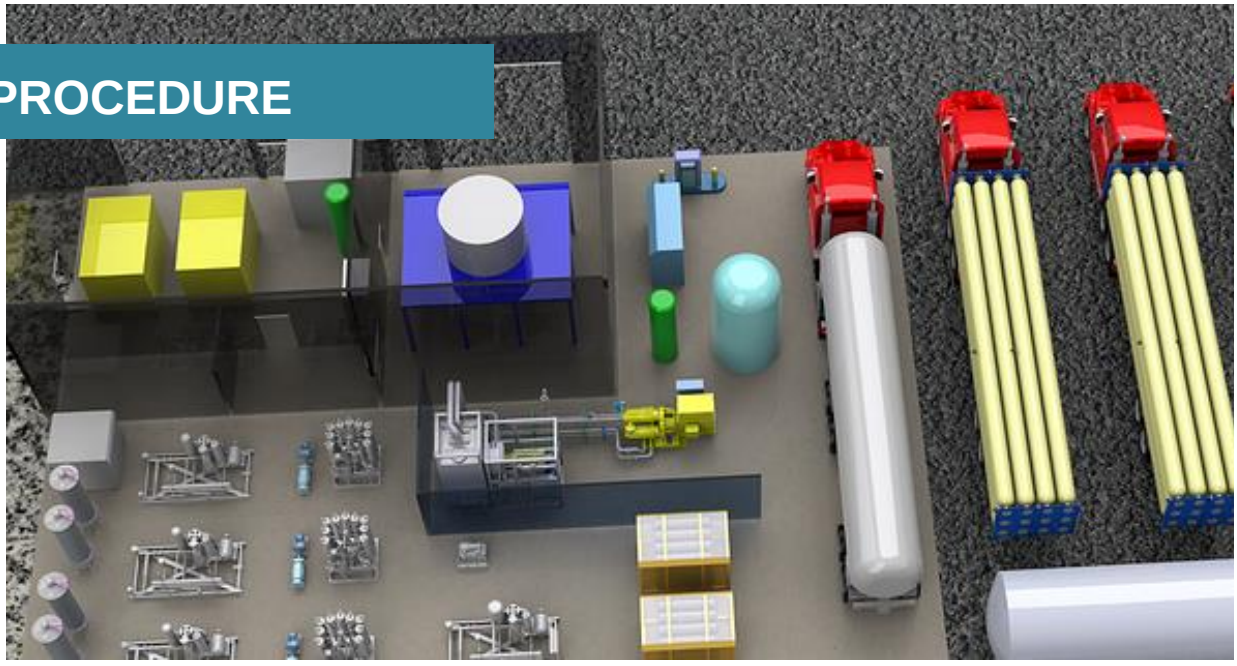
Employees should visit www.worksafebc.com for further information on safety programs and initiatives.

7. Attachment – Working Alone Procedure (HSP-P-002)

WORKING ALONE PROCEDURE

HTEC SAFETY PLAN

PROCEDURE



Identification of the document: HSP-P-002 - Working Alone Procedure

Revision: A

12-Dec-2015

Number of pages: 7

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APPROVALS		
Written by	Verified by	Approved by
Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Working Alone Procedure
REFERENCE	HSP-P-002 - Working Alone Procedure

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	12-Dec-15	Issued for Review - Draft

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

MANAGEMENT COMMITMENT

The management of Hydrogen Technology and Energy Corporation (HTEC) will provide a safe and healthy workplace for all employees, contractors, and others that may visit or enter our facilities. Our firm will establish and maintain a Health and Safety Program designed to prevent injuries and disease and hold it equal to other business values. We are responsible for providing the necessary instruction in health and safety and for addressing unsafe situations in a timely manner. All workers and service contractors are required to work safely and to know and follow our company rules for safe work.

_____ _____

Signature of Management Date

Colin Armstrong, President

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1. INTRODUCTION

The purpose of this procedure is to ensure than all employees and contractors are safe and accounted for work while working alone at any of HTEC's or client's sites.

The definition of working alone is:
Any employee or contractor (employed by HTEC) that is working alone or that does not have regular check-in by personnel onsite.

2. DEFINITIONS

Check-in:
Verbal or electronic contact from the Worker to the Safety Partner indicating that the Worker is safe and of clear mind.

Emergency Contact List:
A list of emergency contact details for each site. This list is available in the main HTEC Safety Folder and is considered to be the most update. Contact details are not listed in this procedure due to the risk of not being up to date.

High Pressure Hydrogen:
Any system involving hydrogen pressure greater than 15 psig. This is in accordance with BCSA definitions.

Safety Partner:
A responsible HTEC employee with whom a Worker working alone can check-in at regular intervals. A Safety Partner must have a basic understand of the potential hazards on site and must have all site contact details on their person during the period of time the worker is working alone.

Safety Program Manager:
HTEC's appointed Safety Program Manager.

Site Safety Manager:
A person onsite who is responsible for the safety of the site and has a basic understanding of potential hazards with the equipment the Worker is working on.

Worker:
Any employee or contractor (employed by HTEC) performing work for HTEC on HTEC or Client equipment.

Working Alone:
Any employee or contractor (employed by HTEC) that is working alone or that does not have regular check-in by personnel onsite.

3. WORKING ALONE PROCEDURE

1) A Worker will inform a Safety Partner that they are planning to perform work or maintenance alone and will inform the Safety Partner of the nature of the maintenance and when they will check-in.
2) If the Worker expects the work to take longer than two hours or there are more or greater hazards, verbal or electronic contact should be made at regular designated intervals as appropriate with the risk. If dealing with high pressure hydrogen (>15 psig) this time interval should 30 minutes. If dealing with Nitrogen or Hydrogen in an enclosed space this time interval should be 15 minutes.
3) During a check-in the Worker will inform the Safety Partner that they are safe. If any uncertain or changing conditions exist on site, the Worker must inform the Safety Partner at this time. It is the responsibility of the Safety Partner to gauge whether the Worker is safe or in clear mind. If the safety Partner is unsure whether the Worker is safe or of clear mind, they must verbally discuss their concerns with the Worker. If uncertainty exists after a verbal discussion with the Worker, the Safety Partner is to contact the Safety Program Manager for further direction.
4) If the Worker and Safety Partner are using electronic means to check-in the Worker will contact the Safety Partner at the designated time and then Safety Partner will respond indicating that they have received the Worker's check-in. If the Safety Partner does not respond to the electronic check-in, the Worker must immediately attempt verbal contact.
5) If the Worker has not made verbal or text contact within 5 minutes of the designated time, the Safety Partner will
    i) Call the site contact (listed on the Emergency Contact List) and ask them to go check on the worker. If no one can be reached:
    ii) Call the HTEC Safety Program Manager (SPM). If the SPM cannot be reached:
    iii) Call the HTEC Emergency Phone Number (listed on the Emergency Contact List), inform Colin Armstrong about the situation, and go to the site with a set of PPE, first aid kit, Emergency Response Plan and fire detection gear.
6) If the Safety Partner does not respond verbally or electronically to the Worker's check-in, the Worker must stop working immediately. If work cannot be suspended or stopped, the Worker must contact the Site Safety Manager or the Safety Program Manager and use them as a Safety Partner until the original Safety Partner is contacted and can continue the role.
7) Both the Worker and the Safety Partner should ensure they are carrying a charged mobile phone. The Worker must not continue work until the mobile phone is charged or another appropriate means of contact can be used. A new Safety Partner should be appointed if their mobile phone loses charge during the work alone period.
8) The Worker should wear all appropriate site PPE and if dealing with a toxic gas should wear a gas detector monitor at all times.
9) **The Worker should always double check that what they are about to do is correct! If in doubt, ask. No assumptions!**

10) The Worker will inform the Safety Partner when they finish their work and leave the site.

4. CONTINUOUS IMPROVEMENT

Continuous improvement of this procedure shall include, but is not limited to:

1) Annual review of this document by the Safety Program Manager
2) Recording of recommend changes using the Change Management Procedure
3) Annual review of pertinent Codes and Standards to:
   a) Verify this documents use in day-today practice and is the latest version
   b) Recommend additional standards to purchase
   c) Confirm this document is in the proper directory, and employees are aware of its location

The Safety Program Manager shall review the proposed recommendations, and if necessary, seek the advice of peers on the recommended change. If the Safety Program Manager agrees with the proposed revision, they shall implement the revised procedure and ensure all workers are informed of the updated procedure.

5. RELATED DOCUMENTS

Change Management Procedure *[under development]*

Emergency Contact List

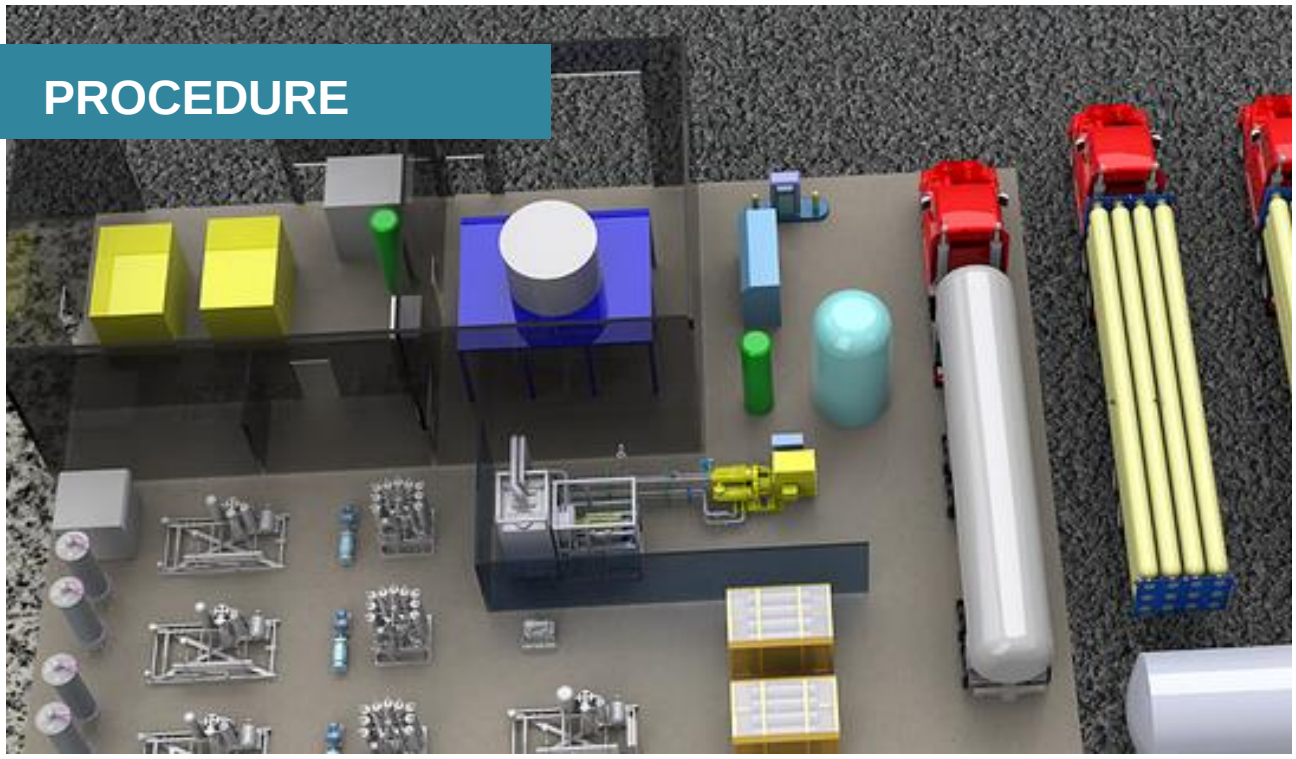
HTEC's ERAP "Emergency Response Assistances Plan"

HTEC Safety Manual *[under development]*

LOCKING OUT PROCEDURE

HTEC SAFETY PROGRAM

PROCEDURE



Identification of the document: HSP-P-003 - Locking Out Procedure

Revision: A

30-Dec-2015

Number of pages: 22

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Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Locking Out Procedure
REFERENCE	HSP-P-003 - Locking Out Procedure

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	30-Dec-15	Issued for Review - Draft

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

MANAGEMENT COMMITMENT

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_____ _____

Signature of Management Date

Colin Armstrong, President

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1. OBJECTIVE

The objective of this procedure is to establish a means of positive control to prevent the accidental starting or activating of machinery or systems while they are being repaired, cleaned and/or serviced. This program serves to:

A. Establish a safe and positive means of shutting down machinery, equipment and systems.
B. Prohibit unauthorized personnel or remote control systems from starting machinery or equipment while it is being serviced.
C. Provide a secondary control system when it is impossible to positively lockout the machinery or equipment.
D. Establish responsibility for implementing and controlling lockout procedures.
E. Ensure that only approved locks, standardized tags and fastening devices provided by the company will be utilized in the lockout procedures.

2. ASSIGNMENT OF RESPONSIBILITY

The HTEC Lockout Safety Manager (LSM) is currently: Ashley Perry.

A. The LSM will be responsible for implementing the lockout program.
B. The LSM is responsible for enforcing the program and insuring compliance with these procedures
C. Unless otherwise appointed by the LSM, the LSM will conduct the annual inspection and certification of the authorized employees.
D. Authorized and Affected employees are responsible for following the established lockout procedures. They are responsible for reviewing the Specific Equipment lockout details for each piece of equipment being locked out.

   An authorized employee is defined as a person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.

   An affected employee is an employee who is required to use machines or equipment on which servicing is performed under the Lockout/Tagout standard or who performs other job responsibilities in an area where such servicing is performed.

E. All other employees in the facility are responsible for insuring they do not attempt to restart or re-energize machines or equipment that are locked out or tagged out.

3. DEFINITIONS

Authorized employee:

An employee who locks or tags machines or equipment in order to perform servicing or maintenance.

Affected employee:

An employee who is required to use machines or equipment on which servicing is performed under the Lockout/Tagout standard or who performs other job responsibilities in an area where such servicing is performed.

Other employees:

All employees who are or may be in an area where energy control procedures may be utilized.

Capable of being locked out:

An energy-isolating device is considered capable of being locked out if it:

- Is designed with a hasp or other means of attachment to which a lock can be affixed;
- Has a locking mechanism built into it;
- Can be locked without dismantling, rebuilding, or replacing the energy-isolating device or permanently altering its energy control capability.

Energized:

Machines and equipment are energized when they are connected to an energy source or they contain residual or stored energy.

Energy-isolating device:

A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy source:

Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Lockout:

The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device:

Any device that uses positive means, such as a lock, blank flanges and bolted slip blinds, to hold an energy-isolating device in a safe position, thereby preventing the energizing of machinery or equipment.

LSM:

A 'Lockout Safety Manger' that has been appointed by the HTEC Safety Program Manager (SPM).

Normal production operations:

Utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance:

Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, maintaining and/or servicing machines or equipment, including lubrication, cleaning or unjamming of machines or equipment, and making adjustments or tool changes, where employees could be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Tagout:

The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device:

Any prominent warning device, such as a tag and a means of attachment that can be securely fastened to an energy-isolating device to indicate that the machine or equipment to which it is attached may not be operated until the tagout device is removed.

4. PREPARATION FOR LOCKOUT

Employees who are required to utilize the lockout procedure (see Lockout Form A) must be knowledgeable of the different energy sources and the proper sequence of shutting off or disconnecting energy means. The four types of energy sources are:

A. Electrical (most common form);
B. Hydraulic or pneumatic;
C. Fluids and gases; and
D. Mechanical (including gravity).

More than one energy source may be utilized on some equipment and the proper procedure must be followed in order to identify energy sources and lockout accordingly. See Lockout Form F for a specific procedure format.

A. Electrical

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Shut off power at machine and disconnect.
3. Disconnecting means must be locked or tagged.
4. Press start button to see that correct systems are locked out.
5. All controls must be returned to their safest position.
6. Points to remember:
    A. If a machine or piece of equipment contains capacitors, they must be drained of stored energy.
    B. Possible disconnecting means include the power cord, power panels (look for primary and secondary voltage), breakers, the operator's station, motor circuit, relays, limit switches, and electrical interlocks.
    C. Some equipment may have a motor isolating shut-off and a control isolating shut-off.
    D. If the electrical energy is disconnected by simply unplugging the power cord, the cord must be kept under the control of the authorized employee or the plug end of the cord must be locked out or tagged out.

B. Hydraulic / Pneumatic

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Shut off all energy sources (pumps and compressors). If the pumps and compressors supply energy to more than one piece of equipment, lockout the valve supplying energy to the piece of equipment being serviced.
3. Stored pressure from hydraulic/pneumatic lines shall be drained/bled when release of stored energy could cause injury to employees.
4. Make sure controls are returned to their safest position (off, stop, standby, inch, jog, etc.).

C. Fluids and Gases

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Identify the type of fluid or gas and the necessary personal protective equipment.
3. Close valves to prevent flow, and lockout.
4. Determine the isolating device, then close and lockout.
5. Drain and bleed lines connection the isolation device and equipment to a zero energy state.
6. Open Drain or vent valve between isolating device and equipment, then lock open.
7. Some systems may have electrically controlled valves. If so, they must be shut off and locked/tagged out.
8. Check for zero energy state at the equipment.

D. Mechanical Energy

Mechanical energy includes gravity activation, energy stored in springs, etc.

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Block out or use die ram safety chain.
3. Lockout safety device.
4. Shut off and lockout electrical system.

5. Check for zero energy state.
6. Return controls to safest position.

5. RELEASE FROM LOCKOUT

1. Inspection: Make certain the work is completed and inventory the tools and equipment that were used.
2. Clean-up: Remove all towels, rags, work-aids, etc.
3. Replace guards: Replace all guards possible. Sometimes a particular guard may have to be left off until the start sequence is over due to possible adjustments. However, all other guards should be put back into place.
4. Check controls: All controls should be in their safest position.
5. The work area shall be checked to ensure that all employees have been safely positioned or removed and notified that the lockout devices are being removed.
6. Remove locks/tags. Remove only your lock or tag.

6. SERVICE OR MAINTENANCE INVOLVING MORE THAN ONE PERSON

When servicing and/or maintenance is performed by more than one person, each authorized employee shall place his own lock or tag on the energy isolating device. This shall be done by utilizing a multiple lock scissors clamp if the equipment is capable of being locked out. If the equipment cannot be locked out, then each authorized employee must place his tag on the equipment.

7. REMOVAL OF AN AUTHORIZED EMPLOYEE'S LOCKOUT BY HTEC

1. HTEC to verify that the authorized employee who applied the device is not in the facility.
2. HTEC employee not remove lockout unless they have spoken to operator that has placed lockout, and they have given permission to remove lockout.
3. Ensure that the authorized employee has this knowledge before he/she resumes work at the facility.

8. PROCEDURES FOR OUTSITE PERSONNEL / CONTRACTORS

Outside personnel/contractors shall be advised that the company has and enforces the use of lockout procedures. They will be informed of the use of locks and tags and notified about the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

The company will obtain information from the outside personnel/contractor about their lockout procedures and advise affected employees of this information.

The outside personnel/contractor will be required to sign a certification form (see Lockout Form E). If outside personnel/contractor has previously signed a certification that is on file, additional signed certification is not necessary.

9. TRAINING AND COMMUNICATION

Each authorized employee who will be utilizing the lockout procedure will be trained in the recognition of applicable hazardous energy sources, type and magnitude of energy available in the work place, and the methods and means necessary for energy isolation and control.

Each affected employee (all employees other than authorized employees utilizing the lockout procedure) shall be instructed in the purpose and use of the lockout procedure, and the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

Training will be certified using Lockout Form B (Authorized Personnel) or Lockout Form C (Affected Personnel). The certifications shall be stored electronically in the HTEC Safety folder. The lockout certification log shall also be updated.

10. PERIODIC INSPECTION

A periodic inspection (at least annually) will be conducted of each authorized employee under the lockout procedure. This inspection shall be performed by Ashley Perry or other appointed employee.

The inspection will include a review between the inspector and each authorized employee of that employee's responsibilities under the energy control (lockout) procedure. The inspection will also consist of a physical inspection of the authorized employee while performing work under the procedures.

The LSM or another appointed employee shall certify in writing that the inspection has been performed. The written certification (Lockout Form D) shall be stored electronically in the HTEC Safety folder. The lockout certification log shall also be updated.

11. LOCKOUT FORMS

The following list of forms are to be completed prior to an HTEC employee or contractor locking out HTEC equipment:

A. List of Authorized Onsite Personnel for Lockout Procedures
B. Certification of Training (Authorized Personnel)
C. Certification of Training (Affected Personnel)
D. Lockout Inspection Certification
E. Outside Personnel/Contractor Certification
F. Specific Equipment Lockout Details Template
G. Master Lockout Form

Lockout Form A

List of Authorized Onsite Personnel
For Lockout Procedures

NAME	JOB TITLE

LOCKOUT FORM B

Certification of Training
(Authorized Personnel)

I certify that I received training as an authorized employee under ***HTEC'S*** Lockout program. I further certify that I understand the procedures and will abide by those procedures.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM C

Certification of Training
(Affected Personnel)

I certify that I received training as an Affected Employee under ***HTEC'S*** Lockout Program. I further certify and understand that I am prohibited from attempting to restart or re-energize machines or equipment that are locked out or tagged out.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM D

Lockout Inspection Certification

I certify that _____was inspected on this date utilizing lockout procedures. The inspection was performed while working on _____.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

_____ _____

INSPECTOR SIGNATURE DATE

LOCKOUT FORM E

Outside Personnel/Contractor Certification

I, _____ (outside personnel/contractor) certify that I have been informed of, and will abide by, HTEC's lockout procedures.

_____ _____

OUTSIDE PERSONNEL/CONTRACTOR SIGNATURE DATE

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM F

Specific Equipment Lockout Details

(Date)

Type of Equipment: _____

General Description: _____

_____

Manufacturer: _____

_____

Model Number: _____

Serial Number:* _____

_____

** If more than one piece of same equipment, list all serial numbers.*

Location of equipment:

_____

_____

Operator Controls

The types of controls available to the operator need to be determined. This should help identify energy sources and lockout capacity for the equipment.

List types of operator controls: _____

_____

_____

_____

_____

_____

Energy Sources

The energy sources, such as electrical, steam, hydraulic, pneumatic, natural gas, stored energy, etc.) present on this equipment are:

ENERGY SOURCE	LOCATION	Lockable		Type lock or block needed
		Yes	No	

Shutdown Procedures

List the steps in order necessary to shut down and de-energize the equipment. Be specific. For stored energy, be specific about how the energy will be dissipated or restrained.

Procedure: _____

_____

_____

_____

_____

_____

Lock Type & Location: _____

_____

_____

_____

_____

_____

How Will De-energized State Be Verified? _____

_____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Start Up Procedures

List the steps in order necessary to reactivate (energize) the equipment. Be specific.

Procedure: _____

_____

_____

_____

_____

_____

Energy Source Activated: _____

_____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Procedures For Operations and Service/Maintenance

List those operations where the procedures above do not apply [See 29 CFR 1910.147 (a)(2)]. Alternate measures which provide effective protection must be developed for these operations. Job Safety Analysis is one method of determining appropriate measures.

Operation Name: _____

_____

_____

_____

_____

_____

LOCKOUT FORM G

MASTER LOCKOUT FORM

(to be fixed near lock storage area)

ITEM	LOCATION	REASON OF LOCKOUT	TIME AND DATE OF LOCKOUT	ESTIMATED DURATION OF LOCKOUT	AUTHORIZED PERSONNEL

9. Attachment – Locking Out Procedure (HSP-P-003)

10. Attachment - Contractor Orientation Questionnaire (HSP-P-021)

Contractor/Subcontractor Orientation Questionnaire

The purpose of this questionnaire is to ensure that the subcontractor has been fully informed about the job and safety procedures. The contractor must complete the questionnaire by placing a check in the appropriate column, and answering the questions. The contractor must return the completed questionnaire to the person leading the training before work commences.

DO YOU KNOW:	**YES**	**NO**
How to report Injuries?	_____	_____
How to report damage?	_____	_____
How to report near misses?	_____	_____
How to report hazards?	_____	_____
The evacuation procedure & muster point(s)	_____	_____
What hazards exist on site?	_____	_____
What the site emergency signal are?	_____	_____
How to obtain protective equipment?	_____	_____
Where protective equipment is required?	_____	_____
What personal protective equipment is required?	_____	_____
Where MSDS's are located?	_____	_____
Where First Aid is located?	_____	_____
Where the safety program is posted?	_____	_____

WERE YOU GIVEN:

	YES	NO
A copy of the client safety policy?	_____	_____
A copy of the general safety rules and regulations?	_____	_____
A copy of the worker's and supervisor's responsibilities?	_____	_____
A copy of the supplementary instructions?	_____	_____
Adequate answers to your questions?	_____	_____

PLEASE INDICATE THE DATE OF YOUR WCB REGISTRATION _____/_____/_____

(If you have not been trained you must attend a training seminar, which will be arranged.)

I agree to comply with the company safety program and WCB regulations:

_____

Contractor/Subcontractor Name **Contractor/Subcontractor Signature**

I have instructed this contractor/subcontractor in regard to any safety hazards related to the type of work being performed by the crew in which he/she is working. I have checked that the contractor/subcontractor has the appropriate safety equipment including: hard hat, safety footwear, safety glasses, respirator and hearing protection as applicable. I have seen the contractor's/subcontractor's current WCB registration.

_____

Supervisor Name **Supervisor Signature**

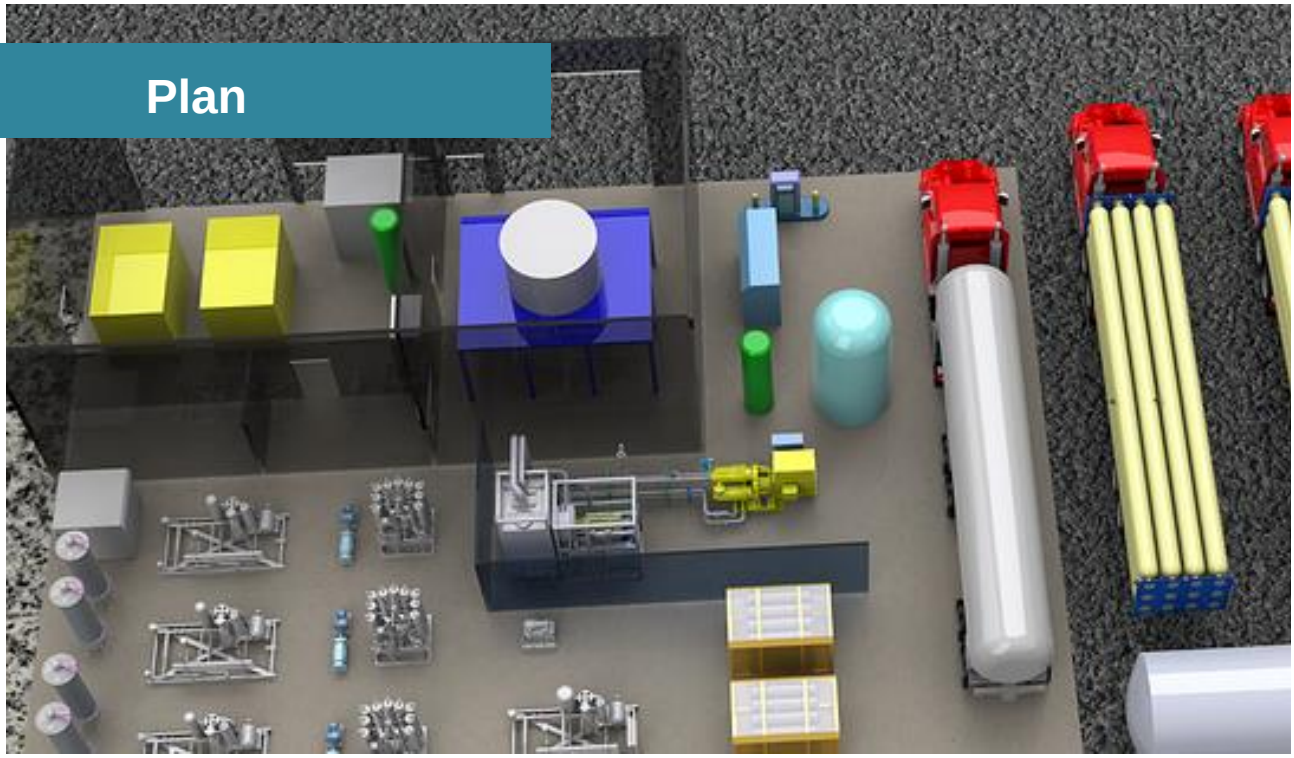
Date: _____

NOTE: this form to be filed with project records by the senior site representative

HYDROGEN SAFETY PLAN

HTEC STATION DESIGN B

Plan



Identification of the document: HSP-P-012

Revision: A

17-Aug-2016

Number of pages: 32

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IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	HTEC Station Design B
REFERENCE	HSP-P-012

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	17-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California.

The purpose of this document is to describe the HTEC Station Design B from a risk and safety perspective. All stations using Design B shall have the same general risks and safety methodologies for mitigating these risks.

All HTEC stations that are built as per HTEC Station Design B will include:

- Multiple hydrogen sources (a McPhy electrolyzer and HTEC PowerCube delivery)
- A Powertech/McPhy Compression, Storage, and Dispensing (CSD) unit
- Supporting utilities including: dispenser and electrolyzer cooling, nitrogen generation and compression, water supply.
- High voltage electrical connections
- Station security walls and doors.

2. Facility Design Safety Overview

The HTEC Station Design B is a sustainable energy initiative focused on selling hydrogen as a clean fuel to Fuel Cell Vehicle (FCV) owners. Hydrogen is delivered to the station using HTEC’s proprietary PowerCube distribution system as well as generated on site using an McPhy electrolyzer. A Compression, Storage, and Dispensing (CSD) system supplied by Powertech labs or McPhy increases the pressure and stores the hydrogen at 12,750 psig. Using the J2601 protocol the CSD system can deliver approximately 5kg of hydrogen to a vehicle at the dispenser.

The presence of hydrogen (H2) at the station makes it necessary to integrate specialized design elements and hydrogen safety systems.

From the perspective of avoiding an incident that could result in injury or death, property damage, or a situation that could endanger the public, the most problematic properties of hydrogen are its broad flammability range when mixed with air and its propensity to ignite at low energy levels. As a result, the focus of the hydrogen safety systems at the station is hydrogen detection, active ventilation, and the elimination of extraneous ignition sources.

If a hydrogen leak occurs in the open air, such as at the fueling dispenser, interconnecting piping—where hydrogen can immediately rise and dissipate in the atmosphere—the safety risk is minimal. However, a hydrogen leak within an enclosed area, such as the compressor container, could potentially pose an unsafe environment. To minimize the risk of an enclosed hydrogen leak, the facility incorporates a series of passive and active systems to prevent the leak from reaching an unsafe level.

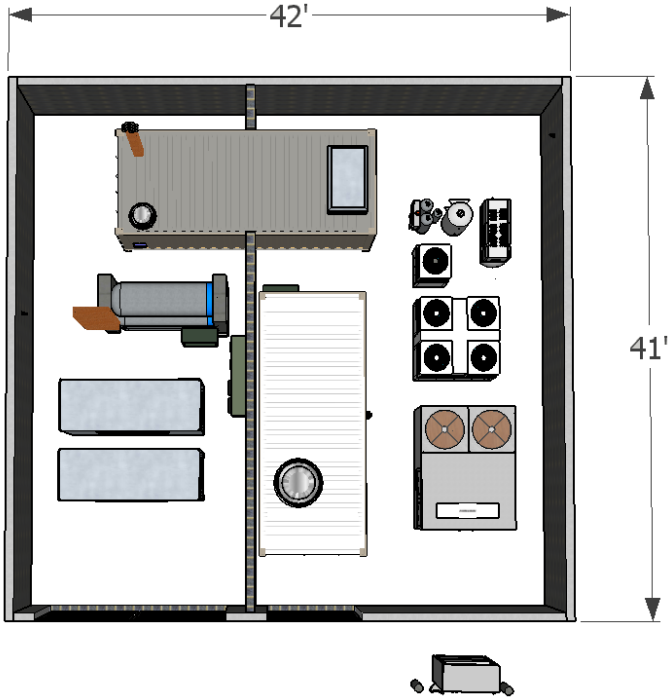
Consequently, the key safety components used to prevent an incident inside one of the station containers at the HTEC site includes hydrogen monitoring and response systems, enhanced

ventilation to prevent hydrogen concentrations from reaching explosive levels, regular system calibrations and testing, and ongoing staff training. The approach to safety at the fueling dispenser is somewhat different, primarily because small hydrogen leaks are quickly dispersed in the open-air environment. Instead the emphasis at the fueling dispenser is a series of redundant systems to stop the flow of hydrogen in the case of an emergency.

3. Station Design Description

Station Design	B
Public or Non-Public	Public
List of Key Equipment	Hydrogen Compressor Module Electrolyzer Module High H2 Pressure Storage Medium H2 Pressure Storage Low H2 Pressure Storage Low Temperature Cooling System Other Non-rated facility utilities Interconnecting piping (above and underground) Hydrogen Dispenser
Facility Security (if applicable)	Fire Barriers walls where necessary, fences, locked gates and security doors.

A general site plan the HTEC station design is shown in the figures below.



Sample Station Layout

3.1. Block flow diagram

Please refer to the appendix for a block flow diagram of the station design.

3.2. Station Layout

While the station layout will be slightly different for each location there will be the following significant commonalities to this design:

1. Two areas with different classifications separated by a fire barrier:
    a. Class I Div II area – contains all hydrogen storage and processing equipment
    b. Unclassified area – contains electrolyzer and unrated utility systems
2. Compliance with NFPA 2 distances to exposures. Fire barriers around the classified area
3. Separate access gates and security doors to both areas
4. A common hydrogen vent stack
5. An oxygen vent that is piped exhausted away from any hydrogen system.
6. A publicly accessible dispenser with underground hydrogen and coolant piping to the dispenser.

For a detailed site layout of this station design, please refer to the appendix.

3.3. Hydrogen Supply

The station design has two sources of hydrogen:

- Hydrogen for the station is delivered to the station via the PowerCube hydrogen distribution system.
- The remainder of the hydrogen supply is produced onsite with a McPhy electrolyser.

Delivered Hydrogen

PowerCubes are delivered to site on a regular schedule. Two high pressure hoses and a two ground wires connect the PowerCube to the station. The PowerCube hydrogen storage modules are located on a concrete pad and are secured via a twistloc mechanism at each corner to resist siemic loads. The PowerCube storage modules are approved under DOT Special Permit # SP 16559

The PowerCube distribution system consists of several PowerCube cylinder modules, and a specialized trailer and forklift which pick up and deliver PowerCubes to each station. Each PowerCube module consists of ten compressed gas Type 3 cylinders capable of storing a total of 89 kg of hydrogen at a pressure of 450 bar (6527 psig). Each cylinder is equipped with two TRVs that release in the event of an overheating scenario. Each PowerCube module requires compressed air to activate a source valve which allows the station to isolate the PowerCube in a ESD scenario.





PowerCube (with Dynetek logo) at a previous HTEC site, and at right without cover. Each PowerCube holds ten high pressure hydrogen cylinders.

Generated Hydrogen (McPhy Electrolyzer 40" Container)

The elctrolyzer and its associated controls are located inside a 20" container. The electrolyzer system is capable of generating upto 200 kg of hydrogen per day (8.3 kg/hr) at 30 barg pressure. To achieve this it will consume 90 kg of water per hour, generating 45 kg of waste water and 90 kg of oxygen gas at atmospheric pressure. At any given time, at most, 1.0 kg of H_2 will be contained withinGenerated hydrogen is piped to a low pressure storage module away from the container.

3.4. Hydrogen Processing Equipment

Major equipment components:

- A single 20ft x 9'-6" ISO container that houses compression, storage, dispenser cooling, and electronic control systems (see image below);
- Two (2) external cooling system modules each approximately 6' by 6' by 5' high;
- One (1) nitrogen generation module.

The equipment will be placed on site such that different rated systems are separated as per NFPA 2.

Compressor and Electrical Room (20' ISO Container)

This modular container houses the main station hydrogen compressor, the high pressure hydrogen storage, and the associated control equipment. This modular container is internally divided into two sections:

Compressor Room and High pressure storage area:

This area of the container has one access point along the short sides of the container. These doors are locked with conventional door lock and deadbolt. This area contains the hydrogen compressor, the high pressure storage and any sequencing or safety valves required. An exhaust fan draws air out of the area from one of the containers side panels. The compressor contains approximately 19 litres (5 US gallons) of hydraulic oil and 78 litres (20 US gallons) of anti-freeze-type coolant.

High pressure hydrogen is stored in six Type 2 cylinders placed inside the container. These high pressure (875 bar) storage tanks are designed to ASME Sec. 7 Div. 3 Code Case 2579. Each has a water volume of 213 L, and will be 9' 6" long and diameter of 1' 6". They are mounted inside the container with specially designed frames which comply with IBC/CSC/ASCE codes. These cylinders receive high pressure hydrogen from the compressor module and provide hydrogen to the dispenser, both via a sequencing panel inside the container.

Control Room and Cooling Systems

This area has one access point (1 door opening out, locked with conventional door lock and deadbolt) and houses the station's PLC, HMI, control panel, an air compressor which supplies the station's pneumatic valves, an air fan (for the dispenser), an electrical breaker box, the station fire alarm panel, and a cooling system for the hydrogen compressor and dispenser.



Figure 1 View from north end of container

3.5. Equipment Utilities

Three onsite cooling units are required for hydrogen processing and dispensing. Two chillers for the electrolyser and one for added dispenser capacity (increased station loads):

- Two cooling systems will be associated with the electrolyser, one to cool a system from 80°C to 25°C and a second small system to cool from 35°C to 7°C.
- The third cooler is for the dispenser which must supply hydrogen at -40°C.

The nitrogen generation module supplies nitrogen to the electrolyzer container for actuating valves and to purge the electrolyzer generation units during a controlled shutdown event. purify the hydrogen supply gas.

3.6. Hydrogen Storage

The primary on-site hydrogen storage is in six high pressure Type 2 cylinders, one large 70 bar Type 1 tank, and up to two 450 bar Powercubes that remain onsite between deliveries.

- The six high pressure (875 bar) storage tanks are described above inside the CSD unit.
- A single 600 L Type 1 tank rated to 70bar.

- This tank receives hydrogen produced on-site by the electrolyser and acts as a buffer system to ensure constant hydrogen flow to the CSD unit.

- Up to two anchored Powercubes, described in the hydrogen supply section.

3.7. Hydrogen Vehicle Fuel Dispenser

A modern style vehicle fuel dispenser allows for convenient and safe fuelling operations. The unit provides compressed gaseous hydrogen fuel to vehicles via a hose and nozzle receptacle that looks and feels much like gasoline pump handle. All hydrogen is cooled inside the dispenser such that there is limited heat building in the hydrogen before it enters the vehicle.

3.8. Site Access and Occupancy

Site Access Control

A 9 foot high concrete wall fence surrounds the station area that includes two access gates and two security doors.

Hydrogen delivery access to the site is via a 15-foot gate located. Another five foot wide gate is required on the non-hazardous side of the station to provide access to the elctrolyzer generation units. The access gate will be padlocked, with access for trained personnel only.

Access for emergency services is through any of the twosecurity doors.

Station Compound Occupancy

The site is unattended, and generally unoccupied. The only time the site will be occupied is during maintenance, hydrogen delivery, and site tours.

4. Hydrogen Safety Engineering Control Systems

HTEC uses the 'Preliminary Hazard Analysis' (PHA) and the 'Hazard and Operability' (HAZOP) methods for identifying safety vulnerabilities (ISV). These analyses are undertaken during the engineering phases of the station development. Using HTEC's previous experiences in designing, building and operating hydrogen stations a pre-design ISV analysis has been completed.

4.1. Preliminary Hazard Analysis (PHA)

The PHA is performed during the preliminary engineering phase to identify site specific design hazards and concerns. The PHA includes all aspects of the station and not just hydrogen hazards. The PHA method generates a documented analysis for all major stakeholders involved in the station development and provides either go-no-go deliverables before detailed engineering can commence or provides deliverables that must be met during detailed engineering.

4.2. Hazard and Operability (HAZOP) Analysis

Before the issuance of final engineering drawings a detailed HAZOP analysis is completed with all technical leads of the project. A suitable 3rd party moderator, not involved with the station design will moderate the HAZOP. The HAZOP breaks the station design into nodes and analyses the system response to key process changes like higher/lower/reverse flow, temperature variations, overpressure scenarios, etc. Deliverables from this analysis must be signed off before engineering drawings can be issued for construction

4.3. Pre-Design ISV Analysis and Risk Mitigation Strategies

The safety system uses a number of layered approaches to ensure system safety and mitigate the various hazards involved in the use of high-pressure hydrogen gas. The following table lists the hazards, and the associated design strategies used to mitigate the hazards:

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
High pressure containment failure	Low	High	Use of: • Design standards for plumbing all high-pressure equipment, including vent stacks; • Pressure relief devices; and, • Pressure sensors for detecting over-pressure situations and disabling station functions as needed.
Back flow of high pressure hydrogen to piping/systems with lower pressure ratings	Low	High	Use of: • Interlocking pressure controls • Pressure relief valves • Check valves and back pressure regulators to prevent backflow (not considered a fail-safe measure)
Small Gas leaks	Medium	Low	Use of: • Design standards for plumbing all high-pressure equipment, including vent stacks; • Hydrogen sensors for detecting leaks; • Pressure sensors for detecting under-pressure situations (potential leakage situations) and disabling station functions as needed; and, • Ventilation fans in areas containing hydrogen gas. • Routine maintenance and leak checking
Hydrogen ‘jets’ to nearby exposures resulting from catastrophic hydrogen failure leaks	Low	High	Use of: • Hydrogen leak design measures (mentioned above) • Compliance with latest version of NFPA 2, including fire walls, deflection barriers, and setback distances.

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Fire/explosion from hydrogen leak combined with a source of ignition	Low	High	Use of: • Design standards for plumbing all high-pressure equipment (to avoid leaks that could lead to fire); • Vent stacks for directing hydrogen leaks away from personnel; • Intrinsically-safe electrical circuitry in areas containing hydrogen gas (such as the compressor rooms); • Purging in the dispenser electrical cabinet, to prevent hydrogen gas leaks from entering the electrical cabinet; • Ventilation fans in areas containing hydrogen gas; and, • Explosion-proof cabinets for electrical circuitry in areas containing hydrogen (where intrinsically-safe methods cannot be used). • Compliance with NFPA 2 setback distances nd NPFA 70 requirements
Hydrogen permeating unclassified areas	Low	Medium	Use of: • Fire walls/sealed barriers to separate classified zones
Vehicle driving away from station with hydrogen hose connected	Medium	Low	Use of: • Hydrogen hose breakaways • Compliance with NFPA 2 for dispenser setback distances • Pressure monitoring of hose hydrogen pressures
Security break-in	Medium	Medium	Use of: • Security locks on doors and gates • Security cameras • Signage indicating ‘danger’ and ‘high pressure’ • Remote operation of station to minimize safety risk in the event of security breach

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Natural Disaster (Earthquake)	Low	High	Use of: • Site works design and installation compliance with rating earthquake zone level and approved by a California structural engineer. • Tie down of equipment to concrete pads sufficient to prevent movement of equipment of pad • Hydrogen source valves that are beside hydrogen storage tanks to minimize exposed piping. • Fail safe design such that if loss of pressure, or air supply control valves close containing hydrogen in storage containers
Asphyxiation from hydrogen or nitrogen leak in confined spaces	Low	High	Use of: • Vent holes in ceiling of containers • Hydrogen sensors in all containers • Oxygen sensors in electrolyzer to monitor both hydrogen and nitrogen leaks that are interlocked with access doors • Extraction fans in all containers.

The following subsections discusses specific design strategies in more detail:

4.3.1. Gas Detection

The hydrogen gas detection system for the 875 bar systems is comprised of explosion-proof gas detection probes connected to a monitoring panel. The monitoring panel reads hydrogen measurements from each probe, converts each measurement to a percentage of LEL, and triggers alarm outputs as needed via a relay panel. The alarm outputs are connected in series with the ESD circuitry, and are also connected to the control system. The alarms are latched, both in the control system PLC and on the monitoring panel

In addition, when a 25% LEL hydrogen alarm is detected, a visual alarm such as a strobe light will activate.The hydrogen alarm outputs cause different system responses, depending on the type and severity of each alarm.

The hydrogen probes are located as follows:

<u>875 bar Compression Container:</u>

- Compressor room
- Electrical room

Electrolyzer Module:

- Generation stacks

Dispenser:

- Inside the dispenser, in the upper portion of the lower half of the enclosure near the hydrogen tubing and valves.

The hydrogen alarms are latched in all areas. To reset any hydrogen alarm, the alarm at the gas detection panel must be reset, and then the alarm via the station HMI must be reset.

The electrolyzer module also includes an oxygen sensor inside the generation room which is interlocked to access doors. If the oxygen level drops below a safe level the system goes into a ESD fault, increases the speed of the extraction fan, and prevents access to the generation room. The reason for this sensor is the presence on nitrogen in the container that is used for controlled shut down processes and valve actuation.

4.3.2. High Pressure Safety

The hydrogen compression, storage and dispensing systems are designed and built per ASME B31.3-2012: Process Piping. This code sets forth engineering requirements deemed necessary for safe design and construction of pressure piping.

The storage banks are operated by a sequence panel which has each bank's piping connection on a common manifold built of stainless steel tubing and fittings with individual shut off valves. In the event of a high pressure incident, each storage bank is equipped with a pressure relief valve. The storage system sequence panel has pressure switches in the relief vent stacks which alert the PLC if there is an over pressure event.

The compressor is equipped with pressure relief valves to protect the compressor from an over-pressure event at the suction inlet and discharge outlet. These pressure relief valves have a pressure switch in the relief vent stack which alerts the PLC if there is an over pressure event.

All vent stacks direct vented gas upward and away from any personnel, and are designed and installed per CGA G-5.5: Hydrogen vent systems.

4.3.3. Emergency Shut Down (ESD)

The station design includes seven emergency shut down (ESD) buttons, located as follows:

- Outside the 875 bar compressor room;
- Inside the 875 bar compressor room;
- Inside the 875 bar electrical room;
- Inside the electrolyzer electrical room;
- Inside the electrolyzer generation room;
- Outside the electrolzyer module;
- On the dispenser;

When any ESD button is pressed:

- The CSD system's control air is shut down, causing all air-actuated valves to revert to a fail-safe state and become inoperable. The control system receives an "ESD fault" signal, and responds by deactivating all station functions, including dispensing and compression.
- The electrolyzer module initiates a safe shut down sequence which safely purges the system with nitrogen gas for 10 minutes.

4.3.4. Ventilation

The 875 bar compressor room includes a ventilation fan to mitigate any hydrogen leaks. The ventilation fan runs continuously at a nominal speed to allow for a minimum of 7 cfm per square foot of floor area. If the control system detects a hydrogen leak in the vicinity, the appropriate fan is run at a higher speed to help disperse the leak.

The electrolyzer uses an air extraction fan that ensures that the number of air changes inside the module is frequent enough to prevent a build-up of hydrogen gas above the lower explosive limit in a worst case scenario. As there is no hydrogen storage in the electrolyzer module, the amount of hydrogen contained within the electrolyzer at any point in time is 164 cuft which is less than the NFPA 2 'maximum allowable quantity' (MAQ) of 1000 cuft.

4.3.5. Dispenser Purge

The dispenser is able to use non-rated electrical equipment in an area classified as hazardous, by housing this equipment in a partially sealed cabinet and using a purge fan to continuously purge and pressurize the cabinet – as long as the purge is maintained, the electrical cabinet interior is considered an unclassified area. The purge fan is located in the electrical room, outside the classified area (15-foot radius around the dispenser).

If the purge is lost (e.g. due to the cabinet being opened), a pressure switch is triggered, which sends an alarm signal to the control system. If the control system detects a loss of purge, the dispenser power supply is interrupted immediately, and the control system deactivates all station functions.

When the cabinet is re-pressurized, there is a delay before the dispenser power is re-enabled, to allow time for at least four complete purges of the electrical cabinet (as per NFPA 496).

4.3.6. Intrinsic Safety

All electrical circuitry in areas classified as hazardous (e.g. the compressor rooms) is designed to be intrinsically safe, through the use of intrinsically-safe barriers where possible. If not possible, other protection methods are used.

4.3.7. Explosion-Proof Cabinets

All electrical circuitry that cannot be designed as intrinsically safe, and must be located in an area classified as hazardous, is housed in explosion-proof cabinets, to avoid all potential for contact between the electrical circuitry and any flammable gases.Non-Public Areas

5. Equipment and Mechanical Integrity

All hydrogen systems used at the station are listed and labeled by parties approved by the AHJ. This 3rd party verification ensures that all systems comply with all applicable codes and standards. Systems at this station that have been 3rd party verified include:

- Hydrogen Compressor Module
- Electrolyzer Module
- Low Temperature Cooling System

All stationary hydrogen storage containers are built to ASME standards.

6. Regulatory Compliance

This station will comply with all necessary regulatory bodies as per the authority having jurisdiction (AHJ). Ultimately compliance with the AHJ will result in permits for the station to operate. Compliance with the following regulatory bodies are of prime importance:

- Fire Department Plans Review Office
- South Coast Air Quality Management District (SCAQMD)
- Water Quality Management Agency

Compliance with the Fire Department will require compliance with NFPA, ASME, CSA, and SAE regulations, of which from a station layout perspective NFPA 2 and NFPA 70 are of high priority (NFPA 2 – Hydrogen Technologies Code, NFPA 70 – National Electrical Code).

During the design of HTEC's Woodside Station, a detailed line by line checklist against NFPA 2 and the California fire code was developed as both a tool for HTEC designers and proof to others that HTEC performed its due diligence in designing this station. The same NFPA 2 and Fire Code tool will be used during the design of any future HTEC stations, especially those in California.

As a further proof of compliance with respects to the regulatory bodies, each station design will be verified and sealed by a 3rd party engineer experienced in hydrogen stations.

7. Supplier /Contractor Selection

The importance of selecting the right vendor or contractor has a significant impact on the safety of HTEC equipment and personnel. All equipment undergoes HTEC technical approval before it is purchased and put into hydrogen service. If HTEC does not have the correct specialist in house to provide a technical assessment of a piece of equipment then HTEC will contract out this assessment. All contractors working for the HTEC on any station design will have various scopes to which HTEC will evaluate the contractor's ability to complete the scope of work effectively and safety.

HTEC requirements for various contractors are as follows:

Site Construction Work:

Contractor must have previous experience in medium duty industrial installations, especially in regards to constructing firewalls.

Electrolyzer Vendor:

Vendor must have significant experience building commercial scale electrolyzers. The equipment must conform to NFPA 2, ASME, etc. and must also be listed and label by an organization approved by the AHJ.

CSD Vendor:

Vendor must have previous experience designing, building, and testing fueling stations. All equipment used must conform NFPA 2, ASME, etc. and must be listed and label by an organization approved by the AHJ.

Tank Suppliers:

Vendor must be a ASME qualified shop and be able to test and certify all vessels in regards to ASME standards.

Mechanical Contractor (Piping):

Piping contractor must have experience with installing high purity gaseous systems and pressures above 6500 psig. Experience installing and maintaining hydrogen or other high purity high pressure systems for industrial gas companies is highly preferred. The contractor must also be certified to install piping to ASME B31.3 Section IX which will be recorded in the HTEC Master Log. Contractor must also have clear experience working with ultra pure piping systems to avoid construction debris collecting in the system and sourcing appropriate equipment (piping and tubing) for the piping of the station.

Electrical Contractor

Contractor must have proven experience in jobs complying with NFPA 70 and, if applicable, NFPA 2. The contractor must also have their electrical ticket for high voltage which will be recorded in the HTEC Master Log.

8. Construction Safety Plan

All construction personnel working at an HTEC sites and location must comply with all of the HTEC safety standards, which includes site orientation and appropriate training. Compliance with construction safety policies is detailed in HTEC document HSP-P-010.

9. Station Operation, Maintenance, and Inspections

A description of how the station will operate in steady state is attached to this document.

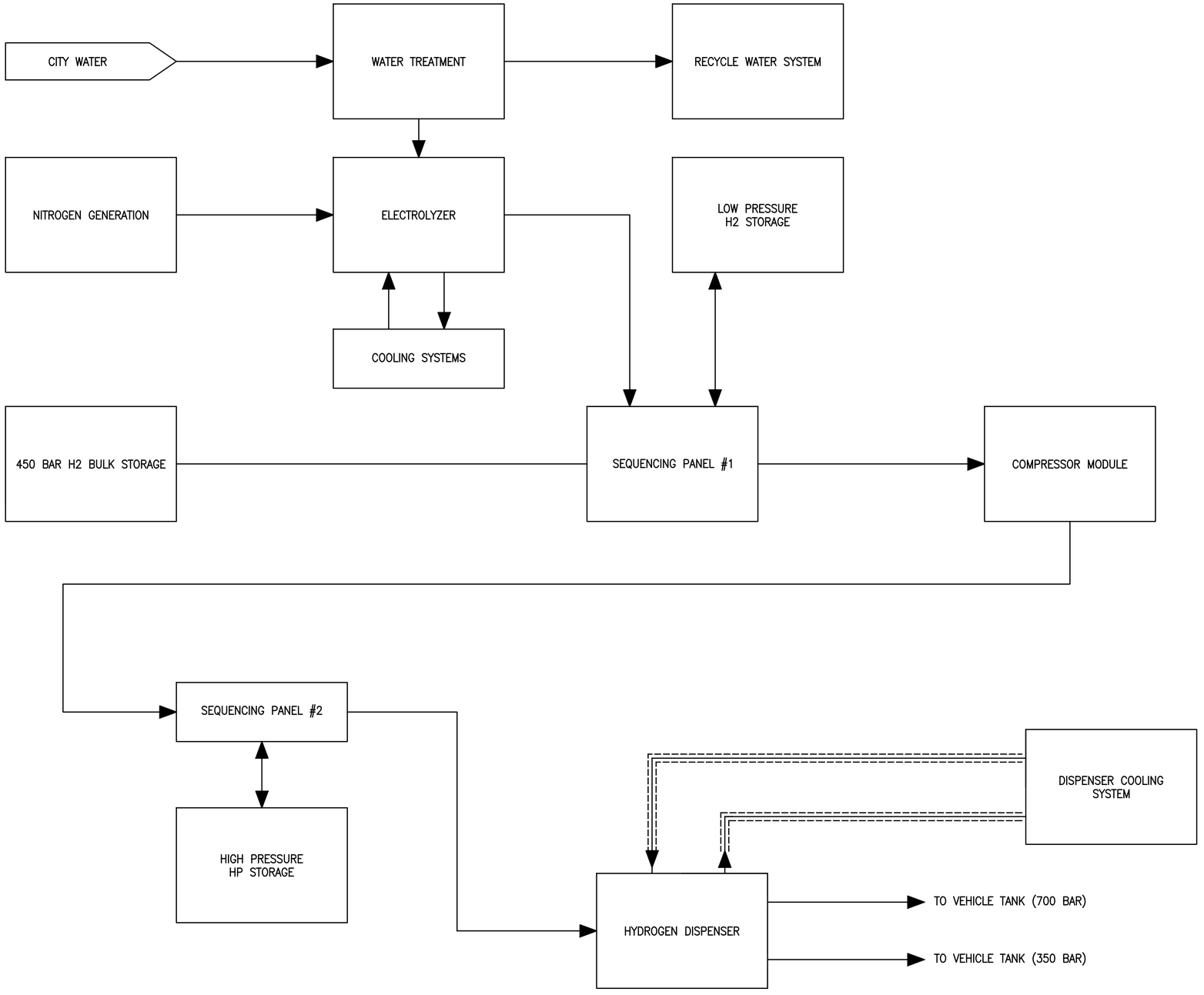
HTEC will follow all maintenance guidelines of the equipment manufacturers; a sample maintenance schedule for the CSD equipment can be found as an attachment to this document.

HTEC will employ or hire contractors to provide continual maintenance checks on the station. HTEC will comply with all regulatory maintenance requirements including:

- Station hydrogen systems visual and leak checks
- Fuel Quality inspections (J2719)
- Dispenser testing (J2601 and DMS)

All inspections, incidences, maintenance hours must be logged as per the NREL data collection program.

10. Attachment – Station Design B Block Flow Diagram



A	ISSUED FOR REVIEW	04-08-16	AP

SCALE:	NA
DESIGNED BY:	AP
DRAWN BY:	AP
CHECKED BY:	GS
APPROVED BY:	CA
PROJECT ENGINEER:	GS

SEAL

PROJECT DESCRIPTION:

HI SAM H2 SAFETY PLAN

DRAWING TITLE:

BLOCK FLOW DIAGRAM
COMPLETE FILLING STATION
WITH ELECTROLYZER

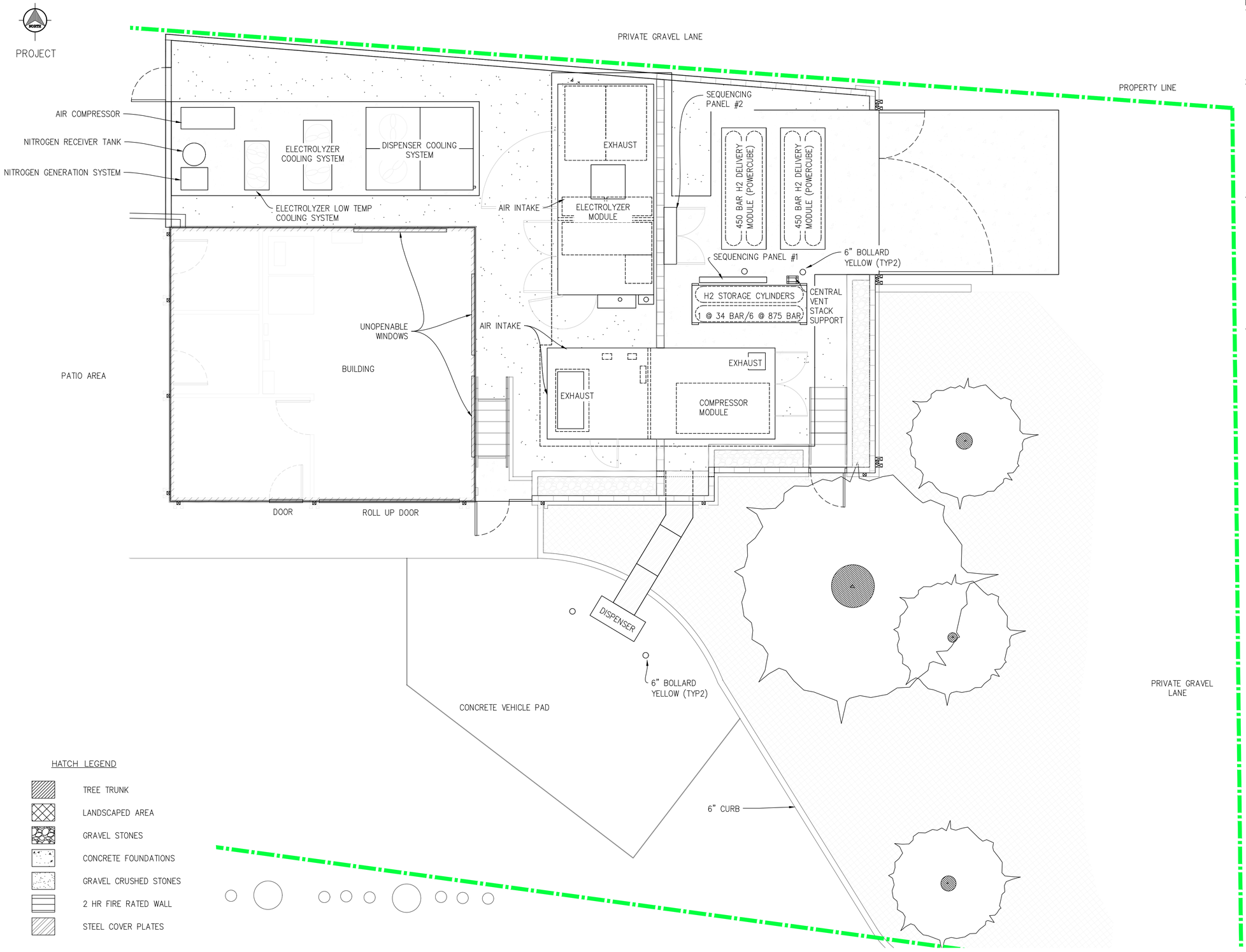
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H050

A | H050-BFD-002

11. Attachment – Station Design B – Station Layout



HATCH LEGEND

- TREE TRUNK
- LANDSCAPED AREA
- GRAVEL STONES
- CONCRETE FOUNDATIONS
- GRAVEL CRUSHED STONES
- 2 HR FIRE RATED WALL
- STEEL COVER PLATES

NOTES:

1. ALL STATION EQUIPMENT AND ARRANGEMENTS ARE IN COMPLIANCE WITH:
   - CALIFORNIA ELECTRICAL CODE NFPA 70 [2011]
   - CHAPTERS 23, 53, 59 [2013] OF THE CALIFORNIA FIRE CODE TITLE 24, PART 2 AND 9 AS DETERMINED IN THE CALIFORNIA STATE FIRE MARSHAL INFORMATION BULLETIN 14–010
   - NPFA 2 [2011] HYDROGEN TECHNOLOGIES CODE
2. COMPLIANCE WITH THE SETBACK REQUIREMENTS TO EXPOSURES AND PROPERTY LINES SPECIFIED IN NFPA 2 AND CHAPTER 23, 53, AND 58 IS BASED ON THE FOLLOWING KEY ASSUMPTIONS:
   - WHERE CHAPTERS OF THE CALIFORNIA FIRE CODE ARE NOT SPECIFIC TO OR CONSISTENT WITH HYDROGEN VEHICLE FUELING STATION DESIGN, NFPA 2 REQUIREMENTS HAVE PREVAILED.
   - REQUIREMENTS IN CHAPTER 23 AND SECTION 2303.1 AND 2309 FOR FUEL DISPENSING DEVICES TO BE 10 FEET FROM PROPERTY LINES DOES NOT PERTAIN TO THE PORTABLE HYDROGEN DELIVERY MODULES
   - CALIFORNIA FIRE CODE CHAPTERS 53 AND 58 DO NOT PRESCRIBE ANY PROPERTY LINE SETBACKS FOR HYDROGEN DELIVERY MODULES.
3. SETBACK DISTANCE COMPLIANCE IS DEMONSTRATED IN THE FOLLOWING DRAWINGS AND DOCUMENTS:

SEPARATION DISTANCE FROM BULK GH2 250–3000 PSIG H2 STORAGE ONLY	H037–GA–019
SEPARATION DISTANCE FROM BULK GH2 3000–7500 PSIG H2 STORAGE ONLY	H037–GA–020
SEPARATION DISTANCE FROM BULK GH2 7500–15000 PSIG H2 STORAGE ONLY	H037–GA–021
SEPARATION DISTANCE FROM BULK GH2 STORAGE SYSTEMS TABULAR FORM	H037–GA–022
SEPARATION DISTANCE FROM GH2 DISPENSING SYSTEMS	H037–GA–023

4. FOR FURTHER SITE DETAILS SEE THE FOLLOWING DRAWINGS:

EQUIPMENT LOCATION DETAILS	H037–GA–007
EQUIPMENT ELEVATION LAYOUT	H037–GA–008
CENTER OF MASS	H037–GA–009
EMERGENCY STOP BUTTON AND FIRE EYE LOCATION	H037–GA–011
PIPING LAYOUT	H037–GA–012
HAZARDOUS AREA CLASSIFICATION	H037–GA–013
EQUIPMENT TIE DOWNS	H037–SK–012

No.	Description	Date	By.
	REVISIONS		
F	UPDATE EQUIPMENT LOCATIONS	17–08–2016	AP
E	UPDATE NOTE DETAILS	14–09–2015	AP
D	ISSUED FOR BUILDING PERMIT	29–07–2015	AP
C	UPDATED FENCE DETAILS	22–07–2015	GS
B	ISSUE FOR HAZOP	07–07–2015	AP
A	ISSUE FOR REVIEW	01–06–2015	AP

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SCALE:	1/4"=1'0"
DESIGNED BY:	CA
DRAWN BY:	AP
CHECKED BY:	GS
APPROVED BY:	
PROJECT ENGINEER:	GS

SEAL

PROJECT DESCRIPTION:

SKYLINE HYDROGEN ENERGY CENTER

DRAWING TITLE:

GENERAL ARRANGEMENT
HYDROGEN STATION SYSTEMS

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PROJECT NO: H037

Rev. No. F | Drawing No. H037–GA–010

12. Attachment – Station Design B - Steady State Operation - Overview

The station can be separated into 4 different areas: H2 Supply/Generation, H2 Compression and Storage, H2 Dispensing, and Station Auxiliaries. Each area is described below from a station control perspective. The individual 'micro' control mechanisms within each area/system are not described here. Please refer to the respective owners manuals for a more detailed understanding of a specific system. This section does not discuss start-up or shut down procedures.

A discrete 5V circuit connects all modules and ESDs. If this circuit loses voltage, all systems enter their respective emergency shut down sequences.

Apart from the ESD circuit the electrolyzer and station auxiliaries run independently of all other station systems; temperature and pressure monitoring trigger these system to run in different states.

H2 Supply/Generation

Electrolyzer

The Electrolyzer module is in Standby mode whenever there is power to the module. In standby mode: the electrolyzer is pressurized, there is no current to the stack, the module could be venting/purging to sustain purity of hydrogen, the module is monitoring the level of the condensate and refilling the condensate recovery when necessary, the module is monitoring the coolant flows as well as the nitrogen pressure, and the module is controlling the temperature of the electrolyte and creating air flow through the container.

The electrolyzer monitors the Nitrogen pressure inlet, as well as the mass flow of cooling and low temperature cooling coolants. If any of these supply products drop below a threshold the electrolyzer will enter into a controlled shutdown sequence.

Whenever the output pressure of the electrolyzer is below 30 bar, current flow through the electrolyzer stack and the electrolyzer starts generating hydrogen and oxygen. A back pressure regulator, upstream of the pressure transducer, ensures that all hydrogen at the exit of the electrolyzer is at 30 barg pressure. All systems described in standby mode are monitored during generation as well.

During generation mode, hydrogen, nitrogen, and oxygen are emitted. The Hydrogen product flows out of the electrolyzer module and into Sequencing Panel #1, while the Oxygen is vented out of the Oxygen vent and the nitrogen is vented through the main vent mast. The Nitrogen is a product of the purification regeneration process inside the module.

Low Pressure Hydrogen Storage

A 600 litre storage tank rated to 38 barg (550 psig), is connected the Sequencing Panel #1. There are no specific controls connected to this tank. All controls and overpressure protection (PSV) are located on the Sequencing Panel #1. The purpose of this storage tank is buffer 'low pressure' Hydrogen supply (<30 barg) flowing from the sequencing panel #1 to the compressor module.

PowerCube

Each DOT certified PowerCube can deliver 89 kg of gaseous hydrogen (GH2) at a max service pressure of 450 bar. There are 10 cylinders per PowerCube with each cylinder having its own isolation needle valve. A manifold panel on each PowerCube houses ¼ turn manual ball valves with are used when connecting it to the station. An automatic safety shutoff valve on each PowerCube requires compressed air from the station in order for the PowerCube to supply hydrogen. This safety shutoff valve will close whenever an ESD is pressed or the PLC determines a leak in the hose connecting the PowerCube to sequencing panel #1.

A minimum of one PowerCube will be onsite for the beginning of daily operation with a minimum pressure of 407 bar (5900 psig) and minimum contained H2 mass of 74.4 kg. The station has been designed with the ability to operate with two PowerCubes on site. Each PowerCube is connected to the Sequencing Panel #1 via a flexible hose, and this panel controls which PowerCube is being used during operation.

To replace a PowerCube on site, a specific set of switch position, manual isolation and purge valves will be used on the sequencing panel;. The switch will indicate to the station that the specific PowerCube cannot be used for hydrogen supply, and to source hydrogen from another PowerCube or to enter electrolyzer mode as discussed below.

Sequencing Panel #1

The pressure of hydrogen supplied to the compressor module is varied using Sequencing Panel #1 (SP1). The SP1 includes both air actuated valves, pressure transmitted and indicators, manual valves, check valves, pressure regulators, Switches etc. There are three supply pressures that can be supplied to the compressor module:

a) ‘Sprint Mode’ (350 barg)
b) ‘Steady State Mode’ (27-29 barg), and
c) ‘Electrolyzer Only Mode’ (20-30 barg).

During ‘Sprint Mode’, pressure from the PowerCube is reduced to 350 bar and flows directly into the compressor module. A regulator inside the compressor module ensures hydrogen pressure is below the maximum allowable suction pressure for the compressor. The station has a mandate to dispense hydrogen with a 33% renewable content. Using hydrogen only from the PowerCube, which may not be considered renewable, not only would violate this mandate but would also incur high station operational costs, due to delivery fees etc. Therefore, the station only enters into ‘Sprint Mode’ when it is required (based on a certain pressure level in high pressure storage).

During the majority of the day (7:30am-7pm), the SP1 will operate in ‘Steady State Mode’. In this state, the 350 barg pressure from the PowerCube is further reduced to 27-29 bar and combines with 30 barg hydrogen being sourced from the electrolyzer (~100 renewable). The low pressure hydrogen storage connects downstream of the mixing point between the two hydrogen streams. This mixed hydrogen stream then flows to the compressor module with an expected pressure of 27-29 barg.

‘Electrolyzer Only Mode’ is a state where only hydrogen sourced from the electrolyzer is used. As the compressor has a lower compression limit, the compressor will be cycled on and off depending on the pressure inside the low pressure hydrogen storage. When the compressor is activated, it will drain hydrogen from low pressure storage until the pressure is approximately 21 barg. At 21 barg an isolation valve shuts off hydrogen supply to the compressor module and the electrolyzer builds

pressure in the low pressure storage to 30 bar at which point the cycle continues. An internal counter ensures that the compressor only restarts up to a maximum of six (6) times per hour to prevent motor overheating and minimal compressor life degradation.

H2 Compression and Storage

Compressing Logic

The specific logic of the compressor is 3rd party IP. This section provides a broad overview of how this logic works. The compressor module accepts any range of H2 pressure between 20 and 350 bar. If the inlet pressure is below 20 bar, an actuated valve closes to avoid depressurization of the line as well as possible damage to the compressor. The compressor is operational any time pressure in either of the high pressure storage banks are below a threshold amount (~860 barg).

Compressed Hydrogen leaves the compressor and flows to the high pressure sequencing panel. Air actuated valves allow the compressed hydrogen to flow into either of the high pressure storage banks. These banks are generally filled one at a time, with the highest pressure bank being filled first, then the next lowest pressurized bank, and then finally the remaining bank. The pressure of each bank is constantly monitored with PITs inside the sequencing panel. If a customer is filling a vehicle while the compressor is running, the compressor does not stop but the vehicle filling logic overrides the logic required to compress the high storage tanks. This means that the high pressure sequencing panel valves adjust to the requirements of filling. After the vehicle is filled, the HPSB (high pressure storage bank) filling logic continues.

H2 Dispensing

Hydrogen Dispenser

The specific logic and valve sequence of how a vehicle tank is filled is 3rd party IP, but the logic must conform to J2601.

A customer will arrive at the dispenser and request a either a 700 or 350 bar fill from the HMI on the dispenser. A payment option will be verified with the customer (credit card, debit card, or fob). The customer connects the appropriate filling nozzle to their vehicle. When system recognizes a connection it will follow the J2601 filling sequence. Hydrogen will be sourced from the lowest pressure bank and equalized with the vehicle tank, then the next highest pressurized tank, and finally the highest pressurized bank. A target pressure or State of Charge (SOC) will be determined by the logic based on J2601 tables; this accounts for the settling and temperature decrease of the hydrogen after it has been dispensed to the vehicle tank. During dispensing the hydrogen flows through a liquid-gas heat exchanger with -40°C coolant which will lower the temperature of the hydrogen in accordance with J2601.

To determine the target SOC inside the vehicle tank pressure values will either communicated via the vehicle pressure sensor or from a pressure sensor on the dispenser. A temperature sensor downstream of the hydrogen heat exchanger combined with the tank pressure reading continuously determines the J2601 filling target pressure/SOC. The dispenser limits the flow of hydrogen to 60 g/s as per J2601. An air actuated valve on the dispenser closes once the target SOC in the tank has been reached, if the customer stops the filling process, or in the case of an emergency. After this valve has closed, the hose line is automatically vented and the customer releases the nozzle from the vehicle. If

a 350 bar fill is being used, the nozzle itself relieves the pressure in the nozzle via the dispenser vent stack, such that the nozzle can be removed from the car. The amount of hydrogen dispensed is measured via a flow meter and recorded against the customer ID (if using a RFID mechanism), or charged to a credit card account.

Station Auxiliaries

Dispenser Cooling System

The dispenser cooling system has its own power supply (not routed through the compressor module) and its own control system. The cooling fans increase or decrease their speed to maintain a -40°C coolant temperature level. An on/off pump continuously moves coolant around the entire system at a set flow rate. The cooling system can be turned off manually and has a discrete link to the compressor module which can turn the system on or off. In the event of an Estop, the dispenser cooling system will be turned off.

Electrolyzer Low temperature Cooling System

The electrolyzer low temperature cooling system is used in the electrolyzer module for gas purification and electrical room ambient temperature control. The system is always in standby mode whenever there is power to the station. The low temperature cooling system has its own control system which increases or decreases its fan speed to maintain a minimum 5°C coolant temperature level. There is a pressure switch in the system to shut off the cooling system in the event that a blockage or isolation valve is shut. There is no communication between Low temperature cooling system and the ESD circuit.

Electrolyzer Cooling System

The electrolyzer cooling system is used in control temperature of the electrolysis stack in the electrolyzer module. The system is always in standby mode whenever there is power to the station. The cooling system has its own control system increases or decreases its fan speed to maintain a minimum 25°C coolant temperature level. There is a pressure switch in the system to shut off the cooling system in the event that a blockage or isolation valve is shut. There is no communication between the cooling system and the ESD circuit.

Air Compressor (N2 Supply)

The air compressor is always in standby mode whenever there is power to the station. The system turns on and off to fill and maintain a set pressure of 6.5 bar (150 psig) inside the air compressor storage tank. There is no communication between the air compressor and the ESD circuit.

Nitrogen Generation System

The nitrogen generation system is always in standby mode whenever there is power the station. The system has its own control system and generates nitrogen whenever the output pressure drop below a set pressure. The generator is a PSA system producing 99.995% nitrogen. The high purity of this nitrogen is required for safe purging of the electrolyzer during a controlled emergency stop as well as for regenerating the electrolyzer purification system.

Nitrogen Storage

A nitrogen storage tank receives the pure nitrogen produced by the generator. It has been sized such that there is always enough nitrogen to completely purge the electrolyzer in the event of an emergency shut down.

14. Attachment – Sample Maintenance Schedule for CSD equipment

This section provides a listing of the maintenance items and schedules for the station's sub-systems.

Refer to the following documents for detailed maintenance procedures:

700 bar compressor – refer to "Instruction Manual"

700 bar compressor chiller – refer to "Installation & Operation Instruction Manual"

The maintenance schedules are as follows:

Component / Test	Type	Minimum Service Interval	Requirements/Components
875 bar Compressor			
Hydraulic oil	AW ISO 46/2 ASTM D2882	Every 4,000 hr or 1 yr interval, or use oil analysis kit to determine change interval	See list of recommended hydraulic oils, reference procedure in Hydro-Pac LX compressor Instruction manual
Hydraulic oil suction strainer	140 micron	First 50 hrs, every 4,000 hr	Wash in solvent bath, blow with compressed air from inside to outside, dry and dip in oil before reinstalling, reference Hydro-Pac LX compressor Instruction manual
Hydraulic oil return filter	25 micron	First 50 hrs, every 4,000 hr	Disposable element, must replace, Hydro-Pac LX compressor Instruction manual
Gas cylinder		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
Hydraulic cylinder		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
Check valves		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
875 bar Compressor Chiller			
Condenser coil		Monthly, or as needed	Inspect and clean, reference user manual
Fluid (water glycol mixture)		Monthly, or as needed	Check fluid quality by inspecting for debris or contaminants, reference user manual
Fluid pressure		Monthly, or as needed	Check for normal outlet fluid pressure
Fluid strainer		Every six months, or as needed	Inspect fluid strainer, reference user manual
Inlet water filter		Annually, or as needed	Inspect and replace as needed

Component / Test	Type	Minimum Service Interval	Requirements/Components
Fluid system and piping		Annually, or as needed	Visually check for leaks and wear on piping components. Replace/tighten as needed.
Electrical system		As needed	Reference user manual J-5562 IOM
Refrigerant system		Annually	Refrigeration Contractor - Perform equipment inspection and refrigerant leak test. Depending on condition of condenser, additional cleaning may be peformed.
Pre Cooler Chiller			
Refrigerant system		Annually	Refrigeration Contractor - Perform equipment inspection and refrigerant leak test. Depending on condition of condenser, additional cleaning may be peformed.
Condenser coil and fans		Monthly, or as needed	Inspect and clean if debris and dirt build up present. Check fans for signs of wear and tear or damage.
Fluid (PTL HPC)		Bi-Annually, or as needed	Check coolant quality by inspecting for debris, contaminants or ice build up inside of holding tank
Fluid pressure		Monthly, or as needed	Check for normal outlet fluid pressure
Fluid system and piping		Quarterly, or as needed	Visually check for leaks and wear on piping components. Replace/tighten as needed.
Pressure Relief Devices			
Hydrogen		Every three years, or as needed	Recertification, to be peformed by FM valves or ASME accredited company.
700 bar Fueling Hose			
Inspection		Annually, or as needed	Visually inspect, replace if needed
Replacement		Every two years, or after pull-out event	Replace hose
350 bar Fueling Hose			
Inspection		Annually, or as needed	Visually inspect, replace if needed
Replacement		Every two years, or after pull-out event	Replace hose
700 bar Fueling Nozzle			
Leak check		Every four to six weeks	Check for leak at nozzle, reference procedure outlines in TK17 H2 70MPa Operating instructions

Component / Test	Type	Minimum Service Interval	Requirements/Components
Lubrication		Every four to six weeks	Lubricate nozzle components, reference Lubrication Plan TK17 H2 70MPa Operating instructions
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TK17 H2 70MPa Operating instructions
Inspection		After pull-out event	Send to manufacturer for inspection
Replacement		Every three years, or as needed	Send nozzle to manufacturer for refurbishment

Component / Test	Type	Service Interval	Requirements/Components
350 bar Fueling Nozzle			
Leak check		Every four to six weeks	Check for leak at nozzle, reference procedure outlines in TK16 H2 Operating instructions
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TK16 H2 Operating instructions
Inspection		After pull-out event	Send to manufacturer for inspection
Replacement		Every three years, or as needed	Send nozzle to manufacturer for refurbishment
700 bar Fueling Breakaway			
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TSA1 H2 Operating instructions
Inspection		After pull-out event	Check for leaks, or send to manufacturer for inspection
Replacement		Every three years, or as needed	Send breakaway to manufacturer for refurbishment
350 bar Fueling Breakaway			
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TSA1 H2 Operating instructions
Inspection		After pull-out event	Check for leaks, or send to manufacturer for inspection
Replacement		Every three years, or as needed	Send breakaway to manufacturer for refurbishment

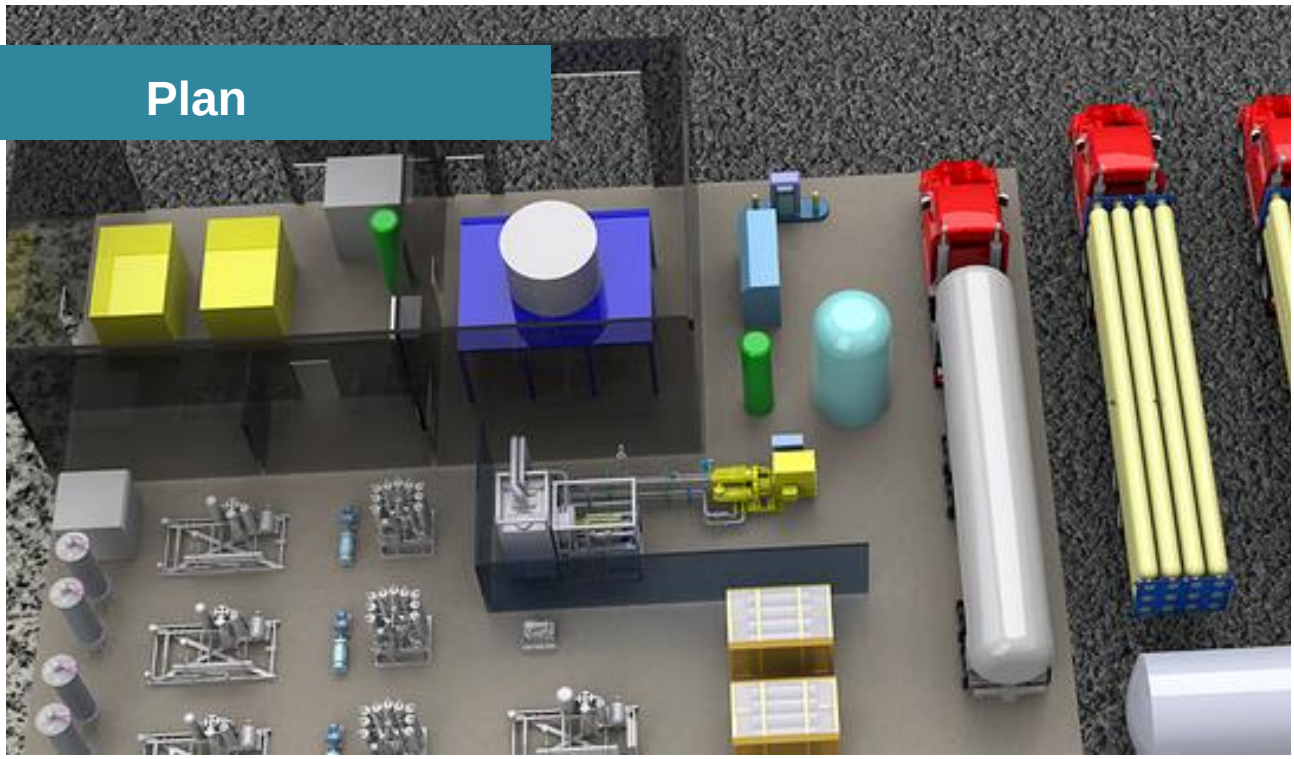
Component / Test	Type	Service Interval	Requirements/Components
Hydrogen Piping			
Inspection		Weekly, or as needed	Visually inspect pipe, valves and fittings
Leak Check		Monthyl, or as needed	Perform leak test on pipe, valves and fittings
Hydrogen Vent Systems			
Inspection		Quarterly, or as needed	Visual inspection of vent system for operational obstructions and support integrity, reference CGA G-5.5
Inspection		Weekly, as needed after weather event	Inspect water drain device for water accumulation, reference CGA G-5.5
Gas Detection System			
		Every three months, or as needed	Calibrate all gas detectors, reference gas detector manual

HYDROGEN SAFETY PLAN

STATION 1: SANTA NELLA H2 STATION

SPECIFIC DETAILS

Plan



Identification of the document: H065-SAF-002

Revision: A

18-Aug-2016

Number of pages: 10

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IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Hydrogen Safety Plan
REFERENCE	H065-SAF-002

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	18-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California.

The purpose of this document is to describe the Santa Nella HTEC Station and any design differences or site safety risks that need to be incorporated on top of design considerations described in HTEC Station Design B (HSP-P-012). Risks in this document may or may not be different from the risks at other HTEC station locations.

It is the expectation that this is a preliminary document and that it will evolve as the project continues, and more complete information is identified.

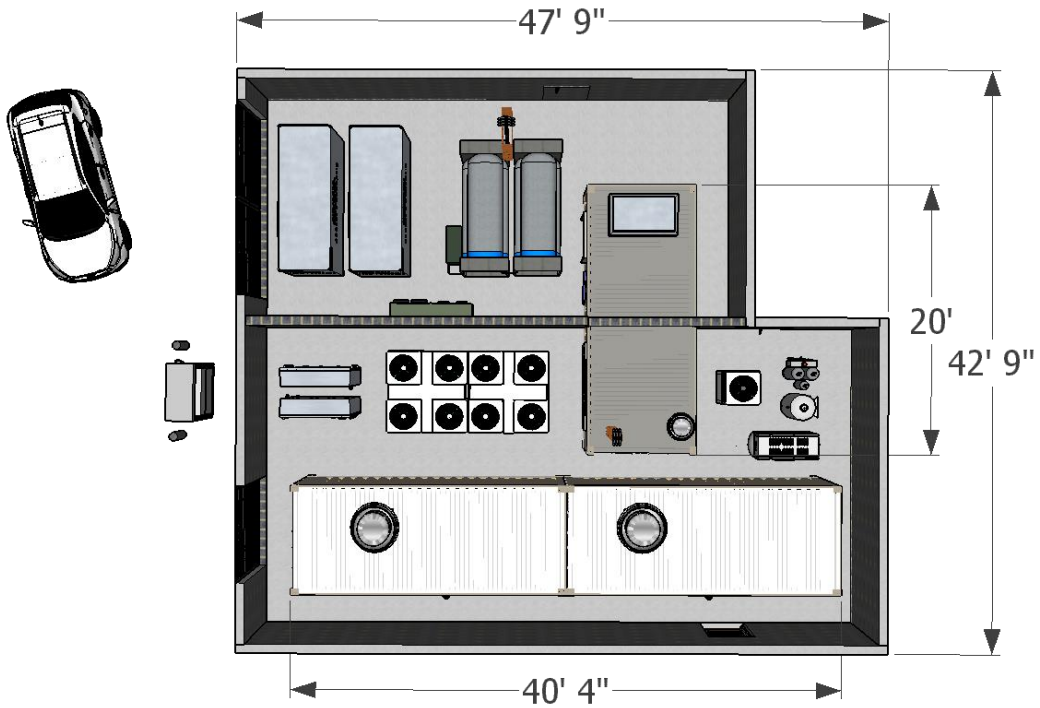
2. Facility Description

Station Name	Santa Nella Hydrogen Station
HTEC Station Design Type & Reference Document	B – (Reference Document: HSP-P-012)
Address	12860 CA-33, Santa Nella, CA
Lot Description	Very large and open, but with significant vehicle traffic
Distance to Fire Department	0.8 miles – Merced County Fire Department
Public or Non-Public Hydrogen Station	Public
Total Station Area:	2064 sqf
List of Key Hydrogen Equipment	Hydrogen Compressor Module Electrolyzer Module High H2 Pressure Storage Medium H2 Pressure Storage Low H2 Pressure Storage Low Temperature Cooling System Other Non-rated facility utilities Interconnecting piping (above and underground) Hydrogen Dispenser
Station Barriers to Entry (if applicable)	Fire Barriers walls where necessary, fences, locked gates and security doors.
Number of attendants for station while open	Zero – Station is remotely operated
Hours of operation	24/7 expect during maintenance and hydrogen delivery

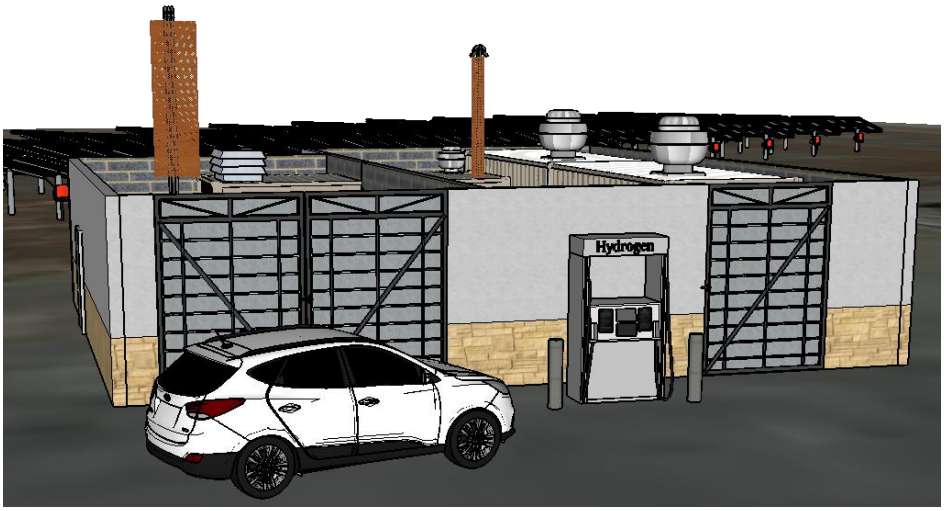
A general site plan and layout of the HTEC station is shown in the figures below. The station is located on a large Rotten Robbie Gas Station, a chain for Robinson Oil Corp. that services both cars and trucks. It is a busy 24 hrs station that is situated just off the I5 highway at Santa Nella.

The HTEC station is located near the south west corner of the property. There are five access points to the property from the main road along the eastern side of the property.

For a station block flow diagram, description of major hydrogen processing equipment, or general site operation, please refer to the HTEC Station Design B document (HSP-P-012).



Proposed Station Layout



Proposed Station Isometric View

3. Site Access and Occupancy

Site Access

There are five (5) access points from the main road (Highway 33). Hydrogen delivery or special equipment delivery will be from the southern most access point. These access point can be seen in the picture below.

Station Access Control

A 9 foot high concrete wall fence surrounds the station area that includes two access gates and 2 security doors. The access gate and doors will be locked, with access for trained personnel only. Each of the gates and doors can be pushed open from the inside to escape the facility in an emergency.

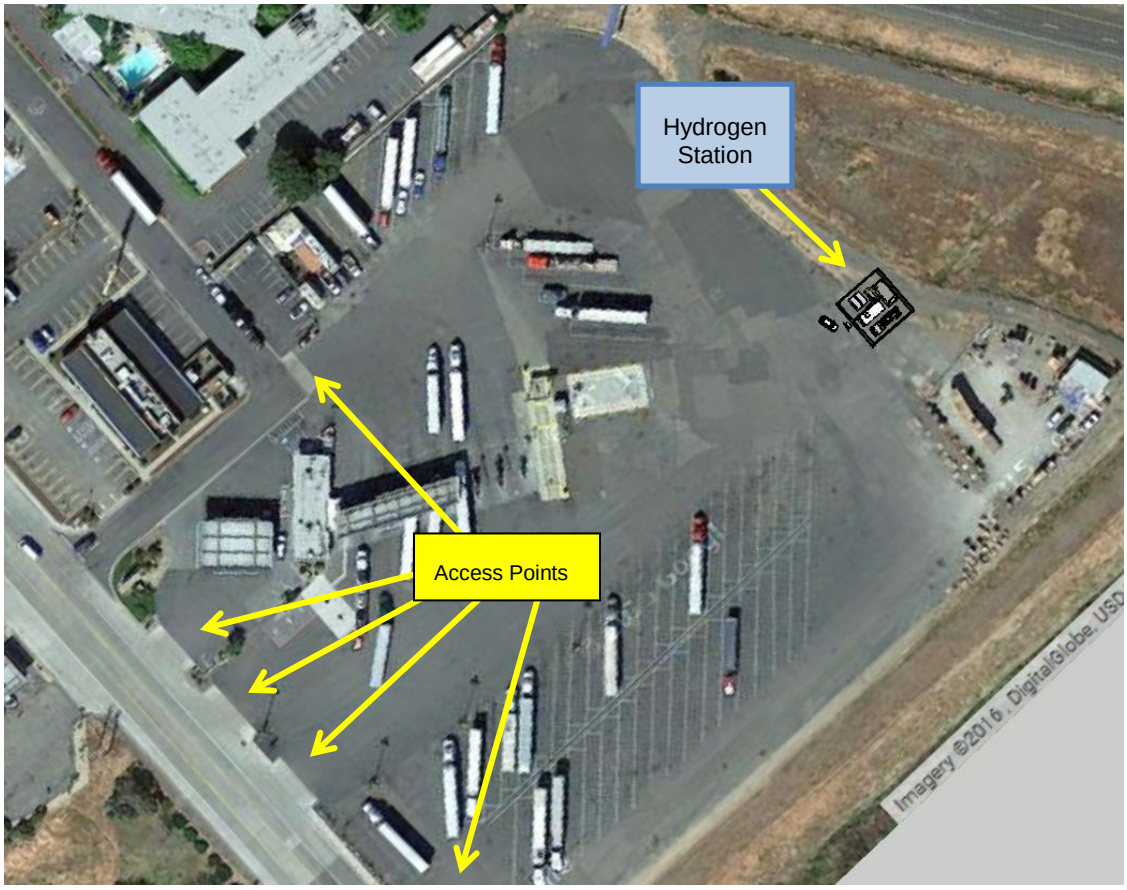
Hydrogen delivery access to the station is via a 15-foot gate located on the site south wall.

Another four (4) foot access gate exists on the site south wall that is required for access and maintenance of the electrolzyer.

Access for emergency services is through either of the two security doors.

Station Compound Occupancy

The site is unattended and generally unoccupied. The only time the site will be occupied is during maintenance, hydrogen delivery, and site tours.



Santa Nella Hydrogen Station - location map

12860 CA-33, Santa Nella CA

4. Site Specific Operation

General operation of the station will not differ from the general operating overview described in HTEC Station Design B.

Station Specific inclusions for control strategy:

- Dispenser will not be operational during compressed hydrogen delivery. This is because when the access gates are open, there is no space to safety park vehicles near the dispenser.
- The access gate to the electrolyzer will need to have either a SOP or interlocking security mechanism to disable dispenser operation. The reason for this is that the electrolzyer is contained in a non-rated zone which will be exposed if the access gates are open and the dispenser is in operation.

5. Site Specific Hazards

The following list details site specific hazards that must incorporated into the station PHA and HAZOP analysis as per HSP-P-012:

The Rotten Robbie site is large open lot, bordered by the west side freeway (I5) to the east, a large ditch to the south, a motel and restaurant on the north side and CA-33 on the west. Distances to hazards as per NFPA 2 are far in access of the setback requirements.

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Collision of large trucks with station	Low	high	Use of: • Large 6”-8” diameter concrete filled bollard around the outside of the station. • Location of site is away from truck parking locations • A concrete raised island between truck traffic and dispenser and station.
Collision of vehicle with station due to low light visibility (site located on 24/7 gas station.)	Low	High	Use of: • Night time lighting • Reflective signage at key locations.

6. Construction Specific Considerations

A preliminary analysis of the station found that there are no extra construction specific safety considerations on top of those included in HSP-P-012.

7. Electrical Connection

Electrical connection for the station is still under review. It is expected that power can be source from either the building on the west side of the site or from the main site electrical connection on the east side of the site near the southern most access location.

It is proposed that electrical power supply for the station can be supplemented by a solar panel field behind the HTEC station. HTEC is not responsible for the installation or maintenance of these solar panels and thus a constant source of power is expected on demand.

8. Special Permitting Considerations

At this time no special permitting considerations are known above those described in HSP-P-012.

9. Site specific Safety Procedures

Preliminary discussions have been completed with landowner only. After receipt of NOPA, HTEC will incorporate the Rotten Robbie safety procedures into this document as a special safety procedure. Thus far, no limiting procedures in regards to site have been found.

HTEC is considering integrating the Rotten Robbie ESD signal into the hydrogen station, but the distance between the two facilities is over 500 feet and may not be necessary.

Station Name	Address	Safety Plan Document #:	Revision
Capitol Hydrogen Station	3939 Snell Ave, San Jose, CA 95136	H066-SAF-001	A – August 18th 2016

THIS DOCUMENT IS MEANT AS AN OVERARCHING SAFETY DOCUMENT AND MUST BE POSTED IN CLEAR VIEW AT SITE.

Brief Station Description:

The Capitol Station is located on at a Valero gasoline station named 'Capitol Service Center". The station has a dispensing capacity of 200 kg/day. Hydrogen is supplied to the station via a HTEC PowerCube hydrogen delivery system. A Compression, Storage, and Dispensing (CSD) system supplied by Powertech labs increases the pressure and stores the hydrogen at 12,750 psig. Using the J2601 protocol the CSD system can deliver approximately 5kg of hydrogen to a vehicle at the dispenser.

Scope of Hydrogen Safety Plan

The purpose of this plan is to provide a guide that will ensure the safe conduct of all project work with an emphasis on aspects involving hydrogen and hazardous materials handling. HTEC is building a network of hydrogen stations in California with the same safety mindset for all stations. Certain elements of this safety plan will be the same for all of HTEC stations while others will be specific to this station.

A complete safety plan for this station is the amalgamation of all the documents listed below:

No.	Document Name	Document Number	Revision
1.	HTEC Safety Policy and Processes	HSP-P-10	A – August 10th 2016
2.	HTEC Hydrogen filling station - Design A	HSP-P-11	A – August 17th 2016
3.	HTEC Capitol Site Specific Details	H066-SAF-002	A – August 18th 2016

Brief Document description:

HTEC Safety Policy and Processes:
includes HTEC safety policies and procedures including training, site orientations, change management, HTEC hydrogen and fuel cell experiences, general hydrogen characteristics and emergency response procedures.

HTEC Hydrogen filling station - Design B:
includes a description of the station design and equipment, hazard analysis, and safety design to mitigate potential risks

Capitol Site Specific Details:
includes site specific information including: a general layout of the station, process flow diagrams, site access, site required safety systems above the station design requirements.

Station 5: Capitol Hydrogen Fuelling Station
Emergency Response & Safety Guide Quick Reference

3939 Snell Ave,
San Jose, CA 95136

This quick reference is intended for technical personnel and equipment operators who have completed all mandatory hydrogen safety and equipment training.

1. Emergency Contact Information:

First Responders	**911**	(Fire / Ambulance / Police)

2. HTEC Emergency Contact Information:

Colin Armstrong	(604) 998-4147 or	(604) 351-0298
Ashley Perry	(778) 229-8059	
Bob Boyd	(510) 922-9613	

3. Powertech Labs

Ashley Tyndall	(604) 590-7500

4. Land Owner

Gurpreet Sethi	(408) 227-4595

Critical Emergency

During a critical emergency, an issue has been identified that is likely to affect the safety, health, and welfare of personnel, or damage the environment or equipment.

The following procedure shall be followed if a critical emergency has occurred:

1. **Push the nearest Red Emergency Shutdown button (ESD).**
2. As an immediate measure, isolate the area for at least 100 meters (330 ft) in all directions, keeping people upwind of the incident if possible.
3. Call 911 to report the emergency, and notify the dispatcher that the emergency involves hydrogen fuel;
4. Follow instructions provided by Emergency Services personnel, giving first aid as appropriate to injured persons.
5. Contact one of the Emergency contacts listed above.

Fires: Use dry chemical or carbon dioxide (CO_2) fire extinguisher – a fire extinguisher is located at in the Control Room (south door of station). Do not attempt to extinguish a fire if the fire is being fed from a hydrogen leak – the source of the leak must be eliminated prior to extinguishing the fire, allow the hydrogen to burn until all the fuel is consumed. The extinguisher can be used to prevent the fire from spreading to adjacent structures.

During a station fire, it is likely that the thermal pressure relief devices (TPRD's) will activate. When activated, the TPRD's release hydrogen through the relief vents located on top of the station. Note that release of the TPRD's may be very loud. The PowerCubes each have their own relief vents, located along the top edge.

Minor Emergency Procedures

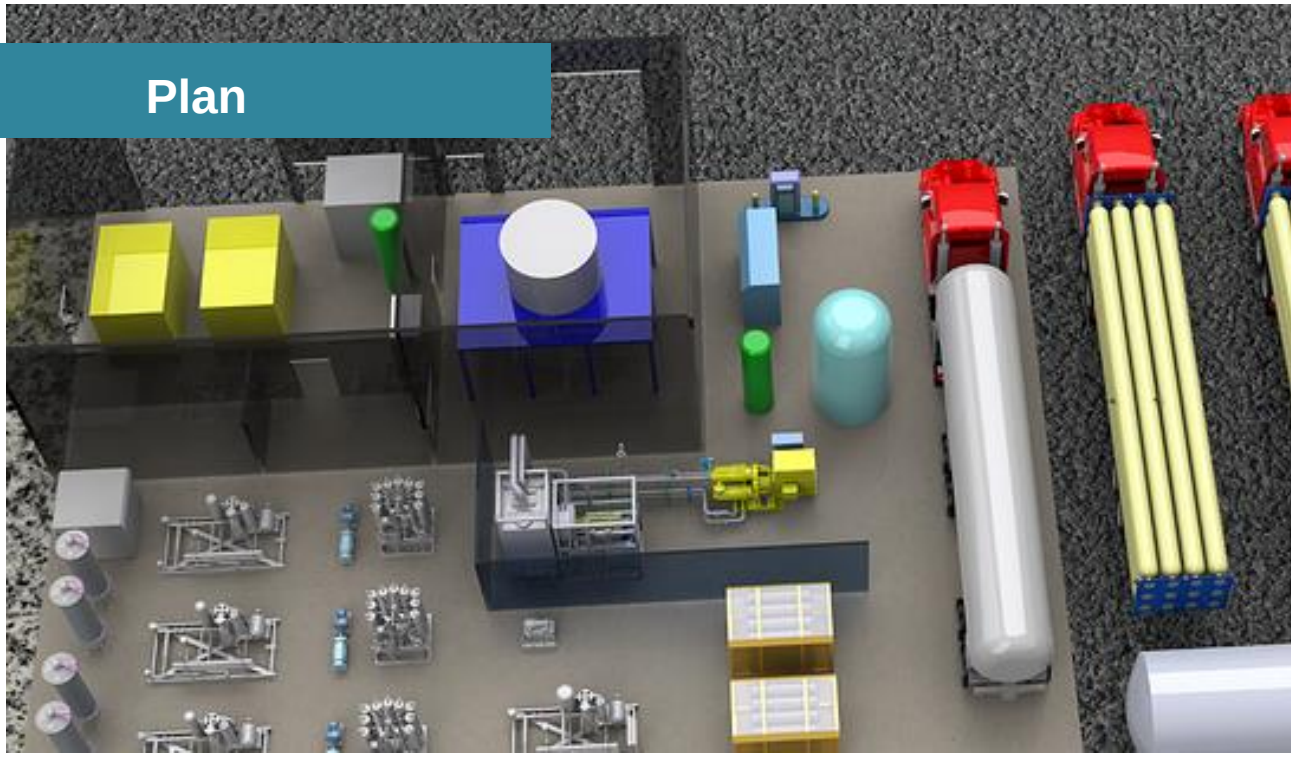
1. Operator shall manage the scene, assess the severity of the emergency, and determine the initial course of action.
2. Take appropriate action to contain and eliminate the emergency. If it is safe to do so, close the Bank Isolation Valves on the PowerCube control panel (on the side of the PowerCube) and/or the station isolation valves inside the high pressure storage area (inside the doors on the station).
3. If required, push the nearest Emergency Shutdown button (ESD). ESD's are located on the Electrical Room and the side of the Fuelling Station.
4. Keep bystanders at least 75m (250 feet) away from the station and PowerCube.
5. Contact one of the Emergency contacts listed above.

HTEC
Hydrogen Technology & Energy Corporation

HYDROGEN SAFETY PLAN

SAFETY POLICY & PROCESSES

Plan



Identification of the document: HSP-P-010

Revision: A

10-Aug-2016

Number of pages: 26

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Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	HTEC Station Safety Policy and Processes
REFERENCE	HSP-P-010

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	10-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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9. Attachment – Locking Out Procedure (HSP-P-003)
10. Attachment - Contractor Orientation Questionnaire (HSP-P-021)

1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California. Its purpose is to provide general safety policy and methodologies for all HTEC stations and where applicable to direct the reader to specific company safety policies that are not controlled by this document.

It is expected that this is a document that will evolve over time as stations mature and new policies and techniques are improved or required.

2. Preserving Health, Safety, and the Environment (HSE)

2.1. Introduction

HTEC has embarked on building hydrogen infrastructure in California to capitalize on the role out fuel cell vehicles (FCV). The success of this program, which involves key station developer stakeholders, the government of California, and the public, depends on HTEC’s ability to provide stations that perform to and exceed CEC standards while preserving the health and safety of HTEC employees, contractors, visitors, the general public as well as the environment in which HTEC operates.

2.2. HTEC Safety Program Policy

HTEC operates all its facilities, distribution systems, and engineering design under a unified umbrella Safety program, (HIP-005 - HTEC Safety Program – Definition & Mgment Commitment”). An uncontrolled copy of this document is attached to this safety document as a reference only. For the most recent version of this document please contact HTEC document control.

The HIP-005 document details HTEC’s commitment in following areas:

- Management Commitment And Program Manager Designation
- Purpose of Health and Safety Program
- Rules And Procedures
- Instruction And Supervision
- Personal Protection Equipment
- Worksite Inspections And Follow-Up
- Incident Reports
- Incident Investigations
- Safety Committee & Safety Meetings
- Workplace Hazardous Material Information System (WHMIS)
- First-Aid

- Documents, Records And Statistics
- Responsibilities & Authority

2.3. HTEC Hydrogen and Fuel Cell Experience

HTEC has extensive experience in designing, building, and operating hydrogen facilities of all pressures, for both liquid and gaseous hydrogen. The key lesson learned in previous hydrogen projects is that communication is paramount with all stakeholders in this type of project.

The following tables provide a summary of relevant projects HTEC and their partners have worked and partnered on:

Facility Name	Location / Purpose / Dates	Station/ Facility Details	Consortium Member Roles (Lead in Brackets)
Skyline Hydrogen Energy and Education Center	Woodside, CA Provide low carbon intensity hydrogen production facility, advanced high pressure distribution and public engagement/education programs Operational Oct 2016	Pressure – 450 Bar Capactiy – two x 7kg sequential fill and 140 kg/day. Hydrogen – delivered in 450 Bar PowerCube modules, and generated on site with electrolyzer	(HTEC) HTEC – site design, build, permitting, operation maintenance, hydrogen supply Powertech – CSD module and support MyPhy – Electrolzyer module and support
Northland H2 Station	Port of Vancouver lot in North Vancouver, BC IWHUP station providing fuel to the fleet of 8 HICE GM trucks and 2 HICE Ford Shuttle buses (2005 – 2010)	*Pressure - 350 Bar* *Capacity - 2 x 7.5kg sequential fill and 75 kg/day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(SDE) Powertech – module build SDE – site design, build, permitting, operation HTEC – maintenance, hydrogen supply
By-product H2 Processing Facility	Located in North Vancouver BC, built to purify and compress hydrogen to 450 Bar for delivery in PowerCubes	*Pressure – up to 450 Bar* *Capacity – 480 kg/day* *Hydrogen – by-product from chlor-*	(HTEC) HTEC – own, operate SDE – design, build.

	to IWHUP facilities and fill tube trailers for industrial gas companies. (2005 – 2012)	*alkali plant*	
Hemlock H2 Station	City of Surrey works yard in Surrey BC to support fleet of 4 H2ICE trucks and 4 FCEV's. (2011 – current)	*Relocated Northland Station*	(HTEC) HTEC - installation, permitting, own, operate, hydrogen supply
Central Works H2 Station	City of Surrey works yard in Surrey BC to support fleet of 4 H2ICE trucks and 4 FCEV's (2011 – current)	*Pressure - 350 Bar* *Capacity - 1 x 5kg sequential fill and 50 kg/day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(Powertech) HTEC – operate, maintain, hydrogen supply. Powertech – module build and installation
Pacific Spirit H2 Station	National Research Council facility at the University of British Columbia in Vancouver, BC installed to support the local fleet of Ford Focus fuel cell vehicles. (2008 – current)	*Pressure - 350 Bar* *Capacity - 2 x 5kg sequential fill and 75 kg/day.* *Hydrogen – delivered in tube trailers or 450 Bar PowerCube modules.*	(Linde/HTEC) Bob Boyd (Linde) – design, approvals. HTEC – took over and continues to operate and supply hydrogen.
Whistler Fuel Cell Bus H2 Station	BC Transit Facility in Whistler, BC installed to provide fuel for 20 revenue service fuel cell bus. (2010 – current)	*Pressure - 350 Bar* *Capacity - 20 x 35kg sequential fill and 1,000 kg/day.* *Hydrogen – delivered as liquid.*	(Air Liquide/BC Transit) SDE – site design and engineering, process and electrical support, permitting, construction management HTEC – maintenance
Victoria Fuel Cell Bus H2 Station	BC Transit Facility in Victoria, BC installed to fuel a demonstration fleet of 5 fuel cell bus fleets. (2009)	*Pressure - 350 Bar* *Capacity - 5 x 35kg sequential fill and 250 kg/day.*	(Air Liquide/BC Transit) SDE – site design and engineering, process

		Hydrogen – onsite electrolysis and tube trailer. (Project cancelled 75% of way through construction)	and electrical support, permitting, construction management.
BC Transit Mobile Fueling Station	Designed to be installed in various locations in BC to support bus demonstrations and special servicing. (2009 – 2012)	*Pressure - 350 Bar* *Capacity - 2 x 35kg sequential fill and 100 kg/day.* *Hydrogen – tube trailer & PowerCube*	(Air Liquide/BC Transit) SDE – design, build HTEC – operate, hydrogen
Vancouver Airport H2 Station	Vancouver International Airport grounds installed to fill HICE truck, shuttle buses and TUGs. (2010-2012)	*Pressure - 350 Bar* *Capacity - 2 x 35kg sequential fill and 100 kg/day.* *Hydrogen – tube trailer & PowerCube*	SDE – site design and engineering, process and electrical support, permitting, construction management. HTEC – operate, hydrogen
Translink HCNG Bus Station	Translink facility in Coquitlam BC installed to provide HCNG for the 4 HCNG revenue service transit buses under the IWHUP. (2006 – 2010)	*Pressure - 200 Bar* *Capacity – 4 HCNG bus fills sequential twice per day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(Clean Energy) SDE – Emergency response planning, hydrogen delivery HTEC – hydrogen supply
IWHUP Outreach Program	Public Open houses Promotional Video	*See IWHUP Video in youtube.* *Http://www.htec.ca/#!resources/cq4t*	SDE/HTEC/Powertech
H2 Vehicle Fleet Program	8 H2-ICE Trucks in IWHUP	*Development and management of users of 8 H2 powered trucks over a 4 year period*	SDE/HTEC/Powertech

2.4. Safety Management – Roles and Responsibilities

For companywide safety roles and responsibilities please refer to HTEC policy document HIP-005.

2.4.1. HTEC Leadership and Administration

As per HIP-005, HTEC leadership and administration have the following responsibilities:

- Senior Personnel will actively be involved in safety meetings, investigating incidents, attending safety meetings, conducting safety audits and follow up to ensure corrective action is taken. Senior personnel include the Leads, Construction Supervisor, Project Manager, President and Safety Program Manager.
- Senior Personnel will ensure that all HTEC's contractors or subcontractors are contractually held to all HTEC's safety requirements, attend safety meetings as required, and have received a safety orientation before commencing work.
- Senior personnel will ensure full compliance with all HTEC, Client, Workers' Compensation Board requirements and regulations.

2.4.2. Station Development Phase

Key people (from a Safety Perspective) that will be involved in the development of each station:

1. Project Manager – will be the Primary Point of Contact from the Project Team
2. Safety Specialist – see below description
3. HTEC consortium technology experts for all components of Project deliverables, namely,
    a. Renewable Energy
    b. Generation and Transportation of supply Hydrogen
    c. Compression, Storage and Dispensing of hydrogen
4. HTEC will employ 3rd party reviewers to provide feedback on all technical and safety aspects of this project.

<u>Safety Specialist</u>

HTEC will assign or employ a Safety Specialist to take responsibility for the overall Safety aspects of the project from an end-to-end perspective. He/She will interface with various stakeholders involved in the project and ensure that we comply with all applicable safety norms and guidelines applicable during the design, shipping, installation, commissioning phase of the project. He/She will also be the primary point of contact for the HTEC Safety Committee, as described in HIP-005.

The Safety Specialist shall also carry out a detailed Safety-Audit jointly if needed with an external agency to check and ensure compliance with the design norms laid out at the project kickoff stage.

Post the commissioning of the Project, the Safety Specialist shall design and roll out a train-trainer program for the 'Safety-Supervisor' who in turn shall train the O&M team members, the First Responders (if applicable) and others as and when needed during the O&M phase of the project.

2.4.3. Station Operation Phase

Key people (from a safety perspective) that will be involved in the operation phase of each station:

1. Project Manager – will be the Primary Point of Contact from the Project Team
2. Safety Supervisor – will be responsible to managing all safety aspects of station and reporting to the HTEC safety committee
3. Maintenance personnel – will perform station maintenance and operational support
4. Equipment and process specialists (internal or external) – will consulted or hired when necessary

Please note that all specific names, contact details, and resumes will be shared post NOPA.

2.5. Safety Management Tools

Please refer to HTEC policy document HIP-005 for direction on safety management tools.

2.6. Management of Change (MOC)

At the time of writing this document, HTEC's management of change policy and procedure has not been approved as a part of HTEC Quality manual.

This station safety policy document (HSP-P-010) will be updated and will reference HTEC's companywide MOC policy once it has been approved. Until this quality policy has been approved, the following MOC procedure will apply to all stations.

Station MOC Policy

Changes to the HTEC HSE systems shall be reviewed and approved according to the protocol outlined below. All changes shall be made in writing dated upon Program Manager approval and added as addenda to the appropriate document in the station Hydrogen Safety Plan. In case of disagreement, the HTEC Safety Committee will consider the reviewers' comments and the Program Manager will make a decision based on the best available information.

Changes to facility HSE systems, such as facility ventilation, hydrogen detection and alarm protocols and other facility design-related issues shall be reviewed and approved by the following, in order:

1. Facility maintenance contractor.
2. A team of partner safety experts composed of one representative from each of the following groups:
   a) Powertech Labs (if applicable)
   b) McPhy Industries (if applicable)
   c) HTEC Hydrogen distribution
   d) HTEC project engineer familiar with Hydrogen Stations
3. The HTEC Safety Committee
4. The Program Manager (in consultation with the Safety Supervisor)

Changes to the HTEC Safety Plan shall be reviewed and approved by the following, in order:

1. A team of partner safety experts composed of one representative from each of the following groups:
   a) HTEC Safety Committee
   b) HTEC Hydrogen distribution
   c) HTEC Project Engineer familiar with Hydrogen Stations
2. The HTEC Safety Program Manager
3. The Program Manager (in consultation with the Safety Supervisor)

3. Safety Procedures

The following safety procedures will be followed at each station. This section provides overall safety requirements as well as direction to other controlled HTEC safety documents.

3.1. Safety Equipment Requirements and Recommendations:

- Protective eyewear must be worn when working around and/or with power tools, caustic liquids or compressed gases, heated materials, and other hazardous situations.
- All personnel who work at the station must wear footwear that provides appropriate protection. No open-toe footwear is allowed in the work areas.
- The use of gloves is required when working with chemicals, heat, and sharp objects, and/or working in cramped spaces. Note that most medical cases involve the hand.
- A minimum level of PPE to be required will be determined by the Project Manager.

3.2. General Work Rules:

3.2.1. Drugs and Alcohol

HTEC has a no tolerance policy for drugs and alcohol while either present at the station or operating the station remotely. If an employee or contractor requires the use of medical drugs or prescriptions which inhibit work practice in any form, the station safety supervisor, via written consent, must authorize and clearly provide modified responsibilities (if necessary) before the employee/contractor commences work of any form at the station.

Once the drug no longer inhibits the employee/contractor, the station safety supervisor, via written consent, will reinstate the worker to their full responsibilities as prior to consuming the medical drug.

3.2.2. Working Alone

If working alone, the HTEC work alone procedure must be followed (HSP-P-002). An uncontrolled version of this document is attached.

3.2.3. Maintenance on equipment

Maintenance on station equipment is not allowed if sources of energy have not been locked out.

Work on equipment or piping must follow the HTEC Lock-out procedure (HSP-P-003). An uncontrolled version of this document is attached. By virtue of following this lock out procedure, personnel injury risks from sources of energy will be significantly reduced. Please note that only employees/contractors that have been trained and certified in HTEC's lock out procedure may lock out equipment for further maintenance.

3.2.4. Confined Spaces

The definition of a confined space is:

> A place where the means of entry or exit are restricted because of location, design, construction or contents. The main hazards encountered in confined spaces are fire or explosion, asphyxiation, toxicity, drowning in liquids or free flowing solids and injury or death if mechanical equipment within the confined space is inadvertently turned on while someone is still inside. These hazards are due to the presence of hazardous gases, vapours, fumes, dusts or the creation of an oxygen-deficient or oxygen-rich atmosphere.

At HTEC stations, certain areas of the containers used to house equipment might be considered confined spaces. Design of these areas will include warning mechanisms, fail safe valves and other risk reducing mechanisms, but this does not eliminate the risk associated with working in one of these confined spaces. HTEC's orientation procedure ensures that workers are aware of areas that could be classified as confined spaces and HTEC's 'Confined Space Policy' ensures that all workers are trained and certified to work in confined spaces.

3.2.5. Hazardous Materials

All personnel working with hazardous materials at the HTEC station must have their 'Workplace Hazardous Materials Information System (WHMIS) training completed. Confirmation and date of complete of WHMIS training must be included in HTEC's Master Log List. All Material Safety Datasheets (MSDS) for hazardous materials will be provided in a binder where the station first aid supplies are stored.

3.2.6. Operation of heavy machinery (forklift)

Only those persons who are trained, certified, and licensed to operate a forklift or other heavy machinery and have met these requirements within the last two years, are allowed to operate these machines. These certifications and licenses must be logged on the HTEC's master list.

3.2.7. Access to Station

Access to HTEC's stations is restricted to authorized personnel only. All authorized personnel must be listed in the Station Access log file. This log file will keep a record of when personnel passed orientation training, the level of their responsibility, and any certification applicable records. For a better description of what training is required, please refer to the training section below.

3.3. Contractor/Subcontractor Hiring and Training

For hiring and training contractors/subcontractors the following must be followed:

- All HTEC contractors and subcontractors must receive training and be knowledgeable of HTEC's HSE requirements and procedures. All contractors or subcontractors hired by HTEC will be trained, supervised and closely monitored to ensure the proper procedures are being followed.
- A pre-construction qualification check will be done to ensure each new contractor/subcontractor is capable of performing all aspects of his/her job safely.
- HTEC will conduct a new contractor/subcontractor orientation for new persons coming onto a station for the first time.
- All contractors/subcontractors will receive a tour of the project site and familiarize themselves with the work environment.
- Leads will be responsible for conducting a familiarization tour of the immediate work area for all new contractors/subcontractors reporting to them. Included in this familiarization tour will be area specific safety procedures, instructions and hazards.
- HTEC will identify safety training required as shown on the Safety Training Checklist.

3.3.1. Required Training

As per the HTEC Safety Program HIP-005, persons who are working with and around hydrogen must be trained on proper hydrogen handling procedures and practices. All contractors/subcontractors assigned field responsibilities will complete the safety orientation from HTEC before starting work on the project site.

The orientation will highlight the following topics:

Site and Hazard Orientation

- Site Rules and Regulations –General
- Site/Project Specific Safety Orientation
- Tour of the Project Site

Safety Policies and Program

- HTEC's Safety Policy
- HTEC's General Safety Orientation

Each contractor/subcontractor will receive a copy of the above, and a copy will be retained in the North Vancouver office.

Additional Site Specific Programs include:

- Construction Safety Rules and Responsibilities (if applicable)
- Emergency Evacuation Procedures
- Safety Equipment
- Personal Protective Equipment
- First Aid
- Protection and Response
- Confined Areas
- Hazardous Goods
- Sign Off Sheets – acknowledge a contractor/subcontractor has completed the HTEC's site safety orientation.
- Safety Recognition Program

3.3.2. Contractor/Subcontractor Orientation Questionnaire

Each contractor/subcontractor must complete the HTEC Orientation Questionnaire before work at the HTEC site can be commenced. The purpose of the questionnaire is to ensure that the subcontractor has been fully informed about the job and safety procedures. The contractor must complete the questionnaire and return it to the HTEC; a uncontrolled copy of this questionnaire is attached.

3.4. First Aid

HTEC is committed to providing and maintaining a first aid program for the purpose of minimizing the effects of job-related injuries and illnesses, increasing productivity, reducing absenteeism and meeting WCB regulations. The company will provide and maintain first aid services, supplies and equipment.

First Aid services, supplies and equipment will be made available to all workers during working hours. The company will ensure that workers receive instructions in the procedure for summoning first aid and reporting injuries.

Workers who sustain a job-related injury or illness, regardless of seriousness, must immediately report it to the first aid attendant for treatment or recording, and where practicable, must also report it to their immediate supervisor. If medical treatment is required the injured worker will be transported to the nearest medical aid facility at the expense of the company.

The first aid attendant will be in complete charge of all first aid treatment of injured worker until medical aid is available. Supervisory personnel will not attempt to over-rule the attendant's decisions relating to first aid or emergency transportation.

Pertinent injury information will be entered in the First Aid Treatment Log Book by the first aid attendant and verified by the injured worker's supervisor.

All personnel assigned to field project sites shall ensure they are familiar with the site procedure to summon first aid, the reporting of injuries and the location of the first aid room.

4. Compressed Hydrogen Fuel Characteristics

This section summarizes the general characteristics of hydrogen and identifies potential hazards.

Hydrogen possesses several unique characteristics and hazards compared to other, more common fuels currently available on the market. Some of these general characteristics and hazards include the following;

- Hydrogen is a colorless, odorless, tasteless, non-corrosive, and flammable gas;
- The amount of energy required to initiate hydrogen combustion is much less than other common fuels;
- Hydrogen/air mixtures can be easely ignited by small energy sources such as sparks;
- Hydrogen is considerably lighter than air: it rises very quickly and does not pool near the ground like gasoline, diesel, or propane fuel vapors;
- Hydrogen rapidly diffuses into the atmosphere;
- Hydrogen fires burn at high temperatures, but are **less** likely to spread to adjacent structures than fires fuelled by other fuel types, because hydrogen is highly buoyant and radiates little heat energy;
- Hydrogen contains a lower amount of explosive energy per volume than most other fuels;
- Hydrogen gas is not toxic but may induce suffocation (asphyxiation) if it displaces oxygen in a confined space.



All combustible fuels are hazardous. Hydrogen is not inherently more dangerous than other fuels, but its properties are unique and it must be handled appropriately.

The low ignition energy of hydrogen presents an increased probability of ignition. However, hydrogen's high buoyancy and high diffusivity in air tend to reduce the duration over which the hydrogen gas-air mixture is in the flammable concentration range.

Additional safety related information and information on hydrogen characteristics can be found from the following sources:

- General Compressed Hydrogen Safety Training Program (Sacré-Davey Innovations)
- http://www.hydrogenandfuelcellsafety.info/
- www.hydrogensociety.net
- www.hydrogen.energy.gov

5. Emergency Response Procedures

THIS SECTION MEANT TO BE REVIEWED FOR TRAINING AND NON-EMERGENCY SITUATIONS ONLY.

REFER TO THE STATION ONE PAGE EMERGENCY GUIDE IN THE EVENT OF A EMERGENGY SITUATION, WHICH WILL INCLUDE ALL UPTO DATE CONTACT DETAILS.

This section details the recommended safety and emergency response procedures that should be followed by technical personnel and equipment operators, and serves as a guide for emergency responders.

If the incident occurs at HTEC fueling station this Emergency Response Procedure should be followed to ensure that equipment is shut down and the proper personnel are informed.

In general, any red emergency shut-down (ESD) button should be pressed during any emergency situation at the HTEC Station.

5.1. Hydrogen Fuel Hose Breakaway

The fuelling hose at the station is equipped with a breakaway coupling. In the event that a vehicle is driven away while the fueling hose is still connected, a small amount of hydrogen will be vented when the breakaway decouples, but the event is not considered an emergency situation. The ends of the hose will seal automatically and no sustained release of hydrogen will occur. In this event facility operators (either onsite or remotely) should press or activate the station ESD button and remain 10m (30 feet) from the vehicle and station, then contact HTEC personnel for instructions. Do not operate the vehicle until it is inspected by qualified personnel.

5.2. Emergency Response Levels

During any emergency situation, operators must assess the incident and identify the appropriate emergency response according to the severity of the incident. Emergencies are divided into the following two levels:

1. **Minor Emergency**
2. **Critical Emergency**

When responding to emergencies of either level, the following equipment is recommended for emergency services personnel:

- full protective clothing including turnout pants, turnout jacket, boots, helmet and face shield; and

For any incident involving fire, a positive pressure self-contained breathing apparatus (SCBA) is recommended.

During the initial stages of an emergency incident, technical personnel and equipment operators are the most qualified personnel to take the command role, until more qualified personnel arrive on scene. The Fire Department will always take the command role when they arrive on scene.

5.3. Minor Emergency

During a minor emergency, an issue has been identified that is unlikely to affect the safety, health, and welfare of personnel, or damage the environment or equipment.

During this emergency level, the equipment operator will generally be capable of managing the scene. A minor emergency may include the following:

- small amount of hydrogen leakage found during PowerCube exchange or otherwise normal station operations;

The following procedure shall be followed if a minor emergency has occurred:

1. Operator shall manage the scene, assess the severity of the emergency, and determine the initial course of action.
2. Take appropriate action to contain and eliminate the emergency. If it is safe to do so, close the PowerCube Isolation Valves on the PowerCube control panel and/or the station isolation valves inside the high pressure storage area.
3. If required, push the nearest Emergency Shutdown button (ESD). ESD's are located on the compressor container module and near the exits of the site.
4. Keep bystanders at least 75m (250 feet) away from the station.
5. Contact the HTEC emergency phone number who will then be responsible for assessing the severity of the incident and taking the appropriate action:
6. Record the emergency details and forward the information to the HTEC Safety Committee and program manager.

5.4. Critical Emergency

During a critical emergency, an issue has been identified that is **likely to affect the safety, health, and welfare of personnel, or damage the environment or equipment**.

Some examples of critical emergencies include the following:

- line rupture, fitting failure, or other significant escape of hydrogen from the station, such as from the relief vents on top of the station;

Note: A release of hydrogen through the station vents will be very loud – the station ESD should be pressed immediately in this event.

- fire in or near the station;
- pressure explosion of any kind;

Small Fires: Use dry chemical or carbon dioxide (CO_2) fire extinguisher – a fire extinguisher is located in the Control Room. Do not attempt to extinguish a fire if the fire is being fed from a hydrogen leak – the source of the leak must be eliminated prior to extinguishing the fire. If the leak cannot be stopped, press the station ESD and allow the hydrogen to burn until all the fuel is consumed. The extinguisher can be used to prevent the fire from spreading to adjacent structures.

During a station fire, it is likely that the thermal pressure relief devices (TPRD's) will activate. When activated, the TPRD's release hydrogen through several relief vents located either on top of the station or through the main station vent stack. Note that release of the TPRD's may be very loud. The PowerCubes each have their own relief vents, located along the top edge of each PowerCube.

During the initial stages of an emergency, the operator is generally the most qualified person on scene, and shall manage the site until more qualified personnel arrive. The Fire Department will always take the command role when they arrive on scene.

The following procedure shall be followed if a critical emergency has occurred:

1. Push the nearest Emergency Shutdown button (ESD). ESD's are located on the south wall of the Electrical Room and the west wall of the Fuelling Station.
2. As an immediate measure, isolate the area for at least 100 meters (330 ft) in all directions, keeping people upwind of the incident if possible.
3. In the event of a fire or explosion, call 911 to report the emergency, and notify the dispatcher that the emergency involves hydrogen fuel;
4. Follow instructions provided by Emergency Services personnel, giving first aid as appropriate to injured persons.
5. Contact at least one of the HTEC individuals listed on the one page emergency guide.
6. If a significant amount of hydrogen has been released (10 kg or more) during the incident, then the following agencies must also be contacted:
    a. the State Emergency Program;
    b. the operator's employer, if not already contacted.

7. Before the station is returned to service, the area must be checked with a methane detector.
8. Record the emergency details and forward the information to the Station Safety Supervisor .

5.5. Hydrogen Release Detection

Hydrogen is not odorized. The only way to detect a leak is typically to hear a hissing sound or use one of the following detection methods:

- Thermal Conductivity Sensor (functions well in stable air environment with minimal temperature variations),
- Catalytic Combustion Sensor (functions well for detecting 0 to 4% hydrogen content in air, but not hydrogen specific, typically used by HAZMAT teams).

5.6. Fire Detection

Hydrogen fires can be nearly invisible in daylight. The following methods should be used to detect a hydrogen fire:

- Long handled broom – the bristles should be made of corn straw, as it will easily ignite but does not release toxic fumes. Hold the broom in front of you as you slowly approach the vehicle and it will ignite when passed through a hydrogen fire.
- Ultra Violet (UV) Sensor (functions better than Infra Red (IR) sensors that are better suited to a brighter fire).

5.7. Reporting Incidents

All emergencies and incidents regardless of their severity must be documented and brought to the attention of the HTEC Safety Committee.

5.8. Dealing with News Media

If there is a significant incident involving the HTEC Fueling Station, the news media may arrive on-site and request information. HTEC is responsible for handling all media inquiries.

At the accident scene;

- Do not give the names of injured persons;
- Do not give any personal opinions; and
- Do not take photographs of the scene; however do not attempt to prevent any press photographer from taking pictures.

If HTEC is not available, remember these additional guidelines when dealing with the news media:

- Direct persons asking questions to the authorized spokesperson and don't say "no comment";
- Remember that there is no such thing as "off the record"; and
- Be courteous at all times.

6. Attachment – HTEC's Safety Program – Definition and Management Commitment (HIP-005)

PROJECT NAME / TITLE	CLIENT / INTERNAL	DOCUMENT
HTEC Safety Program	Internal	HIP-005

Revision	Issue Date	Description / Summary of Changes	Issued By	Approved By
A	2015-Oct-16	Initial	AP	

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1. MANAGEMENT COMMITMENT AND PROGRAM MANAGER DESIGNATION

The management of Hydrogen Technology and Energy Corporation (HTEC) will provide a safe and healthy workplace for all employees, contractors, and others that may visit or enter our facilities. Our firm will establish and maintain a Health and Safety Program designed to prevent safety incidences, injuries and disease, and hold it equal to other business values. We are responsible for providing the necessary instruction in health and safety and for addressing unsafe situations in a timely manner. All workers and service contractors are required to work safely and to know and follow our company rules for safe work.

Signature of Management

Colin Armstrong, President

OCT 16, 2015

Date

The Safety Program Manager (SPM) is: ASHLEY PERRY and by way of the following signature accepts the role and responsibilities determined in this document.

Signature of SPM

Oct 22/2015

Date

2. PURPOSE OF HEALTH AND SAFETY PROGRAM

The purposes of the Health and Safety Program defined in this document are to:

a. determine the activities and strategies to ensure management safety commitments are met;
b. eliminate accidents and control potential hazards in the workplace;
c. provide the foundations for ensuring that safety is a fundamentally integrated part of the culture of the company;
d. co-ordinate the provision of the knowledge and tools required for accident prevention.

3. RULES AND PROCEDURES

Safety rules and procedures will be created and made available to employees and posted as appropriate in facilities.

Documents will be created as required for each facility or section of the program and will be revision and issue controlled. A master Document Log will be kept by the SPM who will be the owner of all rules and procedure documents.

If HTEC employees are on a client's facility, the higher level of safety rules and procedures will apply. It is the expectation that HTEC employees visiting or working on a client's site will ask for a safety induction if one is not provided.

4. INSTRUCTION AND SUPERVISION

Employer/Supervisors will:

a. Orientation - Give general orientation to new workers, visitors and contractors prior to entering the workplace.

b. Instruction - Instruct workers in General Site Rules, Safe Work Procedures and Job Rules (e.g. safety headgear, eyewear and footwear, guardrails/fall protection, WHMIS).

c. Training - Provide training and/or ensure required certification is in place for jobs requiring extra skill or knowledge as well as those with demonstrated higher risk of injury (e.g. manual handling) such that equipment & machinery operators can demonstrate that they can do the job safely before being allowed to operate without direct supervision.

d. Supervision - Observe workers, work practices and equipment operation and initiate corrective action when necessary to ensure safety to personnel.

e. Documentation - Keep records of instruction, training, facility inductions, employee and contractor certifications, safety incidents, investigations, and corrective measures taken.

f. Safety Training - Ensure that the SPM receives the required 8 hours of WCB approved training per year.

5. PERSONAL PROTECTION EQUIPMENT

Personnel Protection Equipment (PPE) will be issued and used by all employees, visitors, and contractors as determined by specific procedures for specific areas and activities. In general PPE refers to safety glasses, hearing protection, high visibility clothing, and protective headwear and footwear.

It is recognized that noise levels above 85 decibels combined with long exposure can permanently damage hearing, so the SPM shall ensure that:

a. Noise is reduced or controlled at the source, where practical.
b. Workers are informed about the noise hazard and the risk of hearing loss.
c. Noise hazard signs are posted in areas, which require hearing protection.
d. Hearing protective devices are provided to and used by all workers exposed to excess noise levels.

6. WORKSITE INSPECTIONS AND FOLLOW-UP

Safety inspections of the work site will be done on a regular basis by the SMP or by a person assigned by the SMP. Inspectors must be knowledgeable with the work process. Employees found to be working in an unsafe manner or in unsafe conditions will be asked immediately to stop work and correct the situation. If an immediate solution cannot be found to remedy the unsafe situation, the matter must be immediately referred to the SMP for action.

All work site safety inspections will be recorded using an Inspection Report form and will include: employees involved in the inspection, potential unsafe working conditions or methods that were observed and/or corrected, and suggestions for corrective action (if possible).

All Inspection Reports will be discussed at safety meetings and corrective actions are to be recorded and addressed in a timely fashion.

Inspection Reports will be reviewed prior to new worksite inspection to ensure follow-up is done.

7. INCIDENT REPORTS

An employee involved in a safety incident as described below will be required to complete a safety 'Incident Report'. An incident report will be a standardized form which will include at minimum the employees involved as well as an incident description. Incident reports may or may not be specifically discussed at a safety committee meeting but will be included in a summarized monthly report. Applicable incidents include:

a. All incidents that result in injury requiring first aid or other medical treatment,
b. Any incidents of violence,
c. Incidents that could cause serious injury or death,
d. Incidents involving 'near misses' that could have resulted in serious injury
e. Incidents involving 'near misses' (serious or minor) that could have been prevented via a procedure,
f. Observations of unsafe acts that could lead to a future incident (does not include observations during an work site inspection)

8. INCIDENT INVESTIGATIONS

All incidents that result in injury requiring medical treatment, any incidents of violence, incidents that could cause serious injury or death, or near misses that could have resulted in serious injury shall be investigated.

Investigations shall be carried out by a person knowledgeable with the work process, but not involved with the incident, as well as a senior staff member to determine the root cause of the incident and identify corrective measures to be taken. Information shall be recorded on an Incident Investigation form and supervisors or worker representatives shall review the reports with all workers. Investigation reports will be presented and discussed at monthly safety committee meetings or special safety meetings as required.

The worker safety authority have jurisdiction (AHJ) shall be notified of any accident resulting in life threatening injury, death or any accident resulting from a major structural failure.

9. SAFETY COMMITTEE & SAFETY MEETINGS

The SPM will create and chair a Safety Committee that has between 3 and 5 personnel. Members will be documented in a separate form. The Safety Committee shall conduct safety meetings, at least once per month, with supervisors and workers to review safety plan implementation, accident investigation reports, inspection reports, corrective action, unsafe work practices, work conditions of concern and any specific safety concerns of management and/or workers.

When practical, short "Tool Box" chats will be conducted at the beginning of each shift to review special operating conditions, hazards that may be encountered during the shift, or any factors that might have changed since the last shift.

Special Safety Meetings will be held as needed prior to initiation of major initiatives such as new operations start-up or long extended hours on customer sites.

Management will review and take action on all items discussed at safety meetings. Minutes of the monthly and special safety meetings will be recorded and kept to document actions taken and items discussed. A copy of the safety meeting minutes shall be posted for reference by workers.

Minutes of monthly and special safety meetings will be taken, held on record and posted for reference by workers. Management will review and take action on all items required.

The shorter "Tool Box" meetings do not need to be recorded unless substantive items are determined during the meeting.

All safety meetings shall be considered teaching moments and are to be recorded on daily timesheets.

10. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

Management will ensure that WHMIS regulations are followed by ensuring the following:

1. All controlled products on site are identified with supplier or workplace labels.
2. Material Safety Data Sheets (MSDS) for products are up to date and made available to workers and the First Aid Attendant.
3. All workers receive education and training to safely store, handle, use, or dispose of products.

11. FIRST-AID

Management shall ensure that first-aid services, supplies and equipment as required by the Occupational Health and Safety Regulation, are available to workers on all shifts. Workers shall be instructed on how to summon first-aid. Workers shall promptly report all injuries to the first-aid attendant. A treatment record shall be maintained.

In the event of a more severe incident requiring external medical services while on a client's site, site representatives will be informed in accordance with their first aid protocols.

12. DOCUMENTS, RECORDS AND STATISTICS

All documentation associated with the Safety Program including procedures, rules, records, meeting minutes, reports and logs shall be maintained in an organized and controlled manner.

The SMP and one member from the Safety Committee shall sign all rules and procedures developed under the Safety Program.

Statistical information shall be provided to employees, managers, and as required by Workers Compensation Board (WCB) to communicate accident, incident and success trends such as number of accident free days.

13. RESPONSIBILITIES & AUTHORITY

Management shall:

a. Lead by setting a good example, wearing PPE and following all safety policies and procedures.
b. Interact with workers regularly to hear first-hand any safety concerns and show workers the importance and top priority a safe workplace is within the organization.
c. Participate in safety meetings and the safety committee (when applicable).
d. Hold supervisors and workers accountable to maintain the Safety Program.
e. Set reasonable health and safety goals and objectives.
f. Provide resources required to implement and maintain the Safety Program.

The SMP shall:

a. Lead by setting a good example, wearing PPE and following all safety policies and procedures.
b. Interact with workers regularly to hear first-hand any safety concerns and show workers the importance and top priority a safe workplace is within the organization.
c. Chair safety meetings and the safety committee.
d. Hold supervisors and workers accountable to maintain the Safety Program.
e. Be responsible for developing, maintaining and issuing all documents, records and informational required by the Safety Program.
f. Be responsible for compiling and providing statistical information.
g. Prepare a program, future activity plan and request for resources to management on a quarterly basis.

If the SPM feels that resources are not available for Safety Program implementation or rules and procedures are not being followed, the SPM is empowered to curtail operations until the issue is resolved.

Personnel are responsible for their own actions and thus must cooperate with program personnel and initiative and never overlook unsafe acts or conditions.

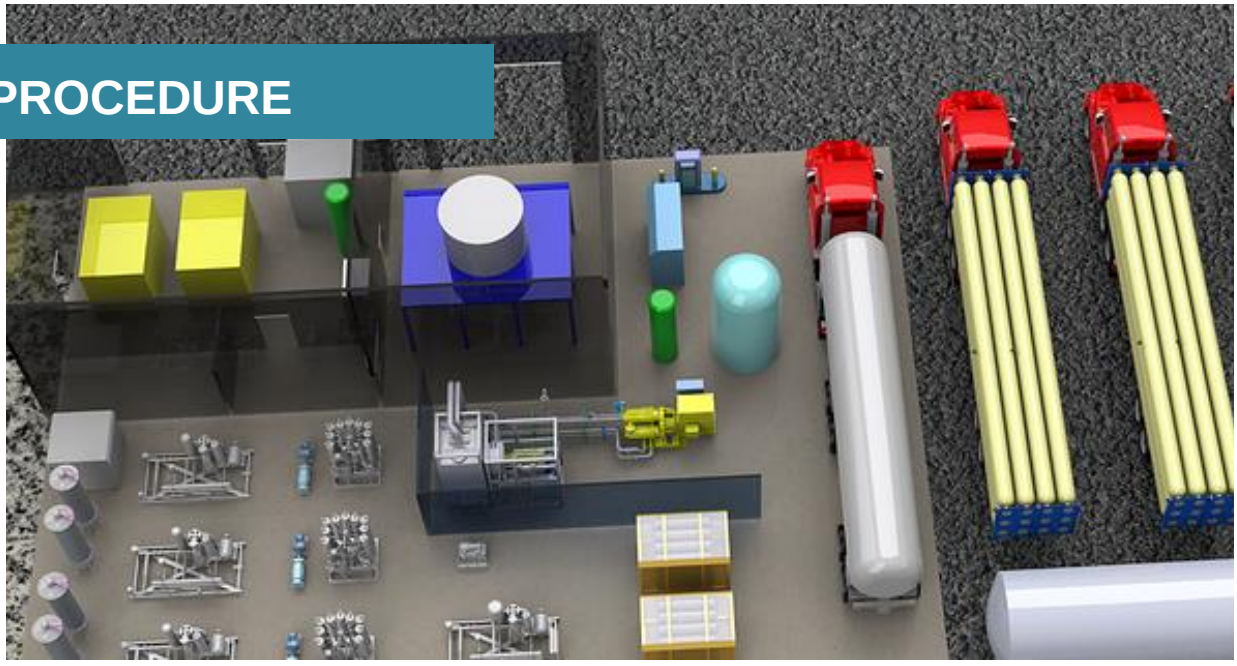
Employees should visit www.worksafebc.com for further information on safety programs and initiatives.

7. Attachment – Working Alone Procedure (HSP-P-002)

WORKING ALONE PROCEDURE

HTEC SAFETY PLAN

PROCEDURE



Identification of the document: HSP-P-002 - Working Alone Procedure

Revision: A

12-Dec-2015

Number of pages: 7

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APPROVALS		
Written by	Verified by	Approved by
Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Working Alone Procedure
REFERENCE	HSP-P-002 - Working Alone Procedure

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	12-Dec-15	Issued for Review - Draft

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

MANAGEMENT COMMITMENT

The management of Hydrogen Technology and Energy Corporation (HTEC) will provide a safe and healthy workplace for all employees, contractors, and others that may visit or enter our facilities. Our firm will establish and maintain a Health and Safety Program designed to prevent injuries and disease and hold it equal to other business values. We are responsible for providing the necessary instruction in health and safety and for addressing unsafe situations in a timely manner. All workers and service contractors are required to work safely and to know and follow our company rules for safe work.

_____ _____

Signature of Management Date

Colin Armstrong, President

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1. INTRODUCTION

The purpose of this procedure is to ensure than all employees and contractors are safe and accounted for work while working alone at any of HTEC's or client's sites.

The definition of working alone is:
Any employee or contractor (employed by HTEC) that is working alone or that does not have regular check-in by personnel onsite.

2. DEFINITIONS

Check-in:
Verbal or electronic contact from the Worker to the Safety Partner indicating that the Worker is safe and of clear mind.

Emergency Contact List:
A list of emergency contact details for each site. This list is available in the main HTEC Safety Folder and is considered to be the most update. Contact details are not listed in this procedure due to the risk of not being up to date.

High Pressure Hydrogen:
Any system involving hydrogen pressure greater than 15 psig. This is in accordance with BCSA definitions.

Safety Partner:
A responsible HTEC employee with whom a Worker working alone can check-in at regular intervals. A Safety Partner must have a basic understand of the potential hazards on site and must have all site contact details on their person during the period of time the worker is working alone.

Safety Program Manager:
HTEC's appointed Safety Program Manager.

Site Safety Manager:
A person onsite who is responsible for the safety of the site and has a basic understanding of potential hazards with the equipment the Worker is working on.

Worker:
Any employee or contractor (employed by HTEC) performing work for HTEC on HTEC or Client equipment.

Working Alone:
Any employee or contractor (employed by HTEC) that is working alone or that does not have regular check-in by personnel onsite.

3. WORKING ALONE PROCEDURE

1) A Worker will inform a Safety Partner that they are planning to perform work or maintenance alone and will inform the Safety Partner of the nature of the maintenance and when they will check-in.
2) If the Worker expects the work to take longer than two hours or there are more or greater hazards, verbal or electronic contact should be made at regular designated intervals as appropriate with the risk. If dealing with high pressure hydrogen (>15 psig) this time interval should 30 minutes. If dealing with Nitrogen or Hydrogen in an enclosed space this time interval should be 15 minutes.
3) During a check-in the Worker will inform the Safety Partner that they are safe. If any uncertain or changing conditions exist on site, the Worker must inform the Safety Partner at this time. It is the responsibility of the Safety Partner to gauge whether the Worker is safe or in clear mind. If the safety Partner is unsure whether the Worker is safe or of clear mind, they must verbally discuss their concerns with the Worker. If uncertainty exists after a verbal discussion with the Worker, the Safety Partner is to contact the Safety Program Manager for further direction.
4) If the Worker and Safety Partner are using electronic means to check-in the Worker will contact the Safety Partner at the designated time and then Safety Partner will respond indicating that they have received the Worker's check-in. If the Safety Partner does not respond to the electronic check-in, the Worker must immediately attempt verbal contact.
5) If the Worker has not made verbal or text contact within 5 minutes of the designated time, the Safety Partner will
    i) Call the site contact (listed on the Emergency Contact List) and ask them to go check on the worker. If no one can be reached:
    ii) Call the HTEC Safety Program Manager (SPM). If the SPM cannot be reached:
    iii) Call the HTEC Emergency Phone Number (listed on the Emergency Contact List), inform Colin Armstrong about the situation, and go to the site with a set of PPE, first aid kit, Emergency Response Plan and fire detection gear.
6) If the Safety Partner does not respond verbally or electronically to the Worker's check-in, the Worker must stop working immediately. If work cannot be suspended or stopped, the Worker must contact the Site Safety Manager or the Safety Program Manager and use them as a Safety Partner until the original Safety Partner is contacted and can continue the role.
7) Both the Worker and the Safety Partner should ensure they are carrying a charged mobile phone. The Worker must not continue work until the mobile phone is charged or another appropriate means of contact can be used. A new Safety Partner should be appointed if their mobile phone loses charge during the work alone period.
8) The Worker should wear all appropriate site PPE and if dealing with a toxic gas should wear a gas detector monitor at all times.
9) **The Worker should always double check that what they are about to do is correct! If in doubt, ask. No assumptions!**

10) The Worker will inform the Safety Partner when they finish their work and leave the site.

4. CONTINUOUS IMPROVEMENT

Continuous improvement of this procedure shall include, but is not limited to:

1) Annual review of this document by the Safety Program Manager
2) Recording of recommend changes using the Change Management Procedure
3) Annual review of pertinent Codes and Standards to:
   a) Verify this documents use in day-today practice and is the latest version
   b) Recommend additional standards to purchase
   c) Confirm this document is in the proper directory, and employees are aware of its location

The Safety Program Manager shall review the proposed recommendations, and if necessary, seek the advice of peers on the recommended change. If the Safety Program Manager agrees with the proposed revision, they shall implement the revised procedure and ensure all workers are informed of the updated procedure.

5. RELATED DOCUMENTS

Change Management Procedure *[under development]*

Emergency Contact List

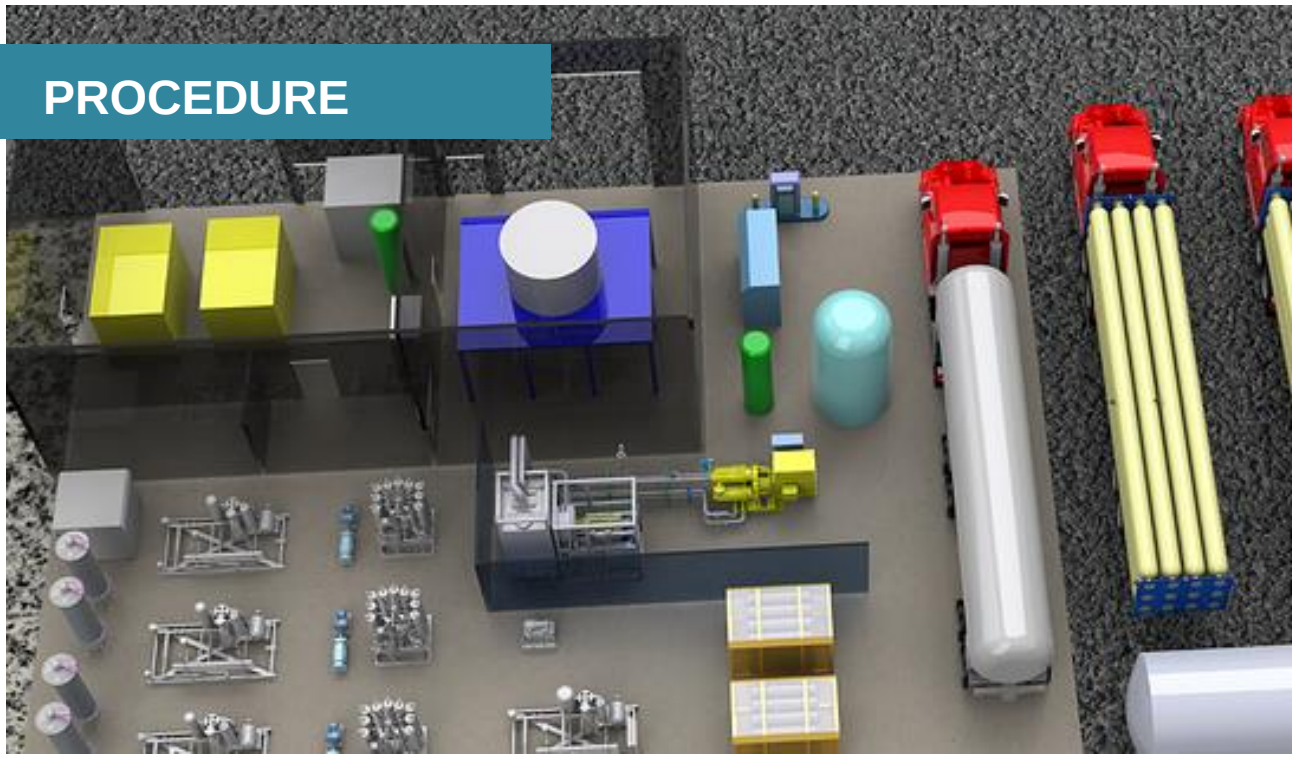
HTEC's ERAP "Emergency Response Assistances Plan"

HTEC Safety Manual *[under development]*

LOCKING OUT PROCEDURE

HTEC SAFETY PROGRAM

PROCEDURE



Identification of the document: HSP-P-003 - Locking Out Procedure

Revision: A

30-Dec-2015

Number of pages: 22

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Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Locking Out Procedure
REFERENCE	HSP-P-003 - Locking Out Procedure

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	30-Dec-15	Issued for Review - Draft

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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_____ _____

Signature of Management Date

Colin Armstrong, President

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1. OBJECTIVE

The objective of this procedure is to establish a means of positive control to prevent the accidental starting or activating of machinery or systems while they are being repaired, cleaned and/or serviced. This program serves to:

A. Establish a safe and positive means of shutting down machinery, equipment and systems.
B. Prohibit unauthorized personnel or remote control systems from starting machinery or equipment while it is being serviced.
C. Provide a secondary control system when it is impossible to positively lockout the machinery or equipment.
D. Establish responsibility for implementing and controlling lockout procedures.
E. Ensure that only approved locks, standardized tags and fastening devices provided by the company will be utilized in the lockout procedures.

2. ASSIGNMENT OF RESPONSIBILITY

The HTEC Lockout Safety Manager (LSM) is currently: Ashley Perry.

A. The LSM will be responsible for implementing the lockout program.
B. The LSM is responsible for enforcing the program and insuring compliance with these procedures
C. Unless otherwise appointed by the LSM, the LSM will conduct the annual inspection and certification of the authorized employees.
D. Authorized and Affected employees are responsible for following the established lockout procedures. They are responsible for reviewing the Specific Equipment lockout details for each piece of equipment being locked out.

   An authorized employee is defined as a person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.

   An affected employee is an employee who is required to use machines or equipment on which servicing is performed under the Lockout/Tagout standard or who performs other job responsibilities in an area where such servicing is performed.

E. All other employees in the facility are responsible for insuring they do not attempt to restart or re-energize machines or equipment that are locked out or tagged out.

3. DEFINITIONS

Authorized employee:

An employee who locks or tags machines or equipment in order to perform servicing or maintenance.

Affected employee:

An employee who is required to use machines or equipment on which servicing is performed under the Lockout/Tagout standard or who performs other job responsibilities in an area where such servicing is performed.

Other employees:

All employees who are or may be in an area where energy control procedures may be utilized.

Capable of being locked out:

An energy-isolating device is considered capable of being locked out if it:

- Is designed with a hasp or other means of attachment to which a lock can be affixed;
- Has a locking mechanism built into it;
- Can be locked without dismantling, rebuilding, or replacing the energy-isolating device or permanently altering its energy control capability.

Energized:

Machines and equipment are energized when they are connected to an energy source or they contain residual or stored energy.

Energy-isolating device:

A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy source:

Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Lockout:

The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device:

Any device that uses positive means, such as a lock, blank flanges and bolted slip blinds, to hold an energy-isolating device in a safe position, thereby preventing the energizing of machinery or equipment.

LSM:

A 'Lockout Safety Manger' that has been appointed by the HTEC Safety Program Manager (SPM).

Normal production operations:

Utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance:

Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, maintaining and/or servicing machines or equipment, including lubrication, cleaning or unjamming of machines or equipment, and making adjustments or tool changes, where employees could be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Tagout:

The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device:

Any prominent warning device, such as a tag and a means of attachment that can be securely fastened to an energy-isolating device to indicate that the machine or equipment to which it is attached may not be operated until the tagout device is removed.

4. PREPARATION FOR LOCKOUT

Employees who are required to utilize the lockout procedure (see Lockout Form A) must be knowledgeable of the different energy sources and the proper sequence of shutting off or disconnecting energy means. The four types of energy sources are:

A. Electrical (most common form);
B. Hydraulic or pneumatic;
C. Fluids and gases; and
D. Mechanical (including gravity).

More than one energy source may be utilized on some equipment and the proper procedure must be followed in order to identify energy sources and lockout accordingly. See Lockout Form F for a specific procedure format.

A. Electrical

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Shut off power at machine and disconnect.
3. Disconnecting means must be locked or tagged.
4. Press start button to see that correct systems are locked out.
5. All controls must be returned to their safest position.
6. Points to remember:
    A. If a machine or piece of equipment contains capacitors, they must be drained of stored energy.
    B. Possible disconnecting means include the power cord, power panels (look for primary and secondary voltage), breakers, the operator's station, motor circuit, relays, limit switches, and electrical interlocks.
    C. Some equipment may have a motor isolating shut-off and a control isolating shut-off.
    D. If the electrical energy is disconnected by simply unplugging the power cord, the cord must be kept under the control of the authorized employee or the plug end of the cord must be locked out or tagged out.

B. Hydraulic / Pneumatic

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Shut off all energy sources (pumps and compressors). If the pumps and compressors supply energy to more than one piece of equipment, lockout the valve supplying energy to the piece of equipment being serviced.
3. Stored pressure from hydraulic/pneumatic lines shall be drained/bled when release of stored energy could cause injury to employees.
4. Make sure controls are returned to their safest position (off, stop, standby, inch, jog, etc.).

C. Fluids and Gases

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Identify the type of fluid or gas and the necessary personal protective equipment.
3. Close valves to prevent flow, and lockout.
4. Determine the isolating device, then close and lockout.
5. Drain and bleed lines connection the isolation device and equipment to a zero energy state.
6. Open Drain or vent valve between isolating device and equipment, then lock open.
7. Some systems may have electrically controlled valves. If so, they must be shut off and locked/tagged out.
8. Check for zero energy state at the equipment.

D. Mechanical Energy

Mechanical energy includes gravity activation, energy stored in springs, etc.

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Block out or use die ram safety chain.
3. Lockout safety device.
4. Shut off and lockout electrical system.

5. Check for zero energy state.
6. Return controls to safest position.

5. RELEASE FROM LOCKOUT

1. Inspection: Make certain the work is completed and inventory the tools and equipment that were used.
2. Clean-up: Remove all towels, rags, work-aids, etc.
3. Replace guards: Replace all guards possible. Sometimes a particular guard may have to be left off until the start sequence is over due to possible adjustments. However, all other guards should be put back into place.
4. Check controls: All controls should be in their safest position.
5. The work area shall be checked to ensure that all employees have been safely positioned or removed and notified that the lockout devices are being removed.
6. Remove locks/tags. Remove only your lock or tag.

6. SERVICE OR MAINTENANCE INVOLVING MORE THAN ONE PERSON

When servicing and/or maintenance is performed by more than one person, each authorized employee shall place his own lock or tag on the energy isolating device. This shall be done by utilizing a multiple lock scissors clamp if the equipment is capable of being locked out. If the equipment cannot be locked out, then each authorized employee must place his tag on the equipment.

7. REMOVAL OF AN AUTHORIZED EMPLOYEE'S LOCKOUT BY HTEC

1. HTEC to verify that the authorized employee who applied the device is not in the facility.
2. HTEC employee not remove lockout unless they have spoken to operator that has placed lockout, and they have given permission to remove lockout.
3. Ensure that the authorized employee has this knowledge before he/she resumes work at the facility.

8. PROCEDURES FOR OUTSITE PERSONNEL / CONTRACTORS

Outside personnel/contractors shall be advised that the company has and enforces the use of lockout procedures. They will be informed of the use of locks and tags and notified about the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

The company will obtain information from the outside personnel/contractor about their lockout procedures and advise affected employees of this information.

The outside personnel/contractor will be required to sign a certification form (see Lockout Form E). If outside personnel/contractor has previously signed a certification that is on file, additional signed certification is not necessary.

9. TRAINING AND COMMUNICATION

Each authorized employee who will be utilizing the lockout procedure will be trained in the recognition of applicable hazardous energy sources, type and magnitude of energy available in the work place, and the methods and means necessary for energy isolation and control.

Each affected employee (all employees other than authorized employees utilizing the lockout procedure) shall be instructed in the purpose and use of the lockout procedure, and the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

Training will be certified using Lockout Form B (Authorized Personnel) or Lockout Form C (Affected Personnel). The certifications shall be stored electronically in the HTEC Safety folder. The lockout certification log shall also be updated.

10. PERIODIC INSPECTION

A periodic inspection (at least annually) will be conducted of each authorized employee under the lockout procedure. This inspection shall be performed by Ashley Perry or other appointed employee.

The inspection will include a review between the inspector and each authorized employee of that employee's responsibilities under the energy control (lockout) procedure. The inspection will also consist of a physical inspection of the authorized employee while performing work under the procedures.

The LSM or another appointed employee shall certify in writing that the inspection has been performed. The written certification (Lockout Form D) shall be stored electronically in the HTEC Safety folder. The lockout certification log shall also be updated.

11. LOCKOUT FORMS

The following list of forms are to be completed prior to an HTEC employee or contractor locking out HTEC equipment:

A. List of Authorized Onsite Personnel for Lockout Procedures
B. Certification of Training (Authorized Personnel)
C. Certification of Training (Affected Personnel)
D. Lockout Inspection Certification
E. Outside Personnel/Contractor Certification
F. Specific Equipment Lockout Details Template
G. Master Lockout Form

Lockout Form A

List of Authorized Onsite Personnel
For Lockout Procedures

NAME	JOB TITLE

LOCKOUT FORM B

Certification of Training
(Authorized Personnel)

I certify that I received training as an authorized employee under ***HTEC'S*** Lockout program. I further certify that I understand the procedures and will abide by those procedures.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM C

Certification of Training
(Affected Personnel)

I certify that I received training as an Affected Employee under ***HTEC'S*** Lockout Program. I further certify and understand that I am prohibited from attempting to restart or re-energize machines or equipment that are locked out or tagged out.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM D

Lockout Inspection Certification

I certify that _____was inspected on this date utilizing lockout procedures. The inspection was performed while working on _____.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

_____ _____

INSPECTOR SIGNATURE DATE

LOCKOUT FORM E

Outside Personnel/Contractor Certification

I, _____ (outside personnel/contractor) certify that I have been informed of, and will abide by, HTEC's lockout procedures.

_____ _____

OUTSIDE PERSONNEL/CONTRACTOR SIGNATURE DATE

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM F

Specific Equipment Lockout Details

(Date)

Type of Equipment: _____

General Description: _____

_____

Manufacturer: _____

_____

Model Number: _____

Serial Number:* _____

_____

** If more than one piece of same equipment, list all serial numbers.*

Location of equipment:

_____

_____

Operator Controls

The types of controls available to the operator need to be determined. This should help identify energy sources and lockout capacity for the equipment.

List types of operator controls: _____

_____

_____

_____

_____

_____

Energy Sources

The energy sources, such as electrical, steam, hydraulic, pneumatic, natural gas, stored energy, etc.) present on this equipment are:

ENERGY SOURCE	LOCATION	Lockable		Type lock or block needed
		Yes	No	

Shutdown Procedures

List the steps in order necessary to shut down and de-energize the equipment. Be specific. For stored energy, be specific about how the energy will be dissipated or restrained.

Procedure: _____

_____

_____

_____

_____

_____

Lock Type & Location: _____

_____

_____

_____

_____

_____

How Will De-energized State Be Verified? _____

_____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Start Up Procedures

List the steps in order necessary to reactivate (energize) the equipment. Be specific.

Procedure: _____

_____

_____

_____

_____

_____

Energy Source Activated: _____

_____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Procedures For Operations and Service/Maintenance

List those operations where the procedures above do not apply [See 29 CFR 1910.147 (a)(2)]. Alternate measures which provide effective protection must be developed for these operations. Job Safety Analysis is one method of determining appropriate measures.

Operation Name: _____

_____

_____

_____

_____

_____

LOCKOUT FORM G

MASTER LOCKOUT FORM

(to be fixed near lock storage area)

ITEM	LOCATION	REASON OF LOCKOUT	TIME AND DATE OF LOCKOUT	ESTIMATED DURATION OF LOCKOUT	AUTHORIZED PERSONNEL

9. Attachment – Locking Out Procedure (HSP-P-003)

10. Attachment - Contractor Orientation Questionnaire (HSP-P-021)

Contractor/Subcontractor Orientation Questionnaire

The purpose of this questionnaire is to ensure that the subcontractor has been fully informed about the job and safety procedures. The contractor must complete the questionnaire by placing a check in the appropriate column, and answering the questions. The contractor must return the completed questionnaire to the person leading the training before work commences.

DO YOU KNOW:	**YES**	**NO**
How to report Injuries?	_____	_____
How to report damage?	_____	_____
How to report near misses?	_____	_____
How to report hazards?	_____	_____
The evacuation procedure & muster point(s)	_____	_____
What hazards exist on site?	_____	_____
What the site emergency signal are?	_____	_____
How to obtain protective equipment?	_____	_____
Where protective equipment is required?	_____	_____
What personal protective equipment is required?	_____	_____
Where MSDS's are located?	_____	_____
Where First Aid is located?	_____	_____
Where the safety program is posted?	_____	_____

WERE YOU GIVEN:

	YES	NO
A copy of the client safety policy?	_____	_____
A copy of the general safety rules and regulations?	_____	_____
A copy of the worker's and supervisor's responsibilities?	_____	_____
A copy of the supplementary instructions?	_____	_____
Adequate answers to your questions?	_____	_____

PLEASE INDICATE THE DATE OF YOUR WCB REGISTRATION _____/_____/_____

(If you have not been trained you must attend a training seminar, which will be arranged.)

I agree to comply with the company safety program and WCB regulations:

_____

Contractor/Subcontractor Name **Contractor/Subcontractor Signature**

I have instructed this contractor/subcontractor in regard to any safety hazards related to the type of work being performed by the crew in which he/she is working. I have checked that the contractor/subcontractor has the appropriate safety equipment including: hard hat, safety footwear, safety glasses, respirator and hearing protection as applicable. I have seen the contractor's/subcontractor's current WCB registration.

_____

Supervisor Name **Supervisor Signature**

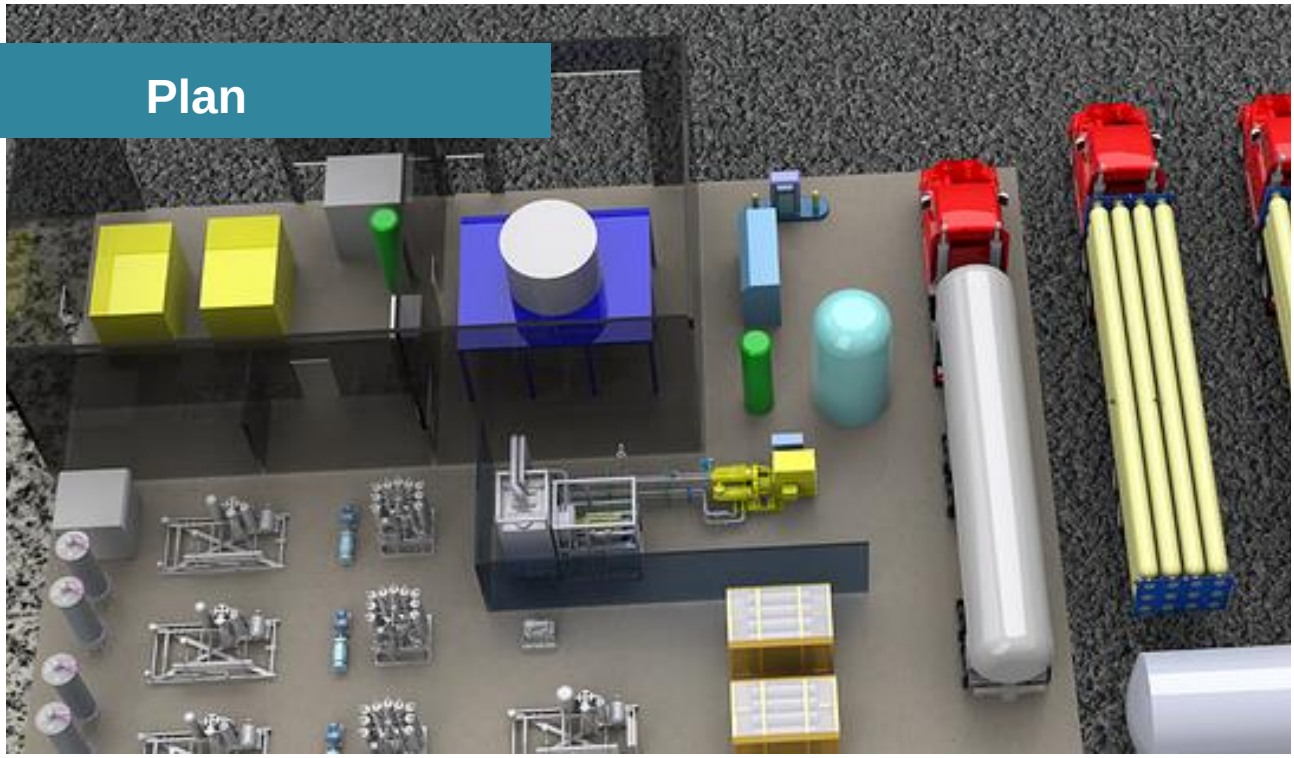
Date: _____

NOTE: this form to be filed with project records by the senior site representative

HYDROGEN SAFETY PLAN

HTEC STATION DESIGN A

Plan



Identification of the document: HSP-P-011

Revision: A

17-Aug-2016

Number of pages: 27

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Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	HTEC Station Design A
REFERENCE	HSP-P-011

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	17-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California.

The purpose of this document is to describe the HTEC Station Design A from a risk and safety perspective. All stations using Design A shall have the same general risks and safety methodologies for mitigating these risks.

All HTEC stations that are built as per HTEC Station Design A will include:

- Single hydrogen sources (HTEC PowerCube delivery)
- A Powertech/McPhy Compression, Storage, and Dispensing (CSD) unit
- Supporting utilities including: dispenser cooling.
- High voltage electrical connections
- Station security walls and doors.

2. Facility Design Safety Overview

The HTEC Station Design A is a sustainable energy initiative focused on selling hydrogen as a clean fuel to Fuel Cell Vehicle (FCV) owners. Hydrogen is delivered to the station using HTEC’s proprietary PowerCube distribution system. A Compression, Storage, and Dispensing (CSD) system supplied by Powertech labs or McPhy increases the pressure and stores the hydrogen at 12,750 psig. Using the J2601 protocol the CSD system can deliver approximately 5kg of hydrogen to a vehicle at the dispenser.

The presence of hydrogen (H2) at the station makes it necessary to integrate specialized design elements and hydrogen safety systems.

From the perspective of avoiding an incident that could result in injury or death, property damage, or a situation that could endanger the public, the most problematic properties of hydrogen are its broad flammability range when mixed with air and its propensity to ignite at low energy levels. As a result, the focus of the hydrogen safety systems at the station is hydrogen detection, active ventilation, and the elimination of extraneous ignition sources.

If a hydrogen leak occurs in the open air, such as at the fueling dispenser, interconnecting piping—where hydrogen can immediately rise and dissipate in the atmosphere—the safety risk is minimal. However, a hydrogen leak within an enclosed area, such as the compressor container, could potentially pose an unsafe environment. To minimize the risk of an enclosed hydrogen leak, the facility incorporates a series of passive and active systems to prevent the leak from reaching an unsafe level.

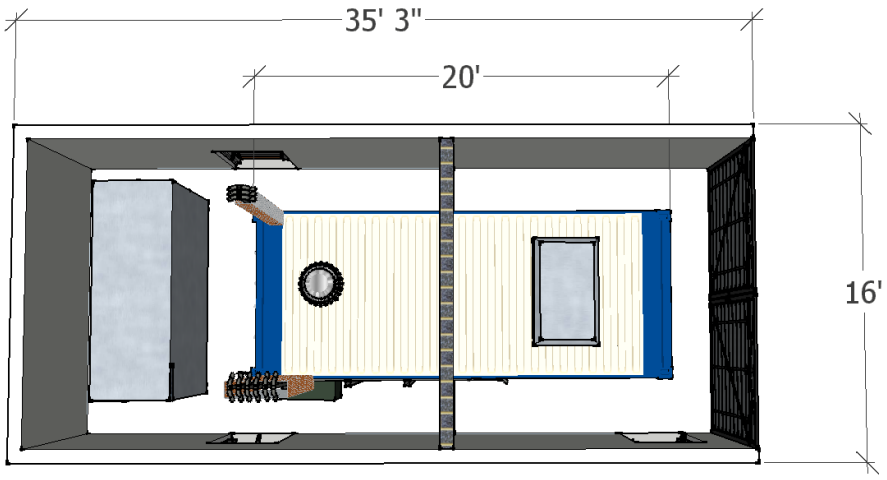
Consequently, the key safety components used to prevent an incident inside one of the station containers at the HTEC site includes hydrogen monitoring and response systems, enhanced

ventilation to prevent hydrogen concentrations from reaching explosive levels, regular system calibrations and testing, and ongoing staff training. The approach to safety at the fueling dispenser is somewhat different, primarily because small hydrogen leaks are quickly dispersed in the open-air environment. Instead the emphasis at the fueling dispenser is a series of redundant systems to stop the flow of hydrogen in the case of an emergency.

3. Station Design Description

Station Design	A
Public or Non-Public	Public
List of Key Equipment	Hydrogen Compressor Module High H2 Pressure Storage Medium H2 Pressure Storage Low Temperature Cooling System Other Non-rated facility utilities Interconnecting piping (above and underground) Hydrogen Dispenser
Facility Security (if applicable)	Fire Barriers walls where necessary, fences, locked gates and security doors.

A general site plan the HTEC station design is shown in the figures below.



Sample Station Layout

3.1. Block flow diagram

Please refer to the appendix for a block flow diagram of the station design.

3.2. Station Layout

While the station layout will be slightly different for each location there will be the following significant commonalities to this design:

1. Two areas with different classifications separated by a fire barrier:
    a. Class I Div II area – contains all hydrogen storage and processing equipment
    b. Unclassified area – contains unrated utility systems
2. Compliance with NFPA 2 distances to exposures. Fire barriers around the classified area
3. Separate access gates and security doors to both areas
4. A common hydrogen vent stack
5. A publicly accessible dispenser with underground hydrogen and coolant piping to the dispenser.

3.3. Hydrogen Supply

The station design has one source of hydrogen:

- Hydrogen for the station is delivered to the station via the PowerCube hydrogen distribution system.

<u>Delivered Hydrogen</u>

PowerCubes are delivered to site on a regular schedule. Two high pressure hoses and a two ground wires connect the PowerCube to the station. The PowerCube hydrogen storage modules are located on a concrete pad and are secured via a twistloc mechanism at each corner to resist siemic loads. The PowerCube storage modules are approved under DOT Special Permit # SP 16559

The PowerCube distribution system consists of several PowerCube cylinder modules, and a specialized trailer and forklift which pick up and deliver PowerCubes to each station. Each PowerCube module consists of ten compressed gas Type 3 cylinders capable of storing a total of 89 kg of hydrogen at a pressure of 450 bar (6527 psig). Each cylinder is equipped with two TRVs that release in the event of an overheating scenario. Each PowerCube module requires compressed air to activate a source valve which allows the station to isolate the PowerCube in a ESD scenario.





PowerCube (with Dynetek logo) at a previous HTEC site, and at right without cover. Each PowerCube holds ten high pressure hydrogen cylinders.

3.4. Hydrogen Processing Equipment

Major equipment components:

- A single 20ft x 9'-6" ISO container that houses compression, storage, dispenser cooling, and electronic control systems (see image below);
- One (1) external cooling system modules each approximately 6' by 6' by 5' high;

The equipment will be placed on site such that different rated systems are separated as per NFPA 2.

Compressor and Electrical Room (20' ISO Container)

This modular container houses the main station hydrogen compressor, the high pressure hydrogen storage, and the associated control equipment. This modular container is internally divided into two sections:

Compressor Room and High pressure storage area:

This area of the container has one access point along the short sides of the container. These doors are locked with conventional door lock and deadbolt. This area contains the hydrogen compressor, the high pressure storage and any sequencing or safety valves required. An exhaust fan draws air out of the area from one of the containers side panels. The compressor contains approximately 19 litres (5 US gallons) of hydraulic oil and 78 litres (20 US gallons) of anti-freeze-type coolant.

High pressure hydrogen is stored in six Type 2 cylinders placed inside the container. These high pressure (875 bar) storage tanks are designed to ASME Sec. 7 Div. 3 Code Case 2579. Each has a water volume of 213 L, and will be 9' 6" long and diameter of 1' 6". They are mounted inside the container with specially designed frames which comply with IBC/CSC/ASCE codes. These cylinders receive high pressure hydrogen from the compressor module and provide hydrogen to the dispenser, both via a sequencing panel inside the container.

Control Room and Cooling Systems

This area has one access point (1 door opening out, locked with conventional door lock and deadbolt) and houses the station's PLC, HMI, control panel, an air compressor which supplies the station's pneumatic valves, an air fan (for the dispenser), an electrical breaker box, the station fire alarm panel, and a cooling system for the hydrogen compressor and dispenser.



Figure 1 View from north end of container

3.5. Equipment Utilities

One onsite cooling unit is required for hydrogen processing and dispensing. The cooler is for the dispenser which must supply hydrogen at -40°C.

3.6. Hydrogen Storage

The primary on-site hydrogen storage is in six high pressure Type 2 cylinders and up to two 450 bar Powercubes that remain onsite between deliveries.

- The six high pressure (875 bar) storage tanks are described above inside the CSD unit.
- Up to two anchored Powercubes, described in the hydrogen supply section.

3.7. Hydrogen Vehicle Fuel Dispenser

A modern style vehicle fuel dispenser allows for convenient and safe fuelling operations. The unit provides compressed gaseous hydrogen fuel to vehicles via a hose and nozzle receptacle that looks and feels much like gasoline pump handle. All hydrogen is cooled inside the dispenser such that there is limited heat building in the hydrogen before it enters the vehicle.

3.8. Site Access and Occupancy

Site Access Control

A 9 foot high concrete wall fence surrounds the station area that includes two access gates and two security doors.

Hydrogen delivery access to the site is via a 15-foot gate located. The access gate will be padlocked, with access for trained personnel only.

Access for emergency services is through any of the two security doors.

Station Compound Occupancy

The site is unattended, and generally unoccupied. The only time the site will be occupied is during maintenance, hydrogen delivery, and site tours.

4. Hydrogen Safety Engineering Control Systems

HTEC uses the 'Preliminary Hazard Analysis' (PHA) and the 'Hazard and Operability' (HAZOP) methods for identifying safety vulnerabilities (ISV). These analyses are undertaken during the engineering phases of the station development. Using HTEC's previous experiences in designing, building and operating hydrogen stations a pre-design ISV analysis has been completed.

4.1. Preliminary Hazard Analysis (PHA)

The PHA is performed during the preliminary engineering phase to identify site specific design hazards and concerns. The PHA includes all aspects of the station and not just hydrogen hazards. The PHA method generates a documented analysis for all major stakeholders involved in the station development and provides either go-no-go deliverables before detailed engineering can commence or provides deliverables that must be met during detailed engineering.

4.2. Hazard and Operability (HAZOP) Analysis

Before the issuance of final engineering drawings a detailed HAZOP analysis is completed with all technical leads of the project. A suitable 3rd party moderator, not involved with the station design will moderate the HAZOP. The HAZOP breaks the station design into nodes and analyses the system response to key process changes like higher/lower/reverse flow, temperature variations, overpressure scenarios, etc. Deliverables from this analysis must be signed off before engineering drawings can be issued for construction

4.3. Pre-Design ISV Analysis and Risk Mitigation Strategies

The safety system uses a number of layered approaches to ensure system safety and mitigate the various hazards involved in the use of high-pressure hydrogen gas. The following table lists the hazards, and the associated design strategies used to mitigate the hazards:

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
High pressure containment failure	Low	High	Use of: • Design standards for plumbing all high-pressure equipment, including vent stacks; • Pressure relief devices; and, • Pressure sensors for detecting over-pressure situations and disabling station functions as needed.
Back flow of high pressure hydrogen to piping/systems with lower pressure ratings	Low	High	Use of: • Interlocking pressure controls • Pressure relief valves • Check valves and back pressure regulators to prevent backflow (not considered a fail-safe measure)
Small Gas leaks	Medium	Low	Use of: • Design standards for plumbing all high-pressure equipment, including vent stacks; • Hydrogen sensors for detecting leaks; • Pressure sensors for detecting under-pressure situations (potential leakage situations) and disabling station functions as needed; and, • Ventilation fans in areas containing hydrogen gas. • Routine maintenance and leak checking
Hydrogen ‘jets’ to nearby exposures resulting from catastrophic hydrogen failure leaks	Low	High	Use of: • Hydrogen leak design measures (mentioned above) • Compliance with latest version of NFPA 2, including fire walls, deflection barriers, and setback distances.

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Fire/explosion from hydrogen leak combined with a source of ignition	Low	High	Use of: • Design standards for plumbing all high-pressure equipment (to avoid leaks that could lead to fire); • Vent stacks for directing hydrogen leaks away from personnel; • Intrinsically-safe electrical circuitry in areas containing hydrogen gas (such as the compressor rooms); • Purging in the dispenser electrical cabinet, to prevent hydrogen gas leaks from entering the electrical cabinet; • Ventilation fans in areas containing hydrogen gas; and, • Explosion-proof cabinets for electrical circuitry in areas containing hydrogen (where intrinsically-safe methods cannot be used). • Compliance with NFPA 2 setback distances nd NPFA 70 requirements
Hydrogen permeating unclassified areas	Low	Medium	Use of: • Fire walls/sealed barriers to separate classified zones
Vehicle driving away from station with hydrogen hose connected	Medium	Low	Use of: • Hydrogen hose breakaways • Compliance with NFPA 2 for dispenser setback distances • Pressure monitoring of hose hydrogen pressures
Security break-in	Medium	Medium	Use of: • Security locks on doors and gates • Security cameras • Signage indicating ‘danger’ and ‘high pressure’ • Remote operation of station to minimize safety risk in the event of security breach

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Natural Disaster (Earthquake)	Low	High	Use of: • Site works design and installation compliance with rating earthquake zone level and approved by a California structural engineer. • Tie down of equipment to concrete pads sufficient to prevent movement of equipment of pad • Hydrogen source valves that are beside hydrogen storage tanks to minimize exposed piping. • Fail safe design such that if loss of pressure, or air supply control valves close containing hydrogen in storage containers
Asphyxiation from hydrogen or nitrogen leak in confined spaces	Low	High	Use of: • Vent holes in ceiling of containers • Hydrogen sensors in all containers • Extraction fan in container.

The following subsections discusses specific design strategies in more detail:

4.3.1. Gas Detection

The hydrogen gas detection system for the 875 bar systems is comprised of explosion-proof gas detection probes connected to a monitoring panel. The monitoring panel reads hydrogen measurements from each probe, converts each measurement to a percentage of LEL, and triggers alarm outputs as needed via a relay panel. The alarm outputs are connected in series with the ESD circuitry, and are also connected to the control system. The alarms are latched, both in the control system PLC and on the monitoring panel

In addition, when a 25% LEL hydrogen alarm is detected, a visual alarm such as a strobe light will activate.The hydrogen alarm outputs cause different system responses, depending on the type and severity of each alarm.

The hydrogen probes are located as follows:

<u>875 bar Compression Container:</u>

- Compressor room
- Electrical room

Dispenser:

- Inside the dispenser, in the upper portion of the lower half of the enclosure near the hydrogen tubing and valves.

The hydrogen alarms are latched in all areas. To reset any hydrogen alarm, the alarm at the gas detection panel must be reset, and then the alarm via the station HMI must be reset.

4.3.2. High Pressure Safety

The hydrogen compression, storage and dispensing systems are designed and built per ASME B31.3-2012: Process Piping. This code sets forth engineering requirements deemed necessary for safe design and construction of pressure piping.

The storage banks are operated by a sequence panel which has each bank's piping connection on a common manifold built of stainless steel tubing and fittings with individual shut off valves. In the event of a high pressure incident, each storage bank is equipped with a pressure relief valve. The storage system sequence panel has pressure switches in the relief vent stacks which alert the PLC if there is an over pressure event.

The compressor is equipped with pressure relief valves to protect the compressor from an over-pressure event at the suction inlet and discharge outlet. These pressure relief valves have a pressure switch in the relief vent stack which alerts the PLC if there is an over pressure event.

All vent stacks direct vented gas upward and away from any personnel, and are designed and installed per CGA G-5.5: Hydrogen vent systems.

4.3.3. Emergency Shut Down (ESD)

The station design includes four emergency shut down (ESD) buttons, located as follows:

- Outside the 875 bar compressor room;
- Inside the 875 bar compressor room;
- Inside the 875 bar electrical room;
- On the dispenser;

When any ESD button is pressed:

- The CSD system's control air is shut down, causing all air-actuated valves to revert to a fail-safe state and become inoperable. The control system receives an "ESD fault" signal, and responds by deactivating all station functions, including dispensing and compression.

4.3.4. Ventilation

The 875 bar compressor room includes a ventilation fan to mitigate any hydrogen leaks. The ventilation fan runs continuously at a nominal speed to allow for a minimum of 7 cfm per square foot of floor area. If the control system detects a hydrogen leak in the vicinity, the appropriate fan is run at a higher speed to help disperse the leak.

4.3.5. Dispenser Purge

The dispenser is able to use non-rated electrical equipment in an area classified as hazardous, by housing this equipment in a partially sealed cabinet and using a purge fan to continuously purge and pressurize the cabinet – as long as the purge is maintained, the electrical cabinet interior is considered an unclassified area. The purge fan is located in the electrical room, outside the classified area (15-foot radius around the dispenser).

If the purge is lost (e.g. due to the cabinet being opened), a pressure switch is triggered, which sends an alarm signal to the control system. If the control system detects a loss of purge, the dispenser power supply is interrupted immediately, and the control system deactivates all station functions.

When the cabinet is re-pressurized, there is a delay before the dispenser power is re-enabled, to allow time for at least four complete purges of the electrical cabinet (as per NFPA 496).

4.3.6. Intrinsic Safety

All electrical circuitry in areas classified as hazardous (e.g. the compressor rooms) is designed to be intrinsically safe, through the use of intrinsically-safe barriers where possible. If not possible, other protection methods are used.

4.3.7. Explosion-Proof Cabinets

All electrical circuitry that cannot be designed as intrinsically safe, and must be located in an area classified as hazardous, is housed in explosion-proof cabinets, to avoid all potential for contact between the electrical circuitry and any flammable gases.Non-Public Areas

5. Equipment and Mechanical Integrity

All hydrogen systems used at the station are listed and labeled by parties approved by the AHJ. This 3rd party verification ensures that all systems comply with all applicable codes and standards. Systems at this station that have been 3rd party verified include:

- Hydrogen Compressor Module
- Low Temperature Cooling System

All stationary hydrogen storage containers are built to ASME standards.

6. Regulatory Compliance

This station will comply with all necessary regulatory bodies as per the authority having jurisdiction (AHJ). Ultimately compliance with the AHJ will result in permits for the station to operate. Compliance with the following regulatory bodies are of prime importance:

- Fire Department Plans Review Office
- South Coast Air Quality Management District (SCAQMD)
- Water Quality Management Agency

Compliance with the Fire Department will require compliance with NFPA, ASME, CSA, and SAE regulations, of which from a station layout perspective NFPA 2 and NFPA 70 are of high priority (NFPA 2 – Hydrogen Technologies Code, NFPA 70 – National Electrical Code).

During the design of HTEC's Woodside Station, a detailed line by line checklist against NFPA 2 and the California fire code was developed as both a tool for HTEC designers and proof to others that HTEC performed its due diligence in designing this station. The same NFPA 2 and Fire Code tool will be used during the design of any future HTEC stations, especially those in California.

As a further proof of compliance with respects to the regulatory bodies, each station design will be verified and sealed by a 3rd party engineer experienced in hydrogen stations.

7. Supplier /Contractor Selection

The importance of selecting the right vendor or contractor has a significant impact on the safety of HTEC equipment and personnel. All equipment undergoes HTEC technical approval before it is purchased and put into hydrogen service. If HTEC does not have the correct specialist in house to provide a technical assessment of a piece of equipment then HTEC will contract out this assessment. All contractors working for the HTEC on any station design will have various scopes to which HTEC will evaluate the contractor's ability to complete the scope of work effectively and safety.

HTEC requirements for various contractors are as follows:

Site Construction Work:

Contractor must have previous experience in medium duty industrial installations, especially in regards to constructing firewalls.

CSD Vendor:

Vendor must have previous experience designing, building, and testing fueling stations. All equipment used must conform NFPA 2, ASME, etc. and must be listed and label by an organization approved by the AHJ.

Tank Suppliers:

Vendor must be a ASME qualified shop and be able to test and certify all vessels in regards to ASME standards.

Mechanical Contractor (Piping):

Piping contractor must have experience with installing high purity gaseous systems and pressures above 6500 psig. Experience installing and maintaining hydrogen or other high purity high pressure systems for industrial gas companies is highly preferred. The contractor must also be certified to install piping to ASME B31.3 Section IX which will be recorded in the HTEC Master Log. Contractor must also have clear experience working with ultra pure piping systems to avoid construction debris collecting in the system and sourcing appropriate equipment (piping and tubing) for the piping of the station.

Electrical Contractor

Contractor must have proven experience in jobs complying with NFPA 70 and, if applicable, NFPA 2. The contractor must also have their electrical ticket for high voltage which will be recorded in the HTEC Master Log.

8. Construction Safety Plan

All construction personnel working at an HTEC sites and location must comply with all of the HTEC safety standards, which includes site orientation and appropriate training. Compliance with construction safety policies is detailed in HTEC document HSP-P-010.

9. Station Operation, Maintenance, and Inspections

A description of how the station will operate in steady state is attached to this document.

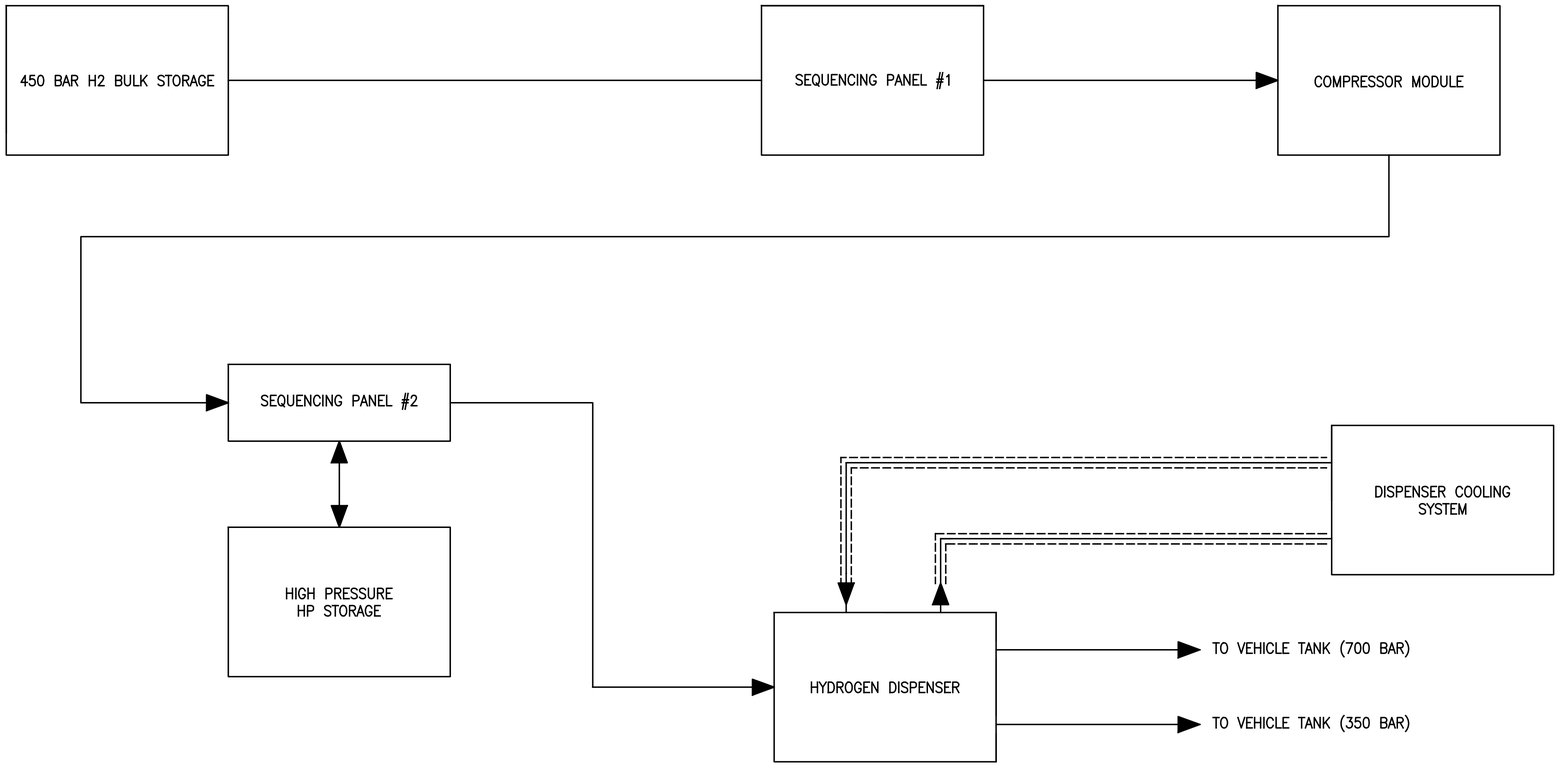
HTEC will follow all maintenance guidelines of the equipment manufacturers; a sample maintenance schedule for the CSD equipment can be found as an attachment to this document.

HTEC will employ or hire contractors to provide continual maintenance checks on the station. HTEC will comply with all regulatory maintenance requirements including:

- Station hydrogen systems visual and leak checks
- Fuel Quality inspections (J2719)
- Dispenser testing (J2601 and DMS)

All inspections, incidences, maintenance hours must be logged as per the NREL data collection program.

10. Attachment – Station Design A – Block Flow Diagram



A	ISSUED FOR REVIEW	04-08-16	AP

SCALE:	NA
DESIGNED BY:	AP
DRAWN BY:	AP
CHECKED BY:	GS
APPROVED BY:	CA
PROJECT ENGINEER:	GS

SEAL

PROJECT DESCRIPTION:

HI SAM H2 SAFETY PLAN

DRAWING TITLE:

BLOCK FLOW DIAGRAM
COMPLETE FILLING STATION

HTEC
Hydrogen Technology & Energy Corporation

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H050

A | H050-BFD-001

11. Attachment – Station Design A – Station Layout

GFO-15-605 - Light Duty Vehicle Hydrogen Refueling Infrastructure









Stn 5 - 3939 Snell Ave, San Jose, CA 95136

12. Attachment – Station Design A - Steady State Operation - Overview

The station can be separated into 4 different areas: H2 Supply, H2 Compression and Storage, H2 Dispensing, and Station Auxiliaries. Each area is described below from a station control perspective. The individual 'micro' control mechanisms within each area/system are not described here. Please refer to the respective owners manuals for a more detailed understanding of a specific system. This section does not discuss start-up or shut down procedures.

A discrete 5V circuit connects all modules and ESDs. If this circuit loses voltage, all systems enter their respective emergency shut down sequences.

H2 Supply

PowerCube Deliveries

Each DOT certified PowerCube can deliver 89 kg of gaseous hydrogen (GH2) at a max service pressure of 450 bar. There are 10 cylinders per PowerCube with each cylinder having its own isolation needle valve. A manifold panel on each PowerCube houses ¼ turn manual ball valves with are used when connecting it to the station. An automatic safety shutoff valve on each PowerCube requires compressed air from the station in order for the PowerCube to supply hydrogen. This safety shutoff valve will close whenever an ESD is pressed or the PLC determines a leak in the hose connecting the PowerCube to sequencing panel #1.

A minimum of one PowerCube will be onsite for the beginning of daily operation with a minimum pressure of 407 bar (5900 psig) and minimum contained H2 mass of 74.4 kg. The station has been designed with the ability to operate with two PowerCubes on site. Each PowerCube is connected to the Sequencing Panel #1 via a flexible hose, and this panel controls which PowerCube is being used during operation.

To replace a PowerCube on site, a specific set of switch position, manual isolation and purge valves will be used on the sequencing panel;. The switch will indicate to the station that the specific PowerCube cannot be used for hydrogen supply, and to source hydrogen from another PowerCube or to enter electrolyzer mode as discussed below.

Sequencing Panel #1

The source of hydrogen supplied to the compressor module is varied using Sequencing Panel #1 (SP1). The SP1 includes both air actuated valves, pressure transmitted and indicators, manual valves, check valves, pressure regulators, switches etc. There are two supply options that can be supplied to the compressor module:

a) 'Sprint Mode' (higher pressure PowerCube)
b) 'Steady State Mode' (Lower Pressure Powercube)

During 'Sprint Mode', pressure from the highest pressure PowerCube is reduced to 350 bar and flows directly into the compressor module. A regulator inside the compressor module ensures hydrogen pressure is below the maximum allowable suction pressure for the compressor. As hydrogen mass

flow rates through the compressor is higher with higher inlet pressures, the station preserves the powercube with the highest pressure for times when the station needs to 'top-up' high pressure storage quickly.

During the majority of the day the station will operate in 'Steady State Mode'. In this state hydrogen will be source from the powercube on site with the lowest pressure of hydrogen. In this way HTEC can maximize hydrogen consumption from each PowerCube, minimize deliveries and preserve pressure.

H2 Compression and Storage

Compressing Logic

The specific logic of the compressor is 3rd party IP. This section provides a broad overview of how this logic works. The compressor module accepts any range of H2 pressure between 20 and 350 bar. If the inlet pressure is below 20 bar, an actuated valve closes to avoid depressurization of the line as well as possible damage to the compressor. The compressor is operational any time pressure in either of the high pressure storage banks is below a threshold amount (~860 barg).

Compressed Hydrogen leaves the compressor and flows to the high pressure sequencing panel. Air actuated valves allow the compressed hydrogen to flow into either of the high pressure storage banks. These banks are generally filled one at a time, with the highest pressure bank being filled first, then the next lowest pressurized bank, and then finally the remaining bank. The pressure of each bank is constantly monitored with PITs inside the sequencing panel. If a customer is filling a vehicle while the compressor is running, the compressor does not stop but the vehicle filling logic overrides the logic required to compress the high storage tanks. This means that the high pressure sequencing panel valves adjust to the requirements of filling. After the vehicle is filled, the HPSB (high pressure storage bank) filling logic continues.

This container houses a cooling system that provides cooling to the compressor system as well as the dispenser, although the internal dispenser cooling is limited in its ability to provide J2601 fills back to back.

H2 Dispensing

Hydrogen Dispenser

The specific logic and valve sequence of how a vehicle tank is filled is 3rd party IP, but the logic must conform to J2601.

A customer will arrive at the dispenser and request a either a 700 or 350 bar fill from the HMI on the dispenser. A payment option will be verified with the customer (credit card, debit card, or fob). The customer connects the appropriate filling nozzle to their vehicle. When system recognizes a connection it will follow the J2601 filling sequence. Hydrogen will be sourced from the lowest pressure bank and equalized with the vehicle tank, then the next highest pressurized tank, and finally the highest pressurized bank. A target pressure or State of Charge (SOC) will be determined by the logic based on J2601 tables; this accounts for the settling and temperature decrease of the hydrogen after it has been dispensed to the vehicle tank. During dispensing the hydrogen flows through a liquid-gas heat exchanger with -40°C coolant which will lower the temperature of the hydrogen in accordance with J2601.

To determine the target SOC inside the vehicle tank pressure values will either communicated via the vehicle pressure sensor or from a pressure sensor on the dispenser. A temperature sensor downstream of the hydrogen heat exchanger combined with the tank pressure reading continuously determines the J2601 filling target pressure/SOC. The dispenser limits the flow of hydrogen to 60 g/s as per J2601. An air actuated valve on the dispenser closes once the target SOC in the tank has been reached, if the customer stops the filling process, or in the case of an emergency. After this valve has closed, the hose line is automatically vented and the customer releases the nozzle from the vehicle. If a 350 bar fill is being used, the nozzle itself relieves the pressure in the nozzle via the dispenser vent stack, such that the nozzle can be removed from the car. The amount of hydrogen dispensed is measured via a flow meter and recorded against the customer ID (if using a RFID mechanism), or charged to a credit card account.

Station Auxiliaries

Dispenser Cooling System

The supplemental dispenser cooling system is increases the dispensing capacity of the station and is required to meet CEC performance specifications. This system has its own control system and the cooling fans increase or decrease their speed to maintain a -40°C coolant temperature level. An on/off pump continuously moves coolant around the entire system at a set flow rate. The cooling system can be turned off manually and has a discrete communication link to the compressor module which can turn the system on or off. In the event of an Estop, the dispenser cooling system will be turned off.

14. Attachment – Sample Maintenance Schedule for CSD equipment

This section provides a listing of the maintenance items and schedules for the station's sub-systems.

Refer to the following documents for detailed maintenance procedures:

700 bar compressor – refer to "Instruction Manual"

700 bar compressor chiller – refer to "Installation & Operation Instruction Manual"

The maintenance schedules are as follows:

Component / Test	Type	Minimum Service Interval	Requirements/Components
875 bar Compressor			
Hydraulic oil	AW ISO 46/2 ASTM D2882	Every 4,000 hr or 1 yr interval, or use oil analysis kit to determine change interval	See list of recommended hydraulic oils, reference procedure in Hydro-Pac LX compressor Instruction manual
Hydraulic oil suction strainer	140 micron	First 50 hrs, every 4,000 hr	Wash in solvent bath, blow with compressed air from inside to outside, dry and dip in oil before reinstalling, reference Hydro-Pac LX compressor Instruction manual
Hydraulic oil return filter	25 micron	First 50 hrs, every 4,000 hr	Disposable element, must replace, Hydro-Pac LX compressor Instruction manual
Gas cylinder		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
Hydraulic cylinder		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
Check valves		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
875 bar Compressor Chiller			
Condenser coil		Monthly, or as needed	Inspect and clean, reference user manual
Fluid (water glycol mixture)		Monthly, or as needed	Check fluid quality by inspecting for debris or contaminants, reference user manual
Fluid pressure		Monthly, or as needed	Check for normal outlet fluid pressure
Fluid strainer		Every six months, or as needed	Inspect fluid strainer, reference user manual
Inlet water filter		Annually, or as needed	Inspect and replace as needed

Component / Test	Type	Minimum Service Interval	Requirements/Components
Fluid system and piping		Annually, or as needed	Visually check for leaks and wear on piping components. Replace/tighten as needed.
Electrical system		As needed	Reference user manual J-5562 IOM
Refrigerant system		Annually	Refrigeration Contractor - Perform equipment inspection and refrigerant leak test. Depending on condition of condenser, additional cleaning may be peformed.
Pre Cooler Chiller			
Refrigerant system		Annually	Refrigeration Contractor - Perform equipment inspection and refrigerant leak test. Depending on condition of condenser, additional cleaning may be peformed.
Condenser coil and fans		Monthly, or as needed	Inspect and clean if debris and dirt build up present. Check fans for signs of wear and tear or damage.
Fluid (PTL HPC)		Bi-Annually, or as needed	Check coolant quality by inspecting for debris, contaminants or ice build up inside of holding tank
Fluid pressure		Monthly, or as needed	Check for normal outlet fluid pressure
Fluid system and piping		Quarterly, or as needed	Visually check for leaks and wear on piping components. Replace/tighten as needed.
Pressure Relief Devices			
Hydrogen		Every three years, or as needed	Recertification, to be peformed by FM valves or ASME accredited company.
700 bar Fueling Hose			
Inspection		Annually, or as needed	Visually inspect, replace if needed
Replacement		Every two years, or after pull-out event	Replace hose
350 bar Fueling Hose			
Inspection		Annually, or as needed	Visually inspect, replace if needed
Replacement		Every two years, or after pull-out event	Replace hose
700 bar Fueling Nozzle			
Leak check		Every four to six weeks	Check for leak at nozzle, reference procedure outlines in TK17 H2 70MPa Operating instructions

Component / Test	Type	Minimum Service Interval	Requirements/Components
Lubrication		Every four to six weeks	Lubricate nozzle components, reference Lubrication Plan TK17 H2 70MPa Operating instructions
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TK17 H2 70MPa Operating instructions
Inspection		After pull-out event	Send to manufacturer for inspection
Replacement		Every three years, or as needed	Send nozzle to manufacturer for refurbishment

Component / Test	Type	Service Interval	Requirements/Components
350 bar Fueling Nozzle			
Leak check		Every four to six weeks	Check for leak at nozzle, reference procedure outlines in TK16 H2 Operating instructions
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TK16 H2 Operating instructions
Inspection		After pull-out event	Send to manufacturer for inspection
Replacement		Every three years, or as needed	Send nozzle to manufacturer for refurbishment
700 bar Fueling Breakaway			
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TSA1 H2 Operating instructions
Inspection		After pull-out event	Check for leaks, or send to manufacturer for inspection
Replacement		Every three years, or as needed	Send breakaway to manufacturer for refurbishment
350 bar Fueling Breakaway			
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TSA1 H2 Operating instructions
Inspection		After pull-out event	Check for leaks, or send to manufacturer for inspection
Replacement		Every three years, or as needed	Send breakaway to manufacturer for refurbishment

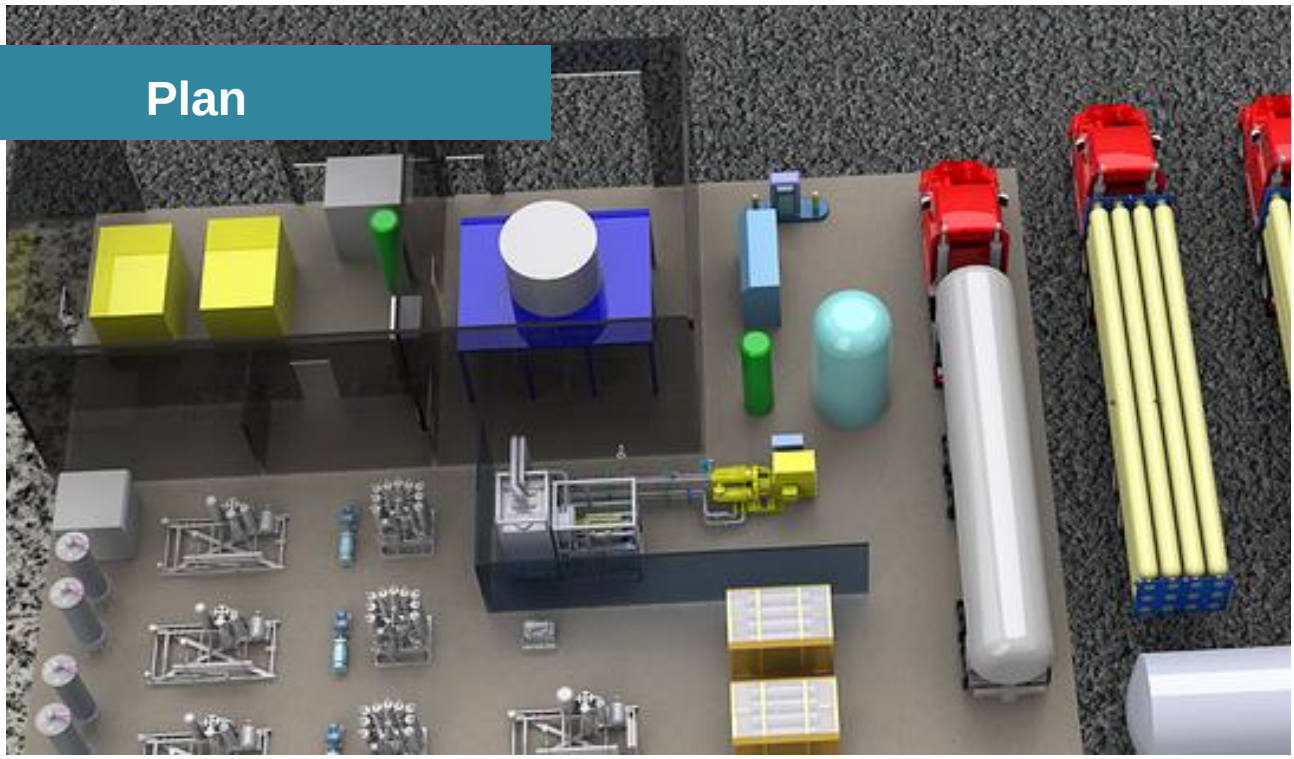
Component / Test	Type	Service Interval	Requirements/Components
Hydrogen Piping			
Inspection		Weekly, or as needed	Visually inspect pipe, valves and fittings
Leak Check		Monthyl, or as needed	Perform leak test on pipe, valves and fittings
Hydrogen Vent Systems			
Inspection		Quarterly, or as needed	Visual inspection of vent system for operational obstructions and support integrity, reference CGA G-5.5
Inspection		Weekly, as needed after weather event	Inspect water drain device for water accumulation, reference CGA G-5.5
Gas Detection System			
		Every three months, or as needed	Calibrate all gas detectors, reference gas detector manual

HYDROGEN SAFETY PLAN

STATION 5: CAPITOL H2 STATION

SPECIFIC DETAILS

Plan



Identification of the document: H066-SAF-002

Revision: A

18-Aug-2016

Number of pages: 10

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Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Hydrogen Safety Plan
REFERENCE	H066-SAF-002

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	18-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California.

The purpose of this document is to describe the Capitol HTEC Station and any design differences or site safety risks that need to be incorporated on top of design considerations described in HTEC Station Design B (HSP-P-011). Risks in this document may or may not be different from the risks at other HTEC station locations.

It is the expectation that this is a preliminary document and that it will evolve as the project continues, and more complete information is identified.

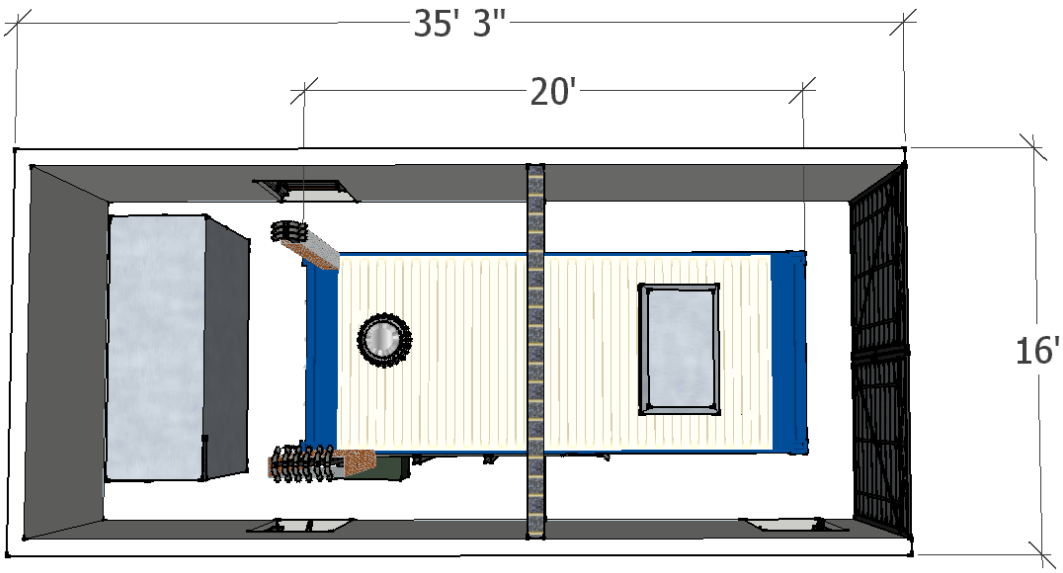
2. Facility Description

Station Name	Capitol Hydrogen Station
HTEC Station Design Type & Reference Document	A – (Reference Document: HSP-P-011)
Address	3939 Snell Ave, San Jose, CA 95136
Lot Description	A large Valero Gas Station at a busy intersection. Two sides of the station back on the concrete walls of a Public Storage facility.
Distance to Fire Department	2.5 miles – San Jose Fire Department (4380 Pearl Ave)
Public or Non-Public Hydrogen Station	Public
Total Station Area:	564 sqf
List of Key Hydrogen Equipment	Hydrogen Compressor Module High H2 Pressure Storage Medium H2 Pressure Storage Low Temperature Cooling System Other Non-rated facility utilities Interconnecting piping (above and underground) Hydrogen Dispenser
Station Barriers to Entry (if applicable)	Fire Barriers walls where necessary, fences, locked gates and security doors.
Number of attendants for station while open	Zero – Station is remotely operated
Hours of operation	24/7 expect during maintenance and hydrogen delivery

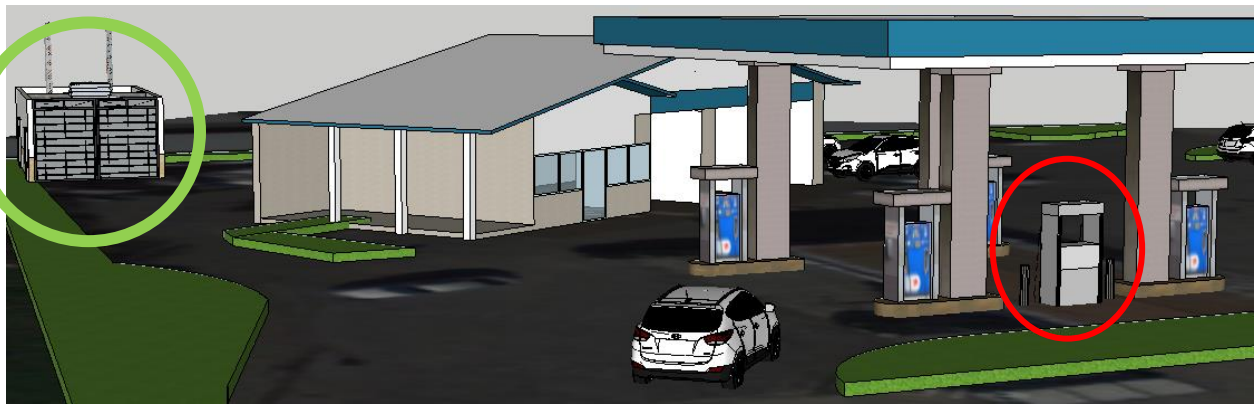
A general site plan and layout of the HTEC station is shown in the figures below. The station is located on a large Valero Gas Station located on a busy intersection between highway 97 and 101. It is a busy 24 hrs/day station.

The HTEC station is located near the east corner of the property. There are three access points to the property from the main road along the eastern side of the property.

For a station block flow diagram, description of major hydrogen processing equipment, or general site operation, please refer to the HTEC Station Design A document (HSP-P-011).



Proposed Station Layout



Proposed Station Isometric View

Station with Green Circle, Dispenser with Red Circle

3. Site Access and Occupancy

Site Access

There are three (3) access points from the main roads (Snell Ave. and Capitol Expressway). Hydrogen delivery or special equipment delivery will be from the southern most access point along the Capitol Expressway. These access points can be seen in the picture below.

Station Access Control

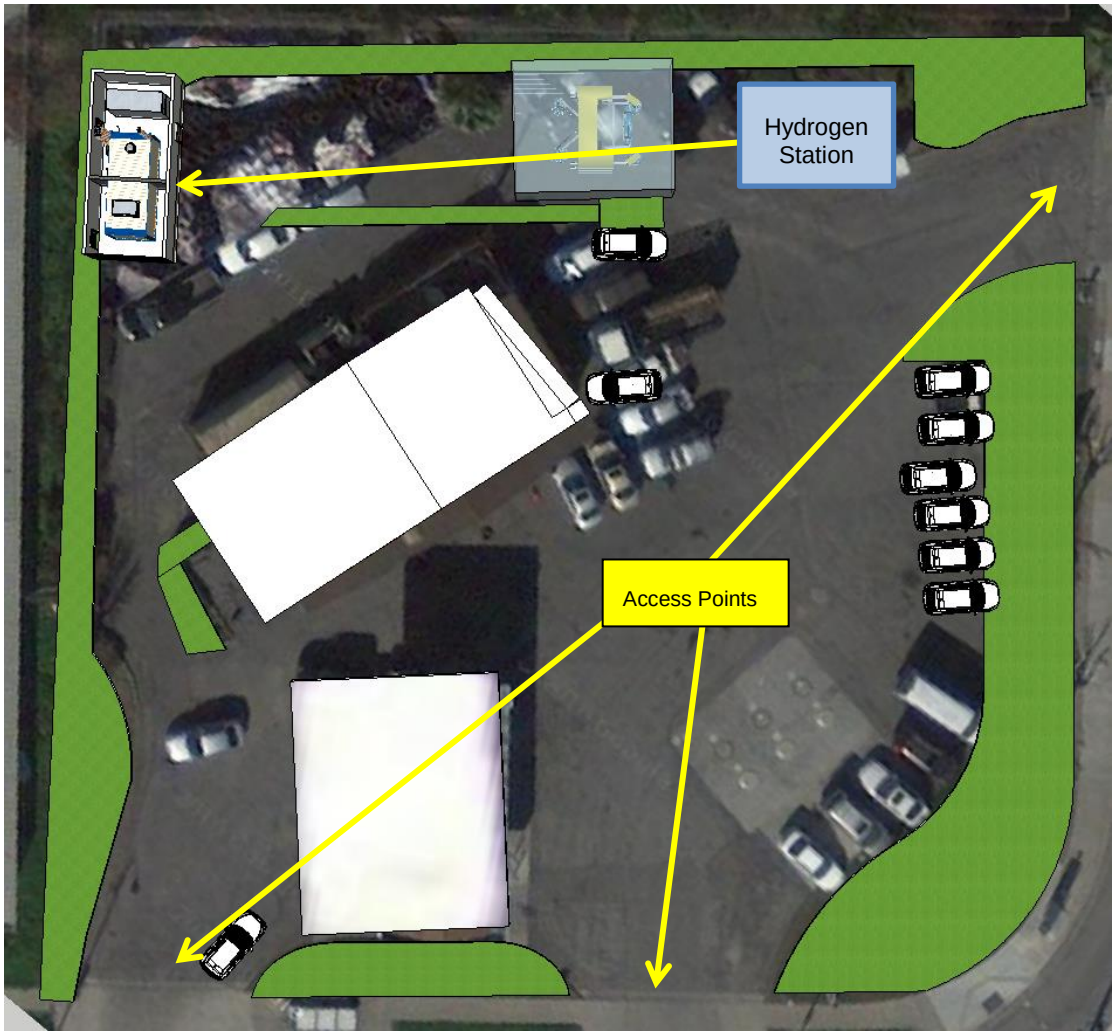
A 9 foot high concrete wall fence surrounds the station area that includes one access gates and 2 security doors. The access gate and doors will be locked, with access for trained personnel only. Each of the gates and doors can be pushed open from the inside to escape the facility in an emergency.

Hydrogen delivery access to the station is via a 15-foot gate located on the site south wall.

Access for emergency services is through either of the two security doors.

Station Compound Occupancy

The hydrogen station is unattended and generally unoccupied. The only time the station site will be occupied is during maintenance, hydrogen delivery, and site tours. The Valero station has an attendant 24 hrs/day.



Station 5: Capitol Hydrogen Station - location map

3939 Snell Ave, San Jose, CA 95136

4. Site Specific Operation

General operation of the station will not differ from the general operating overview described in HTEC Station Design A.

There are no site specific inclusions for control strategy:

5. Site Specific Hazards

The following list details site specific hazards that must incorporated into the station PHA and HAZOP analysis as per HTEC Station Design A (HSP-P-011):

The Valero site is bordered on the northwest and southwest by a Public Storage facility, which has no exposed or openable windows, or air intakes. The Valero station will be building a car wash facility along the northwest side of the property behind the convenience store. HTEC will need to work the designers of the car wash facility to ensure that hydrogen setback distances as per NFPA 2 are complied with. The carwash facility will also increase traffic around the hydrogen station so protective bollards around the station must be included in the design of that station. No exposed overhead powerlines are near the station.

by the west side freeway (I5) to the east, a large ditch to the south, a motel and restaurant on the north side and CA-33 on the west. Distances to hazards as per NFPA 2 are far in access of the setback requirements.

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Collision of vehicles into station due increase traffic around station	Low	Medium	Use of: • 4”-6” diameter concrete filled bollard around the outside of the station. • A concrete raised island between vehicle traffic and station.
Fire/Explosion due proximity of unclassified equipment at future carwash facility	Low	High	Use of: • Communication with carwash designers to ensure NFPA 2 setback distances are adhered to.
Collosion of Hydrogen Deliveries with public	Medium	High	Use of: • Site SOPs which include closing down carwash facility during derliveries • Reflective signs, cones, and tape to cordon off safety zone during deliveries.

6. Construction Specific Considerations

A preliminary analysis of the station found that there are no extra construction specific safety considerations on top of those included in HSP-P-012. If the construction of the station occurs at the same time as the carwash facility, specific site safety guidelines will be necessary and will be included in this document.

7. Electrical Connection

Electrical connection for the station is still under review. It is expected that power can be sourced from the electrical pole on the north corner of the lot.

8. Special Permitting Considerations

At this time no special permitting considerations are known above those described in HSP-P-012.

9. Site specific Safety Procedures

Preliminary discussions have been completed with landowner only. After receipt of NOPA, HTEC will incorporate the Capitol Valero safety procedures into this document as a special safety procedure. Thus far, no limiting procedures in regards to site have been found.

HTEC is considering integrating the Capitol Valero ESD signal into the hydrogen station as the dispenser will be located where current gasoline dispensers are currently located.

Station Name	Address	Safety Plan Document #:	Revision
Portola Hydrogen Station	115 Portola Rd, Portola Valley, CA 94028	H067-SAF-001	A – August 18th 2016

THIS DOCUMENT IS MEANT AS AN OVERARCHING SAFETY DOCUMENT AND MUST BE POSTED IN CLEAR VIEW AT SITE.

Brief Station Description:

The Portola Station is located on at an independent gasoline station named 'Ramies Automotive". The station has a dispensing capacity of 200 kg/day. Hydrogen is supplied to the station via a HTEC PowerCube hydrogen delivery system. A Compression, Storage, and Dispensing (CSD) system supplied by Powertech Labs increases the pressure and stores the hydrogen at 12,750 psig. Using the J2601 protocol the CSD system can deliver approximately 5kg of hydrogen to a vehicle at the dispenser.

Scope of Hydrogen Safety Plan

The purpose of this plan is to provide a guide that will ensure the safe conduct of all project work with an emphasis on aspects involving hydrogen and hazardous materials handling. HTEC is building a network of hydrogen stations in California with the same safety mindset for all stations. Certain elements of this safety plan will be the same for all of HTEC stations while others will be specific to this station.

A complete safety plan for this station is the amalgamation of all the documents listed below:

No.	Document Name	Document Number	Revision
1.	HTEC Safety Policy and Processes	HSP-P-10	A – August 10th 2016
2.	HTEC Hydrogen filling station - Design C	HSP-P-13	A – August 18th 2016
3.	HTEC Portola Site Specific Details	H067-SAF-002	A – August 18th 2016

Brief Document description:

HTEC Safety Policy and Processes:
includes HTEC safety policies and procedures including training, site orientations, change management, HTEC hydrogen and fuel cell experiences, general hydrogen characteristics and emergency response procedures.

HTEC Hydrogen filling station - Design C:
includes a description of the station design and equipment, hazard analysis, and safety design to mitigate potential risks

Portola Site Specific Details:
includes site specific information including: a general layout of the station, process flow diagrams, site access, site required safety systems above the station design requirements.

Station 9: Portola Hydrogen Fuelling Station
Emergency Response & Safety Guide Quick Reference

115 Portola Rd, Portola Valley, CA 94028

This quick reference is intended for technical personnel and equipment operators who have completed all mandatory hydrogen safety and equipment training.

1. Emergency Contact Information:

First Responders	**911**	(Fire / Ambulance / Police)

2. HTEC Emergency Contact Information:

Colin Armstrong	(604) 998-4147 or	(604) 351-0298
Ashley Perry	(778) 229-8059	
Bob Boyd	(510) 922-9613	

3. Powertech Labs

Ashley Tyndall	(604) 590-7500

4. Land Owner

Ron Ramies	(650) 851-6789

Critical Emergency

During a critical emergency, an issue has been identified that is likely to affect the safety, health, and welfare of personnel, or damage the environment or equipment.

The following procedure shall be followed if a critical emergency has occurred:

1. **Push the nearest Red Emergency Shutdown button (ESD).**
2. As an immediate measure, isolate the area for at least 100 meters (330 ft) in all directions, keeping people upwind of the incident if possible.
3. Call 911 to report the emergency, and notify the dispatcher that the emergency involves hydrogen fuel;
4. Follow instructions provided by Emergency Services personnel, giving first aid as appropriate to injured persons.
5. Contact one of the Emergency contacts listed above.

Fires: Use dry chemical or carbon dioxide (CO_2) fire extinguisher – a fire extinguisher is located at in the Control Room (south door of station). Do not attempt to extinguish a fire if the fire is being fed from a hydrogen leak – the source of the leak must be eliminated prior to extinguishing the fire, allow the hydrogen to burn until all the fuel is consumed. The extinguisher can be used to prevent the fire from spreading to adjacent structures.

During a station fire, it is likely that the thermal pressure relief devices (TPRD's) will activate. When activated, the TPRD's release hydrogen through the relief vents located on top of the station. Note that release of the TPRD's may be very loud. The PowerCubes each have their own relief vents, located along the top edge.

Minor Emergency Procedures

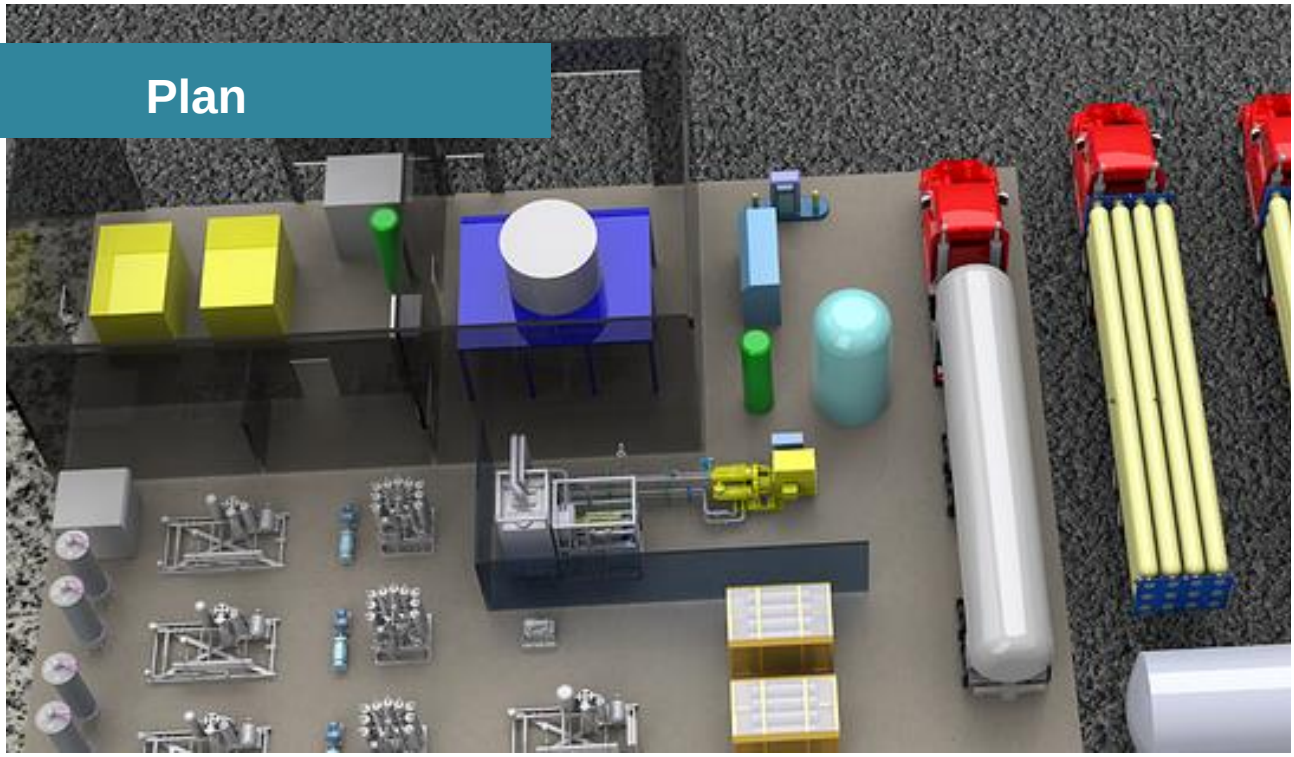
1. Operator shall manage the scene, assess the severity of the emergency, and determine the initial course of action.
2. Take appropriate action to contain and eliminate the emergency. If it is safe to do so, close the Bank Isolation Valves on the PowerCube control panel (on the side of the PowerCube) and/or the station isolation valves inside the high pressure storage area (inside the doors on the station).
3. If required, push the nearest Emergency Shutdown button (ESD). ESD's are located on the Electrical Room and the side of the Fuelling Station.
4. Keep bystanders at least 75m (250 feet) away from the station and PowerCube.
5. Contact one of the Emergency contacts listed above.

HTEC
Hydrogen Technology & Energy Corporation

HYDROGEN SAFETY PLAN

SAFETY POLICY & PROCESSES

Plan



Identification of the document: HSP-P-010

Revision: A

10-Aug-2016

Number of pages: 26

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Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	HTEC Station Safety Policy and Processes
REFERENCE	HSP-P-010

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	10-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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10. Attachment - Contractor Orientation Questionnaire (HSP-P-021)

1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California. Its purpose is to provide general safety policy and methodologies for all HTEC stations and where applicable to direct the reader to specific company safety policies that are not controlled by this document.

It is expected that this is a document that will evolve over time as stations mature and new policies and techniques are improved or required.

2. Preserving Health, Safety, and the Environment (HSE)

2.1. Introduction

HTEC has embarked on building hydrogen infrastructure in California to capitalize on the role out fuel cell vehicles (FCV). The success of this program, which involves key station developer stakeholders, the government of California, and the public, depends on HTEC’s ability to provide stations that perform to and exceed CEC standards while preserving the health and safety of HTEC employees, contractors, visitors, the general public as well as the environment in which HTEC operates.

2.2. HTEC Safety Program Policy

HTEC operates all its facilities, distribution systems, and engineering design under a unified umbrella Safety program, (HIP-005 - HTEC Safety Program – Definition & Mgment Commitment”). An uncontrolled copy of this document is attached to this safety document as a reference only. For the most recent version of this document please contact HTEC document control.

The HIP-005 document details HTEC’s commitment in following areas:

- Management Commitment And Program Manager Designation
- Purpose of Health and Safety Program
- Rules And Procedures
- Instruction And Supervision
- Personal Protection Equipment
- Worksite Inspections And Follow-Up
- Incident Reports
- Incident Investigations
- Safety Committee & Safety Meetings
- Workplace Hazardous Material Information System (WHMIS)
- First-Aid

- Documents, Records And Statistics
- Responsibilities & Authority

2.3. HTEC Hydrogen and Fuel Cell Experience

HTEC has extensive experience in designing, building, and operating hydrogen facilities of all pressures, for both liquid and gaseous hydrogen. The key lesson learned in previous hydrogen projects is that communication is paramount with all stakeholders in this type of project.

The following tables provide a summary of relevant projects HTEC and their partners have worked and partnered on:

Facility Name	Location / Purpose / Dates	Station/ Facility Details	Consortium Member Roles (Lead in Brackets)
Skyline Hydrogen Energy and Education Center	Woodside, CA Provide low carbon intensity hydrogen production facility, advanced high pressure distribution and public engagement/education programs Operational Oct 2016	Pressure – 450 Bar Capactiy – two x 7kg sequential fill and 140 kg/day. Hydrogen – delivered in 450 Bar PowerCube modules, and generated on site with electrolyzer	(HTEC) HTEC – site design, build, permitting, operation maintenance, hydrogen supply Powertech – CSD module and support MyPhy – Electrolzyer module and support
Northland H2 Station	Port of Vancouver lot in North Vancouver, BC IWHUP station providing fuel to the fleet of 8 HICE GM trucks and 2 HICE Ford Shuttle buses (2005 – 2010)	*Pressure - 350 Bar* *Capacity - 2 x 7.5kg sequential fill and 75 kg/day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(SDE) Powertech – module build SDE – site design, build, permitting, operation HTEC – maintenance, hydrogen supply
By-product H2 Processing Facility	Located in North Vancouver BC, built to purify and compress hydrogen to 450 Bar for delivery in PowerCubes	*Pressure – up to 450 Bar* *Capacity – 480 kg/day* *Hydrogen – by-product from chlor-*	(HTEC) HTEC – own, operate SDE – design, build.

	to IWHUP facilities and fill tube trailers for industrial gas companies. (2005 – 2012)	*alkali plant*	
Hemlock H2 Station	City of Surrey works yard in Surrey BC to support fleet of 4 H2ICE trucks and 4 FCEV's. (2011 – current)	*Relocated Northland Station*	(HTEC) HTEC - installation, permitting, own, operate, hydrogen supply
Central Works H2 Station	City of Surrey works yard in Surrey BC to support fleet of 4 H2ICE trucks and 4 FCEV's (2011 – current)	*Pressure - 350 Bar* *Capacity - 1 x 5kg sequential fill and 50 kg/day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(Powertech) HTEC – operate, maintain, hydrogen supply. Powertech – module build and installation
Pacific Spirit H2 Station	National Research Council facility at the University of British Columbia in Vancouver, BC installed to support the local fleet of Ford Focus fuel cell vehicles. (2008 – current)	*Pressure - 350 Bar* *Capacity - 2 x 5kg sequential fill and 75 kg/day.* *Hydrogen – delivered in tube trailers or 450 Bar PowerCube modules.*	(Linde/HTEC) Bob Boyd (Linde) – design, approvals. HTEC – took over and continues to operate and supply hydrogen.
Whistler Fuel Cell Bus H2 Station	BC Transit Facility in Whistler, BC installed to provide fuel for 20 revenue service fuel cell bus. (2010 – current)	*Pressure - 350 Bar* *Capacity - 20 x 35kg sequential fill and 1,000 kg/day.* *Hydrogen – delivered as liquid.*	(Air Liquide/BC Transit) SDE – site design and engineering, process and electrical support, permitting, construction management HTEC – maintenance
Victoria Fuel Cell Bus H2 Station	BC Transit Facility in Victoria, BC installed to fuel a demonstration fleet of 5 fuel cell bus fleets. (2009)	*Pressure - 350 Bar* *Capacity - 5 x 35kg sequential fill and 250 kg/day.*	(Air Liquide/BC Transit) SDE – site design and engineering, process

		Hydrogen – onsite electrolysis and tube trailer. (Project cancelled 75% of way through construction)	and electrical support, permitting, construction management.
BC Transit Mobile Fueling Station	Designed to be installed in various locations in BC to support bus demonstrations and special servicing. (2009 – 2012)	*Pressure - 350 Bar* *Capacity - 2 x 35kg sequential fill and 100 kg/day.* *Hydrogen – tube trailer & PowerCube*	(Air Liquide/BC Transit) SDE – design, build HTEC – operate, hydrogen
Vancouver Airport H2 Station	Vancouver International Airport grounds installed to fill HICE truck, shuttle buses and TUGs. (2010-2012)	*Pressure - 350 Bar* *Capacity - 2 x 35kg sequential fill and 100 kg/day.* *Hydrogen – tube trailer & PowerCube*	SDE – site design and engineering, process and electrical support, permitting, construction management. HTEC – operate, hydrogen
Translink HCNG Bus Station	Translink facility in Coquitlam BC installed to provide HCNG for the 4 HCNG revenue service transit buses under the IWHUP. (2006 – 2010)	*Pressure - 200 Bar* *Capacity – 4 HCNG bus fills sequential twice per day.* *Hydrogen – delivered in 450 Bar PowerCube modules*	(Clean Energy) SDE – Emergency response planning, hydrogen delivery HTEC – hydrogen supply
IWHUP Outreach Program	Public Open houses Promotional Video	*See IWHUP Video in youtube.* *Http://www.htec.ca/#!resources/cq4t*	SDE/HTEC/Powertech
H2 Vehicle Fleet Program	8 H2-ICE Trucks in IWHUP	*Development and management of users of 8 H2 powered trucks over a 4 year period*	SDE/HTEC/Powertech

2.4. Safety Management – Roles and Responsibilities

For companywide safety roles and responsibilities please refer to HTEC policy document HIP-005.

2.4.1. HTEC Leadership and Administration

As per HIP-005, HTEC leadership and administration have the following responsibilities:

- Senior Personnel will actively be involved in safety meetings, investigating incidents, attending safety meetings, conducting safety audits and follow up to ensure corrective action is taken. Senior personnel include the Leads, Construction Supervisor, Project Manager, President and Safety Program Manager.
- Senior Personnel will ensure that all HTEC's contractors or subcontractors are contractually held to all HTEC's safety requirements, attend safety meetings as required, and have received a safety orientation before commencing work.
- Senior personnel will ensure full compliance with all HTEC, Client, Workers' Compensation Board requirements and regulations.

2.4.2. Station Development Phase

Key people (from a Safety Perspective) that will be involved in the development of each station:

1. Project Manager – will be the Primary Point of Contact from the Project Team
2. Safety Specialist – see below description
3. HTEC consortium technology experts for all components of Project deliverables, namely,
    a. Renewable Energy
    b. Generation and Transportation of supply Hydrogen
    c. Compression, Storage and Dispensing of hydrogen
4. HTEC will employ 3rd party reviewers to provide feedback on all technical and safety aspects of this project.

<u>Safety Specialist</u>

HTEC will assign or employ a Safety Specialist to take responsibility for the overall Safety aspects of the project from an end-to-end perspective. He/She will interface with various stakeholders involved in the project and ensure that we comply with all applicable safety norms and guidelines applicable during the design, shipping, installation, commissioning phase of the project. He/She will also be the primary point of contact for the HTEC Safety Committee, as described in HIP-005.

The Safety Specialist shall also carry out a detailed Safety-Audit jointly if needed with an external agency to check and ensure compliance with the design norms laid out at the project kickoff stage.

Post the commissioning of the Project, the Safety Specialist shall design and roll out a train-trainer program for the 'Safety-Supervisor' who in turn shall train the O&M team members, the First Responders (if applicable) and others as and when needed during the O&M phase of the project.

2.4.3. Station Operation Phase

Key people (from a safety perspective) that will be involved in the operation phase of each station:

1. Project Manager – will be the Primary Point of Contact from the Project Team
2. Safety Supervisor – will be responsible to managing all safety aspects of station and reporting to the HTEC safety committee
3. Maintenance personnel – will perform station maintenance and operational support
4. Equipment and process specialists (internal or external) – will consulted or hired when necessary

Please note that all specific names, contact details, and resumes will be shared post NOPA.

2.5. Safety Management Tools

Please refer to HTEC policy document HIP-005 for direction on safety management tools.

2.6. Management of Change (MOC)

At the time of writing this document, HTEC's management of change policy and procedure has not been approved as a part of HTEC Quality manual.

This station safety policy document (HSP-P-010) will be updated and will reference HTEC's companywide MOC policy once it has been approved. Until this quality policy has been approved, the following MOC procedure will apply to all stations.

Station MOC Policy

Changes to the HTEC HSE systems shall be reviewed and approved according to the protocol outlined below. All changes shall be made in writing dated upon Program Manager approval and added as addenda to the appropriate document in the station Hydrogen Safety Plan. In case of disagreement, the HTEC Safety Committee will consider the reviewers' comments and the Program Manager will make a decision based on the best available information.

Changes to facility HSE systems, such as facility ventilation, hydrogen detection and alarm protocols and other facility design-related issues shall be reviewed and approved by the following, in order:

1. Facility maintenance contractor.
2. A team of partner safety experts composed of one representative from each of the following groups:
   a) Powertech Labs (if applicable)
   b) McPhy Industries (if applicable)
   c) HTEC Hydrogen distribution
   d) HTEC project engineer familiar with Hydrogen Stations
3. The HTEC Safety Committee
4. The Program Manager (in consultation with the Safety Supervisor)

Changes to the HTEC Safety Plan shall be reviewed and approved by the following, in order:

1. A team of partner safety experts composed of one representative from each of the following groups:
   a) HTEC Safety Committee
   b) HTEC Hydrogen distribution
   c) HTEC Project Engineer familiar with Hydrogen Stations
2. The HTEC Safety Program Manager
3. The Program Manager (in consultation with the Safety Supervisor)

3. Safety Procedures

The following safety procedures will be followed at each station. This section provides overall safety requirements as well as direction to other controlled HTEC safety documents.

3.1. Safety Equipment Requirements and Recommendations:

- Protective eyewear must be worn when working around and/or with power tools, caustic liquids or compressed gases, heated materials, and other hazardous situations.
- All personnel who work at the station must wear footwear that provides appropriate protection. No open-toe footwear is allowed in the work areas.
- The use of gloves is required when working with chemicals, heat, and sharp objects, and/or working in cramped spaces. Note that most medical cases involve the hand.
- A minimum level of PPE to be required will be determined by the Project Manager.

3.2. General Work Rules:

3.2.1. Drugs and Alcohol

HTEC has a no tolerance policy for drugs and alcohol while either present at the station or operating the station remotely. If an employee or contractor requires the use of medical drugs or prescriptions which inhibit work practice in any form, the station safety supervisor, via written consent, must authorize and clearly provide modified responsibilities (if necessary) before the employee/contractor commences work of any form at the station.

Once the drug no longer inhibits the employee/contractor, the station safety supervisor, via written consent, will reinstate the worker to their full responsibilities as prior to consuming the medical drug.

3.2.2. Working Alone

If working alone, the HTEC work alone procedure must be followed (HSP-P-002). An uncontrolled version of this document is attached.

3.2.3. Maintenance on equipment

Maintenance on station equipment is not allowed if sources of energy have not been locked out.

Work on equipment or piping must follow the HTEC Lock-out procedure (HSP-P-003). An uncontrolled version of this document is attached. By virtue of following this lock out procedure, personnel injury risks from sources of energy will be significantly reduced. Please note that only employees/contractors that have been trained and certified in HTEC's lock out procedure may lock out equipment for further maintenance.

3.2.4. Confined Spaces

The definition of a confined space is:

> A place where the means of entry or exit are restricted because of location, design, construction or contents. The main hazards encountered in confined spaces are fire or explosion, asphyxiation, toxicity, drowning in liquids or free flowing solids and injury or death if mechanical equipment within the confined space is inadvertently turned on while someone is still inside. These hazards are due to the presence of hazardous gases, vapours, fumes, dusts or the creation of an oxygen-deficient or oxygen-rich atmosphere.

At HTEC stations, certain areas of the containers used to house equipment might be considered confined spaces. Design of these areas will include warning mechanisms, fail safe valves and other risk reducing mechanisms, but this does not eliminate the risk associated with working in one of these confined spaces. HTEC's orientation procedure ensures that workers are aware of areas that could be classified as confined spaces and HTEC's 'Confined Space Policy' ensures that all workers are trained and certified to work in confined spaces.

3.2.5. Hazardous Materials

All personnel working with hazardous materials at the HTEC station must have their 'Workplace Hazardous Materials Information System (WHMIS) training completed. Confirmation and date of complete of WHMIS training must be included in HTEC's Master Log List. All Material Safety Datasheets (MSDS) for hazardous materials will be provided in a binder where the station first aid supplies are stored.

3.2.6. Operation of heavy machinery (forklift)

Only those persons who are trained, certified, and licensed to operate a forklift or other heavy machinery and have met these requirements within the last two years, are allowed to operate these machines. These certifications and licenses must be logged on the HTEC's master list.

3.2.7. Access to Station

Access to HTEC's stations is restricted to authorized personnel only. All authorized personnel must be listed in the Station Access log file. This log file will keep a record of when personnel passed orientation training, the level of their responsibility, and any certification applicable records. For a better description of what training is required, please refer to the training section below.

3.3. Contractor/Subcontractor Hiring and Training

For hiring and training contractors/subcontractors the following must be followed:

- All HTEC contractors and subcontractors must receive training and be knowledgeable of HTEC's HSE requirements and procedures. All contractors or subcontractors hired by HTEC will be trained, supervised and closely monitored to ensure the proper procedures are being followed.
- A pre-construction qualification check will be done to ensure each new contractor/subcontractor is capable of performing all aspects of his/her job safely.
- HTEC will conduct a new contractor/subcontractor orientation for new persons coming onto a station for the first time.
- All contractors/subcontractors will receive a tour of the project site and familiarize themselves with the work environment.
- Leads will be responsible for conducting a familiarization tour of the immediate work area for all new contractors/subcontractors reporting to them. Included in this familiarization tour will be area specific safety procedures, instructions and hazards.
- HTEC will identify safety training required as shown on the Safety Training Checklist.

3.3.1. Required Training

As per the HTEC Safety Program HIP-005, persons who are working with and around hydrogen must be trained on proper hydrogen handling procedures and practices. All contractors/subcontractors assigned field responsibilities will complete the safety orientation from HTEC before starting work on the project site.

The orientation will highlight the following topics:

Site and Hazard Orientation

- Site Rules and Regulations –General
- Site/Project Specific Safety Orientation
- Tour of the Project Site

Safety Policies and Program

- HTEC's Safety Policy
- HTEC's General Safety Orientation

Each contractor/subcontractor will receive a copy of the above, and a copy will be retained in the North Vancouver office.

Additional Site Specific Programs include:

- Construction Safety Rules and Responsibilities (if applicable)
- Emergency Evacuation Procedures
- Safety Equipment
- Personal Protective Equipment
- First Aid
- Protection and Response
- Confined Areas
- Hazardous Goods
- Sign Off Sheets – acknowledge a contractor/subcontractor has completed the HTEC's site safety orientation.
- Safety Recognition Program

3.3.2. Contractor/Subcontractor Orientation Questionnaire

Each contractor/subcontractor must complete the HTEC Orientation Questionnaire before work at the HTEC site can be commenced. The purpose of the questionnaire is to ensure that the subcontractor has been fully informed about the job and safety procedures. The contractor must complete the questionnaire and return it to the HTEC; a uncontrolled copy of this questionnaire is attached.

3.4. First Aid

HTEC is committed to providing and maintaining a first aid program for the purpose of minimizing the effects of job-related injuries and illnesses, increasing productivity, reducing absenteeism and meeting WCB regulations. The company will provide and maintain first aid services, supplies and equipment.

First Aid services, supplies and equipment will be made available to all workers during working hours. The company will ensure that workers receive instructions in the procedure for summoning first aid and reporting injuries.

Workers who sustain a job-related injury or illness, regardless of seriousness, must immediately report it to the first aid attendant for treatment or recording, and where practicable, must also report it to their immediate supervisor. If medical treatment is required the injured worker will be transported to the nearest medical aid facility at the expense of the company.

The first aid attendant will be in complete charge of all first aid treatment of injured worker until medical aid is available. Supervisory personnel will not attempt to over-rule the attendant's decisions relating to first aid or emergency transportation.

Pertinent injury information will be entered in the First Aid Treatment Log Book by the first aid attendant and verified by the injured worker's supervisor.

All personnel assigned to field project sites shall ensure they are familiar with the site procedure to summon first aid, the reporting of injuries and the location of the first aid room.

4. Compressed Hydrogen Fuel Characteristics

This section summarizes the general characteristics of hydrogen and identifies potential hazards.

Hydrogen possesses several unique characteristics and hazards compared to other, more common fuels currently available on the market. Some of these general characteristics and hazards include the following;

- Hydrogen is a colorless, odorless, tasteless, non-corrosive, and flammable gas;
- The amount of energy required to initiate hydrogen combustion is much less than other common fuels;
- Hydrogen/air mixtures can be easely ignited by small energy sources such as sparks;
- Hydrogen is considerably lighter than air: it rises very quickly and does not pool near the ground like gasoline, diesel, or propane fuel vapors;
- Hydrogen rapidly diffuses into the atmosphere;
- Hydrogen fires burn at high temperatures, but are **less** likely to spread to adjacent structures than fires fuelled by other fuel types, because hydrogen is highly buoyant and radiates little heat energy;
- Hydrogen contains a lower amount of explosive energy per volume than most other fuels;
- Hydrogen gas is not toxic but may induce suffocation (asphyxiation) if it displaces oxygen in a confined space.



All combustible fuels are hazardous. Hydrogen is not inherently more dangerous than other fuels, but its properties are unique and it must be handled appropriately.

The low ignition energy of hydrogen presents an increased probability of ignition. However, hydrogen's high buoyancy and high diffusivity in air tend to reduce the duration over which the hydrogen gas-air mixture is in the flammable concentration range.

Additional safety related information and information on hydrogen characteristics can be found from the following sources:

- General Compressed Hydrogen Safety Training Program (Sacré-Davey Innovations)
- http://www.hydrogenandfuelcellsafety.info/
- www.hydrogensociety.net
- www.hydrogen.energy.gov

5. Emergency Response Procedures

THIS SECTION MEANT TO BE REVIEWED FOR TRAINING AND NON-EMERGENCY SITUATIONS ONLY.

REFER TO THE STATION ONE PAGE EMERGENCY GUIDE IN THE EVENT OF A EMERGENGY SITUATION, WHICH WILL INCLUDE ALL UPTO DATE CONTACT DETAILS.

This section details the recommended safety and emergency response procedures that should be followed by technical personnel and equipment operators, and serves as a guide for emergency responders.

If the incident occurs at HTEC fueling station this Emergency Response Procedure should be followed to ensure that equipment is shut down and the proper personnel are informed.

In general, any red emergency shut-down (ESD) button should be pressed during any emergency situation at the HTEC Station.

5.1. Hydrogen Fuel Hose Breakaway

The fuelling hose at the station is equipped with a breakaway coupling. In the event that a vehicle is driven away while the fueling hose is still connected, a small amount of hydrogen will be vented when the breakaway decouples, but the event is not considered an emergency situation. The ends of the hose will seal automatically and no sustained release of hydrogen will occur. In this event facility operators (either onsite or remotely) should press or activate the station ESD button and remain 10m (30 feet) from the vehicle and station, then contact HTEC personnel for instructions. Do not operate the vehicle until it is inspected by qualified personnel.

5.2. Emergency Response Levels

During any emergency situation, operators must assess the incident and identify the appropriate emergency response according to the severity of the incident. Emergencies are divided into the following two levels:

1. **Minor Emergency**
2. **Critical Emergency**

When responding to emergencies of either level, the following equipment is recommended for emergency services personnel:

- full protective clothing including turnout pants, turnout jacket, boots, helmet and face shield; and

For any incident involving fire, a positive pressure self-contained breathing apparatus (SCBA) is recommended.

During the initial stages of an emergency incident, technical personnel and equipment operators are the most qualified personnel to take the command role, until more qualified personnel arrive on scene. The Fire Department will always take the command role when they arrive on scene.

5.3. Minor Emergency

During a minor emergency, an issue has been identified that is unlikely to affect the safety, health, and welfare of personnel, or damage the environment or equipment.

During this emergency level, the equipment operator will generally be capable of managing the scene. A minor emergency may include the following:

- small amount of hydrogen leakage found during PowerCube exchange or otherwise normal station operations;

The following procedure shall be followed if a minor emergency has occurred:

1. Operator shall manage the scene, assess the severity of the emergency, and determine the initial course of action.
2. Take appropriate action to contain and eliminate the emergency. If it is safe to do so, close the PowerCube Isolation Valves on the PowerCube control panel and/or the station isolation valves inside the high pressure storage area.
3. If required, push the nearest Emergency Shutdown button (ESD). ESD's are located on the compressor container module and near the exits of the site.
4. Keep bystanders at least 75m (250 feet) away from the station.
5. Contact the HTEC emergency phone number who will then be responsible for assessing the severity of the incident and taking the appropriate action:
6. Record the emergency details and forward the information to the HTEC Safety Committee and program manager.

5.4. Critical Emergency

During a critical emergency, an issue has been identified that is **likely to affect the safety, health, and welfare of personnel, or damage the environment or equipment**.

Some examples of critical emergencies include the following:

- line rupture, fitting failure, or other significant escape of hydrogen from the station, such as from the relief vents on top of the station;

Note: A release of hydrogen through the station vents will be very loud – the station ESD should be pressed immediately in this event.

- fire in or near the station;
- pressure explosion of any kind;

Small Fires: Use dry chemical or carbon dioxide (CO_2) fire extinguisher – a fire extinguisher is located in the Control Room. Do not attempt to extinguish a fire if the fire is being fed from a hydrogen leak – the source of the leak must be eliminated prior to extinguishing the fire. If the leak cannot be stopped, press the station ESD and allow the hydrogen to burn until all the fuel is consumed. The extinguisher can be used to prevent the fire from spreading to adjacent structures.

During a station fire, it is likely that the thermal pressure relief devices (TPRD's) will activate. When activated, the TPRD's release hydrogen through several relief vents located either on top of the station or through the main station vent stack. Note that release of the TPRD's may be very loud. The PowerCubes each have their own relief vents, located along the top edge of each PowerCube.

During the initial stages of an emergency, the operator is generally the most qualified person on scene, and shall manage the site until more qualified personnel arrive. The Fire Department will always take the command role when they arrive on scene.

The following procedure shall be followed if a critical emergency has occurred:

1. Push the nearest Emergency Shutdown button (ESD). ESD's are located on the south wall of the Electrical Room and the west wall of the Fuelling Station.
2. As an immediate measure, isolate the area for at least 100 meters (330 ft) in all directions, keeping people upwind of the incident if possible.
3. In the event of a fire or explosion, call 911 to report the emergency, and notify the dispatcher that the emergency involves hydrogen fuel;
4. Follow instructions provided by Emergency Services personnel, giving first aid as appropriate to injured persons.
5. Contact at least one of the HTEC individuals listed on the one page emergency guide.
6. If a significant amount of hydrogen has been released (10 kg or more) during the incident, then the following agencies must also be contacted:
    a. the State Emergency Program;
    b. the operator's employer, if not already contacted.

7. Before the station is returned to service, the area must be checked with a methane detector.
8. Record the emergency details and forward the information to the Station Safety Supervisor .

5.5. Hydrogen Release Detection

Hydrogen is not odorized. The only way to detect a leak is typically to hear a hissing sound or use one of the following detection methods:

- Thermal Conductivity Sensor (functions well in stable air environment with minimal temperature variations),
- Catalytic Combustion Sensor (functions well for detecting 0 to 4% hydrogen content in air, but not hydrogen specific, typically used by HAZMAT teams).

5.6. Fire Detection

Hydrogen fires can be nearly invisible in daylight. The following methods should be used to detect a hydrogen fire:

- Long handled broom – the bristles should be made of corn straw, as it will easily ignite but does not release toxic fumes. Hold the broom in front of you as you slowly approach the vehicle and it will ignite when passed through a hydrogen fire.
- Ultra Violet (UV) Sensor (functions better than Infra Red (IR) sensors that are better suited to a brighter fire).

5.7. Reporting Incidents

All emergencies and incidents regardless of their severity must be documented and brought to the attention of the HTEC Safety Committee.

5.8. Dealing with News Media

If there is a significant incident involving the HTEC Fueling Station, the news media may arrive on-site and request information. HTEC is responsible for handling all media inquiries.

At the accident scene;

- Do not give the names of injured persons;
- Do not give any personal opinions; and
- Do not take photographs of the scene; however do not attempt to prevent any press photographer from taking pictures.

If HTEC is not available, remember these additional guidelines when dealing with the news media:

- Direct persons asking questions to the authorized spokesperson and don't say "no comment";
- Remember that there is no such thing as "off the record"; and
- Be courteous at all times.

6. Attachment – HTEC's Safety Program – Definition and Management Commitment (HIP-005)

PROJECT NAME / TITLE	CLIENT / INTERNAL	DOCUMENT
HTEC Safety Program	Internal	HIP-005

Revision	Issue Date	Description / Summary of Changes	Issued By	Approved By
A	2015-Oct-16	Initial	AP	

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1. MANAGEMENT COMMITMENT AND PROGRAM MANAGER DESIGNATION

The management of Hydrogen Technology and Energy Corporation (HTEC) will provide a safe and healthy workplace for all employees, contractors, and others that may visit or enter our facilities. Our firm will establish and maintain a Health and Safety Program designed to prevent safety incidences, injuries and disease, and hold it equal to other business values. We are responsible for providing the necessary instruction in health and safety and for addressing unsafe situations in a timely manner. All workers and service contractors are required to work safely and to know and follow our company rules for safe work.

Signature of Management

Colin Armstrong, President

OCT 16, 2015

Date

The Safety Program Manager (SPM) is: ASHLEY PERRY and by way of the following signature accepts the role and responsibilities determined in this document.

Signature of SPM

Oct 22/2015

Date

2. PURPOSE OF HEALTH AND SAFETY PROGRAM

The purposes of the Health and Safety Program defined in this document are to:

a. determine the activities and strategies to ensure management safety commitments are met;
b. eliminate accidents and control potential hazards in the workplace;
c. provide the foundations for ensuring that safety is a fundamentally integrated part of the culture of the company;
d. co-ordinate the provision of the knowledge and tools required for accident prevention.

3. RULES AND PROCEDURES

Safety rules and procedures will be created and made available to employees and posted as appropriate in facilities.

Documents will be created as required for each facility or section of the program and will be revision and issue controlled. A master Document Log will be kept by the SPM who will be the owner of all rules and procedure documents.

If HTEC employees are on a client's facility, the higher level of safety rules and procedures will apply. It is the expectation that HTEC employees visiting or working on a client's site will ask for a safety induction if one is not provided.

4. INSTRUCTION AND SUPERVISION

Employer/Supervisors will:

a. Orientation - Give general orientation to new workers, visitors and contractors prior to entering the workplace.

b. Instruction - Instruct workers in General Site Rules, Safe Work Procedures and Job Rules (e.g. safety headgear, eyewear and footwear, guardrails/fall protection, WHMIS).

c. Training - Provide training and/or ensure required certification is in place for jobs requiring extra skill or knowledge as well as those with demonstrated higher risk of injury (e.g. manual handling) such that equipment & machinery operators can demonstrate that they can do the job safely before being allowed to operate without direct supervision.

d. Supervision - Observe workers, work practices and equipment operation and initiate corrective action when necessary to ensure safety to personnel.

e. Documentation - Keep records of instruction, training, facility inductions, employee and contractor certifications, safety incidents, investigations, and corrective measures taken.

f. Safety Training - Ensure that the SPM receives the required 8 hours of WCB approved training per year.

5. PERSONAL PROTECTION EQUIPMENT

Personnel Protection Equipment (PPE) will be issued and used by all employees, visitors, and contractors as determined by specific procedures for specific areas and activities. In general PPE refers to safety glasses, hearing protection, high visibility clothing, and protective headwear and footwear.

It is recognized that noise levels above 85 decibels combined with long exposure can permanently damage hearing, so the SPM shall ensure that:

a. Noise is reduced or controlled at the source, where practical.
b. Workers are informed about the noise hazard and the risk of hearing loss.
c. Noise hazard signs are posted in areas, which require hearing protection.
d. Hearing protective devices are provided to and used by all workers exposed to excess noise levels.

6. WORKSITE INSPECTIONS AND FOLLOW-UP

Safety inspections of the work site will be done on a regular basis by the SMP or by a person assigned by the SMP. Inspectors must be knowledgeable with the work process. Employees found to be working in an unsafe manner or in unsafe conditions will be asked immediately to stop work and correct the situation. If an immediate solution cannot be found to remedy the unsafe situation, the matter must be immediately referred to the SMP for action.

All work site safety inspections will be recorded using an Inspection Report form and will include: employees involved in the inspection, potential unsafe working conditions or methods that were observed and/or corrected, and suggestions for corrective action (if possible).

All Inspection Reports will be discussed at safety meetings and corrective actions are to be recorded and addressed in a timely fashion.

Inspection Reports will be reviewed prior to new worksite inspection to ensure follow-up is done.

7. INCIDENT REPORTS

An employee involved in a safety incident as described below will be required to complete a safety 'Incident Report'. An incident report will be a standardized form which will include at minimum the employees involved as well as an incident description. Incident reports may or may not be specifically discussed at a safety committee meeting but will be included in a summarized monthly report. Applicable incidents include:

a. All incidents that result in injury requiring first aid or other medical treatment,
b. Any incidents of violence,
c. Incidents that could cause serious injury or death,
d. Incidents involving 'near misses' that could have resulted in serious injury
e. Incidents involving 'near misses' (serious or minor) that could have been prevented via a procedure,
f. Observations of unsafe acts that could lead to a future incident (does not include observations during an work site inspection)

8. INCIDENT INVESTIGATIONS

All incidents that result in injury requiring medical treatment, any incidents of violence, incidents that could cause serious injury or death, or near misses that could have resulted in serious injury shall be investigated.

Investigations shall be carried out by a person knowledgeable with the work process, but not involved with the incident, as well as a senior staff member to determine the root cause of the incident and identify corrective measures to be taken. Information shall be recorded on an Incident Investigation form and supervisors or worker representatives shall review the reports with all workers. Investigation reports will be presented and discussed at monthly safety committee meetings or special safety meetings as required.

The worker safety authority have jurisdiction (AHJ) shall be notified of any accident resulting in life threatening injury, death or any accident resulting from a major structural failure.

9. SAFETY COMMITTEE & SAFETY MEETINGS

The SPM will create and chair a Safety Committee that has between 3 and 5 personnel. Members will be documented in a separate form. The Safety Committee shall conduct safety meetings, at least once per month, with supervisors and workers to review safety plan implementation, accident investigation reports, inspection reports, corrective action, unsafe work practices, work conditions of concern and any specific safety concerns of management and/or workers.

When practical, short "Tool Box" chats will be conducted at the beginning of each shift to review special operating conditions, hazards that may be encountered during the shift, or any factors that might have changed since the last shift.

Special Safety Meetings will be held as needed prior to initiation of major initiatives such as new operations start-up or long extended hours on customer sites.

Management will review and take action on all items discussed at safety meetings. Minutes of the monthly and special safety meetings will be recorded and kept to document actions taken and items discussed. A copy of the safety meeting minutes shall be posted for reference by workers.

Minutes of monthly and special safety meetings will be taken, held on record and posted for reference by workers. Management will review and take action on all items required.

The shorter "Tool Box" meetings do not need to be recorded unless substantive items are determined during the meeting.

All safety meetings shall be considered teaching moments and are to be recorded on daily timesheets.

10. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

Management will ensure that WHMIS regulations are followed by ensuring the following:

1. All controlled products on site are identified with supplier or workplace labels.
2. Material Safety Data Sheets (MSDS) for products are up to date and made available to workers and the First Aid Attendant.
3. All workers receive education and training to safely store, handle, use, or dispose of products.

11. FIRST-AID

Management shall ensure that first-aid services, supplies and equipment as required by the Occupational Health and Safety Regulation, are available to workers on all shifts. Workers shall be instructed on how to summon first-aid. Workers shall promptly report all injuries to the first-aid attendant. A treatment record shall be maintained.

In the event of a more severe incident requiring external medical services while on a client's site, site representatives will be informed in accordance with their first aid protocols.

12. DOCUMENTS, RECORDS AND STATISTICS

All documentation associated with the Safety Program including procedures, rules, records, meeting minutes, reports and logs shall be maintained in an organized and controlled manner.

The SMP and one member from the Safety Committee shall sign all rules and procedures developed under the Safety Program.

Statistical information shall be provided to employees, managers, and as required by Workers Compensation Board (WCB) to communicate accident, incident and success trends such as number of accident free days.

13. RESPONSIBILITIES & AUTHORITY

Management shall:

a. Lead by setting a good example, wearing PPE and following all safety policies and procedures.
b. Interact with workers regularly to hear first-hand any safety concerns and show workers the importance and top priority a safe workplace is within the organization.
c. Participate in safety meetings and the safety committee (when applicable).
d. Hold supervisors and workers accountable to maintain the Safety Program.
e. Set reasonable health and safety goals and objectives.
f. Provide resources required to implement and maintain the Safety Program.

The SMP shall:

a. Lead by setting a good example, wearing PPE and following all safety policies and procedures.
b. Interact with workers regularly to hear first-hand any safety concerns and show workers the importance and top priority a safe workplace is within the organization.
c. Chair safety meetings and the safety committee.
d. Hold supervisors and workers accountable to maintain the Safety Program.
e. Be responsible for developing, maintaining and issuing all documents, records and informational required by the Safety Program.
f. Be responsible for compiling and providing statistical information.
g. Prepare a program, future activity plan and request for resources to management on a quarterly basis.

If the SPM feels that resources are not available for Safety Program implementation or rules and procedures are not being followed, the SPM is empowered to curtail operations until the issue is resolved.

Personnel are responsible for their own actions and thus must cooperate with program personnel and initiative and never overlook unsafe acts or conditions.

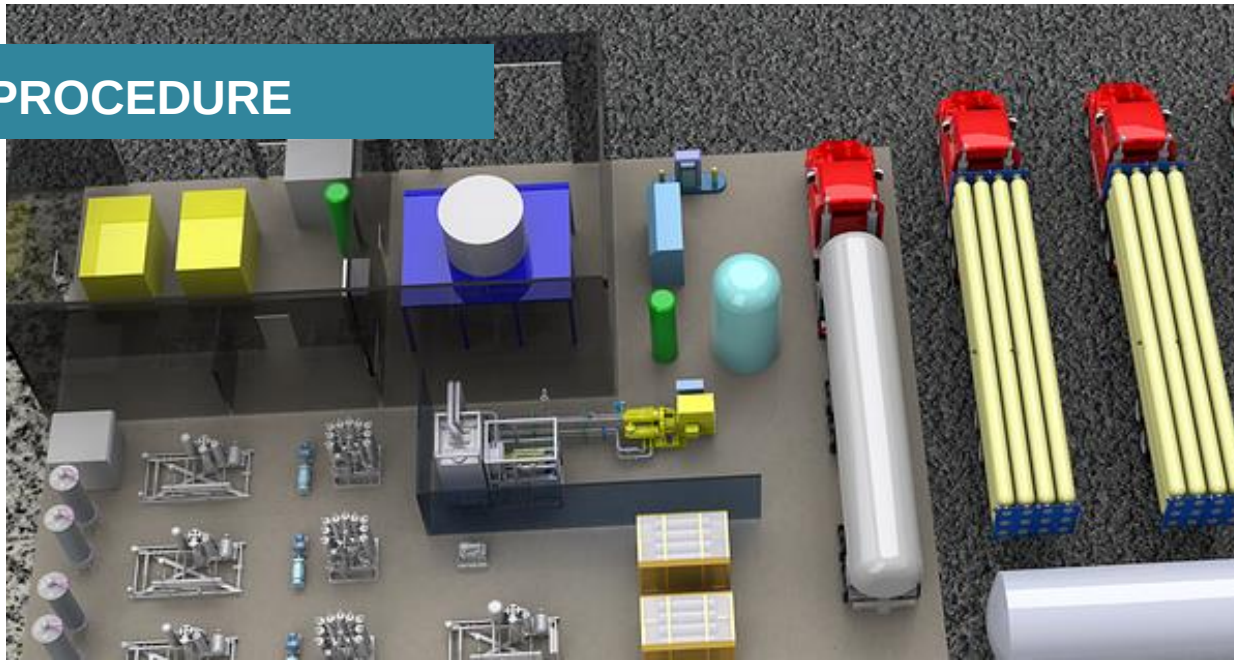
Employees should visit www.worksafebc.com for further information on safety programs and initiatives.

7. Attachment – Working Alone Procedure (HSP-P-002)

WORKING ALONE PROCEDURE

HTEC SAFETY PLAN

PROCEDURE



Identification of the document: HSP-P-002 - Working Alone Procedure

Revision: A

12-Dec-2015

Number of pages: 7

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APPROVALS		
Written by	Verified by	Approved by
Ashley Perry		
(Date and signature)	(Date and signature)	(Date and signature)
Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Working Alone Procedure
REFERENCE	HSP-P-002 - Working Alone Procedure

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	12-Dec-15	Issued for Review - Draft

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

MANAGEMENT COMMITMENT

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_____ _____

Signature of Management Date

Colin Armstrong, President

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1. INTRODUCTION

The purpose of this procedure is to ensure than all employees and contractors are safe and accounted for work while working alone at any of HTEC's or client's sites.

The definition of working alone is:
Any employee or contractor (employed by HTEC) that is working alone or that does not have regular check-in by personnel onsite.

2. DEFINITIONS

Check-in:
Verbal or electronic contact from the Worker to the Safety Partner indicating that the Worker is safe and of clear mind.

Emergency Contact List:
A list of emergency contact details for each site. This list is available in the main HTEC Safety Folder and is considered to be the most update. Contact details are not listed in this procedure due to the risk of not being up to date.

High Pressure Hydrogen:
Any system involving hydrogen pressure greater than 15 psig. This is in accordance with BCSA definitions.

Safety Partner:
A responsible HTEC employee with whom a Worker working alone can check-in at regular intervals. A Safety Partner must have a basic understand of the potential hazards on site and must have all site contact details on their person during the period of time the worker is working alone.

Safety Program Manager:
HTEC's appointed Safety Program Manager.

Site Safety Manager:
A person onsite who is responsible for the safety of the site and has a basic understanding of potential hazards with the equipment the Worker is working on.

Worker:
Any employee or contractor (employed by HTEC) performing work for HTEC on HTEC or Client equipment.

Working Alone:
Any employee or contractor (employed by HTEC) that is working alone or that does not have regular check-in by personnel onsite.

3. WORKING ALONE PROCEDURE

1) A Worker will inform a Safety Partner that they are planning to perform work or maintenance alone and will inform the Safety Partner of the nature of the maintenance and when they will check-in.
2) If the Worker expects the work to take longer than two hours or there are more or greater hazards, verbal or electronic contact should be made at regular designated intervals as appropriate with the risk. If dealing with high pressure hydrogen (>15 psig) this time interval should 30 minutes. If dealing with Nitrogen or Hydrogen in an enclosed space this time interval should be 15 minutes.
3) During a check-in the Worker will inform the Safety Partner that they are safe. If any uncertain or changing conditions exist on site, the Worker must inform the Safety Partner at this time. It is the responsibility of the Safety Partner to gauge whether the Worker is safe or in clear mind. If the safety Partner is unsure whether the Worker is safe or of clear mind, they must verbally discuss their concerns with the Worker. If uncertainty exists after a verbal discussion with the Worker, the Safety Partner is to contact the Safety Program Manager for further direction.
4) If the Worker and Safety Partner are using electronic means to check-in the Worker will contact the Safety Partner at the designated time and then Safety Partner will respond indicating that they have received the Worker's check-in. If the Safety Partner does not respond to the electronic check-in, the Worker must immediately attempt verbal contact.
5) If the Worker has not made verbal or text contact within 5 minutes of the designated time, the Safety Partner will
    i) Call the site contact (listed on the Emergency Contact List) and ask them to go check on the worker. If no one can be reached:
    ii) Call the HTEC Safety Program Manager (SPM). If the SPM cannot be reached:
    iii) Call the HTEC Emergency Phone Number (listed on the Emergency Contact List), inform Colin Armstrong about the situation, and go to the site with a set of PPE, first aid kit, Emergency Response Plan and fire detection gear.
6) If the Safety Partner does not respond verbally or electronically to the Worker's check-in, the Worker must stop working immediately. If work cannot be suspended or stopped, the Worker must contact the Site Safety Manager or the Safety Program Manager and use them as a Safety Partner until the original Safety Partner is contacted and can continue the role.
7) Both the Worker and the Safety Partner should ensure they are carrying a charged mobile phone. The Worker must not continue work until the mobile phone is charged or another appropriate means of contact can be used. A new Safety Partner should be appointed if their mobile phone loses charge during the work alone period.
8) The Worker should wear all appropriate site PPE and if dealing with a toxic gas should wear a gas detector monitor at all times.
9) **The Worker should always double check that what they are about to do is correct! If in doubt, ask. No assumptions!**

10) The Worker will inform the Safety Partner when they finish their work and leave the site.

4. CONTINUOUS IMPROVEMENT

Continuous improvement of this procedure shall include, but is not limited to:

1) Annual review of this document by the Safety Program Manager
2) Recording of recommend changes using the Change Management Procedure
3) Annual review of pertinent Codes and Standards to:
   a) Verify this documents use in day-today practice and is the latest version
   b) Recommend additional standards to purchase
   c) Confirm this document is in the proper directory, and employees are aware of its location

The Safety Program Manager shall review the proposed recommendations, and if necessary, seek the advice of peers on the recommended change. If the Safety Program Manager agrees with the proposed revision, they shall implement the revised procedure and ensure all workers are informed of the updated procedure.

5. RELATED DOCUMENTS

Change Management Procedure *[under development]*

Emergency Contact List

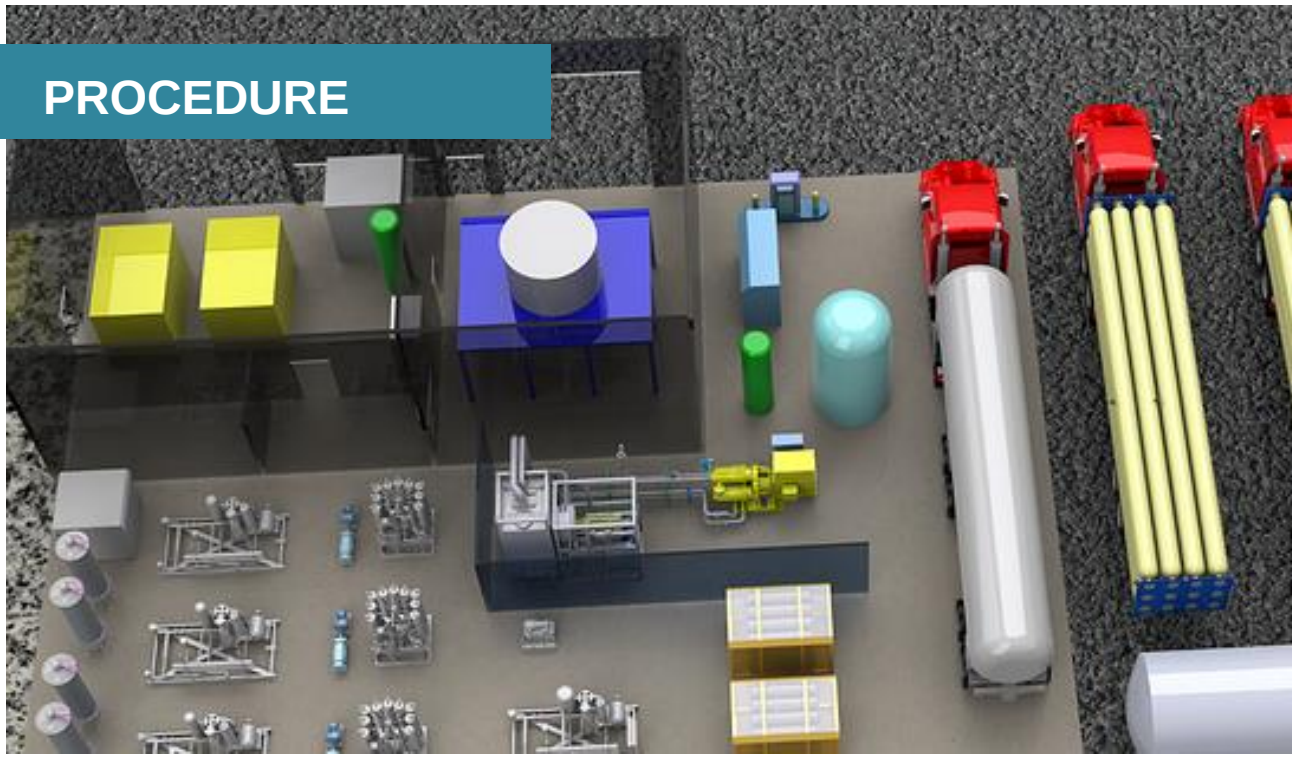
HTEC's ERAP "Emergency Response Assistances Plan"

HTEC Safety Manual *[under development]*

LOCKING OUT PROCEDURE

HTEC SAFETY PROGRAM

PROCEDURE



Identification of the document: HSP-P-003 - Locking Out Procedure

Revision: A

30-Dec-2015

Number of pages: 22

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Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Locking Out Procedure
REFERENCE	HSP-P-003 - Locking Out Procedure

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	30-Dec-15	Issued for Review - Draft

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

MANAGEMENT COMMITMENT

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_____ _____

Signature of Management Date

Colin Armstrong, President

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1. OBJECTIVE

The objective of this procedure is to establish a means of positive control to prevent the accidental starting or activating of machinery or systems while they are being repaired, cleaned and/or serviced. This program serves to:

A. Establish a safe and positive means of shutting down machinery, equipment and systems.
B. Prohibit unauthorized personnel or remote control systems from starting machinery or equipment while it is being serviced.
C. Provide a secondary control system when it is impossible to positively lockout the machinery or equipment.
D. Establish responsibility for implementing and controlling lockout procedures.
E. Ensure that only approved locks, standardized tags and fastening devices provided by the company will be utilized in the lockout procedures.

2. ASSIGNMENT OF RESPONSIBILITY

The HTEC Lockout Safety Manager (LSM) is currently: Ashley Perry.

A. The LSM will be responsible for implementing the lockout program.
B. The LSM is responsible for enforcing the program and insuring compliance with these procedures
C. Unless otherwise appointed by the LSM, the LSM will conduct the annual inspection and certification of the authorized employees.
D. Authorized and Affected employees are responsible for following the established lockout procedures. They are responsible for reviewing the Specific Equipment lockout details for each piece of equipment being locked out.

   An authorized employee is defined as a person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.

   An affected employee is an employee who is required to use machines or equipment on which servicing is performed under the Lockout/Tagout standard or who performs other job responsibilities in an area where such servicing is performed.

E. All other employees in the facility are responsible for insuring they do not attempt to restart or re-energize machines or equipment that are locked out or tagged out.

3. DEFINITIONS

Authorized employee:

An employee who locks or tags machines or equipment in order to perform servicing or maintenance.

Affected employee:

An employee who is required to use machines or equipment on which servicing is performed under the Lockout/Tagout standard or who performs other job responsibilities in an area where such servicing is performed.

Other employees:

All employees who are or may be in an area where energy control procedures may be utilized.

Capable of being locked out:

An energy-isolating device is considered capable of being locked out if it:

- Is designed with a hasp or other means of attachment to which a lock can be affixed;
- Has a locking mechanism built into it;
- Can be locked without dismantling, rebuilding, or replacing the energy-isolating device or permanently altering its energy control capability.

Energized:

Machines and equipment are energized when they are connected to an energy source or they contain residual or stored energy.

Energy-isolating device:

A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy source:

Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Lockout:

The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device:

Any device that uses positive means, such as a lock, blank flanges and bolted slip blinds, to hold an energy-isolating device in a safe position, thereby preventing the energizing of machinery or equipment.

LSM:

A 'Lockout Safety Manger' that has been appointed by the HTEC Safety Program Manager (SPM).

Normal production operations:

Utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance:

Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, maintaining and/or servicing machines or equipment, including lubrication, cleaning or unjamming of machines or equipment, and making adjustments or tool changes, where employees could be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Tagout:

The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device:

Any prominent warning device, such as a tag and a means of attachment that can be securely fastened to an energy-isolating device to indicate that the machine or equipment to which it is attached may not be operated until the tagout device is removed.

4. PREPARATION FOR LOCKOUT

Employees who are required to utilize the lockout procedure (see Lockout Form A) must be knowledgeable of the different energy sources and the proper sequence of shutting off or disconnecting energy means. The four types of energy sources are:

A. Electrical (most common form);
B. Hydraulic or pneumatic;
C. Fluids and gases; and
D. Mechanical (including gravity).

More than one energy source may be utilized on some equipment and the proper procedure must be followed in order to identify energy sources and lockout accordingly. See Lockout Form F for a specific procedure format.

A. Electrical

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Shut off power at machine and disconnect.
3. Disconnecting means must be locked or tagged.
4. Press start button to see that correct systems are locked out.
5. All controls must be returned to their safest position.
6. Points to remember:
    A. If a machine or piece of equipment contains capacitors, they must be drained of stored energy.
    B. Possible disconnecting means include the power cord, power panels (look for primary and secondary voltage), breakers, the operator's station, motor circuit, relays, limit switches, and electrical interlocks.
    C. Some equipment may have a motor isolating shut-off and a control isolating shut-off.
    D. If the electrical energy is disconnected by simply unplugging the power cord, the cord must be kept under the control of the authorized employee or the plug end of the cord must be locked out or tagged out.

B. Hydraulic / Pneumatic

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Shut off all energy sources (pumps and compressors). If the pumps and compressors supply energy to more than one piece of equipment, lockout the valve supplying energy to the piece of equipment being serviced.
3. Stored pressure from hydraulic/pneumatic lines shall be drained/bled when release of stored energy could cause injury to employees.
4. Make sure controls are returned to their safest position (off, stop, standby, inch, jog, etc.).

C. Fluids and Gases

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Identify the type of fluid or gas and the necessary personal protective equipment.
3. Close valves to prevent flow, and lockout.
4. Determine the isolating device, then close and lockout.
5. Drain and bleed lines connection the isolation device and equipment to a zero energy state.
6. Open Drain or vent valve between isolating device and equipment, then lock open.
7. Some systems may have electrically controlled valves. If so, they must be shut off and locked/tagged out.
8. Check for zero energy state at the equipment.

D. Mechanical Energy

Mechanical energy includes gravity activation, energy stored in springs, etc.

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance. In an appropriate visible location onsite, lockout forms A and G must be posted.
2. Block out or use die ram safety chain.
3. Lockout safety device.
4. Shut off and lockout electrical system.

5. Check for zero energy state.
6. Return controls to safest position.

5. RELEASE FROM LOCKOUT

1. Inspection: Make certain the work is completed and inventory the tools and equipment that were used.
2. Clean-up: Remove all towels, rags, work-aids, etc.
3. Replace guards: Replace all guards possible. Sometimes a particular guard may have to be left off until the start sequence is over due to possible adjustments. However, all other guards should be put back into place.
4. Check controls: All controls should be in their safest position.
5. The work area shall be checked to ensure that all employees have been safely positioned or removed and notified that the lockout devices are being removed.
6. Remove locks/tags. Remove only your lock or tag.

6. SERVICE OR MAINTENANCE INVOLVING MORE THAN ONE PERSON

When servicing and/or maintenance is performed by more than one person, each authorized employee shall place his own lock or tag on the energy isolating device. This shall be done by utilizing a multiple lock scissors clamp if the equipment is capable of being locked out. If the equipment cannot be locked out, then each authorized employee must place his tag on the equipment.

7. REMOVAL OF AN AUTHORIZED EMPLOYEE'S LOCKOUT BY HTEC

1. HTEC to verify that the authorized employee who applied the device is not in the facility.
2. HTEC employee not remove lockout unless they have spoken to operator that has placed lockout, and they have given permission to remove lockout.
3. Ensure that the authorized employee has this knowledge before he/she resumes work at the facility.

8. PROCEDURES FOR OUTSITE PERSONNEL / CONTRACTORS

Outside personnel/contractors shall be advised that the company has and enforces the use of lockout procedures. They will be informed of the use of locks and tags and notified about the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

The company will obtain information from the outside personnel/contractor about their lockout procedures and advise affected employees of this information.

The outside personnel/contractor will be required to sign a certification form (see Lockout Form E). If outside personnel/contractor has previously signed a certification that is on file, additional signed certification is not necessary.

9. TRAINING AND COMMUNICATION

Each authorized employee who will be utilizing the lockout procedure will be trained in the recognition of applicable hazardous energy sources, type and magnitude of energy available in the work place, and the methods and means necessary for energy isolation and control.

Each affected employee (all employees other than authorized employees utilizing the lockout procedure) shall be instructed in the purpose and use of the lockout procedure, and the prohibition of attempts to restart or re-energize machines or equipment that are locked out or tagged out.

Training will be certified using Lockout Form B (Authorized Personnel) or Lockout Form C (Affected Personnel). The certifications shall be stored electronically in the HTEC Safety folder. The lockout certification log shall also be updated.

10. PERIODIC INSPECTION

A periodic inspection (at least annually) will be conducted of each authorized employee under the lockout procedure. This inspection shall be performed by Ashley Perry or other appointed employee.

The inspection will include a review between the inspector and each authorized employee of that employee's responsibilities under the energy control (lockout) procedure. The inspection will also consist of a physical inspection of the authorized employee while performing work under the procedures.

The LSM or another appointed employee shall certify in writing that the inspection has been performed. The written certification (Lockout Form D) shall be stored electronically in the HTEC Safety folder. The lockout certification log shall also be updated.

11. LOCKOUT FORMS

The following list of forms are to be completed prior to an HTEC employee or contractor locking out HTEC equipment:

A. List of Authorized Onsite Personnel for Lockout Procedures
B. Certification of Training (Authorized Personnel)
C. Certification of Training (Affected Personnel)
D. Lockout Inspection Certification
E. Outside Personnel/Contractor Certification
F. Specific Equipment Lockout Details Template
G. Master Lockout Form

Lockout Form A

List of Authorized Onsite Personnel
For Lockout Procedures

NAME	JOB TITLE

LOCKOUT FORM B

Certification of Training
(Authorized Personnel)

I certify that I received training as an authorized employee under ***HTEC'S*** Lockout program. I further certify that I understand the procedures and will abide by those procedures.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM C

Certification of Training
(Affected Personnel)

I certify that I received training as an Affected Employee under ***HTEC'S*** Lockout Program. I further certify and understand that I am prohibited from attempting to restart or re-energize machines or equipment that are locked out or tagged out.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM D

Lockout Inspection Certification

I certify that _____was inspected on this date utilizing lockout procedures. The inspection was performed while working on _____.

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

_____ _____

INSPECTOR SIGNATURE DATE

LOCKOUT FORM E

Outside Personnel/Contractor Certification

I, _____ (outside personnel/contractor) certify that I have been informed of, and will abide by, HTEC's lockout procedures.

_____ _____

OUTSIDE PERSONNEL/CONTRACTOR SIGNATURE DATE

_____ _____

AUTHORIZED EMPLOYEE SIGNATURE DATE

LOCKOUT FORM F

Specific Equipment Lockout Details

(Date)

Type of Equipment: _____

General Description: _____

_____

Manufacturer: _____

_____

Model Number: _____

Serial Number:* _____

_____

** If more than one piece of same equipment, list all serial numbers.*

Location of equipment:

_____

_____

Operator Controls

The types of controls available to the operator need to be determined. This should help identify energy sources and lockout capacity for the equipment.

List types of operator controls: _____

_____

_____

_____

_____

_____

Energy Sources

The energy sources, such as electrical, steam, hydraulic, pneumatic, natural gas, stored energy, etc.) present on this equipment are:

ENERGY SOURCE	LOCATION	Lockable		Type lock or block needed
		Yes	No	

Shutdown Procedures

List the steps in order necessary to shut down and de-energize the equipment. Be specific. For stored energy, be specific about how the energy will be dissipated or restrained.

Procedure: _____

_____

_____

_____

_____

_____

Lock Type & Location: _____

_____

_____

_____

_____

_____

How Will De-energized State Be Verified? _____

_____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Start Up Procedures

List the steps in order necessary to reactivate (energize) the equipment. Be specific.

Procedure: _____

_____

_____

_____

_____

_____

Energy Source Activated: _____

_____

_____

_____

_____

_____

NOTIFY ALL AFFECTED EMPLOYEES WHEN THIS PROCEDURE IS IN APPLICATION.

Procedures For Operations and Service/Maintenance

List those operations where the procedures above do not apply [See 29 CFR 1910.147 (a)(2)]. Alternate measures which provide effective protection must be developed for these operations. Job Safety Analysis is one method of determining appropriate measures.

Operation Name: _____

_____

_____

_____

_____

_____

LOCKOUT FORM G

MASTER LOCKOUT FORM

(to be fixed near lock storage area)

ITEM	LOCATION	REASON OF LOCKOUT	TIME AND DATE OF LOCKOUT	ESTIMATED DURATION OF LOCKOUT	AUTHORIZED PERSONNEL

9. Attachment – Locking Out Procedure (HSP-P-003)

10. Attachment - Contractor Orientation Questionnaire (HSP-P-021)

Contractor/Subcontractor Orientation Questionnaire

The purpose of this questionnaire is to ensure that the subcontractor has been fully informed about the job and safety procedures. The contractor must complete the questionnaire by placing a check in the appropriate column, and answering the questions. The contractor must return the completed questionnaire to the person leading the training before work commences.

DO YOU KNOW:	**YES**	**NO**
How to report Injuries?	_____	_____
How to report damage?	_____	_____
How to report near misses?	_____	_____
How to report hazards?	_____	_____
The evacuation procedure & muster point(s)	_____	_____
What hazards exist on site?	_____	_____
What the site emergency signal are?	_____	_____
How to obtain protective equipment?	_____	_____
Where protective equipment is required?	_____	_____
What personal protective equipment is required?	_____	_____
Where MSDS's are located?	_____	_____
Where First Aid is located?	_____	_____
Where the safety program is posted?	_____	_____

WERE YOU GIVEN:

	YES	NO
A copy of the client safety policy?	_____	_____
A copy of the general safety rules and regulations?	_____	_____
A copy of the worker's and supervisor's responsibilities?	_____	_____
A copy of the supplementary instructions?	_____	_____
Adequate answers to your questions?	_____	_____

PLEASE INDICATE THE DATE OF YOUR WCB REGISTRATION _____/_____/_____

(If you have not been trained you must attend a training seminar, which will be arranged.)

I agree to comply with the company safety program and WCB regulations:

_____

Contractor/Subcontractor Name **Contractor/Subcontractor Signature**

I have instructed this contractor/subcontractor in regard to any safety hazards related to the type of work being performed by the crew in which he/she is working. I have checked that the contractor/subcontractor has the appropriate safety equipment including: hard hat, safety footwear, safety glasses, respirator and hearing protection as applicable. I have seen the contractor's/subcontractor's current WCB registration.

_____

Supervisor Name **Supervisor Signature**

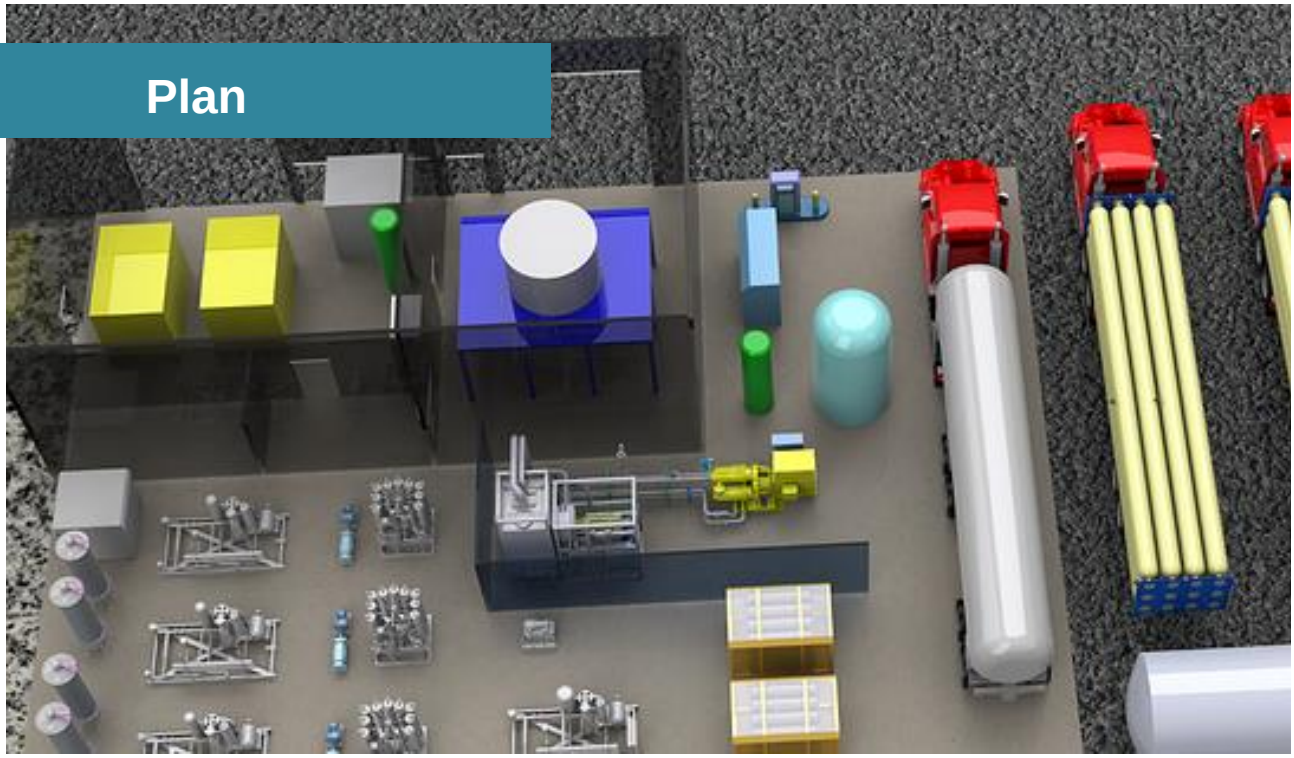
Date: _____

NOTE: this form to be filed with project records by the senior site representative

HYDROGEN SAFETY PLAN

HTEC STATION DESIGN C

Plan



Identification of the document: HSP-P-013

Revision: A

18-Aug-2016

Number of pages: 29

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Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	HTEC Station Design C
REFERENCE	HSP-P-013

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	18-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California.

The purpose of this document is to describe the HTEC Station Design C from a risk and safety perspective. All stations using Design C shall have the same general risks and safety methodologies for mitigating these risks.

All HTEC stations that are built as per HTEC Station Design C will include:

- Single hydrogen source (HTEC PowerCube delivery)
- A Powertech Labs Compression, Storage, and Dispensing (CSD) unit
- Supporting utilities including: dispenser cooling.
- High voltage electrical connections
- Station security walls and doors.

2. Facility Design Safety Overview

The HTEC Station Design A is a sustainable energy initiative focused on selling hydrogen as a clean fuel to Fuel Cell Vehicle (FCV) owners. Hydrogen is delivered to the station using HTEC’s proprietary PowerCube distribution system. A Compression, Storage, and Dispensing (CSD) system supplied by Powertech labs or McPhy increases the pressure and stores the hydrogen at 12,750 psig. Using the J2601 protocol the CSD system can deliver approximately 5kg of hydrogen to a vehicle at the dispenser.

The presence of hydrogen (H2) at the station makes it necessary to integrate specialized design elements and hydrogen safety systems.

From the perspective of avoiding an incident that could result in injury or death, property damage, or a situation that could endanger the public, the most problematic properties of hydrogen are its broad flammability range when mixed with air and its propensity to ignite at low energy levels. As a result, the focus of the hydrogen safety systems at the station is hydrogen detection, active ventilation, and the elimination of extraneous ignition sources.

If a hydrogen leak occurs in the open air, such as at the fueling dispenser, interconnecting piping—where hydrogen can immediately rise and dissipate in the atmosphere—the safety risk is minimal. However, a hydrogen leak within an enclosed area, such as the compressor container, could potentially pose an unsafe environment. To minimize the risk of an enclosed hydrogen leak, the facility incorporates a series of passive and active systems to prevent the leak from reaching an unsafe level.

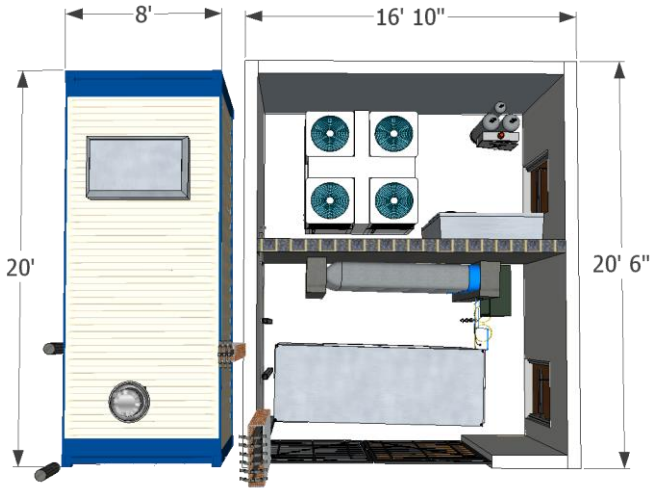
Consequently, the key safety components used to prevent an incident inside one of the station containers at the HTEC site includes hydrogen monitoring and response systems, enhanced

ventilation to prevent hydrogen concentrations from reaching explosive levels, regular system calibrations and testing, and ongoing staff training. The approach to safety at the fueling dispenser is somewhat different, primarily because small hydrogen leaks are quickly dispersed in the open-air environment. Instead the emphasis at the fueling dispenser is a series of redundant systems to stop the flow of hydrogen in the case of an emergency.

3. Station Design Description

Station Design	C
Public or Non-Public	Public
List of Key Equipment	Semi-Permanent Hydrogen Compressor Module with an integrated Hydrogen Dispenser High H2 Pressure Storage Medium H2 Pressure Storage Supplemental medium compression unit Low Temperature Cooling System Other Non-rated facility utilities Interconnecting piping (above and underground)
Facility Security (if applicable)	Fire Barriers walls where necessary, fences, locked gates and security doors. Container security doors

A general site plan the HTEC station design is shown in the figures below.



Sample Station Layout

3.1. Block flow diagram

Please refer to the appendix for a block flow diagram of the station design.

3.2. Station Layout

While the station layout will be slightly different for each location there will be the following significant commonalities to this design:

1. Three areas with different classifications separated by a fire barrier:
    a. Class I Div II area – contains hydrogen storage and the supplemental medium compression unit
    b. Unclassified area – contains unrated utility systems
    c. Exposed containerized CSD unit with both classified and unclassified areas.
2. Compliance with NFPA 2 distances to exposures. Fire barriers around the classified area
3. Separate access gates and security doors to both areas
4. A common hydrogen vent stack
5. A semi-permanent CSD containerized unit that has a publicly accessible dispenser integrated into the container.

3.3. Hydrogen Supply

The station design has one source of hydrogen:

- Hydrogen for the station is delivered to the station via the PowerCube hydrogen distribution system.

Delivered Hydrogen

PowerCubes are delivered to site on a regular schedule. Two high pressure hoses and a two ground wires connect the PowerCube to the station. The PowerCube hydrogen storage modules are located on a concrete pad and are secured via a twistloc mechanism at each corner to resist siemic loads. The PowerCube storage modules are approved under DOT Special Permit # SP 16559

The PowerCube distribution system consists of several PowerCube cylinder modules, and a specialized trailer and forklift which pick up and deliver PowerCubes to each station. Each PowerCube module consists of ten compressed gas Type 3 cylinders capable of storing a total of 89 kg of hydrogen at a pressure of 450 bar (6527 psig). Each cylinder is equipped with two TRVs that release in the event of an overheating scenario. Each PowerCube module requires compressed air to activate a source valve which allows the station to isolate the PowerCube in a ESD scenario.





PowerCube (with Dynetek logo) at a previous HTEC site, and at right without cover. Each PowerCube holds ten high pressure hydrogen cylinders.

3.4. Hydrogen Processing Equipment

Major equipment components:

- A single 20ft x 9'-6" ISO container that houses compression, storage, dispenser, cooling, and electronic control systems (see image below);
- A supplemental hydrogen compression unit with integrated cooling
- One (1) external cooling system modules each approximately 6' by 6' by 5' high;

The equipment will be placed on site such that different rated systems are separated as per NFPA 2.

Compressor and Electrical Room (20' ISO Container)

This modular container houses the main station hydrogen compressor, the high pressure hydrogen storage, the dispenser, a minimal amount of cooling, and the associated control equipment. This CSD system is designed to be semi-permanent, in that it can be relocated or replaced more easily than a permanent CSD system or fixtures. Fire rated walls are not designed to encircle this CSD unit. This modular container is internally divided into two sections:

Compressor Room and High pressure storage area:

This area of the container has one access point along the short sides of the container. These doors are locked with conventional door lock and deadbolt. This area contains the hydrogen compressor, the high pressure storage and any sequencing or safety valves required. An exhaust fan draws air out of the area from one of the containers side panels. The compressor contains approximately 19 litres (5 US gallons) of hydraulic oil and 78 litres (20 US gallons) of anti-freeze-type coolant.

High pressure hydrogen is stored in Type 2 cylinders placed inside the container. These high pressure (875 bar) storage tanks are designed to ASME Sec. 7 Div. 3 Code Case 2579. Each has a water volume of 213 L, and will be 9' 6" long and diameter of 1' 6". They are mounted inside the container with specially designed frames which comply with IBC/CSC/ASCE codes. These cylinders receive high pressure hydrogen from the compressor and provide hydrogen to the dispenser, both via a sequencing panel inside the container.

Control Room and Cooling Systems

This area has one access point (1 door opening out, locked with conventional door lock and deadbolt) and houses the station's PLC, HMI, control panel, an air compressor which supplies the station's pneumatic valves, an air fan (for the dispenser), an electrical breaker box, the station fire alarm panel, and a cooling system for the hydrogen compressor and dispenser.



Figure 1 View from north end of container

Supplemental Medium Compressor Unit

This modular medium pressure compressor unit boosts/optimizes the hydrogen pressure inside each of the medium pressure hydrogen storage to enable fast recompression of the high pressure hydrogen storage. The unit has an integrated compressor cooling system and power supply, but is controlled by the CSD unit.

3.5. Equipment Utilities

One onsite cooling unit is required for addition hydrogen dispensing of hydrogen at -40°C. The CSD unit has limited cooling abilities for dispensing hydrogen, but to increase the capacity of the station, extra dispenser cooling is required.

3.6. Hydrogen Storage

The primary on-site hydrogen storage is in six high pressure Type 2 cylinders and up to two 450 bar Powercubes that remain onsite between deliveries.

- The six high pressure (875 bar) storage tanks are described above inside the CSD unit.
- Up to two anchored Powercubes, described in the hydrogen supply section.

3.7. Hydrogen Vehicle Fuel Dispenser

A modern style vehicle fuel dispenser allows for convenient and safe fuelling operations. The unit provides compressed gaseous hydrogen fuel to vehicles via a hose and nozzle receptacle that looks and feels much like gasoline pump handle. All hydrogen is cooled inside the dispenser such that there is limited heat building in the hydrogen before it enters the vehicle. Unlike other HTEC station designs, the dispenser is integrated into the end of the CSD container; this is a function of the CSD system being semi-permanent.

3.8. Site Access and Occupancy

Site Access Control

A 9 foot high concrete wall fence surrounds all systems except the CSD unit area that includes one access gates and two security doors.

Hydrogen delivery access to the site is via a 15-foot gate located. The access gate will be padlocked, with access for trained personnel only.

Access for emergency services is through any of the two security doors.

The CSD unit has two security type doors.

Station Compound Occupancy

The site is unattended, and generally unoccupied. The only time the site will be occupied is during maintenance, hydrogen delivery, and site tours.

4. Hydrogen Safety Engineering Control Systems

HTEC uses the 'Preliminary Hazard Analysis' (PHA) and the 'Hazard and Operability' (HAZOP) methods for identifying safety vulnerabilities (ISV). These analyses are undertaken during the engineering phases of the station development. Using HTEC's previous experiences in designing, building and operating hydrogen stations a pre-design ISV analysis has been completed.

4.1. Preliminary Hazard Analysis (PHA)

The PHA is performed during the preliminary engineering phase to identify site specific design hazards and concerns. The PHA includes all aspects of the station and not just hydrogen hazards. The PHA method generates a documented analysis for all major stakeholders involved in the station development and provides either go-no-go deliverables before detailed engineering can commence or provides deliverables that must be met during detailed engineering.

4.2. Hazard and Operability (HAZOP) Analysis

Before the issuance of final engineering drawings a detailed HAZOP analysis is completed with all technical leads of the project. A suitable 3rd party moderator, not involved with the station design will moderate the HAZOP. The HAZOP breaks the station design into nodes and analyses the system response to key process changes like higher/lower/reverse flow, temperature variations, overpressure scenarios, etc. Deliverables from this analysis must be signed off before engineering drawings can be issued for construction

4.3. Pre-Design ISV Analysis and Risk Mitigation Strategies

The safety system uses a number of layered approaches to ensure system safety and mitigate the various hazards involved in the use of high-pressure hydrogen gas. The following table lists the hazards, and the associated design strategies used to mitigate the hazards:

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
High pressure containment failure	Low	High	Use of: • Design standards for plumbing all high-pressure equipment, including vent stacks; • Pressure relief devices; and, • Pressure sensors for detecting over-pressure situations and disabling station functions as needed.
Back flow of high pressure hydrogen to piping/systems with lower pressure ratings	Low	High	Use of: • Interlocking pressure controls • Pressure relief valves • Check valves and back pressure regulators to prevent backflow (not considered a fail-safe measure)
Small Gas leaks	Medium	Low	Use of: • Design standards for plumbing all high-pressure equipment, including vent stacks; • Hydrogen sensors for detecting leaks; • Pressure sensors for detecting under-pressure situations (potential leakage situations) and disabling station functions as needed; and, • Ventilation fans in areas containing hydrogen gas. • Routine maintenance and leak checking
Hydrogen ‘jets’ to nearby exposures resulting from catastrophic hydrogen failure leaks	Low	High	Use of: • Hydrogen leak design measures (mentioned above) • Compliance with latest version of NFPA 2, including fire walls, deflection barriers, and setback distances.

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Fire/explosion from hydrogen leak combined with a source of ignition	Low	High	Use of: • Design standards for plumbing all high-pressure equipment (to avoid leaks that could lead to fire); • Vent stacks for directing hydrogen leaks away from personnel; • Intrinsically-safe electrical circuitry in areas containing hydrogen gas (such as the compressor rooms); • Purging in the dispenser electrical cabinet, to prevent hydrogen gas leaks from entering the electrical cabinet; • Ventilation fans in areas containing hydrogen gas; and, • Explosion-proof cabinets for electrical circuitry in areas containing hydrogen (where intrinsically-safe methods cannot be used). • Compliance with NFPA 2 setback distances nd NPFA 70 requirements • Communication with site to ensure permanent electrical installations are never within NFPA setbacks
Hydrogen permeating unclassified areas	Low	Medium	Use of: • Fire walls/sealed barriers to separate classified zones • Underground hydrogen piping to CSD unit from medium hydrogen storage area
Vehicle driving away from station with hydrogen hose connected	Medium	Low	Use of: • Hydrogen hose breakaways • Compliance with NFPA 2 for dispenser setback distances • Pressure monitoring of hose hydrogen pressures
Security break-in	Medium	Medium	Use of: • Security locks on doors and gates • Security cameras • Remote operation of station to minimize safety risk in the event of security breach

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Natural Disaster (Earthquake)	Low	High	Use of: • Site works design and installation compliance with rating earthquake zone level and approved by a California structural engineer. • Tie down of equipment to concrete pads sufficient to prevent movement of equipment of pad • Hydrogen source valves that are beside hydrogen storage tanks to minimize exposed piping. • Fail safe design such that if loss of pressure, or air supply control valves close containing hydrogen in storage containers
Asphyxiation from hydrogen or nitrogen leak in confined spaces	Low	High	Use of: • Vent holes in ceiling of containers • Hydrogen sensors in all containers • Extraction fan in container.
Vehicle collisions with exposed CSD unit	Low	Medium	Use of: • 4”-6” bollards around CSD unit

The following subsections discusses specific design strategies in more detail:

4.3.1. Gas Detection

The hydrogen gas detection system for the 875 bar systems is comprised of explosion-proof gas detection probes connected to a monitoring panel. The monitoring panel reads hydrogen measurements from each probe, converts each measurement to a percentage of LEL, and triggers alarm outputs as needed via a relay panel. The alarm outputs are connected in series with the ESD circuitry, and are also connected to the control system. The alarms are latched, both in the control system PLC and on the monitoring panel

In addition, when a 25% LEL hydrogen alarm is detected, a visual alarm such as a strobe light will activate.The hydrogen alarm outputs cause different system responses, depending on the type and severity of each alarm.

The hydrogen probes are located as follows:

875 bar Compression Container:

- Compressor room
- Electrical room

Dispenser:

- Inside the dispenser, in the upper portion of the lower half of the enclosure near the hydrogen tubing and valves.

The hydrogen alarms are latched in all areas. To reset any hydrogen alarm, the alarm at the gas detection panel must be reset, and then the alarm via the station HMI must be reset.

4.3.2. High Pressure Safety

The hydrogen compression, storage and dispensing systems are designed and built per ASME B31.3-2012: Process Piping. This code sets forth engineering requirements deemed necessary for safe design and construction of pressure piping.

The storage banks are operated by a sequence panel which has each bank's piping connection on a common manifold built of stainless steel tubing and fittings with individual shut off valves. In the event of a high pressure incident, each storage bank is equipped with a pressure relief valve. The storage system sequence panel has pressure switches in the relief vent stacks which alert the PLC if there is an over pressure event.

The compressor is equipped with pressure relief valves to protect the compressor from an over-pressure event at the suction inlet and discharge outlet. These pressure relief valves have a pressure switch in the relief vent stack which alerts the PLC if there is an over pressure event.

All vent stacks direct vented gas upward and away from any personnel, and are designed and installed per CGA G-5.5: Hydrogen vent systems.

4.3.3. Emergency Shut Down (ESD)

The station design includes five emergency shut down (ESD) buttons, located as follows:

- Inside the 875 bar compressor room;
- Inside the 875 bar electrical room;
- On the dispenser;
- Inside the hydrogen storage area; and,
- Inside the station utilities area.

When any ESD button is pressed:

- The CSD system's control air is shut down, causing all air-actuated valves to revert to a fail-safe state and become inoperable. The control system receives an "ESD fault" signal, and responds by deactivating all station functions, including dispensing and compression.

4.3.4. Ventilation

The 875 bar compressor room includes a ventilation fan to mitigate any hydrogen leaks. The ventilation fan runs continuously at a nominal speed to allow for a minimum of 7 cfm per square foot of floor area. If the control system detects a hydrogen leak in the vicinity, the appropriate fan is run at a higher speed to help disperse the leak.

4.3.5. Dispenser Purge

The dispenser is able to use non-rated electrical equipment in an area classified as hazardous, by housing this equipment in a partially sealed cabinet and using a purge fan to continuously purge and pressurize the cabinet – as long as the purge is maintained, the electrical cabinet interior is considered an unclassified area. The purge fan is located in the electrical room, outside the classified area.

If the purge is lost (e.g. due to the cabinet being opened), a pressure switch is triggered, which sends an alarm signal to the control system. If the control system detects a loss of purge, the dispenser power supply is interrupted immediately, and the control system deactivates all station functions.

When the cabinet is re-pressurized, there is a delay before the dispenser power is re-enabled, to allow time for at least four complete purges of the electrical cabinet (as per NFPA 496).

4.3.6. Intrinsic Safety

All electrical circuitry in areas classified as hazardous (e.g. the compressor rooms) is designed to be intrinsically safe, through the use of intrinsically-safe barriers where possible. If not possible, other protection methods are used.

4.3.7. Explosion-Proof Cabinets

All electrical circuitry that cannot be designed as intrinsically safe, and must be located in an area classified as hazardous, is housed in explosion-proof cabinets, to avoid all potential for contact between the electrical circuitry and any flammable gases.Non-Public Areas

5. Equipment and Mechanical Integrity

All hydrogen systems used at the station are listed and labeled by parties approved by the AHJ. This 3rd party verification ensures that all systems comply with all applicable codes and standards. Systems at this station that have been 3rd party verified include:

- CSD system
- Low Temperature Cooling System
- Supplemental medium compressor unit

All stationary hydrogen storage containers are built to ASME standards.

6. Regulatory Compliance

This station will comply with all necessary regulatory bodies as per the authority having jurisdiction (AHJ). Ultimately compliance with the AHJ will result in permits for the station to operate. Compliance with the following regulatory bodies are of prime importance:

- Fire Department Plans Review Office
- South Coast Air Quality Management District (SCAQMD)
- Water Quality Management Agency

Compliance with the Fire Department will require compliance with NFPA, ASME, CSA, and SAE regulations, of which from a station layout perspective NFPA 2 and NFPA 70 are of high priority (NFPA 2 – Hydrogen Technologies Code, NFPA 70 – National Electrical Code).

During the design of HTEC's Woodside Station, a detailed line by line checklist against NFPA 2 and the California fire code was developed as both a tool for HTEC designers and proof to others that HTEC performed its due diligence in designing this station. The same NFPA 2 and Fire Code tool will be used during the design of any future HTEC stations, especially those in California.

As a further proof of compliance with respects to the regulatory bodies, each station design will be verified and sealed by a 3rd party engineer experienced in hydrogen stations.

7. Supplier /Contractor Selection

The importance of selecting the right vendor or contractor has a significant impact on the safety of HTEC equipment and personnel. All equipment undergoes HTEC technical approval before it is purchased and put into hydrogen service. If HTEC does not have the correct specialist in house to provide a technical assessment of a piece of equipment then HTEC will contract out this assessment. All contractors working for the HTEC on any station design will have various scopes to which HTEC will evaluate the contractor's ability to complete the scope of work effectively and safety.

HTEC requirements for various contractors are as follows:

Site Construction Work:

Contractor must have previous experience in medium duty industrial installations, especially in regards to constructing firewalls.

CSD Vendor:

Vendor must have previous experience designing, building, and testing fueling stations. All equipment used must conform NFPA 2, ASME, etc. and must be listed and label by an organization approved by the AHJ.

Tank Suppliers:

Vendor must be a ASME qualified shop and be able to test and certify all vessels in regards to ASME standards.

Mechanical Contractor (Piping):

Piping contractor must have experience with installing high purity gaseous systems and pressures up to 6500 psig. Experience installing and maintaining hydrogen or other high purity high pressure systems for industrial gas companies is highly preferred. The contractor must also be certified to install piping to ASME B31.3 Section IX which will be recorded in the HTEC Master Log. Contractor must also have clear experience working with ultra pure piping systems to avoid construction debris collecting in the system and sourcing appropriate equipment (piping and tubing) for the piping of the station.

Electrical Contractor

Contractor must have proven experience in jobs complying with NFPA 70 and, if applicable, NFPA 2. The contractor must also have their electrical ticket for high voltage which will be recorded in the HTEC Master Log.

8. Construction Safety Plan

All construction personnel working at an HTEC sites and location must comply with all of the HTEC safety standards, which includes site orientation and appropriate training. Compliance with construction safety policies is detailed in HTEC document HSP-P-010.

9. Station Operation, Maintenance, and Inspections

A description of how the station will operate in steady state is attached to this document.

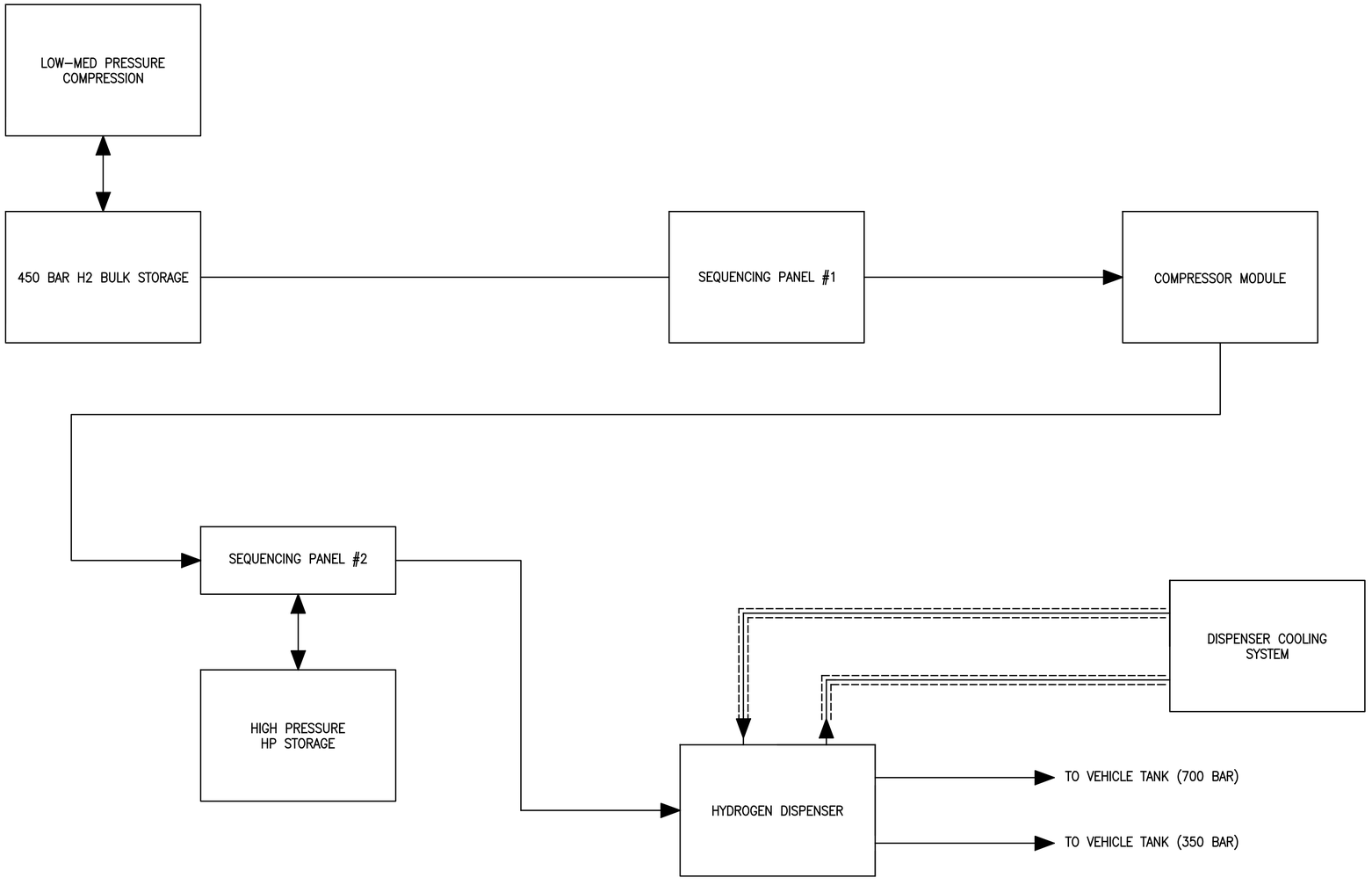
HTEC will follow all maintenance guidelines of the equipment manufacturers; a sample maintenance schedule for the CSD equipment can be found as an attachment to this document.

HTEC will employ or hire contractors to provide continual maintenance checks on the station. HTEC will comply with all regulatory maintenance requirements including:

- Station hydrogen systems visual and leak checks
- Fuel Quality inspections (J2719)
- Dispenser testing (J2601 and DMS)

All inspections, incidences, maintenance hours must be logged as per the NREL data collection program.

10. Attachment – Station Design C – Block Flow Diagram



A	ISSUED FOR REVIEW	04–08–16	AP

SCALE:	NA
DESIGNED BY:	AP
DRAWN BY:	AP
CHECKED BY:	GS
APPROVED BY:	CA
PROJECT ENGINEER:	GS

SEAL

PROJECT DESCRIPTION:

HI SAM H2 SAFETY PLAN

DRAWING TITLE:

BLOCK FLOW DIAGRAM
COMPLETE FILLING STATION
MOBILE CONFIGURATION

HTEC
Hydrogen Technology & Energy Corporation

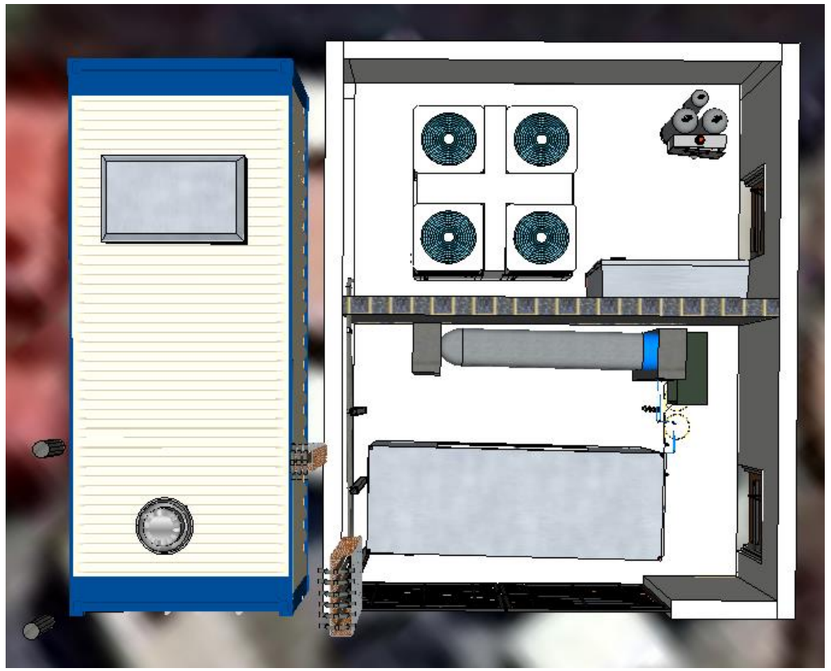
www.htec.ca
PH: (604) 904–0412
FAX: (604) 986–0525

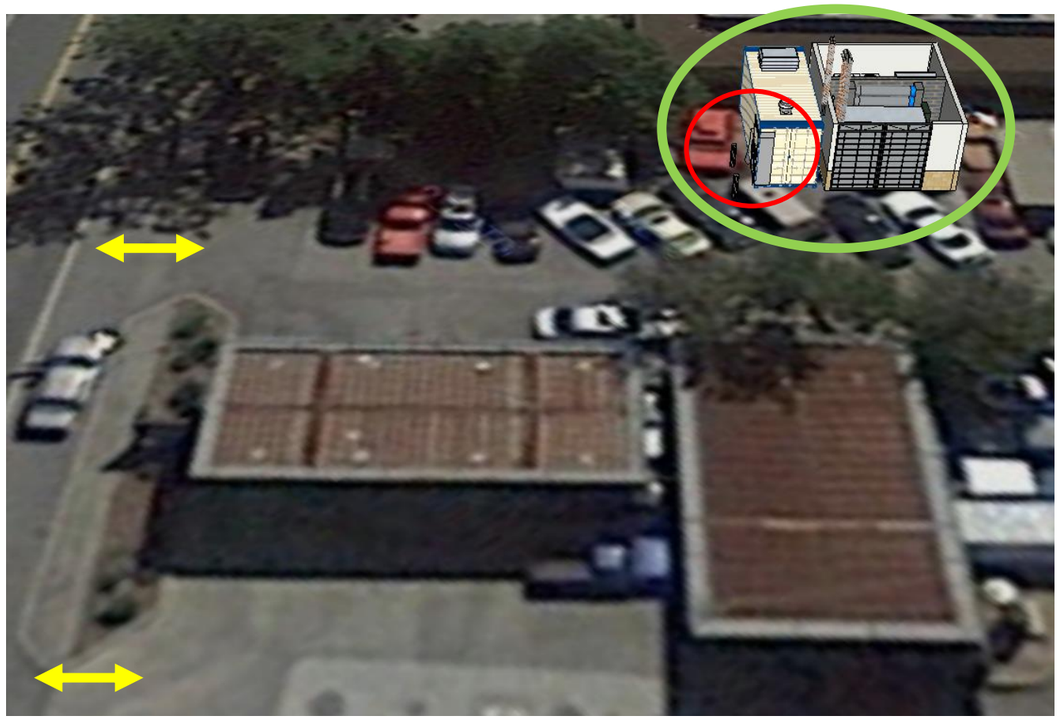
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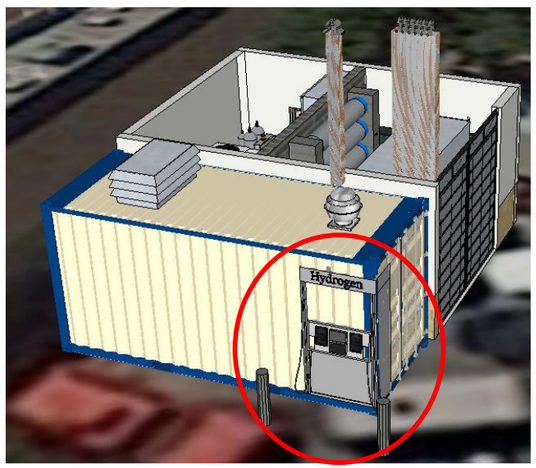
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11. Attachment – Station Design C – Station Layout

GFO-15-605 - Light Duty Vehicle Hydrogen Refueling Infrastructure









Stn 8 - 115 Portola Road, Portola Valley, CA 94028

12. Attachment – Station Design C - Steady State Operation - Overview

The station can be separated into 3 different areas: H2 Supply, H2 Compression Storage and Dispenser, and Station Auxiliaries. Each area is described below from a station control perspective. The individual 'micro' control mechanisms within each area/system are not described here. Please refer to the respective owners manuals for a more detailed understanding of a specific system. This section does not discuss start-up or shut down procedures.

A discrete 5V circuit connects all modules and ESDs. If this circuit loses voltage, all systems enter their respective emergency shut down sequences.

H2 Supply

PowerCube Deliveries

Each DOT certified PowerCube can deliver 89 kg of gaseous hydrogen (GH2) at a max service pressure of 450 bar. There are 10 cylinders per PowerCube with each cylinder having its own isolation needle valve. A manifold panel on each PowerCube houses ¼ turn manual ball valves with are used when connecting it to the station. An automatic safety shutoff valve on each PowerCube requires compressed air from the station in order for the PowerCube to supply hydrogen. This safety shutoff valve will close whenever an ESD is pressed or the PLC determines a leak in the hose connecting the PowerCube to sequencing panel #1.

A minimum of one PowerCube will be onsite for the beginning of daily operation with a minimum pressure of 407 bar (5900 psig) and minimum contained H2 mass of 74.4 kg. The station has been designed with the ability to operate with two PowerCubes on site. Each PowerCube is connected to the Sequencing Panel #1 via a flexible hose, and this panel controls which PowerCube is being used during operation.

To replace a PowerCube on site, a specific set of switch position, manual isolation and purge valves will be used on the sequencing panel;. The switch will indicate to the station that the specific PowerCube cannot be used for hydrogen supply, and to source hydrogen from another PowerCube or to enter electrolyzer mode as discussed below.

Supplemental Medium Pressure Compression Unit and Sequencing Panel #1

The source of hydrogen supplied to the CSD unit is varied using Sequencing Panel #1 (SP1). The SP1 includes both air actuated valves, pressure transmitted and indicators, manual valves, check valves, pressure regulators, switches etc. There are two supply options that can be supplied to the CSD unit:

a) 'Sprint Mode' (higher pressure PowerCube)
b) 'Steady State Mode' (Lower Pressure PowerCube)

During 'Sprint Mode', pressure from the highest pressure PowerCube cylinder flows directly into the compressor module. A regulator inside the compressor module ensures hydrogen pressure is below the maximum allowable suction pressure for the compressor. As hydrogen mass flow rates through

the compressor is higher with higher inlet pressures, the station preserves the powercube with the highest pressure for times when the station needs to 'top-up' high pressure storage quickly.

During the majority of the day the station will operate in 'Steady State Mode'. In this state hydrogen will be sourced from the PowerCube cylinder with the lowest pressure of hydrogen. In this way HTEC can maximize hydrogen consumption from each PowerCube, minimize deliveries and preserve pressure.

The supplemental medium compression unit acts to continually pressurize the highest pressure PowerCube cylinder from the cylinder with the lowest pressure to maximize the hydrogen contained within each PowerCube onsite.

H2 Compression Storage and Dispensing

Compressing Logic

The specific logic of the compressor is 3rd party IP. This section provides a broad overview of how this logic works. The compressor module accepts any range of H2 pressure between 20 and 350 bar. If the inlet pressure is below 20 bar, an actuated valve closes to avoid depressurization of the line as well as possible damage to the compressor. The compressor is operational any time pressure in either of the high pressure storage banks is below a threshold amount (~860 barg).

Compressed Hydrogen leaves the compressor and flows to the high pressure sequencing panel. Air actuated valves allow the compressed hydrogen to flow into either of the high pressure storage banks. These banks are generally filled one at a time, with the highest pressure bank being filled first, then the next lowest pressurized bank, and then finally the remaining bank. The pressure of each bank is constantly monitored with PITs inside the sequencing panel. If a customer is filling a vehicle while the compressor is running, the compressor does not stop but the vehicle filling logic overrides the logic required to compress the high storage tanks. This means that the high pressure sequencing panel valves adjust to the requirements of filling. After the vehicle is filled, the HPSB (high pressure storage bank) filling logic continues.

This container houses a cooling system that provides cooling to the compressor system as well as the dispenser, although the internal dispenser cooling is limited in its ability to provide J2601 fills back to back.

Hydrogen Dispenser

The specific logic and valve sequence of how a vehicle tank is filled is 3rd party IP, but the logic must conform to J2601.

A customer will arrive at the dispenser and request a either a 700 or 350 bar fill from the HMI on the dispenser. A payment option will be verified with the customer (credit card, debit card, or fob). The customer connects the appropriate filling nozzle to their vehicle. When system recognizes a connection it will follow the J2601 filling sequence. Hydrogen will be sourced from the lowest pressure bank and equalized with the vehicle tank, then the next highest pressurized tank, and finally the highest pressurized bank. A target pressure or State of Charge (SOC) will be determined by the logic based on J2601 tables; this accounts for the settling and temperature decrease of the hydrogen after it

has been dispensed to the vehicle tank. During dispensing the hydrogen flows through a liquid-gas heat exchanger with -40°C coolant which will lower the temperature of the hydrogen in accordance with J2601.

To determine the target SOC inside the vehicle tank pressure values will either communicated via the vehicle pressure sensor or from a pressure sensor on the dispenser. A temperature sensor downstream of the hydrogen heat exchanger combined with the tank pressure reading continuously determines the J2601 filling target pressure/SOC. The dispenser limits the flow of hydrogen to 60 g/s as per J2601. An air actuated valve on the dispenser closes once the target SOC in the tank has been reached, if the customer stops the filling process, or in the case of an emergency. After this valve has closed, the hose line is automatically vented and the customer releases the nozzle from the vehicle. If a 350 bar fill is being used, the nozzle itself relieves the pressure in the nozzle via the dispenser vent stack, such that the nozzle can be removed from the car. The amount of hydrogen dispensed is measured via a flow meter and recorded against the customer ID (if using a RFID mechanism), or charged to a credit card account.

Station Auxiliaries

Dispenser Cooling System

The supplemental dispenser cooling system is increases the dispensing capacity of the station and is required to meet CEC performance specifications. This system has its own control system and the cooling fans increase or decrease their speed to maintain a -40°C coolant temperature level. An on/off pump continuously moves coolant around the entire system at a set flow rate. The cooling system can be turned off manually and has a discrete communication link to the CSD unit which can turn the system on or off. In the event of an Estop, the dispenser cooling system will be turned off.

14. Attachment – Sample Maintenance Schedule for CSD equipment

This section provides a listing of the maintenance items and schedules for the station's sub-systems.

Refer to the following documents for detailed maintenance procedures:

700 bar compressor – refer to "Instruction Manual"

700 bar compressor chiller – refer to "Installation & Operation Instruction Manual"

The maintenance schedules are as follows:

Component / Test	Type	Minimum Service Interval	Requirements/Components
875 bar Compressor			
Hydraulic oil	AW ISO 46/2 ASTM D2882	Every 4,000 hr or 1 yr interval, or use oil analysis kit to determine change interval	See list of recommended hydraulic oils, reference procedure in Hydro-Pac LX compressor Instruction manual
Hydraulic oil suction strainer	140 micron	First 50 hrs, every 4,000 hr	Wash in solvent bath, blow with compressed air from inside to outside, dry and dip in oil before reinstalling, reference Hydro-Pac LX compressor Instruction manual
Hydraulic oil return filter	25 micron	First 50 hrs, every 4,000 hr	Disposable element, must replace, Hydro-Pac LX compressor Instruction manual
Gas cylinder		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
Hydraulic cylinder		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
Check valves		As needed	Reference procedure in Hydro-Pac LX compressor Instruction manual
875 bar Compressor Chiller			
Condenser coil		Monthly, or as needed	Inspect and clean, reference user manual
Fluid (water glycol mixture)		Monthly, or as needed	Check fluid quality by inspecting for debris or contaminants, reference user manual
Fluid pressure		Monthly, or as needed	Check for normal outlet fluid pressure
Fluid strainer		Every six months, or as needed	Inspect fluid strainer, reference user manual
Inlet water filter		Annually, or as needed	Inspect and replace as needed

Component / Test	Type	Minimum Service Interval	Requirements/Components
Fluid system and piping		Annually, or as needed	Visually check for leaks and wear on piping components. Replace/tighten as needed.
Electrical system		As needed	Reference user manual J-5562 IOM
Refrigerant system		Annually	Refrigeration Contractor - Perform equipment inspection and refrigerant leak test. Depending on condition of condenser, additional cleaning may be peformed.
Pre Cooler Chiller			
Refrigerant system		Annually	Refrigeration Contractor - Perform equipment inspection and refrigerant leak test. Depending on condition of condenser, additional cleaning may be peformed.
Condenser coil and fans		Monthly, or as needed	Inspect and clean if debris and dirt build up present. Check fans for signs of wear and tear or damage.
Fluid (PTL HPC)		Bi-Annually, or as needed	Check coolant quality by inspecting for debris, contaminants or ice build up inside of holding tank
Fluid pressure		Monthly, or as needed	Check for normal outlet fluid pressure
Fluid system and piping		Quarterly, or as needed	Visually check for leaks and wear on piping components. Replace/tighten as needed.
Pressure Relief Devices			
Hydrogen		Every three years, or as needed	Recertification, to be peformed by FM valves or ASME accredited company.
700 bar Fueling Hose			
Inspection		Annually, or as needed	Visually inspect, replace if needed
Replacement		Every two years, or after pull-out event	Replace hose
350 bar Fueling Hose			
Inspection		Annually, or as needed	Visually inspect, replace if needed
Replacement		Every two years, or after pull-out event	Replace hose
700 bar Fueling Nozzle			
Leak check		Every four to six weeks	Check for leak at nozzle, reference procedure outlines in TK17 H2 70MPa Operating instructions

Component / Test	Type	Minimum Service Interval	Requirements/Components
Lubrication		Every four to six weeks	Lubricate nozzle components, reference Lubrication Plan TK17 H2 70MPa Operating instructions
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TK17 H2 70MPa Operating instructions
Inspection		After pull-out event	Send to manufacturer for inspection
Replacement		Every three years, or as needed	Send nozzle to manufacturer for refurbishment

Component / Test	Type	Service Interval	Requirements/Components
350 bar Fueling Nozzle			
Leak check		Every four to six weeks	Check for leak at nozzle, reference procedure outlines in TK16 H2 Operating instructions
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TK16 H2 Operating instructions
Inspection		After pull-out event	Send to manufacturer for inspection
Replacement		Every three years, or as needed	Send nozzle to manufacturer for refurbishment
700 bar Fueling Breakaway			
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TSA1 H2 Operating instructions
Inspection		After pull-out event	Check for leaks, or send to manufacturer for inspection
Replacement		Every three years, or as needed	Send breakaway to manufacturer for refurbishment
350 bar Fueling Breakaway			
Inspection		Every three months or 20,000 connections	Inspect for leak tightness and proper operation, reference TSA1 H2 Operating instructions
Inspection		After pull-out event	Check for leaks, or send to manufacturer for inspection
Replacement		Every three years, or as needed	Send breakaway to manufacturer for refurbishment

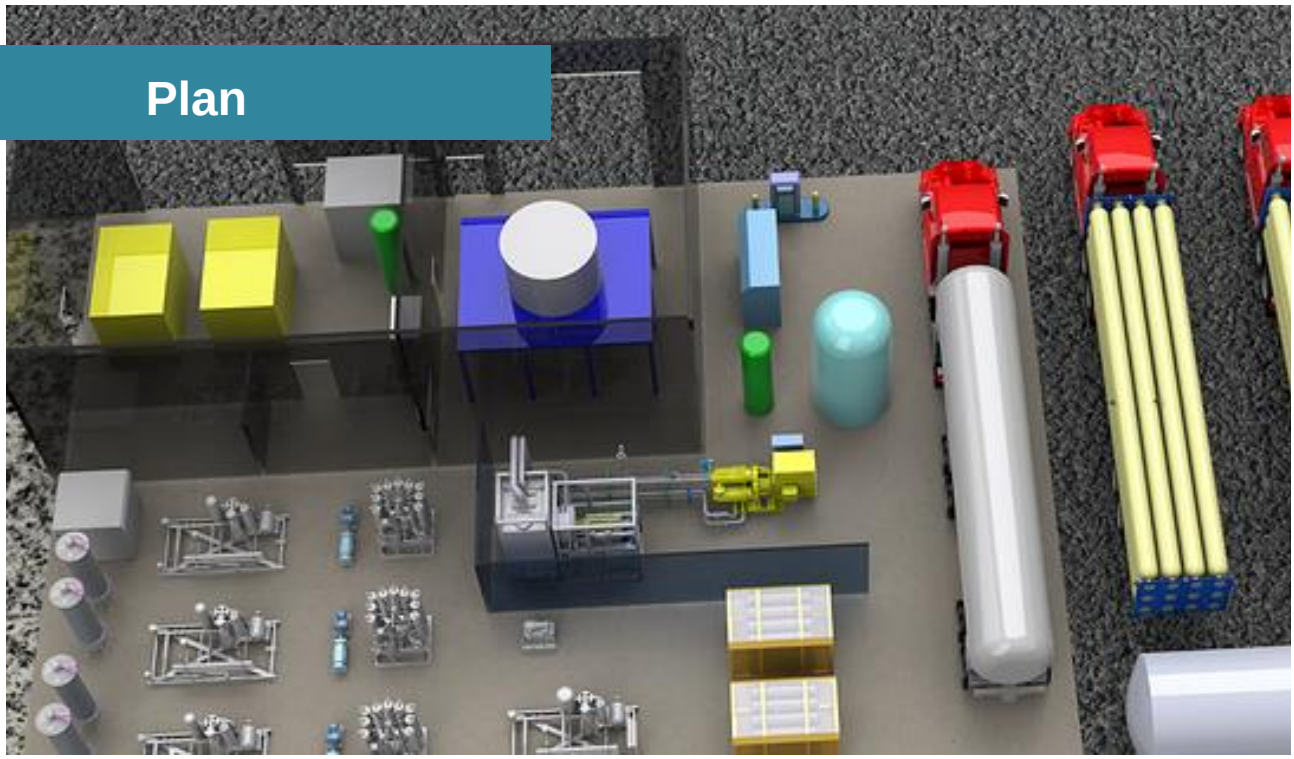
Component / Test	Type	Service Interval	Requirements/Components
Hydrogen Piping			
Inspection		Weekly, or as needed	Visually inspect pipe, valves and fittings
Leak Check		Monthly, or as needed	Perform leak test on pipe, valves and fittings
Hydrogen Vent Systems			
Inspection		Quarterly, or as needed	Visual inspection of vent system for operational obstructions and support integrity, reference CGA G-5.5
Inspection		Weekly, as needed after weather event	Inspect water drain device for water accumulation, reference CGA G-5.5
Gas Detection System			
		Every three months, or as needed	Calibrate all gas detectors, reference gas detector manual

HYDROGEN SAFETY PLAN

STATION 9: PORTOLA H2 STATION

SPECIFIC DETAILS

Plan



Identification of the document: H066-SAF-002

Revision: A

18-Aug-2016

Number of pages: 10

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Signature (on the original's document only)		

IDENTIFICATION OF THE DOCUMENT	
DESCRIPTION OF THE DOCUMENT	Hydrogen Safety Plan
REFERENCE	H066-SAF-002

VERSIONS HYSTORY		
VERSION	DATE	DESCRIPTION OF THE MODICATION
A	18-Aug-2016	Issued for GFO Application

DISTRIBUSION LIST			
INTERNAL		EXTERNAL	
Name, company	No.	Name, company	No.

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1. Scope

This document is a part of a suite of documents that make a “Hydrogen Safety Plan” for a specific station. This document has been prepared specifically for HTEC’s expansion of hydrogen stations in the state of California.

The purpose of this document is to describe the Portola HTEC Station and any design differences or site safety risks that need to be incorporated on top of design considerations described in HTEC Station Design C (HSP-P-013). Risks in this document may or may not be different from the risks at other HTEC station locations.

It is the expectation that this is a preliminary document and that it will evolve as the project continues, and more complete information is identified.

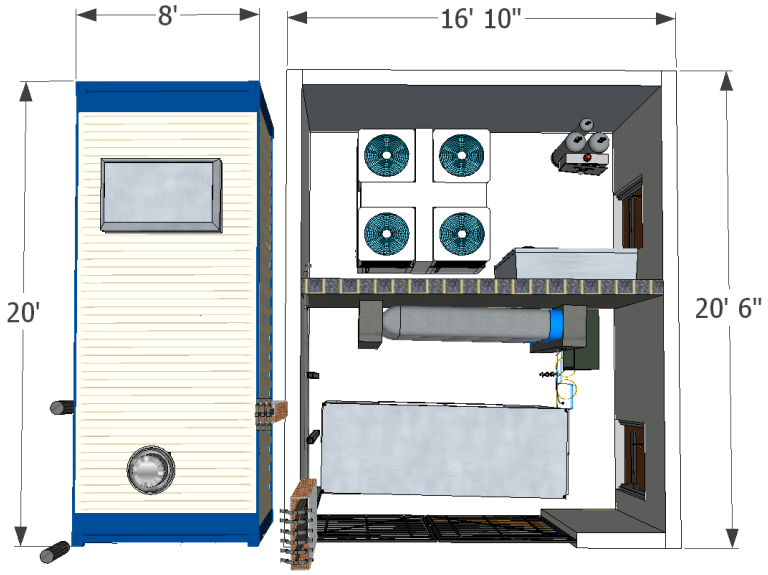
2. Facility Description

Station Name	Portola Hydrogen Station
HTEC Station Design Type & Reference Document	C – (Reference Document: HSP-P-013)
Address	115 Portola Rd, Portola Valley, CA 94028
Lot Description	A busy, independent gasoline and auto service center called Ramies Automotive. Spacious site with lots of parking stalls which the owner has said the station can occupy. The property line nearest the station backs onto a concrete wall of a restaurant. This concrete wall has no windows or air supply inlets.
Distance to Fire Department	187 ft - Located in the next lot northwest to station – Woodside Fire Protection District (135 Portola Rd.)
Public or Non-Public Hydrogen Station	Public
Total Station Area:	513 sqft
List of Key Hydrogen Equipment	Hydrogen Compressor, Storage and Dispensing Module (Semi-Pernament) Supplemental Medium Pressure Compression Unit Medium H2 Pressure Storage Low Temperature Cooling System Other Non-rated facility utilities Interconnecting piping (above and underground)
Station Barriers to Entry (if applicable)	Fire Barriers walls where necessary, fences, locked gates and security doors.
Number of attendants for station while open	Zero – Station is remotely operated
Hours of operation	7am to 7pm expect during maintenance and hydrogen delivery

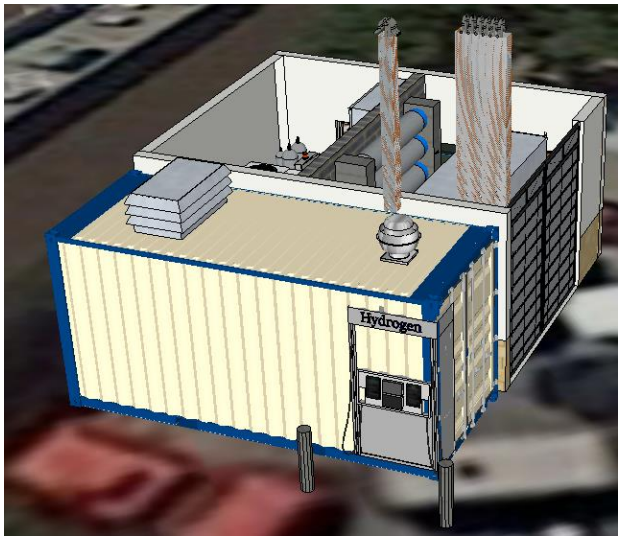
A general site plan and layout of the HTEC station is shown in the figures below. The station is located at a medium sized gasoline station and automotive service center. The station is located 3 miles (5 min drive) away from the I-280 and Alpine Rd. (Exit 22).

The HTEC station is located near the east corner of the property. There are two access points to the property from the main road along the eastern side of the property.

For a station block flow diagram, description of major hydrogen processing equipment, or general site operation, please refer to the HTEC Station Design C document (HSP-P-013).



Proposed Station Layout



Proposed Station Isometric View

3. Site Access and Occupancy

Site Access

There are two (2) access points from the main road (Portola Rd.). Hydrogen delivery or special equipment delivery will be from the eastern most access point. These access points can be seen in the picture below.

Station Access Control

A 9 foot high concrete wall fence surrounds the station area that includes one access gates and 2 security doors. The access gate and doors will be locked, with access for trained personnel only. Each of the gates and doors can be pushed open from the inside to escape the facility in an emergency.

Hydrogen delivery access to the station is via a 15-foot gate located on the site west wall.

Access for emergency services is through either of the two security doors.

Station Compound Occupancy

The hydrogen station is unattended and generally unoccupied. The only time the station site will be occupied is during maintenance, hydrogen delivery, and site tours.



Station 8: Portola Hydrogen Station - location map

115 Portola Rd, Portola Valley, CA 94028

4. Site Specific Operation

General operation of the station will not differ from the general operating overview described in HTEC Station Design C.

There are no site specific inclusions for control strategy:

5. Site Specific Hazards

The following list details site specific hazards that must incorporated into the station PHA and HAZOP analysis as per HSP-P-011:

The Ramies Automotive site is bordered on the southeast by the back concrete wall of a restaurant, of which there are no windows or air intakes along this wall. The Woodside Fire Protection Service borders the northwest side of the property. Along the southwest side of the property the Auotmovitive service center is located and residential units border the property. No exposed overhead powerlines are near the station.

Risk Description	Likelihood	Consequence	Design Mitigation Strategy
Collision of vehicles into station due increase traffic around station	Low	Medium	Use of: • 4”-6” diameter concrete filled bollard around the outside of the station, especially the CSD unit which is the most exposed to traffic.
Fire/Explosion due proximity of unclassified equipment located near CSD unit.	Low	High	Use of: • Communication with site owners to ensure NFPA 2 setback distances are adhered to, after the installation of the station.
Collision of Hydrogen Delivery equipment with public	Medium	High	Use of: • Reflective signs, cones, and tape to cordon off safety zone during deliveries.

6. Construction Specific Considerations

A preliminary analysis of the station found that there are no extra construction specific safety considerations on top of those included in HSP-P-013.

7. Electrical Connection

Electrical connection for the station is still under review. It is expected that power can be sourced from the electrical pole on the south corner of the lot.

8. Special Permitting Considerations

At this time no special permitting considerations are known above those described in HSP-P-012.

9. Site specific Safety Procedures

Preliminary discussions have been completed with landowner only. After receipt of NOPA, HTEC will incorporate the Ramies Automotive safety procedures into this document as a special safety procedure. Thus far, no limiting procedures in regards to site have been found.