

## c. Case Study 3 – Hittistetten Germany

### i Details of the Fuel Cell System

Application :Uninterruptible Power Supply for gas station  
 Customer/user :Gasversorgung Sueddeutschland (gas supplier)  
 Country :Germany  
 City/Town :Hittistetten  
 Date :April 2008  
 Hyper Partner :

#### Fuel Type:

Natural gas		Hydrogen	X	Other *	
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\* Description:

#### Status of development:

Prototype		Verification model		Serial model	X	Other *	
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\* Description:

#### CE Certification (for each component):

Component Name	CE Certification			
1. Fuel Cell GenCore 5T24	YES <sup>1)</sup>	<b>X</b>	NO <sup>2)</sup>	
2. Plug Power Hydrogen Module	YES <sup>1)</sup>		NO <sup>2)</sup>	<b>X</b>
3. Hydrogen Pressure Sensors	YES <sup>1)</sup>	<b>X</b>	NO <sup>2)</sup>	
4.	YES <sup>1)</sup>		NO <sup>2)</sup>	
5.	YES <sup>1)</sup>		NO <sup>2)</sup>	

1) Which directives were used?

Technische Regeln Druckgas – TRG 280 (technical rules for pressurized gas)

Which standards were used?

GenCore Siting and Installation Manual  
GenCore HSM Siting and Installation Manual

Who certified each component/the overall system?

- Plug Power Holland together with Gastec (fuel cell)
- Certification of fuel cell installation was included into whole certification of gas station (TÜV certification)

- Please provide a copy of the certificate of conformance.

2) Was a risk analysis carried out?

- Please provide HAZOP information.
- Please provide information regarding to safety measures taken (i.e. fire protection, ventilation, safety sensor, etc)

**Nominal data:**

Power out (kWe)	5
Heat out (kWth)	
Fuel gas supply pressure (bar)	4.4-7.6
Voltage (V)	24
Frequency (Hz)	
Ambient temperature range (°C)	-40°C - +50°C
IP-rating	
Dimensions (m)	HXWXD 117x91x81cm
Weight (kg)	276

## ii. Installation

### Location:

	Indoor	Outdoor
Remote		
Industrial	X	
Residential		

### Additional information:

(e.g. single/multi family home, rooftop, laboratory, etc )

Fuel cell UPS application for Gas supply station – Fuel cell and hydrogen supply would be installed into a room, although it was originally designed as an outdoor application

### What affected your choice of site location?

Normally the GenCore fuel cell together with the Hydrogen Storage Cabinet will be installed outdoor. In this case, the customer had not enough space to install it outside and asked us, if it is possible to install the fuel cell with hydrogen storage inside a room, which was planned for a battery UPS. The room has a size of (HxWxD 3mx1.8mx3m). Because the room is so small, we decided to install the GenCore with 6 single hydrogen bottles (without the Plug Power hydrogen storage cabinet) and an automatic changeover manifold into this room.

The components of the GenCore fuel cell are not ex-safe, therefore you have to keep a safety distance of 2m from the six hydrogen cylinders (TRG 280 indoor installation). Because of the small size of this room, it is not possible to install all components with that safety distance. Therefore we looked for an opportunity to reduce the safety distance around the bottles. In TRG 280 is written that for an outdoor installation, you only have to keep a safety distance of one meter around the six bottles. To consider this room as an outdoor location it is further written in TRG 280, the room has to have two open walls or one open wall if the depth of the room is not larger than the height.

Therefore we opened the front wall and the roof to have natural ventilation and considered this room as an outdoor location and we were allowed to reduce the safety distance around the hydrogen cylinders to 1m. Now we were able to install the GenCore fuel cell together with the six single hydrogen bottles in this site.

### Installed by:

	Name, contact details
Installation company	zebotec GmbH, Blarerstrasse 56, 78462 Konstanz, Germany
Manufacturer	Plug Power Inc., 968 Albany-Shaker-Road, 12110 Latham, NY
Service company (maintenance)	zebotec GmbH, Blarerstrasse 56, 78462 Konstanz, Germany
Other	

- Please provide copies of installation manuals, service & operational manuals and training material.

# Before & during installation

## Schematic drawing of installation (electrical & mechanical):

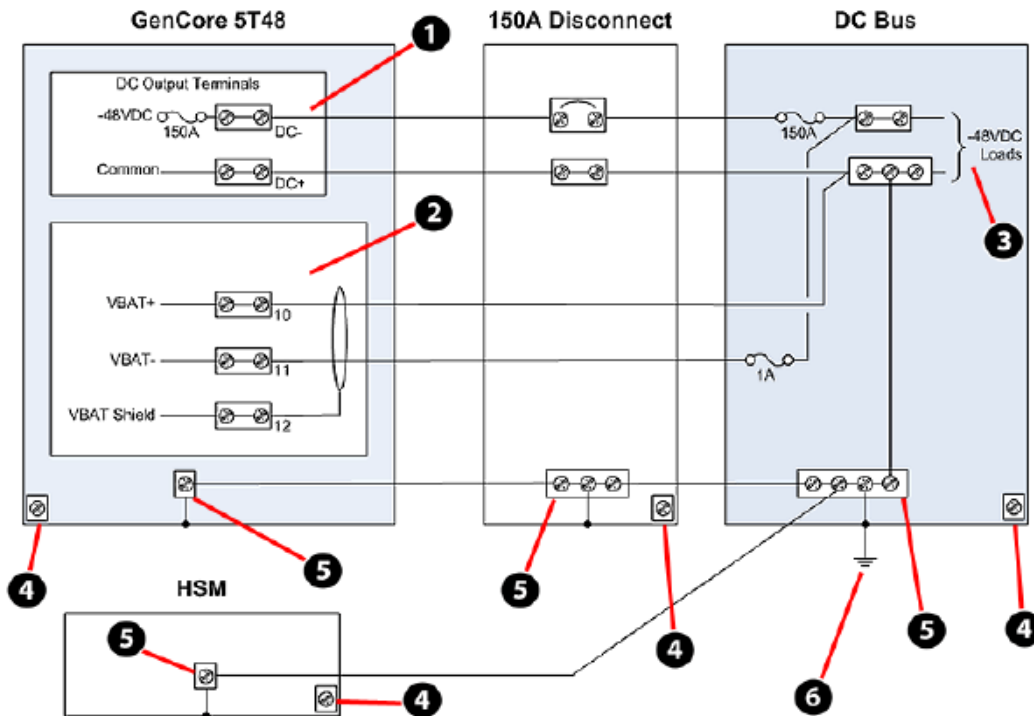
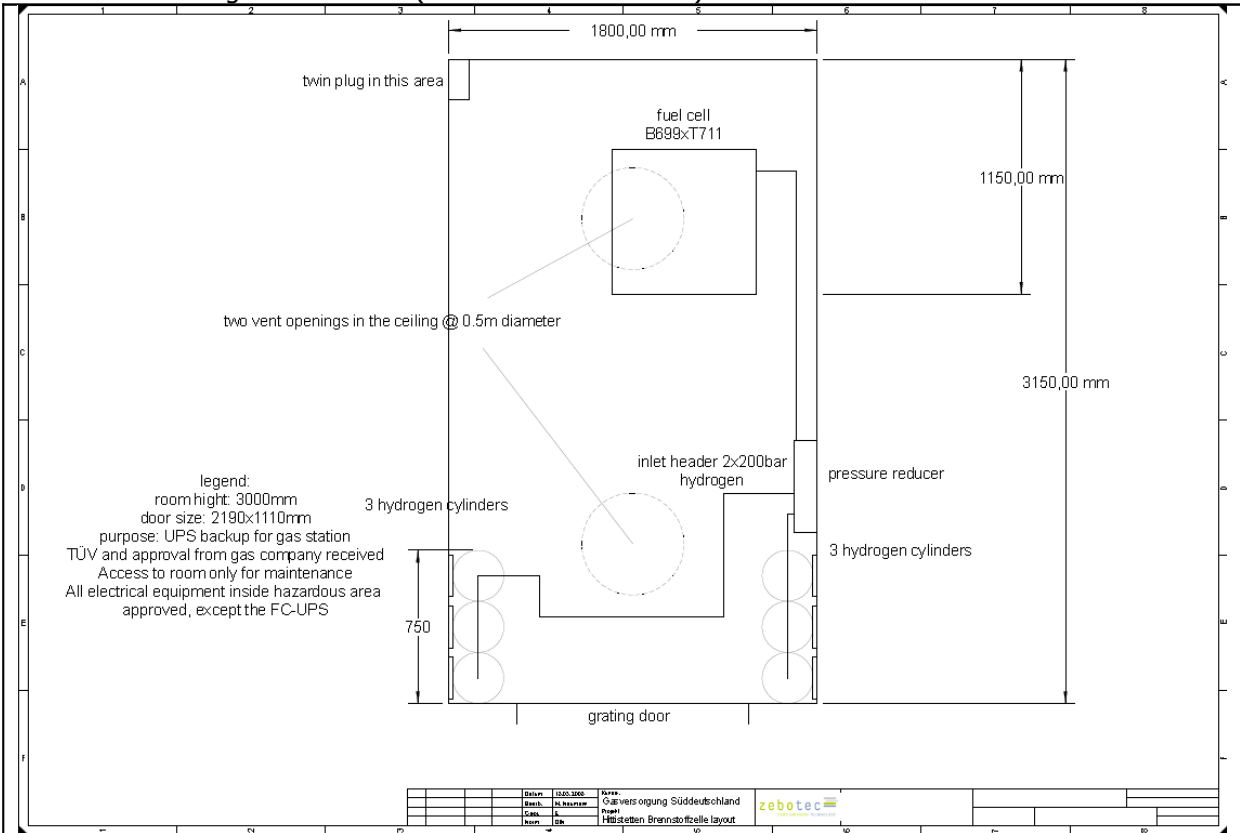


Figure 8-1: 5T48 to Site DC Bus, Internal Ground

- 1 DC Output Terminals
- 2 Terminal Board 2 Site Voltage Sense Connections
- 3 -48VDC Loads
- 4 External Ground Connections
- 5 Internal Ground Connections
- 6 Site Ground

## Site evaluation:

What safety and security measures were taken for each component of the fuel cell system? (e.g. ventilation, fire protection, sensors, barriers, walls, locks)

The GenCore fuel cell has a hydrogen safety sensor and several fans for ventilation. Normally the hydrogen concentration should be below the critical limit of 4%. Otherwise the fuel cell goes into E-Stop.

Additionally to this standard security measures, the room has a gas safety sensor.

Vent line in case of overpressure

- 1.
- 2.

**Fuel supply:**

Piped	x	Generated on site		Stored on site <sup>1)</sup>	x
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1) Describe the fuel storage and any safety devices related to the storage, (e.g. number of cylinders used, size of tank used, storage pressure, materials used etc)

- 6 bottles, 2 banks of 3 with auto change over manifold – Low fuel alarm when switching from one bank to the other
- Each bottle stores 0.7 kg, enough fuel to support 2 hours of run time at 5 kw load
- Fuel level monitoring from Service Interface (SI)
- Excess Relief Valve ensures safe operation in the event of an over pressure situation
- Natural ventilation

2) Describe fuel piping used between components (material, length, internal and external diameter if known, shape connections, etc):

High pressure stainless steel piping is used (diameter ¼inch) with Swagelok fittings to connect the two banks with the automatic changeover and the hydrogen storage with the fuel cell.

3) Describe what precautions were taken if the piping went through a wall (type of wall, type of sealing, piping instructions, fire protection, smoke protection, etc):

Not the case

If the fuel cell was connected to a grid or appliance, what criteria had to be fulfilled?

- 100% uninterruptible power supply
- Constant output voltage range (+24.9-27.5Vdc)

## After installation

What training did the installers, users and service personnel receive?

Installer and Service personnel from zebotec are certified GenCore fuel cell technicians (training through Plug Power Holland). Customer got no training, because zebotec is the responsible operation company.

What emergency procedures are/were in place?

- Automatic conditioning cycle every 4 weeks
- Remote monitoring through GSM Modem
- Service Interface Software

If an approval route was necessary, describe by whom and what was needed?

- TÜV certifies the whole gas supply station incl. fuel cell UPS
- TÜV needs documentation, CE-documents of fuel cell, manuals

Was any commissioning of the installation carried out? If so please provide details.

All work from project planning till commissioning was done by zebotec - "turn-key"

Please describe the service procedure?

- 1 year maintenance (replacement of filters, hydrogen sensor, pressure relief valve)
- 3 year maintenance (same things as above, but additionally replacement of internal batteries and coolant)

## iii Lessons learned

What were the challenges/hurdles for approval?

- Technical staff of TÜV should have more competence in fuel cell applications
- We learned more about Ex-Safety-rules and the relationship between Fuel Cell (which operates with hydrogen, but is not designed to install into an explosion zone) and the hydrogen supply with gas cylinders
- We also learned that although we deal with components which are certified within the EU, not every approval company is familiar with european rules or accept those rules

What were the challenges/hurdles for installation?

- To convince the customer that the site is secure and reliable
- We had to learn many things which are related to explosion-safety-rules, dealing with pressurized gases, etc. to be sure that we are allowed to install the application in that way, we planned it.

What problems were caused by techniques?

We customized a standard product for this application and we had to adapt several things to get each component compatible with the whole application.

What problems were caused by administration, agencies?

nothing

What difficulties did the installer experience?

See "What problems were caused by techniques?"

What difficulties were experienced by the customer?

Nothing > fuel cell UPS application provides a higher technical standard than the normally used batteries

Describe any modifications to the installation process?

Generally, all installations will be carried out with the manuals of Plug Power. This installation was also carried out with the Plug Power manuals, but some things we had to customize and it is very difficult to give a picture of modifications.

In your opinion, if a leak were to occur in the system, where would it be most likely to occur and what would be the most likely causes of the leak? (Describe multiple situations if necessary)

The weak points of this site are the flexible fuel hoses, which connected the six hydrogen cylinders with the hydrogen storage cabinet/automatic changeover manifold. If bottles will be replaced, there is a great risk to overtighten the flexible hose, when connecting to the new bottles. The flexible hoses would be broken you have a big leakage.