

Portsdown Hill Bio-methane Injection Facility – Technical Summary

28th June 2019 Revision 4

Brian Spencer BSc CEng FIMechE MIGEM



SGN

Your gas. Our network.

Contents

1 Introduction	3
2 Processes	4
2.1 Bio-methane Production	4
2.2 Bio-methane Injection	5
3 Process Safety	7
3.1 Pressure Control	7
3.2 Gas Temperature	8
3.3 Gas Leakage	8
4 Site Security	9
5 Environment	10
6 Feedstock Description	11
7 Site Buildings.....	12
8 Acoustic Impact.....	13
9 Designer Competence and Design Approvals.....	14
9.1 Competence	14
9.2 Approvals Process.....	14
9.3 Change Control	15
10 Materials and Quality Control	16
11 HAZOP, SIL and LOPA.....	17
11.1 HAZOP.....	17
11.2 SIL.....	17
11.3 LOPA	17
12 Construction and Design Management Regulation (CDM).....	19
13 Human Factors	19
14 Other Codes and Legislation	20

1 Introduction

Portsmouth Hill bio-methane injection facility was built and commissioned by SGN to allow bio-methane, generated using the process of Anaerobic Digestion by third party producers, to be injected into the gas network for domestic and commercial consumption. The project started as a concept in 2012 and was commissioned in 2014.

The location has been the site of the Portsmouth Hill Pressure Reduction Station (PRS) since it was built in the early 1970's and has undergone various modifications since that time. The site was chosen as the best location for the injection project following an in-depth study by SGN and was selected from several alternatives available. It was chosen because of the large land parcel that was freely available within the SGN footprint, it had good vehicle access, the site was shared with another commercial operation that meant it had minimal impact on the public, it was out of the public eye, the gas network was tested to show that it had sufficient capacity to take the flow of gas envisaged and gave access to a large domestic market, and it presented the most central location for the bio-methane production sites that were being planned at the time.

Biomethane is supported by government in their decarbonisation of heat policy and deployed in RHI legislation

When bio-methane gas is produced it is first known as biogas until all of the non-required component chemicals have been removed leaving pure methane (CH_4). Only once the gas is clean to a very high standard, as required by the Gas Safety (Management) Regulations, can it be injected into the gas network.

There are approximately 100 sites across the UK producing methane in this way and most have the benefit of being close to a gas pipeline where the injection takes place adjacent to the point of manufacture. However, it has been identified that a further 500 UK gas producing sites have the potential to contribute to the gas network but are constrained by their location. The concept of the 'Virtual Pipeline' was first considered in a Feasibility Study presented to SGN in 2012. This proposed the building of a centralised injection facility where low carbon bio-methane could be transported in by road and downloaded into the network. The transport of gas is by trailers similar to those that were already carrying compressed gases around the country between industrial sites. The transport technology was already well tested, it was the injection facility that presented the technical challenge.

The pressure of the gases being transported at the time was 250 bar, so this was used as the benchmark for developing the site. After initial review, it was considered that the best place to inject the gas was into the pipeline entering the existing Portsmouth Hill PRS. This runs at varying pressures but not below 25 bar. Once operational, this site would be the largest 'green gas' input into any gas network within the country – and be the first bio-methane entry point in the UK (and still the only one) to operate without the need to enrich the bio-methane with fossil derived propane. When in full operation the site can meet the annual heat demand for up to approx. 27,000 end users in the local Havant and Portsmouth areas

Because of the unique nature of the site, throughout the design process the most important issue for all the designers involved was safety. The site was designed and built to far exceed the codes of practice and engineering standards available and the lead designer was chosen partly because of their previous experience of designing a similar facility in Scotland. The independently prepared Feasibility Study came to the same conclusions on safety levels as had previously been incorporated and this ethos was maintained throughout the design.

The HSE directorate are aware of the installation and have visited site on at least two occasions as part of their surveillance visits and have not found or raised any concerns with the site.

2 Processes

There are two processes involved in the injection of bio-methane into a gas network. These are;

- Production of the biogas by Anaerobic Digestion and the removal of contaminants to leave bio-methane that is of the right quality
- Controlling the flow and pressure of the bio-methane into the network in a safe manner that complies with legislation

2.1 Bio-methane Production

This document is not primarily concerned with the manufacture of the gas, but the following is a brief summary for background information only and to demonstrate the environmental benefits of manufacturing gas in this way.

Biogas can be manufactured using Anaerobic Digestion from a whole variety of organic materials. These include waste food, farm waste from animals and crops, brewery waste and crops grown specifically for the purpose.

Regardless of the source, the organic materials are mixed into a slurry that can be easily injected into the bottom of large tanks, the digesters. The slurry inside the tanks is heated and agitated then allowed to percolate through over many days eventually leaving the digester where it can be turned into high grade fertiliser (digestate). During this time, bacteria digest the material and produce biogas in an oxygen free environment. This gas floats to the surface and is captured.

The constituents of biogas are primarily CO₂ and CH₄. In addition, other by-products are also produced in small quantities such as hydrogen sulphide, H₂S, oxygen, O₂, and depending on the organic materials, small quantities of harmless substances such as siloxanes found in soap, which finds its way into water treatment works.

Every material used in the digesters undergoes a GQ8 Risk Analysis to assess all of the chemical by-products that may be in the biogas and an appropriate method of removal is applied. This often involves the use of activated charcoal or similar materials that are periodically taken away from site for specialist disposal. GQ8 is a gas industry standard developed for this purpose and is carried out by a team of people each time a new material or mixture is proposed.

With the biogas clean, all that remains is to split the methane from the carbon dioxide. There are a number of methods for doing this including membrane filtration, chemical scrubbing and water washing. These all fall outside of the scope of this report but provide methane of a standard that can be injected into the gas network. On an ever-increasing number of plants, the separated Carbon Dioxide is recovered and reused to displace CO₂ manufactured and often imported from other sources, increasing the carbon benefits of AD plants which include bio-methane production.

2.2 Bio-methane Injection

To ensure bio-methane is injected safely into the network, the quality as well as the pressure must be constantly monitored and controlled. Also, there is a carefully designed process to ensure that the trailer is safely connected to the download facility before de-pressurisation of the trailer can begin.

These are three distinctly different parts of the injection process and these will be considered separately;

- Entry/Connection
- Quality Measurement
- Flow Control

Lorry Entry and Trailer Connection

The original intention for the facility was that it would be un-manned, so everything has been designed to be automated and triggered by the vehicle driver. This has not yet been realized and the site remains manned during download. However, it is the intention of SGN that the site will become unmanned in the future. Despite being a manned operation, all of the automated systems and safeguards are fully operational and initiated by the driver. The process for the driver on arrival is as follows;

- Arrival at site; prior to entry check for any brake hotspots using a thermal imaging device so as to guarantee no potentially flammable sources are taken into the compound
- Establish with SGN System Control Room the identity and validity of the driver and vehicle
- Open gates and drive into turning area before reversing into the allocated download bay next to a stanchion
- Driver disconnects lorry from trailer and hitches to the empty trailer to be returned to the producer
- Only if the vehicle is correctly positioned are the download connections at the stanchion long enough to be plugged in as follows;
 - Earth cable attachment
 - Lorry identification
 - Air supply for valve actuation
 - Gas download hoses
- Once connected, the driver presses a start button on a remote panel and the whole process of download is fully automated
- The dis-connection process is a reverse of the above for the empty trailer and the driver leaves, the gates closing automatically behind him

2.2.2 Control of Gas Quality

Legislation in the form of the Gas Safety (Management) Regulations requires all gas network operators to control the gas quality in their networks within strict limits. There is an extensive list of chemicals that must be kept at levels usually measured in parts per million (ppm). After carrying out the GQ8 analysis, SGN can be confident that only those chemicals present in the digestate, or that are by-products of the Anaerobic Digestion process, may be carried forward to the injection point. Strict monitoring is carried out at various places in the process including at the point where the gas is pressurised into the trailers. It is in the best interests of the producer to ensure that no contaminated gas is sent to the injection facility as it will be rejected and sent back at his cost. Therefore, the same standard of quality monitoring takes place at source to keep this risk to a minimum.

A number of specialist devices are installed to measure levels of H_2S , O_2 , H_2O and H_2 . Before a trailer can download gas into the network, a strict analysis of the gas is carried out by a first stage analyser. A sample of

gas is taken from the trailer immediately after connection as described above. If the sample fails for any reason, up to two more samples are taken before the trailer is rejected. All safety valves through the process remain closed and cannot be over-ridden by the driver.

If during the download a deviation is encountered at the download stanchion or at a secondary monitoring point, this same series of valves throughout the process close automatically trapping any poor-quality gas well before it can reach the gas network.

The entry point into the Portsmouth gas network is on the outlet of the Portsmouth Hill PRS via a 7 bar pipeline. There is one final check of gas quality and any deviation outside of accepted limits will also cause the entire download process to stop.

In addition, it is a legal requirement for any gas operator to add a stenching agent, or odorant, at the point of entry to the network. This is a pumping system with a backup unit and if it fails, this too will shut down the injection process.

All the safety shutdown valves are air operated to hold them in the open position against a spring. Air is supplied by an on-site compressor. Any failure of the compressed air system by leakage or other catastrophic event will ensure that all of the valves will close immediately.

Control Flow of Gas into Network

The Portsmouth Facility has been designed to accommodate up to four trailers in parallel downloading gas at a nominal flow rate of 1,000 standard cubic meters an hour (scmh). At peak flows this could increase to a maximum of 1,200 scmh.

This figure was carefully chosen. Gas already in the network contains a small amount of butane and propane which significantly raise the calorific value, CV, of the methane. Under The Gas (Calculation of Thermal Energy) Regulations 1996, all gas network operators are required to maintain the CV of their gas above certain minimum levels to ensure that all customers get a fair deal when buying energy. If neat methane was sent to customers, they would be buying less energy content than the same volume of gas containing propane and butane. SGN have utilised the tolerance on the CV to mix bio-methane in with the flow of gas coming into the Portsmouth Hill site whilst still maintaining the minimum CV level required by law. This has negated the cost of adding additional propane that takes place at other injection points. There is also an environmental benefit over other sites where additional propane, a fossil fuel derivative, has to be added. To achieve the minimum CV, however, the balance of flow between what is coming through the network and what is being downloaded must be carefully monitored, controlled and, if necessary, limited. Failure to achieve this balance is a further reason that the safety devices would shut, stopping the flow of bio-methane.

Controlling flow and quality of gas are both legislative requirements to ensure that customers are treated fairly and kept safe. The major concern on a site of this type is, however, ensuring that high pressure gas is not released into the network or the atmosphere with the obvious concerns associated with subsequent ignition. Before the gas reaches the flow control system, the pressure has to be reduced from 250 bar to 40 bar and the next section will deal with the safety considerations of this process.

3 Process Safety

3.1 Pressure Control

Throughout the design, safety rather than continuity of supply has been the deciding factor. On a conventional site, such as the original Portsdown Hill PRS, there are two independent devices to protect system safety and security if the pressure control device, known as the active regulator, fails. These devices are designed in such a way that they fail in the open position if a fault occurs. This allows a second device, referred to as a monitor regulator, to take over and control pressure at a slightly elevated pressure but at the same time an alarm is triggered to a central control room to alert them of a need to attend site. If the monitor device also fails and drops open the second and final safety device, a slam shut valve, will sense the further rise in pressure and close the stream preventing further flow of gas. This will raise a second remote alarm. Most sites incorporate a standby stream that is configured to come into operation when the pressure subsequently starts to fall, thus maintaining supplies to customers. It will also go through the same failure sequence if further faults occur eventually shutting down the site.

This philosophy is the basis of the design of thousands of gas installations throughout the UK and is underpinned by the following code issued by the Institution of Gas Engineers and Managers (IGEM), a Chartered Engineering Institution;

IGEM/TD/13 – Pressure regulating Installations for Transmission and Distribution Systems

It can be demonstrated by Risk Assessment that the possibility of failure of this number of devices and allowing high pressure gas through to a low-pressure gas network is beyond the realms of reasonable probability. Three devices in series would all need to fail for this to happen.

However, when looking at the concept of the design for the download facility two things were obvious;

- there was no need to guarantee supplies so a standby stream was not required
- protecting the 25 bar network from the 250 bar upstream was of paramount importance to system integrity and devices that failed closed instead of open would be more appropriate to give an even greater security to the network downstream

With this in mind the system was designed using both pressure reduction from 250 bar to 40 bar and finally flow control into the 25 bar system. Further, instead of reducing the pressure from 250 bar to 40 bar through one module, the pressure reduction was carried out using two separate modules with an inter-stage pressure of 80 bar.

In the event that either module did fail to close, both are designed using Class 2500 rated fittings that can withstand 425 bar. The design pressure for the modules is 300 bar and the working pressure 250 bar giving huge safety margins should any device fail to operate. In the event that the first stage module did not close, the second module can withstand the full 250 bar inlet pressure and continue to operate. Obviously, alarms would be raised remotely indicating what had happened.

Further safety was incorporated, however. Instead of utilising a monitor regulator in each module, these were replaced with slam shut devices that would close instantly on rising pressure, thus each stream has two slam shuts giving both modules two opportunities to shut down. The slam shuts are also required to be of a different design and utilise differing technologies. Therefore, one device on each module is pneumatic whilst the other is controlled by a software-based system. Thus, at Portsdown Hill there are six independent devices protecting system integrity within the 250 bar to 40 bar system. This takes the risk of failure of six devices to operate, in series, way beyond any conceivable level of probability.

Additional guidance was sought from the code ASME B31.8: Gas Transmission and Distribution Piping Systems (ASME – American Society of Mechanical Engineers). All UK codes and specification have historically been

based around American documents. B31:8 further confirms the design philosophy applied at Portsmouth Hill was appropriate for the pressures under consideration.

3.2 Gas Temperature

De-pressurising gas causes a cooling of the downstream gas and pipework known as the Joules-Thomson Effect. If uncontrolled, this will generate ice and extremely low temperatures that are undesirable. To counter this, Portsmouth Hill, in common with all Transmission Pressure Reduction Sites, uses a modular heating system that feeds hot water to heat exchangers within each module. This ensures that outlet gas temperature is maintained at, or above, 0°C. Any failure of this system will cause all of the shut-down valves to close.

3.3 Gas Leakage

Consideration has also been given to the remote possibility of leakage from joints and flanges. The entire site is circled within the security fence by an ultrasonic gas detection system. In addition, each module has a gas detector directly over the gas equipment. If either of these systems detect a leak, all safety valves will close and the gas supply to the boiler room will be shutdown as well as the electrical supply to all buildings, thus removing any potential source of ignition.

A Safety and Integrity Assessment has shown that the risk to life and property is beyond credible limits.

4 Site Security

The entire site has been protected with high grade security fencing with interference detection. In addition, CCTV is used to monitor the site and perimeter. Cameras will automatically home in on any section of fence that is disturbed, and alarms raised at the control room.

The entire site is also illuminated using energy efficient floodlights that are demand activated. This contributes to the mitigation of light pollution. The fact that the site is within an old quarry also prevents overspill of light to the neighbourhood at large.

SGN have a procedure in place for dealing with any attempted unlawful entry, including a lorry driver being under duress.

5 Environment

Government legislates for the use of crops specifically grown for biogas production within the 50/50 crop / waste RHI accreditation scheme. The result is the generation of gas that contributes to low carbon heat and approximately 27,000 end-users have their annual heat demand met from the benefits of this site.

The wider environmental benefits of the eight to ten AD plants that are made viable due to installations of this type should also be considered. These AD plants would not only reduce the unconstrained methane emissions from the waste feedstock but would provide digestate (natural fertiliser) for use on farms reducing carbon emissions from the energy intense chemical manufacture of fertilisers whilst enhancing soil condition by returning carbon content.

The use of waste materials, wherever possible, has beneficial consequences for the environment and the production of bio-methane for domestic and commercial use must be a benefit as it is accepted as one of the cleanest fuels available to us. Additionally, the amount of carbon dioxide that would normally be generated by aerobic digestion of the waste if left to rot in the open is greatly reduced. Added to this is the fact that CO₂ capture and re-use is further enhancing the environmental benefits by reducing the carbon footprints of the producers' sites.

SGN have made a company-wide commitment to environmental improvements across their business. The production and injection of bio-methane forms part of this commitment as it provides a renewable energy source, often from waste material, that is environmentally friendly as well as sustainable. SGN is continually looking for new sources of gas for injection that will further enhance this position.

Wherever possible, dual fuel lorries are being used thus promoting the use of bio-methane as a cleaner fuel.

SGN is committed to ISO 14001 and ensuring that all its activities are as friendly as possible to the environment.

6 Feedstock Description

Pipeline quality bio-methane will be produced by upgrading of biogas produced by anaerobic digestion of a substrate typically comprising:

Maize Silage

Grass Silage

Farmyard Manure (cattle)

Wheat

Technical Glycerine

Brewery Waste

Water Treatment Works Incoming Waste

Food Waste- including unsold produce

Other agricultural waste such as straw, poor quality agricultural produce, and chicken litter

These feedstocks are controlled at source by the producers so SGN have no direct influence over this.

However, as previously stated, SGN will carry out an industry standard GQ8 Risk Assessment of all producers wishing to inject gas into the SGN Network. This process ensures that SGN are fully aware of what organic feedstock materials are being used and what bi-products may be in the bio-methane that will need to be removed or monitored.

It is a strict SGN requirement that a producer notifies SGN of any intended change to the feedstock to allow the GQ8 process to be re-visited. This ensures that no bio-methane produced from different feedstocks can arrive at Portsmouth Hill without prior consent.

7 Site Buildings

A number of small pre-fabricated Glass Reinforced Plastic (GRP) buildings and containers were removed and replaced with new pre-fabricated units housing plant for the new site and erected as part of the construction work. These contain the following;

- ❖ Supervisory Control System/Telemetry – the software-based system that provides the functionality and control, and the communications hub that integrates with Gas Control in Horley
- ❖ Electrical Room – provides all off the switchgear for the various electrical supplies both to the site and the perimeter security fence around the entire site, installed at the same time as part of the government funded project to secure critical national infrastructure
- ❖ Boiler Room – this provides heat input to the gas being de-pressurised from two small boilers. This is required to overcome the Joules-Thomson Effect where gas cools as it is depressurised. Without some heat, ice would form on the pipework and possibly affect the control systems, both of which are undesirable
- ❖ Pump House – this controls the flow of hot water to and from each module
- ❖ Two Gas Quality Sampling Buildings – each houses a device called an Encal 3000 that monitors the quality of the gas at different stages through the installation
- ❖ Air Compressor Housing – This is an acoustic building as this is the one piece of equipment that could contribute to background noise

All new GRP buildings installed for containing the equipment were similar in dimension and shape to those removed and kept deliberately small and modular to minimise the visual impact at the site and ensure separation of key items of equipment.

8 Acoustic Impact

Portsmouth Hill PRS has been operating for nearly 50 years and there has always been noise associated with the pressure reduction. However, given the location of the site and the natural barrier around it there are no recorded complaints relating to noise emanating from the site.

The new modules benefit from thermal lagging which also contributes to noise attenuation. The level of additional noise is minimal and, although never measured, has not raised any issues since commissioning in 2014.

SGN have confirmed that no complaints have been received that relate to any aspect of the Portsmouth Hill facility.

If necessary, a background noise survey could be conducted with the download facility on and off, but this would only be appropriate if a noise complaint were received.

9 Designer Competence and Design Approvals

9.1 Competence

SGN has, for many years, maintained an approved list of competent designers. Whilst this is primarily about the company that supplies the design service, it extends to the review of individuals where this is appropriate. Regular updates are made during the tender process for any major work. As a minimum, Design Companies are required to;

- Adopt ISO 9001 or similar where appropriate
- Provide a range of qualified Engineers to manage the design process including;
 - Chartered Engineers
 - Incorporated Engineers
 - Engineering Technicians

Where these qualifications are not available, the onus is on the supplier to demonstrate by competence assessment and experience that they have the requisite skills.

9.2 Approvals Process

As part of the requirements of the Pressure Systems Safety Regulations 2000, all designs are required to comply with a robust process of design control. Any design affecting the gas network infrastructure must undergo a full process of approval and appraisal prior to the final construction, commissioning and connection to the gas network. This is carried out in accordance with a strict process to comply with the requirements of IGEM/GL/5 that is based on the legislative requirements.

The process is managed by maintaining a register of Approvers and Appraisers and this is held by the Competent Design Authority for the gas industry – DNV GL. All Engineers on these registers have been fully assessed for their experience and competence in their appropriate fields.

SGN used its own system to fully comply with these requirements known as SGN/PM/G/17 - Management Procedure for the Management of New Works, Modifications and Repairs.

This process required that;

- all drawings and documents be produced by (or under the supervision of) an appropriately qualified Engineer, as above
- all documents to be checked and signed as being free from errors
- a complete design package for all engineering disciplines involved to be sent for Design Approval and Appraisal, and for Portsmouth Hill would have specifically included;
 - Gas Engineering
 - Mechanical Engineering
 - Electrical Engineering
 - Control and Software Engineering
 - Civil Engineering

The Approval Stage, is an opportunity for a competent, registered Engineer to comment on every aspect of the designs and recommend or, in some cases, insist on design changes to comply with Engineering and Legal requirements. This process can take several months as it is an iterative process ensuring the best possible design is achieved.

The Appraiser is required to look at the design package and confirm that it has been designed in accordance with all of the correct processes and procedures, and sign off a 'Part B' certificate to allow construction work to commence.

9.3 Change Control

With all complex projects, it is likely that design changes may occur during the building of the installation as on-site technical difficulties arise. The designers work closely with the Client, SGN, and the constructors throughout this period and document all changes through a Change Control process. This ensures that, on completion, all design variations are incorporated, and the final design is reviewed using the same SGN/PM/G/17 process.

10 Materials and Quality Control

Throughout the UK gas industry, it has become a matter of routine to maintain excellent records of material sourcing and supplier quality control. This ensures that only materials and equipment that exactly match the requirements of the industry are purchased.

All equipment suppliers are expected to operate a quality system, usually ISO 9001, to demonstrate that their processes and procedures are fully documented. As the supplier can often be a designer as well, this naturally feeds into the requirements of IGEM/GL/5, as described above.

It is incumbent on the supplier to fully document the manufacturing processes to demonstrate that all the equipment used is appropriate for the duty that it will be required to perform. In addition, there must be full traceability of all pressure containing components back to source. i.e. not just back to other component manufacturers and suppliers, but back to the source of the raw materials used.

This ensures that sub-standard or poor-quality materials or components are not installed. On the very rare occasion this has happened, all pieces of equipment from a supplier can be immediately identified and repaired or removed from the network.

SGN has meticulously sourced components for use on the gas network from reputable suppliers. Suppliers must undergo the same pre-qualification as designers and demonstrate their ability and competence to supply high integrity components and systems. Two key suppliers were identified to provide the gas pressure containing and control equipment for Portsmouth Hill. Both have a long history within the gas industry and, in the case of the 250 bar pressure reduction equipment, the company can also demonstrate experience and competence working for the military on 400 bar systems.

Both companies provided all of the necessary infrastructure and document control systems to satisfy SGN of their ability to safely deliver the necessary equipment from their in-house manufacturing facilities and suppliers.

11 HAZOP, SIL and LOPA

11.1 HAZOP

As part of any design for High Pressure Gas Installations, it has become a routine to carry out an industry standard Risk Assessment known as a Hazard and Operability Study (HAZOP). This was a structured and systematic examination of every aspect of the Portsmouth Hill facility and was extended to cover the trailers arriving at the site as well as the remote gas compression terminals.

During the process, experts from every aspect of the project met and considered everything that could possibly develop a fault or fail, and what the consequence would be. This also extended to human error, but this was later considered separately.

Each fault was assessed for its likelihood and consequence and depending on the output from this analysis, design changes determined.

The process is iterative and can take many days on a complex project such as Portsmouth Hill. All of the output from the studies is carefully documented, designers informed of any required changes, and feedback recorded to ensure that all issues have been dealt with.

The final documents are stored within the SGN construction files for future reference.

11.2 SIL

A Safety Integrity Level (SIL) assessment was also conducted by an independent consultant. This report considers the level of failure attributed to devices required to shut down the site in the event of a process deviation. The quality of devices used must be selected against criteria laid out in the assessment to ensure that the risk to life and property is reduced to levels below those generally acceptable for both societal and consequential risk.

11.3 LOPA

A further safety analysis known as Layer of Protection Analysis was also carried out and further safety recommendations were acted on.

Because of the nature of the activity at Portsmouth Hill, a number of Instrumented Protective Functions (IPF's) were provided as previously stated to take automatic preventative action(s) in the case of unsafe operational parameter deviations. These functions were configured in an Emergency Shutdown (ESD) panel and are completely independent of the process and pressure control system.

To ensure that IPF's performing safety functions comply with the requirements of IEC 61511, DNV GL was requested to conduct a Stage 3 Functional Safety Assessment (FSA) for Portsmouth Hill.

The Stage 3 FSA raised a number of findings which required SGN to implement remedial actions to address those findings. One such remedial action was that SGN should establish a clear link between the Hazard Assessment and Safety Integrity Level (SIL) determination, and hazardous scenarios omitted from the Hazard Assessment should be included in the SIL determination.

Therefore, SGN commissioned DNV GL to conduct a review of the Portsmouth Hill Hazard and Operability (HAZOP) study and carry out a Layer of Protection Analysis (LOPA).

The HAZOP review and LOPA study indicated that the main hazardous scenario at the facility requiring a SIL-rated instrumented protection function was low gas temperature leading to cold fracture of the pipework. An IPF was installed at the facility to protect against this hazardous scenario. The LOPA study determined that this IPF needed to be able to achieve SIL 1 and an RRF of 66.

12 Construction and Design Management Regulation (CDM)

All projects in the UK must comply with this legislation. It is aimed at ensuring clients, designers and constructors all share and use the best and most up to date information. At the time, the 2007 version of the legislation was in force which required the appointment of a CDM Co-ordinator. The role of this person was to ensure full compliance and complete transparency between all interested parties throughout the project.

The process was controlled using Health and Safety Files, and Health and Safety Plans that ensured all relevant information was passed between parties.

All documents are stored within the SGN construction files for future reference.

13 Human Factors

During the project, concerns were raised about the possible human errors that could arise and put the gas network at risk. SGN considered this matter very seriously and had several reports on the matter commissioned. A Human Factors Risk Assessment was subsequently introduced to allow a full risk and consequence analysis to be undertaken specifically related to human error or interference.

As with the HAZOP, this allowed every conceivable risk to be considered and mitigated as necessary reducing any risk to the network to an absolute minimum.

14 Other Codes and Legislation

The entire project was managed in accordance with due cognisance paid to many industry and legislative documents. The following is not an exhaustive list but gives the key documents that were used for reference;

Legislation

Health and Safety at Work Act
Pressurised System Safety Regulations
Pipeline Safety Regulations
Pressure Equipment Directive
Electricity at Work Regulations
Construction Design (Management) Regulations
Gas Safety (Management) Regulations
Thermal Energy Regulations
Dangerous Substances and Explosive Atmosphere Regulations
Equipment for Use in Potentially Explosive Atmospheres
Planning (Hazardous Substances) Regulations
Control of Noise at Work
Control of Substances Hazardous to Health

SGN

CMSO – Management Procedures
SGN/PM/G/17 - Management Procedure for the Management of New Works, Modifications and Repairs

IGEM

TD13 - Pressure regulating Installations for Transmission and Distribution Systems
TD16 - Biomethane injection
TD17 - Steel and PE pipelines for biogas distribution
SR22 – Purging and Venting of Natural Gas
SR24 – Risk Assessment Techniques