NGN/PM/BIO/1

MANAGEMENT PROCEDURE FOR

Bio-methane Network Entry Facility General Functional Requirements

SEPTEMBER 2016

CONTENTS

FOREWORD

This document was approved by the appropriate Technical Authority Level (TAL) and Standards Steering Group (SSG) for use throughout Northern Gas Networks Limited (NGN).

NGN documents are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition by referring to the NGN Register of Documents available on NGN intranet.

Compliance with this document does not confer immunity from prosecution for breach of statutory or other legal obligations.

Contractors and other users external to NGN should direct their requests for further copies of NGN documents to the department or group responsible for the initial issue of their contract documentation

BRIEF HISTORY

First Published as Minimum Functional Specification Bio methane Gas to Grid Network entry connections	July 2014	N/A
First Published as NGN/PM/BIO1	September 2016 Version 1	NGN/PM/BIO/1

DISCLAIMER

This safety and engineering document is provided for use by NGN and such of its contractors as are obliged by the terms and conditions of their contracts to comply with this document. Where this document is used by any other party it is the responsibility of that party to ensure that this document is correctly applied.

MANDATORY AND NON-MANDATORY REQUIREMENTS

In this document:

must: indicates a mandatory requirement.

should: indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment must be completed to show that the alternative method delivers the same, or better, level of protection.

MANAGEMENT PROCEDURE FOR

Bio-methane Network Entry Facility General Functional Requirements

1 INTRODUCTION

This document seeks to provide:

- A specification for the design of the Northern Gas Networks Adopted Equipment to ensure all legislative, national and NGN standards are met.
- NGN requirements relating to the design of the BNEF.

Note: NGN will review the submitted design through the:

MANAGEMENT OF NEW WORKS, MODIFICATIONS AND REPAIRS INCORPORATING COMMISSIONING, OPERATIONAL AND ASSET ACCEPTANCE

Document reference: NGN/PM/G/17.

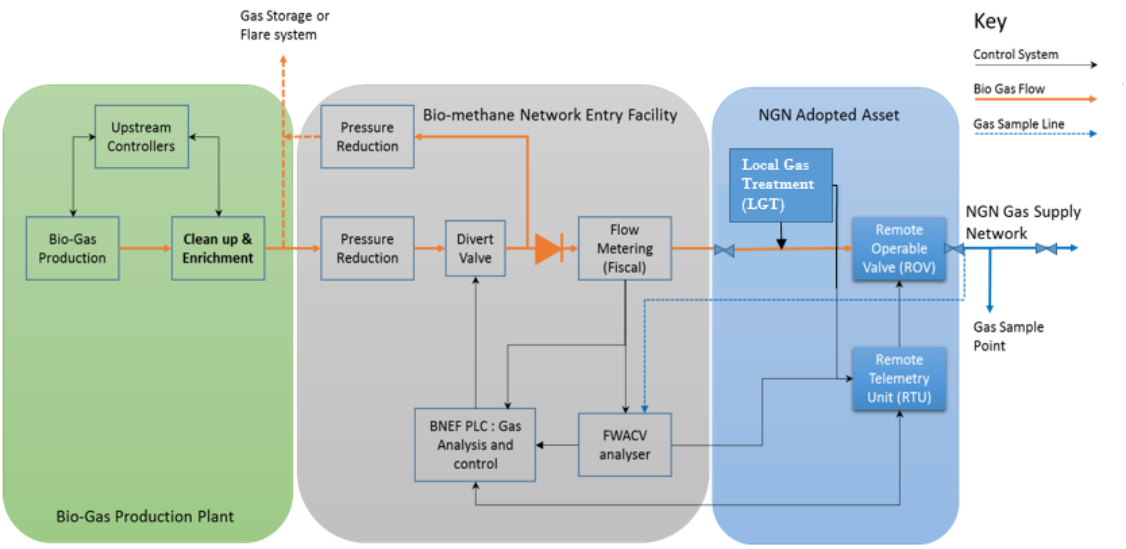
Once approved by NGN at G17 part C, the design will be deemed accepted by NGN.

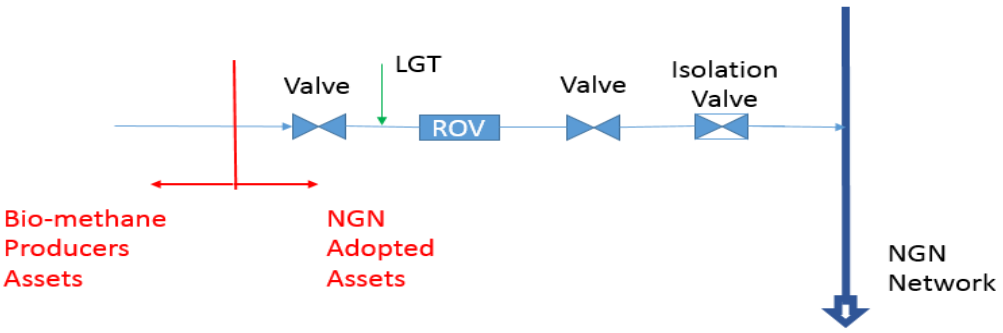
In order to ensure that all stages of the whole process including G17 processes are met a robust programme of events leading up to the initial and any subsequent Gas to Grid Dates must be provided at the kick off meeting which will be held once the project is given the go-ahead. IE on completion of the “securing of a connection point agreement”.

Any intermediate slippage to the programme on key dates will result in a similar slippage to the required Gas to Grid date.

2 OWNERSHIP MODEL

The following diagram depicts the general components of the Bio methane Network Entry Facility. Shown in blue are those elements which will be adopted by NGN. The adoption process will not begin until all G17 documentation has been received and approved by NGN.





Simple Line Diagram showing the NGN Adopted Assets

Figure 1.0: General depiction of a Bio methane Network Entry Facility (BNEF)

3 SCOPE OF BIOMETHANE NETWORK ENTRY FACILITY DOCUMENT

This document sets out the general requirements for the Bio methane Network Entry Facility (BNEF). Any party seeking to inject bio methane into Northern Gas Network's (NGN) gas distribution system from their Delivery Facility (see definition in Appendix B) must conform to these requirements and specification for adopted equipment. Any site-specific requirements (such as those relating to GQ8) for a particular entry point will be specified in the Network Entry Agreement (NEA) for that entry point.
Although the specifics of this document are expected to apply in the majority of cases, NGN reserves the right to amend any aspect of this document at any time. This is to ensure that gas entering its gas distribution system is compliant with legislative requirements in the particular circumstances of each entry point.

It is the responsibility for the Delivery Facility Operator (DFO) to supply, install all equipment and provide NGN with the necessary information needed to obtain regulatory approval. This includes any items such as calibration gases bottles etc. that are required to maintain and operate the BNEF.

This document sets out the minimum specification for the Local Gas Treatment (LGT), Remote Telemetry Unit (RTU), Remotely Operable Valve (ROV) and its controls that form part of a BNEF in order to permit safe, efficient and fit-for purpose grid injection of bio methane.

It is the responsibility of the DFO to carry out the functional safety life cycle in accordance with BS EN 61508 and BS EN 61511 for the BNEF. For this purpose, the ROV should not form part of a Safety Instrumented Function (SIF).

The Responsibility for operation and maintenance of a BNEF may rest with NGN, the bio methane producer or a combination of the two. The Delivery Facility" is the DFO's responsibility and the "Entry Facility" is NGN's responsibility as listed within the NEA.

Biogas Upgrading Plant (BUP) does not form part of the BNEF. Such functions include but are not limited to: -

- Biogas clean-up plant.
- Enrichment with LPG and control of calorific value.

4 GENERAL REQUIREMENTS

The legal obligations upon NGN in respect of gas introduced into its gas systems by a third party, as set out in the Gas Safety (Management) Regulations (GS(M)R) and Gas (Calculation of Thermal Energy) Regulations (Gas(COTE)R), are such that criminal liability cannot be delegated to a third party. Northern Gas Networks will retain control of the ownership, design, operation and maintenance of the remote controlled valve, Odorisation and telemetry to satisfy these legal requirements. The operation of the ROV must be under the sole control of NGN.

Gas not complying with the requirements of Part 1 of Schedule 3 of the GS(M)R must not be injected into a gas grid unless an exemption has been granted by the Health and Safety Executive for a particular requirement. In such a situation the DFO and NGN must ensure that any requirements conditional to the granting of such an exemption are met.

Example: This is based on qualification for the Certificate of Exemption No.1 of 2013 for the Gas Safety (Management) Regulations 1996 [GS(M)R} which permits an oxygen content of equal or less than 1.0% (molar). Should qualification to the exemption not be met or if the exemption be withdrawn, then the normal GS(M)R limit of equal or less than 0.2% (molar) will apply. The current exemption is for <38bar only. For 38bar and above an exemption will require raising with HSE.

NGN have been directed by Ofgem to determine calorific value, the facility and its operation must be in accordance with the relevant Letter of Direction.

Target Calorific Value

All Gas tendered for delivery to the NGN System at the System Entry Point must be in accordance with the target gross calorific value of Gas ("Target CV")

The Target CV will be maintained at a position to minimise the risk of CV capping to the LDZ. It is anticipated that the Target CV will be issued to site (via telemetry update), up to a maximum of four times per hour to provide a close correlation to the movement of FWACV observed in the LDZ, however this process may be modified at any time to match Network conditions on any given day.

A daily email will also be issued to provide the start of day Target CV.

Where the automated update process is not possible or unavailable the calculation of the Target CV will be carried out from time to time on the NGN Distribution Network Control System (DNCS) and will be communicated to site by means of email "or other agreed means" as soon as reasonably practicable after it is determined.

The CV being delivered by the facility will be continually monitored against this Target CV.

Future consideration will be given to the means of communicating the Target CV value to site. Any changes to this arrangement will be subject to discussion and acceptable to all parties.

4.1 Gas Quality Risk Assessment

The DFO and NGN must participate in a measurement risk assessment in accordance with NGN/PM/GQ/8 to determine which parameters must be monitored, the frequency of measurement and the speed of response of measurement system. The recommended limit values must be assessed by the NGN/PM/GQ/8 risk assessment.

The initial risk assessment must set out those changes (e.g. change of feedstock to the Anaerobic Digester, equipment change, etc.) that will require a review of the risk assessment. In the event of one or more such changes, the risk assessment must be reviewed. Where a particular parameter shows increased risk then a change in the monitoring scheme may be appropriate.

4.2 Provisions of the Delivery Facility Operator (DFO)

The DFO must provide bio methane to the BNEF that is compliant with the requirements of Part 1 of Schedule 3 of the GS(M)R, with the exception that it must be unodorised.

The DFO must provide bio methane with a gross calorific value that **equals or exceeds the target CV** agreed with NGN through the Network Entry Agreement (NEA).

The DFO must also provide to NGN telemetry system signals from the BNEF of those parameters identified by the NGN/PM/GQ/8 risk assessment.

The DFO and NGN must produce and agree a local operating procedure for the management of noncompliant gas, including the issuing of a Transportation Flow Advice (TFA), advance notification of ROV shutdown and procedures for restoration of bio methane flow following ROV closure.

4.3 Provisions of Northern Gas Networks (NGN)

NGN must provide full details of the format of data (IE The agreed I/O schedule) for the telemetry interface in order for the DFO to procure suitable equipment to achieve appropriate repeat signals.

5 CONTROL PHILOSOPHY

General

The DFO should deliver Bio methane gas compliant within the requirements of the Gas Safety Management Regulations (GS(M)R), the Gas Calculation of Thermal Energy Regulations (GCOTER), Unified Network Code (UNC) and the Network Entry Agreement (NEA).

The delivery facility supervisory control system should monitor the bio methane gas for conformance with the above regulations and if any component exceeds an agreed tolerance (as set out in the NEA) the DFO supervisory control system must cease flow of gas to the grid by closing the Gas to Grid (G2G) valve. If the G2G valve fails to close the ROV must be closed with immediate effect. This can be initiated automatically by the RTU and / or the NGN System Control (NGNSC).

NGNSC will monitor gas quality data for gas being delivered into the gas network and can manually initiate a closure of the ROV.

5.1 Plant Communications

Communication between the DFO supervisory control system and the RTU should be via Modbus RTU over RS485 (ANSI/TIA/EIA-485-A-1998) or by conventional analogue / digital signals as detailed Appendix H – RTU Specification.

Communication circuits between DFO supervisory control system and the RTU should be electrically isolated either at port level or inline devices.

The communication circuit between control systems should be monitored by a watchdog circuit that should be configurable for its timeout duration. An alarm must be set on activation.

5.2 RTU Control Philosophy

When the RTU system starts up, communications should be established between the DFO supervisory control system before any control actions are initially taken.

Alarm limits for all signals should be configurable to be set outside of signal ranges to inhibit alarm action for that particular signal, i.e. during maintenance activity. The access to the configuration must be password protected and must only be accessible to NGN staff.

All trip set points must be set to not exceed the requirement of the GS(M)R and or NEA. The NEA may have more stringent requirements as a result of network safety.

All limits and timeout values must be configurable at site by NGN personnel via the Human Machine Interface (HMI).

Parameters identified in the I/O (See Appendix I) schedule must be continuously monitored within the NGN RTU and should any parameter exceed programmable high or low limits (outlined within NEA) alarms will be raised at the NGNSC and control actions taken in accordance with agreed alarm responses.

Any alarms or process variable deviation outside of configurable limits which has not resulted in closure of the DFO G2G valve must result in an automated ROV closure. Should any latched alarm be present and the G2G valve is moved from the closed position the NGN ROV must be immediately automatically closed.

Following receipt of any latched alarms to NGNSC, the DFO must provide Root Cause Analysis (RCA) and details of actions taken to mitigate and rectify the failure, prior to any latched alarm being reset by NGNSC and the ROV reopened. If the NGNSC Engineer is not happy with the RCA or this is a repeat alarm condition NGNSC will raise a Next Working Day (NWD) fault for E&I to attend site to investigate the cause.

6 PROCESS AND MECHANICAL EQUIPMENT REQUIREMENTS

6.1 Pressure Regulation and Control System

Pressure regulation and control must comply with IGEM/TD/13. GEM/TD/3, or IGEM/TD/17 depending upon operating pressure. Pipelines must comply with IGEM/TD/1

Note: The design of equipment to be adopted by NGN must comply with NGN's specifications and follow its G17 procedure.

Pressure regulation and control systems are required to control pressure at the point of injection into the gas distribution network. As gas demand in the network increases and pressure in the distribution network falls, the pressure regulation and control system must open the regulator to admit more bio methane. It is anticipated that the network demand will generally exceed bio methane flow and pressures in the distribution network will be so as to permit bio methane flow up to 100% of the agreed daily flow rate.

The maximum flow rate of bio methane must be controlled by assets upstream of the BNEF and not by the BNEF pressure regulation and control system.

6.2 Gas Sampling and Analysis

Gas sampling and analysis must monitor bio methane being injected and provide confirmation that it is compliant with the requirements of Part 1 of Schedule 3 of the GS(M)R and as is specified in NGN document NGN/PM/GQ/8. A schedule of typical parameters that should be monitored is given in the table in Appendix C.

6.2.1 Calorific value

Calorific value must be determined using an instrument approved by Ofgem for determination of calorific values for the purposes of calculating the number of kilowatt hours, under Section 12 of the Gas Act 1986. The instrument must comply with the requirements listed in an appropriate Letter of Approval from Ofgem.

Note: to maintain reliable operation of the FWACV instrumentation, experience has shown that the FWACV instrumentation must remain pressurised / running at all times. The DNO should consider how this can be achieved when the production facility is shutdown.

A facility must be provided to permit representative spot samples of bio methane for laboratory analysis to be safely taken.

The Ofgem approved instrument for determination of calorific values will be subject to onsite performance evaluation test to BS EN ISO 10723 before the letter of direction can be issued by Ofgem.

6.2.2 Water Dew Point

Water dew point sensors must be installed in their calibrated range – this is currently 1 bar atm. No sensors are officially calibrated at any other pressure.
The DNVGL equation of state must be used for calculating water dew point temperature.
The water dew point limit is -10 degrees Celsius at MOP.

6.3 Remotely Operated Valve (ROV)

The ROV must be capable of manual, remote and automatic closure in the event of variation in bio methane outside of the agreed conditions given in of the table in Appendix C, and /or failure of odorisation. The closure action must not exceed 15 seconds.

The means of actuation for the ROV must be either compressed air from the DFO or downstream network gas, this decision will be made by NGN at the detailed design stage. Operation of the ROV must be fully in the control of NGN. The ROV will fail closed, if the DFO fails to provide the supply air.
ROV actuation solenoid is controlled from the NGN instrument 24v supply
The remotely operable valve must have upstream and downstream isolation valves installed, and NGN do not allow the installation of any by-pass mechanism

The ROV valve, Actuator and associated isolations valves must comply with NGN specifications detailed in Appendix A.

The design of equipment (valves & pipework) to be adopted by NGN must comply with NGN's specifications and following NGN/PM/G/17, Management Procedure for the Management of New Works, Modifications and Repairs incorporating commissioning, operational and asset acceptance.

6.4 Metering System Requirements

Metering systems must be designed in according to the principles of IGEM/GM/8 – Part 1. Gas flow metering installation on each production stream must include at least a single metering stream, the meter(s) must be sized to meet 100% duty for the BNEF, utilising a flow meter with pressure and temperature correction, inputting to a suitable Mass Flow Computer for fiscal measurement.

The meter must be supplied flow calibrated by a United Kingdom Accreditation Service (UKAS) approved testing facility with a calibration certificate completed on natural gas at working pressures.

The meter must be calibrated on natural gas at a minimum of 6 flow points over the flow range, with a minimum of 5 repeats at each point in accordance with ISO 9951. Additional calibration points should be considered to cover the low flow region of the meter. The resulting calibration curve should be programmed into the stream flow computer to allow the computer to linearise the meter calibration curve. The DFO should consider the benefits of having a spare calibrated meter available.

The flow meter and the associated metering system must have a combined uncertainty of less than +/- 1% of volume measurement over the specified range, and less than +/- 1.1% of energy measurement over the specified range unless stated otherwise. Refer to Appendix E.

The BNEF designer must ensure that the metering system design achieves the required uncertainty limits stated in this document, including Maximum Permitted Bias and Error (MPB, MPE).

The BNEF designer should insure that the required straight lengths upstream and downstream of the chosen meter meet the metering uncertainty specified. See IGEM/GM/8.

Whatever solution is chosen, instantaneous volume and energy flow and integrated daily volume must be available for acquisition by the Flow Weighted Average Calorific Value (FWACV) system.
An instantaneous volume flow signal (4-20 mA) will be required for odorant Injection system to enable delivery of odorant at the required rate by volume.

The metering installations and their associated systems on commissioning require certification confirming overall metering uncertainty carried out by an appropriate UKAS accredited body.
Please note that the supply and co-ordination of the above is the responsibility of the DFO.

6.5 Odorant Injection

The odorant injection system must be designed in accordance with the principles of IGEM/SR/16, with appropriate allowance for the small-scale operation of the BNEF. NGN require one single LGT (odorant line with joints only allowed at connections to each end, No mid-point connections are allowed. The odorant injection system must inject odorant in order to achieve under normal circumstances an odorant concentration between 5 mg/m^3 and 9 mg/m^3 (see note below) in the bio methane exiting the BNEF. (See Appendix F)

In some circumstances variation from this concentration may be required in order to achieve satisfactory odour intensity within the local gas distribution network so the system must be designed to achieve odorant concentrations over the range 2-16 mg/m3.
Three options for odorant are available depending upon the required concentration and daily volume of bio methane injected: -

a. Odorant NB - 80 wt% (± 2 wt %) TBM, 20 wt% (±2 wt %) DMS.
b. Diluted odorant - Odorant NB 34 wt% (±2 wt %), hexane 66 wt% (±2wt %).
c. Diluted odorant - Odorant NB 8 wt% (±2 wt %), hexane 92 wt% (±2wt %).

The odorant injection system must employ a suitable liquid pump, evaporative wick odorisers must not be used on gas distribution networks operated by NGN.

The odorant pump controller must accept a signal from the metering system corresponding to the instantaneous volume flow rate of bio methane at reference condition and calculate and control the required odorant injection rate to achieve the required odorant concentration.

The odorant tank at site must be suitable for containing liquid odorant and be either a static tank refill by road tanker or container capable of being transported to facilitate for re-filling by the appropriate service provider.

Failure of the LGT equipment to correctly odorise the gas stream will result in the closure of the ROV. The odorant supply must be designed for around 6 months continuous site use at an odorant concentration of 8 mg/m3 at maximum design flow rate and must consider how the replacement tank is put into operation.

A primary odour assessment test point suitable for use by trained rhinologists must be installed downstream of the odorant injection point at a location agreed with NGN.

6.6 Building Construction

The following are general guidelines but each construction site must be assessed to identify and address specific site construction, safety and security measures.

The building must ensure all site security arrangements are in accordance with TD13; and be designed on a site specific basis. The design is to be submitted to NGN for approval.

Compartments within the building, housing NGN equipment, must be subject to access control restrictions; doors must have an intruder alarm connected to the telemetry system.

Internal dividing walls must be sealed (gas tight) so that hazardous area zoning is maintained (specifically safe areas are not compromised). Any ventilation to a compartment must be directly to the outside of the kiosk and not to another kiosk compartment. This applies also to forced ventilation.

DFO must provide suitable housing for the calibration gases bottles and the gas analyser equipment. Subject to any supplier recommendations, as a minimum, this housing must achieve the same environmental requirements as the telemetry system. Additionally, the design of this building must achieve safe and unobstructed movement of the calibration bottles into and around the building.

The design and construction of the building(s) must follow all appropriate building regulations and codes.

7 INSTRUMENTATION AND CONTROL REQUIREMENTS

7.1 NGN Remote Telemetry Unit

The RTU is required to provide all signals (as outlined in the I/O schedule) to and from the DFO supervisory control system. NGN have a requirement to provide gas quality and flow information to National Grid.

In the event of a communications fault between DFO and RTU or RTU and NGNSC then actions must be taken stop injection of gas to grid. The time limits and operating logic are defined in the ***'Bio Methane ISaGRAF Logic'*** document (Appendix H).

The internal logic must be designed to ensure safety integrity is maintained on single failure of electronic parts. On start-up the system must establish a safe position (i.e. ROV shut) and will await an unlatch command from NGNSC before performing any control actions.

The RTU acts as a retransmission unit to telemeter signals from the DFO and BNEF facilities to NGNSC. It controls the operation of the ROV, resets the ROV trip condition and conveys the Target FWACV to the DFO Supervisory Control system.
NGN manually input odorant levels to the equipment controller.
The RTU utilised for Bio methane to grid systems should conform to the requirements of Appendix H.

The RTU is required to provide all signals (as outlined in the I/O schedule) to and from the DFO supervisory control system and communicate these, via satellite, to the NGNSC.
The front panel of the interface is to be fitted with the RTU Human Machine Interface (HMI) screen, showing the graphical layout of the process with indication of valve position, trip conditions and Local/Remote control indication.

The ROV must be operated from NGNSC via the RTU interface. An on-site local control must be installed to allow NGN E&I technician to have site control.

Following receipt of any latched alarms to NGNSC (which will result in ROV closure), the DFO must provide Root Cause Analysis (RCA) and details of actions taken to mitigate and rectify the failure, prior to any latched alarm being reset by NGNSC and the ROV reopened. If the NGNSC Engineer is not happy with the RCA or this is a repeat alarm condition NGNSC will raise a NWD fault for E&I to attend site to investigate cause.

7.2 Gas to Grid valve

The G2G valve will be controlled exclusively by the DFO supervisory system and is the primary device to ensure out of specification gas does not enter the NGN network.

Bio methane Network Entry Facility

The BNEF contains instrumentation systems associated in determining conformance with the Gas Safety Management Regulations (GS(M)R) and the Gas Calculation of Thermal Energy Regulations (GCOTER).

Bio methane delivery pressure and temperature measurements will be made within the BNEF.
Instrumentation systems associated with verifying compliance with the GS(M)R should have an alarm indicating a healthy system. Where discrete instrumentation systems are utilised a common alarm should be amalgamated from the individual instrumentation elements. This alarm should be associated with the [Gas Quality system fail] flag.

7.3 Northern Gas Networks System Control

A Target CV value will be sent from NGNSC to the DFO control system via the RTU at a frequency agreed in the NEA. Along with contractual agreements this will be used as the basis for the set points to which the DFO is to control their system.

NGNSC will have the ability to close and open the ROV. Whilst this ability is provided there may be times in which an NGN onsite presence is required to perform or witness operations before the ROV is opened.

Should a fault develop with the odorant injection system the DFO will cease gas to grid flow until the system is functioning correctly. Should the G2G valve not be closed NGNSC must close the ROV. NGNSC will not request the DFO to cease injection as G2G valve should close automatically.
If ROV is actuated either by RTU or NGNSC the DFO must supply RCA as their plant operation is suspect and NGN have had to safeguard the network. In this event a TFA will be issued and E&I technician to attend site NWD and RCA sent to Network Integrity.

7.4 Flow Weighted Average CV (FWACV)

The DFO system must deliver the functionality required for the FWACV regime, namely requirements set out in the Gas (COTE) Regulations and the conditions specified by both the Ofgem Letter of Direction for the BNEF and the Ofgem Letter of Approval for the chosen CV determination device. Conditions currently specified include the following: -

a. Acquisition and storage of gross CV from the approved CV determination device, together with a flag indicating its quality/suitability for use. For non-continual CV determination devices, the System - CV determination device interface must be such that only one value of each CV determination is acquired.
b. Acquisition and storage of instantaneous volumetric flow rate at the time of acquisition of gross CV.
c. Initiation of daily calibration of CV determination device.
d. Automated tests of apparatus and equipment at periods not exceeding 35 days in accordance with Regulation 6(e) of the Gas (COTE) Regulations. The facility to initiate manual tests of apparatus and equipment either by, or at the request of, the Gas Examiner. Provision of report as the result of automated or manual tests must be in accordance with Regulation 6(e) of the Gas (COTE) Regulations.
e. Calculation of the daily average CV at the end of each Gas Day in the manner specified by the Letter of Direction. This will require confirmation of the quality of individual records (records are Good if the CV determination device is operating within agreed limits) and averaging of only those records that are good and for which gas is flowing past the sample point. In addition a flag must be stored indicating whether the resulting daily average CV is valid (i.e. the maximum time between Good records is less than 8 hours). Gross CV values during calibration or tests of apparatus and equipment must not be included for averaging.
f. Acquisition and storage of integrated daily volume at the end of the Gas Day.
g. In addition to local storage of individual data acquired, appropriate means of secure transfer of data to the HPMIS owned and operated by NGN. HPMIS currently accepts data as CSV files with appropriate check sum to ensure corrupted data is identifiable and not accepted.

A list of files and file structure is provided in Appendix K

FWACV functionality may vary if alternatives to the CV determination devices currently approved by Ofgem become available. Appendix D lists approved Ofgem devices and Software.

Any software and hardware solutions are acceptable provided they deliver the required FWACV functionality, NGN will require demonstration that the required functionality has been delivered. In addition, Ofgem will require testing and approval of any non-approved software and hardware use in the design of the BNEF, by their service provider prior the letter of Approval being issued.

7.5 Telemetry Equipment

The telemetry & control equipment must be housed within a safe area and be sealed from the other building compartments which will contain potential source of gas release.

The telemetry system must use an NGN approved outstation and should be agreed with NGN

with associated HMI. All data should be collected over a number of Modbus/TCP communications link from various sources including but not limit to following: DFO Supervisory PLC, and the FWACV Microbox computer and odorant equipment.

Analogue data from the Supervisory PLC to telemetry outstation must be Institute of Electrical and Electronic Engineers (IEEE) single precision floating point format. Analogue data to remote operations must be 15 bit integer with 0-100% ranged as 5461.27306 (This gives an effective analogue loop range from 0 to 24mA for an integer in the range 0.32767). The Modbus address ranges to be used are as follows:

- Analogue inputs commencing at 30001
- Counters (Analogue Inputs) 31001
- Analogue outputs commencing 40001
- Digital inputs commencing 10001
- Digital Outputs commence at address 1 based on their digital input address
- Double-bit digitals must start on an odd bit address e.g. 10001, 10003 etc.

An example of generic telemetry schedule is listed in Appendix J

A site specific telemetry schedule must be agreed with NGN.

7.6 Communication Interfaces

All communication interfaces must be tolerant of disconnection, and must automatically recover without operator intervention. The following protocols between BNEF modules and NGN modules are permitted.

- TCPMODBUS/TCP
- Modbus/TCP interfaces must support the default port 502 and ‘keep alive’ messages.
- MODBUS ASC11

The preferred settings are: -

- 9600,8,N,1
- 9600,7,E,1

For the MODBUS RTU the preferred setting is 9600, 8, N, 1

7.7 Serial Connections

- Connections between assets under different ownership must be galvanically isolated.
- Connections between different buildings must consider appropriate surge protection.
- Connections exceeding 10m in length must be RS485 or RS422.
- Should use screened cable, with the screen connected at one end only.
- RS485 /422 circuits must use twisted pair cable.

7.8 Ethernet Connections

Ethernet connections between assets under different ownership must implement appropriate additional security measures to prevent the propagation of a security breach for example:
A dedicated or operating system based firewall.

- Control over open TCP ports and protocols.
- Bandwidth management (to mitigate a denial of service attack).

Ethernet connections using copper wiring between separate buildings must: -

- Not exceed 90m.
- Utilise appropriate surge protection.
- Be suitably protected using conduit or cable armour.

Ethernet connections exceeding 90m must either: -

- Use fibre-optic technology, or
- Use Ethernet extending equipment - e.g. DSL over twisted pair.

7.9 Hardwired Interfaces

Any hardwired interconnections between differently owned assets must: -

- Be surge protected.
- Analogue signals must use 4-20mA and be galvanically isolated 4-20mA.
- Digital signals must be galvanically isolated e.g. volt-free contacts.

7.10 Communication Equipment

The Telemetry RTU will communicate with NGNSC via the satellite communication VSAT network, with backup provided by ISDN line and GPRS or suitable alternative(s) agreed with NGN.
.

7.10.1 Router

The NGN approved type router will provide the link and control between the DFO FWACV network, the ISDN line (or agreed alternative) and NGN Telemetry Network. This unit must be suitably mounted within the NGN secured area.

7.10.2 Satellite IDU

The NGN approved type satellite indoor unit (IDU) must be suitably mounted within the NGN secured area.

7.10.3 Satellite Dish

As necessary an NGN approved supplier and installer of satellite equipment will be required to carry out a site survey, to establish an appropriate mounting point for the satellite equipment.
The location of the mounting point will be agreed as part of the detail design approval. The mounting point can be floor or wall mounted, both must be reinforced to withstand the wind loading on the dish. A suitable cable entry point (IP67 to BS EN 60529) must be included for the satellite cables. Lightning protection must be considered in the detailed design and the satellite must be earthed as required by NGN policy.

7.10.4 GPRS Antenna

To enable the GPRS backup communications an antenna must be externally mounted on the GEU housing and the cable routed to the RTU enclosure for direct connection to the DB1 unit. The antenna must provide a minimum 1dB gain and have a Standard Male SMA connector**.**

7.10.5 Ethernet

The Ethernet hub must allow all units connected to the network to communicate with each other and exchange data allowing the operation of NGN Supervisory Control and Data Acquisition (SCADA).

7.10.6 Electrical

When carrying out the design of an installation, designer should take into account the considerations and requirements for designing equipment systems to facilitate maintenance i.e. physical access.

The operational manual must include a description of how the system as installed is to operate and all commissioning records. The manual should also include manufacturers' technical data for all items of switchgear, luminaires, accessories, etc. and any special instructions that may be needed.

Electric shock treatment guide poster must be displayed in the NGN switch room.

It will be the responsibility of the Designer of the BNEF to establish the supply characteristics, form of earthing, fault levels, grading, load requirements as defined in the BS 7671 by liaison with the electrical supplier. These characteristics should be available for all sources of supply.

Preference should be given to the use of a Schneider distribution board (MCB) and constructed in such a manner that circuits can be added or removed without having to isolate the board i.e. isobars.

Designer must incorporate a time delayed residual current device (RCD) at the origin of NGN distribution board.

Designer must incorporate double pole isolation at the origin of NGN distribution board i.e. lockable isolators.

The use of galvanic isolator barriers are the preferred option, they should be designed to comply with the construction requirements of IEC 60079-11, reducing the need for the installation of the 1:1 ratio isolating transformer.

Preference should be given to the use of a socket outlet incorporating a residual current device (SRCD) to BS 7288-1990 for fixed installations.

On a TT system every final circuit must be controlled by a double-pole MCB to allow electrical work to be carried out safely.

TN-C-S (PME) earthing arrangements must not be utilised as a form of earthing due to the risk of circulating currents in the gas installation under earth fault conditions. It is anticipated that the BNEF System will be connected to the TN-S or TT system.

The site earth system must be designed in accordance with NGN/SP/EL/13.

Where the generator is used for temporary or standby generation to supply power, it is a requirement that the system is designed and installed in accordance with NGN/SP/EL/11. It is recommended that protection is verified, with regard to prospective short-circuit and prospective earth fault current. If the generator is relatively small it is likely that its impedance will be much higher than the mains loop impedance. This would have an effect on the disconnection times of protective devices and on the adiabatic effects of fault currents. These also need to be verified to ensure safe operation of the system under fault conditions.

Lightning strike risk calculations must be completed to determine if lightning protection is required for the building including radio antenna etc. This must be in accordance with BS EN 62305 Part 2 & guidance from NGN/SP/EL/13.

The designer should be aware that the electrical equipment installed in hazardous areas should comply with ATEX Directives 94/9/EC (ATEX 95) and 99/92/EC (ATEX 137).

Every final circuit supplying power to hazardous area equipment must be controlled by a double-pole MCB & protected by a 30mA double pole residual current device.

Adopted NGN cable and equipment must be designed in accordance with NGN/SP/EL/23.
Following the initial verification of a new installation or changes to an existing installation, an Electrical Installation Certificate, together with a schedule of inspections, and a schedule of test results, is required to be given to NGN to satisfy criteria within Part 6 of BS7671 and IET Guidance Note No.3. They should be supplemented by further requirements specified in the relevant contract documents.

Electrical systems and equipment must be inspected in accordance with BS EN 60079 part 14 and BS EN 60079 part 17.

Earth loop impedance tests can only be carried out while sites are in a gas free state. Where loop impedance values are required for electrical installations on sites that are operational separate values of Ze, R1 and R2 should be summed to give Zs. Ze is measured using an earth fault loop impedance tester at the origin of the installation with the main switch open. The means of earthing must be disconnected from the installation earthed equipotential bonding for the duration of the test to remove parallel paths. It is the responsibility for the Delivery Facility Operator (DFO) to provide NGN with the Ze value and necessary information needed on an annual basis to provide a foundation

for a complete inspection and testing regime. This will also allow NGN to compare the results with relevant design criteria and satisfy criteria within BS7671.

NGN specification specifies the graphical symbols to be used for representation of electrical, electronic, and telecommunication records associated with NGN plant should be in accordance with NGN/SP/CD0/1 Part2.

NGN as built drawings must use the ISO standards and NGN drawing borders, these should be requested from NGN. The management of engineering drawings records must be in accordance with NGN/PM/RE/3.

Electrical records associated with NGN plant must be in accordance with NGN/PM/RE/9.

8 OWNERSHIP AND RESPONSIBILITIES

Assets associated with the BNEF owned and operated by the DFO are those that carry out the following functions: -

a) Pressure reduction and control.
b) G2G valve.
c) Gas analysis for compliance monitoring.
d) Metering.
e) FWACV system.
f) Supervisory & control system.
g) UPS & battery chargers.
h) Site electrical systems.
i) BNEF buildings and perimeter security
j) Compression systems (where applicable)

Note: With the exception of the G2G valve NGN may still own or operate some or all of these assets.
Assets associated with the BNEF which are owned and operated exclusively by NGN are limited to those that carry out the following functions: -

a) Remote Operated Valve.
b) Remote Telemetry unit
c) Satellite / Radio Communication System.
d) High Pressure Metering Information System (HPMIS) Data Router
e) HPMIS, ISDN Data circuits
f) Primary odour assessment test point.
g) Odorant injection equipment
h) UPS & battery charger

A block diagram of the BNEF is set out in Figure 1.0 (Page 2). Note that the block diagram is intended to show asset groups and not the physical layout of equipment or devices associated with a particular functional block. In particular: the location of the ROV; the location of compression; and the location of LPG enrichment with respect to the G2G may vary, depending on the requirements of NGN and arrangements agreed between the DFO and NGN.

For the purposes of this specification it is assumed that the primary responsibility for operation and maintenance of any asset rests with the asset owner, although it is recognized that commercial arrangements may be put into place with third parties to delegate operation and maintenance.

Any delegation of operation and maintenance of any BNEF asset must be communicated to and approved by NGN. DFO and NGN need to confirm the approvals process on this

9 APPROVAL, TESTING AND COMMISSIONING

9.1 Design Approval

9.1.1 Assets Owned by Northern Gas Networks

Design appraisal and approval for all assets owned by NGN must be managed in accordance with Management Procedure NGN/PM/G/17. If a valid design appraisal (i.e. approved NGN/PM/G/17) for a Minimum Connection BNEF is available then a generic design approval under Management Procedure NGN/PM/G/19 could be acceptable.

9.1.2 Assets Not Owned by Northern Gas Networks

Assets owned by the DFO must be managed in accordance with IGEM/GL/5. NGN must have the opportunity to review and comment on the design of all assets owned by the DFO. Whilst the BNEF is a DFO owned asset, the responsibility for GS(M)R compliance cannot be delegated (IGEM/TD/16: Appendix 3).

For all installations operating at 2 bar and above, a copy of a certified Written Scheme of Examination must be provided to NGN along with all PSSR records and inspections for information only.

9.2 Testing

All personnel carrying out Testing must be competent and adequately trained to do so.

9.2.1 Assets Owned by Northern Gas Networks

Electrical and instrument systems and equipment must be carried out in accordance with BS 7671 and BS EN 60079 part 14.

Pressure testing of all pressure containing components and systems must be carried out in accordance with Work Instruction NGN/WI/PT/1.

All Factory and Site Acceptance Testing must be carried out against written procedures in accordance with NGN/PM/EL/4, which must be agreed and approved with all parties prior to Testing taking place and must take into account all the relevant design documentation and standards.

All testing must be evidenced as detailed in the NGN/PM/G/17 procedure.

9.2.2 Assets Not Owned by Northern Gas Networks

Testing of electrical and instrument systems and equipment must be carried out in accordance with BS 7671 and BS EN 60079 part 14.

All pressure containing components and systems must be pressure tested in accordance with IGEM procedures and declared safe to commission by the DFO.

Whilst the BNEF is a DFO owned asset, the responsibility for GS(M)R compliance cannot be delegated (IGEM/TD/16:Draft Appendix 3), therefore NGN must have the opportunity to review and approve the testing procedures of all DFO owned assets and be included in all Factory and Site Acceptance Testing owned by the DFO. This review must include any PSSR inspection reports on the outlet over-pressure protection device.

9.3 Site Commissioning

It is essential that the DFO has completed all the necessary paperwork and certification to be checked and included as part of the NGN Validation procedure. Particular attention should be paid to the requirements detailed for the FWACV and Letter of Direction (Ofgem), Design Pack appraisal and reviews, Material and Test Certification, Maintenance Manuals, Site Specific access, stakeholder management plan and peculiarities and any other requirement to comply with Legislation and NGN requirements.

All personnel carrying out commissioning and initial validation must be competent in the appropriate discipline and adequately trained to do so.
A written pre commissioning / commissioning Non Routine Operation (NRO) procedure must be used for all activities. This must be developed in compliance with NGN/PM/SCO/4. Particular attention to

timescales for the submission of documentation is essential. Initial metering validation must be carried out in order to demonstrate the accuracy of the measurement system along with ISO 10723 check, demonstrating accuracy of CV measurement equipment.

Suitable systems, software or procedures must be provided or agreed to ensure that compliance can be demonstrated.

9.3.1 Assets Owned by Northern Gas Networks

Following completion of pre- commissioning the telemetry system and Remote Operated Valve system must be commissioned in accordance with the relevant parts of the commissioning NRO.

9.3.2 Assets Not Owned by Northern Gas Networks

Following completion of pre- commissioning and initial validation checks of the flow and gas quality measurement system. The system must be commissioned in accordance with the relevant parts of T/PR/ME/2. The CV analyser will need performance evaluations carried out at agreed intervals. The DFO is required to specify the gas quality procedures they employ, which must be compliant with NGN/PR/GQ/3.

9.4 Documentation

This section details the documentation, which is required from the DFO for the BNEF.

- *IGEM/GL/5 & NGN/PM/G/17 Design Packs*

The designer must provide a suitable design package to meet the requirements of the scope of works in accordance with NGN document NGN/PM/G/17 for NGN owned assets and for DFO owned asset, Institution of Gas Engineers & Managers document IGEM/GL/5. The milestones within the design pack process (e.g. design package available for appraisal) must be shown on the project programme and updated during the project progress meetings.
Successful completion of the IGEM/GL/5 and NGN/PM/G/17 processes will ensure all required documentation has been provided, assessed and approved (for example completion through to Part F of G17).

The design packs as outlined in NGN/PM/RE/9 must contain the project drawings, design calculations, final software program with comments and manufactures data sheet. The DFO designer must arrange for approval and full appraisal of the design packs including Health and Safety file.

9.5 Training and Maintenance Manual

All training and associated training material must be provided to NGN for adopted equipment before site commissioning.
All equipment maintenance and hardware manuals must be supplied before site commissioning.
Maintenance and test frequencies should be agreed and documented before site commissioning

9.6 Submissions Requirements and Timelines

9.6.1 NGN/PM/G/17: New Works, Modifications and Repairs Management

Note: All submissions must be in <u>HARDCOPY</u> form along with electronic copy.

- **Part A: Initiation and Appendix 1: Modification Risk Assessment Form RA1**
  Required on the commencement of project and agreement of gas to grid date

- **Part B: Design Approval / Appraisal Stage**
  This is required not later than 35 working days prior to the agreed gas to grid date.

- **Part C: User Acceptance**
  NGN will issue a response to submission of the Part B within 10 working days on receipt of the Part B. Part C will only receive approval on submission of a compliant Part B. *Note: A number of iterations of this process may be required to achieve approval.*

- **Part D: Installation Completion**
  This is required not later than 10 working days prior to the agreed gas to grid date. Part D will only receive approval on submission of compliant Part D records. *Note: A number of iterations of this process may be required to achieve approval.*

- **Part E(1 & 2): Commissioning Completion**
  This is required not later than 10 working days following completion of site commissioning.

- **Part F: Records completion**
  This is required not later than 30 working days following completion of site commissioning.

9.6.2 Pipeline Safety Regulations (PSR)

For pipelines operating at 7bar or above Major Accident Hazard Pipelines (MAHP), notification under

- Regulation 20, twelve months' notice is required prior to the construction of such pipeline and
- Regulation 21 fourteen days' notice prior to bringing pipeline into use

Notifications are undertaken by NGN following receipt of information relating to the pipeline construction and routing.

APPENDIX A Standards and Regulations

Statutes and Regulations

Gas Act 1986

Statutory Instrument 2002 No. 2776		The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR).
	Implementing:	European Parliament Directive 99/92/EC 1999 (ATEX 137)
Statutory Instrument 1996 No. 192		The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations.
	Implementing:	European Parliament Directive 94/9/EC 1994 (ATEX 100a & ATEX 95)
Statutory Instrument 1996 No. 551		Gas Safety (Management) Regulations 1996
Statutory Instrument 1996 No 439		Gas (Calculation of Thermal Energy) Regulations 1996
Statutory Instrument 1997 No 937		Gas (Calculation of Thermal Energy) (Amendment) Regulations 1997
Statutory Instrument 1997 No 3130		Gas (Calculation of Thermal Energy) (Amendment) Regulations 2002

European Standards

BS EN 60079	Explosive atmospheres: -
Part 0	Equipment General Requirements
Part 10-1	Classification of hazardous areas explosive gas atmosphere
Part 11	Equipment protection by Intrinsic Safety "i"
Part 14	Electrical installations design, selection and erection
Part 17	Electrical installations inspection and maintenance.
BS EN 60529	Degree of protection provided by enclosures (IP code).
BS EN 62305	Protection against lighting.
Part 1	General principles.
Part 2	Protection against lighting. Risk management.
Part 3	Protection against lighting. Physical damage to structures and life hazard.
Part 4	Protection against lighting. Electrical and electronic systems within structures
BS EN 61508	Functional safety of electrical/ electronic/ programmable electronic safety-related systems.
BS EN 61511	Functional safety. Safety instrumented systems for the process industry sector.
BS EN ISO 10723	Natural Gas – Performance Evaluation for On-line Analytical Systems.

British Standards

BS 7671	Requirements for electrical installations (The IET Wiring Regulations).
BS 7288	Specification for socket outlets incorporating residual current devices.

Institution of Gas Engineers and Managers

IGEM/GL/5	Procedures for managing new works, modifications, and repairs.
IGEM/GM/8	Non-domestic meters installations. Flow rate exceeding 6 m3/hr. and inlet pressure not exceeding 38 bar
IGEM/TD/1	Steel pipelines and associated installations for high pressure gas transmission.
IGEM/TD/3	Steel and PE pipelines for gas distribution.
IGEM/TD/13	Pressure regulating Installations for natural gas, liquefied petroleum gas, and liquefied petroleum gas/air.
IGEM/TD/16	Bio methane injection.
IGEM/TD/17	Steel and PE Pipelines for Biogas Distribution
IGEM/SR/16	Odorant systems for gas transmission and distribution.

NGN Documents

NGN/PM/G/17	Management Procedure for the Management of New Works, Modifications and Repairs incorporating commissioning, operational and asset acceptance.
NGN/PM/G/19	Management Procedure for Application of Model Design Appraisals
NGN/PM/GQ/8	Management Procedure for Assessing the Requirement for Gas Quality, Calorific Value and Flow Measurement Systems.
NGN/WI/PT/1	Work Instruction for Pressure Testing Pipework, Pipelines, Small Bore Pipework and Above Ground Austenitic Stainless Steel Pipework
NGN/PM/RE9	Management procedure for instrumentation and electrical records associated with NGN plant.
NGN/PM/EL/4	Procedures for inspection and testing of fixed electrical equipment and systems.
NGN/SP/EL/13	Specification for earthing.
NGN/PM/INE/3	Management Procedure for Selection of Telemetry Points to Operate the NGN Gas Supply System.
MAINT 8	Maintenance of local gas treatment equipment
NGN/PM/INS2	Maintaining the Integrity of Instrument Systems and Equipment
NGN/PM/MAINT12	Part 1: Maintenance of instrumentation systems and equipment
NGN/SP/V6: PART 1	Technical specification for steel valves for use with natural gas at normal operating pressures above 7 bar. part 1 - 100 mm nominal size and above
GIS/V7-1 -	Specification for distribution valves Part 1: Metal-bodied line valves for use at pressures up to 16 bar and construction valves for use at pressures up to 7 bar.
NGN/SP/VA/1: PART 1	Specification for fluid powered actuators for two position (open/closed) quarter turn valves part 1 - general
NGN/SP/VA/1: PART	Specification for fluid powered actuators for two position (open/closed) quarter turn valves part 2 - type testing

Other Documents

Joint office of gas transporters T/PR/ME/2	Work Procedure for Validation of Equipment Associated with Measurement Systems for the Calculation of Mass, Volume and Energy Flow rate of Gas.
IET GUIDANCE NOTE 3	Inspection & Testing

NOTE: ***This List Is Non-Exhaustive****, A Full Set of Standards is available to designers by application to the NGN bio-methane team on a project specific basis. Access on a controlled basis will be granted to the project design team. Contact biomethanedoc@northerngas.co.uk.*

APPENDIX B Definitions used in this document

Anaerobic digestion	Biological process in which microorganisms break down organic matter in the absence of oxygen into biogas and digestate.
Biogas	Gas produced by anaerobic digestion of organic matter.
Bio methane	Methane-rich gas produced by upgrading of biogas.
BNEF	Bio methane network entry facility: the facility to facilitate the injection of bio methane into gas distribution systems.
BUP	Biogas upgrading plant.
NGNSC	Northern Gas Networks System Control
CSV	Comma Separated Values.
CV	Calorific Value.
Delivery facility	The facility from which bio methane may be tendered for delivery at the NGN system entry point.
DFO	Delivery facility operator: The operator of the delivery facility.
Directed site	Site at which NGN has been directed by Ofgem to determine calorific value (letter of direction) under regulations 6(a) and 6(b) of the gas (calculation of thermal energy) (amendment) regulations 1997. Note: there may be more than one directed point on an individual site.
FWACV	Flow Weighted Average Calorific Value.
G2G	Gas to grid Valve
Gas(COTE)R	Gas (Calculation of Thermal Energy) Regulations.
GT	Gas Transporter: a body holding a license under section 7 of the gas act 1986 as amended by the gas act 1995 and by the utilities act 2000.
GS(M)R	Gas Safety (Management) Regulations.
HMI	Human / Machine Interface.
HPMIS	High Pressure Metering Information System.
ISDN	Integrated Services Digital Network.
ITE	Independent Technical Experts.
Letter of approval	Ofgem approval for calorific value determination device
LPG	Liquefied Petroleum Gas: Petroleum gas containing principally butane or propane stored and transported as a liquid under pressure.
MPB	Maximum Permitted Bias.
MPE	Maximum Permitted Error.
NAMAS	National Measurement Accreditation Service. Now run by United Kingdom accreditation service (UKAS) as the sole national accreditation body recognised British government to assess the competence of organisations that provide certification, testing, inspection, and calibration services. It evaluates these conformity assessment bodies and then accredits them where they meet the internationally specified standard.
NEA	Network Entry Agreement.
NRO	Non Routine Operation, (Or Non-Routine Procedure).
NWD	Next Working Day
PRI	Pressure Reduction Installation.
ROV	Remote Operated Valve.

SIF	Safety Instrumented Function. Safety function with a specified safety integrity level (SIL) which is necessary to achieve functional safety and which can be either be, a safety instrumented protection function, or a safety instrumented control function.
SIL	Safety Integrity Level Discrete level (one out of four) for specifying the safety integrity requirements of the safety instrumented functions (SIF) to be allocated to the safety instrumented systems (sis).
SIS	Safety Instrumented Systems. Instrumented system used to implement one or more safety instrumented functions (SIF). An SIS is composed of any combination of sensor(s), logic solver(s), and final elements(s).
TFA	Transportation Flow Advice. Issued by NGN when out of specification gas is tendered for delivery by the DFO. It defines the parameter that is out of specification to the DFO and forms part of the NEA. It allows gas control to notify the DFO that the network cannot accept the submitted flow nomination. See the NEA for example forms.
UPS	Uninterruptible Power Supply.

APPENDIX C Absolute GSMR Limits and Action Alarm Trip Set Points

Description	Units	Absolute Range	Uncertainty	Absolute GSMR limits	DFO Action Limit	Set By	NGN Action Limit (Low Low)	NGN Action Limit (Low)	NGN Action Limit (High)	NGN Action Limit (High High)
Wobbe index	MJ/m³	45.0 to 54.0	+/- 0.10	47.20 - 51.41	51.1	GSMR	47.25	47.50	51.20	51.36
Soot index	-	0 to 1.0	+/- 0.02	0.60	0.60	GSMR	-0.10	0.00	0.595	0.60
ICF	-	-3.0 to 2.0	+/- 0.02	0.48	0.48	GSMR	-0.10	0.00	0.465	0.47
H2S	mg/m³	0 to 10.0	+/- 0.10	5.0	5.0	GSMR	-0.10	0.00	4.55	4.60
Total sulphur content #1	mg/m³	0 to 50.0	+/- 0.10	50.0	50.0	GSMR				
Hydrogen (H2)	mol %	0 to 0.10	+/- 0.01	0.1	0.1	GSMR	0.00	0.00	0.08	0.09
O2	mol %	0 to 2.50	+/- 0.01	1.0	1.0	GSMR	0.00	0.00	0.96	0.98
Water dew point	°C	20.0 to -100.0	+/- 2.00	-10 @ MWP	-10 @ MWP	GSMR	-110.00	-100.00	-10.40	-10.50
Hydrocarbon Dew Point #1	°C	20.0 to -100.0	+/- 2.00	-10 @ MWP	-10 @ MWP	GSMR	-110.00	-100.00	-10.40	-10.50
Calorific Value	MJ/m³	35.0 to 44.0	+/- 0.10		≥ Target CV	NEA	36.90	37.60	42.00	42.30
Pressure	Bar	Site Specific	+/- 0.25		TBA	NEA			MOP	MOP + 2.5%
Temperature	°C	0 to 20 Deg C	+/- 1.00		TBA	NEA	0.00	0.50	19.50	20.00
Flow	sm³/hr	TBA	+/- 1%		TBA	NEA	Site specific	Site specific	0.95	1.00
Carbon dioxide	mol %	0 to 7	+/- 0.10		TBA	NEA	0.00	0.20	2.495	2.50
Nitrogen	mol %	10%	+/- 0.10		TBA	NEA	0.00	0.00	4.70	5.00
Odorant Concentration	mg/m³	4 to 9	+/- 0.10		TBA	NEA	2.00	3.00	10.00	12.00

Notes:
GSMR – Gas Safety (Management) Regulations 1996
NEA – Network Entry Agreement
MWP – Max Working Pressure
MOP – Max Operating Pressure

#1 – non-telemetry item and monitored via spot samples

The DFO PLC MUST put the site into DIVERT mode prior to the NGN alarm settings. Failure to do so will result in the closure of the ROV by the NGN RTU and a TFA notification issued by the NGNSC. On closure of ROV DFO must supply a Root Cause Analysis (RCA).

APPENDIX D Approved Hardware & Software Devices

Ofgem Approved Hardware

Manufacturer	Model
Emerson Daniels	500
Emerson Daniels	700
Elster	Encal 3000 / C6+

Ofgem Approved Software

Manufacturer	Version
DNV GL - Danview (for Emerson Daniels 500)	12B
DNV GL - Danview (for Emerson Daniels 700)	12C
DNV GL - Encalview (for Encal C6+)	12D

APPENDIX E Accuracy for Metering

Design Daily Volume	MPB (See note 1)		MPE (See note 2)	
	Daily Volume	Daily Energy	Daily Volume	Daily Energy
Less than 250,000 m3	0.90%	1.0%	2.9%	3.0%
Greater than 250,000 m3	0.09%	0.10%	1.0%	1.1%
Note 1: Compliance with Maximum Permitted Bias (MPB) must be deemed if (mean error <MPB).				
Note 2: Compliance with Maximum Permitted Error (MPE) must be deemed if (mean error + U (mean error) <MPE).				
Note 3: Subject to agreement with Ofgem that the above accuracy requirements are "requisite to the calculation of the daily calorific value" (see regulation 3 of the Gas (COTE) Regulations.				

APPENDIX F Odorisation

The Gas Safety (Management) Regulations 1996 state the following with regard to odorant for natural gas:

> *The gas must have been treated with a suitable stenching agent to ensure that it has a distinctive and characteristic odour which must remain distinctive and characteristic when the gas is mixed with gas which has not been so treated, except that this paragraph should not apply where the gas is at a pressure of above 7 barg.*

In line with this legislation we odorise all gas entering our network whether above or below 7 barg.

Odorant Level

The level of odorant injected into the bio methane is set out in the Network Entry Agreement (NEA) between the Delivery Facility Operator and NGN. The volume of odorant injected is achieved via telemetry linked to the metering system and the LGT unit. The odorant itself consists of a mixture of 78% tertiary butyl mercaptan and 21% dimethyl sulphide. These constituents give gas its distinctive smell.

In order to mitigate low or high levels of odorant injection into the bio methane, alarm signals are incorporated in the gas monitoring and control system linked to our Gas Control Centre.

GQ/8 Process

All Network Entry Points wishing to connect to the Distribution Network will require to undergo a risk assessment workshop on gas quality. This assessment would be completed in line with the GDN's policy / procedure GQ/8, which would ensure any issues with feedstock producing the potential to mask odorant are identified and mitigation measures employed.

APPENDIX G Siloxanes

Siloxanes are used in products such as deodorants and shampoos and can therefore be found in biogas produced from sewage treatment plants and landfill gas. These substances can create problems when burned in gas engines or combustion facilities.

Currently work has commenced under CEN/PC408 for the development of a European standard for bio methane injection into natural gas which will include a limit for siloxanes. This is still under debate, however DNV-KEMA (NL) are undertaking a test programme on stationary engines which will take 2 years to complete. The results, when available, will be considered when agreeing the final standard.

Additionally testing work has been undertaken by DNV-KEMA (NL) on the impact of siloxanes on domestic & non-domestic appliances although it is not clear if these results will be available to the CEN/PC408 project.

No specific allowable level exists within Gas Safety (Management) Regulations (GS(M)R) for siloxanes however it is expected that interims levels will be announced in the near future.

All Network Entry Points wishing to connect to the Distribution Network will be required to undergo a risk assessment workshop on gas quality. This assessment would be completed in line with the GQ 8 Risk Assessment process, which would ensure any issues with feedstock containing siloxanes are identified and mitigation measures employed. This may require the installation of additional activated carbon siloxane filters to remove the possibility of siloxanes entering the gas network.

APPENDIX H RTU Specification

The purpose of this specification is to give system designers, installers and maintainers, the minimum functional requirements for the Remote Telemetry Unit (RTU), instrumentation and associated equipment related to control, protection and operation of NGN operational gas sites receiving bio methane.

This specification should be read in conjunction with any enquiry documents, data sheets, order or contract issued with this document. Any deviation from this document should be agreed with the applicable NGN project manager. Any site specific requirements will be detailed in other documents provided by NGN.

Scope
The scope of this specification covers the requirements for the RTU, instrumentation, equipment and systems, to facilitate a consistent approach to the function, operation interoperability and maintenance requirements. This includes references to other documents covering testing, pre-commissioning, commissioning and routine maintenance. This specification details NGN requirements for the design and installation of control and instrumentation systems and is supplementary to BS 6739 and NGN/SP/S/21. Specification for General Instrumentation (Document being updated)
All NGN operational gas sites receiving gas from bio methane sources along with any remote sites used for gas blending are covered by this specification.

References
NGN/SP/S/21 – Specification for general instrumentation. Document still being updated
BS 6739 - Code of practice for instrumentation in process control systems: installation design and practice.

BS EN 60079-11 - Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i".
ANSI/TIA/EIA-485-A-1998 - Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.

ANSI/TIA/EIA-232-F-1997 - Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

NGN/PM/G/17 - Management Procedure for the Management of New Works, Modifications and Repairs.

9.6.3 Remote Telemetry Unit
The RTU must be the Brightwell DB1 unit complete with a SST PFB/104 Profibus interface card and may accept direct volt free contact and 4 – 20mA inputs/outputs. **Note**: Pepperl & Fuchs LB barrier system is the NGN preferred system.

DB1 firmware version must be agreed with NGN.

Configuration of the RTU should be in accordance with the requirements of the DB1 Installation and Configuration Manual issue (version msut be agreed with NGN)

An RTU at a remote site could use the same P&F LB system as the main site or could use direct inputs. The decision about which depends on what I/O signals the remote site needs to monitor. Using the P&F system ensures the same physical RTU for spares holding.

The DB1 unit should communicate with the Pepper &Fuchs Profibus Interface module LB 8106 via the SST card running firmware version. If newer firmware versions are available the latest version must be installed

9.6.4 Interface Barriers
Digital logic and fail safe conditions must be in accordance with the requirements of NGN/SP/S/21.

Interface barriers to the RTU should be Pepper & Fuchs LB isolated barrier system type. These should be located in a safe area.

System design should meet the requirements of BS EN 60079-11.

The LB communication module used to interface with the DB1 should be the Profibus DP LB8106 running firmware version as a minimum 6.26. LB8106 must use this or later firmware as available

Intrinsically safe LB modules used for interface to remote equipment must be selected from the following:-

LB3105 4 channel analogue barrier.
LB1108 8 channel digital input barrier.
LB5101 1 channel RTD barrier.
LB6110 4 channel digital output barrier.
LB1003 1 channel frequency input barrier
LB4002 1 channel analogue output barrier

Non-intrinsically safe LB modules used for interface to remote equipment must be selected from the following:-

LB3005 4 channel analogue barrier.
LB1008 8 channel digital input barrier.
LB5001 1 channel RTD barrier.
LB6006 4 channel digital output barrier.

9.6.5 Communication to the RTU

Communication between other control systems and the RTU must be via either hardware standards, ANSI/TIA/EIA-485-A-1998 or ANSI/TIA/EIA-232-F-1997.

Communication circuits between other control systems and the RTU should be monitored by a watchdog that must be configurable for timeout duration. An alarm must be set on activation.
Communication circuits between other control systems and the RTU should be electrically isolated either at port level or inline devices.

The protocol must be MODBUS and the Transmission mode must be RTU and conform to the following:-
Support for function codes 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x0f, 0x10

For function codes 0x03 (Read Holding registers) and 0x04 (Read Input Registers), these should be read in IEEE floating point format, where two 16-bit registers are read for each point (32 bit value). The ordering of the 32 bits within these two registers is as follows;

The lower addressed register, bit 0 of the register value is bit 16 of the IEEE FP value, and bit 15 of the register value is bit 31 of the IEEE FP value.

The higher addressed register, bit 0 of the register value is bit 0 of the IEEE FP value, and bit 15 of the register value is bit 15 of the IEEE FP value.

For example, if the point being read has a floating point value of 38.5156 (0x421A1000 in IEEE FP format), the MODBUS response would be: 01, 04, 04, 42, 1A, 10.00

9.6.6 RTU Control Philosophy

The RTU Control Philosophy must be applied in accordance with the following embedded document:

Biomethane Site – ISaGRAF Logic

Bio methane Site – ISaGRAF Logic: Issue 1.0: 29th January 2016

Documentation

Design documentation must be included within the project NGN/PM/G/17 design pack and should state the firmware revisions for all communication components referenced.

APPENDIX I I/O Schedule

Characteristic	Unit	Range	Source		Destination		G2G Close	NGN ROV auto Close
			DFO	RTU	DFO	RTU		
Calorific Value	MJ/m^3	[35 – 44]	X			X	X	
Wobbe Index	MJ/m^3	[45 – 54]	X			X	X	X
Gas Day Average CV	MJ/m^3	[35 – 44]	X			X		
Gas Day Average RD	-	[0.5 - 0.7]	X			X		
Gas Day CV Not Valid	-	[valid / not valid]	X			X		
System 1 Alarm (FWACV System Fault)	-	[healthy / fault]	X			X	X[5]	
Instantaneous standard volume flow rate	MSM^3/day	[0 - X[3]]	X			X		
Instantaneous energy flow rate	GJ/day	[0 - X[3]]	X			X		
Integrated standard volume flow	m^3	[0-999999999]	X			X		
Integrated energy flow	GJ	[0-999999999]	X			X		
DFO delivery Gas Pressure	barg	[0 - X[3]]	X			X	X	X[2]
DFO delivery Gas Temperature	°C	[-10 - +50]	X			X	X	X[2]
Water Dew point	°C	[-60 - +10]	X			X	X	X[2]
Oxygen	Mol%	[0 - 5]	X			X	X	X[2]
Hydrogen Sulphide	mg/m^3	[0 - 6]	X			X	X	X[2]
Hydrogen	Mol%	[0 – 1]	X			X	X	X[2]
Incomplete Combustion factor	-	[-3 - +2]	X			X	X	X[2]
Soot Index	-	[0 - 1]	X			X	X	X[2]
Nitrogen	Mol%	[0 - 10]	X			X	X	X[2]
Carbon Dioxide	Mol%	[0 - 5]	X			X	X	X[2]
Gas Quality system(s) fail alarm[6]	-	[healthy / fault]	X			X	X	X
Meter Suspect alarm	-	[healthy / fault]	X			X	X	
Relative Density	-	[0.5 - 0.7]	X			X		
Target odorant injection rate	mg/m^3	[2 -12]		X	X			
Odorant integrator total	mg	[0-999999999]	X			X		
Odorant injection system fault	-	[healthy / fault]	X			X	X	
Communication watchdog trip (NG-DFO)	-	[healthy / fault]		X		X		X[1]
Target CV value	MJ/m^3	[35 - 44]		X	X			
NGN ROV valve status	-	[open / closed]		X	X			
DFO G2G valve status	-	[open / closed]	X			X		
DFO recycle valve status	-	[open / closed]	X			X		
Permissive flag to inject gas to grid (all alarms clear)	-	[valid / not valid]		X	X		X	
Dew point latched alarm	-	[healthy / fault]		X		X		X[4]
H2S latched alarm	-	[healthy / fault]		X		X		X[4]
ICF latched alarm	-	[healthy / fault]		X		X		X[4]
Pressure latched alarm	-	[healthy / fault]		X		X		X[4]
N2 latched alarm	-	[healthy / fault]		X		X		X[4]
O2 latched alarm	-	[healthy / fault]		X		X		X[4]
Sooting Index latched alarm	-	[healthy / fault]		X		X		X[4]
Temperature latched alarm	-	[healthy / fault]		X		X		X[4]
CO2 latched alarm	-	[healthy / fault]		X		X		X[4]
Wobbe latched alarm	-	[healthy / fault]		X		X		X[4]

Characteristic	Unit	Range	Source		Destination		G2G Close	NGN ROV auto Close
			DFO	RTU	DFO	RTU		
Hydrogen latched alarm	-	[healthy / fault]		X		X		X[4]
Communication watchdog trip (NG – Blend)	-	[healthy / fault]		X	X	X	X[5]	
Blending point CV_2	MJ/m^3	[35 - 44]		X	X	X	X	
Blending point CV_2 not valid	-	[valid / not valid]		X	X	X		
Blending point average CV_2	MJ/m^3	[35 - 44]		X		X		
Blending point system alarm (System2)	-	[healthy / fault]		X	X	X	X[5]	

[1] ROV should shut within 15 seconds.

[2] Shut in line with NEA.

[3] Max site values rounded up.

[4] If configured, ROV valve trips if G2G valve not closed. Reset by Control Centre.

[5] The G2G should be closed within a period of 6 hours.

[6] May be a composite alarm from a number of discrete instrumentation systems.

APPENDIX J Example Telemetry Schedule

Point Name	Modbus	Function	State 0	State 1	State 2	State 3	Low	High	Units	Comments
ROV	00001	CLOSE ROV	NONE	SHUT						
ROV	00002	OPEN ROV REQUEST	NONE	OPEN						
GQ_REJECT GAS	00003	GQ RESET	NONE	RESET						
SS1	10001	DFO SLAM SHUT CLOSED	ALARM	NORMAL						Note for bio methane site that supply HP pipelines this Slam Shut will be on the outlet of the compressor. There will be no telemetered indication from the slam shut in the GEU.
REJECT_V (LOW BIT)	10002	REJECT VALVE POSITION	ERROR	OPEN	CLOSED	TRANSIT				
REJECT_V (HIGH BIT)	10003	REJECT VALVE POSITION	ERROR	OPEN	CLOSED	TRANSIT				
G2G_V (LOW BIT)	10004	GAS TO GRID VALVE	ERROR	OPEN	CLOSED	TRANSIT				
G2G_V (HIGH BIT)	10005	GAS TO GRID VALVE	ERROR	OPEN	CLOSED	TRANSIT				
ROV (LOW BIT)	10006	NGN ROV POSITION	ERROR	OPEN	CLOSED	TRANSIT				
ROV (HIGH BIT)	10007	NGN ROV POSITION	ERROR	OPEN	CLOSED	TRANSIT				
MTCE1	10008	ENGINEER ON SITE	ON	OFF						
INTRUD_ALM1	10009	INTRUDER ALARM NGN ROV	ALARM	NORMAL						
INTRUD_ALM2	10010	INTRUDER ALARM RTU	ALARM	NORMAL						
MTR_SUSP1	10011	METERING HEALTH	ALARM	NORMAL						
MAINS1	10012	MAINS FAIL RTU	ALARM	NORMAL						
MAINS2	10013	MAINS FAIL DFO	ALARM	NORMAL						
LGT_PUMP	10014	LGT SYSTEM COMMON ALARM	ALARM	NORMAL						
LGT_TANK	10015	LGT TANK LOW LEVEL ALARM	ALARM	NORMAL						

SYSTEM1	10016	CALORIMETER FAULT	ALARM	NORMAL						
CV_NOT_VLD	10017	LOSS OF CV (>8HRS)	ALARM	NORMAL						
BARRIER	10018	PROFIBUS I/O FAULT	ALARM	NORMAL						
RTU_BATT	10019	RTU BATTERY FAIL	ALARM	NORMAL						
CHARGER1	10020	RTU CHARGER FAIL	ALARM	NORMAL						
WATCHDOG1	10021	RTU AND PLC LINK	ALARM	NORMAL						
GQ_REJECT_GAS	10022	UNLATCH ROV	ALARM	NORMAL						
LOC_CONT	10023	LOCAL/REMOTE	ALARM	NORMAL						
CTRL_FAIL	10024	CONTROL OF ROV FAILED	ALARM	NORMAL						
OS_STATUS	N/A (DNCS ONLY)	COMMS STATUS								
ICF	30001	INCOMPLETE COMBUSTION FACTOR					-3	2		
SI	30002	SOOTING INDEX					0	1		
See Comments	30003	BNEF OUTLET PRESSURE (to NGN network)					See Comments	See Comments	BAR	BNEF Outlet pressure IP1, MP1 etc.
T1	30004	OUTLET GAS TEMPERATURE					-20	60	DEGC	
F1	30005	EXPORT FLOW RATE							KSCM/D	Needs to be site specific
CV1_AVG	30006	24 HOUR AVERAGE CV					35	44	MJ/M3	
SG1_AVG	30007	24 HOUR AVERAGE SG					0.5	0.7		
WB1	30008	WOBBE INDEX					45	54	MJ/M3	
*SITENAME*_CV1	30009	TARGET CV VALUE TO DFO (ECHO)					35	44	MJ/M3	
CV1	30010	INSTANTANEOUS CV					35	44	MJ/M3	
SG1	30011	INSTANTANEOUS SG					0.5	0.7		
N2	30012	INSTNATANEOUS N2					0	12	MOL%	

CO2	30013	INSTANTANEOUS CO2					0	8	MOL%	
H2O_DEW	30014	DEWPOINT TEMPERATURE					-100	20	DEGC	
O2	30015	OXYGEN CONTENT					0	2	MOL%	
H2S	30016	HYDROGEN SULPHIDE					0	6	MG/M3	
LGT_CONCEN	30017	CALCD CONCENTRATION					0	30	MG/M3	
HP1	30018	INLET PRESSURE					0	16	BAR	
H2	30019	HYDROGEN CONTENT					0	1	MOL%	
INTG1	31001	INTEGRATED VOLUME							M3	
INT_LGT	31003	INTEGRATED LGT VOLUME							MG	
*SITENAME*_CV1	40001	TARGET CV VALUE TO DFO					35	44	MJ/M3	
PLANT_STATUS	N/A (DNCS ONLY)	POTENTIAL GSMR BREACH	ALARM	NORMAL						
Network Pressure	30020	NGN NETWORK PRESSURE					See Comments	See Comments	Bar	E.g. MP, IP, HP. Located NGN side of ROV

APPENDIX K HPMIS Files and File structure

HPMIS is an Oracle database located at a central server and forms the basis by which many of NGN obligations under the Gas (Calculation of Thermal Energy) Regulations can be managed. Data is imported as CSV files with a fixed data structure that must be adhered to if data is to be located correctly into the HPMIS database.

The following sections lists the file naming and format of the CSV files to be returned from the BNEF to the central Server.

HPMIS file name: Hsite.AByymmdd.Y0n.		
This file contains the results of the end of day averaging process and is generated at the end of the Gas Day (currently 05:00, this needs to be a configurable variable). The stream number is indicated by "n".		
Line	**Structure**	**Example**
1	Header comprising the Instrument number and location description followed by the name and version number of the software generating the data. (Under current arrangements the software that performs the averaging process is approved by Ofgem, so software name and version number must be included.)	"Instrument1234 at location: EODAVE v3.7"
2	Time and date of the last record used in the file that contains individual CV data.	"06:02-20/01/2012"
3	Stream number.	3
4	Blank (Intentional).	-
5	Indication if the average CV is valid (Y, N, or X).	Y
6	Number of records used in the averaging process.	98
7	Average CV (rounded to 1 dp using the normal rules of rounding).	38.5
8	Blank? (Average RD).	0.6324
9	Blank? (Number of records used in tracker averaging).	-
10	Blank? (Tracker CV).	-
11	Blank? (Tracker RD).	-
12	Blank? (Attribution flag).	-
13	Blank (Intentional).	-

APPENDIX L Biomethane De-commissioning/Re-commissioning checklist

This checklist is to be utilised if gas to grid has been achieved but the site will not remain operational, i.e. continue to export gas to grid, until site works have been completed. If this is the case there are two scenarios and resulting tasks, listed below, which must be completed to ensure site is left safe and compliant with all relevant NGN policy, procedures and wider sector Regulation.

- **Power off > 8 hours G17 not complete** – Where power to the GEU is turned off for greater than 8 hours the actions set out in the tables below **must** be carried out.
- **Power on G17 not complete** – Where power is maintained on site whilst site works are completed the actions in the tables below **must** be carried out.

The two tables below show the responsibilities/requirements of both NGN and DFO for both instances:

Tasks to be completed by NGN	De-Commissioning/Re-commissioning Scenarios	
	Power Off >8 hours	Power on – G17 not complete
De-commissioning		
F1 monitoring		●
CV monitoring		●
Lock LGT cage/building	●	●
Password Change RTU settings	●	●
Contact Arqiva (NGN)	●	
Letter of direction*	●	●
Spade must be fitted	●	●
Re-commissioning		
Full end to end inspection required	●	●

Tasks to be completed by the DFO	De-Commissioning/Re-commissioning Scenarios	
	Power Off >8 hours G17 not complete	Power on – G17 not complete
De-commissioning		
Contact NGN system control for access	●	●
Proof of person competency for access to LGT	●	●
Odorant daily inspections and reporting	●	
LGT back purge into tank	●	
Isolate LGT injection point	●	
Letter of direction*		
Spade to be fitted at outlet of GEU	●	●
Re-commissioning		
Prime LGT injection lines (min 4 hours)	●	●
Re-assess ME2 conformity	●	
Re-assess ISO10723 conformity	●	
Full end to end inspection required	●	●

*Following Gas to Grid where site will not resume exporting gas within 28 days then, the letter of direction from Ofgem should be suspended to avoid unnecessary audit inspections.

- Any LGT alarm must be properly investigated and a Root Cause Analysis (RCA) report issued before the ROV can reopen
- Until the relevant DFO equipment, as defined in Network Entry Agreement, has been adopted by NGN, any person(s) working on the LGT system must demonstrate appropriate competences to assess any faults or alarms (LEWA course attendance certificate).

ENDNOTE

Comments

Comments and queries regarding the technical content of this safety and engineering document should be directed to:

Standards Team
Northern Gas Networks Limited
7 Camberwell Way
Moorside Park
Sunderland
Tyne & Wear
SR3 3XM

You can also email the Standards Team at Standards@northerngas.co.uk, or call 07966 887288

Buying documents

Contractors and other users external to NGN should direct their requests for further copies of NGN safety and engineering documents to the department or group responsible for the initial issue of their contract documentation.