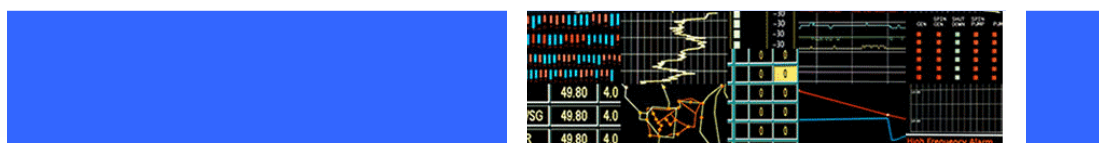


## National Grid Gas (NTS)

Response to Ofgem's Formal  
Information Request on the  
measurement of venting from electric  
drive NTS compressors

Issued 30 December 2008



## 1. Background

On 9 September 2008 the Authority issued a direction modifying special condition C8F of National Grid Gas's (NGG's) gas transporter licence in respect of the NTS to introduce an incentive on NGG in respect of methane emissions from gas compressors. This new incentive being designed to ensure that the environmental costs associated with the venting of methane gas are factored into National Grid's operational decision making processes.

Currently the incentive only applies to gas turbine driven compressors as these sites already have the necessary systems required to calculate amounts of gas vented. This information is a requirement under the Integrated Pollution, Prevention and Control (IPPC) regulations with the volume of methane vented and other emissions being reported annually to the Environment Agency (EA) and the Scottish Environmental Protection Agency (SEPA).

Two existing sites<sup>1</sup> which have electricity driven compressors only are not covered by the IPPC regulations and therefore systems to calculate venting volumes have not been installed on these sites. When the environmental incentive was introduced these sites were excluded from the incentive pending further work to identify if venting could reasonably be measured at these sites and hence be added into the incentive.

On the 24 September 2008, Ofgem issued a formal information request to National Grid which contained two distinct elements. The first related to adding the volume of methane vented from gas driven compressors on a monthly basis (MEV – Monthly emissions performance volume) into the existing monthly data submission to Ofgem. This information has been added to the data submission from September including data from 1 April 2008 and has continued on a monthly basis since. The second part of the information request related to how the incentive could be extended to include emissions from electricity driven compressors. In particular Ofgem asked National Grid to publish a report on:

- details of the steps that NGG would need to undertake in order to measure methane emissions from electrical compressors; including retrospective steps that would be necessary to measure methane emissions from existing compressors;
- an estimate of the costs involved;
- an estimate of the timescales of putting the necessary equipment in place.

The structure of this report is summarised below.

Section 2 describes how the Compressor Operation Advisory System (COAS) installed on gas turbine driven compressors is used to monitor the emissions from these compressors.

Section 3 provides a list of the electric drive compressors that are either already installed or are planned to be installed onto the NTS.

Section 4 provides information on how the COAS system could be used to monitor the venting from electric drive compressors on those sites where COAS is already installed.

Section 5 describes an alternative approach that could be used on sites where there is no operational requirement to install the COAS system.

Section 6 provides a summary of how venting could be monitored at each of the sites.

---

<sup>1</sup> Peterstow and Lockerley

**2. Current process for calculating vent volumes from gas driven compressors**

The gas turbine driven compressor sites each have systems and equipment that are used to monitor the performance of the gas generator, power turbine and gas compressor at the site (the machine train). The systems include field instrumentation which monitors a range of parameters<sup>2</sup> associated with the operation of the machine train. Outputs from the field instruments are fed into a Windows PC based software package called the Compressor Operation Advisory System (COAS) which is used to monitor the overall machine train performance.

The data from the COAS system (pressures, gas composition data etc.) is used in the calculations to meet the environmental reporting requirements associated with the site’s PPC and EU ETS permits. Further information on the methodology used within COAS to calculate venting from gas driven compressors is detailed in Appendix A.

This same data and calculation in COAS is used to report the monthly venting volumes to Ofgem.

**3. Electric compressors on the NTS**

Before discussing how such an incentive could be extended to include electric driven compressors it is worth listing the sites where electric drive compressors are already installed or are planned to be installed on the NTS. The remainder of this document then looks at how venting from these sites could be monitored.

Site	Anticipated Commissioning date of new electric drive units	Notes
Peterstow	Operational	3 electric drive units
Lockerley	Operational	2 electric drive units
Wormington	Dec 08	1 new electric drive added to existing gas drive compressors
Felindre	Jan 09	New compressor site with 2 gas drive compressors and 1 electric drive compressor
Kirriemuir	Jul 09	1 new electric drive added to existing gas drive compressors
Churchover	Sep 09	1 new electric drive added to existing gas drive compressors
St. Fergus	Dec 09	2 new electric drives added to existing gas drive compressors
Hatton	Oct 11	1 new electric drive added to existing gas drive compressors
Peterborough	Oct 12	1 new electric drive added to existing gas drive compressors

**Table 1: Electric Drive compressors on the NTS**

<sup>2</sup> Including pressures, temperatures and levels of vibration.

#### **4. Potential to monitor electric drive compressor venting on sites with the COAS system.**

For those sites with a combination of gas and electric drive compressors<sup>3</sup>, the environmental reporting requirements apply at a site level and hence the venting from the electric drive compressors will need to be reported to the EA and SEPA as the new units are bought online. As COAS is already available on these sites (or will be in the case of the new Felindre site) part of the existing project plans include extending the COAS system to include the venting from these new electric drive units.

As this work is already included in the project build for the electric units themselves, there are no additional costs associated with calculating venting from these units. The COAS system changes are planned to run in parallel with the physical compressor works and the ability to report venting should be operational at the same time the compressor become operational.

#### **5. Potential to monitor electric drive compressor venting on sites without the COAS system.**

For the Peterstow and Lockerley sites where the COAS system is not installed National Grid has identified that data items<sup>4</sup> held in its Integrated Gas Management System<sup>5</sup> (IGMS) could be used to calculate venting.

In order to carry out the calculations on this data it would be necessary to extract the data from IGMS to allow the calculations to be carried out away from the control system itself. The following steps would need to be successfully completed for such a solution to be implemented:

- Writing of scripts to enable the data to be extracted from IGMS and loaded into the Business Objects system
- Writing the equations into the software to calculate vented volumes based on the IGMS data and to produce the necessary output reports
- Developing processes to cover for any missing data items
- Validation/audit of the approach using another compressor where both COAS and IGMS data is available to ensure consistency of approach
- Incorporate venting from Peterstow and Lockerley into current incentive reporting pack

The IGMS system keeps a rolling 13 month data history and it would therefore be possible for the vented volumes from Peterstow and Lockerley to be incentivised for 2009/10. For the first few months of the incentive year it may however be necessary to carry out the monthly venting calculations retrospectively once the solution above has been completed.

The setting of a target vent volume for these two compressors would be limited by the amount of data kept in the IGMS system and it would appear sensible to base any target volume on a 12 month period. Although the data items necessary to carry out this calculation are already available in IGMS, calculating a historic level of venting would be subject to the work previously described, notably ensuring that the equations used to calculate the vented volumes were robust.

It is estimated that all of the necessary systems work could be completed in around 3 months and would cost less than £10k. There would be no material additional ongoing costs.

---

<sup>3</sup> All NTS compressor sites, except for Peterstow and Lockerley

<sup>4</sup> Pressures, temperatures and gas quality measurements

<sup>5</sup> IGMS is the system used to monitor and control the operation of the NTS including compressors

### Using COAS to calculate venting from Peterstow and Lockerley

The alternative option to using IGMS data, would be to install COAS on both the Peterstow and Lockerley sites. Although this would produce a consistent approach across the entire compressor fleet National Grid does not believe the additional costs and longer implementation lead times associated with this approach are warranted.

The exact costs and timescales would need to be determined following a full site survey and appointment of a contractor through a competitive tender process, although the following list gives an indication of the additional tasks required to install COAS (compared to an IGMS based solution):

- Site Survey
- Competitive tender process
- Costs of mobilising a contractor to site
- Design appraisal for software solution and any physical works (e.g. cable routing)
- Updating site records
- Potentially a new PC with new cable runs across the site to link to relevant monitoring points
- COAS Installation costs
- Additional maintenance costs
- Annual site COAS Licence fee

Given these extra tasks both initial CAPEX and annual OPEX would be expected to be substantially larger than, and take several months longer to implement than the IGMS based solution. Also as there would be no historic records in COAS this approach would not enable any retrospective calculation back to 1 April 2009 and there would be no history on which to set an incentive target.

### Peterstow and Lockerley running hours

In considering the benefits of adding the venting from Peterstow and Lockerley into the existing incentive it is worth noting that these sites have historically had low number of running hours (see table 2). It could be expected that this low running hours would correspond with low levels of venting, although this could only be confirmed once calculations of the vented volumes had taken place.

	Lockerley A	Lockerley B	Peterstow A	Peterstow B	Peterstow C
2005	123	74	45	15	55
2006	165	112	11	52	69
2007	159	116	27	249	236
2008 <sup>6</sup>	202	85	7	28	22

**Table 2: Annual running hours for Peterstow and Lockerley Compressors**

<sup>6</sup> Note: 2008 data covers the period from 1 January to 24 December 2008

## 6. Summary

For the following sites National Grid would propose using the COAS system to monitor and report venting. The key reason for this is that COAS is already installed<sup>7</sup> on these sites and presents a zero additional costs solution that can be delivered alongside the electric compressors themselves. The basis and timescales on which these sites could be added into the existing incentive would need to be agreed with Ofgem.

- Wormington
- Felindre
- Kirriemuir
- Churchover
- St. Fergus
- Hatton
- Peterborough

At the Peterstow and Lockerley sites National Grid believes that the best solution for monitoring of vented volumes would be provided by using the IGMS data based solution, which would be substantially cheaper and quicker to implement than the alternative COAS option.

A decision on whether to include Peterstow and Lockerley into the incentive arrangements would need to consider whether their inclusion is efficient given the low number of running hours. If it is deemed efficient, then funding of the costs of associated with establishing monitoring of the vented volumes could be considered as part of the incentive arrangements.

---

<sup>7</sup> Except for Felindre where COAS will be installed alongside the gas compressor units

## Appendix A - Vent Calculation Methodology for gas generator permitted sites.

### Introduction

NTS compressors vent Natural Gas to atmosphere for a number of reasons, including the venting of pipe-work and compressor units, venting of fuel gas systems, leakage from compressor seals etc. For gas generator driven compressors the volume of natural gas vented is required to be reported to the relevant environmental agency under the following regulations:

- **EA PIS** – Environment Agency, Pollution Inventory Schedule
- **SEPA SPRI** – Scottish Environment Protection Agency, Scottish Pollutant Release Inventory
- **SEPA PPC** - Scottish Environment Protection Agency, Pollution Prevention and Control (PPC).

This paper provides information on the reporting requirements to each of the regulatory bodies (EA & SEPA) and the calculation methodologies used.

### EA PIS / SEPA SPRI Report

Under these reports there are five types of NTS compressor venting which are reported: -

- Process vents (depressurising the unit)
- Fuel gas vents
- Starter vents
- Start up purge vents
- Seal leakage vents

The volume of Natural gas vented is split into two values for methane and non-methane volatile organic compounds (VOC's)<sup>8</sup>. The vented volumes are reported on an annual calendar year basis.

### SEPA PPC Report

In the SEPA PPC Permit, Table 5.3 (Mass Emissions to Air) identifies specific areas of plant that require the total hydrocarbons released to be reported. The permit requires this to be reported as the equivalent methane mass of the released hydrocarbons.

The same five types of venting (as above) are calculated for the SEPA PPC report, however the starter and start up purge vents are combined and displayed as 'Other Hydrocarbons Vented'.

In the SEPA PPC report format, the hydrocarbon mass releases values are provided as monthly and annual totals following the end of a calendar year.

### Current Calculation Methodology

---

<sup>8</sup> These are the other hydrocarbons in natural gas (butane, propane, ethane etc.)

The following is a summary of the current methodology used to calculate the venting from each of the five venting categories covered by the EA PIS, SEPA SPRI and PPC reports.

### **Process Vents**

These are the mass of natural gas released when a compressor unit is depressurised. Identification of when a vent has occurred is based on instrument telemetry of the status of the vent valve on the compressor unit. If the valve opens the mass of natural gas released is calculated by multiplying the volume of vented pipework by the change in the gas density between the start and end of the vent.

The gas density calculated using,

- Compressor suction and discharge pressures
- Suction temperature
- Gas molecular weight
- Gas compressibility

The conversion of the volume of Natural Gas vented to methane and non-methane VOC's is carried out using constants that are set on an annual basis using the average St Fergus gas quality.

### **Fuel Gas Vents**

The fuel gas system vent is calculated using a set volume of venting per start of the unit, with the number of unit starts captured by the Compressor Optimisation Advisory System (COAS) system.

To convert the gas volume vented to mass, a standard density (stored as a constant) for natural gas is used. The conversion of the volume of Natural Gas vented to methane and non-methane VOC's is carried out using constants that are set on an annual basis using the average St Fergus gas composition.

### Starter Vents

The starter system vent is calculated using a set volume of venting per start of the unit, with the number of unit starts captured by the COAS system.

To convert the gas volume vented to mass, a standard density (stored as a constant) for natural gas is used. The conversion of the volume of Natural Gas vented to methane and non-methane VOC's is carried out using constants that are set on an annual basis using the average St Fergus gas composition.

### Start up Purge Vents

If the compressor unit has been depressurised (vented), the unit must be purged with natural gas prior to start up. The start up purge vent is based on the compressor vent pipework volume being vented 6 times for each depressurised start.

To convert the gas volume vented to mass, a standard density (stored as a constant) for natural gas is used. The conversion of the volume of Natural Gas vented to methane and non-methane VOC's is carried out using constants that are set on an annual basis using the average St Fergus gas composition.

### Seal Leakage Vents

The seal gas vent is based on the number of compressor running hours and the compressor seal leakage rate (stored as a volume per hour constant).

The compressor running hours is generated from the COAS system.

To convert the gas volume vented to mass, a standard density (stored as a constant) for natural gas is used. The conversion of the volume of Natural Gas vented to methane and non-methane VOC's is carried out using constants that are set on an annual basis using the average St Fergus gas quality.

### Audit of calculation

There is a condition in the Environmental Permits<sup>9</sup> in England and Wales stating that

*"The Operator shall undertake a review of vented and fugitive gas emission from the installation. The review shall address the following issues:*

- *Identify each potential source of such emission, quantify and assess the impact on the environment.*
- *Consider the options to minimise such emissions, giving consideration (but not limited) to the following:*
  - *current vent delay philosophy*
  - *emissions of odourised gas (if any)*
  - *the number of compressor system vents*
  - *the natural gas venting philosophy*
  - *discharge sequencing to prevent inappropriate pressure loads on vent systems*
  - *the use of gas recycling or recompression*
  - *use of vented gas as a fuel*
  - *gas storage, flaring or other alternative venting techniques*

---

<sup>9</sup> Previously called the Pollution Prevention and Control (PPC) permits

*Where improvements are identified propose a timetable to implement such improvements. The review shall be submitted in writing to the Agency. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the review. The improvements identified shall be implemented by the operator from the date of approval by the Agency.”*

A similar condition is also applied by SEPA,

*”By December 2007<sup>10</sup>, the Operator shall complete a detailed review of vented and fugitive gas emissions. The results and conclusions of the review shall be recorded. The scope and aim of the review shall be agreed in writing with SEPA prior to 30 June 2007. The aim of the review shall be to quantify by measurement or by calculation the emissions to air of natural gas from each potential source on the installation, their impact on the environment and to identify the means, and timescale for the implementation of such means (if any), considered to be the best available technique to prevent or minimise further emissions of natural gas into the environment”*

National Grid is currently carrying out energy audits of the NTS compressor sites, with these audits expected to be completed during 2010.

---

<sup>10</sup> National Grid has agreed an extension to this date with SEPA