Joint Office of Gas Transporters

p Report

At what stage is this document in the process?

UNC 0607S:

Amendment to Gas Quality NTS Entry Specification at the St Fergus NSMP System Entry Point

01 Modification

02 Workgroup Report

03 Draft Modification Report

04 Final Modification Report

Purpose of Modification:

This enabling modification will facilitate a change to the current contractual Carbon Dioxide limit at the St Fergus NSMP System Entry Point, through modification of a Network Entry Provision contained within the Network Entry Agreement (NEA) between National Grid Gas plc and North Sea Midstream Partners Limited (NSMP) in respect of the St Fergus NSMP Sub-Terminal.

The workgroup requests that Panel:

- re-assess whether self-governance procedures are suitable for this modification; and
- subsequently issue the report to consultation.

The Panel will consider this Workgroup Report on 19 October 2017. The Panel will consider the recommendations and determine the appropriate next steps.

High Impact: None

Medium Impact: None

Low Impact: Transporters, Shippers and Consumers

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Contents

Timetable

Modification timetable:	
Initial consideration by Workgroup	05 January 2017
Amended Modification considered by Workgroup	07 September 2017
Workgroup Report presented to Panel	19 October 2017
Draft Modification Report issued for consultation	19 October 2017
Consultation Close-out for representations	09 November 2017
Final Modification Report available for Panel	12 November 2017
Modification Panel decision	16 November 2017

Any questions?

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1 Summary

What

This is an enabling modification that seeks to facilitate an increase in the carbon dioxide limit with the Network Entry Agreement (NEA) at the North Sea Midstream Partners (NSMP) sub-terminal at St. Fergus between National Grid Gas plc and NSMP Ltd. It is proposed to increase the limit from 4mol% to 5.5mol% subject to a cap on aggregate CO_2 and N_2 at 7mol% until the end of Gas Year 2023/24 with any continued relaxation in specification beyond that date subject to an objective test of continued requirement. It is also proposed to make provision in the NSMP St Fergus NEA to allow National Grid to reduce the CO_2 limit at the NSMP St Fergus Entry Point to a level between 4.0mol% and 5.5mol% within the period of time for which this Modification applies in the event that another UNC Modification(s) to increase the CO_2 limit is approved in respect of another System Entry Point and which National Grid NTS would otherwise be unable to accommodate without incurring material cost.

Why

The Rhum gas field can be up to 6.5mol% CO_2, the effects of which are mitigated via blending with low CO_2 gas from Norway to St Fergus via the Vesterled Pipeline. This is not sustainable due to the prohibitive cost of procuring this service from Norwegian shippers, potentially leading to the early cessation of production from Rhum and Bruce fields.

The alternative processing and treatment solutions to remove the excess carbon dioxide have been considered upstream of the NTS (both offshore and onshore at the NSMP sub-terminal), however these would require significant investment and time to implement. Rhum would become cash negative and cease production before any project became operational.

How

In accordance with the UNC Transportation Principal Document Section I 2.2.3 (a), the Proposer is seeking to amend the NEA described above via this enabling modification. On satisfactory completion of the UNC process the parties to the NEA will be able to amend the agreement.

2 Governance

Justification for Self-Governance

When the Modification Proposal was first brought before Panel in late 2016, the proposer was seeking self-governance procedures which was subsequently approved. At that time, panel determined the modification was unlikely to have a material effect on the contractual regime for the transportation of gas through pipes because the higher CO_2 gas is unlikely to have a material effect on the self-governance criteria, which are detailed below:

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(aa) existing or future gas consumers. The dilution from low CO_2 (<2mol%) gas from the SEGAL sub-terminal and SAGE sub-terminal (<4mo%) and low (1.5 – 4 mol%) CO_2 gas from Norway via Vesterled means that the gas exported into the NTS will remain below 4mol% under most operating scenarios; and

(bb) competition in the shipping, transportation or supply of gas conveyed through pipes or any commercial activities connected with the shipping, transportation or supply of gas conveyed through pipes. By ensuring continued supplies of UK gas into the system

security of supply will be enhanced, competition will be maintained and flow of gas into the NTS will be maintained; and

(cc) the operation of one or more pipe-line system. Continued flow of Bruce and Rhum gas (up to 5% of UK domestic gas supply) will maintain flow rates in the NTS and extend system life ensuring security of supply and the opportunity to develop additional flows into the system in the future; and

(dd) matters relating to sustainable development, safety or security of supply, or the management of market or network emergencies. The modification will maintain security of supply by ensuring that fields do not prematurely cease production and more indigenous gas will flow into the market, giving greater coverage for market or network emergencies.

Modification 0607S is therefore currently following self-governance procedures. However the workgroup has considered the modification proposal at length and has come to the conclusion that the proposal should be subject to Authority Direction.

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Requested Next Steps

The workgroup now requests that Panel:

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- re-assess whether self-governance procedures are suitable for this modification; and
- subsequently issue the report to consultation.

The workgroup's reasoning as to why the proposal should be subject to Authority Direction can be summarised as set out below.

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Arguments for governance procedures to change to Authority Direction

Several parties, including the proposer (BP), NSMP, National Grid NTS, SSE and Statoil, have indicated that Authority direction should be sought.

Statoil's reasoning is that if the modification is implemented, the resulting changes are considered by Statoil to have a material effect on self-governance criteria bb): competition in or commercial activities related to the shipping, transportation or supply of gas.

Specifically, the proposal as it stands will have an impact on reducing competition or choice in the provision of commercial gas blending services. The proposal if implemented will mitigate the need for blending gas by taking advantage of gas delivered by other producers, some of whom may have undertaken associated investment. Statoil asserts that this cross-subsidy will result in two main distortions in:

a) the market for commercial gas blending services; and
b) competition between the shipper counterparties of the producers concerned.

National Grid NTS considers that Modification 0607S could have a material effect on two of the self-governance criteria (bb) and (dd) as detailed above.

In relation to competition in the shipping of gas (bb), National Grid NTS considers that material issues may exist. The CO_2 limit sought by the proposer is materially higher than is currently in place at any other NTS entry point and National Grid NTS believes that there are potential detrimental effects on competition amongst shippers if other upstream parties were to request a similar limit in the future that National Grid NTS is unable to accommodate by virtue of having granted such flexibility to NSMP. Reference to this flexibility is made again in Workgroup Impact Assessment section h, Impact on Producers. This may arise either due to a proliferation of such requests or a specific locational constraint that would affect the ability of National Grid NTS to meet other existing contractual obligations.

The Workgroup sought clarification on requests for individual parties to change gas quality limits and Ofgem subsequently referred to its decision letter for Modification 0498/0502. This states that requests are currently assessed on a case by case basis on their own merits with respect to the UNC relevant objectives and can be found here: http://www.gasgovernance.co.uk/0502. Ofgem considered that a statement from National Grid NTS was needed to address National Grid's ability to comply with its obligations to avoid any undue preference or undue discrimination in the terms on which it undertakes conveyance of gas and avoid conferring any unfair commercial advantage on any industry party in the event of implementation should be included in the Workgroup report. This has been included in the Workgroup Impact Assessment, section (i) in this report.

National Grid NTS has worked with the proposer and NSMP during the workgroup development phase, seeking to mitigate this potential effect by agreeing a time-limitation on the proposed change, beyond which NSMP would be required to demonstrate a continued need case and a right for National Grid NTS to reduce the NSMP CO_2 limit in the event that such flexibility was demanded by others which needed to be shared. National Grid NTS believes that the Authority should consider whether such mitigations are appropriate to address potential competition concerns and also whether such an arrangement could itself be regarded as discriminatory, given that all other gas quality limits in all other NEAs are not time-limited.

The potential effect on security of supply (dd) relates to early cessation of production upon non-implementation of the modification. The Proposer states in the Modification that if the proposal is not implemented then the impact would most likely be an early cessation of production from the Rhum, Bruce and Keith fields which account for approximately 5% of the UK national gas supply. National Grid NTS assessed this potential supply loss against its 'N-1' security of supply criteria for each of its four future energy scenarios. (The N-1 assessment looks at whether peak gas demand could still be met in the event of the loss of the single largest source of supply). Whilst this assessment showed that the N-1 criteria could still be met under all scenarios, National Grid NTS remains of the view that the volumes of gas that could be lost are material and would serve to degrade UK gas supply security.

SSE believe that Authority decision should be sought due to the negative impact on competition at downstream operations at Peterhead Combined Cycle Gas Turbine (CCGT). During times of high CO_2 content Peterhead will incur higher inherent CO_2 costs than other power generators will be exposed to. In addition, Peterhead will be exposed to a greater likelihood of plant failure during times of CO_2 change. These factors will place Peterhead at a competitive disadvantage compared with other power generators based in GB.

BP believes that Authority direction should be sought to clarify whether the mitigations agreed between the proposer and National Grid are appropriate to address the potential competition concerns and also whether such an arrangement could itself be regarded as discriminatory, given that all other gas quality limits in all other NEAs are not time-limited. While most Workgroup participants support the provision for time limiting the raised CO_2 limit subject to the demonstration by NSMP of an objective continued need, there was a concern that has been raised by a number of Shippers that this ability for National Grid to be able to 'revoke' a UNC Modification either in part or in total, moves away from the current and established principle that any change to gas quality limits are assessed on a case by case basis on their own merits with respect to the UNC relevant objectives and in doing so potentially sets a precedent for future UNC modifications. Furthermore, as already stated by BP and confirmed by the OGA, if the proposal is not implemented then the impact would most likely be an early cessation of

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production from the Rhum, Bruce and Keith fields which account for approximately 5% of the UK national gas supply.

In response to the view expressed by Statoil that the proposal will have an impact on reducing competition or choice in the provision of commercial gas blending services, BP highlighted that there is no UK commercial blending service possibility as each sub-terminal has a standalone Network Entry Agreement, meaning current blending arrangements are upstream of the sub-terminal entry meter.

NSMP, as terminal operator, requires Rhum to procure gas of Area D quality (<2.5mol% CO2) from Norway in a ratio of approximately three molecules Norwegian gas to one molecule of Rhum and in order to ensure gas entering the NTS from the FUKA pipeline remains on specification with respect to CO_2 content, requires a guarantee that these molecules will reach St Fergus at a consistent flow-rate in order that Rhum can produce. This has the effect of diluting the CO_2 content of the Vesterled pipeline and is a service that can only be provided by a Norwegian producer with significant delivery flexibility. Continuation of the current blending requirement will result in significant value leaking from UK Continental Shelf (UKCS) to Norwegian Continental Shelf (NCS) which would be avoided if this modification were approved.

NSMP made further comments that while some offshore pipeline operators may provide a blend service by virtue of the overall services they provide, there is no market for commercial gas blending services in the UK since, as far as NSMP understands it, National Grid NTS does not have a remit to provide blending commercial services. NSMP further suggests that any issue of competition between a producer and a shipper or third party should be between these parties and is not an issue for the Workgroup.

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3 Why Change?

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With the increasing maturity of UKCS as a gas production area, all producers are being asked by the Oil and Gas Authority (OGA) to focus on maximising economic recovery (MER) from existing fields.

The current CO_2 limit at the St Fergus NSMP sub-terminal is 4.0mol%. The commingled stream that arrives at the terminal via the Frigg UK Association (FUKA) pipeline system is derived from a number of Northern North Sea and West of Shetland fields including the BP operated Rhum field. The CO_2 content of the Rhum gas is between 6.2% - 6.5mol% and the Rhum field currently relies on blending with other fields in order to meet Gas Entry Conditions. As this gas is blended with other Shippers' gas within the FUKA pipeline (including the low CO_2 gas from the Laggan/Tormore fields), by the time it enters the NTS the CO_2 content is below 4.0mol%.

On occasions when the Laggan/Tormore fields trip and temporarily cease to export low CO_2 gas into the FUKA pipeline, high CO_2 content gas from the Rhum field can remain in the pipeline. Restarting gas export from the Laggan/Tormore fields then leads to a short duration increase in the CO_2 content of gas arriving at the St Fergus NSMP sub-terminal above 4.0mol% as the increasing pipeline pressure from the Laggan/Tormore restart pushes the high CO_2 Rhum gas along the pipeline and into the sub-terminal. In order to mitigate this intermittent risk of exceeding the 4.0mol% specification limit when Laggan/Tormore restarts, a guaranteed daily flow of additional low CO_2 blend gas is procured from Norway to the St Fergus NSMP sub-terminal via a commercial arrangement. This gas is transported daily to the St Fergus NSMP

sub-terminal via the Norwegian Vesterled pipeline. The commercial mechanism with the Norwegian shippers is costly and Rhum cannot endure having to continually purchase blend gas to cover the brief periods when additional blending gas may be required.

In addition, gas with low CO_2 content is exported into the NTS from the two other sub-terminals (SAGE and SEGAL) which are adjacent to the NSMP sub-terminal. Gas from these terminals allows "fortuitous" commingling of gas within the manifold area of the NTS prior to gas entering the five NTS export pipelines from the St Fergus sub-terminals thereby reducing the combined CO_2 content of the export gas before the gas reaches consumers.

For Information; NSMP gas including Rhum is GS(M)R compliant with or without Laggan/Tormore flows from the Shetland Gas Plant. Bruce/Rhum gas on its own is GS(M)R compliant.

If Rhum gas flows at normal export rates and is commingled with all FUKA sources excluding Laggan/Tormore, the composition of the combined export gas is ~4.5mol% CO_2. With Laggan/Tormore fields flowing and Rhum at peak rates, the CO_2 content of the commingled gas in the FUKA pipeline is <2.7mol%.

Rhum has been delivering natural gas into the NTS as part of a commingled stream since 2005. St Fergus NSMP sub-terminal delivery to the NTS has not exceeded 4.0mol% CO_2 content. Rhum production flows of c.4.5 mcmd is, on average, about 15% of the total flow through FUKA and Rhum and Bruce combined account for approximately 5% of the UK National Supply.

Historically Rhum was able to export gas into the FUKA system without increasing the CO_2 content of sub-terminal NTS delivery gas above 4.0mol% by blending the gas with low CO_2 gas from the Bruce/Keith fields (now almost depleted) and from the Alwyn area field (rates now much lower and not far from 4.0mol% CO_2 content). The suspension of Rhum production in 2010 to comply with EU sanctions against Iran (Rhum is jointly owned by the Iranian Oil Company) has created a disparity in the relative remaining gas volumes and production rates of Rhum gas relative to the Bruce/Keith and Alwyn fields resulting in the requirement for additional firm delivery to the NSMP sub-terminal of low CO_2 volumes of Norwegian blend gas.

The import of firm volumes of low CO_2 Norwegian gas commenced in 2015; this is imported via the Vesterled pipeline (from Heimdal in the Norwegian sector to the NSMP terminal) to offset the decline in blending sources within the FUKA pipeline and ensure the CO_2 content in the export gas from the sub-terminal into the NTS remained below 4.0mol%. This activity was viewed as a short-term measure until the Laggan/Tormore fields and the associated Shetland Gas Plant started up (February 2016). While Laggan/Tormore gas provides low CO_2 gas directly into the FUKA system, modelling of pipeline flow behaviour and the subsequent observation of actual pipeline flows, has led to a requirement for an increase in the volume of firm Norwegian gas which has to be delivered on a daily basis. This is because when there is an unplanned trip/outage of the Laggan/Tormore fields, gas from the Rhum field that is already in the FUKA pipeline causes an increase in the CO_2 content of FUKA pipeline gas. On restart and ramp-up of Laggan/Tormore production, the "slug" of high CO_2 content gas already in the FUKA pipeline is accelerated into the St Fergus terminal causing a pulse of higher CO2 gas which requires the firm delivery of Norwegian gas to blend down to <4.0mol% prior to entry into the NTS.

Once delivered into the FUKA system, the Rhum gas delivery rate at the terminal is largely determined by the flow rates into the FUKA system from the Alwyn area (up to 6 mcm/d) and from the Laggan/Tormore fields (currently up to 14 mcm/d) in addition to the Bruce and Rhum

flow rates. Hence a slug of up to 10 mcm of Rhum composition gas (between 3.8-6.5mol% CO_2) could in principle arrive at the NSMP sub-terminal at rates of up to 20 mcm/d. As an unplanned outage of the Laggan/Tormore fields cannot be predicted, the St Fergus terminal operator has requested a constant volume of Norwegian gas at sufficient quantity to constantly cover the risk of a Laggan/Tormore restart generating a pulse of higher CO_2 gas causing a breach of the CO_2 specification in the NEA (4mol%). A constant flow of Norwegian gas in sufficient quantity is required to guarantee meeting the NEA specification limit of 4.0mol% CO_2 as it would take too long for a reactive increase in Norwegian gas flow to reach the terminal. The cost of continuous provision of this gas at the flow rates required to cover Laggan/Tormore field re-starts is prohibitive.

The provision of processing and treatment solutions to remove the excess CO_2 upstream of the NTS (both offshore and onshore at the NSMP sub-terminal) have been considered however, these would require significant investment and substantial time (3+ years) to implement. The Rhum field will become sub-economic and cease production before such a project could become operational. While the planned life of the Rhum field is until at least 2023, longevity is limited by the economic life of the host platform at the Bruce field. There is insufficient production from the Bruce field to cover the operating costs for the Bruce platform which is reliant on a throughput related cost share arrangement with the Rhum field to cover such costs. If Rhum field cannot flow at sufficiently high rates (either due to the cost of providing Norwegian blend gas or due to curtailment to meet current CO_2 specifications) there will be insufficient flow to cover Bruce platform costs and the Bruce, Rhum and Keith fields will cease production.

In addition, as gas at other St Fergus System Entry Points has a CO_2 content significantly lower than 4.0mol%, modelling demonstrates that gas with higher CO_2 content at the NSMP System Entry Point could be blended with gas from the adjacent sub-terminals without impacting the system or consumers. It should also be noted that CO_2 is not a defined parameter in the Gas Safety (Management) Regulations 1996, and no amendment of GS(M)R is required.

What the effects are, should the change not be made

The significant cost of securing additional firm blend gas from Norway will lead to the early Cessation of Production from the Rhum and associated Bruce and Keith fields. This problem could be addressed by treating the gas for removal of CO_2 at the wellhead or at the terminal, but the investment to bring the quality in line with current specification would be significant, take many years to complete and would make these fields uneconomic.

This modification seeks to establish a change to the existing NEA parameters as a more efficient and economic approach to facilitate delivery of potential new supplies to the System, subject to ensuring no adverse impact on consumers or on the operation of the pipeline system. Therefore, in light of the preliminary views achieved so far, the Panel's engagement is sought to assess the impact of the requested change, in order to confirm that a higher CO_2 limit at St Fergus NSMP sub-terminal would be beneficial for the GB gas market.

If the change is not made then the resulting impacts will most likely be:

- Early abandonment of Rhum, Bruce and Keith, loss of 600 jobs and UK tax revenues.
- Stranded reserves (~50% reserves) that would otherwise be economic to produce.

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4 Code Specific Matters

Reference Documents

None.

Knowledge/Skills

No additional skills or knowledge are required to assess this modification.

5 Solution

This modification seeks to amend a Network Entry Provision within the existing St Fergus NSMP System NEA. This amendment would increase the CO_2 upper limit for gas delivered from the St Fergus NSMP Sub-Terminal System Entry Point into the National Transmission System to 5.5mol% from the current limit of 4.0mol% subject to a cap on aggregate CO_2 and N_2 at 7mol% until the end of Gas Year 2023/24 with any continued relaxation in specification beyond that date subject to an objective test of continued requirement. It is also proposed to make provision in the NSMP St Fergus NEA to allow National Grid to reduce the CO2 limit at the NSMP St Fergus Entry Point to a level between 4.0mol% and 5.5mol% within the period of time for which this Modification applies in the event that another UNC Modification(s) to increase the CO2 limit is approved in respect of another System Entry Point and which National Grid NTS would otherwise be unable to accommodate without incurring material cost.

6 Impacts & Other Considerations

Does this modification impact a Significant Code Review (SCR) or other significant industry change projects, if so, how?

No impact identified.

Consumer Impacts

Consumers can currently receive gas with CO_2 content of 4mol% from both the SAGE and St Fergus NSMP sub-terminals. In the event of a CO_2 excursion by a sub-terminal, fortuitous commingling within the manifold area of the National Grid terminal could prevent the gas entering the five NTS export pipelines from the St Fergus sub-terminals from exceeding 4mol%, although this is not routinely utilised by NSMP.

BP's analysis to support this Modification showed that such commingling could be expected to maintain gas entering the NTS at St Fergus at below 4mol%.

Further impacts (which are not consumer impacts) are detailed later in the report.

Consumer Impact Assessment *(Workgroup assessment of proposer initial view or subsequent information)*	
Criteria	**Extent of Impact**
Which Consumer groups are affected?	Parties located in close proximity to St Fergus.
What costs or benefits will pass through to them?	If implemented this modification will allow for gas of 5.5 % CO2 content to be entered on to the NTS at St Fergus in the very unlikely event that other sub-terminals at St Fergus and Vesterled are not flowing, coincident with a Laggan/Tormore trip. Peterhead CCGT is adjacent to the St Fergus entry terminal and will be directly affected by any change to gas composition as it is the closest offtake point on the NTS. Thus, Peterhead CCGT could receive gas at 5.5mol% CO_2. Though the gas will still be within GS(M)R specification and therefore legally and contractually compliant, it is a "slug" of CO_2, essentially a step change in CO_2 content which might in turn be associated with a rate of change of Wobbe index, which is of interest to Peterhead CCGT. This rate of change of WI risks the trip of the CCGT in order to protect the burners. Any plant trip will result in the operator being exposed to cashout penalties on both the gas and power markets. The extent of the cashout penalties will depend on the number of high CO_2 events, the duration of any forced outage and the prevailing gas and power marginal cashout charges. There is an ongoing review of GS(M)R. However, it is understood that Peterhead CCGT is not in continuous operation as a baseload plant so the risk of CCGT trip is only relevant if/when Peterhead CCGT is in operation.
When will these costs/benefits impact upon consumers?	In the very unlikely event that other sub-terminals at St Fergus and Vesterled are not flowing, coincident with a Laggan/Tormore trip, gas at 5.5mol% CO_2 could flow in to the NTS. This remote possibility could happen at any time during the period the NEA amendment is in place.
Are there any other Consumer Impacts?	The overall amount of CO_2 entering the NTS over the life of the Rhum field will remain unchanged (unless the field were to cease production early) whether the gas is blended with gas of lower CO_2 concentration or allowed to flow unblended. However, if higher CO_2 slugs of gas were to enter the NTS, downstream customers would be liable for the inherent CO_2 cost, (however small) at that time rather than paying for the same quantity of CO_2 but over a longer period. Please refer also to Carbon Cost Assessment.
General Market Assumptions as at December 2016 *(to underpin the Costs analysis)*	
Number of Domestic consumers	*21 million*
Number of non-domestic consumers <73,200 kWh/annum	*500,000*

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Number of consumers between 73,200 and 732,000 kWh/annum	*250,000*
Number of very large consumers >732,000 kWh/annum	*26,000*

Cross Code Impacts

None identified.

EU Code Impacts

None identified.

Central Systems Impacts

None.

Workgroup Impact Assessment

The Workgroup identified a number of areas requiring closer assessment and collated them into a number of key themes, as follows:

a) Further Background to the Change
b) Frequency of Occurrence and the Penetration into the NTS
c) Anticipated Impact on Gas Quality
d) National Grid NTS' Assessment of its Operational Risks
e) Impact on Consumers
f) Impact on Storage Operators
g) Carbon Cost Assessment
h) Wider Considerations
i) National Grid NTS' Assessment of Effect on its Compliance with Relevant Licences and Obligations
j) Workgroup Conclusions.

a) Further Background to the Change

Historic operational procedures & flows at the site

Historically Rhum was able to export gas into the FUKA system without increasing the CO_2 content of sub-terminal NTS delivery gas above 4.0mol% through blending with low CO_2 gas from the Bruce/Keith fields (now almost depleted) and from the Alwyn area field (rates now much lower and not far from 4.0mol% CO_2 content). The suspension of Rhum production in 2010 to comply with EU sanctions against Iran (Rhum is jointly owned by the Iranian Oil Company) has created a disparity in the relative remaining gas volumes and production rates of Rhum gas relative to the Bruce/Keith and Alwyn fields. The daily requirement for additional firm delivery of low CO_2 volumes of Norwegian blend gas to the NSMP sub-terminal, was triggered by the restart of Rhum production in 2014.

Current operational procedures & flows at the site

A schematic illustrating the St Fergus sub-terminal entry to the NTS can be found below that shows the configuration of the various connections and how gas flows combine and feed into the NTS entry point (see Figure 1).

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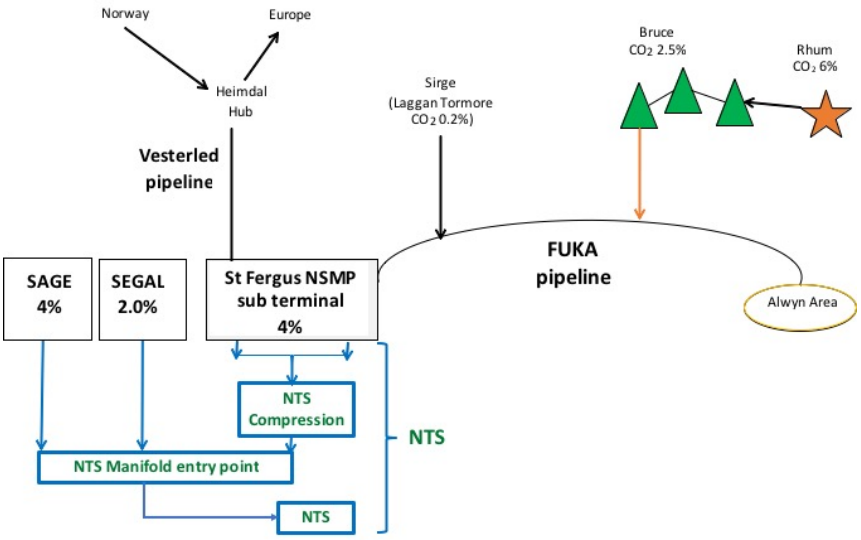

Figure 1: Connections and gas flows into NTS entry point at St Fergus

Problems arise when an unplanned trip occurs at Laggan/Tormore and there is insufficient blend gas to manage the requirement to reduce the CO_2 limit to 4mol% before reaching the NTS entry point.

There are no CO_2 removal systems at the NSMP terminal so the system operator (NSMP) manages the risk by requiring the Rhum owners to procure sufficient quantities of Norwegian gas via the Vesterled pipeline on a daily basis to ensure there is a sufficient supply of gas available for blending should Laggan/Tormore experience an unplanned trip. If this safeguard were not in place then the whole FUKA system would have to be shut down if the high CO_2 gas within the pipeline was removed in some way (e.g. flared). This would impact all of the offshore fields exporting gas into the FUKA system, also shutting oil export from those fields producing associated gas. The FUKA system handles around 10% of total UK daily gas supply.

As a subsea tie-back the Rhum field can only be produced when the Bruce platform is operational. As a consequence, although Rhum gas can be up to 6.5mol% CO_2 it benefits from blending with lower CO_2 Bruce gas. The requested NEA change to 5.5mol% takes into account this blending and is set at a level to accommodate any CO_2 spike in FUKA pipeline gas resulting from a start-up of Laggan/Tormore fields after a production trip while ensuring that the gas export into the NTS remains below 4mol% under most operating scenarios. Setting the NEA limit to 5.5mol% rather than 6.5mol% will require that on occasion e.g. during planned field/terminal outages, the Rhum field will either ramp back or shut down production or source firm quantities of low CO_2 blend gas.

b) Frequency of Occurrence and the Penetration into the NTS

Number of occurrences where St Fergus NSMP Terminal CO_2 limit could have been over 4mol%

Panel specifically requested the workgroup to demonstrate the frequency of occurrence of higher % CO_2 gas and the penetration into the NTS.

The 5.5% limit would only be needed operationally if an offshore trip at the low CO_2 Laggan/Tormore field occurred. When Laggan/Tormore restarts after such a trip it pushes a volume of high CO_2 gas from Rhum towards the terminal in a stream of other UKCS gas and thus causes a temporary CO_2 spike. If the CO_2 limit for gas entering the NTS were to remain at 4mol% then it may not be possible for such high CO_2 content gas to be exported to the NTS. This would result in the shut in of all UKCS fields exporting gas via the FUKA pipeline system and not just the Rhum flows, until such gas could be removed from the pipeline and terminal. This would also impact oil production from these fields (e.g. Buzzard which is one of the UK's largest oil producing fields).

Since the startup of twin compressor operation in May 2016, the FUKA operator has recorded **13** separate "total" outages of the Laggan/Tormore fields (see Table 1 below).

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	Double Compressor Trips at SGP since 2 Compressor Operations (May 16)		
	Date Start	Date End	Total Time (Days)
1	21/05/2016 03:00	21/05/2016 09:00	0.3
2	21/06/2016 20:50	24/06/2016 12:00	2.6
3	26/06/2016 03:00	26/06/2016 10:45	0.3
4	14/07/2016 16:30	15/07/2016 09:00	0.7
5	18/07/2016 18:10	18/07/2016 23:48	0.2
6	07/08/2016 05:32	08/08/2016 22:03	1.7
7	03/10/2016 00:00	04/10/2016 10:30	1.4
8	06/10/2016 13:18	07/10/2016 05:00	0.7
9	08/01/2017 00:51	08/01/2017 09:57	0.4
10	06/02/2017 03:09	06/02/2017 14:46	0.5
11	09/02/2017 11:17	09/02/2017 16:38	0.2
12	11/02/2017 15:04	12/02/2017 11:48	0.9
13	14/02/2017 15:37	15/02/2017 06:42	0.6
	Total		10.5
	Average (Days)		0.8

Table 1: Laggan/Tormore compressor trips

By their nature, unplanned outages cannot be forecast, however the historic uptime of facilities could be considered as an indicator of reliability. The Shetland Gas Plant (SGP), which processes fluids from the Laggan and Tormore fields, is essentially new. As highlighted, since May 2016 a total of 13 trips have been recorded (to end Feb 2017) giving an aggregate of 10 days' outage overall. This equates to a 4% downtime. However, it is understood that SGP has now commissioned an additional compression capacity, which should help maintain and possibly further improve reliability. A contracted new field that is currently under development will also provide additional blend gas into the FUKA pipeline. It is expected that the reliability will be high from new equipment once the initial commissioning and "fine tuning" have been completed. The reliability of another older infrastructure providing gas into the pipeline (existing FUKA Shipper) has been higher at over 98% over the last 1 – 2 years.

As mentioned earlier, Laggan/Tormore gas had been unavailable only 4% of the time. The cost

of purchasing contingency blend gas to cover these unplanned outages is prohibitive to Rhum and no longer sustainable. During sustained questioning from the workgroup, the proposer maintained that if another contingency mechanism cannot be found then it will lead to the early closure of both the Rhum and the Bruce fields.

St Fergus Sub-Terminal System Entry Volumes (May 2012 to May 2016)

A blend gas graph illustrating St Fergus sub-terminals (NSMP, SAGE and SEGAL) system entry volumes from May 2012 - May 2016 is given below (see Figure 2).

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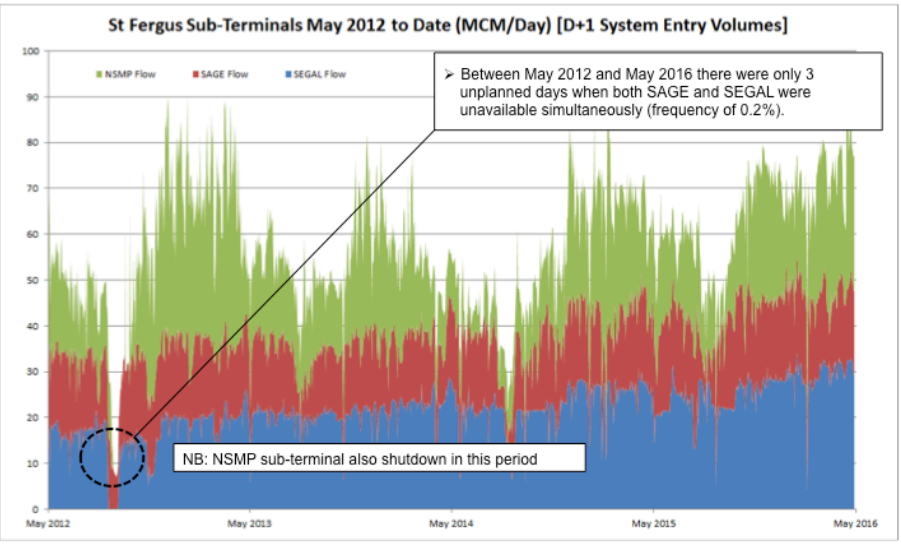

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Figure 2: Blend gas graph

It should be noted that there were only three unplanned days when both SAGE and SEGAL were unavailable simultaneously (a frequency of 0.2%). Under such circumstances, consideration would be given by NSMP to shutting in Rhum flow to mitigate the risk of off-specification gas. However, it should be noted that in the case noted above, the NSMP terminal was also shutdown at the same time so in this instance the issue remains moot.

St Fergus CO_2 Blending Analysis

An example of operational flows at the St Fergus NSMP terminal can be found in Appendix 1. SAGE and SEGAL have separate entry points into the NTS and are downstream of the compression station (see Figure 1); this allows “fortuitous commingling” within the NTS mixing area in the NTS terminal before the commingled FUKA, Vesterled, SAGE and SEGAL gas enters the five NTS export pipelines carrying gas away from the terminals.

Four different scenarios were analysed (see Appendix 2) and all four assume Laggan/Tormore trips for over 60 hours (highest of historical trips observed) on an ordinary summer’s day. Actual average flow rates from SAGE and SEGAL are used but NSMP flows are adjusted in

each scenario. The scenarios suggest that the gas flowing into the NTS does not go above 4mol% even when Laggan/Tormore goes offline unplanned.

A high CO_2 slug is produced but it is dependent on the actual flow rates when Laggan Tormore restarts. The actual size and duration is subject to the speed of the ramp rate. If this rate is slow, there is less pressure in the pipeline, therefore the CO_2 content is lower, but the duration is longer (the amount of CO_2 is the same in total but it is spread out over a longer period). The BP scenarios assume Laggan/Tormore ramps up to full production over a 6-hour period. This longer ramp up of Laggan/Tormore reduces the rate at which off-specification gas arrives at the NSMP terminal, thereby reducing peak CO_2 levels.

For the BP Scenarios, the peak CO_2 slug duration ranges from 10 hours (scenario 1, peak CO_2 3.65%) to 15 hours (scenario 4, peak CO_2 3.87%). Therefore, the duration of 15 hours is considered the worst-case scenario.

The Workgroup asked National Grid NTS to provide a view on the analysis performed by BP and they used the inputs to the four BP scenarios and calculated the CO_2 content that would be expected on the pipelines leaving St Fergus terminal. The results shown below in Table 2 demonstrate that National Grid NTS' calculations align well with the analysis performed by BP. (Note the figure of 172 mscm/d relates to total national demand).

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30th June 2016 (172mscm/d)							
Scenario 1		Scenario 2		Scenario 3		Scenario 4	
BP Results	NG Results	BP Results	NG Results	BP Results	NG Results	BP Results	NG Results
3.65	3.65	3.78	3.79	3.66	3.66	3.87	3.88

Table 2: National Grid NTS analysis compared with BP analysis

Penetration into the NTS

In respect of the BP scenarios, National Grid NTS were also asked to provide a 'heat map' analysis; to determine the risk of high CO_2 gas entering the NTS and how far any out of specification flow might then be expected to reach. The Workgroup also requested that the analysis contained information about the assumed distribution of supplies, where the gas would blend on the NTS and the NTS flow patterns.

Two 'heat map' schematics were provided by National Grid NTS, one from BP scenario 1 and the other from BP scenario 4.

The first 'heat map' (see Figure 3) shows the penetration of aggregate flows of St Fergus gas into the NTS, assuming entry flows are equal to those presented in BP's analysis, scenario 1 (selected because this contains the highest flows of all BP scenarios and is thus a 'worst case' from the BP scenarios):

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- SAGE: 20 mcmd
- SEGAL: 18.3 mcmd
- Vesterled: 8.2 mcmd
- Frigg: 30 mcmd

Supplies from other NTS entry points are proportionate to the 2016 Future Energy Scenarios (FES) for that demand level. The percentages show the contribution to total demand from each supply source.

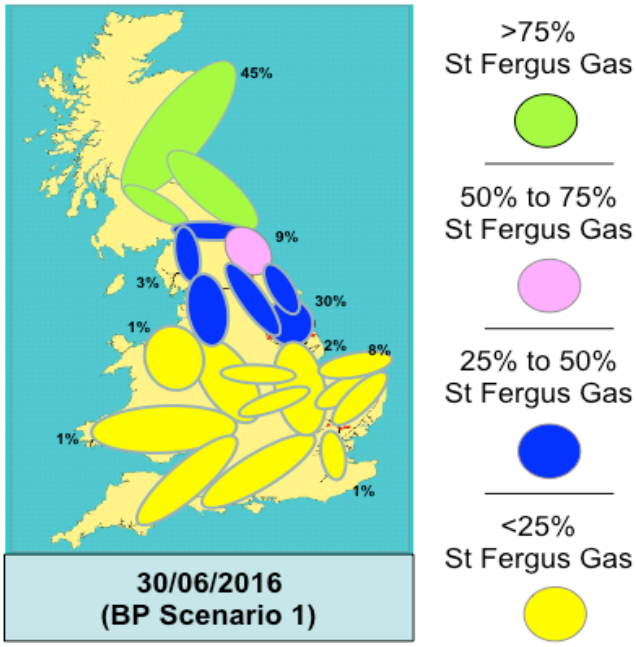

Figure 3: 'Heat map' for BP scenario 1

The second 'heat map' schematic (see Figure 4: 'Heat map' for BP scenario 4) shows the levels of CO_2 on the NTS, assuming St Fergus sub-terminal flows and CO_2 content are equal to BP's scenario 4 (giving a 'worst case' CO_2 entering the NTS from the four BP scenarios). This scenario shows a blend of 3.87% CO_2 entering the NTS, therefore no NTS direct connect receives any gas in excess of 4%.

Supplies from other NTS entry points are proportionate to the 2016 FES for that demand level and deliver gas at their CO_2 limits. The percentages show the contribution to total demand from each supply source.

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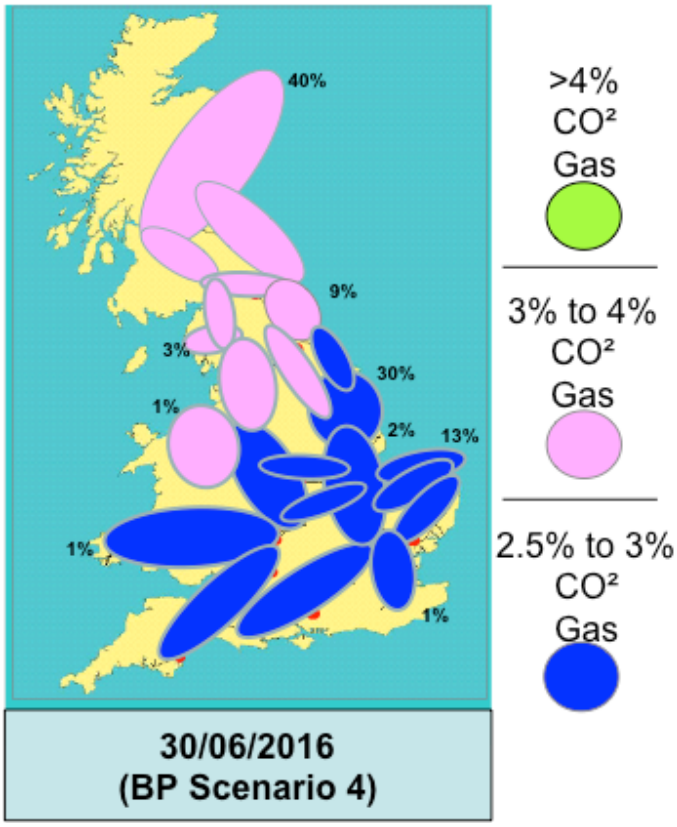

Figure 4: 'Heat map' for BP scenario 4

In order to understand the impact on the St Fergus blending, the Workgroup subsequently also asked National Grid NTS to provide another 'worst case' scenario based on the Shell low flow period in June 2016 (using actual CO_2 data and NEA upper limits). To calculate the CO_2 blend at St Fergus terminal under each of BP's 4 scenarios, National Grid NTS altered:

- the Shell flow from 18.3 mscm/d to 10.4 mscm/d
- Shell CO_2 content from 1.6% to the maximum CO_2 limit of 2.0%

The results below in Table 3 show an increase above 4% CO_2 content entering the NTS under two of the BP scenarios.

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30th June 2016 (172mscm/d National Demand)					
Scenario 1			Scenario 2		
BP Results	NG Previous Result	NG New Result	BP Results	NG Previous Result	NG New Result
3.65	3.65	3.94	3.78	3.79	4.13

30th June 2016 (172mscm/d National Demand)					
Scenario 3			Scenario 4		
BP Results	NG Previous Result	NG New Result	BP Results	NG Previous Result	NG New Result
3.66	3.66	4	3.87	3.88	4.24

Table 3: Additional worst case scenario - National Grid NTS analysis compared with BP analysis

Members of the Workgroup felt that this extreme scenario is unlikely to occur as the low flow from the Shell terminal was caused by a planned outage of the main Segal Shipper and in such a situation the following steps would have been taken in advance to mitigate CO_2 >4% entering the NTS:

- Rhum owners would procure sufficient firm quantities of low CO_2 gas via the Norwegian Vesterled pipeline;
  or
- Rhum owners would cut back or shut in production to limit the volumes of high CO_2 gas

It should also be noted that the BP scenarios, on which this extreme scenario is based, already assume that a number of unlikely events would occur concurrently, namely:

- Conservative assumption in BP scenarios that there would be no low CO_2 blend gas flow via the Norwegian Vesterled pipeline. Vesterled < 3.7% CO_2 with average summer flow rates of 10.4 mcm in 2016.
- Conservative assumption of concurrent outages of all the fields delivering gas into the FUKA pipeline system e.g. BP scenario 4 assumes FUKA is operating at around 20% of normal throughput rates.

It should be further noted that:

- a new Norwegian field is due to start-up shortly which will bring additional volumes of low CO_2 blend gas into the FUKA pipeline system which will further help mitigate any Laggan/Tormore unplanned trip scenarios; and
- The limited resolution of the heat map masks some effects at entry points and does not mean that National Grid's ability to comply with an offtake limit close to another source of supply could not be achieved within the relevant contractual limit.

CO_2 content at Norwegian gas fields

The Workgroup asked if changing the CO_2 limit to 5.5% would introduce a risk of higher CO_2 gas entering through the Vesterled pipeline in the future. Information received from Gassco indicated that:

- The historical range in CO_2 levels have been in the range 1.5% - 3.5%
- Forecast CO_2 levels are expected to be in the range 1.5% - 4%.

c) Anticipated Impact on Gas Quality

The Workgroup sought input from NSMP to improve their understanding of how the plant operates at the right Wobbe Index level and the effect on the CO_2 levels/liquids.

The composition of export gas from St Fergus is monitored by the NSMP control room and procedures are in place to ensure the specification of export gas is maintained. NSMP is fully aware of the composition of commingled pipeline gas upstream of the terminal and therefore would be aware of higher CO_2 concentrations in FUKA pipeline gas well before such gas reaches the terminal (as they are today). If NSMP's pipeline operating model suggested that by processing such gas, the lower specification for Wobbe Index might be breached, NSMP would modify the operating conditions at the terminal (specifically levels of Natural Gas Liquids (NGL) extraction) to ensure that the specification for export gas is met. This can be done relatively

quickly and well within the anticipated transit time of any high CO_2 gas present within the pipeline.

For background information only and in answer to questions from the Workgroup relating to CO_2 concentrations in liquids export and maintaining water dew point, NSMP has stated that, in theory, there is some impact on the water dewpoint of export gas through increased CO_2 content however, this is taken care of by the gas dehydration system and in all cases modelled, the sales gas remains well within specification (by a margin of over 40°C). With respect to CO_2 concentrations in liquids export, NSMP does not believe that this is relevant to a debate on NTS gas specification but it remains NSMP's responsibility to ensure that all products exiting the terminal meet the appropriate specifications.

Impact on other gas quality parameters

The Workgroup requested that analysis be performed on the consequential impacts of increased CO_2 on other gas quality parameters. The St Fergus terminal operator provided correlations of CO_2 content with other NEA Specifications in the gas delivered to the NTS from the FUKA pipeline. The CO_2 content of the processed gas from the FUKA pipeline has been correlated with several GS(M)R parameters measured at the same time (namely, WOBBE, Gross Calorific Value (GCV), Incomplete Combustion Factor (ICF) & Soot Index (SI)). The specification of processed gas from the FUKA pipeline is measured "stand- alone" before commingling with Vesterled gas and is upstream of the NTS compressor station. The data includes certain short-duration periods when blending with Vesterled gas was required due to higher CO_2 concentrations in FUKA pipeline (as per the current blending arrangements). See Figure 5 for correlation of CO_2 with Wobbe Index.

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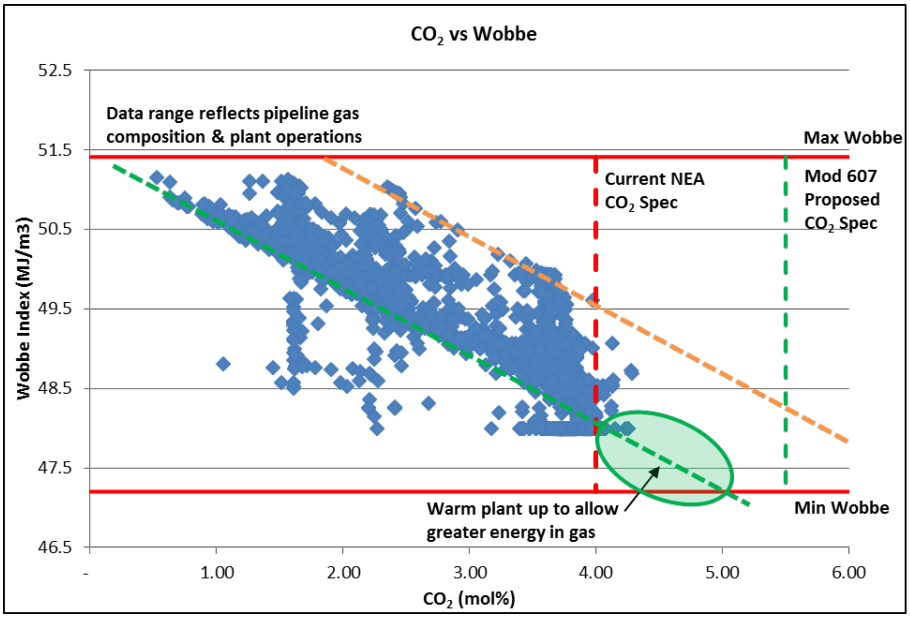

Figure 5: Carbon Dioxide vs Wobbe Index

In summary, the historic data analysed reflects variations in pipeline gas composition and also

plant operation. An increased CO_2 content of FUKA gas reduces Wobbe and (to some degree) GCV of redelivery gas. Higher CO_2 content gas may need to be managed by adjusting the processing plant operation (warmer plant) to reflect the pipeline gas composition and ensure the export gas meets the lower Wobbe specification.

European Standard on Gas Quality

The European Committee for Standardisation (CEN) published its gas quality standard EN16726 in December 2015. Agreement could not be reached on a harmonised range for Wobbe-Index but was for all other components including CO_2, for which the CEN standard states:

- "At network entry points and cross border points the maximum mole fraction of carbon dioxide shall be no more than 2.5%. However, where the gas can be demonstrated to not flow to installations sensitive to higher levels of carbon dioxide, e.g. underground storage systems, a higher limit of up to 4% may be applied."

The standard's application to Member States is voluntary, although the European Commission had already stated its aspiration to see the standard implemented across Europe. To that end, the Commission requested that ENTSOG conduct an impact analysis and propose an amendment to the EU Interoperability Network Code to make its implementation legally binding.

ENTSOG's project to examine the impacts was conducted during 2016 and this CO_2 wording raised a number of issues for GB at that time. For example, it was not clear how the flexibility between 2.5% and 4% would be applied and managed over time, and, as the GB network contains underground storage facilities, it appeared that all GB entry points would need to conform to a 2.5% limit. Analysis by National Grid NTS showed that this would be expected to have a material negative impact on GB security of supply. This, together with a number of other concerns raised by EU market participants, resulted in the Commission announcing at the Madrid Forum in October 2016 that it did not propose to proceed with making the standard legally binding at this stage but would reconsider gas quality harmonisation again when further CEN work seeking to establish a harmonised Wobbe Index range reaches a conclusion, which is unlikely to be before 2020.

d) National Grid NTS' Assessment of its Operational Risks

National Grid NTS assessed the possible NTS operational risks arising from higher CO_2 levels from an NTS integrity perspective. National Grid NTS assessed the risks in terms of:

- Impact on pipeline corrosion rate of higher CO_2 gas if water was present in NTS pipelines.

- Confirmation that the CO_2 levels on the NTS passing a salt cavity storage facility will not have a higher pipeline corrosion rate.
- Impact of higher CO_2 levels on compressor start-up (if any).
- Impact on compressor running associated with a rapid change in CO_2 (such as might be expected with a trip) (if any).

In summary, the conclusions of these assessments are as follows:

- Transportation of gas with a CO_2 content of 5.5% would not increase corrosion risk if the network is dry or in the event that small amounts of water are present which result in thin aqueous films on the inner wall of a pipeline.
- If significant quantities of water were admitted into an NTS pipeline causing the formation of pools of 5mm depth accompanied by gas with a CO_2 content of 5.5%, significant corrosion damage would occur, particularly if multiple instances of such water ingress occurred over the operational life of the pipeline.
- A water dewpoint limit of -10° C at transmission pressures means that corrosion would only occur if the pipeline wall temperature at the location of gas entering from a salt cavity storage facility were at this temperature or below, thus allowing the formation of liquid water in the pipeline. A sustained temperature of less than -10° C has not occurred in the UK based on Met Office records, therefore there should be no impact if gas with a CO_2 content at 5.5% passes a salt cavity storage site.
- Gas with a 5.5% CO_2 content is not expected to impact the performance of National Grid's compressors at St Fergus provided that the total inerts content of the gas (i.e. CO_2 plus nitrogen) remains below 7mol%.
- As a consequence of this output from National Grid NTS' assessment, the Modification was amended to include this aggregate limitation for total inerts content.

e) Impact on Consumers

The analysis conducted suggests that Direct Connects (DCs) should not receive over 4mol% CO_2 as a result of an unplanned outage at Laggan Tormore but a slug of higher CO_2 (up to 3.87%) could enter the NTS and the duration could be up to 15 hours (worst case scenario).

The Heat Maps provided by National Grid NTS identify the flow routes, and areas which might potentially be affected if penetration reaches further zones.

The Workgroup has sought views on the impacts on end consumers. For Modification 0498/502 information was provided by affected parties in relation to:

Combined Cycle Gas Turbines (CCGTs)

- Linking CCGT Trips to Changes in Gas Quality
- Direct Costs for CCGT Trips/Retuning
- Warranty Impacts
- Downstream Consumers – impact on CO_2 Removal Systems

However, the competitive position of Peterhead CCGT could be negatively affected due to increased risk of tripping and consequential cashout penalty if these unlikely events were to occur as a result of the implementation of this modification.

The Joint Office contacted the Major Energy Users' Council (MEUC); the Energy Intensive Users Group (EIUG) and the Chemical Industries Agency (CIA) groups for views on the impacts

on them from this proposal. David Mitchell from CIA attended a workgroup meeting and advised that CIA is supportive of increased gas supplies into GB and thus seeks greater transparency and increased visibility in what restrictions are in place at Terminals. The CIA is in support of this modification. It was noted that Ofgem published gas quality limits at NTS entry points in 2004 although no update had since been made.

f) Impact on Storage Operators

In the very unlikely event that other sub-terminals at St Fergus and Vesterled are not flowing, coincident with a Laggan/Tormore trip, gas penetration analysis has identified that gas storage in the North-West of England could receive gas with a higher level of CO2 than at present. Uniper provided the workgroup with a statement in relation to this (see Statement 1 below).

"For gas storage, the primary concern associated with an increase in CO_2 content is the increased risk of carbonic acid corrosion in any standing water. An increase would raise the average concentration of CO_2 dissolved in any standing water in the pipelines, increasing the corrosion rate. This has the potential, in the worst case, to lead to plant failure. An increase in CO_2 above the current level would need further study to better understand the potential risk throughout the life of the plant. There could also be a small (negligible) reduction in storage capacity and an increase in compressor costs if the CO_2 increase reduces the average gas Calorific Value."

Statement 1: Uniper statement on impact for Gas Storage

g) Carbon Cost Assessment

At present, gas with high levels of CO_2 concentration flows from offshore fields and under normal circumstances is blended in the FUKA pipeline with gas of lower CO_2 concentration feeding into the pipeline from other fields such that the combined commingled flow of gas exiting the St Fergus terminal and entering the NTS meets the current NTS entry specification for CO_2 at 4mol%. Therefore, the tonnage of CO_2 associated with gas with high levels of CO_2 concentration already flows into the NTS albeit in a diluted form.

The options for addressing the possible increases in CO_2 levels in export gas during periods when dilution in the FUKA pipeline is unavailable or reduced are to either:

- allow such gas to flow directly into the NTS up to a new agreed level (5.5mol%), or
- to remove the excess CO_2 above the current allowable specification (4.0mol%) using CO_2 removal technology.

Modification 0498 (http://www.gasgovernance.co.uk/0498) and 0502[1] (http://www.gasgovernance.co.uk/0502) considered the following three scenarios, which are relevant to this modification proposal:

1. Non-removal of CO_2;
2. Removal Offshore; and

Field Code Changed

Field Code Changed

[1] Final Modification Report 0498: Amendment to Gas Quality NTS Entry Specification at BP Teesside System Entry Point and 0502: Amendment to Gas Quality NTS Entry Specification at the Teesside System Entry Point

3. Removal Onshore.

The removal technology in this scenario remains the same as that considered in Modification 0498/ 0502 and the significant cost (c. £200m) and long lead time (c. 3 years) associated with the brownfield engineering modifications required for options 2 and 3, all of which remain unchanged from 0498/0502, renders these options non-viable for use here on an ad-hoc basis. In addition, the key conclusion of the Teesside carbon cost assessment is that significantly more CO_2 is emitted by removing CO_2 from the gas due to the fact that CO_2 removal using amine units, the optimal technology for CO_2 extraction given the CO_2 concentration, requires process heat which generates additional CO_2. The magnitude of expected CO_2 emissions here is similar to the Teesside modification.

It is important to recognise that the overall tonnage of CO_2 in Rhum gas entering the NTS on a day remains unchanged irrespective of the overall CO_2 concentration of the aggregate commingled gas entering the NTS from the terminal. On most days, there is sufficient blend gas to reduce the concentration of CO_2 to below the current spec of 4mol% but the tonnage of CO_2 in the Rhum gas remains in the commingled flow. When there is insufficient blend gas, under this NEA modification, gas would enter the NTS with higher overall CO_2 concentration but (assuming constant flow rates) the tonnage of CO_2 in the Rhum gas would remain unchanged; it would just make up a bigger proportion of what is effectively a smaller volume leaving the terminal.

When this is considered together with the overall cost of mitigation and creation of additional emissions through mitigation, the conclusion for this Modification 0607S, based on data from the Teesside report that the least impact in terms of overall CO_2 emissions is to allow the gas with high CO_2 to flow into the NTS, is also valid for the proposed St Fergus modification.

h) Wider Considerations

Maximising Economic Recovery

Implementing the change will remove the significant cost of securing additional firm blend gas from Norway and remove the probability of early Cessation of Production from the Rhum and associated Bruce and Keith fields. This will have a positive impact on the security of supply for the UK as a whole. Recovery of oil and gas from the specific fields will be maintained, while the continued flow of gas into the pipeline systems ensure a more efficient and economic operation of the pipeline system and the increased utilization of the existing infrastructure capacity will extend the useful life of existing assets and enable further new developments to access the pipeline infrastructure in the future.

The Oil and Gas Authority (OGA) have provided the following statement (updated 08 June 2017, see Statement 2 below) with regards to their involvement to facilitate solutions for blending of high CO_2 gas from the Rhum field in pursuit of Maximising Economic Recovery (MER).

"Following on from the Wood report and the establishment of the OGA as a new regulator for the UK upstream Oil and Gas industry there have been a number of legislative changes to establish the role of the new OGA and to clarify the obligations for all upstream industry participants. The Maximising Economic Recovery Strategy for the UK was published in 2015. The central obligation of this strategy is that 'Relevant persons must, in the exercise of their relevant functions, take the steps necessary to secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters'.

In its pursuit of fulfilling this obligation the OGA has actively intervened with the owners of the Rhum field and the operators of the Bruce field, the FUKA infrastructure and the SIRGE pipeline /Shetland Gas Plant (SGP).

These interventions have included: -

- *Facilitating completion of negotiations of an amended Rhum/FUKA Transportation Agreement which allowed ramp up of Rhum production from 1MCM/d to 5MCM/d albeit with additional payments required to secure arrival of sufficient Vesterled pipeline gas at the FUKA terminal as additional assurance against temporary % CO_2 excursions exiting the terminal. This additional assurance represents significant UK value leakage.*
- *Encouraging follow on discussions between the Bruce/Rhum Operator and the FUKA operator to optimise pipeline and terminal operations which have reduced the requirement for guaranteed Vesterled blend gas at FUKA.*
- *Discussing potential upstream solutions with the owners /operator of SGP around plant trips and the timing of subsequent start ups*
- *Discussing with the prospective new owner operator of the SAGE terminal around the potential use of SAGE CO_2 removal equipment to give further assurance around the % CO_2 leaving the St Fergus National Grid plant (such service provision is potentially alleviated by the change in operatorship away from a US company).*

In addition, the OGA has engaged in discussion with National Grid to promote understanding of the OGA's role and in understanding the capacity for blending and risk reduction across the St Fergus terminals.

The driver for all these interventions is to reduce the economic impact of current blending approaches on the Rhum field and potentially on other high CO_2 fields which based on forecasts and information seen by the OGA will lead to premature cessation of production of the Bruce /Rhum offshore Hub (loss of significant UK gas to the downstream system) and will deter further upstream investments to recover additional gas which are currently being planned contingent on achieving a sustainable lower cost blending solution".

Statement 2: OGA statement on modification proposal 0607S

Impacts on Producers

As a Producer, Shell's ability to accept a higher CO_2 at NSMP (from 4% to 5.5%) will depend the operating status of the various fields delivering gas into Shell St Fergus. Under normal operating conditions, the CO_2 content of this gas may permit a higher specification in the NEA at the NSMP sub-terminal, partly due to previous investment undertaken by field owners delivering gas into Shell St Fergus. However, in non-normal operating conditions, even the fields delivering gas into Shell St Fergus may themselves need a temporarily higher CO_2 content. Approval of the proposed UNC modification may remove National Grid's ability to

accept such gas from other producers, with priority to any flexibility on the part of National Grid given to NSMP flows. In recognition that such flexibility could potentially not be available, National Grid NTS proposed to limit the duration of the proposed CO_2 limit based on its need for use.

Risk of setting precedent

The Workgroup considered whether any decision taken for Modification 0607S might set a precedent for any other, future, requests at entry points. Ofgem's view as expressed in their UNC 0498/0502 Ofgem Decision Letter (25th September 2015) in response to concerns that the 0498/0502 modifications would create unnecessary barriers to future supplies entering the NTS stated:

> "…that it is open to UNC parties to raise any further gas quality modification proposals, and any such modification proposal will be assessed on a case by case basis on its merits and with respect to the UNC relevant objectives; therefore, this decision should not be seen as setting any precedent for the future"…

National Grid has considered this in detail and this material can be seen in section i) below. A number of concerns have also been raised by some Shippers with respect to National Grid's proposals and that these proposals themselves raise issues with respect to precedent setting. These are also set out in section i) below.

i) National Grid NTS' Assessment of Effect on its Compliance with Relevant Licences and Obligations and concerns raised by Shippers as a result.

National Grid NTS considered whether the implementation of Modification 0607 and the subsequent NEA amendment would have an impact on its obligations to avoid any undue preference or undue discrimination in the terms on which it undertakes conveyance of gas and avoid conferring any unfair commercial advantage on any industry party. National Grid NTS concluded that it could continue to comply with these obligations, however National Grid was concerned about whether this would remain the case into the future if other parties were to request similar arrangements that National Grid NTS may not be in a position to grant.

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In and of itself, implementation of Modification 0607 as currently drafted and execution of the subsequent NEA amendment would in National Grid NTS' view be neither unduly discriminatory, nor would it confer an unfair commercial advantage for NSMP or shippers that deliver gas through the NSMP terminal. This is because National Grid NTS does not believe that any detrimental effect on competition will occur whilst no other industry parties demonstrate any requirement for such an elevated CO_2 limit at St Fergus or any other terminals. If such requests were to be made which the NTS is capable of accommodating, again, National Grid NTS does not see any detriment to competition or potential for undue discrimination.

National Grid NTS is concerned, however, about the potential for an anti-competitive effect if such a request occurs in the future that National Grid NTS is unable to accommodate under the current arrangements for gas quality management. This may arise either due to a proliferation of such requests or a specific locational constraint that would affect National Grid NTS' ability to meet other existing contractual obligations. Whilst the provision of information from the OGA to the Workgroup indicates that at present there are no other high CO_2 fields in prospect, there remains a possibility that such requests could still arise from other upstream parties who may wish to widen their specification with National Grid as an alternative to investing in new / replacement processing capability.

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In a wider context, National Grid NTS noted that there have been a number of UNC Modifications brought forward in recent years seeking gas quality limits that are outside the 'norm' as stated in National Grid NTS' Gas Ten Year Statement. As the UKCS declines, GB import dependency increases and sources of supply continue to diversify, National Grid NTS stated its wish to explore with the industry the extent to which these types of requests are likely to continue / increase and hence whether current arrangements for gas quality management and the change process for individual parameters remain appropriate. This is being pursued as part of a separate consultation on gas quality arrangements by National Grid NTS.

The proposer and National Grid NTS have come to agreements in an effort to mitigate these concerns by introducing a time limitation into the legal text and an objective test of continued requirement, together with an option to allow National Grid NTS to reduce the flexibility offered to NSMP should the situation change in future.

The amended Modification v3.0 contains provision for these mitigations. At Workgroup, some participants did not agree that a provision for National Grid NTS to reduce the NSMP limit in the future if flexibility became constrained was the right and fair way of addressing the problem. ~~National Grid NTS needed to consider further its legal position and the Modification Proposer required more time to assess its modification and whether any further changes are required in light of discussion which took place.~~

While most Workgroup participants support the provision for time-limiting the raised CO_2 limit subject to the demonstration by NSMP of an objective continued need, there was concern that allowing National Grid the additional right to unilaterally reduce the flexibility offered to NSMP at any time potentially sets a precedent for future UNC Modifications. It was noted by some Shippers at Workgroup that each UNC modification is considered individually and on its own merits. This mechanism is clearly demonstrated in the Mod 0498/0502 process and the Ofgem Decision Letter. A valuable result of this process is that the possibility of a future Modification seeking similar amendments is not considered in any debate for a submitted Modification as this would require a Workgroup to consider future outcomes, which by definition are unclear. As National Grid noted above, this issue should be part of a further consultation process.

j) Workgroup Conclusions

No clear conclusions have been achieved. Workgroup participants differed in their view of these changes, depending on the impacts they believed were most relevant to them. This report seeks only to document the arguments to inform further consideration within the UNC modification process (which assesses against the Relevant Objectives). Participants believed that there are other considerations, such as the wider UK interest and UK Government Policy, which are beyond the vires of a UNC modification.

The proposer, NSMP and National Grid NTS have come to agreements which aim to mitigate National Grid NTS' concerns by introducing a time limitation into the legal text, an objective test of continued requirement and a mechanism to share flexibility should it be required in the future.

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Comment [RH2]: This was written to support the request to panel for more time.

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7 Relevant Objectives

Impact of the modification on the Relevant Objectives:

Relevant Objective	Identified impact
a) Efficient and economic operation of the pipe-line system.	Positive
b) Coordinated, efficient and economic operation of (i) the combined pipe-line system, and/ or (ii) the pipe-line system of one or more other relevant gas transporters.	None
c) Efficient discharge of the licensee's obligations.	None
d) Securing of effective competition: (i) between relevant shippers; (ii) between relevant suppliers; and/or (iii) between DN operators (who have entered into transportation arrangements with other relevant gas transporters) and relevant shippers.	Positive
e) Provision of reasonable economic incentives for relevant suppliers to secure that the domestic customer supply security standards… are satisfied as respects the availability of gas to their domestic customers.	None
f) Promotion of efficiency in the implementation and administration of the Code.	None
g) Compliance with the Regulation and any relevant legally binding decisions of the European Commission and/or the Agency for the Co-operation of Energy Regulators.	None

This modification to change the CO_2 limit at the NSMP Sub-Terminal has been preceded by discussion between National Grid NTS and BP, aimed at assessing the feasibility of such change. Some of the following considerations therefore reflect both the results of National Grid NTS analysis and BP's own assessment of changes.

Positive impacts have been identified on the objectives of *a) efficient and economic operation of the pipeline system* and on *d) competition among shippers*.

The combined flows of Bruce and Rhum fields contribute around 5% of UK domestic gas supply into the NTS. These flows help towards a more efficient and economic operation of the pipeline system thanks to an increased utilisation of the existing infrastructure capacity and extending the useful life of existing assets. In addition, extending the production life of the Bruce and Rhum assets allows a wider range of gas into the network and mitigates instances of interruption in production flows, due to seasonal maintenance programs which affect the overall supply of gas to the UK market. In addition, the Workgroup has concluded that the lowest cost option would be to permit the entry of up to 5.5% CO_2 content from NSMP at St Fergus rather than install upstream removal of CO_2 or for the blending gas from Vesterled to continue to be procured.

Competition between shippers should be improved through maximization of available production by avoiding early cessation of production, maintaining diversity and reducing reliance on imported gas. In addition, the presence of domestic supplies could contribute to efficient price formation and help sustain the National Balancing Point (NBP) as a liquid hub.

8 Implementation

Currently, self-governance procedures apply and, as such, implementation could be sixteen business days after a Modification Panel decision to implement, subject to no Appeal being raised.

The workgroup notes that should Authority Direction be granted, implementation…

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9 Legal Text

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Text Commentary

As this is an enabling modification, no UNC legal text is required.

Suggested Text

Suggested text to modify the Network Entry Provisions contained within the relevant NEA has been provided by the Proposer.

"2.3 Gas tendered for delivery by System Users to the System at the System Entry Point shall not contain any solid, liquid or gaseous material which would interfere with the integrity or operation of the System or any pipeline connected to such System or any appliance which a consumer might reasonably be expected to have connected to the System. In addition, all gas delivered to the System at the System Entry Point shall be in accordance with the following values:

*(k) Carbon Dioxide not more than 5.5mol% (or such other limit as may be agreed) during the Modification Period and not more than 4.0mol% at all other times**

(o) The aggregate content of CO_2 and N_2 in delivery gas shall not exceed 7mol% during the Modification Period"

*This would be appropriately qualified in the NEA amendment to enable a reduction in the CO_2 limit to between 4.0mol% and 5.5mol% to be applied within the Modification Period with the objective of sharing flexibility available in a non-discriminatory manner if another UNC Modification(s) to increase the CO_2 limit at another System Entry Point(s) were to be approved and which National Grid would otherwise be unable to accommodate at no material cost.

It is also envisaged that at the end of each Gas Year from 2023 NSMP will be required to demonstrate to National Grid NTS that commingled gas with CO_2 concentrations in excess of 4mol% has been received at the St Fergus plant through the FUKA pipeline during that year and if this cannot be demonstrated the Modification Period will end at 1st October of the following Gas Year.

National Grid NTS would be obliged to notify all Users of the start and end dates of the Modification Period and any reduction in the CO_2 limit that may be applied within the Modification Period pursuant to UNC TPD Section I2.2.6.

The Workgroup has considered the suggested text to modify the Network Entry Provisions, provided above and is satisfied that it meets the intent of the Solution.

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10 Recommendations

Workgroup's Recommendation to Panel

The workgroup requests that Panel:

- re-assess whether self-governance procedures are suitable for this modification; and
- subsequently issue the report to consultation.

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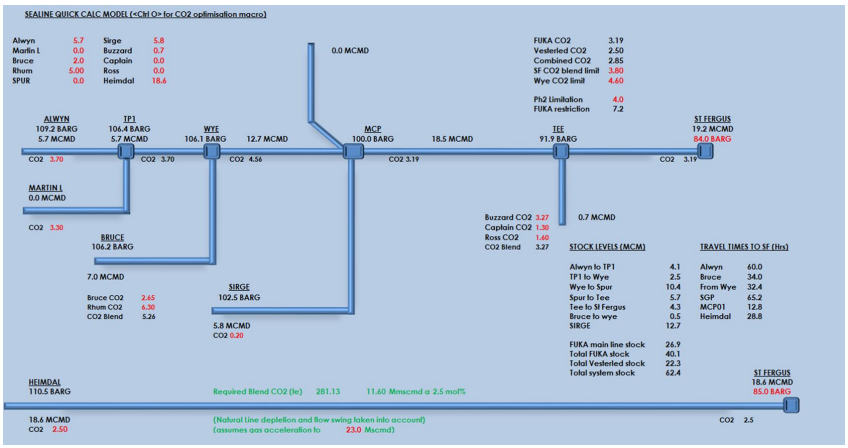
11 Appendices

Appendix 1 - St Fergus Flow Map

Please find below an example of the operational flows at St Fergus NSMP terminal.



Appendix 2 – NTS Blending Scenarios

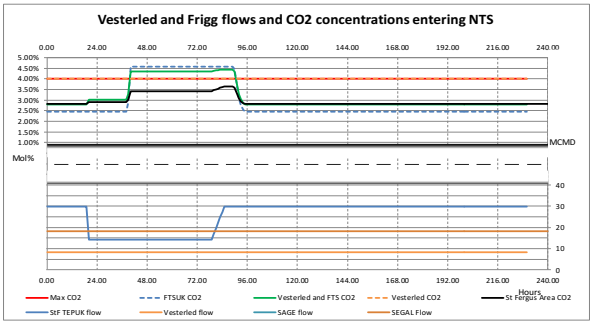
Four different scenarios were analysed and all four assume Laggan/Tormore trips for over 60 hours (highest of historical trips observed) on an ordinary summer's day. These represent four extreme worst case scenarios.

Summer Norm– Reference Day 30 June 2016
NTS Blending Scenario 1

This scenario imagines an offspec event on an ordinary summer's day, using actual average flow rates from SAGE and SEGAL, but adjusting NSMP flows.

It assumes that flows are stable except for Laggan Tormore tripping

- SAGE flow rate of 20MCM/d at 4% CO2 (No blending benefit)
- SEGAL flow rate of 18.3MCM/d at 1.6% CO2 (entry spec)
- Vesterled is flowing 8.2MCM/d at 4% CO2 (No blending benefit – assume some Valemon gas is flowing)
- Frigg system is flowing near maximum rate (30MCM/d) until:
- Laggan Tormore trips – zero flow for 60 hours
- CO2 peaks out at 3.65%



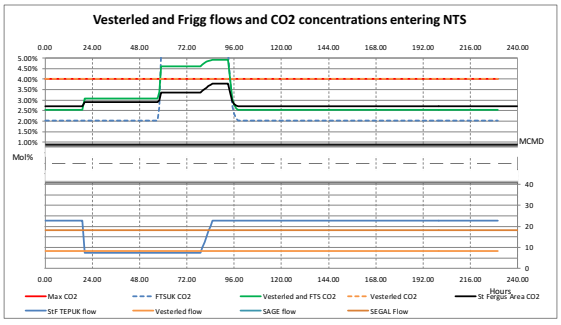
At	Max CO2	Time of max CO2	Time first exceeds 4%	Flowrate at max CO2	Dura (Ho
Frigg UK at St Fergus	4.57%	82	40	22.1	5
Frigg UK + Vesterled	4.45%	86	40	58	5
St Fergus Area	3.65%	86	never	76.3	

Summer Norm– Reference Day 30 June 2016
NTS Blending Scenario 2

This scenario imagines an offspec event on an ordinary summer's day, using actual average flow rates from SAGE and SEGAL, but adjusting NSMP flows.

It assumes that flows are stable except for Laggan Tormore tripping

- SAGE flow rate of 20MCM/d at 4% CO2 (No blending benefit)
- SEGAL flow rate of 18.3MCM/d at 1.6% CO2 (entry spec)
- Vesterled is flowing 8.2MCM/d at 4% CO2 (No blending benefit – assume some Valemon gas is flowing)
- Frigg system is flowing at high rates (23MCM/d – Alwyn is offline) until:
- Laggan Tormore trips – zero flow for 60 hours
- CO2 peaks out at 3.78% CO2



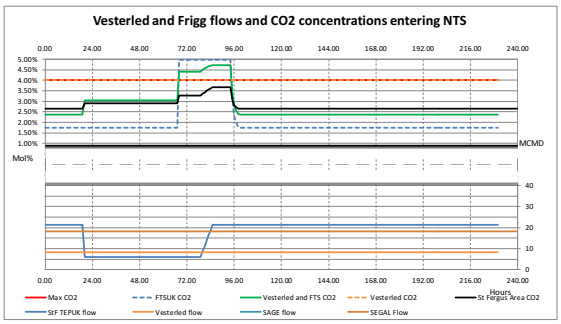
At	Max CO2	Time of max CO2	Time first exceeds 4%	Flowrate at max CO2	Duration (Hours)
Frigg UK at St Fergus	5.27%	83	59	17.6	35
Frigg UK + Vesterled	4.93%	85	59	51	35
St Fergus Area	3.78%	85	never	69.3	0

Summer Norm– Reference Day 30 June 2016
NTS Blending Scenario 3

This scenario imagines an offspec event on an ordinary summer's day, using actual average flow rates from SAGE and SEGAL, but adjusting NSMP flows.

It assumes that flows are stable except for Laggan Tormore tripping

- SAGE flow rate of 20MCM/d at 4% CO2 (No blending benefit)
- SEGAL flow rate of 18.3MCM/d at 1.6% CO2 (entry spec)
- Vesterled is flowing 8.2MCM/d at 4% CO2 (No blending benefit – assume some Valemon gas is flowing)
- Frigg system is flowing at mid rates (21MCM/d – Alwyn is offline and Rhum has reduced to 3.5MCM/d) until:
- Laggan Tormore trips – zero flow for 60 hours
- CO2 peaks out at 3.66%



At	Max CO2	Time of max CO2	Time first exceeds 4%	Flowrate at max CO2	Duration (Hours)
Frigg UK at St Fergus	4.99%	83	68	16.2	27
Frigg UK + Vesterled	4.71%	85	68	49.6	27
St Fergus Area	3.66%	85	never	67.9	0

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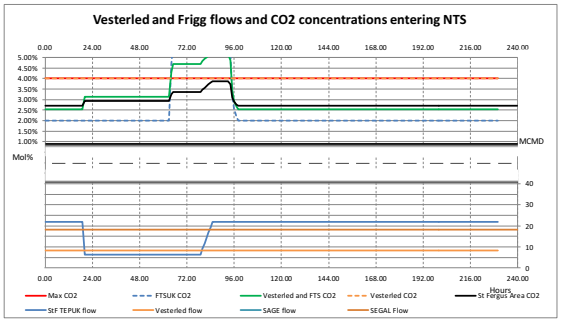
Summer Norm– Reference Day 30 June 2016
NTS Blending Scenario 4

This scenario imagines an offspec event on an ordinary summer's day, using actual average flow rates from SAGE and SEGAL, but adjusting NSMP flows.

It assumes that flows are stable except for Laggan Tormore tripping

- SAGE flow rate of 20MCM/d at 4% CO2 (No blending benefit)
- SEGAL flow rate of 18.3MCM/d at 1.6% CO2 (entry spec)
- Vesterled is flowing 8.2MCM/d at 4% CO2 (No blending benefit – assume some Valemon gas is flowing)
- Frigg system is flowing at disrupted rates (22MCM/d – Alwyn is offline and Bruce has reduced to 1.5MCM/d) until:
- Laggan Tormore trips – zero flow for 60 hours
- CO2 peaks out at 3.87%



At	Max CO2	Time of max CO2	Time first exceeds 4%	Flowrate at max CO2	Duration (Hours)
Frigg UK at St Fergus	5.61%	83	64	16.7	31
Frigg UK + Vesterled	5.17%	87	64	50.1	31
St Fergus Area	3.87%	87	never	68.4	0

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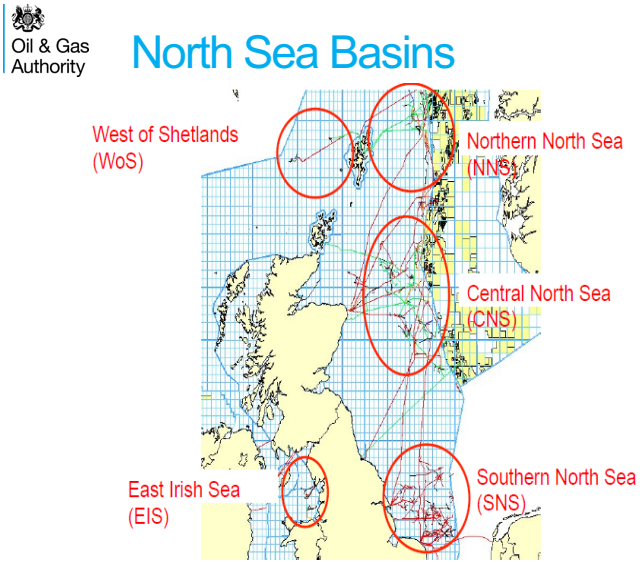
Appendix 3 - Anonymised listing of relevant potential developments from the OGA

BP requested some background information with regards potential developments in the UKCS over the timeframe being discussed for modification 0607S. The following two slides were received from the OGA: an anonymised listing of potential developments coming on-stream in the near future. The data provides useful context in that there are no high CO_2 fields that are either being proposed or are in development in the near future.



Oil & Gas Authority

Proposed Developments % CO2

Proposed Development	Area	Peak Deliverability	CO2	Difference with 4 %
		McM/d	mol%	
A	WOS	0.6	1.2	-2.8
B	WOS	1.8	3.8	-0.2
C	WOS	2.2	3.8	-0.2
D	WOS	3.5	3.8	-0.2
E	CNS	2.8	2.9	-1.1
F	CNS	0.9	2.3	-1.7
G	CNS	2.3	3.2	-0.8
H	CNS	13.4	2.2	-1.8
I	CNS	1	1.6	-2.4
J	CNS	1.5	1.8	-2.2
K	CNS	3.8	1	-3
L	NNS	2	1	-3
M	SNS	6.4	0.9	-3.1
Average			**2.3**	**-1.7**
Weighted Average			**2.2**	

- Indicative data for Potential developments in next 5 years
- Includes gas export from Gas, Gas/Condensate and Oil developments (associated gas)
- Upstream Operator data (e.g. Draft Field Development Plans)
- Dominated by Central North Sea and West of Shetland

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National Grid NTS considers that this is preferable to a 'lowest common denominator' approach whereby a request to increase a limit at an NTS entry point which can be accommodated would be denied because such a limit could not be accommodated at all other locations. The disadvantage is that if further similar requests were to be made by other upstream parties, a 'tipping point' may be reached at which the last party to make such a request is refused while all prior requests have been accepted.

A consequential lack of flexibility may prevent other supplies from entering the NTS.

Page 6: [2] Deleted	Kirkpatrick, Murray	03/10/2017 14:42:00

NSMP suggests that any issue of competition between a producer and a shipper counterparty should be between those parties and is not an issue for the Workgroup.

NSMP further believes that any commercial arrangements that the Rhum Owners may have entered into for the provision of Norwegian gas down Vesterled does not provide an argument for Authority direction as these arrangements are arguably in a different jurisdiction (Norway) and most certainly upstream of the NTS, which is the primary consideration for this Workgroup.

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There is concern that offering 5.5% to a group of shippers at one sub-terminal without offering that limit at other locations could be detrimental to competition between shippers. This are needs to be further explored by the Workgroup.

No other CO_2-related modifications have been raised since 0498/0502 and no other modifications have been raised since this modification was raised on 07 December 2016. (See also Appendix 3 where data from the OGA on potential developments in the relevant area of the UKCS are presented in summary format, all with low CO_2).

Non- implementation of this modification proposal would, it is asserted, lead to early CoP of these field which has a significant impact on security of supply. Early cessation of production at Rhum is an assertion by the Proposer which is supported by the statement from the OGA.

Page 29: [4] Deleted	Rebecca Hailes	06/09/2017 15:39:00

"2.3 Gas tendered for delivery by System Users to the System at the System Entry Point shall not contain any solid, liquid or gaseous material which would interfere with the integrity or operation of the System or any pipeline connected to such System or any appliance which a consumer might reasonably be expected to have connected to the System. In addition, all gas delivered to the System at the System Entry Point shall be in accordance with the following values:

(k) Carbon Dioxide Not More than 5.5mol% during the Modification Period and not more than 4.0mol% at all other times

(o) The aggregate content of CO2 and N2 in delivery gas shall not exceed 7mol% during the Modification Period"

It is proposed that the definition of the Modification Period within the NEA between NSMP and National Grid NTS will have the effect of limiting the duration of these changes to gas quality limits to the time for which they are required. It is currently envisaged that the Modification Period will be defined as being from the effective date of the amendment until 1st October 2024. To accommodate a situation where field life extends beyond the agreed date of 1st October 2024, it is also currently envisaged that at the end of each Gas Year from 2024 NSMP will be required to demonstrate to National Grid NTS that commingled gas with CO2 concentrations in excess of 4mol% has been received at the St Fergus plant through the FUKA pipeline during that year and if this cannot be demonstrated the Modification Period will end at 1st October of the following Gas Year. National Grid NTS would be obliged to notify all Users of the start and end dates of the Modification Period pursuant to UNC TPD Section I2.2.6."