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| UNC Modification | At what stage is this document in the process? |
|-------------------------|--|





UNC 0645S:

Amending the oxygen content limit in the Network Entry Agreement at South Hook LNG

- 01 Modification
- 02 Workgroup Report
- 03 Draft Modification Report
- 04 Final Modification Report

Purpose of Modification:

This Modification will enable an increase to the oxygen content limit of gas permitted by the Network Entry Agreement at South Hook LNG.

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|--|--|
|  | <p>The Workgroup recommends that this modification should be:</p> <ul style="list-style-type: none"> subject to self-governance <p>The Panel will consider this Workgroup Report on 15 March 2018. The Panel will consider the recommendations and determine the appropriate next steps.</p> |
|  | <p>High Impact:</p> <p>None</p> |
|  | <p>Medium Impact:</p> <p>None</p> |
|  | <p>Low Impact:</p> <p>Transporters, consumers</p> |

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1 Timetable

The Proposer recommends the following timetable:

| | |
|---|------------------|
| Initial consideration by Workgroup | 08 February 2018 |
| Workgroup Report presented to Panel | 15 March 2018 |
| Draft Modification Report issued for consultation | 15 March 2018 |
| Consultation Close-out for representations | 05 April 2018 |
| Final Modification Report available for Panel | 09 April 2018 |
| Modification Panel decision | 19 April 2018 |

? Any questions?

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2 Summary

What

In Great Britain, there are two oxygen limits that are pertinent to network entry requirements. The first 2000ppm (0.2mol%) is a safety limit specified in Schedule 3 Part 1 (regulation 8) of the Gas Safety (Management) Regulations. The second is a guideline limit of 10ppm (0.001mol%) contained in National Grid's Gas Ten Year Statement, which is currently in place in the South Hook LNG National Grid Network Entry Agreement (NEA).

This limit was applied at the nearby Dynevor Arms LNG storage facility in South Wales to mitigate the potential for water formation within the molecular sieves. At LNG storage sites, part of the liquefaction process prior to injection was to remove components in the gas offtake from the NTS that would otherwise freeze using molecular sieves. The presence of up to 0.2mol% oxygen in the gas would have therefore reduced the performance of that process and limited the life of those assets.

Why

GS(M)R (1996) allows for maximum O₂ levels of 2000ppm (0.2 mol%), however the current oxygen content limits set out in the Network Entry Agreement (NEA) at South Hook LNG Terminal are set at 10ppm (0.001mol%).

A small level of oxygen breakthrough from the Nitrogen Generation Unit (NGU) at the terminal can cause the 10ppm limit to be breached. As the source of the oxygen contamination is the NGU, the nitrogen ballasting must be reduced to rectify the fault with the NGU. The reduction in ballasting-nitrogen can subsequently cause a breach in the Incomplete Combustion Factor (ICF) specification limit.

When South Hook LNG came onstream at the nearby Milford Haven Entry point, the same 10ppm oxygen limit was applied in the South Hook LNG - National Grid NEA, to mitigate against the aforementioned issues at the Dynevor Arms LNG storage facility. Now the facility is obsolete, there is no longer a requirement for the strict oxygen limit. The proposer believes this limit is unnecessary and restrictive to the efficient operation of South Hook LNG terminal.

How

The proposal is to increase the limit for oxygen, as defined within the South Hook LNG NEA from the current limit of 0.001 mol% (10 ppm), to 0.02 mol% (200ppm). The proposed value falls well within the Gas Safety (Management) Regulation limit of 0.2 mol% (2000ppm). Pursuant to UNC TPD I2.2 this Modification, if approved, will enable a change to the South Hook LNG NEA.

It should be noted that similar enabling Modifications, [0561S "Amendment to the Oxygen Limit within the BBL/NTS Interconnection Agreement"](#) and [0581S "Amending the Oxygen content limit specified in the Network Entry Agreements at Grain LNG"](#) were approved by the UNC Modification Panel in November 2015 and July 2016 respectively and were both implemented under self-governance arrangements. An oxygen content limit of 200ppm (0.02 mol%) was agreed for both Modifications.

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3 Governance

Justification for Self-Governance

Based on two previous Modifications enabling a change to the same O₂ limit, the Proposer believes this is not likely to have a material effect on the self-governance criteria.

~~There is no discrimination between any of these parties. Gas quality limits vary at different entry points~~ and given Modifications 0561S and 0581S have been approved, this proposal isn't expected to materially change the current position in relation to discrimination between parties.

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Requested Next Steps

This modification should be subject to self-governance procedures and be assessed by a Workgroup.

4 Why Change?

De-risking the probability of an Incomplete Combustion Factor (ICF) breach

As explained above, the nitrogen ballasting from the NGU is used to keep the ICF within its specification limit. If there is an oxygen excursion on the NGU this causes the send-out oxygen to go off-specification if the nitrogen ballasting is not sufficiently reduced, in turn possibly causing an ICF specification breach. An increase in send-out oxygen limit would provide more room for an NGU oxygen excursion, allowing the nitrogen ballasting to continue at a higher rate and a reduced probability of a subsequent ICF excursion.

Security of supply

The ability of a Delivery Facility Operator (DFO) to deliver gas to the NTS at an entry point (or subterminal) is limited by the Network Entry Provisions contained in the relevant Network Entry Agreement (NEA) between the DFO and the relevant gas transporter. Amongst other things, the NEA will set a limit on the oxygen content of the gas to be delivered to the gas transporter's system, which is currently set at 0.001 mol% in **South Hook LNG's** ~~South Hook Gas~~' NEA with National Grid.

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As illustrated in [National Grid FES scenarios](#), import dependency is expected to increase and with this, GB can expect greater diversity in the gas composition of future cargoes. The current limit at South Hook LNG is at risk of being too restrictive to meet the composition of future cargoes, therefore it is in the interest of the UK gas market to better facilitate the delivery of LNG cargoes at Milford Haven.

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The short-term solution to achieving this is to allow a relatively modest increase to 0.02mol% in the oxygen limit at South Hook LNG. The second step in the mid-long term is currently being addressed in the current [JGEM Gas Quality Standard Working Group](#).

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Consistency with other entry points O₂ limit

The table below is a summary from Ofgem’s letter to industry titled [Establishing a gas quality Review Group](#) dated 20 September 2004 and the proposed new limit of 0.02mol% for the South Hook LNG NEA sits towards the lower end of the of the total number of 21 entry points cited in 2004.

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| O2 Content Limit (mol%) | # Entry Points | Cumulative # Entry Points |
|-------------------------|----------------|---------------------------|
| 0.001 | 7 | 7 |
| 0.100 | 9 | 17 |
| 0.200 | 4 | 21 |

It should be noted that similar enabling Modifications 0561S and 0581s were approved by the UNC Modification Panel in November 2015 and July 2016 respectively and implemented under self-governance arrangements. An identical 0.02 mol% oxygen content limit was agreed for both.

Therefore, this Modification proposal is consistent with similar change requests to NEAs in the past and in accordance with paragraph I2.2.3 (a) of the UNC Transportation Principal Document, a Code Modification has been chosen as the means by which to effect the changes to the oxygen content limits in the South Hook LNG NEA.

What the effects are, should the change not be made

The risk of avoidable ICF exceedances would still remain at South Hook LNG Terminal should the modest change not be made. South Hook LNG may also be disadvantaged in effective competition between other shippers and suppliers that are not subject to such a strict oxygen content limit.

5 Code Specific Matters

Reference Documents

Two previous similar Modifications are relevant in this case:

- [0561S "Amendment to the Oxygen Limit within the BBL/NTS Interconnection Agreement" and](#)
- [0581S "Amending the Oxygen content limit specified in the Network Entry Agreements at Grain LNG".](#)

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Knowledge/Skills

No additional knowledge/skills required.

6 Solution

Increase the maximum oxygen limit in the South Hook LNG Network Entry Agreement

The solution to the issue raised in this proposal is to increase the permitted oxygen content of the gas in the South Hook LNG Network Entry Agreement from 0.001 mol% to 0.02 mol%. This increased level would remain well within the level of 0.2 mol% allowable under the Gas Safety (Management) Regulations. It would also appear to be significantly lower than the limits permitted at the majority of other NTS entry points.

7 Impacts & Other Considerations

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

Not applicable.

Consumer Impacts

The proposers' view of consumer impacts was that there were not likely to be any, based on implementation of previous Modifications. Therefore the proposer argued that this enabling Modification is unlikely to have a material impact on consumers whose offtake facilities are sensitive to the level of oxygen content in gas.

The Workgroup asked National Grid to produce appropriate analysis showing penetration of South Hook Gas into the NTS. National Grid produced four 'heat maps' – three for a summer's day and one for a winter's day – which show the degree of penetration of South Hook gas into the NTS based on the latest Future Energy Scenarios (FES) data. A similar approach was adopted to the heat map analysis provided for Modification 0581S, however the scenarios for South Hook differ as the FES forecast has changed over time.

On 21 February 2018, the Joint Office contacted the Gas Storage Operators Group (GSOG), the Major Energy Users' Council (MEUC); the Energy Intensive Users Group (EIUG) and the Chemical Industries Agency (CIA) groups highlighting this modification and asking for views on the impacts on their members from this proposal. Once the data from the National Grid heat map analysis was published on the Joint office website on 26 February 2018, the Joint Office again contacted GSOG, Storengy, Uniper and EDF to highlight the analysis and request any views for the workgroup to consider. Two storage operators provided a view to the Joint Office, which are included below. The Modification Proposer highlighted to the workgroup that there has been no evidence submitted by storage operators to date, that a marginal increase in oxygen concentration will have any impact on facilities in the North West, or importantly impose any costs on storage facilities.

Heat Map analysis results

The National Grid analysis looked at Milford Haven flows for summer and winter conditions based on 2017 FES forecasts for a selection of years from 2018 to 2039. In this analysis, during the peak demand conditions, Dragon sub-terminal is forecast to supply up to 20% of Milford Haven gas. South Hook flows are assumed to have an oxygen content of 200ppm which is then tracked with network simulation with a wide variety of supply and demand conditions. All other terminals are assumed to flow based on FES

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forecasts¹ at their contractual specification for oxygen. Therefore this analysis represents a 'worst case' in terms of oxygen content. Results of analysis for winter and summer conditions are then separately displayed with the use of heat maps to demonstrate the penetration of South Hook gas.

Winter demand results

Network analysis for winter conditions are based on peak NTS demands of 490 to 530 mscm/d along with peak flows from Milford Haven (~60-80 mscm/d).

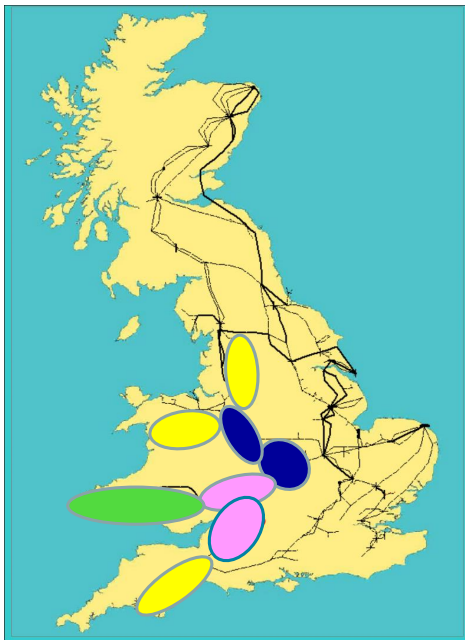
The Dragon sub-terminal is assumed to make up between 10% and 20% of peak flow, with the remainder from South Hook.

The workgroup noted South Hook Gas's observation that their technical maximum capacity is 650GWh/day which translates to approx. 60mscm/d. As such the 80 mscm/d is likely to be a little higher than actually possible.

All storage sites are generally assumed to be withdrawing based on the FES forecasts. Provided this is the case, those in the North-West would not be adversely affected even if South Hook gas penetrated that far into the network.

Network analysis results indicate up to ~25% of Milford Haven gas is observed to move up to the North-West, potentially equating to up to ~50ppm of oxygen content in that region. Please see Figure 1 for a diagram of the heat map analysis for Winter demand. ~~of the four heat maps provided, this effectively is a worst case scenario.~~

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>75%
Milford Gas



50% to 75%
Milford Gas



25% to 50%
Milford Gas



<25%
Milford Gas



¹ The forecasts are used with each of the four FES scenarios, for more information see: <http://fes.nationalgrid.com>

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Figure 1: 'Heat Map' – Milford Haven maximum flows during winter conditions.

Summer demand results

The National Grid analysis results under summer conditions are based on NTS demands of 190 to 200 mscm/d with three levels of supply from South Hook sub-terminal:

- minimum (10-20 mscm/d) – see Figure 2,
- average (20-40 mscm/d) – see Figure 3, and
- maximum (40-60 mscm/d) – see Figure 4.

All storage sites are generally assumed to be injecting during summer based on the FES forecasts.

Storage sites may face a risk on this basis.

High case inputs from South Hook along with low NTS demand conditions leads to a significant proportion of South Hook gas penetrating up to the North West, leading to the potential for up to ~150 ppm of oxygen content in the region. This is shown in Figure 4.

Additional information provided to the workgroup verified that the forecast flows provided are suitable when compared with the actual historical flows observed from 2008 to 2018 (see slide 12 of slide pack provided to workgroup on 01 March 2018). Note that for the last two years Milford flows have been a fraction of those assumed in the modeling.

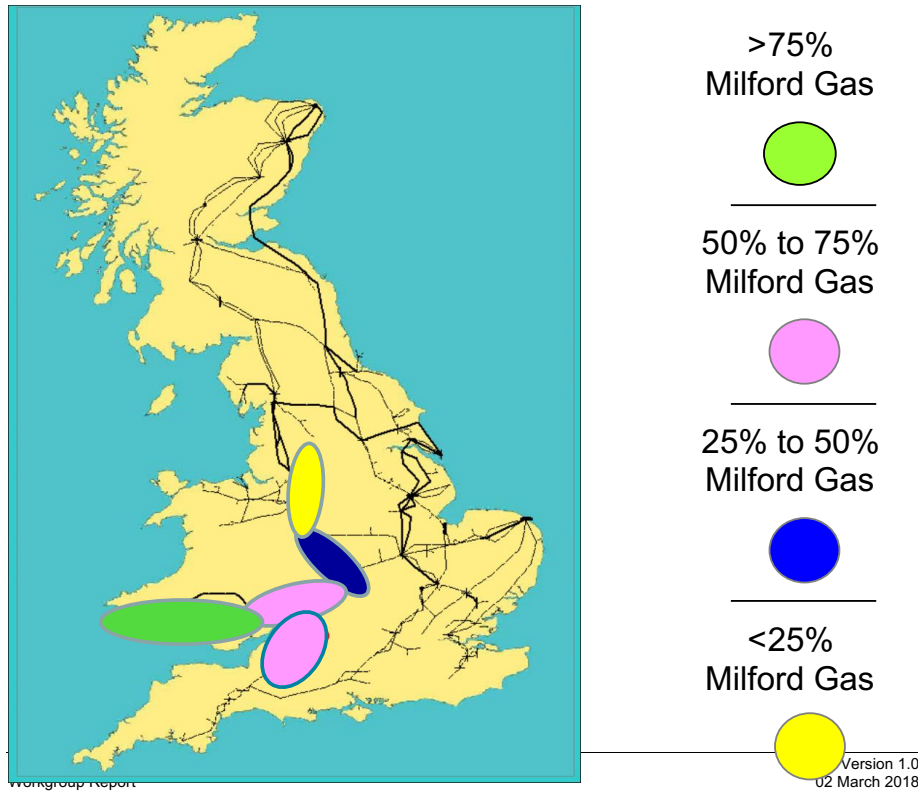


Figure 2: 'Heat Map' of NTS during summer conditions with minimum range of Milford Haven Gas.

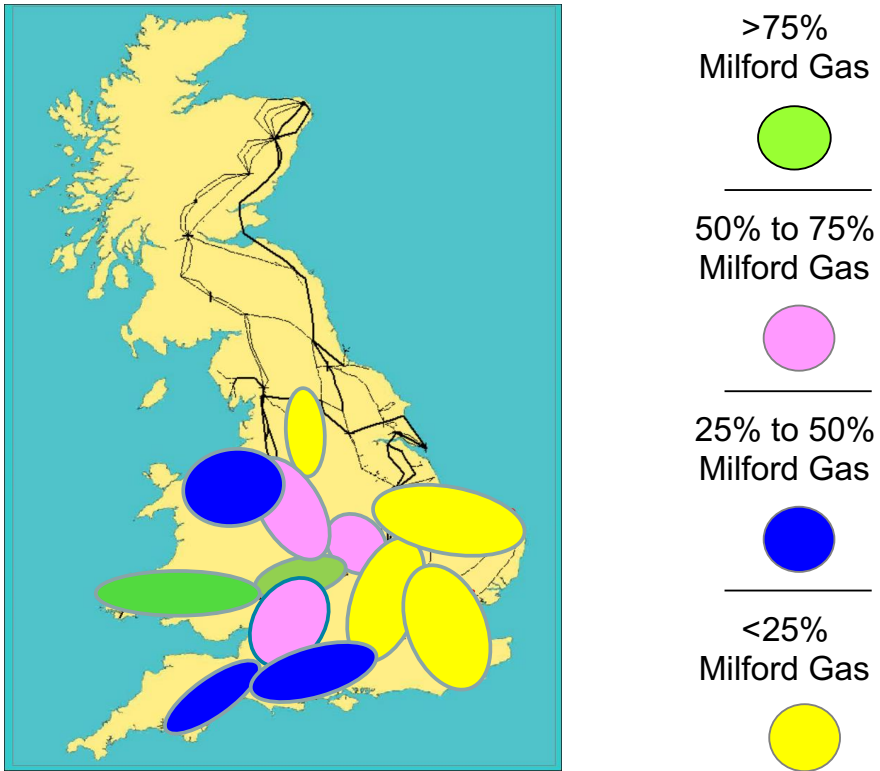
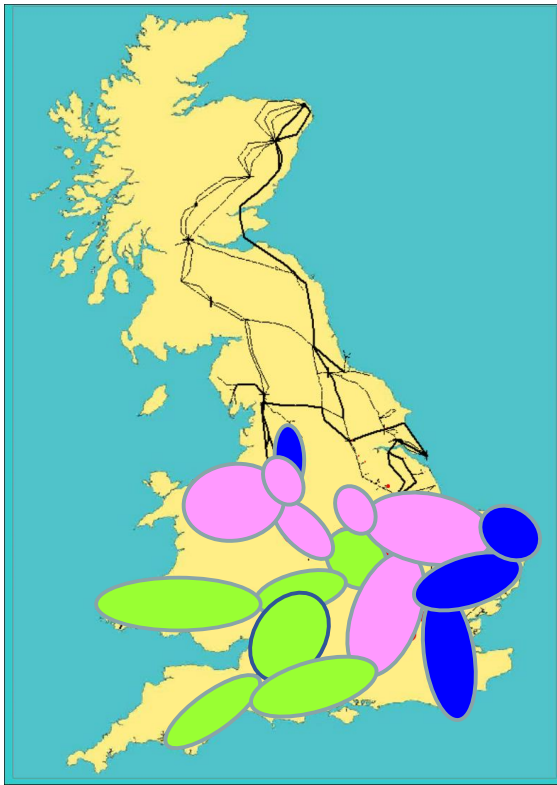


Figure 3: 'Heat Map' of NTS during summer conditions with average range of Milford Haven gas



>75%
Milford Gas



50% to 75%
Milford Gas



25% to 50%
Milford Gas



<25%
Milford Gas



Figure 4: 'Heat Map' of NTS during summer conditions with maximum range of Milford Haven gas.

Workgroup views on Heat map analysis

Initially, some workgroup participants had been concerned at the potential for higher levels of oxygen penetration into the North-West region where several gas storage facilities are situated.

The Joint Office received an email on 28 February 2018 from a North-West based gas storage operator indicating they believed this Modification was not likely to have a material effect on oxygen levels at its North West storage site. The sender did not want further identification put into this report and was unable to be present at workgroup meetings.

Uniper (including Holford gas storage) provided the following view to the Joint Office in writing on 02 March 2018:

As acknowledged in the previous Modification proposal to increase oxygen content at an NTS Entry Point (Isle of Grain LNG terminal, UNC Modification 0581S), an increase in oxygen can have a detrimental effect on "wet" gas systems, such as those used for gas storage. For the purposes of Modification 0581S it was, however, acknowledged that the higher oxygen content gas was unlikely to reach UK gas storage facilities.

An increase in the oxygen content of gas entering gas storage facilities, could require them to incur gas processing costs in order to prevent the additional oxygen entering the system (which could otherwise lead to corrosion). National Grid "heatmap" analysis has highlighted the potential, under credible scenarios, for South Hook gas to flow into the North-West of England, thereby potentially affecting all NW gas storage (which includes Uniper's Holford Gas Storage Site).

As National Grid's analysis was only presented at the very end of the current workgroup development process, Uniper has not had time to assess the technical implications (if any) for its gas storage facility. It would, however, be Uniper's intention to clarify the potential implications in its consultation response.

The workgroup agreed that the analysis could be re-run to improve the accuracy relating to the incorrect figure used for South Hook's maximum capacity, which would result in a slight improvement in the results. There was, however, little need for this since the overall conclusion would not be changed.

After considering the matter, the majority of Workgroup participants were of the view that the consequence of this change would be unlikely to materially affect consumers in a negative manner.

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| Consumer Impact Assessment | |
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| Criteria | Extent of Impact |
| Which Consumer groups are affected? | The majority of the workgroup concluded that overall there would be an immaterial impact of the increased oxygen level. The conclusion was that there could be a net benefit regarding gas coming onto the NTS with the potential ability of South Hook terminal to accept a wider range of cargoes. |
| What costs or benefits will pass through to them? | The workgroup concluded that it was unlikely there would be any costs passing through and the level of benefit could not be calculated at this time. |
| When will these costs/benefits impact upon consumers? | After the UNC Modification Panel decision, the NEA can be modified. Once this is in place, the risk of an oxygen breach will be reduced, and therefore reduce the likelihood of being unable to deliver gas to consumers. Cargoes with a wider specification will also be acceptable, at South Hook LNG, allowing this gas to deliver into the NTS. |
| Are there any other Consumer Impacts? | None |
| 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 |
| Number of consumers between 73,200 and 732,000 kWh/annum | 250,000 |
| Number of very large consumers >732,000 kWh/annum | 26,000 |

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Cross Code Impacts

None.

EU Code Impacts

The Workgroup considered whether the provisions of the EU Interoperability Code apply here and asked National Grid for clarification.

Article 15 of this Code requires Transmission System Operators (TSOs) to cooperate to avoid restrictions to cross border trade due to gas quality differences. The Workgroup noted that the heat maps produced by National Grid (see above) show that under some of the 'summer' scenarios, Milford Haven gas could penetrate across to Bacton. Whilst the specification requested by the Proposer is well within the relevant specification for offtake at Bacton, it is noted that the typical specification for oxygen in North West Europe is 10ppm on a daily average basis.

The Workgroup noted that the EU CEN standard on gas quality currently specifies a limit of 10ppm (0.001mol%) on a daily average basis for oxygen, with flexibility to increase this up to 1mol% where it can

be demonstrated that the gas will not reach an installation that is sensitive to oxygen content. Whilst the European Commission had previously indicated that it wished to make this standard legally binding on member states, at present there are no plans to do so. The Commission indicated that it would revisit the question of gas quality harmonisation after the inclusion of the Wobbe Index within the standard. The Workgroup considered that the merits of this Modification should not be affected by this potential future step.

Central Systems Impacts

None.

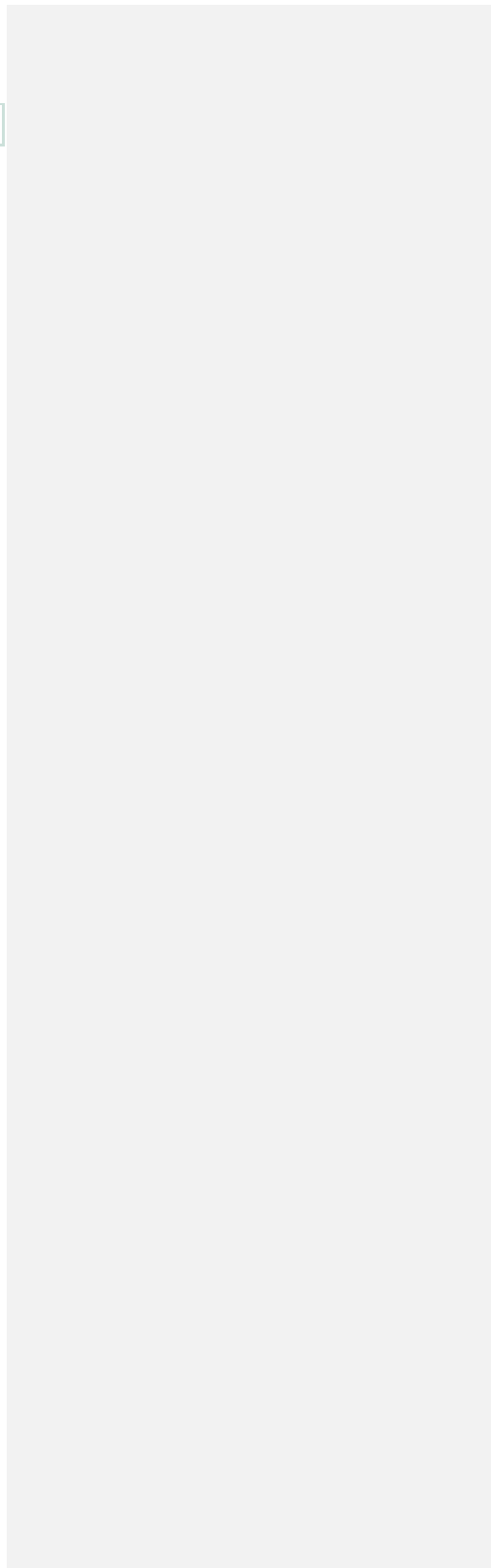
Workgroup Conclusions

The majority of the workgroup concluded that the Modification proposal would have little or no tangible negative consumer impact and therefore should proceed to consultation.

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8 Relevant Objectives

| Impact of the modification on the Relevant Objectives: | |
|--|-------------------|
| Relevant Objective | Identified impact |
| a) Efficient and economic operation of the pipe-line system. | None |
| 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 | None |



Positive Impact of Increasing Oxygen Limits

The Proposer believes positive impacts can be identified for objective 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.

Removing unnecessary restrictions on the deliveries of LNG will allow more gas to enter the UK market, improve liquidity and will therefore help to promote competition between gas shippers and gas suppliers.

The workgroup broadly agreed with the proposer's view relating to relevant objective d) relating to competition, in that more gas could potentially be delivered onto the system.

Members of the workgroup also highlighted that this Modification would help:

- a) facilitate a level playing field among shippers delivering LNG regas to the NTS, and
- b) mitigate a processing issue associated with ICF breach.

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9 Implementation

As self-governance procedures are proposed, implementation could be sixteen business days after the Modification Panel 15 March 2018, if the Panel decides to implement the proposal, subject to no Appeal being raised.

10 Legal Text

As this is an enabling Modification, no UNC text changes are requested.

11 Recommendations

Workgroup's Recommendation to Panel

The Workgroup asks Panel to agree that:

- This self-governance modification should proceed to consultation.

