nationalgrid

Carnforth-Nether Kellet IED Business Case

May 2018

Contents

1 Executive Summary

This paper describes the options available to National Grid to comply with the IED legislation at Carnforth-Nether Kellet and recommends the option best placed to meet the future needs of gas transmission system users and customers.

Carnforth and Nether Kellet compressor stations are located in the north west of the UK. The two stations adjoin each other but are physically separate, each with their own independent control systems and different maximum allowable discharge pressures. For network control purposes the two sites are considered as one. Carnforth-Nether Kellet is used for bulk gas transmission, predominantly moving gas from the northern terminals of St Fergus and Barrow, down the west coast and towards the Midlands.

The units at Carnforth comprise of two Rolls Royce RB211-24 25MW gas turbine driven compressor units (Units A and B) and an additional gas driven LM2500 unit that was commissioned in 2000. Carnforth Units A and B were both impacted by the IED-LCP legislation. Unit B was put on the Emergency Use Derogation (EUD), which limited running hours to 500 hours per year. Unit A was put onto the Limited Lifetime Derogation (LLD), however in 2017 the unit was disconnected from the NTS. Unit C is compliant with IED-LCP requirements. The two Nether Kellet units (Units A and B) are 12MW SGT400 units, which are not impacted by the IED legislation. The units can operate individually or in parallel.

The recommended option for Carnforth-Nether Kellet is to decommission Carnforth Units A and B and complete the partial integration with Nether Kellet. The RIIO-T1 funding request for Carnforth is less than £10m with all work completed by the end of RIIO-T1.

Funding Request Summary (09/10 price base)

The Carnforth-Nether Kellet funding request is less than £10m

RIIO-T1 Output - Decommission two units at Carnforth–Nether Kellet compressor station and provide partial integration across the station by the end of RIIO-T1.

2 Introduction

Carnforth and Nether Kellet compressor stations are located in the north west of the UK. The two stations adjoin each other but are physically separate, each with their own independent control systems and different maximum allowable discharge pressures. For network control purposes the two sites are considered as one.

With the first unit at Carnforth built in 1989, and with more recent investment at Nether Kellet in 2003, the station has a significant role in the operation of the NTS.

Carnforth-Nether Kellet is used for bulk gas transmission, predominantly bringing gas from the northern terminals of St Fergus and Barrow, down the west coast and towards the Midlands. With the commissioning of the Trans-Pennine pipeline in 2007, Carnforth also has a critical role providing an alternative route for gas entering the system on the east coast at the Easington terminal in the event of compression at Hatton or Peterborough being unavailable. Nether Kellet was originally built to compress gas down to reinforce offtake pressures at in the north west and also has some limited capability to move gas north in the event of low flows through St Fergus.

The Carnforth compressor units A and B are impacted by the Large Combustion Plant (LCP) elements of the IED (Industrial Emission Directive). Key actions have had to be taken already to ensure compliance with the IED legislation, with both units being placed under the Emergency Use Derogation (EUD). This paper evaluates whether continuing under the EUD, replacement, emissions abatement or decommissioning is the optimum solution for these units.

3 The Site: Assets and Operation

The compressor units at Carnforth-Nether Kellet are mid-level utilisation units in the fleet. Connected into four feeders, the sites provide a critical compression service for a variety of supply and demand patterns and for resilience support.

The first units at Carnforth compressor station were constructed between 1989 and 1992. These were two Rolls Royce RB211-24 24MW gas turbine driven compressors. An additional gas driven LM2500 unit was commissioned in 2000. In 2017, Carnforth Unit A was disconnected from the NTS and is no longer available. The two remaining units at Carnforth compressor station can be used individually, primarily with Unit C as the lead unit and Unit B as back up and also in parallel configuration, with a maximum discharge pressure of 75barg.

The two Nether Kellet units were built in 2003 to support high demand in the North West and flows along the Trans Pennine pipeline. The units are both 12 MW Siemens SGT400 units, and are also able to operate individually or in parallel.

Operationally, the lead units are Nether Kellet A and B and Carnforth C; all three units are DLE (Dry Low Emissions) gas turbine technology and are compliant with the relevant ELVs. The Nether Kellet units in single configuration are required to maintain pressures in the area under low flow and head conditions. They are used in parallel for higher flow and head

conditions. If flows are higher still, Carnforth Unit C will be switched on and Nether Kellet switched off.

Under low flows, the Nether Kellet units provide back up for each other. There is a pipework connection which allows the Nether Kellet compressor units to be manually configured to operate on the Carnforth feeders for certain duties (and vice versa). Neither site was designed to operate in this manner and therefore some minor reconfiguration work would be required to facilitate this option as routine operation. There is an additional limitation due to Carnforth having a maximum discharge pressure of 75barg and Nether Kellet is limited to a discharge pressure of 70barg. This difference in pressure tier makes change-over between the two sites difficult and increases the risk of breaching pipeline MOPs (Maximum Operating Pressures) in that area.

The running hours of the five units can be seen below. The run hours at Carnforth have been impacted by an extended station outage and also a long term outage on Unit C.

	Individual Unit Running Hours *(financial year)*				
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Carnforth Unit A	40	0	0	0	N/A
Carnforth Unit B	24	10	108	9	1
Carnforth Unit C	15	11	49	33	0
Nether Kellet Unit A	1393	87	282	2316	2745
Nether Kellet Unit B	1762	189	500	2742	3260
Total	**3234**	**297**	**939**	**5100**	**6006**

Table 3.1: Run hours

Between 2013 and 2015, utilisation at Carnforth-Nether Kellet shows a decline primarily due to reduced flows from St Fergus and Barrow terminals. In 2016/17 the St Fergus flows reached a level where parallel operation became required. The two Nether Kellet units were used at this time, due to Carnforth being on outage.

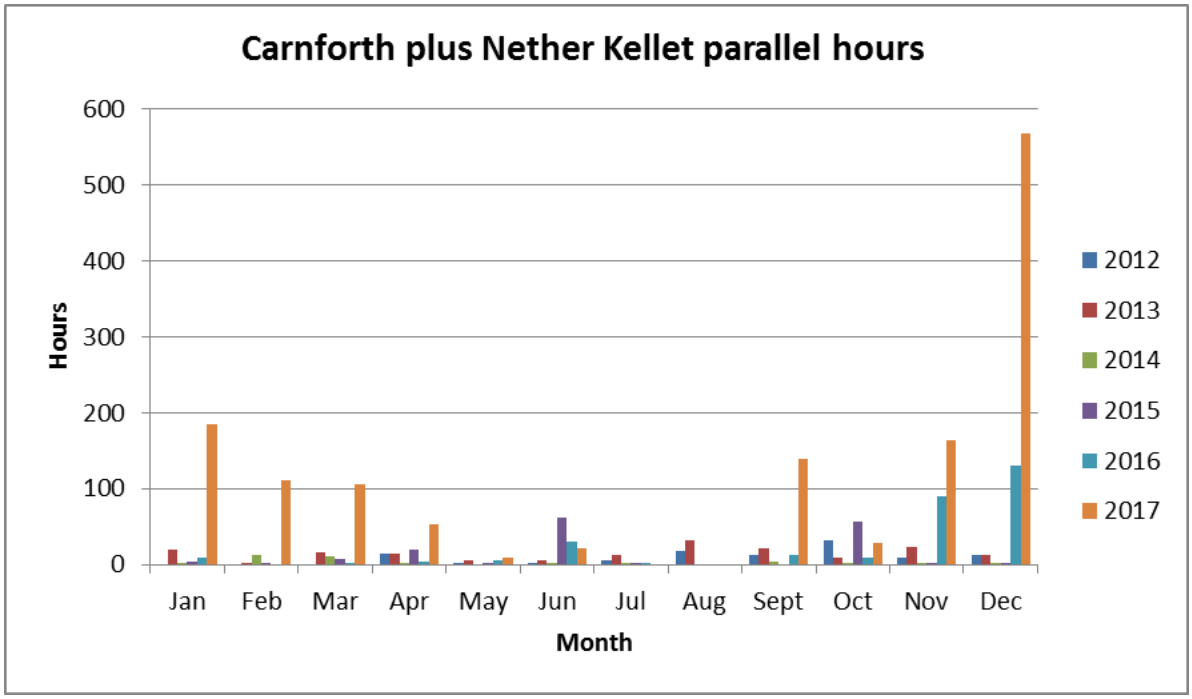

Figure 3.1: Parallel Run Hours

4 Emissions and the impact of IED

4.1 IED: LCP element

The LCP element of the IED applies to all combustion plants with a thermal input of 50MW or more, and combustion plant must meet the Emission Limit Values (ELVs) which are defined in the Directive. Both RB211 units, A and B at Carnforth are impacted by this requirement.

The deadline for compliance with the legislation associated with the LCP element of IED came into force on 1st January 2016. In December 2015, a decision needed to be made on whether to opt for either the Emergency Use (EUD) or the Limited Lifetime Derogation (LLD).

Significant asset health issues had already been identified on Unit A, so although the unit was put onto the Limited Lifetime derogation, in 2016 the unit was disconnected, rather than continuing to maintain availability under the derogation. In line with the outcome from stakeholder engagement carried out as part of our IED submission in May 2015, Unit B remains operational but subject to a maximum of 500 operational hours per year allowable under the EUD. With the 2023 deadline approaching, the decision as part of this reopener is to consider whether these units should now be replaced, abated or decommissioned.

As well as looking at the current role of the impacted units within the context of the Carnforth-Nether Kellet site, these units are also assessed as part of the Cluster analysis. Carnforth-Nether Kellet has a key role in bulk gas transmission on the west coast route which is assessed as an alternative to the east coast route within the Cluster analysis.

5 The Future Requirements

There are several key drivers for the utilisation of the compressor units at Carnforth-Nether Kellet. The site provides compression services for north to south gas flows, and supports demand in the North West. In the context of the broader gas transmission system, the interaction between Carnforth-Nether Kellet and other network compressors means that the units also play a key role in providing network resilience.

5.1 Bulk Transportation

Carnforth-Nether Kellet is a gateway compressor station between north and south and has traditionally been required for bulk gas transmission down the west coast, predominantly from the northern terminals of St Fergus and Barrow south towards the North West and the Midlands.

The site operates as part of a chain of compression on the west coast: with gas flows down from the Scottish compressor fleet (Aberdeen, Kirriemuir, Avonbridge and Moffat) and onto Carnforth-Nether Kellet, Warrington and Alrewas further south. With proposed decommissioning of Warrington under this reopener proposal, and the limited running hours available at Moffat under the EUD, the capability and associated back up at Carnforth-Nether Kellet becomes even more critical for the West coast route. In addition, Carnforth has historically provided resilience to Hatton and Peterborough. Resilience is analysed in more detail in the Cluster analysis within the integrated plan, including scenarios with very low capability on both the east and west coast. With the number of units on the west coast reducing, retaining this resilience from Carnforth-Nether Kellet is of increased importance.

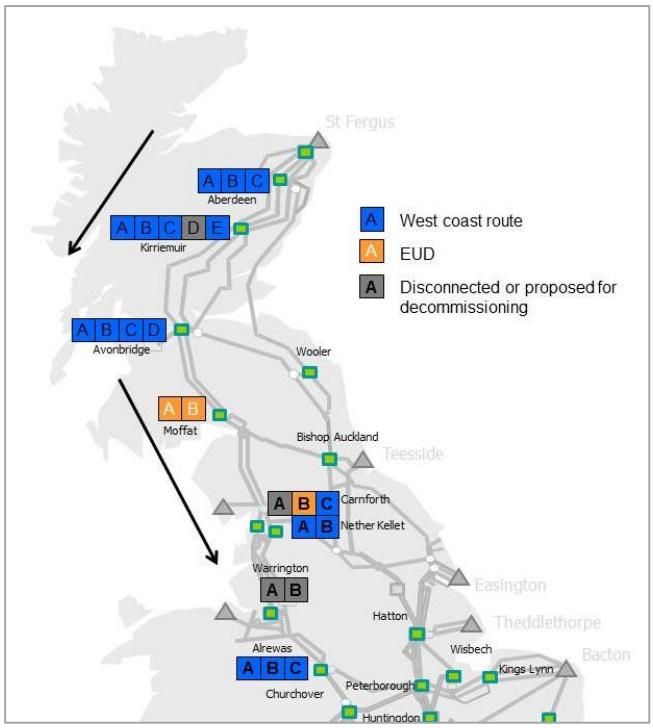

Figure 5-1: Bulk Transportation: the west coast route

The daily operation of the Nether Kellet compressor units is defined by St Fergus flows from the north. As seen in the figure below, the numbers of hours the Nether Kellet units operate in single configuration is highest when St Fergus flows at between 70-80mcm/d. When St Fergus flows are higher, the number of hours in parallel operation increases. Once St Fergus flows are greater than 100mcm/d, parallel hours account for over one quarter of total run hours.

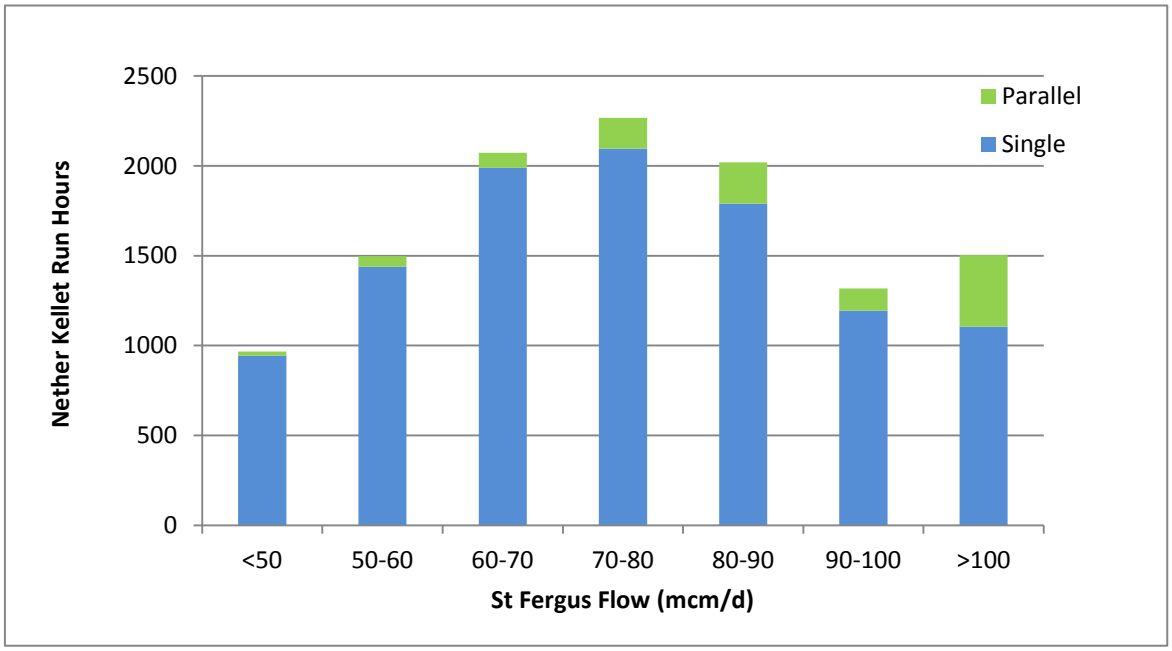

Figure 5-2: Nether Kellet running hours 2012- 2017

The higher St Fergus flows seen since 2016 have resulted in over 20% total run hours at Nether Kellet in parallel. These higher St Fergus flows are forecast across a range of scenarios out to 2030, as shown on the chart below.

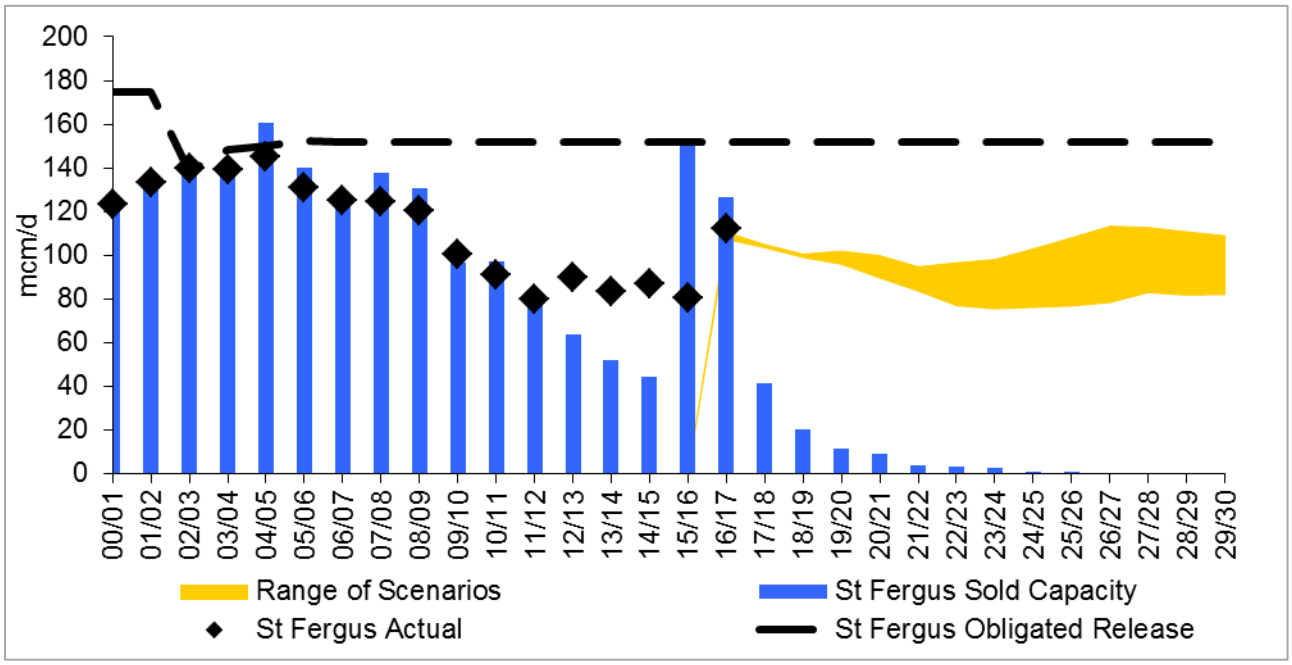

Figure 5-3 St Fergus flows

Carnforth Unit C also supports high St Fergus flows. With the disconnection of Carnforth Unit A, and Carnforth Unit B operating under the EUD there is very limited on site back up available to Carnforth Unit C. Although Carnforth and Nether Kellet can be used interchangeably under certain operating conditions, there is an additional complexity due to Carnforth having a maximum discharge pressure of 75barg whilst Nether Kellet is limited to a discharge pressure of up to 70 barg. This differential pressure tier makes change-over between the two sites difficult and increases the risk of breaching pipeline MOPs in that area.

So primarily Carnforth Unit C and the Nether Kellet units operating either individually or in parallel support the St Fergus obligated entry capacity and provide a critical bulk transmission route down the west coast.

5.2 North West Exit Capability

The Carnforth-Nether Kellet units also support flows in the North West from four sites; Hole House Farm, Hill Top Farm, Holford and Stublach.

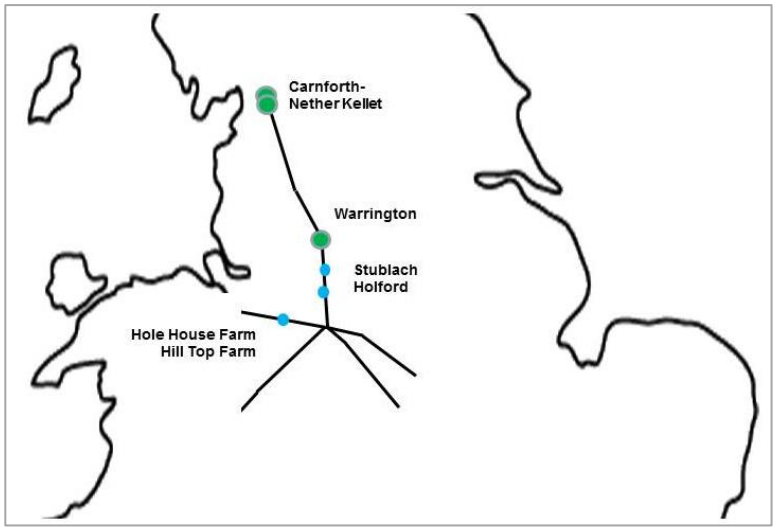

Figure 5-4 North West storage

5.3 Scotland Demand

Currently Nether Kellet has a limited ability to pump north towards Scotland. Looking beyond the requirements of this submission, the site could be configured for full reversal to support Assured Offtake Pressures (AOPs) in Scotland. Whilst there has been a recent increase in supplies from St Fergus, long term forecasts indicate this reverse compression capability could still be required.

5.4 Future Requirements Summary

The historic and forecast flow data and network analysis has been used to verify the capability requirements for Carnforth–Nether Kellet in line with the factors considered above. The continuation of higher St Fergus flows is a key factor in the expected usage of Carnforth Unit C and the Nether Kellet Units. North West storage requirements are also important considerations. A summary of the key considerations is as follows:

- Carnforth Unit C or the parallel operation of the units at Nether Kellet provides the bulk transportation requirements when flows at St Fergus are high
- Carnforth Units A and B have historically provided back up to Unit C however Unit A is disconnected and no longer operational and Unit B operates under the EUD, restricted to 500 hours/year
- Carnforth Unit C or parallel operation of units at Nether Kellet support high North West storage flows
- The Nether Kellet units provide back up for each other under low flow conditions.
- Carnforth Unit C and both Nether Kellet units provide network resilience as part of the west coast gas transmission route
- Currently, back up between Carnforth Unit C and Nether Kellet Units A and B is not fully possible due to the pipework configuration and the different pressure tiers across the two stations.

This assessment of the site's future requirements is a key factor in the options considered for Carnforth–Nether Kellet and the interlinked nature of the two sites and the provision of wider network resilience are important considerations.

6 Options Overview

The options available for Carnforth–Nether Kellet form part of the Cluster network analysis and associated CBA. The asset options cover a range of possible solutions for the provision of back up for Unit C and alternative possibilities for investment in either the east or west coast gas transmission routes. The asset options described below are considered in conjunction with a suite of commercial and regulatory options as part of the Cluster approach.

6.1 The Counterfactual

Having ascertained the likely future usage of the site, a counterfactual option was defined. This option is the option that is closest to business as usual and which is compliant with all the relevant elements of IED. The counterfactual option, Option 0 is to decommission Carnforth Unit A and continue to operate Carnforth Unit B under the EUD. Carnforth Unit C and Nether Kellet Units A and B would continue to be operated as lead units, with limited (500 hours) back up for Carnforth C provided by Carnforth Unit B.

6.2 Physical Options

Looking initially at standalone options for Carnforth–Nether Kellet, four options in addition to the counterfactual are considered:

Option 1

Carnforth Units A and B would be decommissioned immediately. Without these units providing back up for Carnforth Unit C, this option create a partial integration with Nether-Kellet (units A and B) through a common pressure tier. Under this option back up for Carnforth Unit C would be provided by Nether Kellet.

Option 2

This option looks to maintain Carnforth and Nether Kellet as separate stations. Carnforth Unit A is decommissioned. Carnforth Unit B is fitted with emission abatement technology (SCR plus oxidation catalyst), and hence no longer subject to the limited running hours under the EUD. Carnforth Unit C and Nether Kellet Units A and B would continue to operate as the lead units. Under this option back up for Carnforth Unit C is provided by Carnforth Unit B.

Option 3b

This option looks to maintain Carnforth and Nether Kellet as separate stations, and considers Carnforth as an alternative to investment on the east coast gas transmission route. Carnforth Units A and B are decommissioned. A new unit, Unit D, is built at Carnforth on a greenfield site. Carnforth Unit C and Nether Kellet Units A and B would continue to operate as the lead units. Under this option back up for Carnforth Unit C is provided by Carnforth Unit D.

7 CBA Assessment

The recommended option for Carnforth–Nether Kellet was developed as part of a holistic assessment covering both east and west coast investment choices. This is an important feature of the business case, whereby the site specific impact of IED on individual units is also considered in an integrated manner with options and considerations across other network sites. The analysis considers capability at Hatton, Huntingdon, Peterborough, Alrewas and Wisbech as well as Carnforth-Nether Kellet.

For Carnforth-Nether Kellet, the process is a two part process; the counterfactual plus four other options are compared within an initial CBA, including investment costs, asset health costs and OPEX. This provides the basis for selection of a short list of options to take forward to the Cluster analysis. A second CBA is generated as part of the Cluster considering a matrix of different capability levels at all the relevant sites. Please refer to the Integrated Plan chapter for more detail on this part of the process.

To make the initial assessment for Carnforth–Nether Kellet, the options have been grouped based on the level of capability they would provide.

Option	Description	Capability
0: The Counterfactual	Decommission Unit A (RB211) immediately; retain Unit B (RB211) on 500 hrs EUD; keep Unit C and Nether Kellet Units A and B as is	As-is
1	Decommission Units A and B (RB211) immediately; keep Unit C (DLE) as is and create a partial integration with Nether Kellet (units A and B) through a common pressure tier.	Low
2	Decommission Unit A (RB211) immediately; Emissions abatement (SCR + OxyCat) on Unit B; keep Unit C (DLE) and Nether Kellet Units A and B as is.	High
3b	Decommission Units A and B (RB211) immediately; new Unit D on greenfield site; keep Unit C (DLE) and Nether Kellet Units A and B as is.	High

Table 7-1: Carnforth – Nether Kellet option capability

Option 1 provides a low capability equivalent to the counterfactual. As an alternative to keeping Unit B on 500 hours and incurring the ongoing asset health costs, back up for Carnforth Unit C is provided by the Nether Kellet units, made possible by minor investment in pipework reconfiguration. Options 2 and 3b provide high capability, with investment at Carnforth considered as an alternative to east coast investment within the Cluster.

The initial CBA for Carnforth-Nether Kellet looks only at the asset-related costs (investment and asset health) for each option. The Net Present Value (NPV) for the four options is presented in the figure below. The values range from -£70m to -£120m. Option 1 has the most favourable NPV, -£70m, with the counterfactual NPV fairly similar at -£77m. The two high capability options 2 and 3b range from -£113 to -£120m.

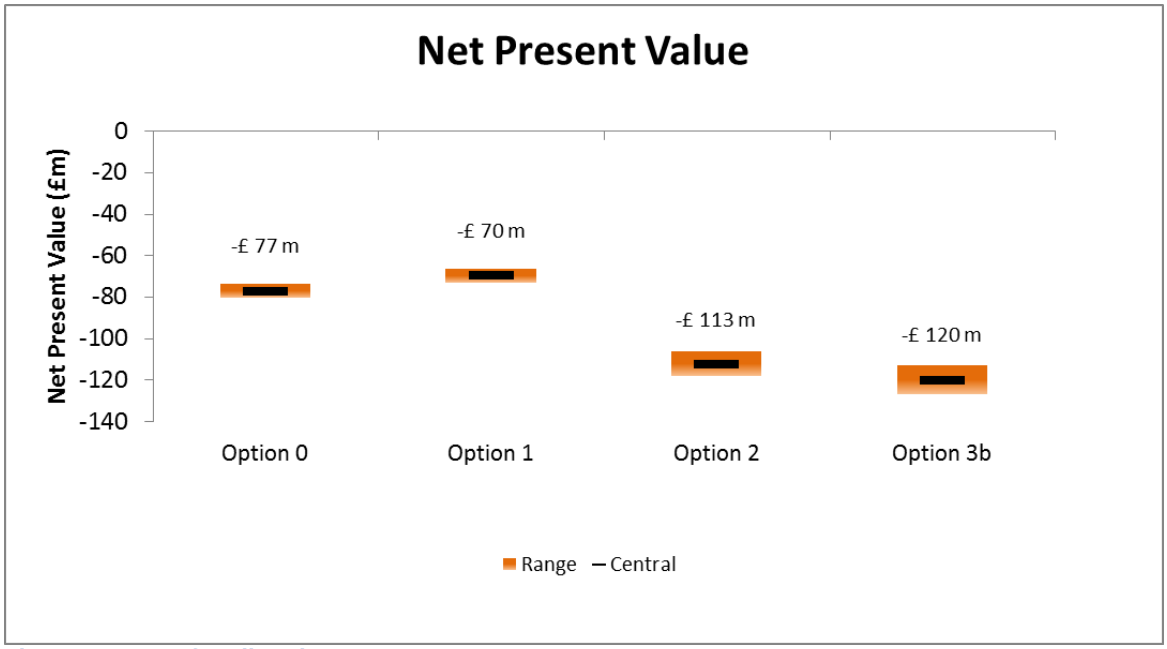

Figure 7-1: NPV for all options

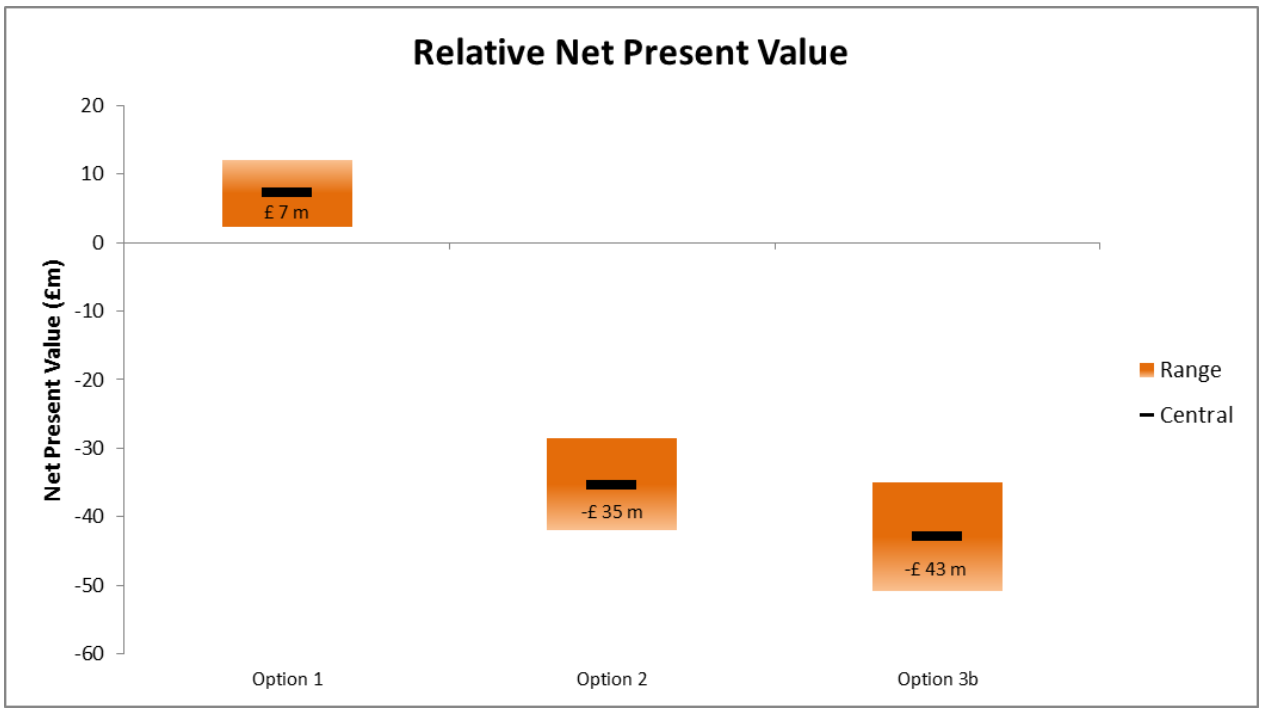

Figure 7-2: Relative NPV

Looking in more detail at the costs, Options 2 and 3b have significant investment costs associated with the new unit or with emissions abatement. Option 2 has lower investment costs than Option 3b but higher station OPEX associated with the ongoing operation of the emission abatement. Based on this initial CBA, Option 1 offers advantages over the counterfactual. The higher capability options are fairly similar to each other.

Based on this initial assessment, the counterfactual, Option 0 is automatically taken forward to the Cluster analysis. Option 1 has the lowest costs and is taken forward as the low

capability option. Option 3b has slightly lower costs than Option 2 and is therefore taken forward as the High capability option. This is summarised in the table below:

The next part of the analysis is described in the Integrated Plan chapter which explores the interaction between Carnforth-Nether Kellet and other proposed investments on the network. The recommended option is therefore one which is validated through the Cluster analysis.

8 Stakeholder Engagement

The consultation for this reopener builds on the comprehensive programme of stakeholder engagement undertaken in 2015. In addition to a series of workshops in October 2016, we have conducted several bi–lateral meetings with interested parties and have incorporated their views. In January and February 2018 there were two presentations at the Transmission Working Group, sharing the analysis and taking questions from stakeholders. There has been a formal consultation which opened on the 14th March and closed on the 13th April 2018. There were no concerns raised regarding the Carnforth–Nether Kellet options, analysis and proposed recommendation.

9 Recommendation

Option 1 is the chosen option as per the Cluster chapter. The Cluster analysis demonstrates the benefits of an east coast route for gas transmission versus the west coast. Hence the low capability option, Option 1, for Carnforth–Nether Kellet is recommended. Under Option 1, Carnforth Units A and B will be decommissioned and a partial integration with Nether Kellet is created. This allows Unit C to be backed up by the Nether Kellet units, creating that resilience, without incurring the additional ongoing maintenance costs of running Unit B under the counterfactual.

10 Conclusion

This submission assesses the options to manage the implications of the LCP directive at Carnforth-Nether Kellet. The recommended decision is to decommission Units A and B, and provide partial integration with the Nether Kellet site.

Funding Request Summary (09/10 price base)

The Carnforth-Nether Kellet funding request is less than £10m

RIIO-T1 Output - Decommission two units at Carnforth–Nether Kellet compressor station and provide partial integration across the station by the end of RIIO-T1.

RIIO-T1 Expenditure Risk - The risk of not completing the works prior to 2021 is medium. The decommissioning and partial integration works will require planning around other network maintenance and outages.