

Moffat IED Business Case

May 2018

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1 Executive Summary

Moffat compressor station, constructed in 1980, has two identical gas turbine driven compressor units designed to operate independently of each other. The units are affected by the Large Combustion Plant (LCP) elements of the Industrial Emissions Directive (IED) as the nitrogen (NO_x) and carbon monoxide (CO) emission limit values from the units are outside permitted levels.

The station was primarily designed to provide network compression to move gas from Scotland to the south. The units are now primarily being used:

- to provide occasional resilience to Aberdeen, Kirriemuir and Avonbridge;
- to provide occasional resilience to Carnforth and Nether Kellet;
- to support entry flows from St Fergus; and
- to move linepack out of Scotland.

The run hours on both units at Moffat have significantly reduced since 2006/07. This reduction in compression requirement aligns with the fall in flows coming onto the National Transmission System (NTS) via the St Fergus Terminal in Scotland.

As part of our May 2015 reopener submission we actively engaged with our stakeholders to get their input into our future compressor strategy. We received stakeholder support in 2015 to make use of the available derogations to comply with LCP. In January 2016, both units were placed on a 500 hour Emergency Use Derogation to maintain network resilience and flexibility for our customers in such an uncertain gas market.

We have continued to review the longer term need of the two units at this station balancing unit asset health costs against the resilience provided by the station. Potential future market developments were also assessed to understand if Moffat would provide future resilience and flexibility for our customers should these changes materialise. It was identified that the station is ideally placed to provide compression capability during any periods of required outage at Carnforth and Nether Kellet. Therefore Moffat would provide network resilience and facilitate the future works being considered as part of IED Phase 2 at these two stations to the south.

Three options were evaluated for this station:

- **Option 0** – Keep both units on 500 hours EUD for the foreseeable future
- **Option 1** – Decommission the compressor station within RIIO-T1
- **Option 2** – Decommission the compressor station in 2024

All three options were presented to stakeholders in our March 2018 consultation document for feedback. We received four formal responses to the consultation, all of which broadly supported the compressor strategy proposed for the network. In the stakeholder engagement sessions held in late 2017 our stakeholders were broadly supportive of decommissioning ageing units where it was no longer economic to continue to maintain them. Their main concern related to ensuring that any options considered would not compromise customer flexibility or network resilience longer term.

In assessing the options for this compressor station, we have taken our stakeholder's feedback into account, in addition to the long term expenditure required to maintain these ageing assets and the historic, current and forecast future use of this station. Based on this

the least regrets option for Moffat is to keep it operating under the 500 hour EUD out to at least 2024. We will revisit the enduring requirement for Moffat as part of our RIIO-T2 business plan.

In our RIIO-T1 proposals we had intended to replace both units, therefore we will now incur additional asset health costs over our RIIO-T1 submission to maintain the reliability of these units until the end of RIIO-T1. The asset health costs associated with maintaining these units form our May 2018 reopener funding request to Ofgem for this site.

Funding Request Summary (09/10 price base)

The Moffat funding request is between £10-20m.

RIIO-T1 Output - To undertake asset health works to maintain the RB211s on 500 hours EUD.

2 Introduction

Moffat compressor station is located in a rural area near the village of Beattock. The station has two gas compressor units; both were commissioned in 1980 to provide network compression to move gas from Scotland to the south.



Figure 2.1: Moffat Compressor Station Location

The two gas compressor units at Moffat compressor station are currently affected by the regulatory requirements of the Large Combustion Plant (LCP) element of the Industrial Emissions Directive (IED). These regulations require us to comply with limits on the gaseous emissions to atmosphere of oxides of nitrogen (NOx) and carbon monoxide (CO) to manage local air quality. See our IED Summary Document for more detail about the IED legislation and its impact on our compressor fleet.

As part of our May 2015 reopener we actively engaged with our stakeholders to incorporate their views into our future compressor strategy¹. We received stakeholder support to make use of the derogations available as part of IED rather than decommissioning stations. Stakeholders felt that the derogations offered more flexibility to adapt in such an uncertain gas market. Therefore to comply with LCP, the two compressor units (thermal inputs >50 MW) at Moffat were entered onto 500 hour Emergency Use Derogation (EUD) in January 2016. The EUD means that each unit is restricted to operating for less than 500 hours per year; and this restriction on running hours means they are exempt from the LCP emission limit values.

¹ <http://www.talkingnetworkstx.com/ied-what-is-ied.aspx>

This business case assesses if there is an ongoing need for compression at Moffat and details all credible options considered for this station. Further stakeholder engagement as part of the May 2018 reopener submission summarised the options considered and gauged stakeholder opinion on the future of the Moffat compression.

3 The site: Assets and Operation

3.1 Current Assets

Moffat compressor station was constructed and commissioned in 1980 with two identical Rolls Royce RB211 gas turbine driven compressor units (A and B). The units were designed to be operated singly and there is no parallel or series configuration capability at the station as this was not required when the station was originally designed. The station can also only be operated north to south, reverse flow capability is not possible.

The station is connected to two pipeline Feeders and to the Gas Networks Ireland Irish Interconnector. It was designed to predominantly facilitate the entry capability at St Fergus and for moving linepack out of Scotland and further south.

There are three above ground installations (AGIs) within the boundary fence of the compressor station. These are for the two Feeders and the Gas Networks Ireland Irish Interconnector offtake.

3.2 Current Asset Condition

Both gas compressor units were installed in 1980 and are approaching their technical asset life of 40 years. The age of the assets mean that there are asset health and obsolescence issues that need to be addressed to ensure continued reliability, safety and environmental compliance at the station. The cost and effectiveness of the various maintenance, repair and replacement options for the compressor assets impact the large items that make up the machinery train (gas turbine, power turbine, gas compressor) but also ancillary systems including the compressor wet gas seals and the auxiliary systems such as the cab infrastructure, cab ventilation systems, exhaust stack and control systems.

3.3 Current Operation

Moffat compressor station was originally designed to provide network compression to move gas from Scotland to the south.

It is now used:

- to provide occasional resilience to Aberdeen, Kirriemuir and Avonbridge;
- to provide occasional resilience to Carnforth and Nether Kellet;
- to support entry flows from St Fergus; and
- to move linepack out of Scotland.

Moffat compressor station use has declined in recent years; the following table provides a summary of running hours for the last 12 years.

Individual Unit Running Hours (<i>financial year</i>)												
	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Unit A	1846	561	748	193	10	34	17	98	7	71	91	9
Unit B	3795	636	1566	190	26	120	11	336	16	211	99	101
Total	5641	1197	2313	383	36	154	29	434	23	282	190	110

Table 3.1: Moffat Historic Running Hours

The run hours on both units at Moffat have significantly reduced since 2006/07. This reduction in compression requirement aligns with the fall in flows coming onto the NTS via the St Fergus Terminal.

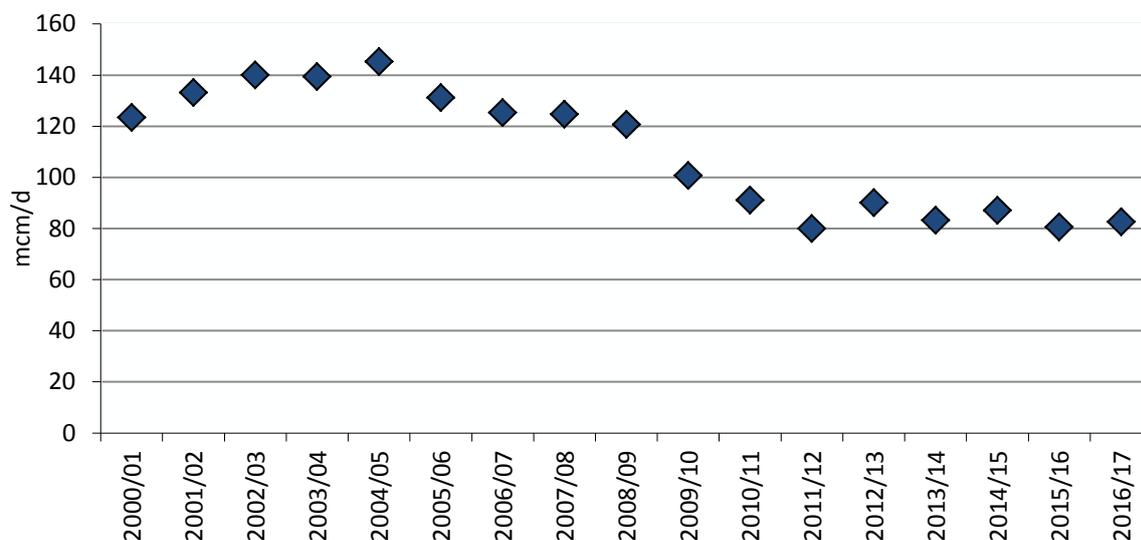


Figure 3.1: Historic actual St Fergus Terminal flows

As noted in the St Fergus IED business case, we have recently seen a notable upward trend in St Fergus flows back to levels not seen since before 2010; we expect these higher flows to continue. Although we have yet to see these flows reflected in the running hours at Moffat, this introduces additional uncertainty around the future requirements for the site.

The station is predominantly used for network resilience when there are multiple outages (planned and unplanned) at the Scottish compressor stations upstream during high St Fergus supply conditions. It has also been used to support the movement of gas south when Carnforth has been unavailable.

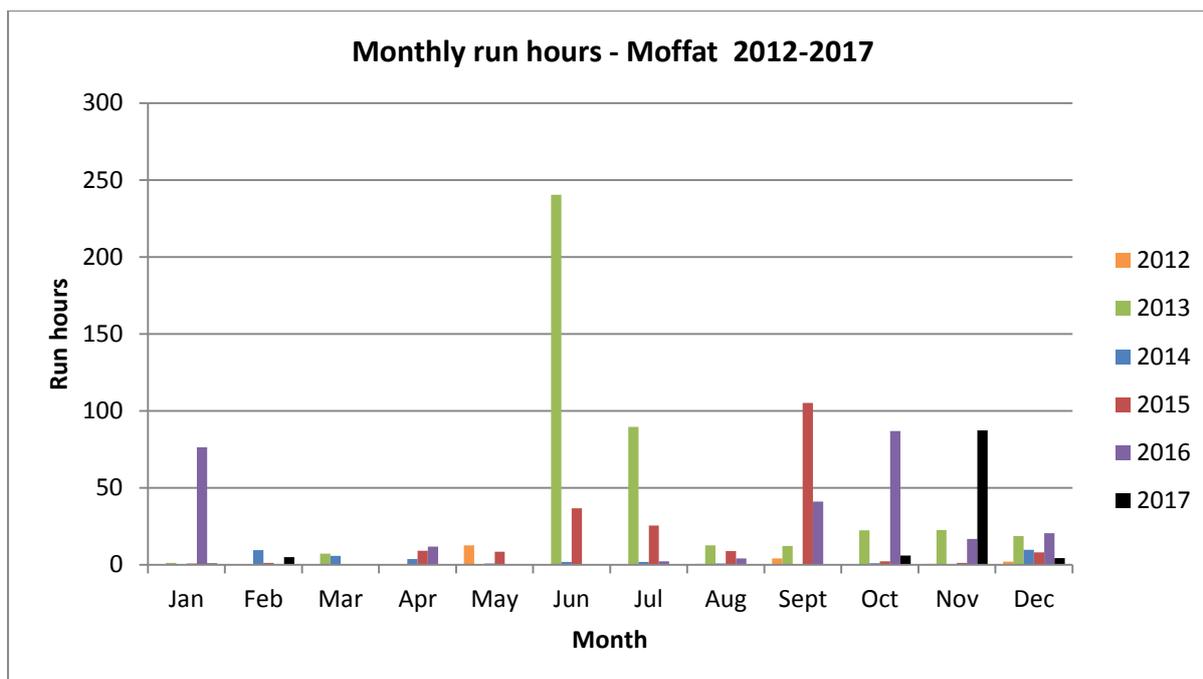


Figure 3.2: Monthly Run Hours for Moffat Compressor Station (2012-2017)

Moffat was required to run at the start of September 2015 (1st to the 6th) due to an unplanned outage at Avonbridge. This unplanned outage occurred at the same time as Aberdeen, Bishop Auckland and Carnforth stations were on planned outages. Moffat was also used at the end of September 2015 (27th – 30th) as Avonbridge only had unit 2A available with all other units on unplanned outage.

There were similar occurrences in 2016 and 2017 with several unplanned outages and restricted access to compression at Avonbridge resulting in Moffat being run. This often coincided with unplanned outages at Kirriemuir which would normally be used to provide resilience to Avonbridge. This requirement can be seen in June 2013, July 2013, September 2015, October 2016 and November 2017. Work is ongoing to improve resilience at the compression assets at Aberdeen, Kirriemuir and Avonbridge which might be expected to reduce, although not completely eliminate, future incidences of this scenario.

4 Emissions and the impact of IED

Prior to our May 2015 reopener submission we engaged with stakeholders from across the energy industry to capture their views on our future compressor strategy.

In January 2016 a decision had to be made at Moffat as the two compressor units at the station were not compliant with the LCP element of IED. Based on the relatively low usage of the station, the decision was made to put both units on 500 hour EUD to comply with the LCP element of IED. This would ensure that the station was still available to provide limited resilience in the event of an outage at any of the Scottish compressor stations.

5 Future Operational Requirements

There have been no recent market signals which would indicate an increased need for the use of Moffat in the near future, although as noted above, the recent increase in flows at St

Fergus (which is within current obligations) does create uncertainty in this area. Our assumption is that the station will run for no more than 400 run hours per year for the foreseeable future, within the 500 hour EUD per machine restriction currently in place.

5.1 Future Risks

The potential future need is a consideration at any compressor station, to avoid the cost and time impact on consumers of reversing a decision, however there is an additional factor to consider at Moffat. Since the Moffat compression was constructed, the surrounding area has been designated as a clean air zone. As the compressor station pre-existed the designation, Moffat has been able to continue to receive environmental permits to operate. If the existing compression was to be decommissioned the current permits would be withdrawn and could not legally be re-issued in the future. In the event of any subsequent need to re-commission the station, only electrically driven compression could be installed.

IED Phase 2 works

Options being considered for Carnforth and Nether Kellet² as part of the IED Phase 2 programme of works may result in an increased need for Moffat while this station to the south is on extended outage. Between Avonbridge to the north and Alrewas to the south there is a 400km stretch of pipeline with Moffat, Carnforth, Nether Kellet and Warrington distributed in between. If both Carnforth and Nether Kellet are unavailable alternative compression would be required to move gas down the west coast. Moffat is ideally placed to provide this capability during the period of outage. Warrington compressor station located further to the south was also considered as an alternative site to provide resilience during these Phase 2 works however the size of the units and its location at the southern end of this stretch of pipeline mean it would be less effective in this role (Figure 5.1).

² due to their close proximity are essentially viewed as the same site from an operational point of view

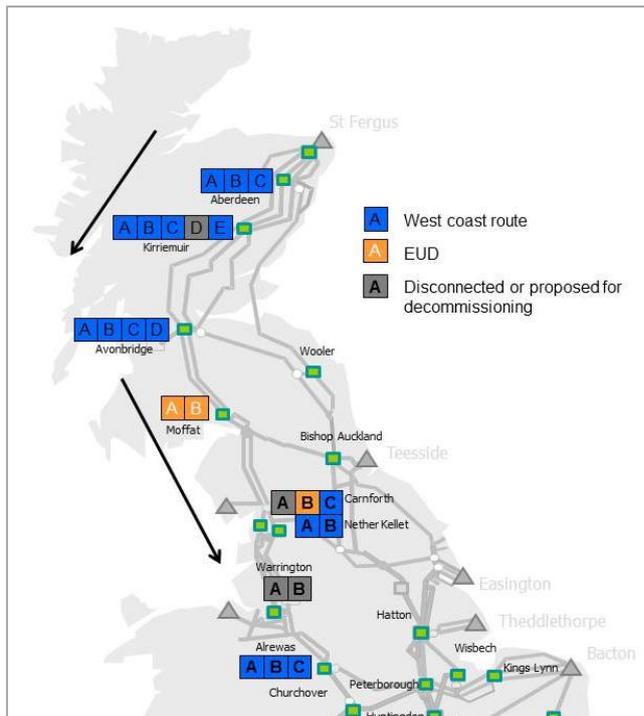


Figure 5.1: Bulk transportation the west coast

At Warrington compressor station the preferred option, following the IED cost benefit analysis assessment, is to decommission the site within the RIIO-T1 period. This site has had very few run hours over the last 10 years as other network compression, including Moffat, are more ideally placed to deal with compression outages in Scotland. Decommissioning Warrington reduces network resilience capability so this needs to be factored into the options being considered at Moffat.

Scotland 1-in-20

As part of RIIO-T1, funding was provided to assess the impact on 1-in-20 network compliance in Scotland as a result of the declining flows seen at the St Fergus Terminal. One of the potential options identified as part of the initial assessment work was to enable reverse flow at the Moffat compressor station. The decline in flows at St Fergus has slowed in recent years which has meant the requirement for 1-in-20 works had been deferred. The situation is currently under review and the options, including reverse flow at this site, are being revisited. The previous assessment indicated that the existing units at this site may not be suited to provide this duty as they are too large and so this option is currently viewed as unlikely to be progressed beyond the optioneering stage.

5.2 Summary

The Moffat compressor station is ideally located to provide network resilience to move gas out of Scotland during periods of planned and unplanned outage at other Scottish compression sites and during period of very high St Fergus flows. It could also be used to provide resilience during periods of outage at both Carnforth and Nether Kellet to the south. As ongoing asset health works at the other Scottish compressor stations and any proposed Phase 2 IED works at Carnforth conclude, the need for the resilience provided by Moffat may reduce. The current flow forecasts suggest that this site is no longer required to support baseline flows at St Fergus.

6 Options Considered

As we have outlined in Chapter 3, Moffat compressor usage has declined since 2008. The station is increasingly used for network resilience during periods of outage and could offer operational flexibility longer term should flows at St Fergus continue to reverse their previous decline. The decision to retain both units on 500 hour EUD longer term needs to be balanced against the ongoing cost of maintaining ageing units. As part of our Integrated Plan approach for the network the options considered for this site were assessed alongside the future site considerations for Warrington.

All credible options considered must:

- comply with emission legislation,
- minimise cost to the end consumer and
- provide a robust long term solution for the NTS.

6.1 Commercial Options

Several commercial options were assessed to determine if they would be suitable alternatives to compression capability at Moffat.

Reduce Obligated Baselines

The obligated entry capacity levels at specific entry points are used to inform our network investment decision making process. Where baselines are significantly higher than the peak physical flows seen via a supply point, this can create uncertainty in the level of investment required. This option would have limited influence on Moffat as its future requirement is predominantly for resilience; therefore this option has been discounted. However inherent network risk would increase if compression capability is reduced.

Turn up and turn down contracts for constraint management

Bi-lateral contractual arrangements at either entry (e.g. LNG) or exit points (e.g. power stations or industrial customers) can be used to manage network flows to prevent constraints. The low level of expected run hours at Moffat and the interdependencies with the other Scottish compressors mean this approach would not be a particularly cost effective alternative, and is therefore not taken forward.

Constraint management scheme

We have considered if a capacity buy back “Option Agreement” or “Forward Agreement” would be an appropriate way of managing the risk of future constraints.

To date historic flows have been well below the baseline at St Fergus so these Agreements would not be appropriate alternatives for Moffat. There is still unsold capacity in the short term auctions for St Fergus so any constraint caused by a reduction in capability would be more appropriately managed using other commercial tools such as day-ahead and on-the-day firm capacity restrictions. Also, an Option/Forward Agreement does not mean that there would be a guaranteed turn down of flows. A Shipper could continue to flow without capacity entitlements if they choose to take the risk in doing so, or could purchase interruptible capacity if this is available to them. Therefore constraint management agreements have not been taken forward.

6.2 Asset Options

Several asset options were considered for Moffat compressor station, these are as follows:

- **Option 0** – Keep the station as-is with both units on 500 hours EUD for the foreseeable future
- **Option 1** – Decommission the compressor station within RIIO-T1
- **Option 2** – Decommission the compressor station in 2024

Option 0 - Keep the station as-is (counterfactual)

This option is maintaining the status quo at the site by keeping both units on 500 hour EUD for the foreseeable future. This option represents the minimum intervention required to ensure compliance with the IED legislation. The predominant cost associated with this option relates to the asset health spend required to keep the engines maintained and running for the foreseeable future.

This option ensures Moffat remains available to provide resilience for the surrounding compressor fleet for the foreseeable future. It also offers future flexibility at the site as the environmental permit would be retained therefore should any of the future risks around supply or demand manifest themselves this option would keep this site operational and available for future adaptations if required.

Option 1 – Decommissioning the station within RIIO-T1

This option proposes decommissioning the compressor station within RIIO-T1. This would remove ongoing maintenance costs associated with the ageing plant. In 2015, we commissioned Amec Foster Wheeler to assess what would be required to decommission the Moffat compressor station.

This option removes the ongoing maintenance costs however it also removes the resilience provided by this site. This option has been assessed alongside the options being considered at Warrington. If this option was taken forward along with an equivalent decommissioning option at Warrington this would result in a 400km stretch of pipeline with limited alternative network resilience for planned and unplanned outages at Avonbridge or Carnforth and Nether Kellet. The IED phase 2 works being proposed at Carnforth and Nether Kellet will result in this station being on outage. As outlined in section 5.1, Moffat is more ideally located than Warrington to provide resilience to facilitate the outages required to undertake the IED Phase 2 works. The historic and forecast run hours at Warrington are significantly lower than Moffat, therefore it was more appropriate to decommission Warrington at this stage. However decommissioning Moffat within the same time period would compromise network resilience and so this option was discounted.

Option 2 – Decommissioning the station in 2024

This option proposes decommissioning the Moffat compressor station in 2024. The two existing RB211s would be maintained until 2023 and then the station would be decommissioned in 2024. This option would maintain resilience for the surrounding compressor fleet for several more years before decommissioning.

This option would ensure that the compression remains available to provide resilience for the surrounding compressor fleet while IED Phase 2 works are undertaken.

The site itself would still be required as the Gas Network Ireland / Bordgais Eireann pipework and AGI would be retained on site.

6.3 Summary of options taken forward

Options 0 and 2 were taken forward to the cost benefit analysis stage. The table below illustrates the capex costs associated with each of the options out to 2035.

Option	T1 funding request (£m)	Forecast T1 totex (£m)	Forecast totex 2021/22 to 2034/35 (£m)	Total (£m)
Option 0	10-20	24.8	10-20	20-40
Option 2	10-20	24.8	10-20	20-40

Table 6.1: Moffat option cost summary

7 Option Evaluation

Of the two options taken forward, Option 0 has been defined as the counterfactual as this is effectively the do minimum option. This option ensures that we remain compliant with IED and provides network resilience to surrounding compressor sites.

A high level cost benefit analysis (CBA) has been undertaken using the Spackman methodology to calculate the present value for each of the two asset options being considered for Moffat compressor station. This method uses the weighted average cost of capital (WACC) to calculate the cost of capital investments, these are then amortised over the full assessment period. All the costs and benefits are then discounted using the social time preference rate (STPR) to allow comparison of costs and benefits being accrued during different time periods. The total of these present values results in the Net Present Value (NPV) for each option as outlined in the chart below. The CBA assessment is over a 45 year period and the price base is 2017/18. All of the costs and benefits are calculated for the first 30 years, and then discounted over a 45 year period in accordance with the RAV (Regulatory Asset Value).

The NPV for Option 0 is -£50m and for Option 2 is £-31m. The longer assessment period in the CBA is the reason for the difference between the NPV calculated costs and the costs in Table 6.3. Option 2's relative NPV, when compared to Option 0 is +£19m. This indicates that this option is the most favourable option from a cost perspective however the intangible benefits provided by the station e.g. resilience are not quantified in this assessment. Option 2 removes the need for long term maintenance on ageing compressor units which is the main cost difference between the options.

All options considered for this site were presented to stakeholders in our March 2018 consultation document for feedback. We received four formal responses to the consultation, all of which broadly supported the compressor strategy proposed for the network. In the stakeholder engagement sessions held in late 2017 our stakeholders were broadly supportive of decommissioning ageing units where it was no longer economic to continue to maintain them. Their main concern related to ensuring that any options considered would not compromise customer flexibility or network resilience longer term. As a result of the feedback received Option 2 was identified as the preferred option for Moffat.

8 Conclusion

In assessing the options for this compressor station, we have taken our stakeholder's feedback into account, in addition to the long term expenditure required to maintain these ageing assets and the historic, current and forecast future use of this station. Based on this the least worst regrets option for Moffat is to keep it operating under the 500 hour EUD out to at least 2024. We will revisit the enduring requirement for Moffat as part of our RIIO-T2 business plan.

In our RIIO-T1 proposals we had intended to replace both units, therefore we will now incur additional asset health costs over our RIIO-T1 submission to maintain the reliability of these units until the end of RIIO-T1. The asset health costs associated with maintaining these units form our May 2018 reopener funding request to Ofgem for this site.

Funding Request Summary (09/10 price base)

The Moffat funding request is between £10-20m.

RIIO-T1 Output - To undertake asset health works to maintain the RB211s on 500 hours EUD.