nationalgrid

Kirriemuir IED Business Case

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1 Executive Summary

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

Kirriemuir compressor station is located in Scotland on the same site as the Kirriemuir multi-junction that conveys the majority of gas from Scotland towards the south. The station comprises three Avon gas turbine driven compressor units (Units A, B and C), an RB211 gas turbine driven compressor unit (Unit D) which was recently disconnected from the NTS and a 35 MW electric driven Variable Speed Drive (VSD) compressor (Unit E).

Unit D is impacted by the IED-LCP legislation and was put on the Limited Life Derogation (LLD), which limits running hours to 17,500 hours in total or until 2023, whichever comes sooner. However, Unit D suffered an in-service failure, and a decision to disconnect the unit was made ahead of significant expenditure on a major overhaul. The VSD, Unit E was commissioned in 2015 as part of IPPC Phase 1 as the lead unit for the site. Low St Fergus entry flows had limited the testing opportunities for Unit E, and modifications to change the operating envelope of the unit were considered. However, recent increasing flows at St Fergus mean we now expect to be able to run Unit E without modification.

The preferred option for Kirriemuir within this submission request is for funding to undertake the decommissioning of the compressor Unit D and no further works. This is based on the VSD being the lead unit on site and covering the high flow requirements whilst the Avon units A, B and C, cover the lower flow requirements. Any changes to network flow conditions may require a future re-wheel of Unit E to match the necessary capability requirements, and may form part of a future submission. The innovative use of variable envelope compression technology may also be considered to mitigate future risks around flow uncertainty. This would build upon National Grid's prior investigation of this technology with the Network Innovation Allowance project 'VECES- Variable Envelope Compressor Economic Study'. Potential future investment at the site, triggered by the implications of MCP legislation on the three Avon units will also be considered as part of a future submission under RIIO-T2 business plans.

The T1 funding request for decommissioning Kirriemuir Unit D is less than £10m, with the decommissioning work all completed within the RIIO-T1 period.

Funding Request Summary (09/10 price base)

The Kirriemuir funding request is less than £10m.

RIIO-T1 Output - Decommission Unit D at Kirriemuir compressor station by the end of RIIO-T1.

2 Introduction

Kirriemuir compressor station was constructed in 1977 to facilitate flows south from St Fergus terminal. It is located on the same site as the Kirriemuir pipeline multi-junction for three pipeline feeders that convey the majority of gas from Scotland

The station comprises three Avon gas turbine driven compressor units (Units A, B and C), one RB211 gas turbine driven compressor unit (Unit D), and one 35 MW electric driven Variable Speed Drive (VSD) compressor (Unit E), which was commissioned in 2015. The site is impacted by the requirements of IED; the VSD was installed under IPPC Phase 1 and the RB211 unit is impacted by requirements of the IED (LCP) directive. This paper evaluates the optimum solution to meet the IED emissions legislation at Kirriemuir compressor station.

3 The Site: Assets and Operation

Kirriemuir compressor station was constructed and entered service in two phases over the period 1977 through to 1985. Initially, the station consisted of three Avon units (A, B and C) and then in 1985, one RB211 unit (D) was installed.. In 2015, a further new unit was commissioned on site - a 35MW electric VSD compressor unit, designated Unit E.

All units can be used in single configuration with the exception of Unit C. Parallel configuration is also possible with the following combinations of units:

- Units A and D,
- Units A and C,
- Units B and C,
- Units B and D,
- Units C and D

Units A and B can be used in series configuration. The station can also be run with Units A and B in series, in parallel with Unit C.

Operationally, Unit D was the lead unit due to its reliability and flexibility. Unit D was installed to help meet requirements for transporting high flows from the St Fergus terminal to demand centres in the south. When flows from St Fergus were at their maximum level in 2003-2004, Unit D was operated in parallel with one of the Avon-driven units (nominally Unit C, with A and B units acting as back-up) due to the high flow and lift requirement. Between 2014 and 2015, Unit D saw very high run hours with corresponding emissions and NOx. This was due to the unit being ideally placed and sized at a time when other units in the Scottish compressor fleet were unavailable, and flow rates being outside of the capability of the larger Unit E. However, in early 2016 there was an in-service failure on Unit D and the unit has not been operational since then.

The VSD unit (Unit E) was designed to be equivalent to the duty of Unit D in parallel with one of the Avon units. Due to a reduction in St Fergus flows during the commissioning period for Unit E, the opportunities for commissioning, testing and use of the unit were limited. A proposal was considered to re-wheel Unit E and de-rate the machine in line with the lower flows. However flows have since increased to levels that are more suited to the operational envelope of Unit E and there is no current need to re-wheel. Unfortunately, having gained

asset acceptance in late 2015, during the summer of 2016 the operation of Unit E was further constrained by feeder outages for essential maintenance work which reduced the maximum possible compressor throughput at Kirriemuir to a level well below the minimum capacity for Unit E. As a result Unit E only saw very limited test running during 2016/17. The unit then experienced a number of technical issues associated with the cooling system and the unit protection system which have limited operation in 2017/18. There is ongoing work to resolve these issues which is expected to complete very shortly.

The running hours for each individual compressor unit over the past five years are shown below:

	Individual Unit Running Hours *(financial year)*				
	2013/14	**2014/15**	**2015/16**	**2016/17**	**2017/18**
Unit A	367	155	1,234	599	1189
Unit B	11	11	783	823	392
Unit C	9	0	58	107	195
Unit D	41	1,522	3,328	0	0
Unit E	N/A	N/A	N/A	2	0
Total	428	1,688	5,403	1,531	1776

Table 3.1: Run hours summary

4 Environmental Legislation

4.1 IED: LCP and MCP elements

The LCP element of the IED applies to all combustion plants with a thermal input of 50MW or more. Under the LCP directive, combustion plant must meet the Emission Limit Values (ELVs) which are defined in the directive. The RB211 unit, Unit D is impacted by this requirement. The deadline for compliance with the legislation associated with the LCP element of IED was the 1st January 2016 and in December 2015 a final decision had to be made for Unit D. The main options at this stage were whether to operate under either the Emergency Use Derogation (EUD) or Limited Lifetime Derogation (LLD). The EUD was considered not suitable as it limits running hours to just 500 hours per year, and at that time Unit E was not operationally proven.

In line with the outcome from stakeholder engagement carried out as part of our IED submission in May 2015, Unit D was put onto LLD. This allowed the unit to operate for a maximum of 17,500 hours in total or until 31st December 2023 (whichever comes first), at which point it would have to be taken out of service and decommissioned. However, in March 2016 there was an in-service failure on Unit D which would have required significant asset health expenditure to bring the unit back into operation. The unit was therefore disconnected from the NTS as an interim measure prior to decommissioning the unit.

The MCP directive will apply from 2030 and will limit emissions to air from sites below 50MW thermal input. There are three units at Kirriemuir that will be affected by the MCP directive. These are Avon units A, B and C. Initially the draft MCP Directive required all non-compliant units to be addressed by 2025. However, this deadline moved back to 2030 in the final directive. The investment options for the three Avon units are not considered as part of this current investment case.

5 Future Operational Requirements

Kirriemuir compressor station was originally designed to provide North-South transmission capability. It is now used for a number of other purposes as well; hence the units have seen variability in run-hours in recent years. As well as bulk transportation capability, the station also provides:

- St Fergus terminal entry capability;
- Network resilience and backup to Avonbridge and Aberdeen compressor stations; and
- Support for Scotland exit pressures.

5.1 St Fergus Terminal Entry Capacity

Historically, Kirriemuir was required to meet high St Fergus entry requirements and the chart below shows the flows from the St Fergus terminal since 2005. In the mid to late 2000s, when flows from the St. Fergus terminal were at their maximum level, Unit D was operated in parallel with one of the Avon-driven units due to the high flow and lift requirement. Unit E was therefore designed to replace the duty of Unit D in parallel with one of the Avon units.

There are also low flow periods - from 2011-2014 and during summer months – which show a clear requirement for the low flow capability (<55 mcm/d) at Kirriemuir. During these periods compression requirements can be met by one Avon unit.

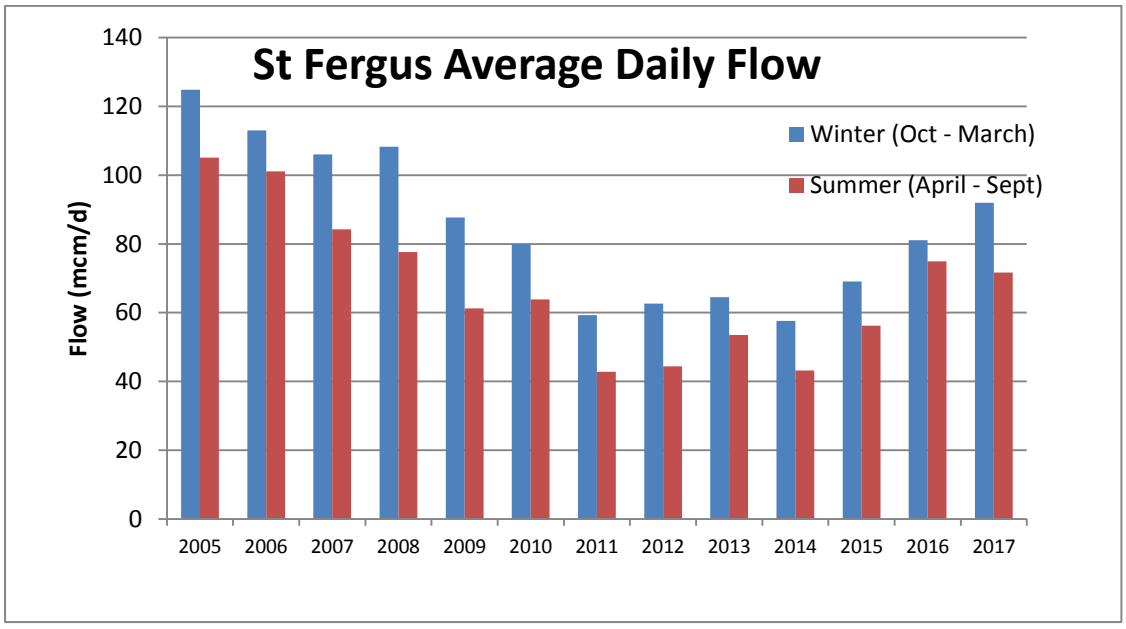

Figure 5.1: St Fergus Average Daily Flow

Flows from the St Fergus terminal have recently returned to relatively high levels.

The future operational requirements for Kirriemuir to meet the St Fergus entry capacity entail Unit E capability for high north – south flows with the remaining Avon units providing the lower flow capability, whilst Unit D is not required.

5.2 Support for Scotland Exit Pressures

Kirriemuir is also required to maintain assured offtake pressures in Scotland, Kirriemuir is used to maintain the suction pressure at Avonbridge compressor station to allow an adequate pressure lift at Avonbridge to meet the high assured offtake pressures at Scottish offtakes. If Avonbridge is unavailable through planned or unplanned outage, Kirriemuir is necessary to directly meet the required pressures at the relevant offtakes.

These pressure requirements can be met by Unit E and the Avon units in either single, parallel or series configuration.

5.3 Network Resilience

Historically Unit D provided resilience to the units at Aberdeen compressor station and since disconnection in 2016, this resilience has been provided by the Avon units A, B and C. Following the increase in St Fergus flows, Unit E can also provide this resilience. In the future, if flows at the St Fergus terminal decline, consideration will need to be given to de-rating and re-wheeling Unit E so that it can take the bulk duty of the site and better fit the flows from the terminal. The potential innovative use of variable envelope compression technology may also be considered to mitigate future risks around flow uncertainty and to build upon National Grid's prior investigation of this technology with the Network Innovation Allowance project 'VECES- Variable Envelope Compressor Economic Study'.

5.4 Future Operational Requirements Summary

Network analysis has been used to verify the capability requirement for Kirriemuir in line with the three factors considered above. The analysis indicates that the capability previously provided by Unit D could be provided by the other units at Kirriemuir:

- Unit E provides capability during high north – south flows and the remaining Avon units could provide the lower flow capability in single, parallel or series configuration.
- Unit E would be required to meet peak requirements if compression at Aberdeen and Avonbridge is unavailable under high flow scenarios from St. Fergus.
- The Avon units can also provide the Scottish compression back-up requirements in single, parallel or series configuration.

The recent increase in flows through St Fergus, and in particular through the NSMP sub terminal, have postponed the need to re-wheel of Unit E although this will continue to be a consideration for the future as changes in flow patterns develop over time.

6 Options Evaluation

The counterfactual option is the option which is closest to business as usual and which is compliant with all the relevant elements of IED. The counterfactual option therefore is expressed as the preferred option relevant to Unit D and its associated capability under the LCP element of the IED directive only. The counterfactual is defined as decommission Unit D and no further works.

The alternative options for Unit D consider whether we need additional capability or resilience. The operational requirements of the site clearly indicate that no capability or

resilience is required from Unit D now that Unit E is operational. Hence the commercial options (reduce obligated baselines, turn up and turn down contracts and disaggregation of entry points) are not considered relevant.

The legislation changes as well as the asset condition referred to in previous sections have altered the viable asset options over the past three years. In the May 2015 IED reopener, there were five options considered for the site, which are presented in the table below. Based on the derogation decision taken and subsequent asset health issues on Unit D, the majority of these options are no longer viable options.

Option Number	Option Description	2018 Option Viability
Option 1	Unit D on the LLD then decommission unit D	Consideration given to immediate or later decommissioning.
Option 2	Unit D on the LLD then decommission unit D; de-rate/re-wheel unit E	Unit E de-rate/re-wheel not required.
Option 3	Unit D on the EUD; de-rate / re-wheel unit E	Not viable: Unit D entered onto the LLD.
Option 4	Unit D on the LLD then decommission and install 1 replacement unit; de-rate and re-wheel unit E	Unit E de-rate/re-wheel not required (no need for additional capability).
Option 5	LLD on Unit D then decommission; de-rate /re-wheel unit E; decommission and replace Unit C	Unit E de-rate/re-wheel not required and Unit C investment not required under this reopener, due to changed implementation date of MCP.

Table 6.1: Option Viability

The options which include a re-wheel are no longer required following the change in flow patterns through St Fergus terminal. Option 5 which included investment in the Avon, Unit C will be considered as part of the future compression strategy in our RIIO-T2 business plan. A further option to consider asset health works on Unit D following the in service failure, and then a later decommissioning date after 2023 was assessed. However, the severity of the asset health issues and associated cost to keep Unit D operational until the end of the LLD period in 2023 was such that this option has not been taken forward.

Hence the preferred option is the counterfactual, to decommission Unit D only. Following the in service failure in September 2016, some limited disconnection has already been completed to take the unit out of service and disconnect from the NTS. It is proposed that the unit will now be decommissioned to plinth level.

7 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 2018 for four weeks. There were no stakeholder concerns raised regarding the options and recommendation for Kirriemuir compressor station.

8 Conclusion

This submission assesses the options to manage the implications of the LCP element of the IED directive at Kirriemuir. The recommended decision is to decommission Unit D to plinth level. This is based on the VSD being the lead unit on site and covering the high flow requirements whilst the Avon units cover the lower flow requirements. The capability of the VSD will need to align to future flows and there may be a future requirement to de-rate and re-wheel. The price for decommissioning Unit D is less than £10m. This work is scheduled to be carried out in 2020-21.

Funding Request Summary (09/10 price base)

The Kirriemuir funding request is less than £10m

RIIO-T1 Output - Decommission Unit D at Kirriemuir compressor station by the end of RIIO-T1.

RIIO-T1 Expenditure Risk - The risk of not completing the works prior to 2021 is low. The decommissioning at Kirriemuir is not connected with other works on the network and will require only one summer outage period.