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**Technical Support for TPCR4 Rollover
Assessment of Non-Load Related & Load
Related Capex.
Initial report - NGG**

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By order of Ofgem



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EXECUTIVE SUMMARY

The current Transmission Price Control period (TPCR4) will be extended to include the additional year 2012/13, the Rollover year. This one year extension will apply to all 4 transmission owners (TOs): National Grid Electricity Transmission (NGET), Scottish Hydro Electric Transmission Limited (SHETL), Scottish Power Transmission Limited (SPTL) and National Grid Gas – National Transmission System (NGG - NTS). KEMA was appointed by Ofgem to assess the additional one year forecast business plans with accompanying investment requirements as submitted by each TO for 2012/13.

This report focuses on the assessment of the Non-Load Related Expenditure (NLRE) and the Flexibility category of Load Related Expenditure (LRE (Flex)) as forecast by NGG for the Rollover year and makes recommendations regarding appropriate expenditure levels for that year. As encouraged by Ofgem a proportionate approach for the one year control has been adopted and the Capex analysis has focused on the most financially material issues. It is Ofgem's intention to perform a full efficiency review of historical Capex as part of RIIO-T1. Similar assessments for the other TOs are summarised in separate reports.

Non-Load Related Expenditure

NLRE is driven by asset replacement and refurbishment requirements to ensure the transmission network continues to deliver the reliability, security and performance levels demanded, along with emission reductions to satisfy statutory requirements. This review of proposed NLRE for 2012/13 has determined that for the Asset Health and Emission reduction categories:

- Within the larger asset groups (e.g. Fiscal Metering and Power Turbines) £24.7m of Asset Health expenditure has yet to be sanctioned, suggesting that the relative priority and value of these projects remain to be ratified for inclusion in the Rollover year. For these projects, it has been assumed that the uncertainty of the proposed costs suggests that expenditure in the range of 70% to 100% of that proposed should be allowed.
- For the smaller asset groups, described under the category of 'Other', Asset Health expenditure of £11.0m has been identified against NOM outputs, but there is no evidence that these projects have been sanctioned. Therefore, for these projects, it

has also been assumed that the uncertainty of the proposed costs suggests that expenditure in the range of 70% to 100% of that proposed should be allowed.

- The ongoing work to obtain planning consent for the most appropriate approach for the Feeder 9 project continues, with a high risk that the process will not have progressed sufficiently for the anticipated initial design and site study work to take place in the Rollover year. It is therefore suggested that the proposed expenditure may not be required in the Rollover year. This amount has, therefore, been deducted from the forecast.
- Detailed review of the entry phase 2 gas quality metering work reveals that, in KEMA's view, £5.5m has previously been allowed, but this expenditure has slipped into the Rollover year. Since this spend has previously been allowed it is not clear that any further allowance is necessary. Hence this amount has been deducted from the proposed expenditure.
- A detailed review of a sample of the Fiscal Metering schemes suggests that the requirements and associated costs appear to be consistent with initiatives undertaken on other networks.
- Detailed review of the re-lifing of two power turbines has shown that this work has not yet been sanctioned. In addition, the cost estimate has been established at an upper limit of rather than with a central estimate of . This spread has been reflected in the suggested expenditure range.
- For Emissions Reduction; the proposed spend has been justified.

From the above discussion, the following estimated expenditures are suggested:

2012/13 Rollover Year NLRE	NGG Forecast (£m)	KEMA Estimate (£m)
Asset Health Total	51.4	30.2 – 39.5
Emissions Reduction	7.6	7.6
Other	3.8	3.8
Quasi-Capex	1.7	1.7
TOTAL	64.6	43.3 – 52.6

Load Related Expenditure (Flex)

LR (Flex) is a new category of spend proposed by NGG for the TPCR4 RO and includes projects that NGG consider necessary to accommodate and manage a perceived increase in the dynamic flows across the network. This new expenditure category incorporates the transfer of projects previously listed under user driven categories as well as additional projects identified subsequent to the April 2010 RRP submission.

This review has determined that the approach adopted by NGG of combining firm signals, such as demand growth forecasts, with more detailed acquisition of market behaviour and user intentions (suitably interpreted, since these are non-firm and have no financial commitment associated with them) along with the use of the SIMONE package is sufficiently well developed to enable future scenarios to be assessed with reasonable confidence and for mitigating actions to be identified. The review has also assessed the specific justifications for the projects (transferred and new) that have emerged from the NGG analysis. This assessment has considered both the validity of the suggested projects and their allocation to the new Flexibility category, or whether they could be associated with revenue drivers, such as incremental entry (or exit) related user signals. In summary, the outcome of this review is;

- The projects at Peterborough (Compressor re-wheel and Flow Control Valve replacement), Bacton (rationalisation) and for the replacement of existing Flow Control Valves (FCVs) at three locations yet to be determined do not appear to have been adequately justified and it is suggested that £15.3m expenditure be deducted from the Flexibility category in the Rollover year.
- The compressor replacements at Asselby and Moffat appear to be principally driven by reducing flows at St. Fergus, albeit replaced by incremental flows at other entry points and therefore should be signalled by incremental capacity to support these incremental entry flows. The Lockerley compressor replacement appears to be principally driven by incremental user signals. Hence, it is considered that all these projects should be excluded from the Flexibility category of expenditure, as they are more readily identified as being subject to revenue drivers. The Flexibility expenditure reduction proposed for these projects in the Rollover year is ██████████

- The Compressor re-wheels at Avonbridge, Bishop Auckland, Huntingdon and Kings Lynn all appear to be subject to the SO Incentive arrangements and it is suggested the associated [REDACTED] be excluded from the Flexibility expenditure.
- The multi-junction modifications at Kings Lynn are considered to be triggered by changing dynamic flows on the network and are not readily attributable to particular entry or exit signals and thus these schemes may be classified under Network Flexibility. This expenditure amounts to [REDACTED], subject to the further consideration, below.
- The FCV projects at Churchover and Pannal & Nether Kellet are considered to be justified and are driven by dynamically changing flows across the network not readily attributable to user signals, and hence can be incorporated under the new Flexibility category of LRE with a proposed expenditure of [REDACTED], subject to the further consideration below.
- The timing of the FCV projects at Churchover and Pannal & Nether Kellet and the Kings Lynn multi-junction projects appears to be driven and justified by recent observed changes to network conditions and there is no evidence to suggest that the need for these projects could have been identified against any particular revenue drivers.
- On the basis of the foregoing, the amount identified as justifiable for inclusion within the new Flexibility category of allowances is £14.0m. However, NGG has stated that these schemes are yet to be sanctioned, aside from some pre-works effort. For these projects, the resultant uncertainty of the proposed costs suggests that a range of 70% to 100% of the nominal amount should be allowed.

From the findings above, the following adjustment to forecast expenditure is suggested:

2012/13 Rollover Year LRE (Flex)	NGG Forecast (£m)	KEMA Estimate (£m)
Network Flex	50.3	9.8 – 14.0

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1 INTRODUCTION

The present transmission price control set by Ofgem in 2006 runs from 1 April 2007 to 31 March 2012. Following recommendations from the RPI-X@20 review the next full transmission price control review will be the first to reflect the new RIIO (Revenue = Incentives + Innovation + Outputs) regulatory model.

In 2010 Ofgem took the decision to extend the current price review period by one year prior to the new RIIO-T1 model. A one year 'Adapted Rollover' of the current TPCR4 period for the financial year 2012/13 is to be applied and implementation of the new price control review of GB's gas and electricity transmission companies will take effect from 1 April 2013. The Adapted Rollover applies to all four transmission companies (TOs): National Grid Electricity Transmission (NGET), Scottish Hydro Electric Transmission Limited (SHETL), Scottish Power Transmission Limited (SPTL) and National Grid Gas - National Transmission System (NGG – NTS).

Ofgem appointed KEMA to provide technical support for the Transmission Price Control 4 (TPCR4) Rollover. As the Rollover review spans a short transitional period, Ofgem adopted a proportionate approach to the one year control. The technical support comprising:

- a proportionate review of forecast capital expenditure, drawing on historical information where appropriate;
- a proportionate assessment of forecast non-load related expenditure (NLRE) for 2012/13 (including both asset health and emissions reduction expenditure);
- a proportionate assessment of forecast flexibility load related expenditure (LRE (Flex) in 2012/13 and
- observations pertaining to the forecast operational expenditure (Opex) in 2012/13.

The result of the review and KEMA evaluation is a recommendation on the appropriate non-load related (NLR) and flexibility load related (LR) capital expenditure for the Rollover year 2012/13. The report excludes detailed consideration of operational expenditure, other than identifying a number of high level observations that Ofgem may wish to consider.

2 APPROACH TO THIS ASSESSMENT

KEMA has reviewed capital expenditure for the TPCR4 period to date provided in the 2009/10 Regulatory Reporting Pack (RRP) and the 2010 Forecast Business Planning Questionnaire (FBPQ) and accompanying Detailed Narrative submitted to Ofgem in July and October 2010 respectively. The levels of expenditure with respect to NLRE and LRE (flex) have been assessed.

KEMA reviewed the NLR and LR capital expenditure for NGG, comparing outturn against allowances and projecting forecasts forward through the Rollover year (2012/2013) to 2017/18. Further analysis was performed on the NLRE to obtain a clear understanding of the levels of investment and volumes of assets installed, replaced or refurbished by major asset category. Further analysis was also performed on the LRE, in particular with regard to the perceived need for flexibility as a new category of spend, introduced by NGG for the TPCR4 RO price control. KEMA also undertook a review of the forecast Opex for the Rollover year and provided a number of key observations.

The Rollover FBPQ submission and accompanying narrative were reviewed paying particular attention to;

- explanations from the TOs with regard to any revision to planning methodologies, asset management strategies and investment criteria since the TPCR4 submission;
- clarification of queries raised from the RRP analysis;
- consistency of the Rollover FBPQ expenditure forecast with the 2009/10 RRP forecast; and
- forecast expenditure in the 2012/13 Rollover year.

Responses to requests for clarification arising from the FBPQ review and issued by Ofgem on 30 November 2010 were submitted by NGG and have been taken into full consideration in this review. In addition, visits to NGG by Ofgem and KEMA on 25/26 January 2011 and on 10 February provided further clarification and understanding of the information submitted.

Using all available information KEMA has made an assessment of:

- appropriate non-load related expenditure for the Rollover year 2012/13; and
- appropriate load-related expenditure categorized as 'Network Flexibility' for the Rollover year 2012/13.

Table 1 and Figure 1 provide the source data against which the NLRE and LRE assessments have been made.

TO Capex	Categories	Actuals		Forecast						
		2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
LR Capex	Entry	41.6	18.9	35.8	23.6	3.1	1.3	1.0	0.7	0.5
	Network Flexibility	-	-	2.0	50.3	43.8	64.1	61.1	40.9	48.7
	Total LRC	41.6	18.9	37.8	73.9	46.9	65.4	62.1	41.6	49.2
NLR Capex	Emissions reduction	37.2	38.4	10.1	7.6	42.0	60.0	60.2	25.3	22.7
	Asset health	38.6	45.0	44.7	51.4	85.7	117.4	53.7	49.0	50.3
	Other	3.3	3.6	3.6	3.8	3.4	3.7	3.8	3.5	3.6
	Quasi-Capex	0.4	2.0	2.0	1.7	0.6	0.6	1.0	-	-
Total NLR	79.5	89.0	60.4	64.6	131.7	181.7	118.8	77.9	76.6	
Cust. Contr. Exp.	Offtake & diversions	4.8	7.7	15.4	9.9	8.0	8.6	8.9	9.1	8.8
	Capital contributions	(1.3)	(6.2)	(15.4)	(9.9)	(8.0)	(8.6)	(8.9)	(9.1)	(8.8)
	Total	3.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Incremental Capex	Entry	33.9	30.8	0.0	35.9	97.0	372.8	639.3	249.1	176.3
	Exit	31.8	48.5	17.5	23.6	25.9	110.3	271.5	387.6	408.9
	Storage	0.001	0.000	-	-	-	-	-	-	-
CNI	12.2	49.9	38.9	14.1	13.5	-	-	-	-	
Logged up Capex	0.4	0.1	2.2	-	-	-	-	-	-	
Total	TO Capex	202.9	238.8	156.9	212.0	315.1	730.3	1,091.7	756.2	711.0

Table 1: LR, NLR and Total Capex, 2009 - 2018

(source: 2010_NGG_TCPR4_RO_FBPQ (Capex)_v1(1).xls,)

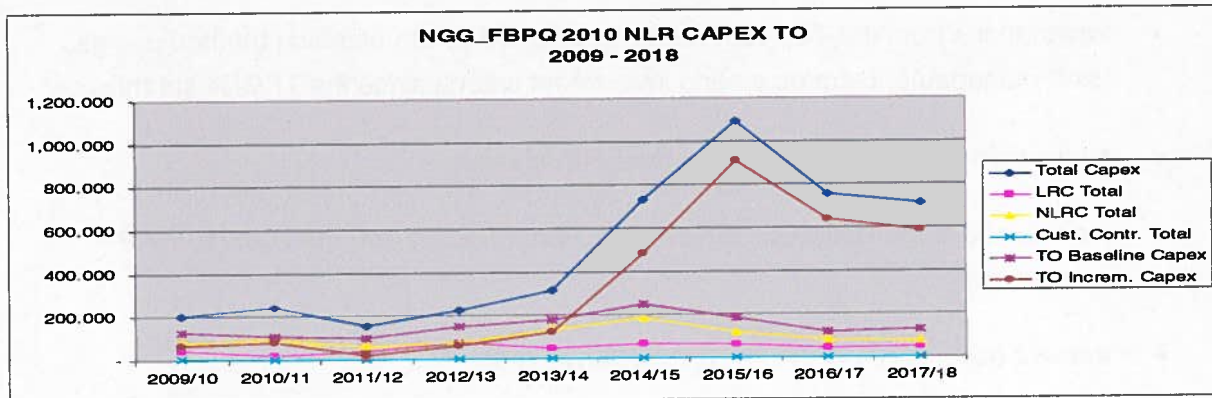


Figure 1: LR, NLR and Total Capex. 2009 – 2018

(source: 2010_NGG_TCPR4_RO_FBPQ (Capex)_v1(1).xls)

3 NON-LOAD RELATED EXPENDITURES

3.1 TPCR4 NLR Expenditure to Date

3.1.1 Comparison of Actual Expenditure and Allowances

Figure 2 shows that the actual NLR expenditure has been larger than the allowances for each year until 2005/06, except for the year 2004/05 in which the actual expenditure was £18.5m and the allowance was set at £19.0m (in 2009/10 prices). In 2007/08 the actual expenditure has been significantly (£70,9m) lower compared to the final TPCR4 allowances. The difference declined in 2008/09 to £4.1m. In the most recent year (2009/10), the actual expenditure was £79.5m against an allowance of £58.1m. This compares to a proposed spend of £75.8m for the Rollover year. However, NLR expenditure was significantly below allowances in the early years of TPCR4.

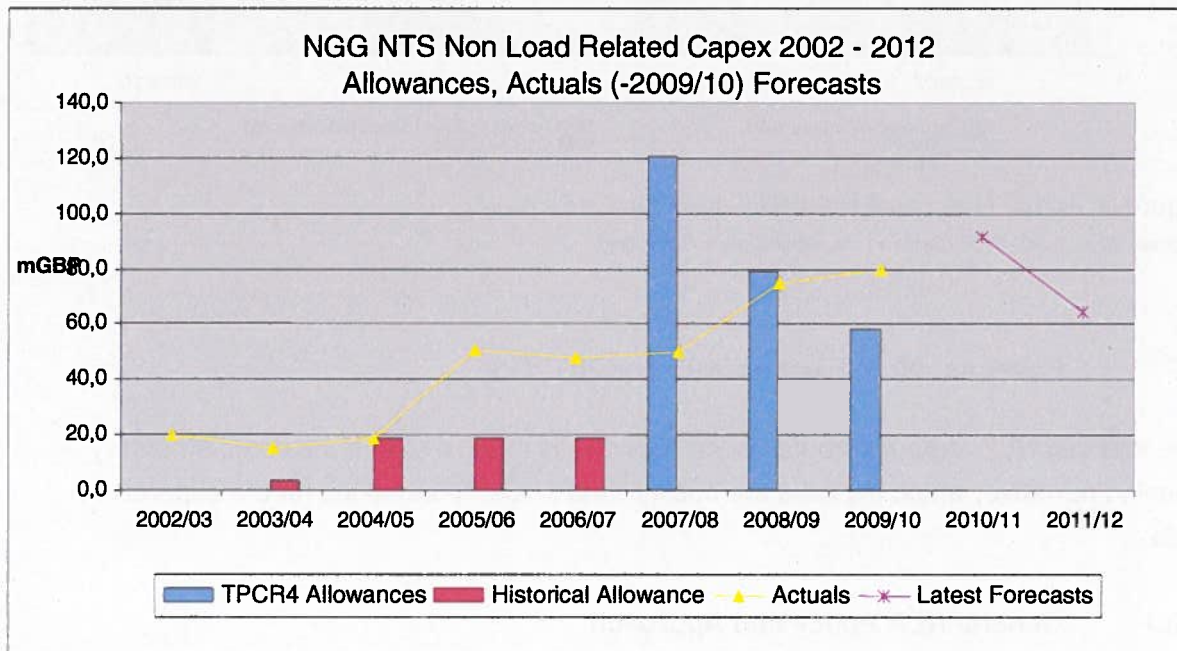


Figure 2: NLR Capex 2002 – 2012, Allowances, Actuals and Forecasts (2009/10 prices)

Source: WP24.2 NGG Comparison with Allowances.xls, label: Data

(NB: 2010/11 and 2011/12 data removed from the above graph/table)

NLR expenditure trends have also been assessed in terms of how the overall spend breaks down into specific categories, based on the information in the NGG RRP 2009/10 document. The RRP confirmed that almost all of the NLR expenditure is on emissions and asset health

related aspects. The trend in actual overall expenditure has been an almost linear increase in NLR Capex from 2007/08. In Figure 3, the build up of the total NLR expenditure is shown. The share of expenditure on asset health aspects has steadily increased since 2006/07 and is the main driver for the gradual increase in Capex from 2007/08. As can be seen from Table 1, this trend continues into the Rollover year, with emissions expenditure dropping to a minimum and asset health expenditure continuing to rise.

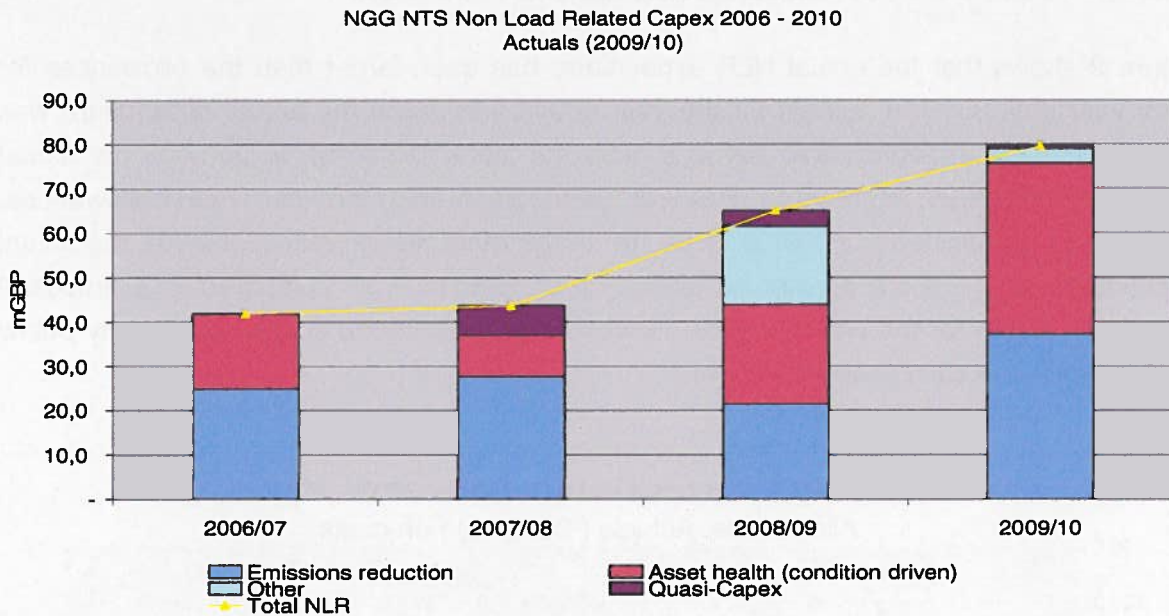


Figure 3: Actual Non Load Related Capex by area

(source: 2010_NGG_RRP Capex v1.xls, label: Capex Summary)

3.2 Forecast NLR Expenditure for 2012/13

The forecast NLR expenditure has been provided in the FBPQ and the complementary detailed narrative, which explains the background to and foundations for the expenditure data.

3.2.1 General NLR Policy and Approach

The NGG approach for maintaining network assets is to focus on defined secondary assets (such as; Flow Control Valves, Compressors, Metering, Cathodic Protection and so on) that support and underpin the primary assets (entry points, pipelines, multi-junctions, compressor sites and exit points). The monitoring of the secondary assets is done by direct inspections. The results are entered in the Network Output Measures (NOMs) methodology, which then provides an indication of where expenditure is required and over what timescale, based on

the secondary asset condition. The NOM methodology appears to be capable of identifying the state of the assets and to determine the need for expenditure necessary to keep these at reliable levels, although it currently only operates at the asset class level, rather than at site specific asset level. Furthermore, the analysis and feedback from NGG suggests that this methodology is still being developed and has yet to be fully integrated into the building of NLR Capex planning requirements. Alongside the NOM methodology analysis of specific condition monitoring and engineering judgements continue to be used to identify programmes of work to optimise asset health and emissions reductions. Furthermore, the analysis suggests that NGG also fully consider the deliverability and ability to finance their programmes of work.

The NOM outputs do provide a general view on investment programming within 2 or 3 year periods although the linkage to specific projects and their associated costs, for example within the TPCR4 RO year, have not been explicitly explained in the FB PQ and associated narratives. However, NGG have explained that this linkage is made using engineering judgement and consideration as to what particular projects might be optimal, given both the NOM output and other requirements that must be met, such as emissions reduction. This has necessitated a top-down approach to the assessment of the proposed Asset Health expenditure.

NGG has also noted that the relatively small size of the asset families (i.e. particular secondary assets used across the NTS) means that a standard unit cost for replacement assets and associated capital spend cannot be developed to the same extent as that for electricity transmission networks. As a consequence, the approach for costing a project has instead been based on building up costs derived from recent history and evidence gathered from suppliers.

NGG has explicit obligations to reduce its green house gas emissions and is undertaking a programme of work on its compressor stations and associated equipment, some of which is planned for the Rollover year to comply with these obligations. The programme is based on a 'fleet' approach where utilisation of the compressor units (running hours) determines the prioritisation to upgrade the affected units.

3.2.2 Trends in Non Load Related Capital Expenditure

In Figure 4 the overall trend for the forecast NLR capital expenditure is provided. Compared to 2009/10 and 2010/11 there is a predicted and approximate 30% decline in 2011/12, recovering somewhat in the Rollover year (2012/13), with subsequent expenditure growth of

more than 300% towards 2014/15, mainly due to increases in asset health expenditure. Further analysis of Asset Health is discussed in section 3.2.3.

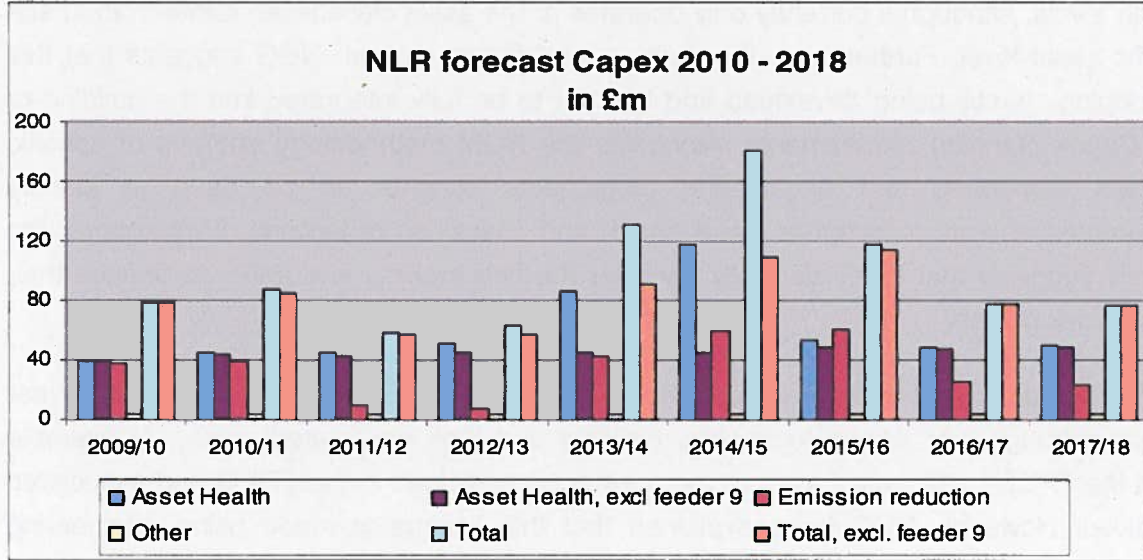


Figure 4: Forecast NLR expenditure 2009 – 2018
 (source: 2010_NGG_TCPR4_RO_FBPQ (Capex)_v1(1).xls, label: Project Listing)

3.2.3 Trends in Asset Health related Capital Expenditure

The forecast for asset health expenditure from 2010 onwards is flat (approx. £45m/year) when the Humber crossing is excluded from the totals, see Figure 5. The forecast investment for the Humber crossing is exceptional and is in addition to the regular Asset Health investments. The Humber crossing work is considered in section 3.2.5 as one of the schemes selected for detailed review.

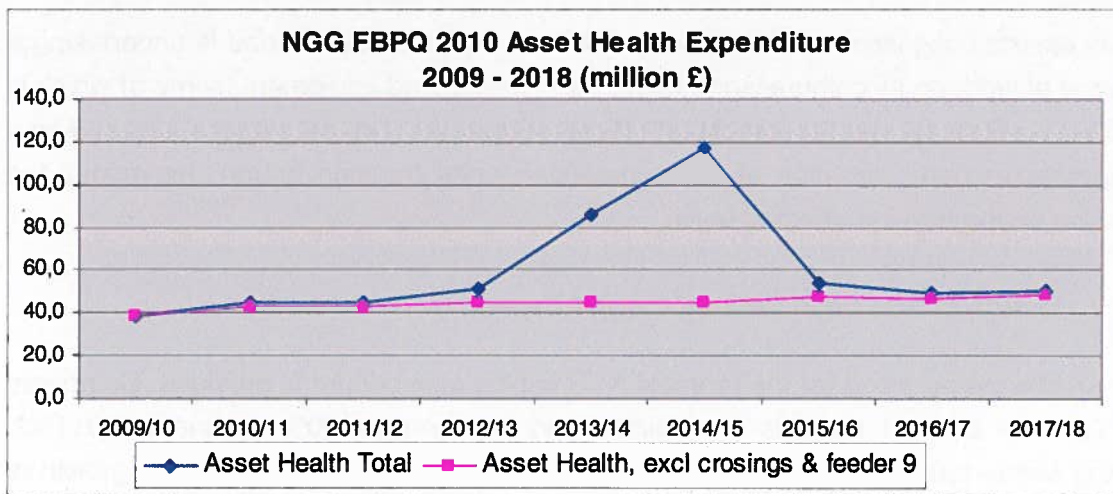


Figure 5: Asset Health Capex forecast (2009 - 2018)

(source: 2010 NGG_TCPR4_RO_FBPQ(CAPEX) v1(1).xls, label: Project Listing)

NOM Description	2012/13
Gas analysers	█
Fiscal metering	█
River crossings inc Feeder 9	█
Control Systems (unit and station) / anti-surge systems	█
Cathodic protection and below ground pipe and coating	█
Exhaust and air intake	█
Power turbine	█
Gas generator	█
Other	█
Total	£51,4m

Table 2: NLR 8 largest spend schemes 2012/13.

(source: 2010 NGG_TCPR4_RO_FBPQ(CAPEX) v1(1).xls)

Table 2 provides an overview of the top eight projects (by NOM description) that require substantial expenditure in the Rollover year. Figure 6 provides a graphical representation of the forecast expenditure for 5 of these NOM categories (excluding the Humber crossing).

NGG Forecast of top 5 asset health projects by expenditure (excl. Humber crossing)

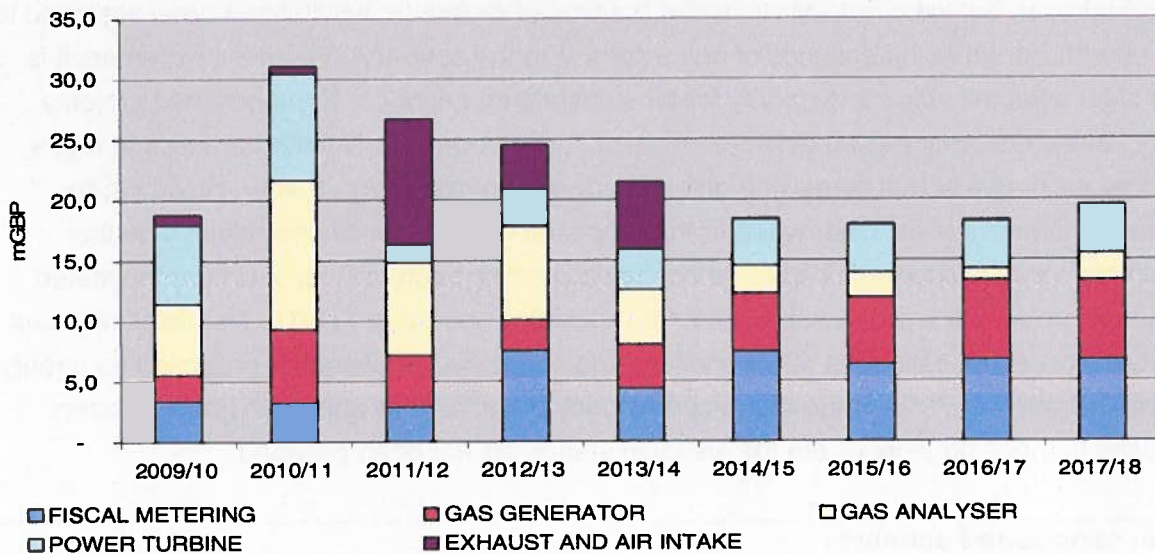


Figure 6: NGG Forecast of top 5 asset health projects by expenditure (excl. Humber crossing)

(source: 2010 NGG_TCPR4_RO_FBPQ (CAPEX) v1(1).xls, label: Project Listing)

The level of Asset Health expenditure appears to be stabilizing around £45m to £50m (see figure 4). For each category of Asset Health expenditure, a review has been carried out to check the scheme sanction status and to check that the NOMs are consistent with the proposed spend. The results are summarised in Table 3. It should be noted that the more detailed costs provided by NGG against scheme sanction were set to a greater number of decimal places and it has not been possible to fully reconcile these numbers against the less precise numbers in the FBPQ. However, this discrepancy is not considered to be material.

It has also been identified that a particular scheme, associated with the entry phase 2 gas quality metering work, in KEMA's view, £5.5m has previously been allowed, but this expenditure has slipped into the Rollover year. Since this spend has previously been allowed it is not clear that any further allowance is necessary. Hence this amount has been deducted from the proposed expenditure in the Rollover. As part of the more detailed review of certain schemes, it has also been identified that the Feeder 9 work (the Humber Crossing) continues through the planning process and this may cause delay, such that the expenditure identified for the Rollover year may not arise and may not need to be reflected in the allowances.

[TABLE REMOVED]

Table 3: Overview of Asset Health schemes regarding sanctioning and NOM identification

(source: 2010 NGG_TCPRA_RO_FBPQ (CAPEX) v1(1).xls, Table 5.10 and NGG sanction information)

Finally, there are a number of schemes that are proposed that involve expenditure within the Rollover year, but were not sanctioned at the time of review (or which have been assumed to be un-sanctioned in the absence of any evidence to the contrary). For these schemes, it is not clear what the value and priority for the expenditure might be. Un-sanctioned projects only have a first engineering estimate of costs. It is a normal engineering practice to make budget estimates at that stage with an accuracy of approximately +/- 40%. However, for these schemes, it is not clear whether the proposed NGG expenditures reflect a central estimate within this range, or whether conservatism has been built in, such that the stated amounts are at the higher level. In order to reflect this uncertainty and to enable allowances that reflect central estimates of expenditure, the suggested allowance is proposed as a range from 100/140 (i.e. 70%) of the requested amount to 100%. This approach has also been applied to those projects where the sanction status has not been provided.

Non sanctioned schemes
Gas Analysers: Replacement gas analysers
Fiscal metering: replacement orifice plates
Fiscal metering: update HPMIS

River Crossing: navigation aids
River Crossing: replacement (OTTER)
River Crossing: Feeder 9 diversion
Anti surge systems: vibration monitoring
Unit control systems: repl. Future strategy
Station process control: repl. Future strategy
Air intakes: Filter enhancement
Air intakes: Air intake heating
Power Turbines: major overhaul future strategy
Power Turbines: Engineering services
Gas generators: RB211 emission red. New technol.
Gas generators: Major overhaul
Gas generators: Strategic spares
Gas generators: Engineering services

Table 4: Examples of 'not sanctioned' schemes

(source: NGG_F208 document, January 2011)

3.2.4 Trends in Emission Reductions related Capital Expenditure

The expenditure trends for Emission Reduction projects are shown in Figure 7. From 2007 emissions reduction projects have been initiated on compressor stations at Kirremuir and St. Fergus (earlier data was not available) and are due for completion in 2013. Yearly (total) expenditure in emissions reduction in the period 2006/07 until 2010/11 is developing from £25m up to £39.3m with a significant forecast decrease in 2011/12 and 2012/13 to £8.4m. In 2013/14 and onwards emissions reduction expenditure is increasing significantly to £42m in 2013/14 and £60m in 2014/15. This rise in expenditure is primarily caused by the Emissions Reduction projects for compressor stations at Huntington and Peterborough, planned from 2011/12 onwards. The variation in total expenditure per annum for Emissions Reduction activities over the period 2009 – 2018 is therefore relatively high (£7.6m - £60m).

[REMOVED]

Figure 7: Emission reduction expenditure for major compressor stations

(source: 2010_NGG_RRPCapex v1.xls, label: Project Listing & NGG Trans PCRRP Capex Tables 0607 Dec07 v2.0 Update, label: Project Listing)

A number of units have relatively high emissions. It is evident that, generally, the units with high emission rates (i.e. those exceeding limits) are being modified or, more typically, replaced by electrical units.

Further influences in developing the emissions reduction strategy over the period have been the increased costs associated with the delivery of Emissions Reduction investment and the challenges faced with the introduction and connection of complex technology to the NTS in the form of large electrical units (Variable Speed Drives, VSD). Due to the low volume and the complex nature of the VSD control system, it is not clear what the costs of modification/replacement per unit are or what the costs related to the installed power of the units are.

The expenditure for Emissions Reduction is significantly reduced for the Rollover year with the work on Hatton appearing to reach completion [REDACTED] and with work at Peterborough beginning [REDACTED]. The spread of expenditure over a number of years and the possible problems with resources would suggest that a more even distribution of Emission Reduction measures could be considered. However, as a result of the uncertainty as to the specification of the compressor units in meeting the wide operating characteristics/duty range associated with the number of supply permutations possible, NGG have concluded that greater certainty should be required of these factors before progressing future investments of a similar scale to those of St Fergus, Kirriemuir and Hatton. The strategy of progressing these three priority sites and putting on hold investment at the next priority sites of Peterborough and Huntingdon explains the low Capex in the Rollover year.

The relative increase in the cost for the total scheme appears to be due to increases in the resource costs of the VSD compressor units and HV supply but moreover are due to the increasing uncertainty of operation into the future where more dynamic flow patterns are expected, with many new supply points anticipated and with unknown flow behaviour. This makes it increasingly difficult to accurately predict the utilisation of the compressors and therefore the specification (e.g. flow and head conditions) and the costs of the VSD compressor unit are increased to cover the range of possibilities. It is not specified yet which compressor units will be replaced by electrical ones.

The specific expenditure on Emissions Reductions proposed at Peterborough is considered in more detail in Appendix B.

3.2.5 Selected NLR Scheme Assessments

Table 5 below provides the list of schemes that KEMA identified for detailed examination.

Scheme	Description	Justification for Selection
Emission reduction project at Peterborough	Emission reduction	A comparison between the Peterborough scheme and that for Hatton suggests relatively high costs at Peterborough, given that its total power is less than that at Hatton (36MW at Peterborough, 74 MW at Hatton), although compressor unit power is larger at Peterborough (24,7MW vs 12 MW).
Fiscal Metering	Asset health	Total expenditure (2009 – 2018): £ 45.3m Expenditure in rollover year substantial higher than in previous years and 2013/2014
Feeder 9	Asset health	██████████. Increasing cost in Rollover year compared to previous years. Cost after Rollover year increases significantly.
Power Turbine / Gas generator	Asset health	Total cost estimated at £72.4m. Cost fluctuating over the years. No trend as a reference to calculate Rollover budget.

Table 5: NLR Scheme selection for in depth review.

Table 6 summarises the issues for each NGG NLRE scheme considered. Each scheme has been assessed under the following headings:

- Need (i.e. has the TO provided a reasonable justification for the work?);
- Design (i.e. has the TO provided the optimum design?); and
- Cost (i.e. are the costs reasonable?).

Scheme	Need	Design	Cost	Comment
Emissions Reduction project at Peterborough	OK	OK	OK	Higher costs at Peterborough, compared to those at Hatton have been explained as resulting from resource cost increases and uncertainty of compressor unit specifications.
Fiscal Metering	OK	OK	OK	Fiscal metering has been reviewed on the basis of information presented by NGG on a limited number of projects. The sanction paper reveals that one of the projects for the Rollover year was costed at ██████████ in the sanction paper (PAC2116), whereas it is now estimated at ██████████.
Feeder 9	OK	Potential issue	Potential issue	Design options still being progressed through planning processes and costs may not be incurred in the Rollover year, given the risk that the planning may not have completed.
Power Turbine / Gas generator	Potential issue	OK	Potential issue	The re-life scheme has yet to be sanctioned and the suggested costs are upper bound, rather than being a central estimate (██████████ ██████████)

Table 6: Summary of scheme assessments.

Full details of the review of these schemes are given in Appendix B.

4 LOAD RELATED EXPENDITURE (FLEXIBILITY)

4.1 TPCR4 LR Expenditure to Date

4.1.1 Comparison of Actual Expenditure and Allowances

A comparison has been made between the actual historical expenditures and the allowances set by Ofgem. Figure 8 shows a graph of the actual expenditure (excluding Milford Haven) by NGG against the allowances for the total Load Related capital expenditure.

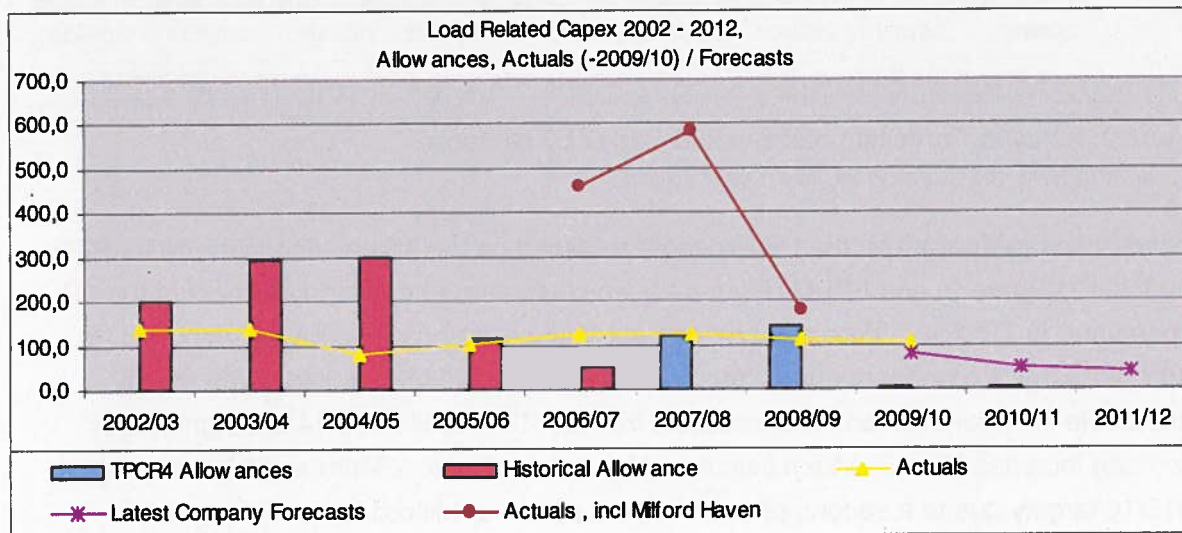


Figure 8: LR Capex 2002 – 2012, Allowances, Actuals and Forecasts (2009/10 prices), excluding Milford Haven

Source: WP24.2 NGG Comparison with Allowances.xls, label: Data

The key observation from Figure 8 is that the actual Load Related expenditure, over all years presented is broadly stable with an average spend of £110m per annum. This is excluding Milford Haven having a major impact on the expenditure historically but also in future expenditure as can be seen in figure 9 and 10.

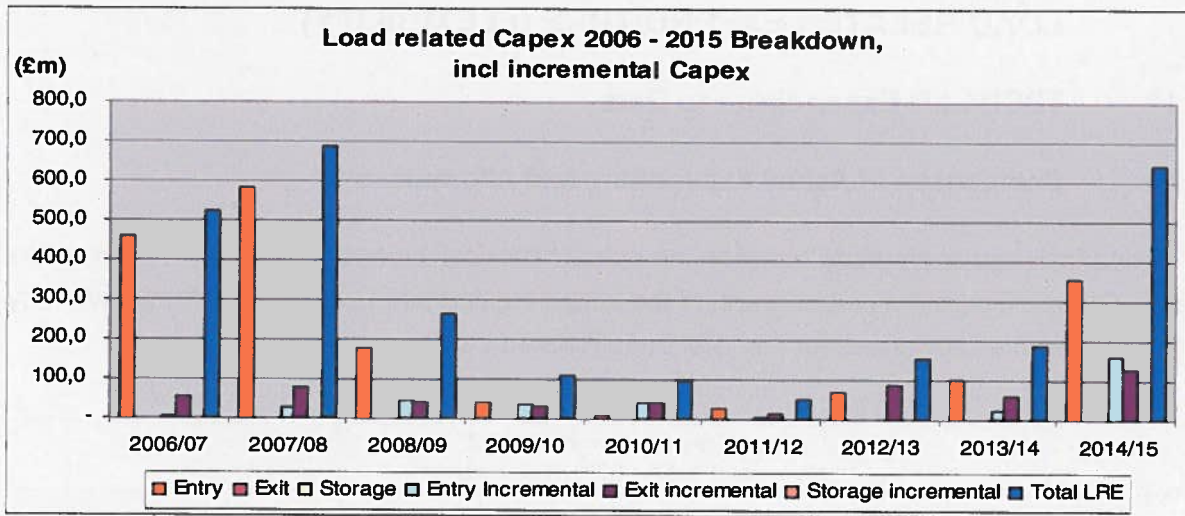


Figure 9: Actual & Forecast Load Related Capex by category
 (source: 2010_NGG_RRP Capex v1.xls, label: Capex Summary)

Analysis was performed on the LR expenditure based on the information in the NGG RRP 2009/2010 (Figure 9) and FBPQ (Figure 10) which confirmed that virtually most of the LR expenditure in TPCR4 to date has been on entry and exit (incremental) development. In particular, large expenditures have been observed from 2006/07 until 2008/09 mainly attributable to Milford Haven. The forecasts from 2010/11 until 2013/14 are significantly lower, an increase in LRE is then calculated for 2014/15 up to £548m and £973m (total) in 2015/16 largely due to a second phase of development at Milford Haven, along with additional entry and exit incremental LRE. Actual expenditure, excluding Milford Haven, has been broadly consistent with the TPCR4 allowances.

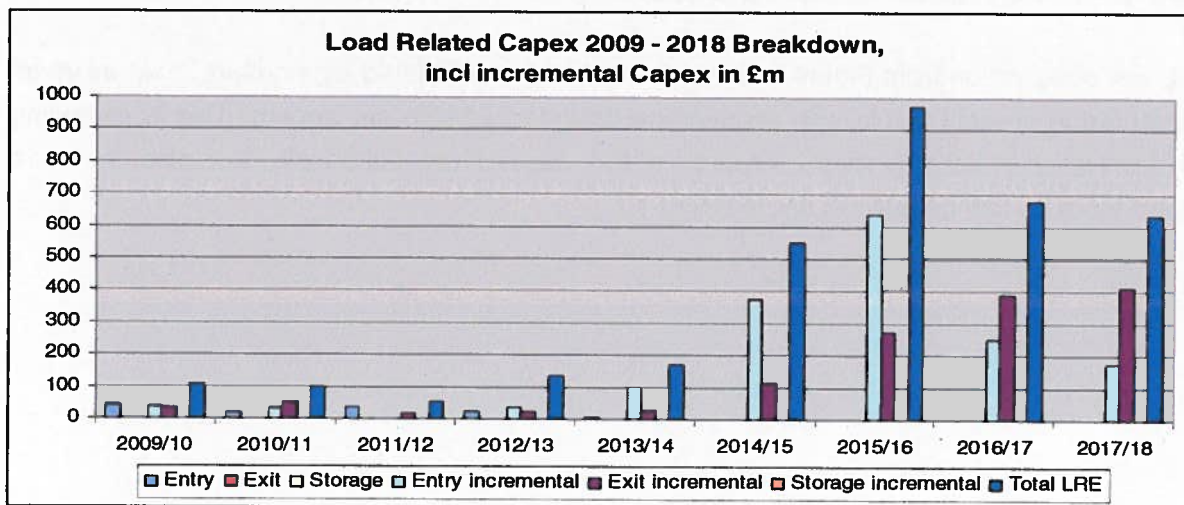


Figure 10: Actual & Forecast Load Related Capex by category
 (source: 2010_NGG_TPCR4_RO_FBPQ (CAPEX) v1(1).xls, label: Capex Summary)

4.2 Forecast LR (Flexibility) Expenditure for 2012/13

4.2.1 Review of Proposed Programme

Flexibility is a new category of LRE that NGG has proposed in the FBPQ and has been applied to investments that enable the network to be reconfigured and to provide resilience against dynamic flows, but that NGG suggest are not driven by individual entry or exit signals.

The idealised methodology that NGG might be expected to take as an approach to estimate the need for true flexibility projects and to determine the quantity of the projected investment is given in the simplified diagram of Figure 11;

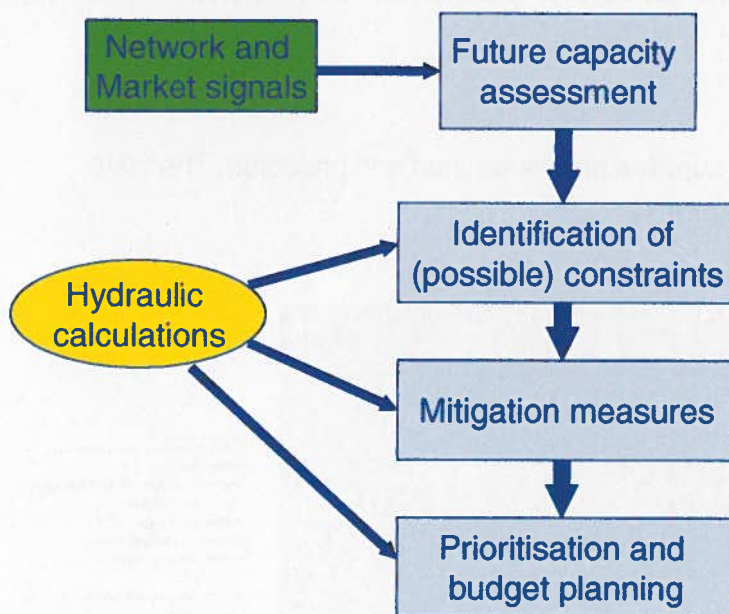


Figure 11: Simplified scheme for overall flexibility needs and the resulting projects

(Source: KEMA approach NG transmission Grid Planning)

NGG has confirmed that it broadly follows these steps, recognising the uncertainties and interactions with entry and exit signals and, more particularly, the market signals pertaining to the developing changes in gas sources and the market behaviour that participants are likely to engage in. NGG has provided information to support this, samples of which are provided in Appendix C and reviewed as follows:

Network and Market Signals

NGG uses a number of considerations to develop scenarios against which the network capability is evaluated, including applying a pro-active scheme to combine the formal submission of user data, with information that NGG seeks on a voluntary basis from users in order to gain an understanding of commercially driven flows that may emerge.

NGG has already seen and is anticipating further significant changes in the flows at St. Fergus (lowering as UKCS output reduces), Easington and Bacton (effectively replacing the flows that were originating at St. Fergus) and increasing dynamics in daily supply and demand with more dynamically changing flows at storage facilities.

NGG has also considered demand change. Demand will be influenced by new CCGTs, particularly in the southern areas of the network as well as more dynamic CCGT operation, particularly from 2015 onwards when EU Directives (specifically the LCPD and the IED) will result in GB coal plant closures and as further penetration of wind-power electricity generation capacity proceeds.

Future capacity assessment

For each entry point the totals of peak supplies are determined and projected. The 2010 forecast for 2011 to 2019 is given in Figure 12:

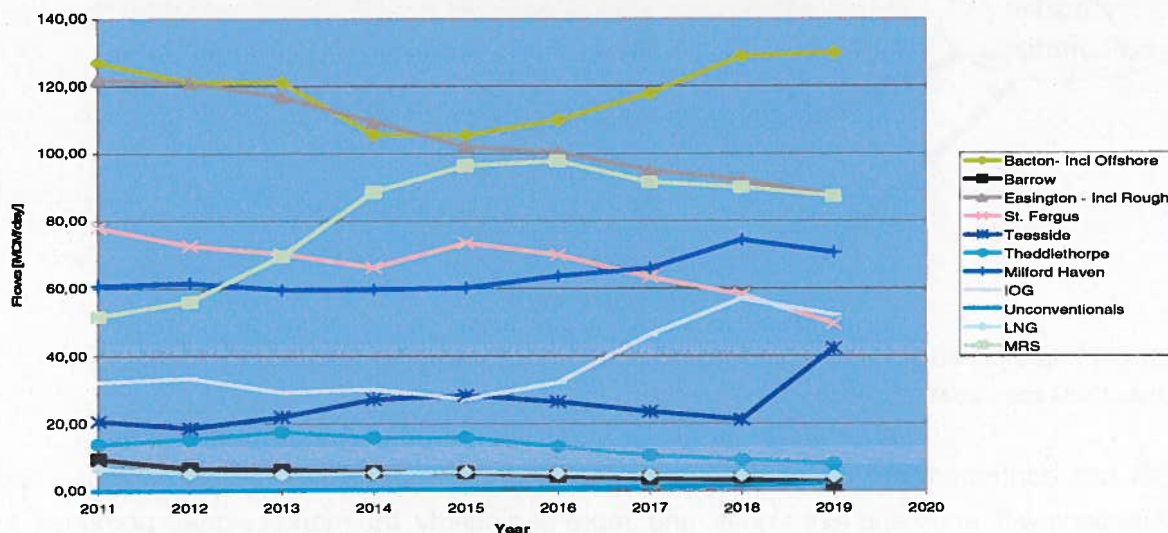


Figure 12: The 2010 forecast for entry point flows.

Identification of constraints

The required capacities of the network components must be determined for all likely scenarios. In these scenarios, the low and high demands and associated flows as well as the

flow directions and the required minimum pressures are determined. A set of around 500 critical scenarios were run for 2012/13, to identify the likely consequences for changing flow patterns, both increases and decreases in capacities for the network and its components, in order to avoid bottlenecks or other constraints on the NTS, or a failure to meet agreed pressure requirements for users that might otherwise lead to buy-backs or curtailments. These are determined by using a network analysis software package known as SIMONE.

Mitigation measures

The above investigations for constraints lead to a number of mitigation measures to address the constraints revealed by the analysis. In particular, Table 7 provides a summary of the mitigation projects proposed by NGG to be initiated in the Rollover year, some also require initial expenditure in 2011/12.

[REMOVED]

Table 7: Flexibility scheme expenditure for the Rollover year 2012/13, and totals

(source: 2010_NGG_FBPQ Capex v1.xls, label: Project Listing)

Several of these projects were previously listed in the 2010 RRP under the Load Related – Incremental Capex expenditure category and NGG has transferred them to the proposed Flexibility category. In addition, several new projects have been identified for inclusion in the Flexibility category in the TPCR4 Rollover submission.

4.2.2 Assessment of proposed programme

Although the above schemes have all been identified using the processes and the key input assumptions previously described, which provides a degree of confidence that mitigating actions may be required, it is not possible to fully confirm whether the suggested programme of work constitutes an optimal mitigation package without re-running the system studies. Such studies are beyond the scope of this review. However, a high level review of the above schemes and their justification, or not, for inclusion in the Flexibility expenditure category is provided.

A number of the schemes involve additional compressor capacity at Asselby, Warrington/Moffat and Lockerley. These projects were originally identified in the RRP as being user driven; noting that the Moffat project is new in the FBPQ and is considered a direct but more effective replacement than the project at Warrington, which had been identified in the RRP. The need for the projects at Asselby and Moffat derives from anticipated reductions in flow from St. Fergus being replaced with flows at other entry points,

such as Easington and Bacton. The rationale for the project at Lockerley is driven by incremental user signals in the South West. These reasons suggest that the projects could be triggered by the appropriate user signals and hence need not be allowed within the new Flexibility category. The costs for the Moffat project have also been considered within the detailed scheme reviews in section 4.2.3. A further consideration here is to eliminate any possibility that the Moffat investment (and possibly the Asselby investment) could be used to reduce the risk of entry capacity buy-back at St. Fergus as a direct result of the disposal of the St. Fergus to Avonbridge pipeline to NG Carbon, an NG subsidiary. Under this disposal it is understood that NG Carbon commit to cover any capacity buy-back costs at St. Fergus resulting from the reduced entry capacity at St. Fergus. On the basis of these arguments it is considered that these investments (amounting to [REDACTED]) should be excluded from the Flexibility category of expenditure.

A further tranche of projects involves re-wheeling of compressors for efficiency purposes, as a result of declining flows at those locations, possibly leading to trips and failures because of operation close to or under surge conditions. However, it is recognised that these conditions are not expected to result from overall demand reductions, but from a shift of flow from St. Fergus to other entry points. It is understood that there is a direct trade-off with regard to NGG's Opex under the System Operator Incentive arrangements, as greater efficiency will result in reduced compressor running costs (lower fuel and electricity costs) which are a specific allowance in the SO incentives. Also, compressor trips are normally covered by a specific provision in the allowance for Operating Margins in the SO incentives, so reducing trips may require less allowance in this category of expenditure. In other words, these investments (amounting to [REDACTED] in the Rollover year) are not driven by user signals or network dynamics, but potentially are entirely associated with NGG's desire to reduce Opex under their SO incentive arrangements.

Of the compressor re-wheel projects identified, those at Avonbridge, Bishop Auckland and Huntingdon had been previously identified in the RRP and had been categorised as user driven investments. The project identified in the FB PQ for Kings Lynn re-wheel appears to have arisen in order to accommodate the developing flow patterns at Milford Haven and Bacton and therefore could also be considered as being subject to revenue drivers. The new project at Peterborough also appears to have been identified to accommodate developing flow patterns at Milford Haven and Bacton and could be considered to be subject to revenue drivers, although the efficiencies being sought appear to be less pronounced than for similar projects and it is not clear that the case is as compelling as for the other re-wheel schemes proposed.

On the basis of the foregoing discussion, it is considered that the Peterborough re-wheel scheme [REDACTED] is not sufficiently justified. Furthermore, it is not clear that the remaining proposed re-wheel projects [REDACTED], although technically justified, should be allocated within the new expenditure category of Flexibility.

At Kings Lynn, a project has been proposed to install multi-junction compressor modifications in order to accommodate bi-directional flows between Kings Lynn and Bacton. The primary driver for this is not incremental capacity but is purely to accommodate the day to day variations in entry and exit flows at Bacton and the dynamic fluctuations in entry flows from the Isle of Grain LNG terminal. The fundamental principle of the Network Code, at the present time, is to allow shippers to nominate however they wish from day to day and to change those nominations during the day within an industry agreed set of operating and commercial rules. The investment at King's Lynn provides additional capability for the management of the network under the Network Code rules and mitigates against the possibility of entry capacity buy-backs (paid by all shippers) and exit capacity penalties (paid by NGG) should there be a capacity constraint. This project was not included in the RRP (April, 2010), but has been presented in the FBPQ (October 2010). The dynamic changes to flows associated with Bacton in particular, for example, as a result of new contractual arrangements associated with the BBL Interconnector, supports this recent identification of the need for this scheme. On balance, it is considered that the expenditure of [REDACTED] is justifiable within the Flexibility category.

The installation of Flow Control Valves (FCVs) has been proposed by NGG to better manage flow patterns across the network. NGG has provided analysis and evidence that supports the view that dynamically changing, within-day flow patterns are already becoming evident at Churchover and Pannal & Nether Kellet. At Churchover, changing flow patterns began to emerge after commercial operation began at Milford Haven, although the need for the replacement of the FCV appears not to have been recognised in the RRP submission in April 2010. However, it is recognised that commercial operation at Milford continues to develop and it is assumed that recent flow patterns have exacerbated the perceived difficulty at Churchover, which is that the existing FCV is undersized. At Nether Kellet, the existing FCV is not capable of meeting flow patterns that are emerging as a consequence of the commercially driven flow requirements associated with Easington. Conversely, the arguments for the Peterborough FCV site appear to be based on a potential future flow pattern rather than a current emerging trend. NGG has also proposed that three existing FCVs ('Existing FCVs Review and Investment') will also need to be replaced although the particular sites have yet to be identified, suggesting that no compelling justification yet exists for this work.

On the basis of the above discussion, it is considered that, whilst the projects at Churchover and Pannal & Nether Kellet [REDACTED] are justified, those at Peterborough and the 'Existing FCVs Review and Investment' are not. It is not clear that the Churchover and Pannal & Nether Kellet FCV projects can be identified against particular revenue drivers as they are intended to deal with dynamic flow changes within the network, and may be considered appropriate for inclusion within the new Flexibility category. The Peterborough FCV and 'Existing FCVs Review and Investment' projects are not considered to be justified and the expenditures of [REDACTED], respectively, have been deducted from the proposed Flexibility expenditure.

The Bacton Rationalization project is considered under the detailed scheme reviews below. Analysis of the project suggests that the expenditure for the Rollover year has not been sufficiently justified as the scheme description lacks detail as to what specific changes are needed at the site and it appears that further design work remains to be done, suggesting reduced confidence in both timescales and costs. It is considered that this rationalization could be categorized as falling under the Flexibility category, since the driver for the investment relates to dynamic flow patterns, rather than to any particular revenue drivers such as incremental entry or exit capacity. The lack of detail and full justification for this project leads to a further deduction from the proposed Flexibility expenditure of [REDACTED].

Table 8 provides a summary of the review of the schemes put forward under the Flexibility category:

[REMOVED]

Table 8: Flexibility Scheme Review Summary

4.2.3 Scheme Uncertainty and Timing

A further consideration is the basis on which the costs have been established for the individual schemes. As with the NLR schemes, it is assumed that for unsanctioned projects, use of an engineering judgement based cost suggests that an uncertainty of some +/-40% may exist. It is further recognised that allowances should reflect central estimates of proposed (and justified) expenditure and for these unsanctioned schemes, conservatism may have been built-in. Therefore, it is suggested that, for any unsanctioned schemes that are justified for inclusion within the Flexibility category of expenditure, a range of allowances can be considered, from 100/140 (i.e. 70%) to 100% of the proposed amount. [REDACTED]



4.2.4 Selected Scheme Assessments

Table 9 below is the list of schemes that KEMA identified for detailed examination.

[REMOVED]

Table 9: LR Scheme selection for in depth review.

Table 10 summarises the issues for each NGG NLRE scheme considered. Each scheme has been assessed under the following headings:

- Need (i.e. has the TO provided a reasonable justification for the work?);
- Design (i.e. has the TO provided the optimum design?); and
- Cost (i.e. are the costs reasonable?).

Scheme	Need	Design	Cost	Comment
Moffat (1x8 MW) Compressor	OK	OK	OK	The relatively high total cost of the Moffat project has not been explained. However, the initial spend identified for the Rollover year is broadly consistent with similar spend on other comparable projects.
Bacton Rationalisation	OK	Potential issue	Potential issue	Specific requirements remain to be developed and it is not clear what the design, timescale and cost will be.

Table 10: Summary of scheme assessments.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 NLR Expenditure

Asset health expenditure (excluding the Humber crossing) has been assessed for consistency with historic trends and with the use of NOMs. NGGs use of the NOMs approach is not yet sufficiently developed to enable conclusions in respect of individual assets, but does identify the extent of work suggested for each asset class. From the review of the proposed 2012/13 NLR expenditure, the following may be concluded:

- In general, the actual spend appears to align with that forecast within the TPCR4 period, if the work on the Humber crossing (Feeder 9) is excluded (approximately £45m).
- Within the larger asset groups (e.g. Fiscal Metering and Power Turbines) about £24.7m of Asset Health expenditure has yet to be sanctioned, suggesting that the relative priority and value of these projects remain to be ratified for inclusion in the Rollover year. For these projects, it has been assumed that the uncertainty of the proposed costs suggests that something in the range of 70% to 100% should be allowed.
- For the smaller asset groups, described under the category of 'Other', Asset Health expenditure of £11.0m has been identified against NOM outputs, but there is no evidence that these projects have been sanctioned. Therefore, for these projects, it has also been assumed that the uncertainty of the proposed costs suggests that something in the range of 70% to 100% should be allowed.
- The Feeder 9 replacement for the Humber crossing has been reviewed in detail and it is considered that the ongoing work to obtain planning consent for the most appropriate approach continues with the risk that the process will not have progressed sufficiently for the anticipated initial design and site study work to take place in the Rollover. It is therefore considered that the suggested [REDACTED] spend may not be required in the Rollover year.
- Detailed review of the entry phase 2 gas quality metering work reveals that the work was sanctioned in 2008 and previously been justified where £5.5m has previously been allowed.

- A detailed review of a sample of the Fiscal Metering schemes suggests that the requirements and associated costs appear to be consistent with initiatives undertaken on other networks.
- Detailed review of the re-lifing of two power turbines has shown that this work has not yet been sanctioned. In addition, the cost estimate has been established at an upper limit of [REDACTED] rather than with a central estimate of [REDACTED].
- Emissions reduction investment has been derived from an optimisation of mandated reductions as agreed with the relevant bodies. However, NGG has determined that there should be some delay to ongoing investment to gain enhanced understanding of the future operational conditions and associated costs. This approach results in only two items of expenditure for this category in the Rollover year; [REDACTED]
[REDACTED]
- Detailed review of the Peterborough compressor replacement (for Emissions Reduction) has identified a higher cost forecast than for previous compressor replacements. This is because of the uncertainty of the specification of the compressor units and HV supply units and the number of units to be replaced, which need to be capable of accommodating a wide range of possible flow conditions at that sight.

As a result of the above conclusions, Table 11 provides a view on 2012/13 NLR expenditure:

2012/13 NLR Expenditure	NGG Forecast £m	KEMA Estimate £m	Comments
Asset Health			
Gas analysers	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes, but with the NGG proposed amount reduced by £5.5m for the scheme that has already been allowed.
Fiscal metering	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes.
River crossings inc Feeder 9	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes and with the Feeder 9 costs removed, given the risk that planning activity will not have completed by the Rollover year
Control Systems (unit and station) / anti-surge systems	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes
Cathodic protection and below ground pipe and coating	■	■	
Exhaust and air intake	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes
Power turbine	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes
Gas generator	■	■	Range reflects the distinction between sanctioned and non-sanctioned schemes
Other	■	■	Range reflects the assumption that schemes are not sanctioned, but with a deduction of £3.9m for the cost of projects not included in the NOMs
Asset Health Total	51.4	30.2 – 39.5	
Emissions Reduction	7.6	7.6	
Other	3.8	3.8	No review has been undertaken for this category.
Quasi-Capex	1.7	1.7	No review has been undertaken for this category.
TOTAL	64.6	43.3 – 52.6	

Table 11: 2012/13 NLR expenditure:

5.2 LR (Flexibility) Expenditure

Flexibility expenditure has been reviewed in terms of the approach that has been adopted by NGG, the assumptions made in undertaking the modelling that forms a key part of the approach and whether the individual projects have been sufficiently justified, both in terms of their underlying justification and in terms of whether they should be allocated to this new category of spend proposed by NGG, rather than being considered as driven by user signals. The following conclusions arise:

Flexibility is a new category of spend proposed by NGG for the TPCR4 RO and includes projects that NGG consider necessary to accommodate and manage a perceived increase in the dynamic flows across the network. This new expenditure category incorporates the transfer of projects previously listed under user driven categories as well as additional projects identified subsequent to the April 2010 RRP submission.

This review has determined that the approach adopted by NGG of combining firm signals, such as demand growth, with more detailed acquisition of market behaviour and user intentions along with the use of the SIMONE package is sufficiently well developed to enable future scenarios to be assessed with reasonable confidence and for mitigating actions to be identified. The review has also assessed the specific justifications for the projects (transferred and new) that have emerged from the NGG analysis. This assessment has considered both the validity of the suggested projects and their allocation to the new Flexibility category, or whether they could be associated with revenue drivers, such as incremental entry (or exit) related user signals. The outcome of this review is;

- The projects at Peterborough (Compressor re-wheel [REDACTED] and Flow Control Valve replacement [REDACTED]), Bacton (rationalisation [REDACTED]) and for the replacement of existing FCVs at three locations yet to be determined [REDACTED] do not appear to have been adequately justified and it is suggested that £15.3m expenditure be deducted from the Flexibility category in the Rollover year.
- The compressor replacements at Asselby [REDACTED] and Moffat [REDACTED] appear to be principally driven by reducing flows at St. Fergus, albeit replaced by incremental flows at other entry points and therefore should be signalled by incremental capacity to support these incremental entry flows. The Lockerley compressor replacement [REDACTED] appears to be principally driven by incremental user signals. Hence, it is considered that all these projects should be excluded from the Flexibility category of

expenditure as they are more readily identified as being subject to revenue drivers. The Flexibility expenditure reduction proposed for these projects in the Rollover year is [REDACTED]

- The Compressor re-wheels at Avonbridge [REDACTED] Bishop Auckland [REDACTED] Huntingdon [REDACTED] and Kings Lynn [REDACTED] all appear to be subject to the SO Incentive arrangements and it is suggested the associated [REDACTED] be excluded from the Flexibility expenditure.
- The multi-junction modifications at Kings Lynn [REDACTED] are considered to be triggered by changing dynamic flows on the network and it is not clear that these changes could be attributed to particular entry or exit signals and thus these schemes may be classified under Network Flexibility.
- The FCV projects at Churchover [REDACTED] and Pannal & Nether Kellet [REDACTED] are considered to be justified and are driven by dynamically changing flows across the network not readily attributable to user signals, and hence can be incorporated under the new Flexibility category of LRE with a proposed expenditure of [REDACTED]
- The timing of the FCV projects at Churchover and Pannal & Nether Kellet and the Kings Lynn multi-junction projects appears to be driven and justified by recent changes to network conditions and there is no evidence to suggest that the need for these projects could have been identified against any particular revenue drivers.
- On the basis of the foregoing, the amount identified as justifiable for inclusion within the new Flexibility category of allowances is £14.0m. However, NGG has stated that these schemes are yet to be sanctioned, aside from some pre-works effort. For these projects, the resulting uncertainty of the proposed costs suggests that a range of 70% to 100% of the nominal amount should be allowed.

As a result of the above comments and recommendations, Table 12 summarises the view on proposed 2012/13 LR (Flexibility) expenditure:

2012/13 LR (Flex) Expenditure	NGG Forecast £m	KEMA Estimate £m	Comments
Network Flexibility	50.3	9.8 – 14.0	Three projects justified in Flex category. Range reflects the assumption that schemes are not sanctioned

Table 12: View of KEMA on LR (Flexibility) expenditure

APPENDIX A KEY ISSUES FROM THE REVIEW OF OPEX

- 1 In the narratives accompanying the FBPQ, the additional expenditures required for the asset diversity, growth and condition amount to £1.8m. This figure corresponds to the expenditures on planned inspections and maintenance as mentioned in Table 2.1 Engineering Opex of the FBPQ. However, this table does not incorporate any expenditure on feasibility studies that need to be written off.
- 2 The impact of real price effects as mentioned in the narratives would amount to £6.5m. From the FBPQ it is clear that the increase in expenditure due to these real price effects for the TO and SO function is consistent with this figure. However, this amount does not appear to include the additional expenditure made for the UK Business Services, which amounts to approximately £6.7m.
- 3 In the RRP for 2010, the average total cost of employees working for the Regulation Directorate is calculated to be £1,285,283. NGG forecast that the total expenditures on employees working for the Regulation Directorate in 2013 will be £3,440,156. This is a difference of £2,154,873. NGG states in its accompanying narratives (source: 2010_NGG_TPCR4_RO_FBPQ_detailed_narrative_v1[1].docm) that the opex for regulatory driven change amounts to £1.0m. However, the analysis above shows that the expenditure increases in the FBPQ are considerably higher.

APPENDIX B DETAILED SCHEME REVIEWS

NLR (Emissions Reduction) - Peterborough

Peterborough is on the list of compressor stations with relative high NOx emissions that is part of an investment programme for installing electrical drives (VSD's) as a replacement for the gas turbines. Phases 1 and 2 involve installation of VSD's at Kirremuir, St. Fergus and Hatton and will be completed in 2012/13. Phase 3 will start in the Rollover year with Peterborough. The investment at Peterborough of [REDACTED] in 2012/13 covers the design work associated with replacement of or modifications to existing compression plant and will include BAT studies, detailed design work and advanced procurement. The expenditure profile for 2012/13 is also consistent with the normal build schedule for emissions reduction investment, as identified for the actual emission reduction expenditure at St Fergus, Kirremuir and Hatton. The relative increase in costs appears to be due to increases in resource costs for the VSD compressor units but also for the HV supply. The higher forecast for the Peterborough Emission Reduction investment is also related to the increasing uncertainty of operation into the future. More dynamic flow patterns are expected where many new supply points are anticipated with unknown flow behaviour. This makes it increasingly difficult to accurately predict the utilisation of the compressors and therefore the specification (e.g. flow and head conditions) and the costs of the VSD compressor units, which have to be able to respond to these flow requirements. It is not specified yet which compressor units will be replaced by electrical ones.

NLR (Asset Health) - Humber Crossing (Feeder 9)

NGG has identified the need to replace feeder 9 as the present feeder is exposed in four places and this may lead to the integrity of the pipeline being compromised, increasing the risk that leakage may subsequently occur, particularly given the possibility that, as with feeder 1 (another feeder that was previously part of the Humber crossing, but is now disconnected), exposures could ultimately become free spans. This is a particular difficulty in the Humber estuary, because of the unusually strong and complex currents. As an interim measure, the existing feeder 9 is being protected from the strong currents by the use of stone placement and the installation of frond matting. Although this solution has a nominal lifetime of ten years, no confidence has been given to this by NGG.

The preferred long term solution is a crossing through a tunnel. See Figure 13. The cost for this solution (along with the cost for current stabilisation works) is estimated at [REDACTED], of which, the activities in the Rollover year have been calculated at [REDACTED].

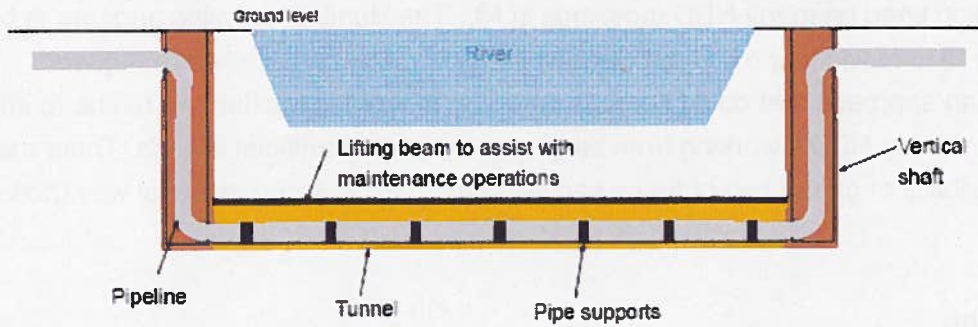


Figure 13: Sketch of the Humber Crossing tunnelling, solution to eliminate risk regarding strong currents on the Humber estuary
(Source: NGG presentation 2011)

NGG have undertaken the following steps in the approach to determine the remedy for the problem:

- 1 Establish an inventory of possible alternatives to the existing crossing.
4 solutions have been considered:
 - a) Horizontal directional drilling
 - b) Deep trenching
 - c) Alternative (but longer) routes.
 - d) Tunnelling
- 2 A list of criteria against which the options can be tested. These included:
 - a) Investment requirements and total cost of ownership (TCO)
 - b) Timing
 - c) Environmental and natural habitat effects and general planning implications
 - d) Advantages or disadvantages to other NG activities
- 3 Decision process

The general approach adopted by NGG appears to be consistent with best practice for such one-off problems, although the level of detail pertaining to each of the four options differs and, in particular, the option of lowering the existing crossing has not been considered, nor have options for self lowering (which is an offshore practice) been considered. The main alternatives that have been considered are discussed below:

Horizontal directional drilling

It was concluded that the maximum feasible length for this approach was 2 km (KEMA concurs with this view), whereas the trajectory for feeder 9 leads to a 5 km distance. However, based on other experiences involving 48" feeders, sections of 1000m - 1200m is a practical solution used on many HDD crossings in NL. The Humber crossing appears to be approximately 3km in width and it is not clear why a 5km distance is therefore required. Furthermore, an approach that could be considered on these assumptions would be to effect the crossing by using HDD's working from barges or temporary artificial islands. There may also be a possibility of one or two of these sections being laid in a conventional way (bottom tow).

Deep trenching

NGG have indicated that the Humber estuary Harbour Master would oppose this option and that there would be reservations by the Environment Agency as a result of excavations through what is a Site of Special Scientific Interest (SSSI). An investigation conducted by ABPmer as part of the stabilization works (the frond matting interim solution) has also provided evidence of an approximate 80 year cycle of morphological changes within the estuary. It is expected that the erosional stress in the estuary may not improve until 2040, and in the interim, several years of further erosional stress is expected and is likely to present similar issues for a deep trench solution, as those experienced on both Feeders 1 and 9.

Alternative (but longer) routes.

These have been extensively investigated and a number of examples are presented in Figure 14. It has been concluded, however, that due to the longer distances and pressure drops, none of the alternatives are considered feasible. [REDACTED]

[REDACTED]

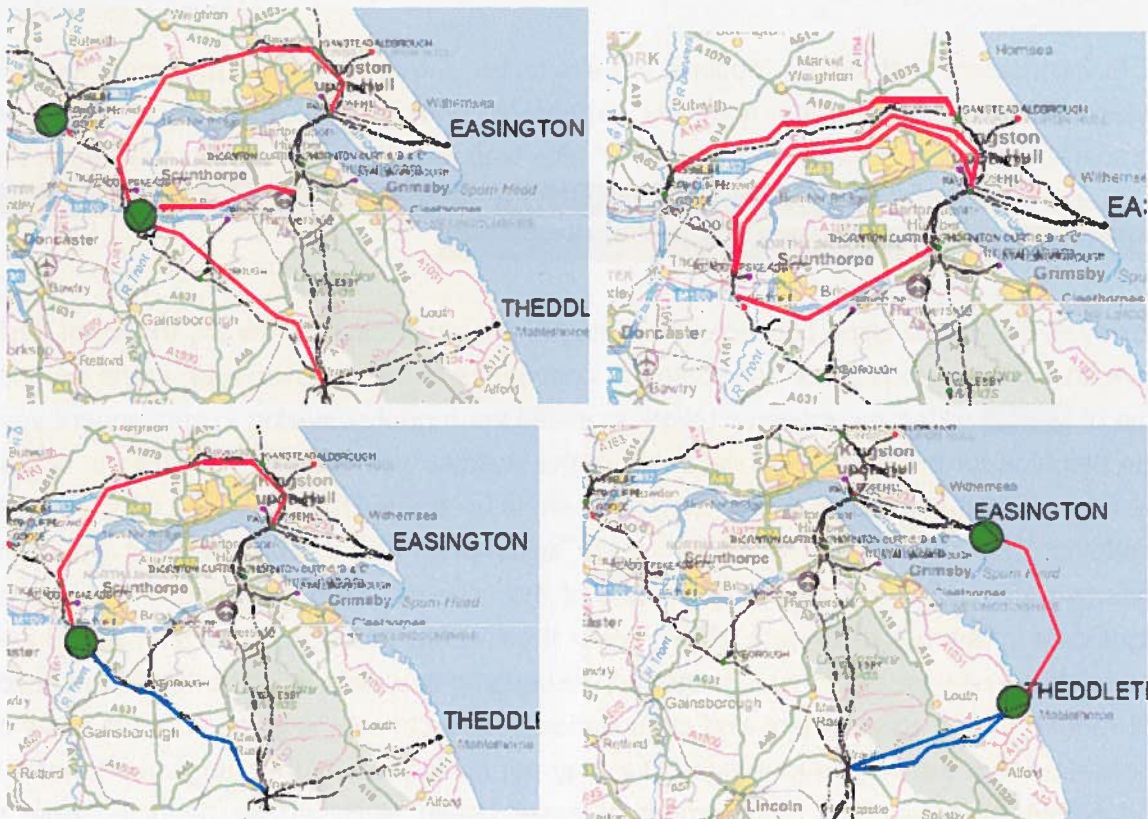


Figure 14: 4 examples of alternative routes for the Humber Crossing

Tunnelling

This option is currently considered to be the most advantageous by NGG, as it is regarded as being technical feasible and delivers the necessary capacity, at lowest cost. [REDACTED]

[REDACTED]

[REDACTED] This spend assumes that planning permission has been obtained and involves detailed design and site investigation work.

A critical issue for all of the feasible options is the need to comply with planning requirements and, in particular, once options have been consulted upon in the pre-planning phase, whether the tunnelling approach will be acceptable to the Independent Planning Commission (IPC), subject only to limited further consultation, but without further consultation on all other options. This creates an uncertainty as to whether the more significant expenditure identified for the Rollover year will actually be incurred, or whether, as a result of the need for further consultations and Planning Act activity, this spend is delayed.

KEMA considers that design options remain to be determined. The preferred tunnelling approach also seems to be relatively expensive, compared to experience with recent comparable projects (a 4km tunnel for a 48" pipe was recently completed in the Netherlands at a cost of €52m). [REDACTED]

However, the critical issue concerns the timing of the expenditure, whereby the initial design work and site investigation is anticipated to commence in the Rollover year, at the proposed cost of [REDACTED] with the subsequent work to install the tunnel occurring in subsequent years. The planning for the proposed investment in the Rollover year can be discussed in terms of the urgency of the problem. At this moment there is no serious free span and possible vortex shedding. This current plan is based on the assumption that the pre-planning work being undertaken by NGG will lead to avoidance of the scheme being classified as a Nationally Significant Infrastructure Project (NSIP) under the recently introduced Planning Act. But this is a relatively new process that is being progressed and there is a risk that the design options will require further assessment and consultation before consent is given. On this basis it is considered that the proposed expenditure may not be feasible in the suggested timescales and KEMA proposes that this element of asset health NLR can be deducted from the allowances.

NLR (Asset Health) - Fiscal Metering

The driver for this investment is the change in policy as a result of the requirement to comply with ISO5167-2003 and any other issues that need to be addressed. This programme was initiated in 2007 and supported by assessments done by Advantica. The project has been sanctioned for different phases and locations. However NGG has only given examples and not a complete overview.

The timing is in line with what could be expected but its execution is not done according the sanction papers. [REDACTED]

Main activity is the replacement of S500 computers but also ultrasonic metering instead of orifice plates. These appear to be straight forward measures and are logical.

This is an ongoing programme of work, and further sites need to be addressed for asset condition issues identified through the Advantica surveys. The costs are considered to be acceptable.

NLR (Asset Health) - Power Turbines/Gas Generators (Power Turbines major Overhaul Future Strategy)

This project has not yet been sanctioned by NG management and therefore only a short description has been received from NGG. [REDACTED]

[REDACTED]. It is this maximum value that has been assumed for the Rollover year, rather than a central estimate (P50). [REDACTED]

LR (Flex) - Moffat Compressor costs

The explanation provided by NGG describes the methodology to assess the issue of reducing flows at St Fergus and the performance needed at Moffat as a consequence and KEMA considers that the need for reversing the compressor at Moffat to accommodate the changing flow patterns as a result of the decline of flows from St. Fergus are justified. The requested [REDACTED] for initial site review and design work, including the introduction of bidirectional flow arrangements are broadly consistent with similar projects identified in the FBPQ and in the RRP.

LR (Flex) - Bacton Rationalization

The underlying requirements for rationalization at Bacton have been explained by NGG and stem particularly from market behaviour, such as flows from BBL and SEAL, as well as activity at Isle of Grain. The NGG investment forecast is based upon the removal of flow restrictions and the transfer of the complex flow control capability onto the individual feeders in and out of the site. The investment will be in conjunction with any necessary asset health investment identified to realize any expenditure efficiencies. The objective of the rationalization of the Bacton Terminal is to increase operational flexibility and robustness, in recognition of its strategic value now and into the future.

The cost estimates are based on a recent feasibility study for a new storage connection into the Bacton terminal facility. The storage connection requires a number of different components including three regulator streams (each comprising a flow control valve, filter, meter and pipe work) and 12 new pipe work connections onto existing pipelines (feeders).

The NGG business planning assumptions base the costs of the flow control valve projects on an estimate of the number of new pipe work connections, the number of regulator streams required and construction costs. The estimates are based on a high level assessment of works, however full costs will only be known at the detailed design stage when each part of the site will be appraised individually. This forecast does not take into account additional complexity or equipment required for a particular installation (such as road crossings and pre-heating) as these can only be identified at the design stage. It also does not allow for the cost of decommissioning existing equipment. This suggests that the currently planned timescales may slip and that costs may differ from those currently envisaged.

APPENDIX C SAMPLE DATA FOR LRE (FLEX) FORECASTING

Figure 15 below shows the total number of entry and exit requests currently in place as an example of the raw data that is used to develop the future capacity requirements:

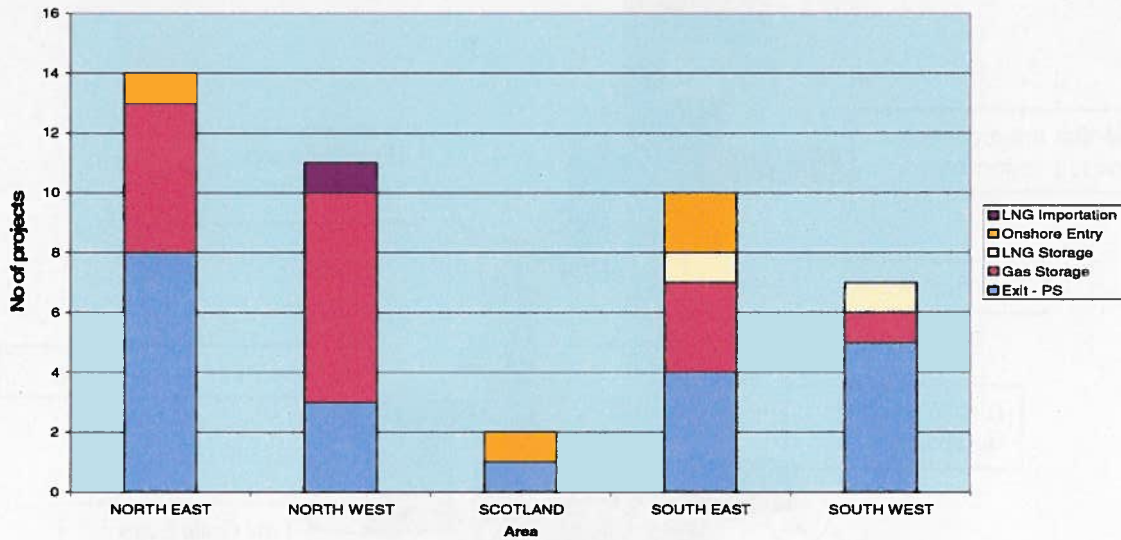


Figure 15: Overview of number of connection requests.

On the basis of this NGG has presented a number of scenarios, an example of which is given in Figure 16.

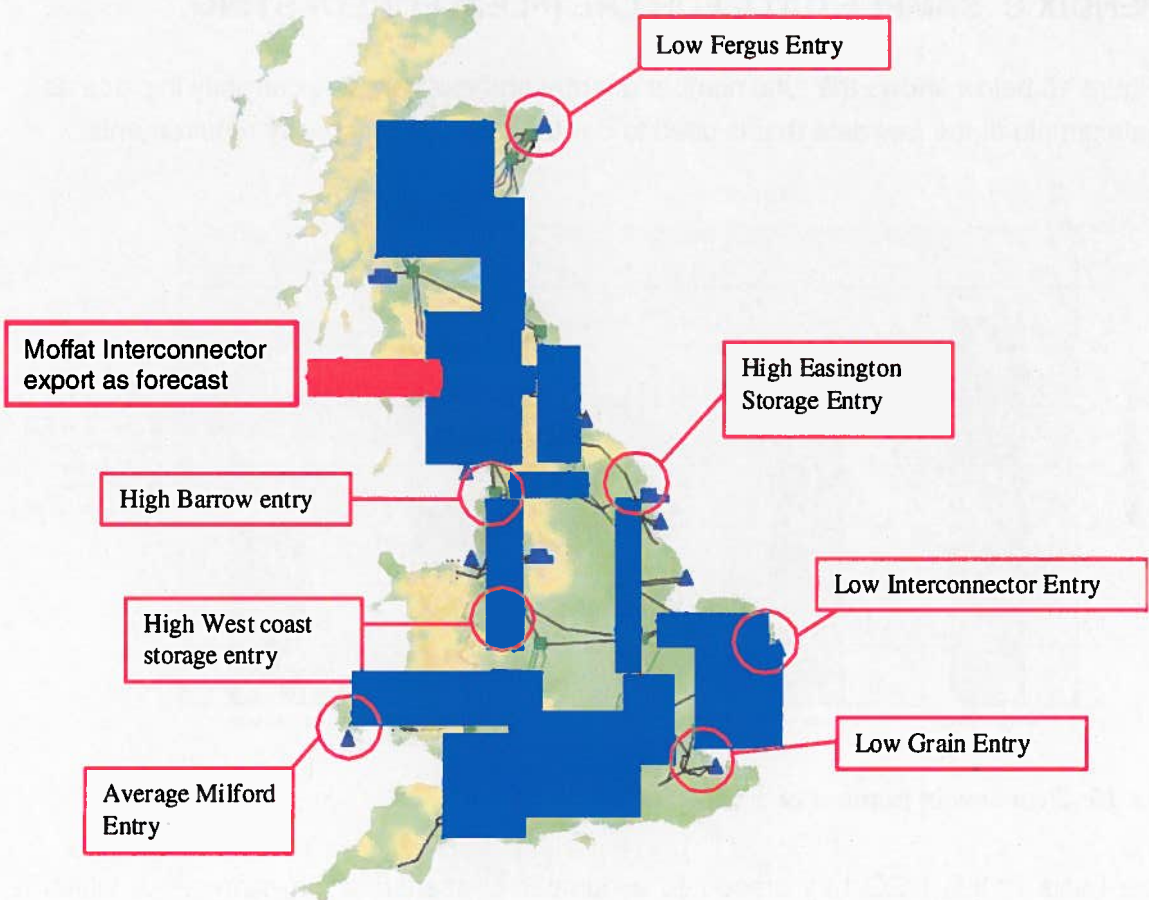


Figure 16: Example of a scenario studied by NGG.

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